

WATER QUANTITY AND FLOWS

Highlights 2001-2002

- The Northland Regional Council operates a hydrometric network consisting of 15 automatic rainfall stations and 29 automatic water level stations. In addition, a daily rainfall reader network provides a further 63 manual rainfall stations, 35 manual groundwater stations and 15 lake level stations water-level sites. Out of these 157 sites, 10 rainfall sites and 14 water level stations form part of a radio telemetry network.
- The Hydrology unit maintains a quality management system ISO 2000\9001 for the collection, processing and archiving of hydrometric data. Data from the Northland Regional Council's hydrometric database was transferred to the NIWA National Hydrometric Database in Christchurch. This includes data from all open and closed water level (both groundwater and surface), flow and rainfall stations (data from a total of 310 stations).
- During 2001-02 a total of 16 weather bulletins were issued for the year of which 8 resulted in heavy rain warnings. There were five significant rainfall events that resulted in severe flooding, two in early September 2001, one in December 2001 and two in June 2002 (including 'The Weather Bomb').
- Annual rainfall amounts varied from near average at Bayley's Beach (91%) to above average at Aupouri (163%) from July 2001 to July 2002. Generally, the Northland region was 20% above the expected annual rainfall. The wettest months were December 2001 and June 2002 and the driest February to March 2002.
- A total of 173 flow measurements were carried out during 2001-02.

Annual Plan Performance Target

To continue to develop and implement a prioritised state environment monitoring programme based on the Regional Policy Statement and regional plans by:

- **Operating a region-wide network for the measurement, recording, and reporting of rainfall, river-flows, lake and groundwater and tide levels.**

The Hydrometric Network

The Northland Regional Council maintains a comprehensive network of hydrometric stations (such as rainfall, water level and flow stations). Monitoring and obtaining information about Northland's climate and water resources is important so that short and long term changes in climate can be detected.

Hydrometric stations have been selected to provide a region-wide coverage. Stations are selected to target key river systems that can be used for flood warning purposes and for low water-flow monitoring. NCR's hydrometric network during 2001/2002 comprised the following:

Rainfall Stations

- 63 daily rainfall stations (rainfall recorded daily by voluntary readers).
- 15 automatic rainfall recorder stations (see map 3.1 and appendix 3).

There was a 3.8% loss of data at the automatic rainfall stations from July 2001 to July 2002. Loss of record was attributed to faulty instrumentation.

Water Level Stations

- 25 automatic water level recorder stations (see map 3.1 and appendix 2).
- 4 automatic tidal water level stations (see map 3.1 and appendix 2).
- 14 manual lake level stations.

Due to access problems, one hydrometric station was closed during 2001-02. This being a water level/flow station on the Rangitane River at Kerikeri. A new station was established on the same river at a new location, 600 metres above the closed station.

Over the 29 water level monitoring stations, there was 2% missing record for the year. This was attributed to faulty equipment and siltation problems.

Groundwater Stations

- 7 automatic water level recorder stations.
- 38 manual stations.

Two new manual stations have been added to the Mangawhai groundwater monitoring run. Ground water monitoring is to be extended in the following areas during 2002:- Aupouri, Bland Bay, Matapouri, Ngunguru, Whangarei and Ruawai.

NRC's network is complemented with stations operated by NIWA and MetService. In addition to NRC's network:

- NIWA operate 24 rainfall and 6 water level stations.
- MetService operate 7 automatic climate stations.

The Telemetry Network

NRC operates a radio telemetry network comprising 9 rainfall and 14 water level stations from the hydrometric network. These telemetered sites provide a real-time picture of the state of the regions water resources during both drought and flood conditions.

During periods of extreme rainfall, the telemetered sites play an important role in ensuring that both the Civil Defence and the general public are kept informed, via media releases, of flooding in Northland. During periods of drought, water levels are monitored and when a low threshold is reached a low flow-gauging program is undertaken in the river catchments affected. These manual flow measurements enable the flow to be accurately determined and are used to monitor water usage.

Four new telemetered rainfall stations will be added to the telemetry network during 2002/2003. These will be located in the high altitude areas of the Mangamuka Hills, Tutumoe Range, Kaeo Hills and in the Kawakawa River catchment. The purpose of these stations is to improve flood-warning capabilities associated with high intensity rainfall in high altitude areas.

During the 2001-02 period a total of 173 flow measurements were carried out in the region, mainly between low and mean flows.



