Community Management of GMOs II

Risks and Response Options

Simon Terry Associates

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Prepared for

Whangarei District Council

In association with

Far North District Council

Kaipara District Council

Rodney District Council and

Waitakere City Council

by

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Executive Summary

1. This report provides analysis of the options available under the Resource Management Act (RMA) for responding to risks arising from the outdoor use of genetically modified organisms (GMOs). It was commissioned by the District Councils of the Far North, Kaipara, Rodney, Waitakere and Whangarei (the Northland Peninsula Councils) and builds on a March 2004 scoping report.

2. The communities of these districts have evidenced significant concern with respect to GMO activities. As a result, the Northland Peninsula Councils have formed an Inter-Council Working Party to investigate the use of RMA instruments acting in addition to national level controls on GMOs.

3. The Northland peninsula is an important agricultural production area with extensive dairy, forestry, and horticultural land use. It also contains ecological areas of significance and is geographically distinct. A wide range of GM products are being researched, including ones applicable to each of the area's major agricultural sectors.

4. While the GMOs commercialised to date are in general directed at reducing harvest losses by combating pests and viruses, research into future varieties is attempting to widen considerably the scope of applications. This includes improved growth in plants and improved tolerance to environmental conditions. As the types of potential benefits available from these new GMOs are also generally available by alternative mechanisms, gains available from GM products need to be measured in terms of their net benefit over those alternative means.

Sources of Risk

5. Such net gains must then be compared with the risks specific to the outdoor use of GMOs. Those who make or use GMOs have the potential to generate economic effects that extend well beyond their own operations. A major source of risk is that cultivation of GM crops will cause economic damage through trace GM contamination appearing in non-GM crops. Trace contamination is sufficient to trigger food product rejection as a matter of course for Japanese and northern European wholesale buyers, irrespective of regulatory approvals. The significant scale of resulting costs has been demonstrated in these and other jurisdictions.

6. A series of environmental risks also attend GMOs. Some are serious and long lasting or irreversible, and few have been researched sufficiently. The scope of risks includes: adverse effects on non-target species (eg birds and insects), GM plants becoming invasive and disrupting ecosystems, and altered genes transferring to other organisms. The more complex GMOs pose additional risks simply because past experience provides little basis for predicting their effects.

7. With respect to cultural effects, the concerns of Maori include: preserving the integrity of nature, potential ecological effects, and which parts of the community stand to the benefit from the technology. A view widely held by Maori is that the mixing of genes from unrelated species is a breach of the integrity of species and an offence to whakapapa.

Deficiencies in National Regulatory Regime

8. There are important deficiencies in the national level regulation of GMOs. A key gap is the absence of adequate liability provisions. There is no liability under the Hazardous Substances and New Organisms Act (HSNO) for damage arising as a result of an activity carried out in accordance with an approval from ERMA (the Environmental Risk Management Authority). While a common law action could be taken, the Ministry for the Environment (MfE) notes that these remedies are often inappropriate. Innocent parties will therefore tend to bear any losses arising from unexpected events and ineffective regulation of GMOs.

9. A recent Crown Law opinion on GMO matters considered only one of six types of financial risk that GMO activities present to communities – that of a council's legal liability for environmental damage. Among the risks not considered was the risk of councils facing environmental cleanup costs and constituents facing losses from GM contamination – matters the Far North District Council had sought to have included in Crown Law's terms of reference when consulted on this. Inadequate provisions for allocation of liability and the setting of bonds mean councils are exposed to costs arising from environmental damage. While economic damage resulting from GM contamination will in the first instance fall on individual constituents, such damage can occur across wide groupings of producers and thus become a community concern.

10. A further important deficiency is that HSNO makes the exercise of precaution a matter for ERMA's discretion. Precaution is an option, not a requirement. ERMA states that it would be acting legally if it did not exercise caution. At the same time, a number of Northland Peninsula Councils have developed policies requiring precaution with respect to the management of GMO risks.

11. This results in a lack of surety of outcome for local government on two levels:
    - Whether ERMA will agree with and act at all on specific concerns that may be held by a council and its community; and
    - Whether, for the risks ERMA concurs need addressing, it will exercise the same degree of caution as would a council and its community.

12. Descriptions of the above deficiencies have previously been put before the Government in its dual role as both the ultimate regulator and the nation's largest investor in outdoor GMO research and it has elected not to remedy them.

Community Management Under the RMA

13. The RMA provides communities with the ability to set rules that embody community determined outcomes, including the level of risk it is willing to accept with respect to activities such as the management of GMOs. District councils have jurisdiction under the RMA to set rules for GMOs that act in addition to those that may be set under HSNO or by ERMA. A council has a general duty of care with respect to its constituents along with a specific duty to monitor and can respond to gaps in the national regulatory regime by placing additional controls on any ERMA approved application.

14. A very high level of financial accountability for ecological damage could be achieved through the use of well framed RMA consent conditions and bond provisions. Additional conditions can also be set to protect against adverse economic effects. What is unclear at this stage is the RMA's ability to provide for the recovery of economic losses. Given a district council's general duties of care for its financial position and that of its constituents, there is a ready justification for mandatory conditions to provide for both financial accountability and avoidance of economic damage.

15. If additional conditions would be insufficient to address the risks a GMO activity presents, the RMA also provides the basis for communities to prohibit classes of activity. A strong precautionary risk management approach may be used to regulate GMOs in these cases, provided the risks can be shown to justify this response.

Classes of GMOs and Response Options

16. At what time applications will come forward for GMO activities is very difficult to forecast. While local research has to date been confined to field trials designed to prevent altered genes from escaping test areas, the next stage envisaged by New Zealand GM plant developers involves pre-commercial projects. Applications based on GMOs commercialised overseas is the other main stream of prospective activity.

17. Different GMOs and their uses pose different levels of risk. GMOs can be grouped into classes of activities that have similar types and/or levels of risk. Five groupings of GMOs are examined in detail: GM plant varieties (food and non-food), GM animals (food and non-food), and GM microorganisms. Rules can be set under a district plan to address potential applications according to such groupings and classes of GMOs. The key high level decision councils and their communities need to make is which classes of GMOs should be unregulated, which should be made discretionary activities, and which prohibited - based on their tolerance for, or aversion to, risk.

18. The following four options provide a basis for making a decision in principle on the best approach to active management of GMOs (vs non-intervention).

Option A. All GMO Activities Discretionary

- All GMO activities are discretionary activities with each assessed on a case by case basis. Each requires a consent and is publicly notified;
- Consent conditions would be set to manage foreseeable adverse effects;
- Accountability provisions designed to ensure damage is remedied or compensated for, to the extent possible, would be mandatory.

Option B. Food Plant and Food Animal Releases Prohibited

- All releases involving food plants or food animals are prohibited;
- Other activities are in general discretionary activities, as in Option A.

Option C. Plant Releases Largely Prohibited, Food Animals Prohibited

- All releases involving food plants, food animals, and production of fibre and biopharmaceuticals are prohibited;
- Other activities are in general discretionary activities, as in Option A.

Option D. All GMO Release Activities Prohibited

- All release activities would be prohibited. Field trials could be subject to additional controls or also prohibited.

Option Evaluation

19. Key measures for evaluation of the four options are: the degree of precaution provided, the effectiveness of financial accountability measures, and the costs of administering the new rules and risks of court action.

- *Degree of precaution provided:* There is a progressive increase in the level of precaution applied in moving from Options A to D. *Option A* provides for a community to determine the level of precaution it seeks on a case by case basis, while *Options B and C* prohibit particular classes of activity and *Option D* prohibits all GMO releases. For any class of GMO made a discretionary activity, if the Minister for the Environment calls in an application, the Minister would then decide the application, rather than the council. Prohibited activities are not subject to call in provisions.

- *Effectiveness of financial accountability measures:* Prohibiting an activity removes the need for consent-related financial accountability measures. Alternatively, if an activity is consented, the effectiveness of RMA instruments will depend on the scope of accountability provided for in the RMA and on successful implementation.

- *Costs of administering the new rules and risks of court action:* Implementation of each option is likely to involve much the same level of expenditure. While ongoing administration costs are uncertain, the RMA provides for full cost recovery from the applicant. Crown Law considers it unlikely that a council would be held liable for consequences resulting from it failing to uphold a rule it had made to regulate GMOs. A plan change would only go ahead following extensive legal checks but it could still attract a legal challenge. Councils should therefore investigate committing to a joint defence of any such challenges. In principle, there may well be no greater risk of any one of options A to D being overturned than another given the evidence to date. Thus, making all GMO releases prohibited activities may be as robust to challenge as making all GMO releases discretionary. Were the court to find fault with a plan change, it seems probable that the rules would be modified rather than deleted.

20. Also important is the extent to which an option would foreclose opportunities. Any decision to prohibit a class of activity is reversible. Thus, if it were later to become evident that a particular GMO activity would be of net benefit to a district, a subsequent plan change could expressly permit that particular class of activity or GMO variety.

21. Option foreclosure is also an issue if GMO activities are allowed to proceed. This could remove the opportunity to build price premiums or new sales through a district marketing itself as excluding the production of specified GM products. If the Northland Peninsula Councils adopted parallel stances to GMOs, there is the wider potential to establish a Northland peninsula exclusion zone with respect to particular GMOs. Five Australian states have legislated for zones effectively excluding GM food production and many other sub-national jurisdictions in other countries have sought to similarly prohibit GMO cultivation.

Decision Points and Next Steps

22. A first decision point is whether to intervene under any option. This turns on whether the benefits of taking action outweigh the costs. Implementation costs are modest when shared between councils and the risk of a legal challenge would be reduced by thorough legal vetting prior to any plan change and agreements between councils to share any costs should a challenge take place. A key potential cost of not intervening is economic damage arising from release of a GMO within a council's district. This alone could in general be expected to exceed the costs of intervening. Depending on the nature of the release and its effects, other environmental, cultural, and legal costs could arise and further tip the balance in favour of intervention. Thus, non-intervention is not considered a useful response option to put forward for further consideration at this stage. A Section 32 analysis is the point at which to further evaluate the costs and benefits of intervention.

23. The analysis suggests that a decision in principle should be made between the four options for intervention described above. A minimum level of joint council response would therefore be for all outdoor GMO activities to be made subject to mandatory provisions designed to ensure funds are available to remedy or compensate for damage, to the extent the RMA will allow. This report also sets out analysis that could be used as the reliable basis for a policy of prohibiting classes of GMOs, were a community to seek this.

24. The extent of the uncertainties surrounding GMO risks, and the potential scale of damage that could result, limits the ability to identify a preferred option through analysis alone. When large parts of the assessment are characterised by indeterminacy (and thus beyond the reaches of conventional risk analysis) and the potential effects are significant, a community's tolerance for risk becomes a critical input to policy formation. In particular, communities should be able to set a floor on the extent of precaution to be specified for their district, as they are the ultimate risk bearers. Thus while this report provides the baseline information required to select between options for GMO management, community consultation forms a further vital component.

25. At the point a response option has been selected in principle, the following steps will then need to be addressed:

- Precise framing of objectives, policies and rules that would support and give expression to the option selected in principle;
- Preparation of RMA s32 analyses to ensure each proposed plan change meets the tests this section sets.
- Individual council and inter-council evaluation of the full proposed plan change.

1. Context and Background

1.1 Introduction

Whangarei District Council (WDC) and the District Councils of the Far North, Kaipara, Rodney and Waitakere (the Northland Peninsula Councils[1]) wish to better understand the nature of potential risks arising from the use of genetically modified organisms (GMOs) and their options for responding to these under the RMA if such activities are carried out in their districts.

On behalf of these councils,[2] WDC asked Mitchell Partnerships and Simon Terry Associates Ltd to prepare a report investigating the risks and response options. The overall objective set for this project is to provide a report that advances research to the point that a favoured response option can be selected in principle.

This report's investigation of the risks and response options builds on the structure established in the earlier scoping report prepared to address these matters and while key descriptions are carried over, additional background information is to be found in that document.[3] In this further stage of reporting, the scope of consideration is similarly limited to the outdoor use of living GMOs and in particular field trials and releases.[4]

1.2 Background and Council Policies

In June 2003, a number of local bodies sought to obtain a clear statutory right to manage GMO activities within their districts, should they choose to exercise such powers. They submitted to the Parliamentary select committee considering amendments to the Hazardous Substances and New Organisms Act (HSNO) that such a right should be specified in this act.[5]

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1 While the area north of the Auckland isthmus is not conventionally labeled a peninsula, it fulfils well this definition and in particular the Latin derivation – *paeninsula,* a conjunction of the words for "almost" and "island".

2 The sponsors of this research are: Whangarei District Council, Far North District Council, Kaipara District Council, Rodney District Council, and Waitakere City Council. Each council is represented on the Inter-Council Working Group on GMO Risk Evaluation and Management Options.

3 Simon Terry Associates (2004) *Community Management of GMOs: Issues, Options and Partnership with Government*.

4 This scope of inquiry is specified by the terms of reference for the report, which in turn reflects the identified scope of community concern.

5 The submission by Local Government New Zealand on behalf of a number of local authorities noted that "Government should provide a clear role for local government in the process of considering applications for general or conditional release of GMOs." LGNZ (June 2003) Submission to the Education & Science Select Committee. Further, Marlborough District Council submitted to Ministry for the Environment: "There needs to be a clear opportunity under the HSNO regime for the consideration of local aspirations to remain GMO free. Like many other areas of New Zealand, Marlborough is a brand in terms of its produce, notably from viticulture and aquaculture. No doubt over time other products will emerge with a Marlborough brand. Where such products rely on a GMO free status, there needs to be provisions for that to be protected at the district level if not appropriate at the national level."

Although Parliament declined to grant an explicit statutory right, subsequent legal opinions from Crown Law and Dr Royden Somerville QC concurred that, in principle, district councils at least have the ability under the Resource Management Act (RMA) to manage the outdoor use of GMOs independently of the national regulator, ERMA. Dr Somerville's opinion, commissioned by WDC on behalf of Northland district councils, further identified that councils had open to them the option of precautionary controls (that allowed for individual determination of proposed GMO activities) as well as the option of a strongly precautionary stance that would prohibit use.

Soon after this opinion and the accompanying scoping report were received by Northland councils, they began hearing submissions with respect to the preparation of Long Term Council Community Plans (LTCCP). The LTCCP process brought forward strong evidence of community concern with respect to GMO activities. Submissions to the Northland Regional Council (NRC), WDC, and Far North District Council (FNDC) in particular evidenced large numbers of submitters (in relative terms) focusing on the GMO issue and these almost universally advocated a precautionary stance (as opposed to submissions supportive of GMO development).

The weight of such submissions led a number of councils to frame policy on GMOs and to form the Inter-Council Working Group on GMO Risk Evaluation and Management Options. NRC adopted the following stance as a part of the LTCCP process:

> The Regional Council is a member of a Northland inter-council working group to discuss a common approach to the management of genetically modified organisms in Northland. Until this group has completed its work, the Council has decided to support a precautionary approach. This means that there should be no further development and field-testing of transgenic organisms envisaged for agriculture, horticulture, and forestry in Northland until the risk potential has been adequately identified and evaluated and a strict liability regime put in place.[6]

Whangarei District Council's LTCCP identified a GM Free district as one of the five Community Outcomes sought.[7] In the plan, the Council commits to a precautionary approach to GMO:

> Council will adopt a precautionary approach to the management of biotechnology in general and to GMO land uses in particular. It will continue to investigate ways to maintain the district's environment free of GMOs until outstanding issues such as liability, economic costs and benefits, environmental risks, and cultural effects are resolved.[8]

Kaipara District Council had adopted in June 2003 the following policy:

MDC (November 2002) Submission on *Improving the Operation of the HSNO Act for New Organisms.*

6 *GE-Related Changes Adopted In First 'Northland Community Plan'*, NRC media release, 23 June 2004.

7 Whangarei District Council Long Term Council Community Plan, p. 8.

8 Ibid, p. 64. The LTCCP also notes that key projects include furthering discussions on Council options for regulating GMOs (p. 62).

> "That Council adopt the direction of a precautionary approach and limit the release of genetically engineered organisms by District Plan Change, bylaw, requiring notification or a combination of these.[9]

Its LTCCP process reaffirmed "support for a precautionary approach" as one of the "Community Outcomes" in the first schedule to the plan.[10] A precautionary approach to GM was also identified as a method for delivering the vision of the future in which "Kaipara District is proud of and renowned for its beautiful environment and sound management of natural resources, where residents enjoy a clean, healthy environment."

Rodney District Council to date has not adopted polices specific to GMO activities although it noted in a summary of the LTCCP consultation that "During the next two years the Council will formulate policy and plans on: … environmental health, such as genetic engineering, biosecurity and contaminated sites".[11] Rodney has however a GM related provision in its draft Trade Waste Bylaw 2004 which prohibits discharges involving GM material from facilities engaging in genetic modification and also declares itself "organics friendly".[12]

In the Far North, we understand 200 submissions were made to the District Plan, most of which requesting that the district become a GM Free zone. The Proposed District Plan is currently subject to an appeal where the remedy sought is that the plan be revised to include "Genetic Engineering as either a prohibited or a notifiable activity and address issues of trespass and liability".[13]

The Council reports that "genetic modification and the implications for the Far North also featured strongly in submissions received" on the first draft of the LTCCP.[14] Of the 32 submissions to the district's LTCCP that related to GM, 29 requested that no GMOs be released into the environment, that the district become a GM Free zone and/or that FNDC be part of a wider regional exclusion zone.[15]

In 2001, Waitakere City Council passed a resolution declaring the district "GE Free in food and field". The Council further resolved "to identify the most effective ways of advancing Council's aspirations for Waitakere City to be "GE-Free", without compromising medical research or currently permitted activities but discouraging in every way possible any form of field trials".[16] The resolutions followed a range of petitions and presentations to the Council requesting that the district remain GM Free.

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9 Kaipara District Council resolution of June 2003. *Genetic Engineering - Issues and Options of Limiting the Release of Genetically Engineered Organisms*, Kaipara District Council, 20 August 2003.

10 Kaipara District Council, Long Term Council Community Plan 2004-2014, Schedule 1, p. 88.

11 Rodney District Council, *Building Rodney's Future Together*, 2004, p. 2.

12 In Schedule 4: Prohibited Trade Waste, Rodney District Council, *Draft Trade Waste Bylaw 2004.*

13 *RMA 0691/03 MT Robinson v. FNDC*: "Matters under appeal that affect more than one text provision".

14 FNDC (April 6 2004) Media Release: "Good Public Response to First Draft of the LTCCP".

15 Summary of submissions to the Far North District Council LTCCP with respect to GE: http://www.fndc.govt.nz/ltccp/ltccp2004_2014/submissionsreceived/GE.pdf

16 Waitakere City Council. Minutes of a Special Meeting of the Council, 14 November 2001, Resolutions 2635/2001 and 2636/2001.

2. GMOs and Sources of Risk

2.1 GMOs and Scope of Benefits

Techniques for modifying genes (see box below) were first commercialised in the 1980s in medical applications. However, it was not until the mid 90s that applications involving the outdoor use of GMOs reached the market. To date, the commercialised applications are overwhelmingly directed at reducing plant harvest losses by modifying genes to combat pests and viruses. These so-called "first generation" applications are however very limited with respect to the range of crops provided for and their geographical spread. Four GM crops account for 99% of all plantings: soybean (46%), cotton (20%), canola/oilseed rape (11%), and maize (7%).[17] Similarly, four countries, the US, Argentina, Canada and China account for 99% of the area under GM cultivation globally.

While the main potential benefits available from these first generation crops are forms of farm productivity enhancement, the convenience of reduced levels of spraying in some cases, or fewer types of sprays, is often cited as a driver for their adoption.

Terminology

Genetic modification (GM) refers to a set of techniques that alter genetic makeup by adding, deleting or moving genes (within or between species) to produce new and different organisms. **Genetically modified organisms (GMOs)** are products of genetic modification. Another term often used to refer to the same technique is **genetic engineering (GE**).[18]

Genetic modification is quite different from the conventional breeding of plants – **hybridisation**. The techniques used by GM result in different end products and different risks, even if two plants of the same species are drawn on.

Biotechnology is the term used to describe a vast range of techniques that make use of biological processes developed over the centuries. Examples of biotechnology include penicillin and bacteria for cheese making. Gene technologies encompass a recent branch of biotechnology activities. This new set of applications draws upon recent discoveries in genetics and molecular biology to make a host of products, from bio-screens in sewage plants, through to genetic identification systems, and screening plants for commercially useful traits.

[17] MAF (May 2002) *Border Control for Genetically Modified (GM) Seeds*, Discussion Paper 31.

[18] The warrant for the Royal Commission defined GM as:

> "• the deletion, change or moving of genes within an organism, or
> • the transfer of genes from one organism to another, or
> • the modification of existing genes or the construction of new genes and their incorporation into any organism." Royal Commission Report, p. 5.

> These 'convenience' effects can include reduced machine movements from fewer herbicide applications, greater flexibility in the timing of herbicide applications, and earlier adoption of no-till or conservation tillage.[19]

Environmental benefits can also be obtained through reduced pesticide loadings, with GM cotton showing the strongest decreases[20] through to GM soy that showed small increases in one study.[21] However, it has also been reported that the migration of genes to weedy relatives results in additional and stronger pesticide use to tame plants acquiring pesticide resistance in this way[22] and this was one of the issues the Royal Commission on Genetic Modification noted when recommending against the adoption of herbicide resistant crops until there was a better understanding of the environmental risks.[23]

While some farms have achieved yield advantages, review studies completed to date show variability across different seed types (mostly small gains and smaller losses), geographic locations and farm size. Only GM cotton has shown significant yield gains. The Productivity Commission of Australia summarised its review of GM crop benefits with respect to food varieties as follows:

> - increases in yields for insect-resistant corn average about 6 per cent, but no significant cost savings are reported;
> - lower yields, averaging about 5 percent, and costs falling about 10 per cent, imply net gains of about 5 per cent for herbicide-tolerant soybeans; … and
> - small yield results for herbicide-tolerant canola, averaging only about 1 per cent, and little evidence of cost reductions.[24]

The long view position on yield is perhaps best summarised by the US Department of Agriculture which concludes that "the application of biotechnology at present is most likely to reduce yield variability but not increase maximum yields. More fundamental scientific breakthroughs are necessary if yields are to increase." [25]

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19 Productivity Commission of Australia, (October 2002), *Modelling Possible Impacts of GM Crops on Australian Trade*, p. 19.

20 Cotton Research and Development Cooperation, (2000), *The Performance of INGARD Cotton in Australia during the 1999/2000 Season*, Final Report.

21 Benbrook, C. (1999), *Evidence of the Magnitude and Consequences of the Roundup Ready Soybean Yield Drag from University-Based Varietal Trials in 199*8, AgBioTech InfoNet, Technical paper no. 1, July.

22 *Hybridization Between Brassica napus and B. rapa on a National Scale in the United Kingdom*, Mike J. Wilkinson etc al, Science Express Reports, October 2003.

23 "Having regard to the evidence on the use of herbicide resistance genes, including the resulting dependency on herbicides for weed control and the possibility of an increase in herbicide resistance in weed plants, we do not consider that these limited uses justify the environmental risk to New Zealand, until more is known about the size and management of that risk. We acknowledge production of pure unmodified seed might provide an economic opportunity. While this is a matter for ERMA the Commission considers crops using herbicide resistance genes should not be approved for release (conditionally or otherwise) until (a) it is clear there is no trend indicating either increased use or increased toxicity of herbicides, and (b) research indicates there is no increase in the weedy outcrossing involving herbicide resistance genes." Royal Commission Report, p. 148.

24 Productivity Commission of Australia, (October 2002), *Modelling Possible Impacts of GM Crops on Australian Trade*, p. 20.

25 *Economic Issues in Agricultural Biotechnology*, USDA Bulletin No 762, February 2001, p.vi.

The extensive effort underway globally to research GMOs for outdoor use is targeting a much broader range of desired effects. These future applications are generally quite a few years away from potential commercialisation as they have yet to be proven both scientifically and commercially – and most research projects do not get to market. Nevertheless, the scope of this work is an important consideration in examining options for community management of GMOs. The research programme includes:

- Improving yields by developing techniques to make a plant more resistant to climatic and other environmental conditions,
- Improving yields by learning how to improve rates of growth or product yield in plants and animals;
- Altering plants and animals to deliver to the consumer by way of foods improved amounts of a targeted substance (e.g., a mineral),
- Modifying plants and animals to act as an alternative means of producing substances (e.g., pharmaceuticals and plastics);

The above is a high level description of different forms of benefits that new GMOs under development could ultimately make available. Appendix 1 of this report examines particular prospects in detail and describes the objectives of their development.

The Parliamentary Commissioner for the Environment notes that GM is "just one field of knowledge creation amongst many that could advance the sustainability of food production systems".[26] Sustainability with reference to agricultural production has been defined by the Ministry of Agriculture and Fisheries as:

> "the use of farming practices which maintain or improve the natural resource base of agriculture, and any parts of the environment influenced by agriculture. Sustainability also requires that agriculture is profitable; that the quality and safety of the food, fibre and other agricultural products are maintained; and that people and communities are able to provide for their social and cultural wellbeing" [27]

As the types of benefits available from outdoor GMOs being researched are almost invariably available by alternative mechanisms, the relevant measure of the gains available from these new techniques will be any net benefit over alternative means available at the time an application for release is made. This would then be compared against the risks particular to the GM means of production to obtain an overall measure of benefits or disbenefits to society as a whole. Given that projected benefits for new GMOs are necessarily speculative, and the range of alternative means of production available in the future is similarly open to conjecture, meaningful evaluation of the net benefits of a particular new GMO will in general need to await the time an application for outdoor use is made.

While some risks are relatively well defined, others are similarly speculative. The potential risks of GMO use are however addressed in detail in this report as the nature of the benefits does not influence the design of mechanisms to manage GMOs to nearly the degree that the nature and extent of risk does and it is options for local

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[26] Parliamentary Commissioner for the Environment (2004) *Growing for Good. Intensive farming, sustainability and New Zealand's environment*, p. 17.

[27] Cited in above reference, p. 26.

management of GMOs that are the focus of our brief for the preparation of this document.

The following subsections first outline the types of GMOs that could potentially come before the Northland Peninsula Councils and then examine sources of risk – economic, environmental and cultural.

2.2 GMOs Potentially at Issue

Pastoral farming, horticulture and forestry constitute the predominant land uses in the Northland region and are major contributors to the local economy. This section reviews the types of GMO use that developers/adopters may wish to introduce to the districts of the Northland peninsula.

As noted in section 1.1, this report limits its consideration to the outdoor use of living GMOs and in particular field trials and releases. Genetically modified food crops, trees, animals, and pharma crops are expressly included. Research within contained laboratories involving GMOs, medical applications involving the manufacture and use of non-viable GM products, and food containing GM products that are not viable are excluded.

Some of the GMOs identified below have already been approved for commercial production in other jurisdictions (such as North America), and would require only approval by ERMA to enter the New Zealand market. Others are still in the developmental phase, and are undergoing field trials in New Zealand or abroad. Most of the GMOs in commercial production in other countries have been developed to target agronomic performance of the crops, and in particular, to provide alternative means of managing weeds and pests.[28] Overall, there are a considerable number of GMOs that could feasibly be proposed for use within the districts, and for which a regulatory response would be required in light of current policy stances.

2.2.1 Livestock

Pastoral agriculture accounts for over half of land use in Northland,[29] ranking the region as the country's fourth largest dairy producer.[30] Potential uses of live GMOs in pastoral farming include GM feed and pasture grasses and GM livestock.

Maize silage is a significant animal feed source. GM maize (including corn) is the second most widely cultivated GMO in countries that have adopted GM agriculture. The main traits that are commercially available are (1) herbicide resistance, (2) insect resistant, or (3) a combination of the two.

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28 Not all GM crops in R+D phase will make it to market; factors that will determine their commercialisation include scientific viability and market demand. With respect to the later, market resistance to GM varieties is already narrowing the range of GMOs that have received market approval. GM Wheat is nearing final R+D phases, yet consumer resistance in key wheat markets has led North American growers to oppose its market approval.

29 http://www.nrc.govt.nz/special/soe.2002/regional.profile/2-3-index.shtml

30 http://www.maf.govt.nz/mafnet/rural-nz/overview/nzoverview007.htm

GM clover and ryegrasses have been the subject of research by AgResearch, a Crown Research Institute (CRI).[31] AgResearch's experimental programmes include white clover engineered with a resistance to porina moth (now abandoned), and so-called high energy perennial ryegrass, that aim better conversion of energy. Across the Tasman, a GM white clover with built-in resistance to alfalfa mosaic virus has recently received a permit by the federal regulator to undergo field trials.[32]

GM research to develop dairy cattle that express valuable proteins in their milk is being conducted by AgResearch and field-trialled at the Ruakura research station.[33] [34] Further CRI experimentation includes GM sheep with increased muscle growth to boost meat yield, and with potential medical applications have been hypothesized.[35] Approval was granted to conduct field trials of the GM sheep in 2000, yet to date no trials have taken place.

2.2.2 Horticulture

Nearly all of the principal fruit and vegetable crops grown in the Northland peninsula - avocado, citrus, kiwifruit, squash – are the subject of GM research and development.[36] Of these, virus resistant GM squash varieties have been commercialised and are being grown on a very limited commercial scale in North America.

GM tamarillo fruits developed by HortResearch (a CRI) to resist black spot virus have already been field-trialled in the Far North. These are one of a wide range of fruits that are currently the focus of GM experimentation, including apple, kiwifruit, cherry and walnut. With the exception of GM papaya grown in North America, none appear to have yet been commercially grown anywhere in the world.

GM varieties of vegetables that are not major crops in the Northland peninsula but which could be grown on a small scale in market gardens include GM potatoes, peas, brassica, all of which are in the research and development phase at CRIs.

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31 In New Zealand, GM pasture and forage grass R + D has been led by Crown Research Institutes, as the private sector have abandoned GM pasture grass projects.

32 See the Office of the Gene Technology Regulator, http://www.ogtr.gov.au

33 In 2003, the research scientists reported that the GM dairy cows had up to 20% the levels of casein (beta-casein and kappa casein) in their milk. Nature Biotechnology, 21, 157 - 162 (2003) and in the *New Scientist*, "GM cows to please cheese-makers", January 26 2003.

34 Details of the research are provided in ERMA Application GMF98009, http://www.ermanz.govt.nz/news-events/focus/gm-cattle-field.asp.

35 Potential medical benefits were identified by AgResearch during the ERMA hearings. See ERMA Decision document. http://www.ermanz.govt.nz/appfiles/execsumm/pdf/GMF99004-002.pdf and the Evaluation and Review report, http://www.ermanz.govt.nz/appfiles/execsumm/pdf/GMF99004-001.pdf. The experiment involves 'knocking out' the gene identified as controlling muscle growth, to create sheep with so-called "double muscles." Further details of the research are available in AgResearch's application to ERMA (GMF99004)

36 http://www.nrc.govt.nz/special/soe.2002/regional.profile/2-3-index.shtml. Kumara is an exception. It is understood that there is no GM experimentation on this crop.

2.2.3 Forestry

Plantation forestry accounts for 10% of Northland's land and this is expected to increase significantly over the next twenty years. Forestry earnings for the Northland region are projected to rise from the current $71 million per annum to $381 million per annum.[37]

Within that timeframe, a number of GM plantation varieties may be ready for market. This includes GM varieties of forest plantation species that are grown widely in Northland, such as *pinus radiata.* The Forest Research Institute (a CRI) is currently conducting field trials of GM pine and spruce trees in Rotorua. These varieties have been modified to be herbicide resistant.

Other current research in forest plantation species includes work on poplar and eucalyptus.[38] Like GM food crops, the GM traits being introduced to tree varieties mostly target herbicide resistance. New traits currently being explored include hardiness to extreme environmental conditions (salt-tolerance and disease resistance) and GM properties that assist product processing (such as reduced lignin). It appears that GM commercial forestry varieties will not be marketed during the next decade, although pre-commercial trialling can be expected to increase over that time.

2.2.4 Aquaculture

Aquaculture currently earns the Northland region $20 million per annum. The industry's contribution is projected to increase to $50 million per annum by 2008.[39] For the time being, shellfish (dominated by Pacific Oyster) are the major focus of aquaculture. However, a report commissioned by Enterprise Northland identifies the potential for the industry to expand to include a much wider range of shell and finfish.[40] While regulation of any marine farming is clearly a regional council responsibility, and freshwater farming would tend to similarly come under its ambit, to the extent that a wider Northland peninsula response to the outdoor use of GMOs is being sought, GM aquaculture is a relevant activity to consider.

A recent review conducted in the US has identified that GM research is being conducted internationally on at least 14 different finfish and shellfish species.[41] This includes research on Atlantic salmon, rainbow trout, carp, goldfish, catfish, shellfish and prawn. The chief GM traits under trial include increased growth rates as well as temperature and disease resistance. In the US, regulators are now reviewing the first application for commercial breeding of a GM fish breed. Atlantic salmon have been

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37 http://www.nrc.govt.nz/special/soe.2002/regional.profile/2-3-index.shtml

38 Trevor M. Fenning and Jonathan Gershenzon. "Where will the wood come from? Plantation forests and the role of biotechnology". In: *TRENDS in Biotechnology* Vol.20 No.7 July 2002, pp. 291-296.

39 Enterprise Northland (2004) "Northland: State of the Economy, November 2004". Note that Rodney District Council is investigating whether it should position to attract land-based aquaculture, with a view to becoming a preferred location.

40 NIWA (2003) *Assessment of the Potential for Aquaculture Development in Northland.*

41 Pew Initiative on Food and Biotechnology (2003) *Future Fish. Issues in Science and Regulation of Transgenic Fish*, pp. 6-7.

engineered with the growth hormone from the Chinook salmon to increase growth rate and food conversion efficiency.[42]

2.2.5 Biopharming

In addition to those GMOs identified above, 'new generations' of GM applications will increase the range of potential GMOs that developers may wish to cultivate in the districts of the Northland peninsula. These include genetically modified organisms that produce pharmaceutical proteins (often termed pharma crops) and GMOs that provide the raw feedstock for industrial uses (such as biofuels and plastics).[43] Cultivation of such GMOs would effectively introduce new land uses. An example of such an application in the outdoor developmental stage is corn that produces proteins for a vaccine to combat porcine transmissible gastroenteritis (in field trial phase in the US).

