

Environmental Monitoring 2008 Data Report

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1 Introduction

Environment Waikato is required to collect environmental information to comply with its obligations under Section 32 of the Resource Management Act 1991. The Environmental Monitoring Programme, Resource Information Group of Environment Waikato is responsible for much of this collection. The Environmental Monitoring Programme is ISO 9001:2000 registered through Telarc New Zealand for the supply of environmental information and services, including water quality, biological sampling, air quality, land and rating information and geographical information systems.

This report summarises the information collected during the 2008 calendar year.

2 Data management

2.1 General

Since data is being collected continuously (Environmental Monitoring's 109 automatic stations generate more than eight million data points each year) good management of the data is essential. Procedures are continually being reviewed and improved in conjunction with the quality system. Extreme events, such as floods or droughts, necessitate that previous work (such as level/flow ratings) is reviewed for accuracy. The compilation and regular review of a Processing and Reporting Manual have improved consistency of data processing, analysis and management.

3 Quality management

To ensure that the database is current and free from major errors, six monthly quality management audits are run. These present the collected data graphically, make comparisons and check for accuracy. Any deficiencies are followed up and corrected.

3.1 Data availability

Real time data is available for all telemetered stations. Data is supplied provisionally until the satisfactory operation of the instrumentation is confirmed.

Data is downloaded at most automatic stations at eight weekly intervals but some remote telemetered stations are serviced at two or three month intervals. Data is processed, checked and archived within two weeks of the station inspection.

The flow / level relationship (rating), derived using flow gaugings, is affected by bed movement or change in the control. As the full range of flows is gauged, the rating is adjusted to complement the gaugings. Since these improvements can be done at any time, users are encouraged to obtain flow data directly from Environmental Monitoring.

3.2 How to contact Us

Requests for data associated with this report can be made by;

Email: inforeq@ew.govt.nz

Phone: (07) 859 0999

Fax: (07) 859 0998

Under current policy, data is free but there is a charge for the time taken to access the data. This charge is waived for certain users, such as educational institutions.

General enquiries to Environment Waikato may be made by:

Phone: (07) 859 0999 or Environment
Waikato's Freephone 0800 800 401

General information about Environment Waikato may be found on our website. Real time river levels and rainfall information from some sites is also available on the website.

Web Home Page: www.ew.govt.nz

Web River Levels: <http://www.ew.govt.nz/Environmental-information/River-levels-and-rainfall/>

Web Rainfall: <http://www.ew.govt.nz/Environmental-information/River-levels-and-rainfall/>

Web Groundwater: <http://www.ew.govt.nz/Environmental-information/Groundwater/>

Web Water Temp: <http://www.ew.govt.nz/Environmental-information/Rivers-lakes-and-wetlands/Water-temperature-levels-in-the-Waikato-region/>

4 Directions

4.1 Work programme 2008/2009

Data capture will continue and quality control methods for incoming data will be improved as required.

Environmental Monitoring's role is being widened to include responsibility for the importation, quality assurance and archiving of more diverse forms of environmental information.

The ISO 9001 quality system will ensure procedures are closely followed and modified as required. As additional areas of work are added to the programme, they will be incorporated in the quality system.

Providing information to customers is an integral part of Environmental Monitoring's service. Regular requests for resource consent information for data analyses are anticipated, particularly in response to extreme events.

4.2 Technology

Acoustic doppler technology has been introduced for the measurement of open channel flows, particularly high flows. Environmental sensors are evaluated as required by the Environmental monitoring team.

5 Summary

This report has summarised environmental data collected by the Environmental Monitoring Programme during 2008.

Procedures used are in accordance with those outlined in the Quality Manuals. Data is stored on Environment Waikato's computer system.

Data is readily available. Under current policy, data is free to all users but there is a charge for the time taken to access the data. This charge is waived for certain users, such as educational organisations.

The ISO 9001 quality system is given priority and the scope of registration will be increased to cover all activities completed by the Environmental Monitoring Programme. Data capture statistics and equipment performance are reviewed and used to improve performance.

5.1 Information network

Table 1 shows the Environmental Monitoring Programme collected over 298 separate time series data sets from 206 permanent recorders and 92 temporary automatic recorder sites in the region during 2006. These are installed for specific purposes, such as flood and resource management and resource consent monitoring. Over fifty stations are linked directly to the office by a telemetry system.

