SETTING THE STANDARD FOR NUTRIENT MANAGEMENT PLANS

Dr D C Edmeades[1], Dr M Robson[2], Dr A Dewes[3]

[1]agKnowledge Ltd. PO Box 9147, Hamilton. doug.edmeades@agknowledge.co.nz
[2]AgResearch, Lincoln Research Centre, Christchurch. Melissa.Robson@agresearch.co.nz
[3] Agricultural Consultant, Hamilton. dewesam@gmail.com

INTRODUCTION

Nutrient Management Plans (NMP) are a relatively new concept in New Zealand and, for reasons discussed in this paper, are likely to become mandatory for many, at the individual farm level, within the next 5-10 years. This prospect should be vigorously embraced and encouraged by all those involved, especially farmers, because it is now known that NMPs not only reduce the environmental footprint but also can have significant economic benefits (Edmeades 2008).

The task ahead is enormous. It will require a clear vision of where we have come from and where we are headed. For this purpose Figure 1 is instructive.

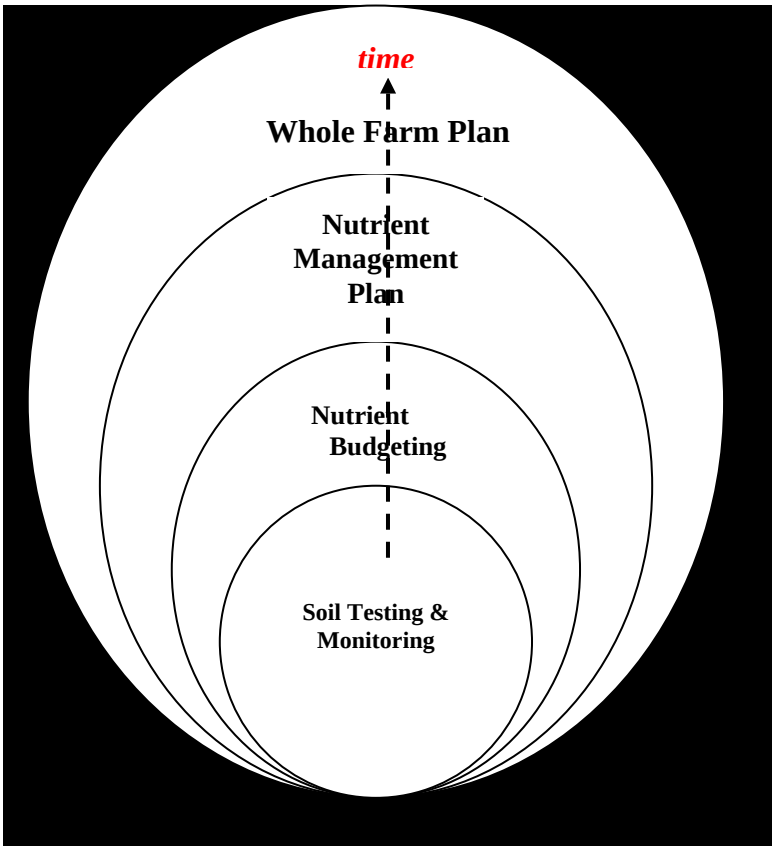

Figure 1: Nutrient Management in Context

Monitoring soil fertility has become routine since the mid 1950s when soil testing was introduced. With the development of OVERSEER® in the early 1990s Nutrient Budgeting (NB) has also been adopted. Nutrient Management Plans (NMP) are now on the horizon with the future prospect that they will become a component of the wider Whole Farm Plans (WFP).

The tentative efforts to date to develop NMPs have been *ad hoc* and hence the purpose of this paper is to outline an approach to nutrient management planning and attempt to define the minimum requirements of a NMP in terms of the technical and non-technical attributes which a NMP should embrace.

DEFINITION OF NUTRIENT MANAGEMENT

Nutrient management includes managing the nutrients (with emphasis on N and P because they are the major 'pollutants') coming onto or leaving ***a farm***[1]. It includes, obviously, the management of fertilisers (organic and inorganic) and any other significant sources of nutrients moving across the farm boundary (e.g. feed supplements) and for dairy farms, effluent management.

