

A guide for managing hill country erosion

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environment
SOUTHLAND
REGIONAL COUNCIL

Te Taiao Tonga



Space planting poles on slips



Native planting and fencing
off erosion prone areas



Case study erosion
control mitigations

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About this guide

This guide is designed to provide hill country farmers with ideas and information on ways to manage erosion-prone land. This guide details three trials of different options carried out in the Orauea catchment in 2023-2024, and outlines the costs and effort involved with each.

Information on other options is also available and links to more advice is also included.

The trials and this guide have been produced with funding support from the Ministry for Primary Industries – Hill Country Erosion Programme.

Mitigation options for hill country erosion

There are a range of options available to landowners trying to manage erosion. If you would like to discuss options to mitigate erosion on your property, please contact Environment Southland to arrange a time.

Option 1

Space planting

Typically, this involves poplar and willow poles planted on eroding slopes, with between 10 by 10 metre and 14 by 14 metre spacing (i.e. 50-100 poles per hectare). Poles must be soaked before planting, cattle excluded for two years, and sleeves put over the pole initially to protect early growth from sheep grazing. More information can be found by visiting the NZ Poplar & Willow Research Trust website www.poplarandwillow.org.nz or contacting Land Sustainability staff at Environment Southland.

Option 2

Fencing for reversion

This approach excludes stock from erosion prone farmland areas so that native trees can establish and grow. This requires an existing seed source nearby that allows natural reversion to occur but can be supplemented by planting native species.

This works best when:

- Rainfall is over 1200mm / year
- East or south facing, sloped cool aspect – orientated relative to the sun
- Within 2km of a suitable seed source (native forest)

Option 3

Afforestation

Planting native or exotic species on slopes. This involves changing the land use from pastoral farming to native trees, or a commercial species. Site characteristics, budget, and long-term management are important considerations when choosing what to plant.

Option 4

Detainment bunds

These are dams which temporarily hold back water during rainfall events. This allows sediment, nutrients, and microbes to fall out of suspension, improving the water quality of rivers and estuaries downstream. These dams also help reduce flood flows. More information can be found from the Phosphorus Mitigation Project online. See <https://atlas.boprc.govt.nz/api/v1/edms/document/A3539038/content>

Mitigation trials in the Orauea catchment

A farmer led catchment group in the Orauea River catchment was chosen for the trial because of a known erosion risk in the catchment due to local geology. This can also contribute to higher phosphorus and microbial losses which are attached to sediment particles lost from erosion. The Orauea River catchment group had previously employed Land and Water Science to help explain and detail the erosion issue with farm-scale maps using radiometrics. This information helps landowners identify the areas on their farm with the highest risk of erosion.

We explored three different methods of mitigation at five properties: land retirement and native planting, pole planting for a landslip, and space planting on a slumping hillside.





Mitigation 1:

Land retirement and native planting

Issue: Significant erosion scarps from stock grazing on steep slopes, leading to high sediment runoff during rainfall events.

Trial: Exclude stock from the steepest area. This includes a southeast to south facing slope with 180 metres of new netting fence. Plant 450 hardy native trees over an area of 2364m².

Description: The native trees were PB2 sized, and some PB5 due to nursery availability at same cost. Larger plants generally provide a greater likelihood of survival due to having more clearance above the grass, and more developed roots. However, larger plants take longer to plant as they require a larger hole to be dug, and are more expensive to buy. Planting occurred in late May.

Outcome: This was an effective option for ensuring vegetation cover comes back to reduce erosion. Some existing fencing gear was able to be used and there was very little pasture growth in the retired area so the impact on the farm operation was minimal. The planting was staged across two planting periods to spread the effort of planting over a month and avoid buying too many plants.

