

HYDROLOGY

SUMMARY 2007-08

OVERVIEW

- The Northland Regional Council (NRC) operates a hydrometric network consisting of rainfall, river, groundwater, tidal and lake water level monitoring stations.
- This network comprises 208 active stations, of which 81 are automated while the rest are manually read.
- 80 of these automated stations are on a radio/cellphone telemetry network
- The network compliments four rainfall and eight water level stations maintained by the National Institute of Water and Atmospheric Research (NIWA) as well as seven climate and 24 rainfall stations maintained by MetService.
- All data gathered is stored in a hydrological database at the Regional Council and transferred to NIWA annually.

PERFORMANCE TARGETS

Continue to implement and improve a prioritized State of the Environment (SOE) monitoring programme and monitor compliance with, and the effects of, the exercise of resource consents and Regional Plans by:	Target Achieved:
➤ Operating a region-wide hydrometric network for the measurement, recording and reporting of rainfall, river flows, lake, groundwater and tide levels.	✓
➤ Collecting water use records and measuring stream flows, groundwater and lake levels associated with significant water abstractions.	✓
➤ Reporting to the Council annually on environmental monitoring activities within three months of the end of the financial year.	Ongoing
➤ Making the results from the annual SOE monitoring programmes available on the Council's website at www.nrc.govt.nz	Ongoing

SUMMARY OF RESULTS 2007-08

- Rainfall – a record wet July with two severe storm events; wet in September, December, February and April; dry in August and January; very dry in October and March and variable for the remainder of the year.
- River Flows – Generally, above average (high flows) in July, August, December, February and May, below average (low flows) for September through to November and January and variable for the remainder of the year.
- A total of 245 flow measurements taken, of which 45 were taken during flood conditions.

INTRODUCTION

Northland Regional Council (NRC) operates a **hydrometric network** consisting of rainfall, river, groundwater, tidal and lake water level monitoring stations, spread throughout the region. There are a total of 208 active stations on this network, of which 81 are automated while the rest are manually read. Of the 81 automated stations, 80 (99%) are on a radio/cellphone **telemetry network**.

During 2007-08, nine new telemetered water level and rainfall stations were installed. These included four in the Kaeo River catchment - at Waiare Road, the Kaeo Fire Station, the outlet to the Whangaroa Harbour and the Whangaroa Wharf - to record flood levels and flows. This data will be used for flood modelling for the Kaeo River Management Plan, as well as providing improved flood warning capabilities for the Kaeo area. Other new stations include water level and flow stations on the Waipoua and Hatea Rivers, and rainfall stations at Oakura Bay, Wilson's Dam and Opua.

From the monitoring period July 2007 to June 2008, 17 severe weather warnings were issued, compared to a total of seven warnings issued in the 2006-07 monitoring period. Three severe weather warnings produced events that resulted in significant flooding in various parts of the region. On the 10 and 11 July 2007, Northland experienced a severe storm from a low pressure system over the north Tasman Sea. Up to 240mm of rainfall was received and gale force winds gusted to over 120km/hr, 'battering' the region over a 12 hour period. A state of emergency was declared in the far north. This storm was as severe as the March 2007 storm that occurred only two months earlier.

During 2007-08, annual rainfall in the Northland region varied between 80% and 147% of mean annual rainfall. Generally, most of Northland received above average rainfall. There was significant variability in climate conditions throughout the year, with July being extremely wet with two storm events, Sept, Dec, February and April being wet, August, October and March being dry and November, January, May and June being highly variable.

River flows in during 2007-08 were characterised by above average monthly flows during July, August, December and February through to May. Lower flows were recorded throughout September to November and January, although some rivers in western areas recorded below their average monthly flows during March and May as well. Near average to above average flows were recorded in June.

During the 2007-08 financial year, a total of 245 flow measurements were carried out in the region of which 45 were carried during flood events. The new Accoustic Doppler Current Profiler (ADCP) has greatly improved flood measuring capabilities.



Photo: Lake Owhareiti at dawn

THE HYDROMETRIC NETWORK

NRC maintains a comprehensive network of hydrometric stations. These can record rainfall, water level, water flow and climate. Monitoring and obtaining information about Northland's climate and water resources is important so that short and long term changes can be detected.

Hydrometric stations have been sited to provide region-wide coverage. Stations also target key river systems so that they can be used for flood warning purposes and for low water flow monitoring.

