

11.1 Introduction

The Auckland Region, like much of New Zealand, is at risk from a range of natural hazards. The irregular occurrences of natural hazard events means they are often poorly understood. Many of the land use management decisions made in the past have tended to exacerbate the risk¹. With the continual growth of the Auckland Region, it is important that public authorities recognise the risk from hazards and undertake co-ordinated responses to ensure the long-term reduction in risk posed to the Region.

Natural hazards are defined within the RM Act as:-

“Natural hazard means any atmospheric or earth or water related occurrence (including earthquake, erosion, volcanic and geothermal activity, landslip, subsidence, sedimentation, wind, drought, fire or flooding) the action of which adversely affects or may adversely affect human life, property or other aspects of the environment.”

Throughout the Auckland Region natural hazards occur in varying severity, in location, and in time. Each hazard poses a different risk to human safety and wellbeing (including public health), infrastructure, and the environment. To deal with the risks posed by natural hazards the RM Act (sections 30, 31 and 35) gives functions to the ARC and TAs aimed at the avoidance or mitigation of the resulting impacts. These functions include developing and placing controls, such as policies and rules, within planning documents or resource consents to ensure adequate measures are taken to protect human life, property and the environment from the impacts of natural hazards. In addition to the function of regional councils and TAs towards the avoidance or mitigation of natural hazards, it may be possible in some cases to remedy the effects of some natural hazards (e.g., beach nourishment to remedy the effects of coastal erosion).

In developing policies and rules aimed at dealing with the risks and impacts of natural hazards, it is recognised that a ‘partnership’ between development and nature must be established. This partnership must aim at keeping people away from hazards, rather than hazards from people.

The most commonly occurring natural hazards in the Auckland Region are flooding (from both overflow and inundation), both in rural and urban areas, and erosion/land instability. Impacts of erosion/land instability are

generally limited to smaller areas and are not Regionally significant. TAs have a number of existing controls for these hazards, which are referenced in district plans, and exercised mainly under the Building Act 2004 and the Resource Management Act 1991. The ARC has traditionally worked with these councils towards compatible policy.

The coastal environment is particularly susceptible to natural hazards. Within the Auckland Region the primary hazards arising from coastal processes include erosion, inundation of low lying areas, land instability, rising mean sea level and tsunamis. These hazards may occur individually, or combine to create a cumulatively more significant hazard.

The sustainable management of the coastal environment with respect to natural hazards should involve the consideration of the particular hazard in the wider context (both above and below MHWS, and over longer time periods), to ensure appropriate methods are used to avoid, remedy, or mitigate natural coastal hazards, while protecting the natural character and processes of the coastal environment.

The least frequently occurring natural hazards include earthquakes, volcanism, tsunamis, various meteorological effects (cyclones, tornadoes, drought) and fire. While of low frequency, they are potentially of major Regional significance and not easily dealt with through land use control strategies. The risks of these natural hazards are poorly understood. The Civil Defence Emergency Management Act 2002 sets out how the region will jointly manage natural (and non-natural) hazards. This Act requires Local Authorities to plan for hazards across the key areas of reduction, readiness, response or recovery. This ensures that these infrequently occurring natural hazards are dealt with by contingency controls such as civil defence and insurance systems.

11.2 Issues

11.2.1 Natural hazards pose a risk to people, property, infrastructure and the environment in the Auckland region

Much of the Region is at risk from one or more natural hazards. In particular, flood damage has had significant impacts in catchments such as the Kaipara River, Hingaia stream, and Opanuku stream. There are innumerable smaller urban catchments in which the

¹ Risk = Consequences x Likelihood

risks posed by flooding are serious. Often these risks are exacerbated by the inappropriate location of buildings and infrastructure in flood prone areas or by flood peaks heightened by an increase in impermeable surfaces in urban catchments. (Infrastructure includes essential lifelines such as transport, water, wastewater, stormwater, telecommunications, and power. The consequence of infrastructure failure as a result of a natural hazard often poses significant and widespread risk to the community in addition to the risk posed by the hazard event itself.)

Serious coastal erosion is occurring around the Region, creating a risk to property and infrastructure. Destruction of property at Omaha in the late 1970s provided a graphic demonstration of the Region's vulnerability to coastal erosion hazards. Almost the entire length of the Auckland coastline is subject to a landwards regression. The area that is likely to be susceptible to the coastal erosion hazard along the Auckland coastline is highly variable due to a number of factors, such as the variability in wave climate and the competency of the underlying material. A broad scale assessment, or regional overview, of areas susceptible to coastal erosion in the Auckland Region over the next 100 years has indicated that for beach environments the areas 'likely' to be susceptible to erosion range from 6 metres landward of the vegetation line at stable beaches with low/limited sand dune systems, to 55 metres at more variable beaches with highly developed dune systems. For cliff areas the assessment has indicated the 'possible' areas susceptible to erosion effects, extending landward from the toe of the cliff, range in width from about 5m in low, competent volcanic cliffs to 235m in high, weakly consolidated cliffs. Site specific analysis is required to determine the actual area susceptible to coastal erosion at any particular site. With continual pressure for development along the coastal margins and with predicted sea level rises associated with global climate changes, the risk is likely to increase in the future.

