Our land, our air

Land use and soil quality

Our land

Northland has a variety of landforms, soil types and associated land uses. Its landforms range from young active sand dunes along the coasts to relatively old greywacke, and volcanic peaks and hills in inland areas. One of the notable features of the region is that it has few high mountain ranges with no part being more than 800 metres above sea level. It also has few large areas of flat, low-lying land, the most significant lowlands being adjacent to the Awanui and Northern Wairoa rivers.

The soils in the region vary considerably, reflecting the very complex geology, in structure and origin, ranging from those which are poorly drained and relatively infertile (for example, gumland soils), to those which are free draining and fertile, primarily of alluvial or volcanic origin.

Over 230 different soil types have been identified and they are generally shown on the NZ Land Inventory NZMS 290 Map series. Some of this land was formerly covered in forest and large-scale deforestation exposed the soil to erosion with off-site effects of flooding, siltation, lowered water quality, and altered high and low flow regimes in rivers and streams. In Northland farming, forestry and horticulture collectively contribute 13.7% of the Gross Domestic Product (GDP) of the region. The future of these industries depends on maintaining the productive capacity of Northland's soils.

The consequence of poor soil management is not only the loss of productivity but also an increased environmental impact including the downstream degradation of water quality. Previous State of the Environment reports identified sediment as a major contaminant of Northland's rivers.

Under the Resource Management Act, both the regional council and district councils have land management responsibilities. The regional council's responsibilities are fairly specific, relating primarily to soil conservation, mitigation of natural hazards, and control of contaminant discharges and associated water quality management. However, it also has a general overview role in terms of identifying and setting policy in relation to any effects of the use, development or protection of lands which are of regional significance.

The regional council also has a specific function as a catchment board under the Soil Conservation and Rivers Control Act 1941 to minimise and prevent damage within its boundaries by floods and erosion, including doing works to lessen erosion or the likelihood of erosion, and promoting soil conservation.

The district councils have the major responsibilities for controlling the subdivision of land and associated land use activities in terms of their location, servicing, effects on natural features and other amenities.

What do we want for our land and soil?

The operative Regional Policy Statement for Northland details existing council and community objectives for each natural and physical resource in the region. The objectives relating to soil conservation and land management are:

- The maintenance, and where possible, enhancement of the life-supporting capacity of soils, especially those which have potential to support intensive primary production.
- The protection of the soil resources, including soil quality and soil quantity, from degradation or loss as a result of unsustainable land uses and land use practices.
- The safeguarding of the life-supporting capacity of water and ecosystems from the adverse effects of unsustainable land uses and land use practices.

The following are the anticipated environmental achievements after the implementation of the policies for soil conservation and land management in the Regional Policy Statement for Northland:

- Continued availability of highly versatile soils for primary production.
- More widespread adoption of soil conservation practices within land use and subdivision proposals.
- Reduction of erosion in high-risk areas.
- Reduction in the volumes of soil and other contaminants entering surface water bodies.

Note: the operative Regional Policy Statement is currently being reviewed. The proposed Regional Policy Statement (2013) is available at www.nrc.govt.nz/newRPS

A stream on a dairy farm that has been fenced and planted to protect the waterway

What is our land use?

Northland's land resource

Information on soil types along with other related physical factors such as underlying geology, slope and drainage, have been used as a basis for classifying the land nationally and within the region. The NZ Land Resources Inventory Worksheets identify eight broad land classes, along with a number of more detailed sub-classes and units. Class 1 land is considered the most versatile and productive in terms of conventional agriculture, horticulture and forestry, whilst Class 8 land has such limitations that it is considered incapable of productive use.

The Worksheets (summarised in Table 5) show that the region has only 400 hectares of Class 1 land and 36,000 hectares of Class 2 land, which together make up about 3% of the total land area. Most of this potentially highly productive land is either volcanic or alluvial in origin and located in the Kerikeri, Whāngārei and Dargaville areas. Some of the freer-draining and/or flood-free Class 3 land, again soils derived from volcanic material, alluvium, sand and peat, is also capable of intensive horticulture and agriculture so has been identified as highly versatile soils on plans available on the websites of the Northland Regional Council and each of the district councils.

** Amendments to the Land Use Capability classification, introduced with the 3rd Edition, Land Use Capability Handbook in 2010, extend the range of limitations that may apply to Class 5 land. A proportion of land currently assessed as 6e on the Worksheets can be reassessed as Class 5e under the amendments.*

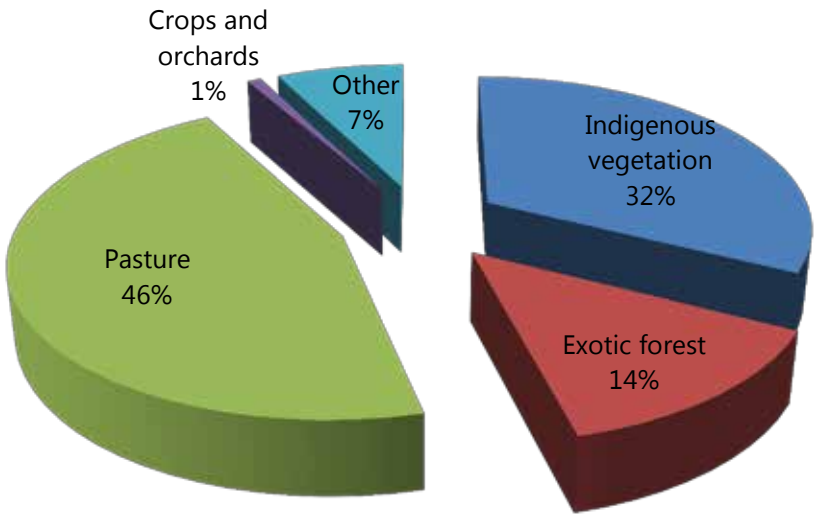
Table 5: Land use capability information for Northland

Land use capability	% of land area	Limitations (increasing limitations from Classes 1 to 8)	Soil types	Land use activities	Locations
1	0.03	Nil	Volcanic loams	All types	Maunu Ōhaeawai
2	2.86	Soil moisture (Seasonally too dry or too wet)	Recent volcanic/peat /alluvial	Horticulture/ cropping/pastoral farming	Kerikeri/Maunu/ Maungatapere Glenbervie/ Ruāwai
3	7.19	Soil moisture/ rocks/drainage /flooding	Alluvial/ volcanic/peat/ clay	Pastoral farming/ horticulture/ cropping	Whāngārei /Kerikeri/ river margins/ Hikurangi Swamp/Awanui Flats
4	23.85	Drainage/ erosion/rocks/ soil pans	Sedimentary/ alluvial/ volcanic/peat/ clays	Dairying/ sheep/beef/ forestry	Throughout Northland

5*	0.66	Stony/dry or too wet for cultivation	Limestone/ volcanic/ alluvium	Pastoral farming/forestry	Small scattered areas throughout Northland
6	48.57	Erosion/steep/ flooding/rocky/dry	Sedimentary/ old volcanic/ greywacke/sand, etc.	Sheep/beef/ forestry	"Waiotira"-type hill country throughout Northland
7	12.14	Erosion/steep/ flooding/stony/wetness	Greywacke/ Sedimentary/ old volcanic/ sand	Sheep/ forestry/ land/ protection-production forest	East Coast hill country, for example, Mt Tiger, gumland and steep, old volcanic, sands
8	2.52	Erosion/steepness/ wetness	Greywacke/ old volcanic/ sand foredunes	Total incapable of productive use	Cliffs, gorges, very steep land and sand foredunes throughout Northland

Like much of New Zealand, agriculture, forestry and horticulture play an important part in the local economy. This is reflected in the percentage of land used for these activities with just under half the land in pasture (46%), and 14% in exotic forest. A small proportion of land is in horticulture (1%) and around a third (32%) indigenous forest (Figure 37).

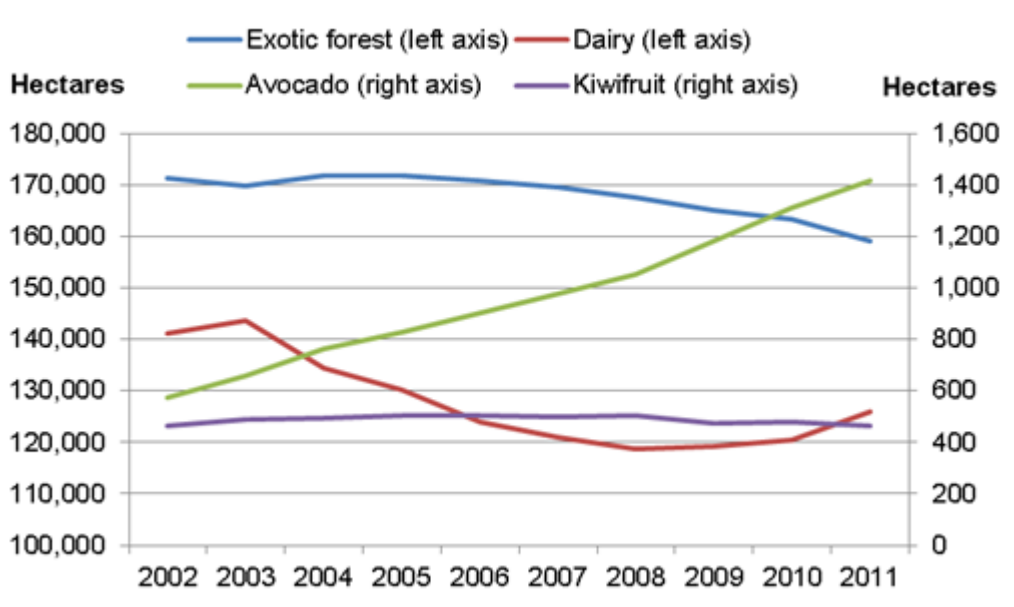
Figure 37: Northland's land cover (Source: Derived from Land Cover Database 3 data)



Based on 2002 and 2007 census data, 2011 sampling, and the recently released Land Cover Database 3, the area in:

- Exotic forest has steadily decreased from 171,000ha to 159,000ha (7%);
- Dairy farming from 141,000ha to 119,000ha in 2008 and back up to 126,000 (10%);
- Avocado orchards occupied 575ha in 2002 and now 1415ha, a 146% increase;
- Kiwifruit increased from 465ha to 505ha in 2005 and back to 464ha in 2011.

Figure 38: Changes in land use (Sources: MAF, Exotic Forest Description; Dairy NZ and LIC, New Zealand Dairy Statistics, various years; New Zealand Avocado Growers' Association Annual Report, various years; Zespri Annual reports, various years)



Pastoral farming

Approximately half of the region's land is used for pastoral farming, with about 385,000 dairy cattle (275,000 cows), 402,000 beef cattle and 400,000 sheep in Northland, in 2011. Within the five-year term of this report, these figures represent a 3.5% increase in dairy cow numbers from 2006 to 2011 but a decrease in total dairy cattle, most probably as a result of the 2009/10 drought. Beef cattle numbers have dropped by 18% over that same period and sheep numbers by 24%.

Dairy

While some dairy farmers are intensifying their production, the regional average lags behind most of the rest of New Zealand in terms of herd size, production per cow and production per hectare. Between 2006 and 2011, the number of herds decreased by 4.5%, the number of cows in milk increased by 3.5%, while effective grazing area and average herd size increased by 4.3% and 8.8%. The total number of dairy stock increased by only 1.8% with the 2011 figure being 3.8% down on the 2008 total, perhaps as a result of the 2009-2010 drought.

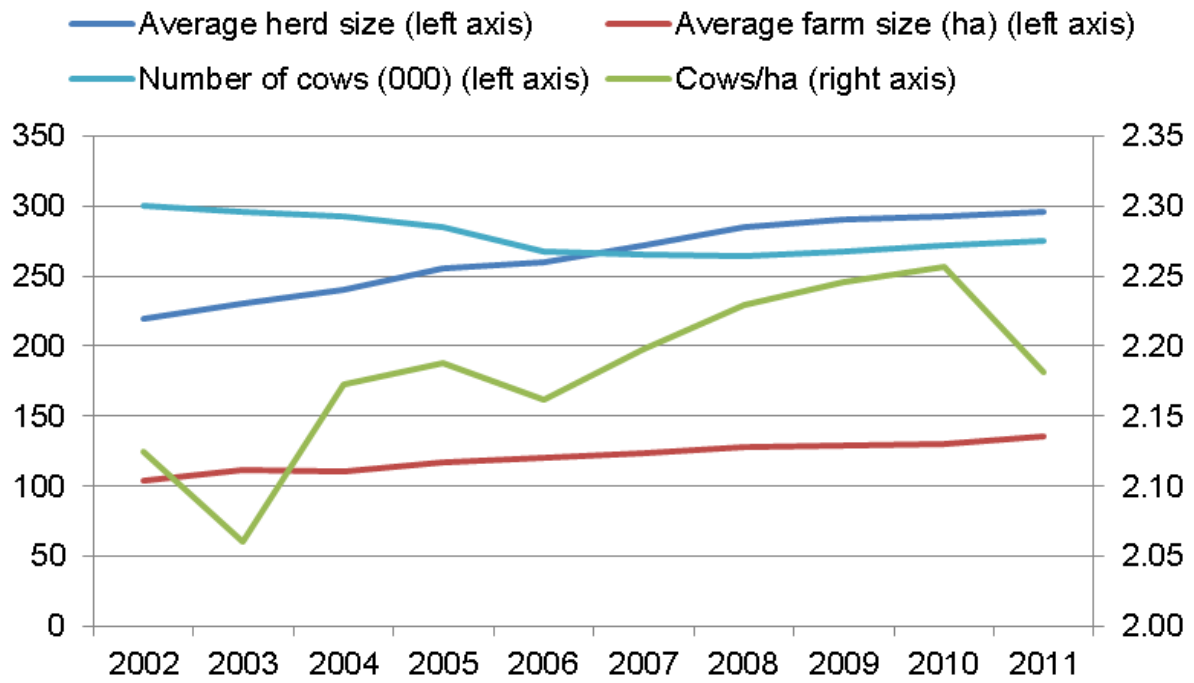
On average, 8.8% larger dairy herds are being carried on fewer but larger dairy farms with the average effective grazing area increasing by 9.7%. The number of cows per effective hectare is around 2.18 but varies from season to season. The issue of significance to soil condition is that larger herds and more cows are being milked through the winter. At some times of the year, late spring and early summer, bigger mobs will be concentrated on smaller areas while paddocks are taken out of the grazing rotation for silage. The area available for grazing will be reduced further when crops are grown on the farm. The concentration of livestock, particularly on wet pasture, can create pugging and compaction issues which degrade soil condition and exacerbate runoff.

Table 6: Dairy stock numbers in Northland (Livestock Improvement Corporation/Dairy NZ – 2006/07 to 2010/11)

4.5% reduction in number of dairy farms	[976 to 930]
3.5% increase in number of cows,	[265,776 to 275,070]
1.8% increase in total dairy stock	[378,152 to 385,000]
but dropped from pre-drought figures of 3.8% increase	[392,577 in 2009]
4.3% increase in overall effective dairy grazing area	[120,926 to 126,081]
8.8% increase in herd size and	[272 to 296]
9.7% increase in effective grazing area per farm	[124 to 136]
Cows/hectare reduced slightly (1.8%) to 2.18 but varies from season to season.	

