The Sustainable Land Use Initiative: Costs and Environmental Outcomes

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horizons
REGIONAL COUNCIL

Authors:
Staci Boyte
Willie McKay
Rhianne Tod

Acknowledgements to:
Maree Patterson
Grant Cooper
Malcolm Todd
Michael Patterson
Jon Roygard
Lizzie Daly

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CONTACT 24 hr freephone 0508 800 80 Help@horizons.govt.nz www.horizons.govt.nz

SERVICE CENTRES	Kairanga Cnr Rongotea and Kairanga-Bunnythorpe Roads Palmerston North Marton 19 Hammon Street Taumarunui 34 Maata Street	**REGIONAL HOUSES**	Palmerston North 11-15 Victoria Avenue Whanganui 181 Guyton Street	**DEPOTS**	Taihape 243 Wairanu Road Taihape Woodville 116 Vogel Street

POSTAL ADDRESS Horizons Regional Council, Private Bag 11025, Manawatū Mail Centre, Palmerston North 4442 F 06-952 2929

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Summary

Erosion occurs naturally but has been accelerated by human land use. The Horizons Region contains New Zealand's largest area of hill country farming, with more than 260,000 hectares of farmed pasture on highly erodible land.

To address this, the Sustainable Land Use Initiative (SLUI) was established in 2006 following the 2004 weather events, which triggered 62,000 landslides and caused an estimated $461 million in damage.

SLUI uses farm-level mapping, informed by the Highly Erodible Land (HEL) model, to prioritise the most erosion prone land. Horizons works with landowners to plan erosion mitigations including afforestation, native retirement, riparian protection, and on-farm soil conservation (space planting of poplar and willow poles). As of 2025, SLUI has mapped more than 700,000 hectares across 987 farms and completed 63,000 hectares of erosion mitigations.

The cost of SLUI to date totals approximately $133 million, funded jointly by central government, Horizons' ratepayers through the Uniform Annual Charge, and participating landowners. Annual programme costs in 2024–25 totalled $8.08 million.

At current implementation rates, erosion mitigations are carried out on about one per cent of top priority land per year.

Modelled scenario analysis illustrates differences in long term outcomes:

- Current SLUI trajectory: Sediment loads could fall by 48 per cent by the end of the century, but when climate change is considered, outcomes range from a 33 per cent reduction to a 5 per cent increase.
- The SLUI + scenario: Implementing erosion mitigations on all top priority land by 2035 and high priority land by 2045 could reduce sediment loads by up to 60 per cent (or 40–56 per cent with climate change) by the end of the century. However, this would require a tenfold increase in annual implementation, impose considerable short to medium term costs, and face constraints in tree supply, contractor availability, and landowner affordability.
- Ceasing SLUI: Without further treatments, sediment loads could increase by 36–96 per cent under climate change, by the end of the century.

Other benefits of the SLUI programme include improved farm productivity, enhanced resilience to storms, and improved stock management.

Landowner uptake is sensitive to external drivers such as carbon prices, policy changes, farm profitability, and availability of contractors and plant supply.

Implementation of the SLUI + scenario would require completing 27,778 hectares of erosion mitigations per year in the short term, compared with the ten-year average to 2025 of 2,891 hectares per year. This would cost:

- Landowners $28 million per year, compared to the current $2.8 million annual average over the last ten years.
- Horizons $14.6 million per year compared to the current $1.5 million annual average over the last ten years.

The scenarios demonstrate that accelerating SLUI could deliver earlier environmental benefits and greater resilience to future storm events, but would require considerably increased investment and implementation capacity. Conversely, ceasing SLUI would likely increase soil loss under even moderate climate change scenarios.

Introduction

About 68 per cent of the Horizons Region's 2.2 million hectares is steep, rolling hill country and contains 17 per cent of Aotearoa New Zealand's highly erodible land (StatsNZ, 2024). Much of this land is underlain by mud, silt, or sandstone - rock types that are naturally prone to slipping, slumping, and other forms of erosion.

Erosion is a naturally occurring process, but human activities can accelerate it. The region has the largest area of hill country farming in New Zealand, with over 260,000 hectares of highly erodible land in pasture. The impacts of the hill country's fragile geology are more pronounced in these grassy expanses of farmland, as there are fewer trees and other woody plants to stabilise the soil.

Since Horizons Regional Council's formation in 1989, the council has maintained an active hill country erosion management programme, continuing the soil conservation work that had been ongoing in the region throughout the 20th century (Guy et al., 2018).

The council's approach to erosion management intensified after the February 2004 storm highlighted the region's vulnerability to severe weather events. The catastrophic storm and associated flooding are forever etched in locals' memories. About 70 per cent of the Horizons Region was affected by the weather, with 62,000 individual landslides recorded, and an estimated 200 million tonnes of soil lost across the region. During the event, 28 tonnes of sediment passed under Palmerston North's Fitzherbert Bridge every second for eight hours.

The impacts of the 2004 storm (Kumaran & Coetzee, 2004) prompted the development of Horizons' Sustainable Land Use Initiative (SLUI), a long-term (and New Zealand's largest) hill country erosion-control programme, to increase the region's resilience to future large-scale storms. The initiative kicked off in 2006 and is a non-regulatory (voluntary) method under the One Plan, Horizons' combined regional plan and policy statement, which has been in effect since 2014.

The original four targeted outcomes of the programme were:

- Erosion rates are reduced to 'natural' levels,
- Rural sector/regional economy is more resilient to future major storm events,
- Lowland communities are protected from the impacts of upstream hill country erosion, and
- Improved water quality in the region's rivers (sediment and visual clarity).

Horizons' approach to reducing accelerated erosion under the One Plan is largely non-regulatory, with the SLUI programme at its core. While policy LF-LAND-P1 (pg. 2-64) states "[t]he Regional Council will encourage and support the adoption of sustainable land management practices", the plan also includes targeted regulatory measures on specific land-use activities that pose elevated erosion or sediment generation risks. These controls primarily apply to vegetation clearance, land disturbance, cultivation, and forestry, particularly where such activities occur near waterbodies or in identified erosion-prone areas.

The council's SLUI programme is a voluntary, incentivised way to support landowners in keeping soil on the hills. Horizons' implementation teams work with landowners to implement erosion mitigations on their properties, including, but not limited to, afforestation (native and exotic species); native forest retirement and protection; poplar pole planting; stream fencing; riparian planting; and sediment traps.

At the end of the 2025 financial year, Horizons' SLUI programme, in partnership with landowners, has:

- Mapped 987 farms, covering more than 700,000 hectares.
- Erected over 2,000 km of fencing alongside streams and retired land.
- Planted 30 million trees.
- Completed 63,000 hectares of erosion mitigations.

This report provides a short summary of the SLUI programme, focusing on its costs, benefits, and modelled sediment loss scenarios. It was prepared in early 2026 to support a Ministry for the Environment project to build economic understanding around future environmental management.

Identifying sediment-producing land

Farm-scale mapping is a critical step in ensuring appropriate, targeted erosion treatment to reduce sediment in the region's waterways.

A model to spatially identify (predict) the most 'Highly Erodible Land' (HEL) in the Horizons Region was developed in 2006 (Dymond & Shepherd, 2006). This HEL layer enabled the prioritisation of farms for on-farm land resource mapping, which identifies sediment-producing land. The main factors used to map sediment-producing land include slope, rock type, soil, vegetation cover, present and potential erosion, and the connectedness of potential erosion to a waterway.

Horizons uses this land resource mapping to classify land into **not erodible**, **erodible**, **high priority**, and **top priority** land to refine targeting for erosion mitigations at the farm-scale. Using the HEL model, produced at the regional scale, alongside farm-scale Land Use Capability (LUC) mapping has enabled Horizons to be more specific at the appropriate scale for farm erosion mitigation options. Targeting erosion mitigations needs this level of accuracy to be effective.

The following image (Figure 1), taken post-Cyclone Gabrielle (2023), demonstrates erosion at, or near, its potential, according to Horizons' erosion treatment prioritisation method. Both slip scars and slip tails are visible.

- The **top priority** land labelled T has severe to extreme erosion and has the greatest potential to deposit sediment into waterways. **Top priority** land contributes approximately five times more sediment than **high priority** land to waterways.
- The **high priority** land labelled H also has severe erosion, but half of it is retained on the lower slope. **High priority** land contributes approximately five times more sediment than **erodible** land to waterways.
- Areas labelled E are classed as **erodible** land and have slight to moderate erosion and contribute less sediment to waterways than top and high priority land.
- The area labelled N has contributed negligible sediment (**not erodible** land).