Land instability occurs as a result of steepness, and because of the existence of a number of inherently unstable geological units, which are widely distributed in the Region.

Cyclones also affect the Auckland Region, bringing high wind speeds and heavy rainfall. These events can cause flooding, coastal erosion and instability all at the same time. In addition, they often cause damage to essential lifeline utilities such as power and telecommunications. Severe cyclones, causing effects such as flooding, winds, storm-surge and landsliding that are beyond those planned for in District Plans, affect the Auckland Region on average once every 100 years.

Although the frequency of occurrence is much less than the above natural hazards, the impacts of major natural hazard events, such as volcanic activity or earthquakes, would be extremely catastrophic for the Region. Historic volcanic eruptions in Auckland have occurred at different locations about once every 1000 years and tsunami waves of 1-3 metres may occur about once every 75 years.

Many natural hazards are not well understood in terms of location, frequency, magnitude and consequences. As a result risk avoidance or reduction mechanisms may be difficult to justify because of gaps in knowledge and understanding, giving rise to increased risk.

Often the level of information required to assess the degree of risk of natural hazards requires a greater level of expenditure than is currently undertaken by TAs. In these situations a precautionary approach is appropriate.

In addition, many people have two common misconceptions of risk: many people do not understand that events occur randomly so that (for example) a recent major event is taken to indicate that the next one will not occur for some years; and many people do not appreciate that an extreme event (e.g. 1% AEP) has a significant chance of occurring in their lifetime. These misconceptions can also result in behaviours and decisions that increase risk.

Traditional approaches to natural hazard management have involved the protection of people and the environment from natural hazards. Some of these measures, such as flood protection schemes and seawalls, may themselves have an adverse impact on the environment.

11.3 Objective

To avoid, remedy, or mitigate the adverse effects of natural hazards on human life, property, infrastructure and the environment, while minimising the adverse effects of measures implemented to reduce the risks of natural hazards.

11.4 Policies, Methods and Reasons

11.4.1 Policies

The following policies and methods give effect to Objective 11.3.

1. *Natural hazard management shall be integrated and co-ordinated between the ARC and TAs within the Auckland Region, and with adjoining regional councils.*
2. *Before provision is made enabling development or redevelopment of land, including intensification of land use, any natural hazards, particularly flooding, land instability and coastal hazards, and measures to avoid or mitigate their adverse effects shall be identified.*
3. *Except as provided in 11.4.1.4 below, development shall only be allowed in the 1% AEP flood plain when:*
 - a. *Any adverse effects of a 1% AEP flood event on new buildings, are avoided or mitigated; except in urban areas, when any adverse effects of the 1% AEP flood event on the habitable floors of new buildings are avoided;*
 - b. *Any new building, structure or reclamation will not;*
 - i. *Divert overland flows, or*
 - ii. *Increase runoff volumes to create a new flood hazard, or*
 - iii. *Accelerate, worsen or exacerbate existing flood hazards;*
unless any adverse effects, including potential cumulative effects, on other properties are avoided or mitigated;
 - c. *Any hazardous substance stored as part of the development, or during the construction, will not create a hazard or significant adverse effect.*
4. *A district plan may provide for an alternative flood standard to that set out in 11.4.1.3 to cater for existing hydrological constraints (including, topographical and geological conditions, the nature of existing development, and the adequacy of overland flow paths), and provided that the alternative district plan provisions shall:*
 - a. *Require flood protection to a standard that is no less stringent than the 2% AEP; and*
 - b. *The adverse effects of the 2% AEP flood event on the habitable floors within the development are avoided; and either;*
 - i. *The adverse effects of the development on flood hazards are contained within the boundary of the site; or*
 - ii. *Any adverse effects on flood hazards on other properties are not permitted by the district plan.*

(See Appendix D for the definition of AEP)
5. *Development that results in changes in the volume of stormwater runoff during a flood event with a greater probability than 1% AEP shall not accelerate, worsen or exacerbate the adverse effects of a flooding hazard unless any adverse effects on other properties are avoided or mitigated.*
6. *Where development or use exists within areas susceptible to natural hazards, construction of mitigation works shall be allowed only where people, property, infrastructure and the environment are subject to risk from hazards, the works are the best practicable option, and any adverse effects on the environment are avoided, remedied or mitigated. The abandonment or relocation of existing structures and the use of non-structural solutions shall also be considered among the options.*
(See also Chapter 7 Coastal Environment)
7. *Any works or structures within the 1% AEP flood plain or overland flow path(s) shall not create or exacerbate a flood hazard, during a flood event with a greater probability than 1% AEP, either at the site or at any location upstream or downstream of the works or structures; unless:*
 - a. *The adverse effects of the flood hazard are avoided, remedied, or mitigated; or*

- b. *The work or structure is required to avoid, remedy or mitigate the adverse environmental effects of a flood event;*

Works may include (but are not limited to) earthworks, riparian planting, piping of streams and the construction of culverts, bridges, retaining walls.