Source: Statistics NZ

Figure 39: Development in Northland dairy, 2002-11



Source: Dairy NZ and LIC, New Zealand Dairy Statistics, various years

Beef

In 2006 there were 469,262 beef cattle in Northland and in 2010 there was a slight decline to 465,169 (-0.9%). This is insignificant as numbers have ranged between 609,552 and 451,849 since 1990, that is, approximately 15% either side of the median. The 2010 low can be attributed almost entirely to the 2009/10 drought. A proportion of beef farmers are also intensively grazing bulls, using 'Techno Grazing' systems, movable electric fencing and water supplies to ensure controlled grazing and pasture use. These more intensive farming systems, including dairying, can lead to decreased water quality in groundwater and in waterways, and to reduced soil health due to pugging and compaction (Northland Regional Council: 2011). Report available from: www.nrc.govt.nz/landandsoils

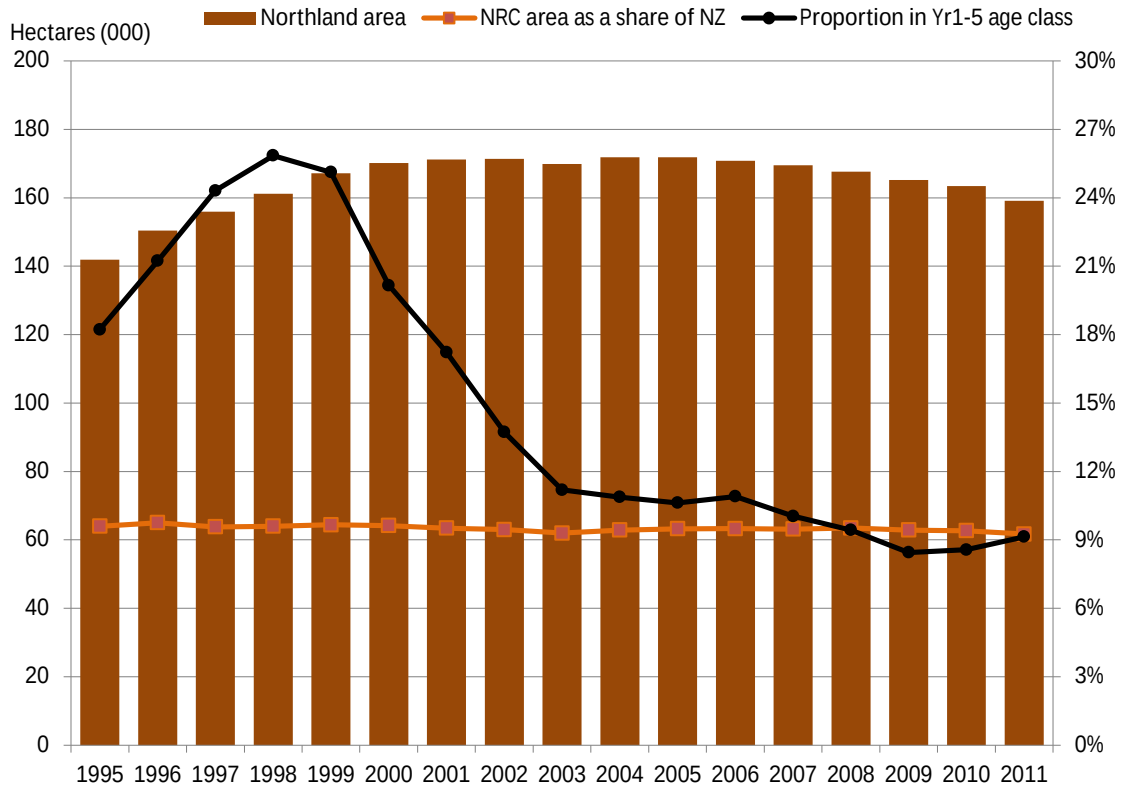
Sheep

Sheep numbers in Northland have dropped from 534,000 in 2007 to 400,000 in 2011 (Statistics New Zealand Agricultural Survey). This represents a 25% reduction in sheep numbers. This decrease is slightly larger than, but broadly in line with, national trends. Some of the most recent decrease may be due to the effect of the recent droughts.

Exotic forest

From the statistics presented in Figure 40 below it would appear that over the last five years there has been a 12,782ha or 7.4% reduction in the area of exotic forestry in Northland. The other significant change has been the decline in the percentage of exotic forest in the Year 1-5 age class since 1998. This shows through in the reduction in the planted area and will also start to show up in reduced volumes available for harvesting annually. These figures are consistent with the trend seen throughout the country.

Figure 40: Exotic forest in Northland



Where has our exotic forest gone?

While there were some small, private woodlots cleared early or as round-wood prior to the 2008 cut-off for "Kyoto forests" (the Kyoto Protocol is an international agreement linked to the United Nations Framework Convention on Climate Change) and not replanted, there are no obvious signs of major forest conversion in Northland, certainly not 12,782 hectares or 7.4% of the peak 2004 area as the statistics suggest. Some small woodlots in the north of the Far North have been cleared for farming and horticulture because transport costs to markets other than the Juken New Zealand Ltd. mill in Kaitāia or Port Marsden make tree growing unprofitable.

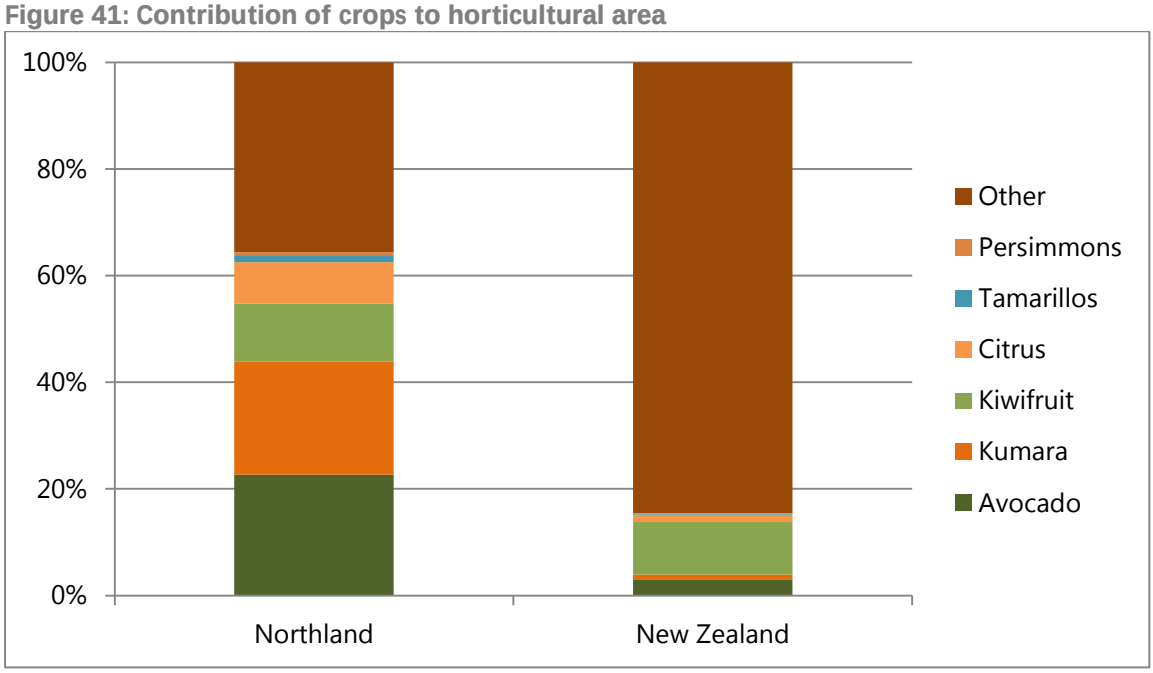
Small areas of pre-Kyoto forests, often very steep areas within the major forest blocks planted in the mid-1980s, have either not been harvested or will not be replanted because of the effort required and/or cost of recovering the logs exceeds the returns. Similarly, leaving wider riparian strips will have reduced the area replanted.

Some of the woodlots on free-draining sandy soils on the Aupōuri Peninsula have been logged and the land use converted to avocado orchards. Again, only relatively small areas are involved.

One possible explanation is that a combination of the need for more accurate accounting of forested land to satisfy climate change forestry policies and plans for and actual harvesting of the mid-1980s forests have refined the actual exotic forestry area statistics and more clearly identified areas of indigenous forest and wetland within the forestry blocks.

Horticulture

Figure 41: Contribution of crops to horticultural area



Source: Statistics NZ, Agricultural census 2007

While horticultural crops occupy only 1% of the agricultural land in Northland, the sector generates around 7% of the region's agricultural Gross Domestic Product (GDP) or 0.6% of the region's total GDP (see Table 2). The industry is a significant employer and contributes more per hectare to the social and economic well-being of the region than any other form of primary production. (Source: Infometrics Regional Database).

The major fruit crops grown in Northland are avocadoes, kiwifruit, citrus and wine grapes. A range of other sub-tropical and temperate fruit is also grown in the region.

Avocadoes are now the most widely planted crop (Figure 41), with the area in avocadoes increasing from less than 500ha in 2002 to greater than 1500ha in 2011. This compares with the second largest crop, kiwifruit, which has remained steady at around 500ha over the same period and citrus at around 300ha. Kumara is the major vegetable crop grown in the region with around 900ha grown annually, or around 95% of the national crop.

What are the issues facing land use in Northland?

Protection of highly versatile soils

The most versatile soils, those which can be highly productive when used for horticulture, arable farming, pastoral farming or forestry, are assessed as Classes 1 and 2, with some Class 3, in the New Zealand Land Resource Inventory survey. They comprise the younger and more free-draining volcanic soils around Whāngārei, Kaikohe and Kerikeri, younger soils developed on sand around various parts of Northland, particularly on the Aupōuri Peninsula, and the more free-draining and least flood susceptible alluvial soils, particularly in the Northern Wairoa-Ruāwai area.

Land that has soil with a land use capability class of 1 or 2 makes up less than 3% of the total land area in Northland. These are the soils with the greatest value for horticultural production.

At the request of the Northland Horticultural Forum, reports were prepared by Enterprise Northland and Northland Regional Council (Jones D., and Cathcart R.: 2011) identifying the scope for horticultural growth in the region and the barriers to that growth. It was identified that significant growth in the horticultural industry could have a significant benefit to the regional economy. Among the major issues identified in the report were the loss of highly versatile soils to non-horticultural or non-agricultural uses and the importance of irrigation water to any growth in the industry.

The Northland Regional Council produced a database identifying highly versatile soils which was provided to the Far North, Whāngārei, and Kaipara district councils. Despite this, there has been little effective control over small lot and residential subdivision on highly versatile soils to date.

The recently Proposed Regional Policy

Statement for Northland tested the issue of versatile soils through a section 32 Resource Management Act analysis. This analysis found that management of versatile soils was not a regionally significant issue in its own right and management of reverse sensitivity and incompatible land uses were a more obvious and pressing concern for primary production. The Proposed Regional Policy Statement therefore did not include specific provisions on protection of versatile soils. However, the issue can be addressed in district plans if there is evidence of a locally significant issue and a need for intervention. For example, Whāngārei District Council introduced an "Urban Transition Environment" Plan Change during the term of this State of the Environment review, with the aim being to better control development on the urban fringe. The same council is now working on a Rural Development Strategy which, among other issues, includes protecting versatile soils.

Erosion-prone land on a hill-country farm

Both of these two Whāngārei District Council initiatives are closely related: the first concerned with protecting the soil itself from unsustainable practice; and the second dealing with the offsite effects of unsustainable practices and uses on, primarily, water quality. There are a number of issues around land use that impact upon these objectives. Good land management practices will help to achieve both the above objectives.

Erosion-prone Northland hill country

Greater than 60% of Northland's land area has a land use capability of six or greater, a proportion of which has moderate to severe erosion potential. Where this land is used for production purposes, whether it is farming or forestry, care must be taken to manage it with respect to its limitations.

Erosion from steep land not only reduces the productive capacity of the land due to the loss of fertile topsoil but also increases sedimentation of waterways downstream.

Severe erosion after an extreme rainfall event

Severe erosion after extreme rainfall events

The intensification of dairy farms and the increase in intensive beef systems can result in increased environmental impacts if farm management is inadequate, or if the farm infrastructure is unable to cope with the increased stock numbers. Where more stock are carried per hectare, or stock are moved in larger mobs, there is an increased risk of pugging and compaction leading to an overall loss of soil drainage and biological activity. This will result in an increase in runoff during rain, which causes sheet erosion, washing fine sediment, nutrients and faecal material off grazing land into and contaminating streams as well as increasing the incidence of gully erosion.

Increased stocking rates also lead to greater volumes of nitrogen per hectare being concentrated in urine patches from where it is leached to streams via shallow groundwater or, on free-draining sandy and volcanic soils, to deeper groundwater.

While the reduction in phosphate fertiliser use on hill country soils helps to reduce phosphorus leaching to streams, it can also have unintended consequences on water quality. With the careful application of phosphorus fertilisers, a well-managed pasture can help to reduce surface forms of soil erosion on hill country and subsequent sediment and nutrient discharges to streams. However, a number of years with poor returns to sheep and beef farmers have resulted in a combination of reduced stock numbers and reduced fertiliser applications. Already there are signs of weakening pasture cover and

increased weed growth. Surveys following major storm events have shown that land in an early stage of reversion, while in rank grass and light scrub, is the most at risk of slipping when compared with dense pasture, heavy scrub, exotic forest or native bush.

Exotic forestry

Forestry figures for Northland show both a decrease in the area in production forest and a decrease in the proportion of the forest in the 1–5 year age class. Any slowdown in the rate of afforestation of erosion-prone and marginal hill country land in Northland is of concern. The council and its predecessor the Northland Catchment Commission have consistently promoted afforestation of such land as a more sustainable form of land use, a means of slowing flood runoff and of controlling soil erosion.

A review in 2011 of current land use relative to land use capability identified further areas of land within (flood risk) priority river catchments which would benefit from afforestation as a means of reducing sediment load in rivers.

While large areas of hill country were planted in pine forests in the 1970s and 1980s, there are still significant areas that would benefit from afforestation, either for production or for carbon sequestration. This apparent reduction in the area of exotic forest is therefore of concern from both sustainable land management and regional economic development points of view.

Kiwifruit PSA

The recent identification of the kiwifruit pathogen in Northland is likely to have major implications for our kiwifruit industry. The gold variety widely grown in Northland is particularly susceptible to the bacterium. If the disease becomes widespread in the region, as it has in others, then there will be a loss in production as vines are either grafted over to more resistant varieties or removed altogether.

A Northland Regional Council Biosecurity staff member inspects kiwifruit for the PSA pathogen

What is being done?

Under the operative Regional Policy Statement for Northland and the Regional Water and Soil Plan the council provided for a range of regulatory and non-regulatory mechanisms to achieve environmental outcomes.

Regulation

Because of the risk of accelerated erosion and generation of sediment, the Regional Water and Soil Plan contains rules relating to earthworks and vegetation clearance on erosion-prone land and within riparian management zones. However, earthworks and vegetation clearance under specified volumes and surface area limits are permitted activities subject to environmental performance standards.

Management of consented activities is the responsibility of the consent holder and is monitored by the council. Persons undertaking permitted activities are responsible for complying with the rules for those activities. The council receives and investigates complaints about land use activities and takes appropriate follow-up action where non-compliance with the relevant consent, if any, or permitted activity rules is found.

The Northland Forestry Guidelines, (adopted in 2012), is a set of guidelines developed between industry leaders and the Northland Regional Council. They are a guide to good practice when undertaking a variety of activities associated with the harvest of plantation forestry and aim to minimise the environmental effects of forestry operations.

Non-regulatory measures

Non-regulatory measures employed by the regional council include advice via its website www.nrc.govt.nz/land, pamphlets, and regular columns in newspapers. The council also promotes sustainable land management via its displays at the Northland Agricultural Field Days and Agricultural & Pastoral shows throughout the region. It partners primary sector groups such as Dairy NZ via its Focus Farms and local discussion groups, and Beef and Lamb New Zealand's Monitor Farm programme, in each case promoting the synergy between increased but sustainable production and reduction in environmental footprint.

The council and its Land Management team are heavily involved in the Ballance Farm Environment Awards, the council as a regional sponsor and its staff as judges and speakers at field days on the supreme winner's property each year. Again, the objective is to demonstrate that environmental stewardship is an integral part of any successful farming, forestry or horticultural venture.

Active advisory services provided by Land Management Advisors include answering specific requests for technical advice, making site visits, providing specific on-farm advice and, where requested, written advice. The most recent extension of these services has been the adoption of policy to prepare water quality improvement plans for landowners within catchments where water quality management is considered the highest priority.

