Farm Plan Environment Module

Freshwater ecosystem health

Chapter Overview

This chapter is broken down into 6 steps outlined below. Each step includes background information as well as a completed example of templates associated with that step. Blank templates are included with hard copies of the resource or can be downloaded from **beeflambnz.com/farmplan**

STEP 1 – Catchment Context and Freshwater Goals

Identify the catchment context you are operating within including any information provided by the council or your local catchment group. Identify any goals you have for managing freshwater on your farm. These may link back to any goals completed in the Introduction chapter.

Template FW1 - Catchment Context and Freshwater Goals

STEP 2 – Identify your waterways

Familiarise yourself with the different types of waterways and map the freshwater features on your farm.

STEP 3 - Assess your waterways

Familiarise yourself with ecosystem health and the different freshwater indicators and measurements. Review any other water testing information that may be available. Select an appropriate assessment tool/s for each sampling site. Record and interpret your results.

Template FW2 – Stream Health Check

Template FW2a – Stream Health Check Recording Table

Template FW3 – Freshwater Assessment Summary

STEP 4 – Identify Risks, Opportunities, and Management Actions

Identify possible risks and opportunities to freshwater ecosystem health and the factors contributing to the risk or enabling the opportunity. Assess the level of risk using the risk assessment matrix. Identify management actions that have been or could be taken. Table 2.1 provides guidance.

Template FW4 – Freshwater Risk Assessment and Management Actions

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STEP 5 – Action Plan

Building on the management actions identified in step 4 document a freshwater action plan with details of those actions that need to be implemented.

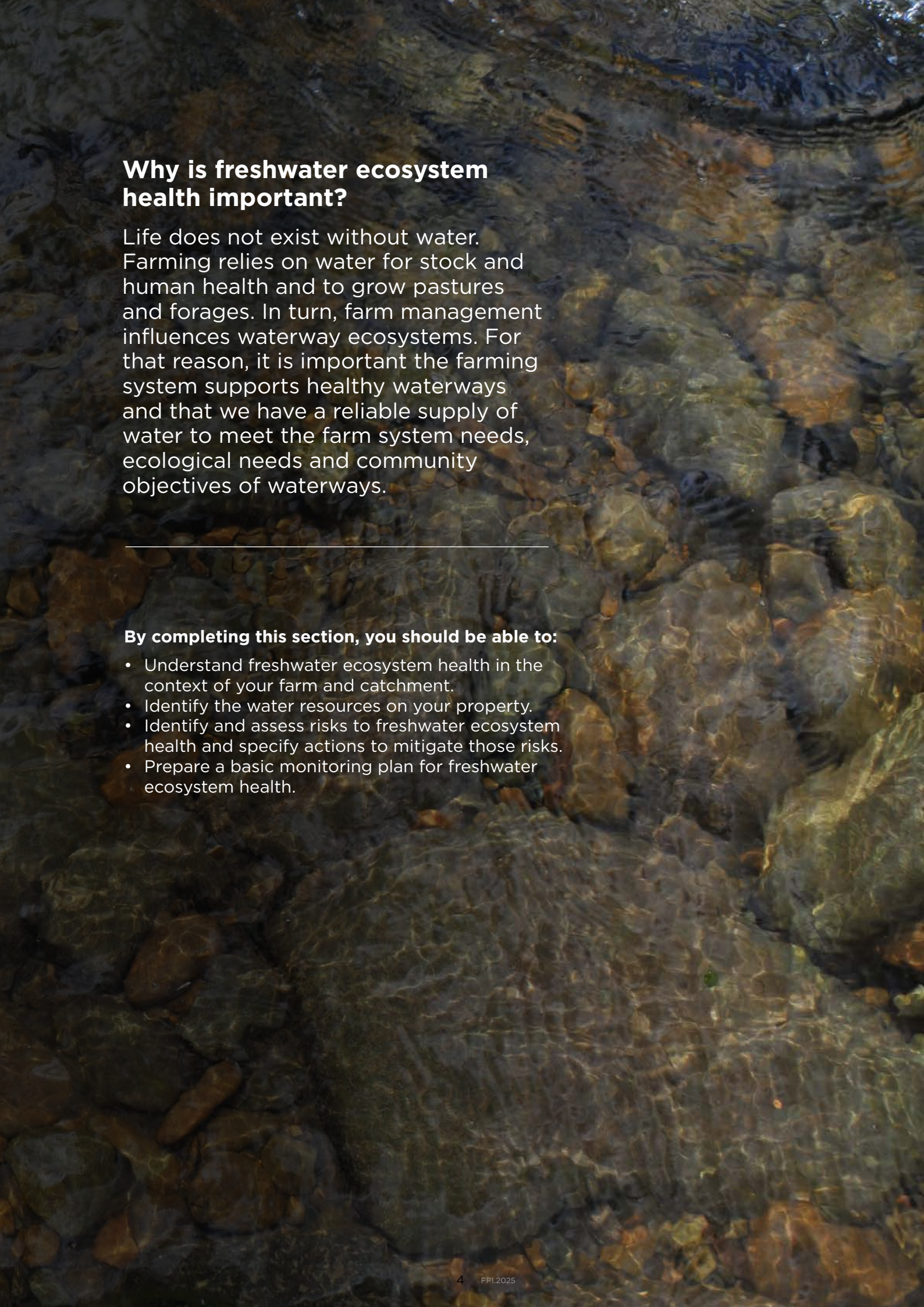
Template FW5 – Freshwater Action Plan

STEP 6 – Monitoring and Review

Develop a regular monitoring programme for your waterways and reflect on and review your freshwater plan.

Template FW6 – Freshwater Monitoring Plan

Additional supporting resources are available at **beeflambnz.com/farmplan** and on the B+LNZ Knowledge Hub



Why is freshwater ecosystem health important?

Life does not exist without water. Farming relies on water for stock and human health and to grow pastures and forages. In turn, farm management influences waterway ecosystems. For that reason, it is important the farming system supports healthy waterways and that we have a reliable supply of water to meet the farm system needs, ecological needs and community objectives of waterways.

By completing this section, you should be able to:

- Understand freshwater ecosystem health in the context of your farm and catchment.
- Identify the water resources on your property.
- Identify and assess risks to freshwater ecosystem health and specify actions to mitigate those risks.
- Prepare a basic monitoring plan for freshwater ecosystem health.

STEP 1 – Catchment Context and Freshwater Goals

Catchment Context values and objectives

It is valuable to consider the wider catchment and catchment values when thinking about why freshwater is important on your farm. Your local Regional Council will have or will over time develop information on the catchment context, challenges and values (CCCV) as part of freshwater farm planning requirements. Typically, this will include cultural significance of the catchment, name of local tangata whenua, regional regulatory requirements, sites of cultural or community significance, species, or ecosystems of cultural or community significance, and priority contaminants to be managed.

