
215S

Chapter 11: Land

CONTENTS

Land

Briefly ....

Rural land uses and development have the potential to affect land resources and also affect the interactions between different parts of the community. For example, changes in land use have been of concern to people especially where there has been rapid change. People have different expectations about living in rural areas and the activities that can go on around them. These types of issues can create tensions within the community. Additionally, in some areas the growth and development that has been experienced in Marlborough in recent years, has led to demands on natural resources that have not been previously experienced.

ISSUES

- Contamination of land from past industrial, domestic or agricultural activities or from accidental spills.
- Discharges to land from on-site domestic waste water, vegetable processing, winery waste and dairy shed effluent.
- Degradation of soil quality from erosion and land use.
- Subdivision in rural and coastal areas.
- Forestry in the Marlborough Sounds.

PRESENT AND FUTURE MANAGEMENT

Land cover and land use in Marlborough

The Council has noted some significant changes in land cover in several land cover classes between 2002 and 2008. There were large increases in the amount of exotic forest, primarily horticulture and artificial surfaces categories and a decrease in the amount of primarily pasture category. The increase in the primarily horticulture category has arisen from an increase in viticulture.

Changes in land cover between 2002 and 2008 are also reflected by changes in land use. Total livestock numbers recorded for Marlborough shows significant decreases in all livestock numbers between 2002 and 2007. The decrease in sheep and beef numbers mirrors national trends, which have fallen steadily since the early 1980s. In comparison, decreases in the number of dairy cattle goes against the national trend, which has seen an increase in numbers over the last 5 years.

As of April 2008, about 22,277 hectares of land were planted in grapes in Marlborough, with a further 778 hectares being made ready for planting. Of the actual plantings, 16,095 hectares are on the Wairau Plain, with the remaining 6,182 hectares in the Awatere Valley and further south.

Soil monitoring

Twenty-five sites have been sampled representing six different land use activities (vineyards, cropping, pasture, dairy, native bush and exotic forestry). A number of different soil properties were measured to assess soil quality with target ranges for individual soil properties being assessed. In general, it was found that soil quality in Marlborough is pretty good with 7 out of 25 sites meeting all their soil quality targets and 16 others only having one indicator out of the target range. However, monitoring has highlighted some soil quality issues under some land use activities.

In 2007 the Council investigated trace element concentrations in different soils types under different land use activities. While many trace elements are essential for healthy plant and animal growth (i.e. copper and zinc), at high concentrations these can have a negative impact on soil fertility and plant health. The investigations found that on average, trace element concentrations were low and similar to concentrations found in other areas of New Zealand. With the exception of cadmium, there didn't appear to be any difference in trace element concentrations between land use activities.

Community concerns about the use of copper, chromium and arsenic vineyard posts resulted in investigations on the levels of these chemicals

in soils and groundwater in vineyards. Arsenic is leaching out of vineyard posts into the soil but this was restricted to within 100 millimetres of the post. Modelling was also used to predict how much arsenic could potentially accumulate in soils over a range of scenarios. This showed that it will take a long period of time before arsenic builds up to concentrations that exceed soil guideline values. Nonetheless, the Council is looking at options to mitigate arsenic accumulation in soils.

The types and concentrations of pesticide residues in soils has also been investigated. Sites chosen were representative of the most intensive land use activities and included six vineyards, five cropping sites, four pastoral properties and three dairy farms. It was found that at four sites no pesticide residues were detected. At eight other sites, DDT was found, although at low soil concentrations.

Extensive land development work, such as re-contouring, is taking place in some areas to make land more suitable for growing grapes. Apart from modification of parts of the Wither Hills in the 1940s and 1950s to address soil erosion, this is a new land practice for Marlborough. Because there is uncertainty as to what the effects of this might be, the Council is undertaking a scoping study. A further study connected with the use of land for viticulture has been the sampling of sites where vines have been grown on the same soil type but in the ground for different periods of time. This will allow the effect of long-term viticulture management on soil quality to be determined without having to wait for years to compare data.

The Council is also investigating 'soil intactness', a tool to see whether soils are staying in place and what might be controlling their movement. A decrease in soil intactness occurs when soil is disturbed and this may reduce the productive capacity of a site. The investigations will help identify trends and issues relating to soil disturbance and land instability in Marlborough.

Contaminated land

Currently in Marlborough, 375 sites have been identified as being either contaminated or have been used for activities or industries that involve the use, storage or disposal of hazardous substances. The most common types of sites include fuel, chemical and liquid waste storage (137 sites); market gardens, orchards and glasshouses (51 sites) and service stations (42 sites).

Once a site is identified as contaminated, or is an activity or industry listed on the Ministry for the Environment's Hazardous Activities and Industries List, that site is added to the Council's 'Sites at Risk' register. After a site is added to the register it is investigated and assigned into one of six categories. Currently of the 375 sites on the register, six sites are classified as contaminated, 17 sites are classified as remediated or managed and 33 are classified as acceptable.

On-site disposal of domestic wastewater

In areas like the Marlborough Sounds, where it is estimated that there are in excess of 4,000 existing on-site systems, it can be difficult to manage the discharge of wastewater. This is because there are poorly drained soils, thin soils, steep slopes, unstable geology, periods of heavy rainfall and the potential for low evapo-transpiration. If not well designed or managed there is the potential for contaminants from any discharge to travel into the surrounding environment. The Council's monitoring has already shown there to be elevated levels of bacteria in some coastal waters and shellfish over summer months.

Changes were made to the Marlborough Sounds Resource Management Plan in 2006 to provide a comprehensive framework to deal with issues arising with the on-site disposal of domestic wastewater. This includes new on-site wastewater management systems only being allowed by resource consent.

Guidelines have also been prepared for investigation, design, installation and management of on-site wastewater management systems. The guidelines draw on the experience of the Council's staff and on national standards to provide examples of best practice. Educational material for homeowners to help improve the performance of their existing on-site systems is also provided by the Council.

Winery waste survey

Marlborough has 47 wineries, 10 of which are located in the industrial areas at Riverlands Industrial Estate and Cloudy Bay Business Park on the eastern side of Blenheim. The remainder are located in rural areas around Marlborough. The Council carries out an annual survey of wineries checking the methods of treating and disposing of wastewater and grape marc.

Compliance rates assessed through the annual surveys since 2002, show that with the exception of 2002, systems for storing grape marc have consistently had higher compliance rates than those for wastewater. Staff carrying out the survey observe that compliance rates tend to correlate with the length and intensity of harvest. In 2008 for example, with the large volume of grapes harvested, some wineries did not have adequate systems in place to deal with the waste generated.

Dairy shed effluent survey

Currently there are 60 dairy farms operating in Marlborough. The Council's monitoring of dairy shed effluent systems is carried out annually. Survey results since the 2000/2001 survey show varying levels of compliance with plan rules or conditions of resource consent. Although dairy shed effluent systems are often recorded as being compliant, at times they are only just compliant. For example, the 2007/2008 survey noted that while 45 out of the 60 dairy shed effluent operating systems were considered compliant, 15 of these were only marginally so. However, what has been promising is that the percentage of farms with major non-compliance issues has been consistently falling over the life of the surveys. In 2001/2002, 20% of operating systems were in major non-compliance, while the last survey recorded no instances of major compliance.

Dairy farms and the Regional Action Plan and Clean Streams Accord

Since this Regional Action Plan was agreed upon in 2004, the targets have not always been met. One target requires there to be no "major" non-compliance as assessed in the annual surveys. (It is noted that in the 2007/2008 year there were no instances of major non-compliance but there had been in previous years.) Instances of minor non-compliance have been above the target of not exceeding 15% in any one milking season. The Council and Fonterra both provide information to farmers to assist them in achieving these targets.

People living in rural areas

The Wairau Plain has long had a history of intense rural production but was coming under increasing pressure from rural residential lifestyle living through the late 1990s and early 2000s. In response to the changes that were happening, the Council investigated roading, domestic wastewater disposal, subdivision, amenity values and landscape issues to help develop a vision about how the Wairau Plain should be managed into the future.

Several years of investigatory work were carried out, including a look at the unprecedented and unforeseen conversion to viticulture on the Wairau Plain. Based on all of this work the Council proposed some changes to the Wairau/Awatere Resource Management Plan and these were publicly notified in 2006. Ultimately however, the Council decided to withdraw the changes because the review of the Marlborough Regional Policy Statement had commenced and the Council felt the issues for the Wairau Plain area would be better addressed through that review process.

One of the interesting aspects to come out of the early work was that if the Wairau Plain wasn't the right place for rural residential living, then where was the right place? To help answer that question the Council commissioned two reports: one to look at impacts from lifestyle and small lot living outside of the Wairau Plain; and an investigation of small lot lifestyle development in the Onamalutu Valley, which had come up against forestry activities.

What was found was that rural areas away from the Wairau Plain were already experiencing problems between lifestyle development and productive use. The study highlighted that the Wairau/Awatere Plan had not anticipated the level of demand for lifestyle living in these areas nor the change in land use with land conversion to viticulture. The report recommended that a broader strategy for dealing with growth issues was necessary through the review of the Marlborough Regional Policy Statement.

Living in coastal areas

Given the values that a wide section of the Marlborough community, and beyond, hold about the Marlborough Sounds, the Council has started a major review of the operative Marlborough Sounds Resource Management Plan. This is much earlier than the Council is required to do so under the Resource Management Act. However, a lot of development has occurred within the Sounds since the Plan was first notified in 1995. There have also been legislative changes that affect how some activities can be carried out, aquaculture being the most notable.

At the same time, the Department of Conservation has begun reviewing the Nelson/Marlborough Conservation Management Strategy, which in part, guides the activities of the Department in the Marlborough Sounds. As a fundamental part of the reviews of their respective documents, the Department and the Council are combining efforts to identify what people value at particular places in the Sounds.

The future of forestry in the Marlborough Sounds

The Council has been considering how forestry as a land use in the Marlborough Sounds environment might be managed in the future. A range of possible scenarios have been looked at instead of replanting with Pinus species. This has included planting with different species or even allowing land once planted to revert to native or indigenous cover.

Coastal property values have also been influencing the future of forestry in the Sounds. This has seen landowners with property in forest, considering subdivision for 30 hectare allotments, rather than continuing the ongoing forest rotation and replanting. The Council has been concerned about how these properties will be managed given the sensitive Sounds' environment and the difficulties in managing re-emerging forest. The Council has therefore been exploring possible options to look after these 30 hectare allotments, including restoring native forest to them.

Wilding pines have been a problem in some areas and the Council, other agencies and various Sounds' communities are currently involved in a number of projects looking at how the spread of wilding pines can be managed. Some property owners (including the Department of Conservation) and communities in the Marlborough Sounds are also taking the initiative, attempting to control wilding pines on their own property, or on the surrounding land.

What is known about Marlborough's wetlands

What is currently known about Marlborough's wetlands, their type and extent and a comparison of this data with historical data, has been collected together in a wetland inventory undertaken in 2001. The 2001 study was a desktop one using topographical maps and aerial photographs. This meant that no field checking of sites was undertaken and no assessment was made about the actual state of wetlands.

A total of 1,149 sites were recorded in the survey, representing 1,242 individual wetlands. Of these, 597 were natural wetlands and 645 were man made, with a high density of these (417) being recorded on the Wairau Plain. 441 of the wetlands were of the palustrine type (marshes, bogs, swamps) and these have decreased in area by 89% across Marlborough between 1840 and 2000. Of those that remain only 24 sites have some degree of protection. Only 3.3% of the original palustrine wetland area remains in the lowland ecological districts with less than 1% of the original area being under some form of protection.

In late 2008 a review of the 2001 inventory was begun using the latest aerial photography and satellite imagery. The current areas of existing wetlands will be mapped and their significance will be assessed through field work and desktop analysis. The 2008 update will include a wetland specialist visiting many of the wetlands to determine their current condition and the pressures facing them.

One of the few remaining natural wetlands on the Wairau Plain

Land

In depth ....

Marlborough's land environment is rich and varied with large areas of mountains, rolling hills, fertile valleys, coastal margins and offshore islands. This varied physical environment has enabled people to make a living from the land from a wide range of rural land uses. Towns, roads and other infrastructure also make use of large areas of Marlborough's land resource. It is important to recognise therefore, that as a community, we rely on the use and development of land resources for our social, cultural and economic wellbeing.

However, both rural and urban land use and development have the potential to affect land resources. For example, in some areas where there has been land clearance activities over time, there is little remaining indigenous vegetation - this is particularly so in southern Marlborough. In other areas, animal and plant pests infestations have invaded and damaged both indigenous and production land ecosystems. Within townships, having good quality water, getting rid of waste and dealing with differing aspirations for how, and where, people want to live, can all have varying degrees of impact on land resources.

Changes in land use, especially in rural areas, can make people anxious. This anxiety is heightened where there has been rapid change. People have different expectations about living in rural areas and the activities that can go on around them. These types of issues can create tensions within the community.

The past legacy of some rural land uses has resulted in areas of land being contaminated with dangerous chemicals. While in Marlborough there are relatively few areas with contamination problems, there is the potential risk to the health of both humans and animals and to the wider environment if these are not dealt with. Some aspects of current day land uses also pose a risk to the wider environment. Traditional activities such as dairy farming result in discharges to land: if these discharges are not carefully managed there is the potential for effluent to get into waterways or for land to become overloaded with effluent.

More recent land development practices have also given rise to potential effects on Marlborough's land resource. One such activity is the extensive re-contouring of land to make it easier for growing grapes. The impacts this might have on soil resources are unknown as is the long-term impact of intensive grape growing on soil quality.

It is expected that the prosperity of Marlborough will continue to depend on the value of production from rural and marine activities. However, influences outside of Marlborough such as the current economic downturn are likely to have an impact on some activities and could result in unintended outcomes for the wider environment. In some areas the growth and development experienced in Marlborough in recent years, has led to demands on natural resources that have not been previously experienced and has, in some cases, made issues that have always been apparent, worse.

In previous state of the environment reports, the range of issues or pressures described as happening to Marlborough's land resources, has been very broad. We had included not only the issues about soil quality, discharges to land and contaminated land, but also things such as the loss of terrestrial biodiversity, the impacts of pests on primary production and ecological values, our towns, waste management and so on. This year however, a separate chapter on some of these issues has been included so that the pressures, actions and monitoring that have occurred can be more fully reported. For this reason the chapters on Townships and Settlements, Waste, Infrastructure and Energy, Biosecurity Risks and Biodiversity also include information about land resources.

PRESSURES ON MARLBOROUGH'S LAND RESOURCES

Contamination of land

Like the rest of New Zealand, Marlborough generally has relatively low concentrations of contaminants in the environment. Despite this, as a result of past industrial, domestic, or agricultural activities or industries, there is a small legacy of contaminated sites here.

A site is considered contaminated when the soil and/or groundwater contains hazardous substances in concentrations significantly higher than normal background concentrations and there is, or is likely to be, a risk to human health or the environment. It is therefore essential that when a contaminated site is identified, it is investigated and managed.

Over the last decade, central government has taken a lead role in addressing issues relating to land contamination in New Zealand. It has developed a series of guidelines that provide a framework for managing contaminated land, which support local government responsibilities under the Resource Management Act. The guidelines illustrate best practice in reporting, risk

screening, classification of sites, site investigations and analysis of soils at contaminated sites. Central government has also supported the development of industry-based guidelines, which set best practice and recommend safe concentrations for specific hazardous substances in soil, water and air to protect human health and the environment. Programmes to collect and dispose of unwanted agricultural chemicals have been instigated. Furthermore, a scheme to provide funding to assist in the remediation or management of high-risk contaminated sites called the Contaminated Site Remediation Fund was set up in 2003.

Contaminated sites in Marlborough have been associated with timber treatment plants, service stations, some rural activities such as sheep dipping or intensive horticulture, and various other industrial activities. These sites can pose a risk to human and animal health and/or to the environment in a number of ways including by:

- direct contact with contaminated soil;
- swallowing food or water from contaminated environments; and
- breathing vapours or contaminated dust.

Contamination of land can also limit use of the land and may reduce land value.

Old sheep dip sites are potentially an area of risk for new rural landowners, given the historical extent of Marlborough's pastoral farming. Many of the chemicals used in sheep dips are hazardous to humans, animals and the wider environment. People exposed to arsenic and other insecticides like dieldrin and lindane over a long period of time, through drinking contaminated water or skin contact with contaminated soil, may not become immediately sick, but could become so over a lifetime. Stock exposed to toxic chemicals may become sick in the same way, and meat and dairy products may contain pesticide residues that could limit their sale to export markets.

With the large increase in viticulture over the last decade there has been community concern expressed about the extensive use of use copper, chromium, arsenic treated wooden posts in vineyards. The issue raised was the potential for these chemicals, arsenic in particular, to leach into soils and water and accumulate to concentrations that would exceed acceptable guideline values. The accumulation of copper and chromium, and more importantly arsenic, into soil may also reduce soil fertility and affect human health through direct contact with soil.

Managing fuel spill, Waitohi Stream, Picton

The Council also gets involved in managing contamination caused by spills or incidents involving hazardous substances. Thankfully this occurs relatively infrequently with the last major incident occurring back in March 2004, when a truck and tanker transporting aviation fuel, went off the road near the summit of Weld Pass, south of Blenheim. About half of the tanker's load of highly flammable fuel was spilt into a paddock during the crash. The spilt fuel was contained in a small gully using absorbent material to block the gully and collect any excess fuel. Samples of soil and water were taken to assess the level of contamination and monitoring continued over a number of months. Although at the time there was some thought that the soil may need to be opened up to reduce deeper contamination through exposure to air, this need did not eventuate. Luckily, aviation fuel evaporates freely when exposed to air, so to some extent the site has remediated itself over time.