The council recognises that the benefits of environmental management work can extend well beyond the boundaries of individual properties and can have benefits to future generations. It therefore makes grants totalling almost $500,000 annually to landowners from its Environment Fund.

Typical activities include sharing the cost of fencing to exclude stock from streams and the coastal marine area, and using fences to protect indigenous wetlands, which act as filters of sediment, nutrients and faecal material. Funds are also allocated for soil conservation works such as planting poplars and willows and fencing bush on highly erodible sites, and for stabilising areas of foredune.

A proportion of this work has been jointly facilitated and funded by the Queen Elizabeth II National Trust and some projects have been of such high indigenous biodiversity value nationally that they have also received financial support from the Biodiversity Condition Fund.

Primary industry partners

The council's Land Management team works in partnership with the following primary industry sector groups:

- Beef and Lamb New Zealand through its Monitor Farm programme, providing detailed land resource inventory data on which development plans are based, and providing specialist input at farmer field days;
- Dairy NZ, through its Focus Farm programme, providing detailed land resource inventory data on which development plans are based, and providing specialist input at farmer field days, and by attending discussion group meetings;
- Northland Horticulture Forum by assisting in the preparation and promotion of a Northland horticulture growth strategy;
- Rural professionals, such as the NZ Institute of Primary Industry Management and the NZ Property Institute by facilitating or participating in workshops, field days and professional development opportunities;
- Ballance Agrinutrients by assisting with staff training, including joint staff training opportunities, and facilitating joint field days and workshops; and
- Northland Agricultural Forum, a rural professionals and farmer organisation that has promoted agricultural research in Northland.

Longer-term achievements

While records of length of fence subsidised, areas of bush fenced, and numbers of trees planted can be listed as outputs of the council's programmes, they are not a measure of actual environmental outcomes. The expected outcomes include regeneration of bush on retired land, improvement in pasture cover, and a reduction in the incidence of soil erosion and in the sediment load in streams. While some of these benefits can be realised within a few years, others take many years, even generations to achieve.

A riparian margin fenced to exclude stock – fencing of riparian margins is one of the ways the council supports improved land management practices. Funding is available through the council's Environment Fund

The region is only now seeing the real benefits of soil conservation programmes and changes of land use initiated in the 1960s and 1970s. The then Northland Catchment Commission and, in the Far North, the Ministry of Works and Development, working alongside the New Zealand Forest Service, promoted and supported afforestation of marginal, erosion-prone hill country. Government encouragement of forestry during the 1980s, at a time when pastoral farming was subject to economic squeeze, resulted in extensive forest plantings by forestry companies on this class of land.

Soil quality

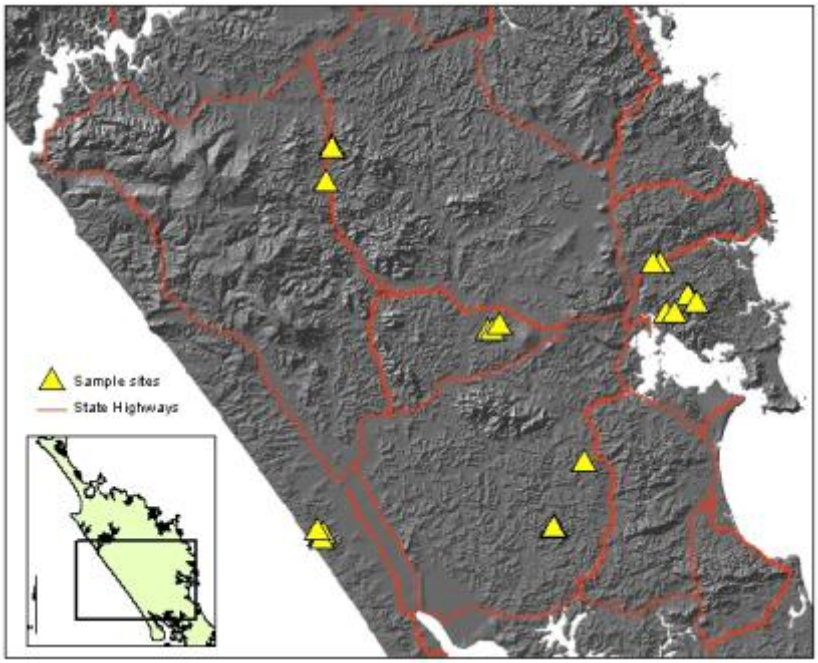
What is our soil quality?

Soil monitoring programme results

The term soil quality can be defined as "the capacity of a specific soil to function, within natural or managed ecosystem boundaries, to sustain plant and animal productivity, maintain or enhance water and air quality, and support human health and habitation" (Soil Science Society of America: 1995).

In order to measure soil quality, the council undertakes five-yearly soil monitoring. The programme has 24 individual sites chosen to represent the major soil types and land uses within the region (Figure 42). The soil types range from fine clays to bouldery clay loams with land uses including dry stock, dairy, plantation forestry, indigenous forest and horticulture. Sites were selected where intensification of land use was expected to occur and where there are a wide range of land uses. They were first sampled in 2001 as part of the national 500 Soils project. These same sites were re-sampled in 2006, and again in 2010-11. The following section analyses and interprets changes in soil quality that have occurred between 2001, 2006 and 2010-11 (for detailed information see the technical report: Soil Quality in Northland 2010-11, available online at www.nrc.govt.nz/landandsoils).

Figure 42: Sample sites in soil monitoring programme



Seven primary soil indicators were measured to assess soil quality (Table 7). The indicators selected to assess soil quality reflect the idea that soil quality is not a single concept, but encompasses aspects of the soil physical structure, chemical fertility, nutrient storage, organic matter resources, and the biology in the soil. There are potentially many indicators that can be used, but for any extensive national or regional monitoring scheme it is not practical to have more than a small core number.

Table 7: Indicators used for soil quality assessment (Landcare Research: 2011)

Group	Indicator	Soil quality information
Group 1 - Fertility	Olsen phosphorus	Plant available phosphorus
Group 2 - Acidity	pH	Acidity or alkalinity of soil
Group 3 - Organic resources	Anaerobically mineralisable nitrogen	Availability of nitrogen reserve, surrogate measure for soil microbial biomass
	Total carbon	Organic matter reserves, soil structure, ability to retain water
	Total nitrogen	Organic nitrogen reserves
Group 4 - Physical properties	Bulk density	Soil compaction, physical environment for roots and soil organisms
	Macroporosity	Availability of water and air, retention of water, drainage properties

The indicators themselves do not measure soil quality. Soil quality is a value judgement about how suitable a soil is for a particular use. The indicators measure attributes of a soil (for example, pH, and bulk density). Consequently, different target values for indicators are needed for different land uses. For example, soils with pH<5 may be of suitable quality to grow radiata pine, but not for a good crop of white clover. The pH level also affects the availability of plant nutrients so soil must be managed within a pH band to ensure, for example, phosphate is available to plants.

Soils that are stony and excessively free-draining may be of poor quality for pasture production, but of excellent quality for vineyards.

A regional council staff member soil sampling in a citrus orchard in Glenbervie

What are the issues affecting soil quality?

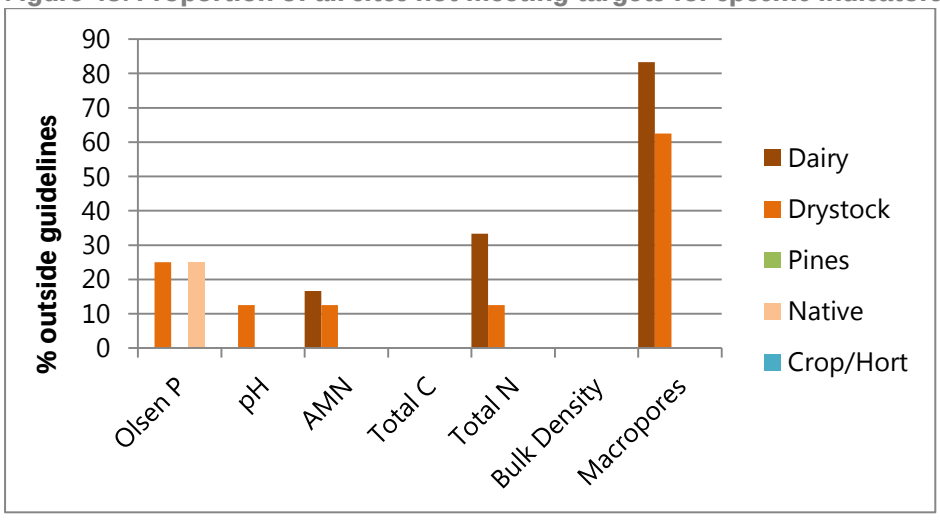
The soil quality characteristics of sites sampled in 2010-11 followed some of the same trends as those seen in other regions of New Zealand. Land use was the major driver of soil quality. Pugging and compaction on more heavily stocked dairy and dry stock sites remains a particular concern (both in Northland and nationally), as comparison of soil quality parameters between 2001, 2006, and 2010-11 suggests an overall significant decline in macroporosity (the large pore spaces in soil).

Pugged soils are a problem because the hard surface on the soil prevents penetration of the water, which reduces the rate of water infiltration into the soil. Compaction affects more of the soil profile, reduces pore space affecting aeration and the rate water drains through the soil profile, and can lead to anaerobic conditions. This can stunt plant growth in addition to increasing erosion and runoff, which affects water quality and farm productivity.

Like many other regions in New Zealand, high total nitrogen and mineralisable nitrogen (N) levels are of concern, particularly on some dairy and dry stock sites. This is because N can get into waterways through groundwater and overland flow from land which can lead to nutrient enrichment problems. In contrast, low Olsen P levels observed on some dry stock sites indicate pasture production is likely to be sub-optimal and could eventually lead to overgrazed conditions. There was an instance of high pH (alkaline) on one dry stock site, which may have been an anomaly, but which can be remedied by adding acidifying minerals or organic material to the soil.

It is noted that due to the small number of sites the standard deviation (variation) is high for many of the indicators, which makes it difficult to make generalisations about the 2010-11 results. The climate variability between sampling years may also have contributed to several sites/indicators changing greatly from 2001 to 2006, and then returning to 2001 levels by 2010-11. Adding more sites to the programme and sampling at the same time of year will help to minimise this variation. Figure 43 shows the number of soil quality indicators that did not meet the quality targets by land use.

Figure 43: Proportion of all sites not meeting targets for specific indicators



How are we measuring up against our objectives?

The following are the anticipated environmental results relevant to soil conservation and land management in the Regional Policy Statement for Northland:

Continued availability of highly versatile soils for primary production

- Areas of highly productive soils have been identified using the New Zealand Land Resources Inventory.
- Only approximately 10% of Northland's land area is considered to have "highly productive and versatile soil" (LUC classes 1, 2 and 3).
- In recent years, large areas of land with prime soils for agricultural and horticultural production have been subdivided for lifestyle blocks and urban development.
- Whāngārei District Council introduced Plan Change No.93 in 2011 which aims to cluster the siting of dwellings within lifestyle block subdivisions rather than have houses scattered throughout the areas of highly productive soils on the outskirts of Whāngārei.

More widespread adoption of soil conservation practices within land use and subdivision proposals

- Runoff from earthworks and changes in land use is continuing to cause erosion and contamination of waterways.
- Since 2010, the Northland Regional Council has been running annual sediment reduction seminars for contractors and consultants involved with earthworks.

Reduction of erosion in high-risk areas; and the reduction in the volumes of soil and other contaminants entering surface water bodies

- Increased resources in terms of regional council land management staff time and resources have gone into soil conservation and water quality improvement initiatives. A recent project has aligned areas of erosion-prone land identified on the land resource inventory with areas of land in pasture from the land cover database. This aids in identifying areas that will benefit the most from soil conservation efforts and assists with targeting resources.
- Poplars and willows have been provided to landowners to assist with soil conservation projects which have been funded through the council's Environment Fund. For example, in the 2011/12 financial year 2170 poplar poles and 5074 willow wands were provided to landowners. The council has contracted landowners to supply poplar poles locally and is also in the process of developing a poplar nursery on council-owned land to secure future supply.
- Water Quality Improvement Plans are now developed for any applicants applying to the Environment Fund. In the 2011/2012 financial year the Environment Fund provided assistance to 44 fencing projects that had a focus on protecting erosion-prone land or protecting rivers and streams which helped fund a total of 72km of fencing. The fund also assisted with 11km of fencing around wetlands.
- Based on a comparison between current erosion severity and type recorded in the NZ Land Resources Inventory Worksheets, soil loss in 2011 is significantly less than in 1975. This is due to improved pasture cover on much of the land that is farmed, reversion of some steeper, scrubby

farmland to bush and widespread afforestation of large areas of marginal hill country in the 1980s.

Poplar planting used to stabilise a hillside.

What is being done?

The council will continue with the programme of re-sampling existing sites to determine the extent and direction of any changes since original sampling. The next re-sampling of these sites will be in 2015-16, but additional sites will be added to encompass different soil types, providing a wider representation of soil types and giving a better geographic spread across the region. More samples across a greater range of soil types and locations will also increase the ability to detect change between land uses.

The findings of this sampling programme have been discussed with field staff of Ballance Agrinutrients who confirm the findings of dropping Olsen P levels on sheep and beef properties. These field staff will assist the council to find additional sampling sites and will provide both historic data on the sites and trends in nutrient levels between the five-yearly sampling.

The council also informs land managers of the soil quality on their properties, and if remedial action is justified, they are advised on possible management strategies to protect the environment while still achieving an economic return from the land. Farmers are encouraged to use the Visual Soil Assessment Tool to monitor the 'health' of their soils. More detailed soil mapping data held by the council is made available to landowners and to their advisors to, for example, increase the levels of confidence in nutrient modelling using OVERSEER or other nutrient management tools.

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Biodiversity and biosecurity on land

Northland is a biodiversity hotspot. Many of the natural values and areas in the region are of international and national significance. They are often the last remaining ecosystems of their type in New Zealand or the world, and representative of the natural character of New Zealand, or they contain examples of values that are not protected elsewhere.

Northland has a wide range of pressures on biodiversity due to it being a narrow peninsula, and its warm climate and diversity of land uses include farming, forestry and horticulture. Forest clearance and the draining of wetlands was historically a major cause of biodiversity decline, with less than 5.5% of original freshwater wetlands remaining (the national average is 10%) and about 26% of original forest cover (Ausseil *et al.*: 2008; Conning: 2001). However, changing land management practices have reduced this pressure somewhat. The impact of introduced animal and plant pests on biodiversity is of major concern and this issue remains the key reason for continued biodiversity decline.

Tuatara, once widespread and abundant throughout Northland, are now restricted to near-shore island sanctuaries like the Poor Knights and Hen and Chick Islands.

What do we want for our terrestrial ecosystems?

The operative Regional Policy Statement for Northland states community objectives for managing significant natural and physical resources in our region. The objectives relating to terrestrial biodiversity and biosecurity management are:

- Maintenance of the biodiversity of the Northland region.
- Protection of the life-supporting capacity of ecosystems through avoiding, remedying or mitigating (in that order of priority) the adverse effects of activities, substances and introduced species on the functioning of natural ecosystems.
- Protection of areas of significant indigenous vegetation and the significant habitats of indigenous fauna.
- The avoidance, remedying or mitigation of the adverse effects of plant and animal pests on the use of land, including its potential for primary production and natural ecosystems.

The following are the anticipated environmental results for terrestrial biodiversity and biosecurity management in the Regional Policy Statement for Northland:

- An increase in the areas of significant indigenous vegetation and the significant habitats of indigenous fauna which are formally protected.
- No significant increase in the number of threatened species in the region.
- Reduction in the damage caused to soils and natural features from pests and noxious plants.

Note: the operative Regional Policy Statement is currently being reviewed. The proposed Regional Policy Statement (2013) is available at www.nrc.govt.nz/newRPS

What is our native land cover?

