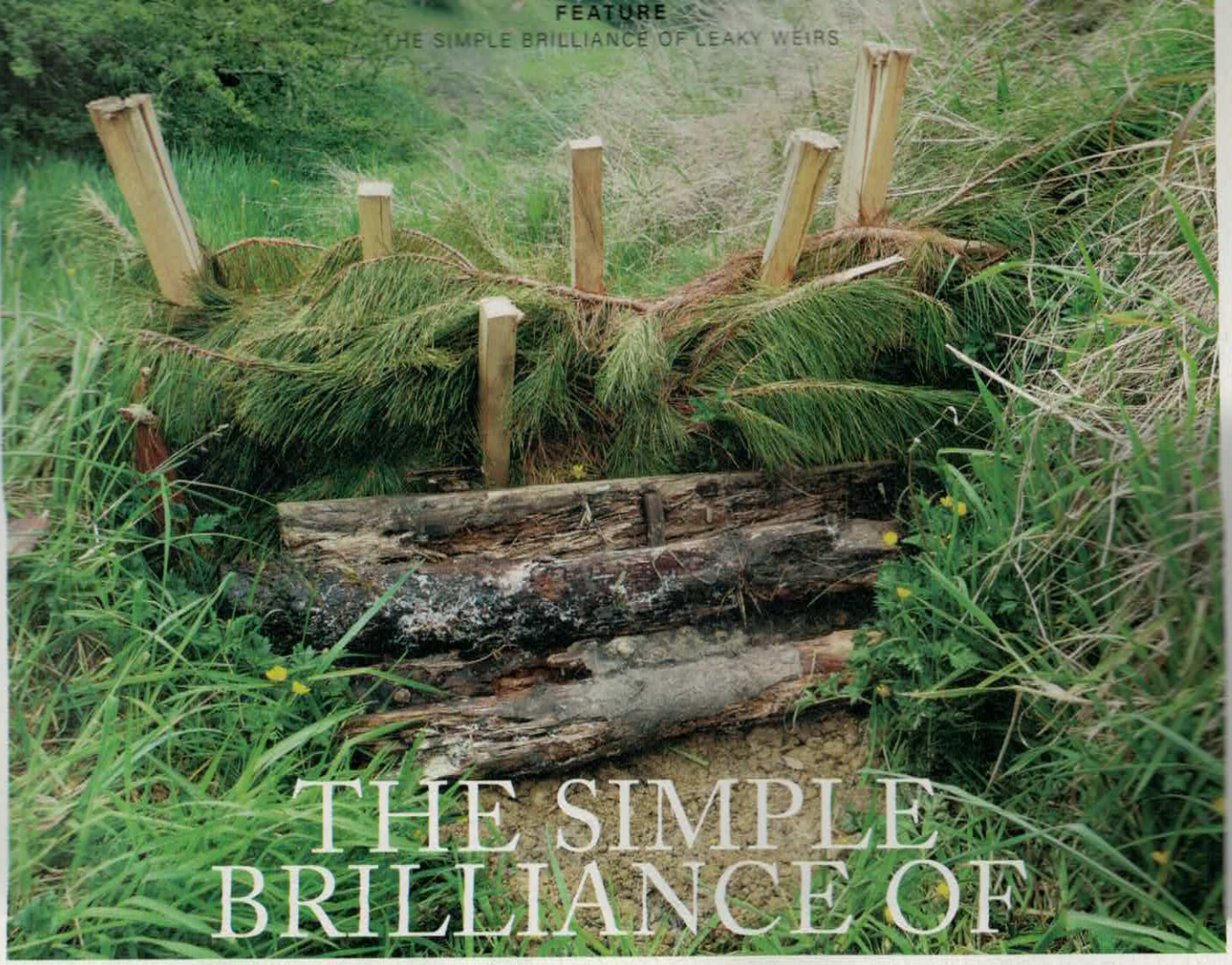

THE SIMPLE BRILLIANCE OF *leaky weirs*

How a basic permaculture design can redirect water, protect against erosion and increase biodiversity on your block.