**Water Level Recording Station –
Waipao River at Draffin Road**



**Water Level Telemetered Station –
Whakapara River at Cableway**

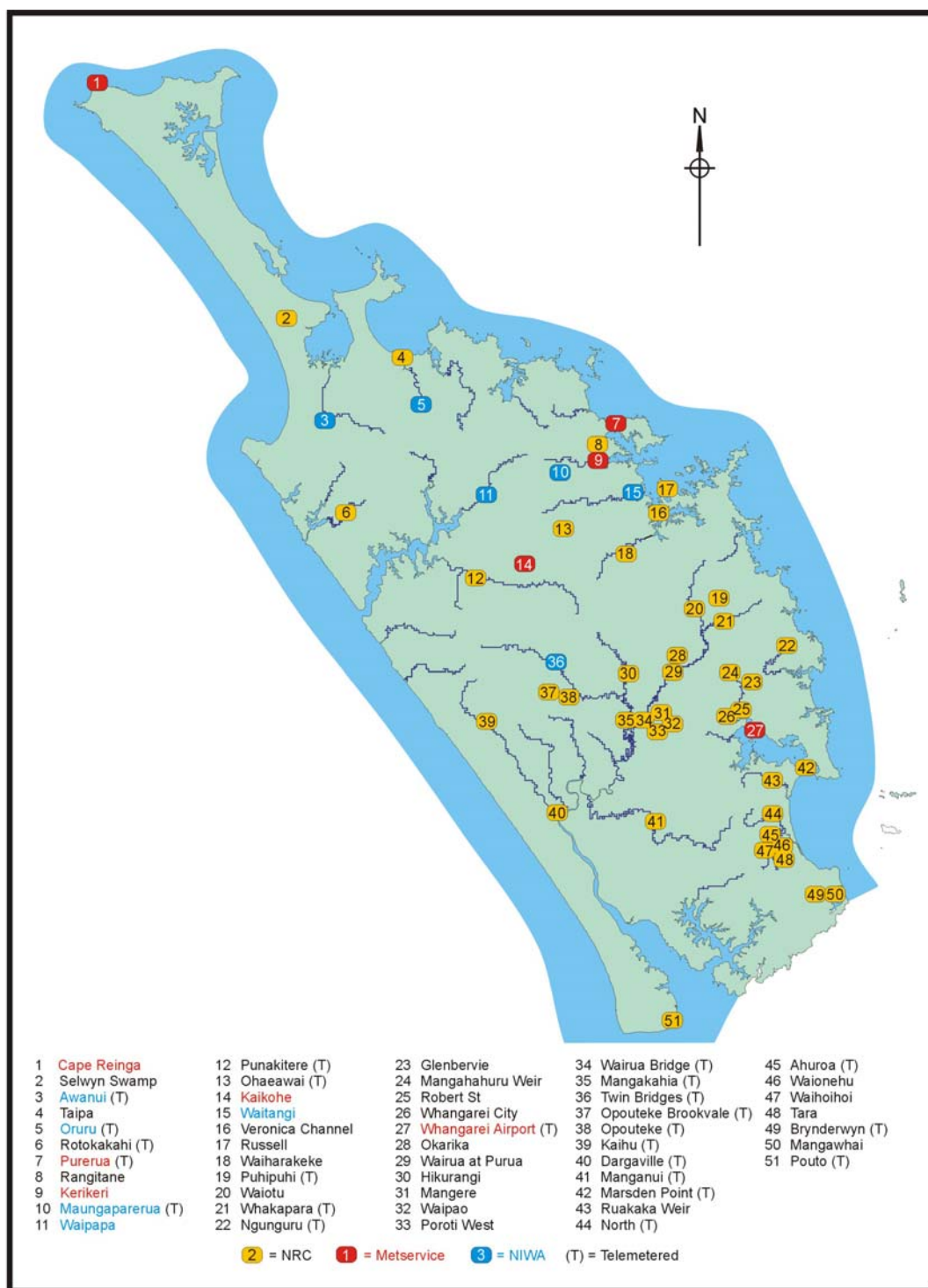


**Russell Ground Water Monitoring
Bore at Hananui Lodge. Recording
Water Level and Conductivity**



**Automatic Telemetered Rainfall
Station at Ohaeawai**

Examples of Surface Water Level, Ground Water Level and Rainfall Monitoring Stations



Map 3.1: Location map of the Automatic Rainfall and Water Level Recording Stations in Northland (refer appendix 2 for details).

Hydrological Databases

The Northland Regional Council has a comprehensive database for storage of hydrometric data; this includes rainfall, water level, flow and some climate data. Data is stored as time dependent data (TIDEDA) on the council archive and is available for use within three months of collection.

During 2002, data from the Northland Regional Council's hydrometric database was transferred to the NIWA National Hydrometric Database in Christchurch. This is included data from all open and closed

water level (both groundwater and surface), flow and rainfall stations (data from a total of 310 stations). Data will be updated to the National Hydrometric Database on an annual basis.

ISO 2000/9001 Quality Management System

All hydrological monitoring and data recording conform to the ISO 2000/9001 Quality Management System. This system has been adopted to ensure that all hydrological data supplied to both internal and external clients is “confidently useable”. That is, data may be used for resource management, engineering design, project operation, scientific investigations without the need for extensive checking, editing and correction. An external audit is carried out at six monthly intervals.

Rainfall

Topographical variation across Northland causes rainfall distribution patterns to vary considerably over relatively small areas. As a consequence, the hydrological team maintains an extensive rainfall-monitoring network across Northland. NIWA and MetService rainfall sites supplement this network.

Northland experiences high intensity rainfalls that are associated with the passage of tropical or subtropical storms that pass over Northland from November through to March. These summer cyclones and thunderstorm events give rise to very high intensity rainfalls, leading to sudden flooding. These rainstorms can yield up to 100 to 150 mm of rainfall per hour.

The MetService provides the Regional Council with frequent warnings of approaching potentially adverse weather systems. A total of 16 special weather bulletins were issued for the Northland region during the 2001-2002 period. Of these bulletins 5 resulted in significant rain events, two in September 2001, one in December 2001 and two in June 2002 (refer rainfall case studies).

From July 2001 to July 2002 the annual rainfall amounts varied from near average at Bayley’s Beach (91%) to above average at Aupouri (163%). Generally, the Northland region was 20% above the expected annual rainfall. The wettest months were December 2001 and June 2002 and the driest February to March 2002.

Figure 3.1 shows the monthly rainfall amounts recorded during 2001-2002 compared with the average monthly rainfall at various Northland locations. These figures show rainfall totals for December 2001 and June 2002 were far in excess of the normal rainfall amounts.