It must also include aspects of pasture, crop, animal and land management where these impact upon the movement of nutrients on to, from, and around the farm.

Because the fertility of the soil is a primary determinant of a) the need or otherwise for fertiliser and b) the losses of nutrients from the farm, an accurate assessment of average soil fertility of a given farm or management unit, relative to the economic optimal soil nutrient levels, is an ***essential foundation*** of a NMP. This point must be emphasized because it logically requires that a NMP must consider the goals and the economics of the specific farming enterprise.

LEGAL REQUIREMENTS FOR NMPS

The purpose of the Resource Management Act (1991) is "to promote the sustainable management of natural and physical resources." In terms of the Act "sustainable management means managing the use, development, and protection of natural and physical resources in a way, or at a rate, which enables people and communities to provide for their social, economic, and cultural well-being and for their health and safety while -

- (a) sustaining the potential of natural and physical resources (excluding minerals) to meet the reasonably foreseeable needs of future generations; and
- (b) safeguarding the life-supporting capacity of air, water, soil, and ecosystems; and
- (c) avoiding, remedying, or mitigating any adverse effects of activities on the environment".

[1]It is accepted that there is at present no clear definition of 'a farm' in the context of an NMP. Given the legal requirement for NMPs (see later) much will depend on the specificity required by the Regional Councils in their Regional Plans. Is the average loading of N and P across all the blocks (LMU – see later) within a given farm, all that is required?. Can farms under common ownership be amalgamated for the purpose of a NMP?

The RMA (1991) is given effect through the regional council's Air, Water and Land (Soil) management plans and with some exceptions[2] farming, including the use of fertilisers, is a permitted activity (i.e. does not require a specific consent) providing the farmer, as a minimum, complies with the Code of Practice For Nutrient Management (a Fertiliser Industry initiative) which in practice embraces the Dairying and Clean Streams Accord (a Dairy Industry Initiative).

Environment Waikato has taken this a step further and under Rule 3.9.4.11[3] fertiliser application is a permitted activity subject to:

1. Having a Nutrient Management Plan (NMP) when nitrogen fertiliser is applied at rates greater than 60 kg N/ha/yr and when any fertiliser is applied to land to which animal effluent is applied.
2. That there is no objectionable odour or particulate matter beyond the farm boundary,
3. That there is no direct application of fertiliser to any water body.
4. Following the Code of Practice for Nutrient Management.

The Environment Waikato guidelines specify that a NMP is based on a Nutrient Budget (NB) which must document all inputs and outputs (of N and P) and assess the potential losses of N and P. Also the NMP must identify actions to minimise any losses of nutrients (N and P) and it is suggested that these actions can be considered under a number of categories[4]. Environment Waikato does not specify what actions or management practices should or could be adopted on any given farm to minimize avoidable losses of N and P. It is left to the individual land owner to implement those options and practices which best suit the farm and its operation.

Environment Waikato does however require that NMPs are made available on request. This implies that the plans are in writing, are accessible and in a form and format that can be readily understood by a third party.

While Rule 3.9.4.11 requires farmers to prepare, and have available, a NMP, it is not specific as to what constitutes a NMP. Furthermore, no goals, guidelines or criteria are set as to the nutrient loadings of N and P required for a specific farm or indeed specific catchment after taking due consideration of the desired quality of the receiving waters. The philosophy inherent in Rule 3.9.4.11 is *laissez faire*[5] – it assumes that farmers are sufficiently self-motivated to achieve at least some qualitative reduction in the N and P losses from their property.