Discharges to land

There are many activities that can result in discharge of contaminants to land. Usually discharges of contaminants arise from the disposal of solid, liquid or gaseous material, generally in the form of waste. However, contaminants are also discharged through the application of agrichemicals and from day to day land use activities.

The combination of favourable soil properties in many parts of Marlborough, and Marlborough's dry climate, makes the discharge of liquid contaminants to land a viable option in many places. Discharging contaminants to land avoids the equivalent discharge to freshwater or coastal waters and therefore helps to maintain and enhance water quality in rivers, lakes, wetlands, aquifers and coastal waters. However, there can be natural limitations to the capacity of the soils to treat and/or absorb contaminants.

In certain locations there is potential for discharges to land to have more serious outcomes. For example, land use activities located over the unconfined Wairau Aquifer can result in contaminants being carried down into the aquifer, if they are not well managed. This could adversely affect the supply of drinking water for Blenheim and Renwick. Other effects include degraded surface and groundwater quality through infiltration and runoff, soil contamination and disruption to land ecosystems. Peoples enjoyment of rural areas (or amenity values) can also be affected if discharges cause windblown rubbish, dust, odour, reduced air quality, attract vermin or have adverse visual impacts.

Some specific examples of activities that discharge contaminants are from:

- Agricultural effluent from dairy sheds, piggeries, wineries and pastoral farming.
- Animal waste in offal pits.
- Agrichemicals used in animal dips and the application of agrichemicals including pesticides, herbicides and fertilisers.
- Farming activities where cropping and stock trampling adjacent to water bodies releases sediments.
- Human effluent from domestic and community sewage treatment systems.
- Waste in landfills and farm dumps, composting and recycling operations.
- Waste from trade and industrial premises.
- Land clearance or other disturbance of land which can release sediments.

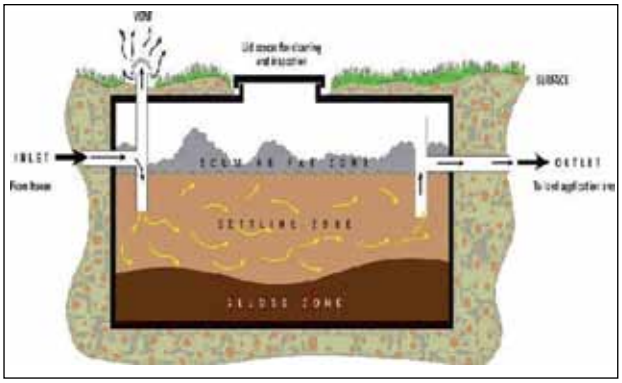
All the above activities can have serious consequences if undertaken in a certain location or in an uncontrolled way. However, two activities - the disposal of human and agricultural effluent - can have more significant adverse effects on the environment.

On-site discharges of domestic wastewater

On-site wastewater discharge systems are used to handle wastewater from buildings where no public sewerage system exists. Although there are a great variety of on-site systems currently available, all consist of two essential parts: the treatment unit and the land application area.

The treatment unit separates the solids from the liquids and breaks down organic matter within the wastewater. The most common form of treatment unit is the septic tank. Wastewater from the kitchen, toilet(s), bathroom(s) and laundry is directed into the septic tank. The heavier solids then settle at the bottom of the tank, while fats float to the top. The liquids then flow out of the tank and into the land application area. This process is shown in Figure 11.1.

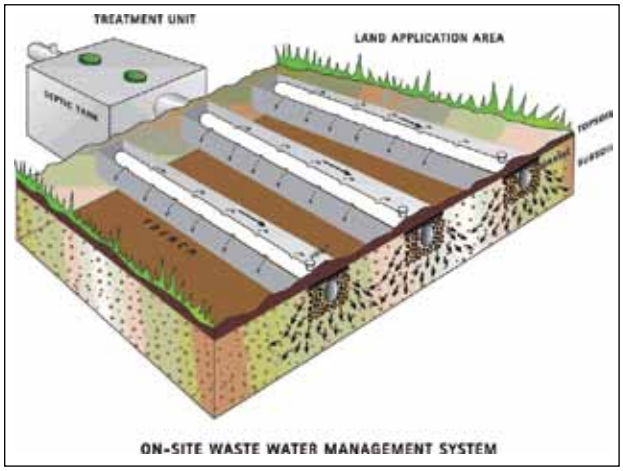
FIGURE 11.1: TREATMENT UNIT



The wastewater from the treatment unit is discharged into the soil by trenches, beds, mounds or dripper lines. The area into which the wastewater is discharged is called the "land application area" - see Figure 11.2. The wastewater still contains harmful bacteria and nutrients at this stage. Biological activity acts to provide essential further treatment as the wastewater passes through the soil.

If discharging domestic wastewater to land exceeds the capacity of the soil to assimilate it, then the wastewater will not be contained within the land application area and can go on to affect the surrounding environment. This includes contaminating water, particularly given the closeness of many on-site systems to

FIGURE 11.2: LAND APPLICATION AREA



streams, to coastal water or, in some cases, to underlying aquifers. People on neighbouring properties can also be adversely affected by the runoff of mismanaged domestic wastewater or from odour associated with the operation of the on-site system.

Vegetable processing, winery waste and dairy shed effluent

Vegetable and grape processing operations in rural areas typically involve discharges to land, and dairy farmers also discharge all dairy effluent to land. Just as for discharges of domestic wastewater to land, those discharging vegetable processing, winery waste and dairy shed effluent wastewater, are relying on soils to treat and contain contaminants present in the wastewater.

The main contaminants present in this type of wastewater are nutrients and organic solids. The discharges need to be carefully managed to ensure that the volume of wastewater does not exceed the hydraulic capacity of the soil because this would cause ponding. It is also important discharges do not result in the excessive application of nutrient, which has the potential to contaminate underlying groundwater, or adversely affect soil structure because this would mean the ability of soils to treat wastewater on an ongoing basis would be greatly reduced.

In the last 10 to 15 years there has been significant land use change in rural Marlborough, particularly with significant increases in the planting of grapes as was described in the Land use change chapter. The expansion of the viticulture industry in the Wairau and Awatere Valleys, as well as further south, has been very noticeable. While this expansion has seen the consolidation of a tourism industry based on viticulture, cellar doors open to the public for wine tasting and purchasing of wines and restaurants and cafes are also now features of our rural areas. Wine companies have also set up processing plants within rural areas to process harvested grapes. It is the waste from the processing plants discharged to land that can affect soils, and possibly groundwater if inappropriately managed.

Ponding of winery waste water

In many areas around New Zealand (Southland and Canterbury, for example) there have been significant changes in land use from pastoral farming or cropping, to dairy farming. The Ministry for the Environment's 'Environment New Zealand 2007' report noted that while the total area of land in pasture has been decreasing since 1972, the area of land in dairy pasture has increased. Further, that dairy cow numbers have almost doubled (from 2.92 million in 1981 to 5.22 million by 2006) even though the actual number of dairy farms has decreased. Dairy farm numbers have decreased in Marlborough in recent years. Nonetheless, existing dairy farms still discharge significant amounts of effluent to land and careful management of this is necessary so impacts on the wider environment are minimised.

If economic conditions change and there was to be a significant shift in land use away from viticulture to dairy farming, then we could see:

- Changes in soil health from livestock manure and from fertilisers.
- Reduction in water quality of rivers and streams and especially of the aquifers underlying the Wairau Plain and Southern Valleys.
- Increases in some greenhouse gases, such as methane.

Degradation of soil quality

Soils have developed from different parent materials and have been influenced by a range of soil forming factors and therefore display a variety of characteristics such as texture, structure, chemical properties, and depth of profile development. What this means is some soils types will be better suited to certain land uses activities than others and the same soil type will need to be managed differently under different land use activities. It also means that if soils are not carefully managed with respect to their land use activity, they are at risk of being degraded.

There are different types of degradation that can occur in our soils such as compaction and soil structural deterioration, accumulation of salts, loss of soil organic matter, accelerated soil erosion and chemical contamination. When it is considered

that only 2.4% of the soils in Marlborough are classified as highly versatile, it is essential that soil degradation is avoided or at least remedied so soil productivity and versatility are not compromised.

Soil erosion can be accelerated through exposure to rain, wind and frost and by vegetation clearance. If cultivation or excavation has loosened soil it is more easily eroded. Eroded soil usually moves downhill and eventually is washed into the rivers and the sea. Marlborough has areas, such as the Wither Hills, where erosion is more likely to occur because of the underlying geology, soils, slope and climatic factors. The Wither Hills were severely eroded prior to the 1950s when the former Marlborough Catchment Board put soil conservation measures in place.

Previous authorities put considerable effort into various erosion control measures, particularly in the 1980s, when significant amounts of central government funding was available and stocking rates on hill country were relatively high. Given the reduction of pressure from hill country grazing the Council does not currently undertake broad erosion related monitoring and control work. Aside from controlling activities such as the cutting of tracks and roads and building platforms by rules in the resource management plans, the one area that the Council still manages for soil conservation is the Wither Hills Farm Park - see box 'Wither Hills Farm Park'.

Erosion control works on the Wither Hills - 1984

Land use

Aside from the significant changes in land use that have occurred with viticulture in Marlborough, other land use activities have also had impacts on Marlborough's natural and physical resources. Changes in land use such as those experienced from subdivision and resulting residential development in rural and coastal areas and from land conversion to forestry have had a range of impacts.

In other cases, the impact on significant natural resources from day to day land use activities is ongoing and has been well reported in previous state of the environment reports, for example, the effect of taking water from aquifers for irrigation. For some resources though, there is little awareness in the community of how significant some of Marlborough's natural resources are and therefore little is done to protect them. One such example is the beach ridge and wetland complex at Rarangi. It is known that there are few wetlands left in Marlborough and therefore those remaining generally have considerable biodiversity value. However, the type of beach ridge system present at Rarangi is unique in New Zealand and rare internationally. Given that a large part of this area is not formally protected there is the potential for day to day farming activities to significantly affect the integrity of the overall complex - see the box 'Rarangi beach ridges and wetland complex' for more about this very special part of Marlborough.

Subdivision in rural and coastal areas

Many districts around New Zealand continue to grapple with how to manage the demand for residential or lifestyle living in rural areas and Marlborough is no different. What normally distinguishes lifestyle living from other residential activity is the size of the landholding. Most rural lifestyle blocks are between 1,000 square metres and 5 hectares. Those of the larger size are often run as hobby farms supported by income from off-farm employment. The smaller blocks have usually been created for residential use but may have enough room to accommodate a horse or a few sheep.

Over the life of the Marlborough Regional Policy Statement the Council has had to deal with a number of issues that have arisen out of people living in rural areas. In looking at the Marlborough Sounds for example, this iconic landscape has long been a desirable location in which to live and holiday, so is characterised in many locations by the existence of homes and baches. The density of residential use varies - ranging from baches in isolated bays, used on an intermittent basis, to ribbon development along the coastline, especially in the inner Sounds, to small settlements and urban communities (e.g. Ngakuta Bay, Okiwi Bay, Anakiwa, Tirimoana, Picton, Waikawa, Havelock etc).

Residential activity has been allowed by the past and present zonings under district schemes and district plans. For example, the Marlborough Sounds Resource Management Plan currently identifies properties that are considered suitable for residential use through the Sounds Residential zoning. The zone rules allow a house to be built on any property as a permitted activity, that is, no resource consent is required.

As part of an international and national trend, coastal locations for houses and holiday homes are increasingly sought after. The same trend is occurring in the Marlborough Sounds, with an increased demand for residential properties being reflected in the number of subdivision consent and building consent applications processed by the Council over the past 10 years. Another change is in the nature of houses and holiday homes - the modest kiwi bach, in which we used to make do, is steadily being replaced with large modern houses, equipped with all the mod cons.

WITHER HILLS FARM PARK

The Wither Hills Farm Park (Farm Park) is located on the southern boundary of Blenheim. The Farm Park has many different experiences to offer the community, including mountain biking, walking and running, spectacular views and the feel of being in the 'country' amongst the sheep and cattle grazing on the farm. It has become increasingly popular in the last 10 years and is recognised as an iconic backdrop to the town.

The Farm Park covers some 1,100 hectares, and aside from its recreational aspects, has as one of its principal functions, soil conservation. This was behind the original purchase of 165 hectares of the current Farm Park land back in 1944. The geological characteristics of the Wither Hills and their historical pastoral management combined to create a severe erosion problem, which was recognised as a potential threat to the township of Blenheim.

The nature of the highly dispersive soils made farming difficult and costly. Along with these problems, and the need to provide appropriate erosion and flood control on land overlooking the Blenheim residential area, the Council continued to acquire more properties to add to the original 165 hectares purchased in 1944. Numerous trials were undertaken during the early years to minimise erosion by using various tree and grass species, fertiliser application and mechanical treatments of the land. The successful treatments were then used from 1958 to treat over 3,000 hectares of land.

The Wither Hills Catchment Scheme was established in 1959. The major part of the northern facing slopes of the hills

was purchased by the then Soil Conservation and Rivers Control Council and the Crown. This land was placed in public ownership so eroded areas could be rehabilitated and the long term risks from erosion reduced. In 1993, the Council bought the 302 hectare Sutherland Stream block to connect the two existing Council administered properties. This has meant that the management of all areas at risk from erosion on these hills has been combined.

A management plan now governs the use of the Farm Park and, not surprisingly, the main objectives are for soil conservation and recreation. Farming still occurs but is used as a management tool and is a secondary objective in terms of meeting the primary soil conservation and recreation objectives. A significant part of the management plan has been the inclusion of an amenity planting master plan. This identifies the potential extent of planting areas within the Farm Park whilst protecting the iconic tussock grassland character of the hills.

RARANGI BEACH RIDGES AND WETLAND COMPLEX

At the end of the last glacial period some 14,000 years ago, the lower Wairau Plain from about Hammerichs Road east to the current coastline was underneath the sea. The formation of the lower Wairau Plain occurred as dunes were built up by gravel and sand from the Awatere River, swept north along the coast by ocean currents. Gravels and sand coming down the Wairau River then filled in the areas behind these dunes to form the lower Wairau Plain. This process continues today with the Wairau Lagoon area still being slowly filled in from behind the Wairau Bar.

At Rarangi the growth of the lower Wairau Plain can be seen with rock stacks and wave cut faces several kilometres away from the current coastline. Radio carbon dating has shown that the ridges near Tuamarina are some 6,600 years old, and the series of raised ridges and wetlands closer to the coast.

The series of dry gravel and sand ridges and associated wetland hollows with semi-natural vegetation are a landform that is unique in New Zealand and rare internationally. Since 1976 eleven reports have been prepared on the Rarangi complex with all recommending that the area needs to be protected in some way. In 1977 the then Department of Scientific and Industrial Research recommended that four areas be given reserve status. These included the wetlands inland from the Rarangi settlement, the wetlands south of the Wairau Diversion, the coastal areas and the wetlands between Rarangi Road and the Diversion.

In 2004 the Department of Conservation reported through its Protected Natural Area Survey, that the dry gravel ridges and associated wetland hollows, were the most valuable unprotected area in the Wairau Ecological Region.

The dry gravel ridges and associated wetland hollows are not only important geologically but they are also home to five species that appear on the New Zealand threat classification system (Hitchmough 2002). The area is one of only two known locations in Nelson and Marlborough where the tadpole shrimp is present, with the presence of some ephemeral habitat being critical to the completion of its life cycle. Two species of plant are classified as in serious decline, which elevates it to nationally significant ecologically.

With less than 1% of the original wetlands remaining on the Wairau Plain, the large intact wetlands of the complex are also significant.

A number of factors act to limit the extent of residential activity in the Sounds. A summary of these is set out in Table 11.1. These limits, or constraints, are reflected in permitted activity standards within the Marlborough Sounds Plan. For example, although a house can be built on any property as a permitted activity, the relevant permitted activity standards state that a house cannot be built in a flood or land stability hazard area, which are defined on the planning maps. If people do wish to build in these areas, then they are required to obtain a resource consent. The risk to life and property of building in the hazard area is then assessed through this process.

In other parts of Marlborough, rural lifestyle living has the potential to conflict with primary production activities. There have long been conflicts between traditional rural land uses such as agriculture, horticulture and forestry, and residential living. Newer land uses can also result in conflicts. The conflicts can be long running or are sometimes only apparent for short periods of time. They occur on the boundaries of towns, where town meets country, and where residential living is surrounded by rural land. (Sometimes conflicts may also arise between industrial or commercial developments that have been allowed to set up in rural areas, and existing residential living.)

TABLE 11.1: CONSTRAINTS TO RESIDENTIAL DEVELOPMENT IN THE MARLBOROUGH SOUNDS

Constraint	Nature of constraint
Fire safety	The closeness of houses to bush clad hills and commercial forestry plantations can create an increased fire risk.
Water quality	The quality of fresh and coastal water is vulnerable to the mismanagement of domestic wastewater (from bacterial contaminants) and earthworks (from siltation).
Water quantity	There is not necessarily year round availability of rain water or stream water for water supply purposes. The period when the population is the greatest (i.e. over the summer months) coincides with the period of lowest rainfall and stream flow.
Natural hazards	Parts of the Marlborough Sounds are subject to geological (e.g. slips), seismic (earthquakes) or flooding hazards. Locating residential activity in areas subject to these hazards creates a risk to public safety and private property.
Climate change	There are sea level rise implications arising from climate change predictions.
Access	There may be difficulties getting to residential properties by road due to topography and slope or because there is simply no road access. Moorings and jetties allow access to properties that do not have road access. The large number of these structures along the coast can affect the quality of the surrounding environment.
Ecology	Parts of the Marlborough Sounds provide important habitat for indigenous flora and fauna. Some of the species that reside in these habitats are already threatened and some of these species are only found in the Sounds. Residential activity in or near these habitats is not necessarily compatible with protecting indigenous flora and fauna.
Domestic wastewater management	Most residential activity in the Marlborough Sounds is serviced by on-site wastewater management systems. However, the nature of the physical environment, particularly the limited treatment and drainage properties of the soils, makes it difficult to ensure that domestic wastewater will be treated and contained on the properties on an ongoing basis.
Landscape/ seascape	The foreground, the sea, and the background, the coastline and the hills, are sensitive to physical change, especially where there are lots of structures, where they are painted in bold colours or where they are sited in prominent locations.
Amenity values	Density and location of buildings, and loud noise can affect the very qualities and characteristics that contribute to people's appreciation of the Marlborough Sounds.
Maori historical sites	Along with those archaeological sites scheduled and mapped by the New Zealand Historic Places Trust, there are many as yet formally unidentified Maori archaeological sites. Construction of buildings and tracks along the foreshore has the potential to unearth these and damage them.

