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Evaluation of the Integrated Catchment Management Pilot Project - final report June 2009

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Executive summary

Managing the water quality of the region's waterways is an important aspect of the work of Environment Waikato. In 2006, Environment Waikato identified that agricultural practices were contributing to rising nutrient levels within the region's waterways, and particularly within the Waikato hydro lakes. In response, they launched a three year intensive policy implementation pilot process, the Integrated Catchment Management (ICM) pilot project, within two of the region's sub-catchments. The objective of the ICM pilot project was to investigate the potential effectiveness of ICM approaches in achieving sustainable improvements in water quality.

The two catchments, Little Waipa and the Waipapa were chosen because they were of a manageable size, were representative of land use within the Environment Waikato region, had a large agricultural component, had a trend of increasing nutrient leaching (and this was able to be monitored), had a mix of relationships with Environment Waikato, and did not have significant geothermal issues[1].

The ICM project focused on working with farmers to change or improve their agricultural practices and included community consultation, working with individual farmers to develop farm management plans, and collation and modelling of data to determine potential effectiveness. The initial consultation process identified that on-farm nutrient management was a priority for farmers and that mainly nitrogen (N) and then phosphorus (P) levels were priority issues for the catchments. So the project focused on nutrient management, with a larger focus on N and latterly on P.

In order to monitor the pilot and determine its effectiveness, the project team developed an evaluation plan with seven key areas to measure. Procedures to collect and collate data relevant to the success areas were incorporated into the project. These included staff collecting and reporting on some information and an independent evaluator collecting and reporting on some information. The independent evaluation was introduced early in the project and regularly fed back into the project as it progressed. Independent evaluation activities included interviews with participating and non-participating farmers, interviews with industry representatives, analyses of spreadsheet data and facilitated meetings with ICM staff.

Key findings from the project were:

Engagement and communication

- The communities were initially cautious Environment Waikato's intentions with ICM and as such community engagement took more time than was initially anticipated. Of interest was that where there were pre-existing relationships with Environment Waikato (for example Stream Care groups) engagement appeared to occur more quickly and easily.
- The initial intention of ICM was to involve 100 per cent of farmers in the project, however this proved to be an unattainable goal with the allocated resource (staff and time). An approach that targeted farms by type and size proved to be a more efficient use of the resources.
- There were 100 farms eligible to participate in ICM in the two catchments; 78 farms and 67 farmers in the Little Waipa and 22 farms and 21 farmers in the Waipapa.
- Of the 78 farms in Little Waipa, ICM engaged, within the project timeframe, 48 (62%) farms, representing 73% of the land area of the catchment. Of these 48 farms, 25 have completed Farm Plans.
- Of the 22 farms in the Waipapa, ICM engaged, within the project timeframe, 12 (55%) farms, representing 84% of the land area of the catchment. Of these 12 farms, four have completed Farm Plans.

[1] Geothermal activity has an impact on water quality and as such can mask the effects of other innovations.

- Most (56) farms engaged in ICM to date, are dairy farms with four being dry stock farms[2].
- Farmers found the ICM process interesting and valuable, and spoke highly of the ICM staff involved. The staff had appropriate knowledge and ability to communicate and build relationships which was essential to effectively engage farmers in the project.

Uptake of actions

- The findings showed that a one-on-one farm planning advisory approach by skilled staff was effective in encouraging on-farm change. Farmers involved in ICM made changes to their on-farm practices as a result of the project.
- Farmers were willing to uptake actions that were affordable, that did not adversely affect productivity or profitability, and that fitted with their farm system. They were less likely to uptake actions that were more costly, did not fit the farm system, adversely affected productivity, or were not proven to work.
- The lack of clear nutrient targets and guidelines for some of the actions being presented were barriers to engagement and uptake of actions; that is farmers need to know what is required and how to get there so they can make informed decisions on-farm.

Impact of actions

- In the Little Waipa ICM had achieved an agreed reduction of on-farm nutrient leaching by four kgN/ha/yr (from 42 to 38kgN/ha/yr on average), on 20 dairy farms, equating to a modelled seven tonnesN/year, with the potential to reduce it to 30kgN/ha/yr if all suggested actions were undertaken.
- ICM had not yet gained agreement from enough farms in the Waipapa to make modelling of agreed actions a feasible option, although the 'at best' option for nine Waipapa dairy farms was a modelled reduction of nine kgN/ha/yr (from an average of 37 to 28kgN/ha/yr).
- Modelling showed that there is still a 'gap' of between four and eight kgN/ha/yr to reach a level of no net decline in water quality[3]. While attenuation may affect this to some extent it is unlikely that this will be enough to reach the targets and other solutions (for example new technologies yet to be developed) may be required.
- The pilot data also showed that if farmers changed their farming system or land use (for example intensification), then this impacted the nutrient budget and their leaching levels could increase again. This highlights the need to ensure that nutrient budgets are revised when there are land use or other on-farm changes.

Environment Waikato systems

- The project highlighted some challenges for Environment Waikato in terms of their internal processes and gave some clear indications of the need for continued improvement of internal integration.

Industry involvement

- The involvement of industry representatives developed as part of the project and was valuable to ensure that all parties involved with nutrient management issues on farms were kept in the loop. This involvement also paved the way for ongoing discussions and collaboration with industry which is significant for future sustainability.

Overall, the ICM pilot approach was effective at engaging the community and the farmers, and encouraging change. It also provided a significant amount of qualitative

[2] Most farms in the catchments are involved in dairying, with a smaller number being dry stock, although these are often large sized farms, some lifestyle blocks and forestry blocks. Dairying is also more intensive and linked with higher nutrient leaching. It is therefore to be expected from both a numbers and a nutrient focus, that most farms involved are dairy-based.

[3] No net decline is the policy objective of the operative Waikato Regional Policy Statement. Current modelling suggests that 'no net decline' in water quality could be achieved if losses did not exceed 22-26kgN/ha/yr. This figure applies to dairy farming in Upper Waikato with the current land use.

and quantitative data on factors that affect achievement of nutrient efficiency on-farm. ICM had a positive impact on reducing N loss in the catchments. Findings highlighted that further strategies need to be investigated to further reduce nutrient losses and as well there needs to recognition that Farm Plans and nutrient budgets need revising if their are land use changes or intensification.

Recommendations

The following recommendations were developed from the findings of the ICM pilot project.

General recommendations

It is recommended that:

1. The link between on-farm practices and the environmental outcomes should be established by independent science of good quality to provide credibility.

2. Environment Waikato consider a targeted approach to catchment delivery, based on environmental risk and potential environmental outcomes, as the findings suggest that a targeted approach may be more efficient in terms of environmental outcomes and resources.

3. Environment Waikato work towards clarifying targets for nutrient leaching at the farm and catchment scale so that these can be clearly communicated to and understood by landholders and provide certainty. For instance, in its review of the Regional Policy Statement, Environment Waikato should set specific, measurable objectives for water quality in receiving water bodies.

4. Environment Waikato consider providing guidelines or policies for on-farm practices that can affect nutrient loss.

5. Environment Waikato continue to work with industry and farmers to develop on-farm mitigation strategies that will reduce nutrient losses.

6. Environment Waikato investigate affordable ways to have an on-farm presence and work with farmers to effect change, for example working with appropriately qualified industry field staff to deliver farm planning advice that incorporates nutrient reduction targets.

7. Environment Waikato work towards improving internal integration.

8. Environment Waikato investigate the feasibility of developing policy intervention that will bring about change in the total population of farmers. For instance, a mix of incentives and regulatory controls could be used in combination with ICM approaches.

Recommendations for future or similar projects

It is recommended that:

1 When planning an ICM project, projects should:
- plan for lead-in time (estimate 12 months minimum);
- expect some initial suspicion and facilitate trust by providing credible information from credible sources;
- plan to consult and allow time for engagement and acceptance;
- gather some information about the community (for example, what is important to them, what resources they have, what are their social dynamics) prior to entering the community;
- consider a targeted approach (for example target farms by farming operation or land area or by those with direct access to waterways);

2 When undertaking an ICM project, projects should:

- be flexible and be able to adjust timeframes and expectations in response to developments on the ground;
- ensure that on the ground staff are knowledgeable about the issues and their practical application, and are skilled at relationship building;
- improve internal integration particularly in situations of compliance;
- include formative and process evaluation activities to monitor progress and provide data to improve and manage risk.

1 Introduction

1.1 Background

Managing the water quality of the region's waterways is an important aspect of the work of Environment Waikato. In 2006, as part of developing a Sustainable Agriculture Strategy, Environment Waikato identified that agricultural practices were contributing to rising nutrient levels within the region's rivers, streams and lakes. The two main nutrients of concern were P (phosphorus) and N (nitrogen), both of which promote algal growth. There was a concern that various agricultural practices (e.g. intensified farming) and land use changes[4], particularly in the Upper Waikato catchment (upstream of the Karapiro dam), were contributing to rising nutrient levels within the region's waterways (Environment Waikato, 2006).

Environment Waikato has a range of strategies designed to affect change within agricultural practices, to assist the reduction in nutrient enrichment of water. These include policies, rules, incentives, assistance, and works programmes. From 2000-2004, when the Waikato Regional Plan was under review there was concern that despite these strategies, the nutrient levels in the waterways were continuing to rise. There was an identified need to investigate whether a more integrated and intensive approach could more effectively promote change. To this end, in 2006, Environment Waikato launched an intensive policy implementation pilot process, the Integrated Catchment Management (ICM) pilot project, within two of the region's sub-catchments.

1.2 Integrated Catchment Management

Integrated catchment management is an approach to managing natural resources. It recognises that because the watershed ecosystem is an integrated system, effective resource management requires an integrated approach. This integration can occur in a variety of ways. It may be across science disciplines and/or between science, policy, management and education, and/or include working with those who live or work within the catchment.

1.2.1 ICM pilot project

The current project involved an integrated approach to nutrient issues in two sub-catchments, between Environment Waikato, local landowners and industry stakeholders. This integration included:

- Environment Waikato's Land Management Officers working with individual landowners to develop environmental Farm Plans;
- Being cognisant of landowner business targets alongside Environment Waikato's environmental targets and developing a partnership between the farmer and Environment Waikato;
- Co-ordinating delivery of Environment Waikato services, for example meeting regulatory requirements and policies, providing information and advice, funding assistance schemes and catchment management works; and
- Facilitating input from other agencies and businesses.

The goal of the ICM pilot project was to investigate the potential effectiveness of integrated catchment management approaches in achieving sustainable improvements in water quality. The objectives of the ICM pilot project were to:

1. Assess possible gains in nutrient efficiency on farms;

[4] In the past seven years land use in the two catchments has shifted significantly. A large proportion of this shift has been conversions from forestry to dairying. A dairy farm loses nitrogen at a rate of approximately 30 to 50 kg /ha per year compared to land under forest which loses nitrogen at a rate of approximately 3 to 8 kg /ha per year (OVERSEER 5.3.6.1 cited in Beatson, in press).

2. Ascertain how reductions in N and P losses could be achieved using current policy tools to address water quality;
3. Identify barriers to, and benefits of appropriate technologies to reduce nutrient losses;
4. Test the theory that an integrated delivery of Environment Waikato's policies – compliance, education and incentives – in a catchment would enable the farming community to achieve reductions in nutrient losses;
5. Determine if the level of nutrient losses achieved by farmers through this process would be sufficient to halt further deterioration in water quality and over what timeframe the gains could be made.

Two catchments were chosen for the ICM pilot project. These were Little Waipa and Waipapa. They are located upstream of Lake Karapiro, in the Upper Waikato[5] catchment. These catchments were selected for the following reasons. They:

- were a manageable size (less than 100 farms per catchment);
- were representative of land use within the Environment Waikato region;
- had a large agricultural component;
- had a 15 year trend of increasing nutrient leaching (and this was able to be monitored);
- had a mix of relationships with Environment Waikato;
- did not have significant geothermal issues[6].

1.3 This document

This document is the final report of the ICM pilot project. The following sections include a description of the catchments and their nutrient issues, a brief review of literature used to inform the evaluation, the method used to evaluate the project, project activities, the findings from the evaluation of the project, the impact of the project, the learnings from the project and the recommendations for the future.

2 The catchments

2.1 Catchment location and land use

The Little Waipa catchment contains 12,210 hectares of land, draining into the Little Waipa Stream. It contains 78 farms and 188km of streams, 93 per cent of which flow through pasture. Most (approximately 74 per cent) of the land in the Little Waipa is used for dairy farming. This is a change from 2002 when only 48 per cent of the land was farmed for dairy, and 40 per cent was in forestry. There has also been an increase in sheep, beef and dairy support farming in the Little Waipa, since 2002.

The Waipapa catchment contains 10,047 hectares of land, draining into the Waipapa Stream. It contains 158km of streams, 86 per cent of which flow through pasture, and approximately 22 eligible[7] farms. Approximately half the land in the Waipapa is used for dairying. This is a significant shift in land use from six years earlier when approximately 15 per cent of the land in the Waipapa was dairy, 46 per cent was for sheep and beef farming and 32 per cent for forestry.

[5] The 'Upper Waikato' refers to the hydrological catchment of around 400,000ha of catchment area between Taupo Control Gates and Lake Karapiro. Local people refer to this area as South Waikato. Some of the catchment is in the Rotorua District and Taupo District areas.

[6] Geothermal activity has an impact on water quality and as such can mask the effects of other innovations. The Waipapa catchment has some geothermal activity and in the three years since the ICM process began this has become more marked in activity.

[7] Of the 25 farms in Waipapa, three extend into Taupo catchment and are subject to Variation No 5 - Lake Taupo. Therefore, they were excluded from the pilot.