Cost Breakdown	Estimated Cost	Actual Cost	Planting & Maintenance
180 metres of fencing	\$3600 (\$20 per metre)	\$1901.24 + 9 hours with tractor and rammer + and additional 13 hours labour	<p>41 planting hours or ~12 plants with guards per hour per person.</p> <p>Glyphosate maintenance spray around plants will occur in October, December, and March. Three hours per spray + 30 L mixed chemical.</p>
300 plants then another 150 between 3x3 and 2x2 metre spacing	300 plants - \$1500 150 plants - \$750 Total: \$2250 (\$5 per plant)	300 plants - \$2031 150 plants - \$1015.50 Total: \$3,046.07 (\$6.77 per plant) for PB2 plants	
300 combi-guards	300 guards - \$450 150 guards - \$225 Total: \$675 (\$1.50 per guard)	300 guards - \$540 150 guards - \$270 Total: \$810 (\$1.80 per guard)	
Contractor	-	\$65 + GST an hour for 7.5 hours. Transport provided \$560.63	
Total	\$6525	\$6,317.94	

Table 1: Estimated and actual costs for land retirement and native planting.

Species number and selection

Species	Size	Number	Species Selection
Flax <i>Phormium</i> Spp.	PB2*	170 75	<p>Five hardy species were prioritised for this site due to frost risk and the need to shade gorse. These species will establish quickly and provide good coverage.</p>
Hebe <i>Salicifolia</i> 'Snowdrift'	PB5*	50	
<i>Carex secta</i>	PB2*	30 25	
Cabbage Tree <i>Cordyline australis</i>	PB2*	25	
Toe Toe <i>Austroderia</i> Spp.	PB2*	50 25	
Total		450	

Table 2: Hardy species chosen to spread over the area, and compete with the gorse.

* Note that PB stands for pint bags. It is a black polythene planter bag with 1 pint equalling 600ml of volume [soil]. Therefore a PB2 bag is 1.2 litres of soil and root mass.



Before



After

Mitigation 2:

Tangoio willow pole planting of a slip

Issue: Slip on a hillside that is likely to continue to move. This has damaged a fence and is a source of sediment to nearby waterways.

Trial: Space planting with Tangoio willow poles at 10 to 14 metre spacing. This is a minimum of 60 per hectare, and max of 100 per hectare in places (10 by 10 spacing). Avoid grazing by cattle for at least two years whilst plants establish as cattle can push poles over and strip the bark.

Description: Poles were soaked for nine days. The overall area was significantly underestimated. Initially only the internal area and edges of the slip were going to be planted. Once walking through the area around the slip there were many cracks and slumps in the hillside indicating more of the slope was going to fail. Therefore, the entire face from top to bottom was planted to prevent future slips. Trees will be pruned to a single leader after two years to help encourage upright growth.

Outcome: Planting went well, using either a specially made pole bar or post hole borer. It did take longer than predicted to walk out poles 5-10 at a time, sleeves and then plant them, however with practice this time would reduce. Sheep grazing will help reduce grass competition however spraying around the base to kill the grass is recommended.

Cost Breakdown	Estimated Cost	Actual Cost	Comments
Tangoio Poles	75 @ \$10 = ~\$750	200 @ \$10 = \$2000 +GST	Planting a larger area at a spacing to maximise grass growth at maturity. Some thinning can be undertaken if starting with a 10 by 10 metre spacing as trees establish. Planting speed was overestimated. Overall, across the project we planted closer to seven poles per hour with three to four staff or five days to plant 730 poles with 4-5 staff each day
Dynex sleeves	75 @ \$6.29 = ~\$500	200 @ \$9.95 = \$1990	
Contractor Rates	\$65/hr + GST for 7.5 hours (10 poles per hour) ~\$560 GST inclusive	\$2865.25 29 hours labour 11 hours travel \$190 for mileage	
Total	\$1960	75 poles was \$2570.72 All 200 poles was \$6855.25	

Table 3: Estimated and actual costs for willow pole planting.



Mitigation 3:

Space planting of a slumping hillside ~3.4 hectares

Issue: Large slumping hillside. This is leading to more erosion and will continue to move without pole planting, eventually taking out fences. Some open slips with bare soil within the area are contributing sediment to nearby waterways.