These conflicts are sometimes referred to as 'reverse sensitivity' conflicts. This is where the effects of one activity on another nearby may lead to constraints on either of the activities being able to be carried out fully. These conflicts centre around what people think rural areas are usually like: peaceful, spacious, and private, with a rural outlook, accessible and with clean air. The reality is that this is not always the case. The range of activities that take place in rural areas means there is often noise, smell, dust, traffic etc.

Some of the more recent issues the Council has faced have been with the expansion of the viticulture industry on the Wairau Plain and in the Awatere Valley. Landscape changes, the loss of shelter belts and trees, noise from bird scarers and from frost fighting machines and spray drift have all resulted in complaints being made to the Council about this particular land use activity.

Some conflicts are between neighbours while others may impact more widely on the community. The types of amenity conflicts or concerns that the Council typically has to deal cover both and include:

- Smell, particularly from the sewage treatment ponds, effluent disposal and spray irrigation of dairy farm effluent.
- Noise, especially from bird scaring devices, wind machines for frost protection, harvesting equipment, rural industries.
- Spray drift particularly where this happens in close proximity to urban areas.
- Smoke from rural burn offs or, as in more recent times in Marlborough, from frost pots being used to protect grapes.
- Loss of rural character with more buildings within the rural landscape and on hilltops or ridgelines.
- Concerns about changes in the rural landscape resulting from extensive crop changes for example, from pastoral farming to viticulture as has occurred on the Wairau Plain and in the Awatere Valley.
- Local roads are sometimes unable to safely handle increases in traffic. This is made worse when traffic from lifestyle blocks comes up against heavy vehicles, such as those from the forestry industry. An example of this has been in the Onamalutu Valley, where both residential and forestry traffic uses the same narrow windy road.

From time to time there are other things such as dust, vibration, degraded water quality or clarity that also form the basis of complaints to the Council about rural land uses.

One of the biggest difficulties facing the Council is in trying to deal with the differences in tolerance between people and communities about what is happening around them. Often in trying to manage amenity conflicts we are managing the different expectations and tolerances that people and communities have.

Rural burn off

Forestry in the Marlborough Sounds

Commercial forestry in the Marlborough Sounds began around 50 years ago with the planting of small isolated areas like Farnham Forest on Snake Point in mid Queen Charlotte Sound. However, in the 1970s, a central government initiated economic incentive scheme was set up to encourage marginal rural land to be developed for commercial forestry purposes. The scheme provided the main momentum for a surge of commercial forestry development in the Marlborough Sounds. This mostly involved the planting of *Pinus radiata* on steep hill country, mainly in Mahau Sound, Hikapu Reach in Pelorus Sound, Linkwater, Port Underwood and on Arapawa Island.

Forest developers included many smaller private owners, who were either farmers with marginal land or private investors who acquired blocks of marginal land, at low prices, purely for commercial forestry development. In addition, the former Forest Service (a central government agency) acquired a number of farms in Queen Charlotte Sound and planted these in pine for commercial gain.

There was a further surge in new planting in the early 1990s that coincided with a period of high returns for timber. The total area of land now planted in *Pinus radiata* and other commercial species is approximately 15,000 hectares.

The viability of commercial forestry in the Marlborough Sounds has been significantly dictated to by the global economy in recent years, particularly the fluctuating kiwi dollar and log/timber prices. New Zealand's isolation has not been helpful to exporters, nor has the isolation of many of the plantations, which are influenced by transportation costs.

One of the outcomes of these pressures has been that some of the Marlborough Sounds' properties planted under the incentive scheme, have now become unviable for continuing (rotations of) commercial forestry. Consequently, some forest owners are leaving forests unharvested and/or are involved in exploring alternative land use succession opportunities.

Also influencing some forest owners has been the unprecedented increase over the last five years, in the value of rural land with a coastal frontage. This trend has presented opportunities for rural land owners to realise the capital value of their land through subdivision for residential purposes. The subsequent sale of the subdivided properties has provided returns that exceed those possible from either farming or commercial forestry.

The Marlborough Sounds are recognised as a unique and sensitive natural environment. Many activities, including commercial forestry, have the potential to create environmental impacts. Issues the Council has been facing with forestry are the impacts from harvesting, the visual impacts and from wilding pines. Another issue, that of the effects of logging trucks on Sounds roads, has been described in the Infrastructure and Energy chapter.)

Impacts of harvesting

Given the Marlborough Sounds terrain, many commercial forestry plantations have been established on steep sites. Once trees are harvested the combination of bare land and steep slopes creates the potential for soil erosion, particularly during rainfall events, until the slope is revegetated. Any eroded soil is carried by runoff downslope and can result in the deposition of sediment into creeks and into the sea. Depending on the amount of sediment, freshwater and marine habitats and biota can be smothered. An increase in the amount of sediment in coastal waters can also adversely affect filter feeding shellfish, such as mussels, cockles and pipi. The harvesting operation may also result in the direct disturbance of stream beds by for example the dragging of logs through streams. However, careful management of harvesting in these sensitive environments can avoid significant adverse effects.

Landscape values and wilding pines

The ability of pine trees to spread from commercial plantations is well documented in New Zealand conditions. The Marlborough Sounds are no exception. *Pinus radiata* seed, from lawfully-established forests, has been able to spread, germinate and create stands of wilding pines over significant areas of land in the Marlborough Sounds. The density of wilding pines varies, ranging from 5 wildings per hectare up to 100 wildings per hectare. In some areas the spread from commercial plantations is limited to adjoining land, but wilding pines have also been able to effectively spread to land far removed from plantations. Some wilding species have also spread from early homestead plantings on many of the Sounds' early pastoral farms.

Wilding pine regeneration

A number of factors have enabled pine trees to spread so easily in the Marlborough Sounds. These factors include:

- The extent and wide distribution of commercial forestry within the Sounds (approximately 15,000 hectares).
- The ability of *Pinus radiata* seed to be easily broadcast by prevailing westerly winds.
- The fact that the topography of the land assists in the broadcast of the seed, particularly where commercial plantations occur on or near ridges.
- The low stature of vegetation on some of the surrounding land (i.e. pasture grass and low scrub).
- Reasonable rainfall.
- Lack of recognition and action by property owners for early stage of infestations as well as a lack of after harvest management of re-growth for non-viable forests.

The establishment of wilding pines throughout the Marlborough Sounds is altering the landscape. Many in the community believe these changes are unacceptable and that wilding pines should be controlled. Wilding pines also have the potential to threaten ecological and habitat values by changing the nature of the vegetative cover.

Although the re-establishment of indigenous vegetation in many parts of the Sounds helps to limit the potential for further spread of wilding pines, it appears there is no long term certainty that a natural succession of indigenous vegetation can overwhelm existing wilding stands.

Additionally, the marginal viability of commercial forestry in some parts of the Marlborough Sounds means that forest owners may choose not to harvest the plantation or, if they do, they may choose not to replant. Unmanaged forests or the regeneration of pines on harvested land will continue to act as a seed source for many years to come. This effect may be overcome, in part, through other opportunities to gain an economic return from the same land. Such opportunities include the replanting of alternative high value tree species, residential subdivision and even allowing the land to revert to indigenous cover and realising the value of carbon sequestration through a carbon trading market.

RESPONDING TO PRESSURES ON MARLBOROUGH'S LAND RESOURCES

Monitoring change in land cover and land use

Marlborough's different land cover patterns reflect human pressures such as land use change and natural pressures such as geological processes. It is important there is a clear idea of the types and amount of specific land cover and land use there are and how these may change over time. This is because any increase or decrease in a specific land use activity like exotic forestry, horticulture or even the growth of towns does have the potential to affect different parts of the environment, for example changes in the demand for water arising from changes in crop type.

Land cover in 2008 has already been described in the Setting the Scene chapter of this report. However, there is difficulty in directly comparing data on land cover from year to year as satellite imagery improves and consequently more detailed analysis is able to be undertaken of the various land cover types. For example Land Cover Database 1 satellite imagery has 12 classes of land cover whereas Land Cover Database 2 imagery enables up to 30 classes of land cover to be analysed. Unless classes are aggregated, it becomes difficult to compare information from the two databases.

Where further analysis through updated aerial photography and field surveys is also taken account of there can be some unexpected changes recorded in land cover type. Despite this the Council has noted some significant changes in land cover in several of the land cover classes between 2002 and 2008. These changes are shown in Table 11.2. There were large changes in land cover in the amount of Exotic Forest, Primarily Horticulture and Artificial Surfaces categories and a decrease in the amount of Primarily Pasture category.

More detailed analysis of the land cover data revealed the increase in the Primarily Horticulture cover was mostly from an increase in viticulture. Most of this increase, that is 95%, was due to conversion from Primarily Pasture, in particular improved pasture. This in part explains the decrease in the amount of Primarily Pasture land cover. Furthermore, the increase in the amount of Exotic Forestry land cover was also found to be largely at the expense of Primarily Pasture, again mainly from improved pasture.

Sheep numbers are steadily dropping in Marlborough

Land use

The changes in land cover between 2002 and 2008 were reflected by changes in land use over this interval and supported by data for livestock numbers and the planted area of a range of crops in Marlborough.

Total livestock numbers recorded for Marlborough in 2002 and in 2007 are given in Table 11.3. This shows that while sheep were by far the most dominant livestock animal in 2007, there were significant decreases in all livestock numbers between 2002 and 2007. The decrease in sheep and beef numbers mirrors national trends, which have fallen steadily since the early 1980s. In comparison, the decreases in the number of dairy cattle goes against the national trend, which has seen an increase in numbers over the last 5 years in response to strong economic returns in the dairy industry.

The decrease in animal stocking numbers reflects to some degree a conversion of pasture in some areas of Marlborough to viticulture, which as already discussed was the main land use change.

The area of land covered in various fruit and vegetable crops in Marlborough in 2002 and 2007 is given in Table 11.4. This indicates that in 2007, with the exception of grapes, the main crops grown were sweetcorn, fresh peas, olives and cherries. It is also notable that with the exception of feijoas, the total area of all planted crops decreased over the reporting interval and for many crops only very small areas are now grown. The decrease in most fruit and vegetable crops generally has been as a consequence of a move into viticulture - see box 'Surveying changes in land area planted with grapes'.

TABLE 11.2: CHANGES IN LAND COVER IN MARLBOROUGH BETWEEN 2002 AND 2008

Landcover class	2002 area (hectares)	2008 area (hectares)	Change in area (hectares)
Exotic Forest	74,026	89,885	15,859
Primarily Horticulture	12,997	26,806	13,809
Primarily Pasture	299,174	276,053	-23,121
Artificial Surfaces	4,014	11,505	7,491

TABLE 11.3: TOTAL LIVESTOCK NUMBERS FOR SHEEP, DAIRY CATTLE, BEEF CATTLE AND GOATS IN MARLBOROUGH IN 2002 AND 2007[1][2][3]

	2002	2007	% Change
Total Sheep	785,000	579,000	-26.3
Total Dairy Cattle	33,000	24,000	-26.5
Total Beef Cattle	72,000	66,000	-9.3
Goats	4,707	3,679	-21.8

1 In 2002 and 2007 an agricultural census was conducted

2 Percentage changes are calculated on un-rounded numbers

3 Source: Statistics New Zealand (2008)

TABLE 11.4: TOTAL AREA (HECTARES) OF SOME FRUIT AND VEGETABLES PLANTED IN MARLBOROUGH IN 2002 AND 2007[1][2]

	2002	2007	% Change
Apples	211	25	-88
Peaches	15	2	-87
Onions	15	0	-100
Olives	449	240	-47
Pears	32	16	-50
Apricots	30	10	-67
Peas (fresh)	761	676	-11
Sweetcorn	842	778	-8
Plums	10	4	-60
Cherries	108	49	-55
Walnuts	43	9	-79
Feijoas	5	11	120
Grapes	7521	17,169	128.3

1 In 2002 and 2007 an agricultural census was conducted

2 Source: Statistics New Zealand (2008)

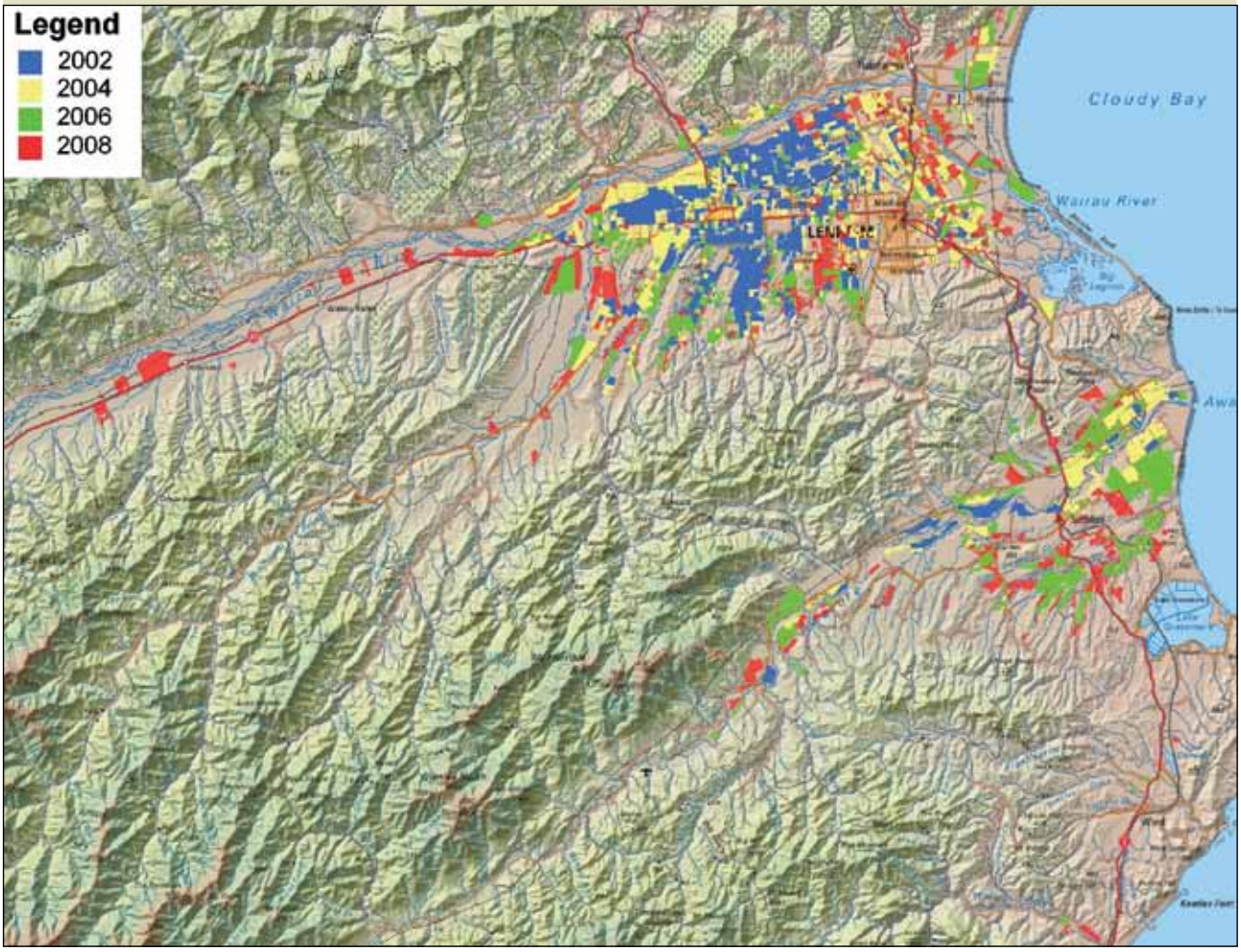
SURVEYING CHANGES IN LAND AREA PLANTED WITH GRAPES

The Council has been surveying the land area planted in commercially grown grapes within Marlborough for the last 9 years. This information is useful for looking at managing water resources, assessing impacts on soils and land settlement trends.

As of April 2008, there was a total area of about 22,277 hectares planted in grapes in Marlborough with a further 778 hectares being made ready for planting. Of the actual plantings 16,095 hectares are located on the Wairau Plain, with the remaining 6,182 hectares in the Awatere Valley, the Blind River and down to the Waima (Ure) River.

Surveys are carried out using a combination of aerial surveys, satellite imagery and ground observation with the data undergoing a continual audit and adjustment process. The intention is to survey at 3 yearly intervals to see how the total land area changes over time. Future surveys however, are likely to be carried out using remote sensing techniques to provide a snapshot in time. This will rely on satellite or aerial photo images, which will be interpreted by computer analysis.

To show the extent of the growth of the vineyards, the accompanying map shows the incremental additions of vineyards at two yearly intervals from 2002 through until 2008.