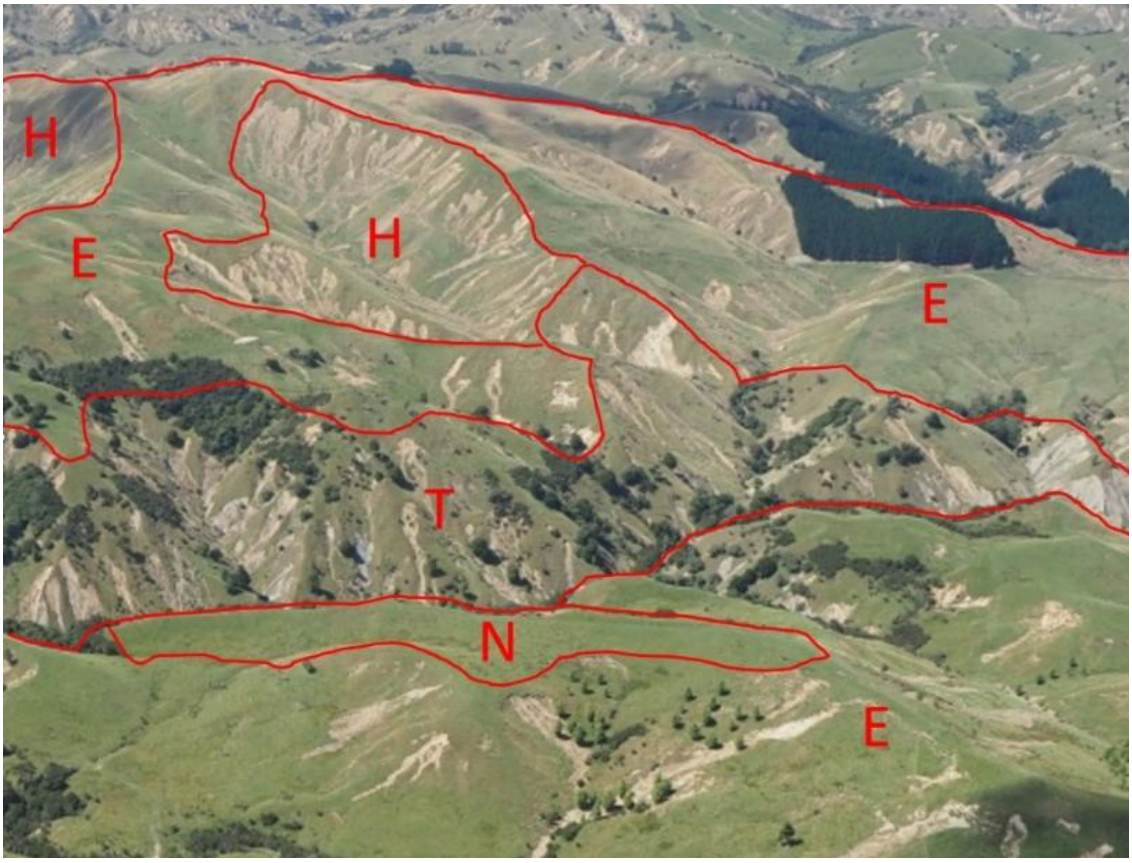


Figure 1. Categorisation of land priorities overlaying an image post Cyclone Gabrielle (2023) in the Tararua District. Source: Horizons Regional Council.

Figure 2 shows the scale and distribution of the 700,000 hectares of whole farms mapped under SLUI across the region, guided by the HEL model. Farm-scale land resource information has been collected to assess the scale of the erosion issue in the region and prioritise mitigations.

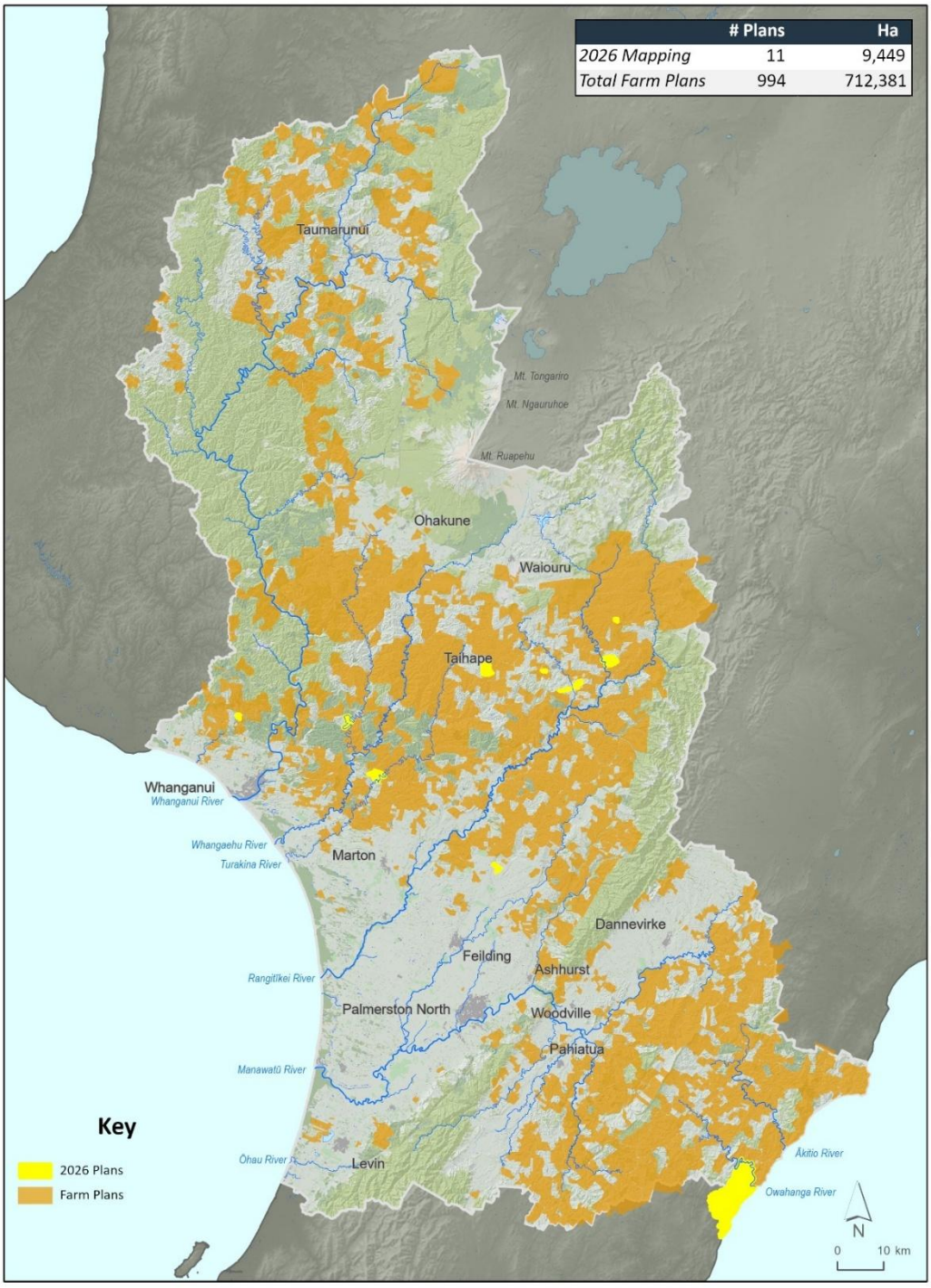


Figure 2. SLUI Whole Farm Plans mapped to date. Source: Horizons Regional Council.