Trial: Space planting of Tangoio Willow at ~14 by 14m spacing. This is a minimum of 50 per hectare, and max of 100 per hectare in places (10 by 10 spacing). Final spacing averaged 65 poles per hectare.

Description: Poles were soaked for seven days. Spacing was chosen due to the area having some movement across most of the hillside. Where there appeared to be less slumping the spacing was increased between the poles towards 15 metres. The planting took a long time as some poles had to be carried up to 200m and around 230 poles were planted in this area. Some areas were too wet during planting so had to be rammed around the base later with a fencing rammer.

Outcome: This hillside was very wet with large areas of boggy ground, critical source areas and wet depressions which will help to increase the survival of the poplar and willow poles. Poplars need to be planted in poorly drained soils/wet gullies with 500mm of topsoil. Willows have some drought tolerance. This area will continue to be grazed by sheep and will be entered into the New Zealand emissions trading scheme to earn income in addition to the grazing.

Cost Breakdown	Estimated Cost	Actual Cost	Comments
Poles – Populus Nigra, Lombardy Poplar and Tangoio Willow	320 @ \$10 = \$3200	230 @ \$10 = \$2300 +GST	Larger spacing of 14 by 14 metres likely over areas of less severe erosion. Overestimated poles required.
Dynex sleeves	320 @ \$6.29 = \$2012.80	230 @ \$9.95 = \$2288.50	
Contractor Rates	\$65/hr plus GST for 32 hours (10 poles per hour) \$2392 GST inclusive	\$3274.60 32.5 hours labour 12 hours travel \$215.60 for mileage	Underestimated overall time to plant poles. This took 4-5 staff two days to complete. Around 5 poles per hour per person.
Total	\$7904 GST inclusive	\$8,078.54	

Table 4: Estimated and actual costs for willow pole planting.

Key learnings from our Orauea catchment trials

- ▶ Pole planting is an appropriate option for erosion mitigation if stock grazing is still desired and an appropriate land use for the site. This is a medium cost and high effectiveness option.
- ▶ Retiring an area from grazing (fencing) and planting natives is the best option when there is marginal grazing benefit with a very high erosion risk. This option has a medium to high cost but is highly effective.
- ▶ The success of fencing for reversion is dependent on available seed source nearby, and often requires some supplementary planting to help the process of native forest establishment. Grazing pests (deer) need control.
- ▶ Detainment bunds are a treatment option to minimise overland flow sediment losses once management actions that keep soil/sediment in the paddock are underway. Management options include grazing and cultivation management, protection of critical source areas, and careful fertiliser application.
- ▶ Obtain expert advice from regional councils, the poplar and willow trust or local nurseries before pole planting. Ensure a thorough understanding of pole handling, transport, planting method and ongoing management for high survival. Always soak poles before planting.
- ▶ Projects that include fencing or earthworks needs to consider the most appropriate time to do this. Earthworks and fencing should be completed in the summer while soils are drier.
- ▶ When planting natives, the best time is autumn and spring to avoid frosts and dry periods, and therefore maximise survival rates.
- ▶ When planting poles the best time to plant is during winter. Poles cannot be cut until the leaves fall off the trees, and then require at least four days of soaking the larger end in clean water before planting.
- ▶ The optimal pole size is 2.5-3m long, straight and with large end diameter 65mm, and small end 45mm.



Key steps to successful pole planting

Successful planting requires careful planning and ongoing management to ensure maximum survival. This includes factors such as species selection, the care and handling of poles from nursery to planting, and post planting maintenance.