[2] See footnote 3

[3] Regional Councils can and do differ in their application and implementation of the RMA. For the purposes of this paper we will apply the rules as set down by Environment Waikato, which appear to be the most advanced in respect to this issue (accessed 15/5/2008)

[4] The categories suggested include: Effluent, Soil, Pasture, Production and Stock, Riparian, Cropping and the risk to waterways from 'hot-spots' such as silage pits, offal holes, farm dumps

[5] There are exceptions including the farms in the catchments of the Taupo and Rotorua Lakes for which nutrient caps are being applied and also for some specific, large irrigation schemes in South Island for which resource consents including NMPs are required

DEVELOPMENT OF NUTRIENT MANAGEMENT PLANS

The Fertiliser Industry's response to the RMA (1991) was to develop a "Fertiliser Code of Practice" on the understanding with regional councils that fertiliser use would be a permitted activity providing farmers complied with this Code. Subsequently it was realised that fertiliser use is but a subset of nutrient management. Thus the Code was broadened and renamed, "Code of Practice for Nutrient Management with Emphasis on Fertiliser Use" (NZFMRA 2007).

The Code defines a NMP as:

> "A written plan that describes how the major plant nutrients (nitrogen, phosphorus, sulphur and potassium, and any others of importance to specialist crops) will be managed. The NMP applies only to that area of the property which is under the direct management oversight of the property manager. The nutrient management plan aims to optimise production and maximise profit value from nutrient inputs while avoiding or minimising adverse effects on the environment."

The Code sets out "Seven Steps" that are required to prepare, implement and monitor a NMP (Figure 2). Important features include: Setting the farm goals, identifying the specific land management units (LMU) within the farm, and for each LMU, identifying and assessing the risks (defined as a combination of the likelihood and consequences of specific event giving rise to nutrient losses occurring), the fertiliser requirements and a nutrient budget.

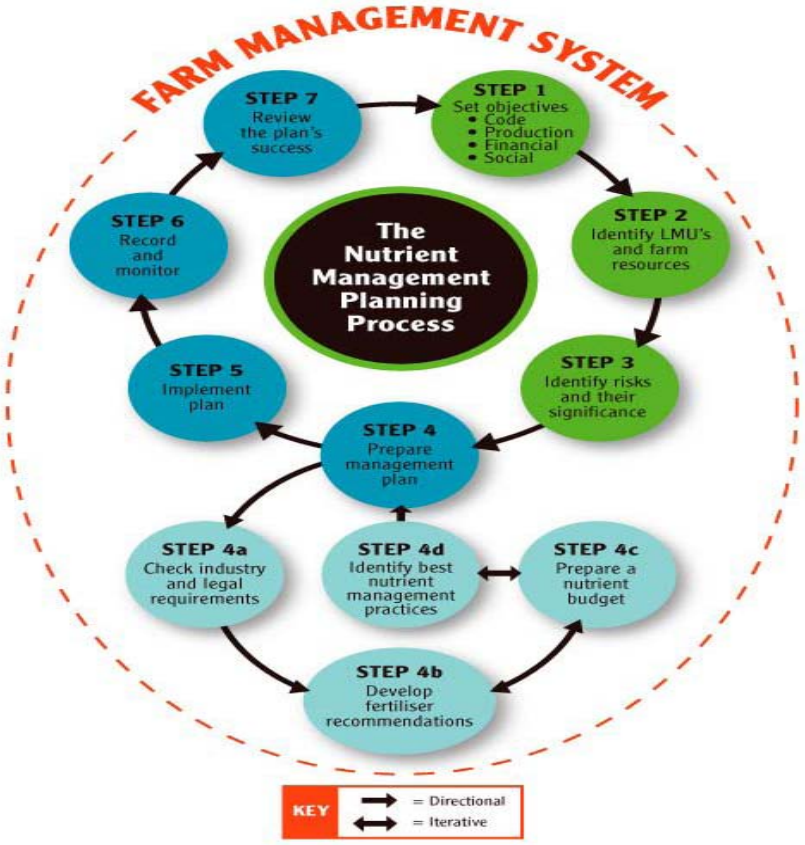

Figure 2: The Seven Step Nutrient Management Plan from the Code of Nutrient Management.

The Code includes a NMP Template together with 'User Guides' and associated 'Fact Sheets'. It appears that the intention of the Code is self-assessment by the land owner to be undertaken by ticking the appropriate boxes. For some reason the 'Template' does not follow the Seven Step process specified in Figure 1 and importantly does not include a Nutrient Budget.