Table 1 Land Use Changes in the Little Waipa and Waipapa Catchments 2002 and 2008

Land Use	Little Waipa				Waipapa			
	2002		2008		2002		2008	
	ha	%	ha	%	ha	%	ha	%
Forestry	4848	40	294	2	3254	32	1224	12
Dairy	5791	48	9030	74	1541	15	4898	50
Sheep / Beef	1240	10	2362	22	4589	46	3226	32
Other	188	2	234	2	97	1	97	1
Undeveloped	113	1	20	0	567	6	567	6
Total ha	**12,180**		**12,210**		**10,047**		**10,047**	

2.2 Nutrient issues

2.2.1 Water quality

Monitoring of water quality in the two catchments began in 1993. The most recent (2008) data shows that on some ecological measures (oxygen content, acidity, clarity, ammonia) the Little Waipa and the Waipapa streams show acceptable levels for supporting a healthy ecosystem. Both streams however, have levels of nitrogen and phosphorus that exceed Environment Waikato's guidelines for satisfactory water quality[8]. These two nutrients are associated with the growth of nuisance aquatic plants.

Environment Waikato guidelines are that in order to maintain ecosystem health and not promote nuisance algal growth, total nitrogen levels in water should be less than 0.5 grams per cubic metre, and total phosphorus levels in water should be less than 0.04 grams per cubic metre. Figure 1 shows the data on nitrogen and phosphorus levels, sampled monthly since 1993, for both catchments. The dotted lines are the trend lines, which as can be seen, are trending upwards.

Figures 2 and 3 are graphs of data from 2003-2007, from both rivers. These show that 100 per cent of the samples collected exceeded acceptable levels; that is, that the N and P levels in all the samples collected were above 0.5gm/m^3 and 0.04gm/m^3, respectively. (Note: the temperature samples in the Waipapa also exceeded acceptable levels. However, this is due primarily to geothermal influences in the area and is not of concern).

It is also important to note, when considering this data, to take the age of the water being tested into account, as it takes time for water to find its way into streams and waterways. Aging tests based on data from 2006 and 2007, determined that the average age of the water in the Little Waipa and Waipapa streams is approximately 50 years old (Morgenstern and van der Raaij, 2007). Therefore, the water being tested pre-dates much of the recent land use change and subsequent intensification. As the recent land use changes and intensifications are associated with higher nutrient leaching loads, this indicates that the nutrient levels in the waterways are likely to rise in future years, in response to the recent land use changes and including intensification (that is, the trend will continue upwards), and any changes that are put in place now may not be observable in stream for many years.

[8]Source: http://www.ew.govt.nz/Environmental-information/Rivers-lakes-and-wetlands/healthyrivers/How-we-measure-quality/#Heading1

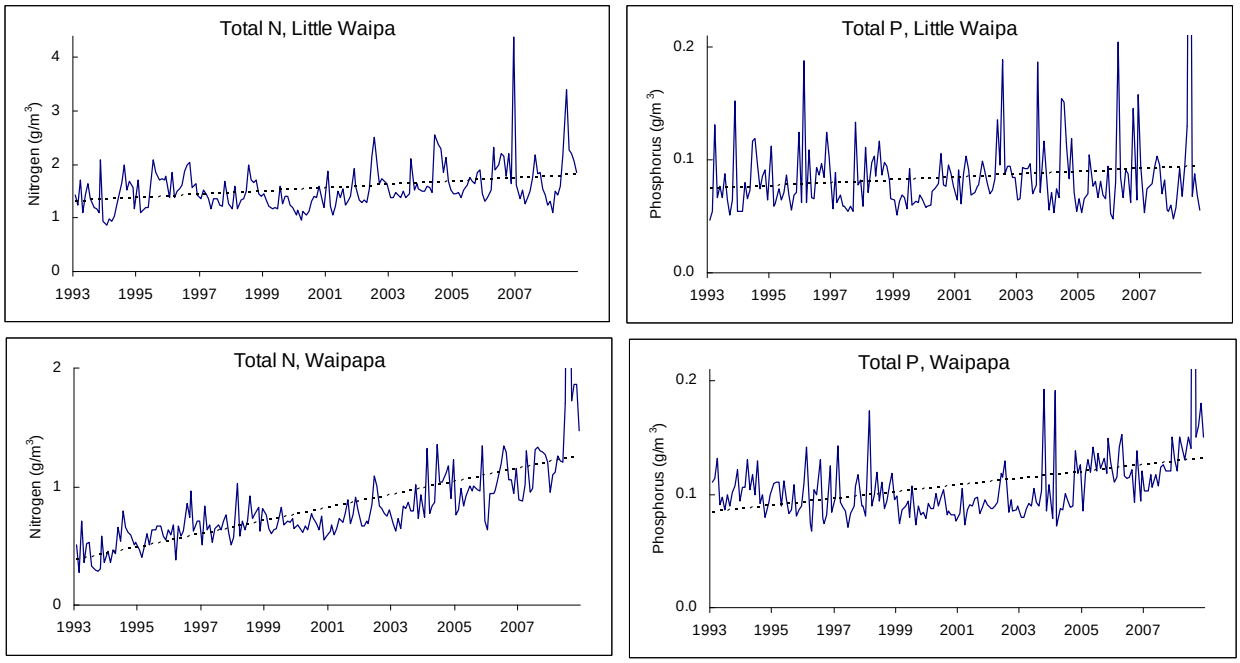


Figure 1: N and P levels Little Waipa and Waipapa Rivers 1993-2007 (source: Environment Waikato).

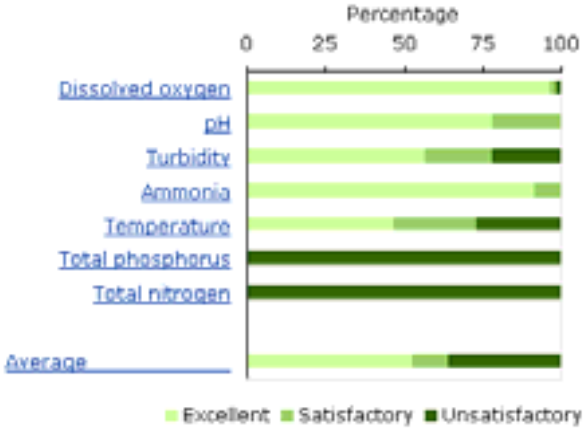


Figure 2: N and P levels in Little Waipa at Arapuni-Putaruru Rd Monitoring Site (2003-2007)

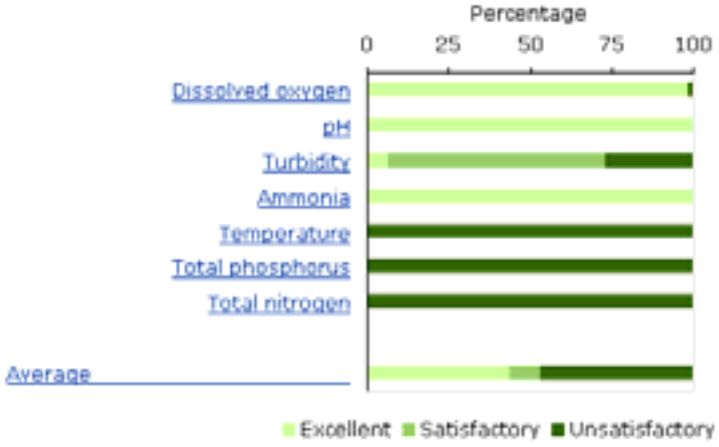


Figure 3: N and P levels Waipapa Stream at Tirohanga Rd Monitoring site (2003-2007)

2.2.2 Nutrient leaching loads

Determining the actual amount of nutrients that are leaching off the land in the catchments and then being carried by the waterways is challenging. This is partly due

to time lag issues with the age of the water; as discussed above, and as well lack of data on some variables. There is no available flowrate data for the Little Waipa and Waipapa streams, and the effect of attenuation[9] is also unknown. However, an estimate of leaching beyond the root zone can be calculated based on landuse data. Estimated average leaching figures - 36 kgN/ha for dairy and 13 kgN/ha/yr for dry stock - were used from Waikato average leaching modelling undertaken by AgResearch (Ledgard and Power, 2004).

Based on revised calculations from 2002 landuse and farm intensity (using the average leaching data above) to include ICM 2008 data the nitrogen leaching load of the Little Waipa is estimated to be of the order of 420 tonnesN/year and the Waipapa of the order of 275 tonnesN/year (this includes the revised average leaching of 40kgN/ha/yr for dairy and 22kgN/ha/yr for dry stock, and the landuse changes from forestry to dairy in both catchments). These loads increased by 80 and 120 per cent respectively, from calculations based on 2002 data[10].

To put this into some context, current modelling indicates that an immediate change to 22-26kgN/ha/year should produce no net decline in water quality (from the 2002 levels). If this is the 'goal'[11], then this would equate to approximately 260-304 tonnesN/year for Little Waipa and approximately 220-260 tonnesN/year for Waipapa[12].

2.3 The catchments: summary

Two catchments, the Little Waipa and Waipapa, were chosen for the ICM project. Both catchments have experienced significant changes in land use in recent years, moving to higher levels of dairying in particular. The Little Waipa and Waipapa streams currently have N and P levels that are above acceptable levels for ecosystem health. These levels are likely to get worse before they get better even if farmers adopt changes recommended in their Farm Plans, as the land use changes and intensification are associated with higher leaching levels and, due to time lag issues regarding the age of the water, this will not be observable for some time.

3 Adoption of innovations

3.1 Key points from literature

Farmers participating in the ICM project do so voluntarily. Recommendations in the Farm Plans are not binding, though compliance with Environment Waikato rules is expected. Current policy documents do not require farmers to consider agricultural innovations that reduce nutrient losses. For instance, any person in the catchment is free to change their land use or activities, with no specific controls on increases in nitrogen or phosphorus leaving the property[13]. Therefore, as Kaine and Johnson (2004) note, "the objective of much of agricultural and natural resource management policy is to change the behaviour of primary producers often by encouraging them to adopt new technologies and practices" (p. 15).

This objective is consistent with the objective of the ICM project, which is essentially to encourage farmers to make changes to their farming practices in order to have a positive impact (long-term) on nutrient levels in the Upper Waikato River's waterways.

[9] Flowrate data is not available for the Little Waipa and Waipapa so in-stream loads cannot be calculated. Attenuation is the natural catchment processes that breakdown the nutrients.

[10] Calculations are reported in Environment Waikato DOCS 1368922.

[11] This 'goal' is an estimate only, based on what is currently known and could change as new information on water quality comes to light.

[12] As reported in Environment Waikato DOCS 1150711.

[13] The exception to this is control over a limited range of activities that discharge contaminants. For instance, control over the effects of point source and non point source nitrogen from dairy shed effluent and farm offal pits in the Waikato Regional Plan, Module 3 Water Quality, Chapter 3.5 Discharges, Animal effluent rules Rule 3.5.5.1 – 3.5.5.4. There are no specific controls on phosphorus in the Regional Plan, but controls to prevent adverse effects of erosion have secondary benefits of preventing phosphorus attached to soil particles entering water bodies.

This may include, for example, reducing the amount of fertiliser applied, wintering off stock, changing effluent management practices, building feed pads, or using new technologies such as nitrogen inhibitors. Some of these practices are subject to the regional council's rules, either consented or as permitted activities, and all of these practices should be viewed as separate innovations in terms of adoption even though the Farm Plan itself can be viewed as an innovation.

Kaine (2004) suggests that a way of understanding the voluntary adoption of innovations is to apply farming systems theory and consumer behaviour theory. Farming systems theory holds that farm context determines the likelihood of an innovation being adopted. Factors relevant to adoption of an innovation are the interplay between biophysical factors (for example topography, soil type, rainfall) and socio-economic factors (for example availability of labour or time, financial resources, the current layout of the property) (Crouch, 1981). Research by Davies, Kaine and Lourey (2007) noted the relevance of farm context to uptake of agricultural innovations (farm technologies and practices). In their study, for example, decisions about effluent applications were influenced by factors such as dairy shed position, slope, and linkages to existing irrigation systems. The ability of farmers to adopt an innovation is variable across a population, because in practice not every farmer can adopt or sees benefit in adopting, a specific practice into their farming system. For example, a dairy farm with rolling topography may not have sufficient land suitable for effluent application to land.

Kaine (2004) proposes that through application of principles from consumer behaviour theory we can begin to understand the likely population of adopters for an innovation, rather than assuming an innovation is applicable to all farmers regardless of their farm context. Consumer behaviour theory is about understanding the decision-making processes of individuals when they are making purchase and consumption decisions in regard to products and services. Purchase decisions are categorised as being on a continuum between low and high involvement (Assael, 1998). Involvement refers to the personal relevance or importance of a product or service to the consumer, and is not an attribute of a product. High involvement purchases are those where considerable effort is put into the purchase decision prior to, and post the purchase, for example purchasing a house. Whereas with low involvement purchases such as buying bread, little cognitive effort is required with consumers preferring to rely on brand, price or other attributes (for example grain).

Kaine and Johnson (2004) state that adoption of innovations by farmers is a high involvement decision, especially where the innovation is novel and unfamiliar, needs integrating into current farm management and has financial implications . Therefore, they propose that "where failure of an innovation can have serious consequences for their business, farmers may sensibly resist the introduction of new technologies or practices – thus non-adoption can be seen as a strategic and rational response to risk" (Kaine and Johnson, 2004).

Part of the evaluation was to assess whether ICM would be effective at engaging farmers in farm planning activities, whether the rate of adoption of nutrient reduction practices would increase as a result of the project, and whether changes in farm practices would be at a scale that would lead to no net decline in water quality. In this project, the scope of the change was defined as all eligible farmers within the catchments adopting the recommended best practices and complying with relevant rules in order to bring about sufficient reductions in nutrient losses.

All eligible farmers in the catchments were considered to be the total population of potential adopters. The graph below shows the total population (N1) that will likely voluntarily adopt a technology or innovation. The use of non-regulatory persuasive policy initiatives such as provision of extension, promotion or incentives has the effect of increasing the rate of adoption in this population (that is shortening the time of adoption by all users from T1 to T2) (Kaine and Johnson, 2004; Pannell et.al. 2006). Importantly, the total number of adopters (N1) does not change.

