


Ruataniwha Water Storage Project
Land Use Intensification Summary Paper
Key Contaminants and Opportunities for On-Farm Management

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Key Contaminants and Opportunities for On-Farm Management

Report prepared for Hawke’s Bay Regional Council

Ruataniwha Plains Water Storage Project

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1. Executive Summary

This summary paper lists and describes the agricultural non-point source contaminants which cause water quality degradation. Diffuse non-point losses of nitrogen (N), phosphorus (P), faecal bacteria and sediment are known to be major causes of surface water quality degradation. The potential sources and factors influencing the quantities of each of these contaminants are identified and the characteristics and processes by which N, P, faecal bacteria and sediment are transported from land to water described. A brief description of mitigation and avoidance options have been provided, as well as examples of the suitability and effectiveness of N and P mitigations strategies that could be utilised in the Tukituki River context.

The information in this paper will inform the Ruataniwha Land Use Intensification Working Party and wider stakeholders and will form a key part of a wider Land Use Mitigation Strategy Report being prepared for Hawke’s Bay Regional Council by AgResearch and Plant & Food.

The long list of avoidance and mitigation options can be divided into two categories: (1) Those that could be adopted with little change to the farm system, add little or no cost or impact on production and (2) Those likely to require considerable change to the farm system and result in reduced profit.

Importantly the suitability, effectiveness and cost of the mitigation options are case specific due to differences in the source and quantity of the contaminants, variations in soil type, topography, climate, land use and farm management system. Many of the mitigation options can be explored in the Overseeer® nutrient budget model and SPASMO.
2. Background

A farm consultancy group lead by Macfarlane Rural Business Ltd (McFarlane report 2010) was commissioned by Hawke’s Bay Regional Council (HBRC) to examine the on-farm economics of expanding irrigation on the Ruataniwha plains through in-river water storage in the Makaroro River. The on-farm study consisted of building seven pre-irrigation model farms to represent current land use on the Ruataniwha Plains and nine post-irrigation models to explore the potential added returns from the expansion of the irrigated area. This study did not consider the potential impact of expanding the irrigated land on the Ruataniwha plains. Therefore it did not explore the effect this might have on nutrients losses to surface and ground water feeding the Tukituki River.

In recognition of the need to investigate opportunities for mitigation HBRC has commissioned AgResearch and Plant & Food to prepare a report to identify, develop and test (utilizing OVERSEER, SPASMO and other appropriate analytical tools) the ability of a range of mitigation and avoidance options (including riparian protection, wetland development, on-farm best management practices, opportunities for off-site mitigation, and low flow) to offset any defined adverse water quality effects from diffuse farm discharges associated with the uptake and use of irrigation on the Ruataniwha plains identified in the NIWA land use / water quality modelling study. Part of this reporting includes a literature review and summary report of the suitability and effectiveness of the range of potential avoidance and mitigation options for agricultural non-point source contaminants of water. The report will be used to assist stakeholders with their understanding of the issues and options, and is a key background document to assist the Land use Intensification Working Party established to assess these issues associated with the Ruataniwha Water Storage project.
3. **Objectives of Review**

This literature review on the avoidance and mitigation options for addressing agricultural non-point source contaminants of water includes the following:

- lists and describes the agricultural non-point contaminants which are the major cause of water quality degradation,
- identifies potential sources and factors influencing the quantities of agricultural non-point source contaminants,
- describes the characteristics and processes by which nitrogen (N), phosphorus (P) faecal bacteria and sediment are transported from land to water,
- lists and provides a brief description of mitigation and avoidance options and provides examples of the suitability and effectiveness of N and P mitigations strategies.

4. **Agricultural non-point contaminants in the Tukituki River**

Associated with intensive agriculture is an increase in diffuse non-point losses of nutrients, particularly nitrogen (N) and phosphorus (P) and faecal bacteria (Gillingham and Thorrold, 2000; Monaghan et al., 2008; McDowell and Nash, 2011). These agricultural non-point contaminants, along with sediment, are the major causes of water quality degradation being seen in waterways in many NZ regions. The Tukituki River in Central Hawke’s Bay is one such waterway with N concentrations in the river in the winter months approaching toxic levels in some stems of the river (Adam. Uytendaal pers. Comm.). Phosphorus levels are also problematic in the Tukituki, with P levels in many stems exceeding the HBRC Regional Management Plan guidelines in the summer months. Faecal bacteria levels are also a problem during low flow periods of the year.
5. Potential sources and factors influencing the quantities of agricultural non-point source contaminants

The major sources of agricultural non-point source contaminants are:

- Mineral soil (P and sediment)
- Organic matter in soils (N)
- N and P fertiliser (N and P),
- Dung (P and Pathogens) and urine (N),
- Effluent (N, P, Pathogens, suspended solids) and
- Imported feed (N and P)

There is a long list of factors that influence the quantities of these sources including:

- Fertilizer type and timing (N and P),
- Rate and method of application (N and P),
- Cultivation practices, including timing (N, sediment, P),
- Soil management (Sediment, P),
- Vegetation management for soil erosion (Sediment, P),
- Livestock type and stocking rate (N, pathogens),
- Feed type (N),
- Grazing practices and regimes (P, N, sediment),
- Soil fertility status (P and N) irrigation practices (N, P and sediment) and
- Effluent practices (N, P, pathogens, and suspended solids).

The highest loadings for faecal bacteria occur where stocking rates are highest, viz. block-grazed pasture for all livestock classes, wintering areas, and stand-off and feed pads for dairy cattle. Poor land based effluent management practices would be another. Other important sources of faecal pollution include direct deposition into stream channels from grazing livestock, and runoff from seeps and wetlands that are accessible by stock.

The major sources of sediment are from accelerated soil erosion and from the loss of small amounts of sediment carried in overland flow from landscapes under intensive agricultural practices (e.g. by livestock treading, wheel traffic and cultivation). This latter source is often referred to as an insidious loss of sediment, where there is no apparent source. It is however important as it can be rich in nutrients. Accelerated soil erosion
can result in large quantities of sediment discharged to water ways (Hicks et al., 2000). The risk of accelerated soil erosion from a landscape is influenced by five factors, rock type, soil type, slope, vegetation cover and erosion type and severity (Lynn et al., 2009). Removal of vegetation, vehicle tracking, earthworks, cultivation practices and storm water are all factors that are going to increase the risk of accelerated soil erosion and the discharge of sediment to water ways.

This is not an exhaustive list of the sources and factors that influence the quantities of these contaminants, but serves to highlight the large number of variables that could contribute to the loss of these contaminants from land to water. Further, the potential losses will also vary with soil type, climate and management practices.
6. Characteristics of nitrogen, phosphorus, faecal bacteria and sediment

The quantities of N and P lost in leaching and overland flow, respectively, are small in comparison to the amounts of these two nutrients cycling in an agricultural system. Both of these macro-nutrients are essential for plant growth, with P additions to pasture and arable systems via P fertiliser. Significant amounts of P can also be brought on-farm in imported feeds. Nitrogen additions in legume based pastures occurs primarily through biological N fixation by rhizobia bacteria that have formed a symbiotic relationship with the legume. There is a small amount of N fixed by free-living micro-organisms. Fertiliser N additions can be in excess of 200 kgN/ha/yr in intensive agricultural systems. Imported feed can also be a significant source of N and should be included in the nutrient budget.

Monaghan et al., (2008) indicated that in comparison to our understanding of sources and pathways of nutrient loss our current scientific understanding of the sources and pathways of faecal bacteria losses from dairy farms is relatively poor, a view that is not new (Wilcock et al., 1999). Faecal bacteria loadings are associated with intensive livestock activities with loadings to waterways associated with overland flow of water from land and direct contamination of streams by livestock.

6.1 Nitrogen

In grazing and arable cropping systems N losses are mainly due to leaching of nitrate down the soil below the root zone (Lynch, 1982). The nitrate anion is weakly sorbed and readily moves in drainage water down the profile. Once below the root zone the N is essentially lost and no longer part of the soil-plant-animal cycle. Leaching occurs during the period of the year when the soils are wet and incident rainfall exceeds soil water storage capacity resulting in net drainage. In grazed pasture systems nitrate-N leaching losses are predominantly from animal urine patches (Ledgard, 2001). One urine patch from a lactating dairy cow can deposit up to the equivalent of 800 to 1000kg N/ha, overwhelming the soil-plant systems ability to assimilate the N into the organic fraction. This increases the risk of N leaching below the root zone. Actions which increase the number of urine patches (e.g. higher per head production or more animals) and or increases the amount of N in the animals diet increases the amount of N that can potentially be lost by leaching from urine patches (Ledgard, 2001). Managing N leaching losses is about managing the number and concentration of N in urine patches.
In cropping systems actions which disturb the soil, destroying soil aggregates exposing organic matter for mineralisation or prevents soil micro-aggregate building to stabilise organic matter, increase the risk of N losses by leaching. Autumn, winter and early spring are periods when rainfall can exceed soil water holding capacity. This results in drainage creating the potential for nitrate leaching. This period is also more sensitive as temperatures are low resulting in low plant growth and uptake of N by plant roots in the soil. This is exacerbated by the fact that farmers are often short of feed in the winter-early spring period, and frequently apply fertilizer N at this time to stimulate pasture growth. Fertilizer N has a small direct impact on N leaching, but a bigger indirect impact through the additional feed grown and eaten and returned in urine.

Di and Cameron (2002) ranked temperate agro-ecosystems based on the potential for causing nitrate leaching in the order: forest < cut grassland < grazed pastures < arable cropping < ploughing of pasture < commercial vegetables. Nitrate leaching losses typically range for:

- Forestry from 1-5 kg-N ha\(^{-1}\) yr\(^{-1}\),
- Sheep and beef from 6-60 kg-N ha\(^{-1}\) yr\(^{-1}\),
- Dairying from 15-115 kg-N ha\(^{-1}\) yr\(^{-1}\),
- Arable from 10-140 kg-N ha\(^{-1}\) yr\(^{-1}\) and
- Commercial vegetables from 100-300 kg-N ha\(^{-1}\) yr\(^{-1}\).

### 6.2 Phosphorus

Compared with N which is controlled by the organic chemistry of a soil, P concentration in soil solution is dominated by the inorganic chemistry of the soil. Further compared with the nitrate anion which is weakly sorbed, the P anion is specifically (tightly) held on soils surfaces. As a consequence, with the exception of soils which demonstrate preferential flow or have a very low anion storage capacity (i.e. Podzols, Coarse sands), P is not lost by leaching below the zone, as is the case with N, but is largely lost in overland flow or surface run-off when rainfall or irrigation water inputs exceed the infiltration rates at the soil surface (Parfitt et al., 2009).

Phosphorus is lost in two forms, dissolved P and soil bound P. Phosphorus bound to soil particles is the dominant form in which P is lost (60-90%) in overland flow from pasture and cropping systems, indicating that reducing P loss is as much about limiting the quantities of sediment lost (Gillingham and Thorrold, 2000). In comparison with N
losses, P losses are small. McDowell and Wilcock (2008) found P losses from dairy-dominated catchments ranging from 1 to 10 kg P ha\(^{-1}\) yr\(^{-1}\) depending on geographical features (e.g., soils, climate) and management factors (e.g. irrigated or dryland, dispose of dairy shed effluent). The range of P losses from sheep and beef farmed land is much narrower and lower at 0.1 to 2.2 kg P ha\(^{-1}\) yr\(^{-1}\) (Lambert et al., 1985). Again in comparison to N, a significant proportion of the P loss on an annual basis can occur during single-storm events (Parfitt et al., 2009).

6.3 Sediment

Accelerated soil erosion results in off-farm impacts, including sediment discharge to water, in river aggradation and damage to infrastructure and siltation. Importantly it also results in a loss of natural capital, impacting on a wider range of ecosystems services many of which are invisible (Mackay, 2008). The loss of sediment in overland flow as a consequence of intensive agriculture practices is small in comparison to the sediment loss from accelerated soil erosion, but significant in the amount of P it contains. Lambert et al., (1985) and Parfitt et al., (2009) showed that as soil P fertility increased the losses of P in overland flow associated with sediment also increased.

6.4 Transport processes governing N and P losses from land to water

In considering avoidance or mitigation options for reducing N and P losses from agricultural land it is important to understand the differences in the processes that transport these two nutrients from land to water. Nitrogen is lost largely by leaching from urine patches. Some N can be lost in effluent in overland flow, or effluent draining directly into streams. While these losses can cause localized impacts, there contribution is small, in comparison to the losses from below urine patches. In comparison P is lost primarily in overland flow and bound to sediment (Parfitt et al., 2009; McDowell and Nash, 2011).

There are a number of reviews that have addressed aspects of faecal runoff from rural catchments by examining pathways and models for predicting loads to surface waters, namely Collins et al., (2005), and Jamieson et al., (2004). While it is possible to potentially calculate loadings, it is much more difficult to estimate in situ concentrations, without knowledge of die-off rates and breakdown of faecal matter in conjunction with farm grazing management.
7. Avoidance and mitigation options

There is a long list of avoidance and mitigation options available for reducing the losses of P, N, faecal bacteria and sediment from agricultural land to water. These include the management of soil Olsen P, deferred effluent irrigation, lower pressure/rate Farm Dairy Effluent application, irrigation practices, reduce N fertiliser inputs, natural and artificial wetlands, low solubility P fertilisers, nitrification inhibitors, inclusion of low N feeds, timing and type of cultivation, restrict autumn and winter grazing, covered winter pads, wet soil management, additives (Al) to fertilisers and soils, fence waterways, conservation trees, greater focus on per head performance, precision agricultural practices (GIS/GPS), avoid waterways with fertiliser application, buffer strips and sorbents near and in streams, to name a few. Changes to the time of key management practices (e.g. calving and dry-off date), the mix of enterprises (e.g. age class ratio of cattle, cropping rotation) through to a change in land use are at the more radical end of the mitigation options.

In the next section a brief commentary is provided on some mitigation options

7.1 Mitigation options for Nitrogen

1. Fertilizer practices. The Fert Research Code of practice for nutrient management, with emphasis on fertiliser use (Anonymous., 2007) sets out best practices for N fertiliser use covering N requirements, rate, timing and form of application, soil conditions (moisture and temperature), minimum pasture covers, management of N on the effluent block, to name just some of the topics covered in the code. These are all designed to maximize the use and minimise the loss of N directly from N fertiliser.

2. Restricted autumn/winter grazing. Losses of N from urine patches are responsible for most of the N leaching and nitrous oxide emissions that occur from grazed pastures. Removing animals from the grazed pasture in the autumn and winter period reduces the number of urine patches contributing to N leaching. A recent study (Shepherd et al., 2011) indicates a significant contribution to N leaching from urine deposited in February/March and, by extrapolation, months before. This finding requires testing in other regions within New Zealand as it represents a shift in the current focus from late autumn/winter management. Restricted autumn/winter grazing would generally be used in conjunction with some type of pad or stand-off area and or with drying-off at the end of the season with animal’s wintered off-farm.
3. **Winter feed pads/herd homes.** The more time animals spend on a feed pad or in a Herd Home in the autumn and winter months the greater the reduction in N loss from the root zone. Urine collected while the animal is on a feed pad can be returned more evenly, at lower rates and at times of the year when net drainage is unlikely. Adjustments to the effluent block area to reflect the increased amount of effluent collected and management of the effluent application become critical, if the benefits of a stand-off pad in reducing losses to the wider environment are to be fully realised.

4. **Stock expulsion from all streams.** Preventing access to perennial streams will reduce direct nutrient contamination from dung and urine and indirectly reduce the amount of vegetation and sediment entering the water ways.

5. **Creation of wetland and riparian attenuation zones.** Trapping and retaining nutrients and sediment in wetlands and vegetation buffers alongside water courses will reduce direct contamination of waterways.

6. **Low nitrogen feed supplements.** Use of feed supplements such as maize silage as an alternative to using fertiliser N boosted grass lowers the amount of N in the diet. This translates into lower N concentrations in urine and the amount of N deposited in a urine patch, reducing the amount of N at risk to leaching.

7. **Nitrification inhibitors.** Nitrification inhibitors target the animal urine patch limiting the microbial conversion of urine-N to nitrate, which is the main source of N for leaching and nitrous oxide emission. Losses of N from urine patches are responsible for most of the N leaching and nitrous oxide emissions that occur from grazed pastures. Current use of nitrification inhibitors on farms is by broadcast application to land (in slurry or granular forms) to try to contact urine patches during the high loss winter/early-spring period. An approach that involves using the animal to deliver the nitrification inhibitor in the urine stream, using a slow-release bolus is under development. There is still uncertainty surrounding the performance of inhibitors in some environments (i.e. warm, high rainfall, free draining soils). A summary of findings from existing field studies indicates that annual pasture responses to inhibitors are small (0-7%) (Gillingham et al., 2012). Further, in one of the few grazing systems studies, at the Massey University Dairy farm, on a mole and tile drained pallic soil, dicyandiamide (DCD) applied 3 times decreased N leaching by just over 20%. In this study the actual amount of N conserved was small.
8. **Land disposal of dairy shed effluent.** Treating effluent as a source of nutrients (N, P, K, S, Ca, Mg, etc) rather than waste and applying effluent to ensure that the amount of nutrient applied does not exceed the capacity of the soil (e.g. 150 kg-N ha\(^{-1}\) yr\(^{-1}\)) will ensure maximum use of the nutrients for pasture growth. It will also reduce the risk of land based effluent application resulting in losses to the wider environment.

In the past, the rule of thumb for effluent application was 4 ha per 100 cows to achieve an N loading of 150 kg-N ha\(^{-1}\) yr\(^{-1}\). At this application rate the potassium (K) input is approximately twice the amount necessary for maintenance. While using K inputs above maintenance does not represent an environmental threat, it does represent poor practice. Excessive K in soils and pasture can result in metabolic problems for lactating animals. If the optimum use was being made of effluent as a nutrient source, then K inputs would drive the application rate per hectare. The Overseer\textsuperscript{®} nutrient budget model can calculate the effluent block area based on a specific N loading or maintenance K input.

9. **Irrigation practice.** Variable rate irrigation has the potential to increase the efficiency of use of water and to reduce drainage and associated risk of N leaching.

10. **Whole farm nutrient budgeting.** Nutrient budgets are useful tools for assessing N flows within the farm system and identifying opportunities for reducing N losses. The Overseer\textsuperscript{®} nutrient budget provides an estimate of nitrate leaching loss for each part of the farm under different management.

A consequence of N-conserving technologies is a lift in production levels. This limits or counters to some degree the benefit they offer in reducing diffuse-source N discharges. Until an N leaching loss target is added to the equation, the use of N-conserving technologies will continue to be governed primarily by their potential to lift production only and not the duel objectives of production increases and N leaching loss reductions.
7.2 Mitigation options for Phosphorus, faecal bacteria and insidious sediment losses

1. Soil erosion. The single biggest opportunity to reduce P loss to waterways from agricultural land is by limiting accelerated soil erosion and sediment movement to waterways from overland flow during rainfall events. On landscapes where soil erosion risk (e.g. wind erosion, slump, slip, rill, stream bank, etc) is an issue there is a systematic land evaluation and planning approach that can be used for tackling this environmental problem (Lynn et al., 2009). Although only a small amount of sediment is generated and lost in overland flow under intensive agriculture by livestock treading, wheel traffic and cultivation, this is a significant source of P. This is because of the high P status of many of these soils.

2. Optimum soil P fertility. The target range should be, the agronomic optimum soil Olsen P levels, for each of the soil types on the farm. Soil fertility above the agronomic optimum makes little economic sense and increases the P run-off risk on soils with low (<50%) anion storage capacity. The Optimum agronomic soil Olsen P levels for each of the major soil orders are listed in the Fertilizer use on New Zealand Dairy farms (Roberts and Morton, 2009). There is an equivalent publication for sheep and beef farms (Morton and Roberts 2009). A recent study (Mackay et al., 2010) indicates that as the physical condition of the soil declines, the amount of P required to sustain pasture growth increases, highlighting the importance of maintaining a good soil physical structure.

3. Fertilizer type and practices. The use of P fertilizer products with a high citric solubility, but low water soluble component (i.e. sparingly water soluble) on soils with low anion storage capacity and during periods of high risk (e.g. late autumn, hydrophobic soils) when surface run-off could occur, offers an option for reducing the potential risk of P losses in the days following application from land to water (McDowell and Nash, 2011). Avoiding direct contamination of water ways during fertilizer application also offers scope for reducing the potential risk of P losses from land to water. Again, the fertilizer industry Code of practice on nutrient management (Anonymous, 2007) provides a very useful resource.

4. Irrigation practice. Variable rate irrigation has the potential to increase the efficiency of use of water, and limit the risk of overland flow and the potential risk of P bound to sediment being lost from land to water.
5. **Land disposal of dairy shed effluent.** By treating effluent as a source of nutrients (N, P, K, S, Ca, Mg, etc) rather than waste will ensure maximum use of the nutrients for pasture growth and limit the impact of land based effluent application to the wider environment. This involves applying effluent ensuring the amount of nutrient applied does not exceed optimum levels (e.g. Olsen P levels < 35 ug ml\(^{-1}\)). The Overseer\(^\circledR\) nutrient budget model can be used to calculate the optimum area for application of dairy shed effluent.

6. **Deferred and low application effluent irrigation rates.** Limiting effluent applications to periods when soil water levels are less than field capacity combined with low application rates, increases the opportunity for effluent to be absorbed into the soil matrix. This will reduce P losses and limits the risk of surface run-off and/or preferential flow of effluent (Houlbrooke et al., 2004; Houlbrooke et al., 2006). Ideally, dairy shed wastewater should be irrigated onto land only when the water storage capacity of the soil will not be exceeded. In addition to the identification of appropriate soil type, timing, volume, location and technique are also key factors in the optimal irrigation of effluent and water. Deferring irrigation when soils are too wet can markedly reduce contaminant transfer to waterways, particularly via subsurface drains and groundwater. Spray irrigation results in less risk of soil saturation and hence less surface runoff and microbial contamination of groundwater than the border strip technique (Collins et al., 2005).

7. **Advanced Pond Systems.** These provide excellent effluent quality and have particular application where soil type and/or climate are unfavourable for irrigation (Collins et al., 2005).

8. **Preventing autumn-winter-spring soil and pasture treading damage.** Removing heavy weight animals, when soils are wet, to free draining soils, a stand-off or feed pad will limit soil and pasture damage (Singleton et al., 2000). Treading can generate sediment and damage to soil pores which are important in the transport of rainfall into the soil profile (Drewry 2006). Limiting livestock treading when soils are wet reduces the amount of damage to the soil surface, and the potential for surface run-off (Betteridge et al., 2003). Further, by limiting plant damage from treading ensures protection of the soil surface from rain drop damage. Parallels exist for the arable industry. Soils damaged by intensive cultivation will have reduced infiltration rates and soils without a vegetative cover are more prone to raingood damage and reduced infiltration rates.
9. **Cultivation practices.** Limiting soil structural damage, disturbance, compaction and limiting the period the soil is bare will all reduce the loss of small amounts of sediment in surface run-off events.

10. **Soil type.** The characteristics of the soil are a key factor in the transfer of faecal microbes to waterways. The avoidance of, or a reduction in, grazing and irrigation of poorly drained soils, which are characterised by high bypass flow and generation of surface runoff, are appropriate management practices. These measures are likely to lead to improvements in bacterial water quality (Collins et al., 2005).

11. **Stand-off/Winter feed pads/herd homes.** An area to stand animals when soils are wet and vulnerable to deformation and damage is an effective tool for reducing both sediment and P loss.

12. **Stock exclusion from all streams and crossings.** Preventing access to perennial streams will reduce direct P contamination from dung and indirectly reduce the amount of vegetation and sediment entering the water ways. This is by reducing damage to stream banks and the land in the immediate proximity to the stream. Under the Dairying and Clean Streams Accord (Fonterra et al., 2003) streams “deeper than a “Red Band” (ankle depth) and “wider than a stride”, and permanently flowing” the Accord’s target is to have dairy cattle excluded from 50% of streams by 2007, and 90% by 2012.

13. **Vegetation buffer zones.** Permanent or temporary vegetation riparian buffer zones can be placed out from streams during high risk periods to trap and collect sediment during rainfall events that result in overland flow (McDowell and Nash, 2011). Riparian buffer strips not only prevent cattle access to waterways, they can also entrap microbes washed down slopes in surface runoff, and, where planted in trees provide shade and improve aquatic habitat (Collins et al., 2005).

14. **Creation of wetland and riparian attenuation zones.** Trapping and retaining nutrients and sediment in wetlands will reduce direct contamination of waterways. There is a lack of area specific metric data on P attenuation rates with both these mitigation options. The risk from livestock or cultivation activities that are likely to create areas of bare or disturbed land can be reduced by installing sediment traps.

15. **Whole farm nutrient budgeting.** Nutrient budgets are useful tools for assessing P flows within the farm system and identifying opportunities for reducing P
losses. The Overseer® nutrient budget provides an estimate of P run-off risk for parts of the farms under different management.

7.3 Sediment from soil erosion

1. **Vegetation management.** Reducing the risk of soil erosion is achieved largely through a change in vegetation (Pollock, 1986; van Kraayenoord and Hathaway, 1986a, van Kraayenoord and Hathaway, 1986b). The most effective vegetation is mature, closed-canopy indigenous or exotic forest (Hicks and Anthony, 2001). Tree/pasture systems have been used widely in hill land pasture systems in New Zealand to reduce mass land movement (Wilkinson, 1999). *Populus* (poplar) and *Salix* (willow) species are preferred as they can be established rapidly from vegetative cuttings and livestock can be grazed during the establishment phase. Mature trees of these species, and other broadleaved species, planted at a spacing of ≤12 m, can reduce land-sliding in pasture by 50–80%. Effective protection against land-sliding is reduced to only 10–20% where there has been incomplete planting of erosion-prone slopes with trees, or where tree stands have not been managed well (Hicks, 1995).

2. **Soil conservation plans/ Whole farm plan.** Regional Councils offer a wide range of soil conservation and environmental packages to assist land owners to tackle erosion within pastoral land (Manderson et al., 2007). Hawke’s Bay Regional Council offers land and environmental plans and also has a Regional Land Care Scheme [www.hbrc.govt.nz/Whatwedo/Land/Landmanagement/tabid/283/Default.aspx](http://www.hbrc.govt.nz/Whatwedo/Land/Landmanagement/tabid/283/Default.aspx).

3. **On-farm industry resource packages.** The Land Environment Plan (LEP) Toolkit from Beef and Lamb NZ (Anonymous, 2008) provides the sector with a resource to assist with identifying if soil erosion is an issue on-farm, if so, the severity of the issue and some guides and actions that can be taken to address the issue as part of resource management and future business planning.
7.4 Assembling the mitigation tool box

Monaghan et al., (2008) points out that the first step in assembling the mitigation tool box requires a clearly defined set of environmental goals for the waterway requiring protected. Since the major source of water contaminants often differs between catchments, it is important that the mitigation options in the tool box are matched to contaminant and to the physical resources and management systems of the existing farm businesses.

![Diagram of mitigation options](image)

**Figure 1:** Examples of the contaminants (white boxes) and potential mitigation actions (grey boxes) on a dairy farm (Taken from Monaghan et al., 2008)

In most cases multiple mitigation options will need to be explored in the process of identifying and prioritizing options that are suitable and most effective for reducing the losses for a specific farm system (Fig.1). As part of the process the implications of how each mitigation option influences other contaminants also needs to be considered. It is also important to appreciate the dangers of not swapping contaminants, for example in reducing nitrate leaching, nitrous oxide emissions are not increased. Some of the N mitigation options have the potential to reduce nitrous oxide and greenhouse gas (GHG) emissions, increasing the overall benefit of mitigation practices on the environment.

Of the avoidance or mitigation options available some come at little cost, require few changes in current practices and hence probably little resistance to adoption? In some instances they may add efficiencies and in other cases additional costs.

Ledgard and Smeaton (2007) divided N mitigation options up into two categories:

1. Options for reducing N leaching that could be adopted at little or no cost or impact on profit
2. Options which reduce N leaching but are also likely to result in reduced profit.

Examining the merits of those that fell into the second category, requires a more detailed examination of the farm business. For example in addition to the use of expert advice on mitigation options the implications to the business would also have to be explored with an agribusiness consultant. It is important to note that in addition to logistics and economics, the development of “symbolic” or “cultural” capital is also important in adoption (Bewsell and Kaine, 2006, Burton et al., 2008)

It is important to remember the relevance, effectiveness and cost of mitigation is case specific due to variations in soil type, topography, climate, and land use and farm management system. For example the merits of stream fencing, riparian or buffer strips will be dependent on the number and length of waterways on the farm. Monaghan et al., (2008) found reducing maintenance fertiliser inputs and Olsen P values back to the optimum agronomic range offered the greatest saving and a predicted reduction in P losses by 30-37% in two dairy catchments they investigated. In two other catchments in the same study the opportunity for cost savings and environmental gains were much smaller (P losses by 7-14%) from reducing maintenance fertiliser inputs and Olsen P, because the soil P levels were closer to the agronomic optimum. This example serves to highlight the danger of prioritizing or generalizing about the effectiveness of mitigations options.

Mackay et al., (2008) pointed out that technologies (e.g. cultivation, drainage and irrigation) used as substitutes for the lack of productive capacity (e.g. weakly developed soil structure, limited profile available water) of soils will lead to increased N loss, through a combination of increased production and greater leaching volumes. They also showed that as the natural capital of soils (Using LUC as a proxy) declined so did the number and efficacy of the mitigation options (Fig.2). This serves again to highlight the danger of generalising about either the suitability or effectiveness of mitigation options from farm to farm.
A large number of N and P mitigation options are incorporated into the Overseer® nutrient budget model. These include for example lower C: N feeds, choice of fertilizer type, nitrification inhibitors, riparian, buffer strips, wetlands, wintering pads, feed-pads and off farm grazing. There are a number of published studies available to demonstrate how mitigations options such as N inhibitors, feed pads, feeds with wider C:N ratios, influence N, P and faecal bacteria loss from grazed pastures (Monaghan et al., 2008).
8. Examples of the suitability and effectiveness of mitigations options

The relevance, effectiveness and cost in dollars and time of the mitigation options are case specific due to the source and quantity of the contaminants, variations in soil type, topography, climate, land use and farm management system. In this section four studies (Ledgard and Smeaton, 2007, Monaghan et al., 2008; Manderson and Mackay, 2008; McDowell and Nash, 2011) that have undertaken detailed analysis of the potential effectiveness of N and P mitigation options for reducing the losses of these two nutrients from pastoral systems are presented and discussed. They provide an indication of the suitability, range in effectiveness and cost/benefit of some of the mitigation options available for reducing contaminants losses from agricultural land to water.

The study of Manderson and Mackay (2008) included six case study farms (dairy, mixed farming, sheep and beef, and a dairy conversion) which were nominated by Horizons Regional Council. In that study on-farm N leaching losses were compared with a catchment water quality target that had been translated into N leaching loss limits /ha for each of the six case farms. Where the farm N leaching loss was higher than the N loss limit mitigation options were evaluated. The assessment of the nutrient mitigation options included cost effectiveness and practicality. The resource management strategy from one of the six case study farms is included as an appendix (Appendix I). The study of Manderson and Mackay (2008) represents the first set of nutrient management plans developed to deliver to a catchment water quality target, through an on-farm per hectare N leaching allocation.

8.1 Nitrogen

Ledgard and Smeaton (2007) on-farm study was charged with exploring the current levels of N leaching losses from dairy farms in the Rotorua catchment and to test options for reducing N leaching and the effects of these on farm profit.
The evaluation of the mitigation options listed in Table 1, reflects farm level outcomes, not necessarily catchment-wide effects. The options are not necessarily additive and some options may be adopted for non-profit reasons (e.g. wetlands). The likely percentage reduction in N leaching varied between the 26 farms in the study. For example the N leaching loss reduction from using a winter feed pad / stand-off pad varied from 5-20%.

On average the category 1 N mitigation options (Optimized for Farm Dairy Effluent (FDE), cows/ha, no N on FDE, no winter N plus greater wintering-off ) and category 2 N mitigation options (All cows wintered in a herd home and no N fertilizer) resulted in a 12% and 45% reduction in N leaching losses, respectively. The category 2 options had a negative impact on income and profitability.
Monaghan et al., (2008) used four case study dairy farms in different catchments to examine a range of N mitigation options on N leaching loss reductions and on farm EBIT (Earnings Before Interest and Tax; Fig. 3). The nitrification inhibitor DCD was found to be a potentially cost-effective measure in all catchments, although the science behind this technology is still lacking in some parts of New Zealand.

**Figure 3:** Total N losses to waterways (bars) and projected cost-effectiveness (symbols) of a range of source management mitigation strategies which target N losses from dairy farms in four catchments ((A) Toenepi, (B) Waiokura, (C) Waikakahi and (D) Bog Burn). Dashed line represents nil change in farm (Reproduced from Monaghan et al., 2008)

Wintering pads were cost-effective in only one catchment in the study of Monaghan et al., (2008), suggesting the wider adoption of this management system is currently unlikely. The other N mitigation options explored, including restricted grazing systems, low N feed supplements and low fertiliser N input all reduce N losses from dairy farms,
however, the economics of these management systems generally incur small reductions in farm profitability.

In the dairy farm case study near Dannevirke of Manderson and Mackay (2008) off-farm winter grazing offered the greatest reduction in N leaching loss (Appendix I). Fencing water ways, construction of a stream crossing and installation of culverts, all requirements under the Dairying and Clean Streams Accord, offered little benefits in mitigating N losses, but would have greater utility in mitigating P and faecal bacteria. Each of these mitigation options came at some cost.