In addition, community catchment groups are a great way to understand the goals, values, and visions your community has. They also act as a support group for working with others in your community including farmers on sharing and setting group outcomes, advances in farming practices, and evaluating progress within a catchment.

In **Template FW1** identify your local catchment(s) and what values or objectives your catchment group, community, and/or Regional Council has identified for the area.

Why is freshwater important on your farm?

Understanding what you and your community value in freshwater then setting goals that align, is an important step to making decisions that achieve good farming and environmental outcomes. Refer to any overall farm vision, values and goals already completed in the Introduction chapter.

Freshwater values and goals often fit into some broad categories including:
- Economic
- Social
- Cultural
- Recreational
- Natural character
- Ecosystem health
- Human health and wellbeing

Examples of freshwater goals:
- Secure safe drinking water available for houses and livestock
- River is safe for swimming, kayaking and other recreational activities in appropriate weather conditions
- Sustainable habitat for native fish and insects
- Provides opportunity for māhinga kai (food gathering) such as eel, koura or trout
- Water is able to be captured during periods of flood and stored for use in irrigation during dry periods

Record any catchment context and freshwater goals in **Template FW1** in "Our Plan". An example is provided below.

Catchment Context and Freshwater Goals

Catchment Context
This varies around the country. See your regional council website for more information.
Freshwater Goals
Secure safe drinking water for house and animals
Safe swimming in the river
Sustainable habitat for native fish and insects

Example

FW1

Blank templates can be found in **Our Plan** section and at **beeflambnz.com/farmplan**

STEP 2 – Identify your waterways

Identifying the water resources on-farm

Below is a guide to help you recognise different types of waterways on your property. A good way to think about it is that regardless of size, or type, an area that holds water is a potential ecosystem to be looked after. Waterways are not just what we see on the surface, but also what is underground. It is just as important to look after groundwater.

Guide to different types of waterways

Broad definitions of the different types of waterways you may come across are outlined below. See glossary for specific defintions. Different types of waterways have different indicators of ecosystem health. It is useful to understand the different types of waterways you have on your property so that you can ensure you are managing them effectively.

Rivers, streams, burns and creeks – continually or intermittently flowing bodies of freshwater.

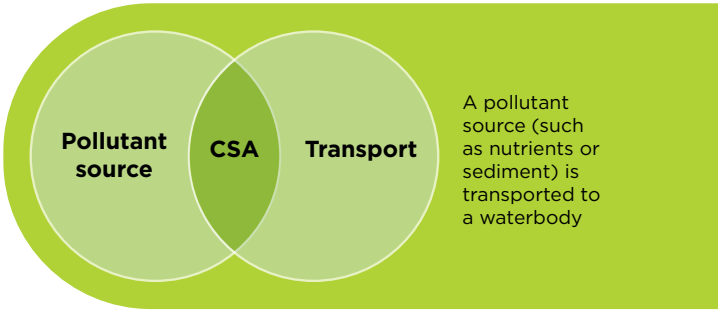
Lakes, tarns, ponds and dams – body of freshwater entirely or nearly surrounded by land.

Artificial watercourse (e.g. ditches, drains, water race) – human-made or modified waterway with continually or intermittently flowing water.

Wetland – Permanently or intermittently wet areas, shallow water, and land water margins that support a natural ecosystem of plants and animals that are adapted to wet conditions.

Groundwater/Aquifers – water that has travelled through the soil, or from river and lake beds, into underground rock formations containing significant amounts of water.

Critical Source Areas (CSAs) – Critical source areas are areas in a paddock or on a farm that can contribute to relatively large amounts of nutrient and sediment losses to waterways. They are a landscape feature such as a gully, swale, or depression that accumulates runoff from adjacent land and delivers, or has the potential to deliver, one or more contaminants to one or more rivers, lakes, wetlands, or drains, or their beds (regardless of whether there is any water in them at the time).



Wetlands

Wetlands are a great tool for farm environmental management. They act like the kidneys of the earth, cleaning the water that flows into them. Wetlands can trap sediment and soils, filter out nutrients and remove contaminants, can reduce flooding, protect coastal land from storm surges, are important for maintaining water tables, and they also return nitrogen to the atmosphere. Given the importance of wetlands we recommend knowing where your wetlands are (both human made or natural). Regional Councils may have an estimate of wetlands on your property and by 2030 will be required to map all natural wetlands in their regions that are 0.05 hectares or greater in size or if less than 0.05 hectares but contains threatened species. Any activity (for example nearby earthworks, vegetation clearance, or stock grazing) that may cause adverse effects on a wetland of any size should be discussed with your Regional Council, as a resource consent may be required.

Note: Human made wetlands do not come under the same national regulations as natural wetlands and may be treated differently. Councils still have obligations to protect all wetlands (natural and human made) under the RMA. So if you have any concerns it is best to contact your Regional Council. We recommend still recording human made wetlands in your farm environment plan as they are an important water body to maintain and look after.

Map your waterways

Review your farm map. You may have completed this as part of Step 3: Farm Mapping in the Introduction chapter. Make sure you have mapped all your waterways and other water features.

This should include:

- ☐ Waterways and waterbodies (eg. wetlands, lakes, dams, springs, ponds, rivers, streams, creeks, intermittent, ephemeral)
- ☐ Drains (surface and/or subsurface) including end points
- ☐ Constructed water features (such as dams, ponds, raceways)
- ☐ Sediment traps and bunds, debris dams, soil conservation flumes and other built structures for resource protection
- ☐ Water crossing points (e.g. bridges, culverts fords and unformed crossings)
- ☐ Critical source areas (CSA) and overland flow pathways
- ☐ Areas prone to flooding
- ☐ Water monitoring or sampling sites

As you review your map identify any obligations you may have for different kinds of waterways. For example obligations to keep stock out of certain waterways or restrictions around wetlands. Your regional council can provide information about what you need to do and by when. Some guidance is also available at **beeflambnz.com/farmplan**.

Freshwater Regulations:

Staying up to date with changing regulations:

When assessing the condition of your freshwater and writing your farm plan it is important to meet regional and national regulatory requirements. Meeting regulations should form your minimum bottom line. If you are unsure where to start contact your local Regional Council. Some guidance is also available at **beeflambnz.com/farmplan**.