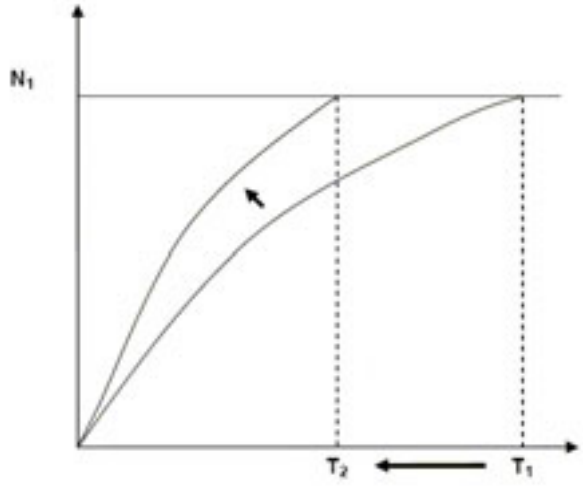


Figure 4: Accelerating the rate of adoption (source: Kaine and Johnson, 2004)

However, Kaine and Johnson (2004) suggest that a mix of different approaches may be required to assist the adoption of different innovations, because different people will respond to different techniques; for example some farmers are interested in field days and new technologies while others will make use of subsidies or, where voluntary adoption is unlikely and the practice is deemed necessary by regulators, changes to regulations may be needed.

As well, policies are often in place to ensure environmental outcomes. These policies may not align with farmers' motivations to adopt innovations that are beneficial to their business and integrate into their farming system, such that practices that may be considered best practice for environmental outcomes may not voluntarily be widely adopted (Pannell et al. 2006; Kaine et al., 2004).

Figure 5 shows the population of potential adopters of agricultural innovations is increased from N1 to N2, by policy intervention to expand the population of potential adopters by creating a need for change in those not willing to undertake change in practices voluntarily.

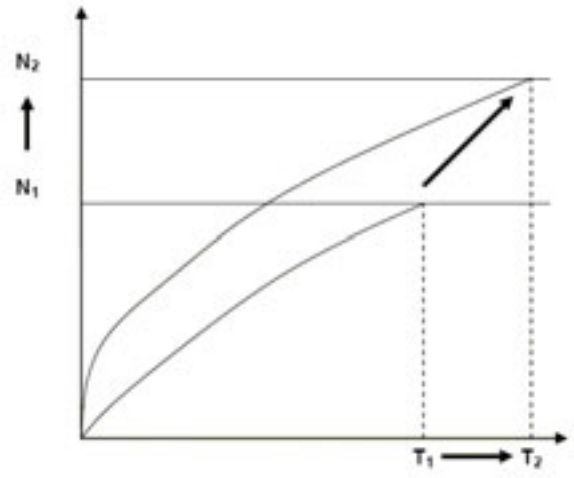


Figure 5: Increasing the population of adopters (source: Kaine and Johnson, 2004)

3.2 Adoption of innovations: summary

In summary, adoptions of innovations such as best practices are affected by a mix of biophysical and socio-economic factors. Determining effective ways to get farmer engagement and adoption includes establishing what benefits will be gained. Increasing the rate of uptake of an innovation may require a mix of different approaches, for example providing advice through programmes such as ICM and incentives such as Clean Stream funding. However, it should be noted that there may still be a number of farmers for whom the uptake of new practices and technologies does not easily fit with their current farm context, and therefore will not voluntarily make changes, such that a regulatory approach may be required.

4 Methodology

At the project's inception, Environment Waikato staff prepared a plan to assist with the implementation and evaluation of the project. This plan had seven key areas of success. These were:

1. Engagement
2. Communication
3. Farm planning process
4. Actions undertaken
5. Environment Waikato systems
6. Feedback to Policy teams
7. Science and process development

Procedures to collect and collate data relevant to the above areas were incorporated into the project. Staff collected and reported on some information and Ruth Hungerford of Momentum Research and Evaluation Limited was asked to assist, as an independent evaluator, with some of the evaluation activities relevant to the first five success areas.

The independent evaluation was introduced early in the project (September 2006). In recognition of the evolving nature of the pilot, the evaluation was to incorporate formative and process evaluation activities and to feedback into the project as it progressed. Evaluation activities included annual interviews with a sample of participating farmers, and in 2008, a sample of non-participating farmers, interviews with industry representatives, analysis of spreadsheet data and facilitated meetings with staff. An interim report was completed in 2008 to report on the evaluation findings to date (Hungerford, TR2008/49).

5 Findings

The following sections report on the ICM pilot project. The first section describes the project activities. The next seven sections report on the project in relation to the seven success strategies mentioned above. This is followed by an analysis of the available data on the impact of the nutrient reduction strategies. The information reported has been gathered from both internal processes and the external independent evaluation.

5.1 Project activities and timeline

5.1.1 Project plan

The ICM pilot project was a three year (June 2006 to June 2009) project. ICM took a developmental approach (see Figure 6) which emphasised community engagement and input to setting targets and determining process (Phase 1). Results from Phase 1 would inform the development of the project, establish the focus and framework, and determine the key tasks and activities that would be undertaken as Phase 2. It was anticipated that Phase 2 would include elements of farm planning and development of

a Catchment Plan. Phase 3 would utilise computer modelling and peer review to estimate the effectiveness of the mitigating actions, and feed this back into the community engagement and farm planning and make changes as appropriate. Phase 3 would include social evaluation to determine direction of the project

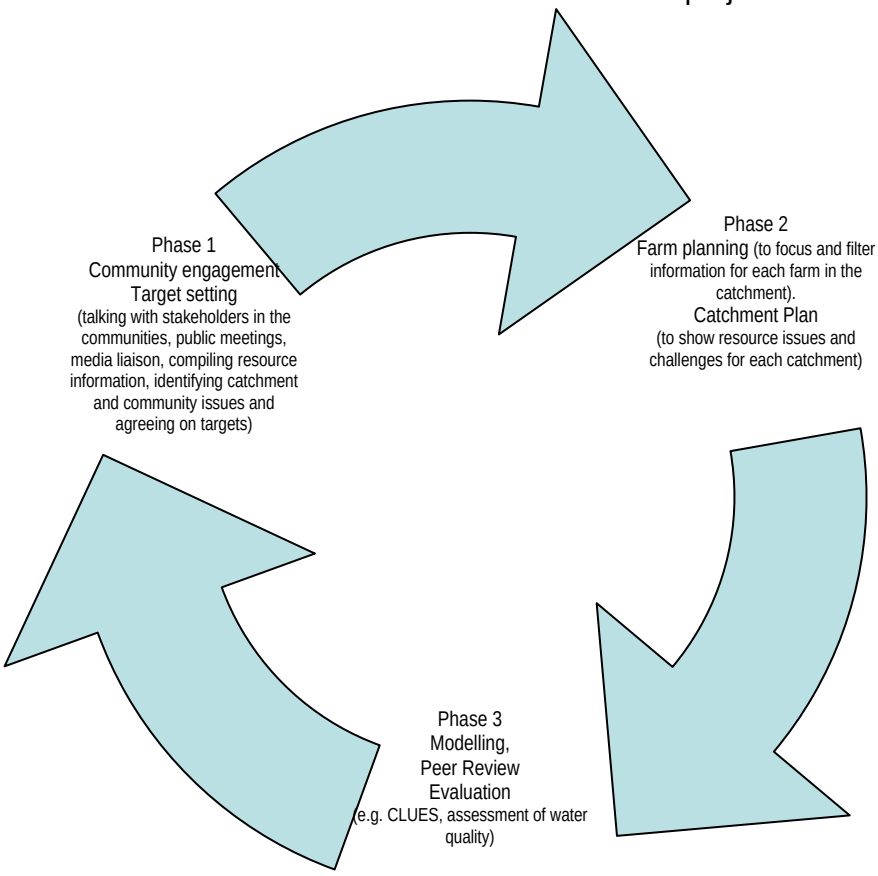


Figure 6: Model of ICM Pilot Project Process

5.1.2 Project activities

In the initial consultation phase of the project farmers emphasised that they wanted to know what they needed to do at an on-farm level to manage nutrients. They asked ICM staff to provide a menu of 'best practice'. A menu was developed and this led to the question of how farmers could determine which of the best practices were the most appropriate for their farm and their system. This resulted in ICM staff developing the farm planning phase of one-on-one, on-farm planning with individual farmers. The initial intention was to complete a Farm Plan for every farm in the two catchments. Nitrogen (N) emerged as a key focus of the ICM project and the Farm Plans because the initial planning phase had revealed a clear trend of increasing levels of N in these two catchments (see Section 2.2 for more detail on nutrient issues).

Farm planning with a focus on N and nutrient management on-farm, was the primary activity of the project. Staff went out on-farm, met with farmers, wrote up Farm Plans and went back on-farm to talk the plans through with famers. As the project progressed, further activities were added. These were:

- workshops and field days with farmers about specific management options;
- the development of links with industry stakeholders;
- development of 'fact sheets' about nutrient management;
- presentations of the findings to internal and external groups.

5.1.3 Project management and staffing

The project began with the equivalent of 1.5 FTE[14] staff members; a full time project co-ordinator, and a half time (0.5) Land Management Office (LMO). The project was overseen by a project manager (approximately 0.15 FTE), and had access to a science provider and other internal staff to assist as needed. The project co-ordinator and LMO were initially responsible for the majority of the 'on the ground work' such as community meetings, on-farm visits and the writing up of Farm Plans. Approximately 18 months into the project another full time staff member (an Agricultural Adviser) was added to the team due to the need for more on-farm systems knowledge. This addition increased the ICM staff to 2.5 FTE plus project manager input.

5.1.4 Timeframes

The estimated timeframe and the actual time taken for various tasks differed, and this was one of the key learnings from the pilot process (see Figure 7 below). As Figure 7 shows the initial planning and community engagement phase was estimated at two to three months. However the budget was confirmed in June, after which staff had to be appointed and the project set up. This delayed the start of the project tasks. Community engagement processes took longer than anticipated and then continued throughout the project as new initiatives were developed, communicated and discussed.

Farm planning (Phase 2) was estimated to be completed, with 100 per cent of farms having Farm Plans, eighteen months into the project (by December 2007). In practice, farm planning started later than planned, and took longer than expected. By June 2009 the coverage was 60 per cent of farms involved and 29 per cent of farms having completed Farm Plans (see section 5.2 for more detail on coverage). The Catchment Plan was also intended to be completed within the first eighteen months and modelling, review and feedback into the process (Phase 3) was planned for the final year to eighteen months. The Catchment Plan was drafted in 2008 rather than 2007 and the modelling occurred at more than one stage of the project and remained an ongoing and integral part of the project providing continual feedback as more was known about the catchments.

[14] FTE = Full Time Equivalent.

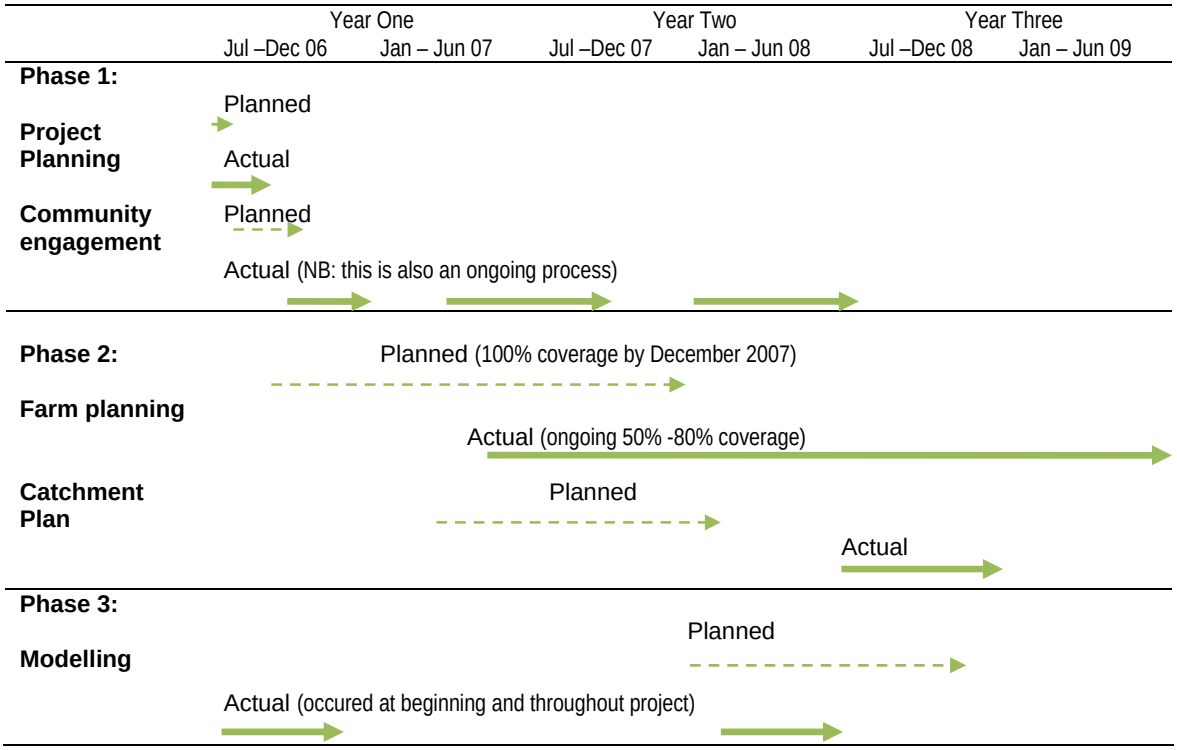


Figure 7: ICM planned and actual timeframe

There were a number of reasons why the estimated timeframes shifted from the original estimates. These were:

1. Staff recruitment could not begin until the budget was confirmed at the end of June 2006. Once the budget was confirmed, it was August before staff were appointed. So the project's actual start date was not July but closer to August / September 2006.