### 8.2 Phosphorus

In a review of the Cost-Effectiveness and Suitability of Mitigation Strategies to prevent Phosphorus Loss from Dairy Farms in New Zealand and Australia, McDowell and Nash (2011) reported reductions in total P losses of:

- 5-20% for shifting to an optimum soil P test,
- 0-20% reduction for a low solubility P fertilizer,
- 10-30% reduction for stream fencing,
- 30–50% reduction for restricted (time) grazing of cropland,
- 10–30% reduction for greater effluent pond storage/application area, and
- 10-30% reduction for low rate effluent application to land,
- 5–30% reduction for alum addition to pasture,
- 0-20% reduction from a grass buffer strips,
- 10-20% reduction with sediment traps,
- -426 to 77% reduction for constructed wetlands particulate, and
- <10% reduction from natural seepage wetlands.

McDowell and Nash (2011) grouped P mitigation options into three strategies, (i) management (ii) amendments and (iii) edge-of-field mitigation. Of these they concluded that the on-farm management strategies offered the most cost-effective way of mitigating P losses.

Monaghan et al., (2008) found in the four dairy farms studied, reductions in total P losses of 7-37% for shifting to an optimum soil P test (Fig.4). Deferred farm dairy effluent management offered scope for reducing by 10-55% in two of the four case study farms. Mitigation of faecal bacteria is not addressed specifically in this section of the
review, but is recognised that many of the mitigation options that reduce P and sediment losses from land to water, will also have a positive influence on faecal bacteria.

Figure 4: Total P losses to waterways (bars) and projected cost-effectiveness (symbols) of a range of source management mitigation strategies which target P losses from dairy farms in four catchments ((A) Toenepi, (B) Waiokura, (C) Waikakahi and (D) Bog Burn). Dashed line represents nil change in farm (Reproduced from Monaghan et al., 2008)
9. Summary

The paper lists and describes the

- agricultural non-point source contaminants which cause water quality degradation
- identifies potential sources and factor influencing the quantities of each of these agricultural non-point source contaminants
- describes the characteristics and processes by which nitrogen (N), phosphorus (P) faecal bacteria and sediment are transported from land to water
- lists and provides a brief description of mitigation and avoidance options and provides examples of the suitability and effectiveness of N and P mitigations strategies that could be utilised in the Tukituki River context

The key message from the paper is that there are a large number of potential mitigation and avoidance options, but the suitability, effectiveness and cost of each option will be case specific due to differences in the source and quantity of the contaminants, variations in soil type, topography, climate, land use and farm management system.
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Mitigation options for reducing N and P losses from intensive dairy and arable and process vegetables farm systems on the Ruataniwha Plains

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Report prepared for Hawkes Bay Regional Council Ruataniwha Plains Water Storage Project

June 2012

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Executive summary

- NIWA has modelled the effect of nutrient discharges on the Ruataniwha Plains from a range of farm systems developed by Macfarlane Rural Business Limited, both under status quo conditions (Scenario A) and with irrigation water available for use from a proposed water storage scheme (Scenario B).
- This paper reports on a desktop study assessing the effectiveness of a range of mitigation and avoidance options for reducing or offsetting non-point source (diffuse) farm nutrient discharges of nitrogen (N) and phosphorus (P) from two of the post-storage Macfarlane farm systems, (7b) Dairy -irrigated light soils and (5b) intensive arable process vegetable using the Overseer® nutrient budget model.
- The Overseer® nutrient budget model was used because it contains a suite of N and P mitigation options.
- The two farm systems selected for the mitigation study have significantly higher inputs and outputs/ha over the pre-storage land uses they replace and together represent a significant part of post-storage land use in Macfarlane's economic study.
- The N mitigation options explored for (7b) Dairy -irrigated light soils with the dairy consultant (Chris Lewis from Baker and Associates) included wintering off, increasing the size of the effluent block, reducing N fertiliser inputs, increasing the amount of maize in the diet and the use of a N inhibitor. For (5b) intensive arable process vegetable, the N mitigation options explored with the arable consultant (Anton Nicholls from Macfarlane rural business Ltd) included altering the ratios of annual to perennial crops, and of high N input cropping options (i.e. potatoes, squash) compared with those requiring little or no N fertiliser, altering planting and harvesting dates and switching from cattle to lamb finishing.
- There is considerable scope to mitigate N leaching losses from both the (7b) Dairy -irrigated light soils and (5b) intensive arable process vegetable farm systems. Reducing N leaching losses of up to 15 kgN/ha/yr did not impact significantly on farm income. Mitigation to achieve N leaching losses of <30 kgN/ha/yr from these two post-storage farm systems, however, comes at some cost, and results in lower production and farm income.
- There is also considerable scope to reduce the risk of P losses from the irrigated dairy operation to the wider environment. Some P mitigation options are rapidly becoming part of accepted industry practices (e.g. Fencing of waterways, as part of the Dairying and Clean Streams Accord) and to the extent they are currently being employed, the scope for mitigation to reduce P losses is itself reduced.
- Findings of this study have been used by Macfarlane Rural Business Ltd to explore the impact of on-farm mitigation on the on-farm economics of expanding irrigation on the
Ruataniwha plains. The findings have also been used for the development of Scenario C (MacFarlane post-storage land use with N mitigation_reduction of N leaching from (5b) and (7b) of 16 and 21 kgN/ha/yr, respectively) to assist NIWA to commence investigation of the link between on-farm N and P mitigation and water quality outcomes.
1. Introduction

Hawke’s Bay Regional Council (HBRC) is currently investigating a water storage project to provide irrigation water to approximately 25-30,000 hectares within the Ruataniwha Plains. As part of this investigation a number of studies have been undertaken to assess the economic and environmental viability of water storage and resulting land use intensification with irrigation. This report incorporates part of the environmental work stream, examining mitigation options for reducing Nitrogen (N) and Phosphorus (P) losses from enterprise classes (7b) Dairy – irrigated light soils and (5b) intensive arable process vegetable using the Overseer® nutrient budget model. These two farm systems were selected for the mitigation study because they represented a significant part of post-storage land use in Macfarlane’s economic study (Macfarlane report 2011) and in both farm systems there was a significantly increase in nutrient inputs and outputs/ha over the pre-storage land uses they replaced.

The Overseer® nutrient budget model was used because it contains a suite of N and P mitigation options and is already in use as an on-farm decision support tool. In recognition of the fact that in the set up and calibration of the catchment model, SPASMO was used to simulate irrigation demand and nutrient losses (N & P) for each of the potential land uses (without mitigation)/ soil type/climate possible with the expanding irrigation, in a separate study (Rutherford 2012 Appendix 2) the calculated N and P outputs from the Overseer and SPASMO models were compared to provide a link between the mitigation study reported here, and the catchment modelling work stream that links land use to water quality outcomes.

In the model comparison good agreement (1:1) was found in the calculated N output (i.e. N leaching loss) between SPASMO and the Overseer® nutrient budget model for the five pre-and post-storage farm systems developed by Macfarlane to explore the on-farm economics of expanding irrigation on the Ruataniwha plains. The farm systems included sheep & beef breeding, mixed livestock, sheep and beef finishing, mixed arable, dairy and intensive arable & process vegetable. The good agreement between the two models gives confidence that the Overseer® nutrient budget model can appropriately be used instead of SPASMO to explore N mitigation options and the calculated N outputs from the Overseer® nutrient budget model can also be used in the NIWA catchment model to explore the influence of mitigation beyond the farm gate on the quality of the receiving waters and on aquatic plant growth.

This study was conducted in partnership with the Macfarlane Rural Business Ltd group to explore concurrently, the impact mitigation and avoidance options would have on the production and financial performance of these two post-irrigation farm systems in addition to N and P losses from these farm systems. Their finding on the influence of N mitigation on the production and financial performance of 7b) Dairy – irrigated light soils and (5b) intensive arable process vegetable are reported separately (Rutherford 2012 Appendix 3).
2. Method-Mitigation of N and P losses from dairy and arable

The focus of the desk top study was the suitability and effectiveness of potential avoidance and mitigation options for addressing N and P as these are the principal nutrients of concern in relation to downstream surface water quality and aquatic plant growth. The influence of the avoidance and mitigation options were explored with two of the nine post-storage farm systems, namely (7b) Dairy - irrigated light soils and (5b) intensive arable process vegetable. These two farm systems were chosen because they represent a significant part of post-storage land use in Macfarlane’s economic study and both have much higher inputs and outputs/ha over the pre-storage land uses they replace. Details about the two farm models are available from the McFarlane report (2011).

The avoidance and mitigation options for addressing N and P losses were taken from the literature review by Mackay (2012) that examined the suitability and effectiveness of a range of potential avoidance and mitigation options for addressing agricultural non-point source contaminants of water commissioned by the HBRC as part of the Ruataniwha Plains water storage project.

2.1 Identifying nitrogen and phosphorus mitigation options for (7b) dairy - irrigated light soils

Mitigation options were explored in partnership with the dairy consultant (Chris Lewis from Baker and Associate) from the Macfarlane team in a series of steps.

First the Overseer® nutrient budget model (Version 5.4.11) was populated with the farm and production characteristics describing (7b) Dairy - irrigated light (silt loam) soils detailed in the Macfarlane report (2011). Irrigation was assumed to follow good practice (i.e. irrigation water is applied in the selected months and at a rate to overcome the soil moisture deficit only, with little or no extra drainage occurring). In the event, the amount of water applied is greater than plant demand, drainage is likely to occur increasing the risk of nutrient leaching losses. To provide Chris Lewis with an indication of the potential N leaching reduction possible with N mitigation, Overseer® was run with the objective of reducing the N leaching losses by 10 kgN/ha/yr from 50+ to 40, 40 to 30, and 30 to 20 kgN/ha/yr for the (7b) Dairy-irrigated light soil farm system without compromising milk solids production. The N mitigation options explored included wintering off, increasing the size of the effluent block, reducing N fertiliser inputs, increasing the amount of maize in the diet and the use of a N inhibitor.
Following discussion and analysis with Chris Lewis, which covered the feasibility, cost, and the difficulty of implementation of each of the mitigation options, four N reduction farm system scenarios were developed, along with a range of other mitigation actions within each scenario (Table 1). Chris Lewis re-ran UDDER a whole farm system simulation model to confirm the operation was biologically feasible and to provide new updated detailed input data (e.g. stocking rates, production levels, inputs, etc) for rerunning Overseer®. The influence of mitigation on farm costs, budgets, cost of capital, financials and profitability are reported separately.

In addition to exploring the influence of mitigation options for reducing N leaching losses, a preliminary analysis was undertaken of the influence of a range of P mitigation. Options for reducing P losses from the (7a) Dairy - part irrigated lighter soils (7b) Dairy -irrigated light soils, and one of the three N reduction farm system scenarios, were also investigated with Overseer®. The P mitigation options explored included the influence of excluding livestock from streams, riparian margins and low water soluble P fertiliser on farm scale P losses.

2.2 Identifying nitrogen mitigation options for (5b) intensive arable process vegetable

A similar process was followed in the investigation of N mitigation for the post-storage (5b) intensive arable process vegetable land use. Options for reducing N leaching losses included altering the ratios of annual to perennial crops, and of high N input cropping options (i.e. potatoes, squash) compared with those requiring little or no N fertiliser, altering planting and harvesting dates and switching from cattle to lamb finishing.

Again, the Overseer® nutrient budget model (Version 5.4.11) was first populated with the farm and production characteristics describing (5b) intensive arable process vegetable and mitigation options evaluated with the objective of reducing the N leaching losses in increments of 10 kgN/ha/yr. This was to provide the arable consultant (Anton Nicholls, of Macfarlane Rural Business) with an indication of the influence of each mitigation option on N leaching losses.

Following discussion with Anton Nicholls and further analysis, which covered the feasibility, cost, difficulty of implementation of each of the mitigation options, eight N reduction farm system scenarios were developed (Table 4). Anton Nicholls re-ran the rotations in the arable farm system model to confirm and/or alter the operation to ensure it was biologically feasible. The new detailed input data (e.g. timing, inputs, production levels, harvesting and planting dates, etc) was used to rerun Overseer® for a second time. Again, the influence of mitigation on farm costs, budgets, financials and profitability are reported separately.
3. Findings

3.1 Nitrogen mitigation for dairy farm systems

The N outputs (N leaching losses) of the Overseer® nutrient budget for the four specific N reduction scenarios used by MacFarlane to investigate the influence of mitigation on farm production and financial performance (Ruhtherford 2012 Appendix 3) are listed in Table 2 and a summary of the N leaching losses from all the scenarios developed and examined as part of the study are presented in Figure 1 for completeness.

In all cases, it was assumed that, N fertiliser is applied uniformly, soils are not damaged by treading and irrigation practices follow best practice to limit unnecessary drainage.

The N leaching losses for the (7a) pre-storage and (7b) post-storage dairy on the light soil (Fig.1), therefore, already capture some “good practices” that will be contributing positively to nutrient use efficiency and nutrient emissions. The N leaching losses from the pre- to post-storage dairy farm system on the light soil increased by only one kilogram from 43 to 44 kgN/ha/yr (Fig 1), despite an increase in cow stocking rate and milk solids production. It reflects the fact that the milking cows are assumed to be wintered off in (7b). If the milking cows are kept on the milking platform during the winter, N leaching losses on (7b) increases to 51 kgN/ha/yr (Fig 1).
Table 1 Description of the nitrogen reduction dairy farm system scenarios and range of mitigation options explored within each scenario.

<table>
<thead>
<tr>
<th>Macfarlane Farm model</th>
<th>Dairy farm system</th>
<th>Supporting data</th>
</tr>
</thead>
<tbody>
<tr>
<td>7a</td>
<td>Dairy part irrigated</td>
<td>Described in Macfarlane</td>
</tr>
<tr>
<td>7b</td>
<td>Dairy fully irrigated (150 N; Wintered on)</td>
<td></td>
</tr>
<tr>
<td>7b</td>
<td>Dairy fully irrigated (150 N; 8 wks off) (^1)</td>
<td>Described in Macfarlane</td>
</tr>
</tbody>
</table>
| 7b_scenario 1         | Dairy fully irrigated (75 N; 9 wks off) \(^2\)  
Eff block = Opt for K | Effluent block optimised for K |
| 7b_scenario 1         | Dairy fully irrigated (75 N; 9 wks off) \(^2\)  
Eff block = Opt for K Plus inc N to 150 kg ha | Increased effluent block area |
| 7b_scenario 1         | Dairy fully irrigated (75 N; 9 wks off) \(^2\)  
Eff block = 150 kg N | Increased effluent block area |
| 7b_scenario 1         | Dairy fully irrigated (75 N; 9 wks off) \(^2\)  
Eff block = Opt for K +DCD | Effluent block optimised for K plus eco N on whole farm |
| 7b_scenario 2         | Dairy fully irrigated (0 N; 9 wks off) \(^2\)  
+ DCD | eco N on whole farm |
| 7b_scenario 3         | Dairy fully irrigated (0 N; 12 wks off) | eco N on whole farm |
| 7b_scenario 3         | Dairy fully irrigated (0 N; 12 wks off)  
+ DCD | eco N on whole farm |

Notes
\(^1\)Wintering off for 8 weeks, June and July, with 100% of the spring herd for June and 75% for July.
\(^2\)Wintering off for 9 weeks, June and July, 100% of herd in both months
\(^3\)Wintering off for 12 weeks, May, June and July, 100% of the herd for three months

The N leaching loss values reported here for (7a) and (7b) are at the high end for those reported for the East Coast as part of the Regional indicators of N leaching (http://www.fertresearch.org.nz/default.aspx) provided by Fert Research. Importantly they represent N leaching losses before the introduction of mitigation options beyond good farm practice.
The four specific N reduction dairy farm system scenarios used by Macfarlane in the economic analysis of N mitigation (Rutherford 2012 Appendix 3) are described in detail in Table 2. The approach taken in each scenario was to investigate mitigation options for reducing nitrate leaching loss from the dairy system on the “light soils” without compromising milk solids production. The N mitigation options focused on reducing the number of urine patches on the paddock and or reducing the amount of N in the urine. This was achieved by exploring the

- influence of a change in the source of feed (i.e. maize silage instead of N fertiliser boosted pasture to change the N concentration in the diet and urine),
- manner in which the feed was fed to the animals (i.e. in the paddock or on a feed pad to manage the number of urinations falling on the pasture) and
- period the cows were off the farm over the autumn winter period when dry

Table 2 Key attributes, inputs, management dates and practices, EBIT, and N leaching losses of the four specific nitrogen leaching reduction farm system scenarios used by Macfarlane in the economic analysys (Rutherford 2012 Appendix3).

<table>
<thead>
<tr>
<th>Farm system</th>
<th>7b</th>
<th>7b_Scenario 1</th>
<th>7b_Scenario 2</th>
<th>7b_Scenario 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Calving</td>
<td>Autumn &amp; Spring</td>
<td>Spring</td>
<td>Spring</td>
<td>Spring</td>
</tr>
<tr>
<td>Winter stock off 1st July until ...</td>
<td>Mid July</td>
<td>Mid July</td>
<td>Mid July</td>
<td>August 1st</td>
</tr>
<tr>
<td>N fertiliser (kgN/ha)</td>
<td>150</td>
<td>75</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Dry off</td>
<td>N/A</td>
<td>31 May</td>
<td>31 May</td>
<td>30 April</td>
</tr>
<tr>
<td>MA Grazing Off</td>
<td>8 weeks</td>
<td>9 weeks</td>
<td>9 weeks</td>
<td>12 weeks</td>
</tr>
<tr>
<td>Cow No. peak</td>
<td>1100</td>
<td>1100</td>
<td>1100</td>
<td>1100</td>
</tr>
<tr>
<td>Winter milk (No.)</td>
<td>270</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Total MS (kg)</td>
<td>488,000</td>
<td>482,000</td>
<td>481,000</td>
<td>457,000</td>
</tr>
<tr>
<td>MS / cow (kg/ha)</td>
<td>440</td>
<td>435</td>
<td>433</td>
<td>412</td>
</tr>
<tr>
<td>Maize Silage (t)</td>
<td>610</td>
<td>744</td>
<td>1076</td>
<td>838</td>
</tr>
<tr>
<td>Grain or similar (t)</td>
<td>349</td>
<td>338</td>
<td>338</td>
<td>317</td>
</tr>
<tr>
<td>EBIT ($)</td>
<td>1,461,762</td>
<td>1,282,823</td>
<td>1,120,865</td>
<td>979,893</td>
</tr>
<tr>
<td>Difference ($)</td>
<td>178,939</td>
<td>340,897</td>
<td>481,869</td>
<td>481,869</td>
</tr>
<tr>
<td>Principal ($) on pad</td>
<td>No pad</td>
<td>No pad</td>
<td>$35k pa x 20 year</td>
<td>$35k pa x 20 year</td>
</tr>
<tr>
<td>N leaching loss (kgN/ha/yr)</td>
<td>44</td>
<td>30</td>
<td>24</td>
<td>20</td>
</tr>
</tbody>
</table>

Note 1. Median calving date for spring herd is 22\textsuperscript{nd} August and drying off date 31\textsuperscript{st} May. For the autumn the median calving date is the 10\textsuperscript{th} April and drying off date 31\textsuperscript{st} January.
Note 2. Only 7b has winter milking – value $56,000 per annum in premiums.
Note 3. 150 N and 75 N don’t have feed pads.
Note 4. ECO N budgeted for 75 kg N/ha and both 0 N/ha models, $57,000 per annum.
Note 5. For 7b_Scenario 2 and3 the feed pad capital cost ($700,000 @ 7.5% interest over 20 year depreciation.
Note 6. EBIT – accounts for depreciation but no principal payments – depreciation $35,000 per annum
While every attempt was made to sustain milk solids production (Table 2), there were adjustments, as follows:

- With 7b_scenario 3, the cows were wintered off for 12 weeks, but the shorter lactation could not be compensated for by increased feeding. There was some discussion of the potential for reducing cow numbers and targeting higher production per head in 7b and 7b_scenario 1-2, and increased cow numbers in 7b_scenario 3 to compensate for the shorter lactation, but this was not modelled. This therefore remains an option which could be explored.

- Construction of feed pads to improve maize utilisation, urine capture and reduce soil damage was added to 7b_scenario 2-3. It is noted that increased demand for maize could increase the local maize crop area.
**Figure 1** Calculated nitrate leaching losses for the (7a) pre- and (7b) post-storage dairy on the light soil for the four specific scenarios used by MacFarlane to investigate the influence of mitigation on farm production and financial performance (listed in Table 2) and other the scenarios developed and examined as part of the study. Additional mitigations include the area of the effluent block and the use of DCD.
Identifying the key elements and results under each scenario:

- **7b**: Cows were wintered off for 8 weeks in June and July, but the farm continues with winter milk production (Table 2). This reduces N leaching losses from the farm by 7 kg N/ha/yr (Fig.1).

- **7b_scenario 1**: One additional week is added to the wintering off period (9 weeks) and winter milk production is stopped. Annual N fertiliser inputs are reduced to 75 kgN/ha/yr and replaced in part by maize silage (Table 2). These actions reduce leaching losses by 14 kgN/ha/yr. The influence of differences in the size of the effluent block to optimize the potassium in the effluent and the use of an N inhibitor (DCD) are included in this scenario as additional options for mitigating N losses (Fig.1).

- **7b_scenario 2**: By switching from N fertiliser boosted pasture, to maize silage as the feed source, N leaching is reduced. This is because reducing the concentration of N in the diet (i.e. feeding maize silage), reduces the concentration of N in the urine (Table 2). Under this scenario, the N leaching was 20 kgN/ha/yr less than (7b). It did come at a higher cost, impacting on the bottom line. This scenario required the construction of a feed pad, increasing the capital for infrastructure. The influence of an N inhibitor (DCD) is also included to add to the mitigation options (Fig.1).

- **For 7b_scenario 1 and 2** the higher capital costs, and lower profitability could be offset through higher productivity (dairy), but the ranking of profitability for farm systems 7b and 7b_scenario 1-2 will be the same.

- **7b_scenario 3**: In addition to a greater proportion of the cows diet from maize silage feed on a pad reducing the concentration of N in the urine, reducing the lactation length to enable the cows to be wintered off for 12 weeks reduces the number of urinations on the pastures during the late autumn and early winter (Table 2). There is evidence to suggest that urine patches in autumn contribute more to winter leaching losses than those deposited in winter. The influence of an N inhibitor (DCD) on N leaching is included in this scenario as an additional option for mitigating N losses (Fig.1).

In summary it is possible to reduce the N leaching losses from 51 kgN/ha/yr for the irrigated dairy system on the light soil through the introduction of mitigation practices to losses approaching 40 and 30 kgN, without compromising milk solids production (Table 2). However this does come at some cost (Table 2). Mitigation to achieve N leaching losses of <30 kgN/ha/yr comes at not only a higher cost, but also results in lower production and income (Table 2). These data are used by Macfarlane and associates (Rutherford 2012 Appendix 3) to examine the implications that on-farm mitigation will have on the on-farm...
production and financial performance and the economics of the water storage project. These data are also being used in the catchment modelling work stream to examine the influence on-farm mitigation might have on water quality outcomes. The approach adopted is described and discussed further in the last section of this report.

3.2 Phosphorus mitigation for dairy farm systems

The P mitigation options examined included the exclusion of livestock from streams, maintaining a riparian margin and low water soluble P fertiliser (Table 3). These are just three of the P mitigation options available (Mackay 2012). The influence each of these mitigation options had on P losses from (7a) pre- and (7b) post-storage dairy operations and 7b_scenario 1, when applied separately and when combined are presented in Figure.2.

**Table 3.** Description of the dairy farm system models and P mitigation options examined

<table>
<thead>
<tr>
<th>7a. Dairy part irrigated, Access to streams</th>
<th>7b. Dairy full Irrig. Access to streams</th>
</tr>
</thead>
<tbody>
<tr>
<td>7a. Dairy part irrigated No access to streams</td>
<td>7b. Dairy full Irrig. No access to streams</td>
</tr>
<tr>
<td>7a. Dairy part irrigated Low water sol P fertiliser</td>
<td>7b. Dairy full Irrig. Low water sol P fertiliser</td>
</tr>
<tr>
<td>7a. Dairy part irrigated 3 ha Rip</td>
<td>7b. Dairy full Irrig. 3 ha Rip</td>
</tr>
<tr>
<td>7a. Dairy part irrigated. Combination</td>
<td>7b. Dairy full Irrig. Combination</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>7b_sc_1. Dairy full Irrig. (150 N; 8 wks off). Access to streams</th>
<th>7b_sc_1. Dairy full Irrig. (150 N; 8 wks off). No access to streams</th>
</tr>
</thead>
<tbody>
<tr>
<td>7b_sc_1. Dairy full Irrig. (150 N; 8 wks off). Low water sol P fertiliser</td>
<td>7b_sc_1. Dairy full Irrig. (150 N; 8 wks off). 3 ha Rip</td>
</tr>
<tr>
<td>7b_sc_1. Dairy full Irrig. (150 N; 8 wks off). Combination</td>
<td>7b_sc_1. Dairy full Irrig. (150 N; 8 wks off). Combination</td>
</tr>
</tbody>
</table>

**Note 1.** Irrigation amount to 450 mm

**Note 2.** Combination is no access to stream, low water soluble P fertiliser and 3 ha of riparian

**Note 3.** The assumption is made that 2 ha of the irrigated and 1 ha of non irrigated area (not from the effluent block) went into riparian on 7a and all 3 ha off the Irrigated block, but not the effluent block on 7b, 7b_sc1 and sc2.
Figure 2 Influence of a range of phosphorus mitigation options on potential phosphorus losses in run-off from (7a) pre- and (7b) post-storage dairy and 7b_scenario 1.
Again, in all cases it was assumed that soil P fertility was in the optimal range (Olsen P 20-40 µg/ml), unless otherwise stated, P fertiliser is applied uniformly, soils are not damaged by treading and irrigation practices follow best practice to prevent run-off. In addition, compliance is assumed with the Dairying and Clean Streams Accord (Fonterra et al., 2003) which sets targets that streams “deeper than a “Red Band” (ankle depth) and “wider than a stride”, and permanently flowing” have dairy cattle excluded from 50% of streams by 2007, and 90% by 2012. The P losses for the (7a) pre-storage and (7b) post-storage dairy on the light soil (Fig 2) therefore already capture some “good practices” that will be contributing positively to nutrient use efficiency and nutrient emissions. It follows that if good farm practices are not followed (as assumed in Overseer) P losses could be understated.

If the assumption is made that animals were excluded from more than 90% of the farm streams, then P losses would be aligned with the mitigation option “No access to streams” for the (7a) pre- and (7b) post-storage dairy operations and 7b_scenario 1 (Fig.2). Excluding animals from streams reduces P loss by over 50% compared with a situation where animals have access to streams. Phosphorus losses of 0.3 to 0.4 kgP/ha/yr reported here are at the high end for those reported for the East Coast as part of the Regional indicators of P loss (.http://www.fertresearch.org.nz/default.aspx) provided by Fert Research.

In looking at P mitigation options it was assumed that the model dairy farm on the Ruataniwha had streams running through the milking platform land. Riparian option covered 3 ha (3m each side of 5 kilometres of streams). This resulted in removing 1% of grazed pasture but would not impact on farm production or on-farm infrastructure, logistics or livestock movement. Clearly on some farms there will be a minimal length of stream to fence and hence the benefits of fencing and riparian on P losses will be very limited. At the other end of the scale there will be farms with highly dissected landscapes crossed by numerous streams. These farms will have large potential reductions in P losses possible by excluding livestock from waterways and through the addition of riparian margins. On these farms, fencing streams will have implications to the cost of infrastructure, operational costs and possibly farm logistics.

In summary, there is considerable scope to reduce the risk of P losses from the irrigated dairy operation to the wider environment through a range of good practices. Some of these mitigation options are already part of accepted industry practices either in whole or in part (e.g. Dairying and Clean Streams Accord). It is worth noting that the assumptions made in exploring the merits of P mitigation serves to highlight the dangers of generalising about the P reductions possible and the cost of mitigation to the farm business. The extent to which P mitigation is possible on different farms, vary considerably.
3.3 Nitrogen mitigation for arable and process vegetable systems

Nitrogen leaching losses calculated for the pre-storage (5a) Mixed Arable - part irrigated farm operation using Overseer® nutrient budget model was 22 kgN/ha/yr (Fig.3). Without mitigation this increased to 46 kgN/ha/yr in the post-storage (5b) Intensive arable process vegetable farm system. The calculated N leaching losses for these two farm, systems modelled with SPASMO were 20 and 50 kgN/ha/yr for (5a) and (5b), respectively (Mackay 2012).

A wide range of alternate intensive arable and process vegetable farm system scenarios were developed. These are described in Table 4. More details on each scenario are listed in Appendix 1 with the description in brackets (e.g. 5b Scenario 1 (Alternate2)) linking the Table to the Appendix.

Options examined in the scenarios listed below included

- Different annual crop type, that was linked in part to the amounts of N fertiliser applied,
- The ratio of annual to perennial crops,
- Rotation length,
- Removal of heavy weight cattle,
- N fertiliser inputs and the timing of N application and
- The proportion of land grazed by lambs.

Each of these alternates was run through the Overseer® nutrient budget model with the N leaching loss presented in Figure 3.

The following scenarios 5b Current, 5b_scenario_4_(Alternate 5) and 5b_scenario_6_(Alternate 7) were used by the arable consultant to explore the influence of N mitigation on farm production and financial performance. In the Macfarlane report on the economics of nitrogen loss mitigation (Rutherford 2012 Appendix 3) these three scenarios are labelled as 5b, 5b(i) and 5b(ii), respectively.
Table 4  Summary of the alternate intensive arable and process vegetable farm system scenarios examined as mitigation options for reducing nitrate leaching losses. More detail on each scenario is listed in Appendix 1.

<table>
<thead>
<tr>
<th>Description</th>
<th>Rotation</th>
<th>Block size (ha)</th>
<th>Rotation length (yrs)</th>
<th>N fertiliser user (kgN/ha)</th>
<th>Lambs finished</th>
</tr>
</thead>
<tbody>
<tr>
<td>5b. Intensive arable &amp; process vegetables (Current)</td>
<td>IRS seed crop → GF rape → peas → GF oats → maize silage → GF oats → potatoes/squash → autumn wheat</td>
<td>54</td>
<td>5</td>
<td>148</td>
<td>5336</td>
</tr>
<tr>
<td>5b Scenario 1 (Alternate 2)</td>
<td>PRG seed crop → 2nd yr PRG → GF rape → peas → GF oats → maize silage → autumn wheat → GF oats → potatoes or squash → autumn barley → back to PRG seed crop 1 March</td>
<td>38.6</td>
<td>7</td>
<td>166</td>
<td>6269</td>
</tr>
<tr>
<td>5b Scenario 2 (Alternate 3)</td>
<td>IRG seed crop → GF rape → peas → GF oats → maize silage → back to IRG seed crop 1 March</td>
<td>45</td>
<td>6</td>
<td>166</td>
<td>5941</td>
</tr>
<tr>
<td>5b Scenario 3 (Alternate 4)</td>
<td>IRG seed crop → maize silage → GF oats → potatoes or squash → GF oats → peas → beans → autumn barley → back to PRG seed crop 1 March</td>
<td>54</td>
<td>5</td>
<td>154</td>
<td>5397</td>
</tr>
<tr>
<td>5b Scenario 4 (Alternate 5)</td>
<td>IRG seed crop → maize silage → GF oats → potatoes or squash → GF oats → peas → beans → autumn barley → back to PRG seed crop 1 March</td>
<td>45</td>
<td>6</td>
<td>183</td>
<td>5582</td>
</tr>
<tr>
<td>5b Scenario 5 (Alternate 6)</td>
<td>PRG seed crop → 2nd year PRG → potatoes or squash → PRG seed crop → 2nd year PRG → peas → beans → back to PRG seed crop 1 March</td>
<td>45</td>
<td>6</td>
<td>164</td>
<td>7604</td>
</tr>
<tr>
<td>5b Scenario 6 (Alternate 7)</td>
<td>IRG seed crop → GF rape → peas → GF oats → maize silage → GF Moata → potatoes or squash → autumn wheat → back to IRG seed crop 1 March</td>
<td>27</td>
<td>10</td>
<td>111</td>
<td>12470</td>
</tr>
<tr>
<td>5b Scenario 7 (Alternate 8)</td>
<td>IRG seed crop → GF rape → peas → GF oats → maize silage → GF Moata → potatoes or squash → autumn wheat → back to IRG seed crop 1 March</td>
<td>54</td>
<td>5</td>
<td>150</td>
<td>4908</td>
</tr>
<tr>
<td>5b Scenario 8 (Alternate 9)</td>
<td>IRG seed crop → peas → GF oats → maize silage → GF Moata → potatoes or squash → autumn wheat → back to IRG seed crop 1 March</td>
<td>54</td>
<td>5</td>
<td>145</td>
<td>5035</td>
</tr>
</tbody>
</table>

Note 1. Where rape was planted GF Oats was used in the arable model. As a consequence probably underestimating N losses for scenarios 2, 3 by 5 to 13%, due to the use of rape

Note 2. Autumn barley entered as Autumn Wheat.
Note 3. Couldn't enter lambs therefore grazed forage crops with generic sheep
Note 4. Centre pivot irrigation system used to optimise irrigation i.e. irrigation is applied to
overcome soil moisture deficit and no extra drainage occurs
Note 5 For scenario 7 pasture was taken out of the rotation & modelled in a separate pasture
file
Note 6. To model N loss for lucerne a separate arable system with a 5 year rotation was
created
Note 7. The N discharges for the lucerne was prorated for the 2 systems to calculate farm N
discharge

Three of the arable farm system scenarios investigated (5b Scenario 4, 5 and 6) had N
leaching losses of approximately 30 kgN/ha, a reduction of 16 kgN/ha/yr on the post-
storage (5b) intensive arable process vegetable model farm used in the initial analysis of
on-farm economics of expanding irrigation on the Ruataniwha plains by Macfarlane (2011).
The dollar returns per hectare from these three (5b Scenario 4, 5 and 6) were still on a par
with those of the post-storage (5b) intensive arable process vegetable model farm. In
comparison, increasing the proportion of lamb finishing (5b Scenario 6 (Alternate7)) only
had a small impact on N leaching losses, but did drop the dollar returns/ha by nearly 50%.
Figure 3 Nitrate leaching losses for the (5a) pre-mixed arable and (5b) post-storage intensive arable process vegetable farm systems and a range of alternate intensive arable and process vegetable farm system scenarios examined for mitigating N leaching losses.
4. Developing a Mitigated N loss Scenario for on-farm economic and catchment modelling

Dairy scenarios 7b, 7b_Scenario 1, 7b_Scenario 2, 7b_Scenario 3 (Table 2) and arable scenarios 5b Current (5b)_scenario_4_(Alternate 5) and 5b_scenario_6_(Alternate 7) (Table 4) have been used by the Macfarlane team to explore the impact of on-farm mitigation on on-farm production and financial performance and the implications of this to the economics of expanding irrigation on the Ruataniwha plains.

