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14.1 Natural Hazards: Main Points

Pressures

- Most towns in Northland are built on plains that are prone to flooding.
- Large areas of highly productive farmland and associated structures are located near rivers and on floodplains.
- Land that is subject to coastal storm waves, surges and exceptionally high tides has been developed for urban or farming uses.

State

- Flooding from rivers is by far the most widespread and most frequently occurring natural hazard affecting Northland.
- Northland is outside of the more active tectonic and volcanic zones, but some parts of the region may still be susceptible to localised damage.
- Because of its long coastline and the encircling shape of many of its east coast bays, Northland is susceptible to tsunami generated by major earthquakes around the Pacific Rim.
- The Aupouri, Rangiputa, Ahipara, and Pouto Peninsulas and the coastal area from Doubtless Bay to Mangawhai tend to have lower rainfall than inland areas, and there is a risk of scrub and grass fires during summer and autumn in most years.
- During high-intensity rainstorms, debris avalanches are a common phenomenon on some of the steep to mountainous country in Northland, regardless of vegetative cover.

Response

- Flood control schemes are currently managed by both Regional and District Councils in Northland.
- Northland Regional Council also operates a flood warning service, based on information collected by telemetered river flow meters, rain gauges, and tidal gauges
- During an emergency, the Northland Regional Council's Civil Defence Plan, together with the various District Council's plans, provides the framework to co-ordinate the organisations, services and people of Northland to guard against the effects of a disaster.

14.2 Introduction to Natural Hazard Management in Northland

Northland is subject to a number of natural events, which, because of the pattern of development within the region, may place human life, property and/or economic production at risk.

Natural hazards include flooding, earthquakes, landslides, fire, tsunami and volcanic activity. Natural hazards that occur in the coastal environment are covered in the Coastal Hazard Section.

14.3 Regional Policy Statement Objectives

The Regional Policy Statement contains the following objective:

- **To avoid or mitigate the adverse effects of natural hazards by minimising and where practicable, avoiding the risk to life and damage to property, infrastructural services and other aspects of the environment, from natural hazard events.**

14.4 Natural Hazard Issues

The following is a summary of the significant resource management issues of the region related to natural hazards:

- The threat to existing and future communities from natural hazards, the potential and nature of which may be unknown.

- Recognition and understanding of the range of existing natural hazard threats and the likely frequency and magnitude of particular events.

- Identification of areas of high hazard risk, especially those prone to erosion, flooding and land instability, and provision of related information on avoidance measures to people.

- Incorporation of comprehensive systems of hazard identification and analysis into the resource consent and building consent processes.

- Damage to natural systems through inappropriate hazard protection measures.

- The contribution which certain land use activities have in increasing the hazard threat especially in high-risk areas. Such activities include:

    - clearance of vegetation by mechanical or other means in areas exposed to the elements and/or with poor soil structures.
    - earthworks, including mineral extraction, in sensitive foreshore and riparian areas.
    - erection of structures, especially buildings, in flood plains.
    - construction of roads on flood-free causeways across the floodplain, which when associated with undersize bridges, creates a damming effect.

- Maintenance of existing protection works, including flood control schemes, and effectiveness of future works.

- Recognition of global warming and the effects of rising sea levels on future land use and subdivision activities along the coast.

- Recognising the need for communities at risk from natural hazards to have emergency management/civil defence plans to enable them to respond when the scale of the natural hazard exceeds the design standards of hazard avoidance or risk mitigation works.

- Recognition that small communities often cannot bear the costs associated with natural hazard disasters. Local authorities need to co-ordinate disaster recovery operations and where appropriate, seek financial assistance from central government.

14.5 Natural Hazards Affecting Northland

Erosion, land instability and flooding are the most widespread hazards affecting Northland, with the greatest damage to property often resulting from extreme rainfall events associated with cyclonic storms. High winds may also accompany these cyclonic storms and may cause damage to buildings and, when soil becomes waterlogged, to orchards, shelterbelts and young pine trees in production forests.