Table 1: Summary of 2008 Automatic Recorders

Permanent recorders			
Sites	Type	Parameters measured	Data sets
25	Rainfall	Rainfall (25)	25
53	Surface Water	Level (53), Flow (40), Water Temperature (12)	105
5	Coastal	Sea Level (5), Water Temperature (3), Wave Amplitude, Wind Speed, Wind Direction, Wind Gust, Barometric Pressure (2)	14
11	Groundwater	Level	11
7	Air Quality	Wind Speed (5), Wind Direction (5), Air Temperature (5), Particulate Matter <10 microns (7)	22
2	Climate	Rainfall (2), Groundwater Level (4), Climate parameters (10)	16
13	Lake Level	Level (13)	13
Totals			206
Temporary/portable recorders			
Sites	Type	Parameters	Data sets
30	Water Quality	Water Temperature (Onset Loggers)	30
8	Water Quality	Water Temperature, pH, Dissolved Oxygen (mg/l & %), Turbidity, Conductivity, Chlorophyll A, Algae	48
7	Water Quality	Suspended Solids, Turbidity	14
44	Totals		92

In addition to the automatic stations there are manual sites where measurements are taken at regular intervals. Manual sites are operated where less detailed information is required and the information collected may be correlated with adjacent automatic stations once a base of data is established.

6 Telemetry system

The flood warning and data acquisition system, *HydroTel* is a SCADA (supervisory, control and data acquisition) system and is capable of handling a wide range of field interfaces. It is also versatile in output and can direct messages to phone, pager, facsimile, modem or database. *HydroTel* handles alarms and data transfer to the Hamilton office.

Some of these sites are used for extreme event warning and are programmed with thresholds that trigger alarms, which are sent back to Environment Waikato's Hamilton office and then out to duty officers.

The telemetry system is also used to operate three floodgates (Lake Waikare Outlet, Whangamarino Control Structure and Te Onetea Stream) in the Lower Waikato Waipa Control Scheme and ten flood pumps on the lower Waihou flood scheme.

The locations of some telemetered stations can be found at:

Web river levels: <http://www.ew.govt.nz/riverlevelsandrainfall/cgi-bin/hydwebserver.cgi/catchments/details?catchment=17>

Web rainfall: <http://www.ew.govt.nz/riverlevelsandrainfall/cgi-bin/hydwebserver.cgi/catchments/details?catchment=16>

Latest readings and earlier data can be found using the web links shown above. For data from sites not listed please contact the following:

Email : inforeq@ew.govt.nz

Phone: (07) 859 0999

Fax : (07) 859 0998

7 Usage of data

7.1 Information requests

Usage of archived data is significant. A database was set up during 1993 to monitor this usage and to ensure that all requests are satisfactorily and promptly answered.

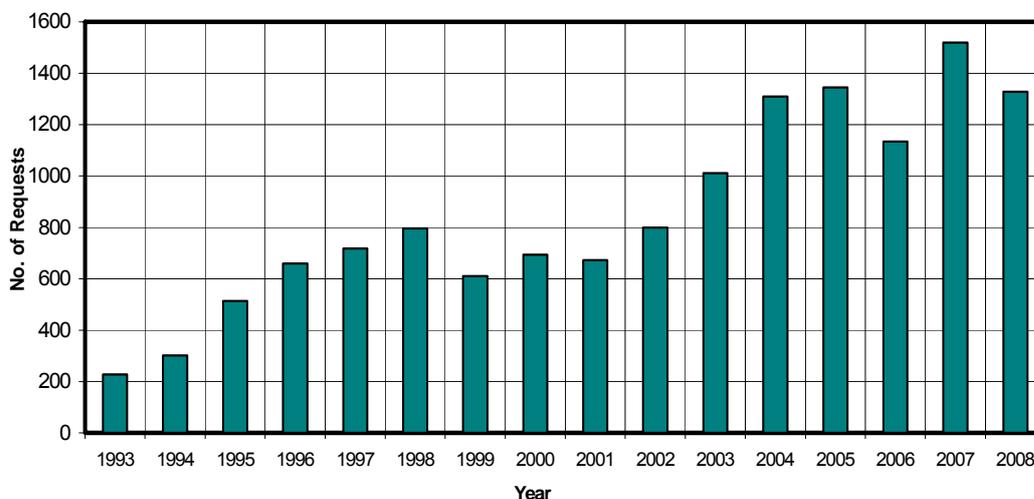


Figure 1: Information Requests Actioned By Environmental Monitoring Staff, 1993 – 2008

Since the database is not accessible to all Environment Waikato computer users and agencies who contribute to the NIWA National Archive, the number of requests is likely to be well in excess of the number of requests logged and actioned. Also not included is real time data, available 24 hours per day and used in the flood warning, river system management and the large number of data sets that are accessible to all staff through corporate applications and databases. e.g. GIS layers, Internet, Smartmaps.

