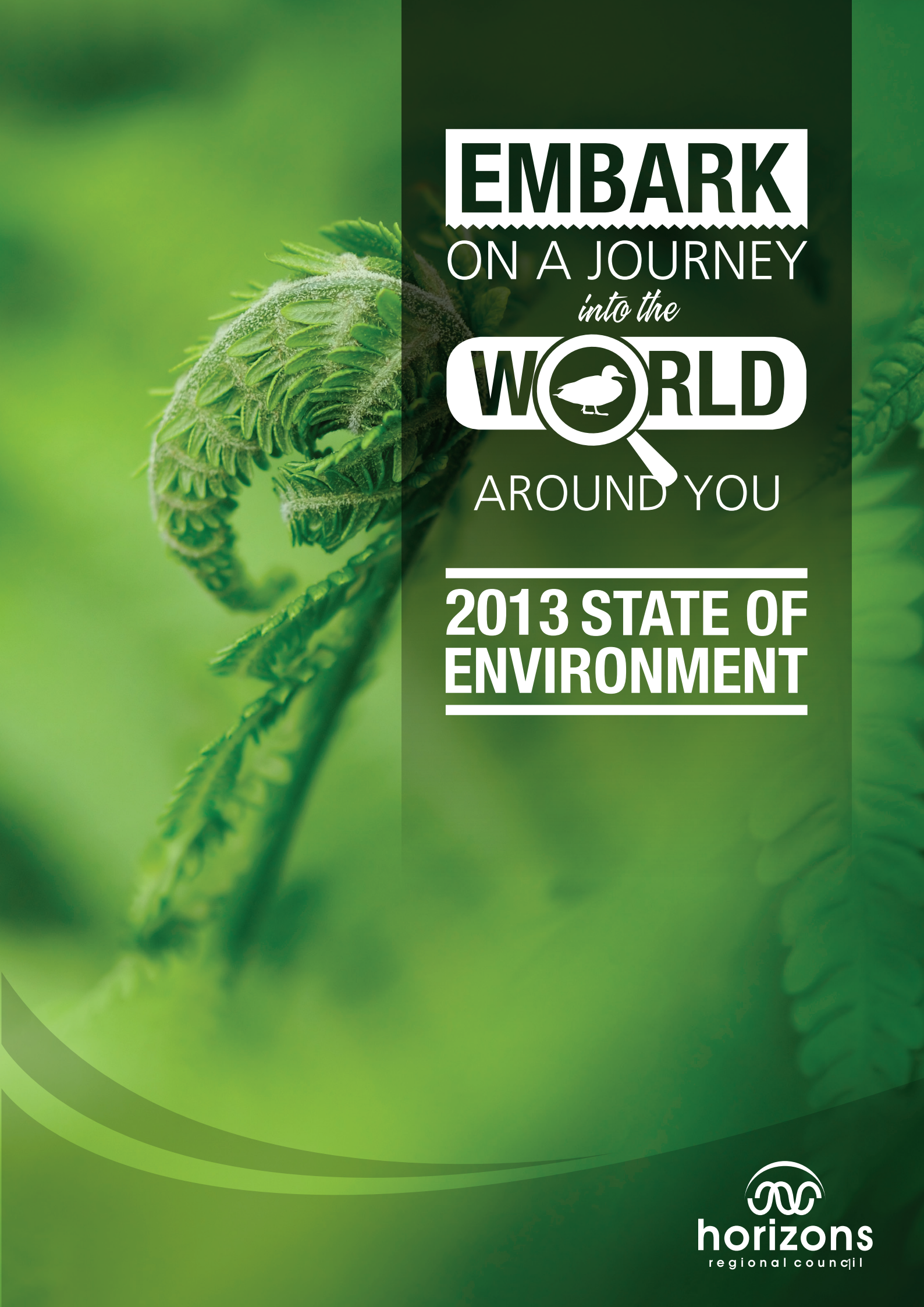


EMBARK

ON A JOURNEY

into the

WORLD

AROUND YOU

2013 STATE OF ENVIRONMENT

horizons

regional council

Our Region

We live in a Region as diverse as the people who call it home. Stretching from Ruapehu in the north to Horowhenua in the south, across to Wanganui and east to Tararua, our Region is carved by rivers, flanked by coast and shaped by hills. As your regional council, we aim to make our Region a great place to live, work and play and much of that comes down to the way we manage our natural resources.

We've come a long way since releasing our last State of Environment report in 2005 which identified our environment as being in a fair state but slowly declining as some resources experienced increasing pressures. Improvements to our monitoring networks and programmes have enhanced our understanding and policy development has led us to take a more integrated approach to natural resource management through both regulatory and voluntary initiatives.

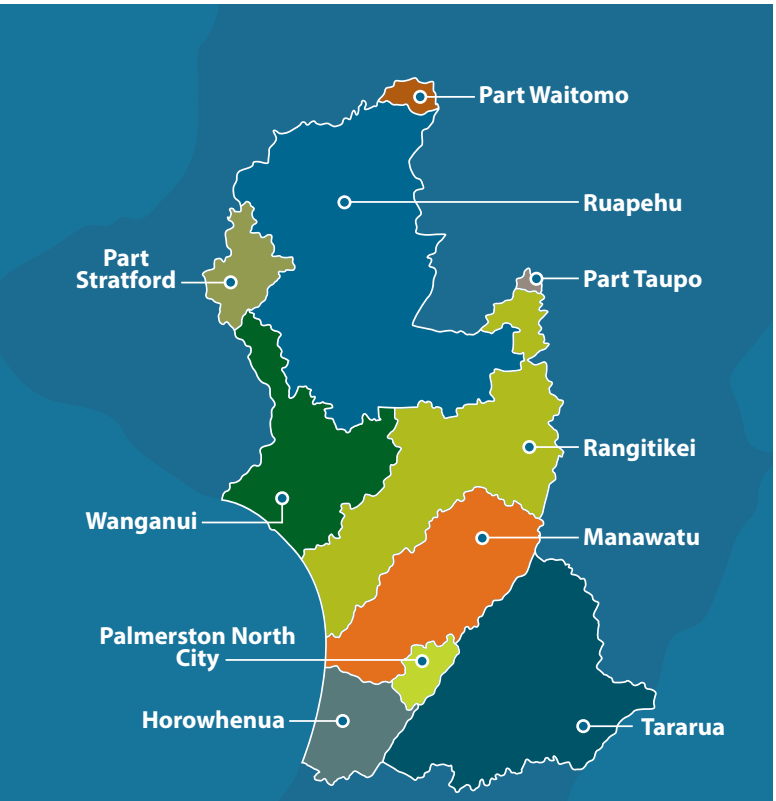
Our water quality monitoring network has more than doubled and, while we still have a fair way to go, we are seeing some promising trends around nitrogen and phosphorus concentrations in some parts of the Region's rivers. We're also collaborating widely with external research agencies including AgResearch, Landcare Research, Massey University, Cawthron Institute, and NIWA whose scientists recently described our continuous sediment monitoring programme as the best in New Zealand.

Cyanobacteria, often referred to as blue-green algae, has been identified as an emerging issue affecting our ability to fully enjoy the Region's numerous rivers and lakes. We've been working with NIWA to identify options for restoration in lakes Horowhenua, Wiritoa and Pauri and have developed our knowledge around blue-green algae in rivers to a point where we're producing some of the best datasets in the country. This data is being fed into a national programme looking at the cause of blue-green algal blooms and what causes these blooms to produce toxins.

We also have a better understanding of groundwater quality and availability across the Region. Recent research highlighted that some of the Region's groundwater may not be suitable for drinking and we are encouraging people who rely on bores for drinking water to get their groundwater tested.

Our last State of the Environment report was released in the wake of the 2004 floods where over two hundred million tonnes of soil was lost across the Region. This report highlighted hill country erosion as a major issue and in 2006 we established the Sustainable Land Use Initiative (SLUI) to help keep vulnerable hill country soils on our hills and out of our rivers and streams. Since then we have worked alongside farmers to identify opportunities for erosion control and sustainable land management on 419 farms, erosion control works have been carried out on over 10,801 ha and recent forecasts show that trees planted today will prevent around half a million tonnes of sediment entering the Region's waterways per year once these trees mature. Work in this area is on-going, with an estimated 50,000 ha of further work required on current SLUI properties to achieve the target for reducing sediment.

These are just a few of many issues touched on in this report. What is evident throughout is that managing our natural resources to achieve a healthy and economically vibrant Region will never be a one-agency job. If we are to preserve and enhance our Region's land, air and water resources for the benefit of our economy and environment we need to work together and collaboration has been a big part of our efforts over the past seven years.



Districts within the Horizons Region

In 2010 we drew industry, iwi, council and community leaders together as part of the Manawatu River Leaders' Forum with a focus on cleaning up the Manawatu River. This model has proven so successful that it is now being considered for Lake Horowhenua. We've achieved major biodiversity gains through partnership with DoC, iwi and the Ruapehu community in the upper Whanganui River catchment; reversing the decline of North Island brown kiwi in the area and creating opportunities for economic growth under the Kia Wharite project. We've also seen the success of partnerships through our SLUI programme and, as tools have been developed to provide consent holders with up-to-date information, we're seeing more and more landowners taking a proactive approach to water management.

As you read through this report you'll see sections highlighting what Horizons is doing and what you can do to help along the way. We hope you'll take these tips on board and get in touch if you would like advice or to provide feedback on any aspect.

While our major challenge will always be around making resources available today, at the same time as providing for the needs of our environment and the future, condensing the knowledge we've gained over the past seven years into a 100-page report has presented a challenge in itself!

A great deal of information can be found within these pages. We hope it will provide a useful snapshot for understanding the state of our natural environment and the pressures our Region is under. However, there is much more to be shared with those seeking further detail and a number of technical reports will be released over the coming months. In the meantime, please feel free to give us a call on toll free number 0508 800 800 to arrange a presentation for your school or community group or visit our website www.horizons.govt.nz to discover further information and resources.

Dr. Jon Roygard
Freshwater and Science Manager

Contents

SINCE 1997

CONSENTED WATER ABSTRACTION

FOR AGRICULTURE INDUSTRY

AND WATER SUPPLY HAS INCREASED FROM

558,527

CUBIC METRES PER DAY

to

1,340,228

CUBIC METRES PER DAY

THAT'S ENOUGH TO FILL **536** OLYMPIC SIZED *swimming* POOLS

WATER USE HAS MORE THAN **DOUBLED** IN THE PAST **16** YEARS

the HYDROELECTRICITY SECTOR IS BY FAR THE **LARGEST** USER OF WATER *in our region*

USING ENOUGH WATER TO FILL 1901 OLYMPIC POOLS PER DAY

17 SPECIES OF NATIVE FISH CALL OUR REGION HOME

OVER **HALF** OF ALL DRINKING WATER IS DRAWN FROM OUR **GROUNDWATER** *supplies*

70%

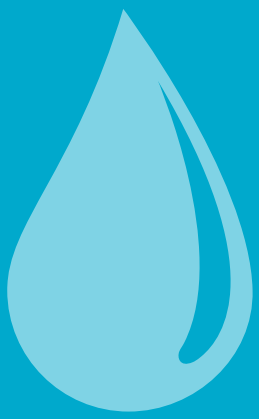
WE CAN **TRACK** WHERE 70% OF OUR REGION'S WATER **IS GOING...** AT ANY ONE POINT IN TIME

WE HAVE HELPED PLANT OVER **115,000** **NATIVE PLANTS** ALONG STREAM BANKS IN THE PAST **3** YEARS

WE HAVE FENCED *over* **600km OF WATERWAYS** IN THE PAST **5** YEARS

THAT'S MORE THAN **3 TIMES** THE CIRCUMFERENCE OF **LAKE TAUPO**

Water



Water Quantity

Managing the Region's water resources both above and below ground is a complex balancing act.

We must weigh up our need to use water with the impact this has on the environment and ensure water is allocated fairly.

Water from our Region's many rivers and streams is used to supply communities and factories with freshwater, irrigate crops and pasture, and provide water for stock-drinking and farming activities. Palmerston North, Feilding, Levin, Wanganui and many of our smaller towns also rely in part on groundwater for their drinking supplies and these underground waterways are a major source of irrigation for farmland.

To ensure water is available to all those who need it, we've established a comprehensive system for allocating water and measuring how much is being used.

Key issues

Every drop of water we take is one less for someone else who may need it or for the creatures who inhabit our waterways.

Key issues for water quantity in our Region include:

- Demand versus availability;
- Impacts of water takes on river health, fish and other aquatic species;
- Impacts of groundwater takes on rivers and lakes; and
- Salt water intrusion.

Pressures on water quantity

Demand for water for agriculture, water supply and industry has more than doubled in our Region over the past 16 years, with the greatest increase occurring between 1997 and 2004.

As surface water becomes fully allocated, demand for groundwater is expected to increase. It's important to manage this demand carefully to mitigate any impact on spring-fed streams, lakes and rivers; well levels; the flow of seawater into groundwater supplies; and the effect on other users.

Our Region has some of the most valuable water in the country. On average an estimated 4,752,000 m^3 is taken per day for hydroelectricity generation – that's enough to fill 1,901 Olympic-sized swimming pools.

All of this water comes from surface water sources and more than half is exported to Waikato as part of the Tongariro Power Scheme. The remainder is used for smaller power schemes.

A further 1,340,228 m^3 per day is consented to be drawn from the Region's water sources for agriculture, industry and town water supplies. This has increased

from 558,527 m³ per day in 1997 and is enough to supply the day-to-day needs of over 4.4 million people, irrigate 26,805 ha of pasture or fill just over 536 Olympic-sized pools.

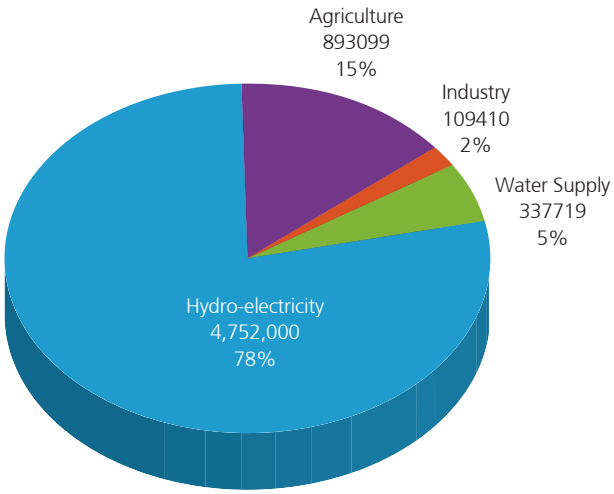
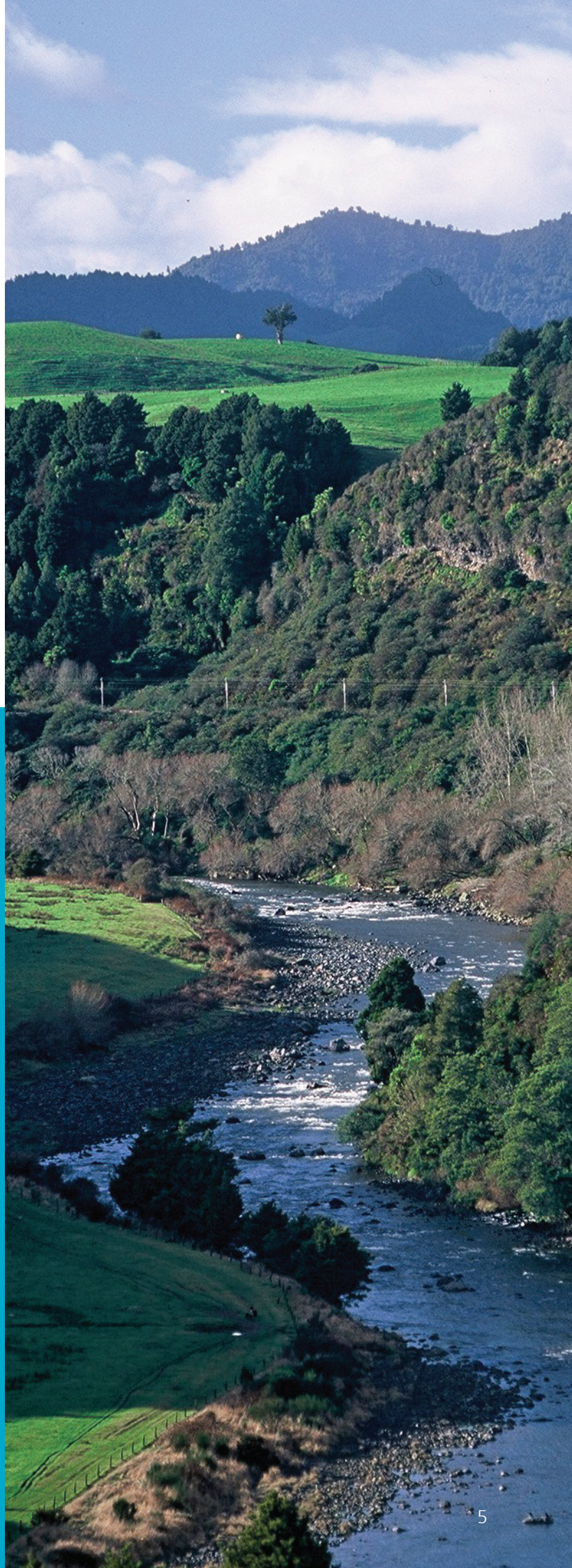


Figure 1: *Proportion of total water allocated in each sector (m³ per day)*

Water quantity at a glance

- Hydroelectricity is by far the largest user of water in our Region.
- Water use for agriculture, industry and water supply has more than doubled over the past 16 years, with the most recent growth predominantly via groundwater takes.
- Our water metering programme is one of the most extensive in New Zealand. 70% of water used for agriculture, industry and water supply is tracked automatically through our water metering programme.
- A simple consenting pathway has been developed to speed-up decision-making, protect in-stream habitats and ensure water is allocated fairly among users.
- Policies have been refined to better manage the effects of groundwater takes on rivers, lakes and other users, and reduce the potential for salt water to be drawn in from the coast.



> “Our Region has a defined amount of water available and we want to ensure it can be enjoyed by as many people as possible.”

Flow gauging in Horowhenua

What we monitor

Water quantity monitoring is one of Horizons’ core monitoring programmes. Data for some of our river sites dates back over 70 years. Our network includes a monitoring station on the Manawatu River in Palmerston North which has the longest continuous flow record in the country. We currently monitor:

- Rainfall at 46 sites;
- Continuous river level/flow at 65 sites;
- Soil moisture at nine sites;
- Water use at 281 sites;
- Groundwater level at 138 manual and 19 automated sites.

We also process up to one thousand manual measurements of river flow every year. Information gathered through this monitoring is vital to water allocation and managing the flood risk. It’s used in a range of water quality, groundwater and resource management projects and tools such as the Farm Dairy Effluent Storage Calculator that informs dairy farm effluent management. Up-to-date information is also available online via the Rivers and Rainfall and WaterMatters sections of our website.

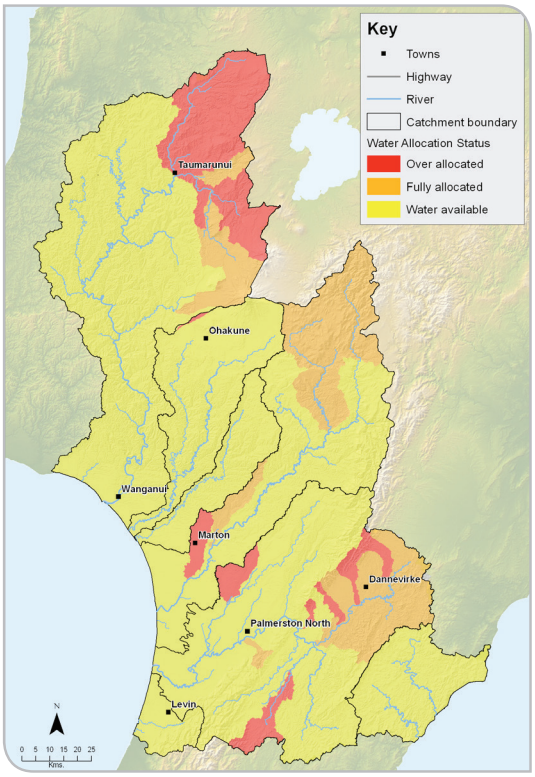
Spotlight on managing demand

Taking too much water from our rivers, lakes and streams could alter the natural flow characteristics; increase water temperatures; leave less oxygen for fish and insects; and promote excessive algal growth.

Taking too much from our groundwater supplies could lower levels in existing bores; reduce flows in spring-fed streams,

lakes and rivers; and cause seawater to enter groundwater aquifers in coastal areas. Uncontrolled abstraction can also reduce availability for others who may need water for stock and domestic supplies. To prevent these effects, we've developed limits and a comprehensive framework for managing water takes. It includes guidelines for efficient water use and helps us determine reasonable requirements to ensure water is allocated fairly.

Setting limits on water takes that are specific to the characteristics of individual catchments allows us to ensure identified values are recognised and protected. For example, areas that are highly valued for their trout fishery have minimum flows that provide greater protection of trout habitat than areas where trout fishery values are lower.



Map 1: *Surface water allocation status in the Horizons Region*

How does our Region stack up?

Surface water

Some areas of our Region are more water-rich than others. Demand for water also varies across the Region and in some places this demand has already reached or exceeded available volumes. These areas include the Upper Manawatu, Upper Whanganui and Oroua catchments as well as the Makakahi, Mangapapa, Tutaenui and Makara Water Management Zones shown in Map 1.

Horizons is working with water users to achieve sustainable water management within the core allocation limits set by the Proposed One Plan (One Plan). We have also taken a 'use it or lose it' approach to water management in our consenting process. Our Region has a defined amount of water available and we want to ensure it can be enjoyed by as many people as possible.

Our recently-developed allocation framework enables us to calculate how much water is reasonably required for a given activity and new or returning consent holders are given up to two years to use up to their allocated limit. If, at the end of this two year period, a consent holder is not using the water they've been allocated we can revisit this and discuss whether some of that water could be redirected to other users. We also have one of the most comprehensive water metering programmes in New Zealand. All new consented surface and groundwater water takes must be metered and larger takes are required to return data on water use either manually or by telemetry. Our Region is well placed to meet national regulations around water metering and Horizons was used as a case study of best practice management in the development of these regulations.

WaterMatters

Horizons' WaterMatters system has transformed the way we capture, analyse and communicate information about water in our Region.

Built by Horizons staff, the web-based system draws data from an extensive flow monitoring network and a network of automatically monitored water meters to provide accurate information about river flows, water levels and water use in close to real-time. It's

reduced the amount of staff time spent analysing data, increased transparency around water use and enabled consent holders to easily track their own water takes for more effective management.

Since the system's public launch in 2007, anyone has been able to view information on water restriction alerts, catchment totals and management zone totals online via the Horizons website www.horizons.govt.nz/watermatters. Consent holders can also log in to view information on their own meter and water use.

Figure 2: *Zones with water use restrictions (in white)*

Records collected by the system have been used to provide information for national water metering regulations and for calculating flows that would have occurred had there not been abstraction. These 'naturalised' flow statistics have been invaluable for setting water allocation limits and minimum flows to ensure sustainable management of the Region's water resources.

Figure 3: *Management zone maps and totals.*

The system's accolades include an Association of Local Government Management (ALGIM) Innovation Award and Ministry for the Environment Green Ribbon Award. However, the true testament to its success can be seen in the actions of our Region's water users as they take a more proactive approach to water management.

Figure 4: *User-specific daily summary information*

Groundwater

Recent analysis indicates that our Region's groundwater is being managed sustainably to meet the needs of the majority of users. Throughout much of the Region, demand for groundwater is very low relative to the rate of recharge; a hydrological process where water moves downward from surface water to groundwater.

This allows groundwater levels to recover during periods of increased rainfall. In some areas (such as the Santoft area of the Rangitikei Groundwater Management Zone) localised abstraction may be impacting groundwater levels and we are monitoring this closely.

> "The true testament to its success can be seen in the actions of our Region's water users as they take a more proactive approach to water management."

Changes over time - water quantity

Demand for water has more than more than doubled in our Region over the past 16 years. The volume of surface water allocated has remained relatively stable since 2004 as shown in Figure 5. However, the allocation of groundwater has increased by 73%.

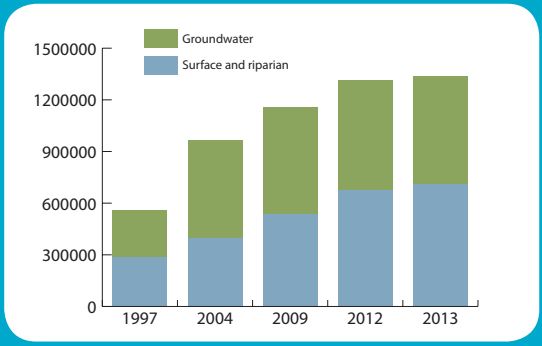


Figure 5: *Change in demand for water between 1997 and 2013 (excludes hydroelectricity)*

While hydro-electricity remains the biggest user of water, the increase in demand has largely been driven by the intensification of agriculture. The number of consents issued in this sector has increased from 435 in 2009 to 653 in 2013. Over the same period, we saw little change in the number of consents issued for industry, water supply or hydro-electricity generation.

Since 2005, most monitored bores show a stable or rising trend in groundwater levels in response to rainfall recharge. This indicates allocation is in balance or at sustainable levels in these areas. A minority show a steadily declining trend, which is likely to be a result of localised abstraction effects and does not appear to represent a regional pattern.

The largest area of declining groundwater is around the Santoft area. Indicative modelling shows that this recent small decline is likely the result of groundwater abstraction. Further targeted investigation is planned for this area.

What is Horizons doing?

We've developed and implemented a comprehensive framework for water allocation to help ensure water is allocated fairly and our environment is looked after. All water users are strongly encouraged to use water as efficiently as possible.

We work alongside industry groups to help people work towards sustainable and efficient water use in their factories, on their farms and in their towns and cities. Up-to-date information on water use throughout our Region is also available via the WaterMatters section of our website.

What can you do?

Making the most of our Region's water resources while looking out for the environment requires us all to do our bit. There are some simple steps you can take to help along the way.

On the farm:

- Use soil moisture probes to monitor your irrigation requirements.
- Assess if your dairy shed water use is efficient. Reducing water here can save you money and reduce effluent storage requirements.
- Monitor for and fix broken pipes and ballcocks.

In town:

- Harvest rainwater for watering your garden.
- Use a watering can instead of a hose.
- Heed your local council's advice during water restrictions.
- Look for ways to reduce your household water use.

Travelling irrigator in operation on a Horowhenua farm

If you're applying for consent to take water or are considering doing so:

- Please give us a call on toll free number **0508 800 800** to discuss your proposed take. The process may be simpler than you expect.
- Make sure you only apply for what you need. We have tools available to help you. Just give us a call toll free on **0508 800 800**.
- Be prepared to invest in a good quality water meter installed by a Blue Tick accredited service provider should your consent be granted.

Flow gauging in Horowhenua

Water Quality & River health

Water falls from the sky, it drips from our taps and it flows down our rivers.

It's essential for everything from farming and factories to swimming, washing and drinking – but what determines the quality of our fresh water and what are we doing to make it better?

Balancing our need to use water today with the responsibility to protect native fish and trout and ensure our waterways are suitable for swimming and recreation is a challenge nationwide. The quality of our fresh water is central to New Zealand's export economy and competitive advantage. It is also of vital concern to local iwi and often plays a starring role in what it means to be a kiwi.

There are a number of factors that contribute to the quality of water in our Region. Some are natural such as climate, landscapes, soils and land cover. Others are man-made such as waste disposal, urban and rural roading development and agriculture.

Since our last report we've made major improvements to our water quality monitoring network. These improvements provide a better picture of the contaminants entering our waterways and their impact on water quality to help identify issues and inform decision-making.

Key issues

As water makes its way downstream, moving out of our native forests through urban and rural areas to the coast its quality generally declines. Key issues for water quality in our Region include:

- Nutrient levels;
- Algal growth;
- Sediment; and
- Maintaining healthy habitats and waterways we can use.

Pressures on water quality

As the way we interact with our environment has changed, so too has our influence on water quality and public expectations around what is acceptable in the Region's rivers.

Some areas of our Region have excellent water quality. For example water quality in the Upper Rangitikei River and Manganui o Te Ao River is a major contributor to the wilderness, scenic and recreational values of those rivers as recognised under their National Water Conservation orders.

Other parts of the Region are in need of water quality improvement. While some of these areas are directly downstream of known discharges such as those from wastewater treatment plants or industrial sites, there are a number of

sites unaffected by direct discharges that experience poor water quality such as the Arawhata and Patiki inflowing tributaries of Lake Horowhenua. Considerable effort and investment has been made to reduce the number and effects of discharges to water over the past few decades. In 1997 there were 439 discharges of dairy farm effluent to water. In 2012 this had reduced to zero. This reflects a shift towards land-based treatment of dairy effluent across the Region. Since 2009, the total number of discharges to water has decreased by just over 11% to 301. Figure 6 shows the remaining discharges to water by type.

