Soil Health

Introduction

A baseline soil quality monitoring programme has been running for the past 2 years in the Greater Wellington Region. The monitoring was part of the national "500 Soils" programme run by Landcare Research with assistance from the Ministry for the Environment. A total of 50 sites have been monitored so far.

A pilot study to begin the Soil Intactness monitoring programme was completed from savings made in the Soil Quality monitoring programme during 2000/01.

Soil Quality

The sampling programme began with the most widespread soil in each of the intensively used groups on both the Wairarapa and Otaki plains. Intensive uses included dairying, market gardening, cropping, grazing, orchards, and indigenous bush. The sampling programme has moved onto the less widespread soils such as the Bideford, Martinborough and Tauherenikau soils in the Wairarapa, and the Manawatu and Rahui soils on the Otaki plains.

In 2002/03, the dominant hill country and steepland soils will be sampled. This will complete the initial part of the soil quality monitoring programme.

After this initial three year programme, sites were to be revisited every five years to determine trends and to address any adverse impacts on soil quality from the present uses.

Soil Intactness

In June 2002, Dr Doug Hicks of Ecological Research Associates was contracted to design and trial a soil intactness monitoring programme. Soil intactness expresses whether soils are staying place. A decrease in soil intactness may reduce land's productive capability on-site. Off-site it may create environmental pressures, notably if soil enters waterways.

Specifically the survey indicates what areas of soil are stable, disturbed but inactive, re-vegetating, or eroding. With careful selection of land use categories, additional information can be provided such as the proportion of farmland where soil conservation plantings have been installed, and the extent of erosion on unplanted land.

The pilot survey was carried out on 1:25,000 prints of orthophotos corresponding to NZMS 260 map, sheet T26, which extends from Masterton to Riversdale.

Soil Quality - Results

- The majority of soil quality properties (86%) fell within acceptable ranges.
- The principle issue of concern was compaction (low macroporosity) that occurred on most soils under pasture as well as under cropping land uses.
- High phosphate levels were found on two market gardens and horticulture sites, this is probably the effect of high fertiliser application rates.

- There was a marked loss of aggregate stability (a measure of how easily the soil crumbles) on the market garden soil.
- Appropriate management could reverse the majority of instances of poor quality.

Soil Intactness

The soil intactness results covered by the pilot survey only relate to one NZMS sheet, approximately 46,000 hectares or 5% of the Region. Approximately 15,000 hectares showed signs of instability.

The results of the pilot trial are summarised in the following Table:

Landuse	% of total area surveyed	% assessed as stable	Comments
Intensive uses (vineyards, orchards, grain crops, dairy pasture)	6%	91%	• 79% of land under intensive use has no other vegetation present, apart from cover associated with the principle use. • 21% has secondary vegetation, mainly shelter belts.
Lowland Pasture (improved & unimproved)	33%	60%	• Most of the unstable land is either riverbanks and floodplains or past gully or streambank erosion. • 50% of lowland pasture has no other vegetation present. • 25% has scattered tree or scrub cover. • 25% has extensive tree or scrub cover.
Hill Country Pasture (improved & unimproved)	40%	21%	• 42% of hill country pasture has no other vegetation present. • Most of the unstable land is hillsides which show signs of past mass movement or gulling. The remainder is valley bottoms.
Exotic forest & scrub	14%	23%	• 39% of exotic forest is closed-canopy stands. • another 36% has canopy gaps with scrub, mostly re-growth amongst young pine stands. • 18% has canopy gaps occupied by grass. • 6% has other trees in canopy gaps, some of these are hardwoods planted up gullies or along streambanks for soil conservation, while a few are remnant bush on similar sites.

Indigenous forest & scrub	5%	11%	• 17% of indigenous cover is closed-canopy bush, a further 12% is closed-canopy scrub. • bush and scrub occupy land recognised as being too erosion prone for grazing or forestry.
Other land uses (urban, riverbeds, water bodies)	2%		• 57% is urban land of which 2/3 is built on and 1/3 is grassed or treed open space. • ¾ of riverbeds are bare gravel or water filled channels, the remainder have some form of tree or scrub cover, usually willows. • None of the river beds were assessed as stable.

Where to From Here?

A further 25 sites are currently being assessed for soil quality sampling during November 2002. This will complete the first cut of sampling for the Region. The database will contain information from 75 sites.