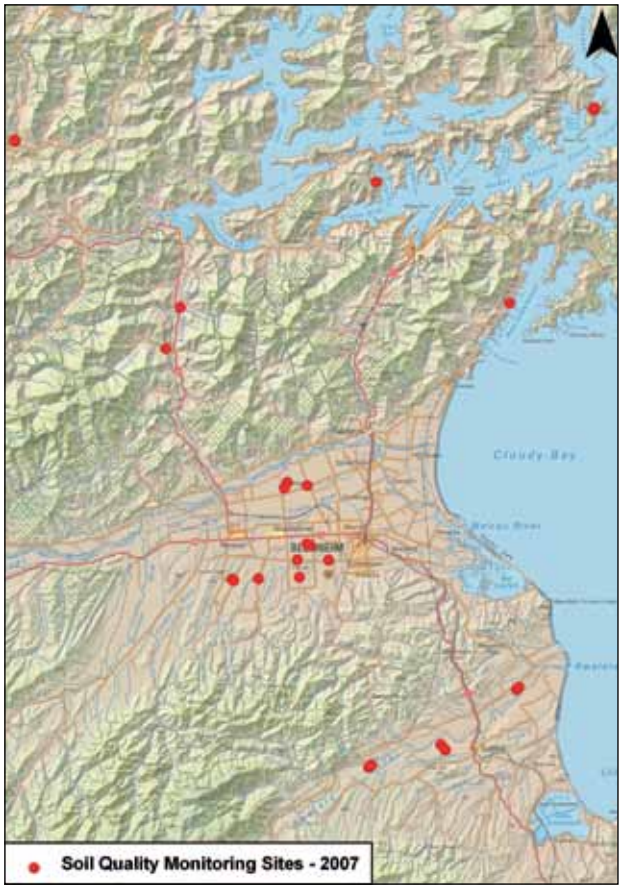


Marlborough's soils

Soil quality monitoring in Marlborough

To help determine the effect of land use practices on the life supporting capacity of soils in New Zealand, a soil quality monitoring programme called 'Implementing Soil Quality Indicators for Land', was set up by the Ministry for the Environment and regional councils in 1999. The monitoring programme involved collecting soil samples from sites that represented the main land use activities and soil types within each region. These were analysed for a suite of physical, biological and chemical properties shown to be robust indicators of soil quality. It was hoped periodic monitoring of these sites would provide an early-warning to identify effects of primary land use on long-term soil quality, and also provide an opportunity to track and identify issues relating to the effects of land use on long-term soil quality. (One of the difficulties in identifying trends in soil quality is that it takes a lot longer than monitoring water quality for example, to identify any trends.)

FIGURE 11.3: LOCATION OF SOIL QUALITY MONITORING SAMPLING SITES IN MARLBOROUGH



In 2000 the Council began its soil quality monitoring programme. Twenty-five sites were sampled representing six different land use activities including vineyards, cropping, pasture, dairy, native bush and exotic forestry (representing four different soil orders i.e. Brown, Pallic, Gley and Recent soils). The location of the monitoring sites is shown in Figure 11.3.

Two types of soil samples were collected from each site, composite samples and soil core samples. Composite samples, which included 25 sub-samples combined to form one representative sample, were taken along a 50 metre transect at a depth of 100 millimetres (Photo (a)). These samples were used for chemical and biological soil analysis. In addition, soil cores were sampled at 15, 30 and 45 metre positions along the transect for physical soil analysis (Photo (b)).

(a) Soil sampling along a transect

(b) Soil core

A number of different soil properties were measured to assess soil quality. The chemical quality of soils was determined by measuring soil pH, total carbon, total nitrogen and Olsen phosphate. The biological quality of the soils was determined by measuring the concentration of potentially mineralisable nitrogen in the soil. The physical quality of the soils was

determined by measuring bulk density and macroporosity. An explanation of each of the soil properties monitored is described in the box 'Soil properties'.

Target ranges for individual soil properties were assessed using a web-based tool designed by Landcare Research to help interpret the quality of a soil that has been sampled. This tool, referred to as SINDI (soil indicators) enables soils to be measured up against current understanding of optimal environmental/production target values.

What were the results?

Sites that were first sampled in 2000 were sampled again in 2007. To obtain reliable, long-term detection and prediction of trends in soil quality, at least three and preferably five points along a time sequence should be obtained. While results at this stage are very interesting, they only provide a snapshot of soil quality under different land use activities in Marlborough.

In general, it was found that soil quality in Marlborough is pretty good with 7 out of 25 sites meeting all their soil quality targets, and 16 others only having one indicator out of the target range as measured using SINDI. However, monitoring has highlighted that there are some soil quality issues under some land use activities in Marlborough.

Total soil carbon (which is a measure of soil organic matter status of soils), was found to be lowest on cropping soils. Cropping soils

SOIL PROPERTIES

Chemical properties	
Soil pH	Soil pH is a measure of the acidity and alkalinity of soil. It affects nutrient and contaminant availability in plants and also affects how well beneficial soil macro- and micro-organisms work.
Total carbon	Total carbon is the total amount of carbon in soil, including carbonates and soil organic matter carbon. Typically, New Zealand soils contain only small amounts of carbonate and therefore total carbon is generally considered a good measure of organic matter carbon in soil. Organic matter helps soil retain moisture and nutrients, contributes to a stable soil structure and provides a source of energy for soil microbes.
Total nitrogen	Nitrogen is an essential major nutrient for plants and animals, and the amount of nitrogen stored in soil organic matter, which is the main form of nitrogen in soil, is an important measure of soil fertility.
Olsen phosphate	Phosphorus is an essential nutrient for both plants and animals. Only a small amount of the total phosphorus in soil is in forms able to be taken up by plants (plant-available P). The Olsen P method provides a reasonable estimate of the amount of plant-available phosphorus in soils.
Biological properties	
Potentially mineralisable nitrogen	Potentially mineralisable nitrogen is a measure of the amount of nitrogen that can be supplied to plants through the decomposition of soil organic matter by soil microbes. It is a useful measure of the soil organic matter quality in terms of its ability to store nitrogen. However, the amount of potentially mineralisable nitrogen has also been found to correspond with the amount of soil microbial biomass. Therefore it is also a useful indicator of microbial activity in soils.
Physical properties	
Bulk density	Bulk density is the weight of soil in a specified volume and provides a measure of how loose or compacted a soil is. Loose soils may be subject to increased risk of erosion, can dry out quickly, and plant roots find it difficult to get purchase and absorb water and nutrients. In contrast, compacted soils have poor aeration and are slow draining.
Macroporosity	Macroporosity is a measure of the proportion of large pores (about 60 microns in diameter) in the soil. Macropores are important for air penetration into soil, extension of roots into the soil and drainage of water. Typically macropores are the first to be lost when the soil is compacted.

Example of a poorly structured cropping soil which makes it susceptible to compaction and reduced water infiltration

Example of soil pugging on the left side of the fence which can lead to low macroporosity in soils

also showed evidence of moderate surface compaction with high bulk density values and in some cases low macroporosity. These results put cropping soils at risk of poor aeration, poor drainage and structural degradation. It is possible that this was a result of intensive cultivation and/or insufficient pasture rotations within the mixed cropping rotation and the effects of tracking of heavy machinery.

One of the dairy pasture sites sampled had elevated potentially mineralisable nitrogen concentrations and two others had moderately high values. The dairy sites had the highest total soil nitrogen concentrations. While a supply of mineralisable nitrogen is essential for plant growth, if concentrations of soluble nitrogen exceed demand there may be a risk of nitrogen loss through leaching from soils, which may impact on water quality.

One of the dairy sites also had an elevated Olsen P (plant available phosphorus) concentration and the dairy and cropping sites overall had higher Olsen P values compared to other land use activities. This reflects the regular application of phosphate fertiliser to stimulate plant pasture and crops on these land uses, which is common farming practice. However, high soluble phosphorus concentrations may result in phosphorus losses from soils by either leaching or more likely overland flow. As with nitrogen, high soluble phosphorus concentrations, can have an adverse impact on water quality.

The dairy sites also all had relatively low macroporosity values, which are likely caused by heavy hoofed stock standing in one location for extended periods of time. Research has shown that macroporosity values below a 10% threshold can adversely affect pasture production. Low macroporosity may also result in poor water infiltration, which in turn may increase overland flow and the potential for nutrient losses from soils.

Trace element monitoring

Another form of soil degradation that can have a negative effect on soil quality is chemical contamination from the accumulation in soils of some types of trace elements. While many trace elements are essential for healthy plant and animal growth (i.e. copper and zinc), at high concentrations in soils these can have a negative impact on soil fertility and plant health. Additionally, some trace elements (i.e. cadmium, lead and arsenic) are not required in soils and their accumulation can have a negative impact on soil, plant and animal health, and in some cases there is potential for them to accumulate in the human food chain. For that reason in 2007 the Council undertook an investigation to determine trace element concentrations in a range of different soils types under different land use activities in Marlborough. (The sites sampled were those established in the initial soil quality monitoring in 2000.)

It was found that on average trace element concentrations were low and similar to concentrations found in other areas of New Zealand (Table 11.5). With the exception of cadmium, there didn't appear to be any difference in trace element concentrations between land use activities. For cadmium however, it was found that there were higher concentrations on dairy sites, most likely related to higher inputs of phosphate fertiliser, which has been shown to contain cadmium as a minor component.

TABLE 11.5: TRACE ELEMENT CONCENTRATIONS (MG KG^{-1}) IN SOILS 2007

Land use/ Activity	Arsenic	Cadmium	Copper	Lead	Nickel	Chromium	Zinc
Viticulture	4	0.1	19	26	19	19	68
Cropping	4	0.2	16	13	18	20	82
Pasture	4	0.1	14	11	14	19	67
Dairying	6	0.4	23	18	19	34	95
Native Bush	5	0.1	19	15	18	32	72
Exotic forest	4	0.1	13	11	7	12	50

TABLE 11.6: SOIL PH, OLSEN P, CADMIUM AND FLUORINE CONCENTRATIONS (MG KG^{-1}) FOUND IN DAIRY SITES

Sites	pH	Olsen P	Cadmium	Fluorine
1	5.3	29	0.3	580
2	5.8	32	0.3	277
3	5.8	28	0.3	447
4	6.2	39	0.5	334
5	5.9	21	0.1	328
6	6.2	32	0.5	242
7	5.9	49	0.5	317
8	6.0	32	0.5	314
9	5.8	37	0.3	205
10	5.9	19	0.4	344
11	5.9	27	0.4	168
12	6.2	20	0.5	212
13	6.2	19	0.6	291
14	6.0	30	0.7	361

Cadmium and fluorine in soils

Because of the elevated soil cadmium concentrations, a more intensive investigation was undertaken to determine the extent of soil cadmium concentrations at several dairy sites in Marlborough. In addition fluorine, another incidental impurity in phosphate fertiliser, was measured.

The results showed that soil cadmium concentrations were in line with those found for farmed pastoral soils in New Zealand. Concentrations were on average about double those normally found in non-agricultural soils (Table 11.6). Despite an apparent accumulation of cadmium in soils in Marlborough, concentrations are still significantly below the current New Zealand health guideline of 3 mg kg^{-1}.

Natural soil fluorine concentrations depend on the soil parent material, with background concentrations in soils typically ranging between 40 - 200 mg kg^{-1}. Fluorine concentrations in this study are therefore higher than background concentrations. However, at normal rates of ingestion of soil by grazing animals, which is their main pathway of exposure to fluorine, the soil fluorine concentrations found are unlikely to result in fluorine toxicity for animals.

Copper, chromium, arsenic accumulation in soils

The Council responded to community concerns about the use of copper, chromium and arsenic vineyard posts by investigating the levels of these chemicals in soils and groundwater in vineyards on the Wairau Plain. (The effect of treated posts on groundwater quality is discussed in the Freshwater chapter).

A study was undertaken to determine if arsenic could move out of treated posts into soil and if so, in what concentrations. It was found that on average across eight different sites on the Wairau Plain, arsenic could move out of treated posts into soil in high concentrations, although accumulation was restricted to within 100 millimetres of the post - see Figure 11.4.

It was also found average arsenic concentrations in below ground samples of wood taken from the posts, were significantly lower than concentrations in above ground samples of the wood and in new posts - see Figure 11.5. This confirms that arsenic is leaching out of vineyard posts into the soil and that leaching from the aboveground portions is likely to be minimal.

Nonetheless, the Council is currently looking into options available to mitigate arsenic accumulation in soils. One option could be advocating to the wine industry the use of alternatives to copper, chromium, and arsenic treated posts. A number of alternatives are currently available including pine posts treated with arsenic-free preservative chemicals, other wood products such as eucalyptus and using non-wood products such as plastic or steel posts.

Pesticide residues in soils

Another type of chemical contamination that may affect soil quality is the accumulation of pesticide residue. To find out the types and concentrations of pesticide residues in soils in parts of Marlborough, the Council has carried out sampling at a small number of sites. The sites were representative of the most intensive land use activities and included six vineyards, five cropping sites, four pastoral properties and three dairy farms.

It was found that at four sites no pesticide residues were detected. At eight other sites, DDT was found, although at low soil concentrations. The presence of low concentrations of DDT in these soils was most likely the result of use of this pesticide in the 1950s and 1960s, when it was commonly applied to pasture to control grass grub. In addition, seven other types of pesticide residues were detected in soils, although again at low concentrations.

FIGURE 11.4: AVERAGE CONCENTRATIONS (mg kg^{-1}) OF ARSENIC, CHROMIUM AND COPPER IN SOIL AROUND TREATED POSTS.

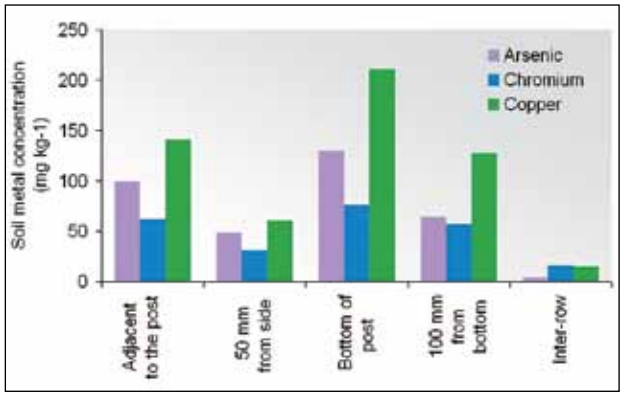
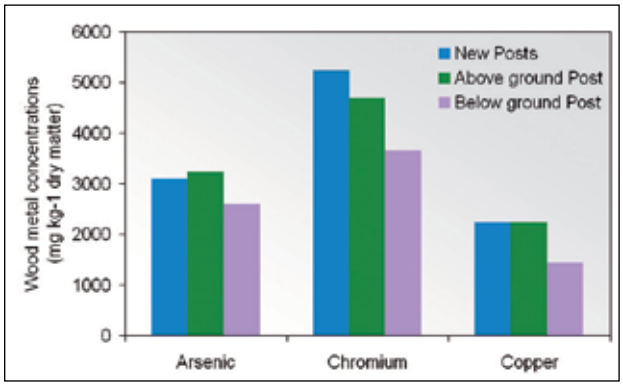


FIGURE 11.5: AVERAGE CONCENTRATIONS (mg kg^{-1}) OF ARSENIC, CHROMIUM AND COPPER IN TREATED VINEYARD POSTS



Copper, chromium, arsenic treated vineyard posts stacked and ready to be used in the field

Examples of plastic (right) and steel (left) posts currently being used in some vineyards in Marlborough

So overall, results indicate that pesticide residues are only found in low concentrations in Marlborough.

Soil maps and fact sheets

Ready access to detailed information about soils is a key factor for landowners and land managers trying to make accurate and timely environmental decisions relating to soil management. To make this soil information available, the Council together with Landcare Research, have compiled detailed soil maps for the lower Awatere Valley and the Wairau Plain. An example of the soil map for the Awatere Valley is shown in Figure 11.6. In addition, soil fact sheets summarising detailed chemical and physical information for individual soil types mapped in these areas, have also been compiled and will be available to the public on the Council's website.