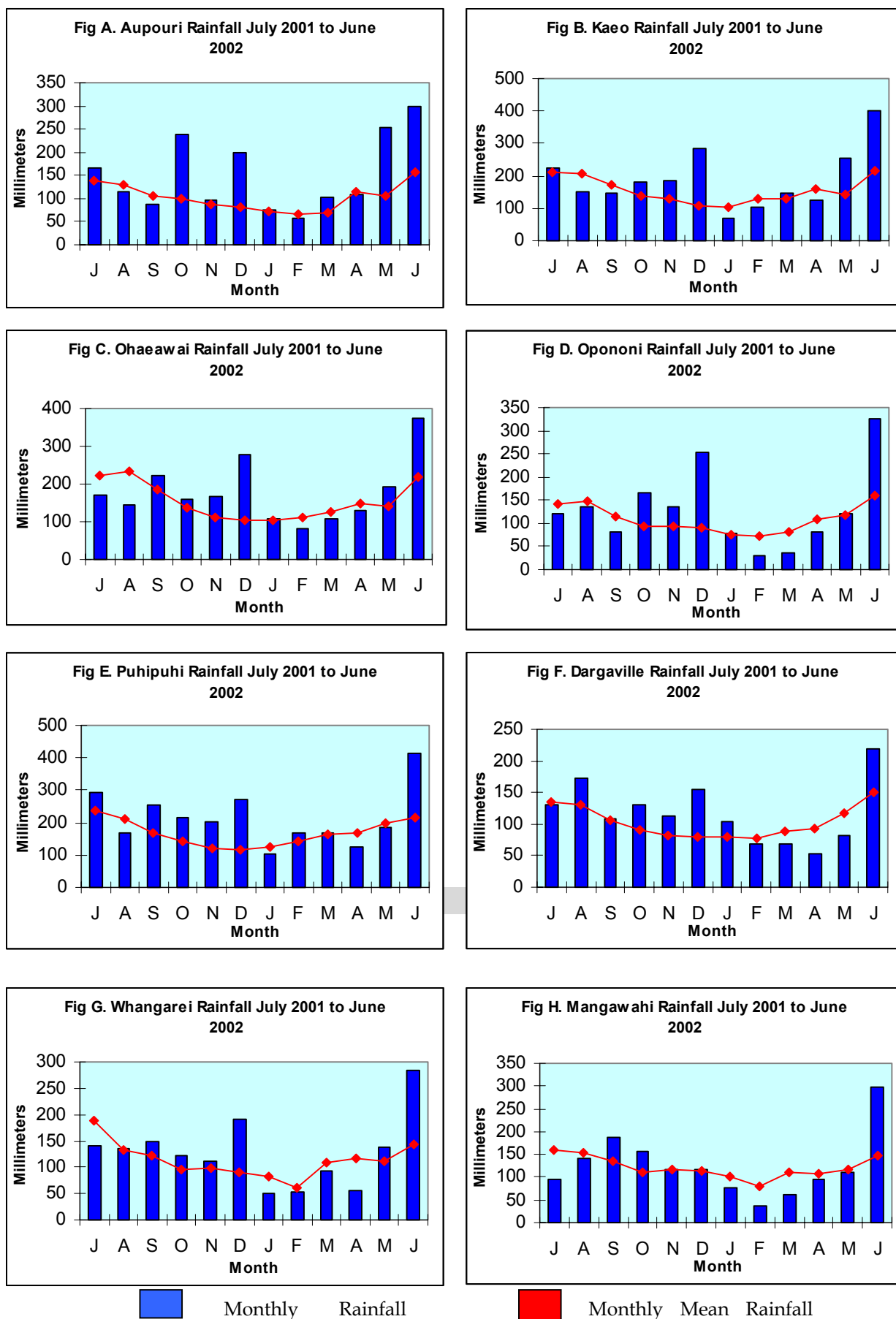


Figure 3.2: Monthly rainfall totals from July 2001 to June 2002 compared to monthly average rainfall

Case Studies – Extreme Rainfall Events

On Saturday 1 September 2001, Kaitia received 50 mm in 20 to 30 minutes with reports of up to 109 mm for the same period. This was a result of severe localised thunderstorm activity causing localised flooding.

On the 4 September 2001, heavy rain caused surface flooding and road closures throughout the region. Rainfall intensities were recorded at 27 to 31 millimetres per hour over the high altitude areas. For example, Ohaewai recorded 27 mm/hr with a total amount of 93 mm for the day. Similarly, the Puhipuhi Hills and Tutamoe recorded 29 - 31 mm/hr with daily totals of 107 mm.

On the 10 December 2001, a fast-moving easterly front with very intense thunderstorm activity produced very intense rainfalls over Helena Bay, Whananaki, Matapouri, and the high hills at Puhipuhi and Glenbervie. A total of 130 – 150 mm was recorded over a 2 hour period at the peak of the downpour. This intense rain resulted in rivers and streams rising rapidly causing slips and flash flooding. Some residences at Helena Bay were forced to evacuate to higher ground. The monthly rainfall amounts recorded at the council's Puhipuhi and Ngunguru telemetry stations were 200% above that expected for December.

December was a very wet month with rainfall totals over twice the expected rain for December. Most rain fell as a result of a storm on 2 December. Heavy intense rain falling constantly at 20 to 25 mm/hr was recorded in the Tutamoe Ranges, 88 mm was recorded over a four-hour period. Rivers rose 1.5 to 2 metres in one hour resulting in major flooding. The Awanui, Mangakahia, Opouteke and Kaihu Rivers reached the highest levels recorded in 13 years. River and ground water levels were still well up by the end of December.

Extreme Events June 2002.

The Northland region was battered by three significant rainfall events during June 2002. These varied from localised to regional events; each accompanied by thunderstorm activity and high intensity rainfalls resulting in severe flood damage. The first event was during Queen's Birthday weekend (1 June). This was an extremely localised event, centred in the Whangaroa area. Small streams became raging torrents within a matter of minutes. Worst effected areas were Totara North, Taupo and Tauranga Bays, and Matangirau (north of Kaeo) where severe flood damage was reported.

The following rainfall totals were reported for the event,

- Kaeo, 103 mm in 24 hours (50mm in two hours),
- Matauri Bay, 126 mm in 24 hours,
- Taupo Bay, 200mm in 12 hours and
- Matangirau recorded 180 mm for the day (75mm falling over 20 minutes) with rainfall intensities of approximately 30 to 40 mm per hour.