42 Ibid, p. 6.

43 See NRC 2002.

2.3 Economic Risks

2.3.1 Trace Contamination

Those who make or use GMOs have the potential to generate economic risks that extend well beyond their own operations. While they are the only ones bearing losses arising from failure of the end product to sell or if it carries a defect, GMOs have a well demonstrated ability to cause economic harm far beyond the entities that undertake the original land use. Such impacts on third parties are termed "spillover" effects.[44]

A major source of risk in this regard is that cultivation of GM crops will cause economic damage through trace GM contamination appearing in non-GM crops. The Royal Commission on Genetic Modification recommended that Government "proceed with caution" on the basis that GM and non-GM crops could be successfully kept apart – and in this way "co-exist". However, the Commission did not identify exactly how this would be achieved and methods for preventing GM crops from contaminating other like crops in conventional commercial production have yet to be demonstrated.

A series of more recent studies have revealed that harvesting, transport and processing pose much greater contamination problems than expected. Investigations by the European Commission resulted in the conclusion that even the ability to keep below a 1% level of contamination of other foods could not be assured in conventional production – a level that would trigger EU labeling requirements.[45] The European Commission was advised by its Scientific Committee on Plants that "A zero level of adventitious presence is unobtainable in practice."[46]

An inquiry by the Western Australian Parliament produced a similarly definitive conclusion and stated**:** "Contamination of non-GM crops by GM crops is inevitable, segregation is not practical and … identity preservation can be achieved, but at significant cost." [47]

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44 Damage to human health is a further potential effect of contamination if the product is destined for human consumption. This is a particular concern with respect to biopharming – a class of GMO discussed in section 2.4.4. Damage to human health from intentional ingestion does not however form a part of this report as this is a separate activity to growing the GMO and can take place independent of any production in the district or region. The food product can be imported from overseas for example. General coverage of risks to human health from contamination is beyond the capacity of this report to examine and will need to be picked up in subsequent work if examination of this risk is considered necessary for policy formation and decision-making.

45 "Co-existence with thresholds in the region of 0.1% is virtually impossible in any of the scenarios considered." A 1% level "might technically be possible but economically difficult because of the costs and complexities." *Scenarios for co-existence of genetically modified, conventional and organic crops in European agriculture*, EC Joint Research Centre, May 2002, p. vi.

46 European Commission Scientific Committee on Plants, as reported by the Commissioner for Agriculture, March 2003.

47 Western Australian Parliamentary Select Committee (2003) *Report of the Standing Committee on Environment And Public Affairs in relation to the Gene Technology Bill 2001 and the Gene Technology Amendment Bill 2001*.

Most recently, the Federal Drug Administration, which oversees GM plants approvals in the United States, signaled its concern that even experimental GM plants under field testing could cause contamination in non-GM commercial food crops. That is, the contamination could occur before the safety of the new GMO had been assessed. The FDA's response suggests that, like the European Commission, it could not identify a workable mechanism for preventing such contamination. The new procedures make such contamination legal so long as the FDA has undertaken a form of prior provisional analysis and approval.[48]

How far GM contamination could be expected to spread under New Zealand conditions is one of the issues being studied under a government funded Crop and Food Institute project that has yet to report.

Given the high levels of consumer resistance to eating GM foods in Europe and the wealthier Asian nations in particular, trace contamination has become a significant issue. Resistance is demonstrated most clearly through examples of rejection by major buyers of product that is found to contain trace levels of GM contamination.

2.3.2 Patterns of Market Rejection

Market rejection due to concerns about trace GMO content can have many causes but three broad categories can be usefully defined with respect to crops:

a) Contamination of a similar variety of crop that is non-GM
b) Contamination of a different crop variety
c) Perceived contamination of a non-GM crop

Before discussing each of these, it is worth noting that the instances cited draw from a narrow range of GM products and countries as the opportunities for extensive contamination are narrow. As discussed above, just four crops account for 99% of all GMOs under cultivation globally and four countries account for 99% of the area under GM cultivation globally. It is also important to note that a majority of current GM production is destined for animal feed[49] and much of the remainder reaches the consumer only in the form of processed foods.

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48 "As the number and diversity of field tests for bioengineered plants increase, the likelihood that cross-pollination due to pollen drift from field tests to commercial fields and commingling of seeds produced during field tests with commercial seeds or grain may also increase. This could result in low-level presence in the food supply of material from new plant varieties that have not been evaluated through FDA's voluntary consultation process …" "FDA Proposes Draft Guidance for Industry for New Plant Varieties Intended for Food Use", FDA, November 19, 2004.

49 US National Research Council (2003) *Environmental Effects of Transgenic Plants. Scope and Adequacy of Regulation*, p. 224. Also see: US National Corn Growers Association (2003) The World of Corn; Economic Research Service, US Department of Agriculture (April 2003) Corn Market Outlook; Economic Research Service, US Department of Agriculture (2002) Oil Crops Situation and Outlook Yearbook 2002; Economic Research Service, US Department of Agriculture; Canola Council of Canada (2003) Soybeans and Oil Crops: Background, 2003.

a) Contamination of a like variety of crop

This form of contamination can take place on many different levels. At its simplest example, it can be contamination of a single crop or a single company's production. In New Zealand, the Gisborne-based company Sunrise Coast experienced this in August 2003 when corn it grew for processing into a product for the Japanese market was rejected. Routine testing by the Japanese pizza maker that was to purchase the product showed trace contamination of 0.05%. This resulted in rejection of the entire line and the company estimates its losses were close to $500,000.[50] This incident is likely to have arisen from trace contamination of imported seed stock.

However, the spread of pollen is the principal cause of GM contamination in Canadian canola and this in turn has caused particular problems for all Canadian exporters of non-GM canola. The Canadian Department of Agriculture and Agri-Food stated in 2003 that: "The production of GE canola is currently adversely affecting the value of non-GE canola in some markets. The EU is effectively closed to all Canadian commodity canola" [51] Since 1998, Canada's annual sales of canola to Europe have dwindled to about $1.9 million a year from $230 million, the Canadian Department of Foreign Affairs and Trade calculates.[52]

US corn exports to Europe have similarly suffered. Although less than half the corn grown in the US is GM, US corn exports to Europe have plummeted to less than 5% of the previous level. The National Corn Growers Association, which represents the majority of US corn growers, estimated that loss of this market had cost around $1 billion in exports by 2001 (or some $300 million a year).[53] This has been due to an absence of, or lack of confidence in, systems to segregate the GM and non-GM products.

A similar but much more widespread effect was expected to result for North American farmers if GM wheat had progressed to the point of commercial release. Proposals for this to be given approval in the US and Canada were resisted by a wide coalition of farming interests in Canada in particular after surveys of traditional export markets showed extraordinarily high levels of market resistance to not only the GM product, but to taking non-GM wheat from a country that grew GM wheat.[54]

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50 Personal communication with Sunrise Coast, November 2003.

51 Agriculture and Agri-Food Canada (March 5 2003) "Adapting to Emerging Concerns in the Introduction of Genetically Engineered Products".

52 The canola experience has prompted other Canadian commodity/production sectors to block the introduction and cultivation of GM varieties. In 2000, GM flax was poised for commercial production. However, it was withdrawn from the market, after concerted pressure from the Canadian Flax Council. The council cited consumer resistance to GM foods in Europe, which accounts for 60% of all Canadian flax sales.

53 USDA (November 29 2001) International Agricultural Trade Report, and US National Corn Growers Association Letter to President Bush, January 23 2003.

54 Survey by US Wheat Associates, as reported by Reuters: *Asian opposition to biotech spring wheat steadfast*, Wednesday October 9.

The scale of potential damages resulting from trace contamination can be very large. The most costly food product recall in US history resulted from a GM corn variety, StarLink, getting into non-GM corn intended for human consumption. This incident in 2000 was particularly expensive as StarLink corn was only approved as an animal feed, and was thus not a legal ingredient in human food supplies. While it was originally picked up as simply a contaminant in a brand of taco chip that was supposed to be free of GM material, the investigation spiraled into a product recall that has already cost biotech company Aventis hundreds of millions of US dollars.[55] The exposure to such events is underlined by the fact that Starlink accounted for only 0.5% of US corn production at the time,[56] and it was a $500 test by a third party in a finished product that triggered these claims.

b) Contamination of a different crop variety

Cropping practices (rotation) or shared handling and processing facilities may establish the conditions for one type of crop to contaminate another (biologically unrelated) crop.

The Australian Wheat Board does not support the farming of GM canola in Australia on the grounds that at least 50% of its sales would be lost if GM content of any form and at any level was present in its shipments.[57] It put forward this conclusion to the South Australian Parliament Select Committee on Genetically Modified Organisms after surveying its customers. The Australian Barley Board objected to GM canola being released on similar grounds.

The concern in both cases is that even though the canola would not cross-pollinate with either wheat or barley, the inability to reliably segregate the various grains through harvesting, transport, storage and shipment processes would result in contamination. Rank Hovis, the largest miller in the United Kingdom, "has repeatedly found evidence of genetically modified soybeans and corn particles mixed in with wheat supplies".[58] Contamination through impure seedstock and pollination are thus just one part of the broader scope of pathways by which contamination can manifest.

55 Some agricultural economists predict that Starlink could ultimately cost over US$500 million. Fortune Magazine, Feb 19 2001, *Reaping a Biotech Blunder*.

56 Neil E. Harl, Roger G Ginder, Charles R Hurburg and Steve Moline (2003) *The Starlink Situation*, Iowa Grain Quality Initiative, p. 12.

57 South Australian Parliament Select Committee on Genetically Modified Organisms (2003) *Final Report*, p. 58.

58 Rank Hovis wheat director Peter Jones, to Carey Gillam, June 3, 2003.

c) Perceived contamination of a non-GM crop

Perceptions of contamination can be as damaging as contamination itself. This form of market rejection need not be based on doubt about the adequacy of segregation systems. It may be made by market gatekeepers (wholesale buyers) who simply perceive damage to a country image (Brand New Zealand), a regional brand (Naturally Northland), or a particular exporter's brand. It may equally be as a result of end use consumers making such a judgement. This risk is much more difficult to quantify but the following describe the scope and seriousness with which this risk is viewed.

- The report of an inquiry by the Western Australian Parliament into potential GM crop production noted that: "The commercialisation of a single GM grain crop may tarnish WA's overall reputation of being a 'clean and green' non-GM producer and thus have implications for the marketability of other WA agricultural products." [59]

- The largest miller in Italy, Grand Molini, told US Wheat Associates: "The European milling industry will simply not buy one more kilo of any U.S. wheat at all if GM wheat is commercialised". [60]

- In New Zealand, Zespri chief executive Tim Goodacre told the company's annual meeting in 2003 "We don't sell into a scientific market; we rely on the consumer perception which is totally different. In Europe [one of Zespri's key markets] the gap between science and consumer acceptance has widened because of the food scares with beef and chicken. This has made the consumer suspicious." Mr Goodacre also said "It puts pressure on when [GE] doesn't even apply to kiwifruit. We don't know what impact GE will have on sales, but do we have to go down that route?" [61]

- One of New Zealand's largest food processors submitted to the Ministry of Agriculture and Forestry (MAF): "The implications for any GM contamination, real or perceived, anywhere in our supply chain, or even just anywhere in NZ, are potentially damaging for all of our business, such is the level of sensitivity of many of our customers to this issue."[62]

Market research undertaken for the New Zealand Government by the National Research Bureau attempted to measure the extent to which GM products could tarnish conventional foods merely by association and surveyed consumers in the UK, US and Australia. Asked whether they would buy New Zealand fruit and dairy products that were not themselves GM, between 20% and 30% said they would cease to purchase, irrespective of price, if New Zealand was at that

59 Western Australian Parliamentary Select Committee (2003) *Report of the Standing Committee on Environment And Public Affairs in relation to the Gene Technology Bill 2001 and the Gene Technology Amendment Bill 2001*.

60 Survey by US Wheat Associates, as reported by Reuters: *Asian opposition to biotech spring wheat steadfast*, Wednesday October 9.

61 "GE moratorium will hurt business", DominionPost, 15 August 2003.

62 Heinz Watties (2002) Submission to MAF on Paper 31, "Border Control for GM Seeds".

time growing related GM products. [63] Even a 1% drop in food export earnings would incur losses of about $140 million a year. The same survey also produced the result that 47% of respondents would be "more inclined" to purchase New Zealand products if no GMOs were released in New Zealand compared to just 2% that would be "less inclined" to purchase.

Canada is a country with direct experience of negative impacts from GM agriculture. The Canadian Government has expressed strong concerns about the impact of GM production on export markets and damage to "Brand Canada". While the commercial plantings of GM crops have not been as extensive as in the US, it has significant GM production. A declassified paper prepared in March 2003 by the Department of Agriculture and Agri-Food states:[64]

> Consumers are becoming more worried that they can't distinguish between GE and non-GE products.
>
> …
>
> These concerns could precipitate a loss of confidence in the integrity of the Canadian food system, which could be very disruptive to the domestic system as well as Canada's ability to export to demanding markets.

Research and Marketing Manager for Research Solutions, Jonathan Dodd, extends this further and believes the effects in New Zealand's case would move beyond the agriculture sector:

> Most New Zealand exporters stand to be negatively affected if New Zealand becomes known as a GM-using country, and this includes many of New Zealand's fastest-growing 'glamour' brands such as Orca, Icebreaker, and Karen Walker, as well as established stalwarts such as Canterbury, MacPac, Air NZ and the All Blacks
>
> …
>
> If New Zealand becomes a recognized user of GM technology, then the brand equity of "New Zealand" will be degraded, creating problems of varying degrees for a wide variety of local brands and exporters.[65]

Further survey work noted in the BERL report also indicated an impact on tourism. While opposition to GMOs was not as strong for tourism as for food products, 6% of those surveyed in the US, Australia and England indicated that they would not purchase travel to New Zealand at any price if New Zealand were to release GMOs, and 24% were less inclined to purchase.[66]

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63 MfE (2003) *Economic Risks and Opportunities from the Release of Genetically Modified Organisms in New Zealand*, http://www.mfe.govt.nz/publications/organisms/economic-impact-apr03/

64 Agriculture and Agri-Food Canada (March 5 2003) "Adapting to Emerging Concerns in the Introduction of Genetically Engineered Products".

65 Jonathan Dodd, (October 2003) "GM allowance to hurt the 'New Zealand' brand?" National Business Review.

66 MfE (2003) *Economic Risks and Opportunities from the Release of Genetically Modified Organisms in New Zealand*, p. 30. http://www.mfe.govt.nz/publications/organisms/economic-impact-apr03/ and John Fairweather and Chrystal Maslin (2002) *Effects of GM Release on Market Perceptions of New Zealand's Environment: Christchurch Case Study of International Visitors*, p. 9.

2.3.3 Option Foreclosure – Branding and Marketing

Another dimension of economic risk is opportunity costs that could result from GMO activities proceeding or not proceeding. The risks involved in GMO activities being deterred or prohibited are addressed separately in Sections 4.4 and 6.1 as this is linked to discussions on changes to district plans.

A key form of opportunity cost associated with GMO activities proceeding is the potential to inhibit branding and marketing options for the Northland peninsula. While the following explores this issue at the level of the district and Northland peninsula economy, these considerations similarly apply at the level of the individual firm.

Attributes that attest to the natural providence of food have been shown capable of generating price premiums of hundreds of percent.[67] These are characteristics sought by affluent consumers who are wary from food contamination scandals, or seek out natural foods for lifestyle, health and other reasons. "GM Free" has demonstrated a capacity to act as one gateway to price premiums as well as expanded sales.

A regional branding strategy for food products, tucking in under Brand New Zealand, would be assisted by the area's geography. The Northland Peninsula Councils cover virtually all the agricultural land north of the Auckland isthmus. With the city providing the southern boundary and the remaining area forming a peninsula into the sea, it is unusually well protected from inadvertent contamination through pollen drift. This would be of both a practical and symbolic benefit. It would also be less likely than other conjoined districts to provide pathways for trace contamination as harvesting and transport activities are more likely, in general, to be contained within the peninsula.

The idea that districts would be established as areas free of certain categories of GM organisms was supported by the Royal Commission on Genetic Modification. Recommendation 13.1 (which was not actioned by the Government) states:

> That the methodology for implementing section 6(e) of the Hazardous Substances and New Organisms Act 1996 be made more specific to … allow for specified categories of genetically modified crops to be excluded from districts where their presence would be a significant threat to an established non-genetically modified crop use.

There are a number of precedents for areas seeking to brand separately on particular issues[68] and also on their GMO status. In Europe, ten regions are jointly pressing for the right to set zones that exclude GMOs. Theses are Tuscany Aquitaine, Upper Austria, Basque Country, Limousin, Marche, Salzburg, Schleswig-Holstein, Thrace-Rodopi, and Wales.[69] Brand image was clearly a major factor in the decisions of the Australian states that have legislated to effectively prohibit the commercial cultivation

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67 *GM-free status sees NZ eggs fetch premium price in US*, Simon Collins, NZ Herald, 27 July 2003.

68 See for example Northland's branding initiative, led by Enterprise Northland: "Northland Naturally", "rich in natural beauty and resource". Marlborough, for example, identifies strongly with its winemaking industry.

69 On November 4 2003, they declared themselves 'the network of GMO free regions' under a document signed by the agriculture ministers of each region.

of GM foods for varying periods - Western Australia, New South Wales and Tasmania being the earliest.[70]

Australia is a major New Zealand competitor in the global sale of agricultural products and it is very significant that at least five of its states (including South Australia and Victoria) have effectively prevented the growing of GM foods. This encompasses the bulk of the agriculturally productive land and has resulted in no commercial cultivation of GM foods having taken place in Australia to date. (The law under which these zones have been created is discussed in Appendix 2.)

Of particular interest to the Northland Peninsula Councils is the South Australian Government's decision to legislate for a peninsula to be provided separate and stronger powers to exclude GM cultivation from an area in which quite strong restrictions already apply.

> Eyre Peninsula must be provided the opportunity to establish the Peninsula as a GM crop free area for marketing purposes.
> …
> Through the legislation and/or other mechanisms the South Australian Government should facilitate, assist and/or empower the communities of Kangaroo Island and the Eyre Peninsula to address the issues associated with establishment, implementation and management of GM crop free areas for marketing purposes, …[71]

The report of the South Australia Parliament further stated that:

> The development of exclusion zones does provide a powerful tool in ensuring the compliance and the regional branding of those zones. This system would provide the greatest protection for the purchaser of the goods from the region. EP is an example of the possible region for an exclusion zone due to the geographical and isolated nature of the region and the existence of separate port facilities.[72]

In other words, it was envisaged that there could well be marketing value in creating sub-zones of strict control, even in a state that had no history of GM production and was in the process of setting significant restraints on any future production.

The degree of benefit available from such a sub-zone are not available to study in this case as in April 2004, South Australia invoked Section 5 of the Genetically Modified Crops Management Act 2004 and designated the entire state as an area in which the cultivation of GM crops is prohibited. The current designation remains in force until April 2007.[73]

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70 The analysis that led the states to legislate for state-wide GM Free food production is detailed in the Western Australian Parliamentary Select Committee Report, July 2003; Parliament of South Australia, House of Assembly Select Committee on Genetically Modified Organisms, Final Report, 17 July 2003; and the Parliament of Tasmania, Joint Select Committee Report on Gene Technology, 2001.

71 Parliament of South Australia, House of Assembly Select Committee on Genetically Modified Organisms (2003) *Final Report*, p. 11.

72 Ibid, p. 54.

73 The Genetically Modified Crops Management (Designation of Areas) Regulations, 29 April 2004. South Australia Department of Primary Industries and Resources, www.pir.sa.gov.au/pages/agriculture/field_crops/gm_crops/gm_crops_des.htm:sectID=2038&tempID=1

While the concept is relatively new, the notion of developing such sub-zones has gained extensive global appeal with a recent conference stating that "over 100 regional and 3,500 sub-regional areas now declare themselves GMO-free".[74]

2.4 Environmental Risks

Some GMOs have been developed to improve crop management, and indirect environmental gains are claimed to result from the improved agronomic performance.[75] GMOs subject to these claims include herbicide and pest resistant plants. Other GMOs are being developed to benefit the environment directly: however many of these are still at an early stage and their ability to deliver the projected benefits is yet to be rigorously documented. In the following subsections, the state of knowledge of the environmental effects of GMOs is outlined, and some of potentially ecological effects associated with GMOs identified.

2.4.1 Research to Date

Research into the potential and actual ecological effects of GMOs has to date been limited. This is due to:
(1) the relative newness of the technology (wide-scale GM plantings began in 1996);
(2) the limited range of GMOs that have gained commercial approval; and
(3) less emphasis on research and monitoring than could have been expected thus far.

The following summaries the current state of knowledge of the ecological effects of GMOs.

- Although GMOs have been grown extensively in the US, Canada and Argentina over the last decade, many of the ecological questions that have been raised about their ecological impact have yet to be researched in the field.[76] The ability to draw conclusions about the effects of these crops on ecosystems (managed and wild) has therefore been limited, and is further hampered by a lack of baseline data that would enable monitoring for the ecological effects of GMOs.[77]

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74 Foundation on Future Farming (January 25 2005) *European conference calls for regional governance*.

75 These issues are not the focus of this section. Potential benefits of GMOs are however discussed in sections 2.1 and Appendix 1.

76 Ecological Society of America, p. 6: "Because the commercialisation of GMOs is relatively recent and is limited to only a few types of crops, many of the ecological questions we raise have yet to be examined empirically". The US National Research Council also concludes that there is inadequate baseline monitoring of agricultural and natural ecosystems to allow for the potential impacts of commercialised GM crops to be assessed. *Environmental Effects of Transgenic Plants. The Scope and Adequacy of Regulation*, p. 218.

77 An expert panel convened by the UN Food and Agriculture Organisation notes: "Monitoring the long-term environmental impacts of GM crops, and adopting best agriculture practices are useful strategies to avert undesirable situations. However, the baseline data required for the purpose of monitoring is not yet available for the GM crops under cultivation." *Report of the Expert Consultation on Environmental Effects of Genetically Modified Crops,* 16-18 June 2003, Rome, Italy, p. 4.

- The experimental phase of GM crop development – small scale trialling - is generally considered inadequate to identify the range and severity of potential environmental effects. In particular, field trials may not be able to detect small but important effects.[78] These may only be discovered through large scale release.[79] At this scale, however, irreversibility becomes a feature as containing GMOs becomes more difficult or impossible, and containment costs are likely to be high.[80] As Wolfenbarger and Phifer note in a review of the state of knowledge of environmental effects:

  > Because some consequences, such as the probability of gene flow, are a function of the spatial scale of the introduction, limited field experiments do not always sufficiently mimic future reality prior to widespread planting. Ecological relationships include many cascading and higher order interactions that are intrinsically difficult to test and evaluate for significance at limited temporal and spatial scales. At larger spatial scales, there is greater possibility for contact with sensitive species or habitats or for landscape-level changes because at larger scales more ecosystems could be altered.[81]

- The long-term effects of GMOs on an evolutionary scale remain an outstanding area of research. In particular, the ecological effects of GMOs in non-agricultural habitats and ecosystems remain largely unstudied.[82]

- Some research has been conducted on the potential benefits of GMOs – such as a reduction in the use of pesticides and herbicides – yet these studies have tended to focus on a single measure (such as reduced pesticide or herbicide use), and thus provide only a partial view of the potential range of environmental impacts.[83]

In reviewing the US regulatory system of GM crops, the US National Research Council concluded that there is insufficient detail provided by Government agencies to allow an independent assessment of the environmental impact of transgenic plants. US National Research Council (2002) *Environmental Effects of Transgenic Plants. The Scope and Adequacy of Regulation*, p. 201.

78 ESA, pp. 22-3.

79 The Royal Society of Canada Expert Panel on the Future of Food Biotechnology notes in its extensive 2001 review, *Elements of Precaution. Recommendations for the Regulation of Food Biotechnology in Canada*, that "data from small field trials may not always provide a realistic picture of the situation that prevails under full commercial production" (p. 145, and p. 125). UN FAO Expert Panel, p. 4 and 7.

80 The US National Research Council advocates post-commercialisation monitoring, but notes that even here, "monitoring may detect some unexpected effects so that action may be taken to prevent or ameliorate those effects, in other cases monitoring may detect those effects so late that environmental damage may be irreversible (e.g., extinction)." *Environmental Effects of Transgenic Plants. The Scope and Adequacy of Regulation*, p. 216.

81 L.L. Wolfenbarger and P.R. Phifer. "The Ecological Risks and Benefits of Genetically Engineered Plants." In: *Science*, Vol 29, December 15 2000, p. 2090.

82 Wolfenbarger and Phifer conclude that the "ecological consequences in non-agricultural habitats and ecosystems largely remain unstudied", p. 2088.

83 Ecological Society of America, Public Affairs Office (November 2003) "Genetically Engineered organisms and the environment: Current status and recommendations", p. 21. The Ecological Society of America is a nationwide association of 9,000 scientists involved in ecological research and teaching. The ESA evaluation of knowledge and knowledge gaps regarding the ecological effects of GM releases was conducted by an expert panel and adopted by the governing board in 2004.

2.4.2 Potential Adverse Ecological Effects

The following provides general descriptions of the types of potential effects that can result from GMO release. It is important to note that each GMO will have a specific risk profile: the potential negative effects listed below will have varying probabilities and the consequences may vary in magnitude dependent on the organism, the GM trait and the receiving environment. Further, not all of the effects have been documented in the field as many of the GMOs identified have not yet reached commercial release. Given the limits of current research and understanding, the absence of field documentation of these effects may not be due to a demonstrated absence of harm, but may instead be due to a lack of research thus far.[84]

Unintended effects and predictability

The process of genetic modification may result in unintended effects, ones that may only manifest later, triggered by different environmental conditions.[85] A key source of unintended effects arises from the location of the introduced gene construct (the assemblage of genes and markers that carries the desired trait, such as herbicide or pest resistance). The location of genes determines their function. Thus far, techniques for introducing the gene construct do not allow for site-specific insertion, only at random locations in the DNA sequence of the receiving organism. As noted by the Ecological Society of America, this randomness may lead to 'position effects': genes expressing unexpected effects due to their location:

> A major cause of unintended phenotypes, known as position effects, stems from the fact that transgenes are inserted into haphazard chromosomal locations, often at multiple sites in the genome. The specific locations of transgenic insertions can influence the level and consistency of gene expression, and the magnitude of these position effects can range from minor to lethal.[86]

A further cause of unintended effects arises from the unforeseen interaction of the introduced gene construct with genes in the host organism. Obvious abnormalities that occur during the GM process will be weeded out during development, but others may remain undetected. Unintended effects arising from random insertion will persist as a risk until techniques that allow for site-specific insertion are available.[87]

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84 The Royal Society of Canada is careful to distinguish absence of harm from absence of evidence: "[…] the claim that "there are no known adverse health or environmental effects" associated with a particular technology can mean very different things. It can mean that rigorous and intensive scientific investigation of the potential harms that might be induced by the technology has failed to show any of those harms (and, in the best case, provided a reliable explanation why the harmful effects do not or will not occur). At the other extreme, this claim might mean simply that no studies to determine if the harmful effects occur have been carried out, in which case the claim is simply an admission of ignorance. In the first instance the claim would be "evidence of absence" (of risk); in the later instance it would be simply a veiled admission of the "absence of any evidence" relevant to the question." *Elements of Precaution. Recommendations for the Regulation of Food Biotechnology in Canada,* p. 198.

85 ESA, p. 9.

86 Ibid.

87 Ibid, p. 9.

Non-target effects

Effects on organisms (plant, animal or microbial) that are not the target of the GM trait are known as 'non-target effects'. Such effects may be *direct*, harming or killing organisms that feed on the GMO, or *indirect*, causing disturbances that cascade through the food web, affecting organisms that are not directly exposed to the GMO. Examples of non-target effects include detrimental effects of GM pest-resistance on beneficial insects in addition to the pests that the GM trait seeks to control.[88]

The insecticide most widely incorporated into GM plants thus far employs a soil microorganism, *Bacillus thuringiensis* or "Bt". In the US, where Bt-pest resistant plants are most widely grown, studies required by the regulatory bodies are short-term tests that focus on a standard group of soil organisms and beneficial insects. Most of the tests conducted are considered to be too small for meaningful statistical analysis.[89] In the UK, farm-scale evaluations (FSEs) of GM herbicide resistant crops were conducted over a three year period to assess whether GM herbicide resistant crops were more or less harmful to on-farm biodiversity than their conventional counterparts.[90] It was reported that two out of three GM crops – beet and spring-sown oilseed rape – were more detrimental to wildlife than conventional varieties:

> There were more insects, such as butterflies and bees, in and around the conventional crops because there were more weeds to provide food and cover. There were also more weed seeds in conventional beet and spring rape crops than in their GM counterparts. Such seeds are important in the diets of some animals, particularly some birds.[91]

Initially, the results relating to the third GM crop under evaluation – GM forage maize – indicated that the GM maize was less harmful to wildlife than conventional maize.[92] However, a subsequent review of the trials by a Parliamentary audit committee deemed the GM maize trials irrelevant as the conventional maize benchmark was dosed largely by a broad spectrum herbicide (Atrazine) that is to be phased out in the EU by April 2005 due to concerns about its effects on biodiversity.

When the results of this work were reviewed by a UK Parliamentary select committee, it also drew attention to the basis on which the study was conducted:

> 24. While we applaud the steps that Government has taken to assess biodiversity in a rational way before permitting an agricultural innovation in the form of GM, we believe that even if some GM crops with some associated herbicide regimes are

88 Ecological Society of America, (November 2004), *Genetically Engineered Organisms and the Environment: Current Status and Recommendations*.

89 ESA, p. 18.

90 The Farmscale Evaluations were set up by the UK Government to examine the effects of GM herbicide resistant crops on biodiversity at farm scale levels of cultivation. In effect, the trials investigated the *herbicide management regimes* of GM crops (beet, maize and oilseed rape) against herbicide practices for growing conventionally bred varieties of the same crops. . Theoretically, it is possible that developing different herbicide regimes to accompany the GM beet and oilseed rape might reduce the effects that these crops and their herbicide management regimes had on farmland wildlife.

91 UK Farmscale Evaluation Team and Scientific Steering Committee (2003*) GM Crops: Effects on Farmland Wildlife*, p. 2.

92 Ibid, p. 2.

> eventually shown to be less harmful to biodiversity than their conventional counterparts, the Government and its advisory bodies are still guilty of setting too low the level of harm.
> …
> 26. The scope of the trials was very narrow and the results cannot be regarded as adequate grounds for a decision to be taken in favour of commercialisation.[93]

Among the ecological communities that may be inadvertently negatively affected by GMOs are soil microorganisms. To date, little research has been done on the effects of GMOs on soil biota to support risk assessment, although New Zealand scientists state that research in the laboratory and in small-scale trials has identified "some statistically significant changes in the structure and function of indigenous soil biota", and that these results are "somewhat unexpected, given that research into this area has only recently begun."[94]

2.4.3 Weediness and Invasiveness

New Zealand agricultural production relies heavily on exotic species. At the same time, many exotic species introduced for agricultural purposes have devastated native ecosystems and are now a serious and ongoing expense to the economy. They are cautionary tales on the difficulty of identifying in advance species that might become invasive. Every year, around two more exotic species become weeds.[95] The warm moist Northland environment is an ideal climate for many weed species which grow more vigorously there than in other parts of the country.[96]

A central ecological issue arising from GM release is the potential for GMOs to spread beyond the site of intended release.[97] GM plants, may migrate by:

- Shift of seed beyond the site of release (dispersal by wind, animals, humans or events such as floods); or
- Hybridisation with relatives of the GM plant (through pollination) or asexual means (such as horizontal gene transfer), allowing the GM trait to move beyond the original host plant.

Predicting which organisms or traits have the potential for invasiveness is not straightforward. The potential for invasiveness is understood to depend on a number of factors, including:

- the presence of wild relatives to the GMO;
- the ability of the GMO to outcross with wild relatives or to direct seed;
- the fitness advantage that the GM trait confers on the GMO or wild relatives.

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93 UK House of Commons Environmental Audit Committee. *GM Foods —Evaluating the Farm Scale Trials*, Second Report of Session 2003–04, Executive Summary, 2 March 2004

94 M. O'Callaghan and T. R. Glare (2001) "Impacts of Transgenic Plants and Microorganisms on Soil Biota". 54th Conference of the New Zealand Plant Protection Society Inc, p. 108.

95 *Tiakina Aotearoa. Protect New Zealand.* The New Zealand Biosecurity Strategy. August 2003, p. 56.

96 Ibid, p. 56.

97 The most basic definition of a weed is a plant or its parts in a site where it is not wanted.

Some GM traits – such as pest resistance – may confer an immediate advantage on GM plants; other traits such as herbicide resistance will not confer an immediate advantage unless they migrate to areas managed by herbicides.[98] Of the two main GM traits currently under commercial cultivation, herbicide resistance has been a key focus of the debate on the potential weediness of GM plants to date. An FAO expert panel concluded that "there is incomplete scientific research or data-analysis on emergence of resistance, genetic makeup of resistant weeds, and weed shifts from GM crops. More targeted research [is] needed." [99]

However, outcrossing (the emergence of herbicide resistant populations through spontaneous hybridisation of GM plants with cultivated or wild relatives) has been documented in Canada. Oilseed rape plants with resistance to three different herbicides were traced, and appear to have resulted from, the hybridising of three rape varieties planted near one another.[100] To eradicate unwanted plants that have developed herbicide resistance, farmers may be forced to use alternative and often stronger herbicides.[101]

The outcrossing of GM crops with wild relatives (via pollen) has tended to dominate the scientific and policy debate. However, direct seeding of GMOs or their dispersal by humans (for example, in transporting seed stocks) may in some cases be more significant pathways to the emergence of weed populations. Direct seeding can occur within the field, with GM herbicide resistant plants appearing in subsequent seasons (such plants are also known as 'volunteers'). In the case of herbicide resistant crops, this can lead to crop management problems, particularly if GM crops with resistance to the same herbicide are used in rotation, or if non-GM crops are grown in rotation.[102] Crops such as oilseed rape are high seed producers, and seeds can remain viable in the soil for many years.