8 Rainfall data

8.1 General

Environmental Monitoring archives rainfall data collected by observers and from automatic stations. Additional sources of rainfall data include NIWA, Genesis and Mighty River Power. Enquiries regarding NIWA rainfall data should be directed to the address shown below.

The National Climate Database

NIWA

PO Box 14-901

Kilbirnie

WELLINGTON

Email: climate-enquiries@niwa.co.nz

Tel: (04) 386 0300

Fax: (04) 386 0574

8.2 Manual sites

Manual sites are operated by observers who typically take readings of accumulated rainfall from a gauge each day at 9am. The results are returned to Environment Waikato every two months and are entered onto the computer database.

The archived data come from sites operated by Environment Waikato volunteers in the region.

8.3 Automatic stations

Where rainfall intensity information is needed, an automatic station is installed and readings of accumulated rain are taken every five minutes during each rain event. All gauges measure rainfall to a precision of 0.5 mm. Most Environment Waikato stations are also telemetered for flood warning purposes.

9 Surface water level data

9.1 General

A manual surface water level station is used mainly in water resource allocation projects and water level readings taken are converted to flow using a rating.

An automatic surface water level station will typically measure the level of a stream, river, wetland, lake or coastal sea levels.

Levels are used for many purposes, including flood warning, resource management and resource consent applications.

9.2 Manual sites

The installation at a manual site typically includes a staff gauge in the water channel and one or more benchmarks. Greater emphasis is now given to correlating flow rather than establishing a rating; however if the control is stable, rating can be a cost-effective method of accumulating basic flow information.

9.3 Automatic stations

An installation includes a recorder and sensor, staff gauge and at least three benchmarks. Stations are visited typically at eight weekly intervals and a biennial inspection check undertaken for changes in any of the reference points.

10 Water flow data

10.1 General

Water flow (discharge) may be measured using a number of techniques including volumetric measurement, chemical dilution, slope/area and float gauging. The one most commonly used at Environment Waikato is current meter gauging.

A current meter gauging indirectly measures discharge by determining cross-sectional area and velocity in a channel section. The discharge is obtained by multiplying these two parameters together.

10.2 Manual sites

A manual flow site has a site installation similar to that of a manual water level station, with perhaps structures such as slack lines, to assist in flow measurement. Flow gauging is done on a regular basis to build up a level/flow relationship (rating). The accuracy of the rating required by the customer will determine the gauging frequency. A stream or riverbed that is unstable or affected by weed will necessitate more frequent measurements.

10.3 Automatic stations

A continuous record of flow at a station is obtained by combining water level data with the rating. To ensure that the rating is accurate over the range of recorded levels, it is important to gauge at low, medium and high levels. Flood events or channel modification may cause a rating change, which then requires another series of gaugings to define the new rating curve.