The Fertiliser Industry has now modified and computerised the NMP template to allow the Field Representatives to prepare NMPs for their clients. It is designed so that generic comments and statements can be cut & pasted into the report and appropriate boxes "ticked." Best Management Practices (BMP) for the use of fertiliser N and P and for effluent are defined and are relied upon as the standard to be achieved Goals in terms of the desired nutrient loadings are not considered and there is no attempt to quantify the effects of a given BMP on the nutrient loadings. Nutrient Budgets are included but the Seven Step Process of the Code is not followed.

There are also some privately developed and owned examples of NMPs. For example, the Ritso Society Inc. has developed an "Environmental Management System" specifically for major irrigation systems. In essence, and similar to Fertiliser Industry's NMP Template, it in part relies on the application of some BMPs covering the various aspects of management. Once again no consideration is given to setting goals for nutrient loadings or what the impact of the BMPs on these loadings might be. Similarly agKnowledge Ltd has developed its own plan, "Total Nutrient Management" (TNM™) which places emphasis on the optimising soil fertility and hence the profitability of the farm at the LMU level. It includes a NB and in a semi-qualitative manner provides the farmer with management options to reduce nitrate leaching and P runoff.

Best Management Practices

Most of the NMPs constructed to-date take the user though a process which ends, as far as the farmer is concerned, with the application of various BMPs. For example the Code of Nutrient Management includes BMPs for Fertiliser Storage and Handling, the Use of Fertiliser N and Fertiliser P. Similarly, the "Environmental Management System" designed by Ritso Ltd, includes a BMP for the design and management of Irrigation Systems. However, the use of generic BMPs is problematic.

There is likely to be a mismatch between a recommended suite of generic BMPs and the unique nature of issues on farms and catchments. What may be best practice in one place may not be optimal, desirable or indeed required, in another place. For example, applying the BMP for the use of fertiliser N may be less useful to the wider environment if indeed phosphorus is the key issue. Similarly, adopting a BMP for riparian planting may be of little benefit if the goal is to reduce N leaching to groundwater. Also each farm is unique. Adopting the BMP for effluent management may be ineffective in terms of managing nitrate leaching if in fact the major source of N leaving the farm is discharged from a standoff pad.

Thus the application of a generic suite of BMPs to all water quality issues is of limited value because there is no identification of the catchment specific problem (s) and linking this to a farm specific solution (s) required to mitigate the identified problem (s). Expressed differently, a knowledgeable farmer would not write a generic NMP for his/her farm. He/she would identify the specific problem(s) and then identify the specific solution (s) required on the farm to deal with that problem(s). Thus, while the term "BMP" carries the implication of

an automatic good outcome, successful environmental outcomes rely on more than BMPs alone.

This highlights another problem with BMPs – they are typically written with technical help by organisations for farmers – in this sense they are top-down solutions. What are in fact required are bottom-up solutions that begin with the requirements of the catchment and work through a process up to specific solutions on the farm. This has other advantages: it allows the farmer flexibility and has the possibility of serendipitous, novel and practical solutions coming directly from farmers.

New Approach Required

In our view a new approach to nutrient management is needed which enables goals to be set and requires that specific and quantifiable farm management activities are developed and applied to achieve those goals. Also, any new approach needs to be sufficiently flexible to be applied to all farms but robust enough to be empower the RMA (1991) at the farm level.

Smyth and Dumanski (1994) developed what they called a Framework for the Evaluation of Sustainable Land Management (FESLM) which defines sustainability through balancing and integrating goals set in five areas, which the authors referred to as pillars: Production, protection, viability, acceptability and risk. In their original form, the goals in the individual pillars are multi-layered and complex. In the interest of practical application on farm we have simplified the terms and propose that:

Any farm management practice is sustainable if the following five goals are achieved simultaneously:

- Production – does the practice achieve the desired production goal?
- Risk – does the practice reduce the risk of not achieving the production goal?
- Economic – is the practice economic?
- Environment – is the practice sustainable with respect to soil, water, air and other relevant resources?
- Social – is the practice socially acceptable?