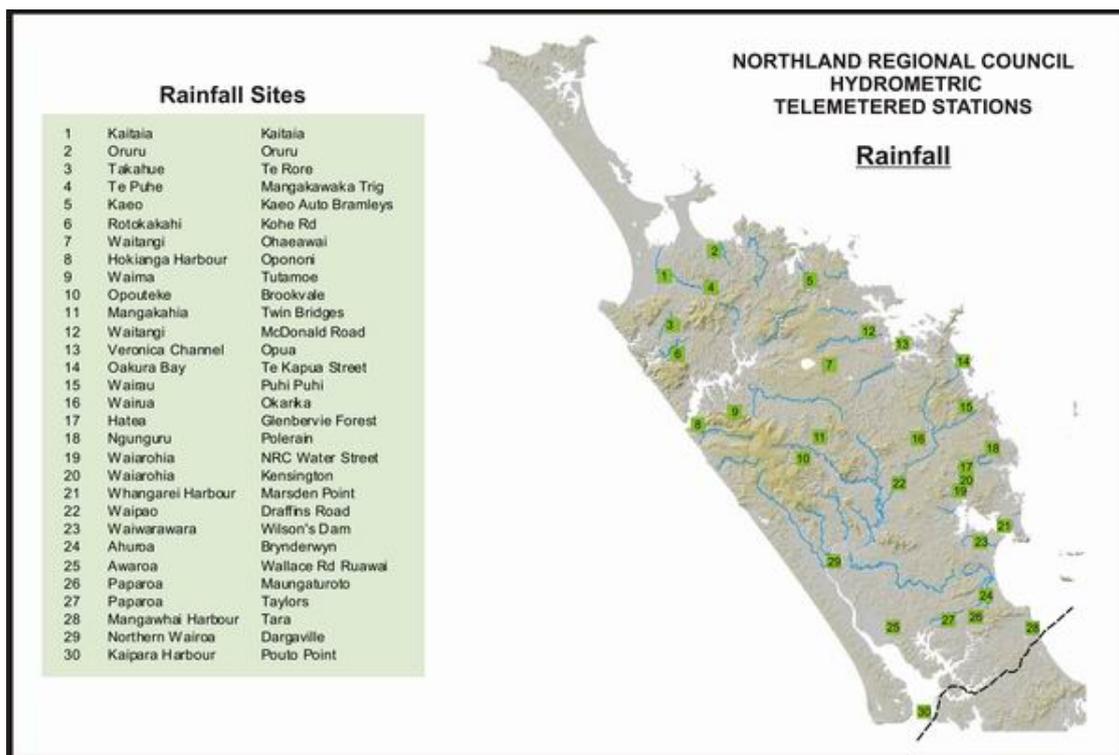
Rainfall Stations

During the 2007-08 financial year, NRC's rainfall monitoring network consisted of:

- 50 manual rainfall stations (rainfall recorded daily by voluntary readers); and
- 30 automatic rainfall recorder stations

In this financial year, new telemetered rain stations were installed at Wilson's Dam (Waiwarawara Stream catchment, west of Ruakaka) and at Opuā Wharf.

From July 2007 – June 2008, there was a 0.9% loss in data from the 30 automatic rainfall stations (compared to 0.5% from 23 stations in the previous year). This can be attributed to faulty instrumentation.

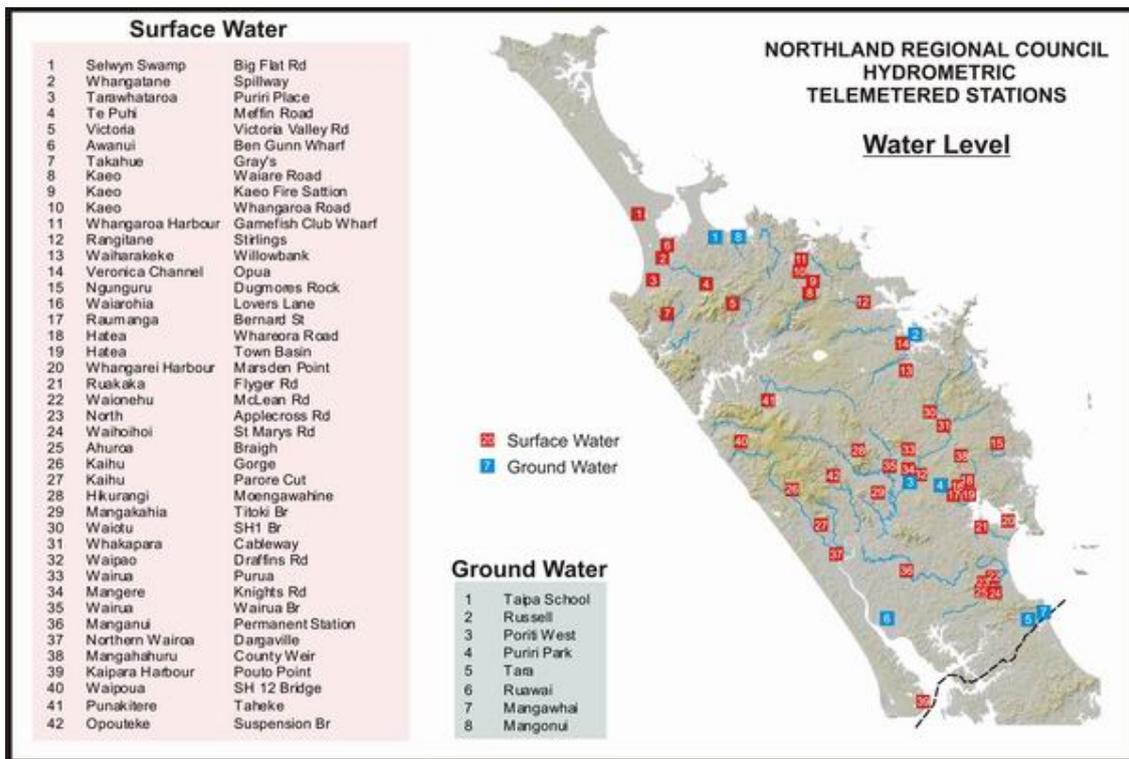


Surface Water Level Stations

During 2007-08, NRC's water level monitoring network consisted of:

- 14 manual lake level monitoring stations (read by NRC staff on a monthly basis);
- 36 automatic water level monitoring stations; and
- Seven automatic tidal water level monitoring stations.