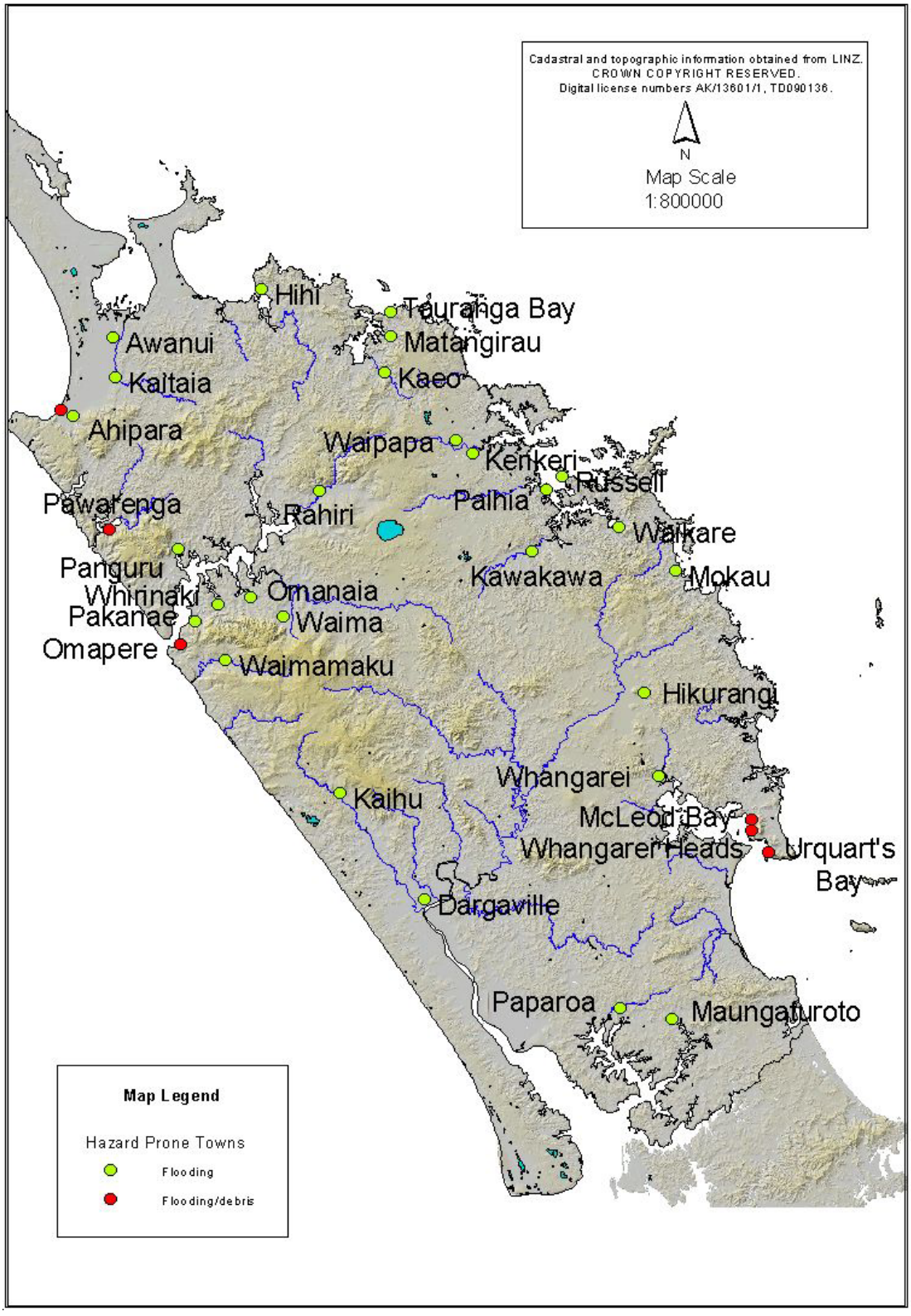
14.5.1 Flooding

Flooding from rivers is by far the most widespread and most frequently occurring natural hazard affecting Northland. The upper tributaries of Northland's rivers drop steeply from the region's mountain ranges and hill country, but quickly become sluggish, meandering channels with their lower reaches affected by the tide. Sediment carried by the rivers has been deposited in the lower valleys, and particularly in the tidal reaches, to create floodplains.