Mitigating soil erosion

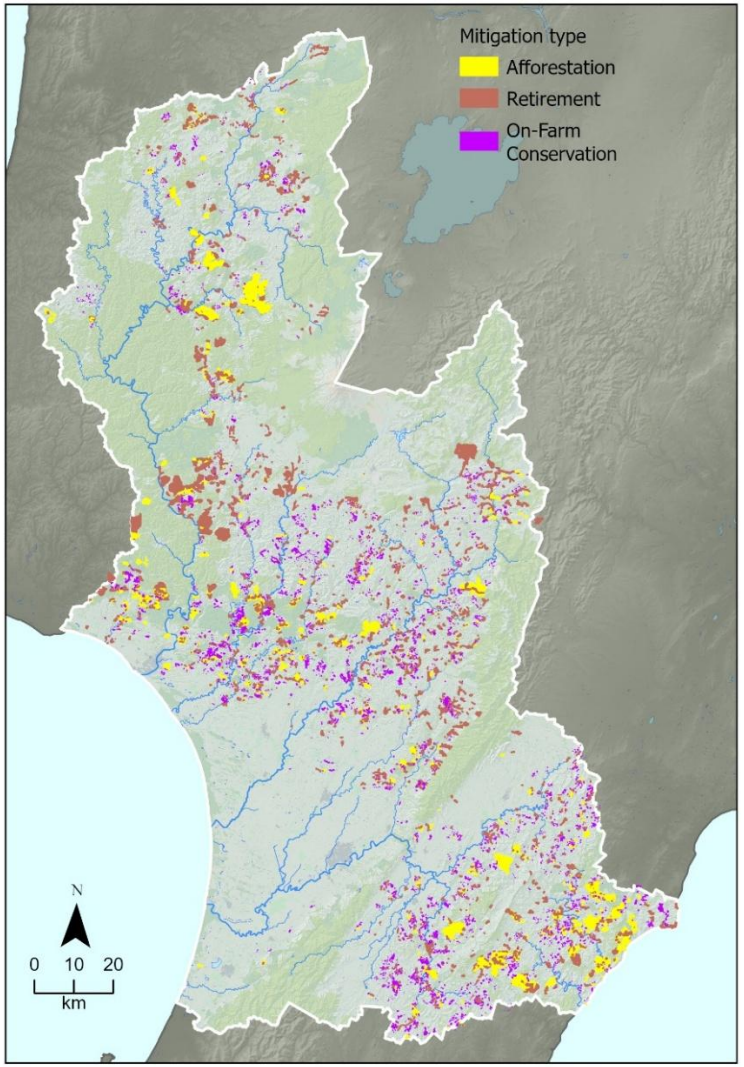
Trees and other woody vegetation play a key role in stabilising the region's erosion-prone hill country. The roots of these plants bind together, creating fibrous mats that hold soil in place and make the land more resilient to disruptive events, such as storms. A canopy of shrubby vegetation and trees protects the land by intercepting rainfall, reducing its volume and energy at the land surface. They also effectively draw water out of the soil profile and reduce the effects of heavy, waterlogged soils.

The council encourages and supports landowners to undertake the following types of planting (among others), under its SLUI programme:

- Afforestation: Planting native or exotic tree species on marginal (not productive) land for full canopy cover.
    - This mitigation can keep the land profitable over a longer term and provide financial resilience to a farming system. Land with low stock carrying capacity can be more economically viable in forestry than pasture.
- Retirement: Native regeneration and retirement from grazing. This can also include retiring riparian margins and wetland areas.
    - On pastureland, the intent is to allow for a native cover to regenerate
        - On riparian margins on pastureland, a buffer strip of long grass can intercept sediment before it enters a waterway
    - On land with existing tree cover, the intent is to protect the long-term survival of the vegetative layer by removing grazing stock, allowing for the sub-canopy to regenerate and survive
- On-farm soil conservation: Planting poplar or willow trees at different intervals on erosion-prone pastureland.
    - This planting method is suitable for lower slopes with sufficient soil and moisture to grow poplar poles.
    - This mitigation helps stabilise the soil due to their extensive root system and reduce the likelihood of erosion by exporting moisture from soils.
    - Poplar or willow planting enables stock to continue grazing pasture in planted areas.

At the farm level, the aim of SLUI is to establish effective vegetative cover on erosion-prone land. The placement of trees on-farm is conducted at a finer scale than the farm mapping; the mapping only identifies the *requirement* for protective vegetative cover. The landowner, with advice from Horizons staff, will establish trees in identified areas of greatest risk on their property. These trees can provide protection for farm assets such as tracks, fence lines, water systems, and buildings, and preserve the productive potential of erodible soils by stabilising entire hillsides.

Figure 3 identifies where, and which type of erosion mitigations have been carried out across the region through the SLUI programme. Progress in establishing Whole Farm Plans and erosion mitigations is reported against successive Hill Country Erosion Fund (HCEF) contracts. The HCEF represents central government's funding contribution to the SLUI programme.



Erosion Mitigations Implementation

HCEF Contract 1 2007 - 2011

6,717 ha works	374 farms in programme
- 3,188 ha afforestation	288,000 ha in programme
- 2,316 ha retirement	209 farms active doing works in this contract
- 1,214 ha on-farm conservation	131 average claims per year in this contract

HCEF Contract 2 2012 - 2015

16,392 ha works	630 farms in programme
- 7,671 ha afforestation	465,000 ha in programme
- 6,636 ha retirement	387 farms active doing works in this contract
- 2,085 ha on-farm conservation	327 average claims per year in this contract

HCEF Contract 3 2016 - 2019

13,681 ha works	783 farms in programme
- 4,277 ha afforestation	573,000 ha in programme
- 6,370 ha retirement	517 farms active doing works in this contract
- 3,035 ha on-farm conservation	454 average claims per year in this contract

HCEF Contract 4 2020 - 2023

18,777 ha works	954 farms in programme
- 10,438 ha afforestation	675,000 ha in programme
- 6,512 ha retirement	586 farms active doing works in this contract
- 1,828 ha on-farm conservation	531 average claims per year in this contract

HCEF Contract 5 2024 - 2027 (2 years out of 4 completed)

7,305 ha works	987 farms in programme
- 3,357 ha afforestation	702,000 ha in programme
- 3,073 ha retirement	376 farms active doing works in this contract
- 875 ha on-farm conservation	373 average claims per year in this contract

Total SLUI mitigations to date

62,873 ha works	987 farms in programme
- 28,930 ha afforestation	702,000 ha in programme
- 24,906 ha retirement	845 farms have done at least one claim
- 9,037 ha on-farm conservation	6,743 claims

Figure 3. Mitigations carried out through SLUI, with key numbers by HCEF contract.

The following figures provide before and after examples of erosion treatment via afforestation (Figures 4 and 5) and space-planting (Figures 6 and 7).

Figure 4. A hillside with moderate soil slip erosion. Source: Horizons Regional Council.

Figure 5. The same hillside as in Figure 4, afforested. Source: Horizons Regional Council.

Figure 6. A hillside before space planting. Source: Horizons Regional Council.

Figure 7. The same hillside in Figure 6 with space planted poplar trees. Source: Horizons Regional Council.

As with all erosion mitigations, the positive effects are not immediately realised, as it takes several years for planting to mature to the point where it reduces the risk of erosion. Even then, the risk cannot be completely mitigated; severe weather events can cause significant erosion and damage. Furthermore, some erosion processes are too deep or aggressive to be protected by tree planting.

Table 1 demonstrates how long it can take for erosion mitigations to mature, and how effective they are once mature (Vale & Smith, 2023):

Table 1. Erosion mitigation types, maturity rate and effectiveness.

Erosion mitigation	Years to fully mature	Annual maturity rate	Effectiveness (estimated erosion reduction)
Afforestation	10	10 %	90 % mass movement 50 % surficial[1]
Bush retirement	10	10 %	90 % mass movement 50 % surficial
Riparian retirement	2	50 %	80 %
Space-planting trees	15	6.66 %	70 %
Gully erosion planting	15	6.66 %	70 %

Similarly, erosion occurs under non-pasture land cover, and it's important to consider the catchment context when planning large-scale erosion mitigation. Table 2 shows estimated modelled sediment loads from natural cover such as native forest, mānuka, and tussock grassland in the Horizons Region. It indicates the background sediment loads that cannot be reduced through management interventions and serves as a reminder that erosion is a natural process that cannot be entirely mitigated (Vale et al., 2025).

Table 2. Natural cover as a proportional area of each FMU and the proportion of sediment load from natural cover by FMU.

FMU (area: km^2)	FMU area under natural cover	Sediment load from natural cover areas (Mt/year)	Proportion from natural cover
Kai Iwi (333)	16 %	0.00856	8 %
Manawatū (5,878)	19 %	0.202	8 %
Puketoi ki Tai (1,168)	15 %	0.0192	4 %
Rangitīkei-Turakina (5,203)	32 %	0.151	8 %
Waiopehu (394)	37 %	0.0230	38 %
Whangaehu (1,995)	27 %	0.0349	4 %
Whanganui (7,221)	55 %	0.654	23 %
Region (22,192)	**35 %**	**1.09**	**12 %**

[1] These figures consider the full life cycle of forestry including the harvest and post-harvest period.