From July 2007 – June 2008, there was a 0.05% loss in data from the 43 automatic water level stations (compared to 0.07% in 2006-2007). This can be attributed to faulty equipment (dataloggers and/or sensors) and telemetry communication problems.



NRC operates seven automatic water level stations in tidal environments. These are located on the east coast at Rangaunu Harbour, Whangaroa Harbour, Opua, Marsden Point and Whangarei City and on the West Coast at Pouto Point and Dargaville. Water levels are continually recorded at either five minute (Whangaroa, Marsden Point and Pouto) or 15-minute intervals (Rangaunu Harbour, Opua, Whangarei City and Dargaville) over the full range of tidal cycles. Barometric pressure, wind speed, wind direction and rainfall are also measured at the Dargaville station and barometric pressure at Pouto Point.

During periods of extreme high tides, there is potential for flooding in low lying coastal areas and Dargaville Township. During such an event, water level, wind and barometric information is gathered via the telemetry system and regularly forwarded to the NRC Emergency Management Officer.



Photo: Stormy seas on the west coast of Northland

During 2007-08, as part of river hazard management, four new telemetered water level stations were installed in the Kaeo River catchment. These stations will provide water level and flow information to improve flood modelling for the Kaeo River Management Plan and will allow for improved flood warning in Kaeo. The water level stations are located at Waiare Road, Kaeo Fire Station, the outlet into Whangaroa Harbour (tide effected) and at the Big Game Fishing Wharf in the Whangaroa Harbour (tidal).

In 2007-08, new telemetered water level/flow stations were also installed in the Waipoua River and the Hatea River, at the Whangarei Town Basin. The Waipoua River site will measure natural water levels and flows in one of Northland's most important, pristine river catchments. The Whangarei site will measure tidal water levels and freshwater inflows to the Town Basin during heavy rainfall events. Information from this station will be used to better predict flooding of the central business district (CBD).



Photo: Rain station, Wilson's Dam



Photo: Water level Station, Waipoua River

Groundwater Stations

During 2007-08, NRC's groundwater monitoring stations comprised:

- Eight automatic water level monitoring stations; and
- 63 manual water level monitoring stations (27 monitored quarterly and 36 monthly).

In addition to measuring water level, three of these groundwater stations also measure conductivity, which is a measure of saline (saltwater) intrusion, and temperature. These stations are sited at Mangonui, Russell and Ruawai. For more information on groundwater monitoring, please refer to the Groundwater section of the Annual Monitoring report 2007-08.

NIWA and MetService Stations

Stations operated by NIWA and the MetService in Northland complement the NRC's hydrometric network. In 2007-08, these included:

- Four rainfall and eight water level stations operated by NIWA; and
- Seven automatic climate and 24 daily rainfall stations operated by the NZ MetService.

THE TELEMETRY NETWORK

The Northland Regional Council operates a radio and cellular phone telemetry network comprising all but one of the automatic stations. This includes 30 rainfall and 50 water level stations from the hydrometric network. Cellular phone and radio communications are currently unavailable at the Waipoua River water level/flow station.

These telemetered sites provide a “real-time” picture of the state of Northland’s 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 public are kept informed of flooding in Northland. During periods of drought, water levels are monitored and when a low flow level is reached, further monitoring is implemented in the affected river catchments. These further measurements are used to accurately monitor the flow and water usage in these catchments so that restrictions on usage can be put in place if necessary.

Future Developments

River hazard management will have the greatest influence on the development of the NRC telemetry network over the next one to two years, as several rivers in Northland have been identified as requiring additional monitoring in relation to flood hazard. Over the next year, an extra five water level/flow stations and two rainfall stations are to be installed in various catchments in order to service some of these rivers.

A communications upgrade during 2008-09 is scheduled to improve communications between the remote stations and the NRC base in Whangarei and update old equipment, in order to improve efficiency.

Hydrological Databases

NRC has a comprehensive database for the storage of the hydrometric data it collects, which includes rainfall, water level, flow and some climate data. Data is usually available for use within three months of collection. Data from the Northland Regional Council’s hydrometric database is transferred to the NIWA’s National Hydrometric Database in Christchurch on an annual basis.

ISO 2000/9001 Quality Management System

All hydrological monitoring and data recording conforms 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”. This means data may be used for resource management, engineering design, project operation, or scientific investigations without the need for extensive checking, editing and correction. An external audit is carried out at six monthly intervals.

Rainfall and River Information on NRC Website

During 2008, telemetered rainfall and river information was added to the NRC website. Data is updated on the website daily and allows users to view information as plots or as tabular format. During heavy rainfall events, information is transferred to the website every two hours. Further development of the website will continue during 2008 – 2009. For more information, go to - www.nrc.govt.nz/Environmental/River-and-rainfall-data/

RAINFALL

Topographical variation (the shape of the land) across Northland means that rainfall distribution patterns differ considerably over relatively small areas. As a consequence, the NRC hydrological team maintains an extensive rainfall-monitoring network in the region, which is supplemented by NIWA and MetService rainfall sites.