2. The community needed time to build trust and be willing to engage in the project.

3. Staff had to develop all aspects of the project. For example, when farmers wanted a 'menu' of best practice, this had to be developed with expert input and produced. When one-on-one Farm Plans became the focus, a specific Farm Plan format had to be designed for the pilot[15];

4. Monitoring tools (e.g. spreadsheets and databases) had to be designed and kept updated.

5. The farm planning process proved to be more time-consuming[16]than anticipated and it was clear that the original target (100 per cent of farms) was unrealistic with the staff and time resource available;

6. There was an initial intention to produce two Catchment Plans, early in the process, that would inform the focus for each catchment. However the 'whole of catchment approach' was not something that either community showed significant interest in pursuing, with a preference towards an individualised farm planning approach. Thus while the Catchment Plans were produced, this was later in the process. While these were intended to create awareness, understanding of Environment Waikato's water quality concerns and engagement with the project the community preference towards individual farm planning became the catalyst for the project's acceptance.

[15] There were other well-documented farm planning processes available, however, they were mainly focused on soil conservation and riparian management and needed significant revision to fit the purpose of the ICM pilot farm plans.

[16] Staff found that the farm planning process (including farm walk, farm plan, second visit) took about 60 hours per farm initially. As staff have increased their skill level and standardised approaches have been developed that time has been revised down to 30-40 hours per farm plan.

7. As more farmers became involved, communication time increased exponentially; staff had to continue to engage more farmers and as well maintain and continue the relationships with farmers that were engaged.

5.1.5 Project activities and timeline: summary

The ICM project took place over three years in two catchments and involved on-farm planning with individual farmers, with a focus on N and nutrient management on-farm. It also included workshops and field days, developing links with industry stakeholders, developing 'fact sheets' about nutrient management, presentations to internal and external groups, and analysis of nutrient data. There were some useful learnings about timeframes from the project. Specifically, some tasks took longer than planned whilst others took place at different phases of the project and/or continued throughout the project.

5.2 Engagement

Engagement was the first key success area. The main components of this success area were to engage farmers in the catchments by working with them one-on- one on farm planning, raise Environment Waikato's profile in the area, and raise farmer's awareness and understanding of Environment Waikato's concerns. Staff also expected that their own knowledge and understanding of the catchments and farmers' perspectives on nutrient management issues would be increased.

5.2.1 Farmer engagement in ICM

ICM began with an intention to engage[17] all farmers in the catchments in the project. This initially involved sending letters and inviting farmers to a public meeting in their catchment where the project was presented. From these meetings some farmers agreed to be involved and the ICM staff began the farm planning process with them. The farm planning process involves a farm walk, developing a Farm Plan, then returning to the farm to discuss the Farm Plan and gain agreement to it. As the project progressed ICM staff used a variety of 'first contact' methods to engage farmers including letters, phone calls, door knocking, invitations to field days, and newsletters. The ICM engagement process can be summed up as follows:

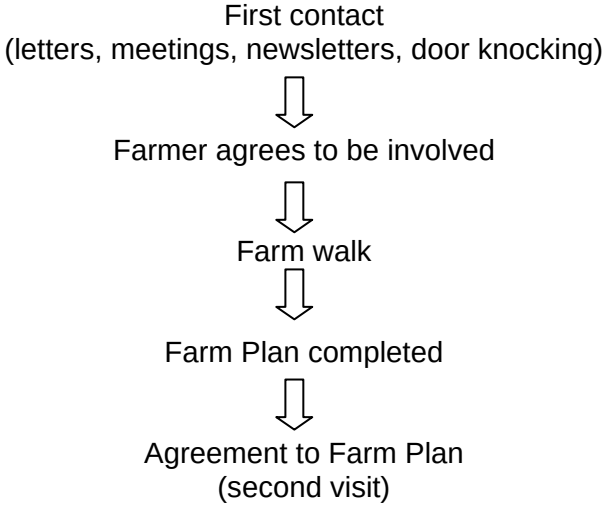


Figure 8: ICM engagement process

Whilst most farmers have been contacted about the project (via mail) not all are engaged in ICM. This is primarily an issue of resourcing; that is having the staff to get around all the farms rather than a situation of farmers specifically refusing to be involved with the project[18].

[17] In this situation 'engagement' is defined as the farmer having agreed to participate in ICM.

[18] There have been a few farmers who have been slower to engage in the project or have been somewhat resistant to participating. One farmer did refuse involvement however he has since sold and moved out of the catchment. Overall most farmers who have been approached have been willing to become involved in the project.

In total there are 100 farms eligible to participate in ICM in the two catchments. There are 78 farms and 67 farmers in the Little Waipa and 22 farms and 21 farmers in the Waipapa catchment. Of these 100 farms, 60 are engaged with ICM and 29 of these have completed Farm Plans. The following tables and figures show the level of engagement in ICM in each catchment by farm and by land area.

In the Little Waipa 48 (62%) of the 78 farms are engaged in ICM (this represents 38 of the 67 farmers as five farmers have more than one farm[19]). The 48 farms engaged represent 73% (8560ha) of the total farmed land area of the 78 farms in the catchment (11716.3ha[20]) Farm Plans have been completed for 25 (32%) of the Little Waipa farms. ICM staff have made first contact with nine (11%) farms and 21 (27%) farms have had no involvement as yet.

In the Waipapa 12 (55%) of the 22 farms are engaged in ICM (this represents 11 of the 22 farmers as one farmer has more than one farm). The 12 farms engaged represent 84% (5306ha) of the total farmed land area (6297ha) of the catchment. Farm Plans have been completed for four (18%) of the Waipapa farms. ICM staff have made first contact with four (18%) farms and six (27%) farms have no involvement as yet.

Table 2: Engagement in ICM by farm

	Little Waipa	**Waipapa**
Number of farms agreed to be involved	13 (17%)	3 (14%)
Number of farms who have had farm walk	10 (13%)	5 (23%)
Number of farms with farm plans completed	25 (32%)	4 (18%)
Total number of farms engaged in project	**48 (62%)**	**12 (55%)**
Number of farms door knocked	9 (11%)	4 (18%)
Number of farms not involved	21 (27%)	6 (27%)
Total numbers of eligible farms	**78 (100%)**	**22 (100%)**

Table 3: Engagement in ICM by land area

	Little Waipa	**Waipapa**
Agreed to be involved	2676ha (23%)	960ha (15%)
Had a farm walk	3422ha (29%)	2006ha (32%)
Farm plans completed	2462ha (21%)	2340ha (37%)
Total land area engaged in project	**8560ha (73%)**	**5306ha (84%)**
Door knocked	1157ha (10%)	555ha (9%)
Not involved	2000ha (17%)	437ha (7%)
Total eligible land area	**11716 ha (100%)**	**6297ha (100%)**

[19] Of these five farmers, two have two farms, one has three farms, one has four farms and one has five farms.

[20] This figure (11716.3ha) is the total hectares that are in production across the 78 farms. It differs from the total hectares of the catchment (12,210ha) which includes non-productive land and other land use such as roading. The same calculation has been used for the Waipapa figures, with the addition that land that falls within the Taupo Variation has also been excluded. So the total farmed area of the 22 farms in the Waipapa catchment is 6297ha, while total catchment area is 10,047ha)

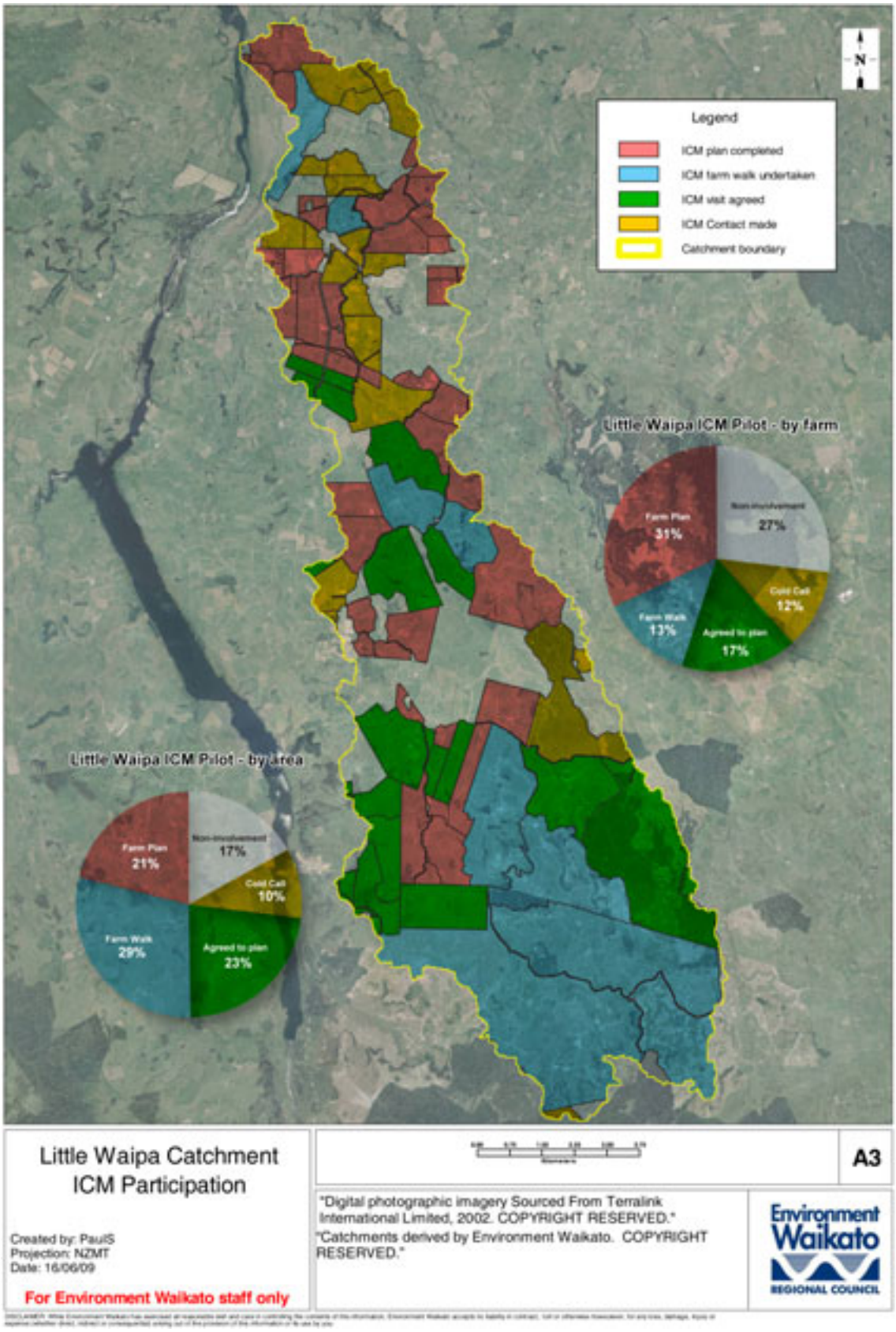


Figure 9: Little Waipa catchment engagement in ICM by farm (n=78) and by land area (n=11,716ha)

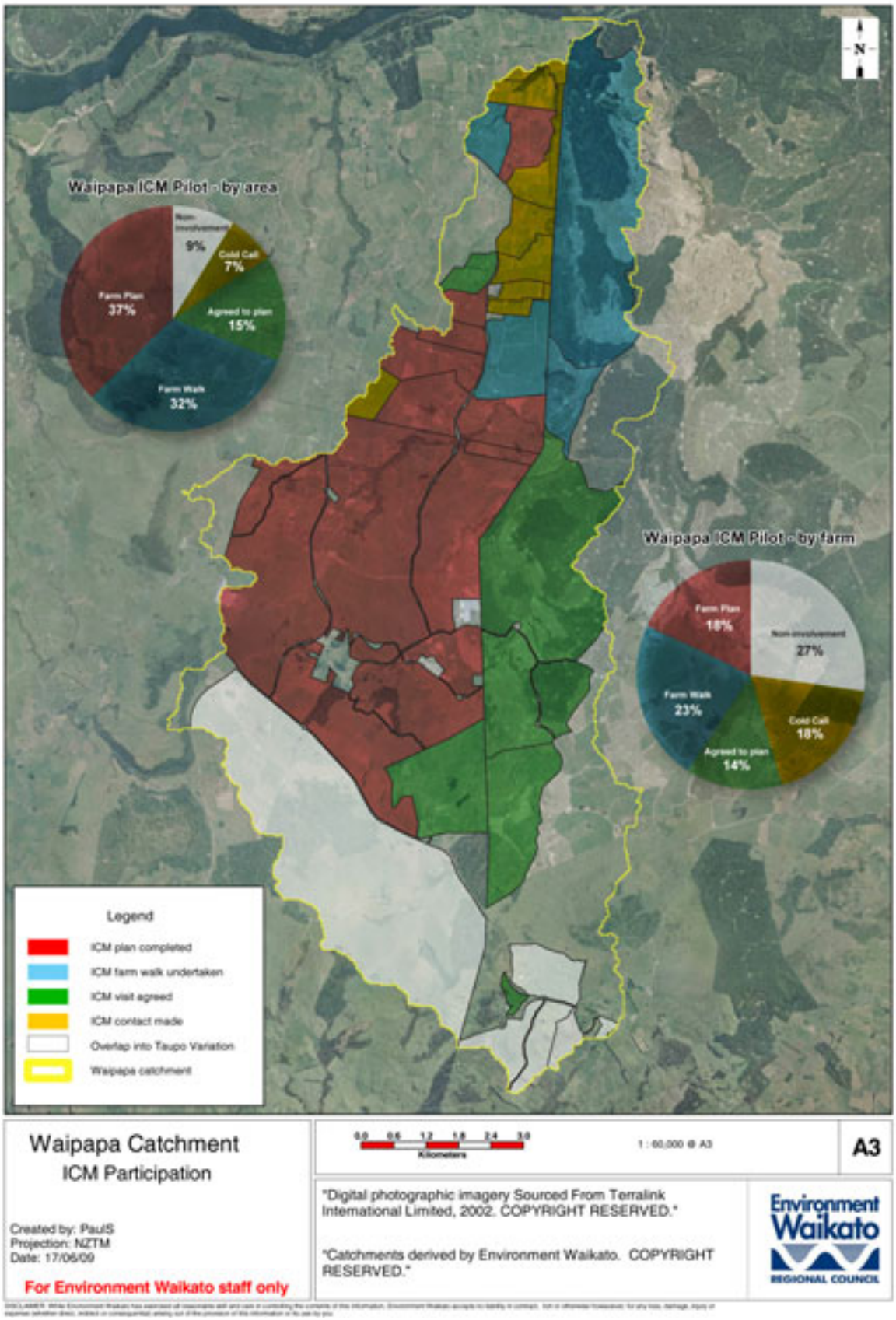


Figure 10: Waipapa catchment engagement in ICM by farm (n=22) and by land area (n=6297ha)

5.2.2 Opinions about Environment Waikato

As the project has progressed the evaluation found a shift in views amongst farmers about Environment Waikato. In the first series of interviews[21] some farmers expressed the view that Environment Waikato was not being completely 'upfront' with them. There was a sense of 'watching and waiting' to see what ICM was about.