Other areas of Northland received only 20mm to 40mm during the event. Due to the rapid development of these types of weather systems, they are very difficult to predict and to warn against.

The second and third events occurred within a day of each other. The MetService issued heavy rain warnings for the 18 June and 20 June (dubbed '*The Weather Bomb*' - a deep depression intensifying northwest of Northland). Council staff issued a series of media releases warning of heavy rain, gale force winds and the potential of widespread flooding. Rainfall amounts recorded over the region for 18 and 19 June varied from 70 mm in the southern (Brynderwyn Hills) and western areas to 110 mm over the far north and East Coast hills. River levels rose rapidly without causing significant flooding.

Heavy rain again fell on the 20 June as a result of the so called the 'weather bomb' which moved slowly over the region from the northwest. The heavy rainfall was general, with recorded amounts over 24 hours varying from 70mm in southern areas to 90mm-140 mm elsewhere. Rainfall intensities reached 21 mm per hour. With the already saturated ground conditions, the elevated river levels from the previous rain event and the additional runoff from this event, severe flooding occurred in low lying river flats. These included the Awanui and Rotokakahi (North Hokianga) catchments, the Kaihu River and adjacent catchments, the Mangakahia River valley, The Wairua River (Hikurangi Swamp), the Kawakawa River

and the low areas of the Northern Wairoa River at Tangiteroria and Pukehuia. Water levels in the Kaihu, Mangakahia and Wairua Rivers reached their highest levels in 15 years (since Cyclone Bola, March 1988). Flooding and slips closed many rural roads throughout the region. Some significant stock losses were reported where farmers did not heed, or could not respond to public warnings of anticipated flooding.

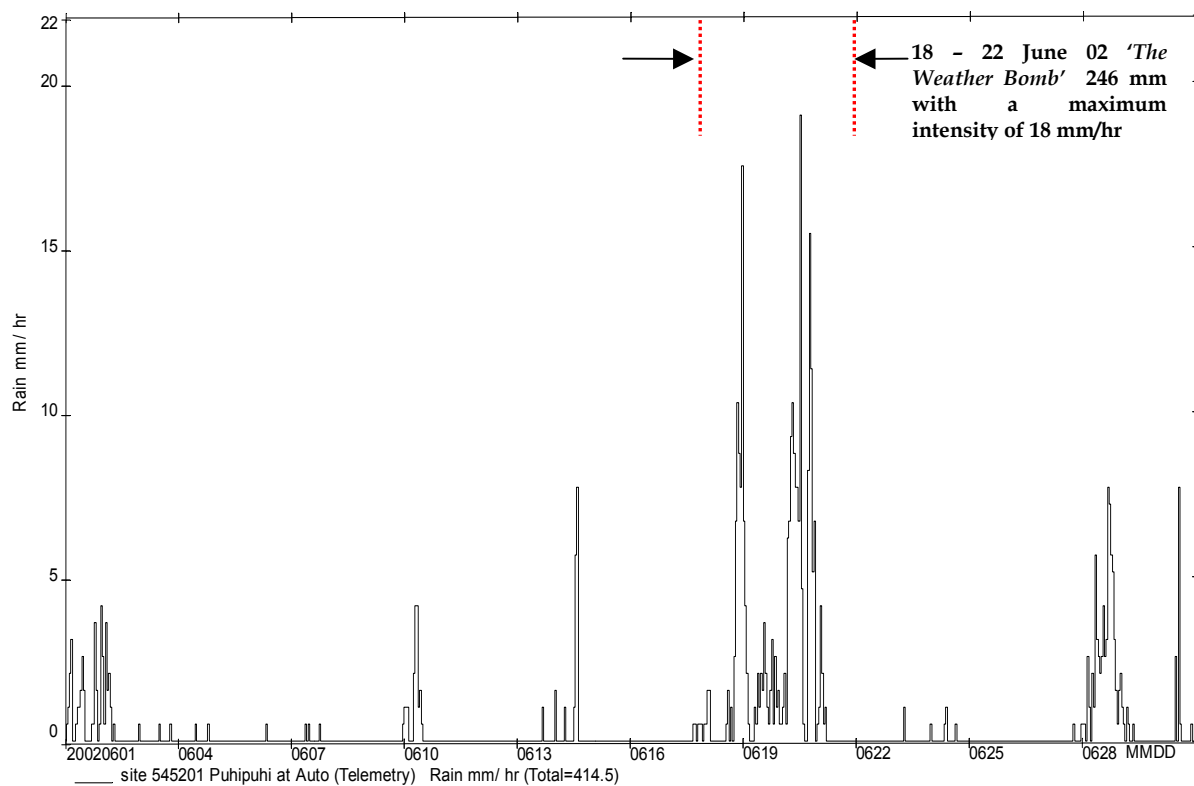


Figure 3.3:- Hourly rainfall plot from the Puhipuhi automatic telemetered station.

Rivers and Streams

Northland is characterised by a large number of small catchments and short, meandering streams of gentle slope. Most of the major rivers flow into estuarine environments and few discharge directly to the open coast. These rivers and streams play an important role in Northland, often providing water for stock, industry and domestic use.

Mainly climate and geology influence the flow regimes of Northland's rivers. Northland's marked seasonal rainfall pattern is reflected in the broad pattern of higher flows during winter months and lower flows during summer months. Most rivers flow at only 10-20% of their yearly average flow in summer.

Droughts occur as a result of lower than usual rainfall causing prolonged periods of unusually low river-flow. During drought months (most typically January-March) more accurate monitoring of stream flow is undertaken to establish levels at which water use restrictions may occur. Flow levels were typically lower over the summer period 2001-2002.

The Mangakahia River data has been used to illustrate typical water level activity, which occurred in most Northland river systems during 2001-2002. Figure 3.4 shows the trends in water level activity from July 1998 to July 2001 (the last four years).