Photo: Rain front, Northern Wairoa River

Northland experiences high intensity rainfall events associated with the passage of tropical or sub-tropical storms that pass over the region from November to March. These “summer cyclones” and thunderstorm events lead to sudden flooding as they can yield 100-150 mm of rainfall per hour.



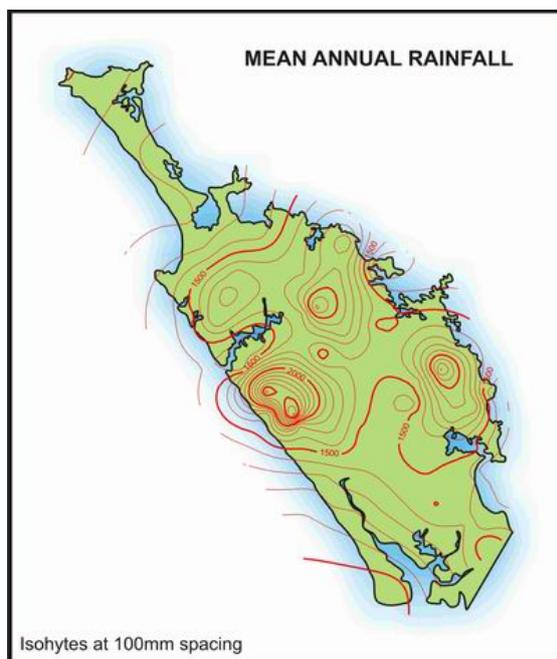
Photo: Isolated rain storm over the Hokianga Harbour

The MetService provides Regional Councils with frequent warnings of approaching, potentially adverse, weather systems. From July 2007 to June 2008, 17 severe weather warnings were issued compared to a total of seven warnings issued in 2006-07. Three severe weather warnings produced significant flooding in various parts of the region.

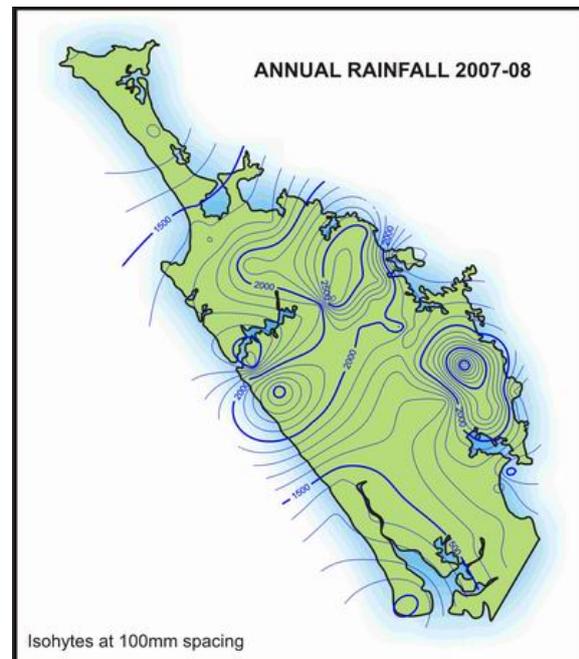


Photo: Ruakaka River in flood – July 2007

The mean annual rainfall for 2007-08 varied from average to above average. The maps below gives a comparison between mean annual rainfall for Northland (in mm) and the annual rainfall amounts received in 2007-08.



Map: Northland – Mean Annual Rainfall



Map: Annual Rainfall for 2007-2008

Northland climate was highly variable during 2007-08. Climatic conditions included a record wet July, extremely wet conditions in September and December and very dry conditions in October and March. Autumn weather conditions were marked by a series of active fronts and intense thunderstorm activity. Winter was characterised by extreme weather patterns. The following is a summary of climatic conditions recorded for each month.

July - Rainfall amounts and river flows were well above average for the month and, in some parts of Northland, at least twice the average. Rain fell for 23 days in July, with heavy rain on 10-11 and 29 July as a result of two severe events. The MetService issued severe weather warnings on both occasions.

On 10 July, a state of emergency was declared in the far north as gale force winds and heavy rainfall produced widespread flooding. Maximum rainfall intensities of 30-40 mm/hr were recorded over many parts of the region. On the 29 July, Northland was again affected by a short but intense rainfall event. In the far north, 50-70mm of rainfall was received over a six hour period. At times, rainfall intensities reached 20-36 mm/hr. For more information on this storm event, please refer to [Case Study 1](#) later in this report.

August - In comparison, August was relatively dry with far north areas around Kaitaia and the Hokianga receiving only 50% to 80% of expected rainfall. More rain fell over areas of the east coast, Whangarei and Kaipara districts (80% to 135% of the norm), due to a localised storm event on the 16 August, which concentrated rainfall in eastern areas of the region.

September - Rainfall patterns were extremely varied during the month, ranging from 40% of the norm to 168%. Above average rainfall was recorded in northern areas of the far north, east coast and Whangarei districts, while below average rainfall amounts were recorded in some parts of the Kaipara district, west coast and mid north areas. The MetService issued a severe weather warning for the 9 September, resulting from a strong moist northeast airflow. Rainfall amounts were expected to reach 50-80 mm over a period of nine hours, mainly in the eastern hills north of Whangarei.

October - Below average rainfall was recorded over the region.