Key steps include:

- ▶ Species selection based on site characteristics – soil, slope, and intended purpose.
- ▶ Estimate pole numbers by measuring the treatment area in hectares and the predicted spacing. Spacing ranging between 10x10m (100 poles/ha) and 14x14m (51 poles/ha) is recommended. Planting at 14 metres by 14 metres can allow more light in when the trees mature but can reduce the effectiveness of erosion control.
- ▶ Minimum length is 2.5m long poles, planted 60-70cm deep and protected by a 1.7m dynex sleeve.
- ▶ Planting cannot occur until mid-June, after leaves fall off the willows in late May/early June. Where possible poles should be rammed in after a hole is started to ensure firm footing. See www.poplarandwillow.org.nz/documents/planting-poplars-willows-successful-planting
- ▶ Poles should not be harvested once willows or poplars begin to grow leaves in the spring.
- ▶ Soak the thickest end (up to 400mm) for at least 4 days in clean water. It is recommended that poles are planted within two weeks of the poles being cut at the nursery.
- ▶ Soak poles close to planting site as they become heavier as they take in water.
- ▶ Once planted, spray glyphosate around the base to minimise competition from grass during establishment and exclude cattle for two years.
- ▶ The poles need to be checked in summer and the soil around the base compacted if necessary to keep the soil tight around the base of the pole.

See 'Willows for the Farm' for more information www.poplarandwillow.org.nz/farmer-guides/selection-of-poplar-and-willow-varieties

Hawkes Bay Regional Council guides www.hbrc.govt.nz/environment/farmers-hub/managing-erosion/willow-and-poplar-poles/



Example (above) soaking poles prior to planting, and (below) spacing of poles over an area of slumped hillside.



Talk to the team at Environment Southland for advice on suitable species so you can avoid planting invasive species.

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es.govt.nz

Information on creating an on-farm poplar and willow pole nursery

The following information is a brief summary of some considerations when growing your own willows' and poplars on farm. Note that all willow and poplar wands and poles should be soaked upright in clean water before planting.

Site: Sheltered from the main winds, and on good deep topsoil and ensure complete stock proofing.

Water systems: Irrigation helps increase survival and growth. Drip lines use less water but may block up. Guns have less maintenance from blocking up, but may cause some damage to trees and use more water.

Species selection: Visit the NZ Poplar & Willow Research Trust website and discuss with your regional council. www.poplarandwillow.org.nz/

Spacing: Rows of poplars/willows should be 3 meters apart to allow driving a vehicle between the rows, and 60cm between the wands.

Method of installing 0.5m wands: Wands must be soaked upright in clean water before planting. Spray grass with glyphosate, put down wool suppression mat, install water system for irrigation, and then ensure access for treating rust and silver leaf. Plant wands in winter/early spring while dormant (no leaves or shoots) but after the main frosts – September. Mowing between rows is recommended.

Choosing a leader: Choose a single poplar growth 'leader' that is not on the downwind side of the poplar wand from the predominant wind as these are prone to snapping off in the early years before the stump is absorbed into the pole. This will ensure larger, straighter poles are produced.

Size of nursery: Total stalls (poplars) should be chosen based on allowing a management regime on a 3-year cycle. Ensure robust labelling of rows, and preferably only one species per row.

Management: Poplar and willow nurseries should be managed on a 3-yearly basis and do a full harvest each year (rather than selective) to help keep management efficient. Ensure cuts occur when time suits. Harvest in winter when dormant and prune in Jan/Feb.

Year 1	Plant a 1/3 of the desired size of the pole nursery.
Year 2	Plant a 1/3 of the size of the pole nursery.
Year 3	Plant a 1/3 of the size of the pole nursery.
Year 4	Harvest (from every stall) the first pole from year 1 plantings. <ul style="list-style-type: none"> - If an A grade pole is produced (length 3m, and minimum small end diameter 45mm, large end diameter 65mm) then allow 2 leaders to grow for the next 3-year rotation. - If not an A grade pole produced, then only allow a single leader to grow.
Year 5	Harvest all poles from Year 2 planting. As above, depending on the quality of pole produced from 3 years, allow either 1 or 2 leaders to grow back in the second rotation.
Year 6	Harvest all poles from Year 3 plantings.
Year 7	Continue to manage on 3 yearly basis to split the work. Whole crop harvests are for ease of management. (alternative is selective harvest but this gets tricky to manage efficiently).