The 2001-2002 period had been characterised by flood events of greater magnitude than the previous three years. There were 3 major water level events which caused significant flooding in the catchment (refer to rainfall case studies)..

Figure 3.5 shows monthly mean flows at various NRC flow stations for 2001/2002. All river flows were well in excess of their average September, December and June flows while over the summer months from February to April flows were normal to below normal.



Mangakahia River at Titoki Bridge in Flood



Mangakahia River Valley at Titoki in Flood

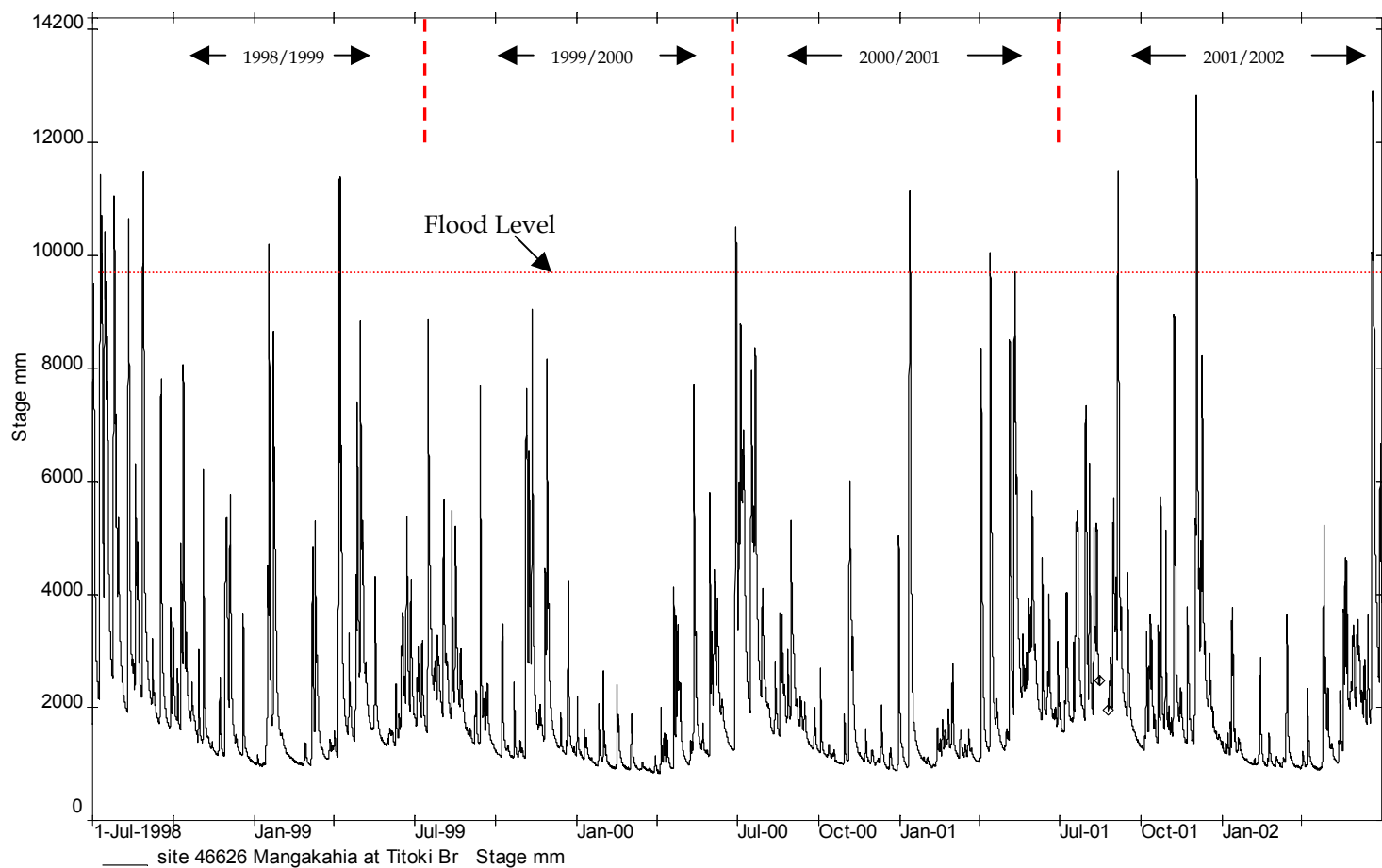


Figure 3.4:- Mangakahia River at Titoki Bridge – Water level trends from July 1998 to June 2002