November - Northland experienced another month of variable rainfall, ranging from 55% of the norm in the outer Whangarei Harbour area, to 135% of the norm in far north areas of the Aupouri State Forest. Average to above average rainfall was recorded in the northern areas of the Aupouri Peninsular, Kaitaia to Coopers Beach and eastern areas from Oakura Bay to Whangarei. A severe weather warning issued for late November resulted in moderate amounts of rain (30-70mm recorded in the eastern hills from Puhipuhi to Whangarei).

December - Wetter than usual conditions in the region.

January - Unsettled weather conditions at the start of the month, however conditions improved from mid to late January, with most of the region recording below average rainfall for this month.

February - Wetter than normal conditions resulting from unsettled weather from mid to late February. Rainfall was at least twice the average for the month in eastern parts of Northland and above average elsewhere in the region, apart from areas south of Dargaville, Pouto Peninsular and Ruawai, where dry weather conditions still prevailed.

March - Rainfall amounts were average to above average in far north areas and below average elsewhere, leading to drier conditions than normal.

April - Northland experienced a series of active fronts producing severe thunderstorm activity and associated intense rainfall. Two severe rain events occurred during the periods 14-16 April and 29-30 April. Both events resulted in flash flooding.

May and June - A series of active fronts continued to create unsettled weather during these months. For more information, refer to [Case Study 2](#) later in this report.

The figures below show monthly rainfall amounts (in blue) from July 2007 to June 2008, compared to the long-term monthly mean (in red) for each area.

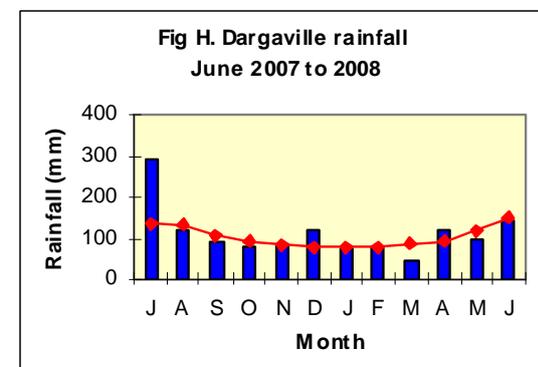
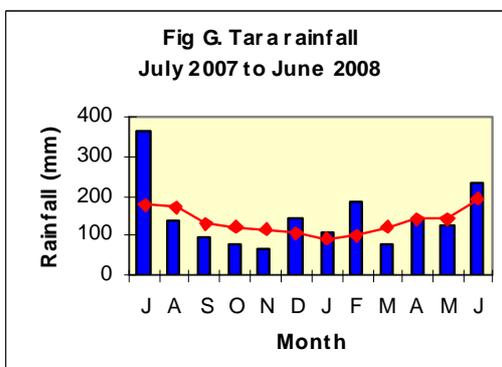
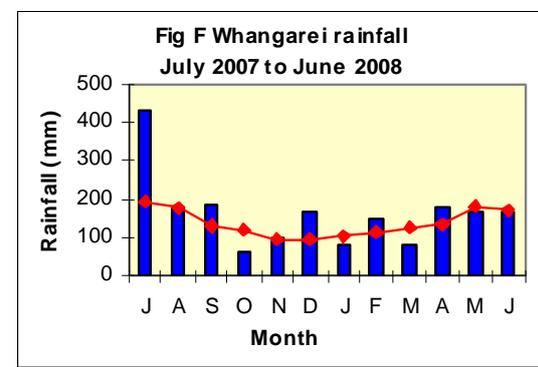
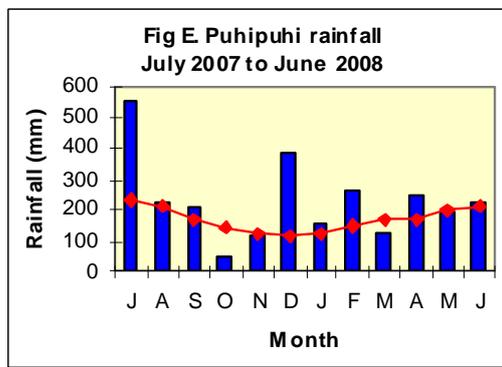
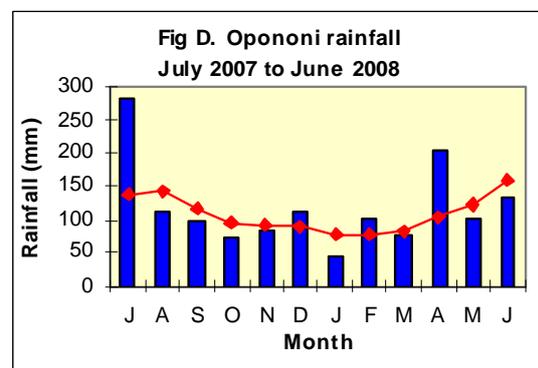
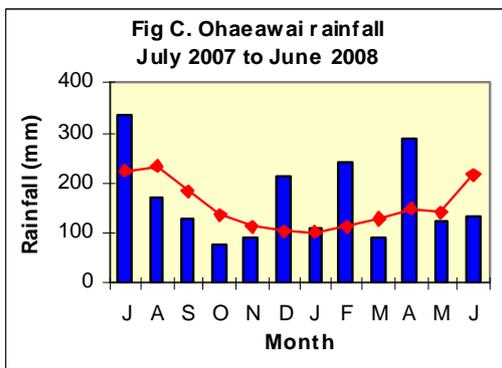
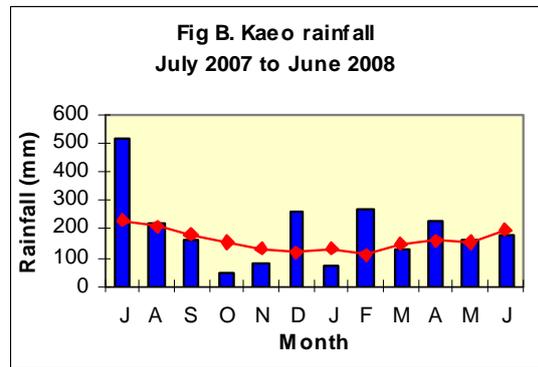
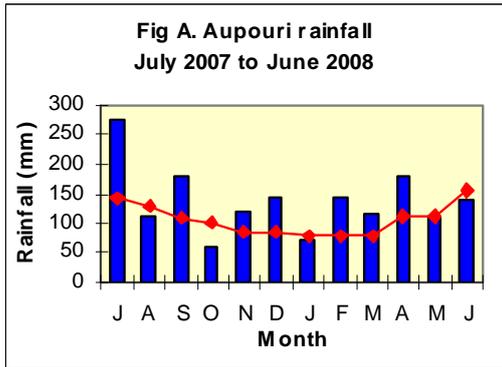


