NELSON CITY

STATE OF THE ENVIRONMENT 2010

Nelson City Council
te kaunihera ō whakatū

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1. INTRODUCTION

1.1 Background to State of the Environment reporting

Councils need to understand the nature of environmental resources in order to manage them on behalf of the community. This includes understanding the effects of activities on soils, waterways, land and the coast. Councils collect this type of information in a number of ways, including:

- state of the environment (SOE) monitoring which looks at the big picture condition of natural resources such as rivers
- social and economic monitoring which does the same for social groupings and economic activities
- consent applications and conditions of resource consents where detailed information on a particular site is provided by the consent applicant
- monitoring undertaken by asset management units of councils as part of providing amenities and services.

The Resource Management Act (the Act) requires councils to prepare a State of the Environment Report (SOE report) at least every 5 years. Rather than create rooms of files, it is good practice to compile monitoring data in a form that is useful and easily understood by others.

1.2 National and Regional State of the Environment Reporting

In 1997 the Ministry for the Environment published the first New Zealand SOE report. This followed a report by the Organisation for Economic Cooperation and Development on New Zealand's Environmental Performance (OECD, 1996). The OECD review noted that, despite our innovative environmental legislation and our clean, green, marketing image, New Zealand's lack of high quality environmental data is a significant barrier to effective environmental planning and management.

The 1997 New Zealand SOE report was the first attempt to report nationally on a broad range of environmental indicators, to highlight national environmental issues and to establish a baseline against which future national monitoring could be compared.

In 2007 the Ministry for the Environment released its second New Zealand-wide SOE report. The report built on and extended the coverage of the 1997 report using more measures of environmental health and longer records. It is available on the Ministry for the Environment web site – www.mfe.govt.nz/publications.

National SOE reporting and regional SOE reporting vary considerably in scale and detail. National data is usually aggregated by local government area, so the reader can assess how one part of the country performs against another, as well as how New Zealand as a whole performs against other countries.

Regional reporting usually covers smaller geographic areas such as a river catchment or a township. It may compare them against an adjoining catchment or town. Regional SOE reporting may also include presentation of issues of regional significance which are not significant at a national level. For example, most Nelsonians are interested in changes occurring at Tahunanui Beach whereas at a national level the percentage of coastline experiencing erosion is more relevant than discussion of a particular beach.

1.3 Past Nelson State of the Environment Reports

Nelson City Council established its state of the environment monitoring programme in 1998 and produced its first SOE report in December 1999. That report provided a consolidation of knowledge concerning the major spheres of the environment: land, sea, freshwater and air. The 1999 report also established an ongoing programme for future SOE reports which included:

- 2001 Freshwater
- 2002 Coast
- 2003 Air and a general category
- 2004 Land
- 2005 consolidation of all environments.

Then the five yearly cycle of reporting was to repeat itself. The SOE reporting process developed in 1999 served the Council well, especially during the preparation of its statutory and non-statutory plans. The air quality report became the "resource inventory" for the Regional Air Quality Plan while the freshwater report did the same for the Freshwater Plan Change. The coastal and land reports linked with action at Tahunanui Beach, marine biosecurity and biodiversity initiatives.

Despite this, the SOE reporting programme had a number of limitations. These were:

- limited staff time available to prepare the reports
- the style of the report did not suit some users
- the rolling programme of reporting meant some data could be up to four years old when that topic was next reported.

While it is now a requirement to prepare a SOE report, the Act is largely silent on the content and presentation style of that report. People want different levels of detail. Some people want the broad conclusions, others want a summary of the results that led to those conclusions, and others want details about the monitoring undertaken.

1.4 The New Deal

To make the SOE report more achievable and useful, a new reporting style has been adopted which includes the following parts:

- preparation and distribution of annual score card reports for each environment we monitor. Initially these are for each major environment sphere (e.g. air, freshwater) but as time permits they could include a broader range of topic areas, which would benefit from more in-depth treatment (such as separating freshwater into water resources and water quality)
- web-based reporting using the annual score card presentation but updated with the latest results. This will be of the most value for topic areas where monitoring is semi-continuous (such as air quality and swimming water quality). It will also be worthwhile for topic areas which are monitored more frequently than once a year (e.g. river ecology is monitored every three months)
- preparation of a consolidated SOE report every five years presenting the key results and data trends for all spheres of the environment and major topics monitored
- posting of electronic copies of supporting documents or topic reports on the Council website so they can be more easily accessed by the public. This will include report summaries and a simple process for people to download an electronic copy or order a hard copy of the report.

1.5 This SOE Report

This SOE report is the first to be based on the new format. It aims to provide a catch-up of monitoring results since the last SOE report of 2005 and to introduce and trial the new score card reporting format. Experience gained compiling this report and comments received following its release will be used to refine the scorecard format. That will then provide the basis for an annual update over each of the next four years until the next consolidated report in 2015.

2. THE NELSON SETTING

Māori lived in the area as early as the 13th century and by 1850 1000 Europeans had settled here. In 2006 the population was 44,300 and it is expected to rise to around 50,000 by 2026. Nelson's population has increased by 1.2% per year over the past 10 years. The urban area contains the largest settlement in the upper South Island. The port and airport are important links to the rest of New Zealand and the world. The port is a major outlet for upper South Island forestry and horticulture. The port is also New Zealand's primary fishing base for national and international fishing – activities including fish processing and ship maintenance, repair and refitting.

Anyone who has approached Nelson by sea or air will be aware that Nelson City is located at the head of Tasman Bay and surrounded by mountainous terrain. This is one of the main influences on the shape of the city. Most of the population lives in the city centre and its suburbs. The surrounding rural area is sparsely populated. Rural valley floors and lower slopes are mainly used for agriculture, but the number of lifestyle blocks is increasing. The rest of Nelson's terrain is either plantation forest or protected native forest.

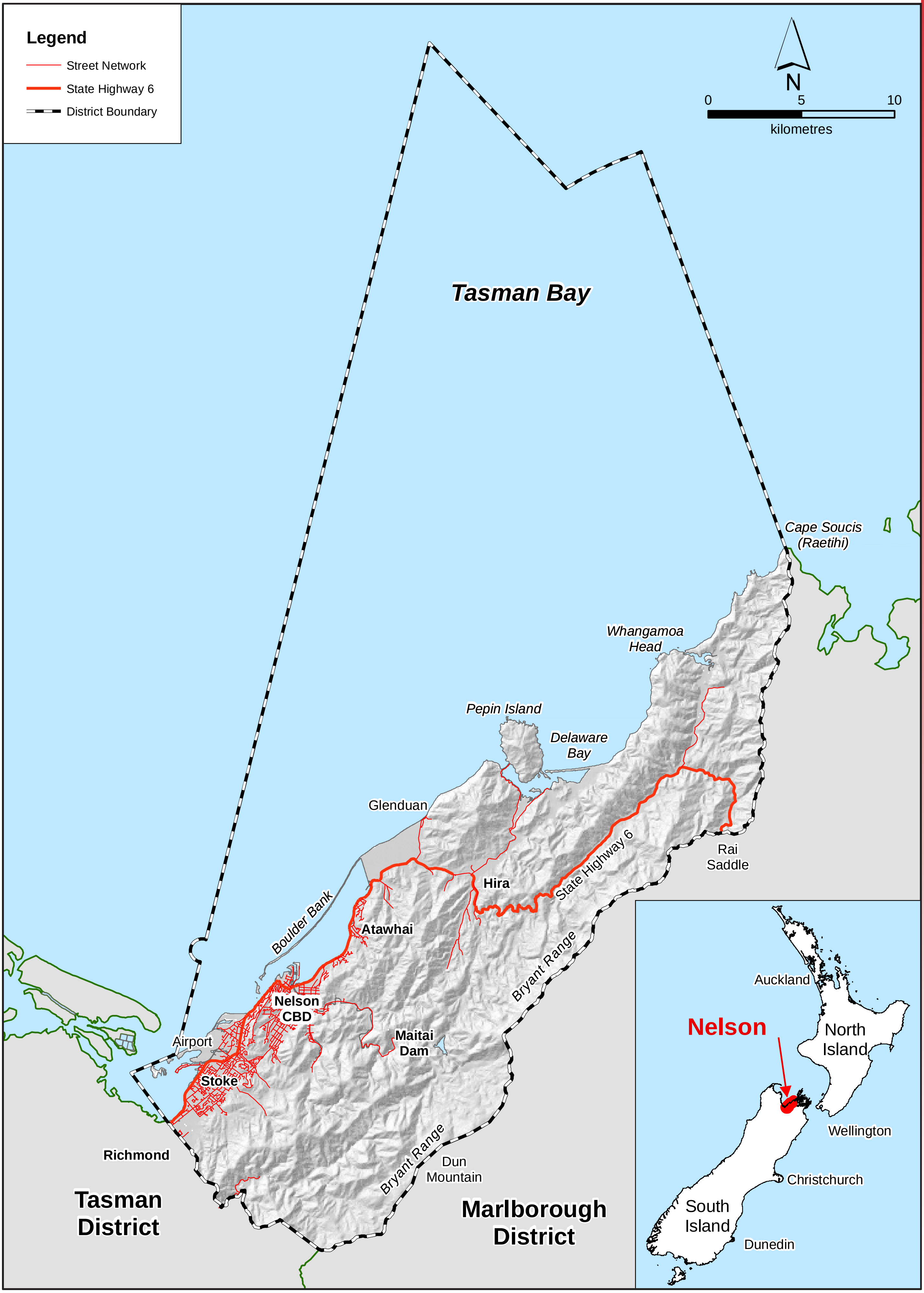
The Nelson City Council area extends from Waimea Inlet to Cape Soucis along the eastern margin of Tasman Bay in the northern South Island (see Figure 2 opposite). This area covers 42,000 ha of land.

As a unitary authority the Council combines the functions of both a district council (management of land) and the functions of a regional council (management of air, water and the coast). As a result, the Council has a wider scope of responsibility than most councils in New Zealand and there is more potential to manage air, land, water and coastal activities in an integrated way. This is especially important when considering the boundaries between air, land, water, and the coast such as river and coastal margins and the way land use affects air quality.

Right: **Figure 2** Coastal Nelson – the area covered by this report.

Figure 2

COASTAL NELSON



3. AIR QUALITY

3.1 Summary

- The Nelson Air Quality Plan (2008) describes the objectives, policies and methods to achieve the National Environmental Standard and acceptable air pollution levels by 2013. Overall, the majority of performance indicators outlined in the Nelson Air Quality Plan are on track with set targets, which are summarised in a score card at the end of this chapter
- Air quality across the Nelson urban area is measured by the concentration of fine smoke particles (PM_{10}) monitored at three locations that incorporate residential and residential/industrial areas. Three air quality management areas, A (Nelson South), B (Tahunanui – Stoke) and C (rest of Nelson) are currently in place (gazetted). Central Government requires gazetted Airsheds (catchments) be monitored, reported on and managed to meet national air quality targets. The Airsheds (or catchments) were identified from monitoring the air pollution characteristics at various locations across Nelson, an assessment of the local climate, dispersion of air pollution and the shape (topography) of surrounding land. Airshed B is split into B1 (Tahunanui) and B2 (Stoke) for management purposes
- Nelson air quality has improved from 2001 to 2008, demonstrated by a gradual fall in both PM_{10} concentrations and the number of times the guideline value in Airshed A and B was exceeded. The guideline value has not been exceeded in Airshed C during the 2008 monitoring seaso
- The implementation of policies outlined in the Nelson Air Quality Plan have reduced air pollution at source by:
  - (a) prohibiting outdoor burning and open fires in houses in urban areas
  - (b) phasing out the use of older burners in Airshed A and B
  - (c) installation of replacement burners with lower emissions
  - (d) restricting the total number of burners
- Many households have benefited from assistance to insulate houses and to change their home heating fuel from wood to electricity or gas as part of the Council Clean Heat – Warm Homes Programme, or to upgrade to a low emission wood burner or pellet fire
- In Nelson, domestic fires and burners contribute the most PM_{10} emissions. Analysis of the different types and numbers of fires and burners has shown that the estimated emissions from domestic heating and industry have decreased by about 40% since 2001 and are tracking closely with Air Plan targets
- Transport is a relatively minor contributor to PM_{10} emissions in Nelson at between 6-10% of the total emissions. However, between 2001 and 2006, the estimated emissions from motor vehicles increased by at least 20%

- Air pollution levels from PM_{10} emissions are highest on calm and cold winter days, when smoke emissions from domestic heating are most prevalent. During these weather conditions, smoke is less likely to be dispersed by wind and can also be trapped under a layer of warm air (temperature inversion)
- Maintaining local weather records compatible with the national climate network is important because the data can be used to identify the key weather conditions associated with air pollution days. This model can then be used to assess the trends in ambient PM_{10} concentrations across years and evaluate the effectiveness of the Nelson Air Quality Plan
- July 2001 was the coldest month since monitoring began and probably explains the high number of exceedances that occurred during the 2001 winter. Another winter in future, and could result in high concentrations of PM_{10} if domestic emissions are not considerably reduced
- The Council is currently on track to meet its air quality goals as defined by the Straight Line Path and the 2013 National Environmental Standard target. However, significant reductions in domestic emissions are still required to achieve this target for Airshed A and B.

3.2 Physical Setting

The hills surrounding Nelson are one of the main influences on the shape of the city. By sheltering Nelson City from the east, south and west, the prevailing wind flow is modified. This creates below average (for New Zealand) wind flow which means smoke and other airborne pollutants do not disperse quickly. These calm conditions, combined with Nelson's frosty winters, have a significant impact on the concentrations of air pollution in Nelson. In combination, the topography and weather conditions may result in temperature inversions, where cold air, along with smoke, vehicle exhaust and other emissions, become trapped under a layer of warmer air. These temperature inversions mainly occur in winter when smoke production from home heating fires is at a maximum. For these reasons, Nelson's relatively small population can have a significant polluting impact on air quality.

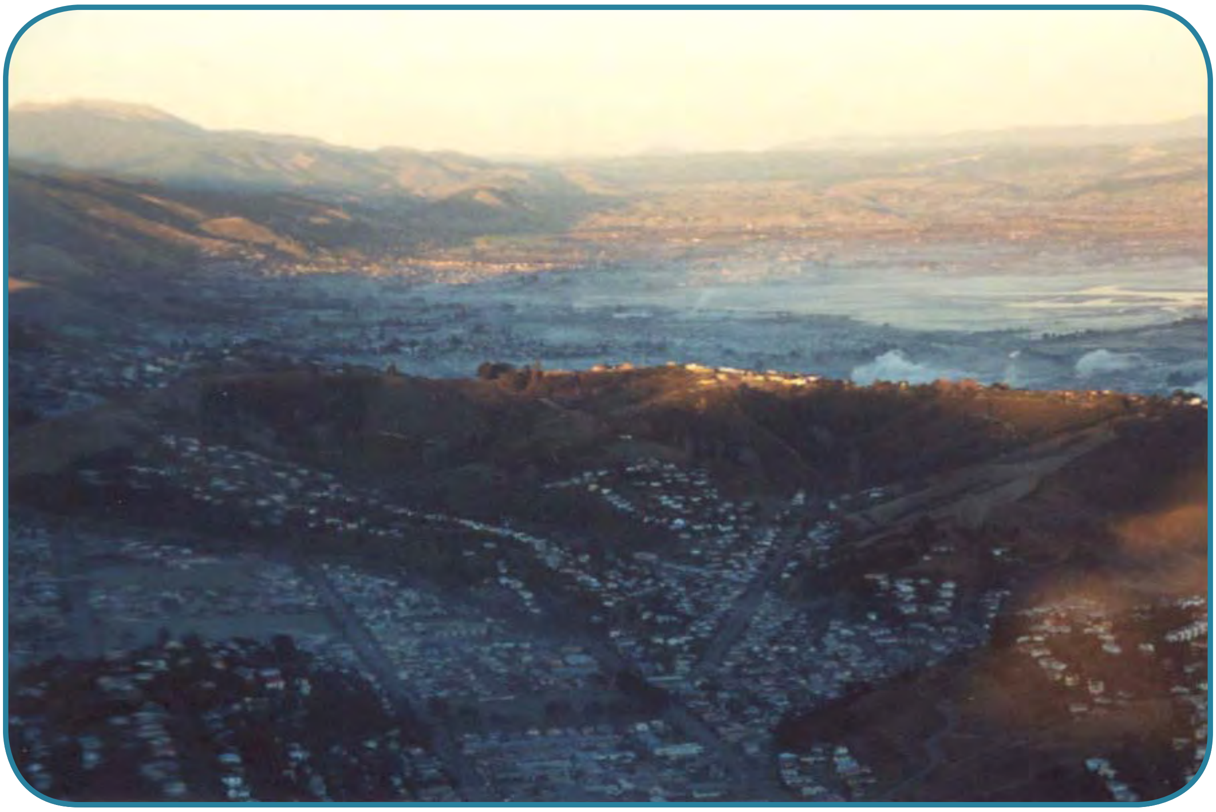


Figure 3.2 Nelson City looking towards Richmond July 12th 2001. Smoke concentrates in low lying urban areas.

Figure 3.2a Tahunanui, looking towards the Barnicoat Range July 12th 2001. Smoke emissions from domestic and industrial sources concentrate between the Richmond ranges and coast.

3.3 Guidelines and Standards

Previous clean air legislation such as the Clean Air Act 1972 was superseded by the Resource Management Act in 1991. In November 1992 the Ministry for the Environment published a "Discussion Document on Ambient Air Quality Guidelines". It proposed an air quality management process and a number of guideline levels for pollutants. This draft was amended to become the "Ambient Air Quality Guidelines, July 1994". The 24-hour average guideline for fine smoke particles less than 10 micrometres (PM_{10}) in size was initially set at 120 µg/m^3 (micrograms per cubic metre of air). The PM_{10} value was reduced to 50 µg/m^3 in 2002 when the guidelines were reviewed, in response to compelling evidence of the adverse health effect of PM_{10} particles.

In September 2004 the "Resource Management Regulations 2004" (National Environmental Standard Related to Certain Air Pollutants, Dioxins and Other Toxics – NES) were introduced. The 2004 NES set the maximum concentration for certain air pollutants and reaffirmed the maximum concentration of 50 µg/m^3 for PM_{10}.

The NES requires councils to:

- ensure that no more than one breach (PM_{10}>50 µg/m3) occurs in any twelve month period by 2013
- to show they are on track to meet the standard of 50 µg/m^3 by 2013 by way of a straight line path.

The straight line path begins at the highest concentration measured in the Airshed and ends at or below the requirements of the standard. Maximum recorded concentrations each year are required to fall on or below the line. If a straight line path to compliance with the NES is not achieved, councils are unable to grant consents for significant PM_{10} discharges in that Airshed.

The Nelson Air Quality Plan (2008) describes the objectives, policies and methods to achieve the NES and acceptable air pollution levels by 2013. The main objectives of the Plan are:

- the maintenance of air quality where it is of an acceptable or better standard
- the improvement of air quality where it is degraded
- the avoidance, mitigation or remediation of any adverse effects on the environment from localised discharges into air.

The objective covers ambient (surrounding) air quality as well as localised air quality effects.

The Ministry for the Environment guidelines and standards are concerned with the cumulative impacts of discharges into air from human activities and natural processes. Air Quality Categories were developed to describe the level of air quality in relation to the guideline value for a range of contaminants (Table 3.3). See the Nelson Air Quality Plan for details of the objectives, methods, guideline and standard values.

The policy targets for fine smoke pollution (PM_{10}) across the urban area are:

- for a steady improvement in ambient air quality with PM_{10} levels remaining below the maximum levels set by the 'Straight Line Path'
- for maximum PM_{10} levels to attain the 'ALERT' Air Quality Category (between 33-50 μg/m^3) by 1 September 2013, or sooner if practicable
- the management of discharges to air from all sectors producing fine suspended particles (domestic, transport, industrial or trade) to achieve or better the 50 μg/m^3 guideline/standard
- reductions in PM_{10} emissions (relative to 2001 levels) in order to achieve the 2013 target:
- at least 70% from domestic heating
- at least 98% from outdoor burning
- at least 10% from industrial and trade sources except in any area with a high concentration of industrial and trade discharges where greater reductions may be required to achieve the target
- a reduction in emissions from the transport sector.

Table 3.3 Air Quality Categories

Based on Ministry for the Environment Ambient Air Quality Guidelines, May 2002.

Category	Measured Value	Comment
ACTION	Exceeds the guideline/ standard value of Straight Line Path, target of 50 µg/ m^3 in 2013	Exceedances of the guideline/standard are a cause for concern and warrant action if they occur on a regular basis
ALERT	Between 66% and 100% of guideline/standard value	This is a warning level which can lead to exceedances if trends are not curbed
ACCEPTABLE	Between 33% and 66% of guideline/standard value	This is a broad category where maximum values might be of concern in some sensitive locations, but generally at a level not requiring urgent action
GOOD	Between 10% and 33% of guideline/standard value	Peak measurements in this range are unlikely to affect air quality
EXCELLENT	Less than 10% of guideline/standard value	Of less concern –the average values are likely to be much less than a 10th of the maximum value

3.4 History of Monitoring

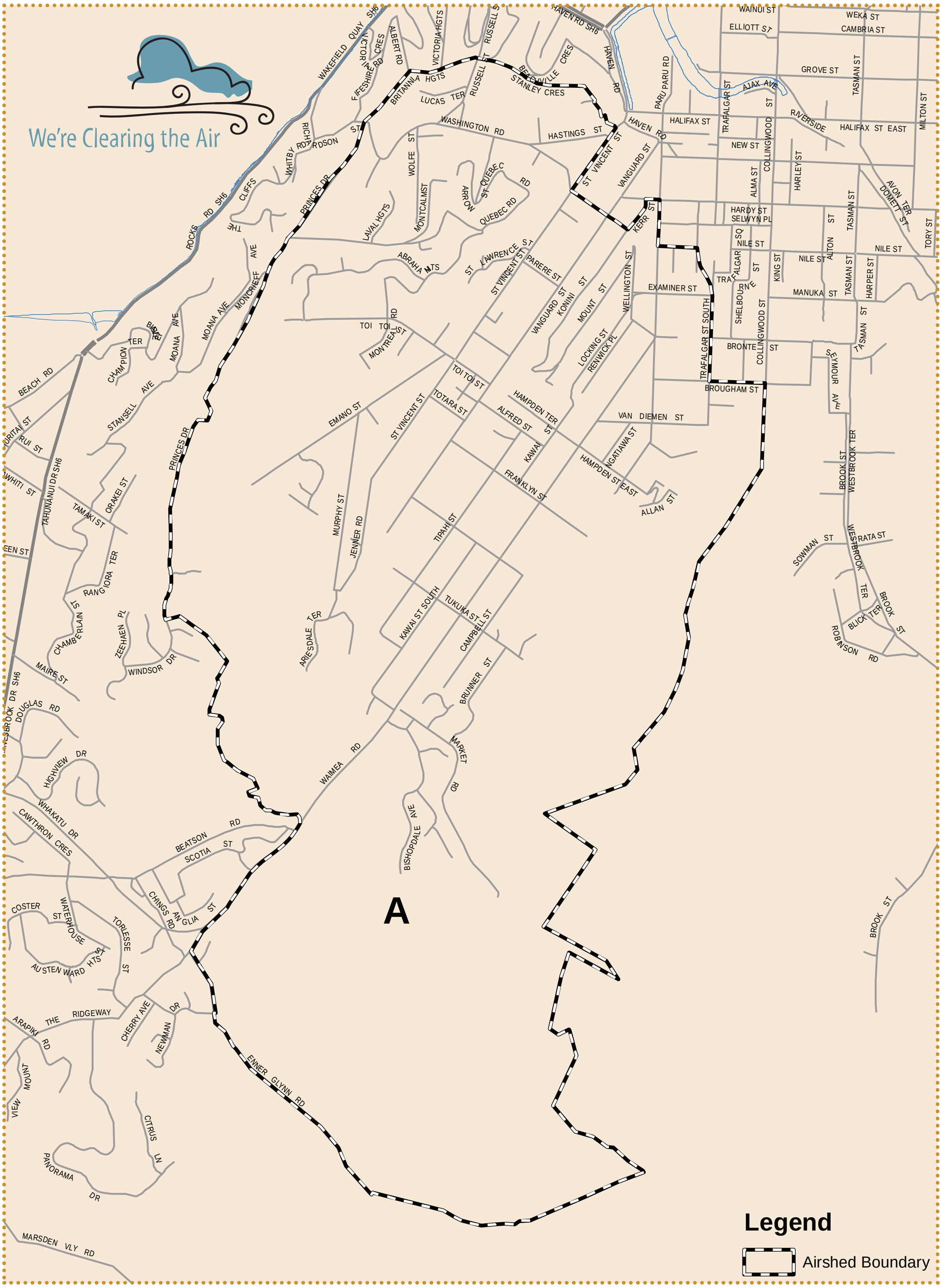
The Council began monitoring black smoke levels in Nelson in 1983. Initial smoke monitoring was carried out at three locations in Nelson: the inner city, Vanguard Street and Quarantine Road. Results of that monitoring suggested that air quality was acceptable based on the equipment and World Health Organisation standards available at that time.

In 2000 the monitoring programme was revised to focus on the finer particles (PM_{10}), which international studies had found were associated with adverse health effects. PM_{10} monitoring equipment was hired and monitoring was undertaken at the Nelson Fire Station in Gloucester Street. The monitoring data for 2000 showed regular breaches of the 120 $\mu g/m^3$ guideline level for PM_{10}. As a result Nelson City Council purchased PM_{10} monitoring equipment and set up both permanent and temporary monitoring sites.

The first permanent air quality monitoring station was established in 2001 in St Vincent St. This area is now known as Airshed A (Figure 3.4). Previous monitoring of black smoke levels in this area had shown it to be the worst affected part of Nelson. A PM_{10} monitor was installed along with a meteorological monitoring station to record changes in wind and temperature. This equipment allowed PM_{10} air pollution levels and associated weather conditions to be measured simultaneously. The Partisol PM_{10} monitor originally installed in 2006 only recorded 24 hour averages.Installation of BAM units in Airshed A and B1 allowed PM_{10} levels to be measured throughout the day at 30 minute intervals.

Temporary monitoring sites were located in Stoke (Keats Cresent), Tahunanui (Nayland Road and Roto Street), The Brook (Sowman Street), the Wood (Milton Street) and in Atawhai (Dodson Valley Road). Comparisons between the various sites provided an understanding of how PM_{10} concentrations varied across Nelson.

A permanent monitoring site was established in Vivian Place, Tahunanui in 2005. The site proved unrepresentative due to contamination from immediately adjoining activities and was moved to a new permanent site at Blackwood Street Reserve in 2006. This area is now known as Airshed B1 (Figure 3.4a). Airshed B is split as B1 (Tahunanui) and B2 (Stoke). The split reflects the different sources of PM_{10} pollution in the two areas; B1 is predominantly industrial while B2 is residential. In 2008 a third site was established in Brook Street in the area known as Airshed C (Figure 3.4b).



Airshed A – Nelson South

Note: Refer to Gazetted Map SO356467 for boundary details, available at the NCC office.

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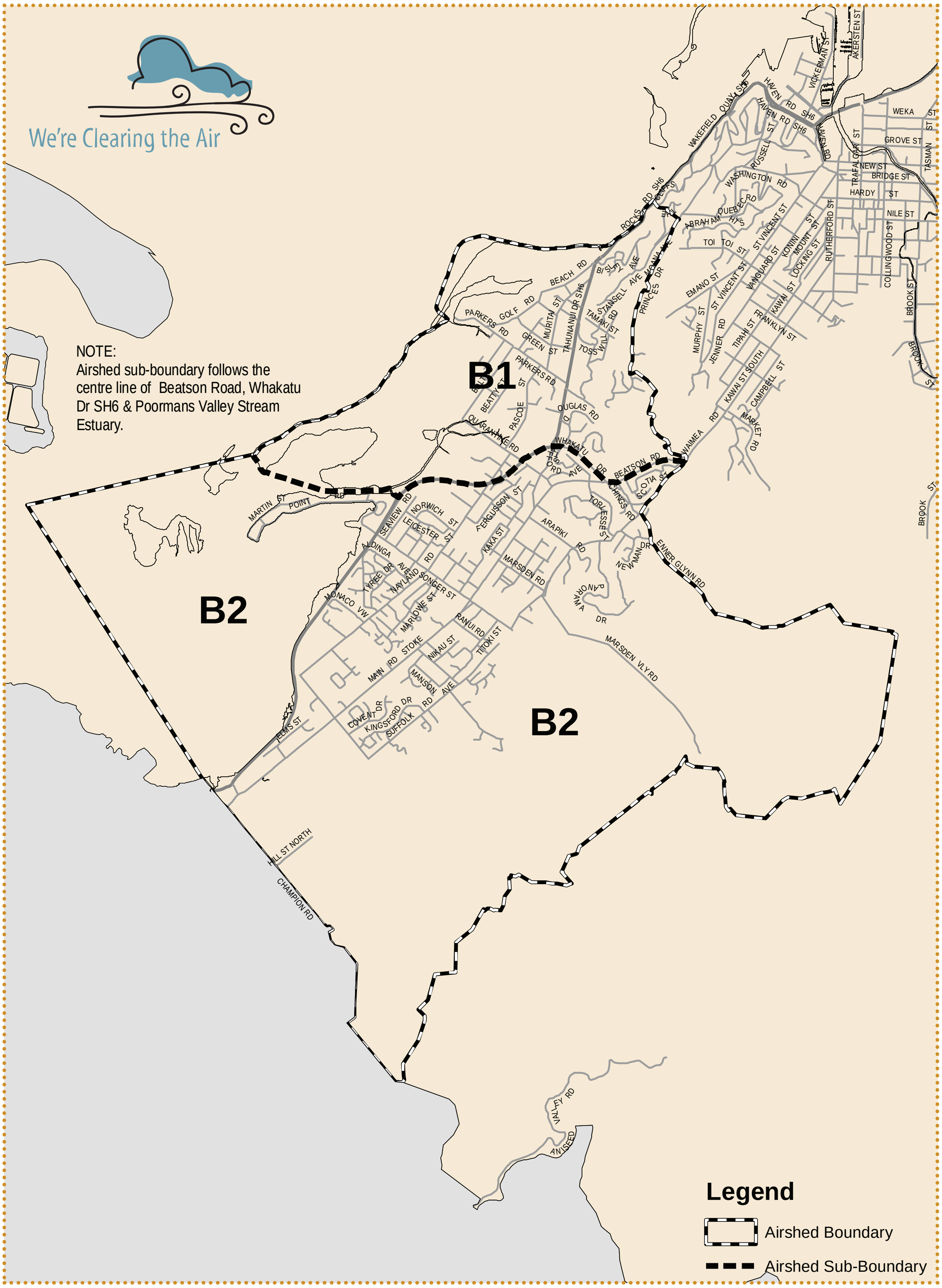
Figure 3.4 The Nelson air pollution PM_{10} monitoring areas, Airshed A.



NOTE:
Airshed sub-boundary follows the centre line of Beatson Road, Whakatu Dr SH6 & Poormans Valley Stream Estuary.

Airshed B – Tahunanui and Stoke

Note: Refer to Gazetted Map SO356468 for boundary details, available at the NCC office.

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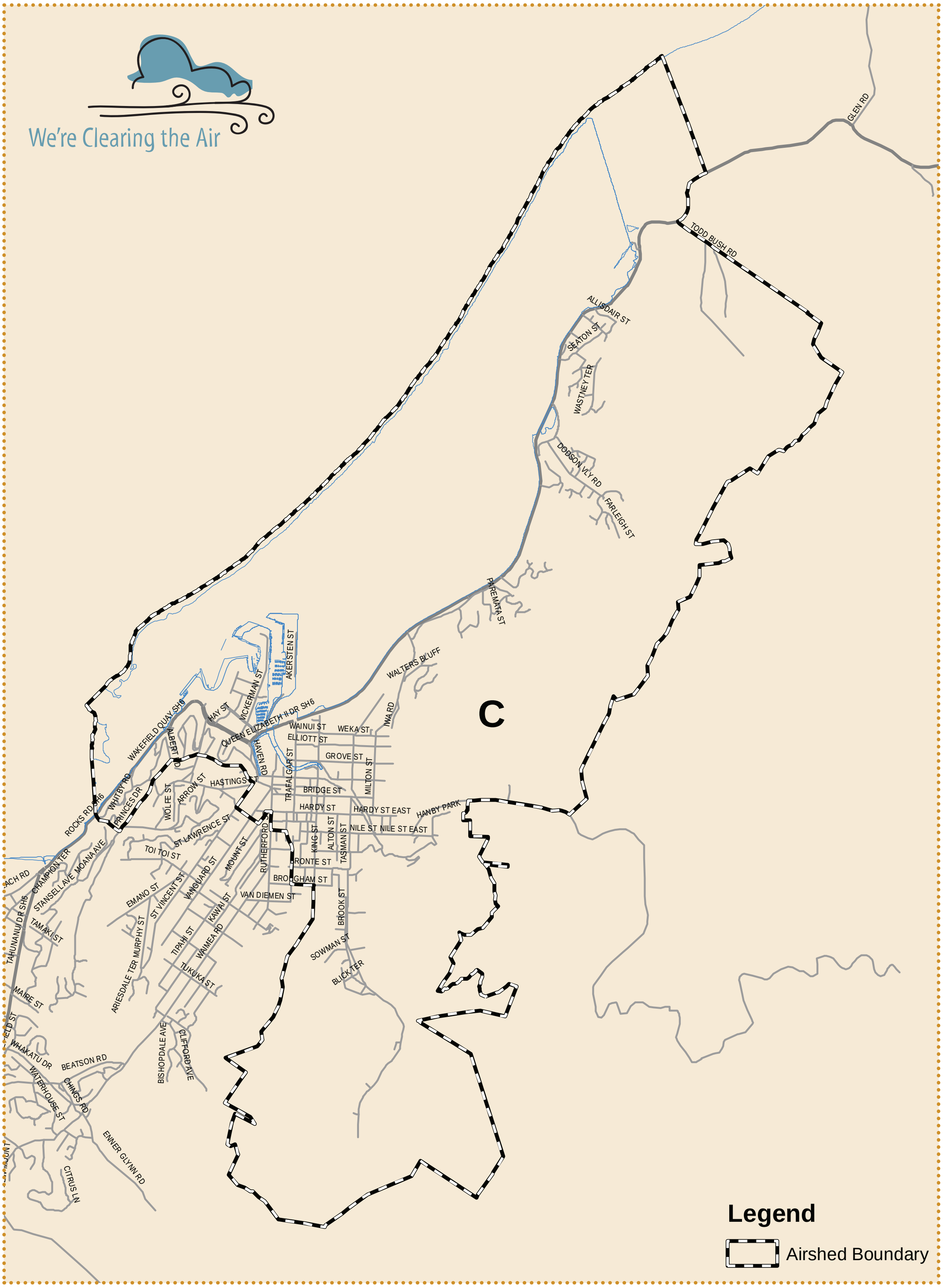
Figure 3.4a The Nelson air pollution PM_{10} monitoring areas, Airshed B1 and B2.