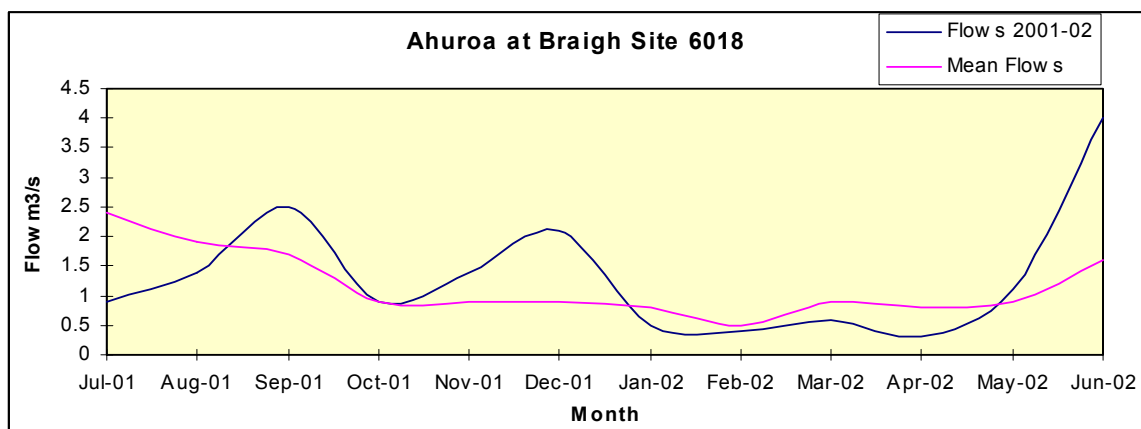
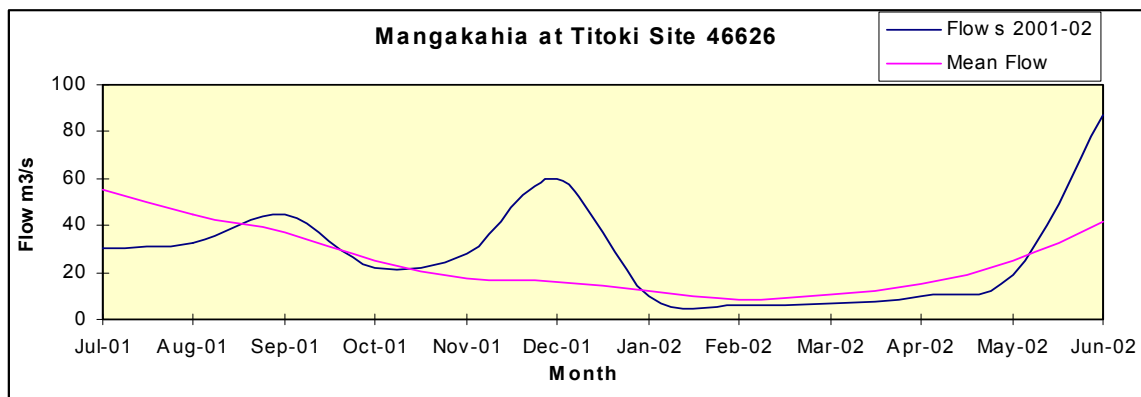
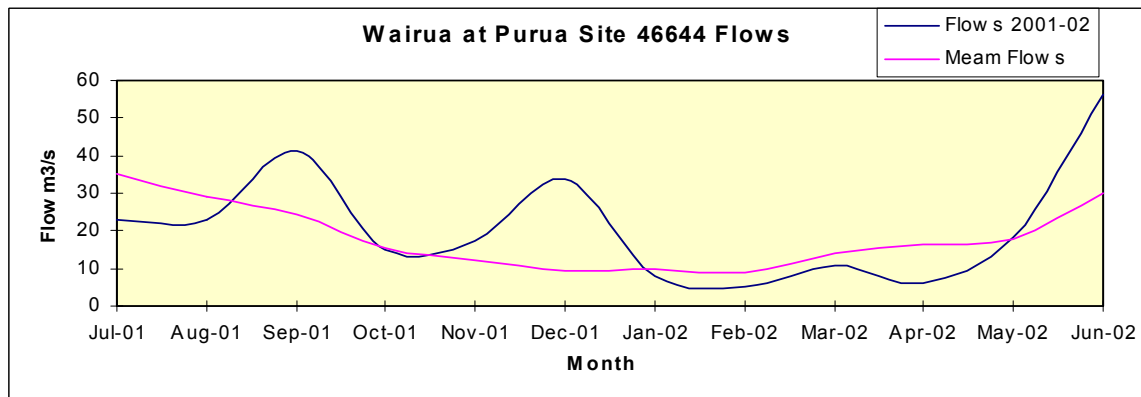
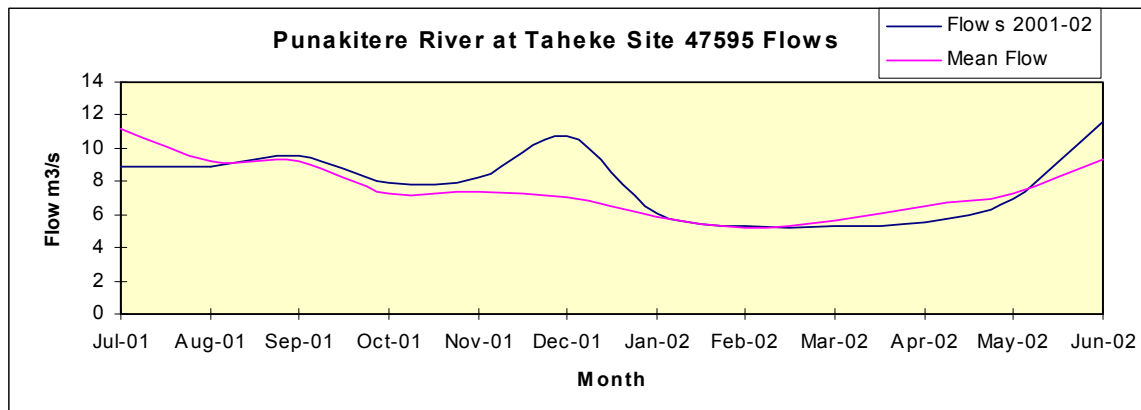


Figure 3.5:- Monthly flows recorded in various Northland Rivers from July 2001 to June 2002..

Tidal Monitoring

The Regional Council operates four automatic water level recorders located in tidal environments. Two are located on the east coast at Marsden Point and Opuia and two near the west coast at Pouto Point and Dargaville. Water levels are continually recorded at either 5 minutes (Marsden Point and Pouto) or 15 minute intervals (Opuia and Dargaville) over the full range of the tide cycles. Barometric pressure, wind speed and direction and rainfall are also measured at the Dargaville station. Barometric pressure and sea temperatures are also measured at Pouto.

Due to the dynamic nature of the sand at Pouto Point, some problems have occurred with sand deposition over the water level sensor. This has resulted in a loss of water level data over a period of 6 months from October 2001 to April 2002. The natural coastal processes have now removed the sand from the sensors however an alternative location for the sensor is being investigated.