> *They [Environment Waikato] should have been more upfront and honest about the underlying reason for the meeting and what farmers could be faced with. i.e. us having to make some big changes [to how we do things on farm].* (Farmer)

These views were not unexpected, as this was a new project and farmers were unsure of what they might be expected to do. There were also other contextual factors to consider. Residents of one catchment had recently been 'consulted' by other organisations and government bodies. This had not been a positive experience for the community and as such, they were wary of other organisations or government bodies coming into their area to 'consult' with them. Other farmers were also aware of, and not entirely supportive of how on-farm nutrient issues had been approached in Taupo, and were concerned that ICM might adopt a similar approach.

This wariness was not apparent in the second series of interviews (2008)[22]. Findings from these interviews were that the ICM project had resulted in more positive opinions towards Environment Waikato. The ICM process of working in partnership with farmers on an individual farm level, contributed to a positive view of both the ICM project and Environment Waikato. Farmers attributed their positive view to the skills of the staff in working with farmers and the ICM process of building partnership relationships with them.

> *[I have a] very good [relationship with Environment Waikato]. I haven't got a problem with them. Because of [the ICM staff] – the way they came across – pretty transparent. A lot of cockies think they [Environment Waikato] are the bad guys – but [the ICM staff] are very good to deal with. … [This project has] certainly changed my attitude [towards Environment Waikato]. Meeting them and hearing where they're coming from. They're just doing their job like anyone else and it's all for the good of everybody. (Farmer)*

5.2.3 Understanding of the issues

Findings indicate that farmers' understanding of Environment Waikato's concerns, and their own knowledge about nutrient losses on farm has increased as a result of the ICM project.

> *[Environment Waikato's] big concern is how we manage our effluent and then direct nutrient application and where it's ending up – keeping it out of the waterways – to maintain water quality. (Farmer)*

Trying to keep our waterways – protect our waterways – trying to encourage us to farm in a way that we can do it sustainably. Wanting us to develop a system that we can do year in and year out and that gives us minimal grief. *(Farmer)*

> *[I learnt] just the whole farming operation – inputs and what's going out the gate with milk. Years ago you just ordered the same fertiliser year in year out. (Farmer)*

[21] The first series of interviews took place in July 2007 and involved all the farmers participating in the project at that time. The project had officially been going for a year but farmers had only been involved for up to a maximum of eight months.

[22] The second series of interviews took place in July 2008 and involved a sample of farmers participating in the project some of whom had also been interviewed in 2007 in order to track any changes over time.

Findings indicate that over the course of the project ICM staff have also increased their knowledge of the catchments and on-farm issues. They have observed that while farmers are generally willing and interested in the ICM project, there is some scepticism, particularly around the scientific proof of the benefits. This has been an ongoing challenge for the project, as the data on the effectiveness of some of the available on-farm nutrient management practices and technologies is not conclusive. In addition, staff noted that farmers are often interested in being able to trial something before committing to it and most of the available products or practices are not trialable.

5.2.4 Engagement: summary

There are 78 farms and 67 farmers in the Little Waipa and 22 farms and 21 farmers in the Waipapa catchment. Of these 100 farms, 60 are engaged with ICM and 29 have completed Farm Plans. These farms represent 73% of the land area in Little Waipa and 84% of the land area in Waipapa. The ICM project has raised awareness amongst farmers about Environment Waikato concerns about nutrient loss on farm and also contributed to a more positive view of Environment Waikato.

5.3 Communication

The second key success area was communication. All farmers within the catchments were initially sent information about the project, were invited to a public meeting (one in each catchment) and have continued to be sent letters, newsletters, and invitations to field days. There have also been print media articles about the project and ICM has a presence at the national Fieldays. Farmers either contacted Environment Waikato directly as a result of the mail outs or public meetings or staff phoned farmers to explain the project and seek their agreement to be involved. If a farmer is engaged in the project then staff will utilise email and phone to keep in contact and follow up on issues or concerns.

In September 2008 a new process of 'door knocking' (cold calling, in person, on-farm) was added to the contact repertoire, in an attempt to increase the numbers of farmers participating. The door knocking involved the staff member in the catchment, approaching farmers on farm to explain the project in person. This process has increased the numbers of farmers contacted and agreeing to be involved.

Findings from interviews with farmers indicated that they appreciated the communication that they received from ICM staff. Farmers reported that the ICM staff returned their calls and kept them informed. The newsletters were valued as they raised their awareness of what was happening with the project and gave them insight into the direction that Environment Waikato was heading.

> *I read most of that [newsletter] to see where they [Environment Waikato] are trying to do things and what they [Environment Waikato] are thinking. Keeps us up to date with what's happening. (Farmer)*

Staff report that farmers have been receptive when they have 'door knocked' although some have requested a bit more time before becoming involved. These findings were consistent with the findings from the farmer interviews. Of the farmers interviewed, two had become involved in the project as a result of the 'door knocking'. Both farmers had heard of the project prior to the ICM staff visiting. They reported that the ICM staff visiting on farm and explaining the project was the catalyst participating in the project.

> *It was a face to face meeting and he [staff member] seemed nice and it sounded like it was not too involved. (Farmer)*

5.3.1 Field days

There have been a number of field days organised over the course of the project. The most recent one (April 2009) included a bus trip to two farms – one with a herd home and the other, an organic dairy farm. This field day was attended by approximately 18

farmers from the catchments. Other field days have included presentations and discussions on nutrient management, farm planning and whole catchment plans and have had varying attendance. One point noted by staff, was that the field days appeared to attract a different group of farmers each time. The question was raised as to whether this was a reflection of recent contact with farmers (that is, were farmers who had recently been in contact with staff more likely to attend field days or was it the content of the field day itself that was the drawcard?).

Findings from the interviews with farmers indicate that whilst contact with the staff or involvement in ICM was an encouragement to attend, farmers attended field days because they were interested in the specific topic, and/or are interested in environmental issues, or in some cases because they were hosting the day. The importance of interest in the topic, was illustrated quite clearly by one farmer who had only attended one part of a field day.

> *I was only interested in part of it and couldn't make the afternoon anyway. I am exploring some of those ways [organic] of farming, and some can be very practical without going organic. (Farmer)*

Reasons farmers gave for not attending were because they were not involved in ICM, and/or unavailable or busy with work commitments, and/or uninterested in the topic being presented.

5.3.2 Communication: summary

ICM used a variety of communication methods to communicate with farmers including letters, newsletters, field days, print media articles, a presence at the national Fieldays, phone calls, emails and 'door knocking'. These methods were well-received by farmers and were a catalyst to engagement.

5.4 Farm planning process

The third key success area was the farm planning process which included Farm Plans and referrals to other sources of information or incentives where appropriate.

5.4.1 Farm plans

A key output of the project was ICM staff providing an individual Farm Plan for each farm. The farm planning process included an initial farm visit which typically took two to four hours and involved meeting with the farmer and their fertiliser representative[23] on farm, gathering nutrient budget statistics, discussing the farm systems and walking over the farm to view topography, pasture, waterways, effluent systems, sheds, raceways, and to conduct VSA (visual soil assessments). Various identified issues and possible actions were also discussed during the initial visit. This information is then used to write a full Farm Plan for the farmer.

The Farm Plans are comprehensive and initially took longer to prepare than had been anticipated (Hungerford, 2008). The process has become more streamlined and the Farm Plans have undergone some refinement. The most recent innovation has been to take some of the more generic information (such as about soil, waterways, effluent, and nutrient management) and turn these into 'fact sheets'. The Farm Plan therefore only contains the farm-specific information, and as such is shorter and more readable for the farmer. However whilst output is now quicker, it is still a relatively time-intensive process, taking approximately 30 - 40 hours per Farm Plan.

Findings from the interviews show that farmers were generally positive about the Farm Plans and the other information they received. The Plans were viewed as useful primarily because they provided a whole picture of the farm operation and the effect of

[23] The inclusion of the fertiliser representatives in the farm visit was an innovation that was developed early in the project and has proved to be beneficial, as the representatives are able to provide crucial information about the nutrient budget, and as well gain information on environmental issues that they can extend to their wider client base.

this on nutrient issues, as well as providing some more information about nutrient management options and encouraging farmers to consider making changes.

> *[The most useful thing about the Farm Plan was] bringing it all together. Before that we had a nutrient budget but that is only one small part – this brought all practices together and gives a good idea of what your footprint is. And then we did the AgResearch thing – took it a step further. The Farm Plan gave a much clearer understanding of what we're doing on farm and how that affects. It clarified our situation and was very educational. No one likes to be told what to do. When you're out on your farm – you're not thinking of these things – but with education you do start to and you realise that we really need to pull finger and get these things in place now. (Farmer)*

5.4.2 Referral and other sources of information

While referral to other networks and services was an intention of ICM, there have not been a significant number of referrals to other services or information sources, primarily because there is a lack of suitable or available services to refer to. Interview findings indicate that the farmers did not tend to have many sources, other than Environment Waikato, for nutrient management information. Fertiliser representatives and farming publications were the only other information sources that farmers reported accessing. ICM staff do send out information on request and also noted that, between them, they were generally able to answer most questions themselves. This finding highlights the importance of having skilled and knowledgeable staff in an ICM project who can provide information and answer questions.

Some farmers have been referred by ICM staff to Clean Streams, and four have specifically taken this up. Evaluation findings indicate that Clean Streams was a good incentive to encourage riparian fencing and planting, and was also a catalyst for some farmers to engage in the project initially. Project Watershed was another internal incentive that staff referred eligible farmers to.

5.4.3 Farm planning process: summary

Farm planning was a primary component of the ICM pilot and one that was valued by farmers for its individualised approach. Preparing Farm Plans was fairly time intensive, initially taking an estimated 60 hours per plan. Standardising approaches, development of templates and streamlining has reduced this to an estimated 30 to 40 hours per plan. Referral to other networks and services was limited by the availability of appropriate services to refer to. Staff did send out further information on request and provided answers to farmer queries, and referred farmers to Clean Streams and Project Watershed. Clean Streams was taken up by four farmers, was an incentive to encourage riparian fencing and planting, and for some, was a catalyst for engagement in ICM.

5.5 Actions undertaken

The fourth key success area was determining actions undertaken. The ICM project aimed to encourage change in farming practices in order to reduce nutrient losses from farms. Actions promoted by ICM focused on more accurately matching nutrient inputs to farm requirements (for example greater cost effective fertiliser use; wintering off; feed pads; herd homes), managing effluent more efficiently (for example increasing effluent area, changing the system), protecting waterways (for example fencing, planting) and using other technologies (for example DCDs nitrification inhibitors).

5.5.1 Tracking actions

ICM had a number of processes for tracking progress on Farm Plan actions including a spreadsheet on which staff recorded progress, second on-farm visits to discuss the Farm Plans and agreement to uptake actions, and evaluation interviews with farmers.

They were also able to encourage compliance with the six permitted activities[24], on a case by case basis and engaged staff from the Resource Use Group[25] where relevant.

5.5.2 Action uptake

As at June 2009, 29 farms, 25 in Little Waipa and four in Waipapa, had a completed Farm Plan, and of these 20 in Little Waipa and two in Waipapa, had had a second visit to discuss their intention to put the actions into practice. In the Little Waipa farmers from all 20 farms agreed to undertake at least some, if not all the actions that Environment Waikato was suggesting. In Waipapa, one of the two farms agreed to make most of the changes and the other did not agree to make the changes. Table 4 summarises the Little Waipa action uptake data from the 20 farms that had a completed Farm Plan and a second visit.

Table 4: Little Waipa: Actions recommended and agreed to (n=20 farms)

Action recommended	No. of farms	Agreed to do	Not intending to do
Lower Urea N in winter	7	6	1
Increase effluent area	14	9	5
Change to land application	1	1	
Spray effluent at optimum times	4	4	
Lower N use on effluent area	2	1	1
Lower N use to within safe ranges	4	2	2
Use riparian fencing and planting	1		1
Increase wintering off	1		1
Assess the use of DCDs	2	2	
Assess putting in a feed pad	6	5	1
Change winter feed crop	3	2	1

5.5.3 Reasons for uptake

5.5.3.1 Staff report

ICM staff perceived that the farmers they worked with were willing to make changes that were easy, affordable, will lower costs, benefit animal health and allow them to retain control of their own herd, farm, animal welfare, and productivity. Staff also noted that outside influences such as the rising price of fertiliser and lower dairy payout often influenced farmers' decisions on changing practices, and that some changes took more time than others to instigate (for example putting in a feed pad). Staff reported that as the project has progressed they felt that they had become more skilled at matching recommendations to farmers' farm systems and practice and that this assisted uptake. Barriers to uptake, observed by staff, included financial capability, lack of scientific proof of the benefits of certain practices or products (for example DCDs), and the lack of clear guidelines for some recommendations (for example effluent storage facilities).