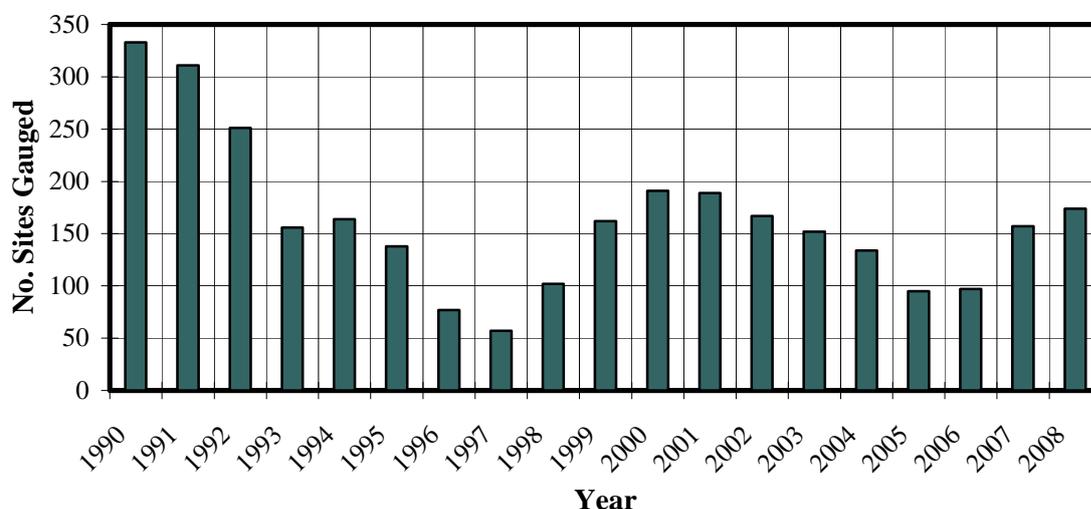


Figure 2: Size of flow monitoring network, 1990 – 2008

Gaugings are generally done only at sites where customers have requested flow information.

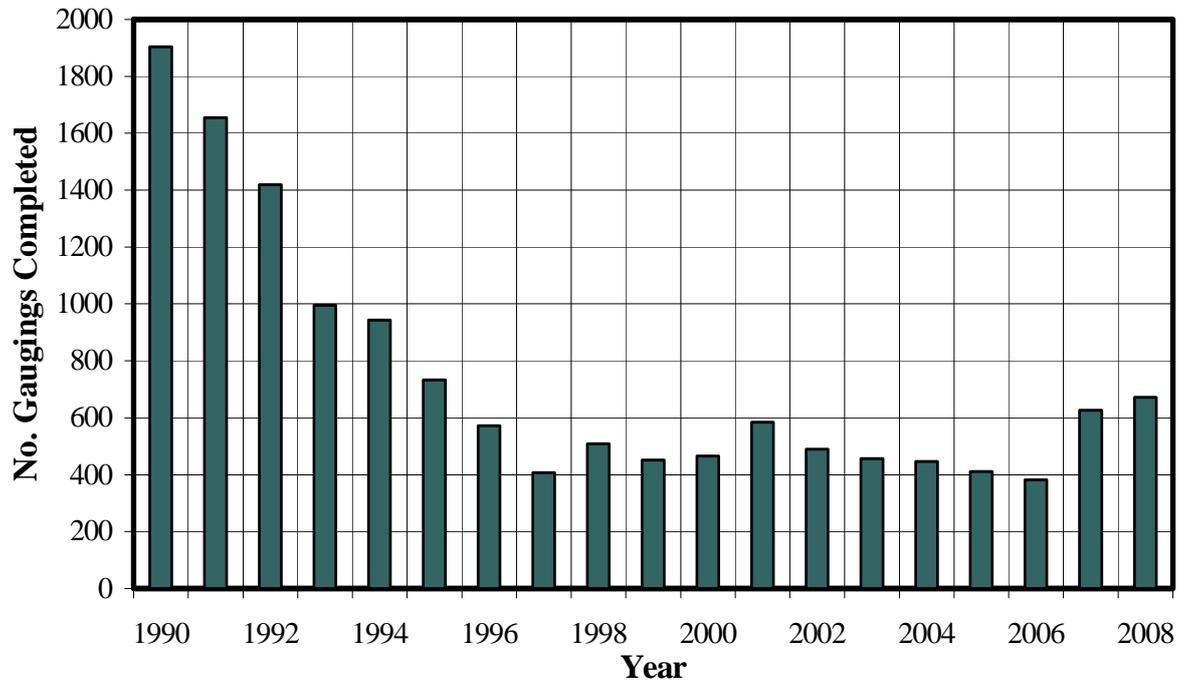


Figure 3: Number of gaugings completed, 1990 - 2008

11 Groundwater level data

11.1 General

Groundwater level is measured using a calibrated depth probe. These are checked for stretch on a regular basis.

Groundwater level measurements (both manually and automatically collected) are filed as the distance down from the top of the bore or well. The levels for these reference points have been calculated in terms of Mean Sea Level.

It is important to contrast the above with surface water stations which operate above (not below) a specific reference level.

11.2 Manual sites

Previous emphasis in groundwater level data collection has been on manual observations; however adequate data has been collected to enable selected bores to predict levels at adjacent sites. In 2008 470 bores were manually monitored.

