Table 2.1 Risk factors and drivers for freshwater ecosystem health

Outlined below are a range of risk factors to ecosystem health, impacts and drivers which can impact ecosystem health of freshwater environments.

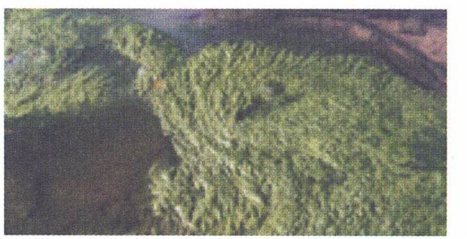
Risk to ecosystem health	Impact to ecosystem health	Driver	On-farm risks	
A. Deposited fine sediment	Sediment accumulates in waterway margins and beds smothering habitat for freshwater fish and invertebrates.	Sediment loss from overland flow due to erosion, or run-off from tracks and yards. It is often impossible to see sediment flows except in high rainfall events. But sediment flow can occur even with very small rainfall events. It is the very fine particles (clay) which have the greatest impact.	• Slope • Rainfall • Erosion-prone soils • Low vegetation cover • Poorly located and/or maintained tracks and yards • Bare soil • Stream bank erosion • High proportion of heavier stock on erosion-prone soils • Riparian margin width too narrow for adjacent activities • Riparian margin vegetation inadequate • Location of stored feed such as baleage, silage pits etc close to waterways resulting in heavy machinery use nearby • Cropping on a slope, particularly when strip-grazed on heavy soils	 Good substrate  Too much fine sediment
B. Excessive algae / periphyton / slime	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.	High nutrient levels 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.	Risk factors as above, and: • Olsen P levels greater than agronomic optimum. • Soil and rock type with low P retention. • Lack of vegetative buffers • Soil type (free-draining soils are greater risk for nitrogen loss) • Stocking rate • Type of livestock (Sheep, Cattle or Deer) • Older vs younger livestock • Over-application of irrigation increases nitrogen risk • Excessive nitrogen fertiliser application • Artificial drainage • Critical Source Areas not well managed • High concentration of nitrogen in diet • Compacted or saturated soil	 Good amount slime  Too much slime

Table 2.1 Risk factors and drivers for freshwater ecosystem health *continued*

Risk to ecosystem health	Impact to ecosystem health	Driver	On-farm risks
C. Nitrogen concentrations	Increased nitrogen concentrations in 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 in 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 root-zone, entering aquifers or lateral systems connected to waterways. It can also be lost in surface runoff in certain conditions.	• Rainfall • Bare soil • Soil type (free-draining soils are greater risk) • Stocking rate • Type of livestock (Sheep, Cattle or Deer) • Older vs younger livestock • Over-application of irrigation • Excessive nitrogen fertiliser application • Bare soil during rainfall events (e.g. break-feeding crop) • Artificial drainage • Critical Source Areas not well managed • High concentration of nitrogen in diet • Compacted or saturated soil
D. Phosphorus concentrations	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. Can lead to issues when phosphorus is limiting in a waterway.	• Rainfall • Slope • Olsen P levels greater than agronomic optimum. • Soil and rock type with low phosphorus retention. • Lack of vegetative buffers • Bare soil • Compacted soil • Bare soil during rainfall events (e.g. break-feeding crop) • Critical Source Areas not well managed • Compacted or saturated soil
E. Faecal bacteria, viruses and protozoa.	Elevated levels of faecal bacteria viruses and protozoa 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. Protozoan oocytes are very easily transported across land to waterways.	• Rainfall • Soil type • Stock type • Stocking rates • 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) • Septic tanks poorly maintained

Risk to ecosystem health	Impact to ecosystem health	Driver	On-farm risks
F. High temperature	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.	Lack of shade and reduced water flow.	• Riparian margins without enough woody vegetation (riparian planting) • Modification of waterways • Reduced waterway flow though water removal
G. Harmful chemicals	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).	Poor practice around use of chemicals and disposal of containers, run-off from infrastructure poorly managed, waste disposal poorly managed.	• 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
H. Altered river channel form and margins	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).	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, cleaning drains) • Lack of diversity in riparian habitat (grasses, shrubs, trees) • Sediment run-off from erosion • Stock access to waterways and riparian areas
I. Toxic algae	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.	• Erosion-prone soils • Low vegetation cover • Poorly located and/or maintained tracks and yards • Bare soil • Stream bank erosion • Cropping on a slope, particularly when strip-grazed on heavy soils

Identify the risk factors and complete the risk assessment for your farm

Table 2.1 Risk factors and drivers above can help you learn about risk factors and drivers and understand the factors contributing to risk. Consider which of these factors contribute to risk on your property. Risks in relation to nutrients can be assessed by looking at the output from an OverseerFM nutrient budget and can help to build your risk assessment. 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.

There are a range of risks to freshwater ecosystem health created by the management of our farm system and that of other land users in our catchments.

Consider these risks and complete the Risk Assessment (**Template FW3**) in "Our Plan" for your own farm and in the context of your catchment management plan (where applicable). This will inform your action plan. For each risk factor you identify on your farm use the following Risk Assessment Matrix to assess the likelihood and consequence to your freshwater resources or your farm business to determine the overall risk for each factor. An example is shown below.

Risk Assessment Matrix

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

Record your risks to freshwater ecosystem health and the risk factors on your farm in the **Template FW3** in the "Our Plan" section of this manual with the overall risk rating for each factor.

Freshwater Risk Template

FW3 Example

Risk to ecosystem health	Risks on your farm	Overall risk
Deposited fine sediment	• *Erosion-prone soils in upper gullies* • *Stream bank erosion*	*Medium* *Medium*
Phosphorus	• *Olsen P test high in paddocks near stream* • *Critical Source Areas*	*Low* *Medium*
Nitrogen	• *Free draining soils on flats*	*High*
Faecal bacteria	• *Overland flow from irrigation* • *Septic tank runoff from house*	*Medium* *Low*
High temperature	• *Lack of trees or vegetation in upper part of stream*	*Medium*
Degraded physical form of waterway and margins	• *Drains need cleaning*	*Medium*
Harmful chemicals	• *Old dip site runoff* • *Septic tank from house*	*Low*
Toxic algae	• *Toxic algae in stream*	*Low*

Blank templates can be found in **Our Plan** section