Key regulatory topics you may wish to discuss are (please note these topics are suggestions and are not fully inclusive):

- Stock exclusion
- Freshwater farm planning requirements
- Winter grazing rules
- Discharge of contaminants
- Water take / use
- Stock-holding areas
- Areas of contamination or nutrient discharge for example the location of farm rubbish pits, offal pits, and silage pits.
- Application of nutrients
- Earthworks and vegetation clearance near freshwater sources
- Any activities near a potable water take / drinking source
- Activities within or near wetlands

STEP 3 – Assess your waterways

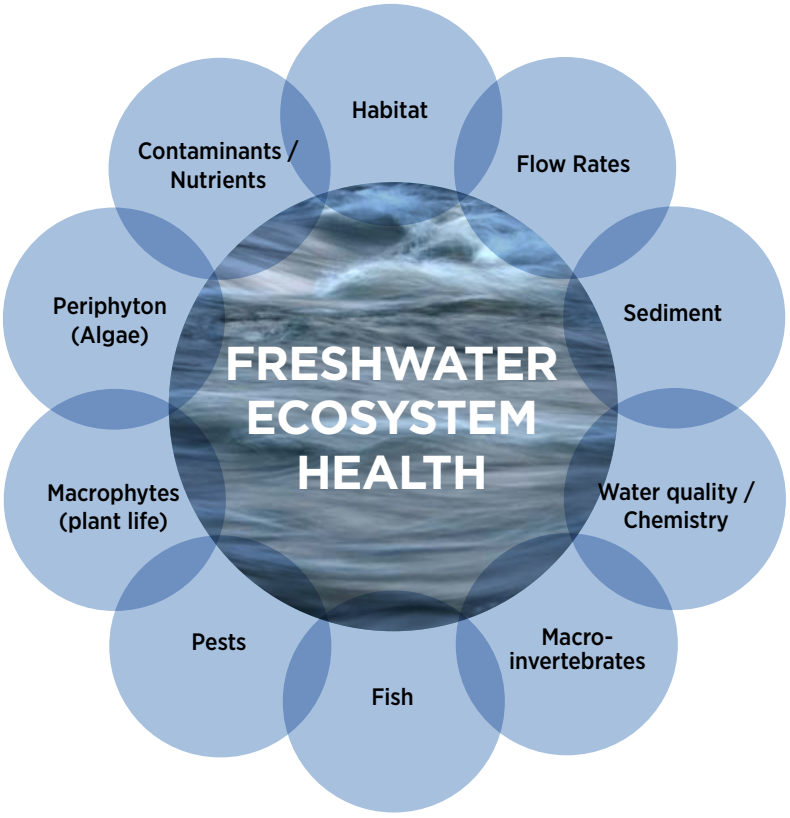
Now that you have mapped your freshwater resources you will get to know how healthy your waterways and freshwater bodies are.

What is freshwater ecosystem health?

Freshwater ecosystem health includes a waterway's aquatic life, physical habitat, water quality and water flow patterns. This helps determine the overall state of the freshwater system.

Water quality often focuses on a number of parameters such as water clarity, the nutrients nitrogen (N) and phosphorus (P) and the faecal indicator, *E. coli*. However, these things on their own don't tell us about how healthy the freshwater ecosystem is and can vary widely in a short space of time.

A number of factors are considered when assessing freshwater ecosystem health. Water quality is one aspect but should be considered in association with shape of waterway, water quantity, flow patterns, habitat quality, fish, macroinvertebrates (e.g. insects, snails and worms), plant life (macrophytes, periphyton), pest species, sediment, clarity, water chemistry, temperature, dissolved oxygen and nutrient content.



Waterways can be good indicators for broader environmental conditions or land uses in the catchment that the stream or river drains from. Depending on the land, how it is used, as well as the characteristics of the waterways, there could be different areas of concern. For example, hill country streams typically have lower levels of nutrients like nitrogen and phosphorus than lowland streams in more intensive farming systems.

However, sediment lost to waterways can be an issue for hill country properties due to the type of soil, rock, and slope.

A waterway's health and quality (e.g. sediments and dissolved nutrients) will often show the effects of farm management. Certain activities on-farm can have a significant impact on waterways but there are many ways to reduce this impact. However, it is important to know what the issue in the waterway is first before changes are made on-farm to address these.

Freshwater indicators and measurements

There are a range of indicators of ecosystem health in a waterway which are covered by the on-farm tools to a greater or lesser extent. These are outlined below adapted and summarised from NIWA.

Stream life

Fish and macroinvertebrates are good indicators of the health of the habitat and to a greater or lesser extent, water quality.

Benthic Macroinvertebrates: Small aquatic animals and insects that live at the bottom of streams and lakes, including the immature stages of insects such as flies, mayflies, caddisflies, stoneflies, beetles and damselflies. There are also worms, snails, leeches and crustaceans such as kōura and shrimps. Macroinvertebrates provide a good long-term (weeks to years) indicator of stressors because different types have different levels of tolerance to water quality and live for a number of years. Just like the quality of your stock reflects their management and health over the last month to years, so too does the presence of different aquatic animals reflect their living conditions in a waterway overtime. This is assessed by sampling the stream and looking at presence of species in relation to their tolerance score. Professionals use the Macroinvertebrate Community Index (MCI).

Fish: There are around 50 species of native freshwater fish in New Zealand, most of which are in decline. They have an important role as top predators in healthy ecosystems and can indicate the abundance of different stream bugs and some ecosystem processes. They are good for assessing biodiversity but links with external stressors are not so clear cut. Many are highly mobile and affected by factors outside the influence of one farm. Fish will sometimes be spotted when assessing streams, it is also possible to spotlight for fish at night (most species are nocturnal). With specialist equipment and training, trapping and electrofishing can be used to assess fish types and numbers.

Water quality

Water quality is measured in a lab from water samples taken on-site. Note: A single test result does not give a true representation of water quality. A number of measurements captured over time are required to better represent water quality. A water sample may be assessed for some of the following components:

Nutrients: Phosphorus (P) and nitrogen (N) are two nutrients that contribute to algal and plant growth in waterways. If there is too much, unwanted algal growth can occur resulting in reduced dissolved oxygen levels and subsequent fish deaths. Different types of nitrogen (nitrate and ammonium) and phosphorus (phosphate) impact waterways in different ways so it can be beneficial to understand which types are present to understand the risk. Both nitrogen and phosphorous are measured as mg/L.

Sediment and Turbidity: Sediment assessment and turbidity are measures of how much fine particulate material is in the water. Too much sediment can reduce habitat for aquatic plants and animals and block out light.

Good substrate

Too much fine sediment

Conductivity: This indicator measures how well water conducts an electrical current and provides a quick indication of salt content. A change in conductivity might indicate a source of pollution as it is generally stable. Needs to be considered in context of other factors such as light, temperature, flow, geology etc.

pH: Measures how acidic or alkaline the water is. Often this will be neutral but can change from a variety of natural or human induced reasons. The pH can be affected by water chemistry and what types of animals live there.

Dissolved oxygen: A variety of measures are used to determine oxygen content and consumption rates. Oxygen is important for plant and animal life to thrive, if the levels drop, ecosystem health can be reduced by making it hard for certain types of aquatic life to survive.