Efforts are also underway through the One Plan to reduce the impact of intensive farming in catchments where water quality is particularly affected. The way our land is used and the amount of water taken from our rivers and streams for agriculture, industry and town supply also impact upon water quality. More information about these pressures can be found in the Water Quantity and Productive Land sections of this report.

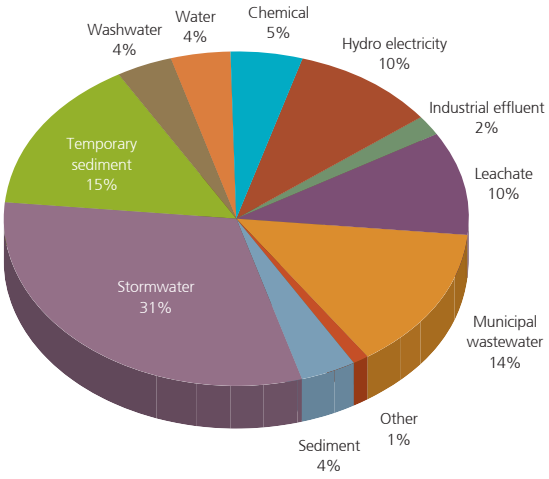


Figure 6: *Consents for discharges to water by type*

Water quality at a glance

- Our monitoring network has more than doubled since 2005, improving our understanding of the Region's water quality.
- Dairy shed effluent is no longer discharged to waterways. It is applied to land instead enabling valuable nutrients to be recycled for grass growth.
- Identifying the economic, environmental, social and cultural values of our waterways has helped us set targets for where we want to be and develop the regional policy document, the One Plan.
- Horizons led the development of the Manawatu River Leaders' Accord to unite community and industry leaders in their efforts to improve the state of the Manawatu River.
- We've contributed to the planting of over 115,000 native plants along stream banks over the past three years and over 600 km of stream fencing over the past five years – this includes works carried out under SLUI.
- Benthic cyanobacteria, also known as blue-green algae, has been identified as an emerging issue for our Region's rivers. Horizons is producing some of the best datasets available and working with national experts to determine the best response.

Collecting monitoring data in the Manawatu catchment

What we monitor

Since our last report in 2005, our water quality monitoring network has more than doubled and we now monitor a greater number of water quality indicators. We currently monitor:

- 16 indicators of water quality including nutrients and sediment at a total of 130 river and stream sites across the Region monthly;
- Continuous sediment loads at 16 of these monitoring sites;
- Algal growth and cover at 54 sites monthly;
- Weekly blue-green algae monitoring at nine sites in the Manawatu;
- The number and types of insects living in our rivers and streams at 48 sites annually;
- Native fish populations at 30 sites annually;
- Pathogens that affect whether our waterways are safe for swimming and recreation at 16 popular swim spots, including two coastal lakes, weekly during summer, and a further 130 sites monthly throughout the year; and
- 12 sites for didymo presence. To date none has been found.

Increases in our monitoring network and improvements to our monitoring programmes help provide a better regional picture of what's entering our waterways and how this affects the health of our rivers, lakes and streams.

Most recently, our continuous sediment monitoring programme, which monitors the effectiveness of measures to control erosion, was described by NIWA scientists as "the most extensive of any in New Zealand".

We are also leading and participating in a number of initiatives to ensure our monitoring and reporting is consistent with other regional councils around the country. This includes developing standardised monitoring protocols and reporting data alongside the national dataset through the Land and Water New Zealand website.

Discharge monitoring

Inputs can come from piped discharges or from the landscape. Measuring what's entering our waterways from major piped discharges at the same time as measuring overall water quality helps determine the relative impact from both sources. It also helps us see whether piped discharges from places like factories and wastewater treatment plants are getting better or worse. We currently measure water quality of piped discharges at 38 sites throughout the Region on a monthly basis.

Specific investigations

Sometimes there's a need to go beyond traditional monitoring programmes to better understand areas of poor or changing water quality. In these cases we can carry out specific investigations. Information gathered during these investigations helps inform key management decisions.

A recent example is the 2011 investigation into plant and insect life up and downstream of the discharge from Palmerston North City Council wastewater treatment plant. In this case assessments were carried out to determine the level of effect of the discharge on aquatic life in the Manawatu River.

This led to further investigations into exactly why the discharge was having an effect. The outcome of this monitoring will inform the future management of this discharge, including consent conditions.

Land and Water NZ

The Land and Water New Zealand (LAWNZ) website is an initiative that pools water quality data collected between January 2004 and December 2011 from 891 sites throughout New Zealand. It presents states and trends for a number of water quality indicators and compares the state of one site to the other 890 nationwide. It's hoped this information will help New Zealanders make informed choices about using and enjoying the resources we all share.
Find out more at www.landandwater.co.nz

> “Like grass on your lawn or paddock, aquatic plants need essential nutrients to grow.”

Catching invertebrates in the Pohangina River at Totara Reserve

Spotlight on nutrients

Like grass on your lawn or paddock, aquatic plants need essential nutrients to grow. The two major nutrients are nitrogen and phosphorus.

In a healthy river or stream these nutrients occur naturally in small amounts. They become an issue when they occur in larger quantities as they overstimulate plant and algal growth which can clog waterways; affect the suitability of our rivers, lakes and streams for recreation; and leave little oxygen for fish and other aquatic species. Some nutrients such as ammonia and nitrate can also be toxic to aquatic life at certain concentrations, but concentrations don’t generally reach these levels in our Region.

The impacts of nutrients on plant and algal growth are the primary reasons for managing nutrients in our Region’s rivers. Research since our last State of the Environment report has shown that both nitrogen and phosphorus are important in controlling this growth.

As a result, we’ve shifted management focus from just controlling phosphorus at low flows to controlling both nitrogen and phosphorus over a wider range of flows.

Nitrogen

Nitrogen can be present in water in a number of forms (nitrate, nitrite, ammoniacal and organic nitrogen) all of which can be measured individually or together as total nitrogen (TN).

Nitrate, nitrite and ammoniacal nitrogen make up the plant available component, soluble inorganic nitrogen (SIN) that contributes to plant and algal growth. The regional results presented in this report are for SIN and the comparision of results nationally is

for total oxidised nitrogen, which is SIN less ammoniacal nitrogen. Trends have been calculated for nitrate alone.

How does our Region stack up?

A national perspective

Overall, the range of nitrogen concentrations measured in our Region is consistent with the national picture. Of the sites we monitor, the Mangatainoka River at Putara in the upper Mangatainoka catchment shows the lowest (best) nitrogen concentration in the Region. Sites throughout New Zealand are ranked from 1 to 850, with 1 being the best. Our Putara site ranks 40th out of the 850 sites monitored.

The highest (worst) median nitrogen concentration in the Region is measured in the Arawhata Stream which flows into Lake Horowhenua. This site ranks as having the second highest (second worst) median nitrogen concentration in the country. The Patiki Stream that flows into Lake Horowhenua also ranks poorly. This stream is valued for its population of rare native fish, the giant kokopu. However it is ranked 4th highest (worst) in the country for median nitrogen concentration.

Interestingly, like our best water quality site, our worst ranking site in the Manawatu is also located in the Mangatainoka sub-catchment. This is our Brechin Stream monitoring site upstream of Fonterra near Pahiatua which ranks 786th out of 850 sites monitored nationally.

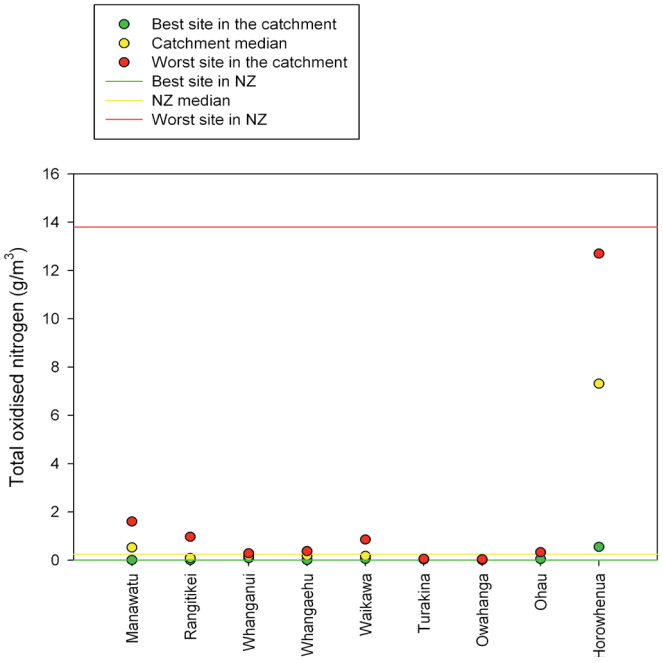
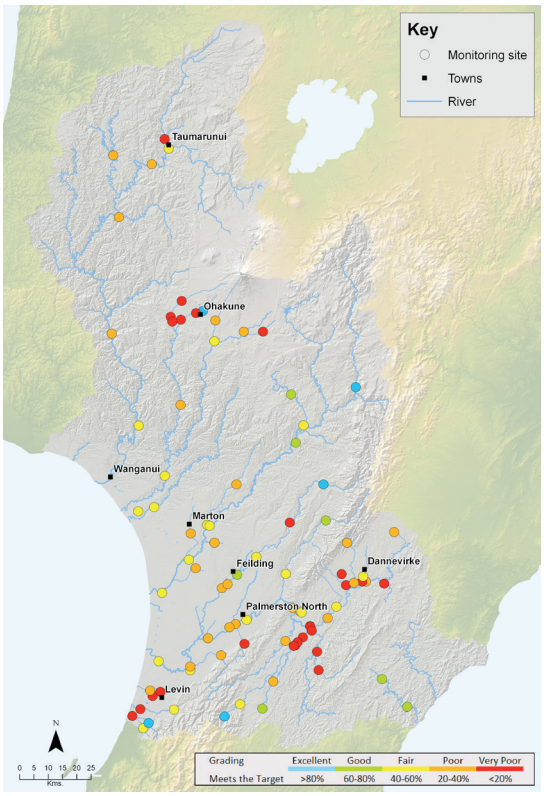


Figure 7: *Nitrogen concentrations in each catchment compared to the best and worst sites nationally*

A regional perspective

Map 2 shows the state of nitrogen concentrations for the Region's rivers since our 2005 State of Environment report. This excludes sites directly downstream of discharges. The map shows the percentage of samples for each site that meet One Plan targets for nitrogen. Sites that meet their target more than 60% of the time are identified as good or excellent. 14% of the sites we monitor fall into this category. These sites are generally located in upper parts of the catchments. 62% of sites are classified as poor or very poor for nitrogen concentrations. Nitrogen targets differ dependent on catchment characteristics and generally reduce as a river makes its way downstream.



Map 2: *Map of nitrogen state (Jan 2005 – Dec 2011)*

Category	Very Poor	Poor	Fair	Good	Excellent
Percent of time meets the target	<20%	20-40%	40-60%	60-80	>80
Number of sites	26	28	22	7	5
% of sites	30%	32%	25%	8%	6%

Table 1: *number of sites within each of the state ranking for soluble inorganic nitrogen*

Nitrogen gradings

EXCELLENT

Water is almost never too nitrogen rich:

Upper catchments of the Mangatainoka, Oroua, Rangitikei, Waikawa and Mangawhero

---

GOOD

Owahanga, Upper Hautapu, Rangitikei at Mangaweka, Oroua above Feilding, Upper catchments of the Pohangina and the Makakahi above Eketahuna.

FAIR

Lower Hautapu, Turakina, Raparapawai, Tokiahuru, Manakau, Lake Waipu tributary, Mangatera at Dannevirke, Mangaatua at Woodville, Manawatu at Palmerston North and Whirokino, Rangitikei mainstem below Mangaweka, Mangatainoka at Larsons Rd, the upper catchments of the Ohau, Ohura, Mangaore and Whanganui, middle Pohangina and Oroua, the lower Porewa Whanganui, and Whanganui.

POOR

Hokio Stream (Lake Horowhenua outlet), Mangahao, Mangapapa, Tamaki, Upper Tokomaru, Most of the Manawatu mainstem, Whanganui at Te Maire, Pipiriki and Wades landing, Mangarangiora tributary, Upper Mangaehuehu, Upper Porewa, Middle Makakahi, Lower Oroua and Mangawhero, Lower Rangitikei Tributaries (Rangitawa, Piakatutu and Tutaenui) and the Lower Whangaehu.

VERY POOR

Water is almost always too nitrogen rich:

Arawhata, Patiki, Brechin, Kahuterawa, Kumeti, Makotuku, Makuri, Tiraumea, Ongarue, Oruakeretaki, and most of the Mangatainoka catchment, the Mangawhero around Ohakune, the Manawatu at Ngawapurua, upper Waitangi, lower Mangatera, and Waikawa.

> “In partnership with local iwi, around a quarter of a million flax plants have been planted around the lake and its tributaries.”

Lake Horowhenua

Lake Horowhenua is a privately owned lake, administered by the Lake Horowhenua Trustees and the Lake Horowhenua Domain Board. Nitrogen levels in Lake Horowhenua, which the Arawhata and Patiki streams contribute to, are a major issue for controlling the growth of weed and toxic algal blooms.

These blooms impede the community’s ability to use the lake for swimming and recreation. Horizons have had a long-standing programme in place to monitor and address water quality issues. This includes fencing and planting initiatives. In partnership with local iwi, around a quarter of a million flax plants have been planted around the lake and its tributaries.

In 2010, Horizons commissioned NIWA scientist Dr Max Gibbs to research and present two reports on the state of Lake Horowhenua and options for restoration.

The first report provided a suite of options for the lake’s restoration. The second provided a more detailed list of actions, some of which are already underway in partnership with Lake Trustees and the Domain Board.

Actions already underway include the implementation of an improved water quality monitoring programme and monitoring for pest fish. Alongside this increased monitoring, we’re also carrying out more stream fencing and planting around the lake and its tributaries.

At the time of writing, five parties involved in the lake’s management, including Horizons, had signed a letter of intent to form a Lake Horowhenua Accord. This is expected to follow a similar model to the successful Manawatu River Leaders’ Accord; underlining the commitment to restore the struggling lake.

Changes over time - nitrogen

Long-term trends

Analysis of long-term trends is limited to the eight sites that were in existence before extensive upgrades to our water monitoring programme.

Over the past 20 years there is no apparent trend for any site except the Rangitikei River at Mangaweka, which shows a significant improvement. Over the past 10 years, both Rangitikei monitoring sites and three out of four Manawatu sites show significant improvements. These statistical improvements signal improved water quality. However, none of these sites have shifted in their state of classification e.g. moved from poor to fair or good to excellent.

Factors contributing to these improving trends may include the removal of dairy farm effluent discharges, increased levels of stock exclusion through fencing and planting waterways, and improvements to direct discharges such as those from wastewater treatment plants or industry.

However, care must be taken when attributing changes in management practices to improved trends over timeframes shorter than 15 years due to the influence of other factors such as rainfall and river flow.

Short-term trends

As of July 2012, we'd collected five years worth of monitoring data at 23 sites in the Manawatu catchment following upgrades to the monitoring programme in 2007. This is the minimum amount of data recommended to carry out trend analysis. Most of these sites showed no trend over the past five years. However, we did see an increase in nitrogen concentrations in the Manawatu River in Palmerston North and the Oroua River north of Feilding. This signals a decline in water quality at these sites. However, none of the sites have shifted in their state of classification e.g. moved from excellent to good or good to fair.

Testing water upstream of stormwater discharge

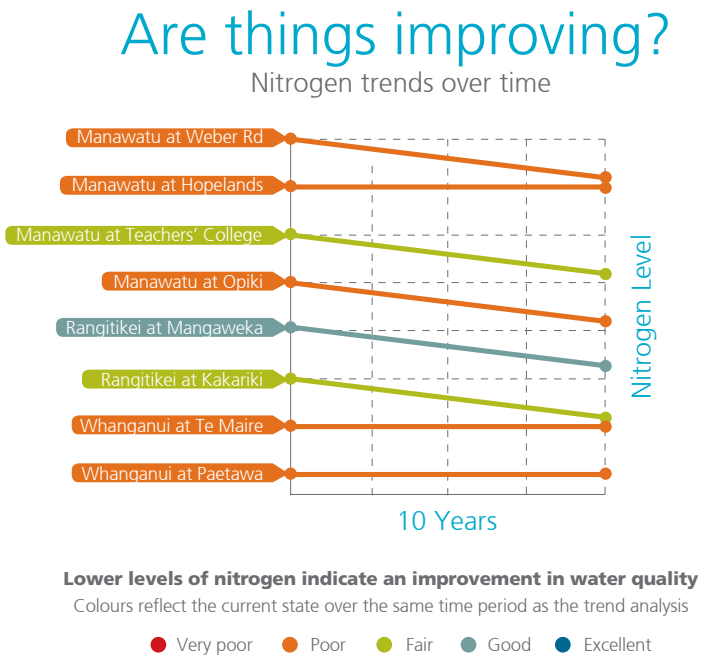


Figure 8: *Nitrogen trends at mainstem river sites from Jan 2002 to Dec 2011*

Phosphorus

Phosphorus can be present in the water in a number of forms (dissolved reactive phosphorus, dissolved organic phosphorus and particulate phosphorus) all of which can be measured individually or together as total phosphorus (TP). Too much phosphorus can overstimulate the growth of plants and algae. Up until 2008, our main focus was dissolved reactive phosphorus (DRP). Now we also look at dissolved organic phosphorus (DOP) as both forms have been shown to play a part in increasing algal growth.

How does our Region stack up?

A national perspective

Overall, the range of dissolved reactive phosphorus concentrations measured in our Region is consistent with the national picture. The following eight sites have the lowest (best) median phosphorus concentrations within our Region, ranking 81st equal out of 876 sites monitored nationwide. They're spread across a number of different catchments as listed below:

- Mangaore Stream upstream of the Shannon wastewater treatment plant;
- Mangatainoka River at our Putara monitoring site; (also one of our best for nitrogen)
- Mangatainoka River at Larsons Road;
- Makakahi Stream upstream of the Eketahuna wastewater treatment plant;
- Owahanga at Branscome Bridge;
- Hautapu Stream at Alabasters;
- Makotuku Stream at Raetihi; and
- Whangaehu River upstream of the Winstone Pulp mill.

The highest median (worst) dissolved reactive phosphorus concentration in the Region is measured in the Mangatera Stream upstream of its intersection with the Manawatu River. This site is in the Manawatu catchment and has the 14th highest (worst) median concentration reported nationally. Phosphorus concentrations at this site in the Mangatera Stream are largely attributable to the Dannevirke wastewater treatment plant. This treatment plant recently received funding from Central Government's Fresh Start for Fresh Water Clean-up Fund under the Manawatu River Leaders' Accord. Funding is being used to line treatment ponds and implement land-based treatment during low flows. These actions are designed to help reduce the impact of Dannevirke's discharge on the stream and wider catchment. The Piakatutu Stream upstream of the Sanson wastewater treatment plant also ranks poorly. This stream flows into the Rangitikei catchment and has the 26th highest median concentration in the country.

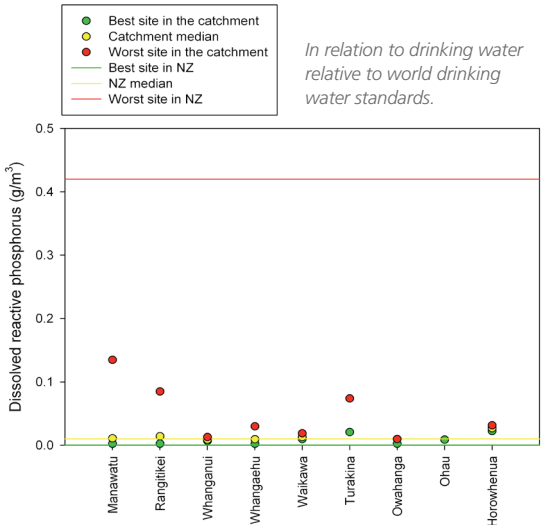
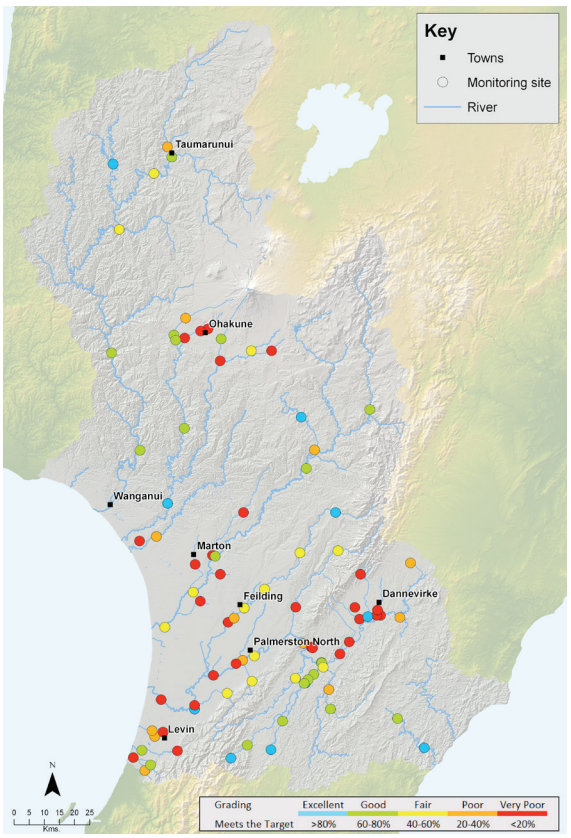


Figure 9: *Phosphorus concentrations in each catchment compared to the best and worst sites nationally*

A regional perspective

Map 3 shows the state of dissolved reactive phosphorus concentrations for our Region since our last State of the Environment report. It excludes sites directly downstream of discharges. This map shows the percentage of samples for each site that meet One Plan targets for phosphorus. Sites that meet their target more than 60% of the time are identified as good or excellent. Phosphorus targets differ dependent on catchment characteristics and generally reduce as a river makes its way downstream.



Map 3: *Map of phosphorus state (time period January 2005 December 2012)*

Category	Very Poor	Poor	Fair	Good	Excellent
Percent of time meets the target	<20%	20-40%	40-60%	60-80	>80
Number of sites	31	13	14	20	10
% of sites	35%	15%	16%	23%	11%

Table 2: *Number of sites within each of the state rankings for DRP*

The 34% of monitored sites in our Region reporting good or excellent concentrations are generally located in upper catchments. Those reporting very poor phosphorus concentrations include the majority of Manawatu mainstem sites, Rangitikei River tributaries and parts of the Mangawhero catchments near Ohakune. 50% of sites are classed as poor or very poor for phosphorus concentrations.

Phosphorus gradings

EXCELLENT

Water is almost never too phosphorus rich: Owahanga, the Upper catchments of the Hautapu, Oroua, Mangaore, Makakahi, Mangatainoka, Ohura, the Lower Tamaki and Whangaehu and the Mangatainoka at Pahiatua.

GOOD

Brechin, Pongaroa, Makuri, Makotuku around Raetihi, Middle Makakahi, Rangitikei Mainstem to Onepuhi, Upper Waikawa and Whanganui, Lower Mangawhero Ohau, and Whanganui, Most of the middle and lower Mangatainoka, Tiraumea upstream of the Manawatu confluence and the Manawatu at Ngawapurua Bridge.

FAIR

Kahuterawa, Mangahao, Upper Pohangina, Tokomaru, and Whangaehu, Middle reaches of the Whanganui mainstem and Oroua, Lower Rangitikei mainstem, Lower Tiraumea and the Manawatu at Palmerston North.

POOR

Arawhata, Hokio, Manakau, Ongarue, Upper Tiraumea, Turakina, Oroua around Feilding, Upper Makotuku, Manawatu at Upper Gorge and u/s Palmerston North sewage, Mangatoro, Manakau Lower Hautapu and an unnamed tributary of the Mangarangiora Stream.

VERY POOR

Water is almost always too phosphorus rich:

Most of the Manawatu mainstem, Mangapapa, Oruakeretaki, Patiki, Raparapawai, Mangatera, Tokiahuru, Lower Rangitikei Tributaries (Porewa, Rangitawa, Piakatutu and Tutaenui), Lake Waipu tributary, Upper catchments of the Kumeti, Tamaki, Ohau, Mangawhero, Mangaatua, Waitangi and Mangaehuehu, the middle Pohangina and the Lower Oroua and Waikawa.

Changes over time - phosphorus

Long-term trends

Long-term trend analysis is limited to the eight sites that were in existence before extensive upgrades to our water monitoring programme. Over the past 20 years the Manawatu River at Opiki shows a significant improvement. This is likely due to improvements in discharges downstream of Palmerston North. There are now fewer point-source discharges in this area and those that remain are subject to increased levels of treatment.

We can also see a significant degrading trend in the Manawatu River at our Hopelands monitoring site where phosphorus levels have increased. Factors contributing to phosphorus concentrations at the Hopelands site may include: direct discharges such as from the Dannevirke wastewater treatment plant, farming and erosion from hill country and stream banks. There've been few apparent trends over the past 10 years with the exception of significant improvements in the Manawatu River at our Opiki monitoring site and in the Whanganui River at Te Maire.

However, care must be taken when attributing changes in management practices to improved trends over timeframes shorter than 15 years due to the influence of other factors such as rainfall and river flow.

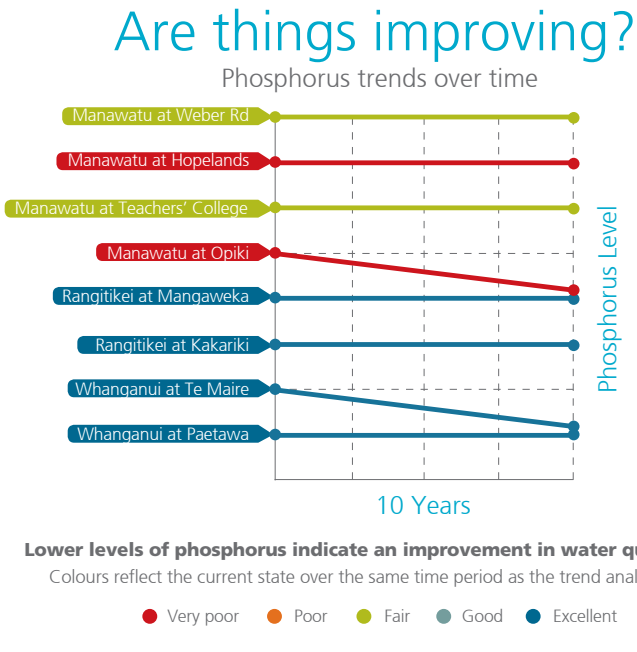


Figure 10: *Phosphorus trends at mainstem river sites from Jan 2002 to Dec 2011*

Whanganui River

Short-term trends

As of July 2012, we'd collected five years worth of monitoring data at 23 sites in the Manawatu catchment. This is the minimum amount of data recommended to carry out trend analysis.

Most of the sites analysed show no trend over the five year period. However, seven sites (30%) do show improving trends. These sites are:

- Mangatera Stream at Dannevirke;
- Mangapapa Stream at Troup Rd;
- Pohangina River at Mais Reach;
- Manawatu River upstream of Fonterra Longburn;
- Oroua River upstream of Affco Feilding;
- Oroua River at Awahuri Bridge; and
- Manawatu River at Whirokino.

> "High nutrient concentrations are a major issue for water quality in our Region and Horizons is leading a number of initiatives to help reduce their impact."

Where are nutrients coming from?

Information for the Manawatu and Rangitikei catchments shows that the majority of nitrogen and phosphorus makes its way into these rivers from the landscape. However, during periods of low flows, when we see less run-off and reduced groundwater infiltration, the proportion of nutrients entering the rivers from direct discharges can increase.

One example of this is the Manawatu River at our Hopelands monitoring site. Most of the time direct discharges contribute 25% of dissolved reactive phosphorus (DRP) across all flows at this site - this is the type of phosphorus available for plant and algal growth. During low flows, this contribution can increase to 58%. Information from our monitoring site at Hopelands shows that the single act of removing phosphorus from direct discharges will improve water quality to a point where it meets the target for DRP during periods of low flow.

One option for removing the effects of direct discharges at low flows is to apply the effluent to land. This is an option being investigated by a number of district councils in the Horizons Region. Horizons has developed a Town Effluent Calculator to assist with these investigations.

Studies have been undertaken to determine how different land uses contribute to nitrogen and phosphorus in our waterways. Results for the Manawatu River at our Hopelands monitoring site show that dairy farming makes up 16% of the land area and contributes 33% of the soluble inorganic nitrogen (SIN) load as shown in Figure 11. The greatest proportion is contributed by sheep and beef farming which makes up 69% of the land area and contributes 59% of the SIN load measured at this site. It's important to note, this is just one example and numbers differ at different parts of the catchment.

Research commissioned by Horizons estimates DRP in the Upper Manawatu catchment (to the point where it meets the Tiraumea River) is predominantly from sheep and beef farms, which contribute 44%. Dairying contributes 29%, forestry 2% and point sources or direct discharges 24%.