Flooding on the Hikurangi swamp (April 2001)

While by their very nature, these floodplains would have been subject to frequent inundation by rivers, clearance of bush from the catchments, changes in the river regimes due to increased sediment loads, and changes in riparian vegetation, have increased the frequency of overflows from the channels. Periodic flooding of the river floodplains is a natural phenomenon and the indigenous ecosystems within the river and on the floodplains have adapted to survive these events. While the high-intensity storms to which parts of the region are subjected would have caused cataclysmic damage, the natural river and floodplain ecosystems were able to recover.

Flooding of the rivers and floodplains has only become a hazard since humans occupied the flood-prone land and erected structures over and beside the rivers. Similarly, flooding of land adjoining the coast and around tidal estuaries by storm surges and exceptionally high tides has only become a problem since that land has been developed for urban or even farming uses. Most towns in Northland are built partly on floodplains and are subject to flooding. Towns most susceptible to flooding are shown in Map 22.



Map 22: Map of towns affected by flooding and debris avalanches

Environmental Impacts of Flooding

As well as the economic and social impacts of flooding, human occupation of the floodplains has also increased the risk of adverse environmental impacts.

Floodwaters carry debris and litter from the catchment, including everything from plastics to car bodies. Timber carried in floodwaters can knit up and jam under bridges, creating a dam which when it breaches can sweep away buildings and downstream infrastructure.

Septic tanks can either be sluiced out by floodwaters, filled with silt, or floated right out of the ground. Their soakage fields can be ripped up by the erosive forces of the floodwater or sealed over by fine sediment carried by the flood. The contents of septic tanks, oxidation ponds and other effluent management systems can be sluiced out by floodwaters, contaminating not only the water, but buildings and land through which the water flows. Flooding of commercial properties, warehouses, chemical stores, service stations and the like can all contribute contaminants to the floodwaters, and plastic products, timber and other floatable materials to the flood flows. The contaminants, debris and sediment carried by the floodwaters are likely to be deposited among the mangroves and maritime rush beds, ready to be floated off and to litter or contaminate the estuary and coastal beaches during subsequent high tides.

14.5.2 Earthquakes

Northland is outside of the more active tectonic and volcanic zones, but some parts of the region may still be susceptible to localised damage. Earthquakes are relatively rare in Northland and until the Mangonui and Peria quakes of 1963, no events which had an epicentre within the region had been recorded. Generally, however, the slight earthquakes felt in Northland have originated well outside of the region.

14.5.3 Tsunami

Because of its long coastline and the encircling shape of many of its east coast bays, Northland is susceptible to tsunami generated by major earthquakes around the Pacific Rim. These same areas of coastal land are at risk from wind, tide and low atmospheric pressure-generated storm surges, which can cause both coastal erosion and tidal flooding.

14.5.4 Fire

While bush fires are not such a threat in Northland as they are in Australia or even in some other parts of New Zealand, coastal scrub vegetation in particular is highly flammable during summer. The Aupouri, Rangiputa, Ahipara, and Pouto Peninsulas and the coastal area from Doubtless Bay to Mangawhai tend to have lower rainfall than inland areas and there is a risk of scrub and grass fires during summer and autumn in most years. Over recent years, residential development has extended into these areas, with houses sited in small clearings in the bush, or even pole houses over standing vegetation. While this may provide a pleasant, natural environment, it does place these dwellings at extreme risk should a fire break out in the scrub vegetation.

14.5.6 Subtropical Storms

Whether it is due to global warming or simply the heavy rain phase of cyclic weather patterns, Northland is subject to extremely heavy rainfall events and these appear to be occurring more frequently. Another explanation could well be, and there is some evidence, that extremely high intensity but very localised rainstorms have always been a feature of Northland's climate, and have strongly influenced the landform of

parts of the region. Because the heavy rainfall events have tended to hit more remote and less populated areas, few reliable records exist. But it is likely that they occur much more frequently than previously thought.

14.5.7 Land Instability/Mass Movement

Northland has a very complex geology with a wide range of soft rocks. These soft rocks are susceptible to deep-seated movement on even very gentle slopes. Where they include muddy limestone, they are more prone to gullying and flow erosion. Even the harder rocks, some of the older volcanic masses and the greywacke of the east coast, which are weathered to a considerable depth with up to 30 metres of soil overlying hard rock, are inherently unstable.