Words & images **Rachel Rose**

When it comes to water, most block owners will not understate the value of having it run through their properties. But just as important is *how* water moves. Water has a will of its own, and left unchecked, it will follow the path of least resistance, forming channels that erode precious topsoil and leave some areas waterlogged and others desperate for moisture.

However, there are a number of low-tech permaculture designs that can help redirect water away from erosion channels to the areas that need it. One of these designs is known as a leaky weir. It is practical, easy to build and requires nothing more than some hand tools, spare materials, a free afternoon and a basic understanding of water.

My experience building leaky weirs comes from Hawke's Bay regional coordinator for New Zealand Landcare Trust, Nathan Burkepile. Known as "Mr Wetland", Nathan consults with land owners around the country and has built leaky weirs to great effect on several projects. He oversaw a series of projects, two on my property in Whanganui and one in Hawke's Bay, where leaky weirs were built to redirect water, reduce erosion and increase infiltration.

Whanganui project 1: leaky weirs

SCENARIO: A small gully with a flattish floor two to six metres' wide on our summer-dry hill country property with 900mm annual rainfall.

PROBLEM: The gully ends in a culvert that passes under a boundary fence. Water infrequently runs fast through the gully during and after heavy rain.

GOAL: Increase water infiltration to help trees survive, reduce waterflow through the culvert and mitigate or prevent erosion.

SOLUTION: Build a series of post-and-weave leaky weirs.

WE BEGAN with Nathan pointing out places within the gully where erosion channels were starting to form. Our goal was to lift the water out of these channels so it could spread over a wider area, slowing the flow. This would also increase water infiltration for vegetation and reduce the risk of erosion.

"Leaky weirs are temporary structures," Nathan says. "They encourage vegetation to develop, and that takes over the job of preventing erosion. Vegetation is the best erosion control you can have."

The key word is "leaky". We're weren't trying to block water entirely, in the manner of a dam. We were trying to calm the water in accordance with permaculture principles. We used materials and tools already at hand to build two leaky weirs in series. My partner hammered in posts in an offset pattern across the gully where channels were beginning to form. We made use of the small wilding pines we'd been cutting down and weaved branches and young trunks through the posts. Then we placed some logs on the uphill side, and reinforced them with some of our sticky clay subsoil. I could have transplanted some rushes for good measure but there's plenty of seed thanks to our fallow pasture which would allow vegetation to take over.

Our leaky weirs in series.

Depending on the materials used, the structure might last five to ten years. Eventually, little terraces of water will pool in the gully. When the vegetation covers the structure, it will become a hump and no one will notice you had a hand in it.

Our leaky weirs in action.

Slowing the water means sediment will drop out, adding to the material on the uphill side of the weir. Because we'd been carrying out large-scale earthworks on our property, when cyclone Dovi came along it pushed a lot of water, thick with sediment, through the gully. However, our leaky weirs worked perfectly. Now there's a thick layer of sediment levelling out the gully behind the structures. What might have taken several years to quietly develop in normal conditions took just one rain event.

Whanganui project 2: Starve the head cut

Elsewhere on the farm, in the middle valley, a couple of head cuts were steadily deteriorating. A head cut forms where the overland path of water narrows and erodes soil: "It's a waterfall, basically," says Nathan. The problem with head cuts is that without intervention, they inexorably move uphill. The lip is continually eroded and over time steep channels form, ever-lengthening. Once you recognise them, you'll see them everywhere, even in miniature form.

Buoyed with the confidence that came from Nathan's advice, we headed off during steady rain with spades in hand.

A couple of years ago, we experimented with a big head cut on another part of the farm by dropping a bale of straw into it and wedging logs and brush above it. This slowed water down and distributed it more widely, while the straw acted as a buffer.

Nathan suggested a different strategy for this project. Here it was better to redirect the flow of water to starve the head cuts, and send the water on a quieter journey where it could do more benefit and no harm.

Once we'd quickly pulled back the long grass to better understand the lie of the land and the existing flow of the water, it was really just 10 minutes of work for my partner to dig out a shallow trench across the slope. As we worked, we could hear the effect as less water ran through the head cuts below us. Water immediately filled the new trench, helping us extend it in the right direction and tweak it. We could have done this with an A-frame water level during a dry spell. But given the water flows are small and there was no risk of creating a washout, it was better to carry out redirection during wet weather when we could see the results in real-time. Also the ground was easy to dig.