Escherichia coli (E. coli): Are bacterial indicators of faecal pollution and other pathogenic organisms that may pose harm to humans and/or animals. *E. coli* numbers can be reported as either 'Colony Forming Units per mL' (CFU/mL) or 'Most Probable Number' (MPN per 100 mL). A water sample needs to be kept cool and analysed within 24 hours of collection.

Other Indicators

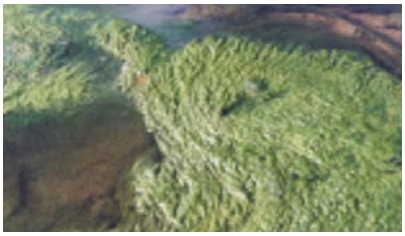
Habitat: Habitat is usually assessed visually and there are a range of components which are assessed to understand the health of the habitat in waterways.

Physical habitat: Habitat provides a place to live, shelter from high flows, protection from predators and a place to lay eggs. It is defined as the whole stream environment including stream bed, banks and land use in the riparian zone and is influenced by geology, climate, land-use and topography. It is assessed visually.

Streambed composition: The type and size of particles that make up the stream bed. Predominantly boulders and cobbles provide a range of hard surfaces for macroinvertebrates and spaces for fish to shelter, feed and nest. Fine sediment can smother these spaces and clog fish gills. It is assessed visually, or by measuring the different sizes of particles randomly selected. It is reported as a percentage coverage by different categories and sizes of particles.

Periphyton: Periphyton is the algae and cyanobacteria attached to sediments or plants and can vary from green to brown and slippery films to long filaments or thick mats. Presence indicates high

Good amount slime



Too much slime

nutrient levels, excess light and high temperatures. Generally associated with stony bottomed waterways, periphyton needs to be assessed in summer at low flow. It is assessed visually and reported as a percentage coverage of the stream bed.

Macrophytes: Large aquatic plants usually with leaves and roots found in muddy or sandy-bottomed streams. At low levels, they provide habitat, oxygen and assist with nutrient cycling, but too much can deplete oxygen levels, and cause sediment build-up on the stream bed. Assessed visually as a percentage based on cover of surface or volume of water they occupy.

Existing waterway testing results

Gather any existing water quality testing results or waterway health testing results that may help inform the assessment plan for your property.

Your local Regional Council will undertake water quality monitoring at specific sites within different catchments as part of their reporting requirements. The data will often be collected regularly and may be a good source of information on the state of the waterways in your area. Water quantity and quality are already monitored on some sheep and beef farms as part of consent requirements for irrigation and other farm management practices. Talk to your local Regional Council or visit their website if you want to know about sites close to your property.

The Land and Water Aotearoa site is also a good source of information - the link can be found at **beeflambnz.com/farmplan**.

Your local catchment community group may also have results from water testing and/or assessing freshwater ecosystem health in your catchment.

Tools for assessing your waterways

It can be valuable to do some waterway assessment yourself to plug any gaps in the existing waterway monitoring and since these don't necessarily provide a detailed assessment of the waterway's health, especially at a farm-scale.
There are a range of methods for assessing ecosystem health and quality of waterways. Some of these can be done yourself or you can engage a specialist to help with these assessments. A brief overview of the following assessments is provided:

- Stream Health Check (Template FW2)
- Stream Health Monitoring Assessment Kit (SHMAK)
- Environmental DNA (eDNA)
- Rapid Habitat Assessment
- Water quality testing
- Wetland assessment

Consider the climatic conditions prior to and during testing as these conditions will have an influence on the variables measured. For example, *E. coli* and sediment measurements can spike after rainfall events.

Below are some assessment tools that you could use to help assess the waterways on your property.

Stream Health Check

The Stream Health Check involves a visual assessment of the stream and its immediate surroundings. Targeted questions are used to determine a score that tells you how healthy, or unhealthy, a waterway is. It is designed to provide an initial feel for the condition of the stream. The value of the Stream Health Check is that it is something a farmer can do themselves because it doesn't require expert stream ecosystem knowledge. There is not a significant amount of time involved in collecting the information and expensive scientific equipment or tests aren't required either. It gives a good indication of overall stream health and can also be used to indicate long-term trends.

Template FW2 Stream Health Check is included in the "Our Plan" section. You can also find a link at **beeflambnz.com/farmplan**. The assessment focuses on four groups of factors that are indicative of stream health including:

- Stream banks and vegetation
- In-stream life
- Potential for contaminants
- Stream channel

An optional **Template FW2a – Stream Health Check Recording Table** is provided to record the score for each question at each site. An example is provided below.

The total score for each site along with the climatic conditions and water temperature should be recorded in **FW3 Freshwater Assessment Summary**. An example is provided following the overview of all the tools.

Stream Health Check

Developed by Dr. Russell Death, Massey University

Related waterway health risk
(see **Table 2.1 Risks and management options**)

Stream banks						
1.	**What type of vegetation is along the banks and sides of the stream?**	Trees with dense groundcover e.g. tussock, toetoe, ferns, flax, rushes. **16**	Tall grasses with patchy trees and groundcover. **8**	Patchy trees, groundcover grazed or absent. **4**	Grazed pasture grasses to stream edge. **2**	**A, D, E, F**
2.	**How continuous is the vegetation (other than pasture) along the stream banks?**	Tall vegetation (over 3m)/trees continuous, or a few small gaps. **16**	Tall vegetation (over 3m)/trees a few large gaps or several small gaps. **8**	Breaks in tall vegetation (over 3m)/trees frequent and very patchy. **4**	Many large gaps in tall vegetation (over 3m)/ trees or no tall vegetation at all. **2**	

Example FW2

Stream Health Check Recording Table

	Site Name: *Upper flats* **Climatic conditions:** *Fine sunny, no rain for 2 weeks*	**Site Name:** *Gorge* **Climatic conditions:** *Fine sunny, no rain for 2 weeks*	**Site Name:** *Lower flats* **Climatic conditions:** *Fine sunny, no rain for 2 weeks*	**Site Name:** **Climatic conditions:**
Stream banks				
1.	16	4	2	
2.	8	8	2	
3.	8	8	8	

Example FW2a

Blank templates can be found in **Our Plan** section and at **beeflambnz.com/farmplan**

Stream Health Monitoring Assessment Kit (SHMAK):

NIWA's Stream Health Monitoring Assessment Kit (SHMAK) gives landowners, iwi, school and community groups simple, scientifically-sound tools and resources to monitor the ecological health of New Zealand's streams. Some of the indicators it measures include: Visual clarity, Water temperature, Conductivity, Nitrate, Phosphate, E.coli bacteria, Periphyton, Macrophytes, Benthic macroinvertebrates, Fish, Current velocity, Streamflow, Stream habitat and Streambed composition

There are a range of kits available for purchase from NIWA. More information and an order form can be found by following the link at **beeflambnz.com/farmplan**. Many Catchment Groups and Regional Councils also have them available for farmers to borrow.