While sheep and beef farming appear to contribute the largest amount of DRP, it also covers the largest land area. Nutrient losses per hectare per year are actually smaller for sheep and beef than some other land uses.

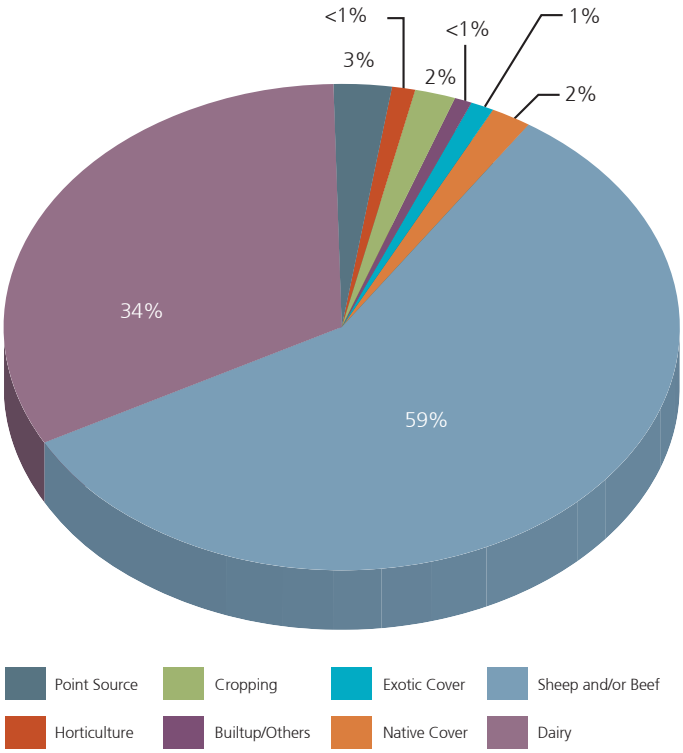


Figure 11: *Percentage contribution from different land uses to nitrogen load in Upper Manawatu River*

What is Horizons doing?

High nutrient concentrations are a major issue for water quality in our Region and Horizons is leading a number of initiatives to help reduce their impact. These include:

- Determining how the landscape contributes to nutrients in the Region's waterways in relation to direct discharges;
- Implementing new policy to address nutrient levels including setting annual average and maximum water quality targets for nutrients;
- Leading change under the Manawatu River Leaders' Accord;
- Developing tools to assist with system design for discharges to land and water such as the Farm Dairy Effluent Storage and Town Effluent Calculators, developed in partnership with Massey University (see case study on page 24).

> “All 930 dairy farms across Manawatu-Wanganui have moved away from discharging treated effluent to rivers and streams in favour of recycling nutrients through land-based treatment.”

Carrying out an irrigator bucket test

Farm Dairy Effluent Storage Calculator

Over the past few decades, there’s been a shift in the way farm dairy effluent is managed in our Region. All 930 dairy farms across Manawatu-Wanganui have moved away from discharging treated effluent to rivers and streams in favour of recycling nutrients through land-based treatment.

This transition has required new skills, investment in infrastructure and, in many cases, farmers have had to incorporate storage into their systems to avoid having to apply effluent to land when soil is very wet and treatment may not be effective.

Many farmers have had issues with storage ponds being too small, resulting in overflows to waterways or the need to apply effluent to wet soil. To mitigate this and better calculate storage requirements of individual farms, Horizons and Massey University have collaborated to develop the Farm Dairy Effluent Storage Calculator (FDE).

This calculator uses information specific to each farm such as climate, soil types, herd size, milking practices, storm water management and more to work out how much effluent-storage space that farm will need. It allows farmers to see how their current ponds compare to long-term requirements and how varying management options impact upon pond size.

It’s enabled farmers to make more informed decisions on new pond development, often saving a considerable amount on the investment by being able to build

a smaller pond as a result of changed management practices. Going forward, it's hoped this will translate to a much higher compliance rate. While originally designed specifically for use in the Horizons Region, the software has now been modified via an Envirolink funded project and is being used by eight regional councils around the country.

Policy for progress

To ensure both the quality of our rivers and lakes and the productivity of our land, Horizons' regional policy document, the One Plan, sets out water quality targets for nitrogen and phosphorus.

Modelling has been carried out to determine the potential outcome of the Environment Court's interim decision on the One Plan. This allowed for a predicted dairy expansion of 11% at our Hopelands monitoring site and projected a 92 tonne reduction in the amount of soluble inorganic nitrogen entering the Manawatu River from the landscape. This modelling predicts a reduction in SIN in the river of 12.4% over 20 years.

Algae

The mix of algae, fungi and diatoms that grow on the beds of our rivers, lakes and streams is also known as periphyton. It's a vital food source for many of the aquatic insects that live in our Region's waterways, which in turn provide a food source for our Region's native fish and trout.

While we need some algae to help our ecosystems flourish, too much algae can have the opposite effect. An excess of algae can reduce the availability of food and oxygen for aquatic communities and change the acidity of our water.

Excess algae also impacts recreation, creating weedy waterways that are unappealing for swimming or fishing. It can make water unpalatable for stock to drink, clog irrigation intakes and, in some cases, produce toxins that are harmful to animals or humans.

What causes it to grow?

Excess algal growth is influenced by:

- High nutrient levels;
- Stable river flows;
- High water temperatures;
- Sunlight; and
- Stable river beds.

The longer the period between flood flows the longer algae has to grow before it's naturally washed away. When nutrient levels are high and conditions are favourable, algae grows faster and reaches nuisance levels sooner. A lack of shade and high water temperatures also influence algal growth. Algal levels are a year-round issue in our Region with some locations showing high algal growth during the winter months.

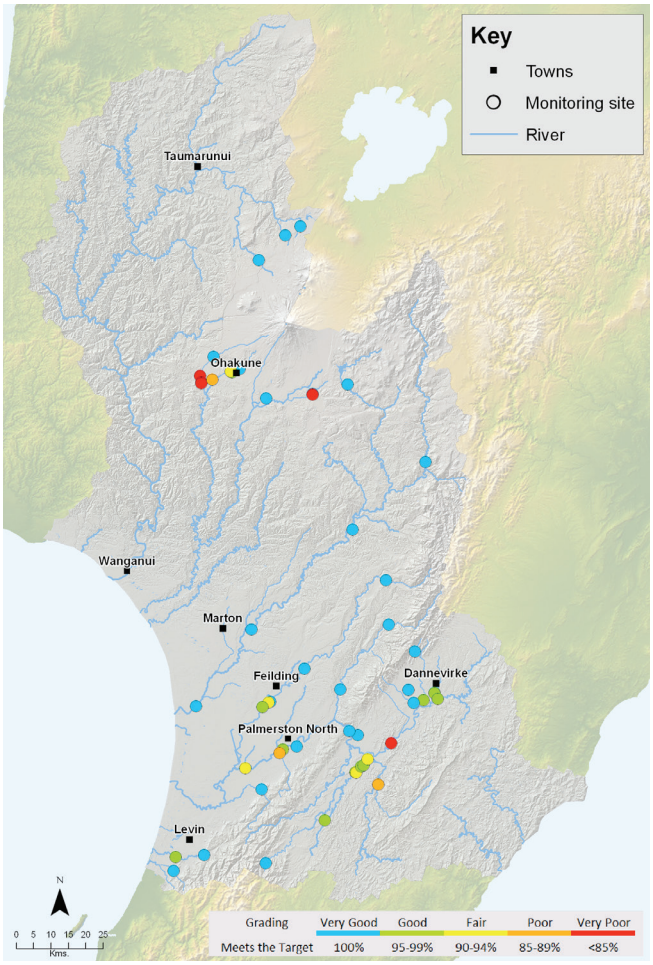
Filamentous algae in the Rangitikei River at McKelvies in 2013

How does our Region stack up?

We have one of the most comprehensive periphyton monitoring programmes in the country and currently monitor algae levels at 54 sites monthly. 53% of sites monitored between December 2008 and December 2011 complied with chlorophyll *a* (a pigment necessary for photosynthesis) levels at all times as set out in the One Plan. However, 15% of sites failed to comply at least 10% of the time. At these sites, algae levels have the potential to cause significant in-stream effects such as lower dissolved oxygen levels. We also take weekly samples at two of our coastal lakes, Lake Dudding and Lake Wiritoa, during the summer months to monitor for suspended blue-green algae.

During the 2011-12 summer season, Lake Dudding recorded three amber alert levels. Lake Wiritoa recorded two amber and one red alert level where people were advised against using the lake, although no toxins were detected in subsequent lab analysis of the samples.

The following map shows the location of river algae monitoring sites in our Region and their overall rankings based on the number of times they meet the target for chlorophyll *a*.



Map 4: *Periphyton monitoring sites graded according to the frequency with which they meet One Plan targets for chlorophyll a*

Category	Very Poor	Poor	Fair	Good	Very Good
Percent of time meets the One Plan target	<85%	85-<90%	90-<95%	95-<100%	100%
Number of sites	5	3	6	11	28
% of sites	9%	6%	11%	21%	53%

Table 3: *The number and percentage of sites falling across the periphyton gradings from chlorophyll a monitoring undertaken between December 2008 to December 2011*

Periphyton gradings

VERY GOOD

Headwaters of the Mangatainoka, Tamaki, Tokomaru, Whanganui, Mangetepopo, Whakapapa, Mangawhero, Makotuku, Waikawa, Ohau, Tokiahuru and Moawhango Rivers. The entire Rangitikei, Pohangina and Mangapapa catchments and also the following upstream of STP discharges for the Oroua (Feilding STP), Mangatera (Dannevirke STP), Waitangi (Waiouru STP). Kumeti at Te Rehunga, Manawatu River at Upper Gorge, Manawatu at Teachers College, Oruakeretaki Stream at SH2.

GOOD

Mangatera Stream downstream Dannevirke STP discharge, Manawatu River at Weber Road, Makakahi River at Hamua, Tamaki River at Stephensons, Mangatainoka River upstream Pahiatua STP discharge, Mangatainoka at SH2, Mangatainoka River at downstream DB Breweries discharge, Oroua River at Awahuri, Manawatu upstream PNCC STP discharge, Mangawhero River upstream Ohakune STP discharge, Ohau River at SH1

FAIR

Mangatainoka River downstream Pahiatua STP discharge, Mangatainoka River upstream Tiraumea River confluence, Oroua River downstream Feilding STP discharge, Manawatu River at Opiki, Mangawhero River downstream Ohakune STP discharge

POOR

Makuri River at Tuscan Hills, Tiraumea River at Ngaturi, Manawatu River downstream PNCC STP, Mangawhero River at Pakihi Road.

VERY POOR

Makotuku catchment downstream Makara confluence, Waitangi Stream downstream Waiouru STP discharge, Manawatu River at Hopelands, Makuri River at Tuscan Hills

Emerging issue

Benthic cyanobacteria or blue-green algae has been identified as an emerging issue in the Region's rivers. During stable flow conditions this algae can proliferate, forming expansive black/brown leathery mats across large areas of riverbed.

Several cyanobacteria species are known to produce natural toxins which pose a threat to human and animal health when consumed or after contact with contaminated water. Until recently, there has been limited

Site	No.of sampling events	% of sampling events with cyanobacteria present	Max cyanobacteria % coverage	% of mat samples with toxins present
Manawatu River at Hopelands	17	29%	10%	20% (5)
Makakahi River at Hamua	17	82%	70%	50% (14)
Tamaki River at Stephensons	17	18%	3%	0% (3)
Mangatainoka River at SH2	17	82%	50%	86% (14)
Oroua River upstream Feilding STP	17	41%	10%	0% (5)
Oroua River downstream Feilding STP	17	47%	65%	0% (8)
Tiraumea River at Ngaturi	17	76%	60%	54% (13)
Tokomaru Stream at Horseshoe Bend	16	69%	15%	45% (11)
Ohau River at Gladstone Reserve	15	27%	5%	50% (3)
Makotuku River at Raetihi	4	25%	2%	100% (1)
Makotuku River downstream Raetihi STP	4	75%	2%	100% (3)
Mangatainoka River upstream Tiraumea River confluence	4	75%	50%	75% (3)
Mangawhero River at Pakihi Road	4	100%	25%	50% (4)

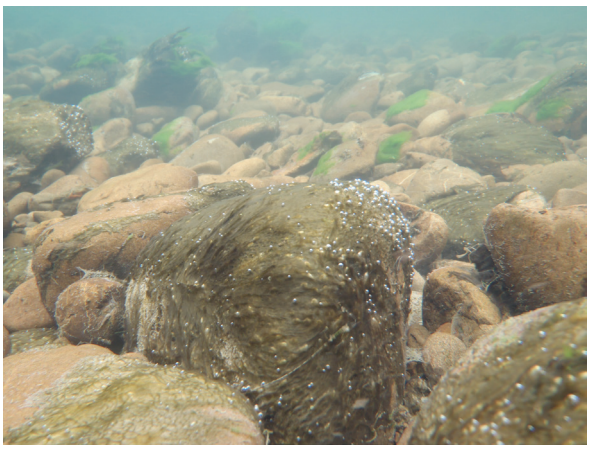
Table 4: *The number of times each site was sampled, the number of sampling events where cyanobacteria was present, the maximum cyanobacteria percentage coverage of the streambed over all sampling occasions and the percentage of samples taken that had toxins present in the mats (number next to % is the number of samples taken) sampled on a weekly/monthly basis between January 2011 to May 2011*

knowledge around the cause of cyanobacteria blooms or why some mats contain toxins and others do not. Between January and May 2011, Horizons sampled at 10 sites on a weekly basis and four sites on a monthly basis. This monitoring showed that cyanobacteria was not present all the time but when it was found it did produce toxins within the mats at some sites (see Table 4).

This report sparked a number of recommendations for further monitoring to look at the causes of cyanobacteria blooms. In January 2012 we began monitoring cyanobacteria coverage, nutrient levels, river flows and substrate size at nine sites within the Manawatu catchment.

This monitoring feeds into a large network of other research being carried out by research institutes and universities. After four months of data collection a review was undertaken to ensure that the programme was delivering on its goals and the following information was taken from the report:

- Cyanobacteria mats were present in variable abundances at all nine sampling sites, with three sites (Makakahi at Hamua, Mangatainoka at State Highway 2, Tokomaru at Horseshoe Bend) showing cyanobacteria coverage greater than 70% on at least one sampling occasion and greater than 40% coverage for extended periods.
- The sites with the highest cyanobacteria coverage had the lowest average total phosphorus and highest total nitrogen. Analysis of this data suggests that cyanobacteria has adapted to thrive in low phosphorus environments.



Cyanobacteria mat in the foreground with tuffs of green filamentous algae

Planting along the Pukemiku Stream near Pahiatua

What is Horizons doing?

Horizons is committed to reducing algal growth in problem areas through a mix of regulatory and voluntary initiatives. These include:

- Fencing to exclude stock from waterways;
- Planting along stream banks to reduce light and water temperatures and soak up nutrients;
- Managing nutrient levels from landscape sources and direct discharges;
- Controlling the effects of water takes at low flows; and
- Completing further science to improve our understanding of the relationship between flow, nutrients and algal growth (including blue-green algae/ cyanobacteria).

Sediment

Like nutrients and algae, sediment is a natural component of any waterway. As mountains and hills erode and waterways shift, loose soil, rocks, mud and silt are washed from the surrounding landscape into our rivers and streams.

Sediment also enters our waterways as a result of human activity through gravel extraction, in-river works, recontouring of land, earthworks and run-off from urban storm water drains. It can also be released from stream banks and riverbeds.

Sediment loads vary across the Region depending on catchment slope and geology, vegetation coverage and type, and how surrounding land is used. Some of our rivers suffer from an abnormally high level of fine sediment made up of sand, silt and mud.

Excess sediment discolours the water, making it unattractive for swimming

and recreation. It can also clog water supply intakes; make water unpalatable for stock to drink; make water unsuitable for human consumption without undergoing significant treatment; reduce the flood carrying capacity of rivers; and smother the in-stream habitat leaving less room for insects and fish.

Sediment can also bring with it a number of additional inputs such as nutrients, pathogens and heavy metals which affect water quality.

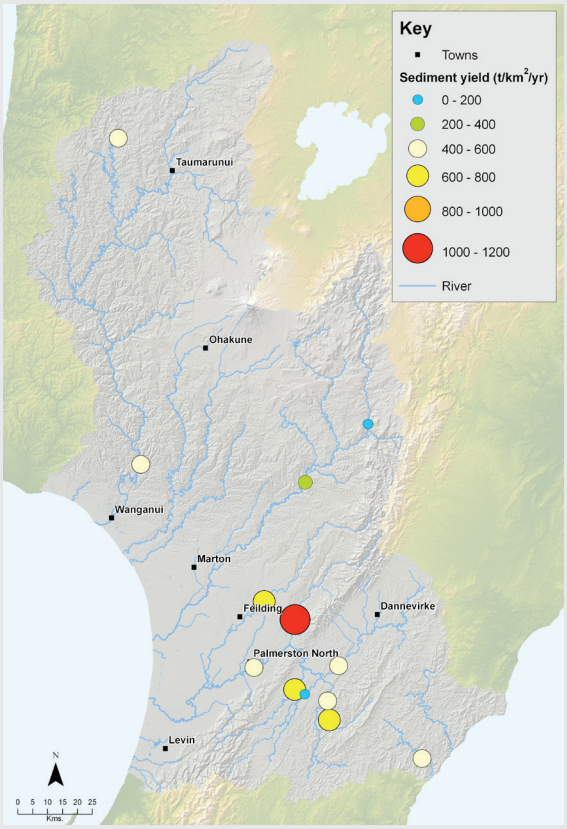
How does our Region stack up?

Suspended sediment is the proportion of mud, sand and silt that washes down our rivers and streams. These fine particles are carried with the flow of a waterway rather than settling to the bottom. The amount of suspended sediment is one of the measures we use to determine the effectiveness of efforts to control land and soil erosion.

We calculate the suspended sediment load, which is the amount of sediment carried past a monitoring site per year. We also look at annual suspended sediment yield. This is the number of tonnes of suspended sediment recorded per km² per year. The annual suspended sediment yield for 13 of our continuous monitoring sites can be seen in Map 5. We monitor a further three sites, however these sites are relatively new and not yet at a stage where we can analyse sediment yield.

Annual Sediment Load:		
Catchment	Monitoring Site	Tonnes/Year
Manawatu	Manawatu at Hopelands	605,590
	Mangatainoka at Pahiatua Town Bridge	55,099
	Makuri at Tuscan Hills	90,750
	Tiraumea at Ngaturi	322,400
	Mangahao at Balance	177,610
	Pohangina at Mais Reach	499,830
	Manawatu at Teachers College	1,921,600
	Oroua at Almadale	210,420
Rangitikei	Rangitikei at Pukeokahu	30,750
	Rangitikei at Mangaweka	592,750
	Ohura at Nihoniho	164,170
Whanganui	Whanganui at Te Rewa	3,322,120
Owahanga	Bridge	152,430

Table 5: *Annual sediment load at Horizons' monitoring sites*



Map 5: *Specific suspended sediment yield at continuous monitoring sites (tonnes/km²/yr)*

The Pohangina River at our Mais Reach monitoring site has the highest annual suspended sediment yield, approximately 1061 t/km²/yr. The Rangitikei River at our Pukeokahu monitoring site has the lowest suspended sediment yield at approximately 40 t/km²/yr.

Sediment in the Turitea Stream

Changes over time - sediment

More than half of our continuous sediment monitoring sites show some improving trends. Although these trends are relatively weak, they provide some cautious optimism that soil conservation efforts of the past decade are helping to improve water quality. Sites showing improvement trends are: the Makuri, Tiraumea, Mangatainoka, Pohangina, Manawatu at Hopelands, Owhanga and Rangitikei at Mangaweka.

Looking for insects in the Pohangina River at Totara Reserve

What is Horizons doing?

The Sustainable Land Use Initiative (SLUI) is a "mountains to the sea approach" to the accelerated erosion problem in our highly erodible hill country. We've identified 665,505 ha within our Region with the potential for severe to moderate erosion. This area includes 272,580 ha unprotected by woody vegetation, which equates to just over 12% of our Region.

Since SLUI's inception in 2006 we've produced 419 whole farm plans which identify on-farm opportunities for sustainable resource management and carried out slope stabilising works on 10,000 ha of highly erodible land.

Opportunities identified in whole farm plans include planting trees, retiring unproductive land and reviewing or upgrading tracks. More information about SLUI can be found in the Productive Land chapter of this report.

Horizons also manages the impact of sediment from other sources such as road works, subdivisions and gravel takes through our consents process. Our river works engineers stabilise river banks, reducing the amount of stream bank erosion. We have also implemented targets in the One Plan for the level of sediment deposited on the riverbed. This relates more closely to the impact of sediment on the habitat for invertebrates and fish.

> "Ensuring our waterways are safe for swimming, fishing and recreation is a big part of what we do at Horizons."

Maintaining healthy habitats & waterways we can use

Fresh, clean water is part of our national identity and when it comes to our rivers, lakes and sea we like to dive right in. Ensuring our waterways are safe for swimming, fishing and recreation is a big part of what we do at Horizons, but humans aren't the only ones reliant on clean water.

Spotlight on fish and insects

Our waterways are home to numerous aquatic animals including insects, worms and snails. These creatures are collectively referred to as macroinvertebrates and they're an important indicator of ecosystem health.

The insects in our rivers and streams graze on algae and provide a food source for fish. Some are more sensitive to changes in water quality than others. By looking at the number and type of creatures living in the water we gain a better understanding of long-term river health.

Our Region is home to 17 native freshwater fish species. As a regional council, we're responsible for ensuring an appropriate habitat for both native freshwater fish and sports fish such as trout. The presence or absence of certain species in a waterway and the health of fish populations helps indicate whether or not habitats are suitable.

Some of our fish are fussier than others, with particular habitat requirements. They're influenced by factors including: distance from the ocean, flow and water velocity, the availability of food, stream bank cover and shading, the type of riverbed, and water quality.

How does our Region stack up?

Macroinvertebrates

Each insect that inhabits our waterways has been assigned a score between 1 and 10 for its sensitivity to pollution. Those with a score of 10 are very sensitive; those at the lower end of the scale are more tolerant. This scoring system is referred to as the Macroinvertebrate Community Index (MCI).

We currently monitor 48 sites on an annual basis with each site receiving an overall MCI score. A score greater than 120 indicates excellent water quality. A score less than 80 indicates poor water quality.

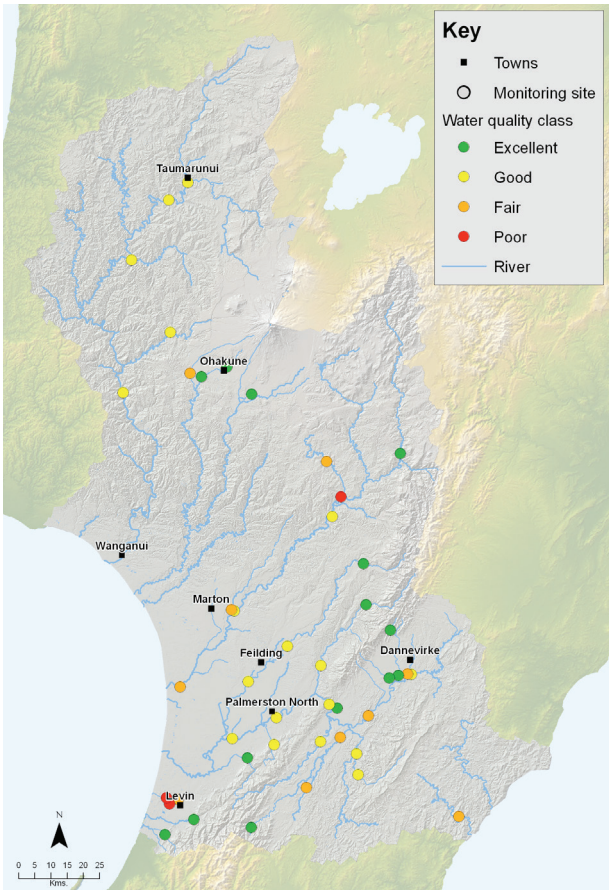
Twenty of the sites we monitor are too young to calculate trends for. However, we can calculate trends for our other 28 monitoring sites. Table 6 and Map 6 show the number and percentage of sites falling into each of the various water quality classes based on median MCI scores over the past four years.

71% of the sites we monitor fall into the 'good' or 'excellent' categories in relation to MCI scores. The three sites showing as 'poor' are Arawhata Stream at Hokio Beach Road, Hokio Stream at lake outlet and the Hautapu Stream upstream of where it feeds into the Rangitikei River.

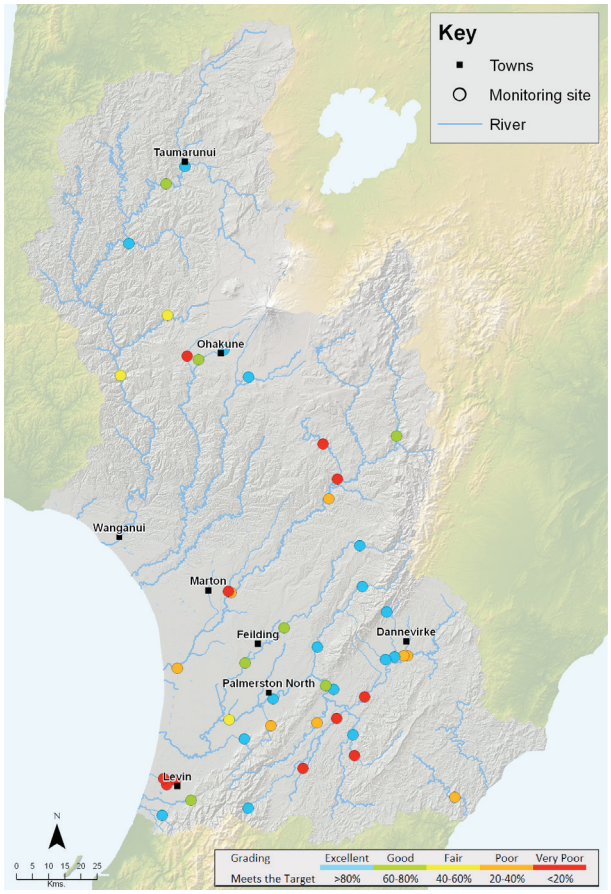
Median MCI scores provide us with a general indication of the health of our rivers. However, by comparing our annual MCI scores against the expected scores set out in the One Plan we're able to assess where we're currently at in relation to our targets. Under One Plan targets 52% of sites are classed as good or excellent (see Map 7 and Table 7.)

Quality Class	Poor	Fair	Good	Excellent
MCI	<80	80-99	100-119	>120
Number of sites	3	10	18	14
% of sites	7%	22%	40%	31%

Table 6: *Number and percentage of sites that fall into each of the water quality classes*



Map 6: *Water quality class based on median MCI scores*



Map 7: *Macroinvertebrate monitoring sites graded according to the frequency with which they meet One Plan targets*

Quality Class	Very Poor	Poor	Fair	Good	Excellent
Percent of time meets the One Plan target	<20%	20-40%	40-60%	60-80%	>80%
Number of sites	11	8	3	7	14
% of sites	24%	18%	7%	16%	36%

Table 7: *Percentage of monitoring occasions that the sites comply with the One Plan targets from 2009 to 2012*

Macroinvertebrates gradings

EXCELLENT - meets the One Plan target more than 80% of the time: Headwater of the Mangatainoka, Tamaki, Oroua, Pohangina, Tokomaru, Waikawa and Mangawhero River. Tamaki at Stephensons, Oruakeretaki at SH2, Tiraumea at Ngaturi, Mangapapa at Troup Road, Pohangina at Mai's Reach, , Whanganui at Cherry Grove, Manawatu River at Teachers College, Whanganui River at downstream Retaruke confluence, Tokiahuru River at Karoi Domain

GOOD – meets the One Plan target 60-80% of the time Manawatu at Upper Gorge, Oroua at Almdale, Oroua at Awahuri, Rangitikei at Pukeokahu, Whanganui at Te Maire, Ohau at Gladstone Reserve, Mangawhero at Pakihi Road.