Airshed C – Nelson City

Note: Refer to Gazetted Map SO356471 for boundary details, available at the NCC office.

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Figure 3.4b The Nelson air pollution PM_{10} monitoring areas, Airshed C.

3.5 Nelson City Emissions Inventory

Air quality monitoring in Nelson directly measures the concentration of fine air pollutants within the air. The PM_{10} concentration measured is a product of the amount of pollutants discharged and the weather conditions at the time. An inventory (or stock-take) of the emissions in Nelson City was undertaken in 2001 (Wilton & Simpson, 2001) to establish the quantity of air pollution emitted from the different sources.

The inventory was repeated in 2006 (Wilton, 2007), as part of a five-yearly update mandated in the Nelson Air Quality Plan. Both studies involved a detailed survey of sources of airborne contaminants, the latter focusing on PM_{10} emitters. The results derived from each inventory are best estimates of what is occurring in real life.

Comparing the results of the 2001 and 2006 inventories provides trends in fire and burner numbers, types of boilers and fuel usage, and vehicle kilometres travelled. This information was used to calculate PM_{10} and total suspended particulate emissions for residential, industrial and transport sources in various parts of the city (Airsheds A, B and C). The 2006 emissions inventory provided a snapshot of winter emissions and incorporates information on domestic heating changes as a result of the Council Clean Heat – Warm Homes Programme (CHWH).

The CHWH scheme has been operating since 2004. It was initially designed to assist lower income households replace open fires ahead of the January 2008 ban. At the end of 2005 the Council decided to extend the scheme to include loans for all people required to replace older enclosed burners located in the worst affected parts of the city. The CHWH scheme currently targets the replacement of pre-1996 burners in Airshed A (Nelson South) and in Airshed B1 (Tahunanui).

Both inventories showed that domestic heating was the main contributing source of PM_{10} emissions in all Airsheds during winter months (Table 3.5). Domestic heating accounted for 92%, 66%, 89% and 88% of PM_{10} emissions in Airsheds A, B1, B2 and C respectively. Industry accounted for 26% of emissions in Airshed B1 (Tahunanui) compared to 2% in Airshed A, B and C. Transport was a relatively minor component, accounting for 6%, 7%, 9% and 10% in Airsheds A, B1, B2 and C respectively.

Table 3.5 Winter PM_{10} – contributing sources for each Airshed A, B1, B2 and C (Wilton, 2007).

	A Nelson South	B1 Tahunanui	B2 Stoke	C Rest of Nelson
% Contribution				
Domestic heating	92	66	89	88
Industry	2	26	2	2
Transport	6	7	9	10
Aircraft	0	1	0	0

Overall, the total PM_{10} emissions across the city in the winter of 2006 were lower than the 2001 estimates by 16%. However, emissions from motor vehicles in 2006 have increased 21% relative to the 2001 estimate. The target in the Air Quality Plan is a 'reduction in emissions from the transport sector'.

Vehicle emissions can be reduced in a number of ways though implementing and promoting programmes in the Nelson Regional Transport Strategy, such as the Public Transport Strategy, and Nelson City Cycling Strategy which ultimately reduce the number of vehicles on the road. However, implementation of these strategies is subject to central Government funding priorities. Other improvements in emission standards can arise from advocating new emission standards for used-imported and new vehicles and cleaner burning fuel.

Improvements in air quality effective from 2003 are largely as a result of the end of outdoor burning in winter in the urban areas and declines in emissions from domestic fires and burners and industrial-scale sources.

The decline in emissions from domestic fires and burners can also be partially explained by a relatively small 6% decline in wood burner usage across the whole City.

Detailed monitoring of other air pollutants, including carbon monoxide (CO), nitrogen oxides (NO_2) and benzene were undertaken in 2001 as part of the investigations for a new arterial road. This work confirmed that in Nelson it was only the PM_{10} levels that exceeded guideline levels. As a result, subsequent Council monitoring has concentrated on PM_{10}, with a periodic review of other pollutants.

3.6 Long-term Trends in PM_{10} Emissions and Concentrations

An emission trend assessment was undertaken (Bluett, Wilton and Ponder-Sutton, 2009) to evaluate the effectiveness of the Air Quality Plan initiatives to date and assess whether PM_{10} values will be compliant with the Straight Line Path in 2013.

The percentage reduction in emissions since 2001 was determined from the number of different solid fuel burners removed and the number of new gas, oil and pellet burners and NES compliant wood burners going into each Airshed.

Trend analysis of PM_{10} emissions showed that domestic heating and industry emissions are decreasing and tracking very closely with predicted Air Quality Plan projections.

It should be noted that the emission trend assessment is likely to underestimate actual emission reductions because the estimates only include changes in domestic emissions by users of the Nelson City Council incentives programme and where Council consent is required e.g. a building consent for the installation of a replacement wood burner.

3.7 Meteorological Effects on Air Pollution Levels

3.7.1 Winter Months

Prevailing local weather conditions can have a significant effect on where, and to what extent, fine smoke particle PM_{10} emissions are dispersed. Localised pollution events can occur from smoke particles trapped by a layer of warmer air during calm cool days and nights; from downhill 'drainage' winds bringing pollutants from the hills to valleys; and from pollutants carried by winds between Nelson and Richmond.

Meteorological records are therefore routinely gathered in Airshed A and B1 to track localised weather patterns. This information can be used to understand how and when air pollution events occur.

Overall, the highest PM_{10} concentrations have occurred during the winter month with the lowest average temperature: in July from 2001 to 2004; and in June from 2005 and 2007 (Figure 3.7).

July 2001 had the lowest average monthly temperature of 4.7°C and the highest occurrence of calm days, 92.6%.

Overall, there has been a decline in the peak monthly PM_{10} concentrations from 110 μg/m^3 in 2001 to 41 μg/m^3 in 2008.

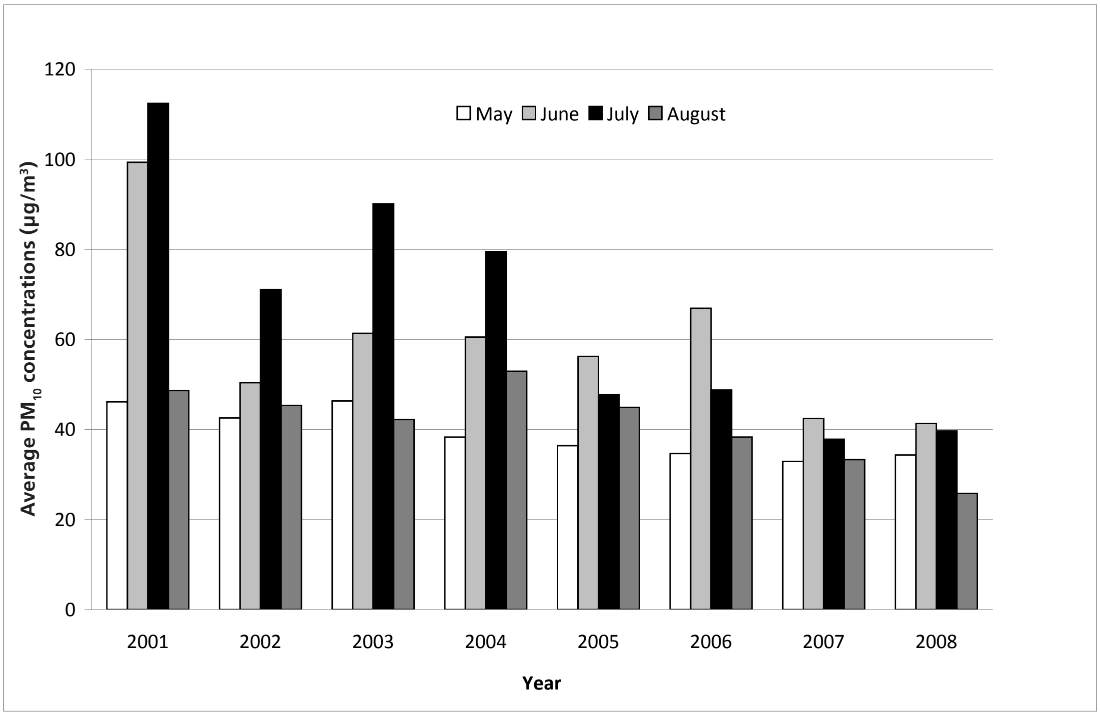


Figure 3.7 Airshed A Average PM_{10} concentrations for winter months, 2001 to 2008

3.7.2 Seasonal Patterns

The monthly average PM_{10} concentrations are also presented for Airshed A, B and C for 2008 to provide a broader picture of how PM_{10} levels vary seasonally across Nelson.

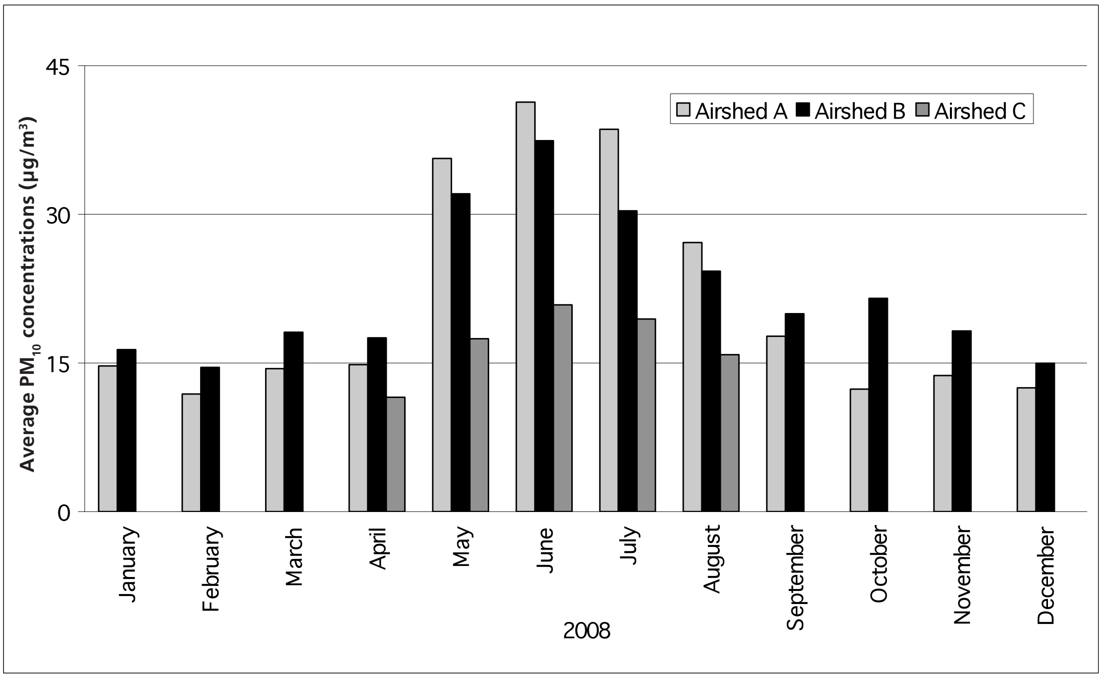


Figure 3.7a Monthly average PM_{10} concentrations for Airshed A, B and C during 2008. Monitoring at Airshed C was over winter from April to August.

Over the year there was a similar pattern in PM_{10} concentrations for Airshed A and B, with a winter peak from May to July when the monthly average is above 30 mg/m^3. The winter PM_{10} concentration recorded at Airshed C is about 50% lower than recorded at Airshed A. The seasonal pattern is a reflection of the amount of pollutants discharged and the weather conditions over the month.

During 2008, the monthly PM_{10} concentration was higher in Airshed B than Airshed A from January to April and September to the end of the year. This probably reflects the combined residential and industrial contribution to this Airshed. The residential contribution from wood burners is concentrated in the winter period while the industrial contribution is distributed evenly throughout the year.

3.8 Meteorological Corrected PM_{10} Data

High PM_{10} concentrations have been shown to predominantly occur on calm, cold winter days because of the increase in emissions from households using domestic heating (including approved wood burners) and because emissions are not dispersed by wind and can accumulate.

A review of the Nelson air quality and meteorological records from 2001-2005 was commissioned by Council and undertaken by Endpoint Consulting Partners to better understand the relationship between monitored concentrations of air pollutants and the prevailing weather conditions (Sherman and Fisher, 2006).

Endpoint used sophisticated statistical techniques to model the relationship between different meteorological variables on days when PM_{10} concentrations exceeded the national guideline levels 50 µg/m^3.

The strongest statistical relationship occurred on days when the temperature averaged 12.7°C or less and over 50% of the day had wind speeds of 2 m/s or less (Figure 3.8). Using this model, it is possible to extract all days that meet the criteria for each year from the monitoring record and to compare air quality across the years. This technique allows the influence of variable weather effects to be largely excluded from the analysis because only the days predisposed to air pollution are considered.

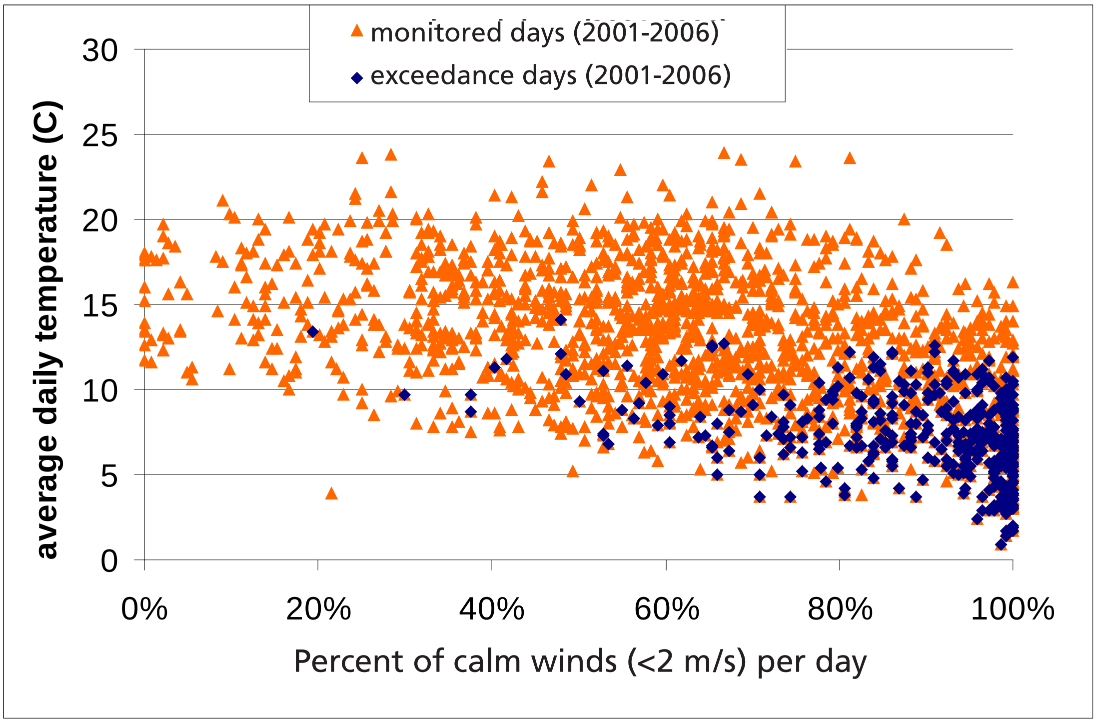


Figure 3.8 Comparison of monitored days and days which exceeded the NES (dashed lines indicate the criteria selected in the analysis for 'exceedance days').

An assessment of the PM_{10} concentrations and meteorological conditions that result in high pollution events was also undertaken by Bluett *et al.*, (2009), as part of the latest emissions trend analysis for 2001-2008 data. The results were consistent with the 2006 study, identifying air temperature and wind speed as the key variables for describing air pollution occurrences.

Overall, the analysis showed the number of potential air pollution days each winter tends to range between 84 and 101 days (over the monitoring period 2001 to 2008). However, average PM_{10} concentrations have fallen from 87 µg/m^3 in 2001 to 39 µg/m^3 in 2008, reflecting a trend towards better air quality in Airshed A (Figure 3.8a).

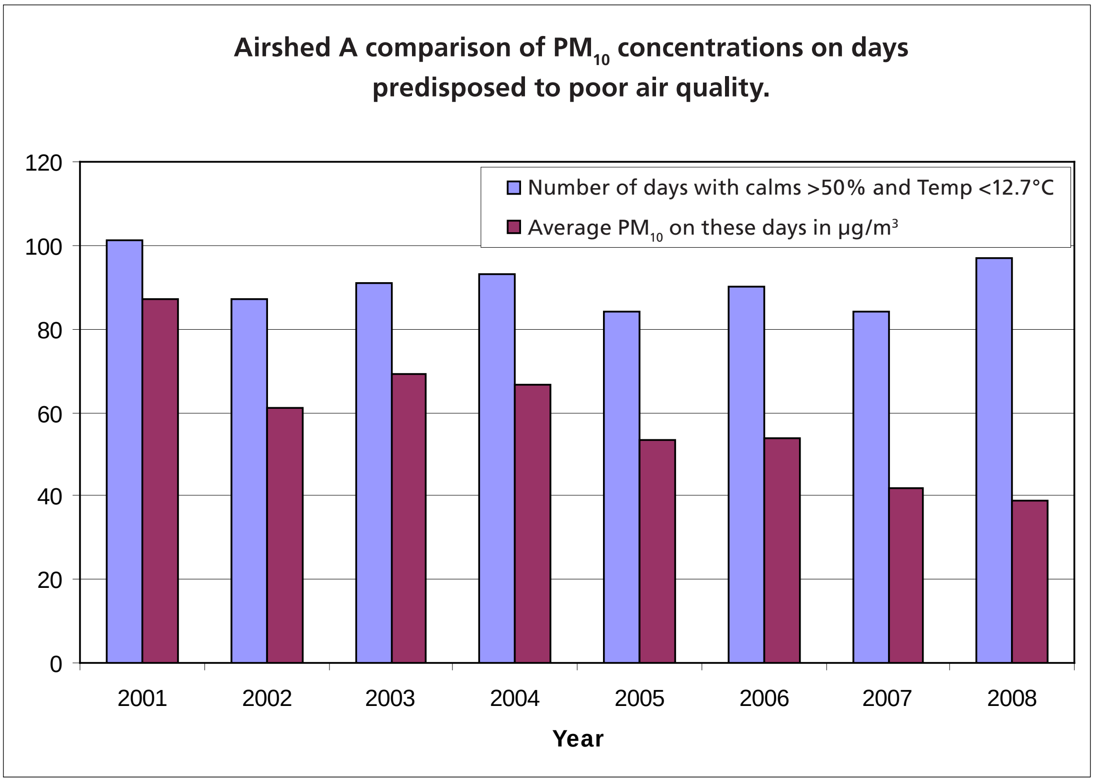


Figure 3.8a Airshed A: Average PM_{10} concentrations on the days predisposed to air pollution for 2001-2008. PM_{10} records are from days when the temperature averaged 12.7°C or less and over 50% of the day had wind speeds of 2 m/s or less. The PM_{10} data was recorded by a Partisol instrument from 2001 to 2006 and BAM instrument from 2006 to 2008.

The trends analysis of PM_{10} emissions from Sherman and Fisher (2006) and Bluett *et al.*, (2009) were consistent, showing a decrease in PM_{10} concentrations during high pollution events of around 30% over the years 2001 to 2005.

The latter study found that estimated PM_{10} emissions from home heating and industry have decreased by 42% over the period 2001 to 2008, and the likelihood of a high potential pollution day resulting in an exceedance has decreased (compared to 2001) by between 20 and 30%.

3.9 NES Straight Line Path

Maximum PM_{10} 24-hour average concentrations are used to set the origin of the straight line path from its inception in 2005 to 2013 when exceedances above 50 µg/m^3 will incur restrictions on granting industrial discharge consents. While these values indicate the maximum exceedance on one particular day, they do not necessarily reflect the overall air quality for the month or the year.

The 2001 maximum PM_{10} concentration recorded for Airshed A of 165 µg/m^3 is used to set the straight line path (Figure 3.9). The zig-zag line shows the PM_{10} maximum measured every year since 2001 and indicates that PM_{10} maximum tracking downward and comfortably under the Straight Line Path (SLP) in Airshed A.

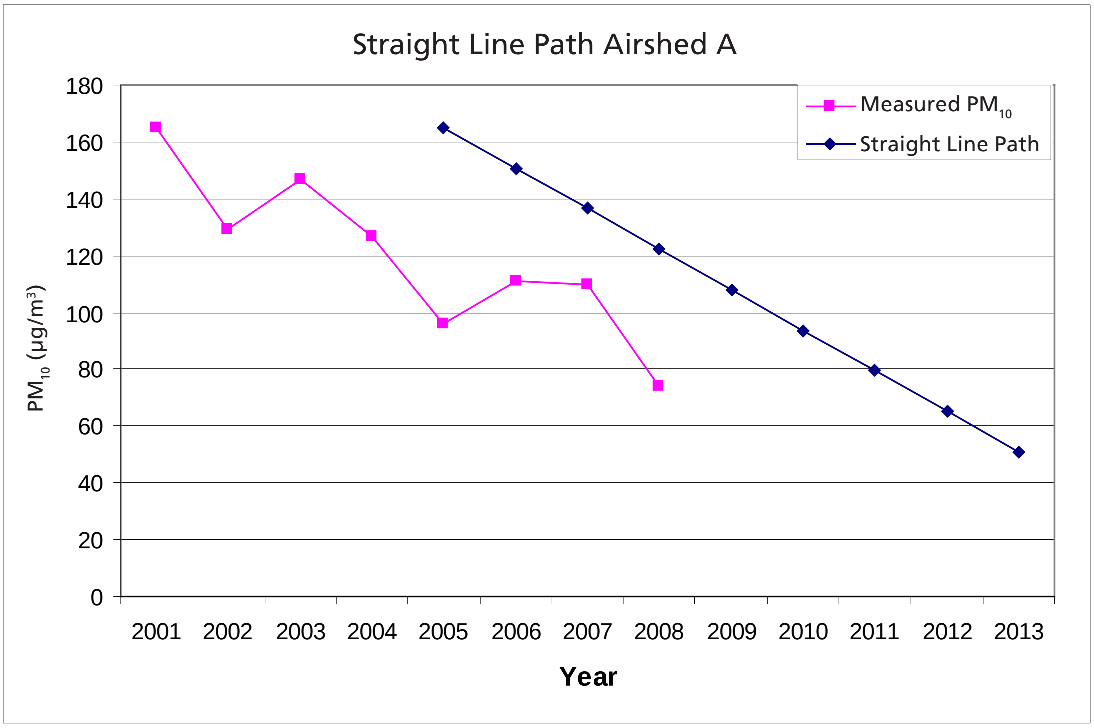


Figure 3.9 Straight Line Path Airshed A, 2005-2013.
Actual measured PM_{10} maximum values are from 2001-2008.

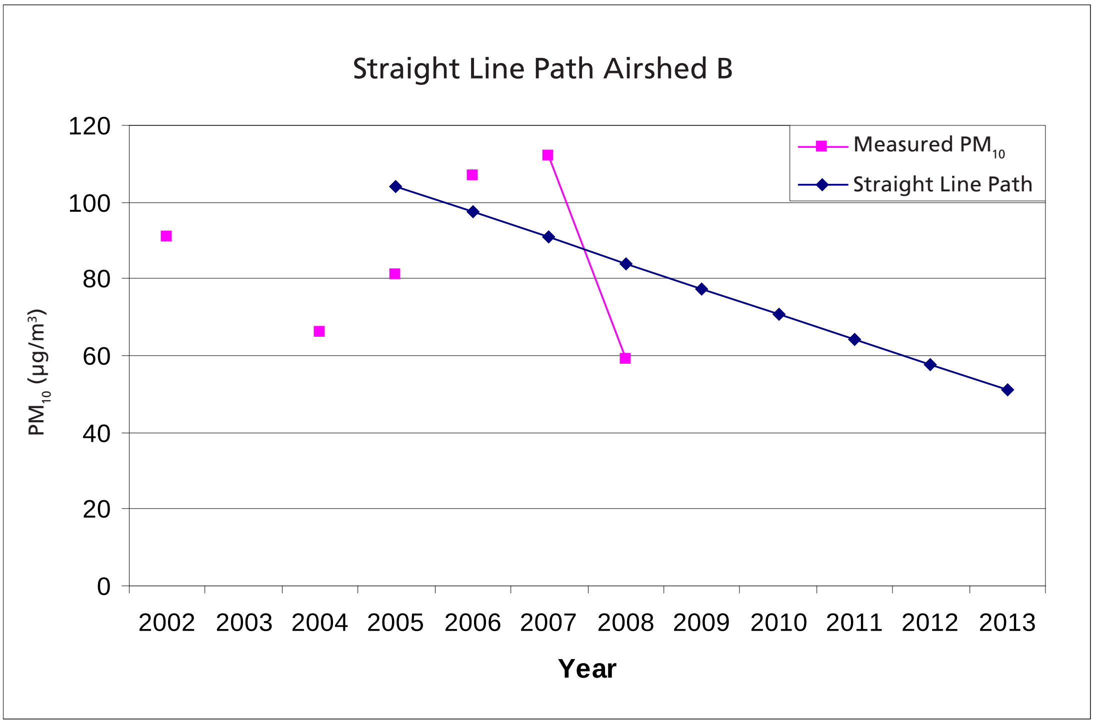


Figure 3.9a Straight Line Path Airshed B, 2005-2013.
Actual measured PM_{10} maximum values for the permanent Blackwood Street Reserve monitoring station are from 2007-2008. The values from 2002 to 2006 are from monitoring at temporary sites in Airshed B.

Airshed B data prior to 2005 is from various locations (Keats Crescent, Nayland Road and Roto Street) and included for completeness (Figure 3.9a). The maximum PM_{10} of 95 µg/m^3 was recorded at Vivian Street in 2006. Monitoring at the existing Blackwood Street Reserve commenced in 2007 with a peak of 112 µg/m^3 (on par with Airshed A), above the SLP for Airshed B. The SLP line for Airshed B (value of 104 for 2005) was calculated from data collected at Vivian Street.

It should also be noted that the provisions of the Nelson Air Quality Plan related to industrial emissions only came into force during 2008. As a result, reductions in total emissions due to resource consent conditions have been limited to date and began after the 2001 peak.

Monitoring commenced at the Brook St site (Airshed C) in 2008. The maximum PM_{10} concentration recorded in Airshed C was 40 µg/m^3 in 2008, 20 µg/m^3 below the straight line path (Figure 3.9b). Changes to wood burner standards and clean air home heating types, along with higher insulation standards should mean that PM_{10} levels will continue to fall in Airshed C without direct intervention.

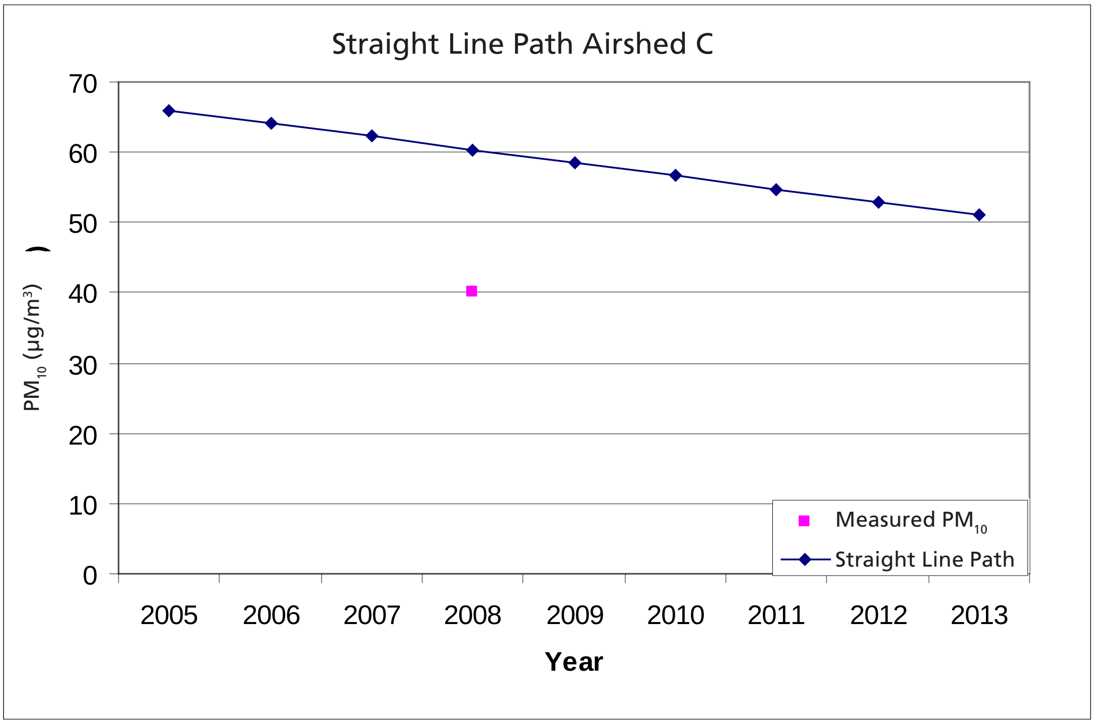


Figure 3.9b Straight Line Path Airshed C, 2005-2013. Actual measured PM_{10} maximum values are for 2008.

3.10 PM_{10} Exceedances

There has been a gradual reduction in the number of exceedances in Airshed A from 81 in 2001 to 24 in 2008. The number of exceedances in Airshed B (Blackwood Street Reserve) was similar over the two years, 9 in 2007 and 11 in 2008. There were no exceedances for Airshed C (Brook Street) during the first complete winter monitoring season in 2008 (Figure 3.10).

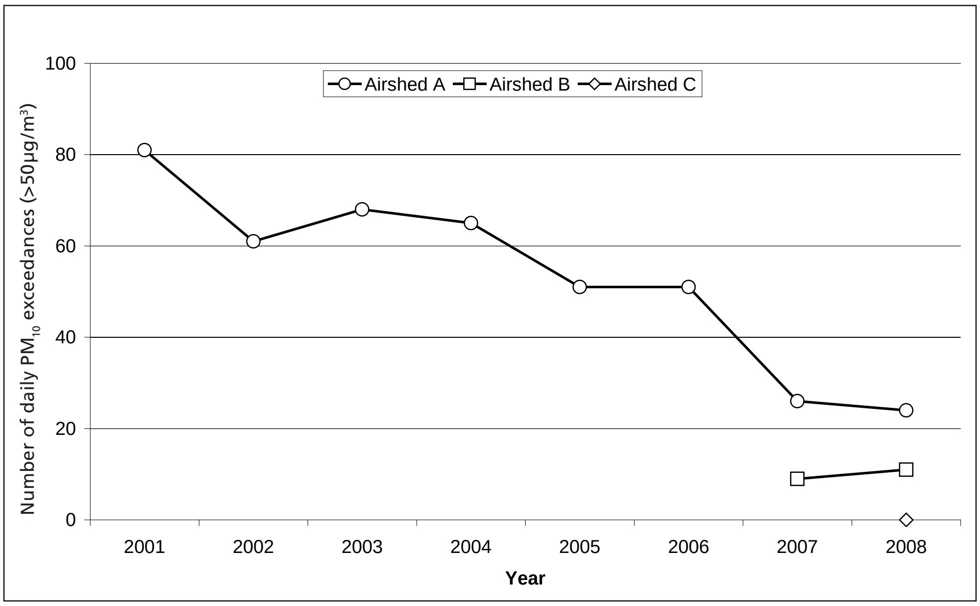


Figure 3.10 The total number of PM_{10} exceedances for Airshed A, B and C, 2001 to 2008 from permanent monitoring stations.