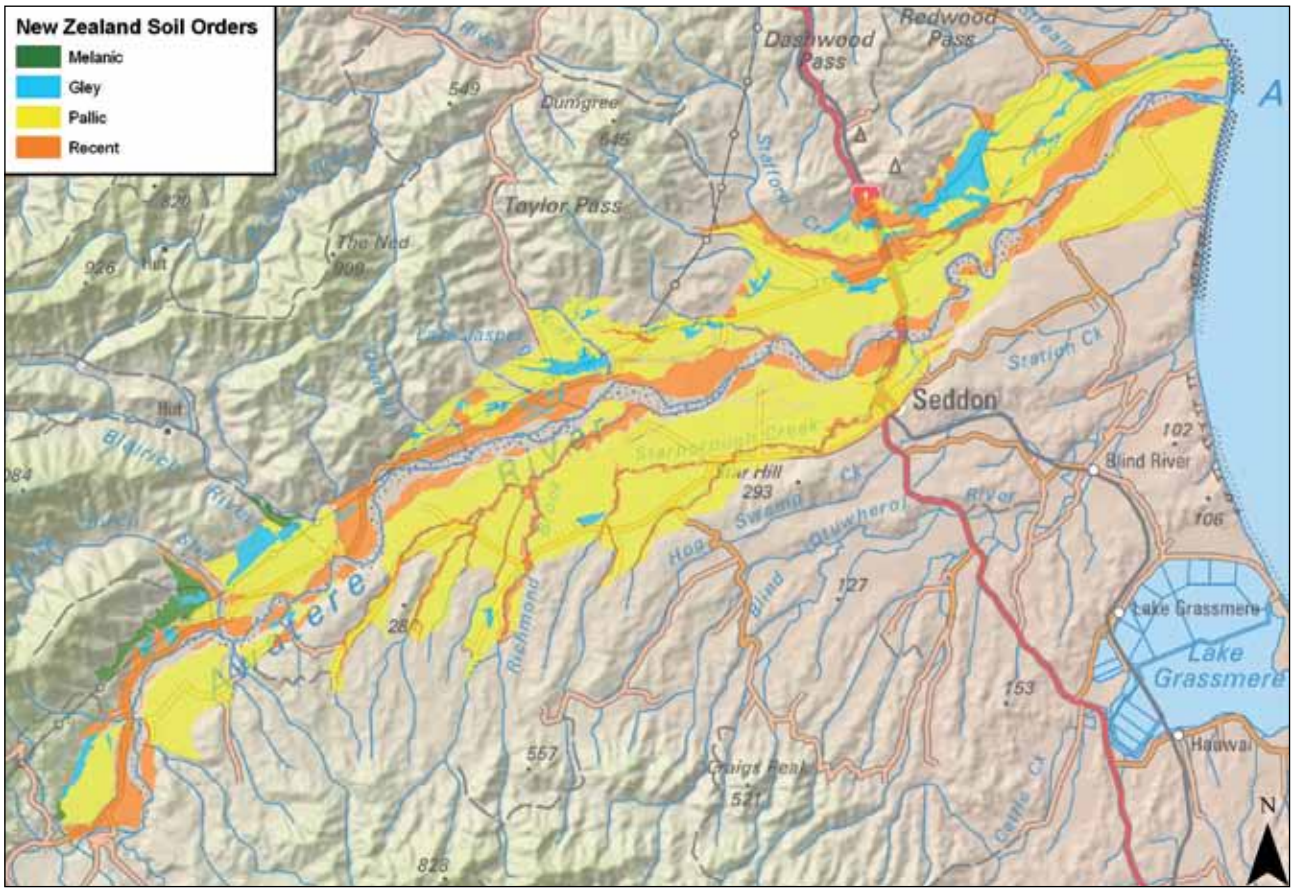
2008 and beyond: new projects and research in soils

Soil contouring

It would appear that high land prices and limited availability of land in traditional grape growing areas in Marlborough are encouraging some people to buy cheaper land (i.e. rolling hill country). In some instances extensive land development work, such as re-contouring is being carried out to make land more suitable for growing grapes. The re-contouring essentially involves re-shaping the land surface to eliminate or reduce the effects of topographic undulations.

Apart from modification of parts of the Wither Hills in the 1940s and 1950s, this is a new land practice for Marlborough. Consequently, there is uncertainty as to what the physical processes involved in land re-contouring are and what the potential detrimental environmental effects might be on the soil resource. To try and understand the processes and effects of land

FIGURE 11.6: DETAILED SOIL MAP FOR LOWER AWATERE VALLEY



re-contouring, the Council has obtained funding from Envirolink and commissioned Landcare Research to undertake a scoping study to investigate this issue.

Results of the initial scoping study will be available in early 2009 and will be used to determine whether there is need for further research or action.

Soil Quality in Vineyards

Compared to pastoral farming viticulture is regarded as a relatively intensive land use activity. There isn't a good understanding however, of what the impact of this intensive land use is having on soil quality.

In collaboration with the Marlborough Wine Research Centre, a work programme is currently under way to investigate soil quality in some vineyards in Marlborough. Soils are being sampled from sites where vines have been grown on the same soil type but have been in the ground for different periods of time. This will allow the effect of long-term viticulture management on soil quality to be examined without having to wait many years to obtain results.

As well as investigating the effect of the age of the vineyard on soils properties, other vineyard management practices are being investigated. These include looking at the effect of adding mulch to soil as this will provide some insight into the effect of increasing soil organic matter on soil quality. In addition there will be a comparison between conventional and organic viticulture management.

Initial results of this study programme will be used to determine whether there is need for further research in this area.

Soil intactness

The concept of 'soil intactness' is a tool to see whether soils are staying in place and what might be controlling their movement. A decrease in soil intactness occurs when soil is disturbed and this may reduce the productive capacity of a site. It is important to know about erosion prone land in Marlborough for a number of reasons:

- Soil loss accelerates sedimentation and nutrient run-off and degrades water quality in adjacent or downstream water bodies.

Examples of land re-contouring in south Marlborough

- Downstream erosion causes rivers to become filled in with silts and gravel, increasing the risk of flooding.
- The gradual loss of topsoil affects the general heath of the soil and reduces fertility and the productive capacity of the soil resource.
- Some types of erosion can affect land stability for housing.

In 2009 the Council began a survey across Marlborough to get a better understanding of soil intactness. The technique is based around analysis and interpretation of aerial photos taken at a given point in time. At 2 kilometre intervals, an area equivalent to 1 hectare is measured and an assessment is made of soil intactness. The assessment will determine if land surfaces are either:

- stable and vegetated;
- unstable and showings signs of past erosion but is currently not eroding;
- recently disturbed surfaces that are re-vegetating; or
- freshly disturbed surfaces that are bare.

It will help identify trends and issues relating to soil disturbance and land instability in Marlborough.

Contaminated land in Marlborough

Identification

To help identify potentially contaminated sites in New Zealand, the Ministry for the Environment has developed the Hazardous Activities and Industries List. This is a list of 53 activities and industries that are considered likely to cause, or have caused land contamination resulting from use, storage or disposal of hazardous substances. Examples include former sheep dip sites that historically used a range of persistent and toxic chemicals such as arsenic, dieldrin and DDT, or sites such as orchards and market gardens that used insecticides containing persistent chemicals like arsenic and lead.

Another way the Council collects information about contaminated land is through the resource consent application process. The resource management plans require information to be included in an application on potentially contaminated sites when rural land is subdivided for residential purposes. Typically this includes land that has historically been used for orchards, glasshouses or sheep dips.

Currently in Marlborough, 375 sites have been identified as being either contaminated or have been used for activities or industries that involve the use, storage or disposal of hazardous substances. Of these sites, 22 different land use activities/industries on the Hazardous Activities and Industries List have been identified. The most common types of sites include: fuel, chemical and liquid waste storage (137 sites); market gardens, orchards and glasshouses (51 sites); and service stations (42 sites).

Information management

Once a site has been identified as contaminated, or is an activity or industry listed on the Hazardous Activities and Industries List, that site is added to the Councils 'Sites at Risk' register. The Sites at Risk register is an electronic database used to manage information about sites in Marlborough. After a site is added to the register it is investigated and assigned into one of six categories. Currently of the 375 sites on the register, 6 are classified as contaminated, 17 are classified as remediated or managed and 33 are classified as acceptable (Figure 11.7).

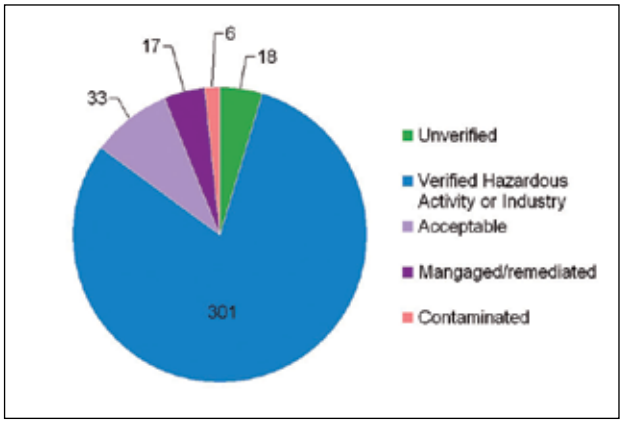
The information stored on the register is useful for a range of organisations including central government, environmental consultancies and is used by the Council in response to Land Information Memorandum (LIM) and Project Information Memorandum (PIM) requests. This ensures that prospective purchasers of properties are aware of the potential presence of contaminants, where this is known by the Council.

Investigation

The Council is also actively involved in assessing and investigating potentially contaminated sites. For example, in 1996 the Council in association with the Ministry for the Environment, investigated and assessed 14 sites in Marlborough that were potentially contaminated. Where necessary remedial action or management was suggested and implemented to reduce the risk at a specific site.

In addition, the Council visited 50 service stations around Marlborough in 1996 to collect information on practices relating to contingency planning, stock reconciliation, spill clean-up kits, oil/water separators and occurrences of any historical spills.

FIGURE 11.7: THE NUMBER OF SITES IN EACH CATEGORY ON THE SITES AT RISK REGISTER



More recently, the risks posed by individual sites on the Council's Sites at Risk Register are in the process of being assessed using a Risk Screening System developed by the Ministry for the Environment. For sites that are, or are suspected of being contaminated, the Risk Screening System provides a nationally consistent method of assigning sites with a high, medium or low risk rank and prioritising them for investigation. The ranking of sites is based on the source-pathway-receptor model (see box 'Source, Pathway, Receptor Exposure Model').

Disused power-spray machine used to treat sheep for parasites with chemicals such as arsenic dieldrin and DDT

Example of a common insecticide used in horticulture and the home garden up until the mid 1970s when it was de-registered

Currently two high risk sites have been identified in Marlborough and both have been investigated further with partial support from central government's Contaminated Sites Remediation Fund. One site is on land - see the box 'Rarangi sheep dip', while the second is in the coastal marine area - see the box 'Picton seabed' in the Coastal chapter of this report.

Discharges to Land

With the exception of stormwater discharges, the number of point source discharges into fresh and coastal water has been reducing in Marlborough since 1995. This probably reflects both the direction of the existing Marlborough Regional Policy Statement (which seeks to reduce the amount and concentration of contaminants and improve fresh and coastal water), and the fact that Marlborough's climate makes land disposal a viable option, especially the low rainfall and high evapo-transpiration over the summer months.

SOURCE, PATHWAY, RECEPTOR EXPOSURE MODEL

(source ECAN)

Source - is the presence of a significant source of contamination.

Pathways - are how the contamination moves from the source to the receptors.

Receptors - are the plants, animals and/or people which may be adversely affected by the contamination.

It is only when the source, pathway and receptor chain is complete that a risk actually exists.

Discharges of treated municipal sewage into freshwater and coastal water still occur. The main discharges to land that occur today are from on-site disposal of domestic wastewater and from vegetable processing and wine production wastewater and dairy shed effluent.

Onsite disposal of domestic wastewater

Almost all houses, holiday homes, buildings used for visitor accommodation and rural industries outside of Marlborough's major towns, rely on on-site systems to manage domestic wastewater. This means that domestic wastewater generated in the building receives initial treatment in some form of treatment unit, such as a septic tank, and is then discharged into or onto a land application area on the property. Contaminants present in the wastewater, such as bacteria and nutrients, are then further treated or absorbed as the wastewater passes through the soil.

However, in areas like the Marlborough Sounds, there are unique constraints to successfully managing on-site domestic wastewater, including poorly drained soils, thin soils, steep slopes, unstable geology, periods of heavy rainfall and the potential for low evapo-transpiration. If the method of treating the wastewater and/or the nature of the land application area does not take into account and reflect the site conditions, there is potential for contaminants to travel beyond the land application area, and into the surrounding environment, through runoff or infiltration.

Most buildings used for residential or accommodation purposes in the Sounds are located close to streams, creeks, or coastal water. This means if the on-site wastewater management system servicing the building performs poorly, there is a risk the subsequent discharge will contaminate water. The Council's monitoring has already established that there are elevated levels of bacteria in some coastal waters and shellfish over the summer months.

It is estimated that there are in excess of 4,000 existing on-site systems in the Marlborough Sounds. The performance of these systems is extremely variable. This is because:

- The systems are not necessarily compatible with site conditions or current occupancy of the building, and were often based on dated standards. For example, many septic tanks in the Sounds discharge wastewater into soak pits or short trenches, which have a tendency to eventually fail when installed in soils of low permeability. The older the system, the greater the potential for failure.
- The age of the on-site system can mean various components are no longer watertight and may therefore leak.
- Not all systems are maintained in an efficient operating condition. A lack of maintenance can contribute to the potential for failure. This situation is made worse by the fact that many on-site systems are inaccessible for servicing.
- Stormwater is entering the treatment unit or land application area, increasing the hydraulic loading on the site soils.

Given the age of some systems, and the rate of property ownership change in the Sounds, present owners may know little about, or even where the on-site wastewater management system is on their property.

Changes were made to the Marlborough Sounds Resource Management Plan in 2006 to include a comprehensive framework to deal with these issues. The objectives of the changes were to ensure new on-site wastewater management systems are designed, located and installed to effectively treat and contain all domestic wastewater on-site, all on-site wastewater management systems perform in an efficient operating condition on an ongoing basis, while avoiding adverse effects on the surrounding environment and that the management of domestic wastewater, associated with residential subdivision and development, does not adversely affect the surrounding environment.

A range of methods are used to achieve these objectives, but of particular note is a requirement for any new on-site wastewater management system to require a discharge permit.

RARANGI SHEEP DIP

Elevated concentrations of arsenic in groundwater were first discovered during routine measurements in the north Rarangi community water supply well in 2001. This raised the question of the potential risk to other users of the Rarangi Shallow Aquifer, the primary source of drinking water for the local community. In response, the Council has undertaken a range of investigations to try to determine the source of the arsenic.

One potential source of arsenic contamination was from a former sheep dip identified in the Rarangi area ((a) below). Investigation of the dip-site revealed soils were highly contaminated with arsenic and this may have been having an adverse impact on the shallow groundwater system underlying the site.

It was decided the best option to manage the risk of arsenic at the dip-site, was to implement a partial remediation to remove the localised core of highly contaminated soil, which may then reduce the movement of arsenic contamination to the underlying groundwater. Any soil remaining at the site that had arsenic concentrations greater than 30 mg kg^{-1} (soil guideline values for protection of human health) was also to be capped with a geotextile membrane and 400 mm of quarry gravel/topsoil. This would essentially mitigate potential human health effects from direct contact with the soil or inhalation of dust that remains on site.

A contribution of 60% to the costs of the partial remediation of the site was obtained from the Ministry for the Environment's Contaminated Site Remediation Fund, with the balance of the costs being met by the Council.

In April 2007, the localised core of highly contaminated soil was removed from the site (Photo (b)) and placed in the regional landfill. The remaining contaminated soil was capped (Photo (c)). Groundwater monitoring in wells up and down-gradient of the former dip site has been undertaken since the soil was removed. Results indicate that the removal of the highly contaminated core of material has had no significant effect on groundwater arsenic concentrations. However, further monitoring will be undertaken to evaluate if there are any changes in groundwater arsenic concentrations with time.

Photo (a) Rarangi sheep dip site

Photo (b)

Photo (c)

The discharge permit applications received by the Council are assessed against the detailed policies in the Marlborough Sounds Plan to determine whether the application should be granted and, if so, under what circumstances the discharge can occur. What is considered, amongst other things, are:

- Whether there is a public sewer located within specified distances from the lot boundary or the closest building on the lot.
- The soil characteristics of the site, including hydraulic capacity and the ability to treat contaminants present within the domestic wastewater.
- Site constraints including geology, topography, slope, lot size and shape, climate, and existing structures.
- Whether the land application area is large enough given the characteristics of the site and is located well away from any surface waterbody or coastal water.
- Making sure the discharge will not contaminate surface water, coastal water or groundwater.
- The way in which stormwater is managed on the site and the potential for stormwater to affect the performance of the on-site wastewater management system.
- Areas subject to instability will not be made worse or the discharge will not initiate instability.
- If the discharge will create offensive or objectionable odour or adversely affect the amenity values enjoyed on adjoining properties.

An assessment of the best practicable option for servicing any residential subdivision is also required. This means that alternatives to on-site management must be considered.

In an attempt to resolve a variable standard in the design of new on-site wastewater management systems, the Council prepared in co-operation with the industry, guidelines for investigation, design, installation and management of on-site wastewater management systems. The guidelines draw on the accumulated experience of the Council's staff and on national standards to provide examples of best practice. The guidelines have been provided to local practitioners for day to day use and are also used by the Council to assess building consent and discharge permit applications.

The Council has prepared educational material for homeowners to help improve the performance of their existing on-site systems. This information was sent to all ratepayers in the Marlborough Sounds in the summer of 2004/2005, has run in the paper each year prior to the summer season and is now included with all building permits or Land Information Memorandum issued in rural areas. These brochures are also available on the Council's website or from the Council.

A number of resorts in the Marlborough Sounds also manage their wastewater by discharging treated wastewater into soil or the sea. The number of resorts discharging to the sea has dropped significantly and there are now only three that do so; two of these are intending to switch to a discharge to land in the near future. The standard of treatment prior to discharge into the environment is monitored by the Council.

Vegetable processing wastewater, winery wastewater and dairy shed effluent

There is some concern with the land based disposal of winery wastewater as this is becoming more frequent in Marlborough. Winery wastewater may contain high levels of organic matter, nutrients and sometimes soluble salts. Therefore regular soil testing is needed to determine what effect land application is having on soil quality/health.

There is limited long term data from sites where regular soil sampling has been undertaken from land receiving winery wastewater in Marlborough. However, where monitoring has occurred this indicates in some cases there may be significant accumulation of salts in soils, in particular sodium and potassium, over relatively short periods of time. This potentially could be a significant soil quality issue as a high proportion of sodium weakens the bonds between soil particles when wet, causing the clay to swell and the particle to become detached, a process called dispersion. The dispersion of clay particles has a negative effect on soil structure and can result in reduced water infiltration, reduced hydraulic conductivity and surface crusting. All of these can have a negative effect on plant growth.

To try and determine the nature and extent of the issue, soil sampling is to be undertaken at sites across Marlborough where there has been a known long-term application of winery wastewater.