Containing GMOs

One strategy that is being considered to reduce the potential for weediness or invasiveness of GMOs involves genetic modification to introduce biological barriers to the spread of GM material. This is known as a biological confinement and compromises three approaches to confining GMOs: reducing the spread or persistence of GMOs, reducing the unintended flow from GMOs to related organisms, and limiting the expression of GM traits. In a 2004 review of biological confinement strategies for GMOs, the National Research Council notes that bioconfinement "is

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98 The spread of herbicide resistant plants into conservation areas could undermine weed management strategies, however. Roundup, one the herbicides most widely provided for in GM herbicide resistant crops, is the Department of Conservation's preferred herbicide. The presence of RoundUp resistant weeds in the conservation estate could compromise the use of this tool, and require the Department to employ more toxic herbicides to control weed populations.

99 FAO Expert Panel, *Report of the Expert Consultation on Environmental Effects of Genetically Modified Crops*, 16-18 June 2003, Rome, Italy p. 5.

100 Ibid.

101 Norman Ellstrand (2003) *Dangerous Liaisons: When Cultivated Plants Mate with Their Wild Relatives*, p. 179.

102 J. Sweet et al (2004) "Botanical and rotational implications of genetically modified herbicide tolerance in winter oilseed rape and sugar beet (BRIGHT Project)", p. 6.

still largely in the conceptual and experimental stages of development".[103] No single strategy is likely to be 100% effective, and mitigation (detection of non-sterile GM fish or insects and their retrieval) may not be feasible in all cases. This is a particularly significant concern where the release of large numbers of GMOs and/or over large areas is concerned.

The Royal Commission was supportive of GM sterility techniques as a form of bioconfinement and recommended that they be "one tool in the strategy to preserve opportunities, especially in the case of those genetically modified crops most likely to cross-pollinate with non-genetically modified crops in the New Zealand context (eg, brassicas, ryegrass, ornamentals)."[104]

The Commission's approval appears to have been based on their *potential* contribution, as the efficacy and commercial viability of new approaches to biological containment – particularly those that involve GM – has yet to be demonstrated. With respect to biological confinement methods for plants, the US National Research Council concludes that "although the efficacy of some is known, most are untested."[105] An outstanding area of fundamental knowledge is the potential of GM sterility mechanisms to have harmful effects on biodiversity.[106]

Horizontal gene transfer

A further pathway through which genes may flow from one organism to another is horizontal gene transfer (HGT). This is the asexual transfer of genetic material between organisms. It is not limited to reproductively compatible species, and allows for transfers across taxonomic kingdoms.[107] It is most widely documented between microorganisms, but is also documented between other kingdoms. Some of the scientific debate about the extent of the risk that HGT poses with respect to GMOs has focussed on the frequency and therefore the probability of serious harm occurring from this natural process. It is often claimed that HGT occurs at very low frequencies.[108] Heinemnann and Traavik note, however, that the rapid development in disease bacteria of resistance to since antibiotics were first used 50 years ago demonstrates that HGT does occur in frequencies high enough to create threats to human health and the environment. Indeed, they argue that the global spread of antibiotic resistance can be almost wholly explained by HGT. In a condensed version of the above paper, they state: "The question of gene transfer is not 'will it happen'

103 US National Research Council (2004) *Biological Confinement of Genetically Engineered Organisms*, p. 1.

104 Royal Commission report, recommendation 13.4.

105 US National Research Council (2004) *Biological Confinement of Genetically Engineered Organisms*, p. 3.

106 A further consideration for confinement systems, beyond their efficacy and environmental safety, is whether biologically confining GMOs will reduce or eliminate buyer concerns about the potential for GM contamination of New Zealand food products.

107 Pew Initiative on Food and Biotechnology (2004) *Bugs in the System? Issues in the Science and Regulation of Genetically Modified Insects*, Report Overview, p. 4.

108 Anthony J. Conner, Travis R. Glare and Jan-Peter Nap. "Popular Summary of: The release of genetically modified crops into the environment II. Overview of ecological risk assessment." A condensed version of a paper published in *The Plant Journal* in January 2003, p. 4.

but 'when and where will it happen'?" [109]

The current low levels of understanding about HGT are in part due to the limitations in techniques available to detect and monitor its occurrence. The same authors note that existing research data do not justify confidence in the statements that HGT happens at very low frequencies. Instead, they argue that it is likely to go undetected as most HGT events are not likely to "immediately change the characteristics of the recipient organism". [110]

A recent US review of the scientific and regulatory issues associated with GM insects notes that for GM insects that are required establish in an ecosystem to perform their intended function (such as biocontrol), scientists may use GM techniques that can heighten the chances of HGT. [111]

A particular area of interest in New Zealand is HGT in the soil. Little research has been done internationally on soil ecosystems and the Royal Commission noted the absence of research and understanding of the implications of GMO release for New Zealand soil ecosystems. It stated that "there is a need for research specific to the New Zealand environment". [112] Research into HGT in currently the subject of a research programme by Environmental Services Research, which notes that:

> "It will be very difficult for regulators to develop a risk framework that takes account of HGT without data applicable to New Zealand conditions." [113]

2.4.4 Future GMOs: new challenges to ecological risk assessment

It is difficult to identify in advance the precise nature of ecological risks that new generations of GMOs pose. There is a developing view, however, that new generations will increase the levels of unpredictability associated with current GMOs. [114] This is because they will differ so markedly from the properties of known crops that form the baseline for current risk assessment.

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109 J A Heinemann and T Traavik (2004) "Problems in monitoring horizontal gene transfer in field trials of transgenic plants". In: *Nature Biotechnology* Vol 22 No 9, September 2004, p. 1105.

110 New Zealand Institute of Gene Ecology (2004) *Gene Ecology Guide to: Measuring Horizontal Gene Transfer*, p. 3.

111 One of the techniques that could be adopted involves the use of transposons, "pieces of DNA that have the ability to move from location to location within a genome and can carry other DNA with them." The report notes that as a result: "Researchers know that transposons sometimes escape their hosts and move to new ones. If this happened with a GM insect, it could, in theory, transfer DNA from a GM insect to a non-GM organism which may or may not be related to the GM insect. In turn, if the transferred DNA functioned in the receiving organism, problems might occur. For example, if a GM insect designed with pesticide resistance genes passed those genes to a pest insect, the pest insect could become more difficult to control." Pew Initiative on Food and Biotechnology (2004) *Bugs in the System? Issues in the Science and Regulation of Genetically Modified Insects*, Report Overview, p. 5.

112 Royal Commission Report, p. 133.

113 *Horizontal Gene Transfer in the NZ Environment*, Abstract for FRST programme C03X0202, 1 October 2002.

114 US National Research Council (2002) *Environmental Effects of Transgenic Plants: The Scope and Adequacy of Regulation.*

Such GMOs include those that incorporate more than one GM trait, are designed to produce pharmaceutical proteins (biopharma crops and animals) or to provide industrial feedstock (see Appendix 1 for further discussion of these applications). Risk assessment - which assumes that "all possible outcomes are known in advance and ... their relative likelihood can be adequately expressed as probabilities"[115] - will not be possible for some new GMOs as they constitute truly novel organisms for which existing plants, animals and microorganisms provide little comparison. The US National Research Council notes:

> Our experience with the few herbicide-tolerant and insect- and disease-resistant varieties that have been commercialised to date provides a very limited basis for predicting questions that need to be asked when future plants with very different phenotypic traits are assessed for environmental risks.[116]

Thus far, food crops such as corn and soy are those predominantly being used as the host for the production of pharmaceutical proteins. This has led the US food industry to advocate use of non-food crops, and for strict containment measures, which could reduce the potential for contamination of the human food chain. However, a shift to non-food crops would not address the broader ecological risks associated with broadcasting pharmaceutical proteins in ecosystems. As the NRC warns:

> "The introduction of such transgenes poses the potential for environmentally associated risks of a wholly different order than those associated with existing transgenic crops. If such a transgene moves into a wild relative, there could be widespread environmental dissemination of the pharmaceutical substance or other non-food substances that could have impacts on wildlife as well as microbial populations."[117]

2.5 Cultural Risks

When the Royal Commission on Genetic Modification considered cultural aspects, it defined culture as the framework of values, beliefs and practices within which a community of individuals operates.[118] Cultural beliefs and attitudes are informed by and defined through knowledge systems (sciences, including ecology, agriculture and medicine, and technologies), spiritual beliefs and relationships (rights and responsibilities) to other human beings and cultures, and to the non-human world. .

To that extent, the potential range of cultural impacts (whether positive or negative) arising from the outdoor use of GMOs encompasses a wide terrain, including environmental and public health, ethics and social justice and they may be far-reaching in their effects on a community, its practices, future opportunities and relationship with the world, human and non-human.

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115 Paul Harrremoes et al (eds) *The Precautionary Principle in the 20th Century. Late Lessons from Early Warnings,* p. 188.

116 National Research Council (2002) *Environmental Effects of Transgenic Plants. The Scope and Adequacy of Regulation*, p. 220.

117 Ibid, p. 246.

118 Royal Commission Report, Appendix 2, p. 263.

In New Zealand, the cultural effects that may follow from the outdoor use of GMOs have been most clearly and consistently addressed by Maori.[119] This section provides an overview of the cultural effects identified by tangata whenua, in line with our brief for this work. Maori consider these to be predominantly negative in impact and wide-ranging. They include concerns about preserving the integrity of nature, the ecological effects of release of GMOs, and which parts of the community stand to the benefit from the technology.[120] An application of GM that constitutes a possible exception to the largely negative appraisal of GM is the use of the technology for medicinal purposes. It should be noted that this more receptive attitude to GM medical applications is cautious, and does not extend to all GM projects.[121]

A view widely held by Maori is that transgenics – the breaking down of species barriers and the mixing of genes from unrelated species – is a breach of the integrity of species and an offence to whakapapa. Reporting on the 11 hui held as part of the Royal Commission process, the Commission noted: "Upsetting whakapapa, mana, mauri and wairua by the mixing of genes between humans and other species was roundly condemned at every hui." [122]

This concern was also widely expressed in a survey of South Island Maori: "Many expressed an opinion that these new technologies (especially GMO's) somehow transgress tikanga, and break the unwritten rules that govern relationships between things." [123]

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119 Other communities that have identified implications for their cultures include the Jewish Community (see the Royal Commission Report, p. 22 ff). Similarly, concerns expressed by Pakeha New Zealanders about the attitudes to nature perceived to drive GM (such as 'playing God') as well as negative effects on animal welfare can be understood as cultural concerns. They describe a concern that the technology (or some of its applications) establishes or reinforces inappropriate relationships between humans and the non-human world. Gene technologies themselves arise from a particular tradition of science, itself predominantly rooted in the Western European cultural perspective(s), rather than evolving independent of cultural beliefs and attendant relationships.

120 While there is no single Maori view on GM, just as there is no single pakeha view on the technology, the cultural concerns indicated below are consistently expressed by the majority of Maori in hui, surveys and in Maori institutional policy on GM. The Federation of Maori Authorities for example does not oppose GM per se, but contends that state of knowledge about GMOs requires a very cautious approach to their development and use. FOMA does not support the transfer of human genes into animals (or vice versa), except in exceptional circumstances (FOMA Submission to the Royal Commission, October 2000). A recent survey of the views of South Island Maori illustrates high levels of shared concern amongst Maori respondents regarding potential negative effects of GMOs on public health and the environment, and its potential negative effects on whakakpapa, wairua and mauri.

121 Kawau Ltd (2004) *The Transfer of Human Genes into other Organisms: A dialogue with Maori*. Report Prepared for Toi te Taiao: The Bioethics Council, p. 8.

122 Royal Commission Report, Appendix 3, p. 153. A national hui held by the Bioethics Council more recently reported a similarly strong level of concern about the breach of whakapapa: "A strong concern surrounded the potential impact of gene technology on whakapapa and human relationships if genes from other organisms are transferred into humans. Other concerns arose from a Maori worldview where all living things are seen as related and balanced. Some saw GM technology as creating the potential for imbalance. Participants felt that uncertainty of what the implications could be for future generations may outweigh the benefits to this generation". Kawau Ltd, *The Transfer of Human Genes into other Organisms: A dialogue with Maori*, p. 7.

123 Mere Roberts and John R Fairweather (2004) *South Island Maori Perceptions of Biotechnology.* AERU, Lincoln University, Research Report No. 268, p. 67.

A potential consequence identified from the breach of whakapapa is harm to the environment or community health:

> Almost every person expressed concerns about the potential for negative effects on humans and the environment especially in the longer term. GMOs were perceived as pollutants which if ingested or released would 'contaminate' people or the environment in some way.[124]

Kaitiakitanga entails a set of responsibilities on tangata whenua to guard and protect the integrity of whakapapa of indigenous biodiversity, and to regulate the use of these natural resources.[125] The outdoor use of GMOs may therefore result in local iwi feeling they have failed to fulfill their duties as kaitiaki. This is particularly the case with respect to potential effects on indigenous biodiversity. This concern forms a central plank of the Waitangi Tribunal claim that was filed in 1991 by three iwi in Te Tai Tokerau (Ngati Wai, Ngati Kuri and Te Rarawa, along with Ngati Kahungunu, Ngati Porou and Ngati Koata). As the Wai 262 claimants explained to the Royal Commission:

> as native flora and fauna are taonga, and each have their own whakapapa related to the whakapapa of all other living organisms, the process of tampering with whakapapa is inherently contrary to tikanga Maori and the Maori worldview. The consequences are great not only for the organisms themselves, who all have a *mauri* but for Maori, who by virtue of the role as tangata whenua and whakapapa links, are *kaitiaki* of those mauri.[126]

In this regard, the agreement between the Crown and Maori established in the Treaty of Waitangi is seen as a relevant to decisions about the outdoor use of GMOs and their potential effects on indigenous biodiversity, as outlined in the above Wai 262 claim. The Maori Congress further comments that: "The management of these taonga ought to be exercised by Maori according to specific cultural preferences. There is a Crown duty of active protection to the fullest extent practicable of Maori interests."[127]

Science-based risk assessments are not considered to provide for the rights and responsibilities of Maori. Instead, as outlined by South Island Maori participants in a recent survey of their perceptions of biotechnology, there is a "need for a proposed cultural risk assessment framework that was grounded in culturally appropriate tikanga, including spiritual beliefs and values as well as actual practices. A purely scientific risk/benefit framework is not sufficient for Maori.[128] The Maori Congress have also called for a Tikanga Maori Framework of Protection as a necessary element for providing for and protecting the interests of the Maori community.[129]

Greater involvement by Maori in decisions about the use of GMOs is a clearly expressed priority in most consultation processes conducted thus far. By way of

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124 Ibid.

125 Maori Congress (2000) Submission to the Royal Commission.

126 Wai 262 Claimants Ngatiwai, Ngati Kuri, Te Rarawa (2000) Submission to the Royal Commission.

127 Maori Congress (2000) Submission to the Royal Commission.

128 Mere Roberts and John R Fairweather (2004) *South Island Maori Perceptions of Biotechnology*, p. 72.

129 Maori Congress (2000) Submission to the Royal Commission.

example, Maori participating in a consultation by the Bioethics Council with respect to the use of human genes in other organisms repeatedly stressed the greater role for community participation in decision making where GM technology has the potential to impact on the local community. This was considered a necessary component of an approach that would give cultural concerns greater weight in decisions:

> Participants expressed a need to include local communities in decision making, reflecting a belief that key decisions on investment and research are being made in isolation from both the wider New Zealand community and from local communities in particular.
> […]
> [It was] the view of most participants that decisions on development and implementation of GM technology should be based in the community rather than driven solely by government.
> […]
> Participants noted that community participation in ongoing dialogue and consultation on genetic modification will suffer if policies and legislation do not reflect community views and aspirations.[130]

Maori make up a considerably greater share of the population of Northland than is represented nationally. In the Far North District for example, the 2001 census recorded 47% of population as Maori and is predicted to exceed 50% by 2006.

Local iwi have been very active participants in the process of developing the GMO policies of Northland district councils and their stances generally reflect the concerns voiced at the national level. The Ngatiwai Trust Board for example supports adoption of a precautionary approach and locally determined controls on GMOs that take full account of Tikanga Maori based values:

> Formulation of a policy on genetic engineering which commits supporting a precautionary approach towards GE.[131]

> Genetic engineering is abhorrent to the values of Tangata Whenua and the risks associated with experimentation in the District are unacceptable. Choices are able to be made irrespective of the legislation [HSNO Act] as to how the WDC should regulate genetic engineering consequences within its jurisdiction. Tikanga Maori based values should play a significant part in determining planning responses.[132]

The relief sought by the Trust Board was that genetic engineering activities be prohibited throughout the district. Ngatiwai is also one of three iwi parties to an appeal which aims to secure local controls on GMO activities through amendment to the Far North District Plan, as described in Section 1.2.

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130 Ibid, pp. 7-9. Also see Mere Roberts and John R Fairweather (2004) *South Island Maori Perceptions of Biotechnology*, p. 71. The 2003 Amendment Act to HSNO instated the existing Maori advisory committee to ERMA, Ngâ Kahautû Tikanga Taiao as a statutory body (Part 4A). The advice that Ngâ Kaihautû is not, however, binding on ERMA decision-making.

131 Ngatiwai Trust Board submission to the Whanagrei District Council's LTCCP 2004 -2014.

132 Ngatiwai Trust Board submission to the Proposed Whangarei District Plan

3. Deficiencies in National Assessment Framework

The previous section identified a series of significant risks and potential concerns attendant to GMO release. Local government has overarching responsibilities that are relevant to any proposed outdoor release of GM organisms. These derive principally from the "Local Government Act 2002" (LGA) and RMA.

The LGA provides for local authorities "to promote the social, economic, environmental, and cultural well-being of communities, in the present and for the future" (S10(b)). It also provides (in Section 14), "principles relating to local authorities". These principles provide for a sustainable development approach to be taken by councils in performing their roles. This links with requirements for sustainable management under section 5(2) the RMA[133] which relates more specifically to land uses such as the field trialling and release of GM organisms.

The relevant responsibilities of local government are outlined in detail in sections 3.1 to 3.3 of a recent opinion by Dr Royden Somerville.[134] The focus of this section is an examination of the extent to which the national level regulation under HSNO covers matters of importance to local government.

3.1 Liability and Compensation

3.1.1 Principles

GMOs for outdoor use are generally commercial ventures with the objective of finding new means to improve agricultural productivity. Thus, rather than new products, the goal is typically new *ways* of producing an existing food, fibre or protein.

Claims for damages resulting from use of GMOs form part of the full cost of selecting that technology to meet a particular objective.[135] If those costs were to fall on third parties, this would not only be unfair, it would provide an undue incentive – a subsidy - for uptake as the full costs would not be carried by the developer or user.[136] In order

133 5(2) In this 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 wellbeing 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.

134 Dr R J Somerville QC (2004) *Opinion on Land Use Controls and GMOs*.

135 "Ensuring that prices reflect **full** environmental costs is **essential** if resource users are to factor in the full social costs of their resource use and consumption decisions. The reliance on market mechanisms is not likely otherwise to be adequate to manage the environment". OECD Country Report on New Zealand, (1996), conclusions and recommendations, p.4.

136 For a full discussion of these points, see Chen Palmer & Partners and Simon Terry Associates, (2001) *Who Bears the Risk*, chapter 4.

that costs do not lie where they fall, clear law is required to allocate risk for liability and to provide for compensation. This is also required to provide for prudential management of a council's financial position.

In August 2002, the Government recommitted to the following principles first adopted when New Zealand became a signatory to the Rio Declaration in 1992:

> "13. States shall develop national laws regarding liability and compensation for the victims of pollution and other environmental damage. …"
>
> "16. National authorities should endeavor to promote the internalisation of environmental cost and the use of economic instruments, taking into account the approach that **the polluter should, in principle, bear the cost of pollution** …" [137]

In other words, the polluter should pay, and be compelled to do so through effective liability laws. This however is not the case for activities regulated under HSNO.

Those who make or use GMOs are not liable under HSNO for any damage arising as a result of an activity carried out in accordance with an ERMA approval. That is, there is no requirement to pay for damage that is shown to be a direct result of the GM release. Only if an operator releases without a permit or breaks conditions of an ERMA approval is it strictly liable for damages.[138] Even then, damages payable are capped at a value that such claims could readily exceed. Further, the scope and form of defences available suggest the operator is at very least likely to have the damage payable reduced, thus leaving a deficit to be picked up by the injured party.[139]

Parties who suffer damage to property have the option of pursuing a civil action via common law torts. However, this involves relying on law ill-suited for this purpose, and which makes daunting demands in terms of evidence, time and financial resources.[140] An MFE discussion paper summarised the position as follows:

> There are considerable drawbacks of cost, timeliness of resolution, and problems of standing which often make common law actions inappropriate. In addition problems of standing for parties to take an action, and the requirements for damage to have been reasonably foreseeable at the time it occurred, will often make common law actions inappropriate.[141]

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137 Rio Declaration on Environment and Development (the Rio Declaration), June 1992.

138 See in particular HSNO s124G, Civil liability
"(1)A person is liable in damages for any loss or damage caused by any act or omission of the person while: (a)developing, field testing, importing, or releasing a new organism **in breach of this Act** … " [emphasis added].

139 See HSNO s124H - Defences to liability under section 124G.

140 The Law Commission did not have confidence that the present liability regime (nor that subsequently modified) would result in due compensation for victims and it listed the following difficulties (p 16 of its report):
- Harm caused is unforeseeable
- Difficult to prove causation
- Person responsible for damage has inadequate funds
- Damage is widespread or diffuse
- Damage is catastrophic or irreversible

141 Discussion document on proposals for law reform relating to contaminated sites, Ministry for the Environment, 1995, Appendix 6.

When Government consulted the Law Commission on the question of how to apportion liability, it referred the matter back to ministers on the basis that this was a policy decision, not a legal question. After observing that GM organisms have the potential to cause "catastrophic" levels of harm, it concluded that: "Government will have to decide how responsibility for any risks of new technology is to be apportioned among the industry, individuals and the state". Government has yet to adequately respond to this question when, as previously noted, it is both the ultimate regulator and the nation's largest investor in research targeting outdoor GMOs.

To date, government documents have focussed only on the perceived difficulties of adopting a policy that would allocate liability to those responsible for the activities. Government has rejected this approach on the grounds that "opportunities" would be lost. A cabinet paper of February 2003[142] stated: "Imposing the more stringent standard of strict (or absolute) liability may deter activities that are socially beneficial and, consequently, stifle innovation and economic growth contrary to government policy." Such thinking miscasts what is truly "socially beneficial". If an activity can not itself sustain the full costs which it imposes on society, including the risk that it will impose damages, then it will have a negative impact overall – a social disbenefit.

An effective liability regime relies on clearly apportioning liability prior to the activity commencing, and also on there being measures to ensure that liable parties have the means to pay. However, HSNO sets no requirement for financial fitness on the part of the applicant. No demands are made on ERMA to conduct any form of scrutiny as to the ability of the applicant to meet claims for damages arising from the activity. Neither does ERMA undertake such scrutiny of its own volition,[143] despite ministerial assurances that it would.[144]

HSNO instead places a heavy reliance on controls and penalties for breaching these. The problem with this approach is that the regulator must accurately foresee all the circumstances in which something could go wrong, and be able to prescribe for these in advance. Yet an important source of risk now recognised in respect of GMOs is unexpected adverse effects. A liability regime based on "perfect" foresight is therefore not suited to these risks.

Even if such a conceptual approach were thought tenable, there remains the question of who would be the residual risk-bearer. That is, should those who cause any harm that may result still be liable? Or would the regulator or Government explicitly take on the liability as a Crown commitment? This question is not addressed by HSNO.

142 Government Response to the Royal Commission on Genetic Modification: Legislative changes for New Organisms –Liability Issues for GM, Cabinet paper, February 2003.

143 ERMA CEO, Bas Walker, to a meeting of ERMA New Zealand's Hazardous Substances Industry Consultative Group and Community and Environmental Group, 23 September, 2004.

144 "ERMA does establish the financial viability of the people doing it, they have to. Because the people have to be financial, first of all to meet some of the conditions – which are very expensive. And secondly, they have to be – like PPL in a sense – they have to be able to meet the conditions of winding down." Environment Minister, Marian Hobbs, in interview with Linda Clark, RNZ, *Nine to Noon*, 29 September 2003.

3.1.2 Local Government Exposures

In August 2003, Crown Law gave the opinion that local government is itself unlikely to be exposed to liability claims arising from the circumstances that have already resulted in large damages suits overseas – those relating to GM contamination of non-GM produce. It stated "If the crop was ERMA approved and the person complied with all the conditions imposed by ERMA then it is unlikely that a claim in negligence would succeed".[145] However losses arising from legal actions against a local authority (legal liability) are just one form of exposure. The wider issue is loss arising from an inability to obtain compensation from those causing damage (financial liability). This opinion also did not consider the position of a council's constituents.

The Far North District Council (FNDC) was interested to explore these outstanding issues and entered into correspondence with MFE when the ministry suggested that a further Crown Law opinion could be sought. We have obtained from the Council copies of its correspondence with MFE and this documents the exchange MFE undertook with FNDC prior to Crown Law being instructed. Disappointingly, the terms of reference eventually set by MFE for the opinion were very narrow. They did not address critical questions that have emerged following release of Crown Law's previous opinion and addressed only a small proportion of the concerns FNDC raised with MFE.

FNDC proposed to MFE on July 22nd 2004 the following as a part of any terms of reference for Crown Law:

> Would a district council, and/or its constituents, be reasonably assured of obtaining financial recompense were an activity involving the outdoor use of GMOs, that had been approved by ERMA, nonetheless cause:
> a) damage to individual trading activities;
> b) damage to the environment;
> c) damage to human health.

MFE instructed Crown Law to examine only whether liability for environmental damage was possible if a council did or did not include rules in a district plan to control GMOs.[146] The key differences between the two framings are as follows:

- MFE requested advice with respect to environmental damage alone, apparently ignoring economic loss and damage to human health.[147] Economic loss is a category of risk that has been amply demonstrated both overseas and in New Zealand;

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145 Crown Law opinion of 8 August 2003, provided to Ministry for the Environment, p.7.

146 MfE's instructions to Crown Law were to provide advice on the following questions:
"1. If a district council does not include rules in the district plan to control GMOs, what, if any, is the potential for liability for the council in respect of any environmental damage within the district arising from any GMOs that have been approved under HSNO by ERMA?
2. If a district council does include rules in the district plan to control GMOs, what, if any, is the potential for liability for the council in respect of any environmental damage within the district arising from any GMOs that have been approved under HSNO by ERMA?"

147 While it is conceivable that Crown Law means the term "environment" to also be inclusive of damage to human health and financial damage, no indication of a wider meaning is contained in the opinion, such as mention of the ACC Act in respect of human health, and we take it that this was not intended.

- The terms of reference are limited to the liability of councils alone. The risks to the council's constituents are not explored;

- The terms of reference are limited to legal liability and the key issue of financial liability is not explored. That is, the question of who pays for any cleanup that may be required. This issue can overlap with legal liability but is often separate as it can arise quite independently.

By circumscribing the terms of reference to exclude many of the most important sources of financial risk, MFE obtained an opinion[148] that may at first sight be interpreted as indicating that there are no serious risks for a council when it indicates instead simply a poverty of scope of analysis.

The following table illustrates the six types of financial exposures communities face with respect to a GMO release in absence of any local controls. Crown Law was asked to address the only one of the six for which there is unlikely to be an exposure.[149] This is indicated by the green shading, while red indicates exposures.

	Council held legally liable	**Council suffers losses**	**Individuals and Businesses suffer Losses**
Environmental Damage		Pays clean up costs	Pays clean up costs voluntarily
Financial Damage		Council trading activities	

It is also worth noting that when FNDC attempted to resolve matters by simply seeking an indemnity from the Crown that would cover any damages suffered, MFE made clear this would not be given.[150]

As a result of the exposures presented by the current law, LGNZ has stated that:

> Even if councils are consulted for a local perspective, local government is not a decision-maker in the approvals process and should not be held liable. A strict liability regime is supported for any physical harm, damage or loss caused by a genetically modified organism. This must be irrespective of whether the harm was caused under an ERMA approval (intended use) or otherwise.[151]

148 Crown Law (3 November 2004) *Advice on potential for council liability arising from rules controlling GMOs*.

149 There are also partial exposures to financial costs arising from any damage to human health to the extent these are not covered by ACC and that the scope of such coverage is uncertain. Note that the table does not consider non-financial damage, such as loss of biodiversity.

150 Personal communication, Pete Nuttall, FNDC, 16 November 2004.

151 LGNZ (2003) *Submission to Parliament with respect to the New Organisms and Other Matters Bill*, p. 8.

Liability Scenarios

In order to clarify the extent to which liability is allocated (or not allocated) for harm resulting from GMO activities, the following identifies a series of scenario events, any parties that are strictly liable, and the ultimate risk bearers.

Scenario Event	Parties Strictly Liable	Ultimate Risk Bearer
Unauthorised release – not ERMA approved (eg through imported seed contamination)	If unintended release, MAF tends to pick up most costs under Biosecurity Act, though the agent responsible also incurs costs. (If a deliberate release, agent faces all costs if can be identified)	Crown
Release conducted as Authorised by ERMA. Financial damage results (eg returns lost due to GMO contamination)	None	Farmers and other affected parties
Release conducted as Authorised by ERMA. Environmental damage results (eg superweeds needing to be controlled)	No liability under HSNO. Applicant may face RMA enforcement order for cleanup costs	Councils, farmers and other affected parties for financial losses beyond cleanup costs. If cleanup costs are not met (eg through the agent being unable to pay) affected parties may also carry these
Release conducted as Authorised by ERMA Damage to human health results (eg contamination of food crop by pharma crop)	No liability under HSNO	Farmers, food purchasers and other affected parties, including the Crown to the extent claims are accepted by ACC
Conditional Release not conducted as Authorised by ERMA and breach of controls causes damage	Applicant liable under HSNO to extent harm caused by breach	Applicant liable for the greater of: - up to $10m, - 10% of turnover, or - three times value of the commercial gain, to the extent funds are available. Affected parties must meet costs thereafter
Unconditional Release, or Field Trial not conducted as Authorised by ERMA, and causes damage	No liability under HSNO	Councils, farmers and/or other affected parties for financial losses beyond cleanup costs.

3.1.3 Identifying the Gaps

Economic Effects

The absence of any remedy for financial harm suffered by a constituent or a council trading activity when no ERMA condition has been breached is a serious gap in the HSNO regulatory framework. Conventional farmers who incur financial losses as a result of GMO contamination could launch a common law action but the ministry acknowledges these mechanisms are generally "inappropriate" and "have failed to manage pollution".[152] Crown Law states that "If the crop was ERMA approved and the person complied with all the conditions imposed by ERMA then it is unlikely that a claim in negligence would succeed".[153] While the RMA could potentially be used to halt a GMO activity causing harm if a breach of s17 were judged to have taken place, there appears to be very little prospect of redress for financial damage under the RMA if a council has not set in place its own regulatory framework for GMO activities.[154]

As described in section 2.3, claims for trace contamination can be very sizable. This is a prime concern in a number of other jurisdictions. In the United Kingdom, substantial scrutiny was given to the issue of whether or not to allow the release of GMOs during 2003. A Parliamentary select committee inquiry into one of a series of official reports generated that year offered the following conclusion with respect to liability issues:

> We are very concerned about possible contamination by gene-flow and pollen spread of non-GM crops and insist that the issue of liability be settled before any GM crops are allowed to be commercially grown in the UK. The Government should ensure, through primary legislation, if necessary, that it puts into place, before any GM crops may be grown commercially in this country, a clear and comprehensive liability regime to underpin any future regulations dealing with co-existence issues. Moreover, liability should lie with the industry and not with farmers. It would be wrong for the Government to allow farmers to be used as a firewall for the industry.[155]

While the UK Government has still to resolve this aspect of the regulatory regime, during December 2004 Germany advanced liability law reforms through the Bundestag. Confirmation of the law changes currently await a further level of approvals but its key features include:[156]

- It makes farmers using GM plants legally responsible for the contamination of non-GM crops;

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152 See previous reference to "inappropriate" and *Pollution and Hazardous Substances Management*, Final report of the Inter-agency Co-ordination Committee, Ministry for the Environment, November 1988, p. 94.

153 Crown Law (8 August 2003) Opinion provided to Ministry for the Environment, p. 7.

154 The use of RMA instruments to achieve financial accountability is discussed in section 4.3.

155 UK House of Commons Environmental Audit Committee (2004) *GM Foods —Evaluating the Farm Scale Trials*, Second Report of Session 2003 –04 Volume I, Executive Summary.

156 German Federal Ministry of Consumer Affairs, Food and Agriculture: "Information on the Amendment to Germany's Genetic Modification Act". See also *Bundestag Passes Stringent Law on Genetically Modified Crops*, Deutsche Welle, 18 June 2004, and *Grüne Gentechnik steht vor dem Aus*, Tagesspiegel, 6 July 2004.

- If the source of contamination of a conventional harvest cannot be pinpointed with sufficient certainty to a particular source, then joint and several liability will apply to the relevant GMO farmers;
- It limits the areas in which genetically modified plants can be grown in Germany;
- Requires a public register to be kept of GMO plantings; and
- Requires minimum distances be kept from non-GM fields and other measures to prevent the spread of pollen from GM plants.

In Australia, the need for reform of federal liability law has been advocated by Western Australia Agriculture Minister, Kim Chance.

> "[The Commonwealth Government is] saying you can rely, for most of the issues, on common law. It's currently hopeless … ."
> …
> "Until we have assurances that we have an adequate legal framework, no state jurisdiction is ever going to lift their moratorium," he said. … Queensland is the only state that does not have a moratorium in place on commercial GM food crops, with the other states and territories maintaining bans until at least next year.[157]

Health Effects

As noted above, regulating the production of GMOs in the outdoors is separate from assessing the safety of their consumption. However, trace contamination raises the issue of human health impacts through inadvertent consumption. Any claim for compensation would first need to negotiate the Accident Insurance Act 1998. Once a claim is accepted by ACC, section 394 of this act prohibits a private action being brought for damages in respect of personal injuries or death. Thus any provisions set for financial accountability by a local authority could provide only for claims not covered by ACC. However, the potential for local government to set provisions for health effects from trace contamination for food GMOs merits examination.