This definition embraces the philosophy and purpose of the RMA (1991). The FESLM approach, like the RMA, is "effects based" and broadens and makes more explicit the definition of sustainability in the RMA which embraces social, economic and cultural well-being. Importantly FESLM provides the framework to link the regional council's Air, Water, and Land (Soil) plans in an objective, specific and quantitative manner to the individual farm. In practice it will be the farmer who defines the production and economic goals for his farm but the environmental and social goals will be determined by the wider community via the RMA (1991) through the regional council's Air, Water and Land (Soil) management plans.

The application of the FESLM is robust and flexible. The goals for water and soil quality are not, and indeed, should not be uniformly the same for all catchments and thus, differences between catchments can be expressed and managed in this manner via the regional plans. This has been made explicit in the recently released Regional Policy Statement from Environment Waikato[6].

[6] Released in 2011 http://www.ew.govt.nz/Policy-and-plans/Regional-Policy-Statement.

Similarly, the farmer has maximum flexibility in terms of his farm management. This is because FESLM like the RMA is 'effects-based' – it should not matter whether a farmer follows generically prescribed BMPs or otherwise. The environmental and social consequences of his farming activities will be assessed and audited solely against whether he has achieved the appropriate goals for the catchment or region in which his farm is located. This effects-based approach, unlike BMPs, will encourage novel farmer-initiated ideas for environmental management.

The connectivity between the farm and environment, which this framework allows, will enable farming practices to be evolved over time so that the future management of agriculture will be based on the requirements of the receiving waters. Up until now this has not been generally possible, except for those specific catchments where an N-cap is now in place.

Finally, this approach makes explicit what is implicit in the RMA – that there must be a balance between farm production and hence the economic welfare of the nation and its citizens, and the need for environmental goals to protect the resources of air, water and land. It is our experience that farmers are very comforted by the FESLM approach because it enables this balance to be formalised and expressed.

MINIMUM REQUIREMENTS FOR NMPs

Non-technical Attributes

Purpose and Motivation

Leaving aside the legal imperative with its environmental and social drivers, NMPs must have a clear **purpose** and this purpose must be sufficient to **engage** and **motivate** all sectors of the primary industries to support their use, so that widespread and permanent changes in on-farm management will occur –"what counts is what works". There is little point in introducing NMPs otherwise. What must be avoided is the situation which arose in some cases around the introduction of NBs. Fonterra and the Fertiliser Industry, to their credit, made a large effort to deliver NB to all dairy farms but this process did not always constructively engage the farmers, except enabling them to 'tick the box' when the shed inspector arrived. On-farm management practices in many cases did not change primarily because the resulting NBs and their implications were not fully explained to the farmer. This can be the outcome of 'top-down' management solutions in this field of activity.

So what will or should motivate the adoption and use of NMPs? There are three differently motivated sectors to consider: the farmer, the related service industries and the central and regional governing bodies.

Farmers will be motivated to engage in the process of NMP providing they can see value – does having a farm specific NMP add value to my farm? Primarily this will be seen in monetary terms and the positive news is that it is estimated (Edmeades 2009) that the value of N and P leaking from an average dairy farm is about $5,000 to $10,000. Using nutrients efficiently, as instructed by a well defined and designed NMP, is good for the bottom line and for the environment. There are also less tangible drivers which farmers will embrace and these are embedded in phrases like, 'being a good steward to the land' and, 'leaving the land in better condition.'

Central and regional government will be motivated to support NMPs if they can see that they will achieve their policy goals. In particular, regional councils will become committed to NMPs if they can see that they are the vital mechanism that links their regional plans for Air, Water and Land (Soils) management directly onto the farm. This is further strengthened if NMPs provide a mechanism to manage catchments on an individual basis.

The motivation for the related servicing industries (dairy, meat, wool and fertiliser) is also direct. Many commentators argue that the New Zealand brand should be based on its 'clean green image'. NMPs could be a very important farm-based component of that brand. Thus, NMPs are likely to be 'good for business.' Furthermore, most are co-operatives owned by farmers – the farmer could benefit financially at their individual farm level and at the corporate level by way of dividends.