In discussion with the Hawkes Bay Regional Council team and their advisors it was decided that with in-river Nitrate load limits not yet being defined, the following approach would be adopted to commence the catchment modelling investigating of the link between on-farm N and P mitigation and water quality outcomes.

The starting point is to set the N leaching limit for (7b) Dairy -irrigated light soils and (5b) intensive arable process vegetable at 30 kgN/ha/yr based on the findings of this study. The choice of 30 kgN/ha/yr is based on a number of considerations. It represents a reduction that is a stretch for both these farm systems, but still achievable. It requires significant changes to the farm system described by MacFarlane, but those changes are not unfamiliar farm practices. For a new dairy operation the system could be designed to meet the N leaching limit from the outset. The production and financial implications of mitigation to 30 kgN/ha/yr is small in comparison to the cost of reducing losses to 20 kgN/ha/yr for the farm systems described in Table 2.

Setting a value of 30 kgN/ha/yr represents a N leaching loss reduction of 14 and 16 kgN/ha/yr from (7b) and (5b) calculated using Overseer®, respectively, in this study. The reduction for 7b is based on the cows wintered off the farm for 8 weeks. If the cows are wintered on the farm the N leaching loss for (7b) increases from 44 to 51kgN/ha/yr. The N leaching losses for 7b used in the NIWA catchment modelling (Rutherford 2012) were derived from the SPASMO model with the cows wintered on the farm.

Because of the large differences in the actual amounts of N leached from individual (7b) Dairy irrigated/soil/climate combinations and (5b) intensive arable process vegetable/soil/climate combinations across the Ruataniwha plain, the decision was made not to set a value of 30kgN/ha/yr or use a percentage reduction based on the reduction obtained in the present study, but rather to subtract the same amount of N (21kgN/ha/yr from all the individual (7b) Dairy irrigated/soil/climate combinations and 16kgN/ha/yr from all the individual (5b) intensive arable process vegetable/soil/climate combinations across the Ruataniwha plain. This was considered a more conservative approach than a percentage reduction in order to maintain links with the findings of the mitigation study as a
number of the mitigation options tend to reduce N loss by the same amount irrespective of site characteristics (e.g. cows off for 8 weeks).

The area in (7b) Dairy - irrigated light soils increases from 2600 ha in the pre-storage to 8500 ha in the post-storage Macfarlane model and (5b) intensive arable process vegetable increases from 0 to 1000 ha, respectively. The total reduction in N leaching from these two farm systems if 21kgN/ha/yr is subtracted from all the (7b) Dairy - irrigated light soils and 16 kgN/ha/yr N is subtracted from all the (5b) intensive arable process vegetable parcels of land these two farm systems are found on across the plains in the post-storage land use scenario, amounts to 140 tonnes. This represents a significant reduction in the amount of N entering the catchment, providing the opportunity to commence an exploratory study of the influence N mitigation of two of the nine post-storage farm systems has on water quality outcomes.

Scenario C can be described as follows: Macfarlane post-storage land use with N mitigation_reduction of N leaching from (5b) and (7b) of 16 and 21 kgN/ha, respectively. Scenario C sits alongside Scenario A (MacFarlane pre-storage land use) and Scenario B (MacFarlane post-storage land use without mitigation) described in more detail in Rutherford 2012, Appendix 1.
5. References


6. Appendix
### Redesign of 1st Intensive Aisle & Process Vegie rotations to reduce nitrogen losses

Each season 300ha = 270ha irrigated crop + 30ha dryland crops (Assume average yield 6000kg/300ha p.a.) is sold

<table>
<thead>
<tr>
<th>1. Currently (assumes 36ha block)</th>
<th></th>
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<tbody>
<tr>
<td><strong>Crop</strong></td>
<td><strong>GF rape</strong></td>
</tr>
<tr>
<td>Peter</td>
<td>GF rape</td>
</tr>
<tr>
<td><strong>Months</strong></td>
<td>Jan</td>
</tr>
<tr>
<td><strong>Yield</strong></td>
<td>4.5</td>
</tr>
<tr>
<td><strong>N rate</strong></td>
<td>100</td>
</tr>
<tr>
<td><strong>Lambs finished</strong></td>
<td>1000</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>2. Alternate (assumes all the block)</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Crop</strong></td>
<td><strong>GF rapeseed</strong></td>
</tr>
<tr>
<td>Peter</td>
<td>GF rapeseed</td>
</tr>
<tr>
<td><strong>Months</strong></td>
<td>Jan</td>
</tr>
<tr>
<td><strong>Yield</strong></td>
<td>4.5</td>
</tr>
<tr>
<td><strong>N rate</strong></td>
<td>100</td>
</tr>
<tr>
<td><strong>Lambs finished</strong></td>
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<table>
<thead>
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<th>3. Alternate (assumes all the block)</th>
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<tr>
<td><strong>Crop</strong></td>
<td><strong>GF rapeseed</strong></td>
</tr>
<tr>
<td>Peter</td>
<td>GF rapeseed</td>
</tr>
<tr>
<td><strong>Months</strong></td>
<td>Jan</td>
</tr>
<tr>
<td><strong>Yield</strong></td>
<td>4.5</td>
</tr>
<tr>
<td><strong>N rate</strong></td>
<td>100</td>
</tr>
<tr>
<td><strong>Lambs finished</strong></td>
<td>1000</td>
</tr>
</tbody>
</table>

Average kg/ha used p.a. = 146

Average kg/ha used p.a. = 146

Average kg/ha used p.a. = 146

Average kg/ha used p.a. = 146

Average kg/ha used p.a. = 146

Average kg/ha used p.a. = 146

Average kg/ha used p.a. = 146

Average kg/ha used p.a. = 146

Average kg/ha used p.a. = 146

Average kg/ha used p.a. = 146
### Mitigation options for reducing N and P losses from intensive dairy and arable and process vegetable farm systems on the Ruataniwha Plains

#### 1. Alternate (assumed 24+ months)

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<th>Crop</th>
<th>Gross margin</th>
<th>90%</th>
<th>60%</th>
<th>30%</th>
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<th>50%</th>
<th>25%</th>
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<th>1%</th>
<th>0%</th>
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<tbody>
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<td>Wheat</td>
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<td></td>
<td></td>
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<td></td>
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#### 2. Alternate (assumed 54+ months)

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<th>Mean</th>
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<tbody>
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<td>Wheat</td>
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<td></td>
<td>$2,073</td>
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<tr>
<td>Total</td>
<td>$2,073</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>$2,073</td>
</tr>
</tbody>
</table>

Average # of days per crop: 156
‘How-to’ Guide

Draft for Review
March 2013

Claire Mulcock
Mulgor Consulting Ltd

Ian Brown
IB Consulting Ltd
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Prepared for Irrigation New Zealand
by

Claire Mulcock  Ian Brown
Mulgor Consulting Ltd  IB Consulting Ltd

Irrigation Audited Self-Management:
‘How-To’ Guide

March 2013

For the background to the Irrigation Audited Self-Management process see:


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We would like to thank the many individuals and organisations who have contributed to the development of this package for Audited Irrigation Self-Management.

Our special thanks to North Otago Irrigation Company, Morven Glenavy Ikawai Irrigation Company, Synlait Milk Ltd and Central Plains Water Ltd for their especial generosity in sharing their ideas and experiences.

However, errors and omissions are ours.
Irrigation Audited Self-Management:
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   8. Generic Template for Farm Environment Plan
   9. Guide to Farm Environment Plan Template
   10. Audit Manual for FEP Audits
   11. Example: Corrective Action Plan
1. **Introduction**

This guide provides explanation, templates and examples to assist schemes or collectives to implement the 6 steps in the cyclical process of Irrigation Audited Self-Management (IASM) (Figure 1). The process can also be used by other groups or collectives, even if the participants are not linked through irrigation.

The report ‘Irrigation Audited Self-Management for managing water quality and quantity within limits’ provides background to this process.

In this guide the term ‘scheme’ refers to any type of irrigation scheme, group of irrigators or catchment collective.

**Figure 1: Irrigation Audited Self-Management Process for Schemes and Collectives**

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2. Scheme Governance and Management for IASM

2.1. Principles of Governance and Management for IASM

Both strong leadership and governance, and well-organised and regularly reviewed systems will be necessary for a successful audited self-management process that achieves environmental objectives for water quality and quantity.

Although the overall responsibility for environmental performance for an irrigation scheme rests at the governance and management levels of the organisation/s involved, it is the day-to-day actions of the water users in their farming businesses that are likely to have the major impact on water quality outcomes. Board and management need to support farm families to improve their knowledge and understanding of the effects of their activities, as well as implementing the IASM plans, audits, reporting and compliance requirements.

The Scheme’s policy documents should cover the criteria that are widely used to check that it is integrating sound environmental management into its organisational management and operations, including:

- A long term vision of excellence in environmental performance
- Environmental management risks and challenges are clearly stated and prioritised
- Environmental management strategy that is clear and provides a consistent and credible approach.
- The scheme uses various forms of assessment including external reviews and stakeholder comments

For irrigation companies, environmental reporting is also a valuable communication tool that can provide balanced information to the wider public regarding environmental impacts and benefits relating to irrigation. It gives the company an opportunity to demonstrate its efforts and investments to improve practices and reduce the negative impacts of irrigation.

There are number of features that are a required for an effective IASM process:

- An environmental policy that sets out the organisation’s commitment to sound environmental management;
- Planning to implement the environmental policy;
- Implementation and operation of specified objectives and targets;
- Checking and corrective actions to measure and track performance;
- Regular review by ‘top management’ to ensure its on-going suitability, adequacy and effectiveness;
- Continuous evaluation and improvement.

Minimum requirements are to address all applicable legislation, but moving beyond compliance is encouraged by the ‘continual improvement’ concept.

2.2. Documenting Environmental Policies and Procedures

Whether Farm Environment Plans and other environmental management activities are required by resource consent or by another process, the scheme or collective should document its policies and procedures. This provides a set of operating rules for use on a day-to-day basis to ensure that practices are consistent and effective across the scheme and with different personnel.
Ideally the scheme would have a full package of policies and operating procedures set up as a comprehensive system for best practice and risk management across all aspects of the scheme management. Environmental Management activities would only be one aspect of this system. Here we only consider the environmental management component, but these documents can’t be created in isolation and will require input from other areas of the business.

The aim of a system like this is not just to achieve compliance with resource consent conditions but to operate at a level above compliance and continuously improve what is done as an organisation. These two objectives are linked but are at different levels.

Some examples are provided of the sorts of written policies, procedures and forms that should make up the operating system / manual in relation to environmental matters. Policies and procedures from other areas of the business (e.g. operating procedures) may also deal with issues that also have ‘environmental’ risks e.g. leaks in pipes, valves etc (either scheme or on-farm) that cause runoff issues for streams, soil loss, neighbour issues etc, so the ‘environmental management’ section does not stand alone.

In general there are three aspects that the documentation should cover:

1. Policies (principles/objectives/direction)
2. Procedures, work instructions, plans, specifications, forms (how an activity is to be done)
3. Records (evidence)

Appendix 1 shows an example table of contents for a scheme or collective’s environmental policies and procedures as one section of a comprehensive system for the whole business. This is based on North Otago Irrigation Company’s (NOIC) schedule for their environmental policies, procedures etc. NOIC’s willingness to share their material is gratefully acknowledged.

Within each section there are some documents that every scheme should have (e.g. Procedure for Farm Plans), but others that would be specific to a scheme.

Appendices 2 to 5 provide generic examples of:

- Scheme environmental statement
- Procedure for Farm Environment Plans
- Procedure for Farm Plan Audits
- Query / Grievance Form

These are based on material made available by Morven Glenavy Ikawai Irrigation Company Ltd (MGI) and NOIC, as well as earlier work from The Ritso Society Inc.

Specific policies and procedures to address particular environmental risks or resource consent conditions would each need to be developed for the particular issue and situation. Research, consultation, draft document, revisions, would be required specific to each issue, especially for complex matters.

For example, NOIC has developed a specific policy that sets out how the company will comply with its consent conditions associated with run off. NOIC is required to “take all practicable steps to ensure for each irrigation supply made .... that the irrigation shall not cause surface runoff”. In order
that water users, scheme personnel and others have a clear understanding of what needs to happen to achieve this consent condition NOIC has produced a policy document that includes defining ‘run off’, practicable steps for runoff prevention, communication, complaint management, costs, enforcement etc. As policies such as this will be specific to each scheme, no templates have been provided. The table of contents for the NOIC run-off management and mitigation policy is shown in Appendix 6, as an example of the matters covered. Each organisation would have to decide where the greatest risks are for their operations and focus on creating the appropriate controls (i.e. procedures) to manage that risk.

Good public relations (PR) and communication with irrigators, potential irrigators and the local community including iwi and environmental groups is needed to assist develop and maintain good relationships. Without a planned strategic approach based on an analysis of the current situation and future goals efforts in this area may achieve little.

For example, negative issues that may be circulating in the community could include:

- Potential impacts of land use change
- Doubts around the community benefit of irrigation:
  - Is this irrigation scheme for the benefit of the few, or does it have benefits for the community as a whole?
  - Is it in fact, doing more harm to the community than good, and therefore not socially acceptable?

NOIC has developed a comprehensive and targeted plan to build goodwill and support both in farming and other stakeholder groups. A summary of their PR and Communications Plan is shown in Appendix 7.

2.3. Preparing operating policies and procedures
Operating procedures are important tools for defining the details that make the difference between success and failure in achieving sound environmental management across the scheme and complying with resource consents. The advantage of having these procedures sitting outside the actual consent is that they can change and be updated without having a consent variation. This is important as it allows both flexibility and continuous improvement.

Developing a complete set of operating procedures can be time-consuming process. But a little time spent in the beginning to organise the effort can help reduce frustration with the process and make the effort more efficient and effective. Using the following 6 steps will help to plan the process.

1. Identify the key areas where policies and procedures might be useful.

2. Select one or two top priority areas for attention. Consider: Which issues need clarification of the process and a more consistent approach? Which areas have highest risk of problems causing non-compliance with resource consents? In which areas are more controls desired or required?

3. For the selected top priority areas, identify all the processes, functions or operations that occur within each of these areas.
5. Identify the appropriate individual to lead the development effort for each policy or procedure and anyone else (e.g. staff, consultants) who can bring relevant expertise to the effort. Often the environmental management documents can't be created in isolation. Input is needed from a number of areas of the business.

6. There should be a document creator, a reviewer and an approver. For example, a scheme’s Environmental Policy Statement might be developed by the Environmental Manager or a contractor, reviewed by CEO and approved by the Board. Generally, policies would be approved at Board level, and procedures would be approved at CEO level.

**Elements of an operating policy or procedure**

- Purpose and Applicability of procedure or policy
- Detailed description of procedure – based on best practice/standards
- Monitoring actions
- Accountability
- Corrective Actions
- Date of last review or revision date

**Level of Detail**

The level of detail to include in standard operating procedures is one of the most difficult decisions to make. Procedures must include all steps that are essential and that should be performed the same way each time. Omitting any of these essential steps may lead to confusion for the reader or performance variation among different workers. On the other hand, procedures should not be so detailed that they are cumbersome and impractical for everyday use.

Depending on the purpose of the procedure, the action points in the procedure can be presented in a number of ways – e.g. written steps in a process, checklist, flow chart (this can readily show branches for different paths).

**2.4. Using the Procedures**

No document on its own is actually going to control the activity or manage the risk. It is important that the points in the document are distributed and understood by everyone involved. Training and informing everyone of the procedures and their responsibilities is as important as the preparation of the document.

For example:

- MGI’s resource consent requires that all new irrigation is designed and installed in accordance with ‘Irrigation Code of Practice and Irrigation Design Standards’ (INZ). In order to be able to demonstrate to CRC that this has occurred MGI has developed an operating procedure. This needs to be communicated to irrigators and to designers and installers. The details of the procedure are covered in an explanatory document and checklist that are made available on the scheme’s web site and promoted in the scheme newsletter.
- NOIC has produced a short brochure that outlines the scheme’s policies and procedures of note for Farm Managers.

The policy and procedures documents are also invaluable for auditing purposes.
2.5. **Document control, Review and update**

Managing the documents and the review and update process is also important. Unless there is a systematic approach to recording and storing the procedures, out-dated versions may end up being used.

All documents should be regularly reviewed and updated. For example: if there is a change in legislation, change in resource consent conditions, change in operations or on a two-yearly basis. The updating trigger/s should be noted in the document.

2.6. **Data recording and storage**

Some of the key data management issues for a scheme or collective implementing an IASM programme are:

- ‘Farm unit’ is the core of the farm plan process, whereas the ‘water user’ i.e. shareholder is the key for the irrigation scheme records.
- For each farm unit / plan there are several ‘contacts’: owner, lessee, manager, sharemilker etc. A particular person who has day-to-day responsibility for implementing the farm plan must also be identified.
- When information is updated (e.g. address change, manager change etc.) it should only need to be changed in one place, and then this change is effective across the system. i.e. a GIS system that identifies ‘farm plan’ units, owners, managers etc., should linked directly to the ‘farm plan’ database.
- There are a significant number of changes every year: e.g. personnel changes, especially in dairy sector, and changes in ‘farm units’ especially where lease blocks are changed, perhaps every year.
- A scheme may want to analyse ‘water take’ data and Farm Plan records together e.g. to benchmark water use by irrigation type or enterprise.

Therefore it is most likely that a specific data management solution will be required, but would need to be linked to existing data sources.

**Catchment scale reporting**

Some of the farm information data collected from the farm plans may be useful for benchmarking purposes with in the scheme or for other reporting.

To make this straightforward, farm plan information should be collected and recorded with this purpose in mind. For example – setting the key categories for ‘enterprise’, and ‘irrigation type’ (e.g. via ‘drop down’ or ‘tick’ boxes will reduce variation and simplify analysis.

Recognise that the farm plan information will only be as up-to-date as the farm plans. Farm Plans may only be updated every 5 years, unless there are changes to personnel or to farm activities.
Summary
There are two aspects to the data that is generated from the farm plan process: administrative records (tracking of personnel, farm plan versions and status, audit dates, audit reports, compliance etc.) and ‘On-farm’ information (enterprise type, irrigation type etc) that may be useful for benchmarking or reporting.

Data management could be best achieved through a combination of a linked GIS and database. A web-based system that can also be accessed and/or updated (as permitted) by various parties (independent auditors, water users etc) may reduce the need to transfer records between parties. Existing schemes will already have various systems for record-keeping, so there is unlikely to be a single ‘data’ solution.

3. Contractual arrangements with water users

Each scheme will have a system for contractual arrangements with their water users. These arrangements will vary from scheme to scheme. However, each scheme will need to ensure that Farm Environment Plan obligations are clearly set out and that non-compliance at the farm level can be dealt with.

These are the matters that should be considered when incorporating Farm Plan requirements into water user contract arrangements.

[to come]

4. Farm Environment Plan

4.1. Description
At the farm enterprise level, each water user must prepare and implement a Farm Environment Plan for their irrigated land use. This plan would be developed, implemented, reviewed and updated in accordance with the scheme’s policies and procedures.

The IASM farm plan programme should include:

- A template for development of individual enterprise Farm Environment Plan provided by the scheme managers;
- Assistance through workshops and individual support to help water users to prepare their plans;
- Scheme standards for on-farm environmental management;
- Scheme procedures to ensure a consistent farm plan process (see example in Appendix 3);
- Implementation of scheme procedures, including compliance and enforcement;
- Provision, by the Scheme, of training and education related to sustainable irrigated land use;
- Provision, by the Scheme, of information to assist in managing water use, where there are benefits to providing this scheme-wide (e.g. climate information, benchmarking of water use).
4.2. Farm Plan template
The generic Farm Plan template (Appendix 8) covers 6 topics:

- Regulatory compliance
- Irrigation Design and Installation
- Irrigation management
- Nutrient and Soils management
- Waterway and riparian management
- Collected animal effluent management

It is intended that a scheme would adapt the template to fit with the particular environmental issues and land uses relevant to the scheme area and their particular regional council requirements. The template is then used by individual irrigators to develop their own environmental farm plan. The template has been designed to:

- be straightforward, yet effective;
- be suitable for all farming activities;
- promote best practices and aim to make ‘good/best practice’ into ‘normal practice’;
- address issues relevant to irrigated land uses;
- provide the scheme operator with a process to ensure that on-farm environmental effects are being managed.
- be consistent with requirements of other farm plans (e.g. sector specific quality assurance);

Each of the management topics has a similar template. The ‘Guide to FEP template’ (Appendix 9) provides an explanation of the different sections of the template.

Incorporation of Codes of Practice and Guidelines for Irrigated Land Use.
Because IASM is a process, existing (and new) codes of practice and other best management practice guidelines can readily be incorporated. There are many existing codes of practice, quality assurance systems and other guidelines for achieving sound environmental management on-farm through use of appropriate management practices. These have been developed for New Zealand farm systems, generally with extensive consultation.

Some of these are sector or product specific (e.g. pork, dairy, kiwifruit, blackcurrants). Others are general and relate to specific activities such as fertiliser use or waterway management. Growers would be expected to implement their own sector or product specific codes, quality assurance or Good/Best Management Practice systems and documents according to market or processor requirements.

Rather than summarise or incorporate material from the various codes and guidelines into the Sustainability Protocol or the Farm Plan templates, it is more appropriate to reference or link the source material. This avoids errors and makes it more straightforward to ensure that updates are incorporated as they are produced. The relevant types of codes and guidelines that provide practical approaches to managing key environmental issues are:

- Irrigation Design Code of Practice and Irrigation Design Standards (Irrigation NZ)
- Irrigation Evaluation Code of Practice (Irrigation NZ)
• Code of Practice for Nutrient Management
• Spreadmark Code of Practice for the Placement of Fertiliser in New Zealand
• Sustainable Dairying: Water Accord
• Region specific waterway and riparian management guides e.g. “Guide to managing waterways on Canterbury farms” & companion guides “Lowland Plains, Streams and Drains” & “Hill Country Streams”.

Relationship with other environmental farm plans
The IASM farm environment plan is specifically targeted to meet the need for a farm plan that addresses management of risks to water quality and quantity. It sets objectives and required outcomes for water quality and quantity and can, therefore, readily be audited for performance against those objectives and outcomes. The IASM plan recognises that, as a plan developed to meet regulatory requirements, copies will usually be available to the regional council.

There are many other types of farm environment plan\(^2\). Not all types are readily auditable against water management objectives, and some include significant personal and financial information about the farm business. It may be more appropriate for these plans to be used to provide information for an IASM plan. Other plan types could be directly comparable. The IASM plan provides for any management area to be covered by another plan. Each scheme, collective or individual would need to confirm that the alternative plan does cover the same objective and outcomes. When the IASM plan is audited, the auditor would need to sight the audit report for the alternate plan.

4.3. Farm Plan Preparation
Schemes should use a workshop process to assist water users to prepare their initial farm plan. Based on experience from NOIC and MGI, most water users could complete their draft plan from attendance at a pre-workshop meeting and a single workshop. Completed plans should be checked on-farm and approved by (or on behalf of) the scheme management.

Each user must consider each objective and required outcome in relation to their specific property (e.g. soil type, slope, irrigation method, irrigated area, land uses) and determine how they will achieve best practice and what monitoring and records they will use to show their achievements.

Farm Plans need to be updated when owners or managers change or changes are made to farm activities. This requires a process for scheme management to check and approve changes to plans. This process should be included in the Scheme procedures and the water use agreement.

As part of the farm plan, all water users would be required to keep records on their farm practices so they can demonstrate that they are carrying out the agreed practices.

\(^2\) For more information on farm plan types see: Mulcock and Brown (2013) ‘Audited Self-Management for Irrigation: Managing Water Quality and Quantity within Limits’ prepared for Irrigation NZ.
5. **Auditing Farm Environment Plans**

The purpose of the Farm Plan Audit is to both check on achievement of the objectives and required outcomes and to encourage improvement.

The Scheme’s Farm Plan Audit procedure sets out the steps and responsibilities for the audit process. See Appendix 4 for an example audit procedure.

The frequency of the audit is likely to be determined by the regional council requirements. A suitable system is annual audits until 2 years of full compliance is achieved, and then audit frequency can be reduced to at least one year in three. This is to ensure that water users are provided with support and information and do get their plans implemented. It also gives regulatory authorities and the wider community assurance that the farm plan process is being rigorously implemented. The opportunity to reduce audit frequency provides an incentive for users. There could be other incentives that can be provided to recognise environmental management achievements.

Auditing the Farm Plans ensures that appropriate systems are in place to manage the environmental risks associated with irrigated land use. Using an independent external auditor adds credibility to the review process. An Audit Manual has been prepared (Appendix 10) as a guide to the proposed external audit and reporting process. It also provides guidance on skills required to effectively audit the farm plans, and includes a template for the audit of an individual farm plan. It includes an example of a farm plan audit.

6. **Reviewing and Revising**

The IASM approach incorporates a feedback loop that provides for ‘continuous improvement’. This provides the basis for the adaptive management - “learning to manage by managing to learn” (Bormann et al, 1993). It recognises that there are inherent uncertainties in our understanding of catchment processes, water user priorities, and the effects of the scheme operation. Knowledge about complex natural systems continues to change, natural systems are themselves dynamic, community expectations and priorities also change. Therefore scheme management systems need to be flexible and able to evolve.

The philosophy of adaptive management is followed where policies and practices are continually revised by learning from the outcomes of previous work. The process is iterative and aspects of the management processes are revisited and reviewed. The Scheme policies and procedures include processes for learning from information gained through monitoring and management actions and using that learning to make improvements both at scheme level and at farm level. In the implementation of their environmental management system, scheme managers would regularly check whether they are satisfied that the scheme is effectively addressing issues and potential areas for improvement are being identified and implemented. The Scheme policies and procedures would be revised as required.
7. Compliance and Enforcement

7.1. Dealing with individual non-performance
To ensure that an irrigation scheme can maintain community and regulator confidence that Farm Environment Plan and any other on-farm environmental management requirements (e.g. ‘irrigation shall not cause surface runoff’) are fully implemented, schemes need to be seen as credible and fair in implementing their environmental farm plan programmes.

The compliance process must identify the set of actions necessary to achieve compliance by all water users, and to correct or halt situations that endanger the environment. This process must be clearly set out and applied consistently across the scheme. The details would need to be developed and refined for a specific scheme and would need to meet any specific regulatory requirements.

IASM compliance should include the following elements:

- Promoting compliance (e.g. through providing training, information etc.)
- Inspections and monitoring (e.g. internal checks and independent third-party audits of Farm Management Plan performance)
- Deterrence (i.e. identification and enforcement of breaches with appropriate penalties to show that there are adverse consequences of non-compliance).

A process for responding to the situation where the independent auditor determines that the water user is non-compliant in terms of the Farm Environment Plan requirements is set out in the Audit Procedure example (Appendix 4). An example of an agreed corrective ‘Action Plan’ to resolve run-off problems observed at an audit is in Appendix 11.

In many cases, a scheme or collective would not be able to physically ‘turn-off’ the water to an individual property, but would usually have the power to suspend or cancel the agreement to provide water. This is a last resort, when all other options have been exhausted, so should be required infrequently. The provision for a scheme to suspend or cancel water supply for non-compliance with environmental management requirements should be included in the water use agreement.

7.2. Reporting for consent or collective agreement
Reporting for resource consent compliance will be set out in the consent conditions. These are likely to cover:

- All properties in the scheme required to have a Farm Environment Plan

  A GIS system that identifies irrigated properties in the scheme command area, and their Farm Plan identifier, can be produced as a printed map.

- An annual summary of the results of the Farm Plan audits

  An example of a summary report for the audit results could be:

  **Farm Plan Audits**

  A summary of the achievement results for the different management areas for 90 Farm Plan audits are shown in the table below.
<table>
<thead>
<tr>
<th>Rating</th>
<th>Irrigation System %</th>
<th>no of farms</th>
<th>Nutrients and Soils %</th>
<th>no of farms</th>
<th>Collected effluent %</th>
<th>no of farms</th>
<th>Waterways %</th>
<th>no of farms</th>
</tr>
</thead>
<tbody>
<tr>
<td>High</td>
<td>24%</td>
<td>21</td>
<td>90%</td>
<td>80</td>
<td>77%</td>
<td>37</td>
<td>87%</td>
<td>62</td>
</tr>
<tr>
<td>Medium</td>
<td>76%</td>
<td>68</td>
<td>9%</td>
<td>8</td>
<td>15%</td>
<td>7</td>
<td>10%</td>
<td>7</td>
</tr>
<tr>
<td>Low</td>
<td>0%</td>
<td>0</td>
<td>1%</td>
<td>1</td>
<td>8%</td>
<td>4</td>
<td>3%</td>
<td>2</td>
</tr>
<tr>
<td>total</td>
<td>89*</td>
<td>89**</td>
<td>48</td>
<td></td>
<td>71</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* One audited property not currently irrigating
** One audited property (small block) does not apply fertiliser

To streamline collation of this type of data from the individual audit reports, they can be can be prepared using a spreadsheet or database set up to extract the required information.

- Identification of any issues of non-compliance with the Farm Environment Plans and details of any action taken to remedy instances of non-compliance

Accurate records need to be kept of non-compliances and actions to remedy.

8. Appendices

1. Example: Table of Contents for Environmental Policies and Procedures
2. Example: Scheme Environmental Policy Statement
3. Example: Farm Environment Plan Procedure
4. Example: Farm Plan Audit Procedure
5. Example: Query / Grievance Form
6. Table of Contents for NOIC Runoff Mitigation and Management
7. Example: PR and Communications Plan
8. Generic Template for Farm Environment Plan
9. Guide to Farm Environment Plan Template
10. Audit Manual for FEP Audits
11. Example: Corrective Action Plan
APPENDIX 1

[This document is based on North Otago Irrigation Company’s Environmental Policy and procedure manual.. Their willingness to share their material is gratefully acknowledged]

Example Table of Contents
for
Environmental Policies and Procedures

<table>
<thead>
<tr>
<th>1. Environment</th>
<th>Status</th>
<th>Who</th>
<th>Date</th>
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<tr>
<td>1.1 Policies</td>
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<td></td>
<td>Scheme Environmental Commitment statement or Policy</td>
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<td></td>
<td>1.1.2</td>
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<td></td>
<td>Corrective Action Policy</td>
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<td></td>
<td>1.1.3</td>
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<tr>
<td></td>
<td>Specific issue policy – e.g. Run-off management</td>
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<td></td>
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<tr>
<td>1.2 Procedures</td>
<td>1.2.1</td>
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<tr>
<td></td>
<td>Procedure for Farm Plans</td>
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<td></td>
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<td></td>
<td>1.2.2</td>
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<td></td>
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<tr>
<td></td>
<td>Procedure for Farm Plan Audit</td>
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<td></td>
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<td></td>
<td>1.2.3</td>
<td></td>
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<td></td>
<td>Special issue procedure</td>
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<td>1.3 Forms</td>
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<td>Farm Plan Template</td>
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<td>1.3.2</td>
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<td></td>
<td>Form for Complaint / Grievance</td>
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<td>1.4 Plans</td>
<td>1.4.1</td>
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<td></td>
<td>Plan for PR &amp; Communications with wider community</td>
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<td></td>
<td>1.4.2</td>
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<td></td>
<td>Plan for best practice workshops / training</td>
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<td>1.5 External Documents</td>
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<td>Resource consents</td>
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<td>1.5.2</td>
<td></td>
<td></td>
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<tr>
<td>1.6 Records</td>
<td>1.6.1</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>Record of Farm Plans and location</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>1.6.2</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>Resource Consent File</td>
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<td></td>
<td>1.6.3</td>
<td></td>
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<tr>
<td></td>
<td>Record of Enforcement/Warnings</td>
<td></td>
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<td></td>
<td>1.6.4</td>
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<td></td>
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<tr>
<td></td>
<td>Record of Farm Plan Audit reports</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Example

Environmental Policy Statement

[Each scheme would need to tailor this to their specific situation]

Environmental responsibility is a fundamental part of xxx’s business and we aim to be a leader in environmentally sustainable irrigation performance in New Zealand. To achieve this we will drive for continual improvement by:

- Meeting or, where less stringent than scheme standards, exceeding applicable legal requirements, including the conditions of our resource consents;
- Promoting responsible and efficient use of natural resources, especially water;
- Ensuring that our shareholders are aware of their environmental responsibilities and supporting them to achieve high environmental standards
- Fully integrating environmental considerations into any new development or expansion of the scheme;
- Understanding, upholding and respecting cultural heritage, in particular respecting tangata whenua values in relation to water, the natural environment and other taonga;
- Taking opportunities to enhance biodiversity values;
- Engaging regularly, openly and honestly with people affected by the scheme operations and taking their views into account in decision making;
- Regularly reviewing our environmental performance and reporting our progress to shareholders, xxxx Regional Council, tangata whenua and the local community.