Environmental Effects

With respect to claims for environmental harm, these may or may not have financial consequences. Environmental damage nonetheless represents a cost to a local authority's territory, whether or not any financial loss is recorded in the council's or others' accounts. This cost may take the form of reduced future potentials or direct financial costs involving clean up or mitigation.

In principle, RMA section 314 provides strong powers to order cleanups for environmental damage caused. However, the effectiveness of these provisions is crucially dependent on the availability of funding. Section 314 enforcement orders will not provide the discipline intended unless the GMO operator has sufficient funds at risk that can be drawn on. Local government is thus also exposed to the absence of a HSNO requirement for GM developers to be financially fit.

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157 Melbourne Age (15 9 2005), *GM crop contamination may spark review.*

As the Royal Commission noted, "The defendant may be a shell company without substantial assets, or may be insolvent."[158] The key risk here is that if the operator has inadequate financial resources to cover environmental damage resulting from its activities, the burden tends to fall on local government.

Local government has already encountered examples of operators leaving clean up costs in their wake for which no party can be held fully liable. It is particularly exposed with respect to contaminated sites. Sites contaminated with hazardous substances for which liability for cleanup has yet to be allocated are all too frequent in New Zealand. The total bill for clean up of these sites is unclear but in August 2004, MFE stated that the cost "is estimated to be in the order of a billion dollars".[159] In certain cases, government has contributed funds towards studies examining how clean up would be undertaken. However, to date it is local government that has been left with the responsibility in most cases. Significant Crown contributions to the clean up of the Mapua site have tended to be the exception in recent years[160] and there Tasman District Council still "assumed"[161] $2 million of the costs as a part of an agreement with the Government.

With respect to ratepayer costs of managing conventional organisms that have negative effects, a recent Biosecurity New Zealand report noted that:

> " … ratepayers contribute between $50 million and $60 million [a year] in funding towards regional pest management strategies, and private individuals and organisations spend further significant sums on biosecurity (reliable estimates are not available, but a previous study has estimated $180 million a year)." [162]

Only if a GMO is present in the outdoors illegally (without an ERMA approval) is MAF compelled under HSNO to undertake a cleanup – as in the case of contaminated maize seed that resulted in GMOs being released inadvertently.

3.1.4 Bonds

As discussed above, a GM developer or operator is not liable for harm caused as long as it obtains and abides by an ERMA consent. Nor does HSNO require ERMA to ensure that an applicant has the means to pay compensation. If an application is made under HSNO section 34 for unconditional release (that is, release without controls),[163] or for a field trial, ERMA has no legal means of imposing a bond or any other financial assurance requirement. Only if the application is made under HSNO section 38(A) for conditional release can ERMA impose financial assurance requirements (under section 38(D)).

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158 Royal Commission Report, p. 319.

159 MfE (2003) *The Contaminated Sites Remediation Fund: Guide to Regional Council Applicants*, p. 3; and MfE (1995) *Discussion document on proposals for law reform relating to contaminated sites*, section 3.5.

160 Treasury Estimates 2000, B.5 Vol. I, p. 508.

161 Personal communication: the term used by Dave Brash, Ministry for the Environment, 1 December 2004.

162 Biosecurity New Zealand (December 2004), *Future Funding of Biosecurity Services*, Discussion Paper No: 04/01, p. 5.

163 And this is approved under section 38(1).

Ideally, financial assurance requirements would provide for a range of instruments that could be drawn upon to set requirements appropriate to the risk of the activity and the financial status of the operator – including bonds and various forms of self-insurance and third party cover.[164] The Australian Gene Technology Act for example provides the regulator with the ability to require that an applicant has insurance in place.[165] Bonds at least were advocated by MfE as a condition of an ERMA approval at the time the HSNO Bill was being considered by a Parliamentary select committee in 1996.[166] ERMA itself also advocated the use of bonds to the Royal Commission on Genetic Modification.[167]

However, Government accepted officials' poorly reasoned recommendation that ERMA not be required to consider whether to take even a bond from an applicant.

> "Requiring the Environmental Risk Management Authority (ERMA) to consider imposing insurance or bond requirements, as a condition of approving release of a new organism to address liability concerns is not supported. Assessing when and how to use such discretion and the amount of any insurance or bond would, generally, be a highly speculative exercise. It would involve consideration of a range of difficult issues that ERMA may not be well placed to undertake. There is a risk that socially beneficial activities might be deterred and capital would be tied up when it could be put to more productive uses."[168]

When ERMA was asked by Environment Bay of Plenty whether it would be likely to require bonds of applicants, ERMA commented in a letter dated 26 January 2004 that:

> It is understood that ERMA New Zealand may be able to require a bond as a condition on approval, however this is not explicitly stated in the legislation and to date exercise of such a power has not been tested.

Given the stance taken by Government, ERMA's outlook, and the absence of any requirement for an applicant to declare its financial fitness,[169] there is little basis for expecting that ERMA will set meaningful financial assurance requirements.

Potential solutions to this issue of financial fitness and the others identified above are discussed in Section 4.3.

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164 For further discussion, see Chen Palmer & Partners and Simon Terry Associates (2001) *Who Bears the Risk.*

165 S62 of the Gene Technology Act

166 MfE's submission to the Royal Commission notes in para 104 that: "the departmental report recommended that eight changes be made. They are concerned: … that a power to require bonds as a condition of new organisms containment approval be created".

167 In its submission to the Royal Commission ERMA noted on page 31 that "using the precedent of the RMA it would be feasible to require operators to post a bond against the costs caused if adverse consequences arise from the improper application of controls".

168 Government Response to the Royal Commission on Genetic Modification: Legislative changes for New Organisms – Paper 5: Liability Issues for GM, Cabinet paper, February 2003, p. 5.

169 ERMA (2003) *Policy Guidelines for the Consideration of Conditional Release Approvals*.

3.2 Precaution

Policy set by a number of Northland Peninsula Councils places emphasis on a precautionary approach being taken with respect to the management of GMOs.

3.2.1 The Precautionary Principle[170]

Traditional risk assessment seeks to estimate the probability that certain defined risk events will come to pass and then make an assessment of the harm that is likely to result. This framework is heavily dependent on two factors.

1. That the scope of important risk events can be defined in advance.

2. That enough is known about the identified risk events to reliably predict the nature of adverse affects and the probability of these occurring.

Risk assessment is a powerful tool when there are known impacts and known probabilities. It is not suitable however for use in circumstances characterised by important unknowns. As many of the targets of environmental regulation have become more complex and less well understood, the limitations of this approach have increased. The precautionary principle is in essence the evolutionary answer to the need for an approach that better allows for the limitations of knowledge that regulators are increasingly confronted with.

The precautionary principle was devised essentially as a response to analysis of the long-run effects of certain substances and organisms that had demonstrated alarming adverse effects that were unforeseen when first approved.[171] Past surprises have included the effects from asbestos, X-rays, DDT and chlorofluorocarbons (CFCs).[172] A seminal work by the European Environment Agency (EEA) reviewed 14 of these unpleasant surprises. *The Precautionary Principle in the 20th Century* draws lessons for regulators from these case studies in support of adoption of the precautionary approach.[173] It describes the principle in the following terms.

> "The precautionary principle is an overarching framework of thinking that governs the use of foresight in situations characterised by uncertainty and ignorance and where there are potentially large costs to both regulatory action and inaction".

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170 Further discussion see: Simon Terry, *Precaution, Liability and the Regulation of GMOs*, Paper to the Biotechnology & Law Conference, 12 March 2004, which this subsection is based on.

171 See Parliamentary Commissioner for the Environment (2001) *Key Lessons from the Long History of Science and Technology: Knowns and Unknowns, Breakthroughs and Cautions*, and Theo Colborn, Dianne Dumanoski, and John Peterson Myers (1996) *Our Stolen Future*, Penguin Books.

172 The latter is a class of propellant formerly used in aerosol cans that came into widespread use in the 1950s with no recognition that these chemicals might cause damage to the ozone layer. This was in spite of a relatively good understanding at the time of the ozone layer and its function in shielding the earth from excessive UV radiation. Only in the 1970s did research first clearly show the link between the use of CFCs and the destruction of ozone in the upper atmosphere.

173 European Environment Agency (2002) *The Precautionary Principle in the 20th Century,* p216.

> "A central lesson … concerns the importance of recognising and fully understanding the nature and limitations of our knowledge. What is often referred to as 'uncertainty' actually hides important technical distinctions." [174]

A key distinction the EEA offers is between risk, uncertainty and ignorance:

- **Risk:** Known impacts, known probabilities
- **Uncertainty:** Known impacts, unknown probability
- **Ignorance:** Unknown impacts and therefore unknown probabilities.

HSNO governs only substances deemed to be potentially hazardous or which are new organisms - where new organisms as a class have shown the potential to be hazardous.[175] These classes of risk were specifically removed from coverage of more general environmental regulation under the RMA and set under special purpose legislation that makes use forbidden until individual assessment is completed and approval is forthcoming.

The nature of these classes of risk also means that assessments will more often involve areas characterised by uncertainty or ignorance. Thus, prima facie, one would expect precaution to be a fundamental guiding principle of HSNO.

The wording that has been the basis for most of the international agreements incorporating the precautionary principle in law is that established at the Rio Earth Summit in June 1992. Principle 15 of the Rio Declaration on Environment and Development, to which New Zealand is a signatory, sets out the following:

> "Where there are threats of serious or irreversible damage, lack of full scientific certainty shall not be used as a reason for postponing cost-effective measures to prevent environmental degradation."

3.2.2 Precaution and HSNO

However, HSNO does not embrace the precautionary principle, nor does it mandate that ERMA be precautionary. Instead, section 7 of the act specifies simply the following:

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174 Ibid, p. 187.

175 The Ministry for the Environment's extensive submission to the Royal Commission on genetic Modification documented the long gestation of the HSNO Act and the numerous practical instances of damage resulting from the introduction of new organisms through importation that led to new organisms in general being viewed as a special category of risk. "There were recent examples of new organism releases which had the potential for damaging consequences, and which pointed to deficiencies in the current controls on new organism imports. Examples which prompted such concerns were the introduction of chinchilla, Channel catfish brought in quarantine as part of an economic development scheme with Maori interests and then destroyed, and marron crayfish for which commercial breeding operations were established and then permission withdrawn requiring the destruction of the stock and a substantial compensation payment." Ministry for the Environment submission, p. 18.

> "All persons exercising functions, powers, and duties under this Act, ... shall **take into account the need for caution** in managing adverse effects where there is scientific and technical uncertainty about those effects. " [Emphasis added]

In *Bleakley v Environmental Risk Management Authority*, the High Court considered whether the Act and the ERMA Methodology provide any requirement on the part of ERMA to observe the precautionary principle. The Court did not accept submissions of the appellants that section 7 embraced the precautionary principle, partly as a result of the Court's reading of the parliamentary debates prior to HSNO's enactment.[176]

As the regulator responsible for implementing HSNO, ERMA itself has stated that:

> "The wording in the Act is very permissive, such that **the Authority would be acting lawfully in deciding that caution was not warranted**, provided it explained why. In practice, the Authority has generally exercised caution." [177] [Emphasis added]

The important point of distinction here is not that ERMA is precluded from implementing the precautionary principle. HSNO grants ERMA relatively wide powers under section 38 1(b) to decline an application such that it is well within the scope of the act for ERMA to deliver precautionary outcomes, were it of a mind to do so.[178] The key point is that rather than precaution being mandatory, HSNO makes it a matter for ERMA's discretion – something to be "taken into account". Precaution is an option, not a requirement.

Detailed submissions have been made to both the Government and ERMA, pointing out the changed circumstances since the passage of HSNO in 1996, especially the wider adoption of the precautionary principle (internationally and in New Zealand Government policy), and the need to revise HSNO accordingly.[179] However, neither has recommended doing so. Nor has the Government's ratification of the UN Cartagena Protocol prompted any review of HSNO with respect to the act's stance on precaution, despite the international protocol's precautionary intent.[180]

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176 *Bleakley v Environmental Risk Management Authority,* 2001 3 NZLR 213 (HC), p.250; paras 160 - 164, McGechan J.

177 ERMA (2002) *Approach to Risk*, p. 3.

178 The extent to which ERMA has the means to deliver precautionary outcomes is usefully explored in Approaches to Risk, ERMA, December 2002.

179 *Departmental Report on New Organisms and Other Matters Bill,* 12 August 2003, pp. 182-185.

180 The Cartagena Protocol on Biosafety 2000 regulates the transboundary movements of modified organisms that are live, and thus capable of reproduction. New Zealand is a signatory to the protocol and Government ratified its commitment in February 2005. Article 1 of the protocol builds directly on the Rio Declaration definition and interprets the precautionary principle in Article 11.8 as follows: "Lack of scientific certainty due to insufficient relevant scientific information and knowledge regarding the extent of the potential adverse effects of a living modified organism on the conservation and sustainable use of biological diversity in the Party of import, taking also into account risks to human health, shall not prevent that Party from taking a decision, as appropriate, with regard to the import of that living modified organism intended for direct use as food or feed, or for processing, in order to avoid or minimize such potential adverse effects." A discussion paper on the question of whether New Zealand should ratify stated that: "New Zealand's regulatory system meets the current requirements of the Protocol for import of LMOs, so ratification would not be likely to lead to a need for any major changes, subject to future decisions made under the Protocol".

Further, it has been observed that the section of HSNO that would provide for the act to be used to support a precautionary approach, s7, appears not have been utilised:

> While it is still in its infancy, there is little evidence to date that decision makers have used this part of the Act.[181]

Finally, ERMA CEO Bas Walker has provided the following summary:

> The Act stops well short of adopting [the precautionary principle], instead talking about "taking account of the need for caution …". I believe Parliament had reason to stop at that point and the Authority has had considerable reservations about going further as well, in part because the "precautionary principle" is so open to varying interpretations. Parliament has had multiple opportunities to tighten the wording, the latest being in October 2003, but has chosen not to do so. That is surely significant.[182]

These positions also need to be taken into account when assessing the likelihood of ERMA adopting precaution in its assessments and the degree to which it is likely to require precaution from applicants when making use of GMOs.

3.3 Accountability and the Role of Local Government

3.3.1 Accountability

A key issue in assessing the risk to a council of an ERMA decision overriding locally determined policy is the nature of the ERMA decision-making process and the limited extent to which a decision can be subsequently challenged.

HSNO provides wide scope for ERMA to assess applications for release such that the outcomes it delivers depend a great deal on the individuals making the assessments. There is the potential to manage more cautiously or less cautiously within the legal framework of the Act. While the act is highly prescriptive in respect of procedural matters, there are remarkably few constraints with respect to how assessments are to be conducted.

The act and the ERMA methodology that derives from it make many important features discretionary. The methodology does not actually set up any precise method or process by which analysis must take place. It has more the form of a checklist of considerations. Those sections that focus on the actual evaluation generally demand of ERMA only that it "take into account" and "consider" a variety of matters.[183]

MFAT (June 2004) *Public Discussion Paper – Cartagena Protocol on Biosafety: Consideration of New Zealand Decision on Ratification.*

181 Michael Harte and Janet Gough. "Sustainability, uncertainty and environmental policy: Lessons from New Zealand's pastoral high country". In: J W Handmer, T W Norton and S R Dovers (2001) *Ecology, Uncertainty and Politics: managing ecosystems for sustainability,* p. 183.

182 Bas Walker in a letter to the Sustainability Council, 21 May 2004, p. 2.

183 The notable exception is section 36. This requires that if a release would be "likely" to cause "significant" harm to the environment or human health, it may not be made. As it is difficult to imagine responsible decision-makers approving a release which they thought at the time was likely to cause significant harm, it is also difficult to view this as a strong bottom line.

There are thus remarkably few limitations on the outcomes ERMA can deliver.[184] This wide discretion given to ERMA results in an absence of meaningful accountability at the time an application is being considered.

At the point ERMA issues a decision, there is no ability to appeal an ERMA decision, other than on points of law. Such judicial review can focus only on the process used to make the decision, not the quality of the information relied on or decisions made, nor the weightings accorded particular considerations. As the HSNO Act and the Methodology in general demands of ERMA only that matters are "taken into account", the scope for effective scrutiny is very limited.

Parliament noted when first passing HSNO that public policy generally dictates there should be one right of appeal from the decision of a quasi-judicial body, but elected not to allow this on the grounds that this would not provide for "a better decision" second time around.[185] Absence of the right to appeal HSNO decisions to the Environment Court (as is available for RMA decisions), significantly limits the ability to ensure a consistent approach with respect to the application of precaution. For local government, it underscores the inability to rely on the HSNO process to deliver outcomes set by the community.

3.3.2 GMOs and the Role of Local Government]

Local Government New Zealand offered the following comments with respect to the ability of the current HSNO legislation to provide for councils to exercise their statutory responsibilities on behalf of their communities.

> Local authorities are to work with local communities towards achieving sustainable development. This means councils will be facilitating the development of Long Term Council Community Plans, in which outcomes for an area are described and the role of council in delivering or enabling the achievement of those outcomes are identified. **We do not believe that the responsibilities given to local government under the LGA have been fully recognised in [HSNO]**. [Emphasis added]
>
> Local authorities have been clear about their desire to have a strong "voice" in the making of decisions about the release/non release of GMOs … .[186]

Dr Somerville noted in this respect that:

> The people of the district may perceive that to sustain the principal uses of rural land in the district depends on avoiding or managing environmental risks associated with GMO-related activities. This may be considered in order to promote a number of values within the purpose provisions of the statutes, ranging from socio-economic, cultural, health and safety values to concerns about the biophysical environment, for example, biological diversity.[187]

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184 See Sustainability Council (October 2003) *Submission in Respect of Revisions to the ERMA Methodology*.

185 Hon Simon Upton, Hansard, 16 April 1996, at pp. 11901-11902

186 LGNZ (2003) *Submission to Parliament with respect to the New Organisms and Other Matters Bill*, p. 5 and 7.

187 Dr R J Somerville QC (2004) *Opinion on Land Use Controls and GMOs*, p. 10.

LGNZ further comments that:

> It is not apparent how the management framework outlined within [HSNO] will allow communities to preserve the opportunities they have identified, and agreed to pursue, as part of their own strategic goals. For example, a district (or a grower association) may wish to brand and market its grapes, wine, oranges, apples, lamb, milk, cut flowers or other crop or produce as GE Free.[188]

HSNO provides for ERMA to notify local government of applications for GM activities that it considers are likely to be of interest.[189] However, ERMA is under no greater duty to take into account submissions of district and regional councils in its decision-making than those of any other submitter.

The absence of provisions that would compel ERMA to accommodate the positions of communities thus leaves local government unable to give surety to their communities that HSNO decisions will not override outcomes they have determined they wish to see. Further, there are at least two matters – liability and precaution - on which local government would tend to seek outcomes that it is far from clear ERMA would deliver under current policy settings.

At the highest level, the key problem for local government can be viewed as a lack of surety of outcome. The uncertainty is on two levels:

> a) Whether ERMA will agree with and act at all on specific concerns that may be held by local governments;
>
> b) Whether, for the risks ERMA concurs need addressing, it will exercises the same degree of caution as would local governments.

188 LGNZ (2003) *Submission to Parliament with respect to the New Organisms and Other Matters Bill*, p. 8.

189 Section 53(4) provides only that: 53 (4) The Authority shall, upon receipt of the application, notify …
(c) If the application is an application for approval of a new organism,—
(ii) any local authority (within the meaning of the Local Government Act 2002) if, in the opinion of the Authority, the local authority is likely to have an interest in the application.

4. The RMA as a Response Framework

4.1 Macro Response Options

In broad terms, there are three macro level policy options councils could adopt in response to the risks posed by outdoor GMO activities and deficiencies in the regulations set at the national level:

a) District councils attempt to foster a change in national law;
b) District councils set local management regimes that act in addition to national level regulation; and
c) No intervention by district councils.

4.1.1 Amendment of HSNO

Amendment of the HSNO Act to remedy its deficiencies would be the most efficient response. However, this would require Government support and proposals to amend HSNO to put comprehensive remedies in place have consistently not been accepted.[190]

A more limited reform proposal would involve amendments to remedy the deficiencies simply from a local government perspective. In particular, amendments to HSNO could be made so as to provide councils with the ability to ensure that their policies in relation to GMO activities are binding on ERMA decision-making. This would provide a simpler means for local government to achieve the same regulatory outcomes as are currently able to be put in place under the RMA. Reform to HSNO would need to be made on two levels and provide for:

- The ability for local authorities to issue policy statements on GM activities such that ERMA would be required to accommodate these policy statements in its decisions;

- The option to examine individual applications in tandem with ERMA assessments and, if required, to set stricter controls to apply within a local authority's district.

190 MfE's report on the submissions to the select committee which considered the extensive amendments to HSNO enacted in 2003 concluded for example that no changes were required to address liability for an ERMA approved activity. It stated on p 144 that: "[…] imposing strict liability for all GM activities, including those that comply with HSNO, is not supported as to do so would be inconsistent with the conclusion that there is no principled basis for special liability rules for GM activities." Further, the ERMA Review undertaken for Government in early 2003 explicitly considered reforms to the ERMA Methodology with respect to accountability and received submissions in support of reforms designed to enhance this. Proposals for enhanced accountability were not accepted. See also the report of the Royal Commission on Genetic Modification and the Government's responses to this in respect of scientific uncertainty and the precautionary principle.

Local authorities would thus have the opportunity, but not the obligation, to work in tandem with ERMA. The reforms would provide a more direct means of achieving the desired outcomes set by a community, while also giving an explicit statutory route and greater certainty to ERMA applicants.

Proposals for such reform were detailed in a report to Northland district councils in March 2004.[191] Responses from the Minister for the Environment, Marian Hobbs, to this report provided no indication that government saw grounds for such a change to HSNO. When commenting on the report, the minister instead emphasised the robustness she perceived in the existing processes. However, she fully contemplated the independent emergence of local government regulation targeting GMOs and stated that, "council's controls will have to be science-based and effects-based, just like those of the Environmental Risk Management Authority …"[192]

An amendment to HSNO that would address key local government concerns thus remains an unlikely prospect and an unreliable response option. When assessing the likelihood of a change in this position, it is important to consider that Government has a dual role as not only the agent responsible for setting policy on the means to be used to mitigate risk attendant to GMOs, but is also the nation's largest investor in R&D involving genetic modification intended for commercial development.

4.1.2 Local Management or No Intervention?

If significant deficiencies exist in the national regulatory structure and Government has consistently determined not to remedy these, what then is the fall back position for local government? Is it then optimal for local government to intervene? This is essentially a test of whether, given the nature and scale of the potential exposures, the cost of intervention is justified by the benefits gained through avoidance of identified risks.

The balance of this report focuses on the options for intervention that could be exercised so as to build on the existing national level regulation and check gaps that impact at the local level, rather than attempting to replace the ERMA assessment process. Following discussion of these options, Section 6.2 specifically addresses the question of whether to intervene at all.

The schematic on the following page shows where this stage of work sits with respect to the investigations to date and the steps required before a decision could be taken to approve a plan change.

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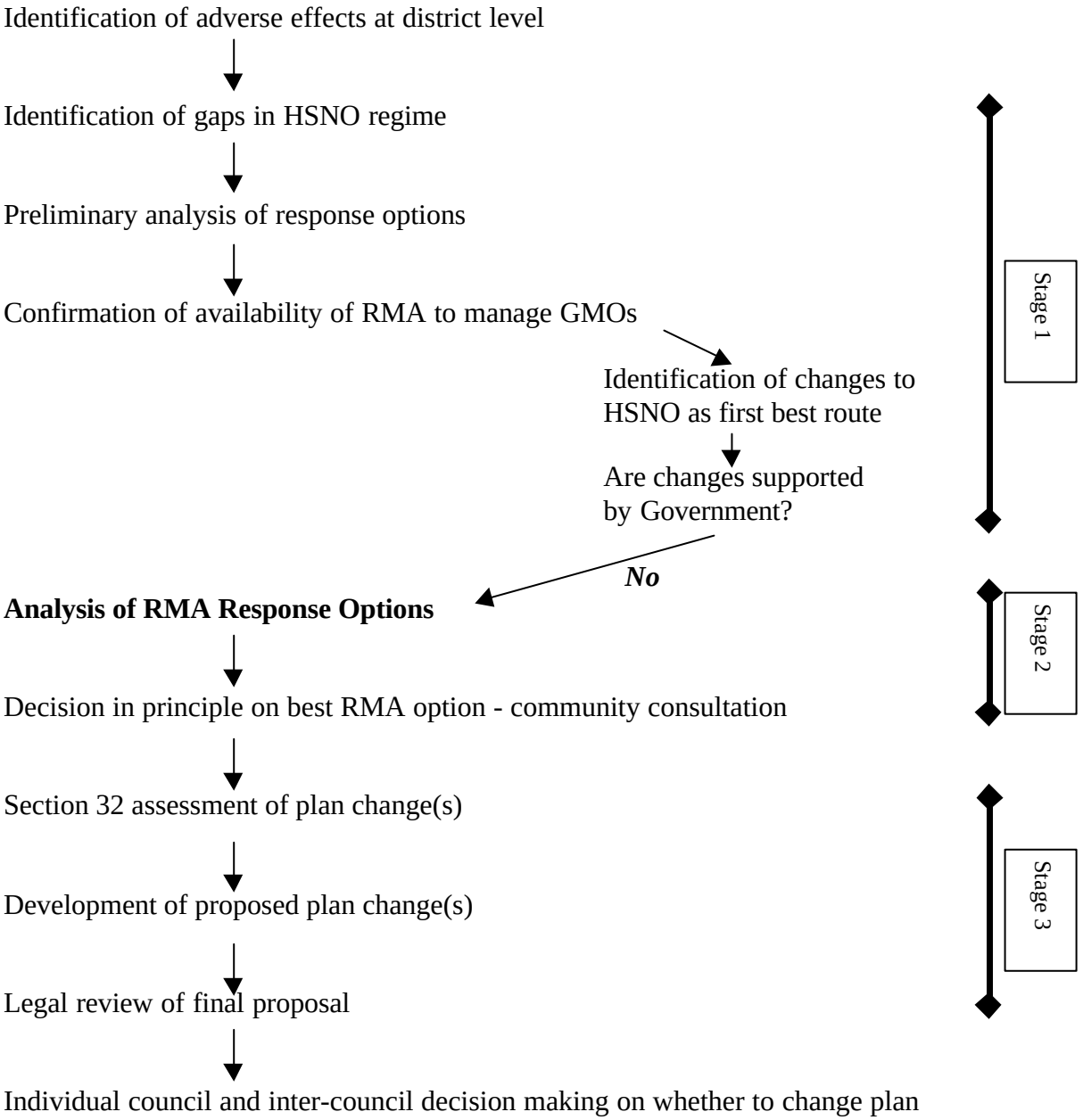
191 Simon Terry Associates (2004) *Community Management of GMOs: Issues, Options and Partnership with Government*, pp.33-40.

192 Statement to Parliament by Marian Hobbs in response to a question for oral answer on 24 March 2004, and *Government doubts councils' right to control GMOs*, Northern Advocate, 26.03.2004.

Decision Making Steps and Stages

(Current step highlighted in bold)



4.2 Availability of the RMA for GMO Management

Given the nature of the gaps identified in the national regulatory regime, the GMO activities of concern, and the statutory powers available to local government, the RMA emerges as the best statutory framework within which to address these deficiencies. It allows precisely targeted rules to be set under a district plan so that specific concerns can be addressed without compromising other activities. Further, a

district plan is the principal statutory instrument designed to regulate land uses and thus encompasses the outdoor uses of GMOs under consideration.[193] The availability of the RMA for use by councils to manage GMO activities was a matter considered in detail by Dr Somerville in March 2004 and his conclusion that district councils have jurisdiction in this regard has also been the interpretation offered by Crown Law opinions.[194]

Although HSNO was passed subsequent to the RMA, and focuses directly on GMOs, it does not extinguish the RMA provisions and these remain open for local authorities to use. Dr Somerville states that:

> I am of the opinion that the provisions of the HSNO Act do not preclude the WDC from exercising its jurisdiction to control GMO-related land uses within its district plan pursuant to the RMA.[195]

If a council wished to implement a framework for community management of GMOs under the RMA, this would ultimately involve a change to its district plan. This is the mechanism by which new rules would be added, following development of specific objectives and policies. It is imperative to ensure that any controls adopted should be firmly based on a robust identification of the issues and appropriately drafted objectives and policies. Much of this report is dedicated to providing clarity with respect to the issues associated with community management of GMO's and the options for rule based control. It ultimately represents the basis for a section 32 justification for the adoption of a proactive approach to the management of GMO's via a District Plan.

Section 75 of the RMA specifies the contents of District Plans. This section is prescriptive and requires that Plans state:

- The significant resource management issues of the district;
- The resource management objectives sought to be achieved by the Plan;
- Policies in regard to the issues and objectives;
- The methods to be used to implement these policies, including any rules;
- The principal reasons for adopting all of the foregoing;
- Information required to be submitted as part of any resource consent application;
- The environmental results anticipated from the implementation of the foregoing; and
- Procedures necessary for reviewing and monitoring the effectiveness of the matters in question.

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193 For further discussion, see Simon Terry Associates (2004) *Community Management of GMOs: Issues, Options and Partnership with Government*, section 4.2.

194 Ibid and Crown Law (3 November 2004) *Advice on potential for council liability arising from rules controlling GMOs*. . Crown Law does however question whether a s32 analysis would support the use of such powers and this position is critiqued in detail in the earlier report - *Community Management of GMOs: Issues, Options and Partnership with Government, p 30-32*.

195 Dr R J Somerville QC (2004) *Opinion on Land Use Controls and GMOs*, p. 20 and 22.

This section of the Act guides the structure and ultimate content of the approach necessary to include controls over GMO's.

In moving forward, it is envisaged that the matters set out within this report would be distilled into a broad statement of the issues that are relevant and the reasons justifying District Plan based management of these issues. Under this scenario, we envisage that objectives and ensuing policies would be crafted to address issues of risk inherent in outdoor GMO activities in the district, and would specify the appropriate management framework for addressing the various levels of risk identified with different classes of GMOs. As outlined in the following sections, a range of options is available to councils for managing the risks and the preferred approach would need to be identified and addressed at the policy level within the respective District Plans. If it is ultimately accepted that there is a justification for District Plan control, based on economic risk, environmental risk, cultural risk and issues surrounding liability and compensation, then this would need to be incorporated within appropriate statements of policy.

Such policy would also foreshadow the methods that are proposed for implementation within the respective District Plans.[196] Section 77B of the RMA sets out types of activities for which rules can be drafted within District Plans. In terms of this section of the Act, activities can be permitted, controlled, restricted discretionary, discretionary, non-complying or prohibited activity status.

Permitted activities are precisely that - activities for which a resource consent is not required if it complies with the standards, terms or conditions, (if any,) specified in the plan or proposed plan.

A controlled activity requires a resource consent but the consent authority has no power to decline consent. The consent authority is able however, to impose conditions on the consent, just so long as the conditions relate to matters over which the consent authority has retained control in the plan.

A resource consent is also required for a restricted discretionary and a discretionary activity. The consent authority may grant a resource consent with or without conditions, or decline the resource consent. If the plan restricts the matters over which the consent authority may exercise its discretion, any conditions imposed must be restricted to matters that have been specified within the plan. A council's substantive decision whether to decline or grant a consent is also confined to these restricted matters.

A resource consent is also required for a non-complying activity. The consent authority may grant the resource consent with or without conditions, or decline it. Particular restrictions for non-complying activities are set out in Section 105D.

No application may be made for a prohibited activity and a resource consent cannot be granted for such activities.

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196 Section 76 enables a territorial authority to include rules in a District Plan for achieving the objectives and policies of the Plan.

Before looking at the question of which of these methods will be most appropriate to manage particular GMO activities, the following subsections examine two high level considerations:

- The extent to which the RMA can provide for financial accountability; and
- The extent to which a precautionary approach is available under the RMA.

4.3 Instruments for Financial Accountability

4.3.1 Duty of Care

An important gap identified in the HSNO regime is the absence of arrangements to ensure GMO users are financially accountable for their activities. As described in Section 3.1, there is no liability under HSNO for damage arising from an activity carried out in accordance with an ERMA approval.

As also noted above, MfE directed Crown Law to address just one of six types of financial exposure a community faces as a result of any GMO release. The opinion is correspondingly limited in its utility.

Councils have a duty of care that extends well beyond the question of its legal liability for environmental damage – the single issue Crown Law was directed to. They are accountable to their communities for the wise management of council funds more generally, and to provide due protection for constituents against threats to their financial resources. A council's exposure to paying for clean-up costs and constituents' exposure to financial losses arising from GM contamination are key foreseeable risks.

An example of the extent to which a council can legally be expected to take into account potential effects was provided by a judgement involving a case between the Ports of Auckland and Auckland City Council. The port company argued that in granting a consent for a residential development near the port, the council should have imposed noise insulation conditions so as to protect the port company from a court action by future residents. The court supported the port company's argument and required the council to redraft the conditions of the consent.[197]

The RMA contains a series of provisions that can be used to put in place instruments to address adverse financial effects of GMO activities. When applied as part of a full set of controls, these can be used to address a significant portion of the forms of financial exposure GMO activities can generate.

4.3.2 Setting Conditions

A GMO operator could become legally responsible in certain cases even if no specific conditions are set on the activity. This would be due to a breach of the general duty to avoid, remedy or mitigate any adverse effect on the environment that is imposed

[197] Ports of Auckland v Auckland City Council, 1999, NZLR 600, Baragwanath J. See also Auckland Regional Council v Auckland City Council, 1997, NZRMA 205, Judge Shepard.

under s17 of the RMA.[198] However, s17(2) makes clear that it will provide only limited financial accountability as "no person is liable to any other person for a breach of that duty".[199]

Partly for this reason, it will be desirable to set conditions that address the key sources of risk so that when adverse effects arise - ones that a council has determined need to be protected against - these will (as far as is foreseeable) be a breach of the conditions and an immediate trigger for actions that remedy and mitigate adverse effects. Section 108 provides wide discretion for a consent authority to set the conditions it deems necessary. Such conditions will tend to be similar within classes of GMOs, with variations to account for particular GMO varieties.