Winery waste survey

Marlborough has 47 wineries, 10 of which are located in the industrial areas at Riverlands Industrial Estate and Cloudy Bay Business Park on the eastern side of Blenheim. Growth in the number of Marlborough's wineries can be seen in Figure 11.8.

The Council carries out a winery waste survey on an annual basis. This involves the Council's staff visiting wineries and checking the methods of treating and disposing of wastewater and grape

marc to ensure there is compliance with relevant rules in resource management plans and/or resource consents where these are required. ('Winery wastewater' refers to the wastewater that is produced from the wine making process and does not include human sewage. Grape skins are referred to as 'grape marc'.) The survey is carried out during vintage, with follow-up visits being carried out if necessary.

Subject to meeting standards, the Wairau/Awatere Resource Management Plan allows the discharge of liquid and solid waste to land from the processing of fruit. Eighteen of Marlborough's wineries have resource consents to discharge winery waste to land.

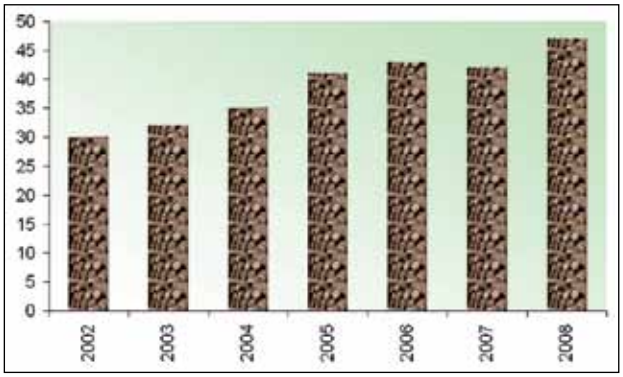
Most wineries spread wastewater to land using a variety of irrigation systems, including travelling irrigators, fixed irrigation lines, subsurface drainage and moveable stationary irrigators. Common methods of dealing with grape marc include composting, spreading to land and feeding to stock. The leachate from marc can be a contaminant if not handled properly. Therefore the grape marc needs to be stored and composted on an impermeable, sloped surface with a leachate collection system.

As wineries in the industrial estates discharge their wastewater and stormwater to reticulated community systems there are different issues to deal with than wineries discharging wastewater to land. Wineries in industrial areas are therefore monitored differently. Stormwater drains and waterways downstream of the wineries in industrial areas are checked regularly during vintage for signs of winery wastewater. If wastewater is found in the downstream stormwater drains then this contamination is tracked to determine the winery responsible for the discharge.

Based on observations made during site visits, winery waste systems are given a status of one of the following:

- Compliant - full compliance with rules or resource consents.
- Compliant (maintenance required) - there is compliance with rules or resource consents, but the system or its management needs to be improved to ensure there is on-going compliance.
- Non-compliant (minor) - a level of non-compliance with rules or resource consents, with some potential for environmental degradation.
- Non-compliant (major) - non-compliance with rules or resource consents resulting in greater potential for environmental degradation. This category is given where any discharges to waterways are found.

FIGURE 11.8: NUMBER OF MARLBOROUGH WINERIES 2002-2008



Compliance rates

Table 11.7 shows compliance rates assessed through the annual surveys since 2002. (Monitoring of wineries has been undertaken prior to 2002 but in terms of being able to report on compliance rates, the data only goes back to 2002.) With the exception of 2002, systems for storing grape marc have consistently had higher compliance rates than those for wastewater.

Over time it has been observed by those carrying out the surveys that compliance rates tend to correlate with the length and intensity of harvest. In 2008 for example, there was a significant amount of grapes harvested and some wineries did not have adequate waste systems or management systems in place to deal with the volume of grapes.

Enforcement action

During the 2008 vintage five infringement notices and six abatement notices were issued. (An abatement notice is a formal warning that the recipient must cease or take certain actions. An infringement notice is a fine of up to $1000.) During the 2007 vintage no enforcement action was taken and during 2006 vintage six infringement notices were issued.

A number of factors are taken into account when assessing what, if any, enforcement action should be taken. These include environmental impacts of the breach, its scale and duration, action taken to address the issue and it happening again, site history, was the breach reasonably foreseeable/avoidable and the attitude of the offender.

Some examples of the types of breaches that became the subject of enforcement action during the 2008 vintage were ponding of wastewater, waste getting into a reticulated stormwater system and grape marc not being stored properly. A description of what occurred with these breaches can be found in the box 'Wineries breaching plan rules or conditions of resource consent'.

TABLE 11.7: COMPLIANCE RATES 2002-2008

	Grape Marc			Wastewater		
Year of Survey	Compliance	Non-Compliance (Minor)	Non-Compliance (Major)	Compliance	Non-Compliance (Minor)	Non-Compliance (Major)
2008	90%	10%	0	72%	20%	5%
2007	100%	0	0	88%	12%	0
2006	96%	4%	0	70%	21%	9%
2005	98%	2%	0	80%	20%	0
2004	97%	3%	0	89%	5%	6%
2003	94%	3%	3%	75%	19%	6%
2002	51%	39%	10%	72%	17%	11%

Dairy shed effluent survey

Currently there are 60 dairy farms operating in Marlborough. The number of farms has reduced over the last 6 years, especially in the lower Wairau Plain area near Blenheim.

For a number of years the Council has undertaken an annual survey of dairy shed effluent systems. The purpose of the survey is to:

- Prevent contamination of groundwater and waterways and the degradation of soil by promoting good dairy effluent management.
- Gain information about the level of compliance for the discharge of dairy shed effluent.
- Ensure compliance with the rules regarding dairy effluent.
- Provide farmers with information about dairy effluent systems and their management.

Both resource management plans have rules about discharging dairy shed effluent or liquid animal effluent. The Marlborough Sounds Plan allows these discharges as a permitted activity subject to standards being met, while the Wairau/Awatere Plan requires a controlled activity resource consent, also subject to certain standards being met.

The survey is based on observations made on site, with the dairy shed effluent system being given one of the following ratings:

- Compliant - full compliance with rules or resource consents.
- Compliant (marginal) - there is compliance with rules or resource consents, but the system or its management needs to be improved to ensure continued compliance.
- Non-compliant (minor) - a level of non-compliance with rules and/or resource consents, and some potential for environment degradation.
- Non-compliant (major) - non-compliance with rules and/or resource consents resulting in a greater potential for environmental degradation.

Compliance rates

Survey results since the 2000/2001 survey show varying levels of compliance with plan rules or conditions of resource consent. Figure 11.9 shows a comparison of compliance rates since 2000. Although dairy shed effluent systems are often recorded as being compliant, at times they are only marginally so. To illustrate this, the 2007/2008 survey report noted that while 45 out of the 60 dairy shed effluent operating systems were considered compliant, 15 of these were only marginally compliant and there was a need for systems to be improved.

One of the more recent concerns has been with the back up effluent systems on a number of the dairy farms. There needs to be the ability to store effluent in case bad weather means that effluent cannot be discharged to land or in case of mechanical failure. Large ponds are usually the main form of back up system. In the last survey it was noted that 57 of the 60 farms visited had some form of back up system. However, it was considered than many of these systems, particularly ponds, would not be compliant in prolonged heavy rain. This was because at the time of the survey, most ponds were completely full and would not have been able to be used for further storage if it rained. Ponds were also noted as being too small to handle the amount of effluent being produced.

What has been promising is that the percentage of farms with major non-compliance issues has been consistently falling over the life of the surveys. In 2001/2002 20% of operating systems were in major non-compliance while the last survey had no instances of major non-compliance - see Figure11.10.

WINERIES BREACHING PLAN RULES OR CONDITIONS OF RESOURCE CONSENT

Ponding of wastewater

In some wineries wastewater is discharged to land by under vine sprinklers. In one vineyard in the 2008 vintage it was found that there were areas of ponding wastewater. Several sprinklers were blocked up with grape marc and not operating appropriately. When unblocked, the sprinklers dripped wastewater to land under low pressure and the discharge rates exceeded the 10 millimetres per day requirement in the Wairau/ Awatere Resource Management Plan. Both an abatement notice and an infringement notice were issued in this case.

The significance of this is that winery waste water may contain high levels of organic matter, nutrients and sometimes soluble salts and if allowed to pond it could affect underlying groundwater, or affect soil structure. If soil structure is adversely affected in this way, there becomes a problem with the ability of the soils to treat wastewater on an ongoing basis.

Incorrectly stored grape marc

During the 2008 vintage a vineyard owner was taking some grape marc from a medium sized winery for composting to place along vineyard rows. While there had been an attempt to construct a grape marc pad and leachate collection system, it was not operational and the composting was occurring directly on soil. Without the impermeable surface, leaching could occur and potentially have a serious impact on the soil underneath and groundwater.

An abatement notice was issued in this case.

Winery waste in stormwater system

Where a winery is located in the industrial area at Riverlands, all wastewater is to be discharged to the Council's tradewaste system. Rainwater from the properties in the industrial area is discharged to the stormwater system. During the 2008 vintage, crates used for hand picking grapes were washed out into the stormwater system. This resulted in grapes and wash water entering the Co-op Drain, which then takes stormwater out to the Wairau Lagoon. Stormwater is not treated prior to being discharged and therefore the grapes and wash water could potentially have an adverse affect on plant and animal life in the Lagoon. An infringement notice was issued in this case.

Enforcement action

The Council has the option of undertaking enforcement action to ensure compliance through issuing either an abatement notice or an infringement notice; undertaking prosecution action, which has a maximum penalty of $200,000 or two years imprisonment; or obtaining an enforcement order through the Environment Court whereby someone can be ordered to undertake certain works or cease certain actions.

The Council has taken two successful prosecutions against dairy farmers failing to comply with rules for discharging effluent. In one of these the discharge of effluent was to land and water. In this case the farmer was fined $20,000. In the second case an

enforcement order was obtained from the Environment Court to require a dairy farmer to carry out certain actions in order to improve the management of effluent on his property. Because the farmer failed to comply with the enforcement order issued by the Environment Court, the Council subsequently prosecuted the farmer. This action resulted in a fine of $25,000, which included fines for breaching the enforcement order and for the dumping of cow carcasses.

Table 11.8 summarises enforcement action taken by the Council over the previous seven dairy seasons.

Dairy farms and the Regional Action Plan and Clean Streams Accord

In the Freshwater chapter the Dairying and Clean Streams Accord was described. The Accord identifies targets to try and improve the environmental performance of dairying. Specific targets in the Regional Action Plan for Marlborough relevant to managing dairy shed effluent are:

- There is no "major" non-compliance with relevant resource consents or permitted activity rules.
- The rate of "minor" non-compliance with relevant resource consents or permitted activity rules shall not exceed 15% in any one milking season and any instance of "minor" non-compliance shall be rectified to the satisfaction of the Council within 2 weeks.
- All dairy farmers that require a discharge permit to discharge dairy shed effluent onto land are operating with the necessary consents.

Since this Regional Action Plan was agreed upon in 2004, the targets have not always been met as can be evidenced by the instances of major non-compliance in previous years. (It is noted that in the 2007/2008 year there were no instances of major non-compliance.) Instances of minor non-compliance are also above the targets set.

Working with dairy farmers to continue to improve the quality of dairy shed effluent and to achieve these targets is important. The Council and Fonterra both provide information to farmers that can assist them in achieving these targets, such as brochures on managing effluent and waterways and posters intended to be put in dairy sheds.

FIGURE 11.9: DAIRY FARM COMPLIANCE RATES 2000/2001 - 2007/2008

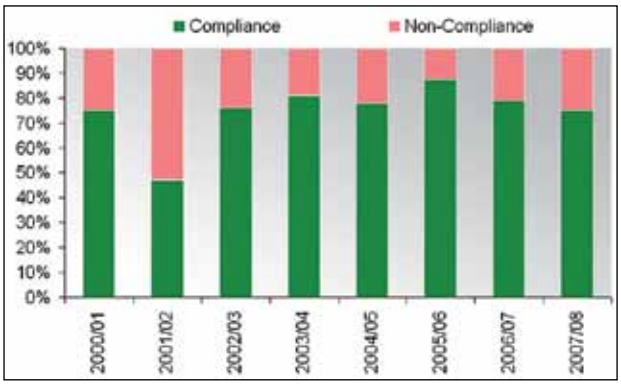
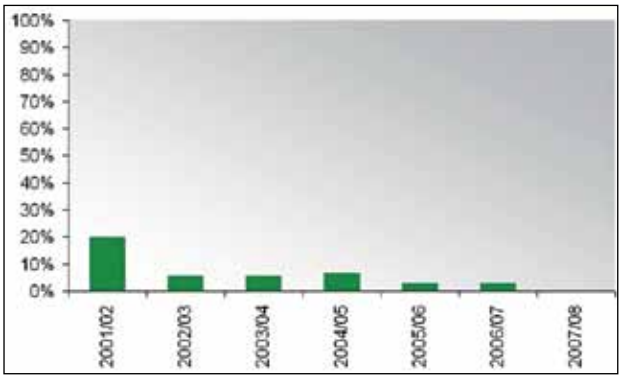


FIGURE 11.10: DAIRY FARM MAJOR NON-COMPLIANCE RATES 2001/2002



People living in rural areas

The Council's concerns about the trend of people wanting to live in rural areas were initially focussed on the Wairau Plain - the area known in the Wairau/Awatere Resource Management Plan as the Rural 3 Zone. This area had long had a history of intense rural production but was coming under increasing pressure from rural residential lifestyle living through the late 1990s and early 2000s. The rapid conversion of mainly pastoral land to viticulture

TABLE 11.8: SUMMARY OF ENFORCEMENT ACTION TAKEN 2001 - 2008

	2001/02	2002/03	2003/04	2004/05	2005/06	2006/07	2007/08
Abatement Notices Issued	8	4	0	4	1	0	0
Infringement Notices Issued	0	0	0	2	0	0	0
Prosecution Action Initiated	0	0	1	0	0	0	0
Enforcement Order	0	0	0	0	0	1	0

Council poster on tips for maintaining dairy effluent systems

Effluent storage pond

Overloading of effluent onto land

during this time brought another set of issues for the Council to deal with. In response to the changes that were happening the Council, began investigating issues such as roading, domestic wastewater disposal, subdivision, amenity values and landscape to help develop a vision about how the Wairau Plain should be managed into the future.

The initial focus was on subdivision as for many years there had been an 8 hectare minimum limit on subdivision on the Wairau Plain. A number of people felt that this was too big an area for rural residential living and wanted much smaller allotments. The 8 hectare size was historically based on an economic farm unit. However, while the Council recognised the demand for lifestyle blocks, it thought the Wairau Plain was not necessarily the best place for this to occur.

Smaller allotments were considered to progressively reduce rural land use options with productive land being lost through houses, buildings, access ways and property boundaries. Subdivision was also thought to have unexpected effects on roading and wastewater management and in some areas on the periphery of the Wairau Plain, constraints on the availability of water. Allowing the spread of residential and rural residential properties onto rural land also had the potential to worsen reverse sensitivity issues, where new landowners' expectations of quiet rural living can be at odds with what happens in rural areas.

Because of these concerns the Council carried out wide ranging investigations. The aim was to develop the existing policy framework within the Wairau/Awatere Plan to provide greater guidance and more certainty of outcomes for people wanting to subdivide and or develop land as well as ensuring the natural and physical resources of the Wairau Plain were well looked after.

Several years of investigatory work were carried out, including a look at the unprecedented and unforeseen conversion to viticulture on the Wairau Plain. A brief overview of the top five priorities that became the focus of investigations is described in the box 'Wairau Plain Priority Investigations'. Copies of reports from these investigations are available from the Council on request.

Based on all of this work the Council undertook to make changes to the Wairau/Awatere Plan and these were publicly notified in 2006. There was a substantial amount of public interest with some 244 submissions being received. The Council did hear from submitters over the course of a five day hearing held in May 2007 but ultimately decided to withdraw the changes. This was largely because the review of the Marlborough Regional Policy Statement had commenced and the Council felt the issues for the Wairau Plain area would be better addressed through that review process.

One of the interesting aspects to come out of the early work on the Rural 3 Zone was that if the Wairau Plain wasn't the right place for rural residential living, then where was the right place? To help answer that question the Council commissioned two reports: one that considered the impacts of lifestyle and small lot living outside of the Wairau Plain; and an investigation of small lot lifestyle development in the Onamalutu Valley, which had come up against forestry activities.

Impacts of lifestyle and small lot development

In assessing the impacts of on-going small lot lifestyle and hobby farm subdivision, the report focused on areas that were within about 40 minutes commuting distance of Blenheim, as this was the area experiencing most demand for lifestyle development within the Rural 4 Zone. (The Rural 4 Zone is a very large zone encompassing most of the rural land in the Wairau/Awatere Resource Management Plan area.) Traditionally, land within this zone had not been as intensively developed as land on the Wairau Plain. Increasingly though, and in part as a response to rising land prices and development pressures within the Rural 3 Zone, the Rural 4 Zone had experienced pressure for increased subdivision for lifestyle block development and for more intensive land uses.

Some parts of the Rural 4 Zone were already experiencing, or very likely to experience issues of incompatibility between lifestyle development and productive uses. For example the harvesting of forests and transportation of logs, is and will increasingly become a source of concern between forest owners and rural residents. (The Onamalutu Valley - A Rural 4 Case Study report looks particularly at issues with increased forestry activity and increased numbers of small lot subdivision for lifestyle purposes - see box 'Onamalutu Valley case study'.)

The main report looked at the difficulties with assessing and determining subdivisions on a case by case basis under the Wairau/Awatere Plan, which had not anticipated the level of subdivision and resubdivision that was occurring in some areas. The report highlighted that the Wairau/Awatere Plan did not provide strong guidance on assessing impacts, particularly cumulative impacts, on matters such as road safety and efficiency, rural character and landscape.