Table 3.10 Annual Performance Indicators/

Annual Performance Indicators		**Airshed A**	**Airshed B**	**Airshed C**
For maximum PM_{10} levels to remain below the maximum levels set by the 'Straight Line Path' (SLP)	**Maximum Allowable SLP in 2008**	122 µg/m^3	84 µg/m^3	60 µg/m^3
	Maximum Recorded PM_{10} in 2008	☺ 74µg/m^3	☺ 59 µg/m^3	☺ 40 µg/m^3
For PM_{10} levels to attain the 'ALERT' Air Quality Category (33-50 µg/m^3) by 1 September 2013, or sooner if practicable		😐 2008 Category = ACTION ➔on track for compliance in 2013	😐 2008 Category = ACTION ➔on track for compliance in 2013	☺ 2008 Category = ALERT ➔compliant now, review monitoring programme after 2009
For no more than one exceedance per year after 2013		😐 24 exceedances in 2008	😐 11 exceedances in 2008	☺ None ➔compliant now, review monitoring programme after 2009
For a steady improvement in ambient air quality since 2001		☺ Decline in PM_{10} levels from 165 to 74 µg/m^3	☺ Decline in PM_{10} levels from 112 to 59 µg/m^3 (data from 2007)	Monitoring started in 2008

Table 3.10a Performance indicators to be met by 2013.

PERFORMANCE INDICATORS TO BE MET BY 2013

Actions required to meet 2013 targets for PM_{10} emissions (relative to 2001 levels) across the urban area:

At least 70% reduction from domestic heating across Nelson (note that domestic heating contributes >80% of total PM_{10} smoke pollution)	😐	From 2001-2008 the estimated reduction in PM_{10} emissions is about 40% Older inefficient enclosed burners will be phased out over several years from 2009 to 2012 in areas of the City, Stoke and Tahunanui Burners in The Wood, The Brook, Nile St area, Atawhai, seaward side of the Port Hills, Todds Valley, The Glen and in the rural area are not subject to compulsory phase-out rules and can continue to be used. Any replacement of burners must be with NES compliant burners
At least 98% reduction from outdoor burning across Nelson	☺	In urban areas, outdoor fires were banned in 2003.
At least 10% reduction from industrial and trade sources across Nelson	😐	Emissions from industry have declined through the use of more efficient burners and through regulation by resource consents
A reduction in emissions from the transport sector across Nelson	☹ ☺	The most recent survey (between 2001 and 2006) shows that the estimated emissions from motor vehicles have increased slightly. Vehicle emissions contribute less than 10% of the total PM_{10} emissions. The Council has promoted a number of strategies, including cycling, walking, public transport and car pooling to assist with reducing vehicle emissions

☺ The Air Quality Plan performance indicator has been met.

😐 The Air Quality Plan performance indicator is showing a trend toward compliance in 2013 but requires further improvement.

☹ The Air Quality Plan performance indicator has not been met and requires a significant improvement for compliance by 2013.

4. LAND AND BIODIVERSITY

4.1 Summary

This Chapter provides an overview of the land environment at a national and regional level in terms of land use (cover), management, ecosystems and threats. Nelson's indigenous vegetation and noteworthy fauna is examined in more detail from a historical perspective. The chapter also includes information from recent ecological surveys:

- the assessment of Nelson's land cover, along with its biodiversity and conservation status, has supported the development of the Nelson Resource Management Plan (NRMP), monitoring programmes and a biodiversity strategy for Nelson
- within the Nelson region, 13 environments are considered at risk (mainly from changes in land use), with less than 20-30% of their native vegetation remaining and that vegetation is also being threatened at a national level. Field surveys have been undertaken to ground-truth the environments mapped and gather baseline site-specific information for future monitoring
- the greatest loss of terrestrial biodiversity in Nelson has come from the clearance of native forests and drainage of wetlands. The loss has declined appreciably in the last 10 years because there is so little remaining to clear or drain, as a consequence of greater biodiversity awareness and because of more positive land management practices. Nelson's most threatened indigenous vegetation and associated fauna is in lowland areas
- more than 190 areas of remnant and regenerating indigenous forest, shrubs and wetlands have been assessed for potential classification as Significant Natural Areas since 2000. The criteria for selecting high priority conservation sites and inclusion within the NRMP Conservation Overlay are currently under review. Most sites surveyed are in the lowland hill country ecosystem, sheltered from coastal influences. A number of other surveyed sites are in coastal hill country and lowland flats and terraces. Fewer sites are in estuary, dune, wetland, coastal flat and upland ecosystems
- the surveys, due to be completed in 2009/10, have been successful in a number of ways, through liaison and raising biodiversity awareness with landowners. The site information will help us to make more informed decisions about how we manage our natural heritage, and to set priorities for providing assistance to land owners and communities.

4.2 Setting the Scene

Nelson's land area comprises approximately 42,000 ha. This is about one third of Nelson City Council's administrative area – the other two thirds of the Nelson area is marine. Most land near the coast is in private ownership, while conservation and public lands dominate in more inland and northern areas. Land ownership in Nelson comprises private land (34%), protected native bush managed by the Department of Conservation (14%), Nelson City Council land (29%) and areas managed as production forest under crown forest licences (23%).

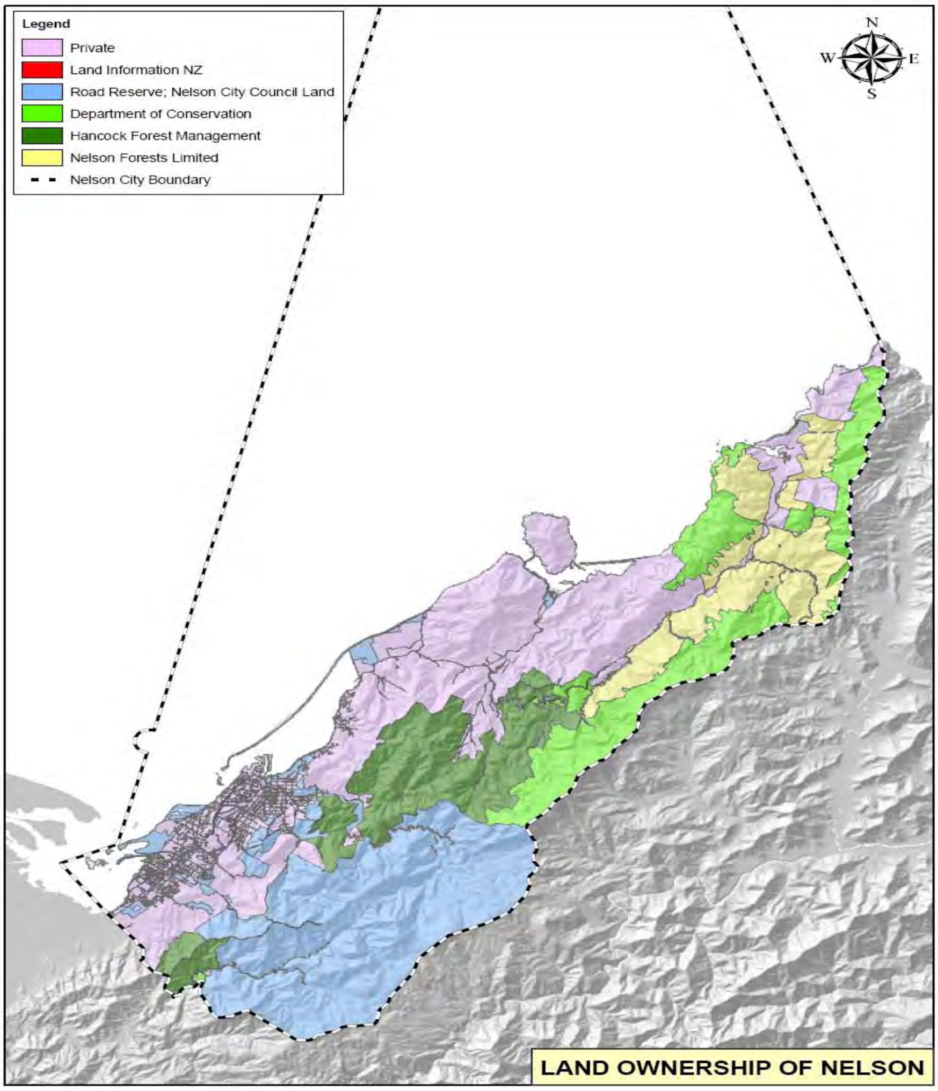


Figure 4.2 Land ownership within the Nelson City Council administrative area.

National Parks and Council reserves protect some of the inaccessible steep hill and mountain country. These managed protected areas do not cover lowland and coastal areas, which are mostly held in private ownership.

Approximately half of the Nelson land area is dominated by exotic (non-native) biodiversity. Some, such as the 22% of land area in exotic production forest and the formal public gardens, are highly valued for economic or aesthetic reasons. Other aspects of exotic biodiversity such as the 6% of the area covered in gorse are less valued.

4.3 Guidelines and Standards

Councils are required to recognise and provide protection for areas of significant indigenous (native) habitats and species as a matter of national importance under section 6c of the Resource Management Act (1991). The Resource Management Act (RMA) does not define what is significant, which has led to issues with interpretation. Over the last 15 years, guidelines have built up based on nationwide surveys using standardised methodologies and a body of good practice examples is now available to guide scientists and resource planners in assessing just how significant an area is.

A range of ecological criteria are considered when assessing a site, including representativeness, rarity, diversity, naturalness, size, shape and connectivity. A site that contains one of the best examples of the characteristic ecosystem types (e.g. coastal sand, dune, spit and boulder communities) in the ecological district is considered to have a high ecological and conservation value.

Figure 4.3 Boulder bank community.

(Source: S. Courtney, Department of Conservation)

The Conservation Overlay of the Nelson Resource Management Plan (NRMP) largely comprises of areas with significant indigenous habitat and species that satisfy the selection criteria within the NRMP.

The Council also has responsibilities under section 35 of the RMA to monitor these natural resources and maintain records. As part of this work, additional surveys of Significant Natural Areas are being undertaken in the Nelson City Council area to identify sites on private land that potentially have significant indigenous species or habitat. The natural areas identified within this work are being reviewed as to whether they shoud be included in the Conservation Overlay or schedules of the Nelson Resource Management Plan (NRMP).

Further work is required to complete this ecological survey (due in 2009/2010) and to consolidate the biodiversity information currently held by the Council and its partners. This information will help us to identify where improvements can be made in the way we manage biodiversity. This may require changes to the NRMP provisions (including selection criteria) to provide better management of significant natural areas and to foster a partnership between landowners and the Council. The surveys will also provide baseline information to monitor the effectiveness of actions by measuring the change in extent and condition of significant habitat cover and species present.

While some natural areas are too small and fragmented to be of significance in their own right, they are still of ecological importance and are used as temporary refuges for wildlife, such as migrant birds. Contemporary planning recognises the importance of preserving and enhancing fragmented natural areas by establishing 'buffer areas' around sites, urban reserves and recreational parks that act as 'green corridors'. Collectively these green spaces are important, and can assist the dispersal of wildlife and recovery of larger remnant and regenerating forest communities.

Figure 4.3a Community planting along Poormans stream, Marsden Valley. Riparian reserves act as 'green corridors' for wildlife, linking remnant vegetation. They also enhance the quality of the river ecosystem for freshwater fish and invertebrate species through shading and nutrient input from leaf litter, amongst other benefits.

4.4 History of Monitoring

In broad terms, the state of the environment reflects the health of ecological communities, measured by key biological and environmental indicators found within an ecosystem.

An ecosystem is defined as the dynamic mix of plant, animal and micro-organisms and the interaction between these organisms and the place where they live. The viability of ecosystems is dependent on the ability of organisms to interact with their environment – life sustaining functions such as seed dispersal and pollination become non-existent in small remnant patches of forest.

The geographic location, climate, land forms, habitat and species are some of the key attributes we use to measure and define a terrestrial ecosystem. Monitoring the state of our environment therefore requires a comprehensive understanding and knowledge of our natural systems.

Environmental information from various sources, including broad-scale satellite imaging of land cover, aerial photography, desk top studies and site-based ecological surveys, has been used to:

- describe and determine what ecosystems occur in Nelson, and how common they are compared to other New Zealand regions
- determine the extent of habitat loss by mapping existing natural areas and comparing this to pre-settlement times
- prioritise survey work to fill information gaps, and design future monitoring and restoration programmes
- select and rank natural areas in terms of their conservation value using a range of ecological selection criteria
- undertake a review of the NRMP provisions to decide what areas of Nelson should be included in the Conservation Overlay and ultimately how they should be managed.

This ecosystem orientated approach to resource management is now firmly integrated in legislation such as the Resource Management Act (1991). Nelson City Council utilises a range of data sources to identify what environments are found in our region and nationwide.

Field surveys have been commissioned and undertaken by the Council to ground-truth the broad-scale surveys and gather site-specific data to further our knowledge and fill information gaps about the ecological communities (habitats and species) that make up our natural heritage.

The national data sets used to describe the Nelson environment in this report include:

- the NZ Land Cover Database. This provides information from satellite images that can be used to calculate the cover of the land use (e.g. urban, forest composition) within the Nelson area
- the Land Environment New Zealand ecosystem-based classification of New Zealand's landscape. The ecological classifications are derived from extensive data sets that incorporate forest composition, climate, land forms and soils. This enables us to compare similar environments regardless of their geographic location.

Environmental data is also gathered from numerous sources to complement the ecosystem overlays including monitoring projects in collaboration with other agencies (i.e. Department of Conservation, Cawthron Institute, NIWA) and from scientists, the general public, interest groups and schools.

A review of Nelson's land cover along with its biodiversity and conservation status was undertaken in 2006. It was developed as a technical report with contributions from the Department of Conservation This review supported the development of a biodiversity strategy for Nelson (Nelson Biodiversity Strategy Technical Report, Lawless and Holman, 2006, Section 4.5).

Surveys of potential Significant Natural Areas on private land have been undertaken in the Nelson City Council area by Mike Harding and Michael North. These areas were originally identified in 2000, based on desktop surveys (Harding, 2000; 2004; 2007). The detailed survey work and reporting has provided a far greater insight into the Significant Natural Areas of Nelson, which is summarised in Section 4.8.

The nomenclature (naming and classification) used for community types in the Significant Natural Areas survey follows that proposed by Atkinson (1985). This system is recognised and used by other Councils and agencies. Each survey site is grouped and described in the context of the Ecological District with in which it resides. This Ecological Region and District classification provides a framework for assessing the "representativeness" of natural areas within a boundary defined by a combination of climatic, topographical, geological and biological factors.

A Biodiversity Ministerial Advisory Committee was appointed to consider how indigenous species should be sustained and managed on private land. It recommended that management should be through local government, and to mainly take a non-regulatory approach.

The Nelson City Sustainable Land Management Advisor provides advice on enhancing biodiversity, assistance in preparing management plans for natural areas, applications for grants from central Government and trusts and with identification of indigenous and pest species.

Nelson City Council can also provide private landowners with funds to assist with biodiversity management through the Biodiversity Fund. This fund assists landowners with fencing of priority riparian margins, pest control and some plant materials.

Opposite: **Figure 4.5** Wakapuaka 1B whanau planting at Delaware Bay with assistance from the Nelson City Council Sustainable Land Management Advisor, Lynne Hall.

4.5 Nelson's Terrestrial Environment

Information from satellite images (from the NZ Land Cover Database 2) has been used to calculate the cover of the land area within the Nelson area in 2005 (Figure 4.5).

Only 6% of the land within the Nelson area is an urban environment of houses, factories, shops and parks. Native (indigenous) forest covers 34%, with regenerating kanuka on hill slopes covering a further 8% of the total area. Areas of gorse and other exotic woody vegetation cover 6%. This could regenerate into native forest, depending on the interplay of fire, land disturbance and weeds and pests. Most of the remainder has been developed as crop and farm land (13%) and as exotic production forest (23%).

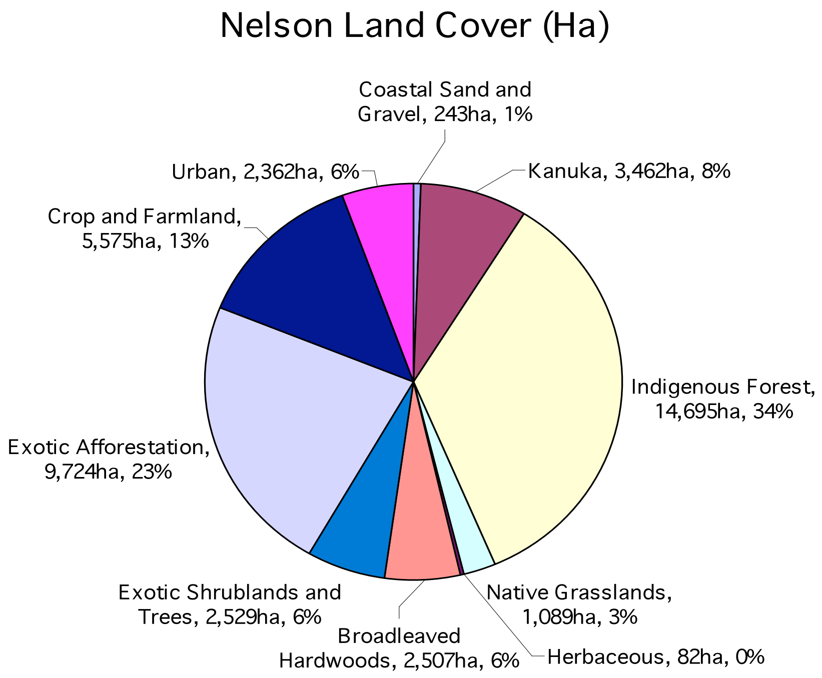
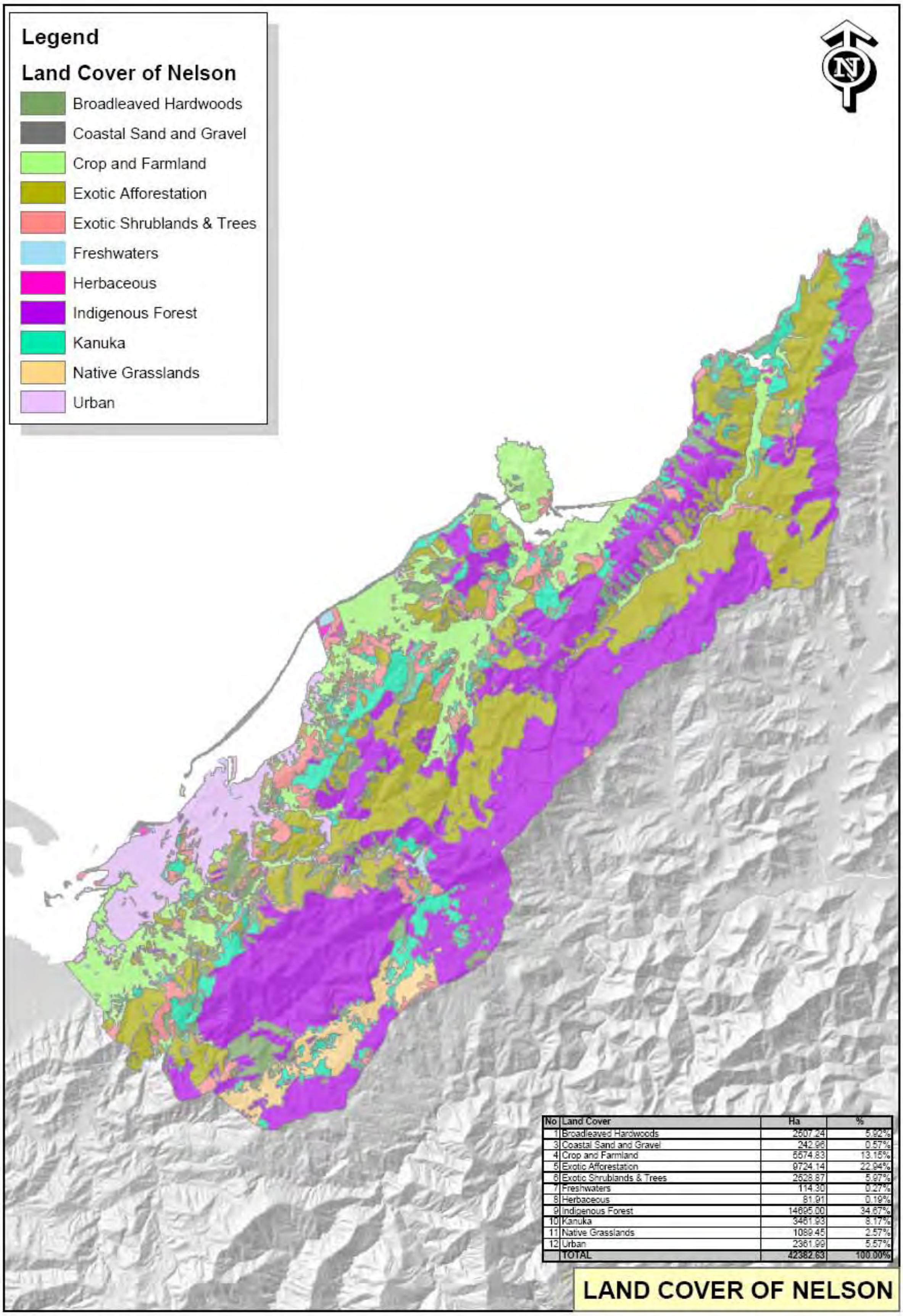


Figure 4.5 Percentage composition of Nelson land cover types derived from NZ Land Cover Database 2 (2005).

At high altitudes and around the coastal margins are areas of native grasslands (3% of total land area) where the extremes of weather suppress the growth of woody vegetation.



No	Land Cover	Ha	%
1	Broadleaved Hardwoods	2507.24	5.92%
3	Coastal Sand and Gravel	242.96	0.57%
4	Crop and Farmland	5574.83	13.15%
5	Exotic Afforestation	9724.14	22.94%
6	Exotic Shrublands & Trees	2528.87	5.97%
7	Freshwaters	114.30	0.27%
8	Herbaceous	81.91	0.19%
9	Indigenous Forest	14695.00	34.67%
10	Kanuka	3461.93	8.17%
11	Native Grasslands	1089.45	2.57%
12	Urban	2361.99	5.57%
	TOTAL	42382.63	100.00%

Figure 4.5a Extent of Nelson land cover types derived from NZ Land Cover Database 2 (2005). The total area and percentage of cover for each Land Cover category is summarised.

Noteworthy facts about Nelson's native forests include:

- some significant tracts of coastal and lowland forest have been retained (unlike many cities)
- special vegetation types of matai – black beech forest and tanekaha – southern rata forest
- 17 species of nationally threatened plants, and a national stronghold for several species including shovel mint and mineral belt endemics
- southern limits for North Island species (tanekaha, pukatea, kohekohe, tawa, black maire) and western limits for Marlborough Sounds species (ramarama, leafless bush lawyer)
- special environments of the mineral belt and limestone belt ecosystems.

Figure 4.5b The regionally endemic Limestone Kowhai (*Sophora longicarinata*) and Three Finger (*Pseudopanax macinytrei*) found in the Bryant Ecological District on the limestone belt. (Source: S. Courtney, Department of Conservation)

Based on what we know about the ecological history of New Zealand prior to human occupation of this area:

- most of the Nelson region below the 1200m tree line was covered in tall forest
- open (non-forest) areas were uncommon and confined to river beds and deltas, wetlands, estuaries, dunes, bluffs, and the Nelson mineral belt
- the region was teaming with wildlife – birds, lizards, bats, insects and seals.

(Source: S. Courtney, Department of Conservation)

4.6 Loss of Terrestrial Biodiversity

The greatest loss of terrestrial biodiversity in Nelson has come from clearance of native forests and drainage of wetlands. The extent of vegetation loss represents historical patterns in land use (Figure 4.6). Loss of native vegetation from Nelson City has declined appreciably over the last ten years, relative to the historical clearances associated with human settlement in the area.

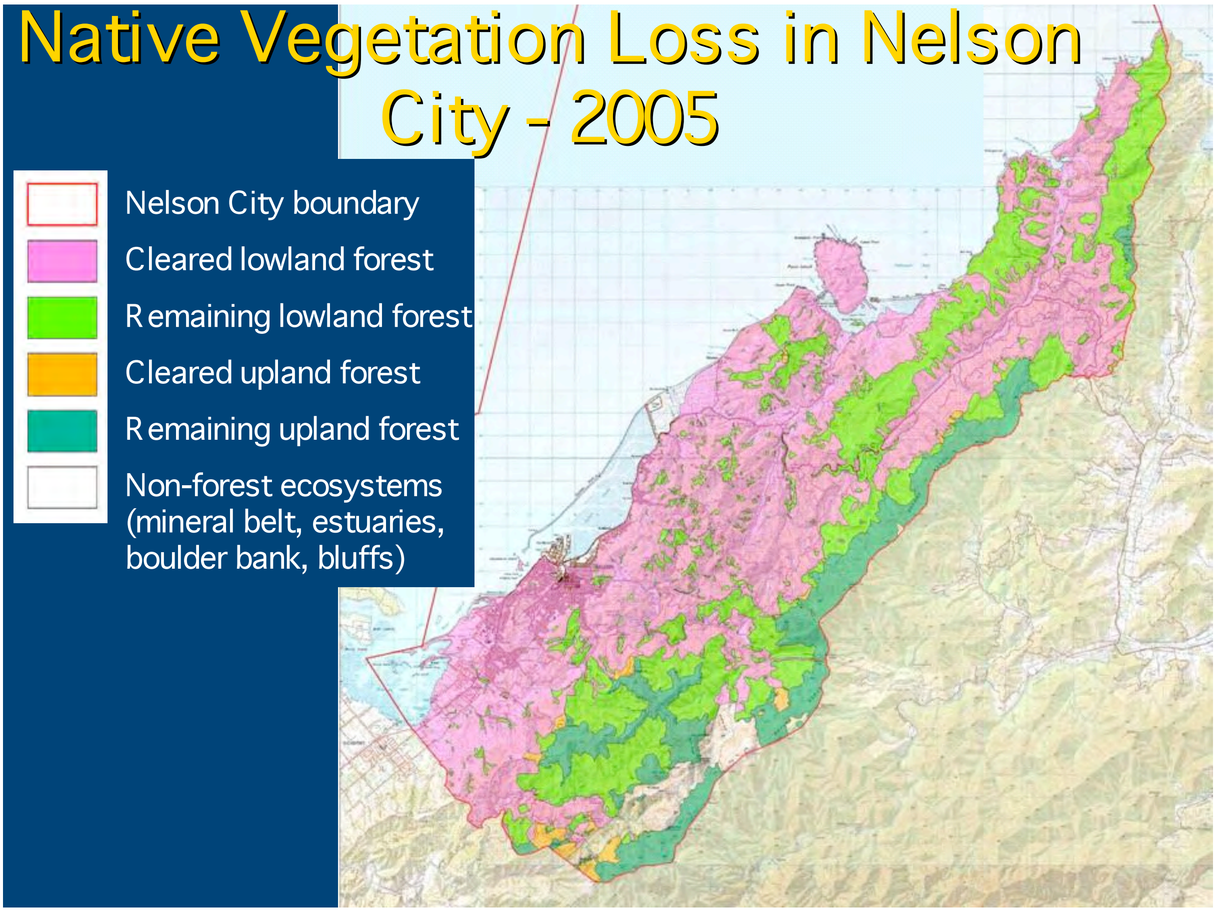


Figure 4.6 Native vegetation loss in Nelson City as of 2005. Green hatched areas show the remaining forest, largely inland and in upland areas. (Source: S. Courtney, Department of Conservation)

4.7 Land Environments of New Zealand

The Land Environments of New Zealand (LENZ) system, with 500 environments nationally, identifies 26 environments in Nelson City. The geographic extent of land cover for the 26 LENZ environments that retain native vegetation cover in Nelson City is shown in Figure 4.7a.

Twelve of the 26 environments in Nelson are included in risk categories. The most at risk ecosystems are those where more than 90% of the original native forests, grasslands and wetlands are gone from New Zealand. These are termed acutely threatened. The criteria for the risk categories is summarised in Table 4.7.

Category	Acutely Threatened	Chronically Threatened	At Risk	Critically Underprotected	Under-protected
Criteria	<10% indigenous cover remaining	10-20% indigenous cover remaining	20-30% indigenous cover remaining	<10% legally protected	<20% legally protected

Table 4.7 LENZ risk categories for native biodiversity.

Nelson has portions of the following six of New Zealand's nationally acutely threatened native environments. Note that the letters and numbers in brackets are national codes for environments under the LENZ system. Please refer to the Lawless & Holman (2006) for further information describing the environments and the LENZ codes.

1. Undulating hills and plains (B1.1a) This environment is managed by the Council as public open space and is where the bulk of Nelson City has been built. Natural vegetation occurs as scattered remnants on the margins of the urban area and in the rural Hira landscape.
2. Wet plains (B4.1a) Indigenous cover remains on 2% (15ha) of wet plains. Twelve hectares (2%) is legally protected by the Department of Conservation and Nelson City Council and a further 3ha of this environment is managed by the Council as public open space. Wet plains are now generally well-drained and have become the industrial areas stretching from Tahunanui and along the eastern shore of Waimea Estuary towards Richmond. The only remaining native vegetation is found in association with the wet plains area at The Glen.
3. Cooler well drained flood plains (J1.1a). Indigenous cover remains on 10% (19ha) of cooler well drained flood plains. There is less than 1ha legally protected, and this is by Department of Conservation. In Nelson the cooler, well-drained flood plains are a feature of the valley leading down into Delaware Inlet. A native forest remnant (Paremata Flats) at the head of the inlet is the only remaining stand of native vegetation in this environment.
4. Warmer well drained flood plains (J1.1b). Indigenous cover remains on 12% (44ha) of warmer well drained flood plains. This is the environment of the city centre, the airport, Tahunanui, residential area and behind Corder Park at Atawhai. The remaining native vegetation is mostly on the estuary margins near the airport.

5. Low fertility well drained flood plains (J1.1c). Indigenous cover remains on 12% (42ha) of it. There is less than one hectare legally protected by Department of Conservation. Six percent (22ha) of this environment is managed by the Council as public open space.
6. High fertility recent floodplains (J1.2b) Indigenous cover remains on 75% (15ha) of these areas. None is legally protected. Ninety-five percent (19ha) of this environment is managed by the City Council as public open space. This is the recently accreted area at Tahunanui beach.

Native ecosystems with 10-20% of their native vegetation remaining are classified as **chronically threatened**. Nelson has portions of the following nationally chronically threatened native ecosystems:

7. Rolling hills (B8.1b) No indigenous cover remains on these hills and none is included in legally protected areas or as public open space. This environment is located in the urban area north of Corder Park.
8. Low fertility hills (E1.1a) Indigenous cover remains on 24% (184ha) of these hills, which are the highest hills of the urban area and the lowest hills of Nelson's immediate backdrop. The remaining native forest forms a narrow band in the Sharland's Creek catchment.
9. Imperfectly drained plains (F5.1b) Indigenous cover remains on 16% (58ha) of imperfectly drained plains. Five per cent (16 ha) is legally protected by QEII, Department of Conservation and Nelson City Council. The largest areas of imperfectly drained plains are on the floor of the Whangamoa Valley but the main areas of remaining native vegetation are around Delaware Inlet.
10. Flood plains (H3.2a) Indigenous cover remains on 11% (58ha) of flood plains. Two per cent (9ha) is legally protected by the Department of Conservation and QEII.

At risk ecosystems have 20-30% of their native vegetation remaining. Nelson has portions of the following native ecosystems that are chronically threatened at a national level.

11. Warmer low fertility hills (E1.1b) Indigenous cover remains on 22% (973ha) of warmer low fertility hills. Two percent (72ha) is legally protected by Nelson City Council and QEII. A further two percent (109ha) of this environment is managed by the City Council as public open space.
12. Fertile plains (K1.1e) Indigenous cover remains on 8% (0.4ha) of fertile plains. None is included in legally protected areas or as public open space.