[This example statement of environmental commitment is based on Environmental / Sustainability Policies developed by The Rito Society / Central Plains, MGI, NOIC and RDR. Their willingness to share their material is gratefully acknowledged]
APPENDIX 3

Example of Procedure for Farm Environment Plans

[This document is based on North Otago Irrigation Company’s Farm Plan procedure. Some aspects of their audit process have been made more generic. NOIC’s willingness to share their material is gratefully acknowledged]

[Note that the Farm Plan Procedure will vary depending on each scheme’s specific arrangement e.g. use of staff / contractors; resource consent / regional plan requirements etc]

1. Scope
This procedure specifies the requirements and work flow associated with the preparation and administration of the Farm Environment Plans (FEP) required by [condition of the resource consents held by xxxx / rule xxx in xxx Regional Plan]. This procedure covers the actions and responsibilities of [scheme] personnel and [scheme] shareholders.

2. Objective
The objective of this procedure is to provide clear written instructions for the preparation and administration of FEPS. This will ensure that [scheme] continues to comply with [its resource consents] and that FEPS are prepared and managed in a consistent and effective manner.

Farm Environment Plans (Farm Plan) are the tool by which [scheme] will ensure that appropriate management practices are implemented on farm to avoid or minimise adverse impacts on water quality and quantity of on-farm activities, especially those associated with irrigation.

3. References

3.1. Resource consents
FEPS are covered by the following resource consent conditions:

[include relevant consent conditions]

[or describe other basis for farm plan requirements]

3.2. Water Supply agreements
[Include relevant clauses from water supply agreement that refer to Farm Plan requirements]

3.3. Related Operating Procedures
• Procedure for Farm Plan Audits

3.4. Relevant contacts
e.g. contact person at regional council re farm plan implementation
4. **Definitions**

**Farm Environment Plan**

**Farm Manager**

**Plan Implementer**

**Baseline practices**

5. **Responsibilities**

5.1. **[CEO]**

The [Scheme] [CEO] is responsible for ensuring that [scheme]:

- notifies all shareholders of their responsibility to prepare and maintain a [scheme] FEP and manage their property so that they achieve the objectives and outcomes set out in their FEP
- supports farmers in preparing their FEPs
- provides information to help farmers implement their FEPs

5.2. **[Administrator or similar role]**

[Scheme] [Administrator or similar role] is responsible for notifying the [scheme] Environmental Co-ordinator [person with responsibility for Farm Plan preparation] of new shareholders or changes to shareholders or shareholdings that may require new FEPs or revisions to existing FEPs.

5.3. **Environmental Co-ordinator**

The [scheme] Environmental Co-ordinator is responsible for:

- ensuring that all properties that receive scheme water have a FEP
- assisting shareholders, and where relevant, their managers, sharemilkers, and other personnel, to prepare and/or update their FEP
- reviewing all new and revised FEPS and approve / check that they ....
- Maintaining a register of all FEPs and key person responsible for its implementation including revisions and updates
- Providing information to those responsible for farm plans with information on implementing their FEP
- Reviewing the FEP structure and content on a regular basis

5.4. **[Scheme] Shareholders**

- [Scheme] Shareholders are responsible for preparing and maintaining a farm plan for each of their farming operations.
- Shareholders must be committed to managing property to achieve objectives and outcomes in Farm Plan and to making changes, if required.
- [Scheme] Shareholders must notify [scheme] when there is a change of management on farm.
- Shareholders must ensure that new managers understand the Farm Plan responsibilities and Farm Plan is reviewed and updated.
Any transfer of water allocation to another person or property must be notified to [scheme] and approved by [scheme]. All land receiving water for irrigation under a transfer arrangement must have an approved [scheme] Farm Plan, even if the transfer is temporary.

6. Procedure

6.1. Requirement for Farm Plans

- All properties receiving [scheme] water must have a FEP.
- The FEP must cover all the land managed as a farm unit, not only the area under irrigation from [scheme] water. Where a shareholder owns/operates more than one property, and these are operated as separate units, a farm plan is required for each unit.
- Properties with [10] shares or less and low environmental risk (e.g. low intensity land use/s), require a FEP, but do not require FEP audits.
- The FEP must be prepared and approved before water can be used.

6.2. Preparing the FEP

- [Scheme] will notify new irrigators of the Farm Plan requirements and procedures.
- [Scheme] will provide assistance to shareholders to develop FEP specific to each property.
- [Scheme] will provide a template for preparation of the FEP.
- Template will specify the objectives and required outcomes. Users will retain flexibility as to how they achieve these.
- [If appropriate, state scheme charge for assistance to prepare the farm plan e.g. Shareholders are required to pay [scheme] for assistance with farm plan preparation at the current rate]

6.3. Farm Plan Approval

- The completed farm plan must be submitted to [scheme] for review and approval.
- Prior to approval, a [scheme] representative will visit the property to check the farm plan details.
- Approved Farm Plans will be entered in Farm Plan register.

6.4. Farm Plan updates

- Farm Plans must be reviewed and updated if:
  - Any one of the owner, manager or plan implementer changes
  - There are significant changes to farming operation or on-farm practices
  - The independent audit identifies that the management practices as listed in the FEP do not fairly represent actual on-farm practice.
- When a Farm Plan is updated it must be submitted to [scheme] for approval, and updating of the Farm Plan Register.
- All Farm Plans must be reviewed and updated every 5 years [If appropriate, state scheme charge for assistance to update the farm plan e.g. Shareholders are required to pay [scheme] for assistance with farm plan preparation at the current rate]

6.5. Responsibility for Farm Plan Implementation

- Both the shareholder and any Farm Manager appointed by the shareholder, are responsible for ensuring that the property has a Farm Plan and it is correctly implemented.
Where a block or property is leased, the shareholder leasing the land must inform the lessee of the Farm Plan requirements. The lessee, and any Farm Manager appointed by the lessee, are responsible for preparing and maintaining the Farm Plan.

7. Review of Farm Plan

7.1. Review of baseline management practices

7.2. Review of Farm Plan structure and process
   - [Scheme] will review the Farm Plan content and process, including management objectives and required outcomes at least every five years, or if the conditions relating to the relevant RMA consents for the Scheme are changed by the xxx Regional Council.
   - Any review of the Farm Plan content and process will be undertaken in consultation with xxx regional council, tangata whenua and the scheme’s community liaison group.

8. Farm Plan Audits
Farm Plans will be audited by an independent assessor on a regular basis, as required under [scheme] consent conditions. Non-compliance will result in enforcement procedures. Refer to ‘Procedure for Farm Plan Audits’.

9. Training and Education
[Scheme] will provide on-going training and education opportunities for shareholders and farm staff to ensure that Farm Plan outcomes can be achieved, and there is an ongoing process of environmental improvement across the scheme.

10. Record Keeping and Reporting
   - [Scheme] will maintain a copy of all approved Farm Plans and a register of Farm Plans and contact information
   - [Scheme] will report on farm plan performance to xxxx Regional Council as required under consent xxxx.
   - [Scheme] will report annually to shareholders, tangata whenua and the scheme’s community liaison group on overall farm plan performance.

11. Sign-Off and Revisions

<table>
<thead>
<tr>
<th>Version</th>
<th>Revision Status</th>
<th>Date</th>
<th>Prepared by</th>
<th>Checked by</th>
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<td>Draft</td>
<td>07/02/2013</td>
<td>CM</td>
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</table>
APPENDIX 4

Example of Procedure for Farm Environment Plan Audits

[This document is based on North Otago Irrigation Company’s Farm Plan Audit procedure. Some aspects of their audit process have been made more generic. NOIC’s willingness to share their material is gratefully acknowledged]

[The details of the audit process and compliance and enforcement measures will vary from scheme to scheme depending, in part, on the particular resource consent conditions, and the scheme management/personnel arrangements.]

1. Scope
This procedure specifies the requirements and work flow associated with the annual audit process for the Farm Environment Plans (FEP) as required by [condition of the resource consents held by xxxx OR rule xxx in xxx Regional Plan]. This procedure covers the actions and responsibilities of [scheme] personnel and [scheme] shareholders, but does not cover the actual audit procedure used by the independent auditor.

2. Objective
The objective of this procedure is to provide clear written instructions for the administration of the FEP audits. This will ensure that [scheme] continues to comply with [its resource consents] and that the audits and related reporting are undertaken in a consistent and effective manner, satisfactory to the consent authority [xxx regional council].

3. References

3.1. Resource consents
FEP audits are covered by the following resource consent conditions:

[include relevant consent conditions]

[or describe other basis for farm plan requirements]

3.2. Water Supply agreements
[Include relevant clauses from water supply agreement that refer to Farm Plan audit requirements]

3.3. Related Operating Procedures
• Procedure for Farm Plans

3.4. Relevant contacts
e.g.

• contact person at regional council re farm plan implementation
• independent auditor
4. Definitions

Farm Environment Plan:

Farm Manager:

Plan Implementer:

Baseline practices:

Action Plan: A plan setting out how a shareholder will address non-compliances identified by the audit process.

Non-compliance: [Define non-compliance - see Audit Manual for a possible approach]

Small holding (low risk): properties with [x] shares or less or [x] ha or less in size, with low intensity farming and/or low water use.

5. Responsibilities

5.1. [CEO]
The [Scheme] [CEO] is responsible for ensuring that [scheme] develops and maintains a Farm Plan Auditing process in order to ensure consistent and effective compliance with the scheme’s resource consent conditions.

5.2. [Administrator or similar role]
[Scheme] [Administrator or similar role] is responsible for scheduling audit visits with the selected properties.

5.3. The [scheme] Environmental Co-ordinator
The [scheme] Environmental Co-ordinator is responsible for the overall management of the Farm Plan Auditing process. This includes:

- Selection of properties to be audited each year
- Selection of independent auditor
- Communication with shareholders
- Communication and reporting to [regional council]
- Management of records
- Assisting with preparation of Action Plans and review of progress

5.4. [Scheme] Shareholders
[Scheme] Shareholders are responsible maintaining farm plans that are auditable and demonstrating practices that provide a high level of confidence that on-farm environmental risks are being appropriately managed.
5.5. **Independent Auditor**
The independent auditor is responsible for conducting the farm plan audit in an acceptable and timely manner and for providing individual audit reports, and a report on audit findings within one month of audit completion.

5.6. **Board of Directors**
The [xxx] board of directors is responsible for taking enforcement action to compel environmental compliance where other methods of managing non-compliances have failed.

6. **Procedure**

6.1. **Schedule Audits**
[Note that some aspects of the audit process may be specified in the scheme’s resource consent and/or regional plan conditions]

- Audits are to be undertaken during the irrigation season
- Determining which farms are due to be audited:
  - New farm plans are to be audited annually until property has two consecutive ‘full compliance’ audits. This includes properties with a new manager or owner or updated plan.
  - Properties with ‘non-compliance’ at previous audit must be re-audited in next irrigation season. Properties that have been rated as non-compliant a result of poor record keeping will not necessarily trigger the re-audit process.
  - At least one third of farms to be audited each year
  - Every farm is audited at least once in three years
  - Smallholdings (low risk) are not included in annual audit process
- Appoint an independent auditor in sufficient time to schedule audit programme
- Notify plan implementers and shareholders (if different) of audit and provisional appointment time
- Finalise audit appointment with plan implementer
- Shareholders are required to pay the full cost of an audit or re-audit. This will be on a cost recovery basis to recoup the fees charged by the independent auditor.

6.2. **Undertake audits and provide reports**

- Independent auditor to visit farms at agreed time and carry out audit.
- Independent auditor will prepare audit report and sent to shareholder and plan implementer (if different) [or could have auditor send reports to scheme administrator to send out] within [2 weeks] of carrying out the farm visit.
- Independent auditor will prepare draft audit summary report to xxxx [scheme] within [one month] of completing on farm visits.

6.3. **Review and Assessment of Audit Report Findings**

- Plan implementers/shareholders will have [1] weeks to respond to the independent auditor with comments/queries.
• If plan implementer and/or shareholder dispute the auditor’s findings and the auditor is not prepared to change their report, then [scheme] will set up a dispute resolution committee. This committee would have the power to:
  o Convene a hearing so that disputes or issues can be presented;
  o Visit the property, if necessary, to view issues in contention;
  o Make a decision on the audit report e.g. to amend the auditor’s report, require the plan implementer and/or shareholder to accept and implement the report; appoint an new auditor to carry out a new audit.

The committee would have a membership of three:
  o Two directors from the Board of [scheme] who are independent of those in dispute
  o An independent person, appointed by the Board [scheme], to ensure that the committee has a balanced representation that includes both farming and environmental management expertise.

• [Scheme] will have [1] weeks to respond to the independent auditor with comments/queries.

• A finalised audit summary report and individual audit reports will be provided to [scheme] by the auditor within [2] weeks after receiving comments.

6.4. Managing Non-compliances

• All non-compliance (see definitions) identified in the audits must be addressed.

• Within 2 weeks of receiving final reports from the independent auditor, [scheme] will send a letter to all shareholders and plan implementers who are non-compliant notifying them that [describe process e.g. they have one month to respond with an action plan to address non-compliance].

• The Environmental Co-ordinator will work with shareholders and plan implementers to prepare and implement action plans.

• The [scheme] Environmental Co-ordinator will maintain a record of time spent working with shareholders and plan implementers on action plans. [Scheme] may recover these costs from the shareholder.

• The Environmental Co-ordinator will visit all non-compliant properties within 6 months of receipt of the audit report to ensure the non-compliance issue/s have been addressed.

6.5. Enforcement

• If the plan implementer and shareholder do not engage in the process to address non-compliance (e.g. do not provide a satisfactory action plan within the required time frames) and/or do not implement the required actions within the required time frames the shareholder will be considered in breach of their water supply agreement and enforcement action will be taken.

• If enforcement action is required, the case will be referred to the CEO, who is authorised to take the following actions at his/her discretion:
  o Verbal warning
  o Written warning – shareholder sent a letter stating that their access to water supply may be restricted or denied if they do not take appropriate action within a specified time [e.g. 30 days].
• Limited water restrictions – e.g. one day on, one day off or reduced amount.
• If satisfactory action still does not result the CEO will refer the matter to [scheme] board for further action. The Board may:
  o Convene a hearing so that disputes or issues can be presented
  o Restrict or deny water supply
  o Require forfeiture of shares [or ‘Cancel agreement to supply water’ or other ‘last resort’ measure]
• Irrigators subject to CEO enforcement action by the CEO may appeal to the Board. The Board’s decision on enforcement is final.
• [Scheme] will use its discretion when taking enforcement action, and will take account of:
  o The seriousness of the non-compliance
  o Degree of co-operation
  o History of environmental issues
• [Scheme] aims to achieve compliance by imposing progressively escalating penalties if environmental issues are not addressed. A guideline for penalties for enforcement actions related to audits is:
  o Warning letter
  o Water supply denied for 10 days
  o Water supply denied for 20 days
  o No access to water indefinitely
• If the re-audit of a non-compliant property gives another non-compliance rating, then the shareholder/plan implementer will receive a letter stating that their access to water will be restricted or denied if appropriate action is not taken within 30 days to address all environmental issues. The Environmental Co-ordinator will visit the property at the end of the 30 day period, and if the required action has not been taken, the matter will be referred to the Board for enforcement.
• Restricting or denying access to water is a ‘last resort’ to compel compliance, and [scheme] will endeavour to resolve environmental issues through discussion and advice. However, in order to protect the interests of all shareholders and their on-going access to water, this step will be implemented if necessary.

7. Training and Education
[Scheme] will:
• Ensure that all shareholders are made aware of the audit procedure and their obligation to meet environmental objectives, or risk being denied access to scheme water.
• provide on-going training and education opportunities for shareholders and farm staff to ensure that Farm Plan outcomes can be achieved, and there is an ongoing process of environmental improvement across the scheme.

8. Record Keeping and Reporting
• [Scheme] will maintain a copy of all records relating to Farm Plan audits for a period of at least 7 years.
• [Scheme] will report on audit results and farm plan performance to xxxx Regional Council as required under consent xxxx. [add details, including personnel responsible]
• [Scheme] will report annually to shareholders and to the scheme’s community liaison group on overall farm plan performance.

9. **Sign-Off and Revisions**

<table>
<thead>
<tr>
<th>Version</th>
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</tbody>
</table>
APPENDIX 5

NOIC Form for Query or Grievance

NOIC BOS 7.5.1 Form for Query Grievance

Once the query is received by NOIC representative/employee, the query must be recorded on this form, and it must be reported to the CEO and Environmental Coordinator WITHIN 1 BUSINESS DAY.

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<tr>
<th>Record</th>
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<tr>
<td>Caller</td>
<td>Query Taken by</td>
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<td>Address</td>
<td>Date</td>
</tr>
<tr>
<td>P.O. Number</td>
<td>Reported to</td>
</tr>
<tr>
<td>Phone Number</td>
<td>Date</td>
</tr>
<tr>
<td>Email Address</td>
<td></td>
</tr>
</tbody>
</table>

**Query / Grievance Details:**

**Response from the Company:**

**List of Action Items and Responsibility:**

__________________________  __________________________
Print Name                  Date

June 2011  REV 2  North Otago Irrigation Company Ltd
© NOIC Commercial in Confidence
# APPENDIX 6

NOIC Policy Document for Run-off Mitigation and Management: Table of Contents

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<td>i. Overview</td>
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<td>iii. Definition of Run-off</td>
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<td>iv. Preventing Run-off – 'Practicable Steps'</td>
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<td>c. Irrigation Scheduling</td>
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<td>d. Managing Existing Irrigation Systems</td>
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<td>e. New Irrigation System Design</td>
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<td>f. Irrigation System Operation</td>
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<td>g. Pod Group Discussion</td>
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<td>h. Equipment Failure</td>
<td>6</td>
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<tr>
<td>i. Know Your Neighbour</td>
<td>6</td>
</tr>
<tr>
<td>j. Record keeping</td>
<td>6</td>
</tr>
<tr>
<td>v. Managing Run-off &amp; System Water</td>
<td>6</td>
</tr>
<tr>
<td>a. Capture Dams</td>
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<tr>
<td>b. Drainage</td>
<td>7</td>
</tr>
<tr>
<td>c. New Watercourses</td>
<td>8</td>
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<td>vi. Research</td>
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<td>vii. Communication</td>
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<td>viii. Complaint Management</td>
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<td>V. Revisions &amp; Sign-Off</td>
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<td>VI. Appendices</td>
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<td>Appendix 3 – Complaint Log Form</td>
<td>16</td>
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</tbody>
</table>
### Example Contents of a Public Relations and Communications Plan – (Based on NOIC Plan)

*This document is based on North Otago Irrigation Company’s Plan. Their willingness to share their material is gratefully acknowledged.*

<table>
<thead>
<tr>
<th>Objectives of the Plan:</th>
<th>Initiative Owner: CEO</th>
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<tbody>
<tr>
<td>1. To build a strong foundation of goodwill among our customers, suppliers, stakeholders, partners and community</td>
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</tr>
<tr>
<td>2. To build farmer and stakeholder support</td>
<td></td>
</tr>
<tr>
<td>3. To ensure ‘no surprises’ from all perspectives</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Measurable Goals (aligned with overall business goals):</th>
<th>Team Members: Administrator, PR Consultant, Environmental Manager, CEO (and Board as required)</th>
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<tbody>
<tr>
<td>1. See direct support from farmer-related organisations (Fed Farmers, Dairy NZ)</td>
<td></td>
</tr>
<tr>
<td>2. Receive active participation and support from external stakeholders &amp; partners (non-farmer stakeholders such as Iwi, Fish &amp; Game)</td>
<td></td>
</tr>
<tr>
<td>3. Create advocates in the community both urban and rural</td>
<td></td>
</tr>
<tr>
<td>4. Stakeholder support and endorsement for the environmental and conservation objectives of the scheme</td>
<td></td>
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<tr>
<td>5. Increasing positive editorial support</td>
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</tbody>
</table>

### The Current Situation:

Although the scheme has been very successful from certain points of view, there appears to be an underlying niggle of discontent in the community emerging every so often in an attack on the scheme or the local farming community. We believe there are a number of drivers at the root cause of these symptoms:

[Describe]

#### Stakeholders & Partners

**Internal:** staff, board, current shareholders, professional advisors

**Next level:** engineering, design and construction companies, irrigation experts and companies, INZ, other irrigation companies in the region, ORC, Ecan, WDC councilors and mayor, funding partners, potential shareholders in already irrigated areas, suppliers, MPI, property owners being impacted by irrigation, Iwi

**External:** banks, real estate agents, Fish & Game, potentially impacted landowners, rate payers, Federated Farmers, non-irrigating farmers not being currently impacted, DairyNZ, agri-business professionals, DoC, farmer groups from outside North Otago, politicians, media, Beef & Lamb, Land & Water Forum

### The Strategy

**A stakeholder engagement strategy**

1. We have had a focus on up-take and on informing our current shareholders – this means we have not been communicating with all the right people
2. Stakeholder involvement in the scheme is far wider than what we have currently assessed – this means we need a much more concerted and widespread communications plan
3. Need to build a ‘social licence’ (permit to ‘operate’ from the community) – this means we should not assume we have that licence and need to cover all these aspects in our communications
   a. H&S
   b. Environmental
   c. Share the spoils
   d. Remediation
   e. Consideration
   f. Information

4. Visibility has been poor – visibility being a line of sight to see what we are doing; multiple lines of visibility protects vulnerability – a single line of visibility i.e. media, makes us vulnerable – this means we need to build multiple lines into what we do

5. The NOIC story has not been clear in terms of how we will pay-back the ‘help’ we received from the community. We need a practical way to tell a story of how a community has bettered itself because of NOIC being here. Need to connect the Oamaru story with the rural community at a nuts and bolts level (like to hear how we actually did something that contributes to the local or wider community) – this means we need a clear, cognizant, practical story for the community

**Deliverables from the Plan**

<table>
<thead>
<tr>
<th>Media</th>
<th>Environmental</th>
<th>Community</th>
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</thead>
<tbody>
<tr>
<td>Key messages pack – simple pack / crib sheet / power point to be used (deals with the issues) – to position us</td>
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<td></td>
</tr>
</tbody>
</table>

A stakeholder briefing program – organized program (who and when) – all helps to deliver the message

- Maori
- Meridian
- Fed Farmers
- INZ
- Politicians
- Councils
- Agribusiness

Want the parties to say – xxxxxx is going about this the right way, professional group, forward looking, use us an example.

Smart, professional, knowledgeable, engaged

Some sort of audit (attitudinal) of the scheme. Third party view from stakeholders – how are we doing, seen?

**Proposed Schedule:**

1. Campaign length = 30 months (February through September 2013) with six monthly reviews
   a. Rev 1.0 September 2011

**Communication Pathways Being Utilised Currently:**

<table>
<thead>
<tr>
<th>Newspapers</th>
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<tbody>
<tr>
<td>Vehicle</td>
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<td>----------------------</td>
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<td>NOIC Web Site</td>
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<tr>
<td>Hand-outs and Information Packs</td>
</tr>
<tr>
<td>Customer Success Stories</td>
</tr>
</tbody>
</table>
### External Relationships Developed:
- Maori
- Fish and Game
- DairyNZ
- Mayor
- Councillors
- AgriBusiness Groups
- Federated Farmers
- Land & Water Forum
- MPI
- Real Estate Agencies
- Banks
- Promoters
- Media
- Potentially impacted landowners
- Beef & Lamb
- AgResearch

### Results Review:

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<th>Vehicle</th>
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<th>Achieved?</th>
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<tr>
<td><em>Press release – economic development report</em></td>
<td>Generate positive press and goodwill in the community about the investment by the District in irrigation infrastructure</td>
<td>Yes – generated both local and region-wide interest; picked up by other magazines; requested by MAF, CIF, other schemes etc.</td>
</tr>
<tr>
<td><em>Paid editorial Waitaki Herald – water feature</em></td>
<td>Inform community about who NOIC is and what we do</td>
<td>Questionable – no feedback</td>
</tr>
<tr>
<td><em>Field Day – Run-Off</em></td>
<td>Engage / Dialogue and Educate between our shareholders, NOIC and ORC on the issue of zero run-off from irrigation water</td>
<td>Yes – generated follow up meetings with ORC and a path forward to resolve the issues. Shareholders may have considered</td>
</tr>
</tbody>
</table>
the day not a success as they did not get clarification but this was not NOIC’s goal as we understood ORC was in conflict going into the day; however, participation was high

Learning from results so far to feed back into the plan of attack:

1. The press liked to report on quantitative results of significant interest such as the multi-million dollar impact of the scheme which generated additional articles of interest for the region as well.
2. Sometimes our message is lost if we are too wishy-washy or mixed in with a number of other articles (paid editorial).
3. Field Days with a specific goal and focus can be very successful and well attended.

Stakeholders

**Internal:** staff, board, current shareholders, professional advisors

**Next level:** engineering, design and construction companies, irrigation experts and companies, INZ, WIC, other irrigation companies, ORC, Ecan, WDC, funding partners, potential shareholders in already irrigated areas, suppliers, Iwi

**External:** banks, real estate agents, Fish & Game, WDC councilors and mayor, potential shareholders in new areas, potentially impacted landowners, rates payers, Federated Farmers, non-irrigating farmers, DairyNZ, agri-business professionals, MAF, DoC, farmer groups from outside North Otago, politicians, media, Beef & Lamb, Land & Water Forum, Fonterra

<table>
<thead>
<tr>
<th>Stakeholder</th>
<th>Communication Task:</th>
<th>Communication Channel:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Staff</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Board</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Current Shareholders</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Professional Advisors</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Appendix 8

Generic template Farm Environment Plan
# Farm Environment Plan

This Farm Environment Plan is required under the resource consent/s held by xxxx irrigation scheme / under the consent held by ABC Farming Ltd, / as a condition of Permitted Activity status. It sets out the management practices that will be used to actively manage environmental issues on the property, with a focus on managing water quality and quantity within limits, as specified by xxx regional council. The Plan will be audited regularly by independent assessors in accordance with the audit, compliance and enforcement procedures as set out by xxxx Regional Council.
## Responsibility for Implementing the Farm Plan

*As the person responsible for implementing this plan, I confirm that the information provided is correct:*

<table>
<thead>
<tr>
<th>Name (Plan implementer):</th>
<th>Signature:</th>
<th>Position (e.g. owner/manager):</th>
<th>Date:</th>
</tr>
</thead>
</table>

## Owner and Lessee Commitment

*As owner/s of this farming business I/we are committed to ensuring that all activities on our property are undertaken in an environmentally sustainable and culturally sensitive manner. We agree to monitor our performance in meeting the management objectives and outcomes in this Plan, and take appropriate actions to address any areas where improvement is needed.*

<table>
<thead>
<tr>
<th>Name (Owner or owner representative):</th>
<th>Signature:</th>
<th>Date:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Name (Lessee or lessee representative):</td>
<td>Signature:</td>
<td>Date:</td>
</tr>
</tbody>
</table>

## Technical approval

*Technical approval by xxxxxxxx (e.g. scheme name)*

<table>
<thead>
<tr>
<th>I have reviewed this plan and believe it to be:</th>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Technically sound and feasible</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Addressing the cause of identified environmental risks</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>3. Able to meet the plan objectives</td>
<td>Yes</td>
<td>No</td>
</tr>
</tbody>
</table>

| Name: |
| Signature: |
| Date: |
Irrigation NZ Farm Environmental Plan Template – March 2013

### Farm Plan Areas

<table>
<thead>
<tr>
<th>Total area covered by Plan (ha)</th>
<th>Effective area (ha)</th>
<th>Irrigated area (ABC scheme)</th>
<th>Irrigated area (other water)</th>
<th>TOTAL Irrigated Area (ha)</th>
</tr>
</thead>
</table>

### Enterprise type

<table>
<thead>
<tr>
<th>Dairy</th>
<th>Sheep/beef</th>
<th>Cattle</th>
<th>Mixed Cropping</th>
<th>Orchard/vineyard</th>
<th>Nursery</th>
<th>Lifestyle</th>
<th>Other</th>
</tr>
</thead>
</table>

### No. of staff (labour units to operate property)

<table>
<thead>
<tr>
<th>DAIRY</th>
<th>SHEEP</th>
<th>CATTLE</th>
<th>DEER</th>
<th>OTHER STOCK (type /no)</th>
</tr>
</thead>
</table>

### Irrigation type / area (water)

<table>
<thead>
<tr>
<th>Irrigation type (water)</th>
<th>Scheme Water Irrigated area (ha)</th>
<th>Other Water Irrigated area (ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pivot</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Linear move</td>
<td></td>
<td></td>
</tr>
<tr>
<td>K-line</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gun</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rotary boom</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Linear boom</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Border dyke</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Long lateral</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Solid set</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Drip / micro</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other ….</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### DAIRY

<table>
<thead>
<tr>
<th>Peak. cows milked</th>
<th>Cows milked in winter Y/N</th>
<th>No cows wintered off farm</th>
<th>No. R1 &amp;/or R2 heifers grazed on farm</th>
</tr>
</thead>
</table>

### SHEEP

<table>
<thead>
<tr>
<th>Ewes</th>
<th>Hoggets</th>
<th>W.lambs</th>
<th>Lamb trading Y/N</th>
</tr>
</thead>
</table>

### CROPS

<table>
<thead>
<tr>
<th>Ha in annual crop</th>
<th>Standard Crop rotation (example rotation)</th>
</tr>
</thead>
</table>

### CROPS

<table>
<thead>
<tr>
<th>Other - vineyards, orchards etc (describe)</th>
</tr>
</thead>
</table>

### Nutrient budget

<table>
<thead>
<tr>
<th>Nutrient budget prepared by: (Person, company, contact details)</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Current farm nutrient losses: N kg/ha</th>
<th>Current farm nutrient losses: P kg/ha</th>
</tr>
</thead>
<tbody>
<tr>
<td>N loss target (if known): kg/ha</td>
<td>N loss target (if known): kg/property</td>
</tr>
</tbody>
</table>

### Collected Effluent

<table>
<thead>
<tr>
<th>Effluent irrigation type</th>
<th>Area irrigated by irrigator type (ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pivot</td>
<td></td>
</tr>
<tr>
<td>Linear move</td>
<td></td>
</tr>
<tr>
<td>K-line / pod</td>
<td></td>
</tr>
<tr>
<td>Travelling irrigator</td>
<td></td>
</tr>
<tr>
<td>Other</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Total effluent area (ha)</th>
</tr>
</thead>
</table>

### Collected Effluent storage Tick box

<table>
<thead>
<tr>
<th>Less 5 days</th>
<th>5-15 days</th>
<th>15-30 days</th>
<th>2 months</th>
<th>3 months</th>
</tr>
</thead>
</table>

### Nutrient budget

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<td>N loss target (if known): kg/property</td>
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</table>

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</thead>
<tbody>
<tr>
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<td>N loss target (if known): kg/property</td>
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</table>

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</tr>
</thead>
<tbody>
<tr>
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<td>N loss target (if known): kg/property</td>
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</tbody>
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<table>
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<tr>
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<td>N loss target (if known): kg/property</td>
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</table>

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<th>Current farm nutrient losses: P kg/ha</th>
</tr>
</thead>
<tbody>
<tr>
<td>N loss target (if known): kg/ha</td>
<td>N loss target (if known): kg/property</td>
</tr>
</tbody>
</table>
Name key roads and show North direction, to enable farm to be located on a road map.

Show on map, if present:
- Land management units (these should align with the blocks used in the nutrient budget)
- Irrigated area by irrigation type
- Effluent area
- Bores/wells
- Water races
- Conservation or covenanted areas/indigenous bush/scrub
- Streams\(^1\) and wetlands, including stock crossing points - Show which streams are fenced
- Standoff areas, feed pads
- Tracks
- Open drains
- Areas that are tile drained
- Lease blocks – including owner name (If the whole farm is leased from one owner, then record this information on page 1)

\(^{1}\) A scheme may wish to include a definition of stream, wetland (e.g. from regional council or Sustainable Dairying: Water Accord (2013))
<table>
<thead>
<tr>
<th>SLOPE</th>
<th>Flat</th>
<th>Rolling</th>
<th>Mod. steep</th>
<th>Steep</th>
</tr>
</thead>
<tbody>
<tr>
<td>TYPE</td>
<td>Movable Spray</td>
<td>Fixed Spray</td>
<td>Drip/Micro</td>
<td>Surface</td>
</tr>
</tbody>
</table>

**LAND MANAGEMENT UNIT 2: A** (Name: ) (repeat for each block identified on Farm Map)

<table>
<thead>
<tr>
<th>LAND USE</th>
<th>Pastoral</th>
<th>Arable</th>
<th>Small seeds</th>
<th>Vegetables</th>
<th>Other horticulture</th>
<th>Other ..........</th>
</tr>
</thead>
</table>

**Area of block (ha)**

<table>
<thead>
<tr>
<th>Stream/s present</th>
<th>Wetland/s present</th>
<th>Soil type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Y</td>
<td>Y</td>
<td>Y/N</td>
</tr>
</tbody>
</table>

**Block Strengths**

**Block Weaknesses**

**ENVIRONMENTAL RISK ASSESSMENT for Land Management Unit A**

Identify risks to water quality from the combination of the natural resources (soil, stream, slope etc.) and current farm practices (stock, irrigation, cultivation etc).