During periods of extreme high tides there is the potential for flooding in the Dargaville Township. The water level, wind and barometric information gathered via the telemetry system are regularly forwarded to the Kaipara District Council's Civil Defence Officer.

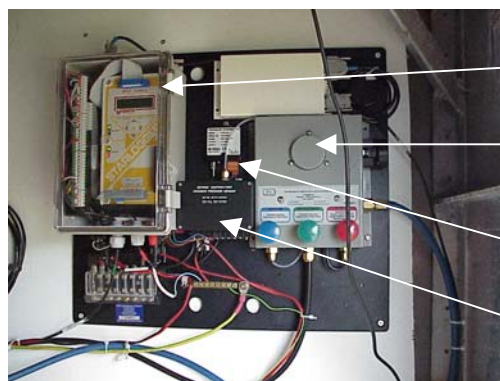
Marsden Point is a telemetered water level station and is operated as a national civil defence tsunami monitoring station. It forms part of an international wide network for monitoring tidal wave activity. Water level is recorded at intervals varying from 10 seconds to 5 minutes. Information is forwarded to the civil defence headquarters in Wellington on request. No tsunami activity was recorded during 2001-2002.



Location of Water Level and Temperature Sensors -Low Tide



Water Level Sensor line - High Tide



Datalogger

Gas Unit

Barometric Pressure Unit

Water Level Sensor

DATALOGGER MODULE - POUTO POINT

Appendix 2: Annual Rainfall 2001/2002 Compared to Mean Annual Rainfall For Various Northland Stations.

Site Number	Rainfall Station	Authority	Start Record	Annual Rainfall	Mean Annual	%
539710	Bayleys Beach	NRC	1976	1040	1144	91
641310	NDC Maungaturoto	NRC	1992	1309	1350	97
549010	Monymusk	NRC	1976	1268	1299	98
534724	Kaikohe Hill	NRC	1985	1618	1635	99
641511	Tara	NRC	1946	1604	1621	99
640411	Glenmohr Road Waipu	NRC	1969	1477	1465	101
533201	Puhata	MET	1979	1546	1481	104
533817	Ohaeawai	NRC	1967	2128	2053	104
545501	Matapouri	MET	1967	1443	1384	104
547512	Massey – Paurua Bay	NRC	1992	1518	1459	104
640436	Brynderwyn Auto	NRC	1981	1444	1395	104
548201	Mangapai	MET	1970	1442	1380	105
535510	Wairoa Farms Waima	NRC	1976	2990	2816	106
630901	Arapohue	MET	1955	1263	1195	106
641413	Hakarau	NRC	1980	1492	1413	106
538801	Mamaranui	MET	1951	1409	1302	108
546301	Glenbervie	NRC	1947	2022	1876	108
537901	Parakao	MET	1951	1597	1470	109
546203	Ruatangata	MET	1963	1793	1643	109
547512	Taiharuru	NRC	1988	1337	1227	109
532311	Takahue Top	NRC	1971	2072	1863	111
545310	Opuawhanga	NRC	1968	2152	1931	111
546212	Jordan Valley	NRC	1967	1743	1568	111
546412	Fergusson Ngunguru	NRC	1968	2112	1889	112
640501	Waipu Cove	MET	1948	1461	1302	112
547338	Robert Street	NRC	1989	1525	1353	113
548211	Jones - Mangapai	NRC	1972	1723	1514	114
549211	Taipuha	NRC	1970	1743	1510	115
532801	Taus Falls	MET	1951	2635	2267	116
545213	Morgan Hukerenui	NRC	1974	1840	1592	116
547220	Te Hihi Maunu	MET	1988	2076	1778	117
641210	Higgins Paparoa	NRC	1991	1658	1421	117
531205	Kaitaia Obs	MET	1985	1580	1334	118
536811	Froggat Opouteke	NRC	1967	2203	1873	118
536812	Brookvale Opouteke	NRC	1987	2051	1741	118
547223	Redwood - Maunu	NRC	1983	1840	1565	118
539812	Dargaville	NRC	2000	1402	1253	119
545111	Towai Dawson	NRC	1978	1875	1575	119
545201	Puhipuhi Auto	NRC	1905	2383	2006	119
547219	Cemetery Rd - Maunu	NRC	1979	1861	1564	119
548310	Whittle Springfield	NRC	1964	1740	1463	119
532611	Waihou Valley	NRC	1979	2032	1691	120
547411	Parua Bay	NRC	1986	1846	1536	120
531310	Te Rore - Mangamuka	NRC	1966	2116	1750	121
544311	Peach Road	NRC	1981	2826	2343	121
546316	Batt Ngunguru	NRC	1987	2189	1804	121
534442	Opononi	MET	1967	1567	1285	122
532710	Puketi Road	NRC	1963	2781	2252	123
532903	Kerikeri Aero	MET	1978	2207	1798	123
530205	Wiessing - Awanui	NRC	1992	1638	1316	124
530701	Kaero	MET	1987	2198	1777	124
531711	Kaero Paitu	NRC	1963	2271	1836	124