A danger that must be avoided is imposing NMPs on the industry that involve more paper work for little or zero benefit. Reversing the issue: is the information to be compiled and analysed in the development of a NMP, as set out in Table 2 going to be useful – can it be utilised for reasons other than the NMP to further improve the various components of the agricultural sector?

The information in the NMP should inform the farmer about the status of one of his most important assets – the soil. It should be apparent from the NMP what the farm goals are and how the fertiliser plan is directed to achieving those goals. It should be obvious whether the current soil fertility is balanced and optimised and that every fertiliser dollar is well spent. The NMP must also provide information on what mitigations options are available on a given farm and what is their likely effect on minimizing N and P losses. Ideally, cost and benefit analyses of the options would be desirable.

The information in a NMP must be available (see Section on Legal Requirements) for auditing purposes. Thus the regional council could have access to on-farm information which should provide some confidence that their regional plans are being enacted. This information may also be instructive in the ongoing process of developing regional Air, Water and Land (Soil) plans.

Similarly, the information from well designed NMPs could be used by the fertiliser industry in their planning cycles. For example, how many farms in a given region are above the optimal nutrient levels and hence require no fertiliser, how many require only maintenance fertiliser and how many need capital fertiliser? If so what are amounts of fertiliser required for a given region. In other words the information could be used to improve the efficiency of their business and their marketing.

Integrity

There is an inherent conflict between environmental compliance and farm productivity. This arises because generally, intensification is a positive driver of productivity but has a negative effect on nutrient loadings. Modern farming must find a way of managing this conundrum and find ways of improving productivity and at the same time reducing the environmental foot-print. Nutrient management lies at the heart of this dilemma and the usefulness or otherwise of NMP will depend on how well these dual and opposing goals are managed.

This is a further reason to adopt the FESLM definition of sustainability into NMPs because it provides an objective and transparent mechanism to balance the conflict inherent in achieving

production and economic goals and at the same time achieving the desired environmental and social outcomes.

Including the FESLM definition also protects the nutrient management process against the conflict of interests that resides within some of the major stakeholders. Consider for example; what position would the cooperatives (Fonterra and the two large fertiliser companies), adopt if the price of milk was $10-$15/kg MS? Intensification resulting in greater volumes of milk and more fertiliser sales would be in their financial interests and indeed the financial interests of their co-operative owners – the individual farmers. But it would not necessarily be in the interests of the regional councils who are charged with the responsibility of managing New Zealand resources under the RMA.

To protect the integrity of the process, NMPs must be grounded in sound, robust science. The interpretations and advice offered must be technically defendable and able to withstand peer scrutiny. An NMP should be independent of commercial considerations: continuing to advise farmers to apply P fertiliser when the Olsen P levels are above the economic optimal, or recommending high fertiliser N inputs when they are not required based on the farm goals, may be good outcomes for the fertiliser company but they are not desirable from an environmental perspective.

Effective, Relevant and Functional

If NMP are to be effective and result in changes in on-farm management, a strong positive relationship between the farmer and the consultant, based on credibility and trust is essential. This requires a large investment of time, energy, skill and knowledge. So to, considerable time is required on-farm to initially gather the relevant information and make the appropriate assessments and then prepare a clearly expressed written report to a peer review and auditable standard.

It has been estimated that a full NMP report of the type envisaged would take about 2 days to compile, in addition to the 2-6 hrs required for the farm visit and the question has been raised, are there sufficient skilled personal at present to undertake this task? (Edmeades & Taylor 2007).

The NMP must be farm specific to be relevant – individual farm visits are essential. The adoption of the FESLM approach will ensure this is the case but the credibility inherent in this approach could be undermined if generic, cut-and-paste templates are adopted.