- 8. *Development shall not be allowed in areas subject to erosion/land instability unless it can be demonstrated that the adverse effects can be avoided or mitigated.*
- 9. *In the coastal environment, new subdivision, use or development should be located and designed, so that the need for hazard protection measures is avoided.*
- 10. *A precautionary approach shall be used (including the development and implementation of plans) in avoiding or mitigating the adverse effects on people, property, infrastructure and the environment of earthquake, volcanic activity, sea level rise, tsunami and global climate change.*

11.4.2 Methods

- 1. *The ARC will gather information and undertake or commission research at a regional scale on natural hazards and their risks and impacts. This information shall be made available to TAs and the general public through a natural hazards database. This will include volcanic, tsunami, earthquake, cyclone, and coastal hazards including the effects of sea level rise and climate change.*
- 2. *TAs will gather information and undertake or commission research on natural hazards, their risks and impacts at a district/city scale, and make this information available to all persons through a natural hazard database. This will include flooding, land instability, coastal hazards and active faults.*
- 3. *The ARC will investigate methods to avoid, mitigate or respond to natural hazards and make this information available to TAs and the general public.*
- 4. *The ARC and TAs will jointly advocate through the Auckland Civil Defence and Emergency Management Group methods to avoid or mitigate the adverse effects of natural hazards on the environment.*

- 5. *The ARC will co-ordinate the management of natural hazards throughout the Region by developing guidelines and strategies, and ensuring consistency among TAs, by co-ordination of action in respect of natural hazards which extend across local boundaries, and by co-ordination of action with the appropriate regional council in respect of natural hazards which extend across regional boundaries.*

- 6. *TAs will give effect to these policies by including objectives, policies, rules and other methods of implementation within district plans to control any actual or potential effects of the use, development or protection of land for the avoidance or mitigation of natural hazards.*

- 7. *The ARC will implement objectives, policies, rules and other methods with respect to any actual or potential coastal hazards arising from the use, development or protection of land in the coastal marine area, through the provisions in the Regional Plan - Coastal, which will encourage subdivision, use and development in the coastal environment to locate in appropriate areas.*

See also Chapter 7 - Coastal Environment.

- 8. *TAs will implement objectives, policies, rules and other methods with respect to coastal hazards through provisions in district plans, including the use of esplanade reserves and strips and coastal setbacks for the purpose of avoiding, or mitigating natural hazards.*

See also Chapter 18 - Esplanade Reserves and Strips.

- 9. *TAs will ensure that flooding, instability and coastal hazards are assessed before any new areas are rezoned in ways that enable intensification of use, or where development is likely to cause adverse effects. This should be done as part of a wider planning process or structure planning process (as described in Appendix A).*

- 10. *The ARC will (for example by advocacy and through Regional Plan provisions) promote a comprehensive catchment-wide approach to flood management.*

- 11. *The ARC will regulate diversions and discharges of stormwater in order to avoid or mitigate adverse effects of flooding and erosion, through the Regional Plan provisions and resource consent process.*

- 12. *TAs will undertake day to day flood management functions. These functions may include (but need not necessarily be limited to): monitoring of flows*

and water levels, issuing warnings to the public and alerting civil defence, operation of floodgates, and infrastructure maintenance such as clearing of debris from culvert inlets and other hydraulic structures.

13. *Within the 1% AEP flood plain and overland flowpaths TAs and ARC will control reclamation and storage of materials likely to be moved by flood events, and ensure that development within the area is located in such a manner as to avoid or mitigate adverse effects of flooding and erosion.*
14. *The ARC and TAs, through the resource consent process, building permits, and monitoring and enforcement procedures, will ensure that any lawfully established hazard mitigation work is adequately constructed and maintained. Construction and ongoing maintenance of hazard mitigation works is the responsibility of the owner.*
15. *The ARC and TAs will develop and carry out coordinated educational strategies aimed at providing the general public with a greater understanding of natural hazards, their associated risks, how these risks are being addressed and how to be prepared for an emergency.*
16. *The ARC and TAs will co-ordinate activities and provide for planning related to civil defence emergency management across the areas of reduction, readiness, response and recovery to avoid or mitigate the effects of natural hazards.*

11.4.3 Reasons

Sections 30 and 31 of the RM Act give the ARC and TAs similar functions in relation to the avoidance or mitigation of natural hazards. The RM Amendment Act