Northland's terrestrial area covers about 1,254,826 hectares with some 32% of this area (419,000ha) in indigenous vegetation (Table 8). Approximately 12% (150,579ha) is designated as protected natural areas, which means it has some form of legal protection (Van Meeuwen-Dijkgraaf: 2008). The Department of Conservation manages 92% of the area covered by protected natural areas however there are numerous other protected natural areas on private and other agency-managed lands.

The kauri snail (far left) is one of many threatened species found in Northland while the kauri forests at Waipoua (right) provide one of the finest examples of this forest type in the world.

Table 8: Estimated area of indigenous land cover in Northland in 1997 (Land Cover Database 1 - LCDB1) and 2002 (LCDB2) and 2007 (LCDB3) (Data source: Ministry for the Environment)

Indigenous land cover class	Area (Hectares)		
	1997 (LCDB1)	2002 (LCDB2)	2007 (LCDB3)
Broadleaved indigenous hardwoods	18,176	17,710	19,721
Depleted tussock grassland	7	7	7
Fernland	76	57	149
Flaxland	168	168	144
Grey scrub	341	339	579
Herbaceous freshwater vegetation	7053	6993	8374
Herbaceous saline vegetation	3368	3368	3156
Indigenous forest	256,585	255,724	248,893
Mangrove	14,614	14,614	15,568
Manuka and/or kanuka	118,706	117,930	122,554
Total native vegetation cover	**419,094**	**416,910**	**419,145**
Estuarine open water	24,727	24,727	25,314
Coastal sand and gravel	16,217	16,163	14,573
Lake and pond	4140	4159	4115
Landslide	16	16	10
River	1968	1968	1964
River/lakeshore gravel and rock	34	34	-
Total other native land cover	**47,103**	**47,068**	**45,976**
Total native land cover	**466,197**	**463,978**	**465,121**

Note: Due to differences in the way that the data for LCDB1, LCDB2 and LCDB3 has been collected and interpreted and a certain amount of error contained within the data, it is difficult to directly compare the data between the different series. The information does however provide a good broad overview and suggests that the total area of indigenous vegetation in Northland has remained relatively stable.

What is the status of native species in Northland?

Northland is considered a "hotspot" for species diversity and local endemism, that is, species that are only found here. The region is the stronghold of the iconic North Island brown kiwi, rare native plants and forest fauna, including 293 terrestrial and freshwater native fauna species (Hitchmough, *et al.*: 2007). Of these, 225 are invertebrates, and 53 are acutely threatened, 13 are chronically threatened, and 160 are at risk. Of the remaining threatened

taxa (birds, bats, freshwater fish, frogs and lizards), 16 are acutely threatened, 20 are chronically threatened, and 31 are at risk.

Native plants found in New Zealand total 2500 and 1200 are known from Northland, of which almost half are found nowhere else in the world. Of international significance are the Poor Knights and Three Kings islands, and the North Cape region, all of which contain many locally endemic, threatened species. Also of international significance are the unique kauri forests around Waipoua, which provide one of the finest examples of this forest type.

Many of Northland's threatened species occur in the most highly threatened ecosystems. Of particular concern are the increasing numbers of threatened species in Northland. In 2004 there were 179 threatened plants recorded in Northland, which had increased to 241 by 2009 (Forester and Townsend: 2004; de Lange *et al.*: 2009).

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Table 9: Summary of threatened and at risk vascular plants in Northland

Northland threatened plant summary		
NZ threat status	**Threat value**	**Count of species**
At risk	Declining	25
At risk	Naturally uncommon	99
At risk	Relict	18
Data deficient	Data deficient	14
Native	Coloniser	8
Native	Extinct	1
Native	Vagrant	8
Threatened	Nationally critical	35
Threatened	Nationally endangered	15
Threatened	Nationally vulnerable	18

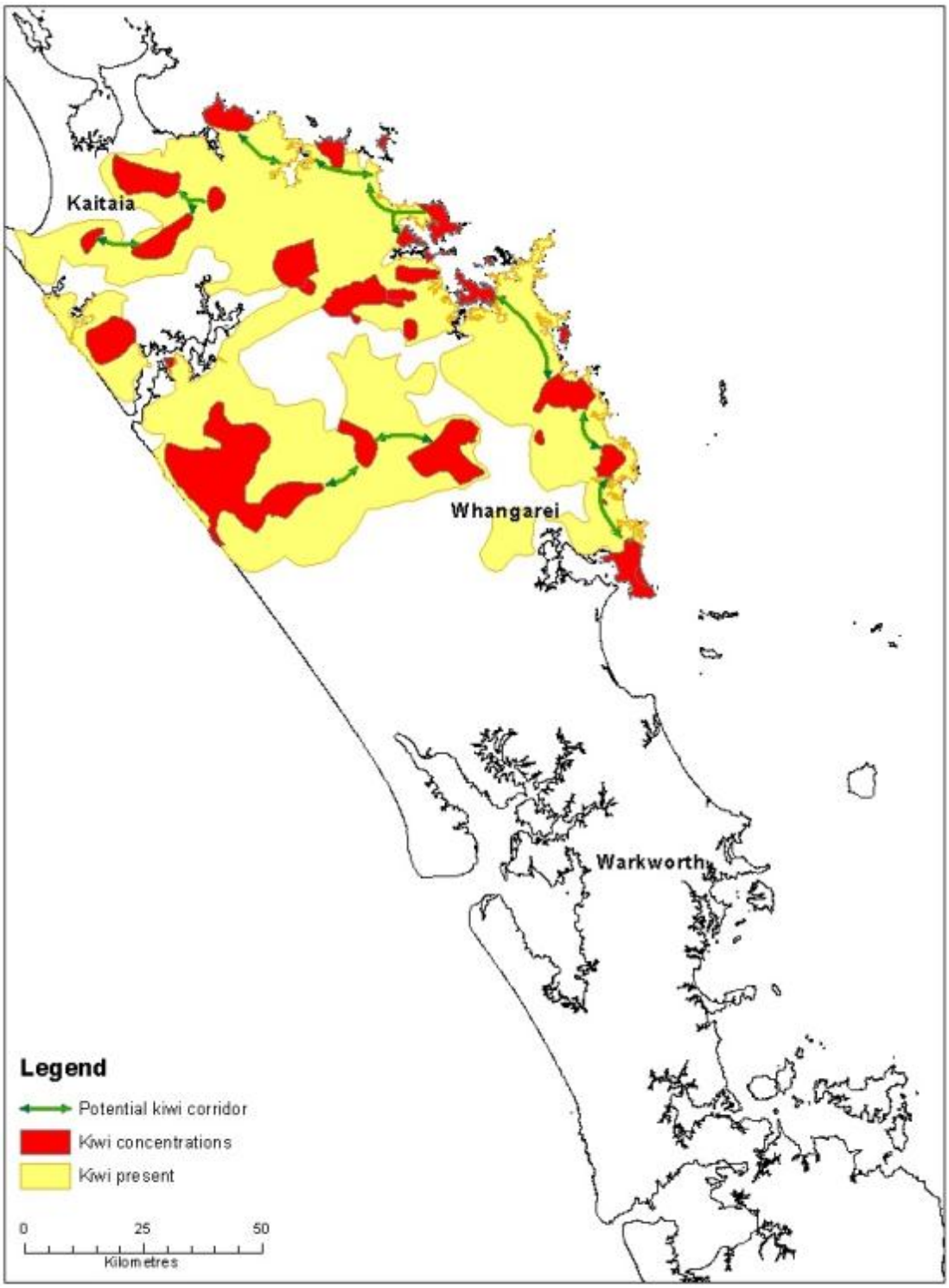
Northland brown kiwi: a key indicator species

Information for the following section is largely taken from the report "Taxon Plan for Northland Brown Kiwi" (Craig et al.: 2011) and *Call count monitoring of Northland brown kiwi 2011* (Craig: 2012). Northland is a stronghold for brown kiwi (*Apteryx mantelli*) as it contains around 32% of the total New Zealand population. There are around 8000 kiwi spread over 25 population clusters both on the mainland and offshore islands.

Kiwi in Northland have the highest productivity rate but also have the highest adult mortality rate, with an average life expectancy of only 14 years, largely due to predation by dogs. North Island kiwi had probably declined in abundance by at least 90% in the previous 100 years (McLennan et al.: 1996) resulting in the localised extinction from many areas.

The presence and number of Northland brown kiwi are good indicators of the state of Northland's biodiversity

Figure 44: Department of Conservation map showing the approximate distribution of brown kiwi in Northland



The two major threats to kiwi in Northland are dogs, which kill kiwi at all stages of their life, and stoats – a major threat to juvinile kiwi. Kiwi also face predation and competition pressure from a range of other introduced species such as cats, ferrets, possums, rats, hedgehogs and pigs. Populations are also impacted by habitat loss and fragmentation.

Current management

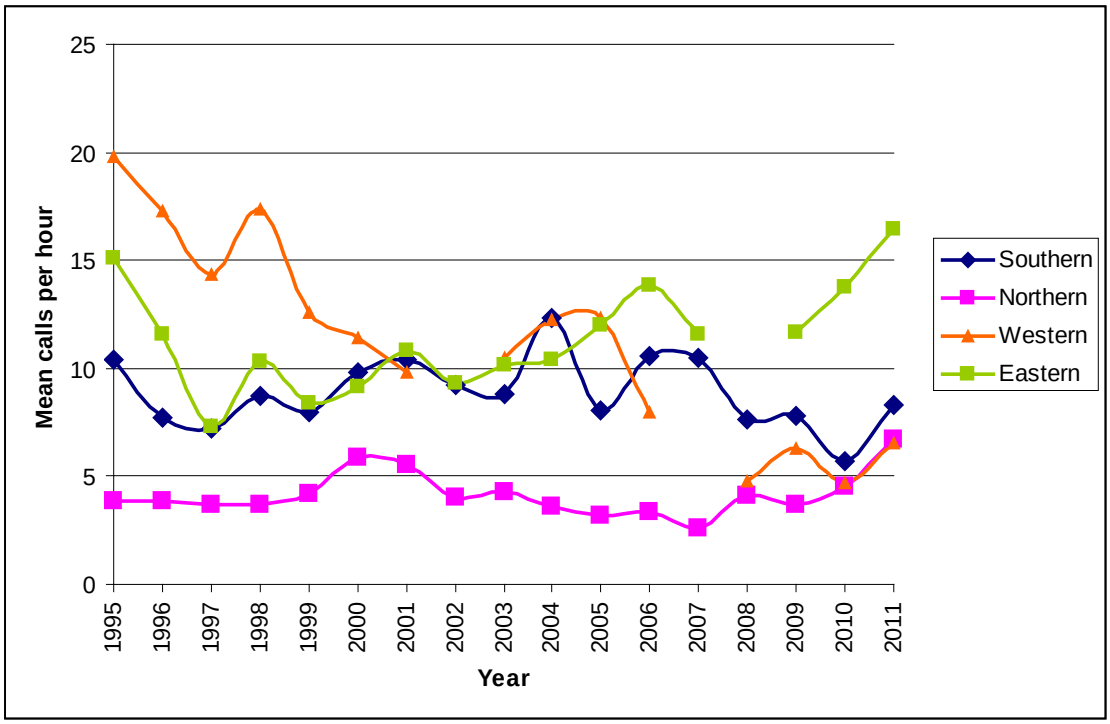
Advocacy programmes have been in place since 1991 to raise awareness of the decline in kiwi populations. This work has led to increased public awareness of threats to kiwi and increased involvement in protection programmes. A number of agencies are involved in advocacy work including the Department of Conservation, Kiwis for kiwi, NZ Kiwi Foundation, NZ Landcare Trust, Queen Elizabeth II National Trust and the Whāngārei Native Bird Recovery Centre. The Whāngārei Kiwi Sanctuary was established with assistance from the 2000 NZ Biodiversity Funding Package. It comprises a mix of public and private land and covers 17,400 hectares, which are managed with the aim of enhancing the mainland population through intensive predator control.

Community groups are involved in active management of kiwi populations at approximately 34 sites in Northland. These projects are on a mix of private and public land and involve predator control and habitat restoration.

Kiwi call monitoring, BNZ operation nest egg, kiwi aversion training for dogs, research and mainland island and offshore island projects all contribute to the efforts underway in Northland.

Population trends

Figure 45: Trends in kiwi call count data 1995-2011 (Craig: 2012)



Trends in call count data collected since 1995 at the 24 original listening stations in the northern, eastern, western and southern survey areas are displayed in Figure 45.

Kiwi call count rates (and presumably kiwi numbers) have trended up in all four clusters for the 2011 listening period. The increases observed for the 2011 listening period are undoubtedly a response to the continued kiwi protection measures that are occurring throughout (Craig: 2012).

What are the issues affecting terrestrial biodiversity in Northland?

Habitat loss and degradation

The landscape of Northland has been dramatically modified through vegetation clearance since the arrival of humans in New Zealand. Early burning of forest by Māori followed by further deforestation and land development by Europeans has dramatically changed indigenous habitats.

Despite the level of land development in Northland, many farms still retain significant remnants of indigenous habitat. However, these remnants are often fragmented and isolated from other areas of indigenous vegetation, lacking in large, mature specimens and vulnerable to damage from grazing stock and invasion by weed species.

Bush fragments scattered among cleared land

In general, smaller areas are more difficult to protect as their proportionally larger edge area creates more opportunity for weed species to become established and allows easier access for stock. Much of the remaining indigenous habitat is either regenerating or podocarp-dominated forest on steeper areas. Wetlands of all descriptions, riverine floodplain forest, volcanic broadleaf forest, dunelands, gumlands and coastal forest are examples of habitats that are critically under-represented in Northland. These under-represented habitat types tend to occur on land that is in demand for other purposes.

Land use pressure

Intensification of land use can impact on indigenous biodiversity in a number of ways. Although in recent years there has been retirement and regeneration of some areas of marginal land, this has often been negated by the intensification of land use on the more

productive areas. Increased fertiliser use and the corresponding increase in stocking rates can lead to higher levels of loss of effluent and nutrients from farms to surrounding areas. Dune lakes, gumlands, bogs and fens are examples of some of the habitat types in Northland that are particularly at risk. These ecosystems have developed under naturally low fertility conditions and the plant and animal species present are adapted to these conditions. Nutrient enrichment brought about through the intensification of land use within the catchment can lead to rapid invasion by weeds leading to a system dominated by introduced species.

Wetlands are threatened not only through nutrient enrichment but also due to changes brought about to their hydrology through the digging of new drains or the deepening of existing drains. Lowering of water tables due to drainage will lead to invasion of the wetland by dry land species and the breakdown of peat based soils leading to shrinkage and subsidence. Drainage will also lead to greater impacts from stock as they are able to access wetlands more easily leading to grazing of ground cover and disturbance by pugging, which also favours weed invasion. Increased nutrient levels in rivers and lakes due to runoff and leaching will lead to increased growth of weed species and frequently leads to a change from a system dominated by native species to one where introduced weed species dominate.

A wetland with newly dug drains

Pest plants and animals

As an island nation, New Zealand is vulnerable to invasive species. This is because the country relies heavily on international freight transport, which can act as pest pathways and our native flora and fauna have evolved largely in isolation without the predation and competition effects of invasive species from other parts of the world.

Northland is particularly vulnerable given that

the region has some of the warmest land and sea temperatures in New Zealand, as well as high levels of sunshine and sub-tropical weather patterns. This makes for excellent establishing grounds for new exotic pests. Pest species that originate from warm climatic environments have the advantage of similar weather conditions, low levels of frost, and very low levels of natural predators to deal with. Northland's forests are also botanically diverse and contain a high number of threatened plants and animals, which are sensitive to the impacts of pest species.

Invasive pest species have the potential to significantly impact on our environment, economy, health and our social and cultural well-being. These impacts can occur through loss of biodiversity, reduced production and impacts on amenity and cultural resources.

What are the main pest species in Northland?

Pest plants

Hundreds of weeds thrive in Northland's warm climate. However, to become a pest plant, a weed must also represent a threat to the region because of its ability to invade or take over land that is productive or has important ecological or cultural values (Table 10).