It can be argued that NMPs would have greater relevance to the farmer if they were to flow from a Whole Farm Plan (WFP). However it is unlikely that WFP will become compulsory and furthermore, different skill sets are required to complete a whole-farm analysis as distinct from developing a nutrient/fertiliser plan. For some farmers introducing a NMP as a consequence of a WFP may be more effective as a means to change on farm practices which impact on nutrient loss. Alternatively because of the legal imperative for NMPs, the most immediate entry point for many farmers will be via an NMP. As a consequence, some farm management practices may change (e.g. wintering cows off, changing stocking rate, using lower N feed supplements) as a means to reduce the environmental foot-print and rationalize the fertiliser expenditure.

In practice, which approach is adopted by a given farmer will depend on the skills of his consultant. The proposed non-technical attributes of an NMP are shown in Table 1.

Table 1: The non-technical attributes required in a Nutrient Management Plan

Attribute	**Consequences for defining a Nutrient Management Plan**
Legal requirements	Must comply with RMA (1991), Regional Councils; Air, Water and Land (Soil) Plans and the Code of Practice for Nutrient Management
Purpose & Motivation	1) Farmers: must add value (financial or otherwise) to the farmer's enterprise. 2) Service industries: must enhance their businesses especially protecting the "clean-green" brand. 3) Government and regional councils: provide a mechanism to implement the Air, Water, Land (Soil) plans on farm in a direct and quantitative manner
Integrity	Must be science-based and technically sound (based peer reviewed science) and preferably delivered by impartial consultants. Must be robust enough to manage the inherent conflict between productivity v environmental goals.
Effective, relevant and functional	Goals and mitigation options must be relevant, specific and quantifiable. Process must be easy to understand and applied and reports must be readable, understandable and accessible. Process should fit into a Whole Farm Plan.

Technical Attributes

It is a given that NMPs must comply with all the legal specifications discussed earlier. It is also essential to ensure that a NMP is specific and hence relevant to a given farm - it must be based upon the goals of the farm. Similarly, it is fundamental that a NMP must identify the various blocks or Land Management Units on a given farm. For the present purposes a LMU or block can be defined as areas of different soil group (sedimentary, volcanic, pumice, peat, podzol or sand), slope (steep, easy, rolling or flat), land use (grazing, cropping including silage and hay, runoff, effluent) or past fertiliser history, as indicated by the current soil tests.

It follows that the soil fertility for each block must be defined and monitored and that nutrient inputs should be calculated to ensure that each block is operated within the economically optimal nutrient levels that maximise the long-term profitability of the farm reflecting the farm's production and economic goals. A nutrient budget should be prepared for each block and for the average for all blocks on the farm[7]. A nutrient budget only indicates some of the risks on the farm (specifically N leaching and P runoff) and does not include other risk factors such as soil quality, and in particular soil drainage and compaction and the accumulation of heavy metals and nutrient 'hot-spots' around yards, raceways, feed-pads and silage bunkers. All of these risk factors[4] need to be appraised and a list of mitigations options prepared relevant to that farm and taking into account the farm environmental and social goals.

[7] See footnote 1

It is essential that the NMP is audited on a regular basis and for this reason the NMP must be set out in a written report that is accessible and comprehendible. The key purpose of the audit is to ensure that the goals set for the farm are being achieved. Needless to say the farmer's prime interest is likely to be the production and economic goals whereas the third party auditor, let us say from the regional council, will likely focus on the environmental and social goals.

AN ELEVEN STEP NMP TEMPLATE

From the above a NMP template is proposed with eleven essential steps beginning with and based upon the FESLM definition of sustainability (Table 2). This builds onto and expands the 7 steps in the Code, noting that the risk assessment is introduced at Step 3 in the Code whereas it is inserted at Step 9 in the proposed scheme logically following consideration of the nutrient budget, soil quality issues and hot-spot's. In practice this difference is minor because this process is likely to be iterative

Table 2: The Technical Requirements of a Eleven Step Nutrient Management Plan.