FAIR – meets the One Plan target 40-60% of the time Manawatu at Opiki, Manganui o te Ao at Ashworth Bridge, Whanganui at Pipiriki

POOR – meets the One Plan target 20 - 40% of the time Manawatu River at Weber Road, Mangatera Stream at Timber Bay, Kahuterawa Stream at Johnston Rata, Mangahao River at Ballance, Owahanga River at Branscombe Bridge, Rangitikei River at Mangaweka, Rangitikei River at Onepuhi, Rangitikei River at McKelvies

VERY POOR – meets the One Plan target less than 20% of the time: Makakahi River at Hamua, Makuri River at Tuscan Hills, Manawatu River at Hopelands, Mangatainoka River at SH2, Hautapu River at Albasters, Hautapu River at upstream Rangitikei confluence, Porewa Stream at Onepuhi, Makotuku River at Raetihi, Patiki Stream at Kawiu Road, Hokio Stream at lake outlet, Arawhata at Hokio Beach Road

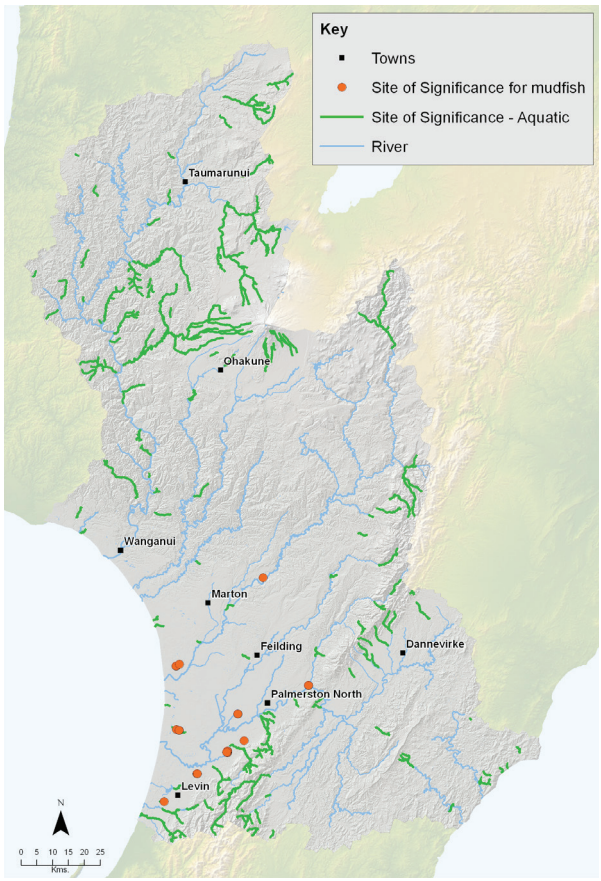
Changes over time - macroinvertebrates

In the 2011-12 monitoring year, we had collected sufficient data at 28 monitoring sites to calculate insect trends. We have seen improving trends in the Whanganui River at our Pipiriki, Cherry Grove and Te Maire monitoring sites. We also found degrading trends for the Hautapu Stream upstream of where it meets the Rangitikei River. The Hautapu sub-catchment has been prioritised for further water quality monitoring, stream fencing and planting.

In general, the headwaters of our rivers and streams have excellent water quality based on MCI scores for insect life. As we move downstream water quality generally decreases due to inputs from the landscape and piped discharges. Many of the sites in the lower catchment (24%) never meet the MCI targets set out in the One Plan.

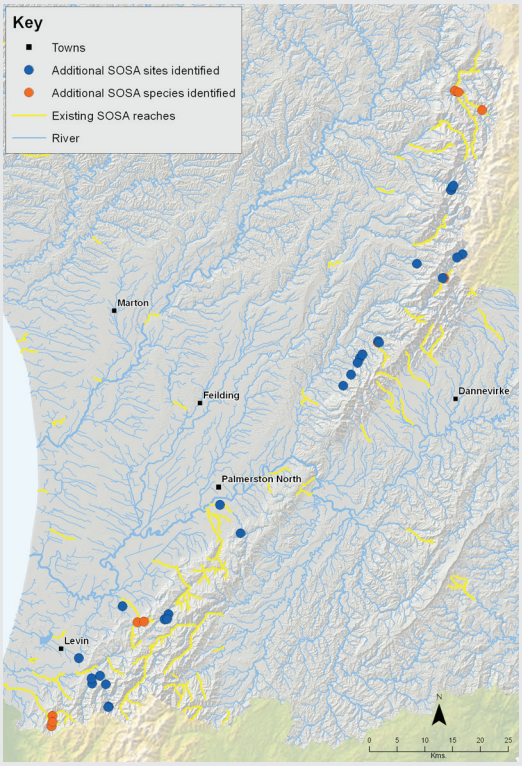
Native Fish

Our Region is home to 17 species of native freshwater fish including the: banded kokopu, giant kokopu, short jaw kokopu, dwarf galaxid, brown mudfish, redfin bully, bluegill bully, lamprey, koaro, common bully, giant bully, torrentfish, smelt, longfin eel, shortfin eel and inanga. River reaches containing rare and threatened fish populations, and those that are home to the rare whio or blue duck, are known as Sites of Significance – Aquatic (SOS-A). 167 SOS-A sites were identified when the One Plan was first developed based on data collected from 1991 - 2006. These sites are shown in Map 8.



Map 8: *Sites of Significance – Aquatic as recognised in the One Plan*

In 2011, a large exploratory survey was carried out by Horizons in partnership with the Department of Conservation (DoC). This survey identified a number of additional sites in the Tararua and Ruahine Ranges in which these rare and threatened species were



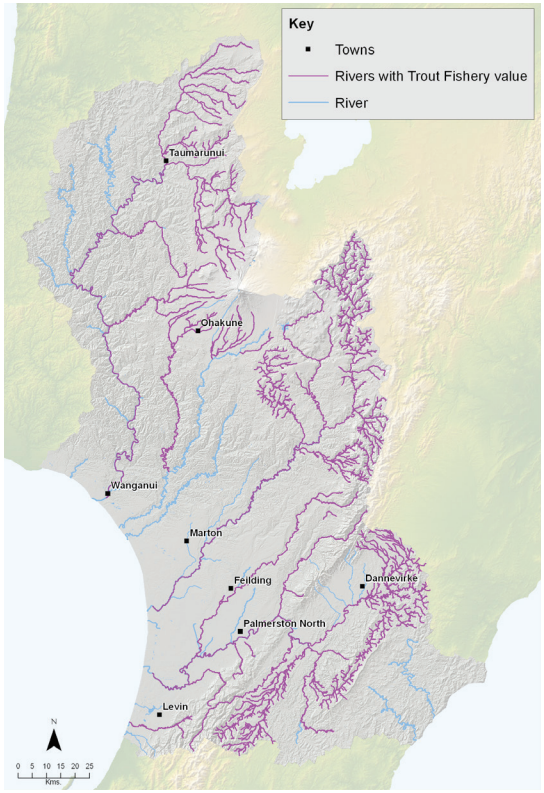
Map 9: *Existing SOS-A sites and newly discovered sites in the Tararua Ranges from the 2011 summer survey*

previously unrecorded in our Region. Despite native fish populations being more widespread than originally thought, predictive modelling tells us that we should be seeing more native fish in significantly more sites across the Region. Map 9 shows where those new sites have been identified.

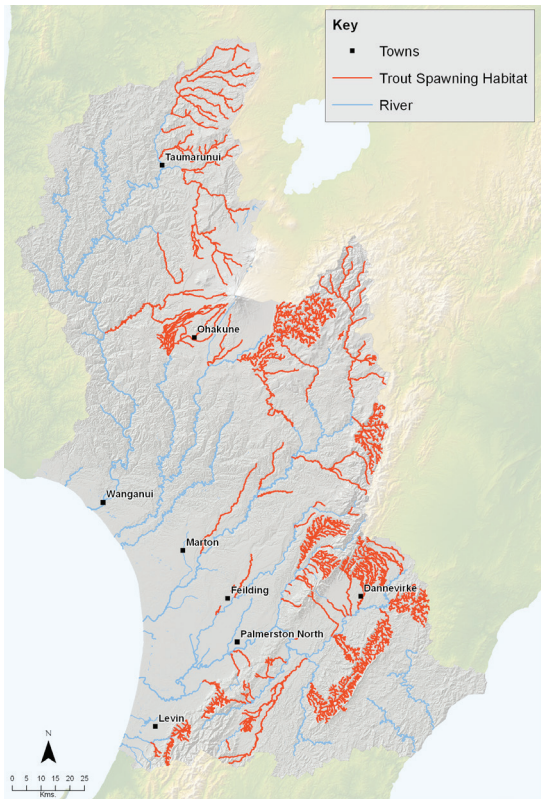
Trout

Fish and Game New Zealand are responsible for the direct management of sports fish such as trout. While we don't specifically monitor these fish, they are captured as part of our regular fish monitoring programmes and we are responsible for protection of habitat under the Resource Management Act (1991). This requirement is recognised and supported in many ways, including through our water allocation framework (see section on Water Quantity) and through the recently developed Environmental Code of Practice for River Works.

The trout species present in our waterways are brown and rainbow trout. These fish and the angling opportunities they provide are widely valued by anglers and contribute to the range of recreational pastimes enjoyed in our Region. Some areas such as the headwaters of the Rangitikei River are internationally recognised for trout fishing. However, trout are recognised as having a detrimental effect on some native fish populations.



Map 10: *Recognised fishery areas within the Horizons Region*



Map 11: *Recognised trout spawning areas within the Horizons Region*

What is Horizons doing?

We're working to protect and enhance our native fish and trout habitats by:

- Actively locating barriers to fish migration and installing fish ladders and ropes to help fish swim past these freely. Sixteen fish ladders were installed in the Manawatu catchment in 2012;
- Identifying significant spawning sites and protecting these areas;
- Monitoring fish populations at 30 sites annually and restoring native fish habitat;
- Requiring the installation of fish screens on irrigation takes to prevent fish from being drawn up into water pipes;
- Setting minimum flows for water takes;
- Planning river works around spawning and migration patterns through our river works code of practice; and
- Stream fencing and planting to provide shade and reduce nutrient and sediment inputs.

We're also leading projects under the Manawatu River Leaders' Accord to restore habitats for whitebait and native fish in at least two sub-catchments over the next two years.

One of the areas targeted for this restoration is the Manawatu River near the State Highway 1 Bridge at Foxton. This was recently identified as one of the largest known inanga spawning sites in New Zealand.

Whitebaiter's catch at the Waikawa Estuary

What's in my whitebait fritter?

Five different native freshwater fish species make up the whitebait catch. Over 90% of these fish are inanga. The remaining species are: koaro, giant kokopu, banded kokopu and short jaw kokopu.

Four species found within the whitebait catch are classified as in gradual decline in the DoC threat classification system. The exception is banded kokopu.

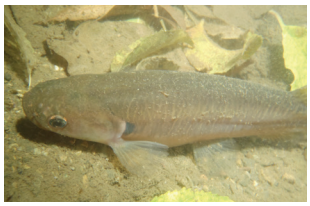
If you find whitebait crawling up the side of the bucket that holds your whitebait catch, please consider releasing these as they are koaro, one of the rarest whitebait species.

Koaro

Inanga

Giant kokopu

Short jaw kokopu



Banded kokopu

Whitebait species life cycle

Illustrator: Sonia Frimmel

Cultural health monitoring case studies

Time to gather a feed

Prepared by Pātaka Moore & Caleb Royal

Pātaka Moore and Caleb Royal are undertaking a project to assess the state of resources in the Ngāti Raukawa rohe (iwi district) from a cultural perspective. This is a brief insight from them into one part of the project.

"We have been monitoring tuatua and tohemanga density on the West Coast beaches in our rohe. The reason we chose to monitor tuatua and tohemanga is simple - they are taonga species for our iwi and hapū. They have been heavily relied upon as a traditional source of kai for centuries.

The ability to adorn tables at our marae and in our homes with tuatua and tohemanga enhances the mana of all that share the feast. The presentation of kai-rangatira (food fit for chiefs) elevates the mana of those guests. Inevitably this is an exercise that is mutually mana enhancing. We know from talking with our kaumātua that these toanga species were once in plentiful supply. Our monitoring is the first step to evaluating the current state of this fishery.

To better understand the pressures on the foods of our area, tangata whenua have used very practical ways of measuring the amount of time and effort used to gather 'a feed'. This system, recently coined by the science fraternity as Catch per Unit Effort (CPUE) has actually been in existence for generations.

We dug for 20 minutes as this is traditionally ample time to gather a meal. Our results spoke for themselves:

Tuatua gathered from Waikawa Beach Nov 2011

- Some sites that have been traditionally rich remain so. More often than not the location of these sites is not common knowledge.
- Some sites that were traditionally rich provided a poor return. It is thought that this may be the result of over-fishing, pollution, or habitat disturbance.

The knowledge gleaned from this monitoring, coupled with historical information from oral history interviews will help us understand how the state of these toanga species has changed over time. Our methods and results are currently being written into a usable form for iwi and hapu to use on the ground.

It is very clear to us that further surveys are needed. Ongoing monitoring and information gathering is vital to the long-term management of these species and therefore the mana of Ngati Raukawa as a distinct group."

Cultural and Environmental Monitoring of Te Taperenui O Whātonga

Prepared by Dr Jonathan Proctor

Rangitaane O Manawatū has occupied the Manawatu catchment for the past 800 years. During this time, cultural practices were interwoven with the natural environment and an elaborate system of food gathering, regulation and use developed in many significant locations. Up until the early 1900s, settlements (papakainga, marae) were located close to resources such as coastal plains, rivers, wetlands and lakes. The practice of kaitiakitanga (guardianship of the environment) was widely used to monitor, manage and sustain culturally significant resources. With growing concerns around resource degradation and pollution of waterways,

significant traditional areas have diminished and vanished. Those that remain have become very precious to Rangitaane O Manawatū and have given rise to a renewed interest in using traditional concepts and practices for managing and monitoring resources and environmental change. The current rapid decline in water quality and the state of mauri in the Manawatū catchment is a significant issue for Rangitaane O Manawatū. The iwi authority's present aim is to use Rangitaane O Manawatū perspectives, values and mātauranga Māori (traditional knowledge) to develop water quality baselines and standards to enhance the mauri of the river. This knowledge will be used as a basis for expressing iwi interests and values as well as establishing guidelines and scientific targets to improve freshwater management. Researchers from Tanenuiarangi Manawatū Inc are collaborating with Horizons, Landcare Research and Massey University to identify and test appropriate methods, tools and approaches for monitoring at selected sites.

Cultural monitoring has begun at four main locations (cultural windows) in the Manawatū catchment, including: Te Āpiti, Te Anaowiro, Kahuterawa, Pukepuke and Moutoa. It's anticipated that spatial and temporal analysis of fish and plants at each site will give Rangitaane O Manawatū a better picture of change in the catchment, and allow management decisions to be made to restore cultural habitats and species and support kaitiakitanga principles. Collaborative research using nutrient modelling of the catchments surrounding cultural windows will hopefully provide an in-depth understanding of the effect best farm and urban management practices, e.g. fencing, riparian planting and effluent management, will have on traditional sites.

Work to date has shown the importance of incorporating mātauranga Māori, and traditional values, with GIS and new computer modelling tools to help express cultural values and perspectives. It is envisaged cultural monitoring will greatly assist Rangitaane O Manawatū and Horizons with evaluating land management initiatives, informed freshwater management decisions, and future planning and policy to restore the traditional values and mauri of the Manawatū River, back to a more acceptable standard.

Spotlight on enjoying our waterways

Water is a major player in the great New Zealand summer. Whether it's swimming, fishing, kayaking or just walking along the river's edge, we all enjoy getting out and experiencing what our Region has to offer. Horizons staff monitor 16 popular swim spots weekly from November through to April and a further 88 sites monthly all year round.

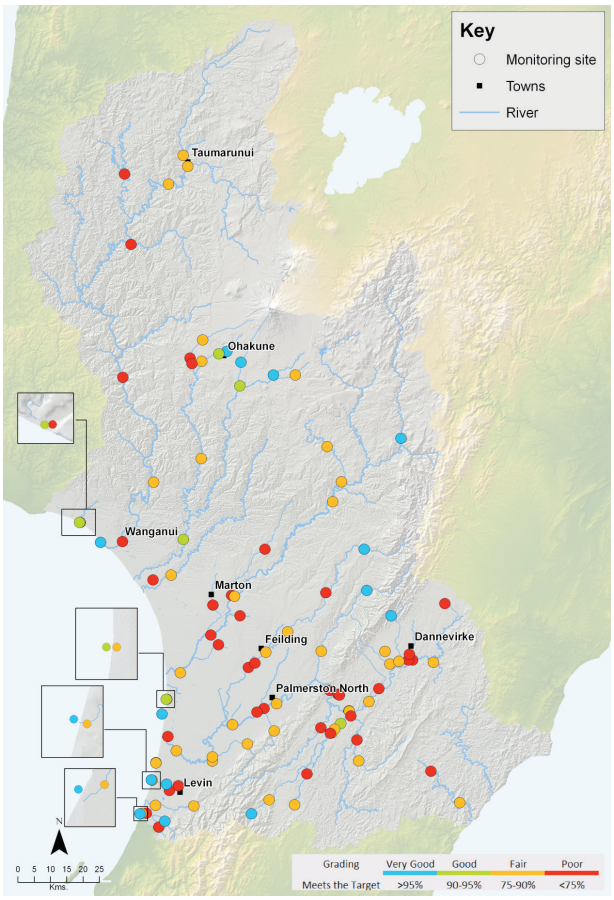
We look for and test for blue-green algae and bacteria that could affect human health. Sources of microorganisms include birds and other wildlife, town wastewater treatment plants, farm stock with direct access to waterways, run-off from farm paddocks, industrial discharges, storm water run-off and leaky septic tanks.

How does our Region stack up?

Results from weekly and monthly monitoring are compared against Ministry for the Environment and Ministry of Health guidelines (2003). These provide a guideline value for microorganisms based on an acceptable risk to swimmers. Results from our monitoring are split into four categories:

- Very good - >95% compliance – almost always safe to swim
- Good – 90 – 95% compliance – mostly safe to swim
- Fair – 75 – 90% compliance – sometimes safe to swim
- Poor - <75% compliance – almost never safe to swim

A compliance rate of less than 75% means a site has failed to meet guidelines for acceptable risk on over 75% of sampling occasions. Map 12 shows the results of data collected between 1 November and 30 April each year since 2005.



Map 12: *Frequency with which sites comply with MfE and MoH guidelines*

As can be seen from this map, a number of our sites fall into the 'poor' category. However, over 70% of our coastal sites tend to be 'very good' or 'good'. Coastal beaches and rivers close to the ranges such as the Upper Whanganui River, Pohangina River, Kahuterawa Stream and Ohau River are generally the best option for safe swimming. Bigger rivers take longer to recover after periods of heavy rainfall but are still suitable for swimming most of the time. Results from our summer monitoring programme are posted weekly on our website www.horizons.govt.nz throughout the summer months and can be found by searching 'safe swim spots'.

Swimmers assess their swim spot at Totara Reserve

Assessing your river swim spot

Before you dive in, it's best to check out:

- Has it been raining? It's safest to wait three days after rain before swimming in the river.
- Does the water look clean and clear? If so and it's a sunny day you should be okay.
- How does it smell? If you observe musty smelling, black slimy mat-like growths on the river bed it's safest for you and your dog to avoid using the river.

Remember to keep an eye out for potential hazards such as sunken logs, rocks, trees on river banks and unstable cliff faces.

What is Horizons doing?

- Monitoring for algae and bacteria that could impact upon human health;
- Requiring treatment of discharged wastewater to remove bacteria;
- Encouraging discharges to land rather than water;
- Studying the factors that lead to blue-green algal growth and toxicity;
- Studying lakes such as Horowhenua, Pauri and Wiritoa to inform management to reduce the frequency of toxic blooms;
- Fencing and planting along stream banks and around lakes; and
- Working in partnership with Public Health to erect signage and warn swimmers about the presence of blue-green algae when applicable.

What can you do?

Water Quality

Maintaining healthy waterways is a community effort and there are some simple steps we can all take to help reduce our impact. Some of the things you can do to help include:

- Keep food debris out of drains to reduce the amount of nutrients entering our rivers and lakes through storm and waste water. Instead, turn your scraps into compost – it's good for your garden and our environment.
- Use phosphate-free laundry and dishwashing products where possible and avoid pouring household chemicals down the sink or flushing them down the toilet.
- Wash your car on the lawn rather than on the driveway or street to prevent detergents running into storm water drains.
- Never dump motor oil, paint or household chemicals in the ground or in a storm water drain.
- Fence off streams to keep stock out of waterways and plant along banks to soak up nutrients while providing shade for fish and insects.
- Call Horizons' pollution hotline on 0508 800 800 if you spot a potential threat to our environment.

Manawatu River Leaders' Accord

The Manawatu River Leaders' Forum was established in 2010 when Horizons Regional Council invited community, council, industry and iwi leaders to come together and take ownership of the Manawatu River and its challenges. Six months on from this initial meeting, the leaders signed an Accord to take action which set out a clear focus, vision and goals to improve the state of the Manawatu River.

In June 2011 the Forum launched their Action Plan, detailing over 130 actions to be taken by various members of the Forum to clean-up the river and identifying six key areas that need to be addressed. These areas are:

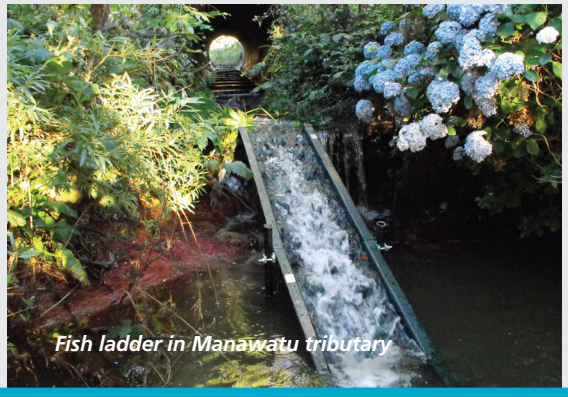
- Sediment;
- Nutrients and bacteria from point source discharges;
- Nutrients and pathogens from agricultural run-off;
- Physical changes from flood control work;
- Protection of native fish and birds; and
- Management of water allocation.

Actions outlined in the Plan will be added to over time. The Forum is committed to keeping the community informed of progress and engaging members of the public in the clean-up process.

Freshwater Clean-up Fund

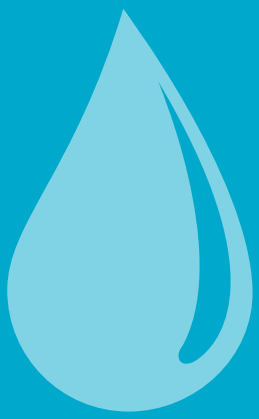
In 2012, the Manawatu River Leaders' Forum was successful in its bid for funding from Central Government's Fresh Start for Freshwater Clean-up Fund, receiving $5.2 million to aid clean-up efforts over the next two years.

Projects benefitting from this funding include: sewage treatment plant upgrades, land-based effluent disposal, stream fencing and riparian planting, native fish and whitebait habitat restoration, development of environmental farm plans to promote best practice nutrient management, and community-led initiatives throughout the Manawatu catchment.



Fish ladder in Manawatu tributary

Clean-up Fund funding has enabled projects to progress much faster than would otherwise be possible and work is already well underway. To find out more visit www.manawaturiver.co.nz.



Groundwater quality

When most people talk of water quality, they imagine rivers, lakes and streams.

Our groundwater resources are not quite as obvious but they are just as important when it comes to water management.

We rely on groundwater to sustain us, to irrigate our crops, to water stock and to service the needs of industry. Ensuring this essential resource is maintained, or enhanced in areas of degradation, is the cornerstone of effective groundwater management.

To do this, we need to understand the factors that influence groundwater quality and work together with our communities to minimise their impact.

Key issues

What we do above ground often affects what's happening underneath and what's happening underneath can affect our surface water. Key issues for groundwater quality in our Region include:

- Suitability for drinking, irrigation and use in industries;
- Interaction between ground and surface water;
- Seawater intrusion; and
- Proper construction of bores to protect against groundwater contamination.

Pressures on groundwater

Almost all water contains some chemicals, minerals, metals and/or salts in its natural state. As it flows through the earth it interacts with the rocks around it, changing its chemical composition as it goes. Local geology is a major factor in the quality of groundwater in our Region and causes it to vary from one location to the next. Groundwater quality is also influenced by sources of recharge water such as rainfall that moves downward from the ground's surface flow patterns and overlying land use.

Shallow bores that draw water from open spaces among gravel and sand underground are most susceptible to pollution from storm water or run-off. Deeper bores are more likely to be affected by chemicals naturally dissolved into water from the rocks. Nearer the coast, the risk of high salinity in groundwater or irrigated soils becomes more of an issue for both water quality and soil fertility.

We also need to manage the amount of groundwater taken for drinking, irrigation, industry and other uses to maintain the quality of our groundwater resources (see section on Water Quantity page 4).

> “Newer groundwater is more susceptible to human influence while water that’s been in the ground longer can contain elevated levels of iron, manganese, arsenic and ammonia.”

Groundwater quality at a glance

- Over half of all drinking water is sourced from the Region’s groundwater supplies.
- Newer groundwater is more susceptible to human influence while water that’s been in the ground longer can contain elevated levels of iron, manganese, arsenic and ammonia.
- Landowners now require a consent to construct a new bore to ensure they meet national standards, are registered on our database and protect groundwater from unnecessary contamination.
- The risk of salt water entering underground aquifers in coastal areas is low and there have been no confirmed cases of seawater intrusion in our Region.

Drinking water sourced from groundwater supply

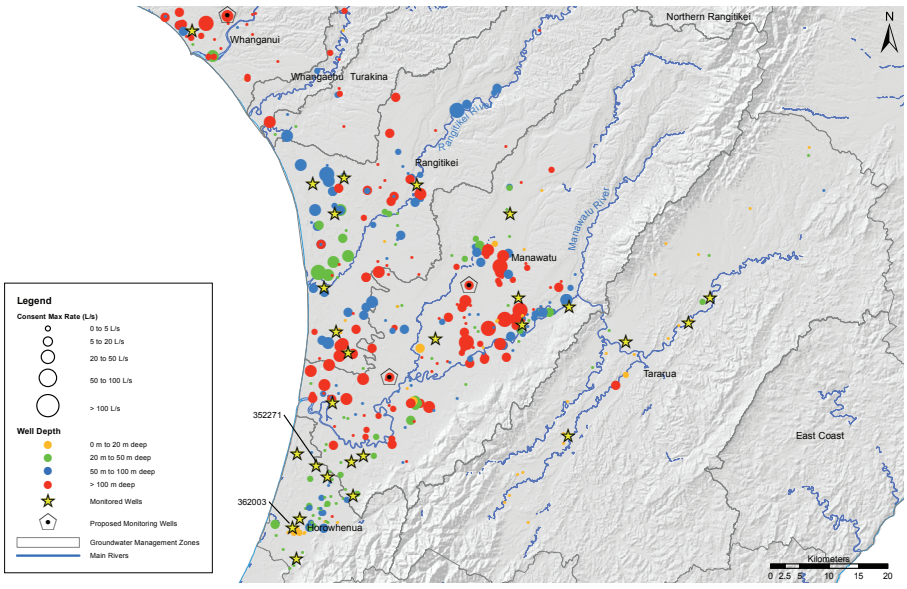
What we monitor

We monitor nitrate levels, temperature, conductivity, dissolved oxygen and acidity at 30 bores throughout the Region.

We also sample for pesticides and herbicides at 40 sites across the Region and seawater infiltration at 32 bores. Some sites are monitored more frequently than others. We currently sample:

- Water quality at six bore sites quarterly in areas of high nitrate concern near Lake Horowhenua.
- Water quality at 24 bore sites at seven-monthly intervals.
- Water quality at two bore sites at irregular intervals.
- Herbicides and pesticides at 40 bore sites at four-yearly intervals.
- Signs of seawater intrusion at seven bores automatically every 15 minutes.

This monitoring helps us assess the state of our groundwater and advise the public on its suitability for drinking, industry or irrigation. It also helps identifies areas of concern so we can put actions in place to maintain or restore water quality.



Map 13: *Location of groundwater consents and monitoring sites by volume and depth*

Spotlight on drinking, irrigation & industry

Over half of our urban drinking water is sourced from groundwater. Not to mention the many rural households who rely on bore water for washing and drinking. Horizons is responsible for ensuring the Region's groundwater meets national standards for drinking water so it can be used both now and in the future.

Factors affecting the suitability of groundwater for drinking, irrigation or industry include:

- Bacteria such as *E.coli*;
- Nitrates;
- Pesticides and herbicides;
- Minerals such as silica, calcium, magnesium, iron and manganese;
- Acidity;
- Salinity caused by seawater entering groundwater aquifers; and
- Heavy metals.

High levels of these inputs can affect water's appearance, taste and odour. They can also be hazardous to the health of humans, plants and stock.

How does our Region stack up?

A national perspective

Groundwater in New Zealand generally falls into two broad categories: oxidised and reduced. Reduced groundwater is water that's been in the ground a very long time. Oxidised groundwater is younger water that's usually closer to the surface. Each category presents its own challenges when it comes to water quality. Reduced groundwater tends to contain higher levels of undesirable

minerals such as arsenic, iron and manganese. Oxidised groundwater is more likely to contain higher levels of nitrates and bacteria that could make us sick.