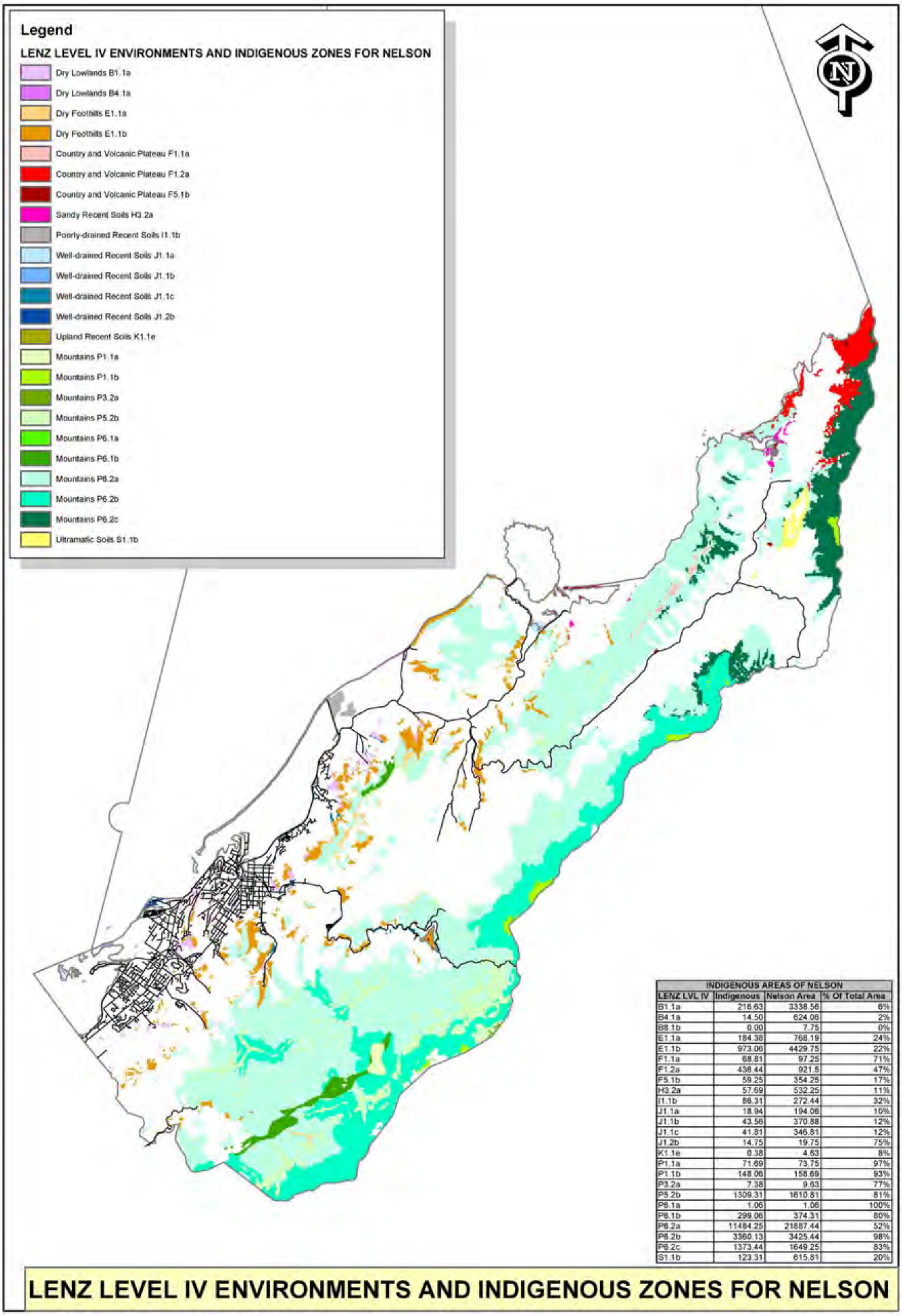
Some ecosystems with more than 30% of their native vegetation remaining are poorly represented in protected areas. They are not considered threatened but are less than 20% legally protected and remain vulnerable to further loss.

13. Flat coastal plains (I1.1b) Indigenous cover remains on 32% (86ha) of flat coastal plains. Three per cent (9ha) is legally protected by the Council and the Department of Conservation. A further ten percent (26ha) of this environment is managed by the Council as public open space.

The other 13 LENZ environments in Nelson are not nationally threatened or under protected. All of these are hill and mountain environments.

The geographic extent of land cover for the 26 LENZ environments that have legal protection in Nelson City is shown in Figure 4.7a. Most of this land is managed by the Department of Conservation and Nelson City Council as reserves.

The areas of Nelson that have nationally threatened and under protected ecosystems with native cover (habitats and species) are shown in Figure 4.7b.

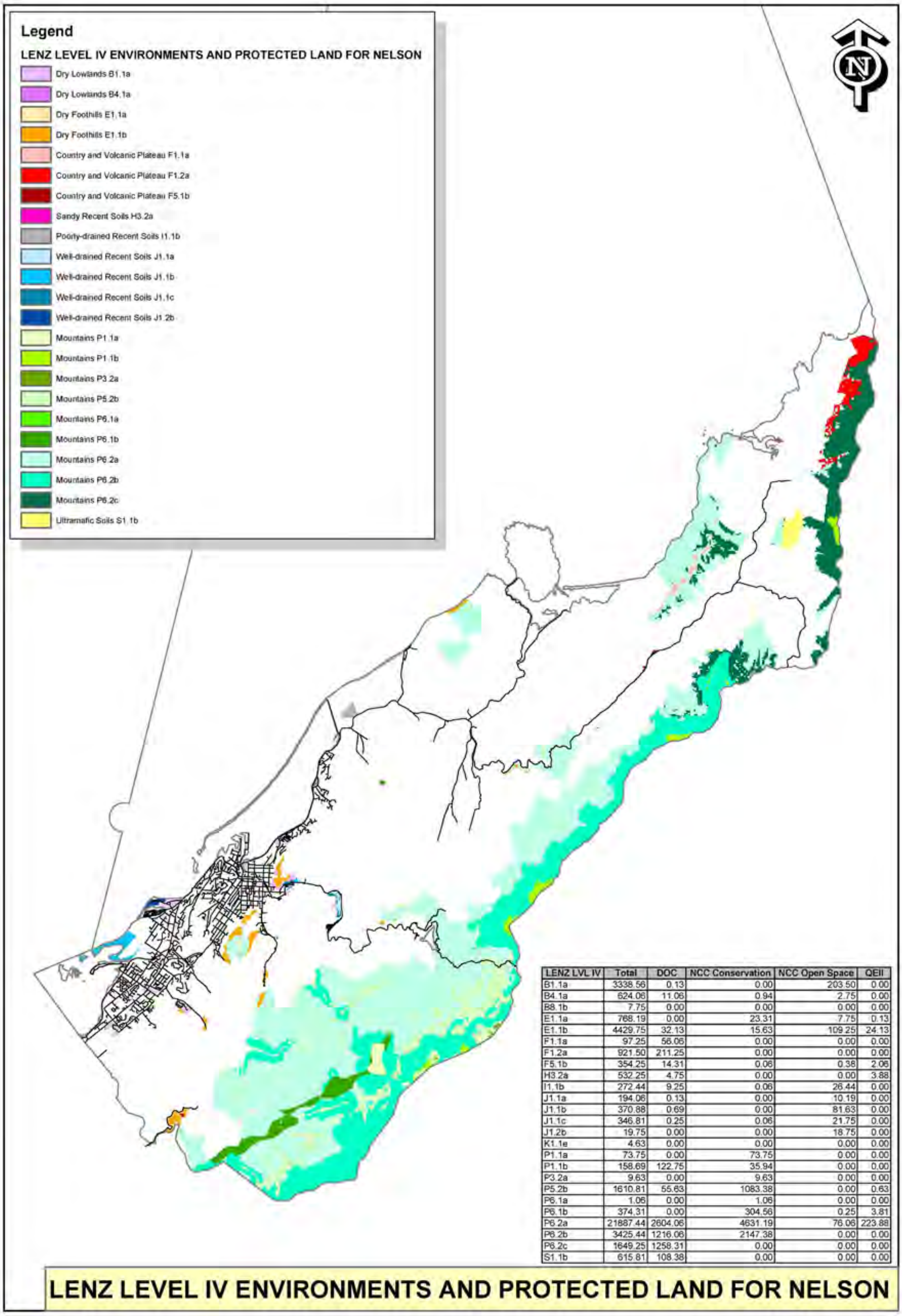


INDIGENOUS AREAS OF NELSON

LENZ LVL IV	Indigenous	Nelson Area	% Of Total Area
B1.1a	216.63	3338.56	6%
B4.1a	14.50	624.06	2%
B8.1b	0.00	7.75	0%
E1.1a	184.38	768.19	24%
E1.1b	973.06	4429.75	22%
F1.1a	68.81	97.25	71%
F1.2a	436.44	921.5	47%
F5.1b	59.25	354.25	17%
H3.2a	57.69	532.25	11%
I1.1b	86.31	272.44	32%
J1.1a	18.94	194.06	10%
J1.1b	43.56	370.88	12%
J1.1c	41.81	346.81	12%
J1.2b	14.75	19.75	75%
K1.1e	0.38	4.63	8%
P1.1a	71.69	73.75	97%
P1.1b	148.06	158.69	93%
P3.2a	7.38	9.63	77%
P5.2b	1309.31	1610.81	81%
P6.1a	1.06	1.06	100%
P6.1b	299.06	374.31	80%
P6.2a	11484.25	21887.44	52%
P6.2b	3360.13	3425.44	98%
P6.2c	1373.44	1649.25	83%
S1.1b	123.31	615.81	20%

LENZ LEVEL IV ENVIRONMENTS AND INDIGENOUS ZONES FOR NELSON

Figure 4.7a The geographic land cover for the 26 LENZ environments that retain native vegetation in Nelson City. **Legend notes:** The LENZ name preceding the code refers to one of the 20 Level I environments; and the associated code indicates the (higher) level of classification for the respective environment.



LENZ LVL IV	Total	DOC	NCC Conservation	NCC Open Space	QEII
B1.1a	3338.56	0.13	0.00	203.50	0.00
B4.1a	624.06	11.06	0.94	2.75	0.00
B8.1b	7.75	0.00	0.00	0.00	0.00
E1.1a	768.19	0.00	23.31	7.75	0.13
E1.1b	4429.75	32.13	15.63	109.25	24.13
F1.1a	97.25	56.06	0.00	0.00	0.00
F1.2a	921.50	211.25	0.00	0.00	0.00
F5.1b	354.25	14.31	0.06	0.38	2.06
H3.2a	532.25	4.75	0.00	0.00	3.88
I1.1b	272.44	9.25	0.06	26.44	0.00
J1.1a	194.06	0.13	0.00	10.19	0.00
J1.1b	370.88	0.69	0.00	81.63	0.00
J1.1c	346.81	0.25	0.06	21.75	0.00
J1.2b	19.75	0.00	0.00	18.75	0.00
K1.1e	4.63	0.00	0.00	0.00	0.00
P1.1a	73.75	0.00	73.75	0.00	0.00
P1.1b	158.69	122.75	35.94	0.00	0.00
P3.2a	9.63	0.00	9.63	0.00	0.00
P5.2b	1610.81	55.63	1083.38	0.00	0.63
P6.1a	1.06	0.00	1.06	0.00	0.00
P6.1b	374.31	0.00	304.56	0.25	3.81
P6.2a	21887.44	2604.06	4631.19	76.06	223.88
P6.2b	3425.44	1216.06	2147.38	0.00	0.00
P6.2c	1649.25	1258.31	0.00	0.00	0.00
S1.1b	615.81	108.38	0.00	0.00	0.00

Figure 4.7b The extent of land cover for the 26 LENZ environments that have legal protection in Nelson City.

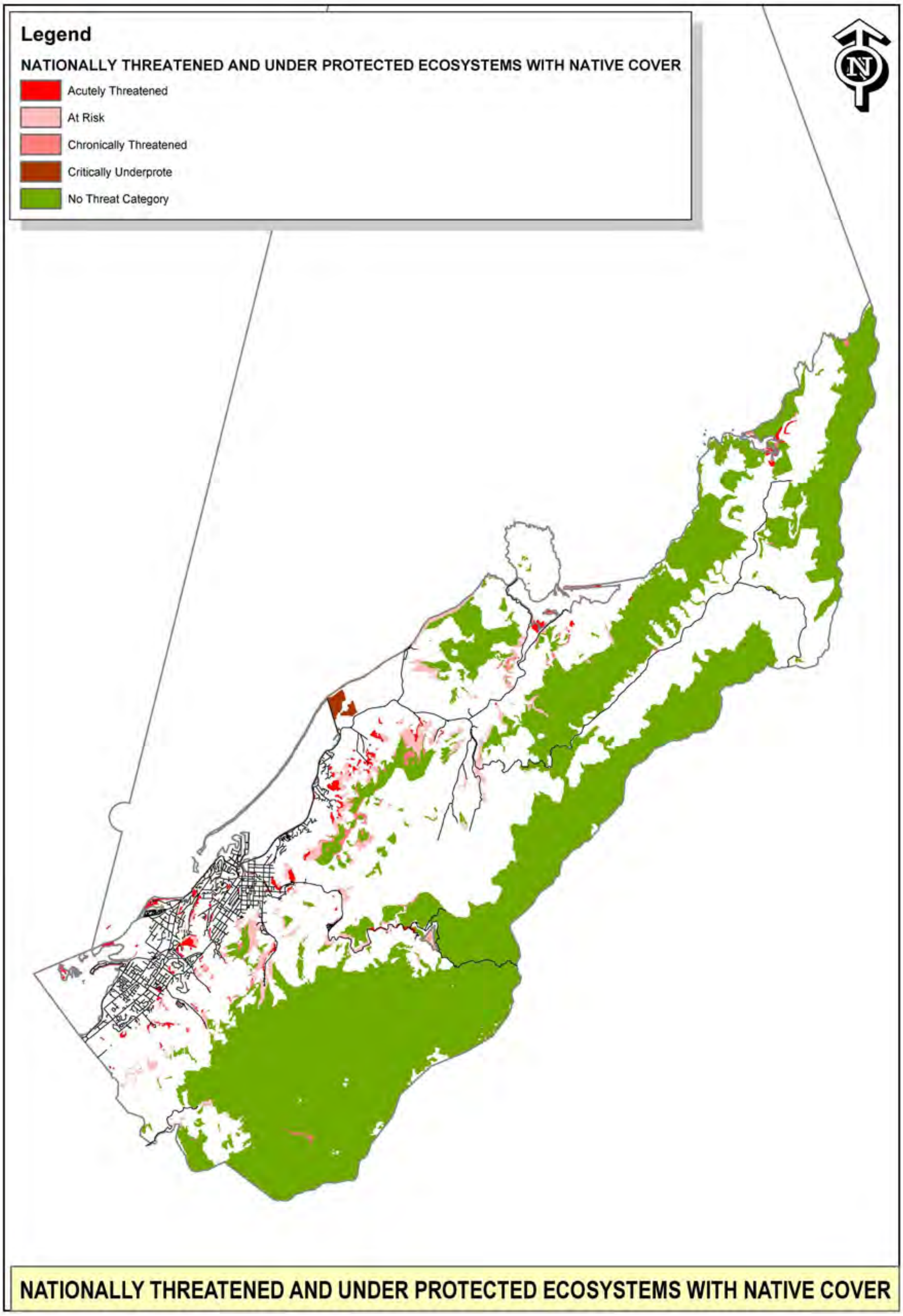


Figure 4.7c Nationally threatened and under protected ecosystems with native cover (habitats and species).

Most of Nelson's nationally threatened and under protected ecosystems with native cover are found on the lower elevation rolling hills and flats. Field work to record species and habitats in these and other native areas are underway as part of the SNA monitoring and regular SOE monitoring to support national priorities for protecting and restoring native ecosystems.

Nelson has already lost many of its iconic and its less well-known native species. The montage below (Figure 4.7d) shows Nelson Haven as it may have appeared to the first people in 1200AD.

Figure 4.7d Some of the species lost to Nelson since people arrived that still survive elsewhere in New Zealand. Illustrated are: Kokako, whio, mohua, kiwi, bats, tieke, takahe and kakapo. Nelson has also lost many of its native reptiles, amphibians and invertebrates. Source: Department of Conservation.

4.8 Survey of Significant Natural Areas

Over 190 sites have been considered for inclusion as potential Significant Natural Areas (SNA), with 134 sites surveyed since 2000. The SNA survey complements earlier surveys of indigenous vegetation on private land undertaken in 1999, which identified 29 sites for inclusion in the Conservation Overlay of the Nelson Resource Management Plan. These surveys have been prompted by the Council's obligations under the Resource Management Act to protect "areas of significant indigenous vegetation and significant habitats of indigenous fauna as a matter of national importance". They are similar to surveys carried out by city and district councils throughout the country.

In this latest survey, ecologist Michael North visited 134 potential significant natural areas on privately-owned properties, Council Reserves and Forestry land in the Nelson City area (Figure 4.8). These areas, covering over 1600 hectares, include valuable remnants of indigenous vegetation, populations of threatened plants and animals, and species previously regarded as locally extinct in the Nelson City area. The significance criteria used to assess potential significant natural areas have been reviewed and revised criteria, consistent to what Tasman District Council uses, are proposed. The existing objectives, policies and rules within the NRMP regarding the protection of significant natural areas are also being reviewed in 2010 and will result in changes to the NRMP in 2011.

Landowners were contacted by letter, a visit and by telephone and then access to properties was arranged. The survey was primarily a vegetation survey, identifying indigenous plants and communities and assessing their ecological values. Survey results, including comments on weed and pest threats and management issues, have been provided to landowners. This survey work is ongoing, with a further six land owners providing approval for survey work in 2010/11. Approximately 14% of the 190 sites originally identified have not been surveyed because access to private land has been declined.

The presence and health of these areas of indigenous vegetation and habitat are a credit to the vision and efforts of landowners. Many areas of vegetation are already appreciated and formally protected by the landowners. The survey results will help Council to work with landowners to ensure the survival of these areas. The results will also allow Council to set priorities for providing assistance to landowners.

Indigenous vegetation in eight broad ecosystem types was surveyed (Figure 4.8a). Most sites surveyed are in the lowland hill country ecosystem, on hill slopes below 600m in elevation and sheltered from coastal influences. A number of other surveyed sites are in coastal hill country and lowland flats and terraces. Fewer sites are in estuary, dune, wetland, coastal flat and upland ecosystems because of extensive modification and low levels of protection.

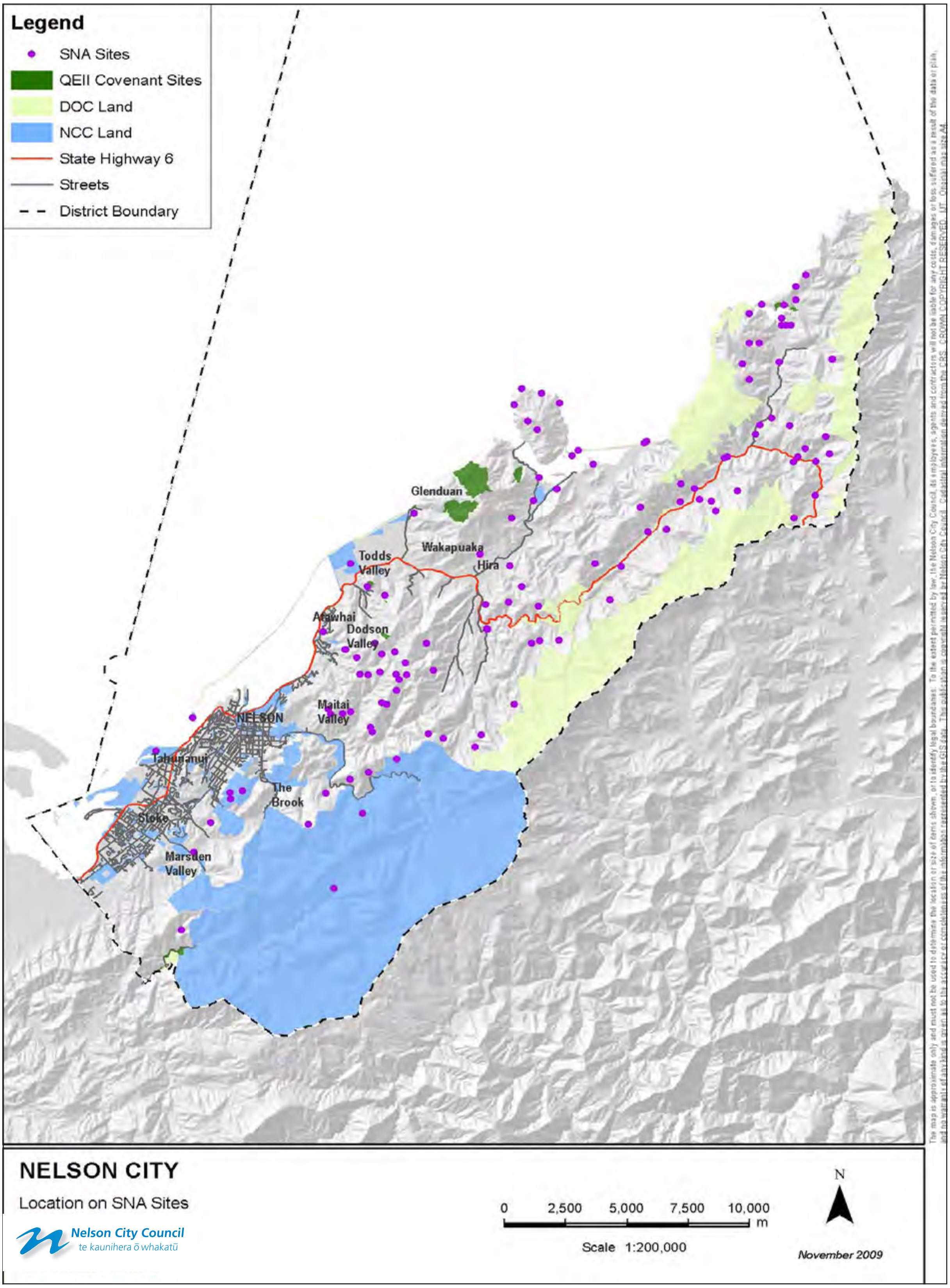


Figure 4.8 Locations of Significant Natural Area sites surveyed since 2001.

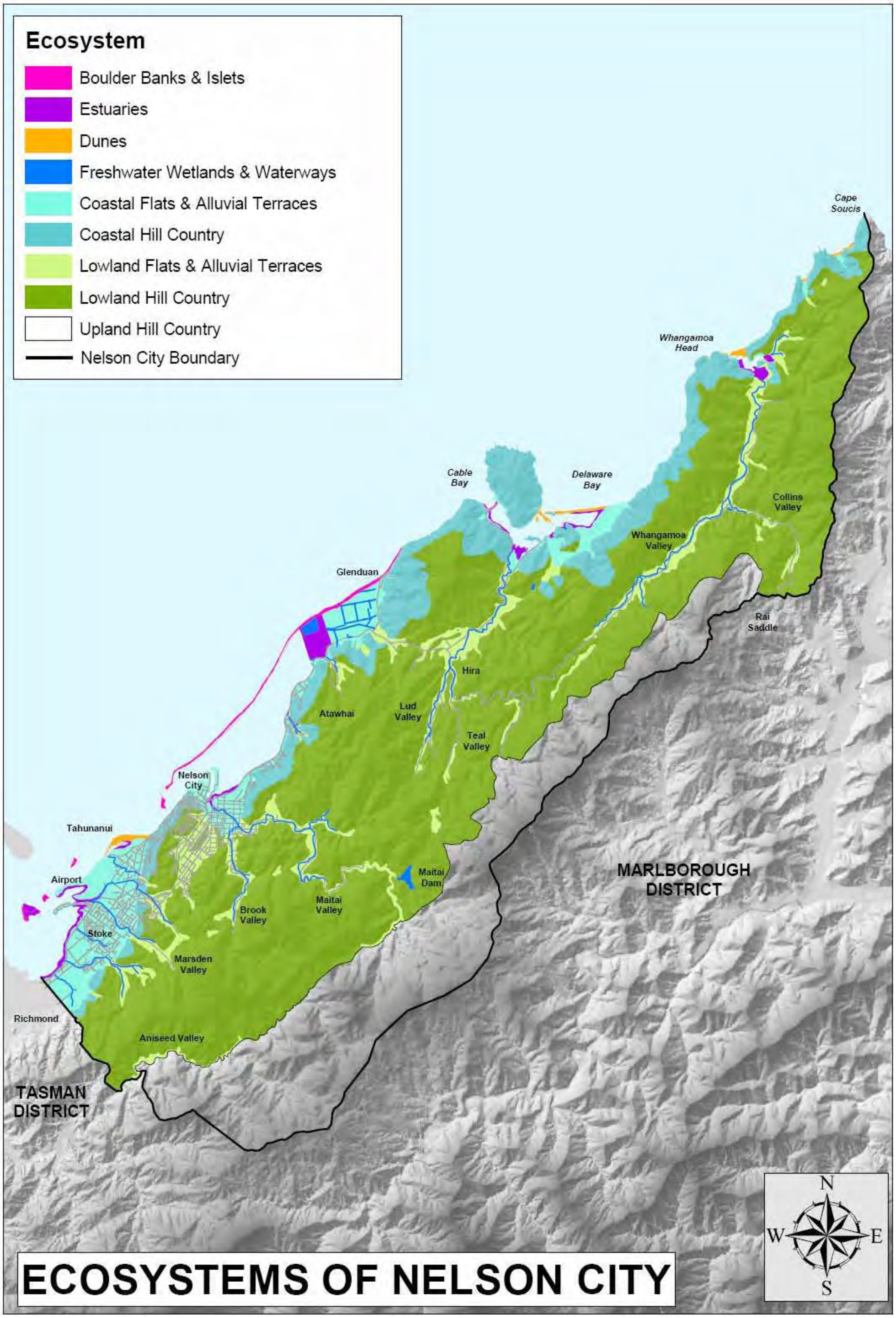


Figure 4.8a Geographic extent of indigenous vegetation in Nelson. Significant natural areas were identified in the eight broad ecosystem types illustrated above.

Estuaries

Estuary margin vegetation occurs in some parts of all the estuaries in Nelson, including Waimea Inlet, Nelson Haven, Delaware Inlet and Kokorua Inlet. Only about 17% of the original extent of estuary margin vegetation remains, largely due to reclamation and farm development. Estuary margins support sedgeland, tussockland and shrubland, dominated by sea rush, oioi, saltmarsh ribbonwood and, sometimes, estuary tussock. Saltmarsh herbs, including shore primrose, remuremu, coastal button, shore lobelia and sea celery are occasionally present.

Two estuary margin sites covering approximately three hectares were surveyed. Fernbird, a regionally threatened species, were recorded at both sites. These birds are part of two known populations in the Nelson area, where they are in critically low numbers. They are confined to the small areas of estuary margin and associated freshwater wetland vegetation at both sites. Coastal shrub daisy and umbrella sedge were also recorded. These species are at risk of extinction in the Nelson area.

Figure 4.8c Oioi beds.

Figure 4.8d Akeake, coastal flax and marram grass.

Dunes

Dune systems and sand spits are dotted along the Nelson coast at Tahunanui, Delaware Inlet, Kokorua Inlet and at several bays towards Cape Soucis. These areas are now almost entirely dominated by exotic species, primarily marram grass, ice plant, gorse, blackberry and grasses. This is the most depleted ecosystem in the Nelson area (along with freshwater wetlands) with less than 1% of the original extent of native vegetation remaining. However the land forms are intact at many sites and there are small remnants of native vegetation including spinifex, pingao, wharariki flax and akeake. Restoration of two dune systems is underway – of which newly established spinifex and pingao tussockland at Tahunanui Beach is the most extensive.

Two dune ecosystem sites covering approximately nine hectares were surveyed. Five plant species that are at risk of extinction in the Nelson area were recorded: two species of porcupine shrub (*Melicytus "Waipapa"* and *Melicytus* aff. *obovatus*), prostrate matagouri, sand sedge and spinifex. Both prostrate matagouri and spinifex are regionally threatened. One site provides breeding habitat for banded dotterel (a nationally threatened species) and variable oystercatcher.

Freshwater wetlands

Freshwater wetlands were never very extensive in the Nelson City area apart from the great 300ha swamp at Wakapuaka that was drained to create farmland in the 1800s. Wetlands were dominated by raupo, harakeke and *Carex* sedges. Also present were manuka shrubland and fern beds of kiokio and swamp kiokio. Less than 1% of the original extent of native wetland vegetation remains and harakeke-dominated wetlands have disappeared altogether. Remaining areas of wetland are dominated by raupo. Only one freshwater wetland area, the Wakapuaka Reserve (Department of Conservation), has formal protection in the Nelson area and restoration opportunities for freshwater wetlands are very limited due to the scarcity of remaining sites.

Seven freshwater wetland sites covering approximately four hectares were surveyed. The largest site covers about two and a half hectares. Three of the wetlands are very small and occur as pockets of dense sedgeland within kahikatea forest. The three main wetlands are dominated by raupo. Two plant species that are at risk of extinction in the Nelson area were recorded. A number of others are very scarce simply because of the critical lack of remaining habitat. Fernbird was recorded at one site and bittern has previously been recorded at one site.

Figure 4.8e Raupo bed in a freshwater wetland.

Coastal flats

Coastal flats were originally present in central Nelson City, Tahunanui, Nelson Haven, Delaware Bay, and at the Wakapuaka and Whangamoa river mouths. These are areas of flat land where there is a marked coastal influence (generally within two kilometres of the coast) and, notably, an absence of frost. They comprise alluvial and colluvial deposits. Only about 2% of the original extent of native coastal flat vegetation remains, making it one of the most depleted ecosystems in the Nelson area. Prominent emergent and canopy species on free-draining sites would have been titoki, tawa, totara and matai, while wetter sites would have been dominated by kahikatea, pukatea and nikau. Kowhai, lowland ribbonwood and narrow-leaved lacebark would also have been present at river deltas. The only area of coastal flat ecosystem that is formally protected is within the Nelson City Council Paremata Flats Reserve.

Four coastal flat sites covering approximately three hectares were surveyed. These sites are dominated by tawa, titoki, mahoe and pukatea, with matai and totara locally common. Eight plant species that are at risk of extinction in the Nelson area were recorded, including taupata, hangehange and wharangi. These are all shrubs or small trees that are frost tender and only occur very close to the coast in the Nelson area. Lowland ribbonwood was also recorded. This species only occurs at one river mouth in the Nelson area and is regionally threatened.

Figure 4.8f Lush interior of titoki, tawa, matai, pukatea forest.

Figure 4.8g Diverse, mixed broadleaf forest.

Coastal hill country

The coastal hill country ecosystem is a fairly continuous two kilometre-wide band on seaward slopes between Nelson City and Cape Soucis. It is generally confined to slopes below the first major ridge, up to approximately 400m altitude. Although only about 22% of the original extent of the native vegetation remains, it is the second most widespread lowland ecosystem in the Nelson area. The original vegetation of all but the immediate coastal margin would have been forest dominated by hard beech, black beech, matai, totara, and rimu. Gullies would have supported emergent podocarps over broadleaved trees such as tawa, titoki, pukatea and mahoe. There have been huge losses of the original coastal hill country forest in the southern part of the Nelson area, with larger tracts now confined to the Drumduan coastal slopes and the coastal slopes north of Delaware Inlet through to Cape Soucis. Some substantial areas of coastal hill country vegetation are formally protected within Mt Richmond Forest Park and other public conservation land. A number of small to moderate sized areas of coastal forest and rockland are protected by QEII and other conservation covenants.

Twelve coastal hill country sites covering approximately 480 hectares were surveyed as part of the Significant Natural Areas study, of which 400 hectares is within one site. Vegetation is diverse, ranging from coastal margin rockland, herbfield and shrubland, to mixed broadleaved hill-slope and gully forests, secondary kanuka forest and scrub, and hill-slope hard beech forest. Podocarps are scattered through some of the forest communities. Most of these areas are heavily modified by goats and pigs and at one site, domestic stock. Old man’s beard is slowly invading.

Twenty-seven plant species that are at risk of extinction in the Nelson City area were recorded. Fierce lancewood, prostrate pohuehue, coastal porcupine shrub, and the grass *Trisetum antarcticum* are nationally threatened. Locally, these are all species of the coastal fringe, emphasising the ecological significance of this highly restricted band of coastal habitat. A further ten species are regionally threatened, including rasp fern, jointed fern, and the maidenhair fern *Adiantum viridescens* (which has not been previously recorded in the Nelson area). Other rare species of interest include the succulent herb *Peperomia urvilleana* which occurs on coastal bluffs, and some grasses and sedges of dry coastal forest slopes.

Robin and Tomtit occur in coastal forest at one large site, which is remarkable considering the restricted distribution of these species in lowland parts of Nelson. Spotted Shag, Little Blue Penguin and Sooty Shearwater breed at one surveyed site. A very large winter roost of Spotted Shag is also seasonally present. It is the largest roost in the region. Foreshore areas of two surveyed sites are known to support the regionally scarce Brown Skink and Spotted Skink.

Lowland flats

The lowland flats ecosystem is confined to river valleys away from direct coastal influence, mostly along the margins of the Maitai, Wakapuaka and Whangamoa rivers. Only about 6% of the original extent of lowland flat vegetation remains. This ecosystem supported the loftiest of Nelson's podocarp forests, with kahikatea, totara and matai emergent over black beech, tawa, titoki, other broadleaved trees and occasionally pukatea. Remnants of this ecosystem occur as ribbons of riparian (riverbank) forest and as very small fragments of forest and treeland on alluvial flats. Such areas are most severely threatened by old man's beard infestations and by a chronic lack of regeneration due to stock grazing. No remnants of this ecosystem are formally protected in the Nelson City area.

Seventeen lowland flat sites covering 17 hectares were surveyed. The largest site is only four hectares and most sites are less than one hectare. Black beech, kahikatea, matai and totara are the dominant canopy species, with tawa at a few sites and pukatea at one site. Seventeen plant species that are at risk of extinction in the Nelson area were recorded. Of these gossamer grass is also a nationally threatened species. Four other species: the sedge *Carex lambertiana*, swamp mahoe, the filmy fern *Hymenophyllum cupressiforme* and the tree fern wheki-ponga, are regionally threatened. Swamp mahoe was presumed extinct in the Nelson area prior to survey, but was found at four sites. Mahoe wao was also not previously known in the area, although it is locally common in the Pelorus Valley. Robins were heard at one site.

Figure 4.8h Riparian margins of the Whangamoa River.

Lowland hill country

This ecosystem covers the majority of the Nelson City area and occurs on hill-slopes below 600m altitude that are sheltered from coastal influences. Although substantially reduced from its original extent in the Nelson City area, this ecosystem is the least depleted of the lowland ecosystems with about 36% of its native vegetation cover remaining. A range of native forest types would have originally occupied this zone, apart from the mineral belt areas which were dominated by tussockland, herbfield and shrubland. Extensive tracts of native vegetation occur on public conservation and Nelson City Council lands, particularly in the Roding and Maitai river catchments, around Whangamoa Saddle and in the Whangamoa Valley. Elsewhere, native forest has been replaced by farmland and plantation forestry. However, many small bush remnants remain, nearly always located in and around gullies. A small number of lowland hill country forest sites are formally protected by QEII or Crown Forest License covenants, and there are extensive forested tracts protected as public conservation land within the Richmond Range Forest Park.