5.5.3.2 Interview findings on reasons for uptake

In order to gain more in-depth understanding of reasons for, and barriers to, uptake of actions, interviews were conducted (in 2009) with a sample of six farmers[26] to hear their report on uptake of actions that were recommended in their Farm Plans. The six farmers had the following actions suggested.

- Stop using Urea (N) in winter months (5 farmers)
- Increase effluent area (3 farmers)
- Lower N use to within safe ranges (2 farmers)
- New effluent system (storage) (2 farmers)

[24] The 'six permitted activities' are effluent, fertiliser, stock in water, culverts, bridges and vegetation clearance (in high risk erosion sites).

[25] Staff from the Resource Use Group at Environment Waikato deal with monitoring of compliance and enforcement.

[26] Note on sample selection. The farmers in this sample were chosen to be interviewed because they had a Farm Plan. They had been involved in the project for between six months and two years. The evaluator had no prior knowledge as to whether the farmers in the sample had taken up any of the actions suggested. Therefore, whilst it was not a random sample it was not biased towards those who had (or had not) taken actions.

- Use riparian fencing and planting (4 farmers)
- Increase wintering off (2 farmers)
- Assess the use of DCD (nitrification inhibitors) (1 farmer)
- Assess putting in a feed pad (1 farmer)

Most farmers had either undertaken the actions suggested, or were intending to uptake the action either this winter or this season (see Table 5). Only two farmers stated that there were actions that they were not intending to uptake, however both farmers were undertaking some of the other actions.

Table 5: Actions suggested and farmer's reported intention to undertake

Action	No. of farmers	Done	Intending to do[27]	Not done
Stop using Urea (N) in winter	5	4	0	1
Increase effluent area	3	2	1	0
Lower N use to within safe ranges	2	1	0	1
New effluent storage system	2	1	1	0
Use riparian fencing and planting	4	2	2	0
Increase wintering off	2	1	0	1
Assess the use of DCDs	1	0	1	0
Assess putting in a feed pad	1	0	1	0

5.5.4 Reasons for uptake of actions and benefits on-farm

The six farmers undertook actions for a number reasons. These included:
- the action was easy to implement
- the action was affordable
- the action had a financial benefit
- the action has another benefit (for example, enhances the property)
- there was an incentive (for example, Clean Streams funding)
- the farmer had an environmental focus
- the ICM project encouraging suggested actions
- there was an outside influence (for example, fertiliser costs)

Table 6 shows the actions that were undertaken by the sample of farmers, and an analysis of which reasons were linked to which actions.

For example four out of five farmers had stopped spreading Urea N in winter. They had made this change because it was easy and saved them money, without adversely affecting pasture growth.

> *Have done that [stopped Urea N in winter]. I haven't noticed any difference with the pasture.* (Farmer)

Two out of three farmers had increased their effluent area. This was viewed as an easy change which (usually) required minimal financial outlay, and had the added benefit of cutting fertiliser costs. The one farmer who had not yet increased his effluent area, had not done so because it would require a greater financial commitment as his current system was not able to cope (having to buy a new pump as the current one was not powerful enough to spread to a larger area). However, he had changed where he was applying the effluent and planned to buy a bigger pump when finances allowed.

[27] Note: farmers who stated that they were 'intending to do' an action had to refer to a specific time frame. That is a farmer had to give a timeframe of when they intended to do it (e.g. this winter or this season) rather than a general time frame. If a general time frame was given then that action was recorded as "not done".

The pump seems to be struggling – but we need to buy a bigger pump. Next time it needs major maintenance then we would consider a bigger pump. I am putting the effluent on more suitable areas though. (Farmer)

The ICM project was also a catalyst for change as the following quote attests. This farmer had been considering increasing his effluent area but credits the project with being the reason why he went ahead and did it.

I would have done it – I was thinking of doing it, but [the ICM staff] suggestions and the Farm Plan were an encouragement to do it. (Farmer)

Table 6: Actions undertaken and farmer's reasons for uptake

Actions Undertaken	Reasons	Example of Farmer Comments
Stop using Urea N in winter	Easy Affordable Financial benefit Outside influence (fertiliser price) Environmental focus	*[There is a] financial return from not putting on N in winter.*
Increase effluent area	Easy Affordable Financial benefit Outside influence (fertiliser price) Environmental focus ICM project	*I would have done it – I was thinking of doing it, but [the ICM staff] suggestions, and the Farm Plan were an encouragement to do it* *What encouraged us was trying to achieve best practice. In [year] we won the best dairy farm enviro awards – so we were on the right track [environmentally].*
Lower N use to within safe ranges	Easy Affordable Financial benefit Outside influence (fertiliser price) Environmental focus	*We're not applying fertiliser where effluent is being applied.…There's a satisfaction that I'm doing my bit.*
New effluent storage system	Financial benefit Outside influence (fertiliser price) ICM project Environmental focus	*The ICM project helped opened our eyes up to value of nutrients and impact on environment and with the price of fertiliser going the way it has, I made the investment [to put in effluent storage]. It has cut down on fertiliser costs.*
Use riparian fencing and planting	Other benefit (enhances property) Incentive Environmental focus Incentive (Clean Streams) ICM project	*We were already utilising Clean Streams funding and also the Farm Plan helped identify the importance of this and just encouraged us to do it, and more of it. …visually pleasing – stream and the trees starting to come away now.*
Increase wintering off	Financial benefit Environmental focus ICM project	*We were doing 25% wintering off and now doing 50%. [It reduces] the N loading and we're not buying feed. Win / win on that one.*

The factors that influence change do not operate in isolation. For example, one farmer had made a number of changes (riparian planting, reducing N, no Urea N in winter, effluent storage). As the quote below illustrates, he has an environmental focus ("doing my bit"), has made decisions based on their financial benefits (cost saving and affordability) and outside influences (rising fertiliser costs), has utilised incentives (Clean Streams), credits the ICM project with increasing his understanding and encouraging the change, and as well, he appreciates that the tree planting has enhanced the property.

We were already utilising Clean Streams funding and also the Farm Plan helped identify the importance of this and just encouraged us to do it, and more of it. ...The ICM project helped opened our eyes up to value of nutrients and impact on environment and with the price of fertiliser going the way it has, I made the investment [to put in effluent storage]. It has cut down on fertiliser costs. And we're not applying fertiliser where effluent is being applied. … There's a satisfaction that I'm doing my bit. Also financial return from not putting on N in winter. Also visually pleasing – stream and the trees starting to come away now. (Farmer)

Farmers reported a number of benefits of having made the changes. A primary benefit reported was that they had saved money (on fertiliser). Other benefits stated were that they had gained more knowledge of nutrient management, and had developed a good relationship with Environment Waikato.

I have gleaned more knowledge... but won't act on it aggressively but I will work through it in my own time – main thing is having a good relationship with Environment Waikato – that's good too. (Farmer)

5.5.5 Barriers to uptake of actions

Reasons why the six farmers had not changed practices included:

- the financial cost
- that they were undertaking one action at a time
- that the action would adversely affect productivity
- that the action was not necessary
- that the action was not proven to work

For example, one farmer did not change his fertiliser practice because he believed not using Urea N in winter would limit optimum pasture growth and adversely affect productivity.

We'll use it [Nitrogen] where we need to and where we get a good response even during the winter. (Farmer)

One farmer noted that he had a deliberate strategy and was undertaking one change at a time in relation to his farm system and priorities.

We have got a deliberate strategy – our options – we are deliberately prioritising the things that will give the greatest benefits first. (Farmer)

Another farmer explained that while he had made some smaller changes, he was not prepared to make larger changes because they required a significant capital outlay and, as well, he was not convinced that they would work.

I might need an overhaul of the system – effluent, organic, standing off – a lot of capital expenditure – not prepared to do that yet – the proof is not there that it will work. (Farmer)

Wintering off was another action that farmers were less convinced of being a good solution. Whilst one had increased his wintering off and one had not, they both considered that it was just shifting the problem to another area.

I do some – have a portion of our herd off in winter. But I think it is just moving the problem from our area to another district. (Farmer)

The lack of nutrient targets and guidelines for certain activities has also been problematic for ICM. Specifically if farmers are to be encouraged to get engaged with ICM and take action they would like to know the answers to questions like:

- What are the overall targets for nutrient loss?
- If we make the suggested changes will this reach the targets?
- What are the guidelines for some of the recommended actions (for example effluent storage facilities)?

ICM staff have not been able to provide full answers to these questions. The lack of targets and guidelines can be a barrier to adopting actions particularly the actions that require a greater financial outlay (for example feed pads, effluent storage), as farmers are understandably reluctant to invest in something that they do not have clear guidelines for and which may not make a significant difference.

5.5.6 Actions undertaken: summary

Evaluation findings show that farmers are willing to make changes to on-farm practices. Of the 20 farmers in Little Waipa with a completed Farm Plan, all had taken up some, if not all, of the actions suggested in their Farm Plans. In the Waipapa only two farmers had completed the farm planning process and of these, one had made changes and one had not. Interviewees reported that the ICM approach was a factor in encouraging the uptake of actions. Other factors that encouraged uptake included the action being affordable, easy to implement, or having a financial or other benefit, the farmer having an environmental focus, or there being an outside influence such as fertiliser costs. Barriers to uptake included the action being viewed as costly, adversely affecting productivity, thought of as unnecessary or unproven, and a lack of clear guidelines and targets.

5.6 Environment Waikato systems

The fifth key success area was Environment Waikato systems. As part of ICM the project staff reported and communicated externally and internally, and as well, worked towards integration of Environment Waikato systems.

5.6.1 Reporting

The ICM staff undertook a significant amount of internal reporting on the ICM project. These included reporting to various committees (for example the Upper Waikato Catchment Liaison Sub-committee) and groups (for example, the Dairy Liaison Group). External reporting on ICM included:

- Presenting about ICM at two Fertiliser and Lime Research conferences
- Presenting about ICM to two New Zealand Association of Resource Management conferences
- Producing and disseminating draft catchment plans for each catchment (Beatson, in publication)
- Producing and disseminating regular newsletters to farmers
- Disseminating the AgResearch Nutrient Management report (Longhurst & Smeaton, 2008)
- Producing and disseminating a report on the evaluation of the project (Hungerford, 2008)
- Producing and disseminating the current report

5.6.2 Internal systems

The ICM project has highlighted some opportunities for improving integration of Environment Waikato internal systems. The two key areas are integration across groups and integration of internal systems.

5.6.2.1 Integration across groups

As expected, there are other Environment Waikato staff working in the catchment, visiting farmers. The evaluation highlighted the need for internal co-ordination and efforts were made to action this. Compliance issues are those that posed the most risk to ICM due to the trust needed to be formed between farmers and staff in a project of this nature. A lack of co-ordination of activities had the potential to undermine ICM, as

farmers might believe at the very least that Environment Waikato is not well-integrated or in a worst case scenario that ICM staff had 'reported' them to the Resource Use Group (RUG), for example, and therefore be less inclined to allow ICM staff on farm. Early in the project the evaluation found that the ICM staff needed to clarify how to approach a non-compliance situation in a way that would maintain their relationship with the farmer and ultimately the integrity of ICM. To this end, ICM staff were upfront with farmers, clearly explained their role and their obligations in terms of notifying any on farm non-compliance issues and agree that they would ensure that the farmer is aware of any notifications that staff are obliged to make.

In the past, there had been regular 'On-Farm Services' meetings where all staff working in a geographical area met regularly to inform each other about what they were doing and when. These meetings no longer occur, but the experience with ICM suggests that a systematic way of ensuring that all staff working in a catchment are informed about work in the catchment, would be useful.

5.6.2.2 Integration of internal systems

One of the intentions of ICM was to develop some internal integration of databases and other 'systems' within Environment Waikato. These systems were the River and Catchment Services and Resource Officer zone filing systems, and using GIS to support Farm Plan development and catchment modelling. Whilst some work was started towards these processes different filing systems and databases across groups and a lack of internal resourcing hindered integration.

5.6.3 Environment Waikato systems: Summary

As part of the ICM pilot project staff undertook significant reporting both internally and externally. This reporting was both written and verbal and included presentations to various committees, conferences, community and stakeholder groups. The evaluation of the pilot also highlighted some opportunities for improving integration of Environment Waikato internal systems. There were occasions where a lack of internal integration across groups was a challenge for staff. The findings support working towards improved integration.

5.7 Feedback to policy

The sixth key success area was feedback to policy. One of the intentions of the ICM pilot project was to be able to provide useful information to inform policy regarding the effectiveness of working at an individual on-farm level to effect change. The pilot utilised a number of methods to collect and collate both qualitative and quantitative information on the likely achievement of nutrient efficiency goals. Qualitative data on the uptake of actions, barriers to and benefits from change of practice on-farm was collected via the independent evaluation and staff records of the farm planning process. Quantitative data from the nutrient budgets and farm planning processes provided data on likely impacts on nutrient loss, if recommended actions are followed (see section 5.9 for more detail on impact). Specific feedback was provided via internal reporting systems, and includes the current report.

In particular, the evaluation showed that the ICM approach was effective at promoting changes on farm and, given farmers' comments about the project, has demonstrated to have increased the rate of adoption of various best practices. Adoption favoured those strategies that are easy to integrate into the farm system and/or are affordable and/or provide financial benefit. However, in terms of the scope of the project:

- There is still not 100 per cent coverage in the catchment, and while most farmers have been willing to engage in the project it is unknown whether the whole population of farmers will participate.
- Not all farmers that have had a Farm Plan have agreed to implement all of the recommendations. Some dispute the relevance of some suggested actions and the likelihood of the scenarios producing the outcome.