Given the complex geology and depth of weathering, extreme caution is necessary when building roads or siting buildings in many parts of Northland. This includes North and South Hokianga, the edges of the various plateaux (Waipoua, Waima and Puketi) and the gently rolling to steep hill country between Whangarei and Dargaville and extending southwards to Kaiwaka. Roads in particular are badly affected by slipping and earthflow erosion, with State Highway 14 between Tangiteroria and Tangowahine, and various roads within Kaipara District being undercut. Land drainage and planting with suitable tree species can reduce the rate at which land is moving but are unlikely to completely stabilise the land.

Slip erosion near Maungaturoto

The weathered greywacke extending along the east coast from Whangaroa Harbour to Mangawhai and inland to west of Whangarei has its own particular stability problems. Amongst the unstable areas are blocks of coastline where crushed and/or more deeply weathered material has been undercut by coastal erosion, resulting in slumping of the adjoining slopes. Similar problems occur on other rock types where they are undercut by coastal erosion, for example on old volcanic rocks at Hihi and conglomerates overlying limestone and Tangihua volcanics on South Head of the Hokianga Harbour.

At several locations, between Ngawha and Kawakawa, around Whangarei and in the southern Otamatea, geologists have recorded crushed argillaceous shale, some is Onerahi Chaos Breccia, which is not only inherently unstable, but is almost impossible to revegetate when exposed by excavations. Water seeping from, or surface water running off acid sulphide deposits in these shales can have a pH of less than two, so preventing plants from becoming established. Uncontrolled stormwater running across these deposits can quickly erode large amphitheatre-shaped gullies up to 30 metres deep. Not only may adjoining property be threatened by the retreat of the gully head, but the large volumes of sediment discharged from the gully can bury downstream land and water bodies. During low-flow periods, the acid discharge can cause adverse effects in receiving waters.

14.5.8 Debris Avalanches

During high intensity rainstorms, debris avalanches are a common phenomenon on some of the steep to mountainous country in Northland, regardless of vegetative cover. These very fluid earth movements have occurred in deeply weathered soils around the edges of the Warawara and Puketi Plateaux, the sides of Mt Manaia, the greywacke hillcountry between Whangarei Harbour and Tutukaka and near Helena Bay, and on soils derived from sandstone at Taipuha. They have also occurred at Mosquito Gully on Pouto Peninsula, but because the land was under grass, the slips were much shallower than when the land was under bush.

The main problem associated with debris avalanches is the damage caused along their narrow flow path. The high energy, very fluid movements scour a path through bush, buildings and roads, causing serious structural damage and are a serious threat to life (refer **Case Study: Hokianga Flood – 21 January 1999**). Avoidance is the only practical method of lessening the risk. Careful planning is required in Panguru, Pawarenga, McLeod Bay, Taurikura and McKenzie Cove.

14.5.9 Threat from Volcanoes

Volcanoes have been active many times in Northland's geologic history and the lava and ash poured out of them make up some of the most striking landscape features of the region. There are two recent volcanic fields in Northland, Whangarei and Kaikohe, which are dormant but cannot be considered extinct. Of the at least 10 volcanic centres which have erupted in the Kaikohe field over the last 20,000 years, Te Puke, near Waitangi, erupted between A.D. 200 and A.D. 700 and Kawiti, near Otiria, some 5,000 years ago.

Observations of both the Kaikohe and Whangarei volcanic fields suggest that volcanoes have erupted progressively along fault lines, with the oldest cones towards one end of a line of cones and the youngest at the other end. It would appear that any threat of further eruptions from these dormant fields is not in close proximity to a previous cone, but somewhere further along the fault, following the line of succession.

In Northland, the greatest danger from volcanic activity is from the eruption of scoria and lava. The first phase of volcanism would probably lead to local earthquakes of low intensity, followed by an eruption of lava from a vent in the ground. The lava flow would be followed by more violent and gaseous eruptions of scoria and ash, forming a cone. As the interval between eruptions in recent times has been approximately 2,000 years, there is a possibility of another basaltic eruption in the Whangarei and Kaikohe fields within the next few centuries.

14.6 Response to Natural Hazard Issues

14.6.1 Flooding

Northland is subject to a variety of hazards, which affect people, property and the environment. Flooding is the most common hazard - several of the region's major settlements, as well as important farming areas, are located within flood plains.

Historically, flood control schemes have been constructed either by Government departments or with the assistance of central government funding. These schemes include those constructed on the Awanui, Wairua, and Northern Wairoa Rivers and on the Waiarohia, Kirikiri and Raumanga Streams within Whangarei city.