Pest plants can be given scores that give an indication of the plant's relative significance, such as biological success and weediness ratings (Esler *et al.*: 1993; Owen *et al.*: 1996). Biological success ratings are associated with the plant's ability to establish and spread, while weediness refers to the nuisance value of the plant. For example, high scores in both would make a plant high priority for management as it could easily spread and establish in new areas and cause significant impacts.

Wild ginger (left) and African feather grass (right) are just two invasive pest plant species found in Northland. For more information about pest plants go to www.nrc.govt.nz/pestplants

Table 10: Impacts of some of the main pest plants in Northland

Pest plant	Problems caused
Kahili (wild) ginger	Kahili ginger forms dense stands in native bush, on road sides and river banks, smothering and eventually replacing all other species.
Manchurian wild rice	Manchurian wild rice is a tall perennial grass that grows up to 3m tall. It forms dense stands in aquatic or semi-terrestrial situations, and can block drains, cause flooding and invade pasture.
Giant reed	Giant reed is a clump-forming, bamboo-like grass. It grows in dry and wet areas, forming dense stands, and can block streams and drains causing flooding, and displacing other vegetation.
African feather grass	African feather grass is a perennial grass that forms large clumps. It invades coastal dune areas, pasture, roadsides and reserves, and can completely suppress all other low-growing plants.
Pampas	Pampas is a perennial tussock-like grass, and is widespread in Northland. It invades dunelands, exotic forests, quarries, roadsides and disturbed native forests. It forms dense stands, excludes other vegetation, and provides habitat for animal pests.
Climbing asparagus	Climbing asparagus forms dense patches on the ground or sub-canopy in most forest types. It smothers other plants, and carpets the forest floor preventing the growth of native seedlings. It is fast growing and rapidly colonises new areas.
Moth plant	Moth plant is an evergreen vine that grows to 10m tall. It is long-lived, fast-growing and shade-tolerant, forming dense, heavy, smothering masses that overtop and strangle supporting plants. It invades intact or disturbed forest and is poisonous.
Taiwan cherry	Taiwan cherry is a deciduous tree growing to 8m tall, and has commonly been planted in gardens. Seeds are dispersed by birds, and naturalised populations are now present in bush areas in Northland, where it crowds out native plants.
Elaeagnus	Elaeagnus is a long-lived, vigorous scrambling vine. It forms a dense blanket smothering native species up to mid-canopy level. It is a problem in forest interiors and can prevent access into recreational areas.
Woolly nightshade	Woolly nightshade is a spreading shrub that grows to 10m. It forms dense, often pure stands, and inhibits or prevents the establishment of native plant seedlings. It also invades pastures, and may be poisonous to livestock.
Privet	Privet is any one of four species of evergreen shrubs or trees. It inhabits bush, gardens, roadsides and ungrazed wasteland areas. It prevents native plant regeneration and can completely dominate areas of bush. It can contribute to respiratory disorders and is toxic to livestock.
Lantana	Lantana forms dense impenetrable thickets, and invades bush edges, pasture, roadsides and wasteland, where it replaces all other vegetation. It is poisonous to stock and humans.

Pest animals

Northland has a number of animal and insect species that are considered pests. Many of them have been present in New Zealand for a considerable period of time, and their impacts affect the regional economy, environment and culture (Table 11).

Table 11: Impacts of some of the main pest animals in Northland

Pest animal	Problems caused
Argentine ants	Argentine ants are often present near sites of human habitation throughout Northland. They impact native invertebrate species through predation and competition. These ants are a domestic nuisance, swarming over food and infesting gardens, and can cause significant costs to the horticulture and agriculture industries.
Feral cats	Feral cats are widespread throughout Northland and live in most terrestrial habitats. Cats kill millions of birds in New Zealand each year, as well as eating eggs, lizards, insects and frogs. They can also spread parasites and diseases such as bovine tuberculosis (Tb) and toxoplasmosis.
Feral deer	There are four species of feral deer in Northland, but none are widespread or numerous. Deer can destroy the understorey of native forest by over browsing, grazing, bark stripping and trampling. Feral deer can also damage crops and exotic forests and can transmit bovine Tb.
Feral goats	Feral goats are widespread throughout Northland. Populations are generally dense in areas of exotic and native forest, as well as in areas of poor pasture/scrub. Goats destroy the understorey of vegetation, and when combined with possum damage to the upper canopy, severe deterioration of the forest can occur. Goats can also cause erosion problems.
Mustelids (ferrets, weasels and stoats)	Mustelids are widespread throughout Northland. They can be devastating to native birds, lizards, frogs and invertebrates. Mustelids can also spread parasites and diseases such as bovine Tb and toxoplasmosis.
Possum	Possums are found throughout the region, and are one of the most destructive animals in forests. Possum browsing damages forests, affects pasture, vegetable and horticulture crops. Possums can also spread diseases such as bovine Tb.
Rabbit	Rabbits are widespread throughout Northland. Infestation levels vary, with greatest densities on hard-grazed lighter and drier sandy and volcanic soils. Rabbits compete with stock for grazing, damage crops and can cause erosion.
Rats	Rats are widespread throughout Northland. They are mainly nocturnal, and eat seeds, bird eggs, nestlings, invertebrates, frogs and lizards. They have a significant impact on native plants and animals, and also eat and contaminate grain and food stores.

What is being done?

Pest management strategies

The Northland Regional Pest Management Strategies 2010-2015 include 100 terrestrial plant pests and 35 terrestrial animal pests, of concern to the Northland region (Northland Regional Council: 2010). A much higher number of pest species in the current strategies are of considerable concern for biodiversity values than for agriculture or horticulture, as is the trend for most regions of New Zealand.

The pests fall under different classifications in the strategies, depending on whether they are established in the region and how widespread they are. The classification of the pest helps guide the strategies' objectives, operational plans and management programmes for each pest.

During 2010/11, 20 new operational plans were developed for the terrestrial pests in the strategies. Each plan covers the five-year period of the strategies and includes clear links between outcomes defined in the Long Term Plan, the Regional Pest Management Strategies and the operational plans. Indicators and measures of performance are defined and are used to gauge programme progress, guide programme improvements and report performance clearly and effectively.

The objectives of the programmes and the management methods vary depending on the pest species and its classification in the strategies, but are either species-led or site-led. The main pest management methods can include education, surveillance, community programmes, occupier control, biological control and council response.

Spraying dune weeds at Waipū Cove

Public awareness

A key aim for the council is to raise public awareness of terrestrial pests by providing information about the pests, their impacts, dispersal and management options through publicity campaigns, publications, events and providing an advice and identification service.

The number of biosecurity enquiries received by the council has increased from approximately 850 in 2007 to more than 1100 in 2011. The council also provides pest control products to customers on a non-profit basis, to assist with animal pest control (for example, possum and rat bait). This service encourages greater public participation in animal pest control and the council currently sells over $50,000 worth of materials each year and provides information to customers regarding best practice pest control methods.

Project possum training day – an initiative that teaches secondary school pupils about possum control and plucking the fur to sell

Biocontrol

Biocontrol (biological control) is the use of naturally occurring enemies and diseases to control pests and weeds. Biocontrol will not totally eradicate a species but aims to suppress populations to low levels. It is the most cost effective method of pest control over a wide area and at remote sites. Once sustainable populations have established and become widespread the biocontrol agents carry on working against the target pest indefinitely.

Biocontrol agents have been introduced to Northland to control pests such as gorse, ragwort, thistles, broom, alligator weed, mist flower, buddleia, Mexican devil weed, St John's wort and boneseed. There are currently nearly 100 species of biocontrol agents in Northland. These include 28 species (including five diseases) of weed biocontrol agents, and more than 30 insect biocontrol agents, including earwigs, lacewings, hoverflies, nabid and pentatomid predatory bugs, numerous parasitoid wasps of aphids, mealybugs, thrips, and scale. There are also 10 species of exotic predatory ladybird and two native species of predatory ladybird, and at least seven species of predatory mites.

A total of $50,000 a year is invested in Northland's biocontrol and a national collective of 13 regional councils and the Department of Conservation provide approximately $670,000 annually toward a national biocontrol programme. The programme is managed by Landcare Research and provides research, quarantine facilities and management of releases of the agents which target plant and insect pests within New Zealand.

Mexican devil weed gall fly – a biocontrol agent

Species-led programme – Manchurian wild rice

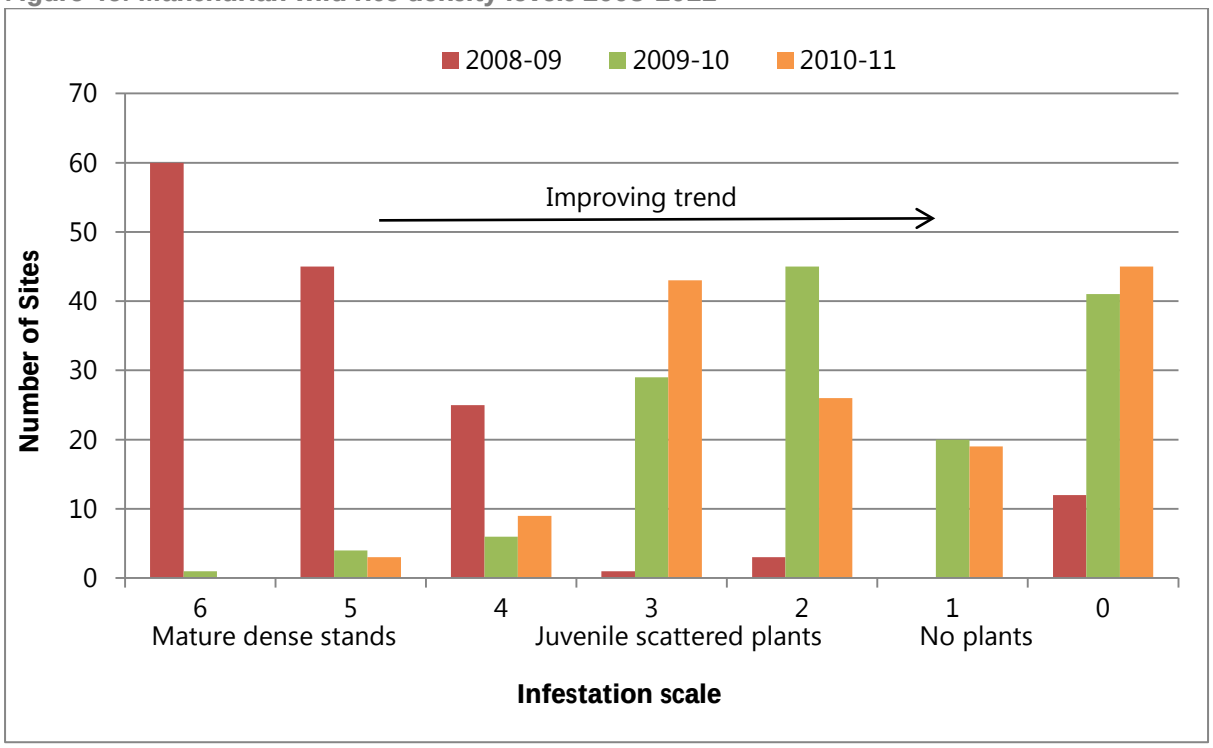
In Northland, Manchurian wild rice covers approximately 500 hectares. It is widespread in the Kaipara district, with the main infestation found next to the Northern Wairoa River and its tributaries. There are also a small number of sites in Whāngārei, Kerikeri, and Mangakāhia. Manchurian wild rice is a tall perennial grass that grows up to 3m tall in aquatic or semi-terrestrial habitats, blocking drains, causing flooding and invading pasture.

Manchurian wild rice on the banks of the Wairoa River

The council is working with the Ministry for Primary Industries to ensure the containment, reduction and eventual eradication of Manchurian wild rice within Northland. The council manages the programme in Northland and has received funding between $240,000 and $320,000 annually from the ministry since 2008. Initially, the programme has focussed mainly on eradication of outlier sites, those sites not connected to the main infestation area which adjoins the margins of the Northern Wairoa River.

Infested sites require repeated spraying and a programme of sustained control is necessary for eradication of the plant at each site. Sites which have been under an active control programme for three years or more are showing a decline in the number of plants and percentage ground cover and there are more sites with only scattered juvenile plants or none at all (Figure 46).

Figure 46: Manchurian wild rice density levels 2008-2011



Species-led programme - Lantana

Lantana

Lantana is a major weed of both natural and agricultural ecosystems overseas, and forms dense impenetrable thickets, invading bush edges, pasture, roadsides and wasteland. It is found throughout Northland with the heaviest infestations located near old settlement areas in the Hokianga and near Whangaroa. The 2010-2015 operational plan aims to remove the threat of lantana to areas of high ecological significance and to reduce the impacts of the plant throughout the wider region, by controlling sites outside the main infestation areas.

There are on-going programmes in Northland to increase awareness of the problems caused by this species; to support research into biocontrol; and to encourage community control. The council-funded control programme is systematically locating and eradicating outlier sites of lantana from the North Cape down the Aupōuri Peninsula, and from the Bream Bay area. Controls of other small outlying infestations located throughout Northland, are also occurring.

Control requires site inspections and spraying for several years to ensure that no viable seeds remain in the soil. The Far North control programme is currently ahead of schedule, with all sites in the stage 1 area now controlled and site surveys and control work extending well into the stage 2-4 zones.

A project to introduce two new rust species as biocontrol agents for lantana was also launched during 2011 with Landcare Research and culminated in importation of the rusts being approved by the Environmental Protection Agency during 2012.

Species-led programme – Feral deer

Feral deer – a rare sight in Northland since the implementation of a joint agency deer response team in 1997

Feral deer are listed as an eradication species in the Regional Pest Management Strategies and rules aimed at preventing their importation and illegal release are in place.

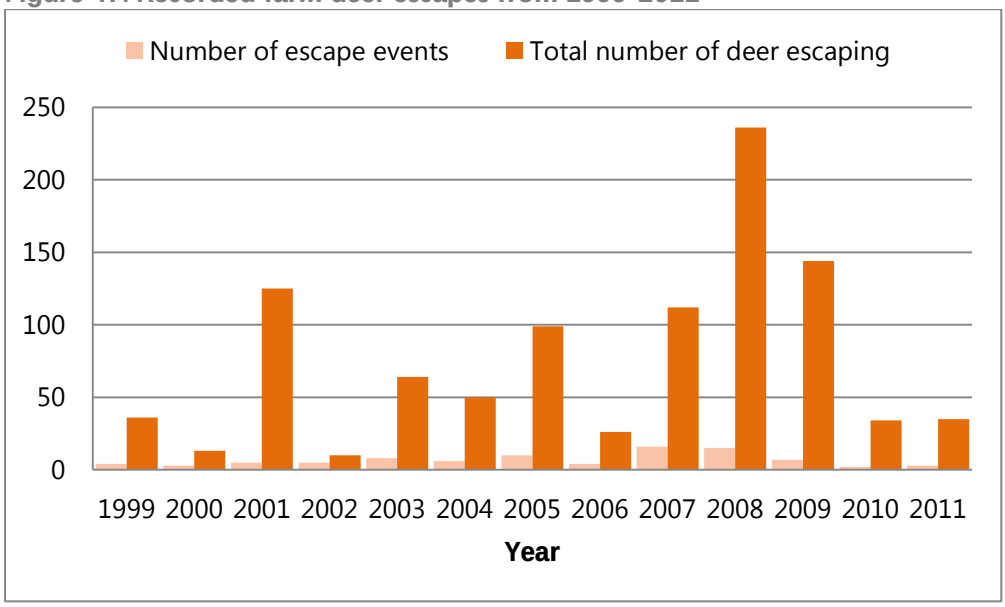
Feral deer are not common in Northland but if left uncontrolled would spread to occupy all available habitats, and damage Northland's unique native forests.