Forty-eight lowland hill country sites covering approximately 1090 hectares were surveyed, including two large sites comprising 700 hectares. Red beech and silver beech forest occurs locally at higher elevations, with hard beech-kamahi forest. Rimu and pockets of black beech dominate some slopes and spurs. Kanuka forest and scrub, and mixed broadleaved forest and scrub are present at disturbed sites. Gullies support mixed broadleaved forest associations, dominated by mahoe, and at lower elevations, tawa, often with remnant emergent matai.

Most sites are in gullies and on associated slopes. Less than a third of the sites support forest on broad faces and most of this forest has regenerated after earlier clearance. One surveyed site supports extensive serpentine vegetation with mosaics of manuka shrubland, shrub-sedgeland, manuka low-forest and rockland. Such vegetation is nationally important, although regionally quite widespread, running as a broken band on ultramafic rock and melange (shear zone) from the Red Hills near Rotoiti to D'Urville Island. Many important remnants occur within this ecosystem. The major threats to these sites are from weeds and pests, with the key species being old man's beard, goats and pigs.

Thirty-one plant species that are at risk of extinction in the Nelson area were recorded. None are nationally threatened but eleven are regionally threatened. Notable species included a small-leaved lacebark, several ferns (parsley fern, giant *Dicksonia* and jointed fern) and the forest herb *Australina pusilla*. One tree and two seedlings of small-leaved lacebark occur at one site and constitute the entire known population of this species in the Nelson area. It would once have been moderately common along river flats. Two tree species, previously unrecorded in the Nelson area were recorded: quintinia and toro. Four bird species that are considered rare in lower altitude parts of the Nelson area were recorded: Rifleman, Kakariki, Robin and Tomtit.

Upland hill country

The upland hill country ecosystem occupies lands from 600 to 1130m altitude and is confined to the main spine of the Bryant Range generally on west-facing slopes. It is dominated by beech forest – largely red, silver and mountain beech, with some hard beech at lower elevations. Nationally significant serpentine vegetation occupies the mineral belt (ultramafic and melange geologies). This varies from upland and sub-alpine tussockland, herbfield and shrubland, to scrub and low forest. Distinct forest also occurs on limestone.

Not surprisingly, native vegetation cover is more prevalent in this ecosystem than in any of the other eight ecosystems, with 84% of the original cover remaining. Almost all the remaining upland hill country vegetation in the Nelson area is protected as conservation land or is administered by Nelson City Council as waterworks reserve.

Only one upland hill country site was surveyed, covering about 20 hectares. This site supports pockets of disturbed red beech forest, kanuka forest, mixed broadleaved scrub and exotic scrub. No notable species were recorded.

Figure 4.8j Upland kanuka forest.

Figure 4.8k Totara, matai and kahikatea on a grazed riverbank.

Conclusions

- The recent survey work complements existing data confirming the picture of local species and habitat loss described by earlier surveys (e.g. Walker 1987) where coastal and lowland areas have suffered almost total loss of indigenous plant and animal species and many surviving remnants are under threat by pests (plant and animal)
- The extensive species and habitat loss means that those remnants which still exist have an even greater significance. They are often one of the few remaining refuges for nationally and regionally rare and endangered species and the future hope for enhancement and restoration activities in the Nelson area
- The continued survival of remnants is usually dependent on the landowner actively maintaining the remnant and controlling pests and weeds. The demands placed on landowners may be beyond the resources of some landowners
- The recent survey work has substantially improved our knowledge of the Significant Natural Areas of Nelson. It has provided information on species composition, extent, condition and threats
- It will provide a sound basis for both landowners and the Council to discuss active biodiversity management and how best to preserve and enhance these important areas.
- It has furthered dialogue between landowners and Council which will assist future discussion of common issues and concerns
- Now that a better understanding of values and threats within these areas exists, the Council is better positioned to develop an assistance package to help protect and enhance Nelson’s biodiversity
- The information collected will allow priorities to be established and where necessary, good decisions to be made between competing projects
- It will also help landowners to access assistance from other funding sources such as the Government’s Biodiversity Condition Fund
- The biodiversity survey work has also identified other potentially significant natural areas where (subject to access approvals) future field survey work is warranted.

4.9 Land and Biodiversity 2009

At the time of writing, no land scorecard had been developed for the Nelson City Council area. Most of the material discussed earlier in this land topic area deals with the results from major surveys which occur infrequently – perhaps every 5 to 10 years at best. Land cover change depends on national land cover surveys using remote sensing techniques which occur only every 5 years at best. Detailed vegetation surveys are expensive to undertake and, as we are still visiting new sites, it will be some time before we can undertake repeat surveys of existing sites.

A land scorecard incorporating the ongoing work programmes: Significant Natural Areas, sustainable land management (native planting, fencing and weed control), Iwi environmental indicators, environmental education and parks and reserve management is due to be completed in the 2010 review.

5. FRESHWATER

5.1 Summary

Water flow measurements are summarised for various sites across Nelson: at the upper catchments of the main rivers – Maitai and Roding, Whangamoa (Collins) and Wakapuaka (Hira) as part of managing the Nelson urban water supply; at Orphanage Creek to represent a small urban stream and at Avon Terrace to monitor the flow levels in the lower Maitai River as it passes through the urban area. The earliest hydrology records date from 1962 at Collins Creek.

Small temporary flow gauges have recently been installed in other Nelson streams to gain a better understanding of the hydrology of these catchments and, in particular, how much water flows in them during drought conditions. Summary statistics for these monitoring sites are also presented.

The river and stream hydrology monitoring is used to determine minimum flows and allocation limits, which are listed in the Nelson Resource Management Plan along with the water quality classification for each river or part of a river, ranging from A (excellent) to E (very degraded).

Water quality classifications are provided for 28 sites. The sites are grouped by catchment: urban and coastal streams; Maitai; Whangamoa and Wakapuaka. The overall quality of each site is based on water chemistry, habitat and biological factors. Guideline values that specify levels of contaminants for the various values/uses of our waterways and biological indices, which were calculated from the communities of aquatic insects and algal slimes found at each site, also tell us about the overall water quality at a site.

These water quality data are given a grade, based on national State of Environment guidance 'trigger levels'. These grades are weighted to give an overall grade for each site, which is provided as a score card at the end of this chapter.

5.2 Physical Setting

Nelson does not have any major freshwater bodies. It has four modest sized rivers; the Whangamoa, Wakapuaka, Maitai and Roding. They drain from the Bryant Range, which forms the south east boundary to the city. The upper Bryant Range is generally in its natural state and managed as conservation land or as a controlled water catchment area. Some parts of the lower or coastal Bryant Range are managed in production forest, generally pine trees. The Bryant Range is rich in minerals and these are often detectable in the rivers that drain from it.

Nelson also has a number of small foothill streams draining coastal hills and coastal flats in a variety of land uses. These include production forest, pastoral land and lifestyle blocks. Urban streams pass through residential, commercial and industrial land uses.

Rainfall in Nelson is modest and well-distributed throughout the year. Within the central city area near the coast, rainfall usually totals about 700mm per year. As you move north of the city or inland into the hills, rainfall rises steadily and peaks at more than 2000 mm per year. While the rain across the region is well-distributed throughout the year, there are some seasonal variations. The highest rainfall occurs during the spring and autumn periods and the lowest rainfall during the mid summer and mid-winter periods. (Figure 5.2).

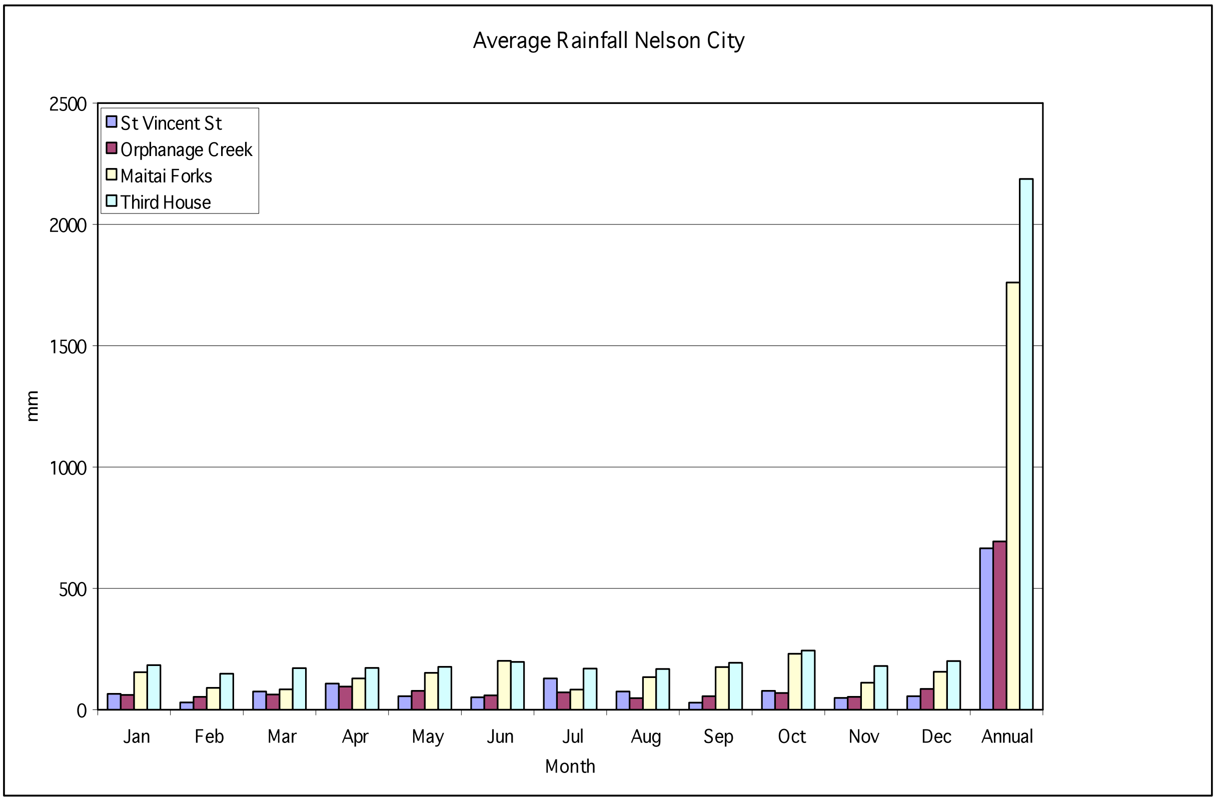


Figure 5.2 Average annual rainfall for selected Nelson stations.

5.3 Guidelines and Standards

A number of plans, guidelines and standards apply to the management of freshwater. They include:

- the Nelson Resource Management Plan
- the ANZECC Water Quality Guidelines 2000
- the Microbiological Water Quality Guidelines 2002
- water allocation guidelines and discussion documents on a national standard for water allocation.

The Nelson Resource Management Plan includes rules regulating minimum flows and allocation limits in the various rivers and streams of Nelson City.

Water takes have to stop if the flow levels go down to the minimum flow levels.

The minimum flows for the smaller foothills rivers (the Teal River, the Lud River and the lower Wakapuaka River) are set at the 1 in 5 year (7 day) low flow. This means the lowest 7 day continuous flow a river is expected to get on average once every five years.

The Upper Wakapuaka and the Whangamoa River minimum flows are set at the higher level of Mean Annual Low Flow (MALF). This means the lowest flow a river is expected to get on average once every year. This is due of the relatively low level of abstraction, and the rivers' high conservation values.

The allocation limits for the rivers set a limit on how much of total flow can be taken for out of stream uses. This varies between 10 and 33 per cent of the five year low flow, with the rivers with least abstraction (such as the Whangamoa) having the lowest percentage allocation limits.

The minimum flows and allocation limits for the Maitai and Roding Rivers were set as part of urban water supply resource consents. The Nelson Resource Management Plan also lists what the water quality classification is, for each river or part of a river, ranging from A (excellent) to E (very degraded).

The classifications are based on a combination of the narrative standards from the Resource Management Act and the various numerical guidelines and standards related to field measurements of water quality, laboratory analysis of water samples, biological indicators of ecological health and tests for a range of contaminants.

The water quality classifications are specifically referred to in rules related to vehicle crossing, stock access and point source discharges (other than storm water). Most of the other freshwater rules require the Council to take the classification of a water body into account when assessing the impact of proposed activities related to it.

5.4 History of Monitoring

Water Flows

Spot measurements of river flows in the Nelson area began early on, associated with the supply of water for the developing city.

The continuous river flow with the longest record is on the Collins River, a tributary of the Whangamoa. This monitoring site was established in 1962 as part of a national network. A number of subsequent sites were established in the headwaters of the Matai and Roding Rivers during the 1970s and 1980s including rainfall sites in the upper catchments as part of urban water supply planning.

Planning for the urban water supply from the Maitai and Roding Rivers also included assessments of water quality and biological habitats within the rivers. Subsequent resource consents to take water for the Nelson urban supply specified requirements related to maintaining residual flows downstream of water intakes and monitoring of water quality and biological habitats associated with the water intakes and downstream of the intakes.

A flow recorder was also established on the Wakapuaka River in the late 1970s as part of a regional network of monitoring stations. Most of these sites still exist and provide a long term flow record for the area.

Over the past ten years, two more permanent monitoring stations have been added. The first one, in Orphanage Creek, represents the small urban streams. The second one, in the Maitai River (at Avon Terrace) monitors the flow levels in the lower Maitai River as it passes through the urban area.

Over the past two years a number of small temporary flow gauges have been installed in other Nelson streams to gain a better understanding of the hydrology of these catchments and, in particular, how much water flows in them during drought conditions.

Water Quality

In late 1999, a stream ecology programme was set up to monitor water quality and in-stream habitat. We initially monitored 38 sites every three months (quarterly). This provided comprehensive coverage of Nelson’s rivers and streams. We tested physical and chemical water characteristics, microbiological water quality and biological indicators.

We reduced the number of monitoring sites to 28 in 2002 as some of the sites proved unsuitable or did not add significantly to our understanding of water quality. Removing unnecessary sites from the programme enabled us to keep the cost of the programme to an acceptable level.

Further information about the health of a stream can be gained by surveying contamination levels in sediment, which is where hydrocarbons and heavy metals settle. This was done for the streams in the Tahunanui industrial area in 1996 and for York Stream, in the central Nelson area, in 1999.

A more widespread programme of sediment sampling and analysis began in 2003, focused on urban rivers and streams. This programme was repeated in 2006 and is due to take place again in 2010.

5.5 Hydrology

Main Recorder Sites

Tasman District Council maintains the Nelson City Council hydrologic monitoring network and the flow archive. Real-time river flow and rainfall data can be obtained from the Tasman District Council web site at http://www.tdc.govt.nz/index.php?RiverflowMapsandPlots

The main recorder sites include:

- Maitai South Branch. This is located upstream of the Maitai water supply intake and is unmodified by water abstraction
- Maitai at Forks. This site is downstream of both the Maitai Dam and the Maitai South Branch intake. Flow is modified by the influence of the dam (takes and discharges) and to a lesser extent by the South Branch intake which is offset by compensation water released from the dam to maintain South Branch flows below the intake
- lower Maitai at Avon Terrace. This is within the lower Maitai Catchment, below Brook Stream. This site is influenced by the Maitai water supply but also includes flow from a number of unmodified side streams including Groom Creek, Sharlands and Packers Creeks and Brook Stream
- lower Maitai, at Girlies Hole. This flood recorder site is above the Brook Stream confluence
- Orphanage Creek. This site is just upstream of Saxton Road. It is representative of the small foothills catchments between Nelson and Richmond
- the upper Roding River. This site is at the caretakers house. Flows are highly modified because it is below the urban water supply intake on the Roding River
- Upper Roding, at Skid Site. This is an unmodified flow because it is above the Roding water supply intake
- the mid Wakapuaka River at Hira. This site is opposite Hira School. It is just downstream of the confluence of the three headwater tributaries of the Wakapuaka. The flow is largely unmodified, although some water is abstracted upstream as part of the Teal/Lud water supply
- the lower Collins River, near its confluence with the Whangamoa River. This is an unmodified major headwater tributary of the Whangamoa river. It is used to predict flows in the Whangamoa.

Table 5.5 Summary Flow Statistics for Larger Nelson Rivers and Streams.

Recording Site	Minimum flow (m^3/s)	Maximum flow (m^3/s)	Mean flow (m^3/s)	Date of maximum flow	Length of record
HY Collins at Drop Structure	0.021	72.524	0.528	22/1/76	From 4/3/62 to 17/3/09
HY Wakapuaka at Hira	0.165	204.323	1.291	23/2/95	From 8/8/78 to 1/5/08
HY Maita South above Old Intake	0.076	59.922	0.802	23/2/98	From 12/5/95 to 7/7/08
HY Maitai at Forks	0.140	168.578	1.378	1/7/98	From 7/3/97 to 30/4/08
HY Maitai at Girlies Hole	Null*	294.637	3.066	23/2/95	From 25/1/86 to 30/7/08
HY Maitai at Avon Terrace	0.046	162.107	1.711	15/4/08	From 12/11/04 to 14/8/08
HY Orphanage at Ngawhatu	0.001	25.323	0.058	23/5/07	From 3/5/04 to 15/4/08
HY Roding at Skid Site	0.135	237.048	1.563	23/2/95	From 22/2/95 to 21/5/08
HY Roding at Caretakers	0.029	152.445	1.340	23/5/07	From 13/2/01 to 21/5/08

*Note: Maitai at Girlies Hole does not record low flows

The summary statistics illustrate a number of characteristics of Nelson catchments:

- extreme storm events in 1995 and 1998 in a number of catchments (Figures 5.5 and 5.5a)
- extreme low flows can occur during dry periods, with 2-5% of the mean flow. This can result in small streams drying up
- extreme high flows can occur during flood events due to very intense rainfall. For example, the 23 May 2007 storm delivered 65mm of rain within the first hour and a total of 108mm over 12 hours. The flood peak was more than 400 times the mean flow
- intense rainfall can be very localised. The 23 May 2007 storm resulted in 108mm of rain in the Orphanage Creek catchment, but only 47mm of rain in the central city (St Vincent St) and about 58mm at Appleby
- the short record available from many recording stations makes it difficult to reliably estimate the frequency of extreme events. Comparing the maximum flows for Maitai at Forks, Maitai at Girlies Hole and Maitai at Avon Terrace (Table 5.1); the Forks' maximum is greater than the Avon Terrace maximum, despite its total catchment area being smaller. This is a result of the length of record for each site. The Avon Terrace site did not exist in 1998 when the Forks recorded its highest flow.

Figure 5.5 Flooding along the Wakapuaka River February 23rd 1995.

Figure 5.5a Flooding in the Glen Flats July 1998.

Small Stream Recorders

The Freshwater Plan Change (to the Nelson Resource Management Plan) has been operative since June 2007. The Plan Change set minimum flows and allocation limits for most rivers and streams in Nelson.

Managing low flows is very important to protect in-stream values. As flows drop, the amount of animal and plant habitat decreases because the streams get narrower and shallower, water temperatures rise often to lethal levels, and dissolved oxygen levels decrease, often to critical levels. In extreme cases, streams dry up completely.

It became necessary to establish flow records for smaller sub-catchments and streams so that the Council would know when minimum flows were reached, and water takes should stop. In order to achieve this in an affordable way, small continuous water height loggers were installed on a number of streams and tributaries (Figure 5.5b). Staff gauges (like a ruler to measure depth) have also been installed on these sites. During 2008-2009 a combination of bad weather and vandalism has resulted in frequent damage to, or loss of, the loggers. As a result there are frequent gaps in the flow records, and the Council has had to reinstate sites and re-work data. Once a representative length of record has been established for each site, the retention of the loggers will be reviewed. Reliance on staff gauges may suffice at that stage.


18/01/2007

Figure 5.5b Small stream flow site Poormans Valley Stream.

Flow statistics for the small streams are included in Table 5.5a. The record for each site is based on the actual flow data and a correlation of these flow records with other sites in the Nelson City Council network with longer-term flow records. The flows are summarised in litres per second (l/s) and the area of each water catchment is also provided. The mean flows range between 13.5 l/s at Todd Valley Upper and 775 l/s at Duckpond Road along the Wakapuaka River, which generally reflect the size of the sub-catchments and stream characteristics.

Table 5.5a Summary statistics for the small stream logger sites.

Recorder Sites	Area (km^2)	Mean Flow (l/s)	MALF (l/s)	5 Year Low (l/s)
Hillwood Intake	0.5	20.8	2.7	2.0
Teal Upper	13.8	375.9	95.9	77.5
Lud Upper	2.2	54.0	10.5	7.6
Lud Lower	9.4	131.9	23.2	16.0
Todds Valley SH6	5.1	29.7	2.3	0.8
Todds Valley Upper	1.6	13.5	1.2	0.5
Wakapuaka at Duckpond Rd	13.4	775.0	204.7	167.2
Poorman at Barnicoat	2.9	101.2	15.3	12.7
Jenkins Creek Upper	3.7	46.2	0.6	Dry

The record for each site is based on the actual flow data and a correlation of these flow records with other sites in the Nelson City Council network with longer term flow records.

5.6 River Ecology and Sediment Contamination Monitoring

The river ecology programme began in 2000. The Cawthron Institute developed the initial Nelson water quality classification system, based on water quality and ecosystem health indicators collected over two years. The sediment contamination monitoring programme commenced in 2003 and was repeated again in 2006.

The information below is drawn from Cawthron Report No. 1340 (Wilkinson, 2007), prepared for Nelson City Council. The report reviews both the river ecology and sediment contamination and compares the 2002 grading for water quality against the long term grading (2000-2007) at each monitoring site.

In the five years since the original grading, the quarterly monitoring events have provided a sound base to compare and update the initial classification. The last section (5.9) provides a summary of the revised water quality classification grading (2007) and compares the long term grading to the 2008 water quality results.

Monitoring sites were selected to represent the range of land uses in Nelson for State of the Environment reporting. Some waterways were monitored at more than one site, so that changes in water quality along the length of the river could be assessed. Five of the sites were located in "pristine" areas where water quality was unlikely to be impacted by contaminants or modifications to the channel or river banks. These control sites give us a benchmark against which we can compare the quality at the more impacted sites. The control sites will also give us information about the impacts of any regional or global environmental change on waterways. For example, if a region-wide drought caused increased slime growth at the pristine sites, increased slime growth at the more impacted sites could also be attributed to the drought, rather than to an increase in contaminants.

Water quality sampling is carried out every three months, and a range of water quality variables are measured on each sampling trip. Water flows in each stream are also gauged regularly. Annual assessments of the stream bed, stream banks and algal slime are made in November/ December, when samples of aquatic insects are also collected. Most aquatic life is unable to tolerate extreme temperature changes, so water temperature has been recorded every hour (spanning up to 12 months) using loggers at various sites in the Maitai, Brook, Wakapuaka, Whangamoa, and Hillwood catchments to gain a better understanding of diurnal and seasonal temperature changes.

5.7 Results of the River Ecology Monitoring

The quality of the monitored sites is summarised in the following pages, which are divided into four groups of sites in different catchments or locations. The overall quality of each water chemistry, habitat and biological factor has been assessed in relation to the quality of the "pristine" reference sites. They are also assessed in relation to guideline values that specify acceptable and unacceptable levels of contaminants for the various values/uses of our waterways. Biological indices, which were calculated from the communities of aquatic insects and algal slimes found at each site, also tell us about the overall water quality at a site.

Where there has been a change since the 2002 review, this is shown with an arrow pointing to the latest result. In some cases a change shows a real improvement or deterioration in condition. It can also result from the increase in the amount of data available, providing a better reflection of the conditions than was available in 2002. This can happen when what is being measured naturally varies a lot. Another reason for changed results is if the standard or guideline levels change. This has happened for faecal contamination – where the current standard uses a higher threshold than that used in the 2002 guideline.

In the Tables 5.7 to 5.7c and Figures 5.7 to 5.7c that follow, a change in status of the aquatic insects or slime growth can change the overall quality from, say, high to moderate (or the other way), even if the water quality has not deteriorated, or some characteristics have improved. This is because the biological health indicators – aquatic insects and slime growth – are a more important gauge of overall condition than one or two physical or chemical water quality measures.

Table 5.7 Stream health/water quality score card for the coastal and urban streams.

Catchment/Site Grouping: *Coastal and Urban Streams*
Main Land Use: *Urban/residential. Some agriculture, industrial & reserve land.*

🟢 Good quality
🟡 Moderate quality
🔴 Poor quality
▶ Better than 2002
▷ Worse than 2002
- No data

	Saxtons	Orphanage	Poorman upr	Poorman lwr	Jenkins lwr	York	Todds lwr	Hillwood
Stream size	SMALL	MEDIUM	SMALL	SMALL	SMALL	SMALL	SMALL	SMALL
Stream banks	🟡 ▶ 🟢	🟡	🟢	🟢	🟡	🟡 ▶ 🟢	🟡	🔴
Stream bed	🔴	🟡	🟢	🟡	🟡	🔴 ▶ 🟡	🔴	🔴
pH & conductivity	🔴 ▶ 🟡	🟢	🟢	🟢	🔴 ▶ 🟢	🔴 ▶ 🟡	🟢	🟢
Oxygen	🔴 ▶ 🟡	🔴 ▶ 🟡	🟢	🟢	🟢	🟡 ▶ 🟢	🟡	🔴
Faecal contamination	🔴	🔴	🟢	🔴 ▶ 🟡	🔴 ▶ 🟡	🔴	🔴 ▶ 🟡	🔴 ▶ 🟡
Nutrients	🔴	🟡	🟢	🟡	🟡	🟡	🔴 ▶ 🟡	🔴 ▶ 🟡
Water clarity	🔴	🟡	🟢	🟢	🔴 ▶ 🟡	🔴	🟡	🔴
Sediment contaminants	🟢	🟢	🟡	🔴 ▶ 🟢	🟡 ▶ 🟢	🔴 ▶ 🟡	-	-
Water temperature	🔴 ▶ 🟡	🟡	🟢	🟡	🔴	🟡	🔴	🔴
Aquatic critters	🔴	🟡 ▷ 🔴	🟢 ▷ 🟡	🔴	🔴	🔴	🔴	🔴
Slime growth	🔴	🔴	🟢	🟢 ▷ 🟡	🔴	🟢 ▷ 🟡	🟡 ▷ 🔴	🔴
OVERALL QUALITY	🔴	🔴	🟢	🔴 ▶ 🟡	🔴	🔴	🔴	🔴

*Note: Where two faces or fish are shown, this means that there has been a change in conditions, for example the increased number of measurements of oxygen produce better results at a number of sites.

Figure 5.7 Map showing the location and conditions at monitoring sites in the group of coastal and urban streams.

Table 5.7a Stream health/ water quality score card for sites in the Maitai catchment.

Catchment / Site Grouping: *Maitai Catchment*
Main Land Use: *Mixed urban, exotic forestry, agriculture & native bush.*

🟢 Good quality
🟡 Moderate quality
🔴 Poor quality
▷ Better than 2002
▶ Worse than 2002
- No data

	Brook upr	Brook lwr	Maitai upr	Maitai upr/mid	Maitai lwr	Sharland	Groom
Stream size	MEDIUM	MEDIUM	LARGE	LARGE	LARGE	MEDIUM	SMALL
Stream banks	🟢	🟢	🟢	🟡	🟢	🟡	🔴 ▷ 🟡
Stream bed	🟡 ▷ 🟢	🟢	🟢	🟢	🟢	🟡	🟢
pH & conductivity	🟢	🟢	🟢	🟢	🟢	🟡 ▷ 🟢	🟢
Oxygen	🟢	🟢	🟢	🟢	🟢	🟢	🟢
Faecal contamination	🟢	🟡	🟢	🟢	🔴 ▷ 🟡	🔴 ▷ 🟡	🟡
Nutrients	🟢 ▶ 🟡	🟡	🟢 ▶ 🟡	🟢	🟡	🔴 ▷ 🟡	🔴 ▷ 🟡
Water clarity	🟢	🟡	🟢	🟢	🟡	🟡	🟡
Sediment contaminants	🟢	🟡 ▷ 🟢	🟢	🟢	🔴	-	-
Water temperature	🟢	🟡	🟢	🟡	🟡	🟢	🟢
Aquatic critters	🟢	🔴	🟢	🔴 ▷ 🟡	🔴	🟢 ▶ 🟡	🟢 ▶ 🟡
Slime growth	🟢 ▶ 🟡	🟢 ▶ 🟡	🟢 ▶ 🟡	🟢 ▶ 🟡	🟡 ▶ 🔴	🟢	🟢
OVERALL QUALITY	🟢	🟡	🟢	🟡	🟡	🟡	🟡

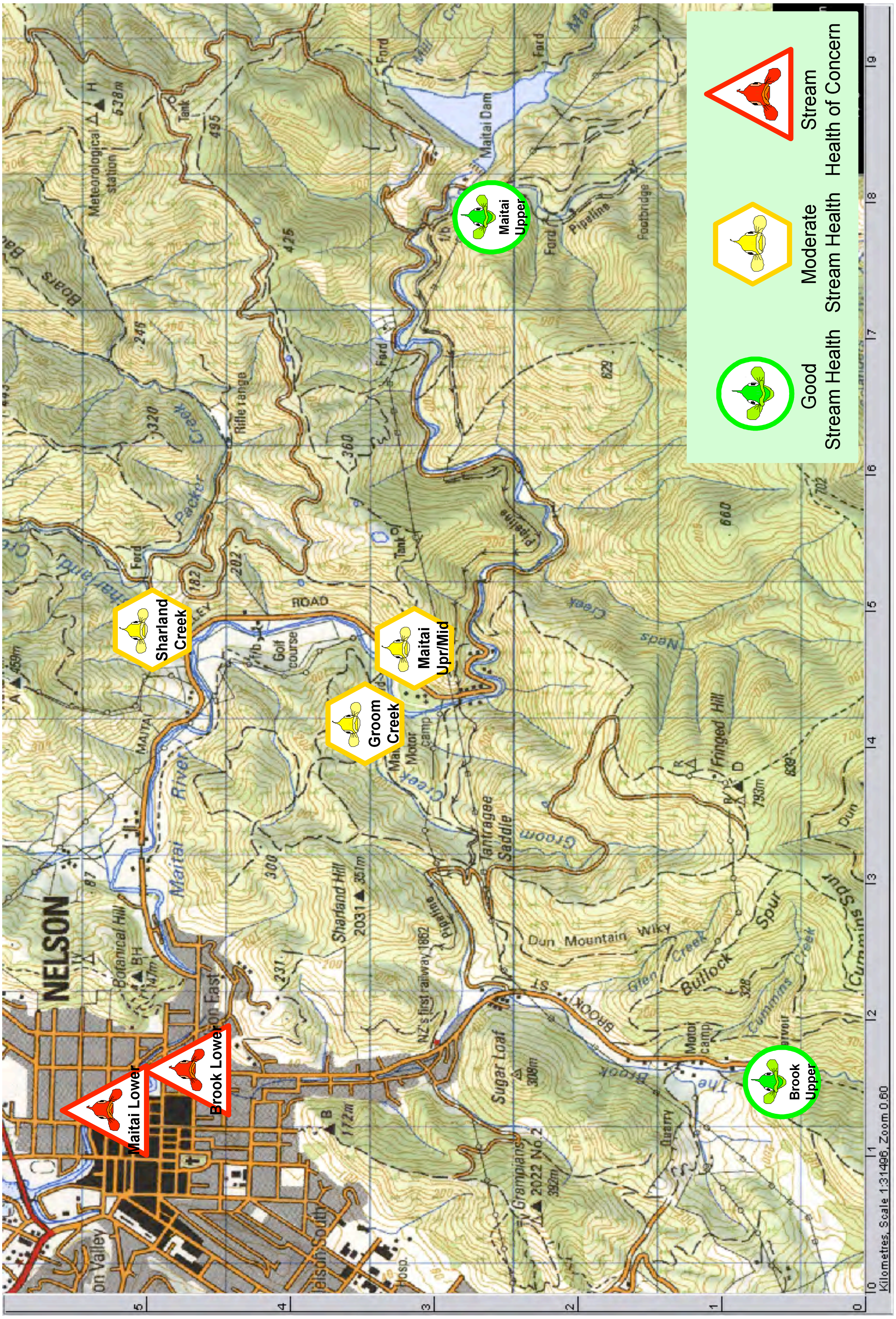


Figure 5.7a Map showing the location and conditions at monitoring sites in the Maitai catchment.

Table 5.7b Stream health/water quality score card for sites in the Wakapuaka catchment.