Environmental DNA (eDNA):

Environmental DNA, or eDNA, refers to all the tiny traces of genetic material that is left behind as living things pass through water or soil. By collecting this discarded DNA and sequencing it, you can get a picture of the plants and animals in an area. It is a tool increasing in popularity as a way to quickly scan environments to detect change, monitor biosecurity threats, and better understand and track fluctuations in ecosystem health. The analysis can identify thousands of species of fish, macroinvertebrates, birds, mammals, reptiles, amphibians, plants, fungi, protists, bacteria, and other organisms from a cup or two of water. A link to find out more and order sampling kits can be found at **beeflambnz.com/farmplan**

Rapid Habitat Assessment:

This assessment was developed by the Cawthron Institute and is used by some of the regional councils, landowners and citizen scientists to help give a quick indication of stream health. You can find a link to their webpage at **beeflambnz.com/farmplan**.

Water quality testing:

Provides a snapshot in time of conditions in the catchment upstream of the sampling site. A sample can be taken by farmers and sent to a lab for testing and analysis. It is important to identify what should be tested, know how to interpret the results and act accordingly when results indicate issues. Unless done very regularly, and accurately, this does not provide a good indication of overall ecosystem health.

Landcare Trust Wetland Assessment:

The New Zealand Landcare Trust have developed a practical tool to assess wetlands which may be useful if you have wetlands on your farm. You can find a link to their webpage on **beeflambnz.com/farmplan**.

Record your results

Record results from your waterway assessments along with any climatic conditions in **FW3 - Freshwater Assessment Summary**. An example is provided below.

Freshwater Assessment Summary

Waterway	Assessment Date	Assessment Type	Climatic Conditions	Results and Notes (such as assessment score, overall health (eg. Good intermediate, low), factors to consider)
Upper flats	*11 Feb 2021*	*Stream health check*	*Fine, sunny, no rain for 2 weeks*	*Score =234 Intermediate Health - Stock access to waterways needs to be reduced*

Example

FW3

Blank templates can be found in **Our Plan** section and at **beeflambnz.com/farmplan**

Interpreting results

Once you have some results from the assessment, it is important to understand what they mean within the context of your farm business. You may want to work with an expert, such as a freshwater ecologist to help interpret your results or answer any questions that have arisen. This can be done in collaboration with neighbours or catchment group members to share the costs.

Step 4 will help to identify key risks and factors contributing to them, along with potential management actions that could be taken.

While monitoring should be done regularly and trends are important to understand, it is also important to act quickly if monitoring indicates an issue. This will help prevent further decline or other issues evolving as many factors are inter-linked in waterway ecosystems.

Because waterway outcomes are determined by all users in a catchment, poor results often will require a community effort. This is another reason catchment groups are valuable. Talk to your neighbours and Regional Council staff about results and collective efforts that can be made to achieve the desired outcomes.

STEP 4 – Identify Risks, Opportunities, and Management Actions

Ecosystem health of waterways is impacted by a range of factors, many of which are influenced by how land is used and therefore is something farmers can actively manage.

Different farms will influence waterways in different ways depending on a range of factors including geology, topography, soil type, climate, and farm system. This is one of the reasons why matching your farm system to the natural resource base is so important and why this is completed in the Introduction chapter.

Forage cropping, particularly in winter can be a significant risk to the ecosystem health of waterways. If you are using forage cropping in your farm system, ensure you complete the forage cropping management chapter. More information can be found at **beeflambnz.com/farmplan**.

Risk and Opportunity Identification

There are a range of risks to freshwater ecosystem health that can be created by the management of your farm system and that of other land users in your catchments. **Table 2.1** identifies some of the common risks and opportunities, the impacts and drivers and some potential contributing factors. Identify which risks apply for your property and the factors that are contributing to them.

If you carried out a Stream Health Check those results will help you identify your key risks. Look for the questions with scores of 2 or 4 and take note of the letter/s (A-I) in the final column. Then refer to **Table 2.1** and use the risks that have those letters next to them as your starting point.

If you have the output from a nutrient budget this can help you identify and assess risks in relations to nutrients. It is important to recognise that even if farm average nutrient loss is low, there may be blocks where it is high. These 'hotspots' are common and can be managed appropriately to minimise risk.

Complete **Template FW4** in "Our Plan". An example is provided after Table 2.1. There is also space in the template to add other risks that you identify in relation to freshwater ecosystem health.

Risk Assessment

For each risk and the factors contributing to it identified, use the Risk Assessment Matrix to assess the likelihood and consequence to freshwater ecosystem health or your farm business and determine if the risk level is high, medium or low. The risk level can then be recorded in **Template FW4** in "Our Plan". This will help you to target and prioritise your management actions.

Risk Assessment Matrix

Likelihood	Consequence		
	Slight	Serious	Major
Low	Low	Low	Medium
Medium	Low	Medium	High
High	Medium	High	High

Management Actions

The final column in **Table 2.1** provides examples of some possible management actions that could be taken to manage the various risks or opportunities identified. In addition to the examples provided in Table 2.1 some other key management practices to consider include:

- Managing the **riparian margin** to ensure it supports the adjacent waterway and is not damaged by stock or vehicles. Consider increasing the margins width as the slope of the paddock increases. Also, check with the local regulations and rules about riparian management and stock exclusion.
- Invest in **stock water reticulation** to help attract animals away from waterways.
- **Planting** appropriate plants or retaining grass to help stabilise soil and stop nutrient runoff flowing directly into water.
- **Maintain water levels** to help promote healthy ecosystems.
- **Consider wet areas on your farm**; they may be classified as a wetland and need protecting or they may lend themselves to being turned into a wetland.
- **Good practice nutrient management** will ensure nutrients are used efficiently and effectively to minimise losses.
- **Prevent sediment run-off** by protecting soils and maintaining infrastructure.
- **Prevent contamination** from faecal bacteria and chemicals by excluding stock from waterways and managing chemical disposal effectively.
- Ensure **infrastructure** is well maintained to help reduce the risk of slips and flood damage.

Consider which of these or any other management actions are appropriate on your property and record these. Then for each management action identified categorise it as: completed, ongoing or new.

- Completed actions require no ongoing implementation, you may like to note the location if applicable.
- Ongoing actions are actions you are currently doing or have done and need to continue doing into the future.
- New actions are those you plan to start.

Record your management actions and if they are completed, ongoing or new in **Template FW4** in "Our Plan". An example is provided after Table 2.1.

Additional resources on risks and actions including the B+LNZ contaminant loss to water factsheet series and guidance on stock water reticulation are available at **beeflambnz.com/farmplan**.