- Some farmers have changed their farm system since having their Farm Plan and have lost the gains they made in their nutrient budgeting.

This suggests that an instrument such as ICM which is designed to increase voluntary adoption as the main driver of on-farm change may be unable to bring about change in the total population of farmers. In addition, within the population of farmers that will engage with this type of policy instrument, a number will not adopt on-farm changes that are not considered directly beneficial to farm business. The lack of uptake of some more costly and new technologies by farmers at this time illustrates that, an adequate policy mix of education, incentives and regulation to control nutrient loss may be required, as voluntary agreements alone are unlikely to lead to nutrient reductions of the magnitude needed (see Section 5.9 for detail on the impact) if no net decline in water quality is to be achieved.

5.7.1 Feedback to policy: summary

The ICM project provided feedback to policy via internal reporting systems and as well, the current report. The evaluation showed that the ICM one-on-one farm planning approach effectively promoted change on the farms engaged in the project and increased the rate of adoption of a range of best practices. However the ICM project was unable within the project timeframe, to work with the total population of farmers. Those who did participate did not agree to undertake all suggested actions, particularly those that were costly or did not have a direct benefit to farm business. These findings suggest that an adequate policy mix of education, incentives and regulation to control nutrient loss may be required in order to achieve no net decline in water quality.

5.8 Science and process development

The seventh key success area was science and process development. The role of the scientific data in ICM has had some challenges. As was discussed in previous sections the inconclusive nature of the data and the technologies available is a barrier to change, both in attitudes and practices. ICM utilised the science and technology available at the time and also developed key relationships with industry.

5.8.1 Use of models

Data attained from the ICM project was modelled using OVERSEER and UDDER software. The modelling indicates that there are gains to be made with the strategies that ICM is encouraging[28] and ICM has contributed to expanding the knowledge and understanding of on-farm nutrient loss. There remains some debate regarding the accuracy of modelling compared to what occurs on-farm, with seasonality of climate and other v although the pastoral industry does use OVERSEER as an accepted modelling tool. More understanding is needed on catchment nutrient pathways however cost, time and complexity have ruled out such measurement in the ICM pilot project.

5.8.2 Industry collaboration

Collaboration with industry stakeholders evolved as a significant output of the ICM project and has implications for the future of this project and other similar initiatives. Initial involvement with industry came about as ICM staff recognised, early on, the benefit of including fertiliser industry representatives in the on-farm visits. It saved time as the representatives were able to provide nutrient budget data on-farm. It has also had the added benefit of increasing the industry representatives' understanding of Environment Waikato's concerns and direction in regards to nutrient input to farms and other environmental issues.

The collaboration continued over the course of the project with the ICM co-ordinator further developing the relationships with the fertiliser companies, and other key stakeholders including DairyNZ, Fonterra, and local iwi. There has been a sharing of

[28] This is discussed in more detail in the next section which covers the impact of ICM's nutrient reduction strategies.

information and a critiquing of each other's information packages for farmers, in relation to nutrient management issues. There is an intention to continue to build on the relationships for the future of ICM and similar projects in other catchments.

5.8.3 Science and process development: summary

There is a limit to the current technology and scientific data that is available. However, the ICM project was able to contribute to knowledge and understanding of on-farm nutrient loss by utilising data collected on-farm and modelling this to determine impact. ICM also resulted in further understanding of the limits of the data and the science available and future areas that could benefit from further work and/or resourcing. Improved collaboration between EW and industry was another valuable output of the ICM project and one which is intended to be further developed.

5.9 The impact of nutrient reduction strategies

The ICM internal monitoring and external evaluation data indicates that the ICM project encouraged on-farm changes to farm practices. In the longer-term[29] the changes will impact nutrient leaching, but whether this will be reduced 'enough', that is to the extent required, was an issue that ICM needed to determine. As well, there was the challenge that the actions required might jeopardise farm profitability in which case there would be little incentive for farmers to undertake the actions.

As part of the project ICM utilised various models and case studies to determine the impact of the strategies. This section presents the results of the modelling and case studies are discussed below.
Notes:

1. The following sections primarily focus on N as nitrogen has been a focus of the pilot, and as such the modelling to date has primarily focused on N.
2. The following sections primarily focus on dairy farms as they make up the majority of farms engaged in ICM for which data was readily available. There is currently one large dry stock farm engaged in ICM, but farm planning is not complete so data from that farm was unable to be modelled for this report.

5.9.1 Case studies

AgResearch was contracted to undertake case studies from the ICM catchments on nutrient management analysis and to integrate this with agronomics and farm economics (Longhurst and Smeaton, 2008).They utilised data from eight farms (in the two catchments), running this through OVERSEER[30] to determine the impact of various strategies to reduce N and P losses. Two farms were then analysed using UDDER[31] to determine the likely cost of the various strategies. Longhurst and Smeaton (2008) found that the greatest contributors to N loss were stocking rate and the amount of N applied as fertiliser. The most effective strategies for reducing nutrient losses (excluding reducing stocking rate and/or removing part of the herd during the winter) were found to be reducing fertiliser input, limiting fertiliser application in winter (May to July), and using DCD nitrification inhibitors. Increasing the size of the effluent block and reducing fertiliser input to this block was also effective as it reduced the overall use of N.

Longhurst and Smeaton (2008) note that there is no single mitigation solution, and that a series of incremental changes in nutrient loses can be achieved by adopting these mitigation practices. Their modelling showed that following best management and

[29] As was discussed earlier, one of the difficulties with a project like ICM is that nutrients take time to leach into the waterways, making it difficult to determine the impact of strategies. It is estimated for example that it may take decades before any significant differences will be able to be tracked. This leaves the option of computer modelling to assess what impact will occur.

[30] OVERSEER® is a nutrient budget software program designed to calculate nutrient budgets and to provide a farm inventory of greenhouse gas emissions and energy use. Nutrient budgets provide estimates of all nutrient inputs and outputs for a farm or a block of land under a long term view. The accuracy of nutrient calculations rely on accuracy of input data, and sound interpretation from a skilled advisor. It should also be noted that the model work on a long term average and thus, does not always match in field measurement due to climatic and farm system fluxes.

[31] UDDER is a dairy production software model that includes financial assessments of any changes in farming practices.

utilising these strategies could reduce N loss by approximately ten kgN/ha/yr down from an average of 45 kgN/h/yr to an average of 35 kgN/h/yr.[32]

In general, the UDDER model showed that profitability was not compromised significantly by many mitigation strategies, particularly in situations of higher payouts. However, some strategies such as the introduction of specialised standoff/animal shelters to remove stock during the winter were not considered cost effective though some farmers have reported other benefits from these technologies. They concluded that there was a need to work on how farmers can fit mitigations into their current dairying systems so that that progress can be made in N leaching without compromising farm profitability (Longhurst and Smeaton, 2008).

5.9.2 Impact on leaching

As was discussed earlier, due to time-lag and other variables, it is not accurate to simply measure current in-stream nutrient levels directly before and after ICM to determine the impact of any on-farm changes to nutrient loss. This leaves the option of modelling available data in order to determine impact. Data from the farms participating in ICM was used to model the extent to which change in nitrogen loss had been and/or could be mitigated by uptake of actions in the Farm Plans.

In order to determine what impact ICM has had on nutrient leaching, nitrogen loss was calculated from the nutrient budgets and the completed Farm Plans[33] of those participating in ICM (n= 20 for Little Waipa and n=9 for Waipapa).

- The "pre ICM" figure is based on the farm nutrient budgets, provided when the farmer first became involved in the project.
- The 'agreed' figure (for Little Waipa only[34]) is based on the actions that farmers have either done or agreed to do and how much each action will reduce N loss.
- The 'at best' figure is based on uptake of all the possible actions (as indicated in the Farm Plan); that is what could be achieved if all the actions recommended in the Farm Plan were undertaken.

There are some cautions with interpreting this data.

- The data only refers to dairy farms.
- The 'agreed' data presented for Little Waipa is taken from the Farm Plans, and actions have not been verified as in place.
- The 'at best' figure is based on putting in place a range of different actions and some of these may not be profitable or preferred options (for example they may be costly or require farm system changes).
- The average kgN/ha/yr leached is presented, however the range is large for each of the categories, indicating some farms have higher leaching rates which has the effect of lifting the average.
- The sample sizes are small; 20 out of 78 farms in Little Waipa and nine out of 22 farms in Waipapa. As more Farm Plans are completed and the data becomes available the modelling will be able to be more robust.

5.9.2.1 Little Waipa: impact of ICM on N loss

In Little Waipa the pre-ICM N loss from the 20 farms ranged from 28-56kgN/ha/yr, with an average of 42kgN/ha/yr. All farms agreed to some actions. Doing the agreed actions reduced the loss by four kgN/ha/year to an average of 38kg/N/ha/yr (range 27-

[32] The average leaching in the two pilot catchments was 42 kg/N/ha/y, higher than the 2004 Waikato average of 36 kg/N/ha/y. This is to be expected due to the differences in climate and soils throughout the region and the intensification that has taken place since then, particularly in the south Waikato area.

[33] The farms included in the samples were those which had completed farm plans, had a second visit and farmers had clarified which actions they had done or intended to do.

[34] Only two farms in the Waipapa had agreed on which changes they would make and the other seven farms (two landowners) had had a second visit but had not agreed as yet to do any actions. Given the small number of farms in this sample, and rather than discard those farmers yet to agree on actions, it was decided to only model pre-ICM and 'at best' figures, that is model on the approach that the recommendations would be acted on.

49kgN/ha/yr). If all suggested actions were undertaken, this could be reduced by a further eight kgN/ha/yr to an 'at best' figure of 30kg/N/ha/yr (range 22-40kgN/ha/yr).

The total amount of nitrogen leaching from the 20 farms, pre-ICM, was 76 tonnes (see Table 7). The total nitrogen leaching load after agreed actions were undertaken was 68 tonnes, a difference from the pre-ICM figure, of seven tonnes. The 'at best' total nitrogen leaching load is 55 tonnes, a difference from the pre-ICM figure, of 21 tonnes.

Overall, the data indicates that ICM has managed to date, to reduce the Little Waipa catchment's nitrogen leaching load by a minimum of seven tonnes (the 'agreed' figure) with the potential to reduce it to 21 tonnes if all actions are followed (the 'at best' figure). As discussed in Section 2.2, Little Waipa has an estimated nutrient leaching load of the order of 420 tonnesN/year so, seven tonnes represents a reduction of two per cent and 21 tonnes a reduction of five per cent over the total catchment.

The 20 Little Waipa farms have an estimated total of 1813ha in production[35]. If we assume that these farms are representative of dairy farms in the catchment and that the actions agreed to would be similar in amount and type then it could be extrapolated that if all dairy farms in the area[36] had Farm Plans then the total reduction in N loss could be in the order of 36 tonnes[37]. This would be a nine per cent reduction in N losses from 'agreed' actions. Using the same calculation the 'at best' figure would be 108 tonnes[38] which would be a 26 per cent reduction.

Acknowledging the assumptions above, the purpose is to put these N losses into context of the estimated amount of reduction needed in Little Waipa, to obtain no net decline in water quality which equates to losses of 22-26kgN/ha/year (or 260-304tonnesN/year). This would require a reduction of 160-116 tonnesN/year which is 28-38 per cent of 420 tonnesN/year currently leached.

5.9.2.2 Waipapa: impact of ICM on N loss

The pre-ICM N loss from the nine dairy farms ranged from 31-48kgN/ha/yr, with an average of 37kgN/ha/yr. If all suggested actions were undertaken, calculations indicate that this could be reduced by a further nine kgN/ha/yr to an 'at best' figure of 28kg/N/ha/yr (range 24-37kgN/ha/yr). The total amount of nitrogen leaching from the nine farms, pre-ICM, was 48 tonnes (see Table 7). The 'at best' total nitrogen leaching load is 36 tonnes, a difference from the pre-ICM figure, of 12 tonnes. What is of note in Waipapa compared to Little Waipa is that seven of the nine farms are still in-process with determining which actions will be most suited on-farm and as such an 'agreed' figure is not yet able to be calculated. It is therefore difficult to establish the extent of the impact of ICM on total N leaching loads in the Waipapa catchment.

Waipapa has an estimated nutrient leaching load of the order of 275 tonnes/year. So, if the farms agreed to all actions then the 'at best' figure of 12 tonnes would be a reduction of four per cent over the total catchment. The nine farms have an estimated total 1296.1ha in production which is 13% of the catchment area. Again, assuming that the farms with Farm Plans are representative of others in the catchment, 'at best' figures based on completing Farm Plans with all dairy farms[39] in the Waipapa catchment would bring about a reduction of 44 tonnes[40] which would be a ten per cent reduction overall. To put this into context the estimated amount of reduction needed in Waipapa, to reach 22-26kgN/ha/year (or 221-261tonnesN/year) would be 54-14tonnesN/year which is 13 -5 per cent of 275 tonnesN/year.

[35] Hectares in production was estimated at 95% of the farm land area based on land not in production from tracks and races and riparian areas etc.
[36] Dairy farming is approximately 74% of the land area in Little Waipa (9030ha).
[37] 4kgN/ha X 9030ha=36120kg.
[38] 12kgN/ha x 9030ha =108360kg.
[39] Dairy farming is approximately 50% of the land area in Waipapa (4898ha).
[40] 9kg/ha x 4898ha = 44082kg.

Table 7: Summary of nitrogen leaching in both catchments pre and post-ICM intervention

Catchment	Pre-ICM		Agreed		At best	
	Average Kg N/ha (range)	Total[1] tonnesN	Average Kg N/ha (range)	Total tonnesN *(difference from pre-ICM)*	Average Kg N/ha (range)	Total tonnesN *(difference from pre-ICM)*
Little Waipa n=20 farms 1813ha (15% of total catchment area)	42kgN (28-56)	75tonnes	38kgN (27-49)	68tonnes *(7tonnes)*	30kgN (22-40)	54tonnes *(21tonnes)*
Waipapa n= 9 farms 1296ha (13% of total catchment area)	37 (31-48)	48tonnes	N/A	N/A	28 (24-37)	36tonnes *(12tonnes)*

Notes: 1. Total tonnesN is the total amount of N lost from all the farms in each sample. That is 20 farms in Little Waipa and nine farms in Waipapa. This figure was calculated by multiplying the land area of each farm by each farm's actual kgNha loss (i.e. not the average), then adding the totals to get an overall total from all the farms in the sample.