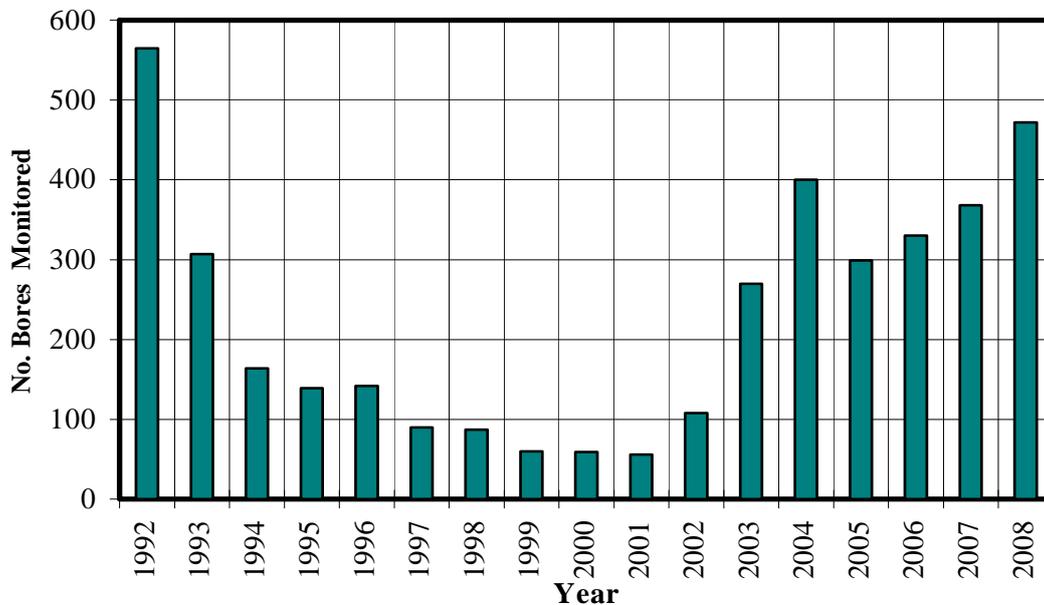


Figure 4: Number of bores in the groundwater level monitoring network (manual), 1992 - 2008

11.3 Automatic stations

Eleven automatic stations, continuously recording groundwater levels, were operating during 2008.

Matamata Airfield has 4 bores with continuous records. These are a water table bore, 20m, 40m and 163m deep bores.

- Hamilton - is a shallow 4m deep bore that has a diving logger, measuring water level.
- Cooks Beach - a shallow 11.0 metre deep bore, has a diving logger, measuring water level.
- Hahei Beach - a shallow bore 10 meters deep has a diver measuring water level.
- a deep bore 104 metres deep has a diver measuring water level and conductivity.
- Opoutere - a shallow bore 20 metres deep has a diver measuring water level.
- Matarangi - a shallow bore 6 metres deep has a diver measuring water level.
- Taupo - a thermal stream has a diver measuring level and temperature.

12 Surface water temperature data

12.1 General

Surface water temperature is measured manually and automatically at selected flow stations. Manual temperature readings may be taken at the time of flow gaugings and as part of regional water quality sampling.

12.2 Manual sites

Manual readings of water temperature are usually taken using a digital thermometer. Samples as part of flow gaugings are taken in the channel as far into the flow as

practicable. Temperature measurements taken during water sampling are taken from a bucket sample collected mid-stream or from the stream bank.

12.3 Automatic stations

Water temperatures are taken at least hourly at automatic stations. Station inspections occur at 8 to 10 weekly intervals and manual readings with a digital thermometer are used to detect deviation of the logged temperature from the true temperature.

13 Water quality data

13.1 General

All Environment Waikato water quality results with a geographic location are stored in the database. Over 4000 samples were analysed during 2008; over 95 percent of these were related to a geographic location.

Automatic samples are also taken at selected sites for specific projects. These water quality measurements are taken using Datasonde logger/sensor instruments and are typically operated for three-day periods.

Reports on the regional rivers and Waikato River are available and can be obtained by contacting Environment Waikato's freephone 0800 800 401 or e-mailing inforeq@ew.govt.nz. These reports are available on our website at www.ew.govt.nz.

13.2 Manual sites

Water was sampled from lakes, rivers, streams, underground and the coast. The Regional River Monitoring project, with 1200 samples from 100 sites, is the largest project. The most comprehensive project (Waikato River) determines 39 parameters routinely compared with others of only one.

13.3 Automatic stations

13.3.1 Datasondes

Datasondes were deployed at eight sites. These deployments typically measured water temperature, pH, dissolved oxygen and conductivity, with chlorophyll A and turbidity monitored at four sites and blue green algae at one site. Readings were taken at 20-minute intervals.