Chart: Monthly rainfall for 2007-08 for each area, compared to monthly average

RIVER FLOWS

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

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

Droughts occur as a result of lower than usual rainfall, which causes prolonged periods of low river-flow. During drought months (most typically January to March), more accurate monitoring of stream flow is undertaken by NRC to establish levels at which water use restrictions may need to be implemented.

During 2007-08, rivers in Northland were characterised by above average monthly flows in July, August, December, February and May. River flows in the far north were also above average for June. Low flows were recorded for September through to November and January, although some rivers in western areas recorded below their average monthly flows during March and May as well. Near average to above average flows were recorded in July.

During 2007-08, a total of 245 flow measurements were taken on the region's rivers, of which 45 were taken during flood events. Over the past two years, there has been a significant increase in the number of measurements taken due to the use of a new Acoustic Doppler Current Profiler (ADCP). This equipment enables flows to be measured more accurately and efficiently compared to traditional methods.



Photo: ADCP flow Gauging - Waipoua River



Photo: Conventional flow gauging Kaihu River

The figures below show the mean monthly flows in 2007-08 compared to the historical mean monthly flows for various rivers in Northland.

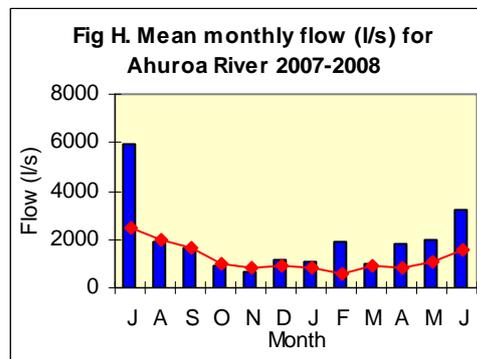
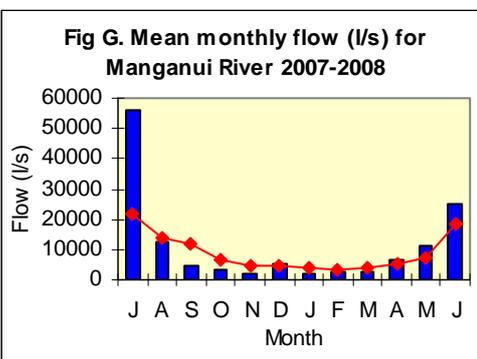
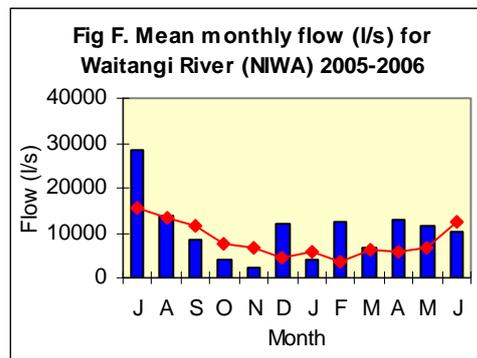
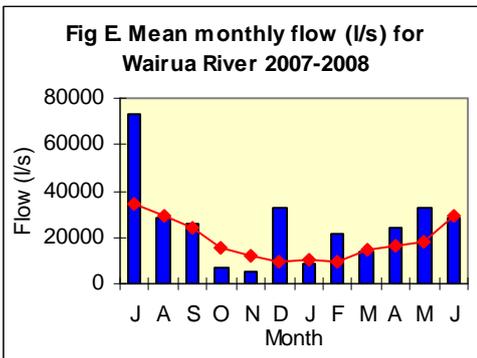
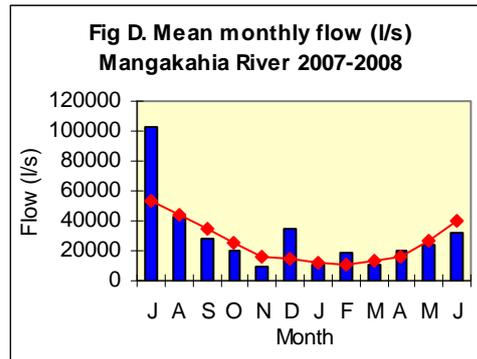
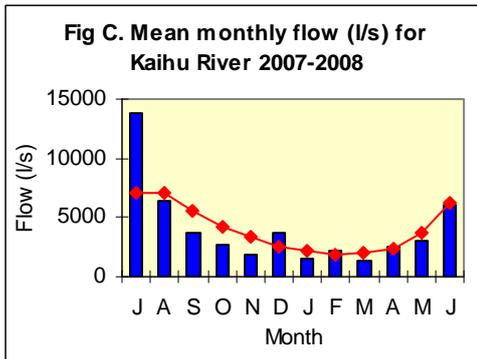
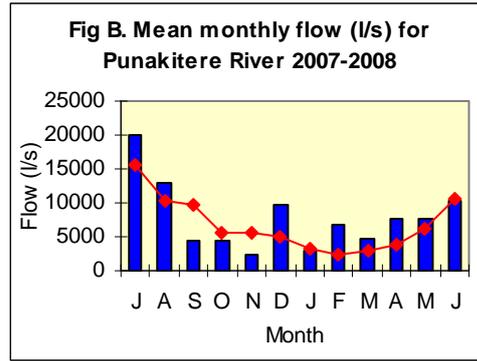
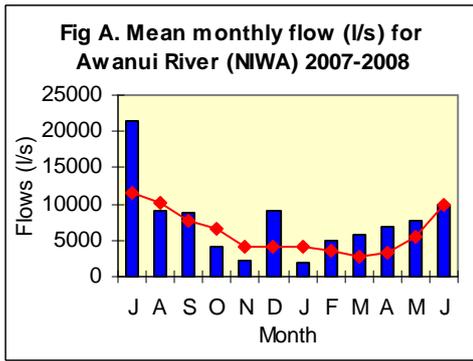