5.9.3 The 'gap model'

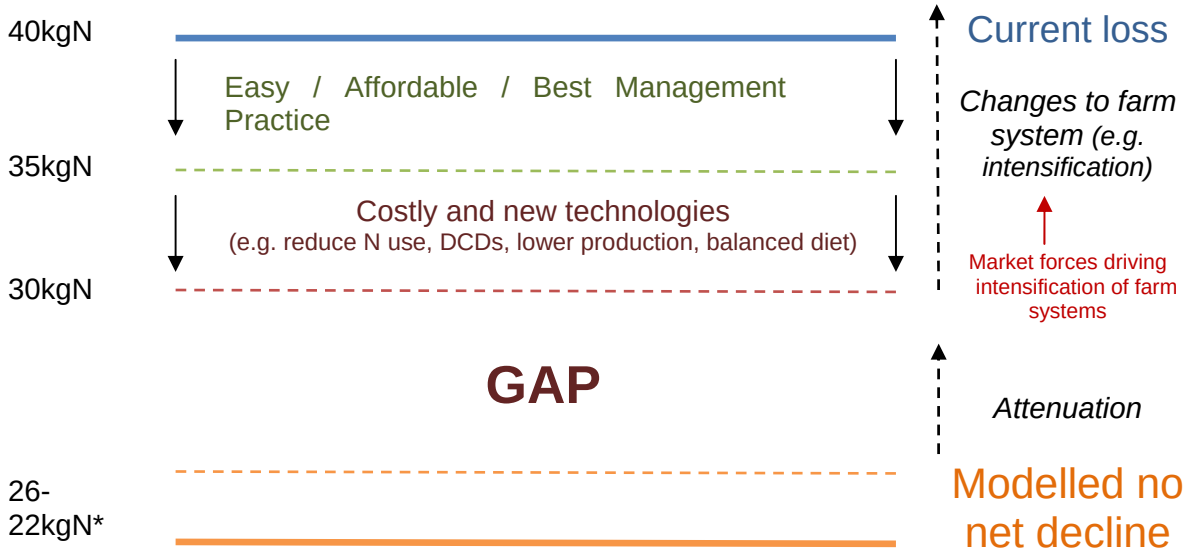
The 'gap model' (Figure 11) was developed from the ICM pilot data and provides some indication of what can impact on on-farm nutrient losses, and the benefits and limitations of an ICM process.

The ICM pilot data from nutrient budgets of individual farms across both catchments was collated. This data indicated that the current (average) nitrogen leaching levels in the two pilot catchments were (on average) 40kgN/ha/year per farm. Modelling of the available data from the Farm Plans found that this rate could be reduced by various changes to farm practices that are affordable and easy to integrate into the current farm system to 35kgN/ha/yr. Such changes are the extension of effluent areas, applying no nitrogen fertiliser to effluent areas, no use of winter N, some lowering of N use (for example to about 180kgN of Urea), mining of excessive phosphorus levels and riparian management.

If more costly and new technologies are adopted such as standoff technologies, further lowering of nitrogen fertiliser and replacing with a balanced diet supplement such as maize, appropriate feed pad technologies, lowering of stocking rate and production in some cases, and the application of DCDs and inhibitors, then this data indicates that ICM farm planning and the uptake of actions can reduce leaching to 'at best' an average of 30kgN/ha/year.

However, ICM also found that farm systems are not static, that is farmers may expand their farms and/or change their land use, and these changes impact their nutrient budget. As an example, within the ICM pilot period two farmers proactively took up the suggested actions and significantly reduced their nutrient loss. They then made the decision to intensify their system and this had the effect of increasing their leaching levels almost to the pre-ICM figures. This finding is important as it shows that reviewing the budget is an important part of farm planning, that there is a need to include expert input regarding the effect of on-farm changes to the nutrient budget as part of farm business, and that an ICM farm planning model, whilst effective, is not a one-off solution but an on-going process to ensure that gains are sustainable.

The modelled 'no net decline' figure of 22-26kgN/ha/yr is the figure that if reached by all dairy farms, has been estimated to result in no net decline in water quality[41]. However reaching this figure reveals a 'gap' remaining after gains made through adoption of nutrient efficient on-farm practices. The data indicates that ICM and on-farm planning can encourage farmers to change practices that will shift the loss rate towards the goal, but is not sufficient to reach the 22-26kg/N/ha/y. Bridging the gap may in part be achieved by attenuation[42] and although this is difficult to quantify it is unlikely that this would bridge the remaining gap. In addition, business decisions to intensify or change farming systems may add upward pressure and reduce gains made. Further strategies may need to be employed in the future such as uptake of new technologies that have yet to be developed or changes to farming systems, to other strategies such as rules or incentives to achieve the goal of no net decline.



Note: *This figure is an approximation. It is modelled on dairy farming only in the Upper Waikato with the current land use distribution.

Figure 11: Nutrient 'gap' model

5.9.4 Impact of strategies: summary

Overall, the ICM pilot data showed that ICM was able to encourage farmers to make changes on-farm. These changes, when modelled, showed that ICM had achieved an agreed reduction of on-farm nutrient leaching in Little Waipa by four kgN/ha/yr (from 42 to 38kgN/ha/yr on average) on 20 dairy farms, equating to seven tonnesN/year, with the potential to reduce it to 30kgN/ha/yr if all suggested actions were undertaken. ICM had not yet gained agreement from enough farms in the Waipapa to make modelling of agreed actions a feasible option, although the 'at best' option for nine Waipapa dairy farms was a reduction nine kgN/ha/yr (from an average of 37 to 28kgN/ha/yr).

The data also showed that whilst ICM did encourage on-farm change that there is a need to include expert input regarding the effect of on-farm changes to the nutrient budget as part of farm business to ensure that gains are sustainable. In addition, even the 'at-best' options would not reduce leaching to the 22-26kgN/ha/year which is the best current estimate for no net decline in water quality, indicating that further strategies may be needed to achieve the goal of no net decline.

[41] This figure is based on an assumed level of dairying at present levels and the presumption that dairy farms would have a different allocation from other land uses.

[42] Attenuation is natural catchment processes that takes up nutrients in the water thus reducing the amount. However there is currently not an agreed extent to which this has an effect, which makes it difficult to include in the model. Current estimates of attenuation rate in these catchments range from 20%-35% but further work is required in this area to calculate attenuation factors.

6 Discussion

From its initial establishment in 2006 through to 2009 the ICM pilot project has undertaken the majority of its planned activities and added other facets as it has developed. Overall, the ICM pilot demonstrated that an approach that includes an on-farm presence by skilled and knowledgeable people and an individual farm planning process can result in on-farm changes that reduce nutrient leaching. The following discusses the key findings in more detail.

Project timeframes and resourcing

The original timeframe for the project was three years. In this time it was expected that all farmers would have a Farm Plan and that these would also have been reviewed. The reality was that most activities took longer than anticipated. Project set up and community engagement, Farm Plan template development, Farm Plan writing all took time. It was also very resource-intensive; there were simply not enough staff to cover all the farms within the timeframe. Whilst they did not work with all farms, the pilot was able to cover a significant proportion of the land area of the catchments and to work with the farms that had more intensive operations and on which changes could have the biggest potential impact. These findings provided some useful data on resourcing and staffing requirements, and also highlighted the need in future projects to allow for lead-in time, and to considered a targeted approach for maximum impact.

Engagement and communication

There were some interesting learnings from the pilot process about engagement in the project. The communities, the staff and the farmers underwent a process over the course of the pilot. Staff were originally greeted with a mixture of anxiety, anger and suspicion; communities were concerned that Environment Waikato was going to 'tell' them what to do and some were wary, having experienced previous 'consultation' processes with other organisations, that had not been entirely positive. There was also some initial curiosity however, and some farmers agreed to participate. Staff worked hard during on-farm visits to communicate and clarify the purpose of ICM and build a working relationship. This process led to further understanding of the issues (both for farmers and ICM staff), and farmers appreciated the Farm Plans and the process and undertook a number of actions and changes to practice.

The skill of the ICM staff was a significant aspect of the ICM project and should not be underestimated. The knowledge and approachability of the staff, their willingness to work on-farm with farmers, to provide information, return phone calls and keep farmers updated contributed to positive views of the project and Environment Waikato and a willingness to consider and put changes into place. Also of import were pre-existing positive relationships between Environment Waikato and the communities. In the areas where these relationships existed (for example with Stream Care groups) the engagement in the project appeared to occur more quickly and there was less initial resistance.

Uptake of actions

The majority of the farmers participating in the ICM project were willing to make some of the changes to their on-farm practices or systems that were recommended in their Farm Plans. The actions that were most likely to be taken up were those that were easy, affordable, and had a financial or other benefit. Outside influences such as the rising price of fertiliser and lower dairy payout often influenced farmers' decisions on changing practices, as did the farmers own environmental focus, and that some changes took more time than others to instigate.

ICM was also able to identify some barriers to uptake. The main barriers were perceived financial outlay, impact on productivity or profitability, lack of clear targets, guidelines and scientific proof about some of the mitigation strategies. These findings

highlighted the need to provide farmers with clear targets, certainty, clarity and support in order to effect change

Impact on leaching

ICM was able to encourage farmers to make changes on-farm that reduced the nutrient leaching load in the catchments. Modelling of data collected for the pilot showed that ICM had reduced on-farm nutrient leaching in Little Waipa by four kgN/ha/yr (from 42 to 38kgN/ha/yr) on a sample of 20 dairy farms, with the potential to reduce it by 12kgN/ha/yr to 30kgN/ha/yr, if all suggested actions were undertaken. ICM had not yet gained agreement from enough farms in the Waipapa to make modelling of agreed actions a feasible option, although the 'at best' option for nine Waipapa dairy farm was a reduction nine kgN/ha/yr (from 37 to 28kgN/ha/yr). These results are in line with the reduction in N losses modelled in the case studies by Longhurst and Smeaton (2008). However, caution needs to be exercised with the 'at best' options as some require capital outlay and/or may not be feasible to undertake and maintain farm profitability.

Further analysis revealed that whilst ICM did encourage on-farm change even the 'at-best' options would not reduce leaching to 22-26kgN/ha/year, which is the best current estimate for no net decline in water quality. Whilst bridging this gap may in part be achieved by attenuation, this is difficult to quantify and it is unlikely that this would be enough. In addition, the pilot data also showed that if farmers changed their farming system or land use (for example intensified), then this impacted the nutrient budget and their leaching levels could increase again. This highlighted the need to ensure that nutrient budgets are revised when there are land use or other on-farm changes. Further strategies may need to be employed in the future such as uptake of new technologies that have yet to be developed or changes to farming systems, to other strategies, rules or incentives to achieve no net decline in water quality.

Internal integration

Internal integration within Environment Waikato was a recurring theme throughout the project. ICM staff were aware of the challenge of needing to work on compliance issues concurrently with best practices and worked to improve internal integration. Integration across systems was also problematic at times due primarily to differences in filing systems and databases used across the organisation. The findings highlighted that integration is an important aspect of a project like ICM and one which would benefit from continued improvement.

Evaluation

Significant to the project being aware of its impact and able to adapt, was having some clear measures of success and ways to evaluate (both internally and externally) itself against those measures. Findings from these evaluative processes were fed back into the project, highlighted issues and potential risks before they escalated and provided rich sources of data to assist with planning.

7 Recommendations

The following recommendations were developed from the findings of the ICM pilot project.

General recommendations

It is recommended that:

1. The link between on-farm practices and the environmental outcomes should be established by independent science of good quality to provide credibility.

2. Environment Waikato consider a targeted approach to catchment delivery, based on environmental risk and potential environmental outcomes, as the findings

suggest that a targeted approach may be more efficient in terms of environmental outcomes and resources.

3. Environment Waikato work towards clarifying targets for nutrient leaching at the farm and catchment scale so that these can be clearly communicated to and understood by landholders and provide certainty. For instance, in its review of the Regional Policy Statement, Environment Waikato should set specific, measurable objectives for water quality in receiving water bodies.

4. Environment Waikato consider providing guidelines or policies for on-farm practices that can affect nutrient loss.

5. Environment Waikato continue to work with industry and farmers to develop on-farm mitigation strategies that will reduce nutrient losses.

6. Environment Waikato investigate affordable ways to have an on-farm presence and work with farmers to effect change, for example working with appropriately qualified industry field staff to deliver farm planning advice that incorporates nutrient reduction targets.

7. Environment Waikato work towards improving internal integration.

8. Environment Waikato investigate the feasibility of developing policy intervention that will bring about change in the total population of farmers. For instance, a mix of incentives and regulatory controls could be used in combination with ICM approaches.

Recommendations for future or similar projects

It is recommended that:

1 When planning an ICM project, projects should:
- plan for lead-in time (estimate 12 months minimum);
- expect some initial suspicion and facilitate trust by providing credible information from credible sources;
- plan to consult and allow time for engagement and acceptance;
- gather some information about the community (for example, what is important to them, what resources they have, what are their social dynamics) prior to entering the community;
- consider a targeted approach (for example target farms by farming operation or land area or by those with direct access to waterways);

2 When undertaking an ICM project, projects should:
- be flexible and be able to adjust timeframes and expectations in response to developments on the ground;
- ensure that on the ground staff are knowledgeable about the issues and their practical application, and are skilled at relationship building;
- improve internal integration particularly in situations of compliance and prosecution;
- include formative and process evaluation activities to monitor progress and provide data to improve and manage risk.

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