One of the other outcomes identified was while analysis of impacts of lifestyle and small lot development within the Rural 4 Zone raised a number of issues, there was no single problem that required a specific "Rural 4" solution. The issues were considered mostly to be those arising from growth generally within Marlborough and could not be worked through in isolation. The report recommended a broader strategy to deal with growth issues was necessary with the review of the Marlborough Regional Policy Statement providing the platform for this. The report also suggested that questions of how much growth should be provided for in Marlborough (especially in rural areas), not just how that growth should be accommodated, were important.

Noise in rural areas

People have differing expectations about what are acceptable amenity levels in rural areas. (Amenity means how noise levels, odour strength, air quality and visual appearance relate to the overall nature of the rural environment). The inherent nature of land based productive activities means sometimes there will be high noise levels. This is especially so when agricultural machinery is being used, stock are moved or held, or crop protection mechanisms are operating. These activities may also result in increased odour levels and reduced air quality. Therefore, current amenity levels in the rural areas of Marlborough do fluctuate because of both routine and seasonal land based primary production management practices. For some people living in rural areas however, fluctuations in noise do not meet expectations of what is often perceived as a quiet and pleasant living environment.

Currently the Wairau/Awatere Resource Management Plan does try to enable established rural land uses and associated management practices to continue to operate in rural areas, so long as the effects from these uses do not constitute a general nuisance or health risk. The difficulty has been in determining exactly what constitutes a nuisance or health risk.

With the success of Marlborough's viticulture industry, landowners have been rapidly converting traditional pastoral land to grapes. Very specific noise issues have arisen as a result. This stems in part from where grapes have been planted, growers wanting to protect their investment and because people want to live in rural areas. The two noise sources of most concern for people living either in rural areas (i.e. amidst the grapes), or on the town boundaries of Blenheim, Renwick and Seddon, are from bird scaring devices and from wind machines (frost fans). The use of frost fans in the last four years particularly has given rise to a number of complaints to the Council and to the Office of the Ombudsman.

Grapes have been planted in areas having an increased likelihood of frost occurring at critical growing periods. However, even in areas where one would not normally expect large numbers of frost days, growers are using a variety of methods to protect grapes from frost including by frost pots, water sprinklers, wind machines and helicopters. These methods are also used for the protection of other horticultural crops throughout New Zealand including for apples, cherries and kiwifruit.

Frosts in Marlborough are mostly radiation frosts that occur during a cool night after a clear, fine day. A low-lying layer of cold air does the damage, but is overlaid by a layer of warmer air. In some areas frost events are more likely at the start and end of a growing season when seasons change but they can also occur during the growing season.

Wind machines or helicopters are used to mix the warm upper air through the cold air, thus raising the temperature in the vineyard and protecting the young flowers, fruit and shoots from frost. However, the noise from both wind machines and helicopters has been the subject of complaints in recent times. With both operating during the night, the ability of residents in neighbouring dwellings to sleep has been affected. It appears as though the use of helicopters for controlling frost in vineyards is unable to be controlled by the Council. This is because once the helicopter is aloft it is no longer able to be within the control of the Council - instead this is the responsibility of the Civil Aviation Authority.

WAIRAU PLAIN PRIORITY INVESTIGATIONS

Defining the attributes and extent of versatile land within the Rural 3 Zone

This aim of this investigation was to determine, with some accuracy, the extent of versatile land within the Rural 3 Zone. This zone had been established by the Marlborough County Council in the late 1980s, to recognise the versatile land resource of the Wairau Plain. What defined the Wairau Plain as being a versatile land resource was a common set of factors including:

- Being within a 20 kilometre radius of Marlborough's major service centre - Blenheim.
- The land being essentially flat, less than a 20 degree slope and suitable for wheeled tractor related activity.
- High sunshine hours with a nominal frost sensitivity limit of the 100 metre contour.
- The physical barrier of the Wairau River being the northern margin of the zone (west of State Highway One) – because of travelling distance from Blenheim, climate (shading/ frost-prone) and land use capability.

Some factors that were not shared across the zone included: soil quality and physical characteristics, quantity of water available, drainage, flooding potential and water table level. These attributes were variable especially around the perimeter of the zone. Although it was initially thought that the zone boundary may need to be altered because of this work, this did not eventuate.

An evaluation of the rural amenities of the Rural 3 Zone

One of the priority areas identified for investigation was the issue of rural amenities. The concepts of 'landscape', 'character' and 'amenity' within the Rural 3 Zone were considered. The outcomes of this study provided a clearer definition of the elements for defining the landscape of the zone, and of various landscape types in interpreting the overall character of the landscape. This included a broad definition/description of the amenities of the Rural 3 Zone and a draft set of Landscape Guidelines.

Part of the study work involved a public perception survey, which was aimed at finding out what the community thought about development of the Wairau Plain, and how this may

change the rural character of the area. Most people taking part said the Wairau Plain was a quiet, traffic-safe environment, with a housing pattern that preserved open space. People were divided about the current perceptions of levels of environmental pollution, with some saying that too much is made of the occasional smoke or smell. Of interest were the strong views that noise and environmental pollution would increase if rural subdivision increased.

Views were divided about whether increased rural subdivision would have a negative impact on remaining natural features, (including waterways, trees and native vegetation). Slightly more than half of those taking part thought that these features would be threatened. The comments on housing density were extremely diverse, reflecting the split views of some who would like to see more of this happening in rural areas, to others with fears that this would change rural character of the Wairau Plain.

Implications of domestic wastewater disposal

Investigating on-site domestic wastewater disposal within the Rural 3 Zone was carried out because contamination of ground and surface water in some areas had been detected in the past. Intensification of subdivision and development in the zone was thought to be a contributing factor. Because of this, information was sought on the sensitivity of the soils and land in the zone to domestic wastewater disposal, in terms of ground and surface water quality, ecological values, soil quality, amenity values and human health.

The key outcomes saw areas mapped that were particularly sensitive to on-site domestic wastewater disposal with management options developed for these areas. While no changes were made to the Wairau/Awatere Plan as a result of these investigations, the information gathered is used day-to-day to avoid an increased risk of contamination.

Other investigations have been carried out by the Council to determine areas where on-site disposal of domestic wastewater has been an issue, for example in Grovetown and Renwick. In response to concerns in Renwick, a reticulated system for gathering domestic wastewater and piping it to the Hardings Road treatment ponds, east of Blenheim, has now been installed.

Roading Investigations

Roading investigations had an emphasis on the impacts of subdivision and land use activity development on the strategic highway and arterial road linkages that cross the Wairau Plain. This largely came about because of concerns of a greater density of residential development occurring than anticipated by the Wairau/Awatere Plan, as well as during the early 2000s, an emerging area of commercial activities along the western part of Rapaura Road. One of the key lessons learned from these development pressures was how important it was to make sure the intended role of the arterial road network was maintained. (Subsequent to these investigations, Rapaura Road became a state highway.)

Investigations also considered the usefulness of applying 'Limited Access Road' status to certain arterial roads within the Wairau Plain. Limited Access Roads are those where usually just one access per property is permitted. The intention of this was to try and firm up the purpose of these roads, which is to provide for the safe and efficient movement of goods and people (as distinct from local roads, which are essentially to provide access to and from property). More information about roading investigations on the Wairau Plain can be found in the Infrastructure and Energy chapter.

Subdivision trend analysis to show cumulative effects of allowing subdivision

An analysis of the Council's decision making on subdivision proposals over a period of 10 years from 1993 through until 2003, showed that 180 new allotments under 8 hectares in size had been created on the Wairau Plain. From 1998 through until 2003, 47 hectares of land zoned Rural 3 was subdivided into allotments of 1 hectare or less. Many of these small allotments had not been anticipated by the Wairau/Awatere Plan and the Council was concerned at what the medium to long term effects might be on land use patterns and rural activity options.

The Subdivision Trend Analysis Study looked at developing a means by which the outcomes of subdivision trends might be predicted. This project involved development of software by the Council to show what might happen cumulatively, in say 10 or 50 years time, if a certain direction in decision making persisted.

ONAMALUTU VALLEY CASE STUDY

The Onamalutu Valley is one of numerous river valleys starting in the Richmond Range and following through to the Wairau River. There is farming on the valley flats but forestry has become a predominant land use with the planting of commercial forestry occurring since the 1970s. The valley has also become a desirable lifestyle location within commuting distance from Blenheim.

Access to farms, lifestyle blocks and recreational areas in the valley is by the Onamalutu Road, a narrow twisting no-exit road. More recently, the Onamalutu Road and the smaller roads that connect to it are being used for transporting logs from exotic plantations established in the valley and surrounding areas.

Subdivision for lifestyle blocks had gradually increased between 1995 to 2004. While the numbers of lots created each year was relatively small, and usually involved subdividing off a single lot rather than multi-lot rural-residential type development, later subdivisions involved re-subdividing existing lifestyle blocks.

At the time of writing the report (2004), there had been relatively few complaints received by the Council from Onamalutu Valley residents about activities such as noise from farm machinery, smell from stock or effluent or road safety issues arising from logging or other trucks. Based on experience elsewhere however, the onset of harvesting forests within the valley and the trucking of logs out of the valley will cause residents of the valley some significant concerns. The main concerns will be noise and safety during harvest, the proximity of dwellings to commercial forests and noise, vibration, dust and road safety associated with forestry traffic. Road safety is likely to be of significant concern as the current alignment and width of the road means logging trucks and other larger vehicles will have to move out of their lane when travelling around corners. This may result in a collision with oncoming vehicles. Another possibility for collisions arises with vehicles exiting (or entering) accesses where there is limited visibility - this problem already exists with some accesses (both domestic and forestry accesses) being poorly sited. Some dwellings are also sited very close to the road.

One of the major conclusions from the report was without significant upgrading of the main valley road or an alternative road access for forestry being found, the Onamalutu Valley was unsuitable for further subdivision or residential development beyond what was currently permitted. This was because of:

- The projected traffic generation from harvesting operations.
- Unsuitability of Onamalutu Road in its current condition for large numbers of heavy vehicles and potential safety issues from logging trucks needing to cross the "centre line" of the road on corners.
- A high probability of conflicts between forestry vehicles and residential vehicles.
- A high probability of residents objecting to forestry traffic on the grounds of noise, dust, amenity and traffic safety.

The report considered that (amongst other things) clearer guidance was needed in the Wairau/Awatere Resource Management Plan to enable assessment of the cumulative effects of traffic impacts.

Onamalutu Road with a dwelling vehicle access (on right) in close proximity to a blind corner

Using wind machines for frost protection is allowed by the Wairau/Awatere Plan so long as each machine meets a specific performance criterion for noise emission and a distance criterion for dwellings not on the property where the wind machine sits. However, with the growth in number of machines being installed over the past 10 years (Figure 11.11), there has been increasing concern about the level of noise produced. Concerns have been mostly from those living within rural areas as there is a significant increase of about 30 decibels in ambient, or background noise, during frost events when wind machines are used.

Although the rules in the Wairau/Awatere Plan have been in place since 1997, the effect of large numbers of machines on ambient noise levels in rural areas, or the effect of separation distances from dwellings, was not anticipated. Making sure people comply with the rules is proving difficult because the rules apply to machines individually. This is problematic as when a complaint is investigated, noise readings cannot be isolated to one machine because of other machines operating and/or where helicopters may also be in use.

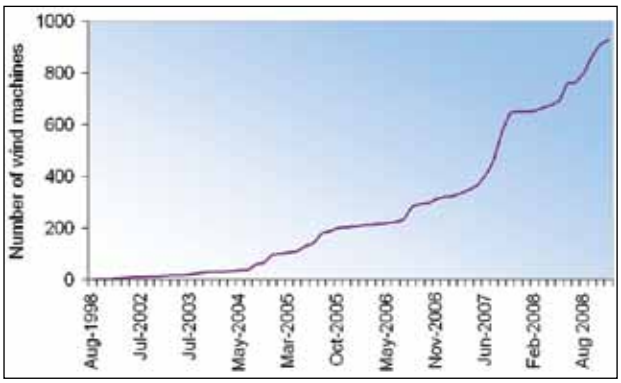
The Council is currently looking at a range of options as to how the noise from wind machines can be managed. In the meantime, the grape growing industry is also being proactive in responding to noise concerns and has developed a code of practice for its members to follow. Although this is only a voluntary code, the intent of the code is to provide guidance on the safe operation of wind machines. The code suggests that machines should only be used when climatic conditions necessitate their use, in accordance with local council rules; and in a way that minimises risk and disturbance to others.

A major point to have come out of the complaints made about the use of wind machines is that most complaints have come from those living within rural areas. This does highlight the very real reverse sensitivity issue that most councils end up facing when allowing people to live on lifestyle blocks in rural areas.

Living in coastal areas

Given the current demand for coastal residential property, the most likely land use change in the Marlborough Sounds over the next 10 years is further residential development. There are already about 5,000 houses and holiday homes in the Sounds. These and their associated jetties, boatsheds and moorings are obviously already part of the landscape in the locations in which they occur, especially the inner parts of Queen Charlotte and

FIGURE 11.11: CUMULATIVE NUMBER OF WIND MACHINES



Pelorus Sounds and Kenepuru Sound. The density of residential activity decreases with distance from the access points of Picton and Havelock, so large parts of the outer Sounds are empty of structures.

The construction of houses and holiday homes in areas where structures are absent from the landscape are likely to stand out and potentially detract from the "natural" appearance of that landscape. Even in areas where there are existing houses and holiday homes, buildings in prominent locations, large buildings, and buildings with bright and bold colours, can all detract from the landscape.

Further residential buildings obviously allow more people to be accommodated, either permanently or temporarily, in a particular location. The more people living and using an area, the less likely it is that the special qualities currently valued by existing residents will continue to be enjoyed. This sort of change is incremental and it is difficult to specify exactly when "enough is enough". The degree of impact will also vary person to person, depending on our own values and experiences - see box 'Perceptions of the Marlborough Sounds'.

The east Marlborough coast is much less developed for residential living, although the Rarangi settlement has provided a coastal living experience for people for many years. There are some limitations on further residential development in Rarangi because of the relatively small size of sections and ongoing concerns about on-site effluent disposal and water availability. Closer to the Wairau Diversion, there has been development of larger lifestyle blocks in the last 10 years. Generally however, there isn't the same level of pressure for living in coastal areas along Marlborough's east coast as has been experienced in the Marlborough Sounds.

Given the values that a wide section of the Marlborough community and beyond hold about this iconic part of New Zealand, the Council has started a major review of the existing Marlborough Sounds Resource Management Plan. This is much earlier than the Council is required to do so under the Resource Management Act. A lot of development has occurred within the Sounds since the Marlborough Sounds Plan was prepared and there have also been legislative changes affecting activities able to be carried out in the Sounds, aquaculture being the most notable.

The review will take some time to complete and is being carried out alongside the review of the Marlborough Regional Policy Statement.

At the same time, the Department of Conservation has begun looking at reviewing the Nelson/Marlborough Conservation Management Strategy, which in part guides the activities of the Department in the Marlborough Sounds. The Conservation Management Strategy applies to all areas managed by the Department, as well as resources and species for which the Department has statutory responsibility.

As a fundamental part of the reviews of their respective documents, the Department and the Council are combining efforts to identify what people value at particular places in the Sounds. Both the Council and the Department recognise that defining the community outcomes for the Sounds as a place will be an important part of reviewing both the Marlborough Regional Policy Statement and the Conservation Management Strategy. What is more, if both documents share a common community vision then that vision is much more likely to be realised. Through a series of workshops with iwi, residents (including owners of holiday homes and boating clubs) and industry and commercial operators (from forestry, tourism, aquaculture, farming and transportation sectors) a spatial planning exercise has started to identify the following:

- 'Places', being areas that share values or resources or provide a natural or logical way to define the boundaries of a particular area.
- Areas or sites where further use or development, or particular types of use or development, may be accommodated.
- Areas or sites that should be protected from further use or development.
- Areas or sites where new or improved facilities are needed.

The focus will be on outcomes those taking part want to achieve rather than how these outcomes may be delivered. It is expected the project will be completed mid 2009.

'Outcome for Places'

Recent management plans prepared by the Department of Conservation have adopted an 'outcome for places' approach to management. 'Places' are areas that share values or resources or provide a natural or logical way to define the boundaries of a particular area. Once 'places' are identified they can be provided with a manageable framework for identifying and integrating the values, objectives, policies and anticipated outcomes for that particular area.

The future of forestry in the Marlborough Sounds

Over time large areas of the Marlborough Sounds have been planted in commercial forestry. A number of factors influence how well commercial forestry does in the Sounds today. Two of these include market forces, along with the cost of isolation, and the environment. Environmental issues range from the impacts on water quality, transport and, given the Sounds' tourism status and visual profile, landscape.

As part of a wider review of forestry policy for the Marlborough Sounds, the Council has been considering how forestry as a land use in this sensitive environment might be managed in the future. A range of possible scenarios have been looked at instead of replanting with Pinus species. This has included planting with different species or even allowing land once planted to revert to native or indigenous cover. Some of the investigations that explored these options are reported here.

Forestry landscape model - the next crop

Initially the Council decided to look at a different approach to replanting trees after harvesting of commercial forestry had finished. This involved looking at the use of different tree species, rather than re-planting a second rotation with pines. The approach was based on values needed to achieve good ongoing landscape and water quality outcomes.

A report was prepared that set out this different approach and described a proposed forestry landscape model for the Marlborough Sounds. (The model was applied to an existing

PERCEPTIONS OF THE MARLBOROUGH SOUNDS

In 2000 the Council commissioned a nationwide public perception survey of the Marlborough Sounds. This survey of 1,154 people was initiated because of concerns around the impacts of marine farms. In having to deal with a large number of proposals for new marine farms at the time, the Council wanted to know:

- To what extent and in what ways do the Marlborough Sounds contribute to the wellbeing of people living in Marlborough and to New Zealanders as a whole.
- To what extent do marine farms detrimentally affect people's ability to provide for their own social and cultural wellbeing.