In the next two years further sampling is proposed in areas where specific soil quality problems have been identified. This will provide greater certainty about the causes of soil quality problems and enable specific remedial actions to be identified.

Soil intactness monitoring for the entire Region is proposed for 2003/04. A further 19 NZMS 260 sheets are required to be point sampled.

Both sampling programmes are compatible with work currently being undertaken by a number of other regional councils. The work emanates from the Land Monitoring Group which has been working on standardising methodologies across councils in order to meet regional and national responsibilities.

As the monitoring programme develops and its findings are further analysed, the information will help Greater Wellington develop strategies that will maintain and enhance the productive capability of soils for future generations.

Air Quality

Air Quality Indicators and Guidelines

Ambient air quality is the general quality of the air that surrounds us. Ambient air quality reflects the cumulative effects of contaminants discharged to air from all sources, both anthropogenic (from human activities) and natural sources.

The contaminants that are currently being monitored in the Greater Wellington Region are particulate matter (PM_{10}), carbon monoxide (CO), and nitrogen oxides (NOx). These are some of the contaminants identified in the Regional Ambient Air Quality Guidelines contained in the Regional Air Quality Management Plan. Several meteorological parameters are also being monitored, (these are wind speed, wind direction, relative humidity and temperature), as they all have a bearing on air pollutant concentrations.

The Regional Maximum Acceptable Level (MAL) Guidelines (based on national guidelines) are recommended only as minimum standards of air quality to protect public health. The guidelines were developed from World Health Organisation Standards and international epidemiological research.

The Maximum Desirable Levels (MDL) are defined as the level that will provide maximum protection to the environment, (including soil, water, flora, fauna, structures, and amenity values*)*, taking into account existing air quality, community expectations, economic implications, and the purpose and principles of the Resource Management Act 1991. Desirable levels are appropriate guidelines or targets in rural or residential areas, and in other areas where good air quality is considered a priority.

The Ministry for the Environment has recently reviewed the National Guidelines and new air quality guidelines based on recent epidemiological research are now in place. Of particular significance is the new guideline for PM_{10}, which has been reduced to 50 $\mu g/m^3$ and is now at a lower threshold than the Regional MDL. The Regional and National Guidelines are shown in Table 3.1.

Regional and National Air Quality Guidelines

Indicator	Maximum Desirable Level (Regional)	Maximum Acceptable Level (Regional /National)	Averaging Times	Techniques for Measurement
Particulates PM_{10}	*70 µg/m³*	50 µg/m³	24 hours	US 40 CFR Part50
	40 µg/m³	20 µg/m³	Annual	US 40 CFR Part50
$PM_{2.5}$ (interim)		25 µg/m³	24 hours	US 40 CFR Part50
Carbon Monoxide		30 mg/m³	1 hour	AS3580.7.1-1992
	6 mg/m³	10 mg/m³	8 hours	AS3580.7.1-1992
Nitrogen Dioxide	95 µg/m³	200 µg/m³	1 hour	AS3580.5.1-1993
	30 µg/m³	100 µg/m³	24 hours	AS3580.5.1-1993

Air Quality Indicators

A useful method to illustrate the significance of the results is to depict the percentage of time that the results fall into certain categories. This method is described by the Ministry for the Environment in the discussion document on Environmental Performance Indicators (Ministry for the Environment, October 1997). Table 3.2 provides a description of these categories.

Air Quality Categories

Category	Maximum Measured Value	Comment
Action	Exceeds Guideline	Completely unacceptable by national and international standards.
Alert	Between 66% and 100% of the guideline	A warning level which can lead to guidelines being exceeded if trends are not curbed.
Acceptable	Between 33% and 66% of the guideline	A broad category, where maximum values might be of concern in some sensitive locations, but are generally at a level that does not warrant dramatic action.
Good	Between 10% and 33% of the guideline	Peak measurements in this range are unlikely to affect air quality.
Excellent	Less than 10% of the guideline	Of little concern.

The results of the air quality monitoring have been assessed using the Regional Ambient Air Quality Guidelines and the categories described above. A full analysis of the results is provided in the 2002 Annual Air Quality Monitoring Report.

Since the ambient air quality guideline concentrations are intended to protect human health and the environment, air quality in Upper Hutt and Wainuiomata should continue to be monitored closely in order to assess the best course of action to improve air quality during the winter.