Chart: Monthly flows from July 2007 – June 2008, compared to monthly average flows

CASE STUDY ONE: A VERY STORMY JULY 2007

Background

On 9 July 2007, the MetService issued a severe weather warning for Northland, Auckland and the Coromandal Peninsular, indicating the development of a low pressure system over the north Tasman Sea. This system was expected to deepen and move closer to Northland during Tuesday 10 July.

The low was forecast to bring periods of heavy rainfall and gale-force easterly winds. Up to 200mm of rain was expected to fall in Northland between Tuesday 10 and Wednesday 11 July. Rainfall intensities were expected to reach 15 to 25mm/hr. In addition, many areas would be exposed to damaging winds, with gusts of 120 km/h

Rainfall

Rain began to fall on the evening of the 9 July and became more intense during the early hours of Tuesday 10 July, continuing until 6pm that evening. Rainfall was recorded at the NRC's Kaeo station. The storm moved in a south-easterly direction and rain had cleared the far north by midnight on the 10 July. Further showers continued south of the Bay of Islands through Wednesday 11 July.

The heaviest and greatest rainfall amounts were recorded in the Awanui and Kaeo River catchments, coastal areas north of Kaeo, the headwaters of the Waipapa River in the Puketia Forest and in the high altitude areas of the Waima Ranges (South Hokianga, Kaihu and Mangakahia Rivers). At the Kaeo rain station, 241mm was recorded over 12 hours. Over this period, rain intensities varied from 13mm/hr to 36 mm/hr.

At the Puhupuhi rain station, total rainfall recorded over 24 hours was 217mm and the maximum rainfall intensity reached 39.5mm/hr. Other areas of Northland that received significant rainfall amounts included the Mangamuka Hills (166 mm over 24 hours, max intensity 31 mm/hr), Waima and Tutamoe Ranges (134-172mm, 34.5mm/hr), Whangarei (180mm, 20.5mm/hr), the east coast at Oakura and Glenbervie (122mm, 32.5mm/hr) and Maungaturoto (111mm).

Before the July event, 20 of the preceding 30 days were wet with total rainfall for the month around 200 to 250mm already. Consequently, the storm arrived on top of already wet ground conditions, increasing runoff into already elevated rivers and streams.

Water Levels

Widespread, severe flooding throughout much of Northland resulted from record high river levels. Kaeo township flooded and bore the brunt of the storm. The water through the town was over a metre high in some places.

Four sites with long-term records (20 to 30 Years) reached their highest ever recorded water level and several, the second highest recorded. The Mangakahia, at Titoki, was a metre higher than the levels recorded during Cyclone Bola. The Waiharakeke River behind Moerewa was a centimetre lower than the highest recorded 36 years ago in 1971. The stop banks along the Wairua River in the Hikurangi Swamp overtopped flooding vast areas of the Hikurangi Swamp.

Flooding occurred in Kaitia after flood waters spilled from the Tarawhataroa Stream. Similarly, the Whangatane spillway over-topped its banks. Flooding also occurred south of Kaitia township at Mangamuka, Rangiahua and Taheke. SH1 was closed in a number of places including Whakapara, Ruakaka, Waipu and the Brynderwyns.

Flood waters from the Northern Wairoa River closed SH14 at Kirikopuni, as a result of record river levels in the Mangakahia and Wairua Rivers. The Kaihu valley was flooded

closing SH12 at Rotu. Large areas of low lying river flats were also flooded at Tangiteroria and Pukehuia. A flood warning was issued for Dargaville because of the high water levels in the Northern Wairoa River coinciding with high tide.