This is supported by New Zealand's National Groundwater Monitoring Programme, which identified two major groundwater quality issues:

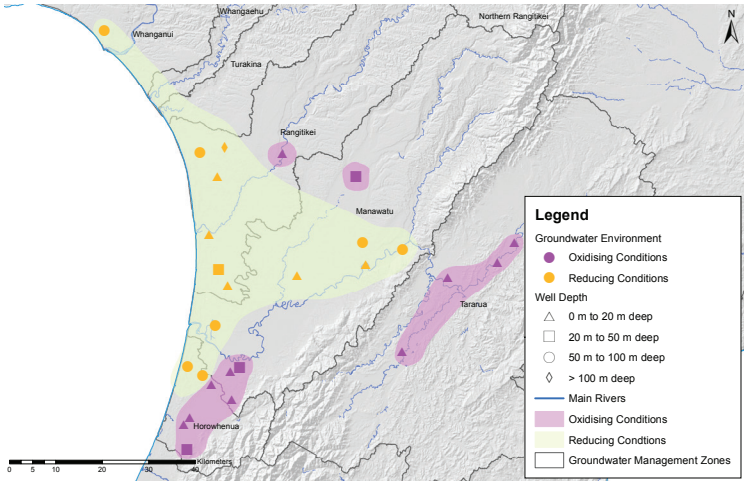
- Naturally elevated levels of iron, manganese, arsenic and ammonia, especially in deeper wells in confined groundwater. National surveys have found slow changes in these levels over time, indicating a natural water-rock interaction.
- Nitrate and faecal bacterial contamination, especially in shallow wells in unconfined aquifers. National surveys have identified rapid changes in these levels, suggesting that human influence is the leading cause.

We monitor these levels closely within our own Region through our comprehensive monitoring programme and contribute this data to the national picture.

A regional perspective

Our monitoring data is consistent with the national picture and areas of oxidising and reducing groundwater conditions are shown in Map 14. While groundwater within our Region is generally suitable for drinking, over the past seven years we have had some test results returned that breached New Zealand Drinking Water Standards (NZDWS). We are working to reduce the number of breaches by improving groundwater quality.

Water treatment systems are also readily available for water supplies affected by bacteria, acidity or high mineral levels. Give our water quality team a call on toll free number 0508 800 800 to find out more.



Map 14: *Areas of oxidising and reducing conditions in Horizons' Region*

Nitrates

National drinking water standards specify a maximum nitrate limit of 11.3 mg/L to prevent effects on pregnant women or bottle-fed babies.

It's not easy to treat elevated nitrate levels in drinking water but they can be avoided by drilling deeper bores or providing alternative water supplies to those at risk.

Of the 27 bores analysed over the past five years, most showed either no significant change or reduction (improvement) in nitrate levels. One shallow bore did show signs of increasing nitrate levels and further investigation will be carried out.

Over the past two decades, nitrate concentrations in six of our bores that were previously above the acceptable limit have decreased. These sites now meet New Zealand Drinking Water Standards; a positive sign of effective nitrate management.

> "Over the past two decades, nitrate concentrations in six of our bores that were previously above the acceptable limit have decreased."

Acidity

The pH scale measures how acidic a substance is. It ranges from 0-14, with 0 being extremely acidic and 14 being basic or alkaline. The optimum pH for drinking water is between 7.0 and 8.5.

Water can be slightly more or less acidic and still be suitable for livestock or irrigation. However, once it falls below 4.0 or above 9.0 it has exceeded guideline values.

Acidic water can corrode plumbing and heating elements and dissolve metals from this plumbing into the water we drink. Higher acidity is associated with higher oxygen levels in shallower bores which could be the result of rainfall passing through the soil.

High pH does not present a problem for our Region, with only three bores showing an occasional value above 8.5. Table 8 summarises pH results for sites monitored across our Region.

> “Naturally occurring minerals such as iron, manganese or arsenic can be dissolved into groundwater, affecting the way it looks, smells and tastes.”

Groundwater bore at the Centennial Lagoon, Palmerston North

Table 8 summarises pH results for sites monitored across our Region.

Guideline	Exceed	Livestock + Irrigation Drinking Water	Drinking Water	Livestock + Irrigation	Exceed
Median pH	0.0-7.0	4.0-7.0	7.0-8.5	8.5-9.0	9.0-14.0
Sites (%) in our Region	0	13 (48%)	14 (52%)	0	0

Table 8: *Distribution of median pH values across NZDWS Guideline Values for drinking water and ANZECC Guideline Values for livestock health and irrigation*

Iron-Manganese-Arsenic

Naturally occurring minerals such as iron, manganese or arsenic can be dissolved into groundwater, affecting the way it looks, smells and tastes. This is more common in older groundwater which has had more time to mix with the rocks around it. Fourteen (61%) of our regularly sampled bores have breached guideline concentrations for one or all of these minerals since 2005.

Guideline	Drinking Water	Livestock	Irrigation
Iron (Fe)	11 (48%)	N/A	11 (48%) for sensitive plants & 1 (4%) for tolerant
Manganese (Mn)	14 (61%)	N/A	12 (52%) for sensitive plants & 0 for tolerant
Arsenic (As)	4 (18%)	0	1 (5%) for sensitive plants & 0 for tolerant

Table 9: *Number of sites showing median values for each category of the NZDWS MAV for drinking water and ANZECC Guideline Values for livestock health and irrigation and percentage (%) of sites sampled. N.B. Sites may fall into more than one category*

Table 9 shows that maximum acceptable values are regularly exceeded for both drinking water and irrigation. The recent addition of arsenic to the parameters we monitor has highlighted this mineral as something to consider when determining the suitability of groundwater for drinking water purposes.

Through the Manawatu Plains and western costal area, treatment may be required prior

to use. However, water quality appears to be suitable for stock watering and treatment systems are readily available. If you are concerned about mineral concentrations in your groundwater, give our groundwater quality team a call on toll free 0508 800 800 to find out more.

Pesticides

Seven of the 35 (20%) bores sampled for the National Pesticides Survey in 2010 showed detectible pesticides in our Region's groundwater. These levels were all within New Zealand Drinking Water Standards but we continue to participate in the four-yearly survey to monitor any changes.

Bacteria

E.coli is used as an indicator of faecal contamination, which poses a risk to human health and makes water unpalatable for stock.

Since 2005, seven of the regularly sampled bores in our Region have breached national drinking water standards for *E.coli* on one or more occasions. The majority of these breaches occurred in wells less than 20 m deep and are likely to be related to contamination from waste disposal activities.

However, three of the bores are over 50 m deep. This is quite unusual as bacteria in groundwater tend to die off over time and the journey from the surface to these depths is prolonged. In these cases it's more likely the *E.coli* detections are due to contamination at the wellhead or sampling procedures. Wellhead construction is an important part of achieving a secure water supply.

Spotlight on ground/ surface interaction

In some parts of our Region, particularly towards the western coastal margin, underground pressures generate an upward flow of groundwater into lakes, ponds, and the lower reaches of rivers and streams.

Groundwater from deeper bores can also affect surface water quality, particularly where bores are poorly constructed with multiple screens. In some areas, elevated nitrogen concentrations in shallow groundwater may contribute to nutrient enrichment in rivers, lakes and streams. Like nitrogen, elevated phosphate levels can also occur in both shallow and deep bores and may contribute to phosphorus enrichment in surface water.

The interaction between ground and surface water has not been widely investigated in our Region. We're currently working to close some of the gaps in our knowledge through a research project with Massey University.

Spotlight on seawater intrusion

Taking water from underground sources in coastal areas faster than it can replenish can cause salt water to be drawn in from the sea. This is known as seawater intrusion and it poses a unique threat to our precious freshwater resources.

Understandably, seawater intrusion can have a major impact on water quality in underground aquifers. It can also impact our groundwater-fed rivers, estuaries and wetland ecosystems. Contamination of coastal bores which we depend upon for drinking and stock water could be devastating for local users and extremely expensive to remediate if at all possible. Where water is used for irrigating crops and pasture, excess salt can also accumulate in pasture, affecting production.

There have been no confirmed cases of seawater intrusion in any of our Region's freshwater aquifers to date. Groundwater levels are generally stable or rising, which suggests the immediate risk of salt water intrusion is low.

Water quality data generally supports this theory. However, there are two areas where further investigation is required.

> “In areas of poor groundwater quality, it is important to ensure care is taken to avoid cross-contamination of aquifers.”

Groundwater bore, Forest Road, Bulls

Spotlight on bore construction

Poorly constructed bores and wellheads allow surface water or very shallow groundwater to seep into bore casings, placing water at risk of contamination. This is particularly relevant for wellheads that are not fenced off from stock or that are subject to inundation by stormwater.

Malfunctioning or poorly maintained on-site wastewater disposal systems are also a common cause of faecal contamination and wells need to be located and constructed in a manner that minimises the contamination risk.

In areas of poor groundwater quality, it is important to ensure care is taken to avoid cross-contamination of aquifers.

Both issues are avoided by promoting a high standard of drilling practice. Horizons staff maintain regular contact with local bore drillers to promote good practice.

Horizons provides advice to drillers and groundwater users about appropriate standards for bore construction, maintenance and testing to ensure that the best access to the groundwater resource is achieved and groundwater quality is maintained.

What is Horizons doing?

We monitor groundwater quality across the Region; support groundwater research; and improve policies on water use, bore construction and wastewater disposal to better manage the quality of our drinking water supplies.

Our work in this area includes:

- Improving policies around bore construction and abandonment;
- Working with septic tank owners and district councils to upgrade poorly performing wastewater systems, particularly in fast-growing coastal communities;
- Requiring all new bores to obtain resource consent to ensure they are properly constructed, registered with us and meet national standards through provisions in the One Plan;
- Requiring six-monthly maintenance of wastewater disposal systems, including septic tanks, to prevent contamination of our groundwater through provisions in the One Plan;
- Developing and implementing a comprehensive manual for on-site wastewater systems design and management;
- Reviewing and upgrading the groundwater network to better inform management decisions;
- Encouraging efficient irrigation to reduce drainage losses to groundwater; and
- Working with district councils to provide advice and technical input into the design and management of land treatment systems for town effluent.

What can you do?

- Unused or abandoned wells should be securely sealed. Don't forget to register them too!
- Fence off your bore or well from stock.
- Ensure new bores are located away from sources of contamination, such as septic tanks and chemical storage areas.
- Ensure new bores are constructed according to best practice and national standards.
- Develop a nutrient plan to help minimise the amount of nitrogen leaching to groundwater.
- Monitor for and fix broken pipes and ballcocks.
- If you are using a groundwater drinking water supply, consider sampling its suitability. We recommend testing for *E.coli*, arsenic, manganese, nitrate, ammonia, iron and pH at the very least.
- If you would like your bore to be considered for Horizons' monitoring programme email our groundwater team on groundwater@horizons.govt.nz or give us a call on toll free number 0508 800 800.

Protect your water supply - register your bore with us by emailing groundwater@horizons.govt.nz. If we know about your bore, we can consider you as a potentially affected party during the consent process.

Poplar pole planting to stabilise hill country soil

ABOUT 75% OF OUR REGION IS CLASSIFIED AS HILL COUNTRY

40% OF THIS LAND has POTENTIAL FOR MODERATE TO SEVERE EROSION

OUR REGION HAS THE LARGEST AREA OF HILL COUNTRY UNDER THE MANAGEMENT OF A SINGLE REGIONAL COUNCIL IN NEW ZEALAND

THE HORIZONS REGION MAKES UP 8% OF NEW ZEALAND'S TOTAL LAND AREA

OUR REGION HAS 18% OF ALL CLASS 1 SOILS AND 14% OF ALL CLASS 2 SOILS in New Zealand

MORE THAN 419 WHOLE FARM PLANS HAVE BEEN PREPARED UNDER SLUI

THE AGRICULTURAL SECTOR CONTRIBUTED AN ESTIMATED $348 MILLION TO OUR REGION'S GPD IN 2011-2012

SHEEP & BEEF FARMING IS THE PREDOMINANT LAND USE IN OUR REGION

SHEEP & BEEF FARMING OCCUPIES 51% OF ALL AVAILABLE LAND IN OUR REGION

DAIRY FARMING OCCUPIES 6.7% OF ALL AVAILABLE LAND IN OUR REGION

Productive land

Productive Land

Our Region's landscape and economy is defined by agriculture which relies heavily on healthy soils and stable land.

As the regional council, we work to ensure these resources are managed sustainably to set our Region in good stead for the future.

Our Region has the greatest area of hill country managed by a single regional council in New Zealand. One of the challenges we face is the need to keep valuable hill country soils on our hills and out of waterways. Our lowlands are also highly productive and, in parts of the Region, irrigation and drainage are used to enhance this productivity.

All types of landuse, from native bush to intensely farmed land, influence the movement, distribution and quality of water in our Region. By being aware of the way land is used throughout our Region and working alongside landowners we can help ensure the future of what is arguably our Region's greatest asset.

Key issues

The main issues facing land management in our Region are:

- Intensification of land use;
- Mitigating the risk of erosion; and
- Contaminated land.

Pressures on productive land

Around 75% of our Region is classified as hill country. It's estimated that 40% of this land has the potential for moderate to severe erosion. This area includes 272,500 ha unprotected by woody vegetation which equates to just over 12% of the Region. There's a real need to mitigate this risk to preserve our productive land.

We also want to keep hill country soils on our hills and out of our waterways to minimise the impact of increased sediment and nutrients inputs on water quality and flood management.

Our Region has some of the best quality soils in the country, known as Class 1 and Class 2 soils. The greatest proportion of Class 1 and 2 soils are used for sheep and beef farming.

However, nationally, there is concern that Class 1 and 2 soils are being rapidly converted for urban growth, which could have implications for future production.

There are also concerns around the intensification of land use and the effect of increased nutrient, sediment and bacterial run-off on water quality. This is being addressed through voluntary fencing and planting initiatives in our Region as well as provisions in Horizons' regional policy document, the One Plan.

> Around 75% of our Region is classified as hill country. It's estimated that just over 40% of this land has the potential for moderate to severe erosion.

Productive land at a glance

- Our knowledge of how land is used in our Region has significantly improved.
- Through SLUI (our Sustainable Land Use Initiative) we have mapped landuse capability on 419 farms and recommended works to address erosion issues.
- Similar soil mapping exercises will be carried out on 80-100 dairy farms in the Manawatu Catchment over the next two years to help farmers achieve best practice in terms of nutrient management, water efficiency and riparian management as one of eight Clean-up Fund projects (see page 37 Water Quality & River Health).
- The Horizons Region makes up 8% of New Zealand's total land area.
- Our Region contains 18% of all Class 1 soils and 14% of all Class 2 soils in New Zealand. These are considered to be the most versatile soils for agriculture and horticulture.
- Over 10,810 ha of slope-stabilising works have been carried out under SLUI since 2006.
- The agricultural sector contributed an estimated $348 million to the Region's GDP in 2011-12.

Slip on hillside in Akitio catchment, Tararua

Farming in the Pohangina Valley

What we monitor

Our continuous sediment monitoring programme, which monitors the effectiveness of measures to control erosion, has been described by NIWA scientists as "the most extensive of any in New Zealand". Much of our monitoring in this area is linked to water quality and more information about sediment can be found on page 28 in the Water Quality section of this report.

Spotlight on land use

Sheep and beef farming is the predominant land use in our Region, with sheep and beef farms occupying 51% or 1,144,510 ha of all available land. This is followed by native cover (31% or 689,420 ha) and exotic cover e.g. forestry (7.5% or 169,320 ha). Dairy farming makes up 6.7% or 149,230 ha of all available land in our Region. It is the 4th largest land use and is experiencing the greatest growth in terms of area.

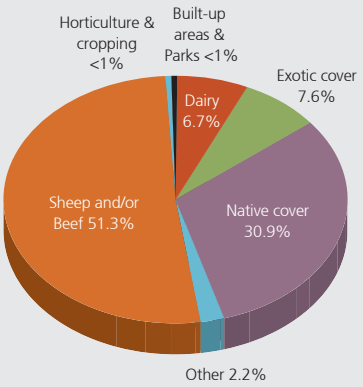
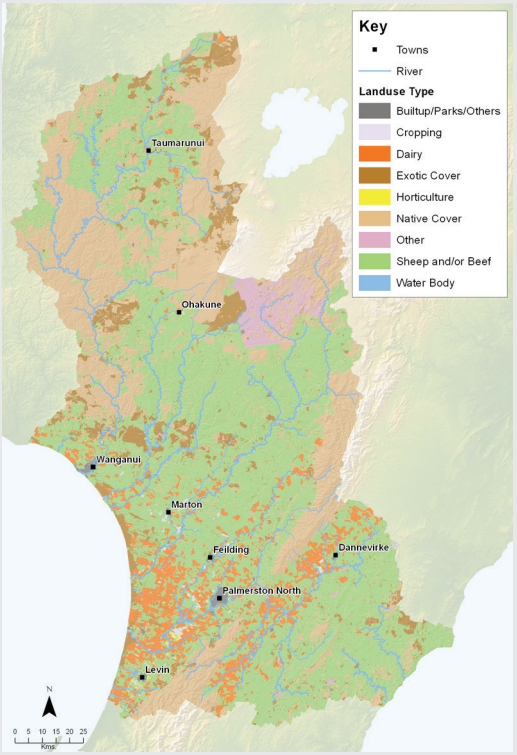


Figure 12: *How land is currently used in our Region*

Map 15 shows the distribution of the land use types in our Region. Intensification of land use i.e. conversion of land to dairy farms, higher stocking rates or higher crop yield per hectare can have flow-on effects for water quality. These include increased nutrient run-off the effects of which are discussed in the Water Quality section of this report. To manage the potential water quality impacts of new dairy conversions all new dairy farms are required to go through a consenting process that considers the impacts on water quality.



Map 15: *Regional land use as estimated in 2008*

Changes over time - landuse

The area under dairy farming in our Region increased from 95,400 ha in 1997 to 105,500 in 2007. This equates to an 11% increase and economic experts have predicted a similar increase in dairy area over the next decade.

Over the same period (1997-2007), the number of dairy herds decreased by 20%. The total number of cows increased by 16% to 287,512 in 2007.

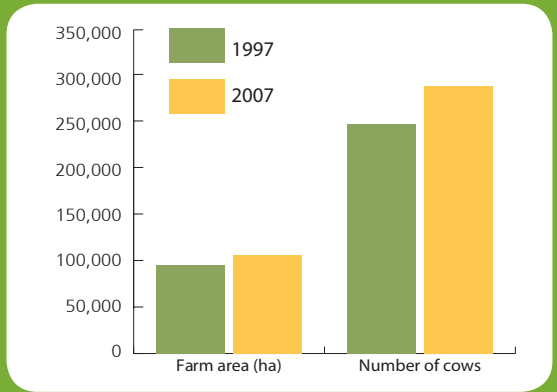


Figure 14: *Intensification of dairy between 1993 and 2008*

Spotlight on erosion

Approximately 75% of our Region is classified as hill country – that's approximately 1,667,322 ha of land. It is estimated that 666,505 ha of this land has potential for moderate to severe erosion.

Of this, 272,580 ha (40%) is considered unprotected as it is not planted in woody vegetation which reduces the risk of erosion. During the storms of 2004, approximately 200,000,000 tonnes of soil was eroded from our unprotected hill country, causing an estimated 30,000,000 tonnes of sediment to enter the Region's rivers and streams.

While sediment is a natural component of any waterway, excess sediment causes a range of social, environmental and economic issues by impacting on flood protection schemes and water quality. The Water Quality section of this report discusses the effects of excess sediment on the Region's waterways.

Flock of sheep on hill country property

Sustainable Land Use Initiative (SLUI)

The Sustainable Land Use Initiative (SLUI) takes a 'mountains to the sea' approach to accelerated erosion in our hill country.

Developed following the significant floods of 2004, SLUI has four key outcomes:

1. Erosion rates are reduced to closer to 'natural levels'.
2. A rural sector/regional economy that is more resilient to future major storm events.
3. Lowland communities are protected from the impacts of upstream hill-country erosion.
4. Improved water quality in the Region's rivers.

A variety of tools have been identified for the successful performance of SLUI but the development of Whole Farm Plans with individual farmers is the key component.

SLUI Whole Farm Plans are about more than just erosion control, although that is their primary purpose. These plans include both environmental and business assessments as the two go hand-in-hand in the search for sustainability.

Every tailor-made plan provides essential information about a specific farm's resources, providing a framework for management of erodible land, cultivation, bush blocks, vegetation clearance and improving farm productivity.

The plans identify on-farm opportunities for sustainable resource management and sustained business growth. One component within these is an assessment of pasture production before and after the implementation of SLUI works.

Since SLUI's implementation in 2006, more than 419 Whole Farm Plans have been prepared and the results are visible in the landscape.

Figure 15a: *Eroded slopes in 2007 - before SLUI works*

Figure 15b: *Same slopes in 2012 – after SLUI works*

Figure 16a: *Eroded slopes in 2007 - before SLUI works*

Figure 16b: *Same slopes in 2012 – after SLUI works*

Benefits and outcomes of SLUI to date

Since the implementation of SLUI, approximately 130,130 ha of erodible farmland has been mapped as part of Whole Farm Plan preparation.

It's estimated that 89,185 ha (69%) of this land had an elevated risk of erosion and was unprotected prior to SLUI's implementation. As of 30 June 2012, works to reduce the risk and impact of erosion had been completed on 10,801 ha of land under the initiative.

Approximately one third of all land with an elevated risk of erosion within our Region is under the management of a Whole Farm Plan.

This is considerable progress towards the objective of the One Plan to have 50% of all land with an elevated risk of erosion under the management of a Whole Farm Plan by 2017.

FAST FACTS

Land retirement (e.g. afforestation, bush regeneration) dominates the SLUI work implemented on the worst of the eroding land.

SLUI has contributed to 258.6 km of stream fencing since July 2008.

7,508,815 trees have been planted under SLUI since 2006

Existing SLUI works, when matured, are forecast to reduce sediment yields from Whole Farm Plan farms by 0.44 million tonnes per year.

Achieving the full target for reducing sediment yields will require an estimated 50,000 ha of further work on current Whole Farm Plan properties.

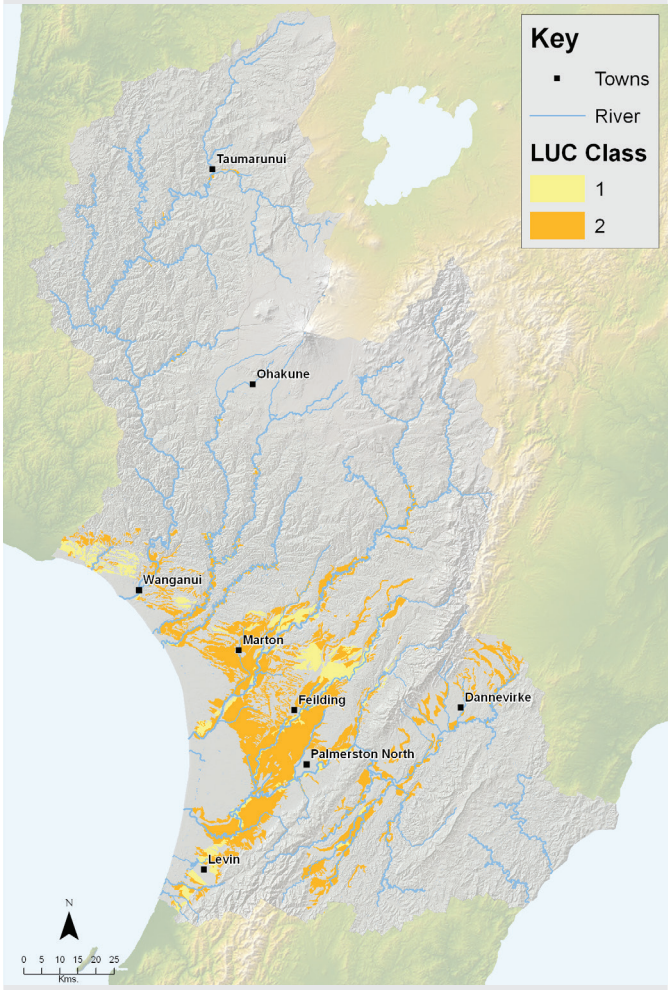
Spotlight on soils

Elite and versatile soils

In New Zealand, highly versatile soils are known as Land Use Capability (LUC) Class 1 and 2 soils. These are the best quality soils, usually considered to be prime horticultural and agricultural land.

Our Region is one of the four regions in the country where LUC Class 1 and 2 soils predominantly occur. The other regions include Canterbury, Taranaki and Waikato.

Our Region, which makes up around 8% of New Zealand, is home to approximately 34,000 ha of Class 1 land, and almost 172,000 ha of Class 2 land. This equates to 18% and 14% of the national distribution of these soils respectively. The distribution of these soils is shown in Map 16.



Map 16: *Distribution of Class 1 and 2 soils in the Horizons Region*

The greatest proportion of our elite and versatile soils (60%) is used for sheep and beef farming. Dairy farming occupies the next largest share (30%). Table 10 and Figure 15 show the proportion of Class 1 and 2 soils under each land use type in our Region.

Land Use	LUC Class 1 (Area km²)	% of LUC Class 1 land	LUC Class 2 (Area km²)	% of LUC Class 2 land
Urban/Parks/Others	2	1	8	0.5
Native Cover	7	2	42	2
Exotic Cover	10	3	38	2
Cropping and horticulture	21	6	62	4
Dairy	81	23	531	30
Sheep and/or Beef	226	64	1049	60
Other	2	0.5	6	0.3
Grand Total	**350**	**100**	**1742**	**100**

Table 10: *Summary of land use types on Class 1 and 2 land*

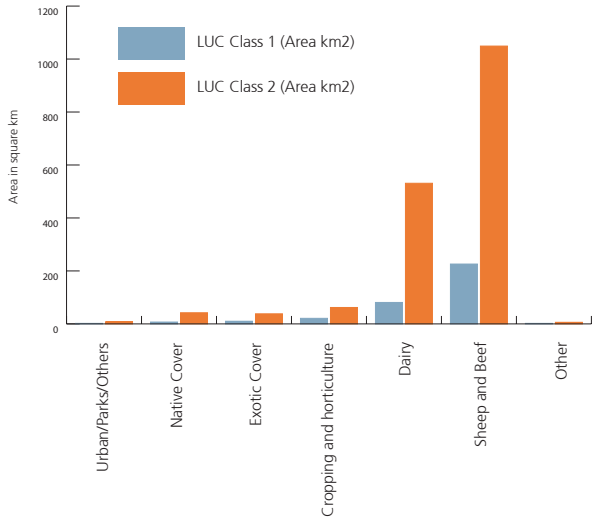


Figure 15: *Land use types on Class 1 and 2 soils in the Horizons Region*

Nationally there is concern over Class 1 and 2 soils being converted for urban use more rapidly than other land use classes and the implications of this for future productivity.

Contaminated sites

The New Zealand Hazardous Activity and Industrial List (HAIL) defines industries and activities that typically store hazardous substances which could cause contamination if they escaped from safe storage, were used or were disposed of on-site.

Under the Resource Management Act (1991), Horizons is responsible for identifying and monitoring contaminated land while district and city councils are responsible for preventing or mitigating any adverse effects of development, subdivision or use of contaminated land.

The HAIL database identifies 536 potentially contaminated sites in our Region. These range from waste storage and disposal facilities to service stations, chemical processing plants and cemetaries. A summary of the types of sites listed and the relative numbers of each site are shown in Figure 16.

Of the sites identified, 27 (5%) are confirmed to be contaminated and 130 (24%) are verified as having a history of hazardous activity or industry. Of the remaining sites, 152 (28%) have an unverified history of hazardous activity or industry and 227 (42%) are considered to be appropriately managed or remediated. The proportion of sites in each HAIL category is shown in Figure 17.

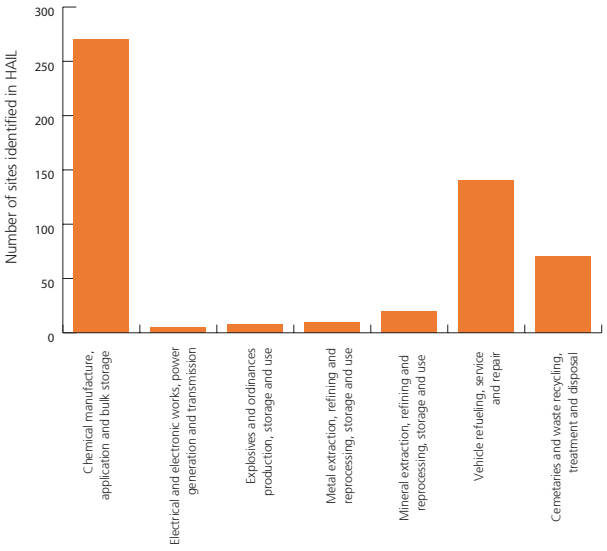


Figure 16: *Summary of the types of contaminated site identified in the Horizons Region*

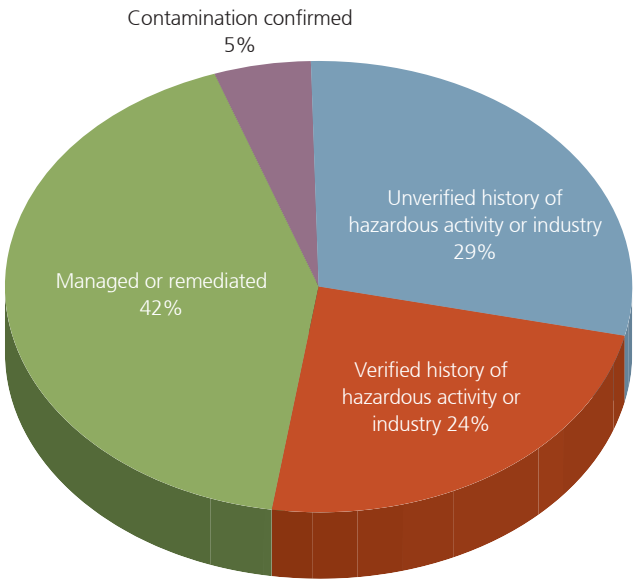


Figure 17: *Contaminated site status according to the HAIL status classification*

What is Horizons doing?