Farming communities are also justifiably concerned as feral deer have been confirmed as an efficient vector of bovine Tb to domestic animals. Feral deer are the main, if not only, vector of Tb transmission to possums (Lugton et al.: 1997). Northland is currently free of bovine Tb however, the economic costs of deer to Northland should Tb become established in feral deer herds and other wildlife, could balloon out to $6 million per annum (Sweetapple: 2006). A joint agency deer response team, funded by the council, Department of Conservation and the Animal Health Board, was established in Northland in 1997 in response to increasing feral deer populations, and associated impacts (Fraser et al.: 1996). The programme aims to remove all feral deer populations, and halt their dispersal through reducing the risk of farm escapes (McKenzie: 1996).

When the programme began in 1997 more than 140 wild deer in five separate herds were established in Northland. By 2007 all red, fallow and wapiti herds had been eliminated and the sika herd had been reduced to very low population levels. Since 2007, the sika herd has been targeted and no remaining individuals are known to exist, however further survey and time is required to confirm eradication. Unfortunately illegal liberations of a small number of fallow and sika deer have occurred in 2012 and these herds are targeted for eradication by the response team.

Deer escapes from farms are common, occurring at an average rate of 6.5 escape events per annum since 1999 (Figure 47). All deer known to have escaped from farms between 2007 and 2011 have been either shot or recaptured so that no further wild herds have established. The cause of escapes is related to stock management, lack of fence maintenance, damage to the fence caused by storm weather events or simply leaving a gate open. Once deer escape from a farm they are easily frightened, becoming wary and extremely difficult to recapture. These deer quickly revert to a wild state. Responding to these escapes and preventing the establishment of wild herds is a key role of the response team.

Figure 47: Recorded farm deer escapes from 1999-2011



Site-led projects

Community projects which target multiple pest species are increasingly popular and by December 2011 regional council staff had helped set up 39 community plans – 21 in the last five years – involving more than 830 people, and 38,000 hectares of land. Community plans are used to help support the protection of kiwi, brown teal and other endangered fauna as well as deliver pest ant and weed control. The majority of the Community Pest Control Areas target multiple pest species.

Community Pest Control Areas targeting possums are monitored at regular intervals and communities are required to keep possums below agreed levels. Wax tag monitoring is a standardised way of estimating possum abundance and is measured by recording the proportion of possum bite marks on tags over randomly located lines. Wax tag indices in Northland prior to possum control were consistently recorded at more than 30% and had reached peaks of more than 70% in some habitats.

Wax tag monitoring is completed annually in a selection of the Community Pest Control Areas with up to 100 lines spread over 10 to 20 different areas in a year. In the last five years, only one of the 39 Community Pest Control Areas has consistently failed to meet targets for possum control. Although results have varied between areas and years, average results across those monitored have consistently shown possum numbers averaging 6% per year (range 0-24%).

Low possum populations can be assumed when wax tag interference levels are below 10% or less. General improvement in the forest canopy, flowering and fruiting of certain plant species such as kohekohe can be attributed to control of possums to these low levels (Nugent *et al*.: 2002).

Case study: Purerua Peninsula

Baby kiwi are vulnerable to animal pests, especially uncontrolled dogs, stoats and cats

Landowners on Purerua Peninsula and the northern entrance to the Bay of Islands have been actively managing predators of kiwi and the endangered Pāteke or brown teal for over a decade. Supported by the Northland Regional Council and the NZ Kiwi Foundation, a charitable trust set up for the restoration of kiwi, landowners have been successful at restoring brown teal and enhancing kiwi populations over more than 3000 hectares of farmland, forestry and native forest.

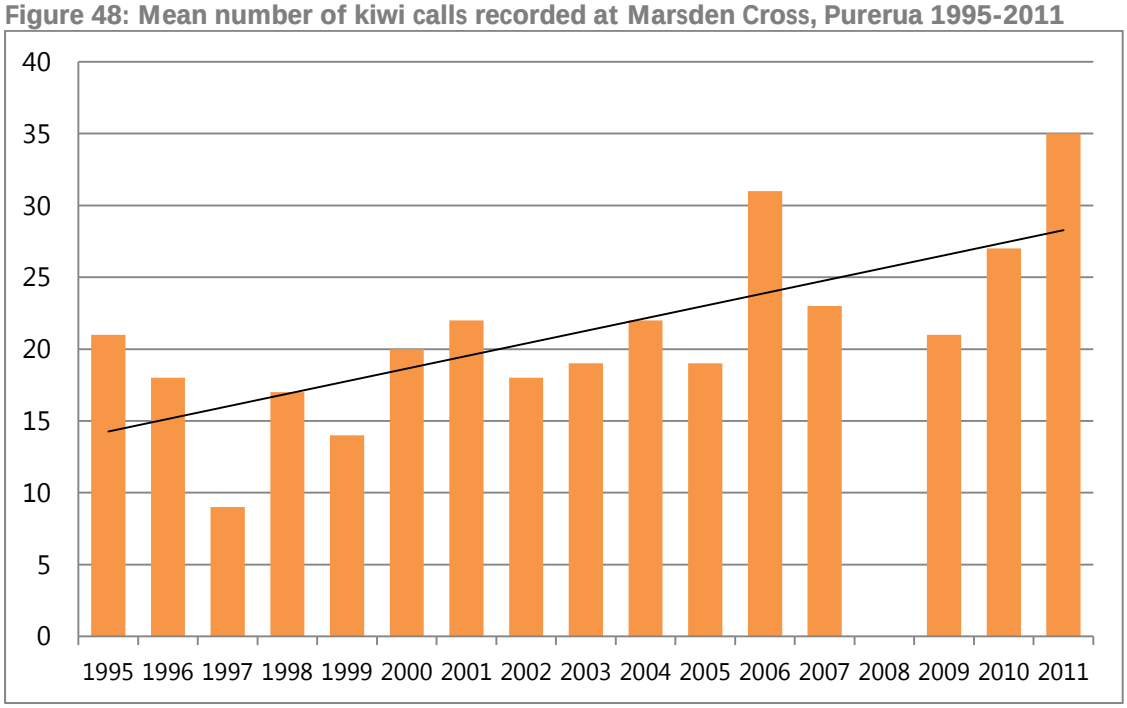
Pest control at this large landscape-scale provides the best opportunity for juvenile Pāteke to survive as they disperse many kilometres from their breeding sites where they are vulnerable to cats and stoats. Kiwi also benefit from pest control undertaken over several thousand hectares as the frequency and impact of predator reinvasion on the core kiwi breeding areas is reduced while providing additional pest free habitat for their offspring.

Trapping the killers of kiwi and Pāteke is a major focus of the project and results collected since 2008 show a 56% decline in the number of cats caught per month and monthly catch levels for stoats of less than 0.4, indicating that

population densities are low. Over 1500 stoat traps and 330 wild cat traps are in place and a zero tolerance policy for wandering or stray dogs is in force. This means uncontrolled dogs are destroyed on sight as they are known to have a severe impact on ground dwelling birds like kiwi and Pāteke as well as preying on livestock.

Northland Regional Councillor Joe Carr reintroduces Pāteke to boost populations at Purerua

Figure 48: Mean number of kiwi calls recorded at Marsden Cross, Purerua 1995-2011



Northland's Top Wetlands Project

The purpose of this project is to identify, document and promote the protection and better management of significant indigenous wetlands in Northland. The first part of the project identified over 300 of Northland's best wetlands and ranked them into groups by ecological district and wetland type. From this list the top ranked 150 wetlands in Northland have been identified.

Landowners with land adjoining any of the top 150 wetlands will be contacted to explain the intentions of the project and provide information specific to their wetland as well as offering advice on managing the wetland and possible assistance. The project has also developed guidelines to help with the identification of indigenous wetlands and guidelines for their management, specific to each wetland type. For more information about the project go to: www.nrc.govt.nz/wetlands

Legal protection and designation

In total, 13.75% of Northland's terrestrial area has some form of legal protection. This equates to 2067 areas covering a total of 180,336ha (Wildlands report No. 1844). Of this total, 1905 areas covering 156,451ha (around 92% of the total area) are protected with the aim of conserving natural values. The remainder of the areas may protect natural values as a by-product of protection but that is not the purpose of the reserve or protected area. So the total amount of Protected Natural Areas comprises around 11% of the total of Northland's land area. If Protected Natural Areas are not in Department of Conservation estate or embodied in district/regional plans, they may have no protection.

Department of Conservation

The agency with both the greatest number of Protected Natural Areas and the largest area is the Department of Conservation: 144,089ha in 802 sites which equates to 92% of the area covered by Protected Natural Areas. Areas managed by the Department of Conservation are classified into a range of different reserve types and are managed under a number of different acts of parliament.

QEII National Trust

The Queen Elizabeth the Second (QEII) National Trust Act provides a legal mechanism to secure the protection of biodiversity on private land through the creation of an open space covenant. An open space covenant is a legally binding agreement between the landowner and the Trust to maintain an area as open space in perpetuity.

At June 2011, Northland had 578 registered QEII National Trust Open Covenants and a further 51 approved, as shown in Table 12. The total land area in registered and approved covenants was 9570 hectares. The largest covenant is 417ha. However, most covenants in Northland are small, with an average size of 15ha. Northland has the largest number of registered covenants of all the regions in New Zealand but the average size is the smallest. Of the 16 regional councils and unitary authorities, Northland ranks fifth in terms of total area covenanted, and in terms of percentage of total area protected with QEII covenants, it is third (0.76% of total area).

Table 12: Number and area of QEII covenants in Northland as of August 2007

	2007 Covenants			2011 Covenants		
	Approved	**Registered**	**Total**	**Approved**	**Registered**	**Total**
Total number for Northland	92	442	534	51	578	629
Total area for Northland (ha)	1552	6561	8113			9570
Average size for Northland (ha)	16.7	14.8	15.2			15.2

Whāngārei District Council

The Whāngārei District Council has a process whereby conservation covenants can be established on private property under the Reserves Act (1977). As at 2010 there were 346 conservation covenants broken into 799 parts covering a total of 1185ha. Average covenant size is 1.5ha and the largest is 58ha.

Nga Whenua Rahui

Māori landowners can protect their indigenous ecosystems under Nga Whenua Rahui kawenata. The agreement is sensitive to Māori values in terms of spirituality and tikanga. Cultural use of these natural areas is blended with the acceptance of public access within the agreements. The objective is long-term protection with inter-generational reviews of conditions.

As at April 2008 there were 15 Nga Whenua Rahui kawenata in Northland covering a total of 3509ha.

Working with other agencies

Biodiversity Northland (formerly Northland Biodiversity Enhancement Group) was formed in 2001 and was New Zealand's first regional biodiversity forum. It is convened by the NZ Landcare Trust and its partners are organisations and agencies with a role in biodiversity protection in Northland. These include Northland Regional Council, Department of Conservation, NZ Landcare trust, district councils, Queen Elizabeth II National Trust, BNZ Save the Kiwi, Fish and Game New Zealand and the Farm Forestry Association.

Biodiversity Northland increases the level of co-operation between the various groups and encourages a strategic interagency approach. Projects to date include development of a landowner self-help kit *Restoring the Balance*, a regular biodiversity display at the Northland Agricultural Field days, workshops on different biodiversity related topics and the *Whole of Northland Project.*

Northland Regional Council Environment Fund

The council's Environment Fund is a contestable fund that was established to assist landowners and community groups to carry out work that has wider environmental benefits for the community. The fund will meet up to 50% of the cost of approved projects in recognition of the fact that environmental protection work carried out on private land has benefits to the wider community. Types of projects funded include fencing of wetlands and waterways, excluding stock from coastal areas, dune protection and restoration and pest control.

For a number of projects additional funding has been obtained from the Department of Conservation Biodiversity Condition Fund. Other projects have been jointly funded with Queen Elizabeth II National Trust where the landowner is covenanting the land.

How are we measuring up against our objectives?

The following are the anticipated environmental results for terrestrial biodiversity and biosecurity management in the operative Regional Policy Statement for Northland:

An increase in the areas of significant indigenous vegetation and the significant habitats of indigenous fauna which are formally protected

- Of the 416,900ha of indigenous vegetation land cover recorded in Northland in 2002 (33% of the total land area of Northland – approximately 1.25 million hectares), 150,084ha had some form of legal protection. This equates to 12% of the total land area in Northland. In 2012, a total of 180,336ha was recorded as legally protected. This equates to 14.4% of Northland's total

land area, suggesting that this environmental result is being achieved.

No increase in the number of threatened species in the region

- In 2004 there were 179 threatened plant species recorded in Northland, and in 2009 there were 241. The increase in number is attributed to several factors including improved knowledge of plant distributions stemming from dedicated survey, taxonomic resolution of long-established tag-named entities, the discovery of novel plants, and the loss of key habitat types through changes in land use practices over the last decade (Forester and Townsend: 2004; de Lange *et al*.: 2009).

Reduction in the damage caused to soils and natural features from pests and noxious plants

- In 1997 it was estimated that there were more than 140 wild deer in five separate populations in Northland. Although these numbers were low there was the potential for a rapid increase in numbers and consequently in the damage that they would do. A joint council, Department of Conservation and Animal Health Board operation led to the total removal of these wild populations, while on-going work ensures any new escapes from deer farms are either recaptured or killed. Feral deer can be very damaging to indigenous forest. By removing much of the understory they stop regeneration and increase the likelihood of soil erosion.
- The council works with a number of local communities in joint pest control operations where the community has identified particular pest animals or pest plants that are a concern to the communities. To date 39 community pest plans have been developed, often targeting multiple species. Included are intensive operations targeting feral goat populations, which impact upon forest health and can lead to an increase in erosion, and possum control operations on possums that are damaging coastal pohutukawa forest, an iconic natural feature of Northland.

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Contaminated sites

What do we want to do with contaminated sites?

The operative Regional Policy Statement for Northland details existing council and community objectives for each natural and physical resource in our region. The objectives relating to hazardous waste are:

- Avoid remedy or mitigate the adverse effects on people and the wider environment arising from the storage, use, transportation and disposal of hazardous substances.
- Avoid, remedy or mitigate the adverse effects of the risks to people and the wider environment from existing contaminated sites.

The following are the anticipated environmental results after implementing the policies for hazardous waste management in the policy statement for Northland:

- Safer use, storage and disposal of pesticides and other agricultural chemicals and reduced risk of soil contamination. Increased public awareness of the risks associated with the improper use of hazardous substances.
- A reduction in the amount of hazardous waste requiring disposal.
- A reduction in the number of incidents of unauthorised disposal of hazardous waste.
- Greater control over the use of contaminated sites and protection against serious off-site environmental damage.
- Continued access to hazardous waste storage and disposal facilities.
- Safer use, storage and disposal of pesticides and other agricultural chemicals and reduced risk of soil contamination.

Note: the operative Regional Policy Statement is currently being reviewed. The proposed Regional Policy Statement (2013) is available at www.nrc.govt.nz/newRPS

What is a contaminated site?

A contaminated site is an area that has the potential to be contaminated with hazardous substances. Hazardous substances comprise those substances which present a significant danger to people and the environment because of their chemically reactive, explosive, flammable, corrosive, toxic or disease causing nature.

A variety of substances fall into this category, many of which are used in manufacturing industries. They range from oil-based products associated with the road construction and motor vehicle industries to various metallic products used in engineering, tanning and timber treatment operations. Pesticides and other agricultural chemicals are hazardous substances, although they can be used so as to not adversely affect people and the environment.

Where are the contaminated sites in Northland?

Locating contaminated sites

The regional council is tasked, under section 30(1)(ca) of the Resource Management Act 1991, with the investigation of land for the purposes of identifying and monitoring contaminated land.

The act defines contaminated land as land that

has a hazardous substance in or on it that has, or is reasonably likely to have, significant adverse effects on the environment.

This section is about sites that appear on the Northland Regional Council's Selected Land Use Register (the register), as a result of investigation. Properties are placed on the register when there is a record of a past or present land use that could potentially result in contamination of the land.

Such contamination could impact on present and future users of that site, and this is done regardless of whether there is any confirmed contamination or not. Our role in managing this data also assists future landowners to establish whether a property has potential liabilities.