<table>
<thead>
<tr>
<th>Current farming activities</th>
<th>Risk: Low Med High N/A</th>
<th>Justification for your Risk Assessment</th>
<th>Need to Adjust or Change Practices Y/N</th>
<th>Current farming activities</th>
<th>Risk: Low Med High N/A</th>
<th>Justification for your Risk Assessment</th>
<th>Need to Adjust or Change Practices Y/N</th>
</tr>
</thead>
<tbody>
<tr>
<td>STOCK GRAZING</td>
<td></td>
<td></td>
<td></td>
<td>FERTILISER USE</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intensive grazing – lighter soils</td>
<td></td>
<td></td>
<td></td>
<td>Fertiliser application near waterways/wetlands</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intensive grazing – heavier soils</td>
<td></td>
<td></td>
<td></td>
<td>High nitrogen fertiliser use</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intensive grazing – winter crops</td>
<td></td>
<td></td>
<td></td>
<td>High phosphate fertiliser use</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Near waterways/wetlands</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Near open drains</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CULTIVATION</td>
<td></td>
<td></td>
<td></td>
<td>DRAINS</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Near to waterways/wetlands</td>
<td></td>
<td></td>
<td></td>
<td>Drain cleaning</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sloping paddocks</td>
<td></td>
<td></td>
<td></td>
<td>Sub-surface drainage</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>With extended fallow periods</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>IRRIGATION</td>
<td></td>
<td></td>
<td></td>
<td>EFFLUENT MANAGEMENT</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Application</td>
<td></td>
<td></td>
<td></td>
<td>Effluent storage</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Maintenance</td>
<td></td>
<td></td>
<td></td>
<td>Effluent irrigation</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Infrastructure (pipes / races)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>EARTHWORKS</td>
<td></td>
<td></td>
<td></td>
<td>OTHER</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tracking/races</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Recontouring</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

2 A land management unit is a homogenous block of land that responds in a similar way under similar management. The units should align, as far as possible, with the nutrient budget blocks.
Regulatory compliance

Management Objective: To ensure full compliance with all resource management regulatory requirements

Required outcomes:
1. Full compliance with relevant regulatory requirements

<table>
<thead>
<tr>
<th>Acceptability of practices</th>
<th>Baseline Practices (examples of practices, others may be added)</th>
<th>Current Practices</th>
<th>Additional actions proposed to meet outcomes &amp; timeframes</th>
<th>Evidence for Compliance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Good</td>
<td>Fully compliant with the regulatory requirements (consent or permitted activity) relating to:</td>
<td>Required</td>
<td>Required</td>
<td>Council compliance reports</td>
</tr>
<tr>
<td>Minimum for all farmers</td>
<td>Water take/use consent/s</td>
<td></td>
<td></td>
<td>Resource consents</td>
</tr>
<tr>
<td></td>
<td>Water metering</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Land use</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Dairy effluent</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Offal pits</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Silage pits</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Any indigenous vegetation and/or habitats of indigenous fauna, including wetlands, that are identified as significant by DoC, MfE, district or regional council are managed to meet any specific requirements</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: A list of all consents held for the property is contained in Appendix one to this plan.

3 Note: Compliance with some of these requirements may be the responsibility of the scheme responsibility (e.g. if scheme manages metering and water take)
**Irrigation System Design and Installation**

**Management Objective:** To ensure that all new irrigation systems and significant upgrades\(^4\) meet industry best practice standards

<table>
<thead>
<tr>
<th>Required outcomes</th>
<th>Covered by alternative plan? Y/N</th>
<th>Name of alternative plan / programme</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. New irrigation infrastructure is designed and installed to deliver water to industry best practice standards</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Acceptability of practices</th>
<th>Baseline Practices (examples of practices, others may be added)</th>
<th>Current Practices</th>
<th>Additional actions proposed to meet outcomes &amp; timeframes for completion</th>
<th>Evidence for Compliance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Poor Generally inadequate</td>
<td>No design or installation checks</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Basic May be adequate for small blocks with low application depth and intensity and low water use;</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• System complies with requirements for flow meter, and limits on flow rate, volume and area irrigated</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• System has been designed with site specific knowledge of the soil, climate and crop needs</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Post installation checks of application rate and distribution uniformity using DIY evaluation or certified evaluator</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Good Minimum for most spray irrigators</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• All new on-farm irrigation infrastructure is designed in accordance with Design Standards for Piped Irrigation Systems in New Zealand (Irrigation NZ, October 2012); Code of Practice for the Design of Piped Irrigation Systems in New Zealand (Irrigation NZ, October 2012) and meets scheme requirements for flow meter, and limits on flow rate, volume and area irrigated;</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Independent evaluation of design/s</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

\(^4\) Define ‘significant upgrade’ e.g. conversion border to spray; k-line to pivot
<table>
<thead>
<tr>
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<th>Baseline Practices (examples of practices, others may be added)</th>
<th>Current Practices</th>
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<th>Evidence for Compliance</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>• All new irrigation infrastructure is installed in accordance with Installation Code of Practice for Piped Irrigation Systems (Irrigation NZ, January 2012); • Commissioning tests show that system performs to desired specifications for:   0 System capacity   0 Application depth   0 Application intensity   0 Application Uniformity (&gt;=85%)   0 Return interval • Operation and maintenance manuals obtained.</td>
<td></td>
<td></td>
<td>Provide commissioning report</td>
</tr>
<tr>
<td>Premium Required to ensure design can achieve effective and efficient use of water</td>
<td>• Comprehensive evaluation and decision-making process used (e.g. INZ Decision support process).</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### Irrigation Management

**Management Objective:** To ensure efficient on-farm water use that meets crop needs and minimises losses.

<table>
<thead>
<tr>
<th>Required outcomes</th>
<th>Covered by alternative plan? Y/N</th>
<th>Name of alternative plan / programme</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. All irrigation applications are justified by monitoring and/or other assessment or information</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Farm practices optimise water applications from irrigation system</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. All staff involved in the operation and maintenance of the irrigation system are suitably trained</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

#### Acceptability of practices

<table>
<thead>
<tr>
<th>Baseline Practices (examples of practices, others may be added)</th>
<th>Current Practices</th>
<th>Additional actions proposed to meet outcomes &amp; timeframes for completion</th>
<th>Evidence for Compliance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Poor Generally inadequate</td>
<td>No formal monitoring or other practices used to make irrigation application decisions</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Basic May be adequate for small blocks, low application rates, low water use; or border dyke on roster</td>
<td>Observations / basic checks made</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Good Desirable minimum for most spray irrigators</td>
<td>Measurements taken and used</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Required outcome: 1. All irrigation applications are justified by monitoring and/or other assessment or information**

- **Poor Generally inadequate**
  - No formal monitoring or other practices used to make irrigation application decisions

- **Basic May be adequate for small blocks, low application rates, low water use; or border dyke on roster**
  - Observations / basic checks made
    - Measure rainfall
    - Consideration of rain/weather forecast
    - Dig holes and check
    - Use a probe (e.g. electric fence standard) to check soil moisture
    - Other...

- **Good Desirable minimum for most spray irrigators**
  - Measurements taken and used
    - Rainfall measured and recorded
    - Consideration of rain/weather forecast
    - Soil temperature monitored
    - Soil moisture assessment actively used:
      - Buried sensors
      - Scheduling service
      - Hand held probe
    - Water balance calculation used

- **Evidence for Compliance**
  - Soil moisture records
  - Staff questioning of irrigation scheduling
<table>
<thead>
<tr>
<th>Acceptability of practices</th>
<th>Baseline Practices (examples of practices, others may be added)</th>
<th>Current Practices</th>
<th>Additional actions proposed to meet outcomes &amp; timeframes for completion</th>
<th>Evidence for Compliance</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>• Crop irrigation scheduling model used</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Use basic checks (holes / fence standard) to check technology / calculations</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Other ...</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Premium</td>
<td>“Good” plus:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Farm-wide water balance modelling using local climate data and ground-truthed with soil moisture monitoring</td>
<td></td>
<td></td>
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</tr>
<tr>
<td></td>
<td>• Records of measurements and irrigation decisions kept to demonstrate how soil moisture levels are managed between field capacity and the Management Allowable Deficit (irrigation trigger point)</td>
<td></td>
<td></td>
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</tr>
<tr>
<td></td>
<td>• Sensor records stored on computer or in notebook and reviewed regularly or provided by scheduling service</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Provide soil moisture records</td>
<td></td>
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</tr>
<tr>
<td></td>
<td>• Staff questioning of irrigation scheduling</td>
<td></td>
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<td></td>
</tr>
</tbody>
</table>

**Required outcome: 2. Farm practices optimise water applications from irrigation system**

<p>| Poor                      | Optimise applications for movable spray systems              |                  |                                                                        |                        |
|---------------------------|-------------------------------------------------------------|------------------|------------------------------------------------------------------------|                        |
| Generally unacceptable    | • Excessive application depths                              |                  |                                                                        |                        |
|                           | • Low application uniformity                                |                  |                                                                        |                        |
| Basic                     |                                                             |                  |                                                                        |                        |
| May be adequate for small blocks, low application rates, low water use |                                                             |                  |                                                                        |                        |</p>
<table>
<thead>
<tr>
<th>Acceptability of practices</th>
<th>Baseline Practices (examples of practices, others may be added)</th>
<th>Current Practices</th>
<th>Additional actions proposed to meet outcomes &amp; timeframes for completion</th>
<th>Evidence for Compliance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Good</td>
<td>• Water distributed evenly (target DU?)</td>
<td></td>
<td></td>
<td>• Provide irrigation calibration record (e.g. a spreadsheet).</td>
</tr>
<tr>
<td></td>
<td>• Spray line shifts made to suitable plan (e.g. GPS on bike; follow map)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Lines moved to cover any dry patches that occur</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Application to non-target areas (tracks, impermeable surfaces, rivers streams) is minimised</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Lines shut down where effluent irrigation is being applied</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• System closed down if runoff and/or ponding occurs</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>• Rotation adjusted according to ET, soil moisture status and rainfall</td>
<td></td>
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<tr>
<td></td>
<td>• Daily checks for excessive runoff/ponding</td>
<td></td>
<td></td>
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</tr>
<tr>
<td></td>
<td>• Daily checks for blocked nozzles, leaking hydrants or hoses, irrigator alignment and problems fixed</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Application rate checks with buckets or rain gauge pre-season</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• System in place for staff to report/fix problems</td>
<td></td>
<td></td>
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</tr>
<tr>
<td></td>
<td>• A baseline audit of the irrigation system is completed by an Irrigation NZ accredited evaluator to identify efficiency improvements. The report should set out the system performance, including well test(s)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• If required, any required upgrades should be included in a workplan with timelines for completion</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Desirable minimum for most low pressure spray systems</td>
<td>• Application rate check results</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Staff questioning of irrigation operations</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Baseline audit report</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Upgrade work plan</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Acceptability of practices</td>
<td>Baseline Practices (examples of practices, others may be added)</td>
<td>Current Practices</td>
<td>Additional actions proposed to meet outcomes &amp; timeframes for completion</td>
<td>Evidence for Compliance</td>
</tr>
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<td>---------------------------</td>
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</tr>
<tr>
<td><strong>Premium</strong></td>
<td>“Good” plus:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Required to fully demonstrate efficient water use</td>
<td>• Application depth and uniformity checks with buckets or rain gauge pre-season, and regularly through season</td>
<td>Required</td>
<td>• Application rate checks</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• System evaluation by certified evaluator 5 yearly, and programme to remedy problems implemented</td>
<td>Required</td>
<td>• System evaluation report and workplan</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Annually complete water use checklist</td>
<td>Required</td>
<td>• Water use check report</td>
<td></td>
</tr>
<tr>
<td><strong>Optimise applications for fixed spray</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Poor</strong></td>
<td>• Excessive application depths</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Generally inadequate</td>
<td>• Low application uniformity</td>
<td></td>
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<td></td>
</tr>
<tr>
<td><strong>Basic</strong></td>
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<td></td>
</tr>
<tr>
<td>May be adequate for small blocks, low application rates, low water use;</td>
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<tr>
<td><strong>Good</strong></td>
<td>• Adjust irrigator speeds according to evapotranspiration (ET), rainfall and soil moisture status</td>
<td></td>
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<tr>
<td>Desirable minimum for most systems</td>
<td>• Monitor pasture/crop growth and development</td>
<td></td>
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<tr>
<td></td>
<td>• Application of water onto non-productive land, including impermeable surfaces and river/stream margins is avoided.</td>
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<tr>
<td></td>
<td>• Check for excessive runoff and adjust system if necessary</td>
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<tr>
<td></td>
<td>• Close down system if excessive runoff and/or ponding occurs</td>
<td></td>
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<tr>
<td></td>
<td>• Monthly: check measuring application rates with rain gauge and keep records</td>
<td></td>
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<tr>
<td></td>
<td>• Wetted width widened on outer spans</td>
<td></td>
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<tr>
<td></td>
<td>• Provide irrigation application calibration record (e.g. a spreadsheet).</td>
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<tr>
<td></td>
<td>• Irrigation incident records</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Application rate check results</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Baseline audit report</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Acceptability of practices</td>
<td>Baseline Practices (examples of practices, others may be added)</td>
<td>Current Practices</td>
<td>Additional actions proposed to meet outcomes &amp; timeframes for completion</td>
<td>Evidence for Compliance</td>
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<tr>
<td></td>
<td>on long pivots or on slopes (e.g. by fitting boom-backs or clipping hoses over truss rods and fitting wide spray sprinklers) • A baseline audit of the irrigation system is completed by an Irrigation NZ accredited evaluator to identify efficiency improvements. The report should set out the system performance, including well test(s) • If required, any required upgrades should be included in a workplan with timelines for completion</td>
<td></td>
<td>• Upgrade work plan</td>
<td></td>
</tr>
<tr>
<td>Premium</td>
<td>“Good” plus: • System evaluation by certified evaluator 5 yearly, and programme to remedy problems implemented • Annually complete water use checklist</td>
<td></td>
<td></td>
<td>• System evaluation report and workplan • Water use check report</td>
</tr>
<tr>
<td></td>
<td><strong>Optimise applications for micro /drip</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Poor</td>
<td>Generally inadequate</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Basic</td>
<td>May be adequate for small blocks, low application rates, low water use; • Pre-season calibration of at least half system area</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Good</td>
<td>Desirable minimum for most systems • System layout plan and control points available at system on/off control station • Pre-season calibration check of each block. Run-time adjustment factors</td>
<td></td>
<td></td>
<td>Provide irrigation application rate record (e.g. a spreadsheet). See example at: <a href="http://www.pagebloomer.co.nz/resources/irrigation-calibration/">http://www.pagebloomer.co.nz/resources/irrigation-calibration/</a></td>
</tr>
<tr>
<td>Acceptability of practices</td>
<td>Baseline Practices (examples of practices, others may be added)</td>
<td>Current Practices</td>
<td>Additional actions proposed to meet outcomes &amp; timeframes for completion</td>
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</tr>
<tr>
<td></td>
<td>applied</td>
<td></td>
<td></td>
<td>Sight system layout plan</td>
</tr>
<tr>
<td></td>
<td>• Regular readings of operating pressure and flow logged by block</td>
<td></td>
<td></td>
<td>Sight calibration sheets</td>
</tr>
<tr>
<td></td>
<td>• System flushing at least annually</td>
<td></td>
<td></td>
<td>Sight log book</td>
</tr>
<tr>
<td></td>
<td>• Determine cause of and manage identified wet or dry spots</td>
<td></td>
<td></td>
<td>Baseline audit sighted</td>
</tr>
<tr>
<td></td>
<td>• A baseline audit of the irrigation system is completed by an Irrigation NZ accredited evaluator. If required, upgrades should be included in a workplan with timelines for completion</td>
<td></td>
<td></td>
<td>Upgrade workplan sighted</td>
</tr>
<tr>
<td>Premium</td>
<td>“Good” plus:</td>
<td></td>
<td></td>
<td>Maintenance plan and records sighted</td>
</tr>
<tr>
<td>Required to fully demonstrate efficient water use</td>
<td>• System maintenance plan in place and records kept</td>
<td></td>
<td></td>
<td>Certified evaluation report sighted</td>
</tr>
<tr>
<td></td>
<td>• System evaluation by certified evaluator within last 5 years; and programme to remedy problems implemented</td>
<td></td>
<td></td>
<td>Completed water use checklist sighted</td>
</tr>
<tr>
<td></td>
<td>• Annually complete water use checklist</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Optimise applications for surface irrigation (e.g. border systems)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Poor</td>
<td>Generally unacceptable</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Basic</td>
<td>May be adequate for small blocks, low application rates, low water use</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Good</td>
<td>Desirable minimum for</td>
<td></td>
<td></td>
<td>Provide irrigation application record</td>
</tr>
<tr>
<td></td>
<td>• Paddocks are monitored and clocks adjusted to soil moisture status, ET, rainfall and length of grass</td>
<td></td>
<td></td>
<td>Staff questioning of irrigation operations</td>
</tr>
<tr>
<td>Acceptability of practices</td>
<td>Baseline Practices (examples of practices, others may be added)</td>
<td>Current Practices</td>
<td>Additional actions proposed to meet outcomes &amp; timeframes for completion</td>
<td>Evidence for Compliance</td>
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<td>------------------------------------------------------------------------</td>
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</tr>
</tbody>
</table>
| Most low pressure spray systems | • Monitor indicator points/areas are setup and clocks adjusted accordingly  
• Gate seals maintained  
• Sills cleaned  
• Head races hard grazed  
• Borders maintained and any holes repaired  
• System in place for staff to report/fix problems | | | |
| Premium | Required to fully demonstrate efficient water use | | | |

**Required outcome:** 3. All staff involved in the operation and maintenance of the irrigation system are suitably trained

<table>
<thead>
<tr>
<th>Poor</th>
<th>No training</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Generally unacceptable</td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Basic</th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
</table>
| May be adequate for small blocks, low application rates, low water use; or border dyke | • Understand resource consent conditions  
• Limited training | | | |
<table>
<thead>
<tr>
<th>Acceptability of practices</th>
<th>Baseline Practices (examples of practices, others may be added)</th>
<th>Current Practices</th>
<th>Additional actions proposed to meet outcomes &amp; timeframes for completion</th>
<th>Evidence for Compliance</th>
</tr>
</thead>
</table>
| **Good** Desirable minimum for most spray irrigators | Relative to their responsibilities, provide on-farm training for all staff involved in irrigation management, including but not limited to:  
- How to avoid runoff and/or ponding  
- Correct application depths  
- Emergency procedures  
- System monitoring for problem identification  
- System maintenance  
- Individual staff responsibilities and accountability | | | • Staff questioning to determine competency  
• Irrigation management data and information is available to staff e.g. Guide to Good Irrigation ....  
• INZ - |
| **Premium** Required to fully demonstrate efficient water use | At least 1 staff member to achieve the Irrigation System Operator Training Standard (from Irrigation NZ). This staff member shall be the person responsible for managing the irrigation systems on-farm. | | | • Certificate of attendance |
### Nutrient and Soil Management

**Management Objective:** To minimise nutrient and sediment losses from farming activities to ground and surface water.

<table>
<thead>
<tr>
<th>Required outcomes</th>
<th>Covered by alternative plan? Y/N</th>
<th>Name of alternative plan / programme</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. All sources and potential losses of nutrients, sediment and effluent are clearly identified</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Nitrate loss target/s for property, as set by scheme and/or regional council, are met or exceeded.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Phosphate (P) and sediment losses to ground and waterways are minimised.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. Soils are well-managed to optimise infiltration and minimise runoff.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Acceptability of practices

<table>
<thead>
<tr>
<th>Baseline Management Practices (other practices may be added)</th>
<th>Current Practices</th>
<th>Additional actions proposed to meet outcomes &amp; timeframes for completion</th>
<th>Evidence for Compliance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Poor Unacceptable</td>
<td>No action in place to identify losses</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Basic</td>
<td>Basic nutrient budget identifies all N and P inputs (only an option where Overseer or other approved budget is not required by regulation)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Likely sources of sediment losses identified</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Good</td>
<td>Nutrient budget</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Whole farm nutrient budget uses budgets for each land management unit/block and is prepared by a suitably qualified operator, using Overseer or approved alternative tool and using agreed input parameter protocol (e.g. industry or regional council).</td>
<td>Provide the nutrient budget &amp; parameter report (input data)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Nutrient budget calculations take full account of all nutrient inputs and outputs Particular note is taken of N and P</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Acceptability of practices</td>
<td>Baseline Management Practices (other practices may be added)</td>
<td>Current Practices</td>
<td>Additional actions proposed to meet outcomes &amp; timeframes for completion</td>
</tr>
<tr>
<td>-----------------------------</td>
<td>-------------------------------------------------------------</td>
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<td>--------------------------------------------------------------------------</td>
</tr>
<tr>
<td></td>
<td>requirements and losses from the property.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Whole farm nutrient budgets are reviewed and revised regularly or as required by regional council.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Critical sites for P and sediment loss</td>
<td>• Identify locations that are key sites for P and sediment losses</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Plan how to reduce P and sediment losses from these areas.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Premium</td>
<td>CSA map and nutrient budget used as key on-farm management tools</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Required to show excellence in nutrient management</td>
<td>• Map showing critical source areas plus plan to reduce nutrient and sediment losses from these areas.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Evidence that CSA map and nutrient budget integrated into day to day decision making processes.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Required outcome:** 2. Nitrate loss target/s for property as set by Scheme and/or regional council are met or exceeded.

<table>
<thead>
<tr>
<th>Poor</th>
<th>Unacceptable</th>
<th>• Nitrate loss target not met and/or no plan in place to meet target by due date.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Basic</td>
<td>May be adequate for small blocks and/or low intensity operation</td>
<td>• Nitrogen risks noted and farm practices address any issues.</td>
</tr>
<tr>
<td></td>
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</tr>
<tr>
<td></td>
<td></td>
<td>• Copy of basic nutrient plan provided.</td>
</tr>
</tbody>
</table>
| Good | Required minimum for most situations | N losses managed to meet targets by:  
Selecting amount /type to apply:  
• Use recommendations on type and amount from qualifed person (fertiliser consultant or farm advisor), or by using an industry approved tool (e.g. wheat calculator) based on:  
  0 Soil testing and plant analysis |
|      |              | Copy of nutrient management plan prepared by qualified person, including:  
  • nutrient budget  
  • soil test results and nutrient analysis (if available)  
  • fertiliser |
<table>
<thead>
<tr>
<th>Acceptability of practices</th>
<th>Baseline Management Practices (other practices may be added)</th>
<th>Current Practices</th>
<th>Additional actions proposed to meet outcomes &amp; timeframes for completion</th>
<th>Evidence for Compliance</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>O Nutrient budget results</td>
<td></td>
<td></td>
<td>recommendations from fertiliser representative.</td>
</tr>
<tr>
<td></td>
<td>O Assessment of pasture quality</td>
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<tr>
<td></td>
<td>O Deep soil nitrogen testing for arable crops</td>
<td></td>
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<tr>
<td></td>
<td>• Matching nitrogen applications in proportion to other nutrients, according to plant and animal requirements</td>
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<tr>
<td></td>
<td><strong>Application techniques and timing</strong></td>
<td></td>
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<tr>
<td></td>
<td>• Using Spreadmark standards or using suitably calibrated equipment for N applications.</td>
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<tr>
<td></td>
<td>• Lower rates of nitrogen (not exceeding 50 kg N/ha/application) applied to match growth cycle of pasture and soil moisture conditions.</td>
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</tr>
<tr>
<td></td>
<td>• Pasture is at least 25mm high (approx 1000kg DM/Ha) before nitrogen is applied</td>
<td></td>
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<tr>
<td></td>
<td>• Nitrogen application is matched to times of high plant growth and crop requirements</td>
<td></td>
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<tr>
<td></td>
<td>• Nitrogen is not applied when the 10cm soil temperature at 9am is less than 6 degrees Celsius</td>
<td></td>
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</tr>
<tr>
<td></td>
<td>• Nitrogen fertiliser is not applied when the ground is saturated and/or when the tile drains are running</td>
<td></td>
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</tr>
<tr>
<td></td>
<td>• Nitrogen not applied to excessively dry or compacted soil</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Other management practices to reduce N losses:</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Cultivation practices and timing adjusted</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Application records</td>
<td></td>
<td></td>
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</tr>
<tr>
<td></td>
<td>• Proof of placement maps</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Soil moisture records and application records</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Acceptability of practices</td>
<td>Baseline Management Practices (other practices may be added)</td>
<td>Current Practices</td>
<td>Additional actions proposed to meet outcomes &amp; timeframes for completion</td>
<td>Evidence for Compliance</td>
</tr>
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<td>---------------------------------------------------------------</td>
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<tr>
<td></td>
<td>to minimise N losses.</td>
<td></td>
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</tr>
<tr>
<td></td>
<td>• Crop rotations adjusted to maximise the use of residual N in the soil and minimise N losses</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Stock wintering practices adjusted to minimise nutrient losses.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Soil compaction from stock grazing and/or heavy machinery movement minimised</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Stock numbers adjusted to meet N target.</td>
<td></td>
<td></td>
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</tr>
<tr>
<td></td>
<td>• Harvest supplements and export from property.</td>
<td></td>
<td></td>
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</tr>
<tr>
<td></td>
<td>• Supplements (e.g. maize silage) substituted for proportion of N fertiliser use.</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Premium</th>
<th>Required to show excellence in nitrogen loss minimisation from farming activities</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>• GPS technology is used for precise application and for a digital record of fertiliser proof of placement, for all N fertiliser spread on-farm</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Required outcome: 3. Phosphate (P) & sediment losses to groundwater and waterways are minimised and critical source areas managed.**

<table>
<thead>
<tr>
<th>Poor Unacceptable</th>
<th>No action in place to manage critical sources and minimise losses</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Basic</td>
<td>Phosphate and sediment risks noted and managed for.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Good</td>
<td>Phosphate and sediment losses managed by: Selecting amount/type to apply:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Use recommendations on type and rate of P applications, as recommended by qualified person (fertiliser consultant or</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Soil test and fertiliser recommendations.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Fertiliser application</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Acceptability of practices</td>
<td>Baseline Management Practices (other practices may be added)</td>
<td>Current Practices</td>
<td>Additional actions proposed to meet outcomes &amp; timeframes for completion</td>
<td>Evidence for Compliance</td>
</tr>
<tr>
<td>---------------------------</td>
<td>---------------------------------------------------------------</td>
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<td>--------------------------------------------------------------------------------</td>
<td>------------------------</td>
</tr>
<tr>
<td></td>
<td>farm advisor) based on:</td>
<td></td>
<td></td>
<td>records</td>
</tr>
<tr>
<td></td>
<td>• Soil testing and plant analysis</td>
<td></td>
<td></td>
<td>• Nutrient budget</td>
</tr>
<tr>
<td></td>
<td>• Nutrient budget results</td>
<td></td>
<td></td>
<td>• Spreadmark accreditation certificate</td>
</tr>
<tr>
<td></td>
<td>• Assessment of pasture quality</td>
<td></td>
<td></td>
<td>• Fertiliser application records</td>
</tr>
<tr>
<td></td>
<td>• Need for capital or maintenance fertiliser</td>
<td></td>
<td></td>
<td>• Field observation</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>• Proof of placement charts</td>
</tr>
<tr>
<td></td>
<td><strong>Application techniques and timing</strong></td>
<td></td>
<td></td>
<td>• Critical source map and action plan</td>
</tr>
<tr>
<td></td>
<td>• Use Spreadmark standards or using suitably calibrated equipment for N applications.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Use split applications where the single application rate would exceed 100kgP/ha, unless there is sound justification around not adhering to this e.g. dry autumn and winter conditions leading to a potential animal welfare issue</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Limit phosphate application between June-August</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Fertiliser is not applied when the soil is saturated and/or excessively dry</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Fertiliser is not applied to severely compacted soils</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Vegetation buffer strips of sufficient width (leave a riparian margin of at least 1-2m on flat land and 5m or more on sloping land.) to filter any runoff are maintained adjacent to all waterways</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Managing key sites to reduce P and sediment losses</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Implement plan to reduce P losses at critical locations</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Acceptability of practices</td>
<td>Baseline Management Practices (other practices may be added)</td>
<td>Current Practices</td>
<td>Additional actions proposed to meet outcomes &amp; timeframes for completion</td>
<td>Evidence for Compliance</td>
</tr>
<tr>
<td>---------------------------</td>
<td>-------------------------------------------------------------</td>
<td>-------------------</td>
<td>-----------------------------------------------------------------------</td>
<td>------------------------</td>
</tr>
<tr>
<td>Premium</td>
<td>GPS technology is used for precise application and for a digital record of fertiliser proof of placement, for all phosphate fertiliser spread on-farm</td>
<td></td>
<td></td>
<td>• Evidence of technology use.</td>
</tr>
</tbody>
</table>

Required outcome: 4. Soils are well-managed to optimise infiltration and minimise runoff

<table>
<thead>
<tr>
<th>Poor</th>
<th>Unacceptable</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Basic</td>
<td>May be adequate for small blocks and/or low intensity operation</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

| Good | Required minimum for most situations | | |
|------|--------------------------------------|-----------------|------------------|------------------------|
|      | • Check for soil compaction         | • Actively reduce adverse effects of significant soil compaction on water and effluent infiltration rates (e.g. using soil aerator etc) | • Recognize the difference in soil types and soil properties and manage accordingly to minimise soil compaction damage | • Field inspection • Soil aeration records • Soil map of property and plan to manage major soil differences |
|      | • Increased crop residue is left in the soil | • Heavy machinery restricted to specified pathways | | |

| Premium | Required to show excellence in phosphate and sediments minimisation from farming activities. | | |
|---------|-----------------------------------------------------------------------------------|-----------------|------------------|------------------------|
|         | • Annual Visual Soil Assessments (VSA) on intensively cropped soils, and records kept. | | | • VSA records |
## Waterway and Wetland Management

**Management Objective:** To manage waterways, wetlands and their margins to avoid stock damage and minimise inputs of nutrients, sediment and faecal contamination

<table>
<thead>
<tr>
<th>Required outcomes</th>
<th>Covered by alternative plan? Y/N</th>
<th>Name of alternative plan / programme</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Stock damage to waterways and wetlands is minimised</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Farm practices minimise soil, nutrient and faecal contamination of waterways</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Acceptability of practices</th>
<th>Baseline Practices (examples of practices, others may be added)</th>
<th>Current Practices</th>
<th>Additional actions proposed to meet outcomes &amp; timeframes for completion</th>
<th>Evidence for Compliance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Required outcome: 1. Stock damage to waterways and wetlands minimised</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Poor Generally inadequate</td>
<td>• Stock have access to waterways</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Basic May be sufficient for some situations</td>
<td>• Grazed only with sheep</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Good Minimum requirements for most waterways, wetlands and regularly wet areas</td>
<td>• Stock excluded from streams and wetlands in accordance with xxx Regional Council rules • All regular stock crossings have bridge or culvert</td>
<td></td>
<td></td>
<td>• Field inspection of waterways and wetlands</td>
</tr>
<tr>
<td>Premium Necessary to show excellence in water body management</td>
<td>• Approaches to stock crossings managed to avoid runoff to waterways • All stock crossings have bridge or culvert</td>
<td></td>
<td></td>
<td>• Field inspection of waterways and wetlands</td>
</tr>
</tbody>
</table>

Required outcome: 2. Farm practices minimise soil, nutrient and faecal contamination of waterways

<p>| Poor Generally inadequate |  |  |  |  |
| Basic May be sufficient for some situations | • Soil and nutrient contamination from farming practices regularly enters waterways |  |  |  |</p>
<table>
<thead>
<tr>
<th>Acceptability of practices</th>
<th>Baseline Practices (examples of practices, others may be added)</th>
<th>Current Practices</th>
<th>Additional actions proposed to meet outcomes &amp; timeframes for completion</th>
<th>Evidence for Compliance</th>
</tr>
</thead>
</table>
| **Good**                  | Maintain vegetated riparian margin suitable to adequately filter any run-off from freshly cultivated or fertilised blocks and/or winter grazing blocks. Width of margin may vary from 1-10 metres depending on slope.  
  - Strip next to riparian margin grazed last when break feeding winter feed crops.  
  - Minimum or no-till cultivation techniques used when high risk of run-off from cultivated blocks.  
  - Runoff from stock races and tracks does not flow directly into waterways. Where necessary this runoff is directed to open pasture. | | | • Field inspection of waterways and wetlands |
| Minimum requirements for most waterways | | | | |
| **Premium**               | Provide adequate filtering of sediment and nutrients e.g. by appropriate riparian buffers at low points.  
  - Riparian planting programme prepared and implemented.  
  - Permanently or frequently wet areas within paddocks are managed to avoid contamination from stock or fertiliser (e.g. fenced out, suitable planting, left uncultivated) | | | • Field inspection of waterways and wetlands |
| Necessary to show excellence in water body management | | | | |
Collected Effluent Management\(^5\)

**Management Objective:** To manage the operation of the effluent system to avoid adverse effects on water quality

<table>
<thead>
<tr>
<th>Required outcomes</th>
<th>Covered by alternative plan? Y/N</th>
<th>Name of alternative plan / programme</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Effluent management and discharge comply fully with all regional council consent(^6) requirements 365 days / year</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Effluent discharge correctly applied to avoid contamination of surface or ground water</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Acceptability of practices</th>
<th>Baseline Practices (examples of practices, others may be added)</th>
<th>Current Practices</th>
<th>Additional actions proposed to meet outcomes &amp; timeframes for completion</th>
<th>Evidence for Compliance</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Required outcome: 1. Effluent system and application fully compliant with regulations 365 days / year</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Poor</td>
<td>• Effluent consent not current</td>
<td></td>
<td></td>
<td>Regional council compliance report</td>
</tr>
<tr>
<td>Generally inadequate</td>
<td>• Effluent consent monitoring shows major or minor non-compliance</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Good</td>
<td>• Effluent consent is current</td>
<td></td>
<td></td>
<td>Regional council compliance report</td>
</tr>
<tr>
<td>Minimum requirements for most effluent management</td>
<td>• Effluent system fully compliant with consent conditions</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Effluent system fully compliant with permitted activity conditions</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Required outcome: 2. Effluent discharge correctly applied to avoid contamination of surface or ground water</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Poor</td>
<td>• Limited storage which means effluent must be applied even when soils conditions are not suitable.</td>
<td></td>
<td></td>
<td>Visual observation</td>
</tr>
<tr>
<td>Generally inadequate</td>
<td>• Effluent irrigator applies effluent at application rates which lead to ponding and/or runoff.</td>
<td></td>
<td></td>
<td>Visual observation and/or evidence that demonstrates this is happening</td>
</tr>
<tr>
<td>Basic</td>
<td>• High risk effluent disposal areas identified</td>
<td></td>
<td></td>
<td>Map showing risk areas</td>
</tr>
<tr>
<td></td>
<td>• Effluent applied at rates that do not lead to ponding and/or runoff.</td>
<td></td>
<td></td>
<td>Bucket test information</td>
</tr>
</tbody>
</table>

\(^5\) This section of this FEP may be covered by an approved audited Dairy Supplier plan or similar e.g. from Fonterra, Synlait. A scheme / collective would need to decide what is acceptable.