Horizons' One Plan requires city and district councils to pay particular attention to the benefits of retaining Class 1 and 2 soils for productive land when providing for urban growth.

We work jointly with city and district councils to identify priority contaminated land (e.g. on the HAIL list) that is expected to be subject to a land use change within the next 10 years.

Where land use changes on contaminated land are likely to increase risks to human health or the environment, Horizons works with district or city councils and landowners to assess the degree of contamination and ensure the land is made suitable for its intended use.

Contractor carries out hillside planting to help reduce erosion

Native blue duck (whio) in Ruapehu

22% OF THE REGION'S ORIGINAL **NATIVE FOREST COVER**

AND 3% OF ORIGINAL **WETLANDS** ARE STILL AROUND TODAY

THERE ARE OVER **20,000** *introduced* **PLANT & ANIMAL** SPECIES IN NEW ZEALAND

OUR REGION HAS THE CAPACITY TO CARRY ABOUT **4.1 MILLION POSSUMS**

INTENSIVE POSSUM CONTROL HAS REDUCED CURRENT **POSSUM NUMBERS** TO AN ESTIMATED **1.6 MILLION**

Horizons HAS SURVEYED **706 BUSH** REMNANTS

43% 43% ARE IN GOOD OR **EXCELLENT CONDITION**

GOLDFISH CAN BECOME A **PEST** IF RELEASED INTO THE REGION'S **WATERWAYS**

KIA WHARITE **TRAPPING** EFFORTS PROTECT **50 PAIRS OF WHIO** *along the* MANGANUI-O-TE-AO AND RETARUKE RIVERS **IN RUAPEHU**

TOTARA RESERVE IS OUR REGION'S ONLY **REGIONAL PARK**

WHANGANUI NATIONAL PARK IS HOME TO THE LARGEST **POPULATION OF NORTH ISLAND BROWN KIWI**

Living Heritage and Biosecurity

Living Heritage & Biosecurity

Our Region is home to forests, wetlands, dunes and waterways unique to New Zealand

At Horizons, we work in partnership with our communities to protect and enhance our patch of native New Zealand.

Stopping the spread of pest plants and animals goes hand-in-hand with maintaining or enhancing native habitats and agricultural productivity. A possum killed to protect farm production often helps protect plants and animals in a neighbouring bush area or reserve. Similarly, a weed eliminated in an important bush remnant can reduce that weed from spreading into surrounding farmland.

Key issues

- Maintaining and enhancing native habitats; and
- Reducing the impact of pests and weeds on agricultural production and recreational opportunities.

Pressures on living heritage and biosecurity

Over 30% of the Regions' land area is under native cover. However, continued development of the landscape has created isolated pockets of native habitat. These can range from large areas such as those in forest parks to very small areas found on private land. Preserving these remnants requires a combination of assistance to help voluntary efforts and regulation.

There have been many pressures on wetlands and bush remnants such as drainage, fire and clearing for agricultural production or other development. Pressures on wetlands also include taking ground or surface water from or near wetlands for drinking, stock water and irrigation. This can affect water levels and lead to changes in the ecosystem. These effects are carefully managed through our water allocation framework, discussed in the Water Quantity section of this report.

Illegal harvesting of native forests is another pressure on biodiversity. Under the Forests Act 1949, indigenous timber can only be produced from forests managed in a way that maintains continuous forest cover and ecological balance. Sustainable harvesting is controlled through permits issued by the Ministry for Primary Industries (MPI) and through biodiversity rules in the One Plan.

There are over 20,000 introduced plants and animals in New Zealand. At least 10% of these have formed self-sustaining and persistent populations, and, of these, approximately 10% become significant ecological or economic pests.

Environmental pests and weeds can change the structure of our native habitats. They often smother or prey on vulnerable native species and can quickly overtake indigenous habitats. Agricultural pests and weeds can reduce the quality of pasture, damage crops and spread diseases that could impact upon our regional economy. Horizons works to stop the spread and reduce the population of plant and animal pests for the benefit of our environment and economy.

Living heritage and biosecurity at a glance

- Over 30% of the Region's land area is in native cover.
- 22% of the Regions' original native forest cover is still around today and 3% of original wetlands remain.
- There is renewed public interest in wetland restoration and Horizons is working with schools, community groups, iwi and landowners to restore wetlands and re-plant riparian margins.
- Horizons has surveyed 706 bush remnants in our Region. 12% are considered to be in an excellent state and very few are classed as poor.
- There are over 20,000 introduced plants and animals in New Zealand.
- Intensive possum control has reduced possum numbers down to an estimated 1.6 million. That's about 40% of our Region's estimated maximum carrying capacity.

Walking track in the Manawatu Gorge

> “The majesty of volcanic mountains and forest ranges, the rivers and bush clad vistas, and the productive agricultural landscape all contribute to our sense of place in nature.”

Fern frond unfurls in patch of native bush

What we monitor

Monitoring biodiversity involves looking at what the extent of native cover might have been, comparing this to what we have today and working to protect the areas identified.

We currently monitor:

- The extent of indigenous cover remaining;
- The number of biodiversity sites under protection and active management; and
- Changes in the environment as an indication of successful pest control and habitat restoration;

In the biosecurity space we monitor:

- The number or density of pests in the environment over time;
- The number of calls we receive regarding pests and weeds; and
- The type of pests and weeds that threaten our environment and production.

Spotlight on native habitats

Without doubt the Region’s natural heritage shapes our economy and cultural identity.

The majesty of volcanic mountains and forest ranges, the rivers and bush clad vistas, and the productive agricultural landscape all contribute to our sense of place in nature.

However, iconic elements of our natural heritage such as native bush, wetlands, and dunes, along with the diversity of native species that live in them, continue to be under threat of further loss.

How does our Region stack up?

A national perspective

The New Zealand Biodiversity Strategy was developed to halt the decline of indigenous biodiversity; described in New Zealand's first national State of the Environment report as the nation's most pervasive environmental issue.

This Strategy and the Proposed National Policy Statement (NPS) on Indigenous Biodiversity identified parts of our Region as unique from a national perspective and worthy of special attention. Horizons' biodiversity work is closely aligned to the direction of the NPS.

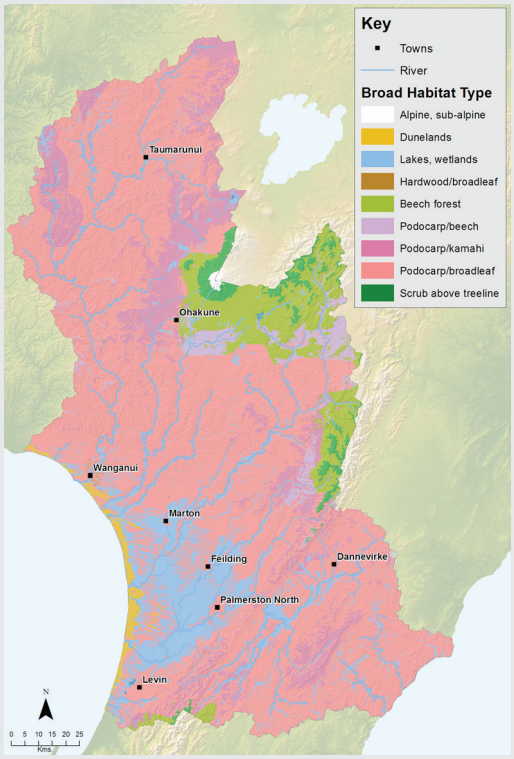
A regional perspective

Prior to the arrival of humans, our Region was dominated by extensive forest cover, fire-induced tussock land on the Central Volcanic Plateau, and large areas of wetland habitat and extensive dune fields along the west coast of the Region. Sub-alpine and alpine habitat dominated above the treeline.

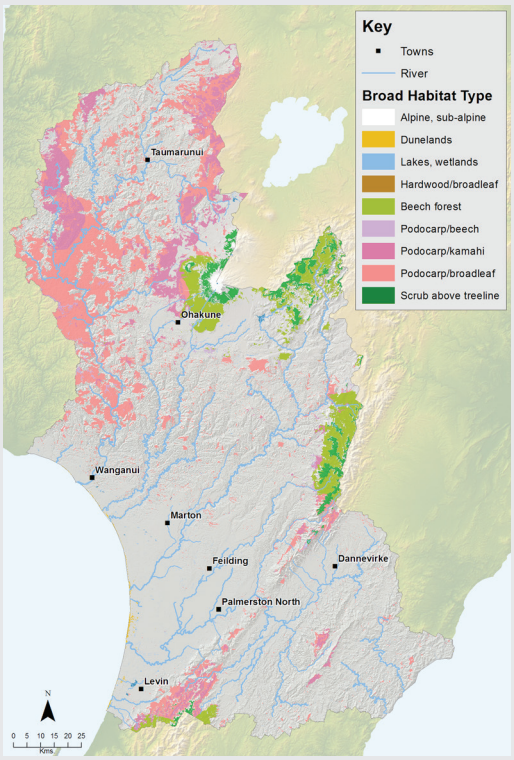
Today much of the indigenous landscape has been replaced with production forestry, pastoral and horticultural landscapes, dotted with towns and cities. Areas prone to fire or suited to agriculture and development (e.g. lowland areas) have experienced the most extensive decline.

Remaining lowland natural habitats are typically small and widely separated. Map 17 depicts the predicted potential extent of general types of native habitat based on current climate, soil and geology. This map reflects what the Region's native vegetation cover would likely consist of today if it wasn't modified by humans.

Map 18 depicts the current extent of native habitats. Clearly there is a defined pattern between the suitability for human use of the landscape and the degree of habitat loss from that landscape.



Map 17: *Predicted potential extent of native vegetation types*



Map 18: *Extent of native vegetation types remaining*

Changes over time

Based on a Region-wide assessment of current forest remnants, our Region has 22% of its original native forest remaining.

Our last State of Environment report put the amount of remaining wetlands at 2%. However, as a result of further information gathered over the last seven years, this statistic has been revised to 3%. While this appears to be an increase, it's mainly reflective of the effort that's gone into looking for remaining wetlands in an attempt to effectively manage the best of what is left. At just 3% of their former extent, our Region's wetlands are highly valuable from a biodiversity perspective.

Incremental losses in native vegetative cover resulting from the clearing of native manuka scrub for pasture, accidental fires, and incidences of wetland drainage continue. All these activities ultimately lead to reduced native vegetation cover.

On the bright side, there are also instances of native habitat creation through the restoration of wet pasture back into wetlands, re-planting of stream riparian margins in native trees and shrubs and regeneration of native cover on retired hill country. These smaller scale changes are a key part of protecting and enhancing our Region's biodiversity.

We are currently working with other regional councils around the country on ways to better track, record and report on changes in the Region's biodiversity.

Bush remnant and wetland condition

As part of Horizons' non-regulatory response to halting biodiversity decline, district-wide surveys of a number of remaining bush remnants and wetlands have been undertaken to identify the extent of what remains and the condition of these fragments (Table 11 and Table 12). Most of the bush fragments surveyed are in a good or fair state. 12% of sites are in an excellent state and very few are in a poor state. Overall 43% of surveyed bush remnants are considered to be in a good or excellent state. 36% of the wetlands surveyed are in a good to excellent state and 64% are in a fair or poor state.

These summaries generally reflect that sites are showing the effects of pest plants and animals, but there is evidence that native vegetation regeneration is occurring and many sites are of sufficient size to support the range of native plants and animals that live in them.

District	Total No. of Bush Fragments (surveyed)	Total area (ha)	Condition			
			Excellent (%)	Good (%)	Fair (%)	Poor (%)
Horowhenua	71	3291	3%	27%	56%	14%
Palmerston North	6	4287	40%	60%	0%	0%
Manawatu	146	3205	6%	38%	50%	6%
Rangitikei	125	3426	5%	32%	57%	6%
Tararua	255	8957	5%	29%	58%	8%
Whanganui	41	3399	27%	22%	49%	2%
Ruapehu	62	2884	68%	30%	2%	0%
Whole Region	706	29449	12%	31%	50%	7%

Table 11: *Condition of bush remnants in the Horizons Region*

District	Total No. of Bush Fragments (surveyed)	Total area (ha)	Condition			
			Excellent (%)	Good (%)	Fair (%)	Poor (%)
Horowhenua	83	2090	6%	20%	37%	37%
Palmerston North	6	43	17%	0	0	83%
Manawatu	35	468	9%	20%	37%	34%
Rangitikei	65	876	12%	17%	34%	37%
Tararua	43	544	10%	25%	37%	28%
Whanganui	54	602	15%	24%	26%	35%
Ruapehu	86	4965	21%	32%	28%	19%
Whole Region	373	9608	12%	24%	32%	32%

Table 12: *Condition of wetlands in the Horizons Region*

> Overall 43% of surveyed bush remnants and 36% of wetlands are in a good to excellent state.

Spotlight on biosecurity

The numbers of significant ecological or economic pests already in New Zealand present a phenomenal post-border biosecurity problem.

We are unique from most other regional councils in that we have no direct port for international travel and trade. As a result, marine and airport biosecurity threats are not as pressing as they may be for other regions.

However, the Horizons Region is traversed by three national highways, acting as a conduit for tourists and trade across the length and breadth of the lower North Island.

This creates its own unique set of problems around managing the role of people and pathways in transporting weeds and animal pests. The monitoring and measurement of pests is as many and varied as the number and type of pests themselves. We've chosen a select range of statistics to present as case studies in this report.

Wetland at Ashhurst Domain

Old man's beard

Old man's beard is a highly aggressive vine that establishes rapidly in forest and river margin habitats. It smothers canopy trees and causes the collapse of forest fragments by supressing successful regeneration of the forest. Old man's beard is considered one of the country's worst environmental weeds. Old man's beard is in an explosive phase of infestation.

The present scale and distribution is too widespread and dense for Horizons to undertake a successful region-wide control programme. The focus for managing old man's beard therefore has been on protecting high-value forest habitats and making sure areas of the Region that are currently free of old man's beard stay that way. The successful control of old man's beard continues to be a hard-fought battle.

The number of known sites in areas thought to be previously clear of old man's beard has increased despite the intensity of control by both Horizons and community groups. A high degree of success is being sustained at site-level but expansion of these programmes into buffer areas has proven expensive and reduces the vigilance that can be spent on areas that are presently clear.

Old man's beard flowers

Contorta pine

Contorta pine is an environmental weed known as a "transformer" species. It invades grassland and shrubby habitat such as tussock and alpine shrublands and turns these habitats into forest. Contorta pine can also invade ungrazed or lightly grazed pastoral environments and compete vigorously with other commercial species within plantation forests. Contorta pine is widespread. The regional focus for management is on protecting the iconic tussock and shrublands of the Volcanic Plateau and controlling isolated areas in a zone thought to be relatively clear of contorta pine. Management of contorta pine on the Volcanic Plateau by the DoC, New Zealand Defence Force, and forestry companies is complemented by Horizons' work with private landowners to undertake control of contorta pine on their properties.

The result is that contorta pine is on its way to being under sustained control on the Volcanic Plateau. Aerial surveys in selected parts of the control zone have identified that areas that were thought to be relatively free of contorta pine have pockets of previously undetected coning trees in large numbers.

These surveys also identified other pine species wilding in the contorta pine control zone. These may be just as much of an environmental pest as contorta pine is. The control of wilding pines and the successful eradication of contorta pine from the control zone are subjects of the upcoming Regional Pest Plant Management Strategy Review.

Possum control

The possum was introduced for the fur trade but has since become the number one animal pest in the Region due to its adaptability to different environments and the severity and extent of damage possums cause to amenity, production and environmental values.

Possums are very destructive to indigenous ecosystems causing localised extinctions of species, forest canopy dieback, and ecosystem change. High populations consume volumes of pasture that could otherwise go to stock (14 - 15 possums can eat the same amount of grass as one sheep) and they can be carriers of bovine tuberculosis.

Possums are widespread but concerted effort by Horizons, the DoC, and the Animal Health Board (AHB), along with the input of conservation groups, land owners and possum fur harvesters, has driven populations down to very low levels over much of the Region. When accounting for known possum control efforts of Horizons, DoC, the AHB, and the rest of the community, roughly 75% of the entire Region is under some semblance of possum control. Based on available possum monitoring information and current habitat information, it is estimated that our Region has the capacity to carry about 4.1 million possums. Under

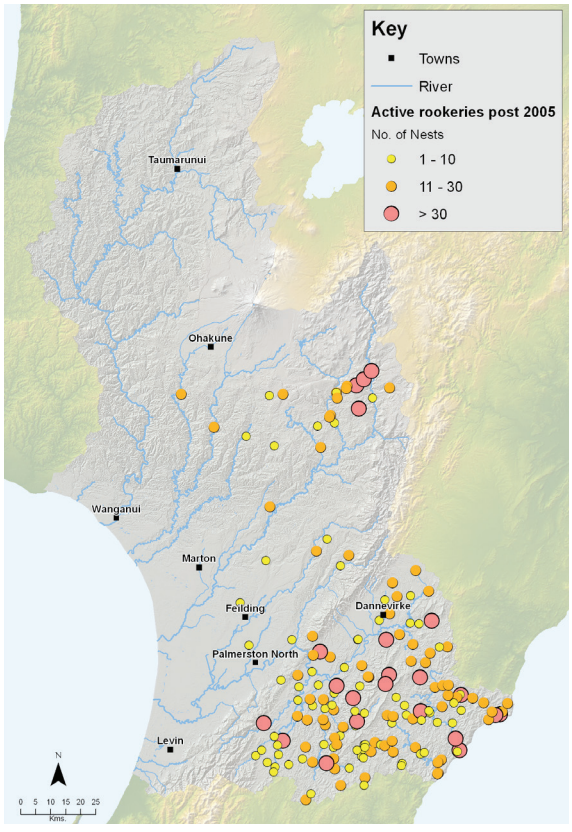
the current control regime, numbers have reduced to around 40% of possible numbers. It is estimated that there are now around 1.6 million possums in our Region. See page 71 for more on what Horizons is doing.

Rooks

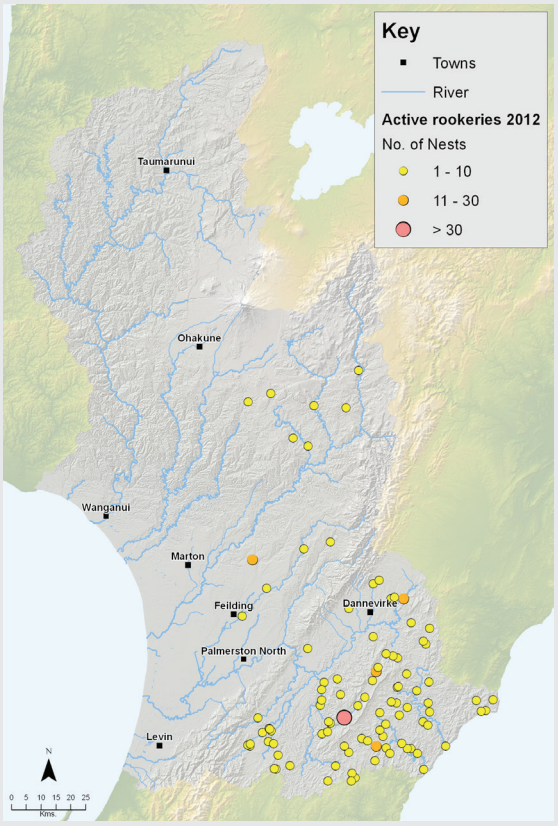
Rooks are a member of the crow family and tend to feed in large social flocks. They can cause significant economic damage to individual farmers by homing in on newly sown cereal crops, ripening peas, broad beans, potatoes, walnuts, pumpkins and fruit. On pastoral land, they eat insects such as grass grub, but this benefit is greatly outweighed by the damage they do to the pasture digging the insects up.

Rooks were once widespread but work by Horizons, along with neighbouring Greater Wellington Regional Council and Hawkes Bay Regional Council, has reduced the population in the lower half of the North Island to the point that eradication is a very real possibility as shown in Maps 19, 20 and 21.

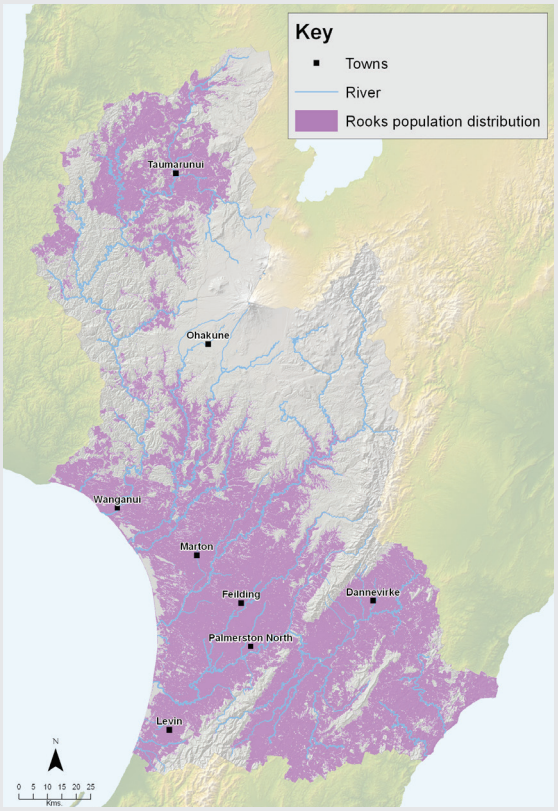
One of the reasons rooks are controlled by regional councils rather than private individuals is that the most effective means of control (poisoning) is not available to the public. Shooting rooks tends only to disperse the population, making them more difficult to manage.



Map 19: *Rookeries in the Horizons Region in 2005*



Map 20: *Rookeries in the Horizons Region in 2013*



Map 21: *Potential distribution of rooks if Horizons did nothing*

> “Roughly 75% of the entire Region is under some semblance of possum control.”

Totara tree in Totara Reserve Regional Park

Pest fish

Pest fish can pose a real problem in our Region’s rivers and lakes by competing with or predating on native species. Some also stir up sediment and undermine shores of lakes, sides of dams and river banks. This can result in stock losses on-farm as stock try to drink from dams where the sides have been undermined. Some of the pest species found in our Region include:

- perch;
- gambusia;
- goldfish;
- rudd; and
- koi carp.

Koi carp were thought to have been eradicated from Lake Horowhenua but a few large koi carp were captured during our recent pest fish monitoring. Many pest fish species like slow moving, low gradient streams.

Totara Reserve

Nestled in the Pohangina Valley, Totara Reserve is our only Regional Park. It’s also one of the last and best remaining examples of lowland forest ecosystems in our Region.

Horizons aims to preserve and enhance the natural heritage of Totara Reserve. We’ve established weed and pest control programmes to target introduced species such as possums, rats, old man’s beard and wandering willy, which have a considerable effect on forest ecosystems.

Possum control has long been undertaken in the Park and monitoring has shown numbers to be well below the levels known to affect forest health and bird life. Monitoring has also shown

an improvement in canopy cover that is usually targeted by possums. It's thought this control is helping to suppress rat numbers, although recent assessment work shows these numbers are still higher than desired. Horizons also targets stoats, ferrets and feral cats in the Reserve.

In December 2012 we began a native bird monitoring programme. The results are pleasing with the discovery of two native species, whitehead and tomtit, which were thought to be absent from the Regional Park. Results also tentatively suggest the abundance of kereru and tui can be linked to pest control efforts.

> "Horizons aims to preserve and enhance the natural heritage of Totara Reserve."

Weed control is an on-going battle but recent reassessment has shown areas affected by old man's beard are getting smaller and new sites are rare. Species that can be eradicated such as wild rose, stinking iris and bamboo are on their way out.

A series of floods in the mid to late 2000s transported fragments of wandering willy (tradescantia) deeper into the Regional Park. The tradescantia leaf beetle was introduced into the Reserve Park in 2011 as a means of control but it is too early to know the impact.

For more on Totara Reserve and its facilities visit www.horizons.co.nz

What is Horizons doing?

Under the Resource Management Act (1991), Horizons is responsible for maintaining indigenous biodiversity and enhancing biodiversity in certain situations. To achieve this, we use both non-regulatory (incentives) and regulatory (rules) approaches.

One Plan incentives

Methods to preserve biological diversity in the One Plan include programmes to provide landowners with information, advice, and in instances of high priority sites, provide financial or project management assistance for landowners to carry out enhancement and protection measures.

Measures include fencing, planting, and pest plant and pest animal control. The One Plan targets are to get 100 of the top priority wetlands and 200 of the top priority bush remnants under a programme of active management within 10 years of the One Plan becoming operative.

Horizons' work to date on the Top-100 wetlands programme and the Top-200 bush remnants programme has progressed so that 73 wetlands and 97 bush remnants are now being managed. We also provide assistance and advice for bush remnants that may not be high priority. Columns A and B in Table 13 are high priority sites.

	Priority				TOTAL
	A	B	C	D	
Wetlands Managed	41	32	0	0	73
Wetlands Managed AND legally protected	23	8	0	0	31
Bush Remnants Managed	37	60	0	0	97
Bush Remnants Managed AND legally protected	14	16	0	0	30
			TOTAL (Managed)		170

Table 13: *The number of priority bush and wetland sites managed by Horizons, and the number of those that are legally protected*

> The One Plan now has rules to ensure that habitats identified as threatened, at-risk or rare suffer no further decline due to some management practices.

Kereru perched on a branch

One Plan rules

To develop better policy for the protection of native habitats under the One Plan, Horizons undertook an analysis to determine to what extent each of the different types of forests that once existed in the Region still occur today.

When looking at the types of native habitats that remain, the Region's mixed Podocarp (native pine) forests, the dunes, and wetland habitats are typically well below 20% of their former extents. These and similar habitats below the 20% threshold are considered at threat from further rapid decline in biodiversity. The One Plan now has rules to ensure that habitats identified as threatened, at-risk or rare suffer no further decline due to some management practices.

Biosecurity Act

Horizons has two regional pest management strategies – one for pest plants and one for pest animals. The regional pest management strategies are designed to safeguard the Region's primary productivity, environmental quality, and biodiversity from degradation caused by pest plants and pest animals. Both strategies broadly group pest plants and pest animals into environmental pests (those that affect environmental quality and biodiversity) and production pests (those that affect agricultural productivity and economy). Many pests fall into both categories and the relative merits of Horizons' intervention is assessed under the Biosecurity Act.

The strategies do not deal with diseases because they are the domain of the Ministries of Health and/or Primary Industry, though Horizons does manage some pests that are known carriers of disease. The strategies also tend not to deal with household pests as these are better managed by the homeowner and commercial pest management businesses. However, our role does include providing advice to the public about the management of pests such as possums, magpies, and ferrets. If you are having problems with pest animals we can offer advice on control options and, in some cases, provide specialised traps.

Possums

Under the current Regional Pest Animal Management Strategy, Horizons aims to progressively bring all rateable land (approximately 1.5 million ha) under possum control by 2017.

Horizons' Possum Control Operation (PCO) programme presently covers approximately 830,000 ha of private pastoral land and bush blocks. It is estimated that the PCO programme has reduced the average number of possums from 0.63 possums per hectare to 0.35 possums per hectare.

In addition to the PCO programme, the possum control work undertaken by the Animal Health Board to protect cattle from bovine TB covers approximately 562,500 ha of rateable land.

What can you do?

Protecting and enhancing our patch of native New Zealand requires a collaborative effort. Here are some of the steps you can take to help along the way:

- Get involved in community conservation groups and local habitat restoration initiatives.
- If you're interested in starting your own restoration project, give Horizons' environmental management team a call on toll free number 0508 800 800 for advice and guidance.
- If you're looking at making changes that could potentially alter native bush, wetlands or dunes, give us a call on toll free number 0508 800 800 to talk this through first.
- Don't release your goldfish into lakes or streams as they compete with native fish and alter the ecosystem.
- If you come across something new in the environment such as an unknown weed or discover an infestation give Horizons a call on toll free number 0508 800 800.
- Don't move introduced plants and animals around the environment. Many of our pesky weeds began life as garden plants.
- Contact our pest control team on toll free number 0508 800 800 for assistance and/or advice on pest control.
- Check, clean, dry, between waterways to prevent the spread of freshwater weeds.