Catchment / Site Grouping: *Wakapuaka Catchment*

Main Land Use: *Exotic forestry & agriculture. Some tracts of native bush and residential development.*

- 🟢 Good quality
- 🟡 Moderate quality
- 🔴 Poor quality
- ▷ Better than 2002
- ▶ Worse than 2002
- - No data

	Wakapuaka upr	Wakapuaka mid	Wakapuaka lwr	Teal upr	Lud upr	Lud lwr	Pritchards
Stream size	LARGE	LARGE	LARGE	MEDIUM	SMALL	SMALL	SMALL
Stream banks	🟢	🟢	🟡	🟢	🔴	🟢	🟡
Stream bed	🟢	🟢	🟢	🟡 ▷ 🟢	🟢	🟡 ▷ 🟢	🟢
pH & conductivity	🟢	🟢	🟢	🟢	🟢	🟢	🟢
Oxygen	🟢	🟢	🔴 ▷ 🟡	🟢	🟢	🟡	🟢
Faecal contamination	🟢	🟡 ▷ 🟢	🟡	🟢	🔴	🔴	🟡 ▷ 🟢
Nutrients	🟢	🟢	🟡	🟢	🔴	🔴	🟡
Water clarity	🟢	🟢	🟡	🟢	🟡	🟡	🟢
Water temperature	🟢	🟢	🟢 ▶ 🟡	🟡	🔴	🟡	🟢
Aquatic critters	🟢	🟢	🟡	🟢 ▶ 🟡	🟢 ▶ 🟡	🟢 ▶ 🟡	🟢
Slime growth	🟢 ▶ 🟡	🟢	🟡 ▷ 🟢	🟡	🟢 ▶ 🟡	🟡 ▷ 🟢	🟢 ▶ 🟡
OVERALL QUALITY	🟢	🟢	🟡	🟢	🟡 ▼ 🔴	🟡	🟢

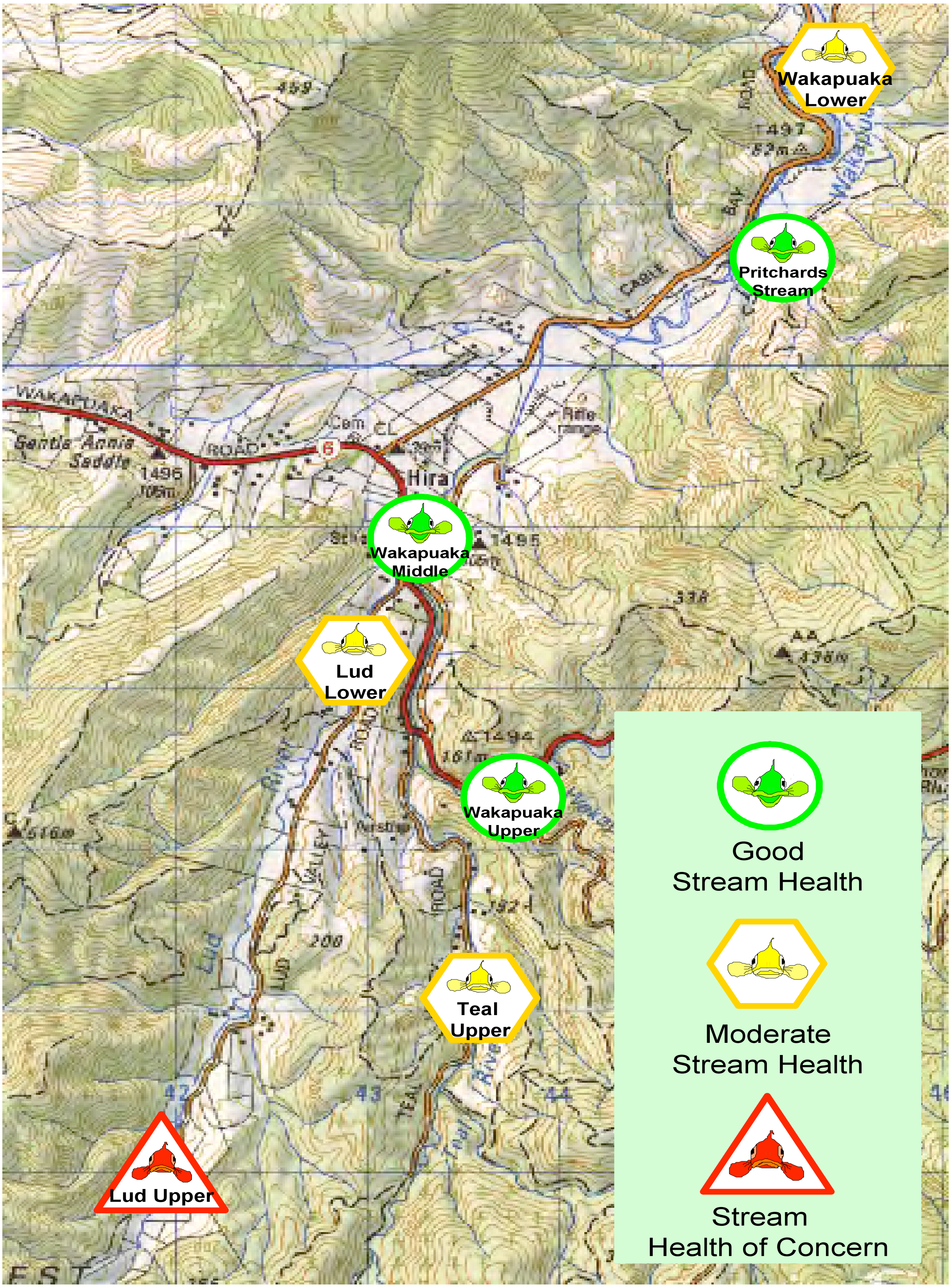
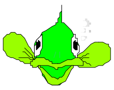
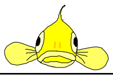
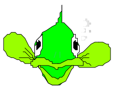
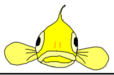
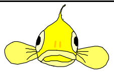
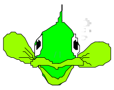


Figure 5.7b Map showing the location and conditions at monitoring sites in the Wakapuaka catchment.

Table 5.7c Stream health/water quality score card for sites in the Whangamoa catchment.

Catchment / Site Grouping: *Whangamoa Catchment*
Main Land Use: *Exotic forestry and native bush. Some agriculture.*

🙂 Good quality
😐 Moderate quality
☹ Poor quality
▷ Better than 2002
▶ Worse than 2002
\- No data

	Whangamoa upr	**Whangamoa lwr**	**Graham**	**Collins**	**Dencker**
Stream size	LARGE	LARGE	MEDIUM	MEDIUM	MEDIUM
Stream banks	🙂	🙂	🙂	🙂	😐 ▷ 🙂
Stream bed	😐 ▷ 🙂	🙂	🙂	😐 ▷ 🙂	🙂
pH & conductivity	🙂	🙂	🙂	🙂	🙂
Oxygen	🙂	🙂	🙂	🙂	🙂
Faecal contamination	🙂	☹ ▷ 😐	😐 ▷ 🙂	☹ ▷ 😐	☹ ▷ 😐
Nutrients	😐	🙂	🙂	🙂	🙂
Water clarity	🙂	🙂	🙂	😐	🙂 ▶ 😐
Water temperature	🙂	😐	🙂	😐	🙂
Aquatic critters	🙂	🙂	🙂	🙂	🙂
Slime growth	🙂	😐	🙂 ▶ 😐	🙂	😐 ▷ 🙂
OVERALL QUALITY					 ▽ 

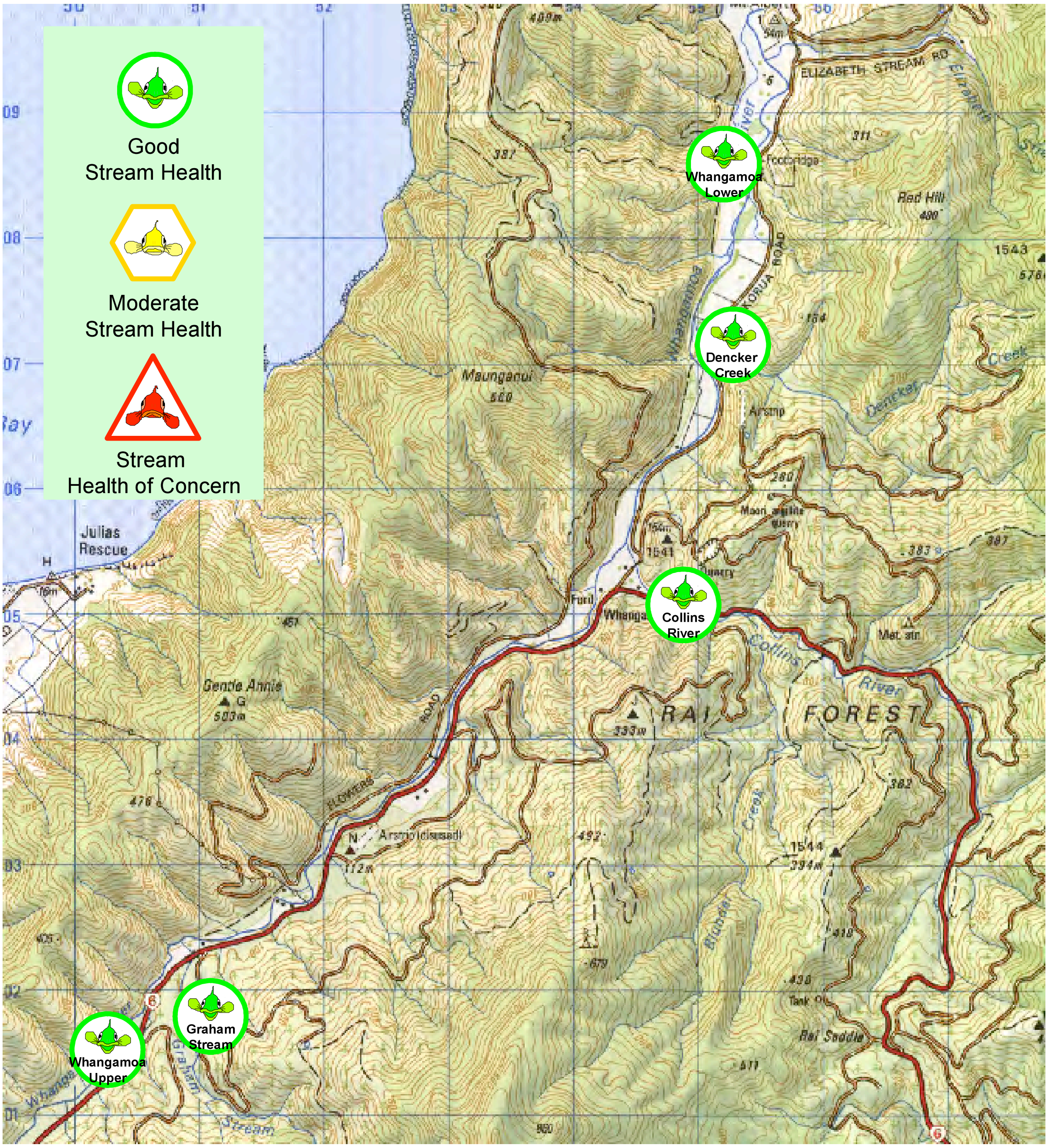
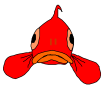


Figure 5.7c Map showing the location and conditions at monitoring sites in the Whangamoa catchment.

5.8 Some General Results for Nelson Freshwater Environments

The coastal and urban streams



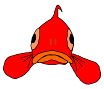
- All of these streams were physically, chemically and biologically degraded, although some were less degraded in the upper reaches
- The presence of fine-grained bed sediments (silts and sands) commonly contributes to the physical degradation of these streams. This can occur via direct run-off into the channel (especially in streams flowing through agricultural land or in streams with unstable banks) or via the stormwater system that drains residential properties and roads. Stream banks are destabilised at some sites by channel work or stock trampling, which contributes to bed sediment loads
- Overall, water quality is poor. These streams commonly have reduced levels of oxygen in the water, poor water clarity, high summer temperatures, faecal contamination and elevated nutrient concentration. Elevated levels of sediment contaminants also occur in many of these streams
- The aquatic insect communities are typical of polluted waters. Only the most tolerant kinds of insects (such as worms and snails) are able to inhabit these streams in abundance. Proliferations of slime and aquatic plants are also common in the nutrient-rich and often unshaded channels (although new riparian plantings will improve shade).

Some specific observations:

- Poorman Valley Stream (which flows from Marsden Valley and through Stoke beside Broadgreen Intermediate and Nayland College) is the best quality stream sampled in Stoke and Nelson City. The upper site in the Marsden Valley Reserve was of good quality with low levels of contaminants and healthy communities of aquatic insects
- The upper site did have elevated sediment contamination. The lower Poorman Valley site is of poorer quality, with more fine sediments in the stream bed, higher bacterial counts, higher nutrient concentrations and some contamination of the sediments with heavy metals. The community of aquatic insects were indicative of very poor quality
- The increased amount of data provided by seven years of sampling showed Jenkins Creek to be in better condition than originally indicated, with improvements in a number of water quality criteria. This is consistent with its recovery after major channel works in 2000. The types of aquatic insects in this creek are typical of poor conditions, elevated temperature and growth of algal slime
- Todds Valley Stream is in poor condition. It is not well shaded and the stream bed has fine-grained and highly mobile sediments. Levels of oxygen in the water are occasionally low, and high faecal bacteria and nutrient levels have been recorded. Water clarity is relatively good (compared with the other small coastal and urban streams). Communities of aquatic insects and the slime growth are both indicators of poor conditions

- Hillwood Valley Stream and Saxtons Creek are both in poor condition. They have minimal shading and the stream banks have been trampled by cattle. They also have fine-grained and highly mobile stream beds, low levels of oxygen in the water, high bacteria and nutrient levels, poor water clarity and prolific slime growth. The types of aquatic insects also indicate consistently poor conditions throughout the monitoring period.

The Maitai River



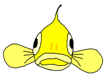
- Water quality is generally highest at the three upstream Maitai River sites, with normal levels of oxygen in the water, low nutrient and faecal indicator concentrations and good water clarity
- Compared with the three upstream sites, the downstream site has increased levels of faecal contamination, decreased water clarity and high water temperatures in summer. Faecal contamination is generally worst following rainfall and during stormflow because this is when faecal matter is flushed off the land into the river. During dry weather faecal contaminants settle out of the water and are killed by sunlight. NCC regularly advises the public not to swim after rainfall
- Communities of aquatic insects represent good quality at the uppermost site, but are slightly to severely impacted at the downstream Maitai River sites
- Poorer water quality in its tributaries contribute to the deterioration in quality of the Maitai River with distance downstream. The Brook has particularly poor water quality and communities of aquatic insects at its downstream sites, but Sharland Creek and Groom Creek also have poorer water quality than the main stem. Sharland Creek is recovering from the effects of forest felling which often causes nutrients to leach into the stream. Ongoing logging in the Packer Creek catchment may cause further nutrient increases in Sharland Creek. Communities of aquatic insects at Sharland Creek and Groom Creek represent good quality.

Some specific observations:

- The quality of the water, stream bed and banks at the three upstream Maitai sites is good, with well-vegetated river banks, little sand and silt in the river bed, well oxygenated water, low nutrient and bacteria concentrations and good water clarity. The quality of aquatic insects at the upper/mid site (near the motor camp) and the Maitai mid site is moderate
- Water quality is poor at the Maitai lower site (near Riverside Pool). Bacterial concentrations are occasionally above trigger levels for contact recreation. Summer water temperatures and nutrient concentrations are high, and water clarity is poor at times. The aquatic insects are indicative of poor water quality and there is an increase in slime growth. Nutrients from logging in Sharland Creek has contributed to elevated levels at Riverside
- The three tributaries that were monitored (The Brook, Sharland Creek and Groom Creek) generally have poorer water quality than the Maitai River

- The Brook is in good condition at the upper site where it is surrounded by native bush. Its condition deteriorates downstream with poorer water clarity, increased nutrients, and high bacterial counts at the lower site (below the Manuka Street ford). The aquatic insects at the lower site indicate poor conditions
- Groom Creek has moderate levels of faecal contamination, nutrients and reduced clarity and the aquatic insects indicate moderate water quality
- Sharland Creek has very high nutrient levels due to logging. These levels are now receding, but logging in the Packer Creek could cause a similar nutrient peak. Fine sediments in the stream bed mean that water clarity is poor at times. Faecal indicator concentrations are occasionally high and the aquatic insects indicate moderate water quality. Little slime growth has been found.

The Wakapuaka River



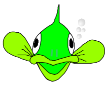
- The upstream Wakapuaka River sites are generally in good condition, with good quality river banks, beds, water and aquatic life
- The downstream Wakapuaka River site is of poorer quality, with low dissolved oxygen and poor water clarity at times, and higher concentrations of faecal indicator bacteria and nutrients than the two upstream sites. The community of aquatic insects is moderately impacted and slime growth is more common
- Unlike the Maitai catchment, water quality at the downstream Wakapuaka site is not heavily influenced by the relatively poor water quality of the tributaries (the Lud and Teal Rivers). Land use impacts (predominantly agriculture) on the main stem and poor shading probably contribute to the decline in quality at the lower Wakapuaka site
- In the Lud River a combination of logging and livestock farming have contributed to nutrient and faecal contamination, and low clarity. Poor stream shading has resulted in elevated summer temperatures, which can impact on insects.

Some specific observations:

- The upper Wakapuaka site (a short distance up the Whangamoa Saddle) and mid site (at Hira) are in good condition, with well-planted stream banks providing good shading, normal oxygen levels in the water, low nutrient levels and cool water temperatures. Both of the sites have cobble river beds, although some fine-grained gravels and sands are present in reasonably high proportions (known to come from road grit). Water clarity is good and bacteria concentrations are low at the upper site. Both sites have healthy communities of aquatic insects and slime growth is low
- The lower Wakapuaka site (just upstream of the bridge on Māori Pa Road) is of poorer quality, with reduced oxygen levels and poor water clarity at times, and higher concentrations of nutrients and bacteria than at the two upstream sites. The community of aquatic insects is moderately impacted, and there is more slime growth than there is upstream. Although water temperatures are higher than at the upstream site, they are always below the lethal range for fish and aquatic insects

- Pritchards Stream is relatively unimpacted, although it has elevated nutrient concentrations and, on one occasion, high bacteria levels. This may be caused by occasional stock access (the catchment is well stocked). The stream bed is coarse-grained (mainly boulders and cobbles) and the banks are well planted, shading the channel. Levels of oxygen in the water and water clarity are high, and a healthy community of aquatic insects is present. Slime growth is generally low, although thick slimy mats do develop after periods of stable flow, probably due to the high nutrient concentrations
- The Teal River site is well shaded by streamside plants. It has coarse-grained beds of boulders and cobbles, although the amount of fine sediments was relatively high on one occasion. Levels of oxygen in the water are high and nutrient concentrations are low. Moderate slime growth indicates that nutrient levels are not low enough to be limiting slime development, and the communities of aquatic insects are indicative of slightly impacted conditions. Water clarity is generally good but decreases following rainfall, particularly at the lower site. Bacteria concentrations are low
- The Lud River sites also have communities of aquatic insects indicating slight impairment, and water quality tends to be poorer than in the Teal River. In particular, oxygen levels are relatively low at the Lud lower site (just upstream of SH6), and both sites commonly have reduced water clarity, elevated nutrient concentrations and high bacteria concentrations. The upper site has grazed, unfenced stream banks, and had increased slime growth. This may have been due to nutrients released by logging of the upper catchment. The lower site has reduced slime growth, and water quality tends to improve downstream.

The Whangamoa River



- Although some water quality factors in the Whangamoa River decline with distance downstream, the downstream site is relatively unimpacted compared with similar sites in the Wakapuaka and Maitai Rivers
- Water and habitat quality are more degraded in two of the tributaries (Dencker Creek and Collins River) than in the mainstem, due to fine sediments in the bed. These probably contribute to poor water clarity (particularly after even minor rainfall) and increased bacterial concentrations. Despite this, these sites are still in better condition than reported in the 2002 review
- Nutrients released by extensive logging of the slopes of the Whangamoa between the upper and lower sites, inputs from the lower tributaries (Collins River and Dencker Creek) combined with poor channel shading may have contributed to the elevated algal slimes observed at the downstream Whangamoa site

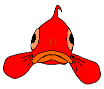
Some specific observations:

- Sites in the Whangamoa Catchment generally have good water and habitat quality.
- The two Whangamoa River sites have well-vegetated river banks and coarse-grained beds, although small amounts of fine gravel/sand are also present, particularly at the

two upstream sites. Oxygen levels and water clarity are high, and water temperatures at the lower (and probably warmest) site are cool enough in the summer months to avoid adversely affecting fish and aquatic insects. Nutrient levels are slightly elevated at the upper site, most likely due to nutrient leaching from clear-felled areas upstream. These nutrients probably contribute to increased slime growth at the lower site, where nutrient levels are much lower. Aquatic insects indicative of excellent conditions (such as mayfly and caddis fly larvae) are dominant at both sites

- Slime growth and faecal bacterial concentrations are higher at the Whangamoa lower site than they were upstream, indicating there is some decline in quality further downstream
- The three sites on tributaries of the Whangamoa River (Graham, Collins & Dencker) have well-vegetated banks, but stock access to the channel has been observed upstream of the Dencker site. These rivers predominantly have coarse boulder/cobble beds, although Collins and Dencker have more fine sediment than Graham. This probably contributes to occasional poor water clarity at Collins and Dencker, which is observed after even relatively minor rainfalls. Faecal bacteria concentrations are elevated in the Collins River and Dencker Creek sites during heavy rainfall (but less so in the relatively pristine Graham Stream), but concentrations are generally low during dry weather flow conditions. All three tributary sites have low nutrient concentrations, healthy oxygen levels, and aquatic insect communities that indicate good water quality. Slime growth is minimal at these sites, despite high growths being reported in Dencker Creek in the previous summary report (Crowe, 2002).

Observations about land use and stream/river condition



- Our data indicates that the aquatic insect communities are poorer at sites receiving run-off from urban and agricultural lands, with a dominance of insects tolerant of poor conditions such as snails and amphipods and only a few occurrences of pollution intolerant species such as mayflies, stoneflies and caddis flies. These communities of aquatic insects are typical of sites with degraded water quality.
- Communities at sites receiving run-off from predominantly native bush and pine forestry catchments tend to have aquatic insects that only live in high quality waters, such as mayflies, stoneflies and caddisflies.
- Our analysis does not show a discernible difference between aquatic insect communities in native bush or plantation forest catchments. Logging does not appear to impact on insects, although nutrients released may increase algal slimes where conditions suit.

5.9 Freshwater Monitoring in 2008

This section provides a summary of the updated Freshwater Classification for Nelson (2007) and the annual scorecard for 2008. The 2008 water quality classification is compared to the long term classification; derived from 2000-2007 baseline monitoring.

5.9.1 Freshwater Classification

The Freshwater classification for State of the Environment monitoring is based on a range of water quality parameters sampled at each site (Table 5.7). These water quality data are given a grade based on trigger levels, and these grades are weighted and combined to give an overall grade for each site. The freshwater grades range from A (Excellent) representing a natural state unmodified river to E (Very degraded) indicative of a severely degraded ecosystem (Table 5.9).

	Parameter (values in mg/L unless specified)	**A – Excellent**	**B – Very Good**	**C – Moderate**	**D – Degraded**	**E – Very Degraded**
Nutrients	**Nitrate-N**	< 0.08	< 0.12	< 0.295	< 0.444	Anything else
	Ammonia-N					
	DRP	< 0.005	< 0.008	< 0.026	< 0.050	Anything else
Physical	**pH (pH units)**	7.2 < pH < 9	7.2 ≤ pH ≤ 9	6.5 ≤ pH ≤ 9	6.5 ≤ pH ≤ 10	Anything else
	Temperature (°C)	< 18	< 20	< 22	< 25	Anything else
	DO (%)	99 ≤ DO ≤ 103	98 ≤ DO ≤ 105	> 90	> 80	Anything else
	DO (mg/L)					
	Spec. Conductivity (mS/cm)					
Clarity	**Turbidity (NTU)**	< 1	< 2	< 3	< 5	Anything else
	Black disc (m)	> 6	> 4	> 2.5	> 0.6	Anything else
	TSS					
E.coli (cfu/100mL)	**2002 classification**	< 10	< 130	< 260	< 550	≥ 550
	2005 Recreational MAC					
Macroinvertebrates	**MCI**	> 120	> 100	> 80	> 60	Anything else
	SQMCI	> 6	> 5	> 4	> 3	Anything else
Periphyton	**Periphyton score**	> 8	> 6	> 4	> 2	Anything else
	Filament > 20 cm, ≥ 30% cover					

Table 5.9 Classification system used to grade individual water quality parameters at each SOE site. The grades for each water quality parameter are then weighted and combined to derive an overall grade for each site.

Notes:

- All classifications are based on the median value over a given sampling period
- Variables shown in grey print are not used in the classification system
- Classification is worked through from left to right across the table
- Grading for nitrogen is based on the sum of the medians for Nitrate and Ammonia-N as nitrate is found in a variety of forms.

This grading system was applied to the combined SOE data collected between November 2000 and August 2008, also including sediment contaminant samples taken at some sites, to assign a long term classification to each site. Figure 5.9 overleaf shows the long term classification for each site and compares it with the grades calculated for the most recent year of SOE water quality monitoring. A brief comment is provided for each site to suggest what appears to have been responsible for any changes observed in the grade for a given site.

Some sites tend to vary up or down a grade from year-to-year so a site being graded lower for a single year should not be seen as a cause for alarm. However, if a site consistently tracks lower than its long-term classification for several years it is likely to indicate a lasting reduction in water quality at that site.

Table 5.9a The Freshwater Classification for the Nelson region.

Freshwater Classifications: their uses and values in the Nelson region.

Class A: EXCELLENT – Natural State Ecosystems (High conservation/ecological value).
Effectively unmodified or other high value ecosystems, typically (but not always) occurring in conservation reserves or in remote, inaccessible, or restricted access locations. The ecological integrity of high conservation/ecological value systems is regarded as intact.
Uses and Values: Water uses which require, or water which is managed for, the highest possible natural water quality (pristine). Provides for flow and fauna, cultural and Tangata Whenua values.

Class B: VERY GOOD – Slightly disturbed ecosystems (generally healthy).
Ecosystems in which aquatic biological diversity may have been adversely affected by a relatively small but measurable degree of human activity. The biological communities remain in a healthy condition and ecosystem integrity is largely retained. Typically freshwater systems would have slightly to moderately cleared catchments and/or reasonably intact riparian vegetation. These systems could include rural streams where there is no significant contamination from grazing (restricted stock access) or forestry, or urban streams with intact or extensive riparian planting and/or esplanade reserves.
Uses and Values: This class includes water managed for values and uses requiring high quality water. Uses and values include aquatic ecosystems and fisheries, water bodies having significant cultural and spiritual values, aquaculture, shellfish and mahinga kai for human consumption, flow and fauna, Tangata Whenua values, human drinking water or contact recreation.

Class C: MODERATE – Moderately disturbed ecosystems (healthy but ailing).
Aquatic biological diversity has been moderately affected by human activity. The biological communities are under some stress from disturbance of their natural habitat. Typical Class C ecosystems would have cleared catchments with only sporadic riparian vegetation. These systems could include rural streams which receive some contamination from grazing (limited stock access) or forestry, or urban streams with limited building setbacks and only limited riparian vegetation.
Use and Values: Includes water managed for uses which require moderately high quality water, such as irrigation and stock water and general water use. Would also provide for limited contact, and non-contact recreation and aesthetic values where the visual characteristics of the water (clarity, colour and hue) are not compromised. May retain some spiritual and Tangata Whenua values.

Class D: DEGRADED – Highly disturbed ecosystems (unhealthy).
Highly degraded ecosystems of lower ecological value. Examples of highly disturbed systems would be urban streams receiving high volumes of road and stormwater contamination with no or little riparian protection, or rural streams which are contaminated by unrestricted stock access.
Uses and Values: Water quality which is suitable only for abstraction where quality is not an issue and contains few instream values, Tangata Whenua values or ecological values.

Class E: VERY DEGRADED – Severely degraded ecosystems.
Severely degraded ecosystems with few or no ecological values. Urban examples would include streams with historical industrial discharges and cumulative sediment contamination, or which have been highly modified or channelised to the extent that natural habitat is no longer retained. Rural streams might be subject to high intensity and frequent contamination from agriculture or land use activities, such as discharge of untreated effluent and uncontained large-scale sedimentation.
Uses and Values: Instream values are severely depleted and water is generally unsuitable for any use. Few values (e.g. Tangata Whenua values).

The 2008 annual scorecard shows a comparison between the long term classification (2000-2007) grade and the 2008 grade for each site (Figure 5.9). A brief comment is provided for each site to suggest what appears to have been responsible for any changes observed in the grade for a given site.

Poor nitrate (higher level of contaminants) and water clarity grades were recorded at a number of sites in the upper and lower catchments. Rainfall and consequent flows were slightly above average in the Wakapuaka and small stream monitoring sites for November and December 2008. Run-off from land in to rivers and streams can increase sediment loads and turbidity (poorer clarity) in water ways, which may settle over the river bed and be detrimental to aquatic life. Run-off into waterways can also increase nutrient levels, such as phosphates and nitrates and encourage the growth of some periphyton (slime) and aquatic plants.

This is the first year to be compared with the long term classification. Some sites may vary up or down a grade from year-to-year so a site being graded lower for a single year should not be seen as a cause for alarm. However, if a site consistently tracks lower than its long term classification for several years it is likely to indicate a lasting reduction in water quality at that site.

2008 Annual scorecard: Freshwater river ecology classification

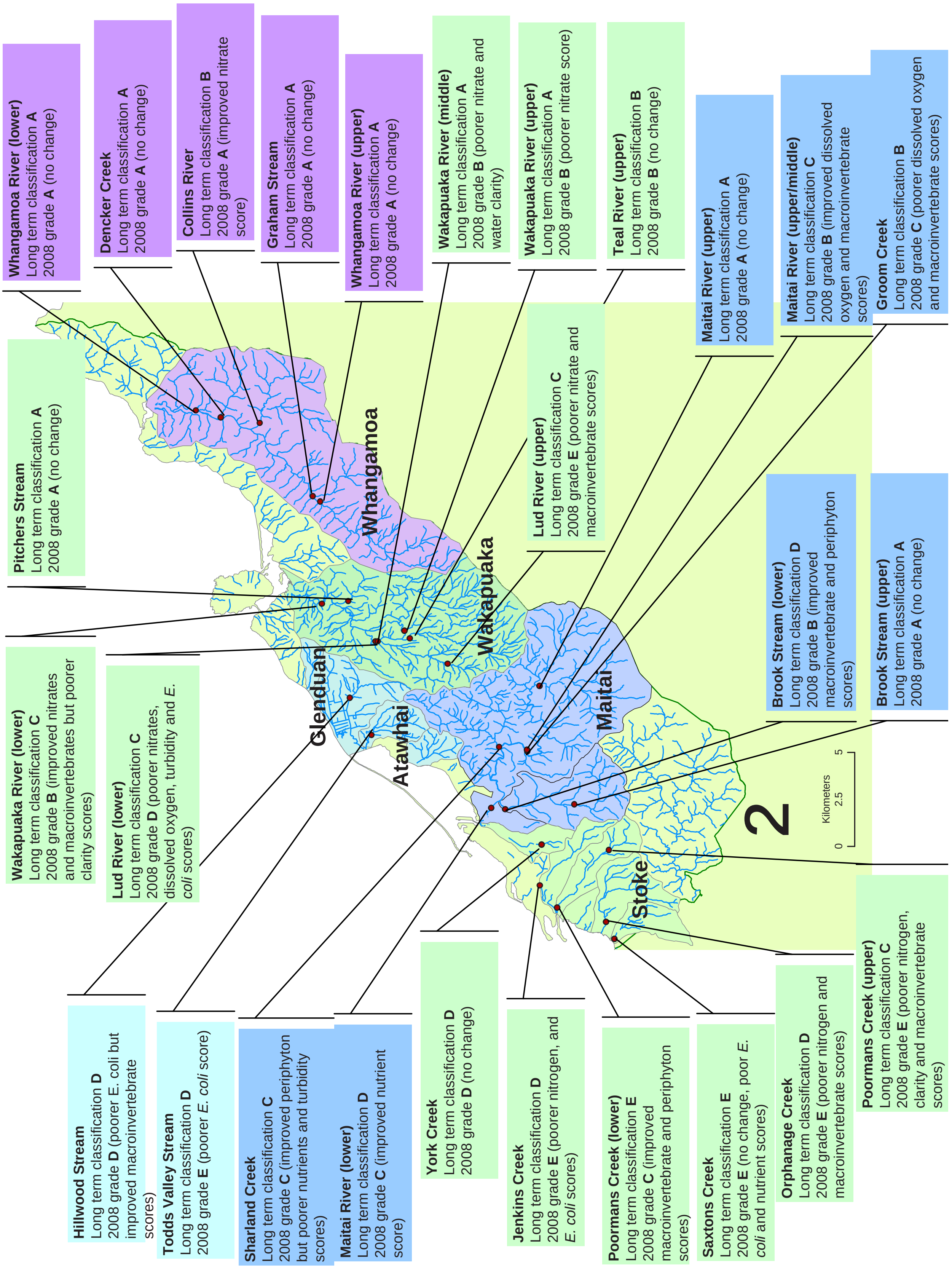


Figure 5.9 Comparison of the long term (2000-2007) score against the 2008 annual score.

6. MARINE

6.1 Summary

Nelson City Council, the Ministry of Fisheries and the Department of Conservation (DoC) are responsible for regulating and managing the marine environment, and consequently have roles that overlap. The integration of planning and management for coastal areas, marine reserves, taiapure, fisheries, and effective biosecurity and regulation of environmental quality, is required to align efforts between agencies.

The Nelson Resource Management Plan includes objectives and rules for the Coastal Martine Area. Nelson City Council is undertaking a number of long-term work programmes with partners to monitor, manage and conserve the coastal marine environment. A range of environmental quality guidelines and standards for water quality, sediment toxicity and bio-accumulation within the coastal marine area (CMA) are summarised.

The key findings from two long-term monitoring studies at Port Nelson and Waimea Inlet are described, which document the effects on the marine environment from land use changes, coastal development and local industry. They provide baseline information for designing future monitoring and reporting.