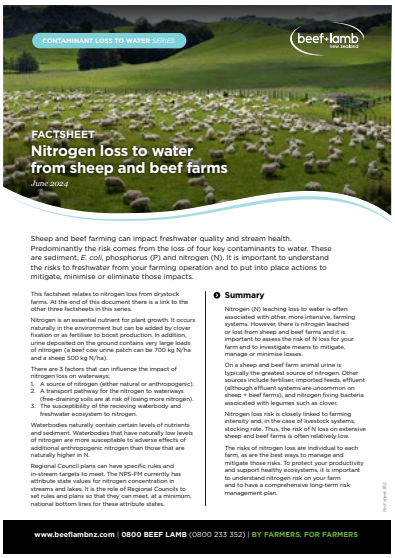


Table 2.1 Risks and Management Options for Freshwater Ecosystem Health

The letters under the risks in the lefthand column correspond to the letters found in the right hand column of the stream health check Template FW2 to link the results of particular questions with the factors that are contributing and actions that can be taken.

Risks and Opportunities to Freshwater Ecosystem health	Impact and Driver	Some potential factors contributing to risk	Examples of possible management actions
Deposited fine sediment **A**	Sediment accumulates in waterway margins and beds smothering habitat for freshwater fish and invertebrates. Sediment loss occurs when overland flow transports accumulated sediment or weak soils. This can occur when soils are wet in areas that are prone to erosion or soil loss, such as sloping land, bare soil, slips, tracks, yards, or undercut riverbanks. While sediment flow is most visible in high rainfall events it can also occur in small rainfall events. It is the very fine particles (clay) which have the greatest impact.	**Sediment source factors** • Slope – steeper slopes have higher risk • Erosion-prone soils • Stream bank erosion from high flow events or stock access • High proportion of heavier stock on erosion-prone soils • Cropping on a slope, particularly when strip-grazed on heavy soils • Low vegetation cover or bare soil – can make land more prone to erosion • Cultivation methods where soil is exposed and cultivation direction **Contamination pathway factors** • Rainfall intensity and duration, during and in lead up to event • Flooding frequency • Riparian margin buffer width too narrow or with inadequate vegetation for adjacent activities • Runoff from poorly located and/or maintained tracks and yards • Location of stored feed such as baleage, silage pits etc close to waterways resulting in heavy machinery use nearby • Presence of CSAs	**Minimise sediment loss** • Removing heavy stock from steep, erosion prone areas • Installing bridges or crossings for stock • Grazing your stock in ways that reduce impact on waterways especially during high risk periods such as winter • Fencing off waterways • Maintaining vegetative cover as much as possible • Direct drilling or minimum tillage, along any contours • Avoid cropping on slopes or highly erodible soils • Poplar pole or other planting on erodible hillsides • Keep storage of supplements or other high traffic areas away from waterways **Slow the flow of water transporting sediment into waterways** • Creating wetland areas or sediment traps/dams/bunds to prevent sediment from entering waterways • Consider size of buffer zone in relation to adjacent activities and risk (buffers zone around waterways must be at least 5m wide) • Leave Critical Source Areas uncropped and ungrazed wherever possible • Planting natives along waterways
Excessive algae / periphyton /slime **B**	Increased plant / slime biomass on stream substrate provides low quality food for stream life. As it decomposes it removes oxygen and alters the water chemistry. It destroys habitat for fish and macroinvertebrates. It is driven by high nutrient levels (N & P) in combination with light from canopy removal. Also, removal of flushing/flood events due to drought, water abstraction or summer low flows. High flows will wash the periphyton off the stones and rocks.	**Nutrient Source factors** • Soil Olsen P levels greater than agronomic optimum • Soil and rock type with low P retention • Excessive nitrogen fertiliser application or poor timing or application practice • Erosion prone soils, stream bank erosion • Location of stored feed such as baleage, silage pits etc close to waterways resulting in heavy machinery use nearby • Stocking rate, type of livestock (sheep, cattle, deer), older v younger livestock • Stocking density during intensive grazing **Nutrient pathway factors** • Lack of vegetative buffers and CSAs not well managed • Soil type (free-draining soils are greater risk for nitrogen loss) • Compacted or saturated soil • Artificial drainage • Over-application of irrigation increases nitrogen risk **Other algal growth factors** • High temperatures, lack of shade • Low flows – drought, water abstraction	**Source** • Review fertiliser programme and nutrient analysis results • Keep storage of supplements or other high traffic areas away from waterways • Removing heavy stock from steep, erosion prone areas • Consider stocking rate and livestock type • Consider stock type and stocking density when intensively winter grazing on shallow soils **Pathway** • Creating wetland areas or sediment traps • Fencing off waterways • Exclude stock from critical source areas • Consider size of buffer zone around CSAs and waterways in relation to adjacent activities and risk • Maintaining vegetative cover as much as possible **Managing temperature and water level** • Manage water removal and extraction to maintain adequate flow rates • Putting in native planting along waterways

Table 2.1 Risks and Management Options for Freshwater Ecosystem Health *continued*

Risks and Opportunities to Freshwater Ecosystem health	Impact and Driver	Some potential factors contributing to risk	Examples of possible management actions
Nitrogen Concentrations **C**	Increased nitrogen concentrationsin waterways can lead to excessive slime and algal growth (periphyton). High concentrations of nitrogen in drinking water has been linked to an increased risk of certain illnesses which may have an impact on human health. Nitrogen is a much more mobile chemical than phosphorus and moves easily through the soil. Nitrogen is dissolved in water and is primarily lost through the soil profile when water in the soil profile moves below the rootzone, entering aquifers or lateral systems connected to waterways. It can also be lost in surface runoff in certain conditions.	**Nitrogen source factors** • Nitrogen excreted in stock urine • Stocking rate and stocking density • Type and age of livestock - Urinary concentration of N is often higher in mature cattle compared to sheep deer or younger cattle • High concentration of nitrogen in diet – different feeds have differing concentrations of N and may alter the amount of N excreted by animals especially in urine • Excessive nitrogen fertiliser application or poor timing or application practices **Nitrogen Leaching factors** • Rainfall • Bare soil – particularly post grazing or application of nutrient or during rainfall events • Vegetation growth rate • Soil type (free-draining soils are greater risk) • Artificial or subsurface drainage increases risk • Over-application of irrigation • Critical Source Areas not well managed • Compacted or saturated soil	• Consider stocking rate and livestock type • Exclude stock from drains and waterways • Avoid grazing cattle in paddocks with tile or mole drains or stony soils and if this is done, limit grazing to lower stock classes and total stocking units • Use of nutrient modelling tool to understand and manage nitrogen losses occurring on-farm • Soil nutrient status is used to guide plant nutrient requirements and fertiliser application. • Use precision or variable rate nutrient and irrigation application where applicable • Maintaining vegetative cover as much as possible, utilise excess nutrients (such as with catch crops), minimise fallow periods where possible. • Constructed/natural seepage wetlands • Leave Critical Source Areas uncropped and ungrazed wherever possible, maintain vegetative cover and a buffer zone around them
Phosphorus Concentrations **D**	Increased nutrient concentrations in waterways can lead to, excessive slime and algal growth (periphyton). Phosphorus is bound to soil particles (sediment), so enters waterways primarily through overland flow of sediment. Direct deposition of phosphorus fertiliser to waterways is another source.	**Source factors** • Olsen P levels greater than agronomic optimum. • Soil and rock type with low phosphorus retention. • Those factors contributing to erosion such as slope, erosion prone soils, heavy stock classes, cultivation methods, cropping or limited vegetation cover • Poorly managed fertiliser application **Contamination Pathway factors** • Rainfall • Slope • Lack of vegetative buffers • Bare soil during rainfall events • Critical Source Areas not well managed • Compacted or saturated soil • Mole and tile drainage	• Review fertiliser programme and nutrient analysis results • Careful placement of fertiliser -use precision or variable rate nutrient application where applicable • Choose fertilisers that reduce P loss risk such as controlled release P fertiliser • Use materials containing P-sorbing elements (eg Calcium, Aluminium and Iron) as backfill when installing artificial drainage systems such as tile drains • Removing heavy stock from steep, erosion prone areas • Grazing your stock in a way to reduce impact on waterways especially during high risk periods such as winter • Creating wetland areas or sediment traps/dams/bunds • Installing bridges or crossings for stock • Fencing off waterways • Consider size of buffer zone in relation to adjacent activities and risk (buffers zone around waterways must be at least 5m wide) • Putting in native planting along waterways • Leave Critical Source Areas uncropped and ungrazed wherever possible • Maintaining vegetative cover as much as possible • Avoid cropping on slopes or highly erodible soils • Poplar pole planting on erodible hillsides