\(^6\) If regional council does not require consent for collected effluent, then this section should be amended accordingly.
<table>
<thead>
<tr>
<th>Acceptability of practices</th>
<th>Baseline Practices (examples of practices, others may be added)</th>
<th>Current Practices</th>
<th>Additional actions proposed to meet outcomes &amp; timeframes for completion</th>
<th>Evidence for Compliance</th>
</tr>
</thead>
</table>
| **Good**                  | • Minimise amount of effluent irrigation by careful yard management and diversion of shed roof water.  
• Sufficient storage capacity is available at all times to ensure that effluent is not applied when soil conditions are near field capacity.  
• Effluent irrigation system is capable of delivering the correct amount of effluent for soil type and slope.  
• Correct amounts of effluent applied for specific soil properties and slope  
• Ensure that effluent area covers at least 8ha/100 cows  
• Ensure an even spread of effluent over the whole of the designated area.  
• Take immediate action if incident or breakdowns occurs including:  
  • Rectify the problem  
  • Clean up if possible  
  • Take action to minimise the risk of the incident / breakage occurring again  
• Staff who are involved in the management of the effluent system are fully trained in the use of the system. |                                 |                                                                 | • Visual observation   |
|                           |                                                           |                  |                                                                     | Visual observation      |
|                           |                                                           |                  |                                                                     | System set-up specifications and follow-up tests |
|                           |                                                           |                  |                                                                     | Bucket tests & visual observation |
|                           |                                                           |                  |                                                                     | Map showing effluent area. |
|                           |                                                           |                  |                                                                     | Map or dairy record of effluent applications. |
|                           |                                                           |                  |                                                                     | Visual observation + map showing exclusion zones |
|                           |                                                           |                  |                                                                     | Incident/breakdown register |
|                           |                                                           |                  |                                                                     | Staff training schedule |
| **Premium**               | • Proof of placement technology used to identify areas of effluent application  
• Fail safe systems such as Gator-buddy and variable rate irrigation to minimize risk of incidents, and application of effluent to high risk areas. |                                 |                                                                 | Proof of placement printouts |
|                           |                                                           |                  |                                                                     | Visual observation      |
Appendix one: List of resource consents held for this property
Guide to Template for Farm Environment Plan

Draft for Review
March 2013

Claire Mulcock
Mulgor Consulting Ltd

Ian Brown
IB Consulting Ltd
Guide to Template
for
Farm Environment Plan

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Guide to Template for Farm Environment Plan
This guide is intended to provide explanations for the generic Farm Environment Plan (FEP) template developed for INZ (Brown and Mulcock 2013).

1. Structure of the Farm Environment Plan
The FEP that is produced from this template is specifically designed so that:

- an irrigator, whether in a scheme, collective or as an individual
  - can demonstrate that they have implemented suitable on-farm practices, record keeping etc. to manage their operation to manage water quality and water quantity within limits set by their regional council.
  - can prepare their own plan, either through one or more workshop sessions, or with support from an advisor.
- The FEP can be readily audited to check whether the pre-set management objectives and required outcomes are being achieved.

Objectives and outcomes are set, but, as far as possible, the on-farm practices implemented to achieve the outcomes are determined by the irrigator to fit with the farm system and natural resource base.

2. Farm Environment Plan Sections

2.1. Responsibility
Page 1 identifies those responsible for achieving the FEP requirements.

Property Owner
This may be a company, trust or other entity, or individual/s. The owner is generally the person/entity who holds the irrigation shares or other rights to water, and is therefore responsible for the FEP requirements. A key contact for the owner/s should be listed.

Lessee
This is the person/s or entity who lease part or all of a property. The owner/s should ensure that the lease agreement passes on FEP responsibilities as appropriate.

Person responsible for implementing FEP
This is usually the person who makes the day-to-day management decisions on the property, and is the person who should attend the audit, with others (e.g. owner) if required.

2.2. Farm Information
This section is to provide a ‘picture’ of the property, not great detail. It should be sufficient to provide an external auditor with an understanding of the type and scale of farm activities on the property. It also provides the scheme with information on irrigation type, enterprise type etc. that can be used for benchmarking or other analysis.
2.3. **Map**

The purpose of the map is to identify the features of the natural and built environment that are linked to managing water quality and quantity. The completed map should give a reviewer or auditor a clear picture of the property. More than one map can be used, if desired, to show different features.

Irrigators are asked to bring 2 copies of their farm map, suitable for drawing on, when they start to prepare their farm plan, either through a workshop process, or individually. Regional Councils can often supply farm maps, on request. The maps are used in the workshop to draw the land management units and other farm information, such as waterways, stock crossings, effluent areas. The maps are then scanned and included in the final farm plan.

To show on map, if present:

- Name key roads and show North direction, to enable farm to be located on a road map.
- Land management units (these should align with the blocks used in the nutrient budget)
- Irrigated area by irrigation type
- Effluent area
- Bores/wells
- Water races
- Conservation or covenanted areas/ indigenous bush/scrub
- Streams and wetlands, including stock crossing points - Show which streams are fenced
- Standoff areas, feed pads
- Tracks
- Open drains
- Areas that are tile drained
- Lease blocks – including owner name (If the whole farm is leased from one owner, then record this information on page 1)

2.4. **Land Management Units**

A land management unit is a homogenous block of land with that responds in a similar way under similar management. These units should as far as possible align with the blocks used in the nutrient budget.

**Block strengths / weaknesses**

A strength is a favourable land quality, while a weakness is a not-so-favourable quality. What is defined as a strength or weakness may depend on the farm activity/ies in the block e.g. stoniness may be a weakness for cropping but a strength for winter grazing of cattle (avoiding pugging).

Examples of strengths and weaknesses

- Free / poor draining
- Deep/ shallow topsoil
- Good /poor soil moisture holding capacity
- Good / poor soil structure
- Flat / moderate / steep land
• Warm aspect / exposed aspect
• Resistant / susceptible to pugging
• Flooding risk
• Erosion prone / stable (no erosion)
• Droughty
• High runoff risk
• High water table
• Naturally sheltered

2.5. Environmental Risk Assessment

The risks to water quality from the combination of the natural resources (soil, stream, slope etc.) and current farm practices (stock, irrigation, cultivation etc.) in each land management unit must be identified. For each topic the grower must provide a brief explanation that explains and justifies why the high/medium or low risk is given. For example a ‘low’ risk for irrigation application might be explained by ‘low application depth per run/gentle slope.’

This table then informs the later sections where specific actions are determined to avoid or minimise adverse effects of farm activities on water quality.

3. Management Topics

IASM covers 6 management areas critical to water quality and quantity management. Other topics can be added if required e.g. some schemes have resource consent conditions requiring them to cover Biodiversity Management.

• Regulatory Compliance
• Irrigation System Design and Installation
• Irrigation Management
• Nutrient and Soil Management
• Waterway and Wetland Management
• Collected Effluent Management

3.1. Management Objectives and Required Outcomes

The management objective for each topic is set by the scheme to fit with their resource consent requirements or other regional council, scheme or community agreed initiative. The objective provides the overall long term direction for that management area.

For each management objective there are one or more ‘required outcomes’. These are the targets that irrigators must be aiming to achieve with their farm management practices. The expectation is that all of the outcomes for a particular management area must be achieved in order to achieve the objective for that management area.
Management Objectives and Required Outcomes

Regulatory Compliance
- Objective: To ensure full compliance with all resource management regulatory requirements

Irrigation System Design and Installation
- Objective: To ensure that all new irrigation systems and significant upgrades meet industry best practice standards

Irrigation Management
- Objective: To ensure efficient on-farm water use that meets crop needs and minimises losses.

Nutrient and Soil Management
- Objective: To minimise nutrient and sediment losses from farming activities to ground and surface water.

Waterway and Wetland Management
- Objective: To manage waterways, wetlands and their margins to avoid stock damage and minimise inputs of nutrients, sediment and faecal contamination.

Collected Effluent Management
- Objective: To manage the operation of the effluent system to avoid adverse effects on water quality.

Required Outcomes

Regulatory Compliance
Full compliance with relevant regulatory requirements

Irrigation Design and Installation
New irrigation infrastructure is designed and installed to deliver water to industry best practice standards

Irrigation Management
All irrigation applications are justified by monitoring and/or other assessment or information

Nutrient and Soil Management
All sources and potential losses of nutrients, sediment and effluent are clearly identified

Waterway and Wetland Management
Stock damage to waterways and wetlands is minimised

Collected Effluent Management
Effluent management and discharge comply fully with all regional council requirements 365 days / year

Farm practices optimise water applications from irrigation system

Nitrate loss target/s for property, as set by scheme and/or regional council, are met or exceeded

Farm practices minimise soil, nutrient and faecal contamination of waterways

Effluent discharge correctly applied to avoid contamination of surface or ground water

All staff involved in the operation and maintenance of the irrigation system are fully trained

Phosphate (P) and sediment losses to ground and waterways are minimised.

Soils are well-managed to optimise infiltration and minimise runoff
3.2. **Other On-farm Environmental Management Plans**

The table below provides an option for a grower to substitute another audited plan or programme for either a single ‘required outcome’ (e.g. Nitrate loss target/s for the property .... are met or exceeded) or a complete ‘management area’ (e.g. Nutrient and Soil Management).

<table>
<thead>
<tr>
<th>Required outcomes</th>
<th>Covered by alternative plan? Y/N</th>
<th>Name of alternative plan / programme</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. All irrigation applications are justified by monitoring and/or other assessment or</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Farm practices optimise water applications from irrigation system</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. All staff involved in the operation and maintenance of the irrigation system are</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The scheme or the regional council must provide guidance (e.g. in a scheme policy or procedure) as to which plans or programmes are acceptable, and how the audit results from that plan correlate with the IASM audit grades.

3.3. **Acceptability of Practices**

Poor – identifies the types of actions (or inactions) that are not adequate to achieve the stated outcome.

Basic - ‘basic’ is a level of activity that stands alone. It provides for small, low intensity properties for which the ‘good’ level of activity is not necessary because the environmental risks are very low, usually because of low water use (application volume and/or rate) and very low nutrient inputs.

Good - identifies the minimum types of actions that need to be carried out on the majority of irrigated farms to be able to adequately manage environmental risks, especially to water quality.

Premium – identifies current practices that give a high level of environmental risk management, and the types of activity that provide for continuous improvement in water quality and/or water quantity management.

3.4. **Baseline Practices**

The FEP template sets out examples of practices that would meet the expected standard for each of good, basic and premium, and some practices that would be considered ‘poor’ or ‘inadequate’.

However, there are numerous options for achieving each outcome, and what is suitable will depend on the type and intensity of the farming operation as well as soil, slope and other natural resource characteristics. Irrigators must be aiming to be in the good and premium categories, unless their operation fits in the ‘basic’ category. (see explanation of ‘basic’ above)

**Current Practices and Additional actions etc**

Irrigators identify their current practices with the ‘tick boxes.’ Where changes to current practices are required in order to meet the outcome then these should be entered in the Additional action column along with an appropriate timeline for implementation.
3.5. Evidence for Compliance
For each outcome, the irrigator must be able to demonstrate to the auditor how, over the entire year or years between audits, they are carrying out the stated practices to achieve the necessary outcome.

The auditor will be assessing:

- the completeness and consistency of implementation of the Farm Environmental Plan;
- the effectiveness of the implementation in ensuring control of environmental operations;
- the effectiveness of the system in supporting achievement of the objectives and outcomes.

To do this the auditor needs to have ‘objective evidence’. S/he cannot use subjective opinion and "here-say" as the basis of their conclusions. To justify his or her conclusions as to whether the objectives and outcomes have been met, the auditor must be able to demonstrate how the evidence provided leads to these conclusions.

Objective evidence includes records, data, reports and actual practice observed during the audit. The auditor will review the evidence to ensure that the records, data, reports that are presented do demonstrate that the objectives and outcomes under investigation have been met.

There are no formal requirements with regard to the standard of records to be kept. Notwithstanding this, the better the records, the better the ‘story’ that can be told and the more likely that the auditor will be able to make an objective assessment.

In terms of record keeping there are a few simple rules.

1. Decide whether it is necessary to keep a written/electronic/photographic record of a particular activity. Only keep records where they help tell a story.
2. Records should be in a form where anybody can pick them up and understand the story that they tell.
3. Good records require a disciplined approach – once you start, then keep going.
4. Remember that a picture tells a 1000 words.
Disclaimer

All information contained within this publication has been compiled with due care, checked for accuracy and published in good faith. It is for the purpose of guidelines only. The authors expressly disclaim all liability to any person relying on the whole or any part of this publication. They accept no responsibility on any grounds whatever, including liability in negligence, for the use or mis-use of the information contained in this document.

Prepared for Irrigation New Zealand

by

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Mulgor Consulting Ltd

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Farm Environment Plan

Audit Manual

March 2013

For the background to the Irrigation Audited Self-Management process see:


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However, errors and omissions are ours.
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Background

The IASM Farm Environmental Plan (FEP) template was developed under an Irrigation NZ sponsored project. The aim of the project was to develop a realistic, practical approach that could be used by community irrigation schemes to address the on-farm environmental issues associated with irrigation management.

As new irrigation schemes are developed and land use intensifies, farmers increasingly find themselves farming under the watchful eye of a concerned community and a demanding market place. In order to substantiate ‘green’ claims and alleviate community concerns, farmers will have to be able to demonstrate that their farming practices are environmentally sustainable.

To ensure that ‘good practice’ environmental management is part of the normal farming business on all the farms in the scheme, the irrigation scheme operator requires each water user to prepare and implement a FEP for their property. This plan must be in accordance with the scheme operator’s own environmental management policies and protocols.

A critical step in the FEP process is the external audit. FEP auditing provides surety that the appropriate systems are in place to manage the environmental risks associated with irrigated land use. It also adds credibility to the FEP process.

The audit process

This manual sets out a step by step procedure, as a guide for those involved in auditing FEPs developed by irrigation scheme participants using the Irrigation NZ model. It provides guidance on planning an audit as well as the on-farm audit itself. It also outlines some of the essential skills that the auditor will need in order to effectively audit FEPs.

Any FEP external audit process should follow the all steps described. However, there will be some variation in detail, especially in relation to the management structures and roles in the particular scheme (e.g. employee roles vs contractors, and board vs staff roles). The detailed requirements and conditions surrounding the external audit should be set out within the scheme’s environmental policies and procedures manual.

Planning an audit

Pre-Audit review

Prior to audit, the auditor should request as a minimum:

1. A map showing the location of the property to be audited.
2. A copy of the current FEP for the property including any associated maps. (e.g. land management units, critical nutrient source area maps etc)
3. A copy of the latest nutrient budget/s for the property including the associated parameter reports and/or the associated Overseer file.
4. A copy of previous audit reports.

If this information is not provided prior to the audit, then the audit should be postponed until such time that sufficient information is provided.

The auditor should thoroughly review the information provided using a pre-audit checklist to guide the review. (Copy provided in Appendix 1)
The pre-audit review should provide the auditor with a good understanding of the property to be audited and guide him/her to the key areas of interest. In particular the review should provide the opportunity for the auditor to:

1. Consider the plan objectives and outcomes in relation to site factors, external compliance history and previous audit history.
2. Assess the overall robustness of the farm management programme to manage identified risks, and
3. Assess the robustness of the nutrient budget results provide.

It is not the auditor’s primary job to judge the technical soundness or completeness of the FEP. All FEPs prepared within a scheme area have to go through an approval procedure and should contain the following approval certificate on the front page of the plan.

<table>
<thead>
<tr>
<th>Technical approval</th>
</tr>
</thead>
<tbody>
<tr>
<td>I have considered this plan and believe it to be:</td>
</tr>
<tr>
<td>1. Technically sound and feasible</td>
</tr>
<tr>
<td>2. Addressing the cause of the identified environmental risk</td>
</tr>
<tr>
<td>3. Able to meet the plan objectives</td>
</tr>
</tbody>
</table>

**Comments:**

**Signature:** (Please print)  
(for the ABC Irrigation Scheme)

**Date:** / /

If as a result of the pre-audit review and/or the actual audit, the auditor has concerns about the FEP itself, then these concerns should be noted and recorded in the Farm Audit report. However, if there is sufficient evidence to verify that the objective and outcomes under consideration have been met, then such concerns should not be used as a basis for non-compliance.

**Sampling**

An auditor’s main task is to verify whether or not the objectives and outcomes as set out within the FEP have been met. Simply because of time constraints, you cannot examine all the records, data, and evidence put forward for each objective and outcome within the FEP. It is also not necessary. If you do not find any problems in the areas that you do sample, then you can reasonably assume that there are no problems in the areas not sampled.

The Irrigation NZ FEP is structured in such a way that it requires an audit of each management area covered by the plan. For each management area the audit should be based on sampling sufficient examples in detail to be able to establish, with confidence, the degree of compliance or non-compliance demonstrated in the particular area of interest under review.

Some basic guides to sampling include:

1. The depth of sampling must be consistent with the significance of the objectives and outcomes under review. (i.e. Spend more time on the significant aspects of operation rather than the less significant ones.)
ii. The depth of sampling must be consistent with the results of previous audits. (i.e. If problems have been evident in previous audits in a particular area of activity then extra scrutiny should be applied in this area.)

iii. The depth of sampling should be directly proportional to the degree of training and understanding demonstrated by the personnel responsible for the operation. If the personnel, when questioned by the auditor, either do not know, or directly contradict what is set out in the FEP then the auditor should sample the records of the operation more intensively than otherwise.

There are no sampling plans, no statistical methods suitable for use in auditing the FEP. The depth of sampling and the degree of rigour to which records are examined has to be left to the judgment of the auditor.

**Timing**

Depending on the size of a property, the complexity of operations, and previous audit history, the pre-audit review could take up to 1 hour. The on-farm component of the audit will generally take from two-three hours. This should be sufficient time for the auditor to introduce the audit process, inspect the property and review the records. Preparation of the audit report, including allowing time for follow-up and receiving feedback from the landowner, should take no more than 1-2 hours depending on the nature of report preparation. (i.e. electronic vs. manual)

The best time of the year to undertake the audit is during the peak of the irrigation season. This allows the auditor to identify any issues that can be attributed to the operation of the irrigation systems.

**On-farm audit**

**Objective Evidence**

Having planned an audit, the auditor now faces one of the most difficult actions required of them, the actual on-farm audit. The auditor is required to assess:

- the completeness and consistency of implementation of the FEP;
- the effectiveness of the implementation in ensuring control of environmental issues;
- the effectiveness of the farming systems in supporting achievement of the objectives and outcomes.

An auditor bases all of their activities on ‘**Objective Evidence**.’ An auditor cannot use subjective opinion and “here-say” as the basis of their conclusions.

Objective Evidence is:

- information supplied as records, data, reports and photographs,
- actual practice observed during the audit, and
- stated practice, if the stated practice can be reasonably supported by other evidence.

*Objective evidence should be completely examined, it should never be accepted on ”face value” alone. An auditor should review the evidence to ensure that the information presented does demonstrate that the objectives and outcomes under investigation have been met.*
When assessing evidence to answer the question, “have the objectives and outcomes been met,” the auditor needs to be asking him or herself.

- What is the evidence demonstrating?
- Where is the evidence leading?
- What story does the evidence tell?
- Is the evidence complete and is it accurate?
- Is non-compliance indicated and if so, have appropriate corrective actions been put in place?

The auditor should also test the level of understanding of the personnel involved in implementing the various aspects of the FEP. For example:

- Are they familiar with the environmental aspects of their work and their importance?
- Do they understand the purpose of the FEP process and what it is trying to achieve?
- Do they know their responsibility and authority?
- Do they know what to do in incident/accident/emergency situations?

The auditor is there to collect and record objective evidence of the good, not just the bad. To justify his or her conclusions as to whether the objectives and outcomes have been met, the auditor must be able to demonstrate how the evidence provided leads to these conclusions.

Details of progress made for each objective under review, and all evidence provided, should be recorded in the property audit report. This information will form the basis of the final conclusions on whether or not the property is compliant or non-compliant.

**Questioning and Communication**

The auditor will be meeting with and interviewing farm staff in a role that is different from their normal operational function.

During an audit, the auditor has to gather objective evidence that demonstrates whether or not the objectives and outcomes as set out within the FEP have been met. The auditor could walk around in total isolation, looking at records, observing work, making notes but this would never give the ability to understand the degree of effectiveness of, and commitment to, the management system.

*Management system audits depend upon people demonstrating their knowledge and implementation of the requirements.*

One of the guides to how evidence must be examined by an auditor is their understanding of the farm staff’s familiarity with the FEP. If the auditor has prepared properly, by reviewing the plan, they know what should be happening before they enter the property.

The auditor’s task is to find out:

- Is it happening?
- Is it understood?
- Is it effective?

To do this, the auditor must ask questions and must communicate with farm staff.

Simply asking the question: "Do you do this test every week?" because that is what the listed management practice says should happen will usually give the response of: "Yes" (or "No").
It does not allow the auditor to assess the staff member’s understanding of what they are supposed to do, because the question itself suggests that the answer should be "Yes". It does not allow the auditor to assess the method of work used for the test because the auditor has not "prompted" the operator to discuss it further. A staff member may be able to provide all the right documentation but if they don’t understand why they are following a particular course of action, then the risk of failure is high.

Asking the question:

"Can you tell me how you match the need to turn on the irrigator with current soil moisture status?" It encourages the staff member to "walk" the auditor through every step of the operation and allows the auditor to verify:

- Does the operator understand the stated management practice?
- Are the good management practices as listed in the plan the same as the actual practice?
- Are the listed actions being enacted?
- Is the operation effective?

Further, supplemental questions or comments may help clarify the situation.

For example:

- "How often do you do this?"
- "Can you show me the record of the results?"
- "How do you know if the results are OK?"
- "What do you do if there is a problem?"

Using this approach the auditor can quickly establish the adequacy and accuracy of the evidence provided. It will also help establish if appropriate actions have been taken in the case where there has been an accident or system failure.

*Breakages, accidents and system failures occur even in the best set up and managed farming operations. As an auditor you should be looking for evidence that where a problem has occurred that it was addressed in a timely manner, and more importantly that appropriate actions were taken to minimize the risk of the problem occurring again.*

An auditor has to be able to make those that they are interviewing relax, as much as possible. Simply asking question after question is, probably, the least efficient way of auditing. It is far better for the auditor to communicate with those they are interviewing in such a way that the auditor can simply stand back and listen, with occasional prompts, where necessary.

The ability to communicate is one of the essential skills of a good auditor. It is not just words, it is:

- being a good listener,
- showing interest in what is being said, or shown
- knowing what to say and when to say it, and
- respecting feeling and sensitivities.

*"The sign of a good auditor is someone who can make the minimum amount of noise and extract the maximum amount of information."*
FEP structure and the nature of the audit

The Irrigation NZ FEP is structured in such a way that allows for an ‘audit’ against the objectives and outcomes for each management area, and a ‘standards assessment’ for each outcome as to where the property sits in relation to good management practice standards. While not part of the audit, understanding where the property sits in relation to recognised good practice standards provides the auditor with further information upon which to base their conclusions. Reporting on this also provides the landholder with a snapshot as to where they fit in relation to recognised industry good management practice guidelines. More detail on the structure of the FEP is provided in the INZ FEP Guide.

Before beginning the audit, the auditor should be clear as to whether their responsibility extends to reporting on the audit alone or the audit + the standards assessment.

The audit

The overall aim of the audit is twofold:

- to determine if the objectives and outcomes for each management area (e.g. irrigation management) covered by the FEP have been achieved, and
- to provide an overall compliance grading for the property.

Making these calls is a four step process, a worked example of which is provided in the sample audit report in Appendix 2.

Step 1: Outcome ratings

For each outcome within each management area the auditor should make an assessment as to whether the outcome has been met. This is best done using the following 1-3 rating scale.

<table>
<thead>
<tr>
<th></th>
<th>1</th>
<th>2</th>
<th>3</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Unlikely that the outcome has been met.</td>
<td>Possible that the outcome has been met.</td>
<td>Likely that the outcome has been met.</td>
</tr>
</tbody>
</table>

In making this assessment, the auditor should clearly set out the basis for their conclusion. (e.g. field observation, soil moisture records etc.)

Also for each outcome, the auditor may undertake a standards assessment if asked to do so as part of the audit. For each standards category, (i.e.: basic, good and premium), require practices are listed in order to meet that standard. The auditors job is to record the standard obtained for each outcome. In order to meet the ‘premium’ standard, the required practices as listed under the ‘good’ category must also be met. If a standards assessment is undertaken the results could be listed in the following manner.

3/P

i.e. Likely that outcome met to Premium standard

Step 2: Objective rating

Average the outcome rating scores to obtain an overall rating for the management area. (e.g. Outcome ratings: 3, 3, and 2 = average 2.67)

1 Note: The standards assessment component of the audit can be undertaken manually but ideally it is better suited to use with an electronic database.
Use the following table to provide an assessment of the level of confidence that the objective has been met.

<table>
<thead>
<tr>
<th>Average outcome score</th>
<th>&lt; 2.0</th>
<th>2.0-2.4</th>
<th>&gt;2.4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Level of confidence</td>
<td>Low</td>
<td>Medium</td>
<td>High</td>
</tr>
</tbody>
</table>

Standards assessments can also be applied at Objective level. To achieve a ‘Premium’ status for the objective, premium ratings must be achieved for each outcome area under that objective. Similarly to achieve a ‘good’ status for the objective, good or premium ratings must be achieved for each outcome area under that objective.

**Step three: Reasons for objective rating and actions required**

By providing a call on whether an objective has been met or not, the auditor is effectively making a judgement based on the following statement:

*The systems and processes in place plus an assessment of action on the ground provide a low/medium/high level of confidence that the objective for (e.g. irrigation management) has been met.*

To complete the process the auditor must be able to justify their thinking by listing both the positive and negative reasons for their decision together with a list of actions required for improvement.

**Step four: Overall compliance grading for the property.**

Guidelines around what constitutes compliance may be provided through the regional plan and/or the irrigation schemes environmental policies and protocols. What this means is that different regional councils and/or different schemes may have different thresholds around what constitutes a pass / fail.

Table 1 below provides an example of how it is envisaged that the pass / fail and compliance grading decisions can be made when using the Irrigation NZ FEP approach.

**Table 1: Example of determining Compliance grading from Management Area Ratings**

<table>
<thead>
<tr>
<th>Pass / Fail</th>
<th>Overall Ratings for each management area*</th>
<th>Compliance grading</th>
<th>Compliance status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pass</td>
<td>All areas high</td>
<td>A</td>
<td>Fully compliant (No action required)</td>
</tr>
<tr>
<td>Pass</td>
<td>No lows and med alone, or mix med + highs</td>
<td>B</td>
<td>Non-compliant - low risk (Written action plan required) (Follow-up by scheme personnel)</td>
</tr>
<tr>
<td>Fail</td>
<td>Any lows</td>
<td>C</td>
<td>Non-compliant – high risk (Written action plan required) (Follow-up by scheme personnel &amp; re-audit required within 12 months)</td>
</tr>
</tbody>
</table>

*To determine the ratings that match with A,B,C grades need to note that properties will not necessarily need to cover all management areas (i.e. some may not need to do any of: Waterway and Wetland Management; Collected Effluent Management or Irrigation System Design and Installation)

**Note:** It is not the auditor’s responsibility to follow up where action is required. This responsibility lies with the irrigation scheme managers.
The audit report

When the auditor has finished each audit, he or she should take a few minutes to think about what he/she has found. Has sufficient information been collected to make an informed decision? The auditor’s decisions must be based on objective evidence. If the evidence hasn’t been provided or the records are incomplete, then the auditor is not in a position to grant a fully compliant rating.

The auditor should prepare a separate audit report for each property audited. A sample audit report is attached in Appendix 2. A draft of the report should be completed while on farm and discussed with the farmer before leaving the property. It is a good idea to highlight both the areas of good performance and the areas of non-compliance. The auditor needs to ensure that the farmer understands the reasons for any non-compliant ratings that have been given.

A copy of the draft audit report should be sent to the farmer within 2 weeks of the actual on-farm audit.

In seeking feedback from the farmer you should ask:

- To identify any obvious errors or mistakes.
- To submit any additional information that wasn’t available at the time of audit.
- To confirm or otherwise that the audit provides a ‘fair and reasonable’ assessment of the situation on the property.

When making the call on the final audit report, the auditor should take into account all of the feedback received. However, ultimately the auditor must make the final decision. In doing so, the auditor should keep whatever records necessary to justify their final decisions.

The property owner/s plus the person responsible for implementing the plan should receive their final report within a reasonable period, (i.e. no longer than one month following the audit).

In addition to the individual property reports the auditor will probably be required to prepare a summary report for the irrigation company. The company will stipulate what they require in this report but it is likely to include:

i. An outline of the audit process used.
ii. A summary of the gradings for each management objective for all properties audited.
iii. A summary of the overall compliance ratings for all properties audited.
iv. Key issues identified during the audit.
v. Recommendations for future audits.

Summary

The audit is a critical step in the FEP process. The audit enhances the credibility of the planning process, and also helps assure external parties that the on-farm environmental risks associated with irrigated land use are being effectively managed.

The audit itself requires careful planning on the part of the auditor. On-farm the auditor’s main task is to verify whether or not the objectives and outcomes as set out within the FEP have been met. Simply because of time constraints, the auditor cannot examine all the records, data, and evidence put forward for each objective within the FEP. An audit should be based on sampling sufficient examples in detail to be able to establish, with confidence, the degree of compliance or non-compliance demonstrated in the particular area of interest which is under review.
The auditor must base all their decisions on objective evidence. An auditor cannot use subjective opinion and here-say as the basis of their conclusions. When assessing evidence to answer the question, have the objectives and outcomes been met, the auditor needs to be asking him or herself.

- What is the evidence demonstrating?
- Where is the evidence leading?
- What story does the evidence tell?
- Is the evidence complete and is it accurate?
- Is non-compliance indicated and if so, have appropriate corrective actions been put in place?

Details of progress made for each objective under review, and all evidence provided, should be recorded in the property audit report. This information will form the basis of the final conclusion and recommended actions from the audit.
# Appendix 1: Audit checklist

Note: If farm plan records are stored in a database, the key information should be retrieved directly to this form.

<table>
<thead>
<tr>
<th>Farm name</th>
<th>Key contact:</th>
<th>Position:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Phone no.:</td>
<td>Cell phone no.:</td>
<td>Email:</td>
</tr>
</tbody>
</table>

- FEP has been approved  Y / N
- FEP relates to farm area  Y / N
- FEP and NB area are same  Y / N

Dates of previous audits:

<table>
<thead>
<tr>
<th>Objectives to be audited</th>
<th>Site factor considerations</th>
<th>External compliance history considerations</th>
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- Any issues from nutrient budget to be followed up on during audit:

- Any issues identified in pre-audit check to be followed up on during audit
Appendix 2: Example Audit report

[to come]
APPENDIX 11

Action Plan: Sunny Hills Dairy

Date: September 6 2011

This Action Plan identifies how issues of non-compliance identified in the 2011 audit of Sunny Hills Dairy's Farm Environmental Plan will be resolved.

Actions agreed by:

Signed: ______________________     Date: ______________
Joe Farmer (land owner)

Signed: ______________________     Date: ______________
Sarah Officer (Regional Council)

Signed: ______________________     Date: ______________
Dave Person (Irrigation Co)

Management Area: Irrigation Management

Issue:
The irrigation operation on the farm has been causing significant runoff. Some causes of the problems have been rectified, but other matters still need to be addressed.

Improvements made in past two seasons:
- Nozzles on k-line were historically providing 0.6mm/sec. These have now been replaced to provide 0.4mm/sec.
- K-lines is now be moved on 12 hour shifts, rather than 24 hour shifts, as previously.
- A GPS system is now used for shifting K-lines to ensure no overlap.
- Soil moisture monitoring system now incorporates rainfall data.
- Taps on sprinklers near towers.