Monitoring Results - Upper Hutt

A mobile ambient air quality monitoring station has been located at Trentham Fire Station in Upper Hutt since June 2000. The period from October 2001 through to October 2002 has been reported in this document. The monitoring data shows that the Upper Hutt area is susceptible to wintertime pollution episodes.

8-hour Average CO Concentration

24-hour Average NO2 Concentration

24-hour Average PM10 Concentration

There was one exceedence of the National Air Quality Guideline for PM_{10} during the winter of 2002; this compares to four exceedences of the guideline during the previous winter. The winter of 2002 was substantially milder than 2001. All pollution episodes occurred during cold calm winter days and nights.

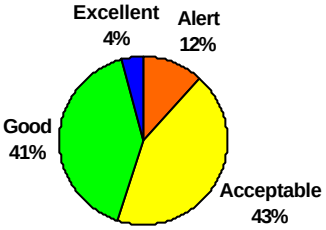
Both CO and NO_2 also peaked during the same period. It is suspected that domestic fires are the main cause of the PM_{10} pollution, with motor vehicles contributing to NO_2 and CO pollution.

Monitoring Results - Lower Hutt

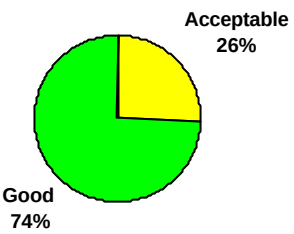
Greater Wellington's first permanent ambient air quality monitoring station has been operating at Birch Lane in Lower Hutt since February 2001. Monitoring results for the period from October 2001 through to October 2002 have been reported in this document.

8-hour Average CO Concentration

24-hour Average NO2 Concentration



24-hour Average PM10 Concentration



The results indicate that nitrogen dioxide levels were elevated during the winter in Lower Hutt. This is likely to be due to the combined effect of motor vehicle emissions and combustion emissions from residential and commercial heating, and with cold calm meteorological conditions. Peak levels occurred at similar times as those recorded at Upper Hutt, indicating the predominant influence of the weather on air pollution levels.

Monitoring Results – Wainuiomata

PM_{10} was monitored at Wainuiomata Bowling Club from October 2001 through to October 2002. Fine particulate concentrations equalled the proposed National ambient air quality guideline on one occasion during the past winter. Peaks in air pollution occurred during cold calm weather conditions when dispersion of air pollutants was poor.

24-hour Average PM10 Concentration

It is likely that emissions from domestic solid fuel fires are the main source of air pollutants in Wainuiomata and are directly responsible for the pollution events.

Future Monitoring

The mobile air quality monitoring station will be moved to Porirua early in 2003. After that it is likely that the station will be placed near central Porirua. The monitoring results for Wainuiomata are cause for concern about community health risk. The high volume sampler will, therefore, remain in Wainuiomata, subject to approval by the Wainuiomata Bowling Club, so that we can gain a better understanding of air quality problems at this location.

Summary

The results of the ambient air quality monitoring carried out in the Greater Wellington Region over the past year have indicated that the highest concentrations of air pollutants occurred during the winter. The higher winter time air pollution levels are the consequence of periods of cold, calm weather and a greater quantity of emissions to atmosphere from combustion sources. Cool, calm conditions restrict the dispersion of air pollutants. The major pollution sources are most likely to be motor vehicles and residential and commercial heating.

Ambient air quality monitoring within the Wellington Region shows that air quality is generally good during the summer months at suburban locations. However, at times, certain areas experience degraded air quality due to a combination of meteorological conditions and local emission sources exerting pressure on the air resource to the extent that it may pose a risk to the health of local populations. With the establishment of a permanent air quality monitoring network, clear trends in air pollution levels are becoming evident. Winter is the likely time for pollution episodes to occur and the severity of this pollution is entirely dependent on the type of winter we experience.

Air quality management is about minimizing peak pollution concentrations in order to safeguard the health of the community. There is ample international medical and epidemiological evidence that once air pollution levels start approaching guideline levels there are tangible and serious health consequences for the community. The most affected are sensitive sub-populations such as the very young, the old and those predisposed to respiratory and cardiopulmonary disorders.

The current ambient air quality network is insufficient to assess the full extent of air quality issues within the Region, with a number of locations still to undergo air quality screening surveys. At the current rate we will not meet the Air Plan objective to have an appropriate ambient air quality monitoring programme implemented by 2004.