Risks and Opportunities to Freshwater Ecosystem health	Impact and Driver	Some potential factors contributing to risk	Examples of possible management actions
Faecal bacteria and pathogens **E**	Elevated levels of faecal bacteria and pathogens in fresh water are a public health hazard and can impact human and animal health. They include Cryptosporidium, Giardia, Salmonella, Campylobacter, Leptospirosis and *E. coli*. Direct deposition of faecal material from stock accessing waterways, and run-off from tracks and yards as well as pasture and crops. Some pathogens are easily transported across land to waterways.	**Source factors** • Stock type • Stocking rates • Septic tanks poorly maintained • Proximity of faecal sources to waterways or bores **Contamination pathway factors** • Water flowing directly from area with faecal contamination into waterway • Stock crossing through waterways • Rainfall • Soil type • Compacted soil • Poorly located and/or maintained tracks and yards leading to run-off. • Bare soil • Critical Source Areas not well managed • Lack of vegetative buffers/riparian margins • Stock access to waterways (particularly cattle, pigs and deer)	• Installing bridges or crossings for stock • Stock exclusion from waterways • Consider size of buffer zone in relation to adjacent activities and risk (buffers zone around waterways must be at least 5m wide) • Creating wetland areas or sediment traps/dams/bunds • Putting in native planting along waterways • Leave Critical Source Areas uncropped and ungrazed wherever possible, maintain vegetative cover and a buffer zone around them • Utilise strategic grazing where applicable • Locate and maintain tracks and yards to minimise overland flow and direct any run off away from waterways.
High Temperature **F**	Many of New Zealand's native fish and invertebrates require cool water temperatures (below 20°C) to survive. Warmer temperatures reduce the oxygen concentrations in waterways and can increase the rate of photosynthesis of weed and algae species. Driven by lack of shade and reduced water flow.	**Shade** • Riparian margins without enough woody vegetation (riparian planting) **Flow Rates** • Modification of waterways • Reduced waterway flow through water removal or extraction	• Putting in native planting along waterways to provide shading • Manage water removal and extraction to maintain adequate flow rates
Harmful Chemicals **G**	Chemicals entering waterways can be toxic to native fish and invertebrates as well as animals and people. Some of the natural chemicals in waterways can increase as oxygen levels go down reaching potentially lethal levels (e.g. arsenic). Driven by poor practice around use of chemicals and disposal of containers, run-off from infrastructure poorly managed, waste disposal poorly managed.	**Contamination Sources** • Waste disposal sites connected to waterways (e.g. high water-table, close to waterway) • Free draining soils or artificial drainage where chemicals are used. • Run-off from silage pits or other areas such as yards, stand-off pads reaching waterways. • Old dip sites	• Offal pits/holes located at least 30m away from waterways and not at risk of a rising water table – bottom of offal pit should be at least 1m above the seasonally highest water table level • Silage pits located at least 30m away from waterways, sealed and any run off is contained (e.g. sump) or diverted to a paddock with appropriate soils rather than a waterway • Chemical mixing area and wash down areas are located well away from surface water • Unwanted chemicals disposed of appropriately (your Regional Council can advise on this) • Fertiliser bins are located away from waterways and are not at risk of leaching if they get wet • Fuel is stored safely and secured with a drip tray to prevent soil contamination • Old dip sites or chemical disposal sites on-farm are sealed

Table 2.1 Risks and Management Options for Freshwater Ecosystem Health *continued*

Risks and Opportunities to Freshwater Ecosystem health	Impact and Driver	Some potential factors contributing to risk	Examples of possible management actions
Altered river channel form and margins **H**	New Zealand's native fish and invertebrates utilise diverse habitat in waterways and the margins including rapids and riffles, pools, runs, backwaters, in-stream cover such as overhanging vegetation, a range of substrate in river bed (gravels, stones and boulders), freshwater plants, debris, undercut banks and riparian vegetation (used for shade, shelter and spawning for some species). Driven by reduced water flow, sediment deposition (see above), lack of riparian vegetation, straightened or narrowed waterways, river widening, river earthworks.	• Modification of waterways (e.g. crossings, straightening, widening, cleaning drains or other river earth works) • Lack of diversity in riparian vegetation (grasses, shrubs, trees) • Sediment run-off from erosion • Stock access to waterways and riparian areas	• No earthworks or where required care taken • Stock exclusion from waterways • Riparian planting • See actions associated with sediment
Toxic algae **I**	Cyanobacteria is a type of slime that can grow in streams and can produce toxins that are lethal to stock, dogs and humans. The toxin can be present even when the algae is dry on the river banks. The exact causes of toxic algal presence are still unclear. But they are often abundant during summer low flows or in streams with lots of deposited fine sediment.	**Flow rate and temperature** • Low rainfall • Reduced waterway flow through water removal or extraction • Slow moving water • Unshaded waterways during long periods of sunny weather • Warm water temperatures **Sediment and nutrients** • Erosion-prone soils • Low vegetation cover or bare soils – can make land more prone to erosion • Poorly located and/or maintained tracks and yards • Stream bank erosion • Cropping on a slope, particularly when strip-grazed on heavy soils • Elevated levels of N and/or P in the waterway	• Putting in native planting along waterways to provide shading • Manage water removal and extraction to maintain adequate flow rates • See actions associated with sediment