The Ministry for the Environment compiled the Hazardous Activities and Industries List (HAIL), which is a list of activities that have the potential to cause contamination and it is this list that drives the selected land use register.

Not all the sites that are listed in the register are actually contaminated. Some of the sites may be clear of contamination, but have never been scientifically tested to establish this.

The register lists sites according to various categories. These are shown in Table 13.

Table 13: Categories of hazardous sites in the Selected Land Use Register

Category	Description	Explanation
U	Unverified history	History of land use on site is unverified.
V	Verified history	Land use history verified, but no sampling done.
1	Contamination confirmed	Sampling has confirmed contamination. No remediation has taken place.
2	Contamination acceptable, managed, remediated	Contamination that was identified has been removed or the site otherwise remediated.
3	No identified contamination	Sampling could not detect contamination.
4	Error	Sites that were placed on the register in error.

Investigation generally involves research into the history of land use on a site. This includes researching historical aerial photographs and investigating reports about activities at sites that could cause land contamination. Council staff will occasionally visit a site and take samples, where the risk of contamination having a significant impact on the environment is high.

Sites that have been found to be significantly contaminated have to be managed by the owner, to ensure that discharges do not have adverse effects on the environment or people. The council has been involved with management of such sites including the issuing of consents for the discharge of contaminants and remediation.

The Selected Land Use Register details many sites throughout Northland that have a historical land use specified in the Ministry for the Environment's Hazardous Activities and Industries List. Although most of these sites are to be found in and around urban settlements and industrial areas, some of the

sites are residential, while others are rural and in remote areas.

In January 2012, a nationally consistent set of planning controls came into effect to protect human health from contaminants in soils. The Resource Management (National Environmental Standard for Assessing and Managing Contaminants in Soil to Protect Human Health) Regulations 2011 (the NES) is implemented by territorial authorities which will ensure contaminants in soil are identified, assessed and remediated to make a site safe for human use.

The NES focusses on the potential impacts of soil contamination on human health. It does not take into account the environmental effects of soil contamination on the wider environment or the discharge of contaminants to land. These issues are managed by the regional council.

What are the issues associated with contaminated sites?

The main concern about contaminated land is that it could present a health risk to tenants, occupants or users of these sites, or result in significant contaminant discharges to the environment.

In the majority of cases, the investigation returns very low levels of contaminants. The liability for remediating a site generally falls on the current landowner. As such, ensuring that a site is not contaminated before you purchase it is very important.

Several sites are currently subject to resource consents which set out the conditions for the management of the sites. This includes monitoring of actual discharges and site management conditions.

What is being done?

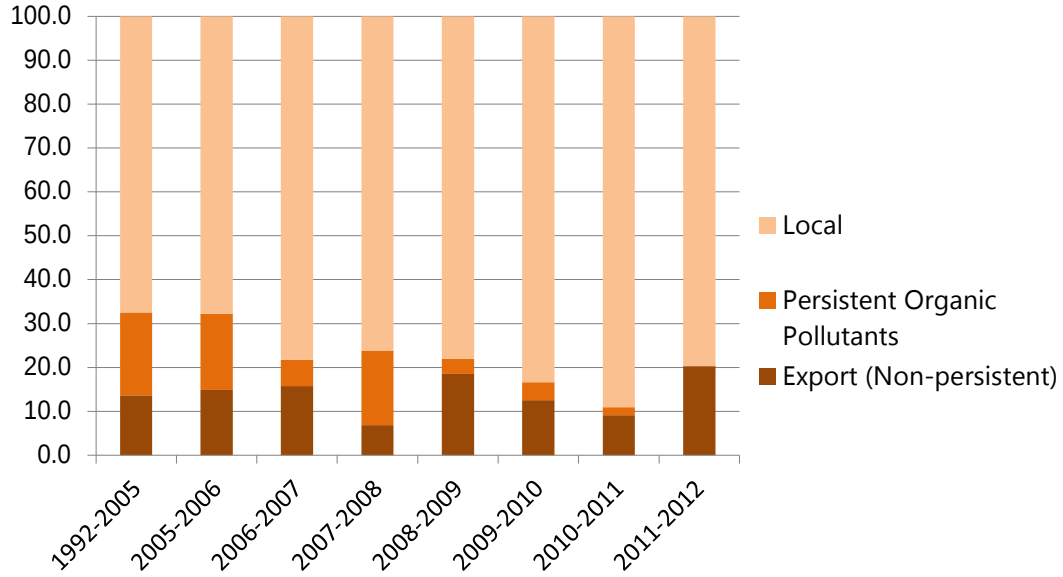
The Northland Regional Council has, for the past 20 years, collected household hazardous waste and related material for repackaging and proper disposal. The council took the initiative at a time when there was no proper disposal service available in Northland to deal with waste that was too hazardous for landfilling in a responsible manner.

This service was originally started to rid the region of persistent chemicals, such as DDT, PCBs and 2,4,5-T that contained dioxin. The service has continued as it was realised that unwanted chemicals are still being found in cupboards, sheds and garages throughout the region.

The service has proven to be a very positive step towards protecting Northland's environment. At least 44 tons of waste chemicals and hazardous substances have been collected and sent for proper disposal over the past 20 years that it has been operational.

The graph (Figure 49) shows a decreasing trend in the amounts of persistent organic pollutants being received by the council. While the composition of hazardous waste has changed, the overall volume of total waste received each year is relatively the same.

Figure 49: Organic pollutants received by the Northland Regional Council through its hazardous waste collection service – types of waste expressed as a percentage of the total collected each year



The council still receives small quantities of hazardous substances, such as DDT, 2,4,5-T, pentachlorophenol, Dieldrin and a host of other chemicals that were banned or phased out many years ago. Most of these are in small containers, with bags or drums still appearing, but these have become the exception rather than the rule. This waste comes mainly from garages or sheds where ownership of the property has changed and the new owner has contacted the council to assist in disposing of leftover agrichemicals in the right way.

In recent years, the quantity of persistent organic pollutants received has decreased, while industrial waste substances left for the council to dispose of has increased. This led the council to review the service. Dealing with hazardous waste generated as a result of industrial processes is the responsibility of the person or business that created the waste and is a cost that must be built into any sustainable business. The intention now is to ensure that commercial generators of hazardous waste take more responsibility for their own waste management.

A container of 2,4,5-T herbicide on top of drums of waste that has been sorted, packed, and ready for shipping

How are we measuring up against our objectives?

Increased public awareness of the risks associated with the improper use of hazardous substances

- The public is increasingly aware of the dangers associated with the improper use of hazardous substances. This is shown in everyday enquiries about the disposal of waste hazardous substances and items such as energy saving light bulbs, smoke alarms, thermometers, and other household items that contain hazardous substances.

A reduction in the amount of hazardous waste requiring disposal

- While the amount of hazardous waste that must be sent abroad for destruction is decreasing, the actual amount of hazardous waste requiring disposal has stayed relatively constant. This is due to improved technology in New Zealand for treating some waste, and a change in the composition of waste which includes increased quantities of industrial waste that is being improperly disposed of.

A reduction in the number of incidents of unauthorised disposal of hazardous waste

- The number of reported incidents where hazardous substances have been dumped illegally is low. Only 14 incidents of hazardous substances dumping were reported over the period 2007-2011.

Greater control over the use of contaminated sites and protection against serious off-site environmental damage

- The Resource Management (National Environmental Standard for Assessing and Managing Contaminants in Soil to Protect Human Health) Regulations 2011 (NES) requires investigation of sites being subdivided or developed, to find out whether the site may be contaminated in a way that could affect human health. The NES will provide more certainty that land contamination is identified and managed. The NES compliments the work undertaken by the council as it will provide new information on the location and extent of soil contamination on sites being developed. Remediation of sites where contamination is identified will reduce the risk of further environmental damage.

Continued access to hazardous waste storage and disposal facilities

- The council's chemical collection service was renewed when the 2012-2022 Long Term Plan was prepared. The council now operates a reduced service that still provides for the collection and disposal of household hazardous chemicals deposited at district council refuse stations.

Safer use, storage and disposal of pesticides and other agricultural chemicals and reduced risk of soil contamination

- The council continues to drive efforts towards the safer use and storage of agricultural chemicals through various educational resources and through enforcement of the Regional Water and Soil Plan rules. The proper disposal of waste hazardous substances has been greatly facilitated by the hazardous chemical collection service over the past 20 years.

Air quality

Air is a life-supporting resource that needs to be protected. In recent years air quality in Northland has become a greater issue of public concern, even though the quality of Northland's air is comparatively good by national standards.

Ambient air quality is the quality of the air that surrounds us, outside buildings or structures, and is the result of climate and topography as well as the combined effects of human activities (industrial, commercial and domestic) and natural sources.

Northland's air quality is influenced by the region's exposure to the prevailing south-westerly wind, which disperses air pollutants. This, along with the relatively dispersed population, an overall low vehicle density and sparse heavy industry, means that natural air quality in Northland is generally of a high standard.

However, regional ambient air quality monitoring has identified that at times pollutants, especially particulate matter (PM_{10}), approach or even exceeds national air quality standards. These exceedances are restricted to specific locations and often occur under specific meteorological conditions.

What do we want for our air quality?

The operative Regional Policy Statement for Northland details existing council and community objectives for each natural and physical resource in our region. The objectives relating to air quality management are:

- The sustainable management of the air resource by avoiding, remedying, or mitigating adverse effects on the environment from the discharge of contaminants to air.
- The reduction of the region's discharges of ozone-depleting substances and the net emissions of greenhouse gases in line with National Policy Statements.

The following are the anticipated environmental results after the implementation of the policies for air quality management in the Regional Policy Statement for Northland:

- The widespread adoption of the best practicable option for all discharges to avoid, remedy or mitigate the adverse environmental effects that may result from the discharge.
- A significant reduction in the number of incidents involving pesticide use, backyard burning and other similar contaminant discharges.
- Greenhouse gas emission levels in line with government directives.

Note: the operative Regional Policy Statement is currently being reviewed. The proposed Regional Policy Statement (2013) is available at www.nrc.govt.nz/newRPS

What are the issues affecting air quality?

Pollutants

The air, like any other natural resource, can be adversely affected by pollutants. Pollutants are substances that, under certain conditions, can harm human, animal or plant life. Polluted air can also interfere with the use and enjoyment of life and property by affecting visibility, causing odour, dust or smoke problems or corroding and disfiguring materials.

Pollutants of concern – such as oxides of nitrogen, reactive organic compounds, particles, carbon monoxide and sulphur dioxide – are released into the atmosphere from a range of human and natural sources. Significant sources of these pollutants include motor vehicles, industrial activities and some domestic and commercial activities. Once in the atmosphere some pollutants can then be transported throughout the region by wind and air currents.

The air quality in Northland is primarily affected by the meteorological conditions that are prevailing at the time. Warm, windy conditions tend to promote better dispersion and hence better air quality than cool, calm conditions. Consequently, air quality in Northland tends to follow a seasonal trend, improving in the summer and deteriorating during the winter months.

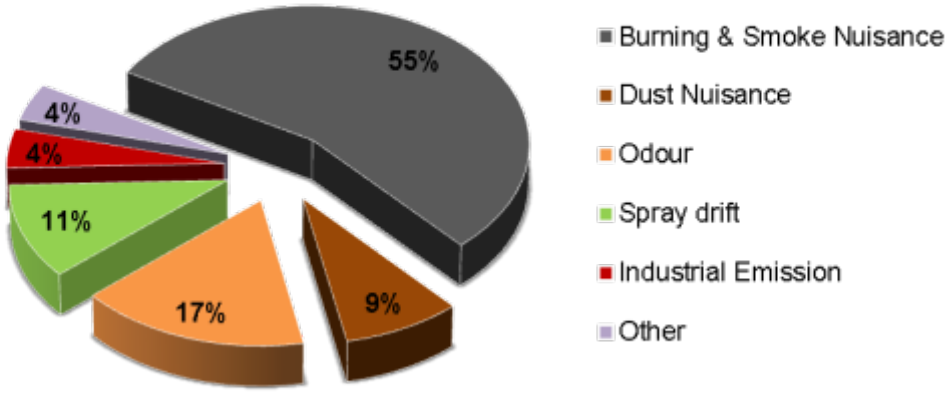
Environmental incidents

Since November 1993 the council has operated a system for receiving, investigating and reporting on environmental incidents 24 hours a day, seven days a week. In any given year, air incidents accounted for one third to one half of all incidents reported.

The majority of air-related incidents are distributed in five specific categories including:

- Burning or smoke nuisance
- Agrichemical spray drift
- Odour
- Industrial emissions
- Dust nuisance (as shown in Figure 50).

Figure 50: Percentage of air quality incidents according to sub-category from 2007 to 2011



Transport

While a single, well-tuned and operated motor vehicle is unlikely to have a significant effect on air quality, collectively motor vehicles reduce air quality, particularly in urban areas. Monitoring both in New Zealand and overseas has demonstrated that vehicles emit carbon monoxide, inhalable particulate matter, oxides of nitrogen, sulphur dioxide, ozone and benzene.

Although new vehicles are more fuel efficient and emit less pollutant per kilometre travelled than older vehicles, the increasing number of vehicles on our roads, the ageing New Zealand light vehicle fleet – the average vehicle age is 12.8 years (Ministry of Transport: 2011) – and the lack of emission control checks on vehicles, largely negate the good performance of new vehicles.

Home heating

Open fires and wood burners are the primary heating source in many houses in New Zealand. Collectively these fires can reduce the air quality to the point where it can exceed relevant national environmental standards for inhalable particulate matter (PM_{10}). Emission of particulate matter and other air pollutants increase, when people use wet, painted or treated wood, in particular. Air-related incidents falling into the home heating category are regularly reported to the council including the use of treated wood or rubbish being burnt in fireplaces.

Burning toxic materials can seriously degrade air quality

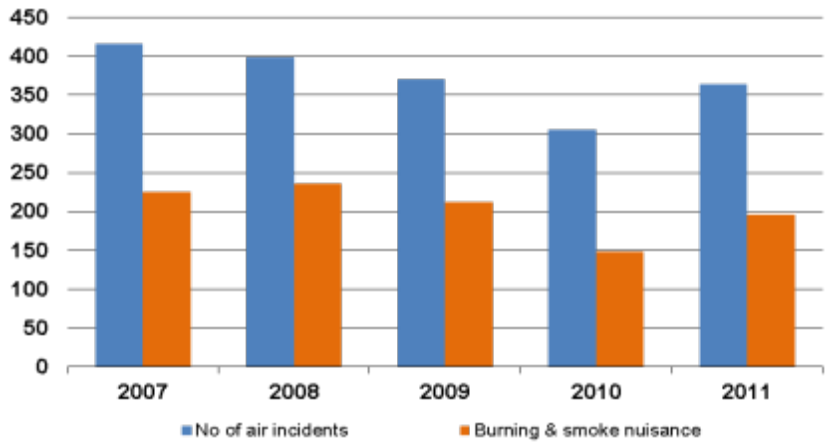
Since 1 October 2005, all new domestic fires in urban areas have been required to meet the national emission standard. This standard was introduced to reduce the amount of smoke pollution caused by domestic fires. Modern wood burners are highly energy efficient and produce fewer air pollutants. It is estimated that a total of around 1.8 tonnes of PM_{10} is discharged to air on an average winter day in the Whāngārei airshed. The main source during the winter is solid fuel burning for domestic home heating, which contributes to 1.3 tonnes (74%) of the PM_{10} emissions on an average winter day (Wilton: 2007).

Backyard burning

Disposing of refuse by burning it in the backyard is no longer considered acceptable in urban areas. The close proximity of neighbouring properties means that smoke and odours from rubbish fires frequently impact on adjoining residents. For elderly residents, very young children or people with pre-existing medical conditions such as asthma, respiratory or heart conditions, the inhalation of smoke can have serious potential effects on their health – aside from the unpleasant, acrid smoke and fumes that can result from the backyard burning of waste.