Freshwater Quality

Introduction

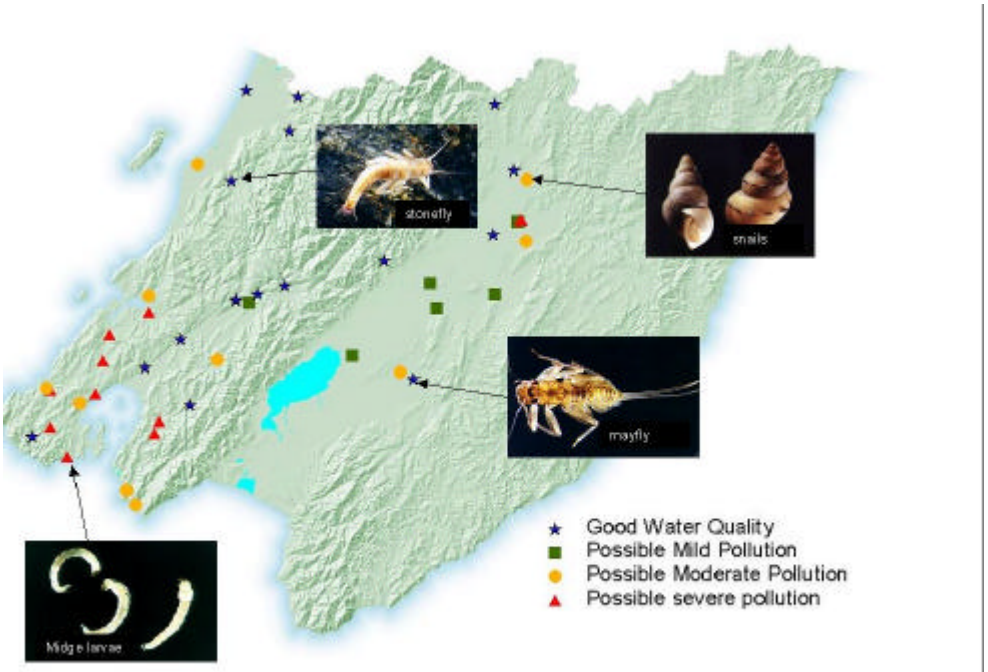
Greater Wellington - The Regional Council monitors water quality and ecosystem health at 51 stream and river sites under the Rivers State of the Environment (RSoE) monitoring programme.

At each of these sites water quality and nuisance algae cover are assessed on a monthly basis while macroinvertebrate communities are sampled each year during summer. Macroinvertebrate monitoring is a useful indicator of stream ecological health as the species present and their abundance can be related to stressors in the environment.

Monitoring Results

Macroinvertebrate data collected over the summer of 2001-2002 showed similar patterns in health of aquatic ecosystems to previous years (Figure 1). The key findings were:

- The best water quality and stream health occurred in streams and rivers in the Taruarua and Rimutaka Ranges such as the Otaki, Hutt, Waiohine, Waikanae, Wainuiomata and upper Ruamahanga Rivers.
- Mild to moderate pollution occurred in streams and rivers affected by agricultural landuses; for example, the Mangaroa, Tuaherenikau, Waipoua, Mangatarere and lower Waiohine and Ruamahanga Rivers.
- The poorest water quality and stream health occurred in streams affected by urban landuses; for example, the Karori, Porirua, Ngauranga and Owhiro Streams and the middle reaches of the Wainuiomata River.



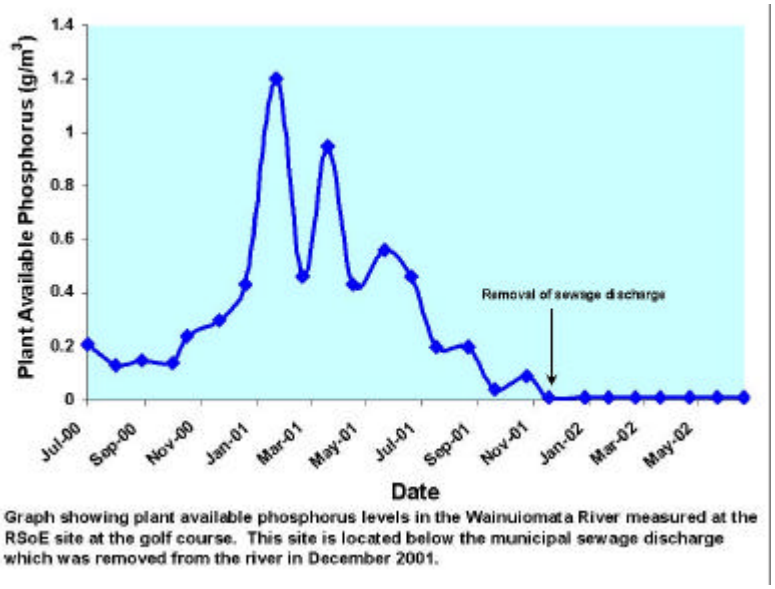
Map of stream health in the Wellington Region as indicated by 2001/2002 macroinvertebrate monitoring results. Examples of the types of macroinvertebrates you'd expect to find in streams of different condition are shown.