Impacts of soil erosion

Activities under the SLUI programme aim to combat common types of erosion in the region's hill country. These types include gully erosion, earthflows, slumps, streambank erosion, and shallow landslides, with shallow landslides affecting the largest proportion of the hill country terrain. Accelerated erosion like this can affect communities and the environment in various ways. Storm events, such as the one that hit the Horizons Region in 2004, illustrate the considerable economic consequences of highly erodible land.

The 2004 event triggered 62,000 landslides, affecting 18,130 hectares of land in the region. The landslides damaged farm infrastructure, disconnected roads, tracks, and raceways, and caused landowners to lose livestock and crops. Horizons estimated the direct financial impact of this single event on the region was $461 million, with agricultural losses accounting for $240 million of this figure.

The estimated 200 million tonnes of soil lost from the region during the storm led to longer-term financial losses. Even small slips can have long-term consequences: landslides create bare slip scars that reduce land productivity, as the soil takes a long time to recover.

Horizons attributed a $141 million reduction in the region's GDP in the 2004-2005 fiscal year to the loss of soil and its productive capacity. Estimated long-term losses to landowners included the cost of funds diverted from improvements and innovations to farm repairs, and losses from slip damage (Smith et al., 2016). Previous research had indicated that it could take 30 years to regain 50 per cent of pre-erosion productive levels (Derose et al., 1995).

A storm in 2015 affected 460 farms in the Horizons and Taranaki Regions, 165 of which were in the Whanganui District (92 per cent of the district's farms), where the greatest rainfall was experienced. The estimated financial impact on hill country farms from this event was $57.6 million, with $37 million in infrastructure damage and $20.6 million in production loss, at an average cost of approximately $125,000 per property. Some farms suffered damages exceeding $500,000 (Ministry for Primary Industries, 2015).

In February 2023, Cyclone Gabrielle battered much of the North Island, with the Tararua District bearing the brunt of the weather in the Horizons Region. Cyclone Gabrielle caused at least $7.8 million in damage to farms in the Tararua District, including slips, damage to fencing and infrastructure, and stock deaths. Rapid assessments by Manaaki Whenua found that over 2,000 hectares of Tararua land were affected by cyclone-induced landslides – nearly 87 per cent (more than 1,700 hectares) of which was classified as High Producing Exotic Grassland, typically used for livestock grazing (McMillan et al., 2023).

The impacts of accelerated erosion extend beyond the farm boundary. When eroded soils enter waterways, they become part of the sediment load transported or deposited throughout rivers, lakes, estuaries, and the sea. Here, sediment can have adverse effects on aquatic life, as its fine particles can fill the small spaces between rocks on the riverbed, making the habitat unsuitable for fish and aquatic insects. Sediment can also smother the riverbed (which reduces oxygen transfer, creating anoxic areas), and introduce additional loads of phosphorus bound to the sediment (which promotes excessive algal or plant growth). These particles can also make the water cloudy, obscuring people's view of hazards in waterways and making the water unpalatable for stock. All of Horizons' river monitoring sites fail the One Plan visual clarity targets[2] (Horizons Regional Council, 2025a).

Sedimentation from accelerated erosion can also affect the river channel's capacity to transport flood waters. Severe weather events transport eroded soils and associated debris throughout Horizons' river and drainage schemes, impacting flood protection assets and accumulating in rivers, which raises the riverbed and reduces the river channel's capacity to transport flood flows. Evidence to the

[2] State from five-year period 30 June 2017 to 30 June 2022.

One Plan hearing panel in 2008 estimated the annual cost of sediment removal from schemes at around $800,000 (Cook, 2008).

Horizons' latest Infrastructure Strategy (Horizons Regional Council, 2024) states that sedimentation of rivers remains a core issue for scheme management in the Horizons Region. The council invests in removing sediment from river channels across its river and drainage schemes each year. Sedimentation is especially problematic along the Ōroua River, as its berms can be more than a metre higher than the land directly outside the stop bank. This reduces the river's carrying capacity during high-flow events.

The cost of SLUI

The cost of running the SLUI programme is borne by Horizons' (through the Uniform Annual Charge (UAC)), landowners and central government (Hill Country Erosion Fund (HCEF)). SLUI is a non-regulatory erosion mitigation programme that, since its inception, has offered financial support to landowners in the form of grants to support erosion mitigations on erodible land.

Funding from central government is not guaranteed as HCEF is a contested fund. However, to date, Horizons has successfully secured five four-year contracts with the Ministry for Primary Industries for the SLUI programme.

The Uniform Annual Charge is applied through Horizons' rates. It is currently $38.42, inclusive of GST and applies to all properties in the region regardless of location or capital value. Benefits accrue to the whole region, as Horizons' land management activity responds to land-based issues which impact on the health of the region's soil and water resources and increased regional resilience to storm events (Horizons Regional Council, 2025b).

The overall cost of SLUI from 2006 to June 2024 was approximately $133 million. Figure 8 shows the proportional contribution from the three main funding sources.

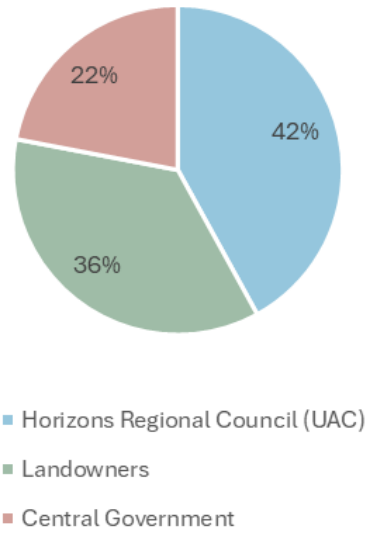


Figure 8. Proportional contribution from funding sources of SLUI over the life of SLUI to June 2024.

For the 2024-2025 financial year, the budgeted cost of the SLUI programme was $8.08 million. Figure 9 shows the proportional contribution from the three main funding sources. This cost includes

not only the direct cost of erosion mitigations but also $650,000 for programme management and administration and $1.6 million in staff time working with landowners.

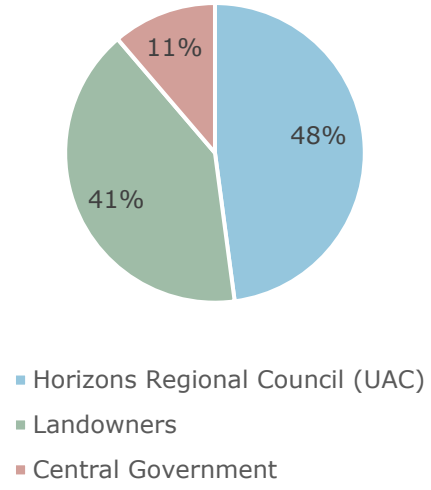


Figure 9. Proportional contribution from funding sources of SLUI over the 2024-2025 financial year.

Table 3 outlines the cost per hectare of the main erosion mitigation types. These costs are based on a ten-year average to 2025[3][4].

Table 3. Costs for erosion mitigation types (ten-year average to 2025).

Erosion mitigation	Cost ($/ha)
Afforestation	1,480
Retirement	2,230
On-Farm Conservation	1,140

Current policy settings – Impact of SLUI

Based on the proportions of **top** and **high priority** land already mapped through SLUI, it is estimated that there are approximately 50,000 hectares of **top priority** farmed land and 200,000 hectares of **high priority** farmed land in pasture in the Horizons Region. Erosion mitigations have treated 8,976 hectares (17 per cent) and 16,158 hectares (eight per cent) of this area, respectively, as of June 2025[5].

At the current rate of progress, SLUI is treating around one per cent of the pastoral **top priority** land each year with erosion mitigations.

Scenarios for estimating the effectiveness of erosion mitigations are multi-layered. The rate of implementation, the rate of maturity of different mitigation types, and the trajectory and impact of climate change must all be considered. Most erosion mitigations take several years to reach full effectiveness and cannot provide immediate or total protection against weather events.

[3] These figures are based on Horizons data.
[4] This reflects the cost of mitigations irrespective of funding source.
[5] Note SLUI figures are based on farmed and forested hill country and exclude Department of Conservation (DoC), other Crown, and Defence land.