Burning and smoke nuisance incidents represent 55% of air quality related incidents reported to the council during 2007-2011 as shown in Figure 50. A comparison of the total number of air quality related incidents with the number of burning and smoke nuisance incidents reported annually during 2007-2011 is also shown in Figure 51.

Figure 51: Number of air quality incidents and burning smoke nuisance



Agriculture

A range of air pollutants are released into the atmosphere from agricultural activities. Agrichemicals, dust, burning and odour are the main air pollutants released from agriculture in Northland.

Rural fires can cause serious smoke nuisance

Other discharges

There are about 332 resource consents for the discharge of contaminants to air in Northland. Many of these consents are for small-scale sewage treatment and disposal facilities, which need appropriate controls placed on air emissions to prevent odour problems. About 80 discharge to air consents, mainly relating to industrial and commercial activities are closely monitored by the council to ensure that there are no significant adverse effects arising from the exercise of these consents.

What is our air quality like?

Clear, clean air is essential for the health and well-being of the Northland community. While poor air quality impacts on health, it also affects agricultural, horticultural and tourism industries.

The resource consent process addresses major point source discharges from industrial processes but many non-point source discharges, such as motor vehicles or domestic fires which do not require a resource consent can also collectively impact on air quality. Air quality monitoring in Northland shows that there are some areas with poorer air quality at times, especially during winter months. In winter there are periods of cold, calm weather when pollutants can build up to levels that may affect human health.

Air quality monitoring to date has shown that the Whāngārei urban area is the most likely to have air pollution episodes during winter. Air quality around busy roads, especially those subject to traffic congestion, can be degraded by pollutants emitted from motor vehicles. Particulate matter (PM_{10}), carbon monoxide (CO) and sulphur dioxide (SO_2) are monitored on a regular basis in Whāngārei and a summary of recent results is presented in Figure 53.

Particulate matter

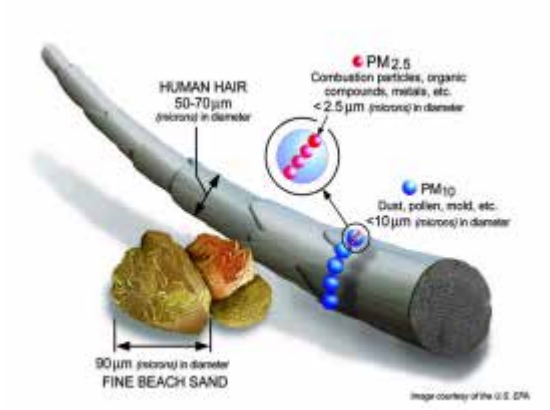


Figure 52: Particulate matter 10mm size (USEPA)

Particulate matter is a collective term used to describe very small solid or liquid particles such as dust, fume, smoke and mist or fog. Particulate material, which has an aerodynamic diameter of less than 10 microns, is referred to as 'PM_{10}' (Figure 52). PM_{10} in the atmosphere originates from both natural (wind-blown dust,

forest fires, volcanic emissions, sea spray and pollen) and anthropogenic activities including automobile exhausts, solid fuel burning, and industrial emissions.

PM_{10} is small enough to be inhaled. Fine particulate matter, especially $PM_{2.5}$ (<2.5 µm diameter in size), can even reach up to the human lungs and aggravate respiratory disorders. Research has shown that fine particles are more responsible for specific health effects. People most susceptible to the effects of particles include the elderly; those with existing respiratory disease such as asthma, chronic obstructive pulmonary disease and bronchitis; those with cardiovascular disease; those with infections such as pneumonia; and children.

The National Environmental Standards for Air Quality (more information on the national environmental standard can be found on the Ministry for the Environment's website at: http://www.mfe.govt.nz/laws/standards/air-quality-standards.html) set by the Ministry for the Environment for PM_{10} in order to protect human health is 50 mg/m^3 averaged over a 24 hour period (MFE 2004). PM_{10} is monitored in Whāngārei city using two devices. The first is a high-volume sampler operated at Water Street once every six days. A second instrument, a beta-attenuation monitor with results presented in Figure 53, operates at Robert Street.

Monitoring results for the period 2007-2011 at Robert Street showed that overall air quality was good most of the time. However, on one occasion PM_{10} concentrations exceeded the national environmental standards. This was on 25 September 2009 when the PM_{10} concentration exceeded the standards and reached 93.6 mg/m^3. This was due to an Australian dust storm that engulfed Sydney and Brisbane two days earlier. Many other cities in New Zealand also exceeded the national standards on that day. Higher results usually occur during the winter months, with lowest PM_{10} concentrations occurring during summer.

Figure 53: Daily PM_{10} concentration at Robert Street in Whāngārei 2007-11

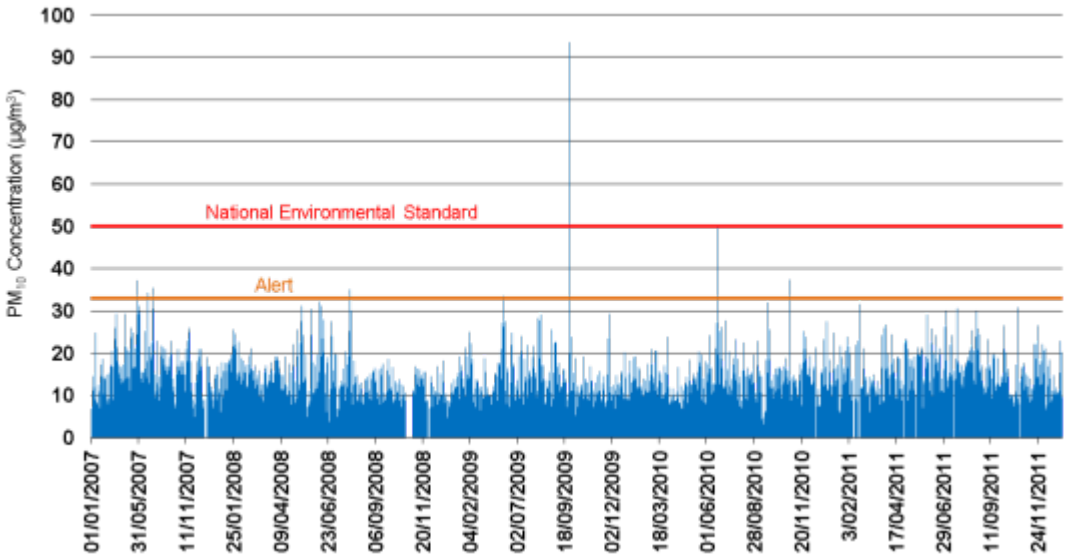
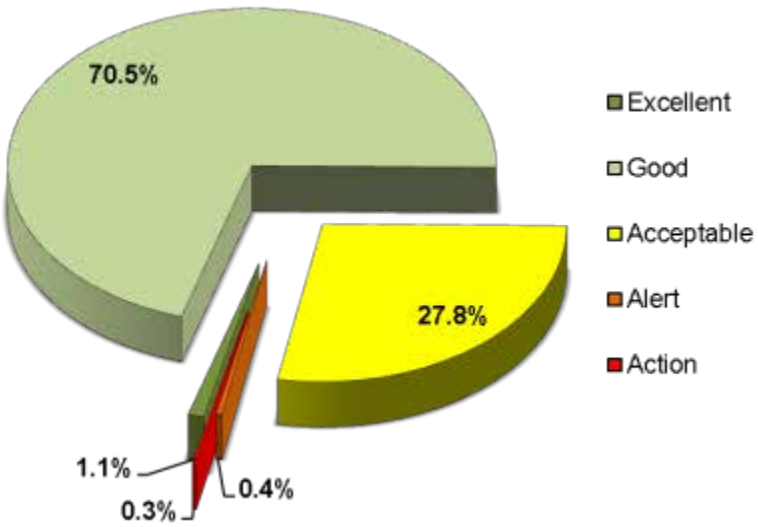


Figure 54: Environmental performance indicator for PM_{10} at Robert Street



The Ministry for the Environment's Environmental Performance Indicator for PM_{10} measures the concentration of each pollutant against the relevant national standard value for that pollutant. To measure air quality, monitoring data is reported as the percentage of data results falling in the different air quality categories, as described in Table 14.

Table 14: Environmental Performance Indicator programme air quality categories

Category	Measured value	Comment
Action	Exceeds the guideline value	Exceedances of the guideline are a cause for concern and warrant action, particularly if they occur on a regular basis.
Alert	Between 66% and 100% of the guideline value	This is a warning level, which can lead to exceedances if trends are not curbed.
Acceptable	Between 33% and 66% of the guideline value	This is a broad category, where maximum values might be of concern in some sensitive locations, but are generally at a level that does not warrant urgent action.
Good	Between 10% and 33% of the guideline value	Peak measurements in this range are unlikely to affect air quality.
Excellent	Less than 10% of the guideline value	Of little concern: if maximum values are less than a 10^{th} of the guideline, average values are likely to be much less.

Carbon monoxide

Carbon monoxide (CO) is a colourless and odourless gas that can be hazardous to human health. It is naturally absorbed from the lungs into the bloodstream because of the stronger affinity haemoglobin has for carbon monoxide than for oxygen. This reduces the oxygen-carrying capacity of the blood.

Carbon monoxide is a trace constituent of the atmosphere produced by both natural processes and human activities, including vehicle use and domestic burning (where incomplete combustion takes place). Places where vehicle emissions accumulate, such as traffic jams, tunnels and car parks, are locations of potentially high exposure levels.

Monitoring of CO at Robert Street has been carried out by the council since July 2010. Results have consistently been below the national standards with 92% of the data collected being within the environmental performance indicator 'excellent' category.

Sulphur dioxide

Sulphur dioxide (SO_2) is a colourless gas that reacts with ambient moisture to generate sulphuric acid aerosols (H_2SO_4). This transformation is the major contributor to "acid rain". Sulphur dioxide is readily identifiable by its characteristic pungent, irritating odour. Studies have shown that sulphur dioxide in combination with particulate matter poses a greater health risk than sulphur dioxide alone. High concentrations of sulphur dioxide are known to trigger the onset of chemical bronchitis and tracheitis. However, lower concentrations may trigger bronchospasm in sensitive individuals such as asthmatics.

Sulphur dioxide is produced during the combustion of fossil fuels, especially coal and oil, due to the oxidation of small quantities of sulphur compounds present within the fuel. In Northland, the major sources of sulphur dioxide are industries. These include the New Zealand Refinery at Marsden Point and other industries that oxidise sulphur as part of their production process, such as the Ballance Agri-Nutrients fertiliser manufacturing plant in Whāngārei.

The council has been monitoring SO_2 in the Marsden Point airshed since the middle of 2007 and at Robert Street since July 2010. The monitoring results obtained indicated that 99% of the time SO_2 concentrations were below 10% of the national standards, that is, within the environmental performance indicator 'excellent' category.

What is being done?

National Environmental Standards

The Ministry for the Environment introduced the national standards for air quality in 2004. The regulation set ambient standards for five pollutants: carbon monoxide, sulphur dioxide, nitrogen dioxide, ozone and PM_{10}. The standards also prohibit certain activities and set emission standards and efficiency criteria for wood burners used for household heating. Under the national standards, regional councils must monitor these five pollutants and publicly notify any exceedances. The implementation of the standards also requires regional authorities to designate areas (airsheds) where air quality has been adversely affected.

Using research carried out by the National Institute of Water and Atmospheric Research (NIWA), the council identified five air sheds in Northland suspected of reaching or exceeding the standards. The five airsheds include Whāngārei city, Marsden Point, Kaitāia, Kerikeri and Dargaville. Maps of the airsheds' distribution are available on the council website at: www.nrc.govt.nz/NESairquality.
In 2011, the national environmental standard was updated to include the following significant amendments:

- Removing existing restrictions in the standard on industry consents for PM_{10} discharges.
- Introducing split target compliance dates depending on the state of air quality in each (non-complying) airshed.
- Making provision for the exclusion of exceptional events (for example, dust storms, volcanic eruptions) from counting as exceedances of the PM_{10} standard.
- Requiring offsets from new industries with significant PM_{10} discharges in polluted airsheds from September 2012.

- Prohibiting new solid-fuel open fires in homes in polluted airsheds from September 2012 (gas open fires will still be permitted).

A polluted airshed is an airshed that does not comply (that is, exceeds) the standards. None of Northland's airsheds currently meet the definition of a polluted airshed.

Regional Air Quality Plan

The Northland Regional Council produced a Regional Air Quality Plan for Northland to manage the region's air resource. It provides guidance to those using the region's air resource and contains rules that permit, control or prohibit activities which cause discharges of pollutants to air.

Marsden Point Air Quality Strategy

The council adopted Plan Change 1 (Marsden Point Air Quality Strategy) on 1 December 2008 (a copy of the change is available online at: www.nrc.govt.nz/marsdenair). The plan change was developed to implement the Marsden Point Air Quality Strategy, which was approved by the council in September 2005. The strategy is therefore considered when making decisions on air quality in the Marsden Point area.

Backyard burning

The council adopted Plan Change 2 (Backyard Burning) on 1 December 2008 (a copy of the plan change is available online at: www.nrc.govt.nz/backyardburning). The plan change was developed to reduce the number of backyard fires in the Whāngārei urban area – the Whāngārei airshed – and, in turn, to help reduce the number of burning and smoke nuisance incidents and improve overall air quality in the city.

Since the controls were introduced in December 2008, a drop in complaints was recorded from 142 incidents in 2009, to 97 incidents in 2010 but rose to 140 in 2011. With only three years of data, and the variance in the data, it is too early to make any firm conclusions on the effectiveness of the plan change.

Investigation of air incidents

All environmental incidents reported to the council's environmental hotline are recorded, investigated and reported to the council meeting every month. An assessment is made on the appropriate follow-up action to take in response to each incident, which may result in formal enforcement action being taken by the council to address the situation.

Regional council staff members assist new and existing industries with technical advice, information and experience to avoid causing problems and to assist with resolving air-related issues that already exist.

Consent monitoring

Around 80 resource consents which have permits to discharge into the air are monitored to ensure that there are no significant adverse effects arising from the exercise of these consents. In the 2007-2011 period about 85% of monitoring confirmed compliance with resource consent conditions, while 10% identified minor non-compliance which required further attention. Approximately 5% of monitoring indicated more serious non-compliance, some of which required formal enforcement action.

Emissions inventory

In order to predict the potential impact of future developments in Northland, it is important to quantify existing discharges so the additional atmospheric burden of future projects can be estimated. An air emission inventory was carried out for Whāngārei

during 2006 to assess the sources and quantities of PM_{10} discharged to air in the Whāngārei airshed. Other contaminants such as fine particles ($PM_{2.5}$), carbon monoxide, nitrogen dioxide, sulphur dioxide, volatile organic compounds and carbon dioxide were also included in the inventory.

How are we measuring up against our objectives?

The following are the anticipated environmental results listed in the Regional Policy Statement for air quality:

The widespread adoption of the best practicable option for all discharges to avoid, remedy or mitigate the adverse environmental effects that may result from the discharge

- All discharge to air consents have environmental conditions relating to best practice options associated with their consent. All point sources (consented discharges) are strictly monitored against their consent conditions and overall, their impact on air quality in Northland is significantly less than the non-point sources (permitted activities). In general, Northland has a high standard of air quality.
- The management of the dust emissions created from unsealed roads is a particular air quality issue for Northland as district councils currently have limited resources to seal gravel roads.

A significant reduction in the number of incidents involving pesticide use, backyard burning and other similar contaminant discharges

- The regional council has an effective complaints system (Environmental Hotline) and has seen a reduction in the number of agrichemical related complaints following the implementation of the Regional Air Quality Plan. The number of air incidents, while high in relation to other reported incidents, is not increasing with the majority of complaints related to back yard burning.

Greenhouse gas emission levels in line with government directives

- The greenhouse gases and ozone depleting substances sections have not been effectively implemented. This is primarily due to the overlap with central government's responsibilities for these sections, and government direction in the case of greenhouse gases, that preclude controls via discharge consent conditions. Detailed information and studies on the effects of climate change on Northland are required, particularly for effective management at the resource consent level.