To help answer these questions the survey sought information on the following:

- The extent to which the Marlborough Sounds can be considered a recreation area of national importance.
- The level of importance people attach to the Sounds as a national icon.
- The particular qualities that people value about the Sounds.
- The types of development that people believe posed a threat to the qualities they especially value about the Sounds.

On a scale of 1 to 5 (where 1 is the least important and 5 the most important), 60% of people considered that the Sounds were very important in terms of their sense of national identity, or what New Zealand means to them. Just over 72% of people thought the Sounds were important as a recreational resource for all New Zealanders. Scenic beauty was one of the main characteristics that people associated with the Sounds and this was also one of the qualities of the Sounds that people valued the most.

Although the survey did have its focus on marine farms, survey participants were asked to name activities they thought could have negative impacts on the aspects of the Sounds they most valued. The most commonly mentioned threat was ferry operations, which was cited by 308 of 828 respondents who thought there were threats of some type. The next most commonly cited threats were residential activity (99 respondents or 12%) and resort development (85 respondents or 10%).

Those people who considered that residential activity, marine farming and/or forestry could have a negative impact on the attributes they most valued, were then asked to identify the impacts they expected these activities to have. The negative impacts most commonly expected from residential activity were adverse visual impacts and on peace and quiet. The negative impacts anticipated by respondents are shown in the following table.

Interestingly, even though the perception survey was initiated because of concerns about the impacts of marine farms, nearly twice as many people identified residential activity as having threats to the values of the Sounds, as did people identifying marine farms.

Negative impacts anticipated by respondents	Residential Subdivision (n=99)	Forestry (n=55)	Marine Farming (n=52)
Inhibit use of coast	9%	0	4%
Inhibit freedom boat movement	3%	2%	10%
Reduced boating safety	1%	2%	2%
Interference with swimming	1%	0	0
Interference with fishing	1%	2%	6%
Adverse visual impact	36%	44%	33%
Adverse effect on water quality	10%	11%	10%
Discourage birdlife	5%	13%	0
Adverse effects on marine life/ecosystem	16%	20%	44%
Noise impacts/impacts on peace	27%	7%	8%
Coastal erosion	3%	15%	2%
Make parts of the Sounds less accessible to general public	10%	7%	23%
Pollution, including from sewage	15%	5%	0
Other	12%	17%	10%

forest at Millig in the Kenepuru Sound.) The model meant retiring the less accessible, less productive and harder to log areas and using high value alternative species as well as pines. The model also suggested different species might be sited, managed and harvested in a way that would enhance their productivity, as well as the aesthetic appeal of the landscape.

Whilst offering positive results at other levels, the report's economic analysis pointed out that the model might be a little less commercially attractive than the traditional pine clear-fell forestry. It also indicated that forestry, whether it be pine or alternative species, becomes progressively more marginal, in the Marlborough Sounds, the more remote the site. This is because of the high cost of logging and difficulties faced in transporting logs.

The report does conclude, however, that there is no doubt the forestry landscape model is more suited to the Marlborough Sounds environment, having greater aesthetic and environmental benefits than traditional pine forestry. The overall aim of the report was to prompt discussion, and generate ideas to support decision-making and management practices for tomorrow's forests in the Sounds.

Future land use in the Marlborough Sounds

The ongoing debate about appropriate and viable rural land use activities in the Marlborough Sounds has been significantly influenced by coastal property values. This has reached the point where landowners with forests are considering subdivision for 30 hectare allotments in preference to continuing the ongoing forest rotation and replanting. (Subdivision of large rural properties down to 30 hectare allotments is allowed by the Marlborough Sounds Resource Management Plan as a controlled activity. This means resource consent must be granted by the Council but conditions can be imposed on the consent given.) The sale of a 30 hectare allotment with one house site, with either water frontage or significant coastal views, has become arguably more financially viable at least in some locations, than the historic commercial forestry activity.

The problem with this is that for those purchasing these 30 hectare allotments, the motivation for doing so generally involves the coastal/water-front experience. Most new owners are unlikely to be aware of the difficulties in looking after a parcel of rural land of this size in the sensitive Marlborough Sound's environment with its steep land, poor quality soils and climatic stresses. Trying to manage re-emerging forest, as well as controlling plant and animal pests, in this environment may prove very difficult for new landowners.

The Council is very conscious of making sure that these blocks of land are appropriately managed, especially if exotic forestry is not replanted. To explore the possible options for looking after these very large and difficult to manage Sound's lifestyle blocks the Council applied for funding from central government's Envirolink funding package.

In developing this project, the Council was fortunate to secure the assistance of a land owner in Oyster Bay in Port Underwood, who was in the process of creating some 14, 30 hectare lots, of the type in question. This property had been planted in forestry with some areas already being harvested and others where good areas of native vegetation existed. A particular focus for looking at the property was how wilding pines could be managed. See the box 'Sounds of Forest subdivision - Oyster Bay' for more about this investigation.

A survey was undertaken to see how the future management of the vegetation could be carried out to enhance the habitat, amenity and landscape character of the whole area.

As part of the Envirolink project, and following on from looking at the Oyster Bay property, the Council had Landcare Research:

- Review the drivers, processes, and impacts of land-use change in the Marlborough Sounds.
- Identify the contribution existing science knowledge can make in developing best practice land-management guidelines, and the areas in which knowledge is lacking.
- Propose a series of activities to assist the development of best practice land-management guidelines and to initiate research to address knowledge gaps.

The report reviewed the complex set of factors involved in land-use change in the Marlborough Sounds. It identified areas of existing knowledge to help the Council and landowners in land-use policy and land-use decisions, and proposed some additional research on profitable land-use options for the Marlborough Sounds and restoration of indigenous forest and subdivision in the Sounds.

The report noted that the Oyster Bay case study provides an opportunity to examine the economic, environmental and social outcomes of a subdivision decision, and also develop guidelines for future subdivisions in the Marlborough Sounds. It also offered the opportunity to explore the potential for innovative policies and programmes to influence environmental outcomes. This was particularly in light of the need to help new landowners with limited experience and knowledge of rural land use and management.

A third part of the Envirolink project was to hold a workshop aimed at landowners who were interested in restoring native forest to the Sounds environment. This was held in April 2007 and involved scientists and other experts giving presentations on a range of topics including:

- the natural history of the vegetation in the Sounds;
- understanding forest succession;
- the ecology of wilding pines;
- how to remove wilding pines;
- how useful is gorse for forest succession;
- pest management to restore native forest;
- restoring native bird populations; and
- the potential for growing native timber plantations.

The workshop also involved a field trip to a property in Hitaua Bay in Tory Channel to see a working example of the results of various pine removal methods. A wilding pine plantation on this property was initially logged in 1987 and various alternative exotic forestry species were planted. In 1989 work began on removing the remaining wilding pines on the property using a range of methods with the aim of restoring native vegetation.

An extensive native planting programme was started in the mid 1990s, along with possum and other pest control. This ongoing restoration work has resulted in a dense and healthy native forest recovering in only a few years.

Dealing with wilding pines

The Regional Pest Management Strategy for Marlborough states that the Council will undertake targeted control of wilding pines, but only where they threaten sites that are highly valued for their natural and ecological values. To this end, the Council, other agencies and various Sounds' communities are currently involved in a number of projects looking at how the spread of wilding pines can be managed. Some property owners (including the Department of Conservation) and communities in the Marlborough Sounds are also taking the initiative and are attempting to control wilding pines on their own property or on the surrounding land.

In more recent times, the Marlborough Sounds Restoration Trust has been formed and has produced a "Wilding Conifer Strategic Plan". The strategy aims to control wilding conifers throughout the inner Queen Charlotte Sound in a strategic and achievable way. This initiative is a reflection of the increasing community awareness of the wildings' issue, which has gathered significant momentum over the last five years - see the box 'Marlborough Sounds Restoration Trust'.

Envirolink

The Foundation for Research Science and Technology has established a research fund (Envirolink) to fund research organisations to provide regional councils with advice and support for research on identified environmental topics and projects. The scheme supports regional councils in two areas of environmental management: adapting management tools to local needs; and translating environmental science knowledge into practical advice.

What we know about Marlborough's wetlands

In previous chapters we have talked about the significant loss of wetlands from Marlborough and the importance of protecting those wetlands that remain. Very few of Marlborough's wetlands do have any formal protection even though the Resource Management Act requires the preservation of the natural character of them from inappropriate subdivision and development as a matter of national importance.

Some wetlands have been identified through the Council's significant natural areas work although the focus of that project has largely been on terrestrial ecosystems. What is currently known therefore about Marlborough's wetlands, their type and extent and a comparison of this data with historical data, was collected together in a wetland inventory undertaken in 2001. (Prior to this time no comprehensive study of all of Marlborough wetland areas had been carried out.)

The 2001 study provided an overview of wetlands rather than a detailed picture. This was because the study was a desktop one using topographical maps and aerial photographs. This meant that no field checking of sites was undertaken and therefore no assessment about the actual state of wetlands was made.

There were two particular types of wetland that were the focus for the study: palustrine wetlands and lacustrine wetlands. Palustrine wetlands have vegetation permanently or seasonally above the water. Marshes, bogs, swamps, fens seeps and flushes are types of palustrine wetland. In comparison a lacustrine wetland has permanent or intermittent standing open water without large

SOUNDS OF FOREST SUBDIVISIONS - OYSTER BAY

The proposal to subdivide about 400 hectares of hill country in Oyster Bay, Port Underwood involves questions about future land use and in particular the role of native vegetation. At present much of the area is planted in pine forest that is being progressively logged. Except for small stream flats, the remainder supports either original forest or various types of secondary native forest.

A survey of the different types of vegetation was carried out over the property to identify areas of natural vegetation, any particularly significant areas and to consider potential management of the vegetation so as to enhance the habitat, amenity and landscape character of the whole area. A particular focus was how the wilding pines present in the secondary vegetation could be managed.

The survey identified four areas on the property that could be potentially regarded as 'significant natural areas' in terms of the criteria used in the Council's significant natural areas project. However, it was also noted that a more detailed assessment than that carried out would be needed to confirm the four areas did in fact meet the criteria.

What was found through the survey work was that apart from pines the area is largely free of ecologically invasive weeds. Scattered old mans beard and banana passionfruit plants were found and the report recommended these should be removed. It was also noted that pampas grass has the potential to invade recently logged areas and broom has been brought in with road gravel. It was also suggested that these plant pests could be removed at this early stage of establishment.

Wilding pines were found to be well established in areas of native vegetation and the report recommended that these could be removed, especially in those areas that had been highlighted as potential significant natural areas. In some areas seedling pines have been sprayed. To encourage natural regeneration, planting with fast growing species such as manuka (seed-bearing branches could be spread over and secured to the ground in patches), kanuka, mahoe and koromiko, was suggested.

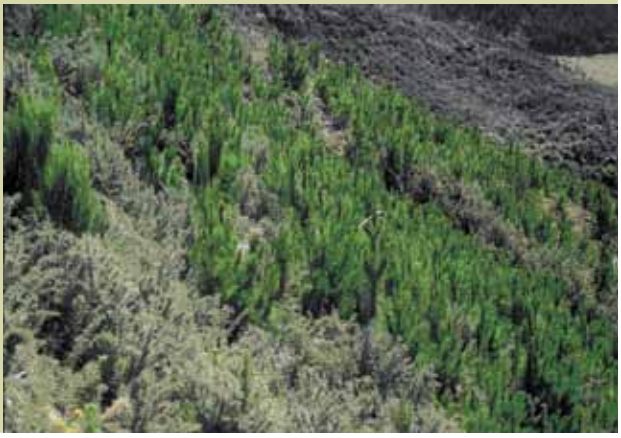
Other recommendations in the report were:

- Some small blocks of pines in isolated areas surrounded by good quality native vegetation could be left to mature and fall naturally (from wind for instance) to be replaced by native regeneration over time, or they could be felled and left.

A general image of much of the property to be subdivided showing the overall pattern of pine forest, secondary native vegetation and original bush in the headwaters of Oyster Bay.

- Small valley floor sites could be planted in kahikatea and matai. There may be small wet areas that could be re-established in cabbage trees and flax.
- The scale of regeneration required to cover areas logged but not replanted is large and active restoration unpractical. Hence all measures that improve the chance of natural regeneration should be followed including weed and pest control. Although some key species of plant are wind dispersed (kanuka, manuka, kamahi, koromiko) most species are bird dispersed so that a healthy population of forest birds such as bellbird, tui and kereru (the only disperser of tawa) needs to be encouraged through possum, stoat and rat control.

An area of logged pines, with very dense pine regeneration. Logging exposes the understorey which can regenerate into mahoe, coprosma and mamaku, often associated with an initial cover of gorse or bracken and nearly always with numerous pine seedlings. In places the pines form a thick cover without other species.



MARLBOROUGH SOUNDS RESTORATION TRUST

- media release from the Marlborough Sounds Restoration Trust 8 April 2008

Major funding for Sounds conservation programme

A new initiative to control wilding pines in the Marlborough Sounds has secured more than $100,000 to fund its campaign.

The Marlborough Sounds Restoration Trust is receiving $90,500 from the New Zealand Lottery Grants Board's Environment and Heritage Fund, and $13,000 from the Department of Conservation's Biodiversity Condition Fund, to go towards controlling the spread of wilding pines in the Sounds.

Trust chairman Andrew Macalister says wilding pines are a significant problem in the Sounds, undermining its scenic qualities and threatening native flora and fauna. In some parts of the Sounds wilding pines are overtaking native plants as the dominant species.

"Wilding pines have been spreading through the Sounds unchecked for decades to the frustration of residents, Sounds users and the tourism industry. As a community group, we decided it was time to do something about it."

The Trust was set up by a group of Sounds' landowners last year. With the support of the Department of Conservation and the Marlborough District Council it commissioned two hard-hitting reports into the impact of wilding pines on the Marlborough Sounds, and developed a management plan for inner Queen Charlotte Sound.

Mr Macalister says the funding announcement is the kick-start the Trust has been waiting for. "We are delighted with the support from the Lottery Grants Board and Biodiversity Condition Fund."

"For the first time, a strategic and planned approach to wilding pine control will be undertaken in the Sounds and on a scale far larger than any work done previously."

The Trust plans to begin the first stage of its wilding pine control programme later this year.

It will initially focus on inner Queen Charlotte Sound, between Ruakaka Bay and Double Cove, part of Grove Arm, and an area of infestation between Curious Cove and Whatamango Bay. In total about 2600ha will be controlled. The control method will be the injection of herbicide into mature tree trunks, with local contractors employed to do the work.

Mr Macalister says that if successful, the Trust will look to extend the programme into other parts of Queen Charlotte Sound in future years.

"The opportunity exists to virtually eliminate wilding pines in the Sounds, dependent on adequate resourcing and the use of effective and efficient modern techniques."

Wilding pines alter the natural landscape

areas of emergent vegetation. The main reason for the focus on these types was that for palustrine wetlands especially, they are poorly documented and under greater threat.

Artificial sites were included as well as in some areas these are the only type of wetland present and they do provide value for species such as waterfowl.

A total of 1,149 sites were recorded in the survey, representing 1,242 individual wetlands. Of the 597 natural wetlands recorded, 441 were of the palustrine type and 156 were lacustrine. 645 man made wetlands were recorded with a high density of these (417) being recorded on the Wairau Plain. Most man made wetlands were stock ponds.

The total area of wetlands recorded was 2,132 hectares and of this 131 hectares were man made. Palustrine wetlands covered 1,641 hectares in area and lacustrine wetlands covered 362 hectares in area. Most wetlands were small in area with 96% being less than 10 hectares in size. 82% were less than 1 hectare in area.

Two wetland types stand out in terms of numbers: swamps and tarns. By area, swamps are the biggest contributor and they are the most common in all except the alpine bioclimatic zone. They have also suffered the largest losses over time.

Pristine wetland

Illegal excavation of existing wetland

The most accurate historical comparisons use data from the lowland ecological districts of Blenheim, Para and Pelorus. These areas made up 90% of the original wetlands of Marlborough. All of their wetlands are found within the lowland and coastal bioclimatic zones and 96.6% of the natural wetland area is less than 100 metres above sea level. These are the areas that have been subject to the greatest development pressures. Taken as a whole these three ecological districts only retain 497 hectares of their original 14,683 hectares of wetland. Over all ecological districts 12,400 hectares of swamp has been cleared and drained.

Palustrine wetlands have decreased in area by 89% across Marlborough between 1840 and 2000. Of those that remain only 24 sites have some degree of protection. Only 3.3% of the original palustrine wetland area remains in the lowland ecological districts with less than 1% of the original area being under some form of protection.

The 2001 wetland inventory identified wetland areas across Marlborough without making any assessments in regards to their significance. In late 2008 a review of the inventory was begun using the latest aerial photography and satellite imagery to update the wetland database and make an assessment about the significance of the wetlands. The current areas of existing wetlands will be mapped and their significance will be assessed through field work and desktop analysis. The 2008 update will include a wetland specialist visiting many of the wetlands to determine their current condition and the pressures that are facing them.

Wetland restoration

The loss of wetlands is still a concern, however, there are many examples of private individuals and organisations carrying out wetland restoration projects across Marlborough. One of the largest wetland restoration projects is the Miawhitu wetland in Greville harbour. The Department of Conservation has recently taken ownership of the wetland and is in the process of restoring water levels back to the original levels by blocking the artificial drainage channel.

Greville Harbour sand dune and wetland complex