Climate change is likely to exacerbate erosion in the Horizons Region, as rainfall plays a key role in accelerating erosion. Climate change projections by NIWA predict that, despite expecting less annual rainfall by the end of the century, the region will likely experience heavy rainfall events when it does rain. These projections also predict that most of the region will experience more frequent heavy rainfall days by the end of the century (Ministry for the Environment, 2024).

With 2021 as the baseline, continuing at the current rate of implementing erosion mitigations, Manaaki Whenua modelling (SedNetNZ) estimates that sediment loads across the region would be expected to decrease by 48 per cent by the end of the century (from 8.8 megatonnes per year (Mt/year) to 4.6 Mt/year). However, when considering an intermediate to high emissions climate change scenario range[6], sediment loads for the region are estimated to be between 6.6 and 9.3 Mt/year, a change that could range from a 33 per cent decrease to a five per cent increase from baseline (2021) (Vale & Smith, 2023). This modelling is focussed on sediment loads to the receiving environment and does not consider the impacts of soil degradation or other on-farm impacts.

There are currently seven proposed Freshwater Management Units (FMUs) in the Horizons Region (Figure 10). The FMUs have varying sediment loads; the main factors contributing to this are the extent of highly erodible land and the size of the FMU. For example:

- The Waiopehu FMU is small and contains a small amount of hill country, so it contributes relatively little to the area's overall sediment load.
- Whanganui is a large FMU and contains a high proportion of erosion-prone land. However, 55 per cent of the FMU is under natural cover, with that land contributing 23 per cent of the FMU's sediment load.
- Puketoi ki Tai is a moderate-sized FMU and contains a high proportion of erosion-prone land. Only 15 per cent of the FMU is under natural cover, with this land contributing four per cent of the FMU's sediment load (Vale & Smith, 2025).

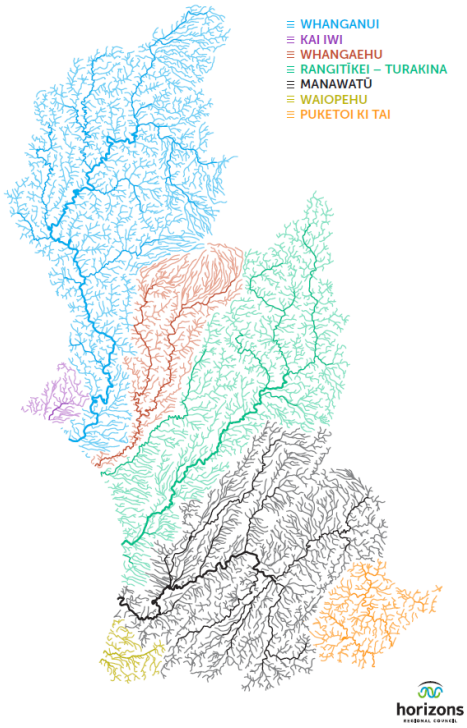


Figure 10. Proposed Freshwater Management Units for the Horizons Region.

Table 4 estimates how the current policy scenario affects sediment loads in each of the FMUs through the end of the century, based on Manaaki Whenua modelling outputs (Vale & Smith, 2023).

[6] Representative Concentration Pathway (RCP) 4.5 to 8.5, similar to the updated Shared Socioeconomic Pathways (SSP) 2 and 3, the intermediate pathways.

Table 4. SedNetNZ estimates of the current policy scenario to the end of the century.

FMU	2021 baseline – total sediment load (Mt/year)	Total sediment load (Mt/year) late century without climate change	Percentage change without climate change	Total sediment load (Mt/year) RCP 4.5 to 8.5 climate change scenarios late century.	Percentage change with climate change
Kai Iwi	0.11	0.07	34 % decrease	0.08 - 0.11	Between 0 and 27 % decrease
Manawatū	2.44	1.27	48 % decrease	2.03 - 2.89	Between 18 % increase and 17 % decrease
Puketoi ki Tai	0.50	0.21	59 % decrease	0.32 - 0.46	Between 8 and 36 % decrease
Rangitīkei – Turakina	1.94	0.90	54 % decrease	1.47 - 2.08	Between 7 % increase and 24 % decrease
Waiopehu	0.06	0.05	20 % decrease	0.05	17 % Decrease
Whangaehu	0.97	0.39	60 % decrease	0.62 - 0.87	Between 10 and 36 % decrease
Whanganui	2.79	1.72	38 % decrease	2.03 - 2.84	Between 2 % increase and 27 % decrease

In 2016, AgResearch conducted research to explore the impact of implementing SLUI, specifically Whole Farm Plans. The researchers interviewed landowners to examine how these plans affected the environmental, economic, and social sustainability of their farm businesses and their local communities. Respondents agreed that the environmental and economic sustainability of their farm had increased. They felt that the investment through SLUI had made their land more resilient to future weather related hazards. Individual farm plans allowed them to more easily identify appropriate management strategies for different areas of their farms.

At the time, no farmers interviewed identified SLUI as having had a negative impact on their profitability and some believed it had a positive impact (25 per cent). Most saw SLUI as having no measurable impact on their profitability – either positively or negatively (Smith et al., 2016).

Other on-farm benefits from the SLUI programme include:

- Improvements to farm productivity through improved pasture management, reduced input costs, and increased stocking rates.

- Diversification of farm income from trees established for timber, carbon, and honey, which contribute to the economic resilience of the farm.
- Improved stock management, e.g., less stock losses in gullies, increased shade and shelter, troughed water for better animal health[7], more reliability in dry summers, and improved grazing utilisation through paddock subdivision (Guy et al., 2018).

Future Scenarios

The following scenarios were initially developed to help Horizons implement the National Policy Statement for Freshwater Management (2020). The focus was on water quality outcomes and reflected the aim to reverse past damage to bring waterways and ecosystems to a healthy state within a generation. However, the results provide a useful indication of the environmental outcomes and costs associated with implementing erosion mitigation at different rates. They are not policy and do not reflect Horizons' position.

SLUI +

This scenario implements erosion mitigations at an accelerated pace. It was developed in 2022 to consider the sediment loss outcomes of implementing erosion works on the most erosion-prone land as early as possible for the purposes of meeting potential water quality targets. Specifically, this scenario assumes:

- all relevant farms would be mapped by 2030,
- full implementation of erosion mitigations on:
    - **top priority** land by 2035,
    - **high priority** land by 2045, and
    - low priority land by 2065.

Modelling estimates that this scenario would reduce the region's sediment load by 60 per cent from an estimated 8.8 Mt/year in 2021 to 3.55 Mt/year by the end of the century. However, when considering an intermediate to high emissions climate change scenario range[8], the model estimates the region's sediment load would be 3.9 to 5.3 Mt/year, a reduction from baseline (2021) of between 40 and 56 per cent.

Table 5 demonstrates how this scenario would affect sediment loads in each of Horizons' FMUs (Vale & Smith, 2023).

[7] Riparian fencing requires reticulation of stock drinking water which reduces the risk of disease. (Beef + Lamb, 2019).
[8] Representative Concentration Pathway (RCP) 4.5 to 8.5, similar to the updated Shared Socioeconomic Pathways (SSP) 2 and 3, the intermediate pathways.

Table 5. SedNetNZ estimates of the SLUI + to the end of the century.

FMU	2021 baseline – total sediment load (Mt/year)	Total sediment load (Mt/year) late century without climate change	Percentage change without climate change	Total sediment load (Mt/yr) RCP 4.5 to 8.5 climate change scenario late century.	Percentage change with climate change
Kai Iwi	0.11	0.06	46 % decrease	0.06 - 0.08	27 to 45 % decrease
Manawatū	2.44	1.02	58 % decrease	1.35 - 1.86	24 to 45 % decrease
Puketoi ki Tai	0.50	0.15	70 % decrease	0.18 - 0.25	50 to 64 % decrease
Rangitīkei – Turakina	1.94	0.64	67 % decrease	0.82 - 1.12	42 to 58 % decrease
Waiopehu	0.06	0.04	21 % decrease	0.05	17 % decrease
Whangaehu	0.97	0.29	70 % decrease	0.34 - 0.46	53 to 65 % decrease
Whanganui	2.79	1.35	52 % decrease	1.15 – 1.51	46 to 59 % decrease

This more stringent scenario emphasises completing erosion mitigations early, thereby increasing resilience earlier and reducing potential costs associated with future weather events. This scenario also results in lower modelled sediment loads towards the end of the century. However, a higher rate of implementing erosion mitigations considerably increases costs in the short to medium term.