The trench above the headcut.

The trench site was a stable slope covered in tall grass, which does a great job of slowing water down and holding soil together. Had it been bare or excavated ground, a more formal and carefully planned solution would be required.

Permaculture focuses on slowing and calming water, rather than a more traditional farming approach of moving water away as soon as possible. It's effectively swales vs drains. However, our trench was not a swale, because it didn't stay on contour its whole length. But the middle section has only a slight fall and here the water immediately calms. There's something very satisfying about seeing theory work in action.

Lakeview Forest, Hawkes Bay project: Leaky Weirs

SCENARIO: A small peat wetland in a forestry block currently being harvested.

PROBLEM: Peat wetlands are important and vulnerable landforms. This one was drying out: a stream had become channelised, creating a firehose effect as water speeds up. This created erosion and was draining the wetland. In addition, a culvert was bringing in water from neighbouring farmland, increasing the depth of the channel and making the problem worse.

GOAL: Restore the hydrology of the peat wetland and enhance water quality and biodiversity.

SOLUTION:

1. Construct leaky log weirs in the upper wetland in order to lift the water out of the channelised stream and spread the flow across the wetland as a sheet flow or multiple small channel flow.
2. Use soil plugs to block the stream.
3. Place large logs across the channel to divert flows to the middle of the wetland.
4. Fill the channelised sections with wood to encourage water out of the channel and across the wetland.

THIS SCENARIO was the inspiration for me to do something with leaky weirs. Nathan was joined by representatives of Hawke's Bay Regional Council, Rayonier Matariki Forests and RedAxe Forestry Intelligence to build leaky weirs on a small peat wetland on a Hawke's Bay forestry block. Part of a community education project, the goal was to use leaky weirs to restore the hydrology of the peat wetland and enhance water quality and native biodiversity.

BELOW Can you spot the wetland? Nathan Burkepile can. He was able to indentify channels or incisions forming, which are draining the wetland.

Here the damage caused by the chanellised stream is more visible: it was 500mm deep in the middle section. As the wetland dries out, dryland pasture plants move in, shouldering aside the naturally occurring carex and rush species.

A leaky weir in construction. The posts were placed on an erosion channel in the upper wetland and made ready for branches to be weaved through.

A completed post-and-weave leaky weir on an erosion channel.

No, that's not a troublesome pile of forestry slash: these logs were carefully placed in the channels to slow water, reduce erosion and cause sedimentation build up, fending off the development of head cuts.

Before: the stream and the surrounding area is eroding significantly.

After: the stream bed has lifted and the exposed ground is now being protected by fast-growing vegetation thanks to the leaky weirs.

The project began in September 2020 and continued in stages. "Spat ropes" were installed in several places to provide climbing species with ways to travel up through culverts, thus enhancing the biodiversity of the wetland.

The team continues to visit to monitor the changes. The leaky weirs and other interventions are successfully lifting the stream bed and helping it reconnect with the surrounding wetland. Vegetation is establishing naturally.

Read More
Transforming a steep, wet block with earthworks and swales
thisnzlife.co.nz

A caution

These projects are rooted in an approach called "adaptive management" by ecologists. Once you've installed these kinds of low-tech structures, monitor them regularly to check they're working as expected. If not, follow the first permaculture design principle – observe and interact – and make adjustments accordingly. Don't do anything that directs water across your boundaries or negatively impacts your neighbours. It's hard to imagine that any work with a spade could trigger the need for resource consent, but the onus is on you to do your research.

More resources

Check out NZ Landcare Trust at its website, landcare.org.nz, to see if there is a regional coordinator in your area or subscribe to its newsletter to find out about upcoming events. ■

Watch more

Nathan likes these videos showing other low-tech techniques for slowing water and preventing erosion, such as ones in this series: **https://www.youtube.com/watch?v=MShLwasZ9o0**

These log drop structures were developed in the dry western climates of the US but Nathan says the same principles can be applied here.