Step	Activity	Comments
1	Define farm goals	Use FESLM pillars of Production, Risks, Economic, Environmental and Social to define farm specific goals. The environmental and social goals must link directly and specifically through the mitigation options (Step 9) to the regional Air, Water and Land Plans.
2	Identify farm blocks (LMUs)	This is the smallest unit of management on the farm as far as nutrient management is concerned. For dairy farms this identifies the 'Effluent' block.
3	Monitor soil nutrient levels	Develop a robust soil/pasture/animal testing protocol setting out the transects to be used on each LMU and the frequency and timing of sampling.
4	Define the economic optimal nutrient ranges.	Monitor soil fertility levels against the economic optimal nutrient levels for each LMU[8]
5	Calculate nutrient and fertiliser requirements	Determine the nutrient requirements for each LMU by comparing the soil nutrient levels to the optimal ranges. Include other non-pollutant nutrients (K, S, Mg, trace elements, and lime) to ensure the soil fertility is balanced (c.f. soil quality)
6	Prepare Nutrient Budget(s)	From the NB, estimate the losses of N (N leaching) and P (runoff) for each block and the average for the farm[9]
7	Assess soil quality	Consider all aspects of soil quality (biological, chemical and physical) and especially drainage, pugging, compaction and accumulation of heavy metals.

[8] It may not be necessary to determine the economic optimal nutrient levels for each farm or farm block. Some general ranges particularly for Olsen P could be determined based on farm production and more specifically farm gross margin

[9] This will depend on how the Regional Councils will apply the rules – at the LMU level, or the average farm level?

8	Assess "hot-spots"	Include offal pits, lane-ways, silage bunkers, fertiliser storage facilities and farm dumps.
9	Define risks[10] and mitigation options	Prepare a list of management options[11] that could be implemented on the farm to reduce N and P loadings and improve soil quality with a quantitative assessment[12] of their likely benefits.
10	Prepare NMP	The standard: it must withstand peer review and be understood by an third party (auditor)
11	Audit NMP	Review the NMP[13] and update Steps 1-10 noting any deviations from the NMP.

CONCLUSIONS

Nutrient Management Plans are likely to become mandatory within the next 5 to 10 years but there is currently no clear definition of the requirements of NMPs. Based on an analysis of the technical and non-technical attributes required in a NMP we have proposed an eleven step NMP. The plan is based around the application of the FESLM definition of sustainability which provides a practical framework which enables specific catchment goals for soil and water quality, as set out in regional council plans, to be linked directly to specific farm management practices required to achieve those goals. The application of the FESLM process also ensures that the eleven step NMP is sufficiently flexible to be applied at the farm level and robust enough to objectively manage the inherent conflict between production and environmental goals.

REFERENCES

Edmeades D.C. and Taylor M. 2007. Five Years in the Field: How to Effect Behaviour Change on the Farm Through Nutrient Management Planning. In Designing Sustainable Farms: Critical aspects of soil and water management. Occasional Report No 20. Fertiliser and Lime Research Center, Massey University Palmerston North.

Edmeades D. C. 2009. Fertiliser Use and the Environment: Win:Win. A presentation to the Agricultural Fieldays Seminar Series. June 2009.

NZFMRA. 2007. Code of Practice for Nutrient Management (with emphasis on fertiliser use). http://www.fertresearch.org.nz/code-of-practice

Smyth A. J. and Dumanski J. 1994. Progress towards and international framework for evaluating sustainable land management. Transactions of the 15th World Congress on Soil Science. July 1994, Vol. 6a.

[10] The risk assessment introduced at Step 3 in 'the Code' is inserted at Step 9 here, to follow consideration of the nutrient budget, soil quality issues and hot-spots. In practice this difference is minor because this process is likely to be iterative

[11] This is the point in the process where the risks (as suggested by the Code of Nutrient Management) can be assessed and these could be addressed under the headings suggested by Environment Waikato (Effluent, Soil, Pasture, Production and Stock, Riparian, Cropping and the risk to waterways from 'hot-spots" such as silage pits, offal holes, farm dumps)

[12] At this point it is not possible to be quantitative about the effects of some mitigation techniques – further science is required. The intention is to be as quantitative as the science allows.

[13] Ideally the NMP should be reviewed and an annual basis as is currently done when considering annual fertiliser requirements.