Today, river management in Northland is the responsibility of both the Regional and District Councils. Northland Regional Council, as the catchment board, is responsible for the minimisation and prevention of damage by floods and erosion. District Councils may, but are not required to undertake river management and drainage works. In practice, this sees both Regional and District Councils working together, with the Regional Council taking a general supervisory role over District Council responsibilities. The Regional Council and the three District Councils have ratified the Northland River Management Policy, below, and to avoid overlap and confusion as to which council is responsible for river management and drainage in a particular area, have defined areas where each council has primary responsibility. Briefly, the district councils are responsible for managing rivers and drainage within urban areas and existing drainage districts, and the Regional Council manages the remaining rural areas and small communities.

River Management Policy

The Northland River Management Policy provides for an integrated approach to flood hazard assessment, involving:

- hazard identification and risk assessment
- risk avoidance by controlling development on flood-prone land, or authorising only development that can withstand flooding
- risk reduction by undertaking flood mitigation works
- site specific emergency management plans to assist communities to cope with greater than design events
- disaster recovery plans for communities that are at risk

Currently, work programmes for Northland Regional Council involves:

- providing information to District Councils for district plans with the aim of assisting them to prevent or control development in areas at risk from flooding
- working with District Councils to develop a list of priority river management programmes and promoting co-ordination of those programmes
- developing management plans for the Kaeo, Waima, Waimamaku, Kaihu and Mangakahia Rivers

Maps showing land prone to inundation have been supplied by the Regional Council to each of the district councils to provide information for Proposed District Plans. This data varies in levels of confidence from assessments based on anecdotal reports and land resource inventory data through to accurate surveys and hydrological models which have been calibrated against actual flood events. The more detailed plans have been prepared for the floodplains of the Northern Wairoa

River and its tributaries, Hikurangi, for the Kaeo River and for the Hokianga settlements affected by the January 1999 floods, that is, Panguru, Whirinaki and Pakanae. The Whangarei District Council has also reviewed parts of the Whangarei City Flood Control Scheme and has included more detailed data in the comprehensive stormwater management plans for these areas.

Emergency Management

During an emergency, the Northland Regional Council's Civil Defence Plan, together with the various District Council's operational plans, provides the framework to co-ordinate the organisations, services, and people of Northland to guard against the effects of a disaster.

Severe weather warnings issued by the New Zealand MetService serve as the primary warning mechanism for weather-related natural hazards. As soon as "alerts" or "adverse weather warnings" are received from the MetService, these are relayed electronically to organisations and individuals who may be affected by heavy rain or flooding. As the MetService updates are received, they too are relayed.

Northland Regional Council also operates a flood warning service, based on information collected by telemetered river flow meters, rain gauges, and tidal gauges.

14.6.2 Earthquakes

Given the low risk of earthquakes in Northland and national requirements as to earthquake standards in building design, providing buildings in Northland are constructed according to these standards, they should withstand earthquakes of the magnitude experienced within the region. The district councils administer the requirements of the Building Act, either directly or via consultants.

14.6.3 Tsunami

The Northland Regional Council maintains a telemetered tide gauge, part of the Pacific Tsunami Warning System, at Marsden Point. Data from the site is continuously relayed to the Council, to the Ministry of Emergency Management in Wellington and to the Pacific Tsunami Warning Centre in Hawaii. The Pacific Tsunami Warning Centre advises the Ministry of any potential threats and these are sent on to the Council. Should the need arise, the Regional Council is able to issue warnings via its civil defence network.

14.6.4 Fire

The whole of Northland is covered by fire control services, including the NZ Fire Service, volunteer services and rural fire units managed by the Rural Fire Authorities (district councils, Department of Conservation or forest companies). These authorities ensure there are trained personnel and equipment available to suppress forest or scrub fires, they monitor the fire risk and are able to regulate the lighting of fires in the open. Full meteorological stations are maintained at Pouto, Dargaville, Opouteke, Kaikohe, Kerikeri and on the Aupouri Peninsula as part of the fire risk monitoring system. The issue of bush fire risk associated with urban development in scrub or bush vegetation has been raised with each of the district councils during the preparation of Proposed District Plans.