13.3.2 Onset temperature loggers

Onset temperature loggers were deployed at thirty river sites. These loggers recorded water temperature at between 15 and 30 minute intervals.

13.4 Groundwater quality

In 2008 a total of 550 samples were taken from 346 groundwater sites which are broken into several monitoring programmes (Regional Groundwater, National Groundwater Monitoring Programme, Taupo and Coromandel Groundwater Projects, Pesticides and Groundwater Nitrates and Schools).

Regional groundwater monitoring is undertaken on an annual basis with 23 parameters determined for 110 sites. 30 sites were monitored quarterly as part of the National Groundwater Monitoring Programme. Routine water parameters were determined on a quarterly basis at 38 sites as part of the Lake Taupo Project. In 2008 pesticides and microbial indicators were monitored at 80 sites across the region. 88 school bores were monitored.

14 Suspended sediment data

14.1 General

Suspended sediment is currently sampled at 22 sites when appropriate river levels are reached in an effort to provide regional coverage of suspended sediment yield. Six of these sites have ISCO automatic samplers installed. Sampling is conducted over the full range of flow conditions and from this the general relationship between flow and sediment concentration can be determined.

14.2 Manual sampling

Water samples are collected and analysed to determine sediment concentrations. The typical method used is depth integrated sampling whereby a sample is collected vertically through the entire water column at three predetermined distances across the channel. A single sediment discharge value can then be calculated from these three samples when they are combined with the concurrent flow gauging data.

14.3 Automatic sampling

The automatic sediment sampling programme was initiated in 1997 with six sites presently having ISCO automatic water samplers installed (two further sites have previously had ISCO's installed). The automatically sampled data is calibrated by sampling manually simultaneously.

Table 2 details the sites where automatic samplers are currently deployed along with the corresponding start date and number of high flow events sampled.

Table 2: Current Automatic Sediment Sampling Sites

Site number	Source	Location name	Start Date	No. of events sampled
660.1	Opiatou River	Downstream Awaroa Confluence	16/07/1999	56
1191.7	Waipa River	Otewa	01/10/2000	26
443.4	Mangapu River	SH3 Bridge Upstream of Mangaokewa Confluence	12/12/2000	44
1167.4	Waingaro River	Ruakiwi Rd off SH22	10/06/2002	33
516.22	Matahuru Stream	Myjers	19/07/2006	18
476.7	Mangatutu Stream	Walker Rd Bridge	22/06/2004	38

In March 2007 a turbidity sensor was added to the Waingaro river site. The aim is to be more effective in determining suspended sediment yields by establishing the relationship between suspended sediment concentration (SSC) and turbidity and then applying this relationship to the nearly continuous turbidity data to produce a record of estimated SSC. The product of river discharge and the estimated SSC is then used to obtain suspended sediment yield data.

The effectiveness of the turbidity sensor will be assessed once further samples have been taken concurrently with the automatic sediment sampler and grab samples.

15 Ecological stream and river monitoring data

15.1 Regional ecological monitoring of streams

The Regional Ecological Monitoring of Streams (REMS) programme was established by Environment Waikato to assess the physical habitat and biological condition of streams and small river systems. It is a bio-assessment method using protocols developed by the New Zealand Macroinvertebrate Working Group. Investigations use a series of habitat scores and benthic invertebrate community compositions as indicators of ecological condition.

Sampling involves evaluating habitat attributes throughout a representative 100-metre reach of each stream, followed by sampling of stream invertebrates and aquatic plants from representative stream habitat types with a kick net. Invertebrates are identified and counted to provide a picture of community structure.

Sites are either reference sites, which were selected to represent relatively, unimpacted stream habitats or monitoring sites, which provide information on the impact of major resource use in the Waikato region. Included in the sampling regime are 'clean streams' and 'project watershed' sites. Approximately 150 sites were sampled in the 2008/09 year.

16 Coastal monitoring

16.1 Regional estuary monitoring programme

The Regional Estuary Monitoring Programme (REMP) was established by Environment Waikato for the purpose of monitoring the long-term changes in benthic macrofauna communities and the sediments they live in which may occur as a direct or indirect consequence of catchment activity and/or estuary development.