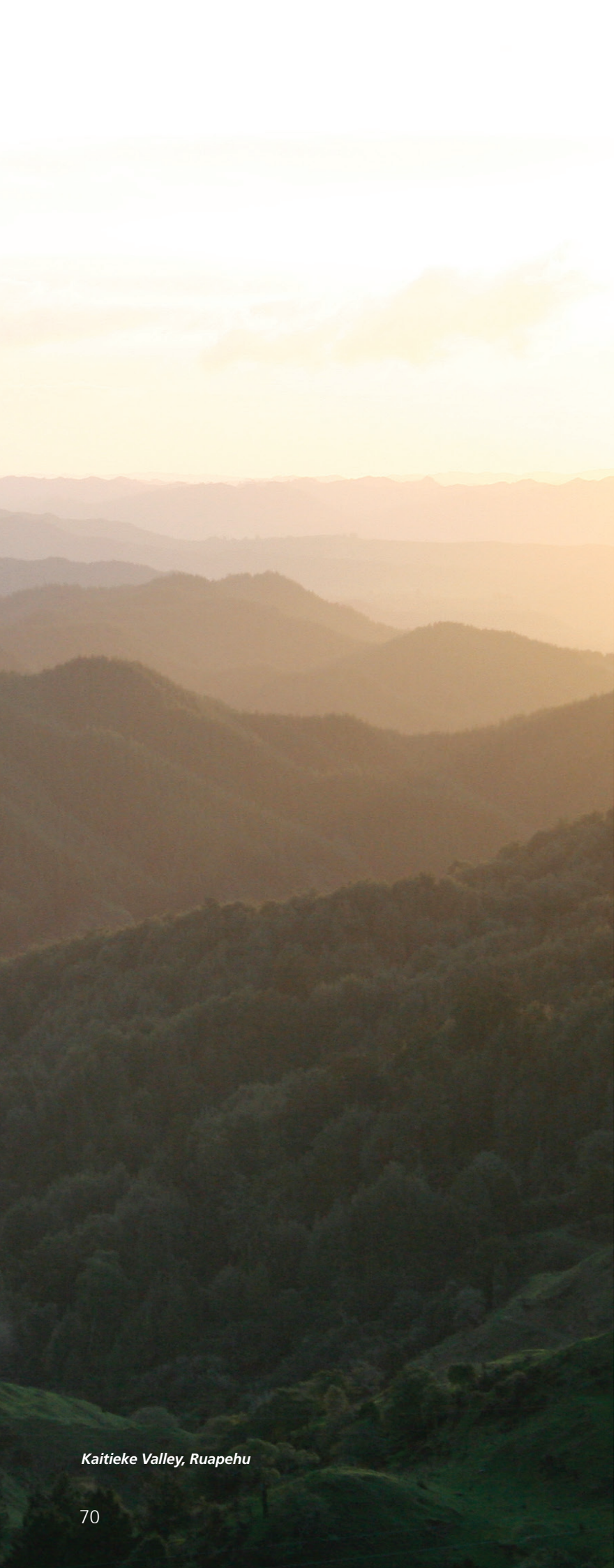
Kia Wharite

Many of us take for granted the unique landscape and wildlife that characterise New Zealand. However, organisations like DoC and Horizons Regional Council know first hand the challenges involved in maintaining the balance required for our native flora and fauna to flourish.

The Kia Wharite project, established in 2008, aims to restore this balance across 180,000 ha of DOC-managed (public) and private land including parts of the Whanganui National Park, the second largest lowland forest in the North Island. This remote area is home to the largest population of North Island brown kiwi as well as many other native plant and animal species.

The Kia Wharite project had a number of lofty aims and, five years in, we are well on our way to success:

- Kiwi call monitoring shows we've reversed the annual 3-5% decline of North Island brown kiwi and indicate we are achieving our target of a 10% increase every three years. There is a time lag between when young kiwi are born and when they start calling. However, initial data shows a 32% increase in call rates between 2010 and 2012 in the Mangapurua area. This is backed up by anecdotal evidence, with visitors to the Park reporting being kept awake by kiwi calls. We await the May 2013 data and are confident it will confirm the increase.
- A trapping network now spans over 50 km along the Manganui-o-te-Ao and Retaruke Rivers and protects 50 pairs of native whio (blue duck). Juveniles known to have successfully fledged range from 34 to 64 per year based on official surveying. Variation is largely due to environmental factors such as the Erua slip impacting upon the river and the whio's food source.



Kaitieke Valley, Ruapehu

- Goat control has increased from 20,000 ha to 35,000 ha per year to enhance forest health. This is in addition to DOC's three-yearly aerial applications of 1080 over 60,000 ha of Whanganui National Park to control possums, ferrets, rats and stoats.
- Relationships between Horizons, DoC, iwi and local communities have been strengthened. This was recognised through the IPANZ Russell McVeagh Award for Working Together for Better Services in 2011 and the project's inclusion as a case study on public sector innovation on the Department of Prime Minister and Cabinet website. It was also highlighted in the Office of the Auditor General's report into prioritising and partnering to manage biodiversity in 2012.
- Working with landowners has been a key driver for Horizons' involvement. We have 30 SLUI farms (see Productive Land chapter) within the project area and work with landowners around managing the whio predator trapping network as well as stream, bush remnant and wetland fencing and planting projects.
- The project also aims to promote economic growth which has been achieved by working with communities to share knowledge and experience to help with meeting project goals.
- Tourism development is also enhanced with opportunities to experience the benefits of Kia Wharite through the Whanganui (river) Journey and the recently developed Mountains to Sea cycle trail and Te Araroa walkway. Local landowners are increasingly offering accommodation and eco-tourism opportunities linked to the project.

GRAVEL
WEIGHING AS MUCH AS
THREE THOUSAND
AFRICAN
ELEPHANTS
MOVES UNDER THE
FITZHERBERT
BRIDGE IN PALMERSTON NORTH
every year

HORIZONS
MAINTAINS 480km
OF
STOP BANKS
IF THIS WERE
LAID OUT IN A
STRAIGHT
LINE

...IT WOULD
STRETCH
FROM WELLINGTON TO
AUCKLAND

WOOD & COAL
FIRES
ARE THE MAIN CAUSE OF
AIR POLLUTION
IN OUR REGION

1 PM10
PARTICLE
IS 1/5 THE DIAMETER
OF A
HUMAN HAIR

NEW ZEALAND
EXPERIENCES A
TSUNAMI
GREATER THAN 1M
IN HEIGHT AROUND EVERY
10 YEARS

WILDFIRE
RISK IS
GREATEST
ALONG THE COAST

IF THE EARTH BEGINS
TO SHAKE
DROP
COVER
HOLD

ALMOST HALF
OF ALL CALLS MADE TO
HORIZONS'
POLLUTION
HOTLINE
ARE DUE TO
SMOKEY FIRES

GRAVEL EXTRACTION IS OFTEN LIMITED DURING
NESTING SEASON or WHITEBAIT
AND TROUT SPAWNING SEASONS
TO PROTECT POPULATIONS AND HABITATS

THINGS TO INCLUDE IN YOUR
EMERGENCY KIT

Healthy communities

Hazard Management

In a Region carved by rivers, shaped by hills and flanked by sea, it's not just about the impact we have on our natural environment; we also need to prepare for what Mother Nature sends our way.

By increasing our knowledge and understanding of the hazards facing our Region we are better prepared to plan for all eventualities, mitigate risks where possible and ensure our communities can get ready to get through.

Horizons plays a key role in leading the Region's response to emergencies and the coordination of emergency planning. We are the Region's flood authority but we also provide an overview of other hazards that could affect our Region such as earthquakes or tsunamis.

As the regional council, we set the strategic direction for natural hazard management. District and city councils give effect to this through policy development and in their district plans which set rules for what people can and can't do with their land.

Hazards often don't abide by lines on a map, making collaboration essential to effective emergency management. Horizons is an active member of the Manawatu-Wanganui Civil Defence Emergency Management Group (CDEM) which combines local councils, emergency services, health boards and other organisations involved in emergency management as part of a coordinated and consistent approach to readiness and response.

Key issues

In 2009, a hazard assessment was carried out to inform our CDEM Group Plan. This assessment helped identify a number of significant hazards in our Region and their potential impact. It also helped identify areas in need of further research.

Hazards we face as a Region:

- River flooding;
- Human pandemic;
- Landslide – widespread hill country;
- Earthquake;
- Electricity failure;
- Wildfire;
- Volcanic activity – Ruapehu;
- Hazardous substance spill;
- Tsunami;
- Coastal erosion/flooding;
- Animal epidemic;
- Severe wind;
- Drought;
- Telecommunications failure; and
- Landslide – Manawatu Gorge.

Horizons is involved in a range of hazard research including investigations into landslide hazards, tsunami evacuation zones, storm surges, coastal erosion and inundation hazards. However, our primary focus for the past several years has been around flood mapping and advice following on from the floods of 2004 which affected 70% of the Horizons Region.

Flood plain mapping projects have been undertaken on all major flood plains in the Region including the Taonui Basin and Whanganui. This research has gone on to inform district plans and emergency management plans to mitigate risks and protect the community.

> “Horizons is involved in a range of hazard research including investigations into landslide hazards, tsunami evacuation zones, storm surges, coastal erosion and inundation hazards.”

Hazard management at a glance

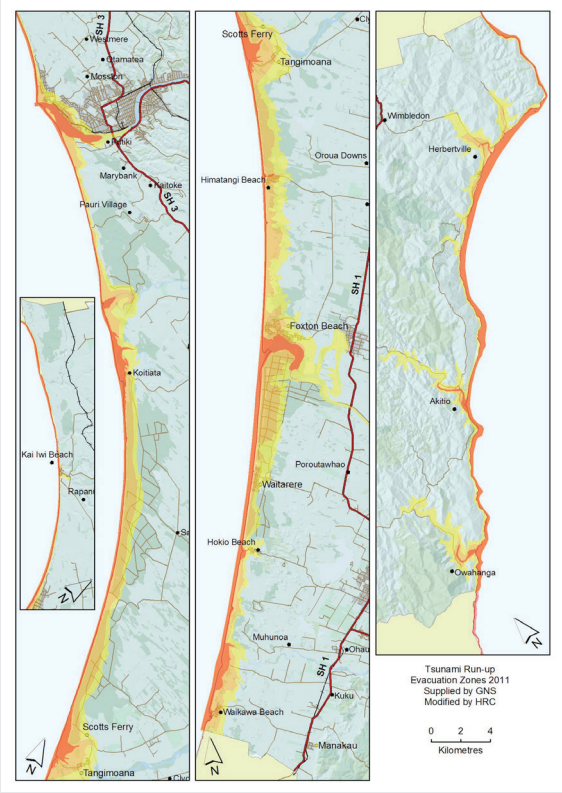
- A hazard survey in 2009 identified the hazards we face as a Region and their potential effects
- Community response plans have been developed for the coastal communities of Tangimoana, Himatangi, Scott’s Ferry, Herbertville and Akitio to provide information about key contacts and safe zones in a tsunami event
- Collaboration is key to effective hazard management as hazards aren’t confined by lines on a map

Setting up a temporary flood barrier at Q West Boat Builders in Wanganui

Spotlight on Tsunami

As a nation surrounded by coast astride a plate boundary, New Zealand experiences a tsunami greater than one metre in height around every 10 years on average. Smaller tsunami occur more frequently and tsunami run-up evacuation zones shown in Map 22 indicate which areas of our coast are likely to require evacuation for different tsunami heights. These zones were determined by modelling carried out by GNS Science and form the basis of our Region's Tsunami Strategy, developed in 2011.

The red zone is simply the topographic map coastline and is usually evacuated in response to a wave height threat level of 0.2-1 m when there's a perceived threat to beach, harbours, estuaries and small boats. The orange zone comes into play when the wave height threat level is 3-5 m arriving on or below high tide. At this point, there is considered to be a moderate land threat and both the red and orange zones should be evacuated. The yellow zone is the worst case scenario. In the case that the official warning is larger than the moderate land threat level or in the case of a natural or informal warning where wave height is unknown, all zones including the yellow zone should be evacuated.



Map 22: *Tsunami run-up evacuation zones*

The nature of the response to tsunami varies by community and expected wave height. For example, a tsunami sourced in the South-West Pacific or Tasman Sea may force the evacuation of all west coast communities such as Foxton Beach, Himatangi and Tangimoana while the threat to Akitio and Herbertville on the east coast requires only a precautionary clearing of the beaches.

Since developing the Tsunami Strategy, emergency management staff from Horizons and local councils have met with affected communities in Tangimoana, Himatangi, Scott's Ferry, Herbertville and Akitio to discuss the tsunami risk and facilitate the development of community response plans which identify key contacts and safe zones among other important information. If you live in a coastal area and would like to obtain a copy of your community response plan get in touch with your city or district council.

What to do in a tsunami

If you live in or visit a coastal area, know where the nearest high ground is and how you will reach it. Think about how you will get as high up or as far inland as you can.

If a tsunami threat is present, listen to your local radio station for Civil Defence advice and never go to shore to watch for a wave. Stay well away from at-risk areas until the official all clear is given.

> "Think about how you will get as high up or as far inland as you can."

Spotlight on the Whanganui River

The Whanganui River is well known for its ability to carry large floods that can threaten residents along the lower river reaches. Horizons is the Region's river flooding authority and in recent years our council has taken the lead in mitigating risks from river flooding in Wanganui. The first part of our Whanganui project was to identify the location and extent of risks. This involved modelling flood levels for a 0.5% or 1 in 200 year flood event.

Since 2007, Horizons and Wanganui District Council staff have been working together to develop a joint flood action plan which clearly identifies the triggers and actions for each council. Our triggers are based on the height of the Whanganui River at the Pipiriki river height gauge.

At the same time as coordinated emergency response planning began, work also started on the first stage of flood protection – actually building a stop bank. This was carried out in the lower reach of the river to protect the Balgownie area. In a couple of areas, it was necessary to use something other than a permanent structure to allow river access.

Horizons has a team trained to set up a moveable steel flood barrier at Q West Boat Builders that cuts across the slipway. The team will be called into action when river levels reach 13 metres at Pipiriki and work for two to three hours to erect the barrier at Q-West and another at the Wanganui Sailing Club as a precautionary measure before floodwaters flow downriver.

Following the completion of these works, the Wanganui community was consulted about a proposed Stage 2 of the flood protection works to increase the level of flood protection for the Kowhai Park/Anzac Parade and Putiki flooding compartments. The message from the community was that flood protection was not something they can afford at the moment. As a result, the project has been put on hold but the emergency response plans remain in place.

Spotlight on the Manawatu River

Over the years the Manawatu River has carried large floods that threatened the property and livelihoods of those within the catchment. Horizons' Lower Manawatu Scheme (LMS) aims to mitigate flood risk by providing flood protection for 320 km² of pastoral, horticultural and urban land stretching between Ashhurst and the sea, enhancing the economic viability of the wider Manawatu and Palmerston North area.

As a whole the LMS includes a 100 km reach of the Manawatu River plus many tributaries, with more than 250 km of stop banks bordering its length. In rural areas the LMS is designed to contain a 100-year flood, which has a 1% chance of happening in any given year. The Moutoa sluice gates and floodway located between Foxton and Shannon play a vital role in this scheme as they divert flood flows past 30 km of slow-flowing, winding river channel that could never carry enough water.

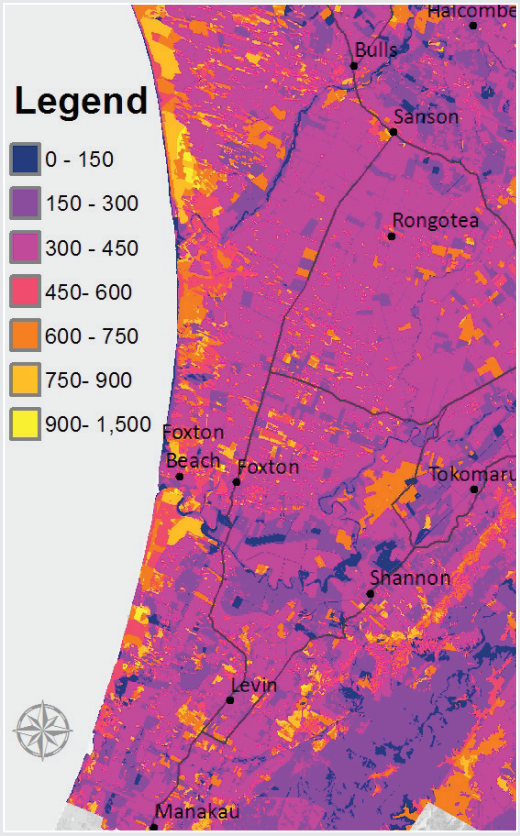
Palmerston North City has a higher standard of flood protection than the rural areas as without it between 2,800 and 5,300 homes would receive substantial damage in a large flood. Its stop banks are designed to protect Palmerston North from a 1 in 500 year flood. Upgrading of Palmerston North's flood protection has been ongoing since 2007 and is almost complete.

Horizons provides world class river height forecasting on many of the Region's rivers. This information is available to view online at www.horizons.govt.nz

Tararua coastline

Spotlight on wildfire threat analysis

A wildfire threat analysis is a systematic method of identifying the level of threat a particular area faces from wildfire. The level of threat is generally related to a combination of ignition potential, potential fire behaviour and the values threatened. These factors may themselves be derived from other combinations of factors, for instance, potential fire behaviour can be determined from a combination of climate, topography and fuels.



Map 23: *Wildfire threat along the Region's west coast*

Horizons has undertaken an assessment of the wildfire threat as part of our contract for service for rural fire fighting. Map 23 shows areas of low risk (dark blue) through to high risk (yellow). This information helps to plan for fire response. Notice how the coastal strip is at higher risk than much of the farm land? This is due to the free draining nature of the sand country and values at risk (e.g. large-scale forestry

blocks). A permanent restricted fire season is in place in the 3 km coastal margin as a result of the increased risk. For more information see the Horizons website.

What is Horizons doing?

Our next steps involve consolidating research commissioned to date to identify gaps in our knowledge. Recent events such as the Christchurch earthquakes have shown us just how important it is to keep refining our knowledge of hazards and the risks to our communities.

As our flood plain mapping projects draw to a close, further research on hazards such as earthquake folding and faulting, liquefaction and ground shaking will likely be commissioned as joint projects with the CDEM group and partner councils.

Let's not forget that we live in a very active part of the world and while we can take reasonable steps to mitigate the risk, there will always be a residual risk that we will need to plan for together. Horizons' role in civil defence emergency management is central to managing that residual risk.

> "We live in a very active part of the world and while we can take reasonable steps to mitigate the risk, there will always be a residual risk that we will need to plan for together."

What can you do?

Natural disasters can strike at any time but there are steps you can take today to help you and your family get ready to get through:

- Learn about the disasters that could affect you or your property.
- Create and practice a household emergency plan. Remember, a disaster may affect essential services and restrict your ability to travel or communicate with family and friends.
- Assemble and maintain emergency survival items. Remember, you could be on your own for three or more days so plan to be able to look after yourself and your household. Emergency survival items include:
  - Torch with spare batteries or a self-charging torch.
  - Radio with spare batteries.
  - Wind and waterproof clothing, sun hats and strong outdoor shoes.
  - First aid kit and essential medicines.
  - Blankets or sleeping bags.
  - Pet supplies.
  - Toilet paper and large rubbish bags.
  - Face and dust masks.
  - Non-perishable food and water for at least three days.
- Have a get-away kit in case you have to leave in a hurry.

For more information on how you can get prepared for an emergency visit www.getthru.govt.nz

Air Quality

There is little more important than the air we breathe and the quality of this air can have a huge impact on our health and surroundings.

Horizons is responsible for monitoring air quality and working with communities to achieve National Environmental Standards.

Air quality in our Region is pretty good when compared to the national picture. However, in some of our townships, wood burners used for home heating in winter combined with the local topography can create air quality issues, particularly on cold, still nights.

Key issues

High winds, low population densities, low transport movement and a lack of polluting industries all benefit air quality in our Region. While air quality is generally pretty good, there are a couple of key issues to consider:

- Pollution – particularly from domestic wood and coal fires; and
- The impact of air quality on human health.

Pressures on air quality

Air quality is influenced by a number of natural and man-made factors including sea salt, pollen, dust, volcanic activity, home heating, outdoor fires and emissions from vehicles and factories. Local weather patterns and topography also play an important role in determining the quality of air we breathe and in this Region we enjoy a relatively high standard of air quality.

Despite this, we need to make sure we effectively manage common localised pressures such as spraying, burnoff, odours and smokey fires to reduce any potential health effects caused by fine particles in the air.

While transport continues to contribute to the state of air quality in our Region, domestic wood and coal fires used for home heating are of greatest concern, particularly during the winter months. These produce high concentrations of particulate matter (PM) which is easily inhaled into the lungs.

Taihape and Taumarunui have been identified as areas where air quality could breach national air quality standards and are known as "gazetted airsheds". This is largely due to their location and the effects of home heating in winter. However, air quality issues in these towns are relatively small when compared to other parts of New Zealand.

Air quality in Ohakune, Feilding, Dannevirke and Pahiatua is also classified as degraded and these towns are on Horizons' watchlist for air quality issues.

> "Ambient air quality is influenced by both natural factors and by the activities of humans."

Air quality at a glance

- Monitoring across the Region has identified Taihape and Taumarunui as the two areas most at risk of exceeding national guidelines for air quality.
- Neither Taihape nor Taumarunui feature when compared to the 27 worst air quality sites in New Zealand.
- Domestic wood and coal fires are the main source of air pollution in our Region.
- There are 161 current discharge to air permits in our Region covering a range of activities from crematoriums to wind farms.
- Smokey fires are the most frequent complaint to our pollution hotline.

Taumarunui township 2006

Beta Attenuating Monitoring (BAM) instruments installed in Taumarunui

What we monitor

Monitoring carried out at 12 towns between 2001 and 2003 identified Taihape and Taumarunui as having the worst air quality in our Region. These two sites are referred to as "gazetted airsheds" and are at risk of exceeding national guidelines for pollution particles known as PM_{10}.

We continuously monitor PM_{10} concentrations in these two locations using Beta Attentuating Monitoring (BAM) instruments, which are checked and calibrated each autumn in preparation for the winter months when the risk to air quality is greatest.

> "The effects of poor air quality are predominantly respiratory (lung) and cardiovascular (heart)."

Spotlight on air pollution

There are many potential pollutants that contribute to poor air quality including fine particles, oxides of nitrogen, carbon monoxide, sulphur dioxide, ozone and numerous hazardous hydrocarbons and metal compounds. National guidelines on air quality require the measurement of PM_{10}.

WHAT IS PM_{10}?

A PM_{10} particle is less than 10 micrometres (10µm) in size, or one fifth of the diameter of a human hair. PM_{10} pollution includes

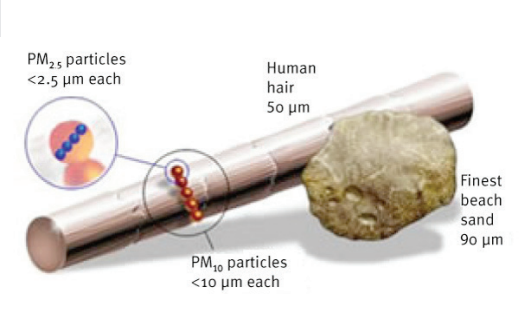
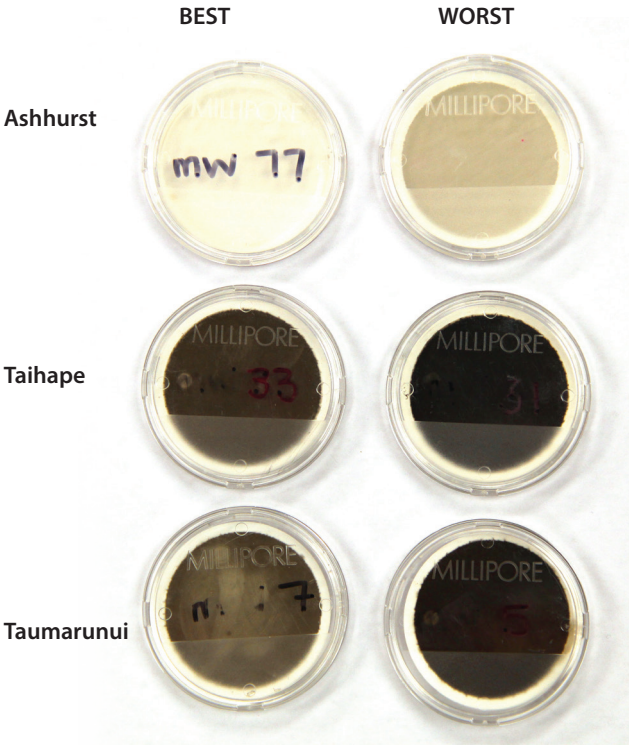


Figure 18: *Comparative size of particulate matter. Diagram courtesy of MfE.*

particles referred to as coarse (between 2.5 and 10µm) and fine (less than 2.5µm, also known as PM2.5).

Coarse particles tend to settle to the ground within a few hours of being emitted but finer particles can remain in the air for weeks. Figure 18 shows the size of these coarse and fine particles (PM10 and PM2.5) compared to a strand of hair and a grain of beach sand. They are tiny – some too small for the human eye to see!



Filters from air quality monitoring showing best and worst results after seven days of monitoring for Ashhurst, Taihape, and Taumarunui in 2001.

Spotlight on human health

In most places in New Zealand, PM10 concentrations are highest over the winter months due to wood and coal fires used for home heating. There's substantial evidence that breathing particulate matter (PM) is harmful to human health, particularly smaller fractions such as PM10, PM2.5 and even finer particles.

The effects of poor air quality are predominantly respiratory (lung) and cardiovascular (heart). Impacts range from reduced lung function and symptoms that impact a person's ability to carry out activities to those resulting in hospital admissions, reduced life expectancy and, in extreme cases, death.

Modelling estimates around123 premature deaths per year can be attributed to PM10 exposure in the Horizons Region. The majority occur within the populations of Palmerston North (41) and Wanganui (27), followed by Levin (11) and Feilding (10). Estimates for the Region's two gazetted airsheds were lower at six for Taumarunui and less than one for Taihape due to smaller populations and, in the case of Taihape, a lower incidence of mortality between 2005 and 2007. The 2012 Health and Air Pollution New Zealand study estimates that human-produced PM10 pollution is responsible for around 1,170 premature deaths in New Zealand each year.

Due to the impact of degraded air quality on human health, the Health Act 1956 also gives city and district councils and health boards some responsibilities for dust, smoke and odour. We are committed to working in partnership with these authorities on issues of air quality in our Region.

How does our Region stack up?

A national perspective

While the air quality of Taihape and Taumarunui is clearly compromised during the winter months, when compared to data for the 27 towns with the poorest air quality in New Zealand, neither of these places would feature on the graph below (Figure 19).

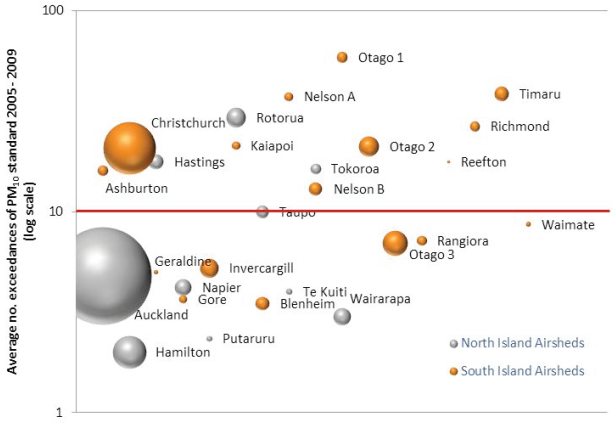


Figure 19: *Air quality in non-complying airsheds around New Zealand, 2005-2009 (from MfE's Clean Healthy Air for all New Zealanders (August 2011)*

What do the National Standards say?

The National Environmental Standards for air quality (NES) came into effect in October 2004 and were amended in 2011. These standards are regulations made under the Resource Management Act (1991) which set a guaranteed minimum level of health protection for all New Zealanders.

The NES is made up of 14 separate but interlinked standards which include:

- Seven standards banning activities that discharge significant quantities of dioxins and toxins into the air;
- Five standards for ambient (outdoor) air quality;
- A design standard for new wood burners installed in urban areas; and
- A requirement for landfills over one million tonnes of refuse to collect greenhouse gas emissions.

Regional Councils and unitary authorities are responsible for managing air quality under the Resource Management Act (1991). They are required to identify areas where air quality is likely, or known, to exceed the standards. These areas are known as airsheds.