4.3.3 Bonds

If a condition is breached and damage occurs, the question then is how to ensure sufficient funds are available to meet the financial costs. A further instrument available under the RMA is the ability to require a bond from an applicant. Section 108A affords wide powers in this respect and provides in particular that a bond may:

- be set to cover any "conditions the consent authority considers appropriate" (108A(1))
- "continue after the expiry of the resource consent to secure the ongoing performance of conditions relating to long-term effects" (108A(1))
- "provide that the liability of the holder of the resource consent be not limited to the amount of the bond" (108A(2)(c))
- "require the holder of the resource consent to provide such security as the consent authority thinks fit for the performance of any condition of the bond" (108A(2)(e))
- "require the holder of the resource consent to provide a guarantor" (108A(2)(f))

Section 108A(3) also recognises that environmental effects may only become apparent long after the activity has ceased.

> If a consent authority considers that an adverse effect may continue or arise at any time after the expiration of a resource consent granted by it, the consent authority may require that a bond continue for a specified period that the consent authority thinks fit.

It is clear that well framed consent conditions and bond provisions can provide for a very high level of financial accountability for ecological effects. The above powers

198 Crown Law opinion entitled: *Advice on potential for council liability arising from rules controlling GMOs*, 3 November 2004, p. 2.

199 RMA s17(2) provides that "The duty referred to in subsection (1) is not of itself enforceable against any person, and no person is liable to any other person for a breach of that duty".

address the long timeframes[200] and wide range of conditions that could be required to guard against such potential effects resulting from a GMO release. Procedures can be devised and put in place at the time of any plan change to guide the proper assessment of the level of bond required and the period for which it is to be in place.

Bonds can cover both foreseeable and unforeseeable causes of damage. Thus they could be drawn on to pay for foreseeable damage such as the eradication and clean up costs of a GM crop cross-pollinating with a neighbouring farmer's conventional crop. What is not clear is whether the bond provisions can also be framed to provide compensation to that farmer for financial losses suffered if the GM contaminated crop is rejected in the market, or the harvest value is lower.

4.3.4 Enforcement Orders

Consent conditions can nonetheless be set to guard against financial damage, and any breach of these can trigger a further important RMA instrument - an enforcement order under s314.[201] Such an order can provide for payment of monies for "any actual and reasonable costs and expenses which that other person has incurred or is likely to incur in avoiding, remedying, or mitigating any adverse effect on the environment" as a result of a breach.[202]

Whether an enforcement order can be used to recover financial damages is however also unclear. The RMA definition of "environment"[203] is inclusive of economic conditions which affect not only natural and physical resources but also all people and communities, and this provides a good base for the proposition that the terms "remedy" and "mitigate" should cover financial losses as well as environmental damage. However, we are not aware of case law on this point and further investigation would be required to develop the proposition.

Any person can apply to the Environment Court for an enforcement order.[204] If such an order were to cover adverse financial effects resulting from the breach of a condition, this would open the way for affected landowners to gain redress.[205] For if the Environment Court supports an application, it then has wide powers to instruct

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200 The Royal Commission notes that: "The effects of genetic modification are expected to be likely to manifest only in the long term". Royal Commission report, p. 311.

201 This is quite separate from an enforcement order under the Biosecurity Act that would be used to remedy a breach of border regulations, as opposed to the effects of an authorised release.

202 RMA s314(1)(d).

203 The term "Environment" is defined under s2 to include:
(a) Ecosystems and their constituent parts, including people and communities; and
(b) All natural and physical resources; and
(c) Amenity values; and
(d) The social, economic, aesthetic, and cultural conditions which affect the matters stated in paragraphs (a) to (c) of this definition or which are affected by those matters.

204 RMA s316.

205 The extent to which costs incurred as a result of damage to human health can also be recovered would be influenced firstly by the extent to which ACC accepts a claim and then by this question of interpretation.

actions to be taken to "avoid, remedy or mitigate", including the payment of monies to affected parties.[206]

A key question that arises if the financial damage were serious is whether the Court would order payment to be made from a bond taken to secure performance of conditions set to protect against ecological harm. In absence of such an order, or if it were to eventuate that neither bonds nor enforcement orders were able to be used to sufficiently protect against financial damages, there is a significant risk that damage of any serious scale will not be paid for by the consent holder. GMO operators would then have the incentive to use a commercial vehicle that was itself of little realisable value[207] and serious claims against it would leave a deficit. In this case, unless the council or the Government volunteered funds, the losses would lie where they fell - with innocent individuals and businesses.

4.3.5 Opportunity Costs

One type of loss it seems very unlikely RMA instruments would cover is costs that are not actually suffered, but involve the loss of anticipated future earnings. Such opportunity costs may take the form of a non-GM farmer who suffers GM contamination in one year, losing a premium contract for future years due to buyer concern that contamination will recur. At the district-wide level, such contamination incidents could take the form of a lost ability for non-GM farmers to access markets that require surety of the absence of trace contamination. The latter effect could also potentially be felt as a reduction in the brand value of the district/peninsula.

4.3.6 Financial Contributions and Monitoring

Where there is clearer scope for financial effects to be provided for alongside environmental effects is through financial contributions.[208] A traditional motivation for their use is if there are adverse effects that are fully anticipated and can not be avoided, remedied or completely mitigated and financial contributions are paid to a local authority as an offset to secure a consent. Such an approach would not however cover many of the potential effects of greatest concern as these are uncertain in their scope and scale, and thus not readily subject to pre-estimation. (Non-traditional uses of financial contributions may be able to be used to greater success but this would require further investigation.)

More clearly applicable however is the use of financial contributions to cover a council's monitoring obligations under RMA.[209] Sections 35(2)(d) and (e) set an obligation to monitor as follows:

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206 As noted in Section 3.1, there is also the option of utilising common law tort actions. That section also notes the significant limitations on these.

207 Not withstanding the bond requirements in respect of ecological effects.

208 Provided for under RMA s108(1)(a).

209 Provided for under RMA s108A(1)(c).

> (2) Every local authority shall monitor—
> …
> (d) The exercise of the resource consents that have effect in its region or district, as the case may be,—
> (e) and take appropriate action (having regard to the methods available to it under this Act) where this is shown to be necessary.

When preparing a specific chapter in a district plan to cover GMO-related land uses, it would be necessary to include in the objectives and polices, the purposes of any financial contributions. In the methods, it would be necessary not only to categorise the activity status of such land uses, but also to have rules in relation to adverse effects.

4.3.7 Conclusion

A very high level of financial accountability for ecological effects could be achieved through the use of well framed consent conditions and bond provisions. Conditions can also be set with a view to avoiding or mitigating adverse effects, including economic damage. What is unclear at this stage is the RMA's ability to provide for the recovery of economic losses.

Given a district council's general duties of care for its financial position and that of its constituents, the overt nature of the gaps in the national law, and the extent of harm that GMO activities could cause, there is a ready justification for setting mandatory conditions on any GMO activity such that there is financial accountability for adverse ecological effects. There is a clear legal pathway for this and the resources required by councils to collectively establish and administer such provisions appear quite reasonable when measured against the scale of potential damage. Similarly, there are good grounds to establish consent conditions to avoid or mitigate economic damage. The extent to which provisions would also be set to cover financial losses is a matter for further investigation.

A related consideration is the s35 duty to monitor. In light of the extent of community concern evidenced through relevant hearings in the Northland peninsula, an absence of monitoring would set up an exposure for the relevant councils with respect to their s35 duties. ERMA is not required to make monitoring a condition of any approval it may grant for a GMO activity and has to date very rarely set monitoring requirements. Further, even if ERMA were to require this of an applicant, monitoring may not take place within the district in question, or may not cover all the effects of interest to a particular TLA. Monitoring can be expensive and if a council wishes for this to be paid for by the GMO operator, it will need to make this a consent condition, which will in turn require a district plan change to bring GMO activities in under the plan.

The above represents a strong case for a minimum level of joint council intervention. (A preliminary comparison of the costs and benefits of this action is discussed in Section 6.2.) If this conclusion is accepted, then any outdoor GMO activity in the district would need to obtain a consent if it were not prohibited. All would be subject to at least: provisions for financial accountability in respect of ecological effects, consent conditions to avoid or mitigate economic damage, and a requirement for financial contributions for monitoring.

4.4 RMA and Precaution

4.41 If Additional Controls Are Insufficient

In addition to the issue of financial accountability, a second and deeper deficiency identified in the GMO regulatory regime is the absence of a requirement under HSNO for activities to be assessed in line with the precautionary principle. As discussed in Section 3.2, there is certainly scope under HSNO for ERMA to deliver outcomes fully consistent with the precautionary principle. However there is no requirement to do so. This gap opens up two general forms of concern:

> a) That ERMA could demonstrate an approach with respect to certain aspects of risk assessment (or a particular application) that is distinctly less risk-averse than that held by a council and its community.
>
> b) That ERMA could demonstrate an across-the-board approach to risk that is distinctly less risk-averse than that held by a council and its community.

With respect to the first, there may be certain aspects of risk assessment that a TLA wishes to set rules for to provide assurance that community-determined policies will not be breached through the absence of controls at the national level. The following are examples of controls councils could set that would be new and additional to ERMA controls, or which could enhance any ERMA had put in place:

- Research prior to undertaking the outdoor GM activity to characterise and test a GMO. Such research may be needed to rule out certain adverse effects and/or to allow controls to be devised to avoid, remedy or mitigate identified potential effects;
- Prior research into particular effects having been completed and having raised no significant causes for concern. (This may include prior research under New Zealand conditions, or research into the effects within a particular ecosystem or locality within New Zealand);
- Ongoing research and monitoring of effects when the activity is undertaken within the district. This would allow for adaptive management whereby controls to address previously unidentified effects could be specified as they appear;
- Areas within which the activity is to be confined, including minimum distances from other non-GM or GM plants or animals;
- Times of year the activity is restricted to;
- Consent/Agreement from neighbouring or potentially affected parties.

Minimum standards can be set for certain controls (including any of those above), with others subject to individual assessment and condition setting.

With respect to the second general case identified above (ERMA demonstrates an across-the-board approach to risk that is distinctly less risk-averse than a council and its community), this can also be addressed to an extent by adding new conditions. However it raises the question of whether a community will judge the risks associated with certain classes of GMOs to be sufficiently great that it would seek to prohibit classes of activities, and the extent to which the RMA can be used to support this.

4.4.2 Availability of a Precautionary Approach

When considering the RMA, the courts have ruled that a precautionary approach is inherent in the Act. An extensive review of the requirements of the act with respect to precaution is provided in *Shirley Primary School v Telecom Mobile* and the following is stated by the Environment Court.[210]

- "The Resource Management Act was precautionary and thus justified a precautionary approach. Such an approach was inherent in the Act – in particular in s 3(f)."

- Section 3(f) is considered to be "precisely what the precautionary approach is about". Section 3(f) states that the term "effect" includes: "Any potential effect of low probability which has a high potential impact."

- The precautionary principle "should be recognised as a restatement of s 3(f) and the precautionary approach". It is not considered separately in making rulings for this reason.

- "We consider the effect of s 3, especially 3(f), is that the court is required to evaluate beyond the balance of probabilities (i.e., 50-50) where the risk (even if low) is of high potential impact."[211]

As Dr Somerville notes, in *Golden Bay Marine Farmers v Tasman District Council*, the Environment Court ruled that a precautionary approach may be applied:

(a) through the application of and analysis of the factual evidence under the provisions of s.3 RMA, particularly s.3(f) – that regard be had "*to potential effects of low probability but high potential impact*";
(b) after findings of fact are made, a precautionary approach may be inbuilt into the various relative provisions of the plan – objectives, policies, rules, methods, etc; [212]

As discussed in Section 3.2, traditional risk assessment relies on an ability to identify the nature of risk events and their probability to adequately regulate for them. Some of the potential effects will be known to a reasonable degree. However, the extent to which the probability of the risk occurring is unknown, or both the nature and the probability of the risk are unknown, is quite significant in relation to GMO release. In other words, in many cases regulators are left at best with uncertainty as to what may be the effects (probabilities unknown), or simply ignorance (if neither the nature of

210 *Shirley Primary School v Telecom Mobile Communications Ltd,* NZRMZ, 1999, paras 10, 221, 222 and 130 respectively. These interpretations were confirmed in *Clifford Bay Marine Farms Ltd v Marlborough District Council.*

211 By way of comparison, note that HSNO section 36 that sets minimum standards requires that an application not be "likely" to cause "significant" harm with respect to a range of environmental and human health concerns.

212 Dr R J Somerville QC (2004) *Opinion on Land Use Controls and GMOs*, p. 26, citing Environment Court W42/01, 27 April 2001, p. 76.

the risk or the probability is known). Risks are indeterminate if they are one of these two types.[213]

At this point, other approaches are useful in guiding decision making. It is in this context that the precautionary principle has evolved and offers assistance. The greater the extent of uncertainty or ignorance, the more one aspect of precautionary thinking comes into play. This is the involvement of those parties that are most directly affected by potential outcomes that can not readily be predicted. Two New Zealand writers in this field state:

> In many instances, it is argued, the existence of indeterminacy will mean that the expert should have no more privilege or standing than the lay person in the policy development process.
> [...]
> When faced with uncertainty and indeterminacy, science by itself can no longer guide policy makers.[214]

The RMA also embodies this approach of accrediting those who ultimately bear risk with the ability to define the risk parameters they as a community are most comfortable to adopt. Section 31 (b) sets a base for this by providing for "the control of any actual or **potential effects** of the use, development, or protection of land" [emphasis added]. Sections 3(e) and (f) further contribute to the ability to regulate for potential harm, with the definition of effects including:

> (e) Any potential effect of high probability; and
> (f) Any potential effect of low probability which has a high potential impact.

Section 32 4(b) provides a key additional precautionary element by specifying that an evaluation of any proposed change of plan must take into account the following:

> (b) the risk of acting or not acting if there is uncertain or insufficient information about the subject matter of the policies, rules, or other methods.

As Dr Somerville notes:

> The reference to "risk" in section 32(4)(b) in the context of uncertain or insufficient information would suggest a need to consider management steps which anticipate future adverse effects which cannot be quantified by a probabilistic risk analysis.[215] A precautionary risk management approach involves taking anticipatory measures and considering alternatives in light of potential significant or irreversible harm that could result from proceeding on the basis of uncertain and/or inadequate information.[216]

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213 Another set of terminology adopted in this area is to subdivide uncertainty into three types: statistical, model and fundamental. The "model" term is broadly equivalent to the EEA use of the term uncertainty while "fundamental" maps to the EEA term ignorance.

214 Michael Harte and Janet Gough. "Sustainability, uncertainty and environmental policy: Lessons from New Zealand's pastoral high country". In: J W Handmer, T W Norton and S R Dovers (2001) *Ecology, Uncertainty and Politics: managing ecosystems for sustainability,* p. 185.

215 Section 32(4)(b) is wider than the wording in section 7 of the HSNO Act which refers to scientific matters when taking a precautionary approach.

216 Dr R J Somerville QC (2004) *Opinion on Land Use Controls and GMOs*, p. 13.

Dr Somerville further states that a precautionary approach may be used as the root rationale for regulating GM activities within a district.

> A strong precautionary risk management approach available to the WDC is to implement a policy of establishing GMO-exclusion areas within which GMO-related land uses are prohibited.
>
> An alternative precautionary risk management approach which involves a policy of establishing a GMO-management area or areas within which GMO-related land uses are controlled by risk management methods including rules, while GMO-related land uses outside the management areas are prohibited, is also available to the WDC.[217]

A precedent for such embodiment of the precautionary principle into RMA plans has been established through variations to accommodate the aquaculture industry in Tasman and Golden Bays via the Tasman Coastal Plan, following an extensive Environment Court Inquiry.[218]

In summary, if a community undertakes investigations and analysis that leads it to conclude that a precautionary approach is warranted, it has the ability to deliver this outcome itself through use of the RMA.

4.5 Discretionary and Prohibited Activities

The RMA provides councils with a range of potential response options. The first option entails leaving the respective District Plans in their current state. From our analysis it seems that all of the plans in question permit activities unless they are otherwise controlled (which is the general presumption adopted in the RMA) This would mean that GMO activities would be permitted activities within each of the districts. As noted above, such an approach would leave unchecked a series of risks that could be addressed through instruments requiring in particular a significant degree of financial accountability on the part of the applicant, including effects resulting from unforeseen outcomes.

The option at the other extreme would be to prohibit all GMO activities in the respective districts. This option would rely on such activities being assigned prohibited activity status in each district plan.

Prohibited activities are rules in the plan that expressly prohibit in the district or in a given part of a district the activity subject to the rule. No application may be made for such activities, and no resource consent can be granted.

While the option to prohibit is clearly available where it can be demonstrated that there is just cause based on soundly identified risk, there is a clear warning against using this power improperly. In *New Zealand Mineral Industry Association and Chief Executive of the Ministry of Economic Development v the Thames Coromandel*

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217 Ibid, p. 27.

218 See decisions AP252/00, W19/2003, W10/2004, and W89/2004.

District Council[219] the Court reviewed the correct approach to a prohibited status under the Resource Management Act, and concluded that:

> it should only be used when the activity in question should not be contemplated in the relevant place under any circumstances.

The Court also warned against a plan change to prohibit an activity when in reality the consenting authority was simply trying to indicate a higher hurdle rather than an outright ban:

> Prohibiting an activity is a legitimate planning tool, but one to be used sparingly and in a precisely targeted way…..it is therefore a distinct exception to the permissive effects based philosophy of the Act as a whole. It is not, we think, legitimate to use the prohibited status as a de-facto but more complex version of a non complying status. In other words it is not legitimate to say that the term prohibited does not really mean forbidden, but rather that while the activity could not be undertaken as the plan stands, a plan change to permit it is, if not tacitly invited, certainly something that would be entertained.

Clearly adoption of prohibited activity status for any activity in a district needs to be soundly based. It could only be adopted for those GMO activities that entail inherent risk that is not tolerable for economic, environmental, social or cultural reasons. As is discussed further in Section 6, the degree to which this could be seen as appropriate will depend considerably on a communities' degree of aversion to risk.

However, it should be noted that prohibiting an activity does not necessarily preclude such activities from occurring for all time. The proponent of such an activity is always entitled (subject to the plan having been operative for at least 2 years) to promote a privately initiated plan change to enable the activity in question. Moreover, the prohibition can be reviewed on an ongoing basis as a result of the necessity to review District Plans on a 10 yearly cycle.

In between these poles are a spread of options based on a "sliding scale" approach, whereby the plans would incorporate rules providing for prohibition for those GMO activities that are regarded as presenting unacceptable levels of risk and a discretionary rule framework for those GMO activities that have generally acceptable risk levels, but are not necessarily appropriate to occur in all circumstances; or for those GMO activities that can proceed based on current knowledge, but where there is a need to set in place mandatory requirements on project proponents, including appropriate controls for addressing damage which may result from the land use.

In formulating appropriate rules, generally accepted terms of reference necessarily apply. For example, a rule may be specific or general in its application (Section 76(4)) but it must not be uncertain or vague (as confirmed most recently in the Ngatiwai Trust Board case).[220] Any rule in a District Plan must be for the purpose of carrying out a councils' function under the RMA and as stated above, must achieve the objectives and policies of the plan (Section 76).

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219 Environment Court W50/2001, 30704 Thomson, EJ

220 *Ngatiwai Trust Board v The Whangarei District Council*, Environment Court A57/04, L J Newhook, 28-Apr-04.

Section 5.1 and Appendix 1 of this report document different levels of risk for different activities and this prima facie suggests a sliding scale approach to control of GMOs, based on degree of risk. As stated above, where a GMO activity is accepted as being able to occur in the district, but not in every instance or it is appropriate to set conditions, obligations or limitations on the activity that would result, we suggest that it is appropriate to provide for such activities as discretionary activities (or restricted discretionary activities).

A discretionary activity requires a resource consent to be obtained, and may be subject to a range of District Plan based standards. A particular advantage of this category of control is that it may be specifically tailored to restrict the Councils discretion to certain relevant matters. The council ultimately holds the discretion to grant or withhold consent. If consent is granted, it may be granted subject to conditions. Applications would be notified to provide for an essential component of the process by enabling community input into the decision making process. Rules for discretionary activities would be tailored such that any activity can be specifically assessed against certain precursors in order to qualify for such status and/or activities that do qualify can be assessed against specific matters or performance standards.

The overall advantage in this approach is that those GMO activities where the risk is regarded to be highest or unacceptable can be prohibited. If information comes to light in the longer term, whereby this perceived risk proves to be unfounded, then a plan change can be adopted to reduce the degree of control. Minimum protections by way of instruments designed to address adverse financial effects would in our view be a bottom line inclusion. Other safeguards relating to economic, environmental, social and cultural risks could also be covered by discretionary rules, so long as they are additional to, and did not duplicate, those set by ERMA.

Such rules might also specify that information (in particular that derived from monitoring) will be made readily available to people in the community so that they can participate effectively in any further local government policy development relating to GMOs, and so that any cumulative effects and residual effects can be best understood by all with an interest in such matters.

5. Option Definition

5.1 Classes of GMO Activities

Different types of GMOs carry different risks. However similar GMOs can be brought together into classes of like organisms which could be expected to have similar types of effects that councils may be required to avoid, remedy or mitigate. In this way, response options can be framed to govern classes of GMOs.

The very wide scope of research into GMOs means a large number of types of potential activities have to be considered. However, classes often share similarities with respect to key potential effects so that very similar controls can be used to regulate not just classes of GMOs but groups of such classes.

Appendix 1 provides a detailed survey of the research prospects under investigation, their anticipated uses and the risks currently identified. Analysis of this spread of prospects makes clear that although the understanding of potential effects is far from complete, certain features about the type of GMO or its intended market of themselves have a large influence on the potential for risk. In particular, the following distinctions are central to assessing the scope of risk.

- Whether the GMO is one normally used for the production of food: The economic effects of these GMOs have the potential to be significantly greater than for non-food varieties.

- Whether the GM organism is a plant, an animal, or a microorganism: The nature of the risks and the ability to control the spread of a GMO differs greatly between plants and animals in particular.

Based on these distinctions, five high level groupings have been identified.

GM (food) plants
GM (non-food) plants
GM (food) animals
GM (non-food) animals
GM microorganisms

These high level groupings can be subdivided into individual classes of activities based on the intended purpose of the GMO:

Food production;
Fibre production;
Pharmaceutical production;
Industrial substances production;
Biocontrol or bioremediation;
Ornamental purposes.

Our survey shows at least 21 classes of activities under the five high level groupings, as listed below. Only three of these classes have been commercialised to date – with GM plants used to produce food the overwhelmingly dominant one.[221] The profiles in Appendix 1 are set out on the basis of these classes.

Activities involving GM (food) plants

GM (food) plants to produce food
GM (food) plants to produce pharmaceuticals
GM (food) plants to produce industrial substances
GM (food) plants to produce fibre
GM (food) plants for biocontrol or bioremediation

Activities involving GM (non-food) plants

GM (non-food) plants to produce fibre
GM (non-food) plants to produce pharmaceuticals
GM (non-food) plants to produce industrial substances
GM (non-food) plants for biocontrol or bioremediation
GM (non-food) plants for ornamental purposes

Activities involving GM (food) animals[222]

GM (food) animals to produce food
GM (food) animals to produce fibre
GM (food) animals to produce pharmaceuticals
GM (food) animals to produce industrial substances
GM (food) animals for biocontrol or bioremediation

Activities involving GM (non-food) animals

GM (non-food) animals to produce fibre
GM (non-food) animals to produce pharmaceuticals
GM (non-food) animals to produce industrial substances
GM (non-food) animals for biocontrol or bioremediation

Activities involving GM microorganisms

GM (live) vaccines used in animals[223]
GM microorganisms for biocontrol or bioremediation

The above represent the classes of GMOs that district councils should consider in assessing options for community management of GMOs. Identification of these classes offers an effects-based means by which councils and their communities can focus on the key concerns when assessing options for community management of GMOs, and any subsequent framing of new rules.

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221 Other classes of GMOs is which one or more approvals have been made are GM (live) vaccines used in animals and GM animals to produce food (fish).

222 In this context, "animals" are assumed to include mammals, birds, aquatic organisms and insects.

223 Animal vaccines are a border-line case in this list as they involve the potential for indirect release of live organisms via excretion, rather than direct release on to the land.

5.2 Nature and Timing of GMO Activities

5.2.1 Modes of Outdoor Activity Under HSNO

In addition to considering the class of GMO activity that may be proposed, a council would also need to consider the extent and nature of the GM activity and the legal requirements that would be imposed irrespective of ERMA. The HSNO Act provides for three distinct modes of outdoor uses of GMOs. These are:[224]

> *Field trials:* This provides for experimental trials to be carried out under controls that have the objective of ensuring no altered genetic material leaves the test site during the trial and that all heritable material is removed upon its conclusion.[225] Also provided for under HSNO s40 is the contained development of a GMO. This involves somewhat different statutory requirements but for the purposes of this report, the term "field trials" shall be used to include outdoor GMO development projects.
>
> *Conditional release:* Release under case specific controls that can range from those only slightly less restrictive than a field trial or only slight more encumbering than an unrestricted release.[226] Conditional release covers both more extensive experimental activities (e.g., allowing for some release of GM material from the test organisms) through to commercial activities (where the GMOs are cultivated or bred for market). The nature and strength of the conditions is at ERMA's discretion. No applications for conditional release of a GMO have been made since it was introduced to HSNO in 2003.
>
> *Release (unrestricted):* Release of a GMO without any conditions on the use of it, or restraint on the time for which approval is given.[227] The new organism is accepted as a part of New Zealand's biological stock. No unrestricted releases of a GMO have been authorised in New Zealand.

5.2.2 Expected Timing and Form of Activities

At what time GMO developers and end users will seek permission for activities and the precise form of those activities is sufficiently uncertain that ERMA finds it quite difficult to forecast this, even with its ongoing contact with many of the most likely applicants. As described in Appendix 1, there is a wide ranging frontier of research into GMOs internationally with hundreds of varieties under research and development. The question of when applications are likely to come forward in New Zealand is probably best approached in terms of broad trends.

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224 There are a number of other sections of the act devoted to modes of approvals for use within the laboratory which do not constitute outdoor uses and so are not addressed by this report.

225 While there have been a number of breaches of field trial conditions - even for the relatively limited number undertaken in New Zealand, and those with respect to a Northland based GM tamarillo trial were among the most serious to date – the intent is to keep the altered genetic material within the test site and remove it after the trial.

226 These are regulated under HSNO s38.

227 These are regulated under HSNO s34.

Within New Zealand, research has to date been confined to field trials under controls set with the intention that no altered genes escape the test areas. However, the next stage envisaged by New Zealand GM plant developers in the near future involves pre-commercial development under HSNO's conditional release provisions. Tony Conner of the Crop and Food Institute identifies the intended scope of such work with respect to GM potatoes in the following terms:

> This must allow for the full evaluation of GM lines in a manner similar to the evaluation of potential new cultivars from traditional breeding programmes. Implicit in such field trials will be the need to assess GM crops in farm-scale trials with most of the farming practices applied to existing crops. This must involve all standard agronomic practices and the use of conventional farm machinery. The harvested produce must be allowed to undergo normal processing assessment using standard industry practices.[228]

Under an application for a conditional release, ERMA can set very few or a great many controls of any form. There has been no precedent to date to guide how it may respond. The purpose behind the 2003 amendments to HSNO however was clearly to provide a framework for such pre-commercial releases that would allow GMO projects to progressively move to commercialisation, other things being equal.

With respect to GMOs developed offshore, as described in Section A1, the current varieties commercially available are unattractive in general to New Zealand farmers as they predominantly target pests and problems not present in this country. Applications for use of such varieties could nonetheless come forward for a variety of reasons.

One potential driver could be the desire to legalise the growing of a particular GM variety so that it was no longer a "new organism" under HSNO, for which there is zero tolerance under the act. This would mean imported seed unintentionally containing some GM seeds of that variety would then pass border inspection. A further strategic motivation could be to compete against or head off a national or regional branding initiative. Strategic marketing considerations are an important motive for corporate initiatives and such action could be used as part of an effort to maintain a future ability to release GMOs. A type of application that could serve each of these two purposes is seed multiplication. This is an activity New Zealand routinely engages in for conventional seeds.[229] An approach was made to ERMA for GM seed multiplication in 1998 but did not proceed.[230]

While the projected timelines for overseas development of new GMOs are relatively well documented, which of these new products will be considered worth bringing to New Zealand and at what stage in their commercialisation is very difficult to provide useful guidance on.

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228 *We have to test GM in the Kiwi context*, Tony Conner, *NZ Herald*, 28 August 2003.

229 The purpose is to bulk up seed supply during the Northern hemisphere off-season.

230 ERMA described the approach from Monsanto in the following terms: "GMR98001: To import for release canola (*Brassica napus L.*) genetically modified for resistance to Roundup herbicide, for the purposes of seed multiplication and export of grain and to allow breeding of specific brassica crops for animal forage in New Zealand."

5.3 Four Response Options

While there are a large number of ways in which an active council response can ultimately be framed, discussion at this stage can be usefully focussed on four broad approaches to regulation of the classes of activities identified above. Detailed design issues can be addressed as a subsequent stage of investigation. As discussed further below, it is expected that robust community and stakeholder consultation will be key to informing an "in principle" decision.

An option that would exclude GMOs of all forms is not put forward as the scope of this report is limited to outdoor uses of GMOs[231] - which are those the RMA can address. (Note that GMOs that have been grown in other jurisdictions but are no longer live - eg processed foodstuffs - are not outdoor uses in the New Zealand context.)

Neither is a "do nothing" option set out here as this requires no particular specification and remains a natural counterfactual against which any proposal for intervention will be compared. Such an assessment is made in Section 6.2 which specifically addresses the issue of whether to intervene.

The following options are framed to address the choice of which classes of GMOs should be discretionary activities and which prohibited, as this is the key high level decision councils and their communities need to make. Whether particular parts of a district should be treated differently from the general rules can be given consideration at the time detailed design of the rules is undertaken, as these are in effect sub-options to any decision in principle. However, the inability to predict the type of GMO and industry sector that release would in fact be sought for (as distinct from the range of research prospects that could be of interest), the resulting likely location of demand for particular zones of GMO development, and the extent to which the form of development sought could be contained within the defined area, pose compounding problems to devising meaningful consultation options based on this concept and also rule changes in advance of a well defined activity.

[231] As noted in the introduction to this report, this is its prescribed scope of reference.

5.3.1 Option A. All GMO Activities Discretionary

Each application for a GMO activity is individually determined, subject to pre-specified mandatory conditions. Key features of this option include:

- All GMO activities are discretionary activities;
- Each requires a consent and is publicly notified;
- Consent conditions would be set to manage foreseeable adverse effects, such conditions tending to be common within a class of GMO;
- All applications are subject to mandatory monitoring and financial accountability provisions designed to ensure any damage is remedied or compensated for, to the extent possible under the RMA;
- Field trials are restricted discretionary activities (subject primarily to financial accountability provisions) while the scope of conditions able to be applied to all other activities is unrestricted.

The following table summarises the coverage this position provides for each class of release activity (the main block) and all types of field trials (far right column). "D" indicates a discretionary activity, and "RD" indicates a restricted discretionary activity.

Option A	**Releases**						**Field Trials**
	Food Plants	**Food-Animals**	**Non-food Plants**	**Non-food Animals**	**Micro-organ-isms**		
Food	D	D	-	-	-		
Fibre	D	D	D	D	D		RD
Biopharming & Industrial	D	D	D	D	D		RD
Biocontrol Agent	D	D	D	D	D		RD

As noted above, it is proposed under this option that all field trials would be restricted discretionary activities. This narrows the considerations that a council can take into account when determining whether or not to grant a consent but appears justified given the legal requirements for containment HSNO imposes on any application for a field trial. This approach is not proposed for release applications as to limit the range of potential controls that a council could utilise would place it in a less flexible position than ERMA. Central government was careful not to restrict the range of actions ERMA could take to control a conditional release activity. Councils may agree with ERMA that a particular control is the optimum method, but simply wish to reduce risk by toughening the control, so it would be prudent for councils to maintain full flexibility in its response options.

Any outdoor GMO activity will require ERMA approval irrespective of a district council's requirement for it to be consented as a discretionary activity. It would greatly assist a council's consideration if it had in hand ERMA's decision on the activity before hearing a consent application. ERMA's decision will provide not only its analysis of the risks and benefits, it will detail the constraints or controls that ERMA has imposed on the activity. In particular, the decision will detail any geographic controls that would restrict the areas in which the activity could take place at all, or if there are stricter limits on activities in certain areas.

The nature of the required plan change would determine the scope of any considerations that would be compulsory for a council to weigh. To what extent information would be sought from the applicant to cover specific local effects (eg ecological risks), or whether the council wished to commission independent advice (eg local economic impacts), would be a matter for the council to determine and provide for in its plan.

5.3.2 Option B. Food Plants and Food Animals Prohibited

In addition to the parameters set out in Option A, activities using food plants and food animals (for food and/or non-food purposes)[232] would be prohibited. Specifically:

- All food plant releases are prohibited;
- All food animal releases are prohibited;
- Field trials for biopharming of food plants are prohibited;
- All others activities are discretionary activities, as in Option A.

The table below again summarises the results, where "P" indicates a prohibited activity and the cells are coloured red, while discretionary activities are coloured yellow.

Option B	**Releases**						**Field Trials**
	Food Plants	**Food-Animals**	**Non-food Plants**	**Non-food Animals**	**Micro-organ-isms**		
Food	P	P	-	-	-		-
Fibre	P	P	D	D	D		RD
Biopharming & Industrial	P	P	D	D	D		P / RD
Biocontrol Agent	P	P	D	D	D		RD

[232] The test would be whether the plant or animal has a role as a food source, rather than whether a particular plant or animal is to be used for food. Thus corn for animal feed would be covered as it is a food plant, while other animal feeds that are not also sources of human food would not be covered.