537815	Kereru Tangowahine	NRC	1978	2092	1673	125
546126	Okarika Riponui	NRC	1977	1624	1297	125
439202	Waiharara2	MET	1983	1573	1244	126
530810	Matauri Bay	NRC	1986	2517	1986	127
425902	Paua	MET	1970	1569	1224	128
531715	Kaeo Bramley's	NRC	1971	2495	1950	128
531411	Victoria Valley	NRC	1966	2246	1747	129
548210	Palmer Mangapai	NRC	1988	1695	1316	129
534503	Rawene2	MET	1977	1642	1249	131
439301	Rangiputa	MET	1970	1592	1176	135
530710	Giesber -Kaeo	NRC	1983	2305	1710	135
531911	Kaikaha Kerikeri	NRC	1987	2298	1662	138
439201	Waiharara1	MET	1956	1659	1182	140
542010	Wakelins Haruru Fallsb	NRC	1979	2199	1554	141
543012	Whangae	NRC	1981	2189	1552	141
530204	Aupouri	NRC	1967	1797	1231	146
532503	Omahuta	MET	1977	2849	1740	163
438111	Wallace - Houhora	NRC	2001	1877	short record	na
531414	Peria	NRC	2000	2346	short record	na
536612	Tutumoe	NRC	2001	2647	short record	na
536810	Twin Bridges	NRC	1991	1565	short record	na
537614	Coates Kaihu	NRC	1995	1779	short record	na
543013	Kawaglen Whangae	NRC	1999	2178	short record	na
543110	Opuia	NRC	1993	1827	short record	na
543311	Oakura Murphy	NRC	1993	1920	short record	na
545312	Dandilion - Puhipuhi	NRC	1995	2488	short record	na
546218	Cathcart - Ruatangata	NRC	1990	1887	short record	na
546512	Wellington Bay	NRC	1993	1445	short record	na
547224	McIntosh Otaika	NRC	1995	1706	short record	na
547225	Cooper Whatitiri	NRC	1998	1761	short record	na

Appendix 3: Hydrology Station Details as indicated on Map 3.1(Automatic Rainfall and Water level Recording Stations in Northland)

Site	Site Name(River)	Agency	Recorder Type	Telemetered
1	Cape Reinga	MetService	Rainfall Station	
2	Selwyn Swamp	NRC	Water Level Recorder	
3	Awanui Rain	NRC	Rain Recorder	Telemetered
3	Awanui	NIWA	Water Level Recorder	Telemetered
3	Kaitaia	MetService	Rainfall Station	
4	Taipa	NRC	Groundwater Level Recorders	
5	Oruru Rain	NRC	Rain Recorder	Telemetered
5	Oruru	NIWA	Water Level Recorder	Telemetered
6	Rotokakahi	NRC	Water Level Recorder	Telemetered
6	Rotokakahi	NRC	Rain Recorder	Telemetered
7	Purerua	MetService	Rainfall Station	
8	Rangitane	NRC	Water Level Recorder	
9	Kerikeri	MetService	Rainfall Station	
10	Maungaparerua Rain	NIWA	Rain Recorder	Telemetered
10	Maungaparerua	NIWA	Water Level Recorder	Telemetered
11	Waipapa	NIWA	Water Level Recorder	Telemetered
12	Punakitere	NRC	Water Level Recorder	Telemetered
13	Ohaeawai	NRC	Rain Recorder	Telemetered
14	Kaikohe	MetService	Rainfall Station	
15	Waitangi	NRC	Rain Recorder	
15	Waitangi	NIWA	Water Level Recorder	Telemetered
16	Veronica Channel	NRC	Water Level Recorder	
17	Russell	NRC	Groundwater Level Recorders	
18	Waiharakeke	NRC	Water Level Recorder	
19	Puhipuhi	NRC	Rain Recorder	Telemetered
20	Waiotu	NRC	Water Level Recorder	
21	Whakapara	NRC	Water Level Recorder	Telemetered
22	Ngunguru Weir	NRC	Water Level Recorder	Telemetered
22	Ngunguru Rain	NRC	Rain Recorder	Telemetered
23	Glenbervie	NRC	Rain Recorder	
24	Mangahuru Weir	NRC	Water Level Recorder	
25	Robert Str	NRC	Rain Recorder	
26	Waiarohia	NRC	Water Level Recorder	
26	Raumanga	NRC	Water Level Recorder	
26	Puriri Park	NRC	Groundwater Level Recorders	
27	Whangarei	MetService	Rainfall Station	
28	Okarika	NRC	Rain Recorder	
29	Wairua	NRC	Water Level Recorder	Telemetered
30	Hikurangi	NRC	Water Level Recorder	
31	Mangere	NRC	Water Level Recorder	
32	Waipao	NRC	Water Level Recorder	
33	Poroti West	NRC	Groundwater Level Recorders	
34	Wairua Bridge	NRC	Water Level Recorder	Telemetered
35	Mangakahia	NRC	Water Level Recorder	Telemetered
36	Mangakahia Twin Bridges	NRC	Rain Recorder	Telemetered
36	Mangakahia	NIWA	Water Level Recorder	Telemetered
37	Opouteke Brookvale	NRC	Rain Recorder	Telemetered
38	Opouteke	NRC	Water Level Recorder	Telemetered
39	Kaihu	NRC	Water Level Recorder	Telemetered
40	Dargaville Water Level	NRC	Water Level Recorder	Telemetered
40	Dargaville Wind Speed & Direct	NRC	Wind Speed/Direction Recorder	Telemetered

40	Dargaville Barometric	NRC	Barometric Recorder	Telemetered
40	Dargaville Rainfall	NRC	Rain Recorder	Telemetered
40	Dargaville	MetService	Rainfall Station	
41	Manganui	NRC	Water Level Recorder	Telemetered
42	Marsden Point	NRC	Water Level Recorder	Telemetered
43	Ruakaka Weir	NRC	Water Level Recorder	
44	North	NRC	Water Level Recorder	Telemetered
45	Ahuroa	NRC	Water Level Recorder	Telemetered
46	Waionehu	NRC	Water Level Recorder	
47	Waihihoi	NRC	Water Level Recorder	
48	Brynderwyn	NRC	Rain Recorder	Telemetered
49	Tara Rain	NRC	Rain Recorder	
49	Tara	NRC	Groundwater Level Recorders	
50	Mangawhai	NRC	Groundwater Level Recorders	
51	Pouto	NRC	Water Level Recorder	Telemetered
51	Pouto	NRC	Sea Temperature	Telemetered
51	Pouto	NRC	Barometric Pressure	Telemetered