Figure 11 shows that this scenario would require a tenfold increase in the annual implementation rate across the three priority classes compared with the current SLUI implementation rate.

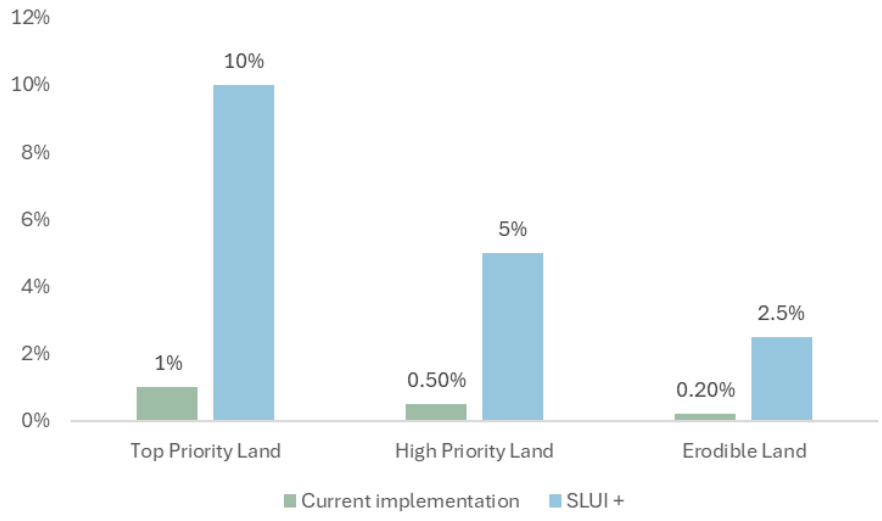


Figure 11. Rate of implementation of SLUI under each scenario.

In the Horizons Region, **top priority** land is estimated to produce about 25 times more sediment than **erodible** land (approximately 5,000 tonnes per square kilometre annually, compared with 200 tonnes per square kilometre annually). Consequently, Horizons' focus is on treating **top priority** land, as this has the greatest impact on the region's overall sediment loads.

Table 6 demonstrates the amount of erosion mitigations carried out across the region in each priority category to date and how long it would take to fully implement the programme, assuming an implementation rate based on the average of the ten-year period to 2025.

Table 6. Rate of implementation of erosion mitigations and how long it would take to complete under each scenario.

Land prioritisation category	Completed to date[9]	Implementation rate into the future[10]		Years to complete	
	Current SLUI	Current SLUI	SLUI +	Current SLUI	SLUI +
Top priority	17 %	1 %	10 %	83	10
High priority	8 %	0.5 %	5 %	184	20
Erodible	3 %	0.2 %	2.5 %	485	40

Implementation of the SLUI + scenario would require completing 27,778 hectares of erosion mitigations per year in the short term, compared with the ten-year average to 2025 of 2,891 hectares per year. Based on the implementation rate, this would require completion of erosion mitigations annually on:

- 4,185 hectares of top priority land (15 per cent of the work programme),
- 9,262 hectares of high priority land (33 per cent of the work programme) and,
- 14,331 hectares of erodible land (52 per cent of the work programme).

At the current funding ratios, this would cost:

- Landowners $28 million per year, compared to the current $2.8 million annual average over the last ten years.
- Horizons[11] $14.6 million per year, compared to the current $1.5 million annual average over the last ten years[12].

These are the costs for implementing erosion mitigations only and do not include costs of farm mapping, staff advice, or implementing the SLUI programme overall.

Beyond the cost, this accelerated approach would also put pressure on plant supplies, planting and fencing contractors, and other critical support required to implement erosion mitigations. These are already subject to shortages at times under the current SLUI programme, and this accelerated approach would likely result in significant afforestation. Any accelerated scenario would therefore require careful management.

Horizons established its own poplar nursery to ensure a reliable, high-quality supply of quality poles for on-farm conservation works. Currently, this nursery produces around 35,000 poles per year. An accelerated version of SLUI would require considerably more plants and, therefore, likely more plant nurseries - the capital costs for which are not represented in this case study.

Farm profitability and affordability would likely limit the rate of implementation. This scenario may not be achievable without making accelerated implementation compulsory, which would likely

[9] February 2026
[10] Based on 10-year average to 2025
[11] Includes central government contributions.
[12] Costs do not account for inflation or other future cost increases.

require an increased funding share from local government, central government or both and even then, carries a risk of undermining the constructive relationships Horizons has built with landowners. In reality, this scenario may not be achievable even with potential for increased funding but was considered to deliver upon some, if not all, of the objectives of SLUI within a generation and demonstrates the significant investment in time and resourcing necessary to implement largescale change over these timeframes.

Figures 12 and 13 show the distribution of long-term costs and sediment loads to implement SLUI at the current rate and the accelerated rate (SLUI +). These are simplistic summaries as they do not include costs associated with tree replacement following weather events or maintenance, nor do they consider climate change.

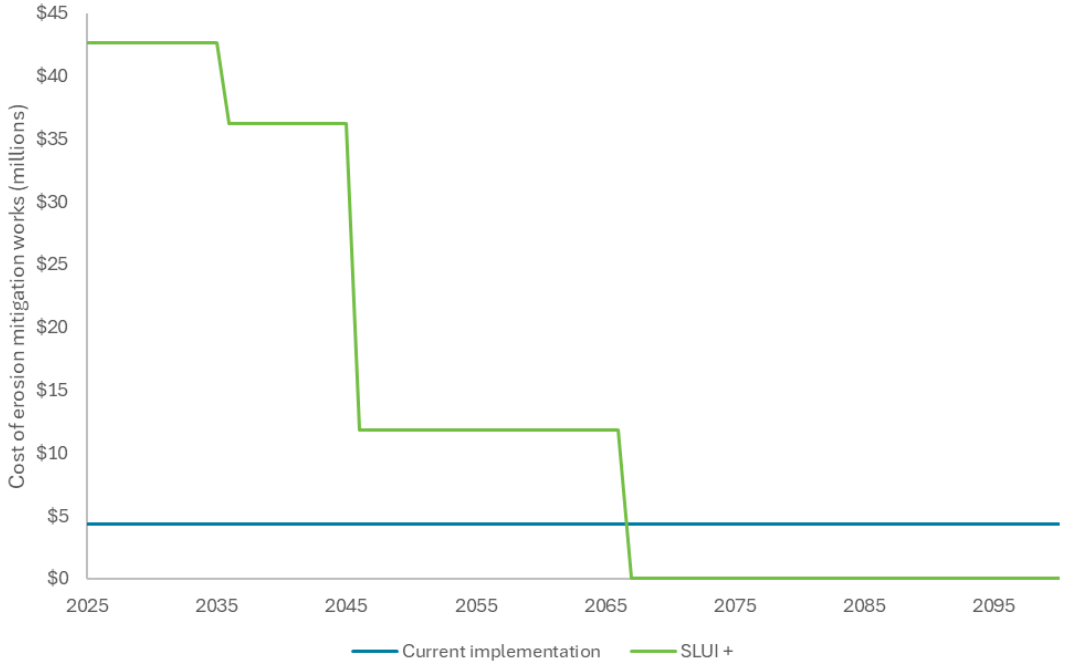


Figure 12. Estimated cost of implementing erosion mitigations at the current rate and SLUI +.