Many other highways and rural roads were closed for a time, either due to flooding, slips or downed trees. The gales were responsible for major power outages across the region.

Wind

Climate data from NRC's climate station at Dargaville indicated average wind speeds of around 70km/hr during the evening of 10 July, with sustained gusts of 110km/hr and a maximum gust of 125km/hr (34.7 m/s). Winds were largely from the easterly quarter later swinging to the south-east. The gale force winds generated a significant storm surge on the east coast, elevating high tide levels by approximately 0.4 metres.

The NRC commissioned NIWA to provide extensive analysis of rainfall, river flow and wind information from the storm event. For more information, go to:

<http://www.nrc.govt.nz/Resource-Library-Summary/Research-and-reports/Natural-hazards/>



Photo: Waiharakeke in flood, July 2007

CASE STUDY TWO: INTENSE RAINFALL AND THUNDERSTORM ACTIVITY DURING AUTUMN

March 2008

March rainfall amounts were average to above average in the far north areas and below average elsewhere. Low rainfall amounts were recorded in the areas surrounding the Kaipara Harbour (34% of normal at Pouto and 59% at Dargaville) and some areas south and west of Whangarei (46% at Marsden Point and 57% in the Brynderwyn Hills). Most rainfall fell over five days from 1-5 March, particularly in the far north areas where 60-100mm was recorded.

Moderate rises in water levels were recorded during this time. There was a relatively settled period during mid-March, with rain returning towards the end of the month. Typically, river flows were average to above average in the far north and below average in central, western and southern areas of the region. For example, river flows in the Kaihu, Mangakahia and Manganui Rivers were 60% of the normal March flows.

April 2008

Northland experienced a series of active fronts during April, which produced severe thunderstorm activity and associated intense rainfall. Two severe rain events occurred during the periods 14-16 April and 29-30 April. Both events resulted in flash flooding.

On 15 April, thunderstorm cells developed over an area from the North Hokianga to Kerikeri. This band of mobile thunderstorms moved quickly southwards producing intense thunderstorm activity and severe lightning strikes. At the Omapere telemetered rain station, 67.5mm of rain was recorded in one hour and 97mm over 3 hours. Rainfall amounts of 20-27mm/hr were being recorded inland and along the western hills of Northland, from the Hokianga to the Kaipara Harbours. Flood warnings were issued for the west coastal areas, inland areas of the Mangakahia River catchment and the low-lying river flats at Tangiteroria.

On 29 April, the Meteorological Service warned of another series of active fronts, "bringing moist northerlies and thunderstorm activity that could produce some intense downpours, especially in the eastern hills. Rainfall rates were likely to be 20mm to 30mm/hr". As predicted, early on 29 April, heavy rain fell over the eastern hills of Glenbervie and the northern hills of Ngunguru. Rainfall amounts of 23-40.5mm/hr were recorded. The heavy rain and thunderstorm activity was more intense in the northern hills of Ngunguru where 86mm fell in three hours, resulting in slips and road closures.

During the evening of 29 April, thunderstorm activity returned to an area of the eastern hills from the Bay of Islands to Whangarei. Rainfall amounts of 31mm/hr were recorded at Puhipuhi, 55mm/hr at Oakura Bay and 65mm/hr in the northern hills of Ngunguru. Once again, flash flooding, slips and road closures resulted. Total daily rainfall amounts for 29 April were: Whangarei/Glenbervie 86-96.5mm, Oakura Bay 121.5mm, Puhipuhi 109mm and the northern hills of Ngunguru 178mm. Elsewhere, rainfall amounts varied from 10.5mm at Dargaville to 62.5 mm at Kaeo. Flood warnings were issued for Hikurangi Swamp, Wairua River catchment and the low lying river flats at Tangiteroria.

May 2008

Northland continued to experience a series of active fronts during May, some of which produced severe thunderstorm activity and associated intense rainfall. On 25 May, 33mm/hr was recorded at the Paparoa rain-gauge station, compared to 9mm at Maungaturoto and 3mm at Ruawai.

On 27 May, a developing low to the north west of Northland was blocked by a high pressure system further to the south of the North Island. A band of heavy rain from south

of the Bay of Islands to Whangarei became relatively stationary and over a 12 hour period heavy rain fell over the hills north of Ngunguru and Whangarei. Rainfall amounts of 75mm and 78mm were recorded with intensities reaching 17mm/hr. Minor surface flooding resulted.

Thunderstorm activity through May resulted in varied rainfall amounts over the region, from 40% of the May average in the Pouto Peninsular to 160% of average in Whangarei. Lower than normal rainfall was recorded over the west coast areas and some parts of the far north. Above average rainfall was recorded, mainly along the east coast. River levels were normal or above normal for May.

June 2008

Northland continued to experience a series of active fronts during June, some of which produced severe thunderstorm activity and associated intense rainfall. On average, there were 20 days of rain during June, with 60-70% of the monthly rainfall amounts recorded during mid to late June. Generally, below average rainfall was recorded in most areas of the far north and average to above average in the surrounding areas of Whangarei, inland south of Kaikohe and southern Kaipara areas south of Dargaville, Maungaturoto and Mangawhai. River flows were average to above average for this time of year.