Figure 1

Water quality data obtained between July 2001 and June 2002 showed similar spatial patterns to those shown by biological indicators.

At most sites there was no notable difference between water quality results from this year to previous years. However, marked improvements in water quality had occurred on the Ngarara and Wainuiomata Rivers, particularly in levels of plant available phosphorus (Figure 2). These improvements in water quality are almost certainly linked to the removal of municipal sewage discharges from these streams over the last year.

Both the Ngarara Stream and Wainuiomata River have long been identified as having some of the poorest water quality in the Region and the removal of sewage discharges from these water bodies represents an important step in improving their environmental health.



Graph showing plant available phosphorus levels in the Wainuiomata River measured at the RSoE site at the golf course. This site is located below the municipal sewage discharge which was removed from the river in December 2001.

Figure 2

Groundwater

Groundwater Quantity

Groundwater levels in most rainfall-recharged aquifers were low for the last six months of 2001; several aquifers reached record low levels during this time. The drop in groundwater level was the result of relatively low winter rainfall compared with previous years. Above average rainfall during early summer caused groundwater levels to rise and return to average levels.

River-recharged aquifers did not exhibit the same decline as their rainfall-recharged counterparts. The wetter than usual summer assisted recharge and the water level in these aquifers has remained high during 2001 and 2002.

Groundwater Quality

Groundwater quality is generally high in the Wellington Region although some shallow aquifers in the Wairarapa and Te Horo continue to show varying degrees of nitrate contamination.

Paraparaumu Shallow Groundwater Investigation

During 2001-2002 we continued our investigation into the shallow unconfined aquifer underlying the Paraparaumu, Waikanae and Raumati areas. A major achievement this year has been the establishment of a network of privately owned wells to measure the depth to groundwater at many points in the aquifer. Repeated water level measurements using this network allow us to describe the aquifer's flow characteristics. Measurements taken so far indicate that autumn and winter groundwater conditions are similar. Measurements taken over the next five months will show us how groundwater conditions change in response to reduced rainfall throughout summer.

Areas of Concern

During the year we have identified a number of groundwater zones that are close to or at, their full allocation, and a number of other zones that are coming under increasing stress. In December we applied a moratorium on new resource consent applications to take groundwater from the Parkvale and Martinborough groundwater zones. The identification of heavily utilised groundwater zones highlights the need for us to improve our investigation programme to confirm the safe yield of aquifer systems.

Hydrology

Introduction

Greater Wellington – The Regional Council monitors rainfall, river flows and lake and tide levels at over 70 sites across the Region. Our monitoring network provides a flood warning service by using rain gauges high in the Tararua Range and water level recorders on the major rivers. These give advance warning of possible flooding and allow early action to be taken. The monitoring network also helps us to plan ahead for drought management and water supply purposes.

The *Regional Freshwater Plan* gives direction about low flow thresholds for some rivers in the Region. This is so that people can take and use the water for drinking, agricultural use and industry while making sure that there is still enough water flowing to keep the rivers healthy. We also need enough water in our rivers for swimming and other recreational activities.

July 2001 to June 2002 was a twelve-month period of few extreme events, especially when compared to recent year's floods and drought events.

Of note, however, was a torrential burst of rain that hit Wellington City on 10 January 2002. It lasted for almost exactly one hour and in that time 94 millimetres of rainfall was recorded at our Karori Reservoir raingauge. A rainfall event of that intensity is very rare in New Zealand. The deluge caused surface flooding to the city and a number of slips, including a large one on The Terrace that caused two households to be evacuated. A number of businesses and the central fire station sustained flood damage.

Another feature was the very low rainfall experienced in the eastern hill country area of the Wairarapa during the first half of 2001 and extending into the first part of the monitoring year. Fortunately significant rainfall occurred during spring and summer averting a drought.