14.6.5 Subtropical Storms

In addition to heavy rain warnings, the MetService includes strong winds alerts and warnings to the Regional Council and the media. The Regional Council has on occasions emphasised the strong winds part of these warnings and urged boaties to secure craft and avoid putting to sea during the event.

Just as the Building Act requires minimum standards for buildings to withstand earthquakes, so too does it require minimum standards to withstand wind loading. That is, the wind hazard threat to structures caused by subtropical storms can be managed by district councils under the building consent process.

14.6.6 Land Instability

The Regional Council has previously provided data on instability to each of the district councils as input into their preparation of Proposed District Plans. In Kaipara District, this comprised a detailed urban land use capability survey (ULUC) of Mangawhai and Molesworth Peninsula. The Whangarei District was provided with an ULUC survey of an area in the upper Kirikiri Stream catchment and Hikurangi. The Far North District received ULUC surveys of each of the urban areas and settlements around the shores of the Bay of Islands from Huai Bay to Opito Bay, but not including Kerikeri-Waipapa, as well as an ULUC survey of Opononi-Omapere. Among the limitations identified in these surveys and ranked according to seriousness are instability and the potential for settlement (in peat).

In addition, the former Northland Catchment Commission prepared a map showing potentially unstable land within Whangarei city. This data was reviewed and a report and maps prepared by DSIR geologists, noting in particular the presence of Onerahi Chaos Breccia. This data is used by the Whangarei District Council when considering building development within the identified areas.

14.6.7 Debris Avalanches

Over the next year, urban land use capability surveys will be undertaken in Pawarenga, Panguru, Whirinaki, Pakanae and Kaeo to identify flood-free areas where buildings can be safely erected. In Pawarenga and Panguru in particular, the threat from debris avalanches will be identified.

14.6.8 Volcanoes

The threat from volcanoes has not been provided for in the Far North and Whangarei District Plans because the risk is, at this stage, considered insignificant. It is proposed however, that these assumptions be reviewed by more authoritative bodies.

14.7 Case Study: Hokianga Flood – 21 January 1999

On 21 January 1999, a high-intensity rainstorm moved down the west side of the Northland Peninsula tracking from the Whangape Harbour in the North Hokianga, down to the Waima and Tutamoe Ranges, and across the southern districts to Kaiwaka and Mangawhai.

Very intense stormclouds developed within the system, dropping extremely intense rain over isolated areas in a very short time. Rainfall amounts recorded at Opononi indicated that 211mm fell over a five-hour period and it was estimated that in the hills behind Opononi and Omapere, 300mm may have fallen over a four-hour period. Estimated rainfall amounts of 300mm to 350mm may have fallen on the plateau of the Warawara Forest, above Panguru and Pawarenga, possibly over a two to three-hour period. As a result, rivers from these steep catchments rose dramatically causing flash flooding, particularly in areas of the North and South Hokianga where the settlements of Panguru, Pawarenga, Pakanae and Whirinaki were devastated.

To indicate the isolation of these thunderstorm events a rainfall station only five kilometres north of Panguru, at Rotokakahi Valley, recorded only 45mm. Ten kilometres north of Rotokakahi Valley only 3mm was recorded during the whole event. The spatially erratic behaviour of this event highlights the importance of having representative rain gauges over Northland to monitor isolated, but significant rainfall events.

Extensive flood damage following the Hokianga flood

Source: Northern Advocate

14.8 Case Study: Kerikeri Flood – 19 March 1981

On 19 and 20 March 1981 the Kerikeri basin catchment was subjected to a rainfall event resulting from intense thunderstorm activity. This event exceeded any other rainfall recorded in New Zealand for an 8.5-hour duration. A maximum rainfall amount of 448mm was recorded in the Kapiro catchment, with a recorded rainfall intensity of 174mm in 2.5 hours.

Massive flood overflows occurred from one catchment to another. The Puketotara River overflowed into the Kerikeri River on the floodplain near State Highway 10. The Kerikeri River overflowed into the Waipapa Stream across Waipapa Road. Flows were up to 1 metre deep and spread over an area of approximately 10 km^2.

The resulting flooding caused considerable damage to property, horticultural blocks, bridges, historical buildings such as the Stone Store and Kemp House, and one person died.

Kerikeri flood

Source: Northern Advocate