5.3.3 Option C. Plant Activities Largely Prohibited, Food Animals Prohibited

In addition to the parameters set out in Option B, activities involving non-food plants for the production of fibre and biopharmaceuticals would be prohibited. The overall position is:

- All food plant releases are prohibited;
- All food animal releases are prohibited;
- Non-food plants for the production of fibre and biopharmaceuticals are prohibited;
- Field trials for biopharming of food plants and non-food plants are prohibited;
- All others activities are discretionary activities, as in Option A.

Option C	**Releases**						**Field Trials**
	Food Plants	**Food-Animals**	**Non-food Plants**	**Non-food Animals**	**Micro-organ-isms**		
Food	P	P	-	-	-		-
Fibre	P	P	P	D	D		RD
Biopharming & Industrial	P	P	P	D	D		P / RD
Biocontrol Agent	P	P	D	D	D		RD

5.3.4 Option D. All Release Activities Prohibited

In addition to the parameters set out in Option C, those release activities not already prohibited would become so. Under this option, attention would be focused on the sub-options for addressing field trials. There are three broad possibilities for these:

D(i): Restricted discretionary
This would be in line with a stance that is strongly precautionary with respect to all releases, but sets only limited and pre-declared issues that could be controlled with respect to field trials.

D(ii): Discretionary
This stance would remain strongly precautionary with respect to all releases, but leave open the grounds that could be used to control or refuse consent to a field trial.

D(iii): Prohibited
This stance would be strongly precautionary with respect to all releases, and all field trials.

Option D	**Releases**						**Field Trials**
	Food Plants	**Food-Animals**	**Non-food Plants**	**Non-food Animals**	**Micro-organ-isms**		
Food	P	P					
Fibre	P	P	P	P	P		D or P
Biopharming & Industrial	P	P	P	P	P		D or P
Biocontrol Agent	P	P	P	P	P		D or P

6. Option Evaluation

6.1 Assessment Elements

An RMA section 32 analysis of any proposed new rules is ultimately required in order to support a plan change to give effect to these. This in turn requires clearly defined objectives and policies[233] which the rules can be tested against to determine if those proposed are the most appropriate.[234]

The degree of uncertainty surrounding many key risks attendant to GMOs suggests that further development of those objectives and policies is best carried out iteratively with the options analysis. Option evaluation at this stage therefore needs to be conducted at a somewhat higher level.

Key issues that will inform decision-making at this stage include: the effectiveness of the measure in addressing the risk, as compared to alternatives; and the expected cost of implementing and administering the required rules. The following subsections address these issues through evaluating each of the four response options in terms of the expected:

- Degree of precaution provided;
- Effectiveness of financial accountability measures;
- Costs of administering the new rules and risks of court action.

A further issue which is important in the context of the current stage of high level decision-making is the extent to which an option forecloses opportunities – both GMO development options and alternatives reliant on the absence of GMOs or particular GMO classes.

6.1.1 Degree of Precaution

Options A to D show a progressive increase in strength of precaution.[235]

- *Option A:* represents the minimum intervention necessary to secure a community-determined level of precaution. Every GMO activity would require a TLA consent and this would provide an opportunity to place additional or more

233 Section 1.2 lists the relevant policies adopted to date by Northland peninsula councils.

234 In particular, section 32 (3) and (4) require:
(3) An evaluation must examine-
(a) the extent to which each objective is the most appropriate way to achieve the purpose of this Act; and
(b) whether, having regard to their efficiency and effectiveness, the policies, rules, or other methods are the most appropriate for achieving the objectives.
(4) For the purposes of this examination, an evaluation must take into account-
(a) the benefits and costs of policies, rules, or other methods; and
(b) the risk of acting or not acting if there is uncertain or insufficient information about the subject matter of the policies, rules, or other methods.

235 Discussion of the risks attendant to different types of GMO applications is contained in section 5 above.

stringent conditions on any application ERMA had approved under HSNO. This option leaves a TLA flexibility to consider case specific issues as they arise and discretion whether or not to permit an activity.

- *Option B:* exercises strong precaution in respect of food plants and food animals, while taking a minimum intervention approach with respect to other potential releases. This option focuses in on the leading source of concern that has been identified in public opinion surveys and that which has demonstrated a capacity to impose financial losses on non-GM food producers.

- *Option C:* would extend the focus of new rules to include prohibiting the release of GM non-food plants to make fibre (commercial forestry in particular) and also those used for biopharming and industrial substances. If community concerns run beyond food-related releases and include other plant-based GM products, but do not extend significantly beyond this in scope, then Option C would cater to this position.

- *Option D:* represents a very strong precautionary approach that would prohibit all GMO releases.

An important caveat is that if the Minister for the Environment exercises the right to call in an application under the RMA, the Minister would then decide the application, rather than the council. This applies for any class of GMO that was made a discretionary activity. If an activity is prohibited, the Minister can not intervene as no application can then be made.

6.1.2 Financial Accountability

Financial accountability is addressed in two different ways in the four options. If use of a GMO is a discretionary activity, the issue is addressed explicitly through consent conditions, bonds and financial contributions. If a GMO activity is prohibited, financial accountability is addressed implicitly through the source of risk having been barred from taking place.

As one moves through the options from A to D, the extent to which reliance is placed on consent conditions falls away and more classes of activity are prohibited. Prohibiting an activity eliminates the need for consent-related financial accountability measures as these would not apply.[236] If an activity is discretionary and is consented, there are a suite of measures that can be utilised under the RMA to provide for financial accountability. The effectiveness of these will be subject to a number of factors including:

- *Scope of accountability provided for in the statute:* It is clear that the RMA can provide for full accountability with respect to ecological damage. The extent to which economic damage can be covered is unclear and this requires further investigation. Opportunity costs are very unlikely to be covered.

[236] Consideration still needs to be given to whether any additional provisions are needed to cope with a GMO activity that ERMA has approved but the TLA has prohibited.

- *Scope for setting bonds provided for in the statute:* It is again clear that the RMA provides fully for bonding related to ecological damage, but it is not clear that it covers economic damage.
- *Nature of the guidelines established for setting bonds and their successful execution:* Councils will need to have carefully developed guides for setting bonds so that these are comprehensive in provisioning against potential risks and are successfully implemented.

Thus there is less certainty of the effectiveness of financial accountability measures the more GMO classes are made discretionary activities, and the scope for application becomes less clear.

6.1.3 Administrative Costs and Legal Risks

Administrative Costs

There are one-off costs involved in implementing any plan change and also those involved in administering the new rules.

Looking first at implementation costs, it is likely that each of the options will involve much the same level of expenditure. This is because the bulk of the costs arise from the process of researching alternatives, consulting on alternatives, and setting in place the desired change. While one option may ultimately involve a significantly great number of rules or wider scope, the costs of arriving at any position are likely to be fairly similar. Discussions with WDC confirmed that the participating councils will be best placed to estimate these costs on the basis of past proposed plan changes and thus have not attempted to research this question – particularly as it would not reveal significant differences between options.

There will however be more variation in the cost of administering different options. The costs will be lowest if intervention is minimal, or where a class of activity is prohibited. Option D would tend to carry the least cost in terms of administering applications for consents.[237]

There is a great deal of uncertainty as to what the costs would be under any options that provide for council discretion due to the difficulty in predicting the:

- Number of applications that would come forward;
- Types of application (field trial or release);
- GMOs in question;
- Purposes of use (research or commercial production).

There is also considerable uncertainty as to the extent of community concern each consent application would generate and the resources a council considers it is appropriate to devote to an application – this too being largely a matter for council's discretion.

[237] The actual position would depend on the policy position selected with respect to field trials and the extent to which field trial applications were made.

The distribution of these costs will of course depend on the cost recovery policy adopted. The RMA clearly provides for full cost recovery[238] from the applicant and this would seem to be a prudent measure in cases involving GMO decisions.

The best guide to total costs is probably derived from a strategic level assessment. It seems reasonable to presume that if Northland Peninsula Councils establish district level conditions to GMO development, when the area has had very limited GMO activity in the past and has already evidenced community concern via LTCCP submissions, GMO developers will in general look to other districts in preference. We are not aware of any features of the Northland peninsula that would attract GM development in preference to other parts of the country. Indeed, local developer Wrightsons has elected to extend work on GM ryegrass it began in New Zealand by migrating this work and any field trials that result to Australia.[239] The opportunities for research locations are thus international and, prima facie, the costs of administering consent applications could turn out to be low.

Legal Risks

An important caveat however is that GMO developers will also regard the emergence of local controls on GMO activities as a barrier to business development and may seek to challenge such controls through the courts. Thus a plan change could attract a challenge that has a strategic purpose of testing the new rules. The form of challenge may depend on whether the activity was prohibited or discretionary. In the first case, the plan provisions would be challenged whereas a discretionary activity could also be challenged on the basis of the conditions set, or the decision not to grant a consent.

Councils that adopt the new rules will naturally have undertaken extensive legal reviews prior to implementing a plan change, and refined the proposals to be robust to litigation. To the extent that potential litigants are also advised that the plan changes are robust to challenge, the incentives for following through on the threat of a court challenge are greatly reduced as it is then more clearly exposed not only to meeting its own costs, but also those of the council it challenges.

In very general terms, the risk of such an action being taken probably does not vary greatly between the options. The strategic purpose of the litigation would be to overturn any form of local control that could hinder GMO projects, so each would be a target from that perspective. The key question then is how well rules established under each of options A to D would be likely to withstand legal challenge. This is a question which is naturally easier to address once specific provisions have been developed and it is in any case one for which independent legal advice will be required. In principle, however, we understand there may well be no greater risk of any one of options A to D being overturned than another given the evidence to date. Thus, making all GMO releases prohibited activities may be no less robust than making all GMO releases discretionary. We are confident that forms of plan change can be developed that would be robust to challenge and understand a legal view is

238 Section 36 (1) (b).

239 *$6.5 million biotech boost*, Press Statement by Hon Pete Hodgson, 03 March 2005. On page 2 it is stated that "Development and field trials will be carried out in Australia".

being sought on the strength of the s32 analysis that could be developed in support of approaches presented here.

If a challenge were to proceed nonetheless, Section 6.2 discusses how this cost would be controllable and would most likely be shared between councils that were implementing like plan changes.

Were the court to find fault with a plan change, it seems unlikely that the provisions would be simply deleted. More likely is that these would be softened so that the end result in any event would be a locally determined set of measures to manage GMO risks.

A further dimension is that Crown Law considers it unlikely that a council would be held liable for consequences resulting from it failing to uphold a rule it had made to regulate GMOs. It also does not see councils being liable as a result of an activity that was approved under the rule, but the rule did not succeed in controlling a particular adverse effect.[240]

6.1.4 Foreclosure of Opportunities

GMO Development Opportunities

Option A: does not foreclose the use of any GMO varieties, as all applications are at a council's discretion to consent. *Option B:* precludes the commercial production of GM food crops and animals, but makes pre-commercial field trials discretionary. *Option C:* in addition prohibits GM plant fibre crops, such as forestry, while *Option D* prohibits all remaining classes of release.

An important feature of the RMA's plan provisions is that a decision to prohibit an activity is entirely reversible. Thus, if it were to become evident in the field trial stage and in light of new information that a particular GMO activity would be of net benefit to a district, the leadtime involved in gaining an ERMA consent would not be so different for that required to achieve a plan change. The change would, however, be specific to a particular class or GMO variety, and could leave in place the protections against risks from other GMOs if new information had not suggested a change of rules was also required.

For a number of classes, products being developed for the New Zealand market (such as GM pine or GM cows) are not expected to be commercialised for around a decade – the period within which a district plan undergoes a routine review. Thus the only GMO activities affected for such classes are pre-commercial evaluations.

We are not aware of characteristics from a regulatory approvals point of view that would offer unique benefits for pre-commercial evaluations to be undertaken in the Northland peninsula. Neither is it clear that farmers of the relevant district would gain any special advantage from hosting such work. Pre-commercial development would therefore be likely to pose risks to Northland peninsula producers for no direct gain.

[240] Crown Law (3 November 2004) *Advice on potential for council liability arising from rules controlling GMOs,* paras 9 and 11.

As has recently been demonstrated with respect to GM ryegrass research, any reluctance by New Zealand consent authorities to approve development work can be overcome by undertaking such work offshore.

Branding and Marketing Opportunities

There is also the potential for foreclosure of opportunities through permitting development of one or more classes of GMO activity. This could remove the opportunity to build price premiums or new markets through a district marketing itself as excluding the production of specified GM products. Different options offer different potentials for branding and marketing efforts, at a company or district level, designed to alter buyer perceptions, if not the fact, of the extent to which "GM Free" produce could be sourced from a district.

- *Option A*: could offer branding potential with respect to markets sensitive to GM content if it were shown over time to result in an absence of one or more classes of GMO, food varieties in particular. However, as all applications to council would be individually assessed and discretionary, in the medium term there would be no clear basis for a marketing claim that would significantly distinguish the area or its products in this respect.

- *Option B:* offers the potential for a district to market itself as excluding the production of GM foods. This can be used by non-GM producers to advise customers of the correspondingly reduced risk of any trace GM contamination being found in foods produced in the area. While overseas initiatives suggest individual districts and sub-regions are capable of driving marketing initiatives based on policy set within that area alone, if the Northland Peninsula Councils adopted parallel stances to GMOs, this would allow the creation of a Northland peninsula exclusion zone, with respect to food GMOs for example. The geographical characteristics of such a zone would enhance both the perception and the fact that the zone was remote from any other plantings of GM food crops.

- *Option C:* carries the same potential for marketing but with a broader claim – that GM forestry and non-food plant biopharming and industrial crops production is also excluded. Trace GM contamination in food is far and away the most sensitive market issue so it is difficult to gauge the additional value in marketing terms relative to Option B.[241]

- *Option D:* presents the potential to make a stronger claim still – that there would be no GMO releases at all (only potentially field trials under conditions designed to prevent any altered genes leaving the research area). Here too, the value to

[241] As noted in Appendix 1, GM cotton is grown in one of the Australian states that has also prohibited GM food crops. We have not been able to find references that would suggest to what extent removal of this fibre crop would alter marketing potentials for food products. How GM pine plantations would be regarded (compared to GM cotton), and whether exclusion of these and most other non-food crops would enhance marketing potentials is a matter that would require specialist research to address. It would also depend on the particular markets being targeted. The potential for GM pine pollen to show up in standard tests performed on kiwifruit, as noted in section 3.1, is one such area for investigation.

purchasers of a further reduced likelihood of any form of trace contamination is difficult to gauge without specialised research. However, the boldness of such a stance of itself would offer branding opportunities.

6.2 Whether to Intervene?

The above evaluations provide a final set of material that informs the first decision point for councils – whether to intervene at all. We now draw together and to an extent repeat analysis already presented in order to provide a focus on that question. To briefly recap key background:

There are clear deficiencies in the national regulatory regime: Liability provisions are quite inadequate and HSNO makes optional, not mandatory, the exercise of caution in assessing risk.

There are well identified sources of risk: Overseas experience has demonstrated the capacity for very significant economic damage to arise and environmental risks have been well documented but their significance for the most part is still to be researched.

There is a clear legal basis for intervention under the RMA: District councils have jurisdiction, RMA instruments can be used in parallel with the HSNO Act, and they can specifically target the forms of GMO activity that have generated community concern.[242]

If there were no intervention, the identified risks would not be addressed. The important issue however that requires consideration before committing to intervention is the cost of acting. In particular, do the benefits of intervention outweigh the costs? Despite significant uncertainties on both sides of this equation, analysis of the form and context in which these costs arise provides a clear basis for answering the question.

6.2.1 Costs of Intervention

Turning first to the costs of intervention, as noted above these come in three forms: implementation, administration, and those that could arise if a legal challenge is mounted to a plan change or plan variation.[243]

Administration Costs: These are fully recoverable from the applicant and so need not pose any direct cost to a council. It does generate compliance costs for an applicant but this is the case for all other activities covered by a plan.

Implementation Costs: As identified in section 4.3.7 and further discussed below, there is a very good chance that a council faced with the prospect GMO activity

[242] Dr Somerville has provided opinions to this effect and Crown Law either supports the interpretations, or in the case of the relationship with HSNO, has not contested this.

[243] New rules may be introduced either through a plan change or a plan variation, depending on the district plan. Use of the term "plan change" is intended to also cover a "plan variation".

would ultimately end up making a GMO related plan change, if only to recover monitoring costs. As the incremental cost of making a plan change that also specified other simple controls would be modest, the implementation costs that would actually be avoided by not doing so are likely to be modest. If shared between councils as envisaged, the net additional costs that can be counted against a plan change directed at local management of GMOs shrinks further.

Legal Defence Costs:

As Crown Law considers it unlikely a council would be held liable for it failing to uphold a rule it had made, or if the rule did not succeed in controlling a particular effect, there seems little basis on which to provide for such contingent costs.

The single source of potentially significant cost is a legal challenge to a plan change. There are a series of important characteristics to this:

a) *It is a contingent cost taken on only after detailed legal review:* While there are clear indications that GMO developers would look seriously at challenging any form of local controls, whether such a challenge would actually take place will not be known until such parties have had legal opinions prepared giving them an assessment of the chances of a challenge succeeding. No council would proceed with a plan change before having received legal advice that the change was considered sound and likely to be able to withstand challenge. It is probable, therefore, that the potential litigant will receive much the same advice and that would tend to quell a reasonable challenger. This would especially be the case if the advice was that a challenge would only serve to confirm the *vires* of the plan change and provide a clearer precedent for future like initiatives. While the threat of court action can be used as a strategic weapon in its own right at an early stage, once legal reviews suggest a sound plan is available, the value of the threat largely evaporates. Progressively, the limited utility of such a threat against a carefully prepared change will be well understood.

Alternatively, the challenger's legal advice may be that a small part of the plan is open to challenge but the likely result of any court action would be a minor alteration. In such a case, the incentive would be to negotiate directly with the council. This and other variations on the theme would result in no court action taking place and no defence costs being incurred.

b) *It is a controllable cost:* If legal defence costs do arise, it is important to observe that while a council is bound to respond, it has considerable control over how much is spent on the action. Also, one of the options it has for responding is to seek an out of court settlement. Further, council has the option to make a further plan change at any time if it comes to understand that there is a legal exposure it had not previously identified. Finally, if the council wins the case, costs can be claimed from the challenger. Under these scenarios, the net cost to a council of defending an action would be small or much reduced.

c) *It would be a shared cost:* The councils participating in the Inter-Council Working Party are approaching the prospect of community management of GMOs on the basis that a uniform response across the districts they cover will be the optimum and that the costs involved will be shared. To the extent that councils in the Northland peninsula adopt parallel or similar plan changes for managing GMOs, it would seem reasonable that they commit to mounting a joint defence to challenges made to any one of the grouping so that councils are not individually exposed. This would in part recognise that in absence of a plan change, a council would individually face legal risk from the other side - through constituents alleging the council failed in its duty of care.

It is also important to note that the risks identified in this report are by and large common to all other councils, and a considerable number are monitoring developments in the Northland peninsula with a view to recommencing their own investigation of response options once these have been more clearly defined. They too are prospective partners in a broader agreement providing for mutual cover with respect to this particular litigation risk.

Further, there is precedent for LGNZ acting as the co-ordinator and banker for such an arrangement. It has taken on this role when there have been parallel concerns across a number of local authorities and there is agreement to share the risk of any court costs. Given the availability of such risk sharing arrangements, options should be assessed at this stage on the basis that an arrangement can be devised. This can be confirmed or otherwise explored at the time a formal s32 analysis is completed, should the costs of acting begin to approach the expected costs of not acting.

Also to be taken into account on this side of the ledger are any public benefits that would result from the use of GMOs in the district. The difficulty in accounting for these is that, to date, the varieties for which field performance is known have in general shown only modest private gains and public benefits would be slight if any. On the other hand, the many research projects currently under way are, in general, not at a point of development where reliable data can be drawn on. Hence these represent a pool from which future opportunities may emerge but for which the benefits remain speculative at this point.

6.2.2 Benefits of Intervention

The costs of not intervening (and hence the benefits of intervention) cover a wider set of possibilities and have different distributional impacts. However, some large potential costs arising from not intervening that first affect individual ratepayers would quickly loop back to become costs to the wider community.

A serious category of risk for a council is the financial liability for clean-up of any environmental damage that may result from a GMO activity. Due to the inadequate liability and financial assurance arrangements under HSNO, councils are exposed to meeting the costs of clean-up if the polluter does not pay. A clear warning from the past in respect of such costs is offered by the thousands of sites throughout the country contaminated with hazardous substances which it is estimated will cost

around $1 billion to clean up. A significant proportion of this cost can not be recovered from the polluter and Government funding has been committed to only a very small number of sites, leaving councils with the problem of "orphaned" sites. Clean up costs for organisms will vary greatly but can amount to tens of millions of dollars, as the painted apple moth and varroa mite programmes have shown. Government has made no commitment as to whether it would provide financial support for cleanups that are required following an authorised release - as opposed to unauthorised GM contamination incidents that MAF is bound to address under HSNO.

While certain forms of environmental damage may also have commercial implications for food producers, it is the economic impacts of GM contamination that are the most apparent threat. Any detectable level of GM contamination in food products is in general sufficient to trigger product rejection in key export markets including Japan and Northern Europe. The scale of financial damage arising from such contamination has been demonstrated to be very high overseas. In New Zealand, at a time before any GMO has been approved for release, one food producer has already lost close to $500,000 in one product rejection incident - via contaminated imported seed.

Were a similar contamination incident to result from a GMO deliberately released in this country, the potential impact on the returns to growers in that district in particular, and the country in general, would be very significant according to statements made by major exporters.[244] Thus what would in the first instance be a loss to an individual constituent of the district is likely to have spillover effects to other producers and to the brand of the area and/or the nation, depending on the nature of the product and the contamination. This general principle was illustrated through the apparent hoax that foot and mouth disease had been deliberately released on Waiheke Island in May 2005 and the ensuing concern over its potential wide ranging impacts.

While it can be argued that a council's general duty of care extends to a single producer, the case becomes compelling when the extent of the probable spillover effect is taken into account. It is this link that brings closer to councils the economic costs arising from GM contamination. For, as discussed in 4.3.7, simply the threat of such financial harm and concern about this will tend to trigger a council's s35 duty to monitor. In order that a council obtains the form of monitoring it requires to adequately protect against this risk and that it is not burdened with significant expense in achieving this, a plan change would most likely need to be made so it could become a condition for the GMO activity, which would then require a consent. (It should be emphasised that this chain of considerations arises due to the unusual magnitude and extent of potential spillover effects from GM contamination.)[245]

At the time a change is being made to bring GMOs under the plan, the question then naturally arises, should not a bond be taken to protect against ecological damage and conditions also set which are designed to protect against adverse economic effects? (Note that at the point measures such as this are in place, a position equivalent to Option A would have been reached.)

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244 See section 2.3.2 and Appendix A1 in particular.

245 There are many different activities that co-exist either without adverse interaction or with only minor boundary issues but GMOs are an unusual case due to the scope for spread of the effects and because of low or zero tolerance for this contamination in key markets.

Just how far a council's duty of care extends and what its legal exposure is if it took no action in these circumstances is unclear. While Crown Law suggests there is no liability, other legal opinion suggests this view is too narrow. What seems highly likely however given the community initiatives to date is that even if no legal action were taken by concerned constituents, they would in any case initiate a private plan change. This would then require the council to become intimately involved in a s32 analysis.[246] Either way, therefore, there is a good chance a council would arrive at the point where a s32 analysis will need to be seriously evaluated.

The only current requirement for a developer to undertake a GMO activity in a district is to obtain an ERMA consent and district plans need to anticipate such activities rather than arriving to regulate after the fact. The comparatively long timeframes required to make a plan change mean that an approach of waiting for evidence that a particular GMO activity is set to arrive in a district would result in missing the opportunity to take effective precautionary measures. To the extent a dependable legal opinion was provided that a proposed plan change was *vires* and likely to withstand challenge, the costs of a potential court defence would need to be discounted and then further diminished to the extent these are shared. It would then require only a rather small cost to be the expected result of taking no action for the benefits of a plan change to outweigh the costs of intervening.

The evidence presented in Section 2 strongly indicates that the degree and form of resistance to GM contamination is such that simply the release of a GMO variety, rather than even the fact of a contamination incident, could alone be expected to generate costs to food producers that in general far exceed the potential benefits on the other side of the ledger.[247] These costs would then have flow on impacts for the district's economy and community that would be expected to be less in scale than the private costs but still well above that other side of the ledger.

Part of the reason the release in itself could have such an impact is that expectations would be strong with respect to most plant GMOs that contamination would soon thereafter appear in like non-GMO plantings (plants being the clear immediate prospects). While the identification of GM contamination in non-GMO produce may have a higher cost to particular producers whose crops have tested positive, the impacts in terms of lost markets and sales premiums may not be so different for other farmers who are perceived to be exposed to the same contamination. A range of

246 While the applicant for the plan change may be required to pay for the preparation of a s32 analysis, as its purpose would be delivery of a public good, a council may well end up funding or part funding this exercise and would in any case need to invest in building expertise to evaluate the analysis.

247 Naturally, there are a huge range of variables that would influence the estimated costs including: the type of GMO, the area it is released in, the controls set, the extent of any planting, and so forth. As a council's response must cater to a broad range of possibilities, this conclusion is based on the assessments offered by those producers closest to major markets and incorporates their views as to the significance of GM contamination and on the forms of GMO release that can reasonably be expected (Again see section 2.3.2 and Appendix A1). With respect to benefits of GMOs, as noted above, it is difficult to identify any public economic benefits to a district from commercialised GMOs and benefits that could arise from future GMOs are highly speculative in their magnitude and quite uncertain in their timing. To the extent that a particular GMO did show strong benefits, reversibility of policy naturally allows for a change of rules that would account for this while there are considerable risks of irreversibility with respect to the costs side of the equation.

additional costs (potential and expected) resulting from a GM release and/or GM contamination are discussed in Section 2 and include: adverse environmental effects, negative cultural effects, and adverse impacts on tourism. Depending on the circumstances and assumptions made, such factors would swell the expected total cost of inaction accordingly.

While ERMA may well have already undertaken an assessment of the risks and benefits of a particular release, in addition to the issues discussed in Section 3 it is important to note that ERMA's assessment would be carried out using different assumptions to those that a council's s32 analysis would require. Thus different results could readily arise even if the same baseline data was used in each case. In particular, national economic benefits would be submitted to ERMA in support of a release whereas district-level benefits would be considered by a council. As we are not aware of GMOs whose benefits could only be realised in a particular district, were a council to foreclose a GMO activity in its territory, this need not represent a foreclosure of the GMO project in the way refusal of a consent for a power project would with respect to a unique project site.

A further factor is the extent to which a council perceives it could be exposed to legal action in respect of its duty of care and the weighting it would apply to this risk. The complexities of this question remain to be researched for such cases.

In summary, *prima facie*, non-intervention would seem a very unlikely conclusion of the s32 analysis if the proposed plan change was constructed in accordance with the framework identified in this report and the other legal opinions and reports so far prepared.

6.2.3 Conclusion

The objective set for this report was to develop options to the point that a decision in principle could be taken on a preferred response option. As discussed in the following subsection, a single option could not be put forward at this stage as community consultation will be required before the best form of active response can be identified. Following that process and identification of the preferred option, a separate and subsequent stage of decision-making will be required before a council would have sufficient information to commit to implementing a particular option. That information would include:

- A fully specified proposed plan change and section 32 analysis;
- A legal review of its robustness to challenge; and
- Clear arrangements with other councils as to how costs are to be shared by those councils proposing to commit to a like plan change.

Thus the decision required at this stage is simply whether there is sufficient evidence to justify proceeding with further development of an active response option. Given the above, it is clear that not only is there sufficient evidence to justify proceeding, but that this work is likely to be triggered in any event and the only difference in a council refraining from being proactive is that it would lose control of the form of plan change to be put forward (at least in the first phase). The legal issues associated have been

worked through to the point that there is a clear track to preparation of a sound plan change. Thus, non-intervention is not considered a useful response option to put forward for further consideration at this stage.

6.3 Community Attitudes to Risk Critical

If a council is to intervene, the key high level decision councils and their communities need to make is which classes of GMOs should be discretionary activities and which prohibited, based on their tolerance for, or aversion to, risk.

There are a number of different dimensions and forms of risk to consider. For some of these, the level of information available provides a reasonable guide to the nature of the risk and the chance of if coming about. For others, it will be important to look at higher level considerations such as whether a risk is reversible or not.

However, what stands out is the extent of uncertainty surrounding many of the underlying risks – especially the potential economic and environmental effects - and the potential scale of damage. This applies to points of analysis that are key to predicting outcomes.

When considering GM food crops, a decade's experience of these in the market has at least provided a significant pool of information on potential economic effects. Past experience means a key basis for assessment of any response will be the extent to which it is considered to adequately cover the economic risks of GM food production. However, even for this class of GMO, environmental effects remain under-researched.

This means that in weighing the attributes of each option, a great deal depends on the degree of precaution sought. There is no objective standard as to what is a correct level of risk. It is not an objectively determinable factor. It is subject to individual and collective determination, through evidence of what is, and judgements about what might be. ERMA notes that:

> … the way individuals and communities perceive risk affects the way that they respond to situations that they perceive as risky and consequently the level of risk that they are prepared to accept (or tolerate) in any particular circumstance. Some researchers have found that risk analysts tend to consider only two components of risk – the likelihood of the event occurring, and the size of the event should it occur. The lay public, however, tends to consider risks within a much broader context, and takes into account a wide range of factors.[248]

The RMA provides communities with the ability to set rules that embody community determined outcomes, including the level of risk it is willing to tolerate with respect to particular activities, such as the management of GMOs. A minimum level of joint council response that would be likely to flow from a s32 analysis would be provision for all outdoor GMO activities to be subject to mandatory provisions designed to ensure funds are available to remedy or compensate for damage, to the extent the RMA will provide for this.

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248 ERMA (December 2002) *Approaches to Risk*, p. 11.

This report has also found evidence that would support the use of a strong precautionary approach under the RMA. In particular it would appear that the extent of risk posed, or indeterminacy in the face of serious potential effects, could be used as the reliable basis for a policy of prohibiting classes of GMOs, were a community to seek this.

The extent to which each community wishes to provision against risk is a critical input to policy formation. When large parts of the analysis are currently characterised by indeterminacy (and thus beyond the reaches of conventional risk analysis), when a number of the potential effects are significant and some irreversible, it follows that communities should be able to set a floor on the extent of precaution to be specified for their district, as they are the ultimate risk bearers. As there is no opportunity to appeal an ERMA decision that overrides a community's views, communities will themselves need to set rules to manage GMOs if they wish to assure particular outcomes.

7. Implementation Issues

7.1 Community Consultation

Any process targeting the implementation of plan changes, or variations to account for the management of GMOs, is naturally first reliant on adoption of the approach at a political level. One of the purposes of this paper is to assist in bringing the issue to the fore with the respective Councils, and a possible outcome is a political constituency willing to pursue plan changes, or variations for the management of GMOs. If this is indeed ultimately the case, community and stakeholder consultation is an imperative.

Although LTCCP consultations have in general indicated caution with respect to GMO use, there remain a wide range of views held within the community and by stakeholders with respect to the use of GMOs. Before embarking upon plan change/variation processes it is therefore important that potential changes to the district plan are widely debated and the Council fulfils its consultation obligations.

The RMA implicitly requires consultation on new policy and the way it provides for public input on plan changes and the promulgation of new plans. The RMA does not provide a definition for the term consultation but the *Oxford Dictionary of Current English* (1987) defines consultation as "the act or process of consulting, deliberation, conference".

In our view the most complete definition to date of what consultation is or should be, was provided by the Court of Appeal in its decision on *Wellington International Airport Limited v Air New Zealand (1993)*. Whilst this case was not a case determined in terms of the RMA (in fact it related to whether the airport company had conducted adequate consultation with the airlines before making a significant increase in airport fees) it provides a useful baseline of what consultation is, and what it is not for RMA purposes. The approaches have been widely adopted in RMA circles for this reason.

In this case, the Court recognised that consultation is not merely telling or presenting. The process is based on a willingness to change a proposal. It includes listening to what others have to say and considering responses. It is founded on sufficient time being available for discussion and should be a genuine effort by the consulting party. Consultation requires sufficient information being provided to those being consulted so that they can make intelligent and informed decisions and responses. Consultation means that the party that is conducting the consultation must keep its mind open, and be willing to change and give genuine consideration to requests and even start afresh. This does not preclude that party having a working plan already in mind. Finally, consultation requires the party consulting waiting until those being consulted have had a say before making a decision.

With these foundation consultation principles established, we see the following as comprising a first step for the respective contributing Councils pursuing a plan change for the management of GMOs.

In the first instance, sufficient information has to be provided in order to fuel the consultation process. This document could be utilised as the basis for the preparation of a public discussion document, which would be issued to key stakeholders and the community more generally for comment. This process could be supplemented by direct engagement with key stakeholders and interested community groups and individuals via specifically targeted meetings, open days and forums.

In tandem with these more conventional methods there is also some value in our view, in the adoption of a more global consultative approach, whereby constituent communities are subject to surveys about the issues and more of an overall representative rate-payer response is able to be obtained. The bottom line is that as many contributing views as can reasonably be obtained, should be obtained. Consultation with respect to this matter needs to be robust because subsequent plan changes have the ability to set precedents, in both the councils considering this reform and in other districts that are monitoring their development. As noted above, any endeavour to utilise prohibited activity status in a plan should necessarily occur sparingly. This in itself warrants full and balanced engagement with stakeholders and community interests.

Consultation of this nature would also serve to further inform the section 32 analysis. The end result of such a process is a more robust approach moving forward.

At the completion of this consultation process the details of a plan change/variation could then be prepared, which would be followed by the usual processes of notification, submissions, further submissions and hearings. We envisage that the overall structure of the necessary plan changes, at least at a fundamental level would be termed in a reasonably common way for all of the District Plans at issue. Obviously, the way the change was ultimately inserted into each plan would need to be adapted to the structure of the plans themselves. However, this is certainly not an impediment to the adoption of a combined approach to the GMO issue.