Pruning: Prune in Jan-Feb. Remove laterals, and sub leaders.

Harvesting: Cut poles in winter when trees are dormant (all leaves have fallen off), and spray every cut to prevent diseases.

Figure 2 (Opposite page): Example of an on-farm poplar pole nursery. Poplars are a year old, pruned back to a single leader. Weed suppression mat was used for the first year, and irrigation is supplied from guns above the poplars. The site is sheltered from prevailing winds and grass is mowed.



MPI hill country erosion programme

The hill country erosion programme is a partnership between the Ministry for Primary Industries (MPI), councils and landowners.

It provides funding support to regional erosion-control projects that are beyond the capacity of councils to address on their own. Both councils and landowners also provide funding throughout the programme, in a cost sharing approach.

Environment Southland received funding through the MPI Hill Country Erosion Programme for 2023-2024, and previously in 2019-2020.

With funding from the hill country erosion programme, Environment Southland has received support to:

- ▶ develop an erosion control strategy and implementation plan for Southland
- ▶ trial land treatment options within the Orauea Catchment

The HCE programme supports councils to:

- work with landowners in mapping and identifying erosion-prone land;
- deliver catchment initiatives and sustainable land management projects;
- build their technical capacity to deliver erosion-control work (staff training).

It also supports councils to plan for and treat erosion-prone land, through:

- space planting of trees (far enough apart that pasture can grow for grazing stock),
- land retirement, and
- reversion to native vegetation or forestry.





Glossary

Afforestation - planting commercial trees in an area that did not have trees within the last five years. Can also refer to the establishment of native forest.

Detainment bund - a small dam built across a water flow path (gully) to temporarily hold back overland flow, allowing sediment to drop out of the water.

Dynex sleeve - plastic sleeve of varying length (dependant on pole length) which protects the young tree from sheep grazing whilst it grows. Dynex sleeves are not sufficient to prevent cattle grazing, so cattle must be excluded from pole planting sites for two years.

Fencing for reversion - exclude stock with a post and wire fence to allow native trees to establish and grow. Usually from an existing natural seed bank, but can be aided by planting of natives.

Hill country - land with a slope above 15 degrees and altitude below 1000m, typically used for sheep and beef farming.

Mitigation - reducing the severity of erosion or other environmental impacts with actions that address the cause of the issue.

Pint bags (PB) - a black polythene planter bag with 1 pint equalling 600ml of volume. Available in varying sizes, from 'PB1' to 'PB5'. For example, a PB2 bag is 1.2 litres of soil and root mass. Plant size relates directly to pint bag volume i.e. PB1 typically contains young plants that are very small, whilst PB5 contains older plants that are more fully grown.

Poles - large (1.5-3m), young, poplar or willow tree stems which grow roots and sprouts once planted in the ground.

Space planting - planting willow or poplar poles at a sufficiently wide spacing to reduce erosion whilst also allowing grass to grow.

Stakes - small (<1m), young, poplar or willow tree stems which grow roots and sprouts once planted.

Wands - medium (1-1.5m), young, poplar or willow tree stems which grow roots and sprouts once planted.

Where to find more information

Poplar and willow information
www.poplarandwillow.org.nz/

Environment Southland good management practice advice www.es.govt.nz/community/farming/good-management-practice

Ministry for Primary Industries – Hill Country Erosion Programme for councils www.mpi.govt.nz/forestry/funding-tree-planting-research/hill-country-erosion-programme/

Hawkes Bay Regional Council poplar and willow planting guides www.hbrc.govt.nz/environment/farmers-hub/managing-erosion/willow-and-poplar-poles/

Hill Country Erosion video from Hawkes Bay
www.youtube.com/watch?v=ms8TMZWclbA

Contact the team at Environment Southland for further support and advice, including on farm visits.

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