The score card at the end of the chapter provides a summary of the key coastal marine environment indicators from the Port Nelson and Waimea inlet studies.

The National Environmental Statement on sea level rise is due during 2010, which is expected to advice Councils to plan for a 0.5 to 0.8m rise in the next 100 years. Coastal planning, developments, monitoring and restoration programmes will need to address such changes.

6.2 Physical Setting

Approximately two thirds of the area that Nelson City Council is responsible for is within the coastal marine area (CMA). This 80,000ha area is between the top of the tide (mean high water springs) and the twelve mile limit (New Zealand Territorial Sea).

The Nelson CMA is varied in character. It includes:

- four major estuaries. These are all classified as of national importance
- the Back Beach area. It is classified as of international significance because it is the only known habitat of the endemic predatory beetle *Cillenum tillyardi*
- geo preservation features such as the Nelson and Cable Bay boulder banks are both classified as of international significance
- exposed rocky coastline areas in the north, classified as of national significance
- Horoirangi Marine Reserve (between the Glen and Cable Bay) and the Delaware Bay taiapure
- the largest commercial port in the top of the South Island. It is also New Zealand’s busiest fishing port
- dredge fisheries for scallops and oysters.

The Nelson CMA is adjacent to

- Abel Tasman National Park
- aquaculture management areas in Tasman District
- the Marlborough Sounds, which is the largest green lipped mussel producing area in the country.

6.3 Guidelines and Standards

Nelson City Council controls the effects of non-fishing uses of the sea through its Nelson Resource Management Plan. A variety of guidelines and standards exist for water quality, sediment toxicity and bio-accumulation within the CMA. The principal ones are:

- the Australia and New Zealand Environmental Conservation Council Guidelines (ANZECC) and associated Interim Sediment Quality Guidelines which cover most metals but not semi-volatile organic compounds (such as oil)
- the Microbiological Water Quality Guidelines, which cover water quality for swimming and shellfish collecting
- the Australia New Zealand Food Standards Code (ANZFSC 2002) which covers acceptable levels of contamination within shellfish flesh.

Other international standards are used when there is no relevant national standard or guide. These include the standards developed by the US Army Corp of Engineers as part of the Puget Sound Disposal Analysis Programme (PSDDA).

6.4 History of Monitoring

The inter-tidal and shallow near-shore environments have been extensively modified by reclamation, sediment run-off from the land, and fishing. In most cases, communities of native plants and animals that favoured undisturbed environments have been replaced by other native communities that thrive in more disturbed sediment and nutrient-laden conditions.

A number of exotic species have recently been observed, such as pacific oysters *Crassostrea giga*, the seaweed *Undaria*, the sponge tunicate *Didemnum "candidum"*. It is likely they have been occurring for many years (Lawless and Holman, 2006).

Nelson City Council, the Ministry of Fisheries and the Department of Conservation are responsible for regulating and managing the marine environment, and consequently have roles that overlap.

The integration of planning and management for coastal areas, marine reserves, taiapure, fisheries management and more effective biosecurity and regulation of environmental quality is required to align efforts between agencies (Nelson Biodiversity Strategy, 2007).

Joint work programmes to improve biosecurity, collation of marine biodiversity information are currently underway and will be reported on in future annual reports.

The key findings from two long-term monitoring studies at Port Nelson and Waimea Inlet are provided to illustrate the range and scope of monitoring carried out by the Council.

Nelson Haven and the Port

In 1996 Nelson City Council and Port Nelson Limited commissioned Cawthron Institute to conduct a Port-wide water quality monitoring programme, focusing on chemical contamination in sites within the Port and lower Maitai River. That work revealed localised contamination hot spots existed in the lower Maitai River where it joins Saltwater Creek and enters Nelson Haven, and also within the Port area where ship and vessel maintenance activities currently or previously occurred. These findings led to work within the lower Matai Catchment, Port and marina areas to clean up the existing contamination through dredging and to reduce future contamination by better regulation of activities.

In 2003 Nelson City Council and Port Nelson commissioned the Cawthron Institute to design and implement a long-term monitoring programme (over four years) for the Port area and the wider Haven to better quantify changes occurring in these areas and to target any remedial action that may be required in the future. Section 6.5.1 is drawn from Cawthron Report 1328 (Conwell, 2007).

During 2002, Cawthron Institute was contracted by the Sustainable Management Fund to develop a national protocol for monitoring and reporting the condition of New Zealand estuaries. As part of the protocol development a number of estuaries were assessed, including the Waimea Inlet. This work provided a baseline assessment of the Waimea Inlet for Nelson City Council and

Tasman District Council State of the Environment Monitoring (Gillespie, Clark, and Conwell, 2007; Clark, Gillespie, Forrest and Asher 2008). Since this initial work the Waimea Inlet has been re-surveyed (see section 6.5.2) and work has commenced on Nelson Haven and Delaware Inlet.

6.5 Trends 2001-2008

6.5.1 Nelson Haven Contamination (2004-2007)

The programme adopted a staged approach in order to spread the considerable cost of this type of work. Twenty sites were identified including control sites outside of the main port area (Figure 6.5).

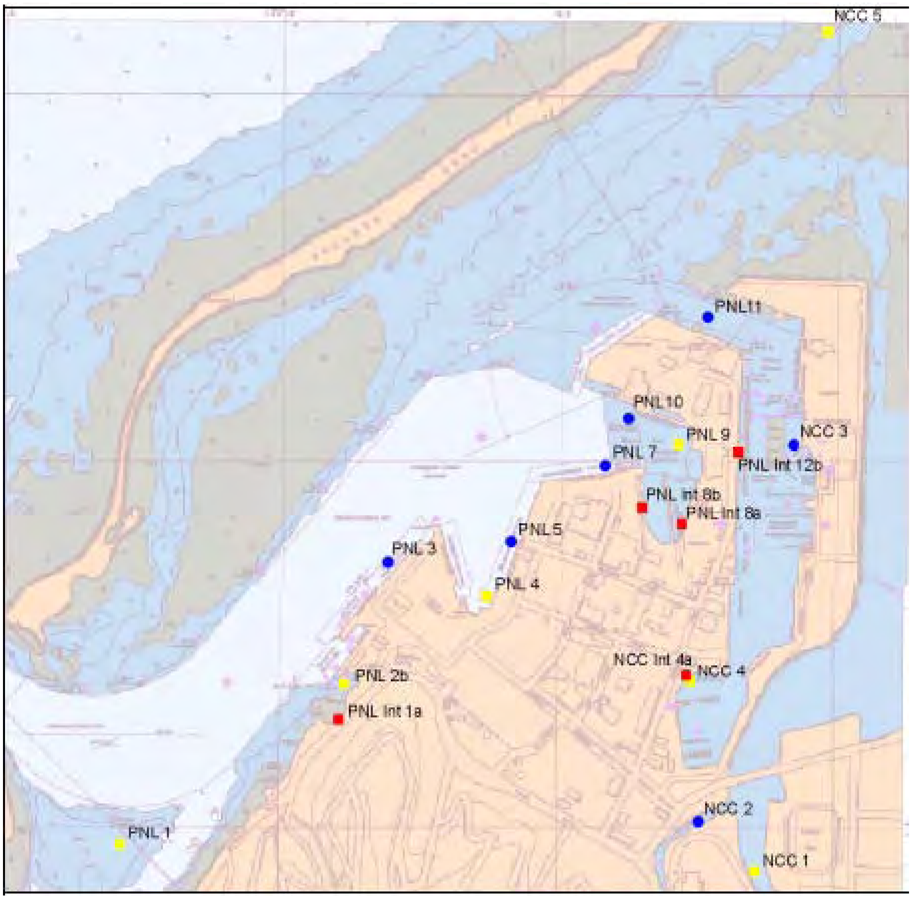


Figure 76.5 Contaminant monitoring sites Nelson Haven.

Legend

Sites: Port Nelson Limited (PNL), Nelson City Council (NCC), Inter-tidal (Int)

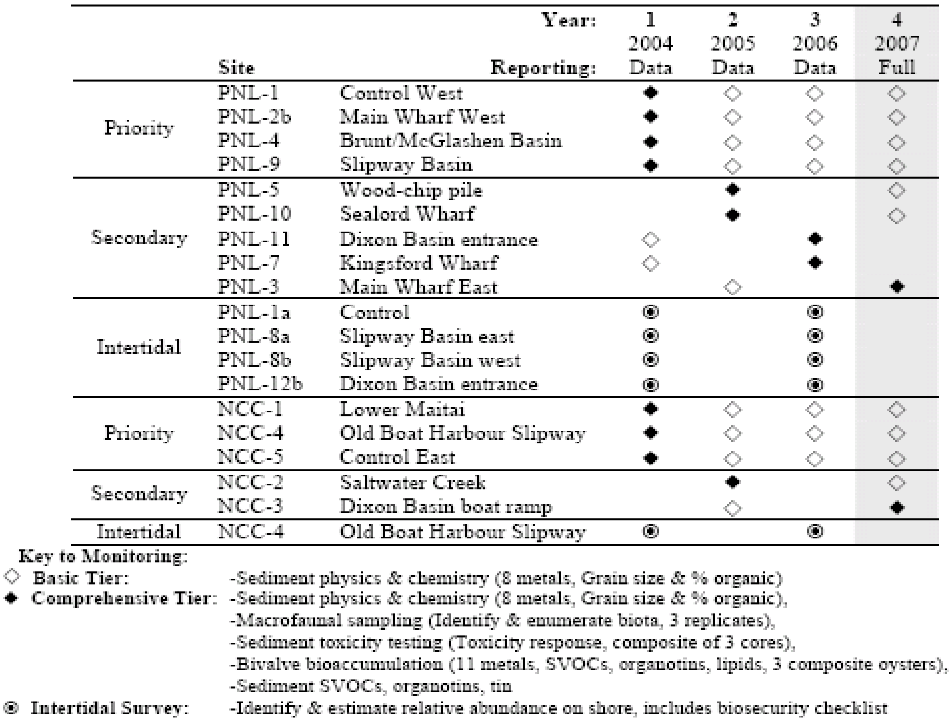
Yellow – priority subtidal sites surveyed annually
Blue – secondary subtidal site surveyed every second year
Red – intertidal and biosecurity survey every two years

Each site had a rolling programme of tests associated with it which included:

- sediment physics and chemistry (sediment characteristics and metal contaminants)
- assessment of biological communities living within the sediment to assess the ecological health of the sites
- sediment toxicity testing to assess the biological impact of the sediment on selected species
- bivalve bio-accumulation of metal and semi-volatile organic compounds (SVOCs)
- sediment accumulation of SVOCs and marine anti-fouling compounds
- survey of intertidal species to assess ecological health and identify invasive marine species.

The programme for each site is itemised in Table 6.5.

Table 6.5 Contaminant Sampling Programme Nelson Haven



		Year:	1	2	3	4
			2004	2005	2006	2007
	Site	Reporting:	Data	Data	Data	Full
Priority	PNL-1	Control West	◆	◇	◇	◇
	PNL-2b	Main Wharf West	◆	◇	◇	◇
	PNL-4	Brunt/McGlashen Basin	◆	◇	◇	◇
	PNL-9	Slipway Basin	◆	◇	◇	◇
Secondary	PNL-5	Wood-chip pile		◆		◇
	PNL-10	Sealord Wharf		◆		◇
	PNL-11	Dixon Basin entrance	◇		◆	
	PNL-7	Kingsford Wharf	◇		◆	
	PNL-3	Main Wharf East		◇		◆
Intertidal	PNL-1a	Control	⦿		⦿	
	PNL-8a	Slipway Basin east	⦿		⦿	
	PNL-8b	Slipway Basin west	⦿		⦿	
	PNL-12b	Dixon Basin entrance	⦿		⦿	
Priority	NCC-1	Lower Maitai	◆	◇	◇	◇
	NCC-4	Old Boat Harbour Slipway	◆	◇	◇	◇
	NCC-5	Control East	◆	◇	◇	◇
Secondary	NCC-2	Saltwater Creek		◆		◇
	NCC-3	Dixon Basin boat ramp		◇		◆
Intertidal	NCC-4	Old Boat Harbour Slipway	⦿		⦿	

Key to Monitoring:

◇ **Basic Tier:**	-Sediment physics & chemistry (8 metals, Grain size & % organic)
◆ **Comprehensive Tier:**	-Sediment physics & chemistry (8 metals, Grain size & % organic), -Macrofaunal sampling (Identify & enumerate biota, 3 replicates), -Sediment toxicity testing (Toxicity response, composite of 3 cores), -Bivalve bioaccumulation (11 metals, SVOCs, organotins, lipids, 3 composite oysters), -Sediment SVOCs, organotins, tin
⦿ **Intertidal Survey:**	-Identify & estimate relative abundance on shore, includes biosecurity checklist

Overall conclusions arising from the four-year programme are:

- copper, lead and zinc exceeded guideline levels at a number of sites throughout the Nelson Haven and are considered to be the most significant contamination. Nickel and chromium exceeded guideline levels at a number of sites but are likely to have been influenced by naturally occurring nickel and chromium derived from the Nelson Mineral Belt
- levels of mercury, arsenic and cadmium were low throughout the Haven and often undetectable
- levels of organic contaminants such as oils and antifouling paints varied across the Nelson Haven with low levels at outer and control sites but levels exceeding both possible and probable effects guidelines within inner marina areas and boat servicing areas
- the results of sediment toxicity testing coincided with elevated levels of metals and organic compounds. The most impacted sites were the Old Boat Harbour, the Slipway Basin and Saltwater Creek in the inner marina. Another impacted site was Kingsford Wharf
- contaminant bio-accumulation in shellfish varied across the study area. However, all sites, including one outer control site, breached food standards for arsenic and often zinc and copper. The highest concentrations of contaminants were recorded in the Old Boat Harbour. Arsenic is naturally occurring within the rocks of the Nelson Mineral Belt which is the likely source for much of the arsenic recorded
- in general, there was a trend of decreasing species diversity and abundance with increasing sediment contaminant levels. The Old Boat Harbour and Slipway Basin and the Lower Maitai River had the poorest range of species, and a dominance of pollution sensitive species. Species richness and diversity were highest at the control sites and Main Wharf East site. No invasive species on biosecurity check lists were reported during the course of the survey.

6.6 Waimea Inlet

Waimea Inlet is a shallow, bar-built estuary located within Tasman Bay and adjacent to Nelson City (Figure 6.6). It is classed as a fluvial (river) erosion, barrier (island) enclosed estuary. It is one of the largest estuaries in New Zealand – estimated to cover a total area of 34.6 km^2, with 28.7 km^2 comprising a variety of intertidal flat habitats (primarily over mud and sand). The remainder consists of sub-tidal areas; ie. river and tidal channels. Ten islands within the inlet, with a total approximate area of 296 ha, contribute to considerable habitat diversity.

Figure 6.6 Bells Island in Waimea Inlet with Nelson suburbs in the background.

There are two tidal openings to the estuary located at opposite ends of the barrier island, Rabbit Island. Owing to its broad, shallow configuration and a tidal range of up to 4.2 metres, the tidal component of approximately 62 million m^3 is largely drained with each ebbing tide, resulting in a relatively rapid flushing rate. Residence time for Waimea Inlet has been estimated to be about 14.4 hours (or 1.2 tidal periods) as a lower limit. However, somewhat longer times might be expected if we assume a partial return of inlet water with succeeding tides.

Freshwater contributions are relatively minor, compared to the size of the tidal component. As a result, salinity ranges from 30 ppt (parts per thousand) to 35 ppt throughout most of the inlet. However, reduced salinities have been reported for some localised areas close to river mouths and channels. The main freshwater inflow to the estuary is via the Waimea River and its tributaries, including the Roding, Lee, Wairoa and Wai-iti rivers that drain the southern and eastern catchments. The resulting freshwater discharge (annual mean flow 20.8 m^3/s) separates into a primary and a secondary channel at Rabbit Island to coincide with the two tidal openings. The primary channel, taking most of the flow, is presently on the eastern side of the island. A number of smaller streams (total mean annual flow of 0.55–0.65 m^3/s) also contribute to the total freshwater inflow.

A survey of inter-tidal habitats in the Waimea Inlet (Figure 6.6a) indicates the area is dominated by unvegetated habitat (77% of the total estuary area, covering 2480ha). Almost half of the unvegetated habitat was classified as soft mud (34% of the total estuary area). The remaining unvegetated areas consists of a variety of habitats, the most predominant of which were firm mud and firm sand (23% and 10% of the total cover, respectively) and cobble and gravel beds (together covering 8% of the total area). The vegetated habitats were diverse, although each covered less than 4% of the total estuary. Herbfields were the most abundant of these, covering 123ha, of which glasswort *(Sarcocornia quinqueflora)* was the dominant species. Approximately 98ha of the estuary (3% of the total cover) was described as rushland, and the majority of this is vegetated with searush *(Juncus kraussii).* A mixture of macro-algal species formed beds covering 2% of the estuary, and there were minor oyster fields and areas of seagrass, tussock and scrub.

Figure 6.6a Waimea Inlet habitat types.

6.6.1 Human Occupation

Waimea Inlet and the surrounding lands have been occupied since the 1500s. A large, but fluctuating, Māori presence was associated with the Waimea Pa and 35 archaeological sites have been recorded, including 27 Māori midden or oven sites.

Europeans colonised the area in the 1840s and began an intensive programme of land development, resulting in significant changes to the estuary and its surrounds. Approximately 45,000 people live within an 8 km radius of the inlet.

6.6.2 Catchment Characteristics

Area

The total area of the Waimea Inlet catchment is 812 km^2.

Geology and soils

Most of the central lower estuary catchment is relatively flat or undulating, particularly the Waimea Plain and the river valleys. However, the catchment extends south to the Gordon Range and east to encompass the eastern slopes of the Richmond and Bryant ranges and the Dun Mountain, draining predominantly steeply sloped land. The Dun Mountain "mineral belt" region contains ultramafic rock formations that are particularly high in metals such as copper, nickel and chromium. The composition of the estuary catchment and its soils reflect the complicated geological structure and history of the region. Most soils are characteristically of low natural fertility. The fertile, deep, fine soils on the lower flood plain of the Waimea River are a notable exception. The catchment soils impart a physical (e.g. texture) and chemical (e.g. heavy metal) "signature" to the estuary substrate.

6.6.3 Land Use

During the period of Māori and European settlement, but primarily within the past 150 years, land-use modification to the estuary margins has been significant. This has restricted the ecological connectivity between the terrestrial and coastal sea environments. These modifications include the draining of freshwater wetlands, burning and logging of coastal native forests, urban development (domestic and industrial), rubbish disposal and livestock grazing. The inlet is close to the urban and industrial areas of Nelson, Stoke and Richmond.

Some of these land uses have resulted in a loss of inter-tidal habitat (e.g. fringing mudflat and saltmarsh) through in-filling, particularly on the Nelson (eastern) side of the inlet. It has been estimated that approximately 200 ha of inter-tidal habitat has been removed in this way.

The greater estuary catchment is presently dominated by native bush, exotic forests and pastoral development. However, a variety of other agricultural and urban uses are also represented, particularly within the lower regions (Table 6.6).

Table 6.6 Waimea Inlet catchment land use.

Land use	Area (ha)	Cover (%)
Planted forest	25,877	31.9
Indigenous forest	25,359	31.2
Prime pastoral	20,797	25.6
Scrub	3,950	4.9
Tussock	2,414	3.0
Prime horticultural	1,425	1.8
Urban	645	0.8
Total	**81,170***	

* Includes some minor uses not defined.
Source: *Estuarine Environmental Assessment and Monitoring: A National Protocol* (Cawthron Institute, 2002).

6.6.4 Estuary Values and Uses

Waimea Inlet plays a significant role in the integration of terrestrial and coastal marine ecosystems. It provides critical habitat for a variety of plant and animal species, maintaining coastal productivity and nourishing the marine food web. High value is placed on the habitat provided for waterfowl, fish and invertebrates by the inlet's terrestrial ➔ wetland ➔ coastal aquatic continuum. The inlet has been classed by the Department of Conservation as a wetland of national importance (one of 73 in the country). It has also been ranked as an estuary of international importance for migratory birds. Its significance is mainly owing to its large size and the potential ecological importance of its complex and varied physical and biological structure.

The estuary's visual and aesthetic values are very important to the region, particularly for residential developments along the estuary margins (e.g. Monaco, Mapua, Best Island) and elevated subdivisions in Nelson, Stoke and Richmond.

In view of the high ecological, biodiversity and aesthetic values placed on the inlet, some shore/wetland walkways and reserves have been established (e.g. Higgs Reserve, Waimea Inlet Walkway) and the estuary is of potential importance to a developing ecotourism industry. The inlet is used for a variety of recreational pursuits, including boating, swimming, waterskiing, waterfowl shooting and fishing (e.g. for whitebait, flounder and kahawai). The pressure of increasing recreational usage is seen as a particular threat to the natural character of the estuary.

The inlet is also used for wastewater discharge including treated sewage (from Bells Island regional sewage treatment facility) and stormwater from industrial, agricultural (horticulture, drystock farming, dairying) and urban (Stoke and Richmond) sources. Areas of Rabbit and Bells islands have been used for the land disposal of sewage sludge from the Bells Island oxidation ponds since 1993 and 1996, respectively.

6.6.5 Water and Sediment Quality

Some of the above uses indicate potential threats of contamination to environmental quality. Studies of faecal bacteria concentrations in waters and shellfish indicate that the inlet (with the exception of the immediate mixing zone from the Bells Island wastewater outfall) is suitable for contact recreational activities, but unsuitable for gathering shellfish for human consumption. Freshwater inflows and direct run-off from estuary margins are thought to be the primary contributors of bacterial contamination.

Effluent discharge from the Nelson regional sewerage facility at Bells Island may be perceived as a particular threat to the estuary environment. However, conditions for effluent composition and discharge, as well as monitoring requirements for the receiving environment, have been adopted as part of the consent process to minimise this threat. So far, monitoring reports conclude that enrichment effects on the estuary have been minimal, due to the ebb-tide discharge schedule and the flushing characteristics of the outfall location. Localised reductions in water and sediment quality in the vicinity of industrial and domestic point source discharges occurred prior to establishment of the Bells Island treatment facility. These have recovered to a more natural condition since incorporation with the regional wastewater treatment scheme in 1983.

Another perceived threat to ecological health is chemical leachates from contaminated soils. This has occurred at a former Fruit-growers Chemical Company industrial site bordering on the inlet at Mapua. The 3.3 ha site was found to contain high levels of primarily DDT and dieldrin and both have been observed in Mapua channel sediments. Remediation work has been undertaken on this site but a reservoir of contaminant is still likely to exist within deeper sediment.

6.6.6 Exotic Plant and Animal Species

The exotic saltmarsh cordgrass *(Spartina anglica)* was introduced into Waimea Inlet during the 1930s through a series of intentional plantings. After 50 years it had become well established, covering over 30 ha with several dense stands. A herbicide spray programme was implemented from 1986 to 1999 because of the impact of the cordgrass on the natural character of the inlet. The spray programme was successful, and *Spartina* has been largely eradicated from the inlet. Simultaneous environmental monitoring suggested that short-term herbicide effects on native habitats were minimal. Although long-term effects (e.g. sediment redistribution and reorganisation of native habitats) are yet to be determined, areas previously colonised by *Spartina* seem to have returned to a natural character.

A more recent invasion by an exotic bivalve, the Pacific oyster (*Crassostrea gigas*), occurred in the Nelson region during the early 1980s and the oyster subsequently spread to Waimea Inlet within a few years. It is now well established in a number of inter-tidal locations within the inlet. The resulting oyster beds and shell banks have led to localised pockets of sediment enrichment, and represent a significant departure from the natural character.

6.7 2008 Score Cards

The results from reports commissioned up to 2008 are summarised for the marine score card.

Nelson Haven and the Port Score Card 2008 😐 ☹ ☺

Result	Score
Nickel was elevated at all sites tested during 2007, and usually above probable effects guideline levels. Levels were no higher than those recorded during previous monitoring rounds.	😐
With the exception of nickel, and consistent with previous monitoring rounds, sites where metal contamination exceeded guideline levels were the Lower Maitai, Saltwater Creek, Brunt/McGlashen Basin, and Kingsford Wharf sites.	😐
Chromium levels exceeded possible effects guidelines at the lower Maitai River and Brunt/McGlashen Basin. These levels are similar to those previously recorded at these sites.	😐
Copper and zinc concentrations at most sites were similar to previous recorded levels, with the exception of Kingsford Wharf, which had higher copper levels than those previously recorded but lower zinc levels.	😐
Lead levels were similar to those previously reported. The Saltwater Creek and Kingsford Wharf sites exceeded possible effects guidelines. Levels at Kingsford Wharf were slightly lower than those previously reported while those at Saltwater Creek were about 20% higher.	😐
Mercury levels were either lower than detection limits or, where detectable, had decreased since previous monitoring.	☺
Anti-fouling compounds including tributyl tin and its breakdown products dibutyl and monobutyl tin exceeded possible effects guidelines at sites monitored around the main wharves and marina basins but were lower than previously recorded levels. The presence of breakdown products suggests much of this contamination is historic and in the process of degrading.	😐
Two sites were tested for shellfish bio-accumulation during 2007. These were Main Wharf East and Dixon Basin. At Main Wharf East zinc, copper, and arsenic levels exceeded safe levels for shellfish consumption, while at Dixon Basin only arsenic levels exceeded those for safe consumption. It should be noted that these contaminents occur naturally in the Nelson area.	☹
Three sites were tested for sediment toxicity. These were Main Wharf East, Dixon Basin and Kingsford Wharf. No significant effect on amphipod survival was recorded for Main Wharf East or Dixion Basin but there was significant amphipod mortality at the Kingsford Wharf site.	☹

Waimea Inlet Score Card 2008

Result	Score
The total area of the estuary mapped in 2007 is slightly larger than it was in 2002, even allowing for changes in tide height or inter-tidal boundaries. It appears the estuary has grown through coastal erosion.	😐
The area of soft mud has increased between surveys suggesting the estuary may be progressively receiving more fine sediment. Fine sediment has also been noted as an issue in Nelson rivers and streams.	☹
Herbfields dominated by Glasswort (Sarcocornia quinqueflora) were significantly more extensive in the latest survey. This appears to be associated with habitats created by intertidal erosion.	☺
Areas of rushland (primarily Junctus marsh), tussock land, grassland and estuarine shrub covered areas seem to have grown slightly.	☺
Eel grass meadows seem to have decreased slightly although this appears to be a natural fluctuation.	😐
Removal of the causeway between Rabbit Island and Rough Island appears to have increased tidal flushing and led to local increases in biodiversity including establishment of sponge beds.	☺
A sponge bed extending over 4.8 ha and containing 69 separate species was located and mapped in the Monaco-Saxton Island channel.	☺
Re-survey of the four fine-scale monitoring sites showed them to be in a similar condition to 2002 – slightly enriched, but in a healthy state.	☺
The re-survey did not find any evidence of obvious pollution or nutrient enrichment.	☺
With the exception of nickel and chromium, which are considered to be naturally occurring, levels of contamination in the sediments were low and similar to other New Zealand estuaries.	☺
The abundance and diversity of creatures living in the sediment at the monitoring sites was similar to that of other New Zealand estuaries. The density of polychaete worms at one site suggested some enrichment but this was not consistent with laboratory analysis of samples from this site for organic or nutrient enrichment.	☺

7. MICROBIOLOGICAL WATER QUALITY

7.1 Setting the Scene

Good climate and high visitor numbers over the summer months mean Nelson's excellent marine beaches and rivers are used intensively for recreational uses. Where people have close contact with water for recreational uses, the quality of the water may affect people's health.

There is an established link between water quality and illness risks associated with swimming. Nelson City Council has obligations under the Resource Management Act 1991 and the Health Act 1956 to monitor environmental factors affecting the environment and public health. This includes reducing or managing conditions that are likely to affect the environment or affect the health of people in that environment.

Water contaminated by sewage and excreta may contain a diverse range of pathogens (disease causing micro-organisms such as viruses, bacteria and protozoa). During swimming and other 'high contact' water sports there is a reasonable risk that water could be swallowed, inhaled, or enter ears, mouth or nose or cuts in the skin; allowing pathogens to enter the body.

Research is continuing into the health risks associated with contamination of water by sewage and excreta. Until recently scientists believed that gastro-enteritis was the main health effect from contact with polluted water, but it is now becoming clear that respiratory health effects, such as coughs and colds, also occur and may be more common than gastro-enteritis. In most cases, the ill-health effects from exposure to contaminated water are minor and short-lived. However, the potential exists for more serious diseases such as Hepatitis A, protozoan infections and salmonellosis.

7.2 Guidelines and Standards

Microbiological water quality is assessed in terms of the Microbiological Water Quality Guidelines 2002, which were jointly prepared by the Ministry for the Environment and the Ministry of Health. Responsibility for implementing the guidelines is shared between local authorities and public health agencies. In Nelson that means Nelson City Council and the Medical Officer of Health.

The guidelines rely on a combined approach of sanitary survey and water quality surveillance. The sanitary survey identifies the contamination sources and risks within each area and classifies the area accordingly. The surveillance has a dual role. It provides the measured water quality at each site which, when combined with the sanitary risk at each site, allows a site grade to be assigned in terms of its suitability for recreation. The surveillance also provides for day-to-day management of the sites by establishing what actions are to be taken when sample results exceed a specified threshold value (Figure 7.2).

Figure 7.2 Microbiological Water Quality Guidelines Management Sequence.

RECREATIONAL WATER SAMPLE EXCEEDANCES – MANAGEMENT PROCEDURE

Based on Microbial Water Quality Guidelines Page D9 (Box 1) and E9 (Box 2).

FRESH WATER – *E.Coli*

GREEN

No Alert
Routine
Sampling

AMBER Alert

Single sample exceeds
260 E Coli/100ml

- Consider explanation for exceedance. If no obvious explanation re-sample **asap** otherwise continue with routine sample cycle
- If an inexplicable picture of exceedance continues Council discusses with the PHS
- Geoff Cameron (03) 546 1541 geoff.cameron@nmdhb.govt.nz
- Ed Kiddle (03) 546 1649 ed.kiddle@nmdhb.govt.nz
- Neil Silver (03) 520 9912 neil.silver@nmdhb.govt.nz

RED Action

Single sample exceeds 550
E Coli/100ml

- Council notifies PHS by email (All the PHS contacts as in the Amber Alert box)
- Council discusses with one PHS contact by phone and implements any recommended action
- Council re-samples **asap** and again on the following day
- Council maintains investigation, surveillance and management (Ongoing PHS notification not required where health warnings in place)
- Council to discuss with PHS before surveillance site is returned to normal status

MARINE WATER – *Enterococci*

GREEN

No Alert
Routine
Sampling

AMBER Alert

Single sample exceeds
140 Enterococci/100ml

- No need to notify PHS
- Continue with routine sample cycle

RED Action

2 consecutive samples exceed
280 Enterococci/100ml

First red sample – action

- Council notifies PHS by email (as in the Fresh Water Amber Alert contact list) of all results for the site
- Resample asap and again the next day

Second red sample – action

- Council notifies PHS by phone and discusses with a PHS contact and implements any recommended action
- Re-sample **asap** and again on the following day.
- Council maintains investigation, surveillance and management (Ongoing PHS notification not required where health warnings in place)
- Council to discuss with PHS before site is returned to normal status

(Single sample because of fresh water survival and potential for more pathogens.)

7.3 History of Monitoring

Surveillance Monitoring

Monitoring of water quality for contact recreation commenced in the 1990s. At that time monitoring involved the use of different indicators (the organism measured), different laboratory procedures (the way in which it is measured) and compared the result against different guideline levels. As a result it is difficult to compare monitoring undertaken prior to 2002 (when the current guidelines were implemented) with current results. Therefore this discussion is restricted to the period from 2002 onwards.

The surveillance monitoring programme includes both freshwater and marine sites. Freshwater sites are primarily located on the Maitai and Wakapuaka Rivers.

The Maitai River is the most heavily used for contact recreation and has the longest history of monitoring. There are a number of swimming holes throughout the main stem of the river. The monitoring programme includes a representative number of them, including an upstream site at Smiths Ford. This site provides a measure of the background level of contamination in the river before the river enters the area where human uses and activities may contribute contamination (a control site).

There is a trade-off between the number of monitoring sites and the frequency each site is monitored. The 2002 guidelines rely on at least 20 samples per site, per year and 5 years of record in order to calculate a final site grading. As a result not all swimming holes are monitored, but those included are used to represent a part of the river (reach), and are monitored at least once a week during the summer period.

Monitoring of the Wakapuaka River commenced late in the summer of 2006 with two sites – one in the Hira reserve near State Highway 6 and the other near the coast at Paremata Flats Reserve.

Marine sites are located at the main bathing beaches and the areas where water sports such as waterskiing and windsurfing take place. As with freshwater sites the 2002 guidelines resulted in a reduction in the number of sites but an increase in the frequency of sampling.

Sanitation Survey Monitoring

From time-to-time the surveillance programme identifies a site where bug counts are higher than expected. An example of this is the Collingwood St Bridge site where regular breaches of the red action mode were occurring. Upstream of the Collingwood Street Bridge site, bug levels were far lower and complied with guidelines (Figure 7.3).