Actions Required:
A full system assessment must be undertaken by an Irrigation NZ accredited evaluator by December 20 2011 [specify date]. Their report should set out the system performance for both the centre pivot and K-line system and make recommendations on upgrades. It is important that these recommendations are actioned.

This evaluation cannot occur until the system is operating at full capacity (approx November), therefore a cautious approach to irrigation management is required to minimise the risk of run-off in the meantime and the interim actions outlined below will be instigated.
A list of INZ accredited assessors and their contact details is provided below.

**Interim Actions (in place immediately)**

- End gun on pivot to be turned off (or turned off in high risk areas) until its application rate has been assessed.

- Be very careful to schedule irrigation so that the amount of water applied is linked to evapotranspiration, rainfall and soil moisture status, e.g. Monitor evapotranspiration and soil moisture status and adjust scheduling accordingly.

- Review data from aquaflex on a daily basis to inform scheduling decisions - the amount of water applied must not exceed the amount required to restore soil moisture to field capacity.

- Ensure new irrigation manager is trained in system operation within the next month.

- Develop a farm map that identifies areas that have a high, medium and low risk of run-off and pay close attention to practices within these areas. If in doubt, do not irrigate high risk areas. Risk factors include slopes greater than 7%, shady areas, the presence of watercourses, areas of known ponding, gullies where run-off may leave the property boundary, etc.

- Monitor run-off ‘hot spots’ at
  - Hills Rd boundary paddock
  - St Stephen’s Rd crossing point
  - Simons Rd culverts

Take a photo every time there is a change in water movement at these points. This is important to ground-truth the run-off problem. If increased run-off is observed at these sites, ask yourself why and what can I do to prevent it?

**Medium-Term Actions (in place before Christmas)**

- Develop clear written irrigation scheduling procedures – xxx irrigation co to assist by providing template.

- Ensure all staff involved in irrigation management receive comprehensive training and that these staff sign that they have received and understood this training - xxx irrigation co to assist by providing staff training checklist.

**Long-term Actions**

- Improve drainage in wet areas to reduce risk of ponding.
• Capture run-off at bottom of paddock adjacent to St Stephens Rd by creating a dam or ‘wetland. Regional Council to provide further advice on suitable options to address this issue.

Actions for xxxx Regional Council

• By [insert timeframe], Sarah to provide further information on options for dealing with run-off in drain in paddock beside St Stephens Rd - particularly creating a dam or ‘wetland’ at bottom of paddock to prevent run-off from entering neighbours property.

• Sarah to provide advice on difference between nil and negligible run-off and the standard expected by [insert timeframe].

• Sarah to prepare note for council file documenting existing ponds in paddocks 56, 55, 54, 52, 22 and 21. These ponds existed prior to irrigation - complete.
Managing Water Quality and Quantity within Limits

March 2013
Draft for review

Claire Mulcock
Mulgor Consulting Ltd

Ian Brown
IB Consulting Ltd
Disclaimer

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Prepared for Irrigation New Zealand
by
Claire Mulcock
Mulgor Consulting Ltd
Ian Brown
IB Consulting Ltd

Irrigation Audited Self-Management:
Managing Water Quality and Quantity within Limits
March 2013

A description of the Irrigation Audited Self-Management process plus templates, manuals and worked examples have been developed as 'Irrigation Audited Self-Management: A ‘How-To’ Guide' [complete reference].

Acknowledgements
We would like to thank the many individuals and organisations who have contributed to the development of this package for Audited Irrigation Self-Management.

Our special thanks to North Otago Irrigation Company, Morven Glenavy Ikawai Irrigation Company, Synlait Milk Ltd and Central Plains Water Ltd for their especial generosity in sharing their ideas and experiences.

However, errors and omissions are ours.
1 Introduction

There is increased pressure for all land users to manage water and land environmental issues within limits, and report on their performance. Irrigation NZ (INZ) is committed to supporting all irrigators achieve high standards of on-farm environmental performance. Over recent years, mainly to meet resource consent requirements, several irrigation schemes have begun using an audited self-management (ASM) approach that includes individual environmental farm plans and an audit requirement. Primary sector groups and other industry organisations have also implemented environmental performance programmes, particularly in response to pressures from markets and from the general public to demonstrate that primary produce, especially food, meets safety and quality standards and farm practices are environmentally sustainable.

While it is clear that ‘one size’ won’t fit all, it is likely that there are sufficient commonalities among different irrigation schemes, various land uses, and the approaches of different regional councils to mean that there are benefits in developing a generic approach that can be tailored to specific needs. As an organisation that covers many different land use types, INZ also wants to understand and link with industry organisations and others to avoid growers facing duplication of effort, cost, paperwork etc. to meet different requirements (e.g. market and regional council).

Under the National Policy Statement for Freshwater Management 2011\(^1\) (NPS) regional councils must set enforceable water quality and quantity objectives and limits. Once set, these limits must be achieved and monitored. Growers need to have sound on-farm environmental management for both water quantity and water quality and demonstrate this to both regulatory authorities and the wider community in a systematic way. The use of farm environment plans, linked with an appropriate audit process, provides a means of achieving efficient use of water and maintaining water quality within set limits while retaining flexibility for the farm enterprise. This approach is not limited to irrigation schemes and could be used by individual irrigators or other grower collectives such as catchment groups, groups of irrigators or sector groups.

This review and analysis of current and planned sector activities and regional council requirements and expectations has provided input for an updated irrigation audited self-management programme (IASM) that irrigators and others can implement to assist them to meet both freshwater quality and quantity objectives and targets. This system can be linked closely with other environmental management and reporting options available to growers.

\(^{1}\) Freshwater Management National Policy Statement issued by notice in the Gazette on 12 May 2011 New Zealand Government
2 Scope

This work provides the basis for a national framework to support the consistent and credible implementation of an Audited Self-Management programme for irrigators to meet regional council requirements to meet water quantity and quality limits. It covers:

a) A stocktake and analysis of:
   • current irrigation sector environmental activities and programmes including experience gained from practical implementation
   • current and future statutory requirements and expectations as outlined in catchment plans or other national/regional instruments
   • current and future industry programmes and interoperability with audited self-management for irrigation (IASM)

b) Identification of methods to mitigate the identified risks

c) Use of existing programmes to provide an IASM programme to meet current and anticipated future needs

d) ‘Packaging’ the IASM to provide a national framework

e) Providing a visual representation of the IASM for easy comprehension and uptake.

The outputs include a package of materials that irrigation schemes and other grower collectives can use to develop an IASM programme to meet regional council requirements to manage water quantity and quality to achieve specified limits. These resources include templates for farm environment plans, and examples of policies and procedures protocols for audit, compliance, reporting and corrective action. (See ‘IASM How-To Guide’

A number of existing packages have provided experience of useful approaches. The updated package builds on these experiences to support and assist irrigators effectively manage water and nutrient use on farm. While the primary target is irrigation schemes and groups of irrigators (‘collectives’), the needs of individual irrigators are also considered. Non-irrigators can use the package, too, recognising that many of the issues to be addressed are similar.

There are overlaps between the needs of irrigation schemes to show how irrigators are achieving good environmental management, and sector or other approaches which may also use farm plans, appropriate record-keeping and maybe audits. To avoid duplication of effort by growers and others it is important to maintain strong communication among all parties and develop processes that minimise unnecessary overlaps. However, as the focus of the IASM will be on water quality and quantity management, growers may well use other planning and management tools for some aspects of their business.

The ‘IASM How-To Guide’ outlines the delivery process for successful and cost effective IASM implementation, considering the capacity and capability within the industry, and consistency and integrity of the delivery process.

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2 Add reference
3 Why do irrigators need to manage to limits?

3.1 Regulatory Framework
Regional Councils must set enforceable limits on water quality and the amount of water that can be abstracted from our rivers, lakes and aquifers as directed by the National Policy Statement for Freshwater Management 2011. Where water resources are over-allocated (in terms of either quality and/or quantity) methods must be put in place to reduce over-allocation over agreed timeframes.

As major water users, irrigators are seen as a key group who need to ensure efficient water use, and at the same time meet water quality standards. Because many of the impacts of farming on water quality are hard to monitor directly at the individual farm level, growers need to have a method to demonstrate that they are applying water correctly to avoid wastage and that nutrient and other losses are minimised. Growers must show that they recognise both national and local values for water resources and demonstrate that the intrinsic values of fresh water resources are being retained. If irrigators cannot show how they are managing water quantity and quality responsibly to avoid problems, future access to water for irrigation is at risk.

3.2 Why use Audited Self-Management?
Audited Self-Management (ASM) has been strongly endorsed by the Land and Water Forum\(^3\) (LaWF) as an important approach for environmental management in the primary sector, with ASM defined as:

*A management programme (individual, industry, or land user collective) which allows for the credible and transparent demonstration (audit) that agreed actions have been implemented (in this instance for water quality and quantity)*.  \(^4\)  

LaWF: Second Report 2012\(^5\) (Glossary)

The LaWF has a wide membership and has drawn on the knowledge, imagination and energy of people across New Zealand over several years, in its efforts to find ways to address water management issues in New Zealand using a shared vision and a common way forward through a stakeholder-led collaborative process.

Therefore, it is appropriate for irrigators to adopt ASM, as defined by LaWF, as a key method for irrigators to address water management issues. Many aspects of current irrigation sector approaches to environmental management can readily be incorporated.

The ASM approach endorsed by LaWF is based in part on their conclusion that (LaWF Third Report\(^6\) 2012) that ‘water quality will be maintained and improved only if individual enterprises adopt good management practices (GMP)’ and ‘ASM is a key tool in implementing GMP and can be used across

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\(^3\) LaWF – Land and Water Forum - has brought together a wide range of industry groups, environmental and recreational NGOs, iwi, scientists, and other organisations with a stake in freshwater and land management, with active observers from local and central government to assist in developing a common direction for freshwater management in New Zealand and provide advice to the Government.

\(^4\) ‘and quantity’ added to LaWF definition.

http://www.landandwater.org.nz/

http://www.landandwater.org.nz/
most management methods (regulatory and non-regulatory). Different mixes of contaminants, different patterns of land-use (current and historical), and the complexities of natural environments mean that management approaches will need to be tailored to specific catchments.

ASM provides irrigation schemes and catchment groups with a method to allow individual enterprises to determine their good management practices according to land use, irrigation type, farming intensity and the natural environment etc. Often there is no realistic farm level monitoring to check outcomes for water quality issues (e.g. N leaching or P runoff), so a process, such as ASM, is needed to ensure that suitable practices are in place on each property through the audit process and that desired outcomes are being met.

3.3 What is Audited Self-Management for Irrigators?
IASM further defines the LaWF generic description of ASM to describe a method for irrigators and irrigation schemes to demonstrate that agreed actions are being carried out through a process that includes farm management plans and audits. The necessary actions are those required to achieve pre-set management objectives to meet community set goals and corresponding limits for freshwater quality and quantity. IASM recognises that individuals and enterprises must be able to act innovatively and in ways that support economically profitable and efficient operations.

The management objectives for the IASM programme may be set in a number of ways including through a regional plan, resource consent or ZIP\(^7\), or by an irrigation scheme or a grower collective, such as a catchment or irrigator group. Where practical, measurable targets will also be set (e.g. all cattle out of streams, N load targets, annual irrigation application rate testing).

IASM has an enforceability requirement through the ‘audit’, with consequences for inaction, although incentives for good performance can be part of the package.

In some cases, IASM may include the transfer of day-to-day RMA compliance responsibilities to users under agreed terms and conditions. For example, a group of individual water users may be given responsibility for sharing a water allocation amongst themselves under agreed terms and conditions rather than through individual allocation and management consent conditions. However, IASM to manage within limits is not just ‘implementation of a few checks and balances in order to have greater control over water management’. It must enable progress towards objectives and limits for freshwater management to be monitored and tracked.

Where the management objectives have been set through regional plans and/or resource consents for water, the regional council will be the ultimate enforcement agency. In other situations, such as objectives that are set by an irrigation scheme, or agreed through a negotiated community process (e.g. ZIP), but not necessarily required by the regional council, then these groups would also define or agree on the audit and enforcement process.

IASM provides for linkages with other environmental management programmes (e.g. dairy, arable, horticulture) and business planning tools.

\(^7\) ZIP – ‘Zone Implementation Programme’ for Canterbury Water Management Strategy. See: canterburywater.co.nz/
Public confidence in any audited self-management programme is important. The programme needs to be credible to all stakeholders, including individual land users, industry, regulators and the wider community. If the audited self-management process is robust, transparent and accountable and, over time, achieves progress towards community aspirations for water, then trust will be developed.

Another important aspect of this approach is that it also retains flexibility for individual enterprises to determine their own management practices to meet the type and intensity of operation, soil type, topography etc., rather than having generic practices imposed.

The most practical way to improve water quality on-farm is for individual enterprises to adopt recognised ‘Good Management Practices’ (GMP). However, appropriate GMPs will be different for different enterprises, different soils, topographies etc., so a method is required to plan, implement, review and update the GMPs in a systematic way across a large number of farms. IASM recognises that GMPs alone may not be sufficient to achieve the necessary limits, in some situations.

The IASM programme must be based on responsibilities for each irrigator, as well as overall responsibilities for the irrigation scheme or irrigator collective. So that progress of each enterprise can be checked, individual irrigators need to record in a management plan that is regularly audited:

- Objectives and targets for water quality and quantity that they must achieve (set by plan, consent, irrigation co or group)
- An assessment of the water quality and quantity risks from their farming system
- Their actions, practices etc. to achieve objectives and targets (specific to property, but a minimum standard or practice may be set (e.g. through a regional rule, consent, or an irrigation company policy))
- Timelines for improvements

As the governance body for the IASM programme, the irrigation company or collective would have an Environmental Plan or Strategy and operational protocols that set out:

- Objectives and targets based on those in a resource consent, regional plan and/or those set through a local community process (e.g. upper Waikato catchment groups, or zone committees (Canterbury))
- Process for preparation and review of individual management plans (‘farm environment plans’)
- Process for audit / enforcement / reporting
- Process for consultation and communication with stakeholders
- An education and adaptive management programme

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8 See Appendix 1 for explanation of ‘GMP’
4 Using IASM to meet requirements for managing to limits

4.1 Current and likely regional council requirements

Regional Councils are in the process of preparing or revising regional plans to set enforceable quality and quantity limits for fresh water management and methods to avoid or reduce over-allocation in response to the directives of the NPS for Freshwater Management.

The majority of councils have not yet confirmed their programmes to set and achieve limits.

As discussed further in section 5 and Appendix 1, the terms ‘Farm Plan’, ‘Farm Environment Plan’ (FEP) and ‘Nutrient Management Plan’ (NMP) are used to describe a range of different reports, with varying amounts of detail and specificity. For example, some NMPs provide only a limited list of identified environmental risks and management actions, whereas others are very comprehensive and are almost FEPs. In this section we use the terminology NMP or FEP that the particular council uses, but have not analysed all the requirements to determine how comprehensive the particular NMP or FEP is expected to be.

Several councils already require NMPs in severely degraded catchments, or for N applications over a base minimum. Canterbury, Otago, Horizons and Southland all require FEPs in some situations. However, other councils are also considering NMPs and FEPs as an approach to track progress towards N and P loss limits that they expect to set in the near future.

In the next few years, the following councils expect to require Farm Environment Plans /Nutrient Management Plans at least for intensive farming: Auckland, Waikato, Bay of Plenty, Hawkes Bay, and Southland. In Otago, FEPs will be a supported method, but other options will also be available. FEPs are required through the resource consent conditions for two irrigation schemes. Other councils are still considering how to set and achieve water quality limits.

Figures 1 and 2 provide a summary of where council requirements in 2012, and what is anticipated in 2-3 years. Table 1 in Appendix 2 gives more detail.

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9 NMP - Nutrient Management Plan. For a description of NMPs see Appendix 1
REGIONAL COUNCIL REQUIREMENTS

Northland RC – No FEMP or NMP requirements yet. Notified RPS requires establishment of nutrient loss limits in plan reviews.

Horizons – Sept 2012 Interim Envt Court decision on One Plan: - NMP’s for all dairy, irrigated sheep and beef, horticulture and cropping. - NMP’s for N application > than 60kg/ha/yr for all.

Taranaki Wellington Tasman Marlborough West Coast – No specific FEMP or NMP requirements at present.

Auckland – No specific FEMP or NMP requirements yet. Rural advisory panel established.

Gisborne – No specific FEMP or NMP requirements as yet. Land & Water Advisory panel established.

Hawkes Bay RC – No specific FEMP or NMP requirements as yet.

Otago Regional Council – No specific FEMP or NMP requirements as of yet. Plan change 5A requires farm specific direct water quality monitoring. FEMP required as condition of consent for NOIC and Terras.

Environment Southland – Requirement for FEMP (NMP as a section) for all new dairy conversions.

Waikato RC – Require NMP’s for applications of N > 60kg/ha/yr (Rule3.9.4.11). Require NMP’s under N cap within Lake Taupo catchment (Reg Plan variation 5).

Bay of Plenty – Require nutrient benchmarking & NMP’s for farming in Rotorua Lakes catchment (Rule 11), but not been enforced. RPS identified all Rotorua Lakes as catchments at risk, with N and P caps to be established through subsequent plan reviews.

ECAN – LWRP requirements – pre 2017
All land users record nutrient losses
Change of land use requires FEMP with NMP

LWRP requirements – post 2017
FEMP with NMP for all farming above N threshold.

Hunui-Waihu Plan
All land users in ASM & have FEMP w NMP by 2017

Figure 1: Current Regional Council Requirements for Farm Environment Plans or Nutrient Management Plans

FEMP – Farm Environment Management Plan
NMP – Nutrient Management Plan
RPS – Regional Policy Statement
REGIONAL COUNCIL REQUIREMENTS
Expected in next few years

Northland RC — Expecting programmes underway to establish water quality limits

Taranaki — Full review of Regional Land & Water Plan to begin

Horizons — ??

Wellington
Expecting introduction of N & P caps especially for sensitive groundwater zone areas but timing uncertain

Marlborough, Tasman — Expecting programme underway to establish water quality limits

Otago Regional Council — FEPs accepted method. Required for some consents e.g. irrigation schemes

Environment Southland — Expecting expanded requirement for FEMP for intensive land uses. Introduction of N cap very likely

Auckland — Expecting zoning and water quality limits establishment programme (similar to that of Canterbury) to be underway with requirements for FEMP

Waikato RC — Expecting requirements for FEMP for all intensive farming within N caps and with required reductions over time — as component of full regional plan review.

Bay of Plenty — Expecting requirement for FEMP for all intensive farming with N caps and with required reductions over time — as component of full regional plan review

Gisborne — Expecting programme underway to establish water quality limits

Hawkes Bay RC — Expecting establishment of N&P limits and requirements for FEMP as evidence by Tukituki plan change.

ECAN — Expecting FEMP requirements as result of sub-regional plan development. N loss thresholds for all land uses and water quality limits

FEMP — Farm Environment Management Plan
NMP — Nutrient Management Plan
RPS — Regional Policy Statement

Figure 2: Likely Regional Council Requirements for Farm Environment Plans or Nutrient Management Plans in next few years
Comment and feedback from regional councils indicated that auditable Farm Environment Plans and Nutrient Management Plans are increasingly being viewed as a key tool to achieve widespread on-farm improvements in water quality and quantity management to limits. Councils see the potential for a ‘farm plan’ process to move beyond compliance and encourage on-going learning and improvements.

Key issues raised included the need for credibility and transparency for all stakeholders. To achieve credibility, councils recognise that the wider community has high expectations that the rural sector will make the changes necessary, and that strict monitoring and enforcement will need to be implemented. In addition, to meet requirements of the NPS, Farm Plans need to be auditable and enforceable.

There will be differences across councils in their approaches to Farm Plans, particularly because of the range of key issues in different regions e.g. Canterbury has a strong irrigation focus, Otago has a focus on water quantity management with the 2021 deadline looming for historic mining rights for water to change to resource consents. Some other councils that have had a long term involvement with farm plans for soil erosion are likely to use that experience and community understanding as a basis for on-farm water quality and quantity management.

4.2 Key features of an IASM approach, including Farm Plans
ASM as an approach has been defined by LaWF (see Appendix 1), but has not yet been well-developed as a concept. To meet the expectations of LaWF that ASM can work as a management tool for achieving on-farm objectives for water quality and quantity including implementation of GMPs, it needs further refinement.

Earlier irrigation environmental management approaches were built as ‘environmental management systems’ (EMS). EMS is a well-established and well-documented process here and overseas, in agriculture and in other industries (see Appendix 1). EMS uses a continuous improvement cycle of ‘Plan, Act, Check, Revise’. For ASM to be credible for regulatory compliance purposes and to achieve on-going improvement, a systematic approach, such as the EMS cycle, is necessary. A diagram of the proposed IASM process for schemes and collectives is shown in Figure 3a. A similar process for individual irrigators is shown in Figure 3b.
Figure 3a: Irrigation Audited Self-Management Process for Schemes and Collectives

Sets policies, standards, and procedures
- Systems and record keeping
- Compliance and enforcement
- Legal contract includes requirement to prepare & implement Farm Plan
- Demonstrates common sense managing to limits to meet objectives

Irrigation Audited Self-Management

Checks overall achievements and reviews overall progress towards objectives

Farm Plan Audits

Checks achievement of objectives and required outcomes and encourages improvement

Figure 3b: Irrigation Audited Self-Management Process for Individual Irrigator

Sets legal requirements to prepare, implement, audit Farm Plan and report

- Resource Consent or Permitted Use
- Compliance and enforcement
- Farm Environment Plan
- Sets out objectives and activities and records used to demonstrate management to limits

Irrigation Audited Self-Management

Reporting for consent
- Dealing with non-performance

Audit report received
- Record keeping to track progress

Independent check of progress towards objectives and outcomes; encourages improvement
IASM puts the personal desire expressed by many growers ‘to improve the farm environment’ into a framework where the results can be demonstrated. It takes an approach that requires and builds personal responsibility and knowledge, encourages innovation, but has regular checks and a regulatory backstop to ensure progress towards water quality and quantity limits.

The key aspects of managing water quality and quantity to limits are practical, common sense actions to manage nutrients carefully to avoid contaminating water, and to apply irrigation water efficiently so that excess water is minimised. Figure 4 outlines some common-sense actions that are incorporated into IASM.

Figure 4

Common sense management of water quality and quantity to limits

Irrigation

- Water little and often
- Don’t water beyond field capacity
- Measure soil moisture
- Minimise evapotranspiration
- Take into account weather forecasts
- Match crop requirements
- Distribute water evenly
- Maximise water reliability

The common sense factors

Nutrients

- Minimise direct losses to waterways
- Volume, distribution and time critical
- Rotate crops
- Maintain soil health
- Capture, re-use or recycle nutrients

The approach

- Personal responsibility and knowledge
- Encourage innovation
- Regular checks
- Regulatory backstop
4.2.1 Audit
The audit requirement is essential, as IASM must be able to show that it is achieving, as a minimum, regulatory compliance. The performance of irrigators in managing water quality and quantity to limits will be scrutinised by councils and the community, so progress towards the objectives and targets needs to be tracked. To provide the necessary credibility the audit should cover an assessment of:

- the performance against the management objectives and targets, as well as actions
- the overall robustness of the management programme to manage identified risks
- the level of confidence in the nutrient budget results (as minimising nutrient losses is a key requirement)

4.2.2 Farm Environment Plan
The FEP process must minimise paperwork and maximise improving knowledge about water management and implementing actions on the ground. However, many growers will need to keep more detailed records on some aspects of their operations so they can demonstrate that they are achieving their objectives and targets.

Initially each farm needs to complete an assessment of the environmental issues and risks associated with water quality and quantity in relation to their farm operations. This helps to determine the farm policies, appropriate good management practices and actions that need to be implemented to manage within limits for water quality and quantity. The risk assessment would cover the land resource attributes and the farming system. For example: risks and therefore GMPs for irrigation on flat land would be different to those on steeper rolling country, or for arable farming and dairy.

The risk assessment process will be particularly important for irrigation schemes that cover a range of soil types, slopes, farm enterprises and irrigation type as the scheme is unlikely to be able to set generic GMPs suitable for all enterprises.

Features of a Farm Environment Plan for IASM
Each FEP would usually cover a block or blocks of land that are run as a management unit (‘a farm’) by one or more managers, who may or may not be the land owner/s. Irrigation schemes have an added complication that those with the rights to access water and with contractual responsibilities (often, but not always, shareholders) are not always the ‘hands on’ managers. Both parties need to be involved in the FEP process. The FEP should be prepared, as far as possible, by the person/s who have responsibility for day-to-day management, with input/approval from the owner/s, if they are different people.

A FEP would need to cover:

- Property and land use information
• Description of different ‘land management units’\textsuperscript{10} within the farm
• Risk assessment of the effects of farming activities and options for management, including:
  o Irrigation
  o Stock
  o Cultivation
  o Fertilisers
  o Effluent application
• Management objectives / targets for the components of the farming systems that have an impact on water:
  o Irrigation Management
  o Nutrient and Soil Management
  o Waterway and Wetland Management
  o Collected Effluent Management
• Nutrient Management would require an appropriate nutrient budget, as this a key tool for understanding nutrient cycling on farm and managing nutrient loss.
• Practices / Actions / Records / Timelines

Note that these are the key issues for water management and focus on aspects that can be readily audited. Other environmental management topics can be added, if desired, or specifically required by a scheme or resource consent etc. For example: biodiversity, energy etc.

The Farm Plan should include objectives that address specific aspects of water management that are important to Maori. In the FEP most of these matters will require the same on-farm practices that are needed to achieve other community goals for water. However, schemes or collectives should work with local iwi to ensure their objectives are correctly understood and included. Some schemes have iwi liaison committees/groups to assist them.

If the FEP is prepared as part of an irrigation scheme (or other collective) arrangement, then the scheme would want to check and approve the FEP to ensure that the necessary standards are achieved and that the FEP has accurately identified the risks and appropriate actions etc.

An irrigator with an individual consent may be required to contract professional assistance to check the plan or the regulator may provide a check of the FEP’s adequacy.

4.2.3 Irrigation schemes and other collectives
Schemes and other collectives can streamline and support a ‘managing to limits’ programme such as IASM and increase the opportunities for success compared to an individual grower implementing a programme. Family farms typically do not have the management resources to implement complex systems on their own, and even large farms look for management options that avoid duplication.

The governance and leadership by a scheme or collective can provide support for individual growers in the form of management, planning, systems, training and other assistance. They can also provide

\textsuperscript{10} A land management unit is a homogenous block of land with that responds in a similar way under similar management. These units should align with the blocks used in the nutrient budget.
a compliance regime that focuses on achieving improvements, rather than strict enforcement and sanctions.

4.2.4 Incentives and Sanctions
During discussions with various parties the question ‘how do you incentivise audited self-management?’ was raised. This is particularly relevant when there is little real incentive for a landholder to get involved in this type of programme. It is also important when looking to foster continuing improvement in management practices. It is well known that the environmental performance across any group of landowners will follow a ‘bell curve’ distribution. (See Figure 5). Regulatory compliance sets the baseline which all farms have to comply with. Those to the left of the baseline are likely to face sanctions in some form, as they don’t meet the minimum standard. The shift of the bell curve to the right shows how improvements in overall environmental performance can occur over time. Incentivising this movement could come through a range of mechanisms such as financial incentives, easing the consenting pathway and longer consent durations. Developing an incentives scheme is beyond the scope of this study.

![Figure 5: Using GMPs to improve water quality outcomes](from presentation to NZARM conference 2012 by Mackenzie I.)

4.2.5 Expected outcomes
‘Managing to limits’ sets the framework for the achievement, in due course, of community agreed water quality and quantity outcomes. Achievement of these outcomes will come from a combination of measures, including the control of point source nutrient contributions, catchment scale mitigations, and on-farm environmental management programmes. IASM is a key tool in the case of the latter. If, with time, the water quality and quantity outcomes are not achieved, then a review of
the overall programme will be necessary. Amongst other things this could necessitate a revision of the IASM management objectives.

Ultimately the overall effectiveness of the IASM programme will be judged by a combination of the following factors:

- The extent to which growers buy-in to the programme and actively seek to reduce their environmental footprint;
- Documented evidence of both widespread use of optimal management practices and the achievement of the management objectives and targets; and
- Public confidence in the programme.
5 Farm Plans in New Zealand

5.1 Farm Plan types
Farm Plans of various sorts, and more particularly Farm Environment Plans, have been widely used throughout New Zealand over many years to provide a record of planning and actions towards a wide range of objectives (e.g. soil conservation works, farm business planning, native biodiversity protection, riparian management), often as part of a grant or subsidy programme.

Some examples and further information on the range of Farm Plans are given in Appendix 1. This wide range of plans means that the term ‘Farm Plan’ or ‘Farm Environment Plan’ is often understood differently by different people. A key difference in the various plans is the purpose for which they are prepared.

In the context of an IASM programme the plan is specifically a ‘Farm Environment Plan to manage both water quality and quantity to meet regulatory requirements’. It will either be required by the regional council to meet resource consent or regional plan requirements, or may be an option to avoid an alternative, such as a resource consent application. A key difference between most Farm Plans and one for an ASM programme is that the Plan must be auditable and include provision for corrective actions where required. (i.e. ‘auditable’ assumes that there are clear objectives that the Plan is aiming to achieve, so that the auditor can make an assessment as to whether or not the farm practices are achieving the objectives.)

5.2 Current ‘Farm Plans’
Most of the farming sector organisations have a farm management planning package for their members.

Depending on the purpose for which the package was designed, plans may be voluntary, often starting from natural resource assessment (e.g. Beef and Lamb’s Land and Environment Plan) or compulsory if the grower wants to be part of market scheme (Sustainable Wine Growing, NZGAP(HortNZ)). Other plans cover specific issues e.g. Nutrient Management Plans (NZ Fertiliser Association/Ballance/Ravensdown).

Regional Councils also have a wide range of farm plan types, generally linked to grant/subsidy programmes for works for soil conservation, riparian management etc.

Table 1 provides a summary of a number of sector plans, and shows which IASM features they include.
**Table 1: Summary of sector farm management plans**

<table>
<thead>
<tr>
<th>Parameters</th>
<th>BLNZ - LEP 1&lt;sup&gt;11&lt;/sup&gt;</th>
<th>BLNZ - LEP 2</th>
<th>BLNZ - LEP 3</th>
<th>DairyNZ - SMMP&lt;sup&gt;12&lt;/sup&gt;</th>
<th>Supply Fonterra</th>
<th>HortNZ NZGAP</th>
<th>Morven Glenavy&lt;sup&gt;13&lt;/sup&gt;</th>
<th>Fertiliser Co. NMP&lt;sup&gt;14&lt;/sup&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Voluntary / Required</td>
<td>Voluntary</td>
<td>Voluntary</td>
<td>Voluntary</td>
<td>Voluntary</td>
<td>Required</td>
<td>Required for many markets</td>
<td>Required</td>
<td>Voluntary and required</td>
</tr>
<tr>
<td>Collective / individual</td>
<td>Individual</td>
<td>Individual</td>
<td>Individual</td>
<td>Individual with collective reporting</td>
<td>Individual with collective reporting</td>
<td>Individual as part of collective</td>
<td>Individual</td>
<td></td>
</tr>
<tr>
<td>Blocks / land management units</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes as part of nutrient budget</td>
<td>Yes as part of nutrient budget</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Risk assessment and options</td>
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<td>Limited</td>
<td>Limited</td>
<td>Limited</td>
<td>No</td>
<td>No</td>
<td>Limited</td>
<td>Limited</td>
</tr>
<tr>
<td>Management objectives and targets</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>Yes – set at catchment scale</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Nutrient budget</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>No – currently but likely</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Management practices / actions</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Limited</td>
<td>No currently Likely – criteria to achieve</td>
<td>Yes</td>
<td>Limited</td>
</tr>
<tr>
<td>Monitoring and review</td>
<td>No</td>
<td>Limited</td>
<td>Limited</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes – against criteria</td>
<td>Yes</td>
<td>Limited</td>
</tr>
<tr>
<td>Built in audit process</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
<td>Yes – against criteria</td>
<td>Yes</td>
<td>No</td>
</tr>
</tbody>
</table>

<sup>11</sup> BLZ LEP 1,2,3: Beef and Lamb New Zealand: Land and Environment Plan Levels 1, 2 & 3
<sup>12</sup> SMMP: Sustainable Milk Production Plan
<sup>13</sup> Morven Glenavy Ikawai Irrigation Co Ltd
<sup>14</sup> NMP: Nutrient Management Plan
5.3 Farm Environment Plans as a management tool

Farm Environment Plans are used for a wide range of management purposes. Some are single purpose, others cover several aspects. These include:

- Risk / business planning / business management tool
- Plan for determining and securing grant funding (e.g. soil conservation plan)
- Plan to meet market requirements (e.g. food safety) / secure niche markets (e.g. food or fibre quality)
- Plan to meet regulatory requirements (e.g. consents to take/use water)
- Plan as part of voluntary programme to demonstrate sound environmental practices to wider community

Concern about duplication of plans and particularly audits is widespread. However, in many cases the IASM plan would be complementary, or a sub-set of other farm plan types. Figure 6 shows how the IASM plan for water quality and quantity incorporates only some of the features of a ‘whole farm plan’. The IASM process provides for some or all objectives and targets in the FEP to be covered by a separate auditable plan (see IASM ‘How-To’ Guide).