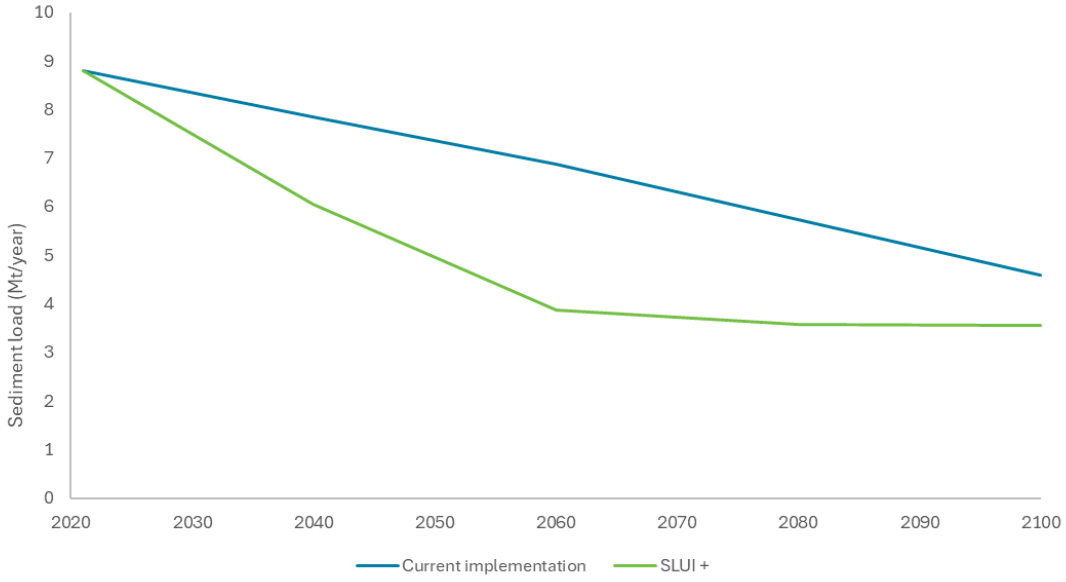


Figure 13. Predicted sediment load over time based on the current rate of implementing SLUI and the SLUI + scenarios. Note this does not consider climate change.

Ceasing SLUI

If SLUI implementation had ceased in 2021[13] (meaning no further erosion mitigations were carried out), modelling estimates that the region's sediment loads would be expected to decrease by two per cent by the end of the century as existing mitigations mature (from 8.99 Mt/year to 8.79 Mt/year). However, when considering an intermediate to high emissions climate change scenario range[14], the model estimates that sediment loads for the region would increase to between 12.3 and 17.6 Mt/year - a 36 to 96 per cent increase in sediment load from baseline by the end of the century. This scenario assumes that erosion mitigations from other sources would also cease, which may not be the case.

Table 7 demonstrates how this scenario would affect sediment loads in each of Horizons' FMUs (Vale et al., 2022).

Table 7. SedNetNZ estimates to the end of the century under a ceasing SLUI scenario.

FMU	2021 baseline – total erosion load (Mt/year)	Total erosion load (Mt/year) late century without climate change	Percentage change without climate change	Total erosion load (Mt/year) RCP 4.5 to 8.5 climate change scenario late century.	Percentage change with climate change
Kai Iwi	0.11	0.11	4 % Decrease	0.12 - 0.17	9 to 55 % increase
Manawatū	2.55	2.49	2 % Decrease	3.68 - 5.33	44 to 109 % increase
Puketoi ki Tai	0.51	0.48	6 % Decrease	0.69 - 0.98	35 to 92 % increase
Rangitīkei – Turakina	1.97	1.93	2 % Decrease	2.87 - 4.15	46 to 111 % increase
Waiopehu	0.06	0.06	0 % change	0.07 - 0.08	17 to 33 % increase
Whangaehu	0.99	0.96	3 % Decrease	1.39 - 1.99	40 to 101 % increase
Whanganui	2.81	2.75	2 % Decrease	3.43 - 4.93	22 to 75 % increase

[13] The baseline date used in the SedNetNZ modelling.
[14] Representative Concentration Pathway (RCP) 4.5 to 8.5, similar to the updated Shared Socioeconomic Pathways (SSP) 2 and 3, the intermediate pathways.

Scenario summary

A region-level summary of the more and less stringent scenarios compared to the current rate of SLUI (current policy settings) is shown in Table 8.

Table 8. SedNetNZ estimates to the end of the century for all scenarios and the percentage with erosion mitigations predicted in 2035.

Scenario	2021 baseline – total erosion (Mt/year)	Total erosion (Mt/year) late century without climate change	Percentage change without climate change	Total erosion (Mt/year) RCP 4.5 to 8.5 climate change scenario to late century.	Percentage change with climate change	Percentage with erosion mitigations predicted in 2035 (top priority: high priority: erodible land)
Current rate of SLUI implementation	8.8	4.6	48 %	6.6 – 9.3	33 % decrease to 5 % increase	27 %: 13 %: 5 %
SLUI +	8.8	3.55	60 %	3.9 – 5.3	40 to 56 % decrease	100 %: 58 %: 23 %
Cease SLUI 2021	8.99[15]	8.79	2 %	12.3 – 17.6	36 to 96 % increase	17 %: 8 %: 3 %

[15] This number differs to the other two scenarios as it is based on a previous version of the model.

Assumptions and limitations

- The ceasing SLUI scenario is based on a 2021/2022 version of the SedNetNZ model. The current policy setting scenario and accelerated SLUI scenario are based on a 2023 version of the model, which also incorporates some of the lowland riparian works carried out through other initiatives. For this reason, the total sediment load values differ between these scenarios. However, it is important to consider the magnitude and direction of travel for modelling outputs rather than absolute figures.

- Climate change projections have moved on from Representative Concentration Pathways (RCPs) to Shared Socioeconomic Pathways (SSPs). This report references RCPs as these were used in the relevant modelling. RCPs 4.5 to 8.5 were highlighted as they most closely align with SSP2 to SSP3 and reflect a middle-of-the-road scenario to the inequality scenario. The median value for climate change scenarios was used.

- The rate of SLUI implementation of one per cent **top priority** land per year, 0.5 per cent **high priority** land per year, and 0.2 per cent **erodible** land per year is based on a ten-year average to 2025 of SLUI erosion mitigations. This is the assumed projected rate when considering the costs of each scenario. However, the assumptions differ slightly from those used in the sediment load projections produced by SedNetNZ modelling. For more details, see Vale & Smith (2023) and Vale et al (2022).

- In estimating future rates of implementing erosion mitigations, it has been assumed that the rate will reflect the ten-year average to 2025, which does not account for real-world influences such as potential regulation, funding availability, or on-the-ground implementation challenges.

- In estimating future costs of SLUI, only the costs of erosion mitigations are considered. These are based on the average costs over the past ten years and are expressed in today's value. They do not account for any future inflation. It has also been assumed that the funding contributions from each source (landowners, Horizons' UAC, and central government) remain at the current ratio.

- For the SLUI + scenario, barriers to increasing the rate of implementing erosion mitigations in terms of the supply of trees, appropriate advice, and contractors are not accounted for.

- Erosion mitigations included in SedNetNZ modelling and implementation maps and figures represent work carried out in partnership with Horizons only. Spatial data for any other erosion mitigations carried out in the region are not accounted for.

- Co-benefits of erosion mitigation such as habitat provision or carbon sequestration have not been considered.

Discussion: Influences on the rate and effectiveness of implementing erosion mitigations

SLUI is a voluntary, incentivised programme, which landowners tend to take part in when it makes financial and practical sense. Their willingness to participate in the programme is strongly influenced by the following key drivers (which can also influence each other):

Market and economic drivers

- Alternative land-use returns, such as fluctuations in revenue from carbon and mānuka honey.
- Affordability, as landowners must fund a share of erosion mitigation work.
- Seasonality, affecting the ability to carry out work such as fencing and planting.
- Contractor capacity, which can constrain delivery during peak months (Guy et al, 2018).

When the returns for alternative land-use are high, planting trees becomes more attractive. For example, growing mānuka trees for honey became a profitable venture around 2006. Investment in mānuka planting peaked between 2018 and 2024 in the Horizons Region, with landowners establishing 3,250 hectares of the species during this period.

The region also experienced a dramatic increase in planting following the Climate Change Response (Zero Carbon) Amendment Act 2019. This legislation strengthened the Emission Trading Scheme (ETS) by no longer accepting overseas trading units, which provided certainty for the domestic carbon market and made carbon forestry very profitable. Carbon prices rose sharply from $19 per tonne in 2018 to $86 per tonne in 2022. Between 2020 and 2021, external financiers funded large afforestation projects in the region to speculate on carbon prices. Horizons' SLUI programme contributed only small grants to these projects to ensure **top priority** land and riparian buffer strips were protected.

Market drivers can also have the opposite effect, disincentivising investments in erosion mitigations. Carbon prices recently fell to $35 (late 2025)[16] in response to changes to the ETS.

Horizons adjusts SLUI grant rates to keep erosion mitigation work attractive amongst such pressures. Recently, the council increased grant rates for afforestation on **top** and **high** priority land in response to rising establishment costs, government policy changes that create uncertainty around afforestation rules, and downward pressure on carbon prices.