7.2 Potential Commonality of Plan Provisions

If a change of plan is pursued, it is necessary to consider how appropriate provisions can be inserted into the plans of each of the districts adopting new rules. As one would expect, each of the District Plans is set out in a different way, with some being primarily based on a zoning approach and others organised around issues rather than zones.

The purpose of this section of the report is to briefly identify the inherent structure of each of the District Plans in question and suggest how issues, objectives, policies and methods relating to community management of GMOs might find their way into the respective documents.

7.2.1 Far North District Council

The Far North District Council operates only in part according to its proposed District Plan. While nearly half the appeals have been resolved, those outstanding affect large portions of the plan (mainly the Coastal Environment, Landscape, Indigenous Flora and Fauna chapters) (see RMA s19). In general terms this plan adopts a zoning approach to management of land use activities. In addition a number of district wide provisions are also relevant in the management of land use within the district. This means that the proponent of any land use activity needs to understand what rules apply, both in respect of the zoning of a given property, and also in respect of the rules which apply throughout the district.

The plan adopts a permissive approach. Where land use activities not otherwise controlled they are assumed to be permitted.

The Far North Proposed District Plan is divided into five parts comprising general provisions, environment provisions, district wide provisions, appendices and district plan maps. Part 2 – Environment Provisions contains rules applying to specific zones.

Part 3 incorporates district wide provisions. These provisions apply to the control of land use activities regardless of zone. In our view, this is the most appropriate location for a chapter that imposes control over GMOs. We favour a district wide based approach to the issue, rather than a zoned approach on the basis that GMO activities that are not prohibited could be pursued in any zone within the district. Moreover, adopting a district wide approach to the management of GMO more readily enables the sliding scale controls referred to earlier in this report to be adopted for the differing categories of potential GMO uses in a comprehensive way. This is preferred to insertion of controls on a zone by zone basis.

7.2.2 Whangarei District

Whangarei District also operates under a proposed plan in a similar manner to the Far North District Council. The structure of this proposed plan differs from the Far North approach in that it adopts an approach to objectives, policies and methods organised around issues, rather than being area or zone based. While the plan identifies classes of activity, this has been done only where the specific identification of activities is the most appropriate way to manage effects. Most rules in the plan relate to any activity, thus act along the line of performance standards relevant to any activity that might come forward. These plans are generally recognised as “effects based” plans where rules are tailored to management of individual effects.

The general presumption within this plan is that every activity, except subdivision, is permitted unless it is regulated or prohibited by a rule in the plan.

It is envisaged that provisions dealing with the management of GMOs would need to be split within this plan, with issues, objectives and policies appearing under this section of the plan and relevant rules appearing later within the rules section. This is not at all problematic, and simply means that objectives and policies ultimately find themselves separated from rules within the document, rather than forming part of the

same chapter. The advantage in such an approach is that any potential land user can review the rules section in order to determine whether a resource consent is required for any particular activity. If a consent obligation is triggered, then relevant objectives and policies come into play in assisting the Council with its decision making function on the subsequent resource consent application. It is envisaged that the sliding scale approach to the management of GMO activities (prohibited and discretionary activity status dependent upon GMO classification) could be tailored into the rules sections of the Proposed Whangarei District Plan.

7.2.3 Kaipara District Plan

The Kaipara District Plan is operative. In terms of structure this plan is more akin to the Far North District Plan than the Whangarei District Plan. It adopts more of a zone based approach, where rules are set out for specific zones which results in area based controls. However the plan also includes objectives, policies and rules that apply at a district wide level.[249]

As suggested for the Far North Plan, a separate chapter having applicability at a district wide level is the most appropriate approach for the management of GMOs. Again this chapter would include all issue identification statements, objectives, policies and rules in one location within the plan.

7.2.4 Rodney District

Rodney District Council operates under a proposed plan which was first notified in 2000. This plan also adopts a zoning approach with an overlay of "general rules", which are rules which apply across the district. In terms of structure, the plan is mixed with some chapters including a full suite of objectives, policies and rules that have relevance to a specific zone (for example rural, residential, business, open space and recreation) whereas other chapters include issues, objectives and policies relating to certain matters and rely on rules being implemented in the various zoning and rule chapters later in the plan (for example Highly Valued Natural Resources chapter).

If Rodney District Council ultimately wishes to insert provisions for managing GMOs in its district, we would suggest that a new chapter including relevant issues, objectives and policies with respect to GMO management would be appropriate. Given the current structure of the plan it is then likely that the rules to be adopted would need to be inserted into each of the relevant zone chapters.

7.2.5 Waitakere City

Waitakere City also operates in terms of its proposed plan which has been amended as a consequence of Council decisions and appeals. The printed version is essentially a "decisions version" as at 10 May 2002. This plan is divided into three parts being the policies section, rules section and the planning maps. From our review of the

[249] For example hazard mitigation, heritage and landscape protection, transportation, public works and services, land subdivision and monitoring.

structure of the plan it is evident that relevant issue identification of objectives and policies relating to the management of GMOs would logically fall within chapter 5, which includes significant resource management issues and the response, objectives, policies and methods. This chapter is pivotal to the District Plan and sets the policy context for subsequent rules. The approach within this chapter is largely effects based and sets out those specific issues that require some type of rule intervention in order to achieve acceptable environmental outcomes.

The first volume of rules (note there are two) includes those rules that are applicable at a city wide scale. We would envisage that this would be the logical location for rules pertaining to GMOs, rather than one which that is based on the individual zones (Volume 2 of the rules).

7.2.6 Overview

Whilst there are differences in the structure and format of the respective District Plans, it is our view that the fundamentals of what ultimately would need to be inserted into these plans can have a reasonable degree of commonality across the various districts. Whilst some of the language ultimately utilised in a plan change would need to be refined to match the language used in the District Plan in question, the fundamentals would remain largely unchanged. Any local differences that need to be accounted for are primarily structural differences in the way that the plans are set out, rather than fundamental issues of style.

7.3 Next Steps

The overall objective set for this project was to advance analysis to the point where a decision in principle could be made on how to respond to the risks associated with the outdoor use of GMOs. The resulting report has described the key risks in detail and analysed the available response options.

The analysis suggests that the decision in principle should be made between four response options, as detailed above. The ability to identify a superior option by analysis alone is limited by the extent of the uncertainties surrounding the risks they would address, and the potential scale of damage that could result. While this report provides the essential elements of the factual matrix required to make such a decision, the indeterminacy of important sources of risk means that community consultation forms a further vital component.

A number of the Northland Peninsula Councils have already received significant community comment on the issue of GMO activities during LTCCP and district plan hearings. However, it is the preferences of communities with respect to particular response options that are now required.

This means that a key next stage will be preparation of a community consultation document as a part of designing an overall consultation process. Should review of this report trigger an interest in further research on particular matters, it will be important to establish at an early stage whether this additional research is carried out

before or after the community consultation is undertaken. Either may be appropriate depending on the nature of the issue, but an early decision on this will assist in minimising the time required to assemble a full package on which the Inter-Council Working Party and ultimately the individual councils can base decisions.

Although this report focuses on the response options available to district councils, it is also of relevance to regional councils. It was anticipated that a legal opinion on the potential role of regional councils with respect to GMO management would have been obtained by LGNZ and available for the analysis in this report but this has not occurred and examination of boundary issues awaits such an opinion.

At the point a particular response option has been selected in principle, assuming this involves a plan change, the following steps will then need to be addressed:

- Development of the precise framing of objectives, policies and rules that would support and give expression to the options selected. This would involve detailed research into the particular mechanisms to be used to implement the chosen option and would also involve a thorough legal review of these options and their implications.

- Development of individual plan changes or variations required to implement a generic set of rules into each council's plan;

- Establishment of a memorandum of understanding between councils to a joint defence of any challenges to a related plan change in order to cover this financial risk;

- Preparation of RMA s32 analyses to ensure each proposed plan change meets the tests this section sets.

It is assumed here that such work will continue to proceed under the auspices of the Inter-Council Working Party and thus issues of timetable co-ordination and development of a joint implementation strategy will be addressed through this group.

Appendix 1 Review of Classes of GMOs

The following profiles classes of GM activities that display key effects that are sufficiently similar to allow for a common basis of regulation at a high level, as discussed in Section 5.1. Here, we profile five groupings of classes: food plants genetically modified for food purposes (A.1) and non-food purposes (A.2), non-food plants genetically modified for fibre, ornamentals and other uses (A.3), GM animals (A.4) and microorganisms (A.5).

A.1 GM Plants For Food Production

A significant number of GM food varieties are already on the market and a considerable amount of GM research is dedicated to GM food projects. Should they prove commercially viable, applications for a wide range of GM food crops may emerge in the near future.

A.1.1 Economic Risks

Economic effects associated with GM crops have demonstrated an ability to generate spillover effects of a very significant scale and scope, as described in Section 2.3. Devising controls for such economic impacts has provided one of the greatest challenges to regulators. The absence of any demonstrated means of preventing GM crops from contaminating non-GM crops of a like variety means conventional farmers are particularly exposed when there is resistance to GM contamination in targets markets. As we have also seen, even perceptions of an inability to prevent gene flow can have serious economic consequences.

Food production is the dominant economic activity of the Northland peninsula, and contributes $975 million per annum to the economic output of the Northland region alone.[250] Thus any market rejection of produce due to GM contamination could have far reaching effects on the regional economy.

If the economic impacts of GM food crops were confined to the single non-GM counterpart, that would allow a direct tradeoff assessment to be made on a crop–by-crop basis. However, the spillover effects clearly extend further. Just how far and with what severity has been inadequately researched to date.

The single quantitative study commissioned by Government[251] to date does however provide grounds for believing that the effects would be significant. As already noted above, the National Research Bureau surveyed consumers in the UK, US and Australia specifically to assess the extent of this effect. Asked whether they would buy New Zealand fruit and dairy products that were not themselves GM, between

[250] Enterprise Northland Pastoral Farming Development Group (2003) Land Use, Farming and Horticulture in Northland 2003

[251] In the public domain.

20% and 30% said they would cease to purchase, irrespective of price, if New Zealand was at that time growing related GM products.[252]

In the wake of a series of food scandals including Mad Cow disease, educated and affluent consumers in Europe and the Far East increasingly want 'safe' food. "A majority of Europeans do not support GM foods. These are judged not to be useful and to be risky for society", the European Commission reported in its most recent official survey.[253]

Wholesale purchasers and major retail chains are the centres of power in the food market and perform a gatekeeper role. Their assessment of customer tolerances, not regulations governing labelling, also dictates what is presented to customers to select from. Most existing GM food production has gone to animal feed,[254] or been refined into products that until recently escaped labeling requirements in major markets such as the European Union. Soy and maize, the two biggest GM crops, can find markets this way at present but products whose primary market is direct human consumption do not.

In the US, one of the most GM-tolerant markets, GM potatoes were voluntarily withdrawn by their developer after two seasons' limited cultivation. The withdrawal was made in response to the refusal by US food companies to use the GM potatoes in their product lines.[255] In particular, fast food giants McDonalds and KFC rejected the product. GM tomatoes were similarly withdrawn in the US after two season's cultivation, also due to market resistance.

Heated opposition to the proposed release of GM wheat is the most recent example of strong market resistance to GM foods intended for human consumption. When North American wheat exporters consulted their major buyers as to the acceptability of GM wheat, the responses were clear-cut across Europe and Asia. Not only was there near universal refusal to take any GM wheat, many stated they would reject shipments that contained even trace GM contamination - including all Japanese importers surveyed where Japan is the biggest purchaser.[256]

It is already well recognised that there are opportunities to gain sales and/or market premiums through providing produce that not only shows no GM content when tested, but is perceived to be GM Free by the purchaser. In New Zealand, this effect is marked with respect to corn products (sweetcorn and maize for grain). New Zealand is a small scale grower and is not a low cost producer. Current sales levels are

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252 MfE (2003) *Economic Risks and Opportunities from the Release of Genetically Modified Organisms in New Zealand*, http://www.mfe.govt.nz/publications/organisms/economic-impact-apr03/

253 European Commission (March 2003) *The attitudes of Europeans to the environment*, Eurobarometer Survey No 58.

254 US National Research Council (2002) *Environmental Effects of Transgenic Plants. The Scope and Adequacy of Regulation*, p. 224. Also see US National Corn Growers Association (2003) The World of Corn; Corn Market Outlook, April 2003, Economic Research Service, US Department of Agriculture; and Oil Crops Situation and Outlook Yearbook 2002, Economic Research Service, US Department of Agriculture.

255 US Department of Agriculture (2000) International Agricultural Trade Report: "Canada Mounts Strong Challenge to U.S. Frozen Potato Fry Producers/Exporters".

256 US Wheat Associates (2002) *GM Wheat Customer Acceptability Survey. Results from Asia*.

underpinned by the perception that New Zealand is free of GMOs.[257] All sweetcorn exports from New Zealand must meet a zero tolerance test for GM contaminants. With respect to maize for grain, Federated Farmers maize grower's spokesman Colin McKinnon cites the importance of a GM Free status to the industry's biggest buyer:

> Penfords are adamant that if there is any contamination whatsoever, they will stop buying from us. If the growers lost Penfords as a buyer, the maize industry would collapse. You can't lose 30% of your sales.[258]

A.1.2 Potential Demand in New Zealand

The financial benefits to date from using GM food crops have been modest at best. Changes in yield are a key performance parameter[259] and it is not clear that there is currently a significant yield advantage from GM crop seeds across the board.[260]

In the meantime, conventional breeding is continuing to lift yields. "An estimated 50% of yield gains in major cereal crops since the 1930s has come from genetic improvements through conventional breeding techniques".[261] For some mainstream crops, the figures have been much higher (wheat 75%, soybeans 85%). What can be expected is that as each new conventional seed variety is developed, the GM variant of that line will tend to also be developed and released. Thus, it is likely that GM seed will keep up with conventional breeding advances in this respect, on a lagged basis. However, any gains (in relative terms) are expected to be progressively eroded. As better means of dealing with pests are developed, productivity gains from using GM seeds would be reduced or eliminated.[262]

Of the four GM crops accounting for 99% of global plantings, New Zealand does not grow cotton, nor soybeans other than for research purposes and the canola industry is tiny. Of these four, this leaves only maize as a current prospect for local cultivation.[263]

From a marketing perspective, Federated Farmers Maize Growers spokesman, Colin MacKinnon, sees GM maize cultivation as a threat to existing maize for grain production:

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257 Bruce Clark, Sunrise Coast, Personal Communication, September 2003.

258 *Reassessment of GM Tolerance Levels Resisted*, Bob Edlin, Straight Furrow, August 2, 2004, p. 9.

259 The other major parameters are: segregation and regulatory costs, herbicide costs, seed costs, and producer returns. Note for example that while GM soybean harvest yields are actually reduced, savings made on the applications of chemicals are also reduced and the convenience for farmers of reduced applications has often been a trigger for conversion to GM soy seeds.

260 GM cotton has shown consistent gains in certain jurisdictions, but not in all. See Section 2.1 for further discussion of this point.

261 USDA. *Economic Issues in Agricultural Biotechnology*, USDA Bulletin No 762, February 2001, p iv.

262 See Teulon and Losey (2002) *Issues Relating to the Practical Use of Transgenic Crops for Insect Pest Management*, and Canadian Wheat Board (2002) *A discussion paper on Agronomic Assessment of Roundup Ready Wheat*, p 11.

263 Federated Farmers view of current GM crops in general is that "the GM crops in existence at the moment have no real attraction to New Zealand growers." Federated Farmers Grains Council Chair, Neil Barton, Newsroom September 30 2002. For similar comments, see Federated Farmers media releases September 19 2002 and March 14 2003.

> "The way our markets are, the majority of our customers require GE-Free maize. It's important that we retain our GE Free status. [Contamination] would be a major blow to the maize-growing industry."[264]

From an agronomic perspective, one of New Zealand's leading maize scientists, Alan Hardacre, does not believe there is any compelling argument to introduce GM maize.[265] This is also the view of Tony Conner, the scientist foremost in advocating GM food production in New Zealand, who states:

> There is no economic demand for GM maize here; we do not have European corn borer, and weed control by existing herbicide systems is good.[266]

One of New Zealand's major seed companies, whose parent company develops GM plants, assured farmers they would continue to have access to the most recent developments in seed stocks, even if GM plants were prohibited in the future. Pioneer Brand Products research manager, Richard Brenton-Rule, stated that:

> GM conversions are not made until the end of a variety's conventional commercial development. Therefore the original non-modified product will always be available.
> …
> For instance the BT gene has little application here because we don't have a major problem with the caterpillar it controls.[267]

It generally take 8-10 years to develop a new crop variety, so varieties likely to be commercialised in the next 10 years will tend to be known development projects now. The new plant varieties expected to be commercially available within the next 5 years are limited to:[268]

- Herbicide resistant maize, oilseed rape, wheat, sugarbeet, chicory, cotton;
- Insect resistant maize, cotton, potatoes;
- Stacked herbicide and resistant maize and cotton.

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264 Rural News, May 25 2004, "Maize company wants compensation".

265 *No GE opportunities yet for NZ growers*, by Sarah McVerry, Country-Wide Northern, 1 March 200, and *Zea mays Breeding in New Zealand: Analysis of the probability of perpetuating transgenes in breeding material,* Allan K. Hardacre, Crop and Food Institute, May 2004, p. 9.

266 *We have to test GM in the Kiwi context, NZ Herald*, 28 August 2003.

267 GM moratorium no disadvantage to maize growers, Erena McCaw, Rural News, 3 September 2002.

268 European Science and Technology Observatory (2003) *Review of GMOs under Research and Development and in the Pipeline in Europe.*

A.2 GM Food Plants for Non-food Purposes

A.2.1 Food Plants for Biopharming

Investment in plant biopharming is being made on the basis that plants, including GM varieties, will prove capable of reproducing certain pharmaceutical and industrial substances at costs lower than alternative production routes. In general, the intended product is not a novel one. It is the prospect of a lower cost production method that is attracting research and development.

However, this work carries the potential for major risks to food producers because food plants are overwhelmingly the dominant types being used in the research and development of so called "pharma" crops.[269] The outdoor production of such crops is being trialled in the US and the US Food and Drug Administration (FDA) has already documented the contamination of a soy food crop by trial pharma corn. The breach was due to those managing the trial planting failing to observe the required conditions.[270]

Economic risks

The potential threat to food manufacturers from pharmaceutical contamination is of such concern that even in the home of agricultural biotechnology, the issue has provoked very strong responses, most notably from the country's significant food industry interests. The Grocery Manufacturers of America has recommended that: "The FDA needs to make it absolutely unequivocal that drugs do not belong in food and that FDA will use the full arsenal of its civil and criminal enforcement powers if such non-food or non-feed products appear in the food supply. … FDA should emphasize that the consequences of failed containment are not limited to regulatory violations and are not limited to those directly involved in drug development. Any failure of containment could expose large and small businesses involved at every stage of food manufacture and handling …"[271]

Corn is the plant most commonly used in pharma crop research.[272] The North American Millers' Association is concerned that use of this staple food crop for pharmaceutical production poses a significant risk to the food industry:

> A positive detection of plant-made pharmaceuticals and industrial products in food or feed at any level, therefore, would require the immediate recall and destruction of all products manufactured from that grain. Under current regulatory standards, this zero tolerance creates an intolerable risk for U.S. food processors.
> …

269 Pew Initiative on Food and Biotechnology (2002) *Pharming The Field: A Look at the Benefits and Risks of Bioengineering Plants to Produce Pharmaceuticals*.

270 *FDA Action on Corn Bioengineered to Produce Pharmaceutical Material*, FDA Media Release, November 19 2002.

271 Grocery Manufacturers of America (6 February 2003) *Food Industry Comments on Proposed FDA Regulations for Plant-Made Pharmaceuticals*.

272 Pew Initiative on Food and Biotechnology (2002), *Pharming The Field: A Look at the Benefits and Risks of Bioengineering Plants to Produce Pharmaceuticals*, p. 11.

> Consideration [should] be given to prohibiting the use of food crops, especially corn, to produce plant-made pharmaceuticals.[273]

Pharma crops also pose considerably greater environmental risks than GM food crops. An extensive report published by the National Research Council, a part of the US Science Academy, issued the following caution.

> "The production of non- edible and potentially harmful compounds in crops such as cereals and legumes that have traditionally been used for food creates serious regulatory issues. With few exceptions, the environmental risks that will accompany future novel plants cannot be predicted." … "[their introduction]… poses the potential for environmentally associated risks of a wholly different order than those associated with existing transgenic crops." [274]

The concerns outlined above may also have led a leading Crop and Food Institute scientist, Tony Conner, to advise participants of a biopharming seminar in 2003 that he did not expect ERMA would grant an approval for the outdoor release of GM pharma plants.[275] It is reasonable to assume therefore that researchers, especially those at Crop and Food, will be focusing on biopharming prospects that can sustain the costs of indoor production, should the research be commercialised.

Indoor production is likely to provide a mutually beneficial solution to the needs of the pharmaceutical industry on the one hand, and the food industry on the other. Both sectors require purity of product: the food industry must avoid contamination of their products by GM pharma crops, while one of the limitations on commercialisation of any biopharming prospect is the ability to isolate and purify the small quantity of desired product. Indoor production allows much greater ability to manipulate the growing environment (such as the ability to eliminate or reduce pathogenic contamination) as well as what is emitted from it (such as crop residues in soil and pollen flow).

Control options

Confining biopharming to indoor production could therefore represent a means of addressing concerns in respect of actual contamination. However any risk management strategy must also address risks arising from perceived contamination. Given the scale of damage that could result from any actual escape of altered genetic material, and the potential for concerns amongst overseas buyers not familiar with the particular controls, the only standard that would seem workable is one requiring that no altered genetic material escaped into the environment. This is effectively a lab standard.

273 Letter from NAMA to Regulatory Analysis and Development, APHIS, March 22, 2004,

274 US National Research Council (2002) *The Environmental Effects of Transgenic Plants*, p246.

275 Oral statement by Tony Conner to the Symposium on Biopharming, Royal Society Buildings, Wellington, 28 May 2003.

A.2.2 Food Plants for Industrial Substances

A companion technology to biopharming is the use of food plants to produce industrial substances such as plastics. For regulatory purposes, they can be grouped with pharma crops and treated similarly.

Food crops are already used to produce industrial substances: conventionally bred food crops such as corn and sugar beet are used in ethanol production, and potatoes are used to produce industrial starches.

The hope with GM industrial crops is that domesticated and well characterized food crops might be modified to produce industrial substances (biofuels, oils, starches and plastics) more efficiently than wild plants, or that industrial feedstocks may be produced more environmentally sensitively than production by chemical processes. In the US, research is underway to genetically modify soy and corn varieties to produce petrol.[276] One of the most advanced GM biofuel plant projects using food crops is a GM potato variety that produces industrial starch.[277] An application for commercial cultivation of the potatoes in Sweden is currently filed with the European Union regulatory authorities.

In the UK, GM food and feed crop varieties (GM herbicide resistant oilseed rape and sugar beet) were proposed for biofuel generation. However, these two GM crops were also found to adversely affect farmland wildlife and are unlikely to be approved for cultivation (see Section 2.3.2). An additional consideration is the potential for actual or perceived contamination of the food chain by GM food crops producing industrial substances places. While the potential medical consequences of ingesting food contaminated with industrial substances instead of pharmaceuticals may differ, as a class the risks are of much the same level and form and it would seem appropriate to treat such GM activities in the same way and prohibit them.

Plant-based fuels offer a potential but small part of the solution needed to reduce fossil fuel use and to develop more sustainable energy sources[278]. Yet as identified by the US National Research Council, the potential ecological effects that the presence of new precursor compounds for plastics new to the plant kingdom may hold have yet to be identified and researched (See Section 2.3.4).

Thus far, the GM potato appears to be the most advanced of the GM industrial plant projects. Other applications are further out due to the complex or novel biochemical pathways involved.[279]

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276 Iowa State University Centre for Designer Crops.

277 The potatoes, developed by BASF subsidiary Amylogene, produces an industrial grade starch (high amylopectin starch content) that is tailored to the needs of industries such as paper production. Regulatory approval is not sought for human consumption; however, following extraction of the starches, the potato pulp is intended for use in animal feed. Amylogene HB, Summary Notification C/SE/96/3501

278 Plant biofuels can only replace a small portion of the petroleum based fuels due to the land required. J D Murphy (2002) "Biotechnology and the improvement of oil crops, genes, dreams and realities." In: *Phytochemistry Reviews* 1: 67-77.

279 Genewatch (2004) *Non-Food GM Crops: New Dawn or False Hope? Part 2: Grasses, Flowers, Trees, Fibre Crops and Industrial Uses*, p. 19.

A.2.4 Food Plants for Biocontrol and Bioremediation

Limited research is being pursued using food plants as biocontrols. In New Zealand, one of the avenues using GM to control possum population is GM carrots.[280] The experimental project is to develop carrots that control female possum fertility by delivering an oral contraceptive (GM potatoes are also being used in the experimental stages).

The practicality of this method for controlling the possum population (its comparative effectiveness and safety to 1080) has yet to be demonstrated as the experiments are in their early stages. Currently, the GM carrots are being developed in the US and Australia. In 2001, ERMA granted approval for GM carrots and potatoes developed by Landcare's US research partners to be imported for contained feeding trials.[281]

Use of a vegetable crop to deliver fertility control to possums is likely to raise significant market issues, particularly given the scale and regularity with which the GM bait would need to be delivered to ensure a high level of infertility within the possum population. If the product proves viable as a biocontrol, large-scale production of the GM carrots (and potentially potatoes) in New Zealand, stringent controls would need to be set to limit the risk of the GM carrots entering the human food chain[282]. If market resistance is sustained, such controls may not be sufficient to reduce marketing and branding risks. In this sense, the use of food plants used for GM biocontrol poses similar risks to pharma crops in marketing and branding terms so there would be good grounds for treating them similarly.

A.2.4 Food Plants for Fibre

We are not aware of research in New Zealand or overseas into fibre crops based on food plants that would be ready for release in the next five years.[283] For the sake of clarity and consistency, it would seem appropriate to treat this class of activity for release similarly to other food plants.

A.2.5: Food Plants for Animal Feed

The cultivation of GM animal feed in New Zealand pastures raises high risks of actual or perceived contamination of other food products. This is particularly the case as most animal feeds incorporate crops that are also grown for direct human

280 Dr Phil Cowan, Landcare (2000) Submission to the Royal Commission.

281 Application GMC00020

282 Continued overseas production of the GM carrots (should this control method prove effective) may reduce the marketing risks arising from cultivation in New Zealand, yet this could make the proposed control method economically unviable by dramatically increasing the overall costs.

283 There are crops with both food and fibre uses. GM cotton is a key example where the crop is grown principally for fibre use, but cotton oil can also be derived from it. As is discussed below, New Zealand does not grow cotton so this issue is unlikely to arise. Another potential example is flax. A form of GM flax has been developed in Canada and forms of flax can be used to derive edible linseed. Such a use here would seem very unlikely due to the cultural concerns it would pose.

consumption. In New Zealand, the most likely use of a GM crop for animal feed in the near future is GM maize. Maize for silage is the single biggest crop in the arable sector.[284] As discussed above, the maize for starch production sector is particularly susceptible to the potential for harm by association as much of the sector is producing for customers that have a zero tolerance policy to trace GM contamination.

[284] Statistics New Zealand, *2002 Agricultural Production Census (Final Results) June 2002: Commentary.*

A.3 GM Non-food Plants

A.3.1 Non-Food Plants for Fibre (cotton)

GM cotton is one of the four dominant GM plant varieties – and the sole GM fibre crop to reach commercial production. However cotton is not grown commercially in New Zealand and there are no indications that this is expected to change.[285]

A.3.2 Non-Food Plants for Fibre (forestry)

Wood is a significant production sector for Northland and is New Zealand's third biggest export earner, with forestry accounting for $2.9 billion in sales or 8% of export income.[286]

New Zealand is one of a just a few countries undertaking field trials of GM tree varieties. These countries include Australia, Canada, Chile, France, Italy, Japan, South Africa and the US, with the last accounting for 61% of field trials.[287] The bulk of GM forestry research is directed at three plantation species: poplars, pine and gum varieties. Pine is the central focus of New Zealand research by the Forest Research Institute, which is also conducting trials on spruce. For the time being, the crown research institute is the sole entity field trialling GM trees. In the last few years private sector companies - Carter Holt Harvey and Fletcher Challenge - that were engaged in GM tree R+D and had received regulatory approval to advance to field trial phase have set aside these plans.

While commercial cultivation appears to be imminent in Latin America,[288] the prospect of commercial cultivation of GM trees in New Zealand is likely to be around a decade away. Tree trials are longer in duration, due to the longer life cycle of tree species comparative to food crop species. FRI trialling of GM pine and spruce is an 11-year project, while a further GM pine trial investigating the species' reproductive development is 22 years in duration.[289]

Market Acceptance

Although development of GM forestry varieties has been underway for some time, consideration of whether to adopt GM forestry is increasingly being seen as a market acceptance issue. This is primarily due to the exclusion of GM trees from a new global certification regime for sustainable forestry.

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285 MAF (May 2002) Border Control for Genetically Modified (GM) Seeds, MAF Discussion Paper No: 31, p. 3.

286 Statistics New Zealand. New Zealand External Trade Statistics, June 2004.

287 Roger A Sedjo (2004) *Genetically Engineered Trees: Promise and Concerns*, p. 30.

288 Ibid, p. 4.

289 ERMA application codes GMF99005 and GMF99001 respectively.

Forest Stewardship Council (FSC) certification has become the preferred standard and it prohibits the use of GMOs in FSC accredited plantations.[290] Draft standards for New Zealand FSC, if adopted, would further prohibit certificate holders from field trialling GM trees, and from laboratory research for the development of GMOs for commercial release.[291]

Industry experts predict that FSC certification could become a prerequisite for market access in the future:

> "If the current trend continues certified wood is likely to be the norm rather than something a few owners are making a small premium on. … FSC certification will soon become a standard requirement for selling wood products in the New Zealand and international markets. Those that do not have certification may suffer in terms of market access or discounted log prices." [292]

As of 2005, 42% of all New Zealand plantation forests are FSC certified.[293] Withdrawal from GM R+D from major forestry companies appeared to have been driven by branding considerations. [294] It is understood that FSC certification offered higher economic returns than the GM route for Carter Holt Harvey. Further, the industry has identified country brand vulnerability to the introduction of GM forestry to forestry production:

> "Offshore competitors, unable to profit from biotechnology in their own country's forests (mainly in those countries, unlike New Zealand) who still rely on native forests for wood production, could seek to enhance their competitive position against New Zealand by encouraging consumers to believe that wood produced from New Zealand biotechnology and trees carries a high risk." [295]

Cross sector effects: GM pine pollen and food production

Analysis to date has not adequately assessed the potential spillover effect of a non-food GM release on food and other products. In particular, the extent to which New Zealand's forest products would suffer in branding and marketing terms, and how these losses would measure against potential gains from GM forestry have yet to be assessed. Another factor in light of the existing pest problems posed by pines is the impact of wilding GM pine populations could have.

A concern with broad ramifications is the impact of GM pine pollen dispersal on non-GM foods. While the pollen would not interfere with the reproduction of food plants,

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290 Use of biological control agents shall be documented, minimized, monitored and strictly controlled in accordance with national laws and internationally accepted scientific protocols. Use of genetically modified organisms shall be prohibited. Section 6.8, Document 1.2 (Revised February 2000)

291 Forest Certification New Zealand Inc. National Standard for Certification of Plantation Forest Management in New Zealand. Clause 6.8, Draft 1, November 7 2002.

292 P F Olsen, forestry management service. See also: Olsen News, Issue No 15 – June 2001, http://www.pfolsen.co.nz

293 New Zealand Forest Industry Council. *Forestry Facts and Figures*, 2004/2005.

294 *Forestry group abandons GM trial*, NZ Herald, November 24 2001

295 Carter Holt Harvey, Fletcher Challenge Forests (2000) Joint Submission to the Royal Commission on Genetic Modification.

GM pine pollen is nonetheless capable of clinging to food produce. This is a significant consideration for two reasons:

a) Pine pollen can travel for hundreds of kilometres, affecting very large areas; and
b) Some tests for trace GM content involve crushing the entire food such that any GM pollen clinging to the skin can trigger a GM contamination report, even if the product itself is non-GM.

The latter issue was highlighted by Zespri International in its presentation to a Parliamentary select committee in October 2003. General Manager for Innovation, Nigel Banks, noted that kiwifruit were especially at risk as the fruit's furry skin readily traps pine pollen. This indirect physical contamination pathway has yet to be fully explored to identify which other crops are similarly at risk and whether testing protocols could be altered so that positive contamination results could be waived if only surface GM pollen was detected.

The second and linked consideration is perceptions of contamination simply because a GM plant is growing in the same area, even though it is not a food plant. Again, Zespri offers caution in this respect:

> New Zealand is especially exposed to the potential impacts of negative perceptions associated with a change to our status as a GE-free food producer. The New Zealand horticulture sector is potentially one of the most vulnerable among these because of the huge importance of the image of the New Zealand horticultural production environment in the minds of consumers of our horticultural products. These perceptions and Zespri's reputation for producing safe to eat fruit, naturally, have been built over time and after years of careful investment. Trust once broken will not easily be restored.[296]

A key question is whether New Zealand is more vulnerable in this respect than agricultural areas of Australia, and if so to what degree. As described above, a number of Australian states have been sufficiently concerned about the potential effects GM food cultivation to prohibit this. However, at the same time two have allowed GM cotton production[297] – a non-food fibre plant. The utility of the related precedent requires investigation.

Councils have the option of adopting a strongly precautionary approach and prohibiting the release of GM fibre plants, or alternatively regulating for these as discretionary activities. If GM fibre plants are to be managed as a discretionary activity, the following could be incorporated as conditions to a consent:

> 1. An effective mechanism must be available that would protect non-GM food producers from having their products register positive for GM contamination due to GM pollen from the activity; and
>
> 2. Evidence is provided that food producers will not suffer to any significant extent from perceptions that GM trees contaminate food products.

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296 Zespri (2003) Submission to Parliamentary Select Committee considering the NOOM Bill, p. 2.