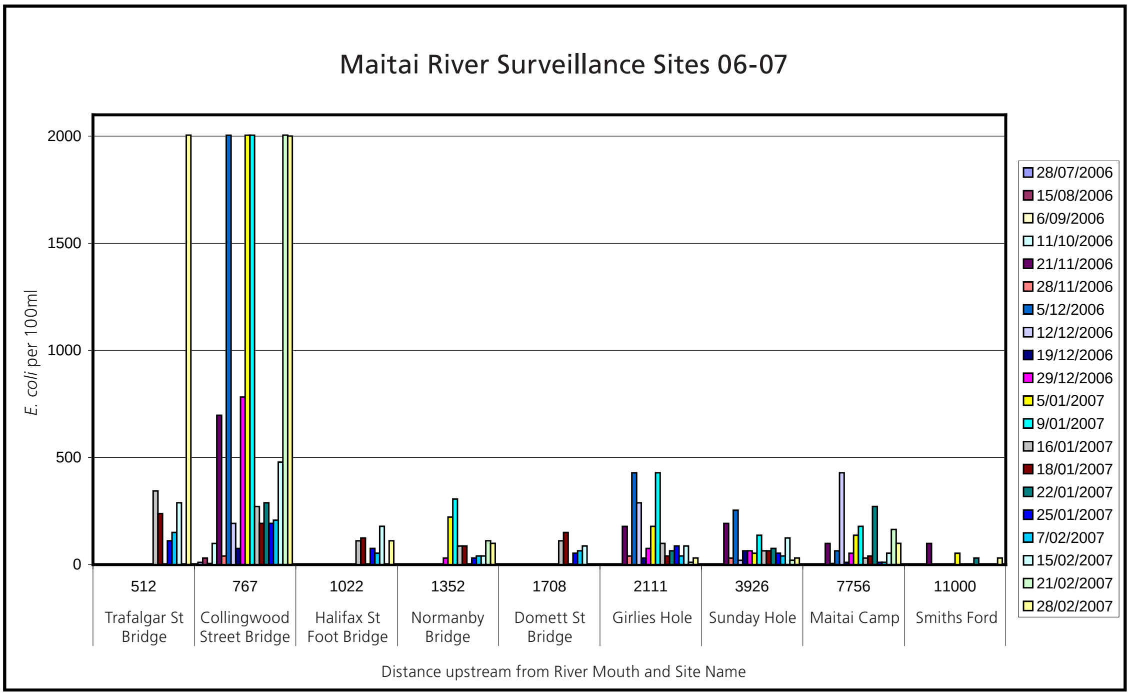
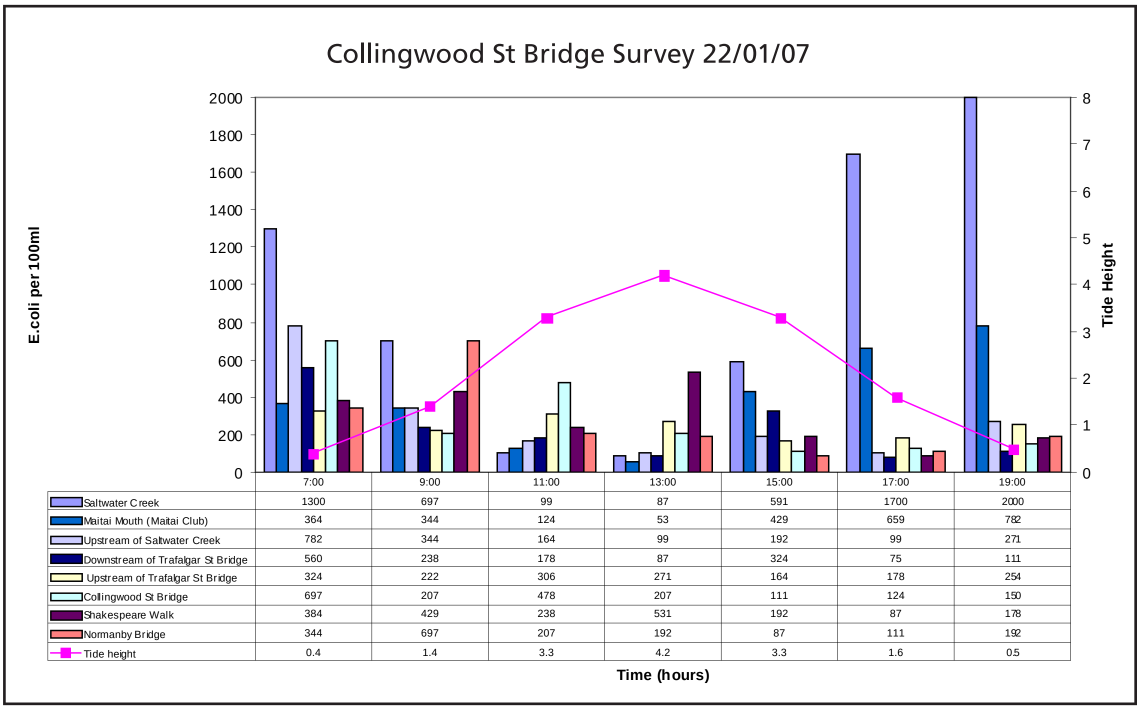


Figure 7.3 Comparative bug counts – Maitai River monitoring sites 2006-2007.

Samples were taken from stormwater outfalls in the area and while some of these had elevated bug counts they were not high enough to explain the levels recorded at the Collingwood St bridge site. Two separate surveys at multiple sites, repeated over the entire tidal cycle (12 hours), were undertaken. The results from the January 2007 survey is shown in figure 7.3a below. The data did not show any obvious pattern except for dilution occurring at high tide.



	7:00	9:00	11:00	13:00	15:00	17:00	19:00
Saltwater Creek	1300	697	99	87	591	1700	2000
Maitai Mouth (Maitai Club)	364	344	124	53	429	659	782
Upstream of Saltwater Creek	782	344	164	99	192	99	271
Downstream of Trafalgar St Bridge	560	238	178	87	324	75	111
Upstream of Trafalgar St Bridge	324	222	306	271	164	178	254
Collingwood St Bridge	697	207	478	207	111	124	150
Shakespeare Walk	384	429	238	531	192	87	178
Normanby Bridge	344	697	207	192	87	111	192
Tide height	0.4	1.4	3.3	4.2	3.3	1.6	0.5

Figure 7.3a Lower Maitai Survey January 2007.

The monitoring and survey results were reviewed by scientists at ESR (Institute of Environmental Science and Research Ltd) who were unable to establish the source of the contamination but recommended a number of investigations to establish the cause of contamination including:

- further assess routine bug monitoring results against tidal records
- measure salinity at the time of bug sampling to see if seawater or freshwater is present, so the correct indicators can be used
- measure suspended material in the water at the time of bug counts to see if re-suspension of bugs is occurring
- measure bug counts in river sediments to see if they are acting as a reservoir of bugs
- undertake flow measurements to identify if groundwater is resurfacing in the Collingwood St Bridge area
- review the location and status of all drains and outfalls in the area
- undertake microbial source tracking (MST) investigations in the area. This involves laboratory analysis of water samples to determine what species of animal is the most likely source of the bugs.

At the time the ESR report was received Cawthron Institute was in the process of setting up and trialling MST technology in Nelson. Cawthron agreed to use the Maitai River as one of the two sites to trial the new technology.

Cawthron collected water quality samples from the Maitai River in the vicinity of Collingwood St Bridge during December 2007 and analysed them for bugs as well as MST markers. All samples from the Maitai River showed contamination from cattle and possums and a strong human contribution was also detected in all samples collected downstream of the Halifax Street footbridge. The human contribution was confirmed by at least two separate markers in each water sample.

The Cawthron report recommended that while the animal-sourced contamination was likely to be from diffuse sources, the human contribution in the lower river area was likely to be from leaking pipework or cross connections between sewer and storm water systems in the urban area around the Collingwood and Trafalgar Street bridges.

Subsequent re-testing of storm water outfalls in this area revealed very high bug counts in both the Collingwood Street storm water system and to a lesser extent (but still high) the Trafalgar Street storm water system. A programme of sampling throughout these systems revealed a number of cross connections (sewer and storm water) within the systems and an area of collapsed sewer line in upper Nile Street. These problems have been rectified and subsequent testing has shown an improvement in water quality. Further monitoring is required to determine whether the health warning can be lifted from this part of the river.

7.4 Wakapuaka Sanitation Survey

In 2007, the Council decided to include sampling of the Wakapuaka River as part of its routine annual recreational water monitoring programme. Two sites were selected, one at the Hira Reserve (behind the shop) and the other at Paremata Flats Reserve near Delaware Inlet.

Results from water quality samples taken from both the Wakapuaka River sites regularly exceeded the national guidelines, giving rise to both "Alert/Amber Mode" or "Action/ Red Mode". Of particular note, Paremata Flats Reserve had eight samples above the "Action/Red Alert Mode". Figures 7.4 and 7.4a show the results of the 2007-2008 bathing season.

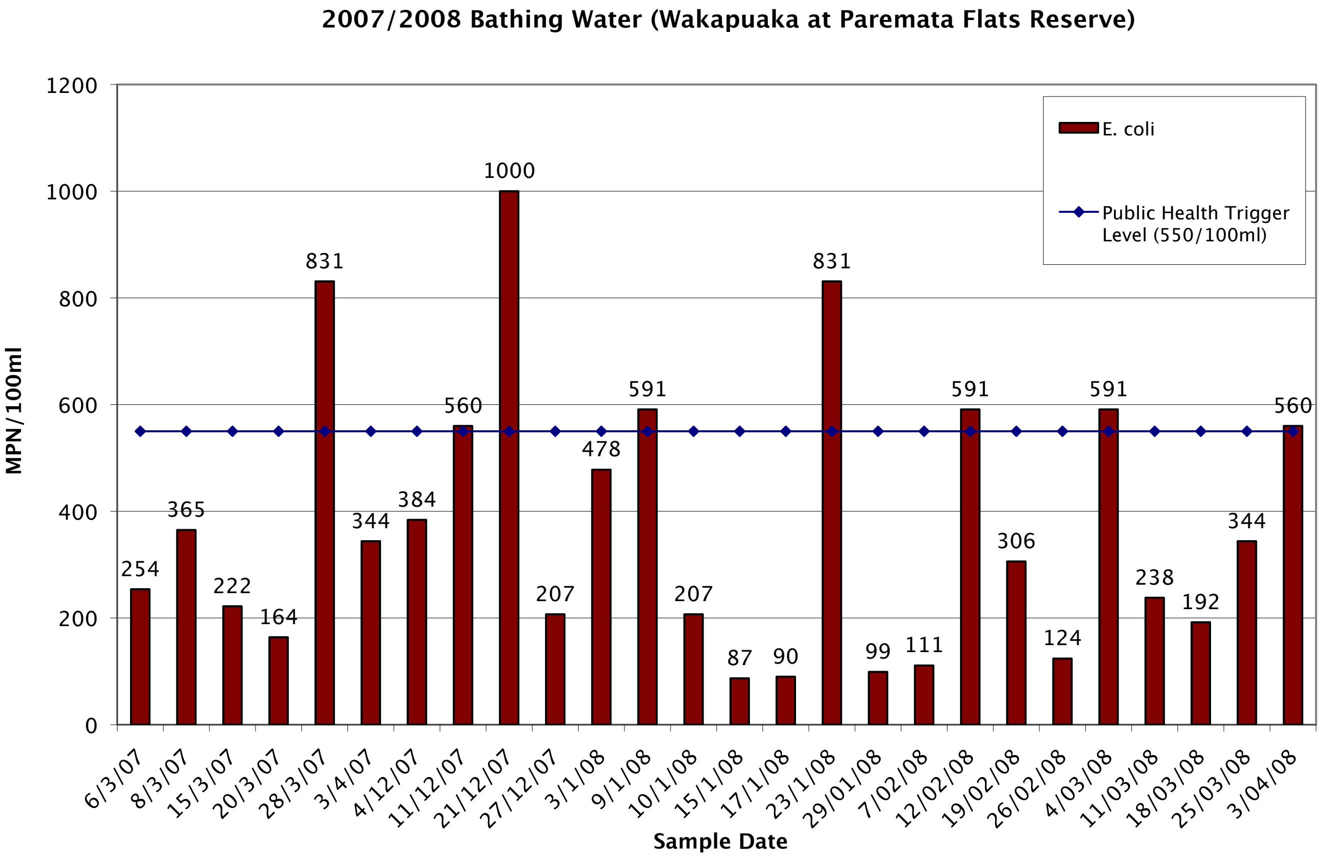


Figure 7.4 Microbiological monitoring results Wakapuaka River at Paremata Flats Reserve.

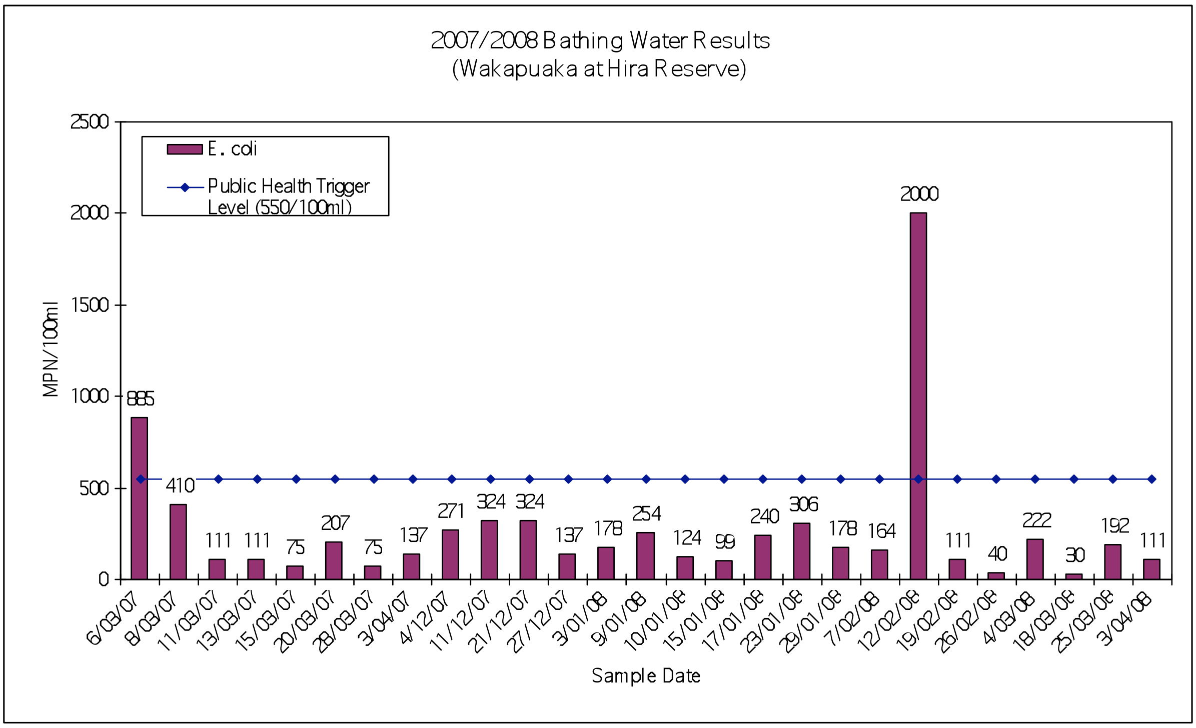


Figure 7.4a Microbiological monitoring results Wakapuaka River at Hira Reserve.

The Council discussed these results with the Medical Officer of Health and his staff and decided that a sanitation survey was needed. Water quality sampling was undertaken during March 2008 at a range of sites throughout the catchment and then again in one sub-catchment of the river in April 2008. The bug counts recorded are shown in Figure 7.4b.

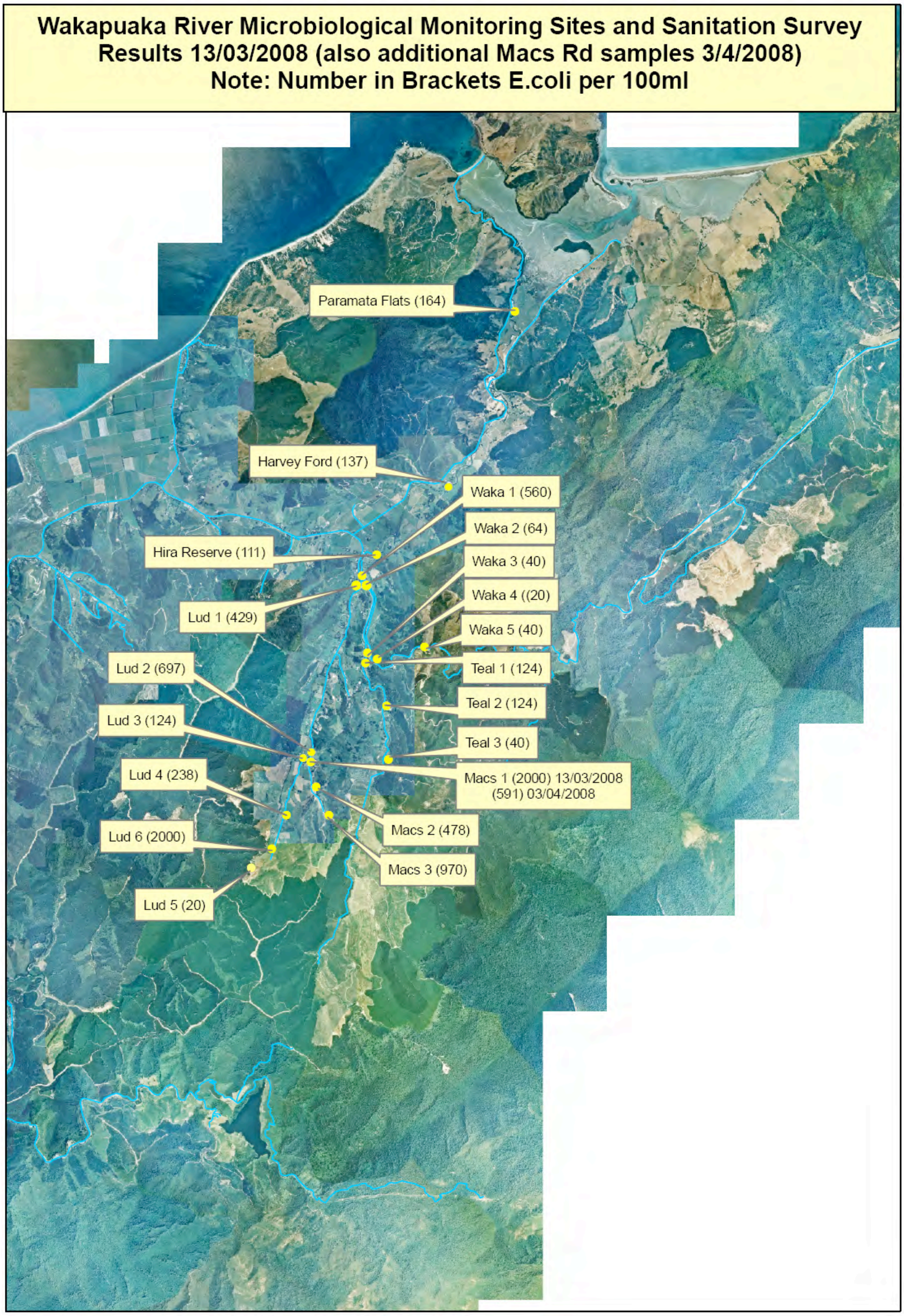


Figure 7.4b Wakapuaka sanitation survey 2008.

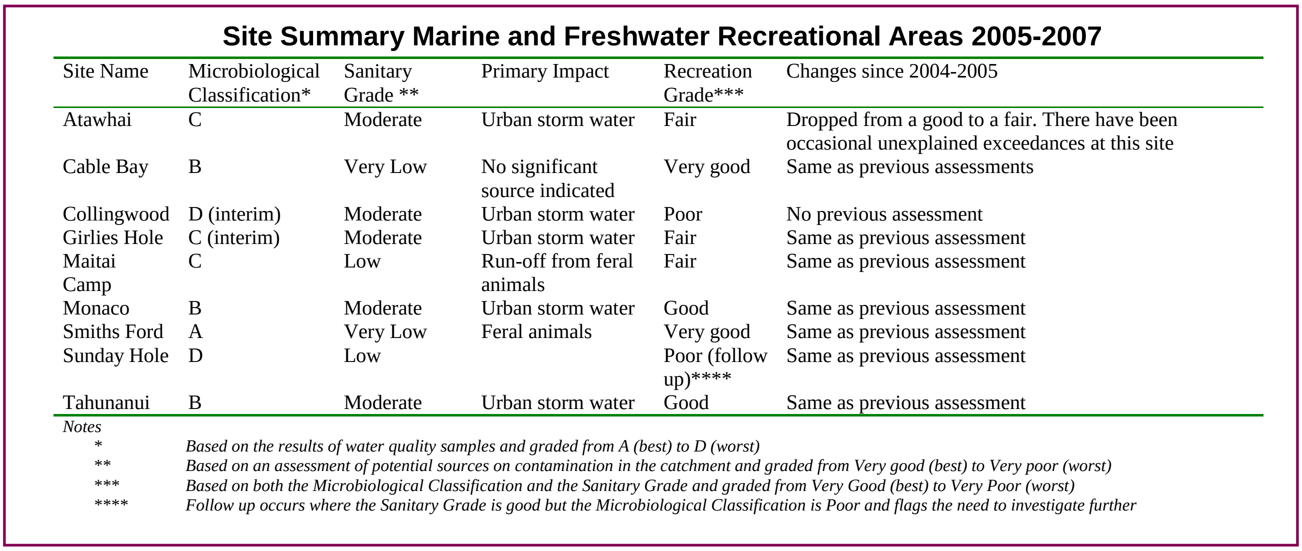
The results suggest that:

- water quality is good in the areas dominated by native bush and plantation forestry
- water quality quickly deteriorates in the areas dominated by pastoral and small holding land uses
- it is likely that grazing of farm animals is mainly responsible for the decline in water quality in these more intensively farmed or settled areas.

The Council hopes to work with the Wakapuaka River community to explore ways of improving the river's water quality, particularly during the summer swimming season.

7.5 Results 2001-2007

Long-term monitoring results and catchments assessments are used to calculate suitability for recreation grades (SFRG) for each monitoring site. It requires a minimum of 5 years of data and 100 samples to calculate a full grading for a site, although interim grading can be calculated from as few as 20 samples. The last full grading was undertaken in 2007 and is presented in Figure 7.5 below.



Site Summary Marine and Freshwater Recreational Areas 2005-2007

Site Name	Microbiological Classification*	Sanitary Grade **	Primary Impact	Recreation Grade***	Changes since 2004-2005
Atawhai	C	Moderate	Urban storm water	Fair	Dropped from a good to a fair. There have been occasional unexplained exceedances at this site
Cable Bay	B	Very Low	No significant source indicated	Very good	Same as previous assessments
Collingwood	D (interim)	Moderate	Urban storm water	Poor	No previous assessment
Girlies Hole	C (interim)	Moderate	Urban storm water	Fair	Same as previous assessment
Maitai Camp	C	Low	Run-off from feral animals	Fair	Same as previous assessment
Monaco	B	Moderate	Urban storm water	Good	Same as previous assessment
Smiths Ford	A	Very Low	Feral animals	Very good	Same as previous assessment
Sunday Hole	D	Low		Poor (follow up)****	Same as previous assessment
Tahunanui	B	Moderate	Urban storm water	Good	Same as previous assessment

Notes

*	*Based on the results of water quality samples and graded from A (best) to D (worst)*
**	*Based on an assessment of potential sources on contamination in the catchment and graded from Very good (best) to Very poor (worst)*
***	*Based on both the Microbiological Classification and the Sanitary Grade and graded from Very Good (best) to Very Poor (worst)*
****	*Follow up occurs where the Sanitary Grade is good but the Microbiological Classification is Poor and flags the need to investigate further*

Figure 7.5 Marine and Freshwater Recreational Areas 2005-2007.

The gradings show a fairly stable situation, with the main bathing beaches graded as good or very good. The swimming holes in the Maitai River deteriorate the further downstream you go. The furthest upstream site, at Smith's Ford, has a "very good" assessment which falls to a "fair" assessment at Maitai Camp and to a poor assessment in the lower river through the urban area.

This pattern is normal for an urban catchment where there are many potential sources of contamination. With the exception of the Collingwood Street Bridge site and downstream to Nelson Haven, the lower river complies with the guidelines except during periods of rain and for about 36 hours afterwards, until the water clears.

The Council advises that people should not swim in the Maitai River for 36 hours after any rainfall that is heavy enough to discolour the water.

7.6 2008 Score Card

The 2008 scorecard for microbiological water quality is presented below. It uses the Microbiological Assessment Categories (MAC) within the 2003 Microbiological Water Quality Guidelines. The guidelines use the past five years of routine monitoring results to assess a grade.

The score card presents this five-year site grade alongside an interim grade for the past summer only for each site at which 20 or more samples are taken per year (this excludes Smith’s Ford). This provides a comparison between last summer and the long-term average.

MAC grades range from A, which has very low bug counts and never exceeds guideline levels, through to D which has high bug counts and regularly exceeds the guidelines. The criteria used for classification are shown in Figure 7.6 below and the score card (Figure 7.6a).

A	Freshwater: 95th percentile of samples less than or equal to 130 E.coli per 100ml Marine: 95th percentile of samples are less than or equal to 40 enterococci per 100ml
B	Freshwater: 95th percentile of samples are between 130 and 260 E.coli per 100ml Marine: 95th percentile of samples between 41 and 200 enterococci per 100ml
C	Freshwater: 95th percentile of samples are between 261 and 550 E.coli per 100ml Marine: 95th percentile of samples are between 201 and 500 enterococci per 100ml
D	Freshwater: 95th percentile of samples are greater than 550 E.coli per 100ml Marine: 95th percentile of samples greater than 500 enterococci per 100ml

Figure 7.6 Microbiological assessment categories.

Figure 7.6a 2008 score card.

8. IWI PERSEPECTIVE

Prepared by Ursula Passl on behalf of the Iwi of Nelson.

An extract from Nga Taonga Tuku Iho ki Whakatu Management Plan for Nelson City State of the Environment Report.

8.1 Introduction

The way in which *tangata whenua* (people of the land) view the natural environment is unique from other New Zealanders. Nelson *iwi* released an introduction to these differences in *Nga Taonga Tuku Iho Ki Whakatu Management Plan 2004* – a collective iwi management plan for the Nelson *rohe (area)*. This chapter summarises key elements from the management plan for inclusion into the State of the Environment Report.

8.2 Spiritual Framework

Creation plays a fundamental role in the way *tangata whenua* interact with their environment. The children of *Ranginui* (the Sky Father) and *Papatuanuku* (the Earth Mother) became *nga atua kaitiaki* (the supernatural guardians) of all the elements of the natural world. *Nga atua kaitiaki* created *nga taonga tuku iho* (the treasured resources) by breathing life into them – all resources are therefore *uri* (descendants) of the *atua* and are regarded as *taonga* (treasures). The following *atua kaitiaki* provide a framework for illustrating the relationship *tangata whenua* have with natural environment (see Figure 8.2):

- *Tawhirimatea*, the *atua* of the wind and the air
- *Tumatauenga*, looks after tangata whenua; he is also the *atua* of war
- *Tane Mahuta*, the fertility force and the guardian of *ngahere* (trees) and ngamanu (birds)
- *Tangaroa*, the *atua* of the *moana* (seas), *nga awa* (the rivers), *nga roto* (lakes) and wetlands
- Rongomatane, presides over peace; he is also the *atua* of cultivated foods
- Haumie-tiketike, the guardian of wild foods, including fern roots.

Figure 8.2 Tangata whenua relationship with the natural environment

Ranginui – The Sky Father

Nga atua kaitiaki

Tawhirimatea

After the separation of Ranginui and Papatuanuku, Tawhirimatea stood by his father and declared war on land and sea – he continues to assail tangata, the forests and the seas with the force of high winds and storms.

Air links all the different elements of the natural world. Tangata whenua greatly value and respect air – it is an essential element of life, a taonga to be protected and maintained.

Tumatauenga

Traditionally, Tu was called upon throughout the lives of tangata whenua. Tangata were often dedicated to him in tohi (the baptismal rite) and before they took part in battle.

The relationship tangata whenua have with the natural environment is a spiritual and a physical one, guided by rules that govern the behaviour of tangata tiaki (human guardians). These rules or life principles handed down from generation to generation have become enshrined in lore.

Rongomatane & Haumie-tiketike

Tangata whenua manage and utilise mahinga kai (food-gathering areas) to meet their spiritual and physical needs. Mahinga kai are essential for tangata whenua to maintain customs, such as manaakitanga – this tradition includes the customary practice of koha, (the giving and receiving of gifts) and is often expressed through the provision of kai (food) to manuhiri (visitors). Tangata whenua demonstrate their respect for the mana (authority and status) of their guests by providing them with local delicacies. This act of giving reflects the reputation of the host people, as the abundance of the kai (food) provided, reflects their ability as rangatira (chiefs) and kaitiaki (guardians) to sustain local resources and cultural traditions.

Tangaroa

Within the realm of Tangaroa is Kiwa (the guardian of the ocean) and Tutewehiwehi, the atua of inland water creatures).

Wai (water) is regarded with great respect as it symbolises the spiritual link between the past and the present. Wai (water) is an essential element of life. It is considered to transcend life itself. As kaitiaki (guardians), tangata whenua believe that the maintenance of the mauri (life force) of wai is necessary to ensure the physical and spiritual survival of all things. A water body with an intact mauri is able to sustain healthy ecosystems. Nga awa are a source of wai and have a mauri, mana and tapu of their own. Traditionally nga awa were central to the lives of tangata whenua, because they provided transport routes for canoe travel, access to fishing grounds, and strategic locations for settlements.

Fishing and the taking of shellfish, beached whales and marine flora all play an important role in the lives of coastal tribes – in economic, social and spiritual terms. Maintaining mataitai kaimoana (food gathering places of the sea) is essential to sustain tangata whenua customs and traditions.

Tane Mahuta

According to Māori lore, all flora and fauna associated with the ngahere (forests) are the children of Tane. During Tane's search for a female being to produce humankind, he cohabited with many different female forms and created all the things that live in the forests including trees, tree ferns, climbing plants, nga manu (birds) and ngarara (insects)

The forests provided the habitat for many taonga (treasures), which were central to the lives of tangata whenua. Matauranga (knowledge) associated with these taonga included what kai (food) to eat, rongoa (medicines) for different ailments, and what materials to use for a variety of construction tasks. Extracts from different plants were used to make dyes for clothing, kete (baskets) and rongoa. Tangata whenua have accumulated matauranga about the medicinal properties of plants – this matauranga is illustrated by the many spiritual and practical uses plants have in the lives of tangata whenua today.

Papatuanuku – Earth Mother

Whenua is the land; the body of Papatuanuku and provider of nourishment. Whenua also means placenta, underlining the nurturing and life-giving properties of both entities. The land links the past, present and future – it unites kinship and individual identity. Traditionally, land formed the social and economic basis for Māori society. Tribal rights to land were based on: take taunaha (discovery), take raupatu (conquest), take tupuna (inherited rights), and take tuku (gifting). The fires of occupation – ahi kaa roa, confirmed rights to the land.

8.3 Linkage Between the Spiritual and physical Worlds

Tangata whenua believe that because of the relationship of *nga atua kaitiaki* (the spiritual guardians) with natural resources, everything is interconnected. The linkage between the spirit world and the physical world is therefore central to the *tangata whenua* environmental perspective. This is reflected in the following life principles guiding the relationship *tangata whenua* have with natural resources:

- *a sense of kinship with all things*
- *a regard for nga taonga tuku iho as being gifts from the atua*
- *a sense of responsibility for nga taonga tuku iho as appointed kaitiaki*
- *a sense of commitment to look after nga taonga tuku iho for future generations*
- *an ethic of giving back what is taken from the environment in kind.*

Key elements associated with these life principles are explained in the following paragraphs:

- for tangata whenua, relationships are paramount. *Whanaungatanga* (nuclear and extended family relationships) and *whakapapa* (genealogy) form the basis for the relationship between all things – relationships between people, the relationships between people and the physical world and relationships between people and the spiritual world
- the divine origin of all things is reflected in the belief that everything has a *wairua* (spirit) and a *mauri* (life force), without one the other cannot exist. People, the land, sea, rivers, plants and animals all have a *mauri* and *wairua*; they are all *taonga* (treasures). All these elements are *tapu* (scared) in recognition of the life force and spirit that exists within them. The physical and spiritual health of all resources is of great importance to tangata whenua
- through the relationship with the spiritual guardians, tangata whenua believe they have a duty to their ancestors (those living and those to come) to take care of and protect the *nga taonga tuku iho* in the *rohe* (area). These include places of cultural significance, natural resources and other taonga. Looking after natural resources requires that *tangata whenua* as the human guardians carry out their inherited responsibilities by following *tikanga* (customary practices) and using *matauranga* (traditional knowledge). *Kaitiakitanga* (guardianship) involves the application of resource management practices, rules and techniques to ensure the long term well being of the natural environment
- although tangata whenua are focused on maintaining and enhancing the health and well being of nga taonga tuku iho, using natural resources (customary use) is also an important aspect of managing resources. Customary use relies on the sustainable management of natural resources and is fundamental to maintaining the cultural identity of tangata whenua.

8.4 Future Iwi Score Cards

Nelson Iwi and Nelson City Council staff have collaborated to develop a set of cultural indicators to provide an iwi-based cultural assessment of the health of Nelson rivers and estuaries. It is intended that the result of iwi-based monitoring will be reported in future Nelson State of the Environment reports alongside Council's monitoring.

9. REFERENCE LIST

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