Freshwater Risk Assessment and Management Actions

Risks and Opportunities to Freshwater Ecosystem health	Factors contributing to risk or enabling opportunity	Risk level	Management Actions	Action completed, ongoing or new
Deposited fine sediment	*Erosion-prone soils in upper gullies*	*Low Medium*	*Plant poplar poles in erodible gullies* *Wetland is established in boggy area at bottom of hill block gully leading into Flynn Creek to also act as a sediment trap*	*Ongoing* *New*
Deposited fine sediment	*Stream bank erosion*	*Low Medium*	*Stock excluded from stream banks* *Riparian vegetation established to assist with long term bank stability and to help capture and filter overland flow*	*Completed in 2021* *New*
Phosphorus and Sediment	*Critical source areas*	*Low*	*Keep critical source areas uncropped and with permanent vegetative cover* *Pasture on CSAs only grazed when dry*	*Ongoing* *Ongoing*
Phosphorus and Algae	*High Olsen P levels*	*Low*	*Continue soil testing* *No P applications until P levels back to agronomic optimums*	*Ongoing*
Nitrogen	*Free draining soils on flats*	*Low*	*Nutrient analysis undertaken* *Limited nitrogen is currently used*	*Ongoing*
Faecal bacteria	*Frequent stock crossing through waterway*	*Low*	*Install a culvert at stream crossing of Flynn Creek*	*New*
High temperature	*Lack of trees or vegetation in upper part of stream*	*Low*	*Establish suitable native plants in buffer zone*	*New*

Example FW4

Blank templates can be found in **Our Plan** section and at **beeflambnz.com/farmplan**

STEP 5 – Action Plan

Building on the management actions identified in step 4, Template FW4 document an action plan to protect and enhance freshwater ecosystem health. This should include details of those actions that still need to be implemented. Include the action to be taken along with its location, priority, timeframe and who is responsible and any other people that may need to be involved.

Record your Freshwater Action Plan in **Template FW5** in "Our Plan". An example is provided below.

Freshwater Action Plan

Action	**Location** Land Management Unit or Paddock	**Priority** (Low, Medium, High)	**Planned Timeframe**	**Person responsible** and others involved	Date completed and evidence of completion
Plant 100 poplar poles in erodible gullies each year at 14m spacing. Cattle to be excluded via hotwire from area for at least a year. Replacements established two years after initial planting as needed.	*Hill Block*	*Medium*	*2021-2025*	*Manager* *Land Management Advisor*	*Will take photos and keep invoices*
Wetland is established in boggy area at bottom of hill block gully leading into Flynn Creek, will need to be fenced and planted.	*Bottom of Hill Block*	*Low*	*2025*	*Manager, Land Management Advisor, Fencing contractor*	
Riparian vegetation established at 2m spacing in the now stock excluded Flynn Creek. Pre-spraying and release spraying of planting required.	*Flynn Creek*	*Medium*	*2022-2024*	*Manager, Land Management Advisor*	*Will take photos and keep invoices*
Culvert erected at stock crossing point of Flynn Creek. Resource consent application likely required.	*Flynn Creek*	*Medium*	*2024*	*Owner, Manager, Land Management Advisor*	

Example FW5

Blank templates can be found in **Our Plan** section and at **beeflambnz.com/farmplan**

STEP 6 – Monitoring and Review

Long-term monitoring of your waterways will help you to keep track of any changes in freshwater on your farm. By carrying out your own checks it will help keep you informed about their current state, which you can use to help guide your farm management decisions.

Things to consider when establishing a freshwater monitoring programme on your farm:

- Choosing sites to assess your waterways that are representative or typical of the rest of the waterways on the property if not all waterways are sampled.
- If you have long stretches of waterways on your property you may choose to break this into smaller sections to asses.
- Depending on the situation, it might be beneficial to assess a waterway where it enters the farm and again where it leaves the farm and to include additional sampling sites along the main stem of a waterway.
- Streams for sampling need to be wadable under normal flows (so excluding large, braided rivers).
- Use the same location/s each time you make an assessment. This can be marked with a metal standard in a place that won't get lost during floods.
- Take photographs up and down the stream to track changes in the waterways and areas around them. Photo-point monitoring is explained in the Biodiversity chapter.
- Determine the assessment/s to be used – see Step 3 for more information
- Determine assessment frequency, this will vary depending on which assessment is used but should be at least annually. A freshwater ecologist will be able to offer advice on this.
- Carry out the assessments at the same time of the year and under similar stream water flow conditions (ideally low flow when there has not been any recent rain).
- Keep a written record of the assessment results to track progress over time.
- Assign responsibility for monitoring and have that person record the approximate assessment dates from the monitoring plan in their calendar or diary.

Set out your Freshwater Monitoring Plan in **Template FW6** in "Our Plan". An example is provided below.

Freshwater Monitoring Plan

Waterway Site Name	Assessment type	Person Responsible	Monitoring Frequency	Assessment Due Date			
Upper flats	*Stream Heath Check*	*Manager*	*Once per year*	*Feb 2021*	*Feb 2022*	*Feb 2023*	*Feb 2024*
Gorge	*Stream Heath Check*	*Manager*	*Once per year*	*Feb 2021*	*Feb 2022*	*Feb 2023*	*Feb 2024*
Lower flats	*Stream Heath Check*	*Manager*	*Once per year*	*Feb 2021*	*Feb 2022*	*Feb 2023*	*Feb 2024*
Wetland 3	*Landcare wetland assessment- Wetmak- photo points*	*Manager*	*Once per year*	*March 2021*	*March 2022*	*March 2023*	*March 2024*

Example

FW6

Blank templates can be found in **Our Plan** section and at **beeflambnz.com/farmplan**

Record Results in **FW3 – Freshwater Assessment Summary** when completed.

Review

At least annually you should reflect on and review your Freshwater Plan to ensure it remains a living document. When you record your assessment results may be a good time to do this.

Some things you might want to consider:

- Has there been any changes to your catchment context?
- Are there any new rules, regulations or market requirements to be met?
- Has there been much variation in your waterway assessment results? Any key explanations for these?
- Have there been any changes to the risks to freshwater ecosystem health or the factors contributing to them?
- How is your action plan progressing, is it still fit for purpose and achievable? Are any additional actions required?

For further information please see:

beeflambnz.com/farmplan and the B+LNZ Knowledge Hub.

The other chapters in the B+LNZ Farm Plan: Environment Module are:

- Introduction
- Managing soil health
- Integrating native biodiversity
- Responding to a changing climate
- Waste and chemical management
- Forage cropping management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