Currently the REMP involves routinely monitoring five permanent sites in both the southern Firth of Thames and Whaingaroa (Raglan) Harbour. The ecological component is based on monitoring a suite of 26 "indicator" species/taxa characteristic of intertidal communities. Sampling involves the collection of 12 replicate core samples (13 cm diameter and 15 cm deep) from a permanent 100 m² area at each permanent site. Macrofauna are separated from the sediment by sieving (500 µm mesh), preserved with 70% isopropyl alcohol in seawater and stained with 0.1% Rose Bengal. In the laboratory, the macrofauna are sorted, and the indicator species/taxa identified and counted. The sediment component of the REMP involves the collection of sediment samples from each site for the analysis of a suite of parameters including surface sediment grain size distribution, organic matter content and pigment concentration. The rate of deposition/erosion at each site is measured using square concrete tiles (0.3 x 0.3 m) buried to a depth of 0.2 m, where the distance from the sediment surface to the plate is measured using knitting needles. Macrobenthic community composition and measured sediment variables are analysed using multivariate statistics. Trends in environmental gradients and macrobenthic communities can then be used to infer estuary health.

16.2 Beach profiles

Beach profile sampling is done to monitor dune erosion. Many beaches on the Coromandel Peninsula (predominantly the eastern seaboard) are in the network. The

frequency of sampling depends on the occurrence of storm events and demand for data, but is typically done two monthly, annually or 10 yearly.

The number and spacing of manual sites (profiles) along each beach is determined by historical and potential damage to property on the frontal dunes. Consideration is also given to Environment Waikato's responsibility to collect baseline data as outlined in the Resource Management Act.

Each profile is referenced to a benchmark of known level and distance to enable comparison. Each survey runs from this point toward and beyond the water's edge. All surveys were converted to one common datum.

The archive containing the profile data has been amalgamated with that of NIWA and now includes their data collected prior to March 1997, along with all Environment Waikato data.

Surveys also include photographs of the profile from four positions: seaward, landward, up and down the beach.

At present consultants survey profiles from Whiritoa to Whangapoua inclusive on a regular basis (usually two-monthly). Environment Waikato's emphasis at present is to survey the remainder of the network, where possible in conjunction with this work. Sites involved are from Port Jackson to Kennedy Bay and at Opoutere Beach.

An annual survey of sites from Northland to Bay of Plenty to be done each September was started in 2002 in conjunction with other agencies. The sites in the Environment Waikato region network were completed in September 2008.

Sites north of Coromandel township were profiled in March (16 profiles completed), June (16), July (16), September (16), and December (16). The sites at Opoutere were profiled in March (5 profiles completed), June (5), July (5), September (5) and December (5). A total of 108 profiles were completed by staff in 2008.

17 Bathing beach bacteriological sampling

17.1 Bathing beach bacteriological sampling

A listing of all the beaches sampled over the 2006 - 2008 summer periods are provided at <http://www.ew.govt.nz/Environmental-information/Our-coast/Coastal-water-quality/Coastal-water-quality-for-swimming/>

The results from these surveys are held in the Environment Waikato Hydrol database. Parameters measured included water temperature, salinity, enterococci and faecal coliforms.

Results to date have indicated that the beaches sampled generally do not have bacteriological water quality problems.

17.2 Lake Taupo - bathing beach bacteriological sampling

A listing of all the beaches sampled over the 2007 - 2008 summer period are provided at <http://www.ew.govt.nz/Environmental-information/Rivers-lakes-and-wetlands/Learn-about-our-lakes/Lake-Taupo/How-clean-is-Lake-Taupo/Water-quality-monitoring-map/>

The results from these surveys are held in the Environment Waikato Hydrol database. Parameters measured included water temperature, black disk, e-coli, enterococci and faecal coliforms.

Results to date indicate that Lake Taupo does not have bacteriological water quality problems.

18 Geothermal data

18.1 General

Areas which are, or have the potential to be, commercial geothermal sources of energy are regularly monitored. These areas include Ohaaki, Wairakei and Taupo.

18.2 Methodology

Groundwater levels are taken six weekly for a representative network of 17 bores. Levels in eight additional bores in Taupo are measured twice yearly.

Water temperature profiles are also constructed for some of these bores using a calibrated thermocouple, which is lowered down the bore.

Flows from hot water springs are measured using calibrated weirs and water temperature is taken. In some instances the springs have completely dried up and regular photographs are taken as evidence of this.

19 Air quality

19.1 Ambient air quality monitoring

Air quality monitoring was carried out by Environment Waikato at a number of sites within the region during 2008. These included Hamilton, Tokoroa, Te Kuiti, Taupo, Matamata, Putaruru, Ngaruawahia and Waihi.