The NES sets a compliance standard of no more than one exceedance of the of the 50µm/m3 PM10 concentration (averaged over a 24 hour period). For more on the NES see the Ministry for the Environment website www.mfe.govt.nz

A regional perspective

An analysis of the PM_{10} data collected in Taihape and Taumarunui shows that winter air quality in these towns is degraded by emissions from wood burners (providing about 83% of the PM_{10} recorded). PM_{10} levels sometimes come close to the National Environmental Standard (NES) level of protection of 50 (µg/m³) (Figures 20 & 21). However, both sites continue to comply with the National Environmental Standard by not exceeding the 50µg/m³ threshold on more than one occasion per year.

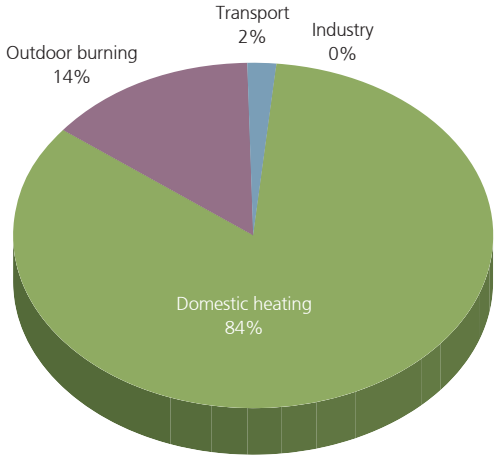


Figure 20: *Relative contribution of fine particles by source - Taumarunui*

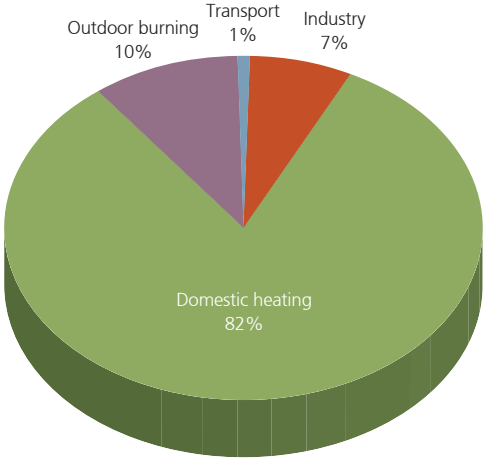


Figure 21: *Relative contribution of fine particles by source - Taihape*

Changes over time

Taihape, for which we have five full years of monitoring data, has only exceeded the 50µg/m³ standard on one occasion (July 2011). However, it has had several days with concentrations in the 'alert' zone (concentration above 33µg/m³).

The Taumarunui monitoring site has been operating since August 2009. The NES 50µg/m³ alert level has been exceeded at this site three times – once in each year of monitoring record.

Figures 22 and 23 show the monitoring results for the Taihape and Taumarunui sites as number of times each NES alert level was exceeded.

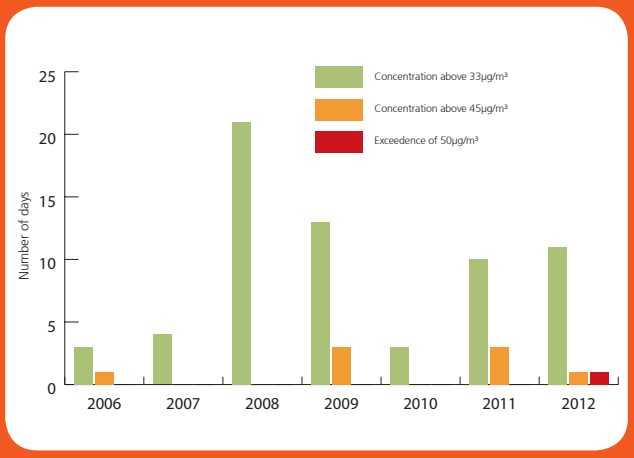


Figure 22: *Number of days that average concentration of PM_{10} has exceeded each NES alert at Taihape*

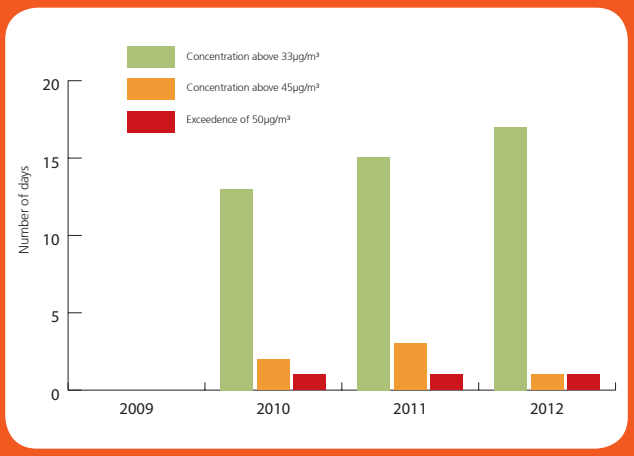


Figure 23: *Number of days that average concentration of PM_{10} has exceeded each NES alert at Taumarunui*

Smoke signals

Almost half of the 423 calls made to Horizons' Pollution Hotline in 2012 related to air quality. 31% of these calls were about smokey fires and included concerns around odour, ambient air quality and fumes.

In the first instance, we advise callers to talk to the person responsible for the fire. However, if they don't feel comfortable doing this, our Environmental Protection Officers are happy to give the person a call and remind them that smoke, odour and dust discharges must not result in objectionable or offensive effects beyond their property boundary.

Once people are aware of the effect their fire is having on others, they tend to take steps to remedy it. Very few incidents require further compliance action.

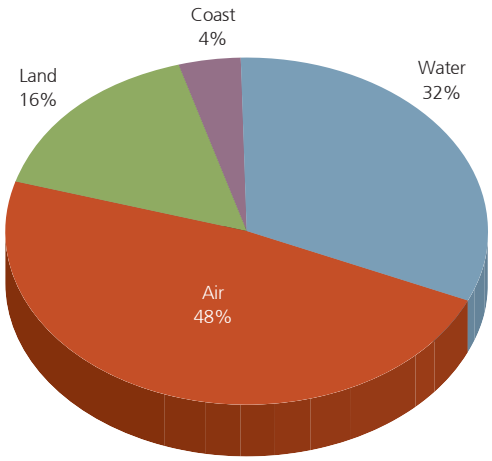


Figure 24: *Proportion of calls to Pollution Hotline by topic*

Up-to-date monitoring data and further information is available on the AirQualityMatters section of our website www.horizons.govt.nz

What is Horizons doing?

Horizons' focus for air quality is two-fold:

- Protecting air quality where it is already good.
- Improving air quality in areas where it is not so good.

We are achieving National Environmental Standards and regional standards for ambient air quality through the One Plan policy framework.

On-going monitoring in Taihape and Taumarunui helps track how air quality in these towns compares to National Environmental Standards. As a result, our efforts are focused on educating communities about the health risks posed by human activities.

Our Pollution Hotline also responds to complaints around air quality issues twenty-four hours a day.

> "Our efforts are focused on educating communities about the health risks posed by human activities."

What can you do?

There are some simple things that communities can do to help decrease the impact of their fires on their local air quality:

- Make sure your home is well insulated to help keep the heat in.
- Consider installing a NES compliant woodburner.
- Burn dry firewood – not only does dry fire wood burn more cleanly, smoking less and therefore emitting fewer fine particles into the air than green or 'wet' wood, it also burns more efficiently, heating your home better.
- Buy your firewood early – buying green or wet wood in the summer time and storing it in a dry ventilated place, preferably for a year or more, will ensure you have dry wood to burn when you need it. This might also cost you less as green wood is often cheaper than dry.
- Don't burn treated wood, household waste or food scraps indoors or out – these can give off toxic substances.
- Have your chimney swept every year.

Check out Horizons' information pamphlet "Help your fire quit smoking" for more info and helpful tips.

Tararua

Gravel Use & Channel Management

Rivers provide freshwater for our economy, enjoyment and aesthetic pleasure, but they also provide us with another valuable resource - gravel.

Many of our Region's rivers and streams have stoney bottoms that provide a home for fish and insects and a significant supply of gravel, conveniently deposited for us to collect and use for roading and construction. Our Region actually contains some of the best gravel for roading and rail ballast in the country.

A river's character is intricately linked with the land through which it flows and its flow regime. The grade of a river combined with the geology of its headwaters and catchment influences the types and size of sediment it carries as it naturally erodes its banks and channel. The size, duration and velocity of river flows determine how far sediment is carried and where it is deposited.

We work to monitor the volume and movement of gravel within the Region's rivers, to ensure it can be used for roading, construction and other purposes without upsetting the natural balance or compromising flood protection.

Key issues

The key issue for gravel use and channel management in our Region is:

- Effective management of gravel extraction.

We need to ensure the extraction of gravel is managed to the benefit of our local economy and flood protection schemes while balancing the effects of this extraction on our natural environment.

Pressures on gravel use and channel management

There's a long history of gravel extraction in our Region. Demand for good quality gravel and aggregate for roading, rail and construction is high. There's also a desire to source gravel near to where it will be used to keep transport costs at a minimum.

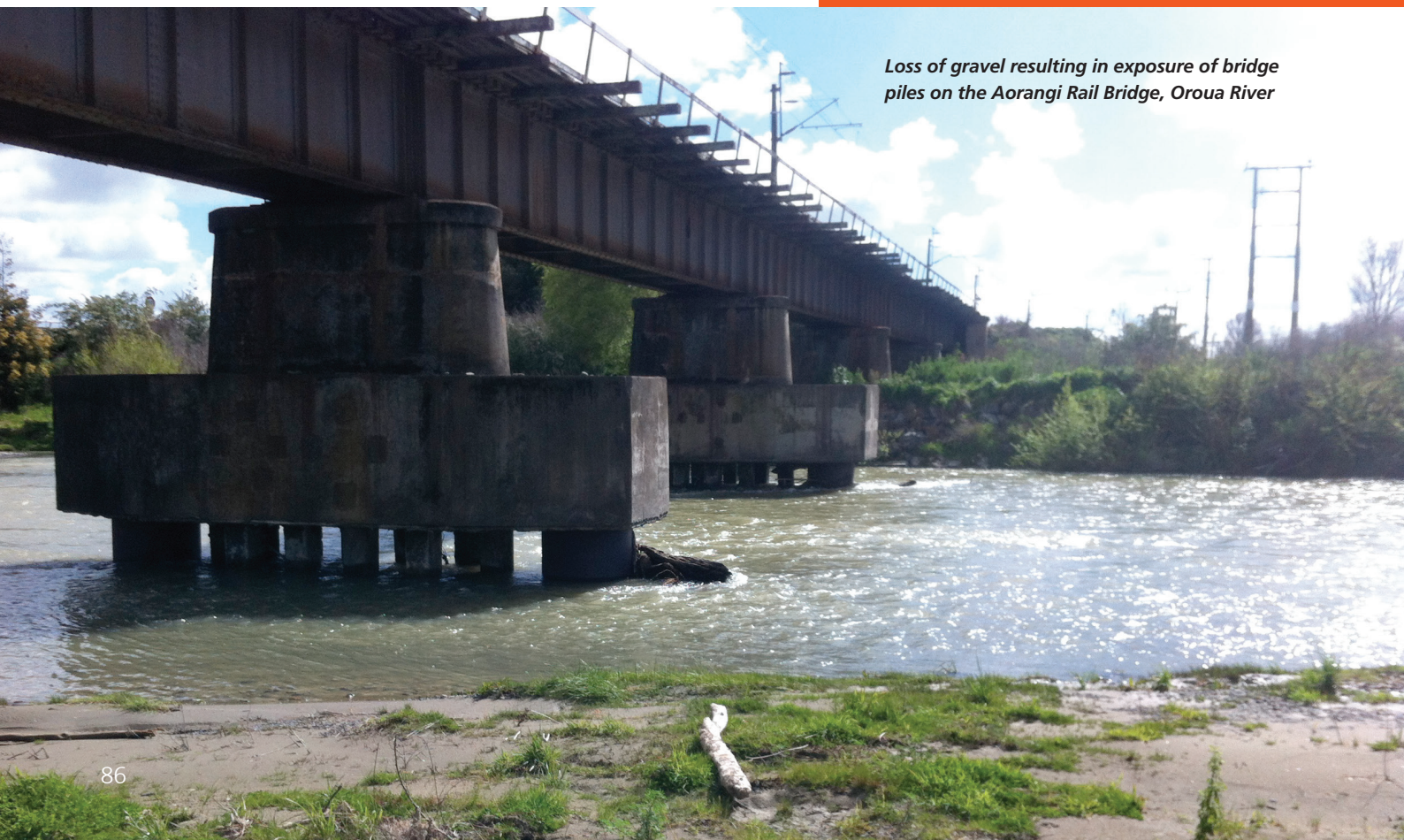
In recent years, there's been a move towards taking gravel from river banks and flood plains rather than the wetted area of the river to reduce the effects of taking gravel on the insects and fish that call our rivers home. However, there is still a need to take gravel from stream and river beds at times when gravel build-up is affecting flood protection.

This is the case in many of our larger rivers where we see significant deposits of gravel on the river banks. These tend to be upstream of narrow parts in the river and on the inside of river bends where there is insufficient energy to move the gravel through. Large floods can transport huge amounts of gravel through a river system, sometimes removing or depositing gravel where it can adversely affect bridges and flood protection works.

Gravel extraction and flood protection works can impact the natural character of a river. If uncontrolled, these works can speed up the erosion process. These adverse effects are mitigated through our consenting process and comprehensive code of practice for river works.

Gravel at a glance

- Approximately 6,000 m³ of gravel moves under Fitzherbert Bridge in Palmerston North every year. That's equivalent to the weight of 3,000 African elephants.
- Horizons maintains 480 km of stop banking in the Region. If this were laid out in a straight line it would stretch from Wellington to Auckland.
- Horizons manages 53 dams for flood protection – more than any other organisation in New Zealand.
- Horizons has developed a comprehensive code of practice for river works including gravel extraction. This helps mitigate the effects on fish, insects and nesting birds.
- The One Plan has improved policies around gravel extraction and set limits to manage rivers under pressure.



Loss of gravel resulting in exposure of bridge piles on the Aorangi Rail Bridge, Oroua River

What we monitor

We measure the amount of gravel extracted for use and changes in the amount of gravel in the Region's rivers and their banks through cross-section surveys. Under this surveying programme the channel profile is measured at predetermined points and results are compared to previous surveys.

River cross-sections have been undertaken for several decades in all our major rivers, including the Manawatu, Rangitikei and Whanganui, through to smaller streams in the South-east Ruahines.

Since our last State of Environment report we've implemented a more structured approach to surveying. There are currently 46 river reaches (areas) included in our survey programme and surveying is carried out every five or ten years. The timing and frequency of surveying is based on several factors including:

- Rate of gravel transport in the river – this may increase following a large destabilising flood and is generally greater in steeper rivers.
- Extraction pressures upon a river or particular reach of that river.
- The time lapsed since the previous full survey.
- Whether a river is experiencing obvious channel degradation or aggradation – the survey is required to address remedial measures and policies.

These surveys let us know about changes in river shape and gravel supply over time which inform policy review, consents for gravel extraction and design of flood protection works. Four areas were surveyed in 2012. The cross-sections covered a total of 21 km. In the 2013-14 financial year, we're intending to survey a further 13 river reaches. This includes two reaches of the Manawatu River.

> "Surveys let us know about changes in river shape and gravel supply over time which inform policy review, consents for gravel extraction and design of flood protection works."

Spotlight on extracting gravel

The One Plan sets out the amount of gravel that can be taken from rivers and river reaches around our Region. These limits are known as long-term annual allocable volumes and range from around 500 m³/year to as much as 100,000 m³/year, depending on the size of a river reach, rates of gravel replenishment, and river management requirements.

Some rivers have no set allocable volume. Gravel extraction from these rivers is managed in relation to potential site-specific effects, natural rates of gravel replenishment and risks to flood management infrastructure.

People wanting to extract large volumes of gravel are required to apply for resource consent. If granted, this consent will state how much gravel can be taken from a specific area by that consent holder per year. It may also include conditions around when gravel can be taken to ensure nesting birds and in-stream communities are not disturbed.

Small amounts of gravel (up to 50 m³/year) can be taken without resource consent, providing certain rules are adhered to as set out in the One Plan.

Consent holders are required to provide Horizons with a monthly record of the amount of gravel taken. This lets us know who is exercising their consents, where gravel is being taken from and how much a consent holder is taking in relation to their consented volume.

A Regional perspective

72 resource consents have been granted for gravel extraction from rivers across the Region.

The greatest proportion of gravel allocation is in the Manawatu catchment (58%) followed by the Rangitikei catchment (31%) as seen in Figure 25. Map 24 shows the location of consents in our Region.

Gravel at Higgins' quarry near Bulls

Protecting native habitats

Habitats in the riparian margin along the river's edge are special. Some provide critical nesting areas for native birds. These areas have been recognised as Sites of Significance – Riparian (SOS-R) in Horizons' One Plan. Birds found in these Sites of Significance – Riparian include the wrybill, royal spoonbill, banded dotterel, black-fronted dotterel, nankeen night heron.

Disturbing gravel in these areas at certain times of year can destroy the nests of birds such as dotterels whose cleverly camouflaged eggs resemble the surrounding substrate and are difficult to see. Horizons seeks to avoid the impacts of riverside activities by including conditions in resource consents that specify what times of the year the activity can take place.

Dotterel eggs in the riparian margin.

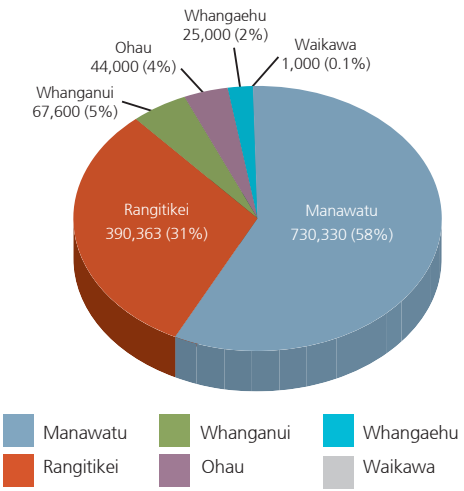
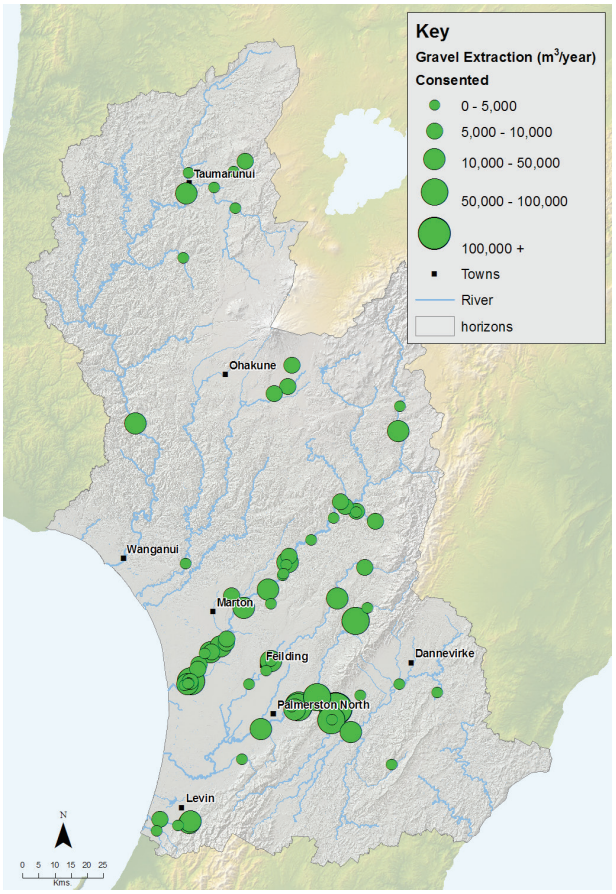


Figure 25: *Proportion of total gravel allocation by catchment*



Map 24: *The maximum annual consented volumes for each gravel extraction consent in the Horizons Region (m³/year)*

In the year 2011-2012, a total of 1,258,293 m³ was allocated for extraction across 72 resource consents. However, the total volume extracted was considerably less, particularly in the Rangitikei, Whanganui and Whangaehu catchments, at just 442,013 m³ as seen in Figure 26.

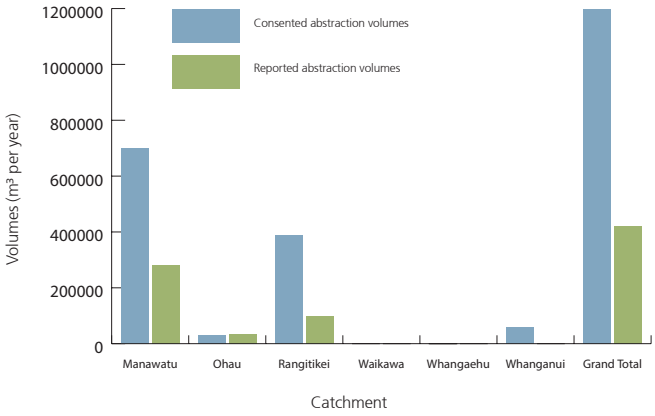


Figure 26: *Comparison of consented annual gravel extraction volumes and actual annual extraction in each catchment between July 2011 and June 2012*

The One Plan sets out total annual allocable volumes for some rivers and river reaches in our Region. This includes seven reaches of the Manawatu River. As can be seen in Table 14, the extracted volume for 2011-12 fell within volumes set out in the One Plan.

Reach of the Manawatu River (as designated in the One Plan)	Allocable Volume (m³/yr)	Current Consented Volume (m³/yr)	Extracted Volume in 2011-12 (m³/yr)
From 1 km upstream of Ngawapurua Bridge to source	20,000	40,000	10,950
1 km upstream to 2.5 km downstream of Ngawapurua Bridge	no extraction	0	0
2.5 km downstream of Ngawapurua Bridge to Ballance Bridge	15,000	20,800	0
Manawatu Gorge to Karere Rd	2,500	2,500	0
Karere Rd to Hamilton's Line	15,000	15,000	9,963
Hamilton's Line to Oroua confluence [2009 onwards] the 2 km aggrading reach between 39 Miles (NZMS 260 S24:212-832) and Benchmark 643 (NZMS 260 S24:226-830)	17,500	14,500	0
Hamilton's Line to Oroua confluence [2009 onwards] the 2 km aggrading reach between BM 604 (NZMS 260 S24:206-833) and BM 622 (NZMS 260 S24:207-826)	35,000	35,000	6,500

Table 14: *Reaches of the Manawatu River that have total allocable volumes designated in the One Plan alongside the volumes already consented and the volumes extracted in 2011-12*

Changes over time

Gravel is a valuable resource for roading and construction. Over 4,000 tonnes of gravel is used for every one kilometre of double-lane road. The demand for gravel in our Region has remained steady but we have seen some changes in where this gravel is taken from. Due to the ecological impacts of taking gravel from wet riverbeds, a larger proportion of our Region's total gravel take is now extracted from river banks and flood plains.

Through our surveying programme we noticed a reduction in the volume of gravel in the Manawatu River downstream of the Ashhurst Bridge. As the lowering of the river bed could cause issues for flood protection, we have stopped any further gravel extraction from this reach of the river and redirected gravel extraction to other parts of the river where gravel is building up.

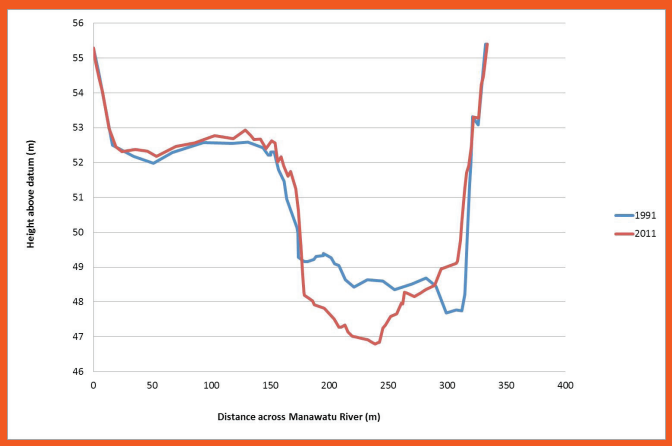


Figure 27: *Cross-sectional view of temporal changes in mean bed level in the Manawatu River, at Ashhurst Bridge*

What is Horizons doing?

We are committed to ensuring the sustainability of this Region's gravel resource and flood protection for the community. We have a number of policies in place to prevent over-extraction and protect native birds, fish and trout.

Perennial weed, field horsetail, has also been identified as an issue for gravel management and we are working alongside gravel extractors to try and find ways to minimise its presence in gravel products. We have alerted territorial authorities about field horsetail's presence in road-forming product and, that to protect clear land, non-horsetail bearing product should be used in horsetail free areas.

We are also supporting investigation into the biological control of horsetail by assisting the Lower Rangitikei Horsetail Control Group's Sustainable Farming Fund project. Information cards have been made available for the general public and users of gravel products, letting them know the products could contain root fragments of field horsetail and providing information about storage and disposal.

“Gravel is a valuable resource for roading and construction. Over 4,000 tonnes of gravel is used for every one kilometre of double-lane road.”

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Glossary

Ruapehu

Abstraction: the act of taking water from a river, stream, lake or groundwater source.

Airshed: a geographical area where air quality could exceed national air quality standards. These areas are identified based on existing air quality data and factors that affect the spread of pollution such as local geography and weather.

Biodiversity (short for biological diversity): The number and variety of living things found in a particular habitat or ecosystem.

Biosecurity: the management of pest plants and pest animals that affect economic, amenity or environmental values.

Bore: a hole that is dug or drilled into the ground for the purposes of abstracting groundwater, monitoring groundwater levels, or monitoring groundwater water quality.

Chlorophyll *a*: a pigment present in most algae and plant species that is crucial for photosynthesis.

Core allocation limit: the total volume of water that may be abstracted from a water body at flows above the minimum flow.

Cyanobacteria: also known as blue-green bacteria, blue-green algae, and cyanophyta, these are bacteria-like organisms that obtain their energy through photosynthesis.

Diatom: a microscopic single-celled marine or freshwater algae.

Erosion: process by which earth and soil is worn away by the action of water, wind, river flow or other physical processes.

***Escherichia coli* (*E.coli*):** a type of faecal bacteria commonly found in the intestines of humans, other warm-blooded mammals and birds, and is normally excreted in their waste.

Freshwater macroinvertebrate: aquatic animals such as insects, worms and snails.

Headwaters: the upper reaches of a river close to or forming part of its source.

Gravel extraction: the act of taking gravel.

Indigenous (biodiversity, ecosystems): the living organisms, habitats, and ecosystems that are naturally found in the Region or in New Zealand.

Introduced (species): living organisms that are not native to New Zealand but were transported here, deliberately or accidentally, by humans.

Macroinvertebrate Community Index (MCI): an index that provides us with information on water quality based on the number and type of macroinvertebrates found at a site. It is calculated by assigning a score to aquatic species depending on their tolerance to organic enrichment.

Median: a statistic that is the middle number in a set of numbers ordered from highest to lowest.

Minimum flow: in relation to surface water allocation, this is the measured flow in the river at which non-essential abstractions must cease.

Naturalised (species): an introduced species that has formed self-sustaining and persistent populations.

Non-point source (diffuse): contaminants that cannot be easily defined as originating from a particular point or activity but are derived from the surrounding landscape. Diffuse contaminants can include run-off from agricultural and urban landscapes and leaching from activities such as agriculture, unlined waste stabilisation ponds and landfills.

One Plan: Horizons Regional Council's proposed combined resource management plan and policy statement for the next 10 years. It sets out policies and rules around the way in which we interact with our natural environment in order to balance the need to use natural resources for economic and social wellbeing while keeping the environment in good health.

Pathogen: a bacterium, virus, or other microorganism that can cause disease.

Periphyton: the collective of diatoms, fungi and algae found on the beds of rivers and streams.

Point-source discharges: discharges that can be attributed to a specific outlet such as a pipe or drain and can be sampled for physical, chemical and biological components.

Resource Management Act: New Zealand's main piece of legislation that sets out how we should manage our environment.

Riparian planting: Planting trees and other plants next to a waterway to reduce nutrient run-off, provide shade for aquatic life and stabilise river or stream banks.

River catchment: all the land from the mountains to the sea that is drained by a single river and its tributaries.

Seawater intrusion: the movement of saline water into coastal freshwater aquifers due to natural processes or human activities.

Significant trend: a trend that is statistically significant (within a 5% margin of error) but with a rate of change less than 1% per year.

Substrate: the surface or material on or from which an organism lives, grows, or obtains its nourishment. E.g. the stones, rocks, gravel, logs and sediment on the river bed that provide a home for fish and insects.

Sustainable Land Use Initiative (SLUI): a mountains to the sea approach to managing erosion on hill country farmland.

Telemetry: an automated means of returning environmental monitoring or water use data to Horizons via the cell-phone network.

Tributary: a stream that flows into a larger stream or body of water.

Unitary authority: A type of local authority that has a single tier and is responsible for both city or district and regional council functions.

Water Management Zone: for the purposes of managing water quality, water quantity and the activities in the beds of rivers and lakes, the river catchments in the Region have been divided Water Management Zones and sub-zones. Groundwater has been divided into Groundwater Management Zones.

Palmerston North

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