Regulatory and policy drivers

Despite being voluntary and non-regulatory, the broader regulatory and policy environment continues to affect participation in the SLUI programme. Several significant political events have impacted the implementation rate of erosion mitigations in the Horizons Region:

- **2007:** First Hill Country Erosion Fund (HCEF) contract, which limited afforestation funding to < 5 hectares.
- **2010:** Second HCEF contract, which increased the available funding.
- **2020:** He waka eke noa, a climate action partnership formed to develop a framework to measure, manage and reduce agricultural greenhouse gas emissions.
- **2020:** National Environmental Standards for Freshwater (NES-F) with the Freshwater Farm Plan system proposed.
- **2023:** National Environmental Standards for Commercial Forestry (NES-CF).
- **2024:** Amendments to NES-F.

[16] Monthly NZU spot price series derived from publicly available NZ ETS market data compiled in the NZU price dataset (GitHub) and visualised via Wikimedia Commons.

- **2025:** Changes to ETS, which limit registration of new plantings on LUC class 1-6 land*.

***The full impact of restricting the registration of LUC Class 1-6 land in the ETS for hill country landowners remains unclear, with this period of uncertainty likely to slow afforestation in the region.

These events have influenced landowner confidence and the financial viability of afforestation or other erosion mitigations.

Environmental and adverse event drivers

Severe weather events can lead to a period of financial strain for rural landowners, which in turn affects participation in the SLUI programme. Events such as droughts or storms can disrupt farming operations, causing a decline in profits and a redirection of capital toward on-farm repairs or to offset livestock and production losses.

These outcomes are illustrated in Sheppard's (2009) study on the effects of the severe 2008 drought on Horizons' SLUI programme. This research found that the implementation of erosion mitigations was sensitive to the profitability of sheep and beef farming. With tighter budgets, long-term environmental investments, such as SLUI projects, can be harder to prioritise.

External funding drivers

External funding sources can substantially increase total SLUI implementation in particular years. In the past, these have included:

- Afforestation Grant Scheme (AGS 2009 -2013 & 2016-2017).
- 1 Billion Trees Fund (1BT 2018-2021).
- Jobs for Nature (2020-2023).

As discussed earlier, Horizons adjusts SLUI grant rates in response to the drivers listed above. The decision framework for grant setting evolves over time, reflecting changes in establishment costs and uncertainties arising from national-level regulatory changes.

Figure 14 shows the yearly implementation rates of three erosion-mitigating measures (afforestation, retirement, and on-farm soil conservation) since SLUI's inception.

Afforestation shows the most variability in implementation rates, as it is heavily influenced by external market and political drivers. For example, afforestation peaked in 2013, the final year of AGS funding, and in 2020, associated with the increase in carbon farming in the region. Large-scale afforestation projects also typically increase retirement areas within and around newly planted forests.

On-farm soil conservation, primarily delivered through Horizons' pole planting programme, shows consistent implementation patterns over time, reflecting their lower sensitivity to external factors.

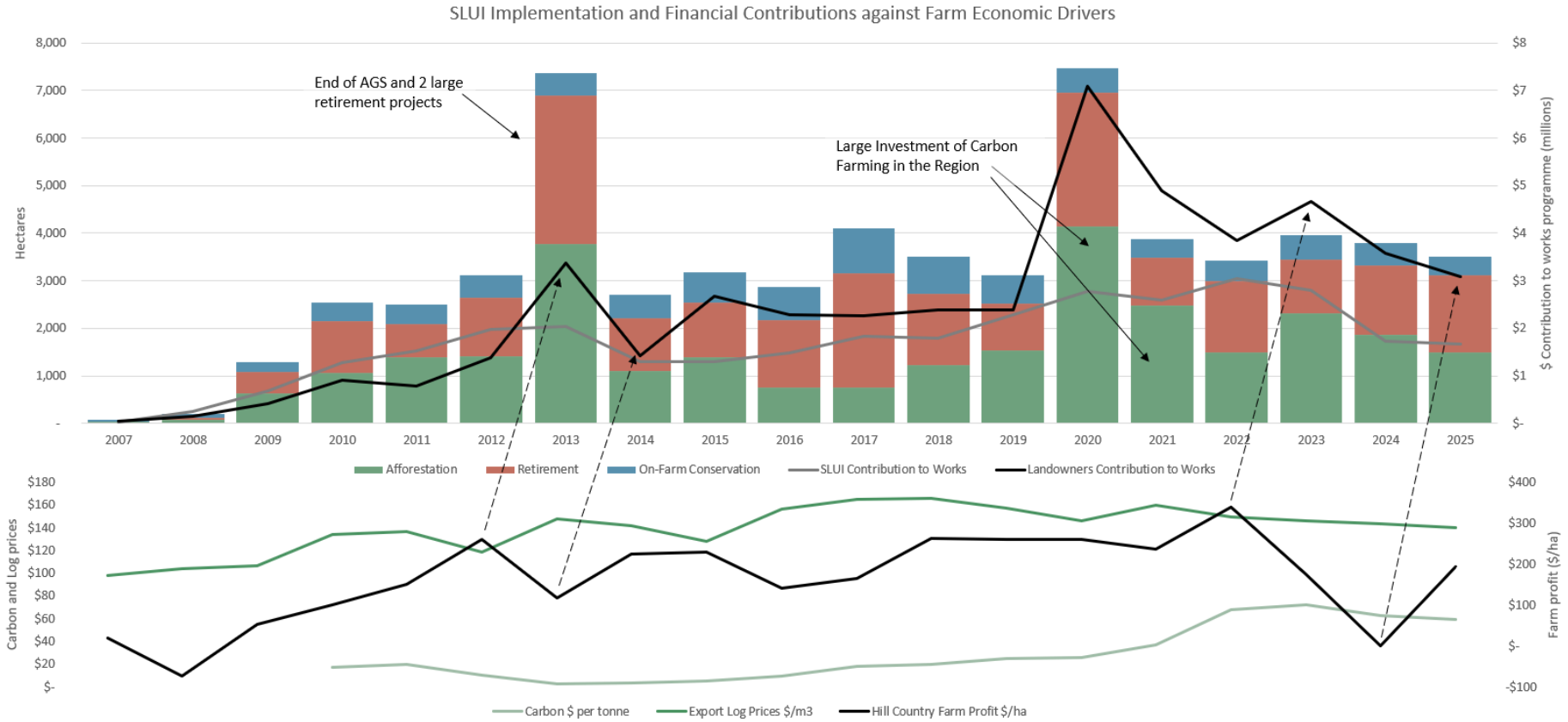


Figure 14. SLUI implementation and financial contributions against farm economic drivers. This suggests a one-year lag relationship between hill farm profits and landowner contributions to SLUI projects. The graph indicates that when farm profits rise (as shown by the bottom black line), SLUI contributions often increase the following year (as shown by the top black line). Conversely, when farm profits drop, SLUI contributions drop the following year. It is important to note, however, that this is only an observed pattern, not a confirmed correlation.

Source: SLUI data and Beef and Lamb Farm Survey data.

Conclusion

The modelled scenarios illustrate the relative benefits, limitations, and trade-offs associated with implementing SLUI at different rates. Accelerating implementation could deliver environmental outcomes earlier in the century and strengthen resilience; however, it would require substantial investment and face practical barriers in delivery capacity, including plant supply, contractor availability and technical advice.

Conversely, ceasing SLUI would likely increase soil loss and reduce the region's resilience to future storm events. Although existing erosion mitigations would continue to mature and provide some ongoing benefit, modelling indicates that, under climate change, regional sediment loads could increase by 36–96 per cent by late century.

Constructive working relationships between Horizons and landowners have supported voluntary participation in SLUI. This collaboration has enabled the programme to achieve substantial erosion mitigation while supporting practical farm management outcomes. Interviews in 2015 with landowners participating in SLUI reported no impact on farm profitability in most cases, with some cases reporting increased profitability. Increased resilience to weather related hazards, improvements to farm productivity and improved stock management were also reported.

Willingness of landowners to participate in SLUI has also been influenced by other factors including market drivers, severe weather events, regulation and policy changes, and external funding sources.

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horizons.govt.nz

24 hour freephone 0508 800 800
fax 06 952 2929 | **email** help@horizons.govt.nz
Private Bag 11025, Manawatu Mail Centre, Palmerston North 4442