In Hamilton, concentrations of suspended particles (PM₁₀), and benzene were measured at the Peachgrove Road air quality monitoring site. In addition, benzene monitoring was carried out at a “traffic peak” monitoring sites in Bridge Street, Victoria Street, London Street, Greenwood Street and Peachgrove Street near the Peachgrove Intermediate School. In Taupo, Te Kuiti, Tokoroa, Matamata, Putaruru, Ngaruawahia and Waihi monitoring was carried out for PM₁₀.

Information on the air quality indicators can be found on the following web page; <http://www.ew.govt.nz/Environmental-information/All-about-air/Air-quality/>

20 Clean streams

20.1 General

Clean Streams is an Environment Waikato project to encourage and support farmer efforts to reduce the impacts of farming on waterways. Fencing off streams, lakes, rivers and wetlands to keep stock out of them is one of the most effective ways of protecting waterways from the effects of farming. The fenced area filters out pollutants and can be planted with trees and shrubs to further enhance the environment.

The monitoring period runs for 10 years with nine representative sites currently monitored throughout the region. The monitoring approach includes the recording of stream temperatures, ecological sampling, and the taking of water samples for turbidity analysis. The results of this monitoring can be used as indicators of the quality of stream habitat. At each location a control site is also monitored to illustrate that any changes in stream temperature observed over time are a result of fencing and planting along a given reach of stream rather than some other external factor. Photographing the planted and fenced reaches of stream is another part of the monitoring strategy and is undertaken to provide a visual reference of change.

The initial data sets will provide baseline information to which subsequent data can be compared.

20.2 Methodology

Water temperature loggers are deployed in the stream securely attached to a waratah driven into the stream bed. Typically the loggers are deployed in early December and retrieved in March so as to capture the higher summer water temperatures as these are most likely to influence stream habitat.

The ecological monitoring is a bio-assessment method using protocols developed by the New Zealand Macroinvertebrate Working Group. Investigations use a series of habitat scores and benthic invertebrate community compositions as indicators of stream ecological condition. This monitoring is conducted mid-summer.

Water samples are taken downstream and upstream of the planted/fenced reach of stream for turbidity analysis to determine if water clarity changes through the reach. These samples are taken when the temperature loggers are retrieved toward the end of summer.

Photos are taken starting at the location of the logger downstream of the planted and fenced reach moving upstream into the upper stream reaches. The photos are taken when the temperature loggers are retrieved.

21 Catchment environmental monitoring

21.1 General

As part of Project Watershed and Peninsula Project implementation, the Catchment Environmental Monitoring (CEM) Programme was established to demonstrate the long term benefits of soil conservation. To date monitoring has been established in selected priority soil conservation catchments in the Waipa, Lower Waikato, Upper Waikato and Coromandel management zones. The monitoring period will initially run for 10 years.

The aim of the CEM programme is to provide a representative (and where possible quantitative) indication of changes in various environmental parameters resulting from soil conservation and river management work. Parameters include changes in the hillslope erosion, sedimentation in surface water, water temperature and in-stream ecological habitat. Stream bank erosion, riparian vegetation and fencing are monitored in the Riparian Characteristics Survey (RCS), completed once every two years in each priority catchment.

21.2 Methodology

The RCS monitoring involves field observations in selected catchments to quantify estimates of the amount of fencing, vegetation, and erosion along a series of 1 kilometre stretches of riparian margin. The data is collected with GIS software using a

handheld computer. In conjunction with the RCS survey, photo points are taken at 250 metre intervals to provide a visual reference of change.

Water temperature loggers are deployed both downstream and upstream of where soil conservation work has commenced or is planned. It is anticipated that as planted vegetation along the treated reach of stream grows and increases shading influence over the stream, the temperatures recorded at the downstream site will decrease relative to the temperatures recorded at the upstream site. Typically the loggers are deployed in early December and retrieved in March so as to capture the higher summer water temperatures as these are most likely to influence stream habitat.

The ecological monitoring is a bio-assessment method using protocols developed by the New Zealand Macroinvertebrate Working Group. Investigations use a series of habitat scores and benthic invertebrate community compositions as indicators of stream ecological condition. This monitoring is conducted mid-summer.

Water samples are taken downstream and upstream of the planted/fenced reach of stream for turbidity analysis to determine if water clarity changes through the reach. These samples are taken when the temperature loggers are retrieved toward the end of summer.

22 Updates to report

Environmental Monitoring will continue to collect environmental information and will update and modify this report as necessary.