297 GM cotton is commercially grown in New South Wales and Queensland.

A.3.3 Non-Food Plants for Biopharming and Industrial Substances

While a number of researchers have pointed out the benefits of using non-food plants for biopharming, superior knowledge of food plants has seen pharma research continue to be overwhelmingly dominated by their use. Thus the availability of pharma crops involving non-food plants for commercial release is a considerable time away. A key consideration in assessing this class of GMO is the level of uncertainty or ignorance regarding the potential ecological effects of the novel plant.

A.3.4 Non-Food Plants for Biocontrol and Bioremediation

Projects have been established to experiment with GM trees to remediate contaminated soils.[298] Further, GM thale cress has been proposed as a potential tool for detecting unexploded landmines in third world countries. However, some landmine experts have questioned the contribution that the GM plant could make and point to potential hazards associated with its use, including enticing livestock onto mined land.[299]

A.3.5 Ornamentals

Flower varieties – carnations and poppies - are the first GM ornamentals. GM carnations and poppies are being cultivated in Australia. In 1997, Crop and Food received approval to field trial GM lisianthus at their research facility in Levin. GM traits include longer vase life and new colours to species.

The introduction of GM ornamental plants for commercial nurseries or private gardens may raise significant biosecurity issues. Ornamental plants are the source of ¾ of invasive exotics in New Zealand today.[300] Around Auckland alone there are four garden escapes annually, as ornamentals establish as weeds. GM ornamentals may pose higher biosecurity risks if the GM traits protects them from management or broadens the ecosystem conditions they can tolerate (salt or drought tolerance).

GM lawn grasses for potential use in amenities such as sports fields and municipal parks and private gardens are also in the pipeline. Recently, an application to allow for the use of GM herbicide resistant bentgrass on golf courses was withdrawn. It is uncertain when the first GM grass will receive regulatory approval. Restricting GM grasses to the site of intentional release will be a significant challenge, because of their capacity for outcrossing, hybridisation and vegetative propagation.[301] The potential for gene flow from GM to non-GM grass is high. Traits such as herbicide resistance could result in invasiveness, and the make management of wild seeding GM grasses more difficult. Grass seed can be spread easily through imported grass seed and bird seed.

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298 The Royal Commission refers to such developments in its report, p. 157.

299 "GM Cress could seek out landmines", BBC, 28 January 2004.

300 *Tiakina Aotearoa. Protect New Zealand.* The New Zealand Biosecurity Strategy, 2003, p. 56.

301 US National Research Council (2004) Biological Confinement of Genetically Engineered Organisms, p. 102. The Research Council notes that few biological confinement techniques have been reported because little funding has been available for basic research (p. 104).

Economic effects

As yet, the economic effects of pursuing commercial GM ornamental planting are not known. However, Tasmania has permitted ongoing cultivation of GM poppies, while placing GM food production under a moratorium until 2008.

A.4 GM Animals

This is a broad-ranging category, including mammals, poultry, insects and fish (as adopted by the US National Research Council). To date, only one GM animal, an ornamental aquarium fish, has been commercialized.[302]

A.4.1 GM Animals for Food

Livestock

Research is being conducted on a range of domesticated animals bred for food. A Canadian University has developed a GM pig breed that processes feed more efficiently has been developed. The so-called 'enviropig' is reported to excrete less phosphorous.[303] GM experimentation involving poultry is being conducted in other countries, yet this does not appear to have resulted thus far in breeds that are close to commercialisation.

Thus far, New Zealand research has brought forth a single GM experiment involving livestock for food purposes that has reached field trial phase. In 2000, AgResearch received regulatory approval to commence outdoor trials for a GM sheep; as yet, however, the trials have not commenced.[304]

Marketing issues

The slower pace of developing GM livestock breeds may be in part due to the greater technological challenge: one that Fonterra scientists have claimed not only faces significant technological hurdles, but is of questionable benefit and may also meet with market resistance.[305] This may explain why the dominant focus of producer board spending in research is exploring new commercial opportunities through biotechnology tools that do not require GM livestock for financial returns to be secured. Major research vehicles of the meat and dairy industry (such as Ovita) instead have turned largely to gene sequencing and the identification of genetic traits of commercial interest that can then be introduced and multiplied through traditionally bred stock.

Meat and dairy producer boards have also adopted policies that explicitly exclude the use of GMOs. Meat New Zealand (now Meat and Wool New Zealand) states:

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302 A GM zebrafish was granted regulatory approval in the US in 2004. Pew Initiative on Food and Biotechnology (2004) *Issues in the Regulation of Genetically Engineered Plants and Animals*, p. 101.

303 The pig is genetically engineered to secret phytase, an enzyme which degrades plant phosphorus, allowing the pig to utilize it more efficiently.

304 GMF99004, AgResearch genetically modified sheep with an inactivated myostatin gene.

305 "Leaving aside genetic modification for the production of nutraceuticals in milk, it seems unlikely that transgenic modification of milk for functional or nutritional purposes will occur in the foreseeable future." L Creamer et al. "Dairy Products in the 21st Century". In: *J. Agric. Food Chem.* 2002, *50,* p. 7189.

> Meat New Zealand's policy is that no genetically modified products will be developed for release into the food chain while a majority of consumers remain concerned about GM foods.[306]

Meanwhile, the Deer Industry New Zealand explains:

> At this stage, Deer Industry New Zealand does not support the introduction of GM organisms into animals or into the deer industry food chain (including pastures and feeds).[307]

These policies send clear signals to export markets such as the UK, New Zealand's number one export destination for sheep meat[308] All major UK supermarkets have adopted policies precluding the use of GM food ingredients in house brands; these supermarkets have a policy of providing their customers with the option of animal products not produced with GM animal feed, or ensure that products are labeled as such. New Zealand sheep meat suppliers to Tescos, the single largest UK buyer of New Zealand mutton and lamb, require farmers to quality assure that the animals supplied are not genetically modified and have not been reared on GM animal feed.[309]

GM Fish

While the market reception of GM fish has yet to be tested, there is no reason to assume that it will be exempt from the consumer and gatekeeper resistance that has met GM foods thus far. Containment of GM finfish and shellfish will also pose significant challenges, which will likely raise significant market and ecological issues.

An indication of the possible sensitivity to GM in fish production is the policy of the largest King Salmon exporter. King Salmon (also known as Chinook or salmon) is the most significant finfish in New Zealand aquaculture. 70% of King Salmon exports are destined for Japan.[310] In the 1990s, King Salmon Ltd was conducting trials on GM king salmon in order to increase growth rates. The company has since discontinued this research, and the marketing of its products are now firmly anchored on assurances that King Salmon are GM free, stating that:[311]

> New Zealand King Salmon uses international sources of feed for the fish that will provide them with a healthy, balanced diet. Formulated by the world's leading salmon

306 Meat New Zealand (2003) Submission to the Education and Science Select Committee on the New Organisms and Other Matters Bill.

307 Deer Industry Policy on Genetic Modification. The producer board's policy is explicitly precautionary: "Deer Industry New Zealand supports the precautionary principle in relation to GM such that Deer Industry New Zealand would not support the introduction of GM to the environment/food chain until the risks associated with that course of action are properly understood and can be assessed as acceptable."

308 As above.

309 Tescos' policy can be viewed at http://www.tesco.com/corporateinfo/. The first indicates the degree of market sensitivity, as no GM animals have been approved for human consumption anywhere in the world.

310 2000 figures provided by the Seafood Industry Council. http://www.seafood.co.nz/business/fishaqua/species/salmon.asp

311 This includes the feed on which the King Salmon is reared. "Art of the Raising and Preparing", http://www.kingsalmon.co.nz/mainsite/ArtOfRaisingAndPreparing.html

> feed suppliers, the raw materials - South American fishmeal and oil - are obtained from good quality, sustainably managed sources and are totally free of any bovine or genetically modified products. […] The salmon are not genetically modified and are healthy and disease free, so antibiotics, vaccines and chemical treatments are not used.[312]

Ecological concerns

Key science institutions in the US and Canada, where GM fish development is furthest advanced, have issued strong warnings on the potential ecological risks posed by GM finfish and shellfish. These concerns are based on the demonstrated impacts of non-GM farmed fish on wild populations. These ecological concerns include the potential for increased fitness of GM species (due to traits such as higher growth rates and disease resistance), and the ability of GM fish species with higher fitness to outcompete wild or native communities, or to disperse the GM trait throughout wild or native communities by interbreeding[313].

The US National Research Council notes that GM shellfish will require costly containment that may still not provide the level of containment required to prevent shellfish from outcompeting naturally occurring shellfish populations.[314] The Council noted that ecological principles and empirical data indicate "a considerable risk of ecological hazards being realised should transgenic fish or shellfish enter natural systems".[315]

Significant aquaculture species in New Zealand are seafarmed or farmed in the intertidal: this includes King Salmon, and shellfish such as oysters and mussels. Pacific oysters (the key shellfish commercially cultivated in Northland) are cultivated on racks in the intertidal.[316] Shellfish containment is particularly difficult at the larval stage, when shellfish dispersal capability is highest.[317]

In its comprehensive report on GM foods, an expert panel of the Royal Society of Canada considered in detail the potential risks that GM fish species (in particular trout and salmon) might pose to native fish populations. The panel concluded that the escape of GM fish from aquaculture facilities could lead to swamping of native fish due to predation, competition for food and feed and the transmission of disease and parasites. The Society noted that interbreeding of GM with non-GM species would not be necessary for such negative impacts to be realised[318] and has called for a moratorium on seafarming GM fish.[319]

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312 http://www.kingsalmon.co.nz/mainsite/ArtOfRaisingAndPreparing.html

313 A concern here is that the GM trait may have unintended effects in wild or native populations that could cause extinctions, by increasing one component of fitness while fatally compromising another. US National Research Council (2002*) Animal Biotechnology: Science-Based Concerns*, p. 84.

314 Ibid**,** p. 11.

315 Ibid, p. 92.

316 NIWA (2003) *Assessment of the Potential for Aquaculture Development in Northland*, p. 8.

317 US National Research Council (2002) *Animal Biotechnology: Science-Based Concerns*, p. 92.

318 Royal Society of Canada (2001) *Elements of Precaution*, p. 151.

319 Ibid, p. 190. The UK Agriculture and Environment Biotechnology Commission (AEBC) came to similar conclusions in their review of the regulatory responses required to address to issues arising with GM animals, noting: "the commercialisation of GM fish raises significant

In New Zealand, the escape of GM fish species could also pose risks to significant trout fisheries. Further, the GM breeds may provide additional challenges for struggling native aquatic species, through direct predation, food and habitat competition, and alteration of habitat. [320]

Although GM Atlantic salmon is nearing commercialisation in the US and developers in China are preparing to apply for regulatory approval for two lines of GM carp[321], commercial GM fish production does not seem appear to be imminent in New Zealand. An approval in another jurisdiction may bring forward a possible desire to introduce a GM fish species in New Zealand.[322]

A.4.2 GM Animals for Fibre

The relationship between food and fibre production in livestock farming is intimate. Animal fibre is an intrinsic by-product of meat and dairy farming - New Zealand's top two export earners.[323] To date, no experimentation to genetically modify livestock for altered fibre has reached development or field trial stage. Domestic genetic research to improve and diversify animal fibre is predominantly genomics, that is, research identifying genes believed responsible for desirable qualities. The findings are used to assist traditional selective breeding programmes.[324]

GM animal fibre production cannot therefore be considered in isolation from its potential effects on the market acceptability of food production. Further, the commercial success of GM animal fibre production requires market approval and acceptance of food products from GM livestock to provide a financially viable opportunity for livestock farmers.

Unless there is consumer acceptance of GM meat, GM livestock fibre is not commercially viable. A review of FRST funding of New Zealand research and development of GM livestock for food and fibre indicates that in both arenas, market approval is some time in the future.[325]

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environmental concerns because of the possibility of the fish escaping from the aquatic net pens used in offshore fish farms." The AEBC therefore recommended: The commercial production of GM fish in offshore aquatic net pens should not be permitted while there is significant uncertainty about the environmental consequences of the fish escaping to the wild and about the containment of the fish in net pens." *Animals in Biotechnology* (2002), pp. 5-6 and p. 38 respectively.

320 Van Roon M and Knight S (2004) *Ecological Contexts of Development: New Zealand Perspective*, p. 205. Van Roon and Knight note that although it is difficult to draw direct links between the introduction of exotic fish species and the fate of natives, in some instances the linkages are clear. Severe decline in the native galaxiid koaro followed introduction of trout to Rotorua lakes in the 1900s. Further research suggests that giant kokopu do not survive in the presence of brown trout.

321 Ibid, p. 5.

322 Enterprise Northland (2004) *Northland: State of the Economy, November 2004.*

323 Wool is New Zealand's tenth largest export while hides and leather from livestock rank as New Zealand's 12th largest. Statistics New Zealand (June 2004) External Trade Statistics.

324 Some experimentation is being conducted in Canada to modify goats that will produce spider's silk in their milk. Nexia Biotechnologies, "Biosteel Extreme performance fibers", http://nexiabiotech.com

325 The review was conducted using the Foundation for Research Science and Technology Funding database and the ERMA approval database.

Overall, it is not expected that any GM animal fibre application will be ready for outdoor commercial breeding in the next five years.

A.4.3 GM Animals for Biopharming and Industrial Substances

Food Animals

A UK Government committee estimates that around 50 products are in development that use pharmaceutical substances produced by GM animals. Most of these are farm animals, although fish are also being considered as potential pharmaceutical producers.[326] In New Zealand, the most advanced R+D projects using farm animals to produce pharmaceutical proteins by Crown Research Institute, AgResearch, involves GM cattle engineered to produce proteins for potential use in the treatment of multiple sclerosis.[327] Until 2004, New Zealand was also the site of experimental production of pharmaceutical proteins in GM sheep. The protein was being produced in the sheep milk engineered with a human gene sequence coding for AAT protein, and was destined for incorporation in a treatment to slow the progress of cystic fibrosis. The trial, conducted by Scottish-based company PPL Therapeutics, was abandoned in 2003 after commercialization partner, Bayer, withdrew from the joint venture.[328]

The use of livestock animals (animals that are part of the human food chain) to produce pharmaceutical or industrial substances is likely to raise clear marketing issues around the food chain safety and integrity. This, although livestock breeds such as cattle or sheep may be more easily contained than some plants, and the value of the animals will provide incentives to ensure they do not escape.

The ability of handlers and processors to ensure that biopharming animals and their products are kept distinct from animals destined for the food chain is a key issue, although physical containment measures may not be sufficient to address market damage from perceptions that the New Zealand or regional supply chain is compromised by the presence of sheep with human genes or pharmaceutical producing cattle. The risks arising from farm animals with such novel genes extend well beyond marketing. Among them, the US National Research Council includes the possibility of generating potentially pathogenic viruses.[329]

There is a strong consensus emerging by review committees established to review the regulatory issues around GM that the use of food animals to produce pharmaceutical (and industrial) substances is not advisable. The US National Research Council recently reviewed biological means of confining GMOs and noted that with respect to

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326 UK Agriculture and Environment Biotechnology Commission (2002) *Animals and Biotechnology,* p. 13.

327 The cattle are engineered with human myelin basic protein. The medical viability of these proteins has yet to be demonstrated. Further details of the AgResearch project are available at http://www.ermanz.govt.nz/news-events/focus/gm-cattle-field.asp

328 "Transgenic sheep slaughtered as Dolly's creators run out of money", *The Independent* (UK) July 16 2003 and "Dolly the Sheep Firm Faces the Chop", Reuters, September 15 2003.

329 These could arise from recombination between sequences of the vector used to introduce a transgene and related, non-anthropogenic viruses already present in the animal. US National Research Council (200) *Animal Biotechnology: Science Based Concerns,* p. 52

production of pharmaceutical or industrial substances in animals: "Alternative nonfood host organisms should be sought for genes that code for transgenic products that need to be kept out of the food supply."[330] Similarly, the Royal Commission also recommended that food animals be avoided in biopharming. Recommendation 7.5 states: "wherever possible, non-food animals, or animals less likely to find their way into the food chain, be used as bioreactors rather than animals that are a common source of food."[331]

Markets

While Europeans, like New Zealanders, show support for medical applications of GM, their rejection of GM foods is high. As indicated above, New Zealand sheep farmers producing for Tescos must already prove that the sheep are not genetically modified, even though no GM sheep breeds have yet been approved for the food chain. As a representative of the US National Food Processors Union noted the news headline "*Medical Carrots Containing Vaccine Found in Baby Food: Recall Underway*" is "something we never want to see"[332], the potential effects of a single contamination incident involving a pharmaceutical producing GM farm animal could deliver a devastating blow to the reputation of the New Zealand meat industry.

This is particularly the case with respect to highly sensitive consumers such as those in the UK (New Zealand's largest sheep meat market), for whom the memory of BSE and foot and mouth outbreaks will still be fresh. As the US National Grain and Feed Association submitted with respect to GM pharma food crops, "the cost exposure to the grain and food industry from another contamination incident is potentially huge, with a long-term impact over many years. So that even a small probability of an accident occurring is a highly significant risk exposure to the existing grain and food industry." [333] There is no reason to believe that New Zealand's valuable sheep and beef meat industry would fare better if such an event were to occur.

Non-food animals

Research is also being conducted using non-food animal species to produce pharmaceutical substances. Examples of animal species used for these purposes that may not trigger negative perceptions or present a risk to the supply chain include silkworms that are increasingly seen as offering great potential for efficient production of commercially valuable substances.[334] These are viewed as less risky as

330 US National Research Council (2004) *Biological Confinement of Genetically Engineered Organisms*, p. 6.

331 Royal Commission report, p. 162.

332 Pew Initiative on Food and Biotechnology (2002) *Pharming the Field.* Proceedings from a workshop sponsored by the Pew Initiative on Food and Biotechnology, the US Food and Drug Administration and the Cooperative State Research, Education and Extension Service of the US Department of Agriculture, July 2002, p. 16.

333 US National Grain and Feed Association (2003) Submission to the US Food and Drug Administration on "Guidance for Industry: Drugs, Biologics and Medical Devices Derived from Bioengineered Plants for Use in Humans and Animals".

334 Pew Initiative on Food and Biotechnology (2004) *Bugs in the System? Issues in the Science and Regulation of Genetically Modified Insects*, p. 26.

they are intended for indoor production, whereas GM farm animals used for pharmaceutical production would likely be intended for outdoor breeding.

A.4.4 GM Animals for Biocontrol

Biocontrol

Biocontrol involves the use of living organisms to target other living organisms that have become a public health, ecological, or economic threat. Typically, it involves the introduction of one (usually) exotic species to an ecosystem to combat another exotic species that has become a pest, due to a lack of natural predators that serve to control the population of the intruder. Biocontrol is thus an alternative to chemical control methods (such as the use of pesticides). New Zealand has a long history of biological control, including biocontrol introductions that have proved disastrous (the introduction of stoats and ferrets in an attempt to control rabbits) and later, highly successful application of this approach (controlling insect pests in agriculture and forestry) that have undergone increasingly more rigorous assessment.[335]

The traditional challenge that biocontrol poses arises because the behaviour of an exotic species in a new environment can never be fully predicted. A potential outcome of biocontrol using live organisms is that one exotic pest species may be replaced by another. While subject to rigorous assessment, biocontrol can be a high risk strategy that may be further compounded by genetic modification, where this confers enhanced fitness on the biocontrol agent. In a review of GM technologies for possum control, the Parliamentary Commissioner for the Environment noted:

> The extent of what is yet known about biocontrols of genetically modified organisms is perhaps the most difficult and challenging aspect of this investigation. There are vast and fundamental gaps in our knowledge of those technologies, how they function, and what effects they might have on New Zealand's unique biodiversity, on non-target species or the broader environment […] There are equally critical gaps in our knowledge and understanding of the attitudes and acceptability of thresholds of New Zealanders, and of consumers in our overseas markets, for such technologies. It seems a precarious course for New Zealand's environmental, social and economic future to advance technologies with such potentially awesome powers and capacities, when so little is yet known about the methods themselves, their possible effects, and societal responses.[336]

GM Insects

GM insects are being considered for several biocontrol functions, among them, controlling insects that spread disease to humans and animals. The aim would be to replace populations of insects which spread disease to humans, livestock or plants with almost identical populations which do not cause this damage. Other biocontrol roles include eradicating pest species.

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335 Parliamentary Commissioner for the Environment (1999) *Caught in the Headlights: New Zealanders' Reflections on Possums, Control Options and Genetic Engineering*, pp. 15-16.

336 Ibid, p. 86.

While GM insect R+D is still at an early stage, there is general agreement that GM insects pose unique risks[337]. Like GM aquatic organisms, GM insects are considered to pose a particularly high ecological risk due to their mobility and their size. It is generally accepted that once released, GM insects will be difficult to recall. GM sterility is being pursued as an option to reduce the potential for GM biocontrol agents establishing unwanted populations. However, there is as yet little research into GM biological confinement techniques, and current methods for sterilization to prevent GM insects from mating to breed new populations (radiation) reduces the vigour of the insects by ten times, and may thus compromise the biocontrol function of the insects[338]. Moreover, the large number of insects in any population could make even a small failure of sterility techniques problematic.[339]

This is particularly the case as GM insects for biocontrol are designed to establish in ecosystems. For example, GM insects designed to replace insects that transmit diseases must establish in the environment to achieve their intended function.

In a review of the issues and regulatory responses required to address GM insect releases, US scientists note that traditional genetic improvement of biological control agents used for suppressing pest insects has involved removing biological boundaries (lengthening life active phases in life cycles, increased tolerance to temperature extremes) to ensure they effectively combat target pests.[340] As the review notes:

> The risks of biological control agents emerge from the same qualities that can make them successful. They exhibit the ability to disperse widely, have a high reproductive rate, establish permanently in the new environment, and are intrinsically programmed to harm other insects or plants.[341]

The emergence of new pest species from feral biocontrol introductions may also have economic effects on agricultural production. For this reason, the use of biocontrol agents will need to be subject to strict evaluation.

GM roundworms to control possums

The leading GM biocontrol animal agents under development in New Zealand are targeted at possum control. AgResearch is experimenting with the use of GM parasites. The research involves genetically engineering an intestinal worm (nematode) to carry a biocontrol that could control possum fertility or vaccinate possums against Tb, thus serving as a self-maintaining biological control system.[342]

The BERL report cites the following as the current state of research:

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337 US National Research Council (2002) *Animal Biotechnology: Science-Based Concerns*, p. 83.

338 US National Research Council (2004) *Biological Confinement of Genetically Engineered Organisms*, p. 4. UK Government Agriculture and Environment Biotechnology Commission (2002) *Animals in Biotechnology*, pp.13-14.

339 National Research Council, ibid.

340 Pew Initiative on Food and Biotechnology, Bugs in the System. Issues in the Science and Regulation of Genetically Modified Insects, p. 30.

341 Ibid, p. 33.

342 Dr David Heath (AgResearch) presenting to the Royal Commission, New Zealand Association of Scientists Hearing, 24 January 2001, Transcript, p. 2639.

> "Two possibilities have been suggested; GM-based fertility control and GM vaccines. […] Both could be distributed by using a possum-specific parasite (nematode) as a vector. Fertility control is considered unlikely to be viable for another 5-10 years, but a Tb vaccine is probably viable within 2-5 years." [343]

The implication therefore is that even if a GM Tb vaccine is proven in the next 2-5 years, it would be somewhat longer before this would be commercialised. Evidence given to the Royal Commission in 2001 stated that an initial product suitable for testing in the field was likely to be at least five years away. After initial field-testing, development and refinement was likely to continue for a further 3 to 5 years.[344]

[343] MfE (2003) *Economic Risks and Opportunities from the Release of Genetically Modified Organisms in New Zealand*, p. 42.

[344] Dr Phil Cowan, Landcare (2000), Submission to the Royal Commission, p. 3.

A.5 GM Microorganisms

The term microorganism refers to viruses, bacteria and fungi. The actual or potential uses of GM microorganisms include production of pharmaceuticals, fermentation, vaccines in human and veterinary medicine, biocontrol and bioremediation. Much of the application of GM to microorganisms does not require the release of GMOs to deliver their intended benefits.[345] This section provides examples of outdoor use of live GM microorganisms to indicate the kinds of applications that are coming forward in New Zealand and other jurisdictions.

A.5.1 Vaccines

Vaccines are used extensively in the prevention or limit the effects of diseases to which both humans and animals are vulnerable. Immunisation is developed using bacteria or viruses, and delivery methods that include injection, inhalation and ingestion. Parasites – such as intestinal worms (see above) – may also be used to deliver the vaccine.

Vaccines allow for health care to focus on prevention rather than therapy. GM offers the possibility of developing vaccines for a number of diseases for which vaccination is theoretically possible, but for which no vaccines yet exist. GM vaccines are considered to provide safer and more effective approaches to disease prevention.[346] [347]

The potential for negative effects of the vaccine beyond any benefits to the target population will in part be determined by the ability of the live GM vaccine to persist and replicate in the environment. There appears to have been little risk-associated research on the potential negative ecological effects thus far.[348]

The GM vaccines that may pose direct ecological or market risks in themselves are vaccines that comprise **live** GM final products. The vaccines that do not contain live GMOs in the vaccine are not considered here. (These include so-called subunit vaccines and recombinant vaccines that contain pure proteins).[349]

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345 Note that large-scale fermentation using microorganisms does entail significant waste disposal issues.

346 New Zealand Veterinary Association (2000), Submission to the Royal Commission. Also see T Traavik (2002) "Environmental risks of genetically engineered vaccines". In: *Genetically Engineered Organisms: Assessing Environmental and Human Health Effects*.

347 The approval for use of live GM vaccines is guided by HSNO, as these constitute new organisms. ERMA is able to co-decide with or delegate decisions regarding the approval for use of GM vaccines to MedSafe (in the case of human treatments) or the Agricultural Compounds and Veterinary Medicines (AVCM) Group under the New Zealand Food Safety Authority (in the case of animal treatments).

348 Most research is focused on identifying potential immunological effects on the vaccinated individuals or population. T Traavik (2002) "Environmental risks of genetically engineered vaccines". In: *Genetically Engineered Organisms: Assessing Environmental and Human Health Effects*, p. 332.

349 As of 2000, with one exception all the GM vaccines approved for use in New Zealand were produced using GM techniques, but the end product does not incorporate a live GMO. The exception is a single, live GM vaccine (a cholera vaccine) was recalled under instruction from

The types of GM vaccines that may pose ecological and other risks that extend beyond the target population are:

1. **Vectored DNA vaccines** (live viruses that are capable of infecting, but not harming, the target organism in order to deliver the vaccine which has been introduced by GM)
2. **Gene-deleted viral vaccines** (live vaccines incorporating the virus that causes the disease)
3. **Naked DNA based vaccines** (where a defined segment of DNA that will cause immunity to the disease is injected into the target organism)

Ecological risks

Microorganisms are ubiquitous, and play many vital functions in environmental metabolism, for example, mineralisation of organic matter, nitrification and nitrogen fixation.[350]

At a general level of risk, the US National Research Council notes that the implications of releasing GM microorganisms into the environment have yet to be adequately analysed:

> […] information about the ecology and evolution of transgenic microbes in the wild is limited. Microbes [microorganisms] occur in extremely large populations with short generation times, so they adapt quickly to adverse conditions. Their environments change constantly, resulting in unpredictable and variable selection pressures.[351]

There is some evidence that GM bacteria have reduced survival fitness due to the load that the additional (inserted) genetic trait places on them. However, it cannot be claimed that all GM bacteria are 'unfit' in the natural environment, as the ability of the GM bacteria to persist may depend on where it its environment, with a host of variable selection pressures.[352]

It is generally accepted that viral recombination in natural infections is a major driver in the evolution of new viruses. One of the theoretical risks posed by live GM vaccines is the potential for the development of new strains of the virus or bacteria by processes such as horizontal gene transfer, which may increase the range of species that the virus or bacteria may affect. The non-target species may be ill-prepared to defend itself from attack by the new virus due to a lack of genetic resistance. According to the NRC, more research is needed to evaluate the risks associated with the release of GM viruses.[353]

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the Ministry of Health when it was discovered that the product had not undergone the required assessment by ERMA. Royal Commission report, pp. 248-9.

350 OECD Working Group on Harmonisation of Regulatory Oversight in Biotechnology (2004) *Guidance Document on Methods for Detection of Micro-Organisms introduced in the Environment: Bacteria*, p. 10.

351 US National Research Council (2004) *Biological Confinement of Genetically Engineered Organisms*, p. 139.

352 Ibid, p. 142.

353 Ibid, p. 140 and 144.

Horizontal gene transfer amongst bacteria is also well documented (although there are methods that may reduce the probability of this form of gene exchange from occurring).

Biological confinement measures to limit or eliminate the spread of GM microorganisms are largely focussed on reducing their fitness. The efficacy of these methods has yet to be demonstrated in the natural environment. There is as yet little data on the long-term persistence of GM vaccine viruses, and the efficacy of techniques that handicap (attenuate or weaken) the virus are not yet clear.[354] The engineering of suicide genes in bacteria is the subject of laboratory experiment, but it is understood that suicide genes can reduce, but not eliminate a survivor GM bacterial population.[355]

Markets

Thus far, there appears to be little end-consumer concern regarding the use of GM vaccines. GM vaccines may reduce the need for use of antibiotics in intensively farmed livestock, which has become a focus of consumer concern. Given the resistance to GM foods, it is yet to be seen how consumers will react to the use of GM vaccines as a substitute for antibiotics once their use and consumer awareness of that use is more widespread.

It remains to be seen whether detectability of the GM vaccine in end products (e.g., GM vaccine marker genes detectable in meat) will raise issues with gatekeeper buyers such as supermarkets and food processors, who are anxious to avoid loss of consumer confidence in their products should GM be detected in a random test conducted by consumer advocate groups.

A.5.2 Bioremediation

Experimentation with the genetic modification of microorganisms is underway with a view to refining the tools for the remediation of contaminated sites. Bacteria are among the organisms of choice for this purpose. The ability of to alter the metabolic pathways of microorganisms to mineralise contaminants is seen as the source of their potential usefulness in bioremediation.[356]

The use of GM bacteria for bioremediation does not necessarily require a release: GM bacteria can be used as *biosensors* as a preliminary screening system detect the presence and potential toxicity of contaminants at a site.[357] Some GM microorganisms are being developed for release at a contaminated site. GMOs are also being developed to bioremediating the target pollutants, although it appears that the initial GMOs developed for this purpose have not performed well in the field.[358]

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354 Ibid, p. 147.

355 Ibid, p. 152.

356 WS Atkins Environment (2002) *Genetically Modified Organisms for the Remediation of Organic and Inorganic Pollutants.* A report commissioned by the UK Government Department for Environment, Food and Rural Affairs, p. 9.

357 Ibid, p. 149.

358 Ibid, p. 151.

Thus far, this area of GM application is still largely confined to the laboratory; however, a handful of field tests for GM microorganisms designed for bioremediation have been conducted overseas.

For GM bacteria to act effectively as bioremediators in a contaminated site, they must be able to survive, compete and be able to degrade or accumulate the target pollutant.[359] These same characteristics may be the source of a risk that the GM bacteria will persist (at the site and beyond the site) well after the task for which it is released has been completed. As discussed above, dependable biological containment mechanisms that might reduce the undesired spread of GM microorganisms, or their parts are still to be demonstrated.

Much bioremediation will occur in terrestrial environments, and will be focussed on restoring polluted soil systems in particular. Contaminated sites may pose ongoing and, in some cases, acute risks to biodiversity and to the local economy, making a strong case for bioremediation of some form, where non-GM organisms can also contribute. This said, considerable research is still required to gain baseline knowledge, such as the functioning of microbial populations (the biodiversity of New Zealand's microorganisms is poorly understood[360]), in order to begin to assess the potential behaviour and effects that the introduction of GM microorganisms will have.[361]

359 WS Atkins Environment (2002) *Genetically Modified Organisms for the Remediation of Organic and Inorganic Pollutants.* p. 22 and 88.

360 Ministry for the Environment (1997) *The State of New Zealand's Environment*, Chapter 9.

361 WS Atkins Environment (2002) *Genetically Modified Organisms for the Remediation of Organic and Inorganic Pollutants*, p. 149.

Appendix 2
Australian States Prohibiting GM Food Cultivation

Australian legislators have developed a model of joint decision-making by federal and state governments with respect to GM release that defines distinct roles for the two levels of government in assessing GMO release applications.

Section 21 of the Australian Gene Technology Act 2000 (GTA) requires the federal Gene Technology Regulator (the equivalent of ERMA) to assess applications for GMO release in terms of their effects on human health and the environment. Its duties are broadly science-based assessment. States, on the other hand, are provided with a right to decline the release of GMOs in their territories on the basis of economic considerations.

> **"21 Ministerial Council may issue policy principles**
> 1) The Ministerial Council may issue policy principles in relation to the following:
> (a) ethical issues relating to dealings with GMOs;
> (aa) recognising areas, if any, designated under State law for the purpose of preserving the identity of one or both of the following:
> (i) GM crops;
> (ii) non-GM crops;
> **for marketing purposes**;
> (b) matters relating to dealings with GMOs prescribed by the regulations for the purposes of this paragraph." [Emphasis added][362]

This provision has been invoked by at least five of the eight states including: New South Wales, Western Australia, Tasmania, Victoria and South Australia. Each has introduced legislation that allows the state to effectively prevent all commercial growing of GM foods in their territories for multi-year periods through designations issued under the legislation.[363]

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362 http://scaletext.law.gov.au/html/pasteact/3/3428/top.htm. Note also that 21(3) states "Regulations for the purposes of paragraph (1)(b) may relate to matters other than the health and safety of people or the environment, but must not derogate from the health and safety of people or the environment."

363 Premier of NSW, Press Release (4 March 2003) Labour's Policy on commercial release of GM food crops; Minister of Agriculture, Western Australia, Media Statements 4 April 2003, 25 February 2003 and May 30 2001; Victorian Department of Agriculture (8 May 2003) Press Release; Statement by Agriculture Minister Paul Holloway on ABC news, 9 May 2003; Parliament of South Australia, Select Committee on Genetically Modified Organisms, Final Report, 17 July 2003; Department of Primary Industry, Water and Environment (February 2003) Gene Technology Policy Review Position Paper.