In the development of the IASM ‘How-To’ Guide useful features and implementation experiences from this review have been incorporated. Some of the key aspects that have been identified as important for IASM are:

- Keep it simple
- Electronic, as far as practical, but recognise many growers prefer to work on hard copy
- Need to have clearly identified purpose (e.g. to reduce xx by yy across collective area)
- Need to be able to report i.e. demonstrate that action is being taken to address issues
- If using process to collect large amounts of grower data, need to be sure of quality and purpose for collection
- All those in scheme/collective should have a farm environment plan, even for a small block. Everyone needs to be included. If ‘low risk’ can minimise audit requirements. Some small blocks can have high risk activities
- Need a process to update plans with changes in managers/owners
- Support from grower leaders
- Need a governance framework
- Incorporate both sanctions and incentives
Figure 6: Elements of an IASM farm plan compared with key elements of a Whole Farm Plan
6 Risks associated with an IASM approach

The key to an effective environmental policy and procedure framework is the identification of risks and the organisational response to the management of these risks. As part of this review process, an assessment of the risks associated with the IASM approach was undertaken. The analysis is based on the following assumptions:

1. That the IASM approach is an effective way of managing the environmental aspects of a farming operation
2. That the IASM approach is part of a package which includes supporting measures including information/awareness programmes
3. That the IASM approach is underpinned by regulatory provisions

The risks associated with an IASM approach can be divided into 4 key areas.

- Risks relating to programme credibility
- Risks around the ‘buy-in’ and commitment to the process by growers, primary sector groups and regional councils
- Risks around the set-up of the programme
- Risks around the operation of the programme

To varying degrees, failure in any one of these risk areas will undermine the effectiveness of the IASM programme.

The source of these risks are many and varied recognising that IASM as a process has a number of potential failure points. It is also complicated by the fact that IASM is a process that covers collectives but involves a large number of individual enterprises each with its own unique farming system and management structure, and a large number of individual managers each with their own management style.

The risk management strategies suggested are considered necessary in order to minimise the prospects of failure and to maximise the effectiveness of the IASM process as a process for effectively managing the environmental aspects of a farming operation.

The risk management strategies suggested fall into seven categories.

- **Communication** - Good communications at all levels is critical to the success of the process, and will be assisted by clear understanding of different roles and responsibilities. This includes communication between:
  - the regional council and the collective body
  - the collective body and individual landowners
  - the industry support sectors and growers
  - IASM programme managers and the general public.

- **Skills, knowledge and training** - The training requirement includes training personnel to assist growers with the preparation and on-going implementation of their plans, programme governance training, training of auditors, and training for growers. The aim must be to build enough capability and capacity within the industry in order to effectively implement IASM programmes.

- **Support** – Support for growers as they transition into the IASM process. Support includes providing advice on options, working through issues as they arising on-farm, and follow-through when action is required.

- **Process** – Includes the full IASM set up including scheme protocols, Farm Environmental Plan, audit and compliance processes
- **Governance** – Good governance is critical to the success of the programme. The governance body (i.e. the collective entity) must have good systems and processes in place for management and oversight purposes and provide clear guidance on roles and responsibilities.

- **Purpose** – While the primary purpose for IASM is for the management of environmental effects from on-farm activities it has other purposes particularly as a risk management tool. Broadening the scope of IASM use will enhance its effectiveness.

- **Format** – Ease of use will be a key factor when it comes to the uptake of the IASM by growers. Central to ease of use is linking the programme through an electronic format, but recognising the need for paper-based options. Streamlining recording and minimising duplication and overlaps between various reporting requirements will assist gain grower support.

The full results from the risk assessment are presented in Table 2 below.
<table>
<thead>
<tr>
<th>Risk (What can happen?)</th>
<th>Source (How / why might it happen?)</th>
<th>Potential Risk Management Strategies</th>
</tr>
</thead>
</table>
| Lack of public confidence in IASM approach (i.e. the approach is seen as a ‘whitewash’ and loses its credibility). Any loss of confidence and credibility in the approach could ultimately undermine its effectiveness by increasing tensions between land users and the wider public. | A lack of public confidence in the approach could occur for a variety of reasons including:  
- Poor communication, reporting and feedback on progress made through IASM. (i.e. the public are not kept informed of progress made.)  
- Key on-farm environmental issues are not addressed even though an IASM approach is in place. | Potential risk management strategies include:  
- The development and implementation of a communications Plan  
- Regular review and feedback to the community  
- Inadequacies in FEPs picked up through farm plan approval process and/or audit process. |
| Limited grower buy-in and support for the IASM concept. Plans are prepared but are not fully backed by growers. | Limited grower buy-in and support for the IASM concept could occur for a variety of reasons including:  
- Plans are prepared by consultants, with little input / buy-in from grower  
- Reasons for introduction of concept are not clearly explained. Concept seen solely as an academic exercise to keep the regional council happy.  
- Limited support provided for growers during the implementation phase.  
- Benefits of concept poorly articulated.  
- Goals / outcomes / appropriate practices not clear  
- Expectation that a generic programme is acceptable.  
- Negative media coverage of poor audit results (c.f. publicity re effluent compliance) | Potential risk management strategies include:  
- Providing information to growers that clearly and consistently sets out expectations and responsibilities under the programme.  
- Training of consultants  
- Inclusion of support structure for growers during the implementation phase.  
- Providing flexibility within approach to recognise different farming systems, management approaches, and individual aspirations.  
- Obtaining grower feedback |
| Limited buy-in and support for the concept from industry organisations particularly where a generic process is imposed upon growers | Limited buy-in and support from industry organisations for the IASM concept could occur for a variety of reasons including:  
- IASM concept is seen to be in direct conflict and/or competition with already prepared or proposed industry schemes.  
- Pressure upon industry sectors from grower levy payers to resist the implementation of the IASM approach.  
- Industry organisations have limited involvement in the development of the IASM concept.  
- Growers ‘blame’ scheme/sector for increased rules and paperwork. | Potential risk management strategies include:  
- Reasons and benefits of IASM approach clearly explained to industry organisation.  
- IASM concept set up to avoid duplication and to link in with existing industry schemes as far as possible. (e.g. Supply Fonterra could supply nutrient component of IASM) |
<table>
<thead>
<tr>
<th>Risk (What can happen?)</th>
<th>Source (How / why might it happen?)</th>
<th>Potential Risk Management Strategies</th>
</tr>
</thead>
</table>
| IASM approach by default leads to a culture of ‘achieving compliance alone’ is all that needs to be achieved. | The promotion of IASM as an approach could result in a ‘compliance achievement only’ culture for a variety of reasons including:  
- There being little or no incentive for growers to be involved beyond the minimum standards.  
- A strong focus of the audits becoming ‘compliance’ checks without a learning and adaptive management component.  
- The benefits of adopting an adaptive management approach are undersold. | Potential risk management strategies include:  
- Strong educational component built into programme  
- The setting of clear and measurable targets within IASM programme which provide ‘stretch.’  
- Promotion of the multiple benefits of IASM approach.  
- Incentivise continuous improvement aspects of the programme. |
| The system becomes overly bureaucratic adding to costs and detracting from its main function of affecting change on the ground. | The system adopted could become overly bureaucratic for a variety of reasons including:  
- Poorly defined allocation of responsibilities and inadequate controls.  
- Poor governance and/or management by scheme or collective.  
- Reporting requirements that seek information that is beyond that is essential for regional councils to fulfil their functions.  
- Regional Councils can’t ‘let go’ sufficient control to give IASM opportunity to work.  
- Poor performance by some IASM programmes means that Regional Councils increase control over all IASM programmes. | Potential risk management strategies include:  
- Regional Council sets up multi-stakeholder management group to oversee programmes in region. The nature of these groups might vary from region to region reflecting regional differences. In Canterbury for example the Zone Committees may be the appropriate groups.  
- Upfront agreement between the regional council and collective entity on nature of programme.  
- The establishment of clear governance and overall management procedures.  
- Introduction of industry and regional council supported support programme for those IASM programmes which are under performing |
| Significant grower frustrations and negativity develop towards the process | Frustration and negativity towards the process from growers could develop for a variety of reasons including:  
- Lack of or poor communication with programme governance body.  
- Unnecessary changes to the mode of operation of the IASM programme.  
- A failure to follow due process through the operation of the IASM programme. (i.e. due process steps are not followed)  
- Inconsistencies in the approaches adopted between farms in the programme.  
- Duplication – growers are asked to provide the same data for more | Potential risk management strategies include:  
- IASM programme protocols that clearly set out roles and responsibilities as well as the mode of operation.  
- Clear and regular communications between IASM programme management and growers.  
- Regular liaison between industry bodies and regional councils to minimise duplication and maximise overall programme effectiveness.  
- IASM focuses on managing water quality and quantity to limits |
<table>
<thead>
<tr>
<th><strong>Risk</strong> (What can happen?)</th>
<th><strong>Source</strong> (How / why might it happen?)</th>
<th><strong>Potential Risk Management Strategies</strong></th>
</tr>
</thead>
</table>
| On-farm improvements are not recognised in the short term as contributing to improved environmental outcomes | The contribution of on-farm improvements may not be recognised in the short term for a variety of reasons including:  
- A lack of understanding of the impacts of lag times. (i.e. on-farm nutrient losses may take several years to reflect in improved environmental outcomes)  
- Unrealistic expectations | Potential risk management strategies include:  
- Establishment of ASM programme multi-stakeholder monitoring and review groups to review progress against all sources of monitoring information (e.g. water quality data, on-farm audit results etc.) and ensure goals are realistic. These groups should meet at least once per year. |
| Management strategies as set out in the plans are inadequate to manage environmental risks associated with key on-farm activities and/or to meet the management objectives and targets. | There are a variety of reasons why the management strategies as set out in the plans could be inadequate including:  
- Insufficient guidance in the management objectives and targets to clearly direct a ‘high standard of environmental management.’  
- An underestimation of what is required to manage the identified environmental risks.  
- Insufficient editing of FEP template and/or personalisation for particular property. | Potential risk management strategies include:  
- Include as part of the IASM programme protocols the requirement for FEP approval. A peer review panel should also be provided to hear and make judgement on any disputes on the content of the FEP submitted for approval.  
- Provision of a support and/or advice system for growers preparing FEPs  
- The provision of clear guidelines for growers on FEP preparation and requirements. |
| Management strategies as set out in the farm plans are not implemented at all or only partially implemented. | There are a range of reasons why the strategies as set out in the farm plans may not be implemented. These include;  
- Apathy towards the process  
- Lack of ownership of plan content. (i.e. plans prepared by consultant with little grower input)  
- Lack of management skills to implement plan  
- Financial pressures  
- A lack of awareness of the issues and/or management options.  
- Seasonal differences – some management strategies may not be required some seasons because of seasonal factors. | Potential risk management strategies include:  
- The inclusion of clear audit and compliance procedures within the IASM programme protocols.  
- Information/awareness support programmes. (e.g. know your soils, and irrigation efficiency field days)  
- Property specific FEPs which clearly reflect individual’s aspirations while providing an outline of how the management objectives and targets will be met. |
<table>
<thead>
<tr>
<th>Risk (What can happen?)</th>
<th>Source (How / why might it happen?)</th>
<th>Potential Risk Management Strategies</th>
</tr>
</thead>
</table>
| Plans are not updated when farm activities change or when new owners or managers come onto the property. Farm plans are farm operation and manager specific, the risk lies in the farm plans not fairly reflecting new ownership and/or management aspirations. | There are a variety of reasons why plans may not be updated when required including:  
- There are no or inadequate procedures and controls in place covering what happens when changes in activities and/or management personnel occur. | Potential risk management strategies include:  
- The inclusion of provision within the IASM programme protocols requiring FEP updates if there is a significant change to the farming operation or to on-farm management practices or if a new manager is appointed.  
- The inclusion of provision within the IASM programme protocols requiring grower members to notify IASM programme managers when there is a change of management on farm. |
| Audit process doesn’t pick up on non-compliance and/or inadequate follow through on non-compliance. | A failure of the audit process to pick up on non-compliance could occur for a variety of reasons including:  
- A potential failure of the audit process and/or a failure to follow through on non-compliance identified through the audit process.  
- Inadequately trained auditors | Potential risk management strategies include:  
- All farms must be audited by an external auditor at least once every three years.  
- All issues of non-compliance identified by the auditor must be addressed by scheme/collective/individual.  
- Scheme/collective has ‘complaints’ process so others can advise of possible non-compliances  
- High risk properties will be dealt with as a matter of priority.  
- Ideally the Irrigation scheme or Irrigation collective will provide support to the grower to develop an Action Plan to address issues identified. Actions plans will include specific timeframes for action.  
- Enforcement action will ultimately be taken in the event that other actions fail.  
- Auditors are required to be ‘accredited’ by regional council |
<table>
<thead>
<tr>
<th><strong>Risk (What can happen?)</strong></th>
<th><strong>Source (How / why might it happen?)</strong></th>
<th><strong>Potential Risk Management Strategies</strong></th>
</tr>
</thead>
</table>
| Lack of overall IASM programme governance and management oversight. | A lack of overall IASM programme governance and management oversight could occur for a variety of reasons including:  
• Insufficient governance controls.  
• Lack of scheme/collective commitment to the process | Potential risk management strategies include:  
• The provision of IASM programme governance and management oversight training.  
• On-going support of IASM programmes  
• Introduction of a regular IASM programme effectiveness check. |
7 Conclusions
Managing to limits

- The world has changed, and managing to limits for water quality and quantity means that growers will need to demonstrate compliance to a greater extent than has been required in the past.
- Throughout New Zealand, regional councils are in the process of setting objectives and limits for freshwater management and determining approaches to achieving them. The approach taken by each council is likely to vary, reflecting local differences.

Audited Self-Management

- ASM (Audited Self-Management) as an approach has been endorsed by Land and Water Forum for groups and individuals to achieve and demonstrate on-farm results.
- An Irrigation Audited Self-Management (IASM) programme can provide a package for irrigation schemes, collectives and individuals to manage water quality and quantity within limits and meet new regulatory requirements.
- IASM is a suitable approach, but not the only one. To avoid duplication IASM should continue to be developed as a programme that can be linked with other plans.
- A collective approach has advantages over individuals being left to work on their own, such as: efficiencies in a group working together; greater opportunity to support on-going improvements; easier to demonstrate progress to the wider community.

ASM for Irrigation (IASM)

- Existing Farm Plans are many and varied, and have different purposes and styles
- The elements required for water quality and quantity management and compliance are a sub-set of ‘whole farm plans’, but are not necessarily included in all types of Farm Plans.
- Some plans (e.g. farm business plan) may be best used as source of information for an IASM farm plan. Others, especially those that are audited, may provide an alternative option, as long as they cover the necessary water quality and quantity issues, even though the current purpose of the plan is not for RMA compliance (e.g. NZGAP).
- Duplication and overlap of plans and audits may not be a major issue. Most plans are voluntary (e.g. Beef and Lamb’s Land Environment Plan, Sustainable Milk Production Plan) and are not formally audited. An IASM Farm Plan would be complementary to a plan such as ‘Supply Fonterra’ which could be used as a component of the IASM FEP. With plans like NZGAP, that are audited, the same auditor should be able to cover a section on RMA water management requirements. The IASM process can be sufficiently flexible to link with other plans and avoid duplication.
- An IASM on-farm programme should consider those areas of farming activity which potentially have an impact on water quality and water quantity including: irrigation, stock, fertiliser, cultivation, waterways and wetlands, and effluent management.
- Based on these areas of farming activity, an IASM programme should include as a minimum, management objectives and targets for irrigation, nutrients, and waterway/wetland
management. The farm plan would be part of a package which includes supporting measures including information programmes.

- The IASM Farm Plans need to reflect the uniqueness of individual properties
- Good Management Practices alone may not be enough to achieve targets and further measures may be required in some situations.
- The Farm Plan template will need to be adapted for each scheme / group etc and for specific regional council requirements.
- Farm Environment Plans are only part of the IASM package. Other aspects of the package (e.g. governance frameworks, information, training) will also need to occur so that the system has a higher likelihood of success.
- IASM must provide clarity about what is to be audited and what against.
- The IASM process should encourage a culture of continuous improvement.
- IASM Farm Plans should be electronic, but need on-farm support. There are risks that a checklist/tick box approach may not be sufficiently robust.
- Maori cultural issues need to be better understood by many schemes and incorporated into on-farm objectives and targets, for example, through consultation with local iwi at the scheme governance and management level during scheme/collective policy development and design of farm plan template.
- IASM has to play a tangible part in achieving outcomes, but need to note the likely lag effects in downstream water quality outcomes (e.g. in estuaries). Both demonstrating that practices have changed and robust catchment water quality monitoring will be required.
- Both incentives and sanctions should be included.
8 Appendices

Appendix 1: Terminology and Definitions

*Audited Self-Management and Environmental Management Systems*

‘Environmental Management System’ (EMS) and ‘Audited self-management’ (ASM) are two terms that commonly used to describe processes that can be used to manage water quality and quantity on-farm. The terms are used in slightly different ways by different authors and different groups.

**Audited self-management**

**Audited self-management** (ASM) is a term that has been recently adopted for water management in NZ. The Land and Water Forum (LaWF) in their second\(^\text{15}\) and third\(^\text{16}\) reports (2012) report settled upon the following definition for ASM for water quality, although it is equally applicable to water quantity:

> ‘A management programme (individual, industry, or land user collective) which allows for the credible and transparent demonstration (audit) that agreed actions have been implemented (in this instance for water quality).’  
> LaWF report 2 2012 (Glossary)

The first LaWF report\(^\text{17}\) (2010) (paragraphs 103/4) described ASM more narrowly:

> “Used in conjunction with GMP, audited self-management (ASM) is an established audit system designed to verify adherence to GMP requirements, particularly where certification leads to market benefits. Used with regulatory compliance, ASM schemes transfer day-to-day resource management responsibilities to users under agreed terms, and subject to transparent audit. Commonly, an auditor approved by the regulator (a regional council) is engaged to undertake a compliance audit, which is then accepted by the regulator as proof of regulatory compliance by the consent holder.”

ASM involves groups or schemes developing their own policies, procedures and plans to achieve environmental outcomes that have been agreed with the regulator with third party (independent) auditing of environmental systems and performance i.e. the group accepts responsibility for the environmental aspects of their operations.

The LaWF Report (paragraph 106), states that in order for ASM to work effectively within a regulatory compliance framework, ASM needs to provide:

http://www.landandwater.org.nz/  
• robust and accessible data
• clearly defined roles, responsibilities, and consequences
• accessible and transparent governance
• open and regular communication between partners.

What is clear from the literature is that, while there is general agreement on what ASM entails, there is also a fair degree of latitude within the definition. This is highlighted by Willis\(^{18}\) in evidence to the Hurunui-Waiau Regional Plan Hearing (2012). In this he describes two types of ASM:

a) Industry schemes e.g. Dairying and Clean Streams Accord that provide a goal and range of services to industry participants. Accountability for performance rests with governing body

b) ASM schemes that have property specific obligations, to achieve a collective goal. Individual properties are accountable for performance towards goal (and may be sanctioned for non-performance).

Willis sees type (a) providing tools and support that will help to achieve type (b) plans.

Carruthers\(^{19}\) (2011), considered that, based on LaWF first report, ASM as a concept needed further development to achieve LaWF’s aspirations for the approach.

Environmental Management Systems (EMS)

Another term that has been used in relation to audited farm environment plan processes for irrigation is ‘Environmental Management System’ (EMS). For example, ‘An Environmental Management System for Irrigation Schemes in New Zealand (2009)\(^{20}\), describes an EMS process that also fits the definition of ASM.

An Environmental Management System (EMS) is defined as:

“An environmental management process implemented by an operator to assess, avoid and/or mitigate risks to the environment arising from their farming activities.

It is a ‘tool’ that enables a farming operation of any size or type to control the impact of its activities, on the natural environment.

\(^{18}\) Statement of evidence of Gerard Matthew Willis on Proposed Hurunui and Waiau River Regional Plan on behalf of Fonterra Co-operative Group Ltd and Dairy NZ (submitters to Canterbury Regional Council) Oct 2012


An EMS approach may be used to demonstrate to markets and regulators adherence to good management practices, agreed standards, or agreed management objectives.”

An Environmental Management System (EMS):

- Serves as a tool to improve environmental performance
- Provides a systematic way of managing an organisation’s environmental affairs
- Is the aspect of the organization’s overall management structure that addresses immediate and long-term impacts of its products, services and processes on the environment
- Gives order and consistency for organizations to address environmental concerns through the allocation of resources, assignment of responsibility and ongoing evaluation of practices, procedures and processes
- Focuses on continual improvement of the system

![Environmental Management System (planning and action cycle for continuous improvement)](image)

**Figure 7 : Environmental Management System (planning and action cycle for continuous improvement)**

The ‘Environmental Management System’ (EMS) approach is based on the ‘Plan, Do, Check, Revise’ cycle of management and continuous improvement (Fig 7). This process is well-documented and has been adopted in agriculture across Australia and New Zealand to demonstrate their environmental stewardship and obtain marketing advantages by communicating their sustainable production initiatives. A critical factor in EMS for agriculture is an audit process, often external, to provide proof...
that natural resources are being carefully managed. EMS typically includes a risk assessment of environmental issues.

It is important to note that an ASM process is not necessarily an EMS. However, an EMS process can be effectively used to underpin an ASM arrangement.

**Farm Plans**

The term ‘Farm Plan’ is used in New Zealand and overseas for a wide range of planning documents developed by, or for, growers for use within their business. Some plans are internal to the business and others are available to a limited audience or even publicly available.

Farm plans types can be grouped into three broad categories:

1. Whole farm plans
2. Farm environment plans (may be single issue)
3. Nutrient management plans (may also be a component of a whole farm, or farm environment plan)

Checklist plans

The reasons for having a farm plan are varied and the purpose of the plan usually determines the type of plan. Some of the drivers for farm plans are:

- Risk / business planning / business management tool
- Plan for determining and securing grant funding (e.g. soil conservation plan)
- Plan to meet market requirements (e.g. food safety) / secure niche markets (e.g. food or fibre quality)
- Plan to meet regulatory requirements (e.g. consents to take/use water)
- Plan as part of voluntary programme to demonstrate sound environmental practices to wider community

The farm plans reviewed in this study were mostly based on the premise that having a good understanding of the resource was a good starting point.

In order to identify the elements that are required for water quality and water quantity management, it is useful to clarify how these plans differ.

**Whole Farm Plan**

A ‘Whole Farm Plan’ or ‘Whole Property Plan’ is the most extensive type of farm planning document. The purpose is to review and tabulate full range of resources, goals and aspirations, financial and other constraints and develop a programme for the farm and farm family to achieve their aspirations over time. It is often prepared as part of strategic planning for succession planning or property
development. They may include detailed personal information on family aspirations and financial matters.

**Farm Environment Plan**

‘Farm Environment Plans’ typically cover a sub-set of the Whole Farm Plan and focus on the land and water resources. The Farm Environment Plan concept is not new with various forms having being promoted by agencies and used by growers for various purposes for many years. Blaschke and Ngapo (2003)\(^1\) and Brown (2006)\(^2\) described the types of farm environment plans that have been used in NZ.

The early use of farm plans in NZ was centred around soil conservation. The plans described the land resource and land capability and issues, then set out a works programme, such as tree planting etc. These plans were usually associated with, and a condition of, grant funding.

Farm plans range in complexity and sophistication from the simplest, which provide a list of recommended environmental works to be completed, to the most complex which model the effects on the whole farm business and the viability of activities implemented to address environmental issues.

Brown (2006) notes that good results are reported from a number of regions from many years of farm planning activities, despite the lack of a direct evaluations of the farm planning process and positive environmental outcomes. He also notes that, where success has been reported, the farm plan itself has only been the start of the process. Other factors include on-going commitment and support and the development of close working relationships between the councils and their landholder clients.

Other types of farm plans include forestry oriented environmental farm plan, riparian plans, comprehensive farm plans. See Blaschke and Ngapo for more detail.

Farm Environment Plans generally meet the following criteria:

- Individual farm scale – impact of farm activities on an environmental issue/s
- Historically, often single issue focussed (soil erosion, riparian management), but some take a farm/environmental system approach to address multiple issues
- Implementation based on land user’s objectives, resources and timescale
- Generally include a significant works component
- Often prepared by agency staff in consultation with landowner

The variation between the different environmental farm plans makes them difficult to categorise. The range of examples can be differentiated according to the environmental management issue they

\(^{1}\) Blaschke P and Ngapo N. 2003. Review of New Zealand Environmental Farm Plans. Prepared for Ministry for the Environment

target. (e.g. erosion, riparian, biodiversity, pests or soil health); issue scope (single issue plans, single plus secondary issues, or multiple issues); targeted farming type; comprehensiveness; structured framework and content (traditional, checklist based, multi-report or single document); method of issue assessment; the manner in which they are prepared (do it yourself, workshops and groups or consultancy); inclusion of management agreements and the degree of monitoring that is used.

This means that there is a wide variation in understanding and expectations around a Farm Environment Plan. However, as the term has already been used to describe land user plans for managing environmental issues arising from irrigated land use, there appears to be little reason to change the terminology. It seems inevitable that whatever details are added (e.g. Farm Environmental Management Plan for Irrigated Land Use’), they will be referred to as ‘Farm Plans’. Therefore the term ‘Farm Environment Plan’ and ‘Farm Plan’ for short, as suggested as appropriate.

Nutrient Budget

A **nutrient budget** provides an assessment of the nutrient outputs (production, runoff, leaching losses etc.) and nutrient inputs (fertiliser, feed supplements, effluent etc.) within a particular farm system. Nutrient budgets assist with understanding nutrient use and movements within a farm and evaluating management scenarios to optimise production and reduce losses from the farm system.

Nutrient budget models such as OVERSEER, are used calculate and estimate these nutrient flows and produce the nutrient budget report. The nutrient budget helps inform fertiliser and other nutrient management recommendations. The nutrient budget report can also be used to make a judgment on the potential for risk of environmental impact through nutrient losses such as run-off and leaching, and greenhouse gas emissions.

A nutrient budget is an important component of a nutrient management plan, but is not, itself, a nutrient management plan, as it does not set targets to be achieved.

Nutrient Management Plan

A nutrient management plan is “a written plan that describes how the major plant nutrients (nitrogen, phosphorus, sulphur and potassium, and any others of importance to specialist crops) will be managed. It aims to optimise production and maximise profit value from nutrient inputs while holding or minimising any adverse effects on the environment.” (Nutrient Management Code of Practice)

Nutrient management plans vary in size and scope but normally include a nutrient budget and identify actions to minimise losses of N and P (including via effluent, soil, surface and ground water, stock and crops etc). Edmeades et al. (2011) note that ‘It has been estimated that a full NMP report

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of the type envisaged would take about 2 days to compile, in addition to the 2-6 hrs required for the farm visit. The NMP must be farm specific to be relevant – individual farm visits are essential.' They note that the credibility inherent in a full NMP approach could be undermined if short cuts are taken and NMPs are not robust and credible.

Nutrient management plans are generally single purpose plans (i.e. to manage on-farm nutrients) but the boundaries between NMPs and FEPs are a rather ‘hazy’ particularly when riparian and irrigation actions are included with mitigation measures within the NMP. This compounds the confusions around the understanding and use of the terminology.

Mladenov (pers. comm.) notes that the intention of the NMP process is to be iterative and follow a farm, tracking progress towards limits through monitoring and assessing the management actions undertaken to achieve the identified nutrient management goals and objectives.

Figure: Nutrient Management Plan in the context of nutrient budget and FEP

Good Management Practices

Good Management Practices (GMPs) is a term used to describe practical measures that are recognised as appropriate e.g. in codes of practice, guidelines, manuals and user guides (e.g. Code of Practice for Nutrient Management, Irrigation Design Code of Practice, many riparian management guidelines) as being acceptable for agreed situations to reduce or minimise an adverse environmental effect. For example, GMPs for N fertiliser application are set out in Code of Practice Nutrient Management; standards for riparian fencing and planting are described in various guidelines for different regions.

GMPs are particularly important where appropriateness of a practice in any one situation is strongly influenced by a wide range of factors (e.g. the changing nature of the operation, land and soil type, land use, weather, season, regulatory and market influences, and financial considerations). Therefore some degree of modification of a generic practice (e.g. soil moisture monitoring for irrigation scheduling) is required to suit the specific nature of the operation and/or local circumstances.

GMPs also important where there is diffuse pollution such as runoff or leaching which is difficult to monitor accurately and/or to determine sources of problems. As GMPs need to be specific to the particular natural environment and land use enterprise they cannot be readily detailed at regional or catchment level.

Achieving ‘Good Management Practices’ (GMPs) on-farm would be an integral part of an IASM programme. Where GMPs need to be adopted part of an IASM programme, they must be incorporated within a framework, such as a management plan that sets out the purpose of the GMP (i.e. what is the objective for the practice) and shows that the particular practice is appropriate (e.g. for that soil type, land use etc). The audit would assess whether the practices have been implemented.
Appendix 2: Regional Council requirements
Regional Council Requirements for Farm Environment Plan and Nutrient Management Plans

The following tables provides a summary by region of the requirements now, and expected requirements in about two years’ time for Farm Environmental Management Plans.

<table>
<thead>
<tr>
<th>Region</th>
<th>2012</th>
<th>In 2-3 years</th>
</tr>
</thead>
<tbody>
<tr>
<td>Northland</td>
<td>No specific FEP or NMP requirements as yet. New RPS notified requiring establishment of nutrient loss limits through subsequent plan reviews</td>
<td>Expecting programmes underway to establish water quality limits</td>
</tr>
<tr>
<td>Auckland</td>
<td>No specific FEP or NMP requirements as yet. Rural advisory panel established</td>
<td>Expecting zoning and water quality limits establishment programme (similar to that of Canterbury) to be underway with requirements for FEP.</td>
</tr>
<tr>
<td>Waikato</td>
<td>Requirement for NMPs for any applications of N greater than 60kg/ha/yr (Rule 3.9.4.11) Requirement for NMPs under N cap within Lake Taupo catchment (Reg Plan variation 5)</td>
<td>Expecting requirements for FEP for all intensive farming within N caps and with required reductions over time – as component of full regional plan review.</td>
</tr>
<tr>
<td>Bay of Plenty</td>
<td>Requirement for establishment of nutrient benchmarking and NMPs for farming in Rotorua Lakes catchment (Rule 11), but has not been enforced. RPS has identified all Rotorua Lakes as catchments at risk, with N and P caps to be established through subsequent plan reviews</td>
<td>Expecting requirement for FEP for all intensive farming with N caps and with required reductions over time – as component of full regional plan review.</td>
</tr>
<tr>
<td>Gisborne</td>
<td>No specific FEP or NMP requirements as yet. Land &amp; Water Advisory panel established</td>
<td>Expecting programme underway to establish water quality limits.</td>
</tr>
<tr>
<td>Hawke’s Bay</td>
<td>No specific FEP or NMP requirements as yet.</td>
<td>Expecting establishment of N&amp;P limits and requirements for FEP as evidence by Tukituki plan change.</td>
</tr>
<tr>
<td>Manawatu / Wanganui</td>
<td>Sept 2012 Interim Environment Court decision on One Plan requires NMP’s for all dairy, irrigated sheep and beef, horticulture and cropping. Requirement for NMP’s for any application of N greater than 60kg/ha/yr for all of the region</td>
<td>Full review of Regional Land &amp; Water Plan to begin</td>
</tr>
<tr>
<td>Taranaki</td>
<td>No FEP or NMP requirements</td>
<td></td>
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<tr>
<td>Wellington</td>
<td>No specific FEP or NMP requirement as of yet.</td>
<td>Expecting the introduction of N &amp; P caps especially for sensitive</td>
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<tr>
<td>Region</td>
<td>Requirements</td>
<td>Status</td>
</tr>
<tr>
<td>-------------</td>
<td>------------------------------------------------------------------------------</td>
<td>---------------------------------------------</td>
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<tr>
<td>Tasman/Nelson</td>
<td>No specific FEP or NMP requirements as of yet.</td>
<td>Expecting programmes underway to establish water quality limits</td>
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<tr>
<td>Marlborough</td>
<td>No specific FEP or NMP requirements as of yet.</td>
<td>Expecting programmes underway to establish water quality limits</td>
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<tr>
<td>West Coast</td>
<td>No specific FEP or NMP requirements as of yet.</td>
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<tr>
<td></td>
<td>Lake Brunner protocols: Soil testing protocols and application of P fert with water solubility of less than 10%</td>
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<tr>
<td>Canterbury</td>
<td>LWRP requirements – pre 2017</td>
<td>Expecting FEP requirements as result of sub-regional plan development. N loss thresholds for all land uses and water quality limits.</td>
</tr>
<tr>
<td></td>
<td>• Existing land users record nutrient losses</td>
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<td></td>
<td>• Existing land users – Lake Zone – require FEP (NMP as section) according to schedule 7.</td>
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<td></td>
<td>• Change of land use – requirements for FEP (NMP as section)</td>
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<td></td>
<td>LWRP requirements – post 2017</td>
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<tr>
<td></td>
<td>• Requirement for FEP (NMP as section) for all farming activities above N threshold.</td>
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<td></td>
<td>Hurunui-Waiau Plan</td>
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<td></td>
<td>• All land users must be part of ASM programme and have FEP (NMP as a section) by 2017</td>
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<tr>
<td>Otago</td>
<td>No specific FEP or NMP requirements as of yet.</td>
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<td></td>
<td>Plan change 6A requires farm specific direct water quality monitoring.</td>
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<td>FEP required as condition of consent for NOIC.</td>
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<tr>
<td>Southland</td>
<td>Requirement for FEP (NMP as a section) for all new dairy conversions</td>
<td>Expecting expanded requirement for FEP for intensive land uses. Introduction of N cap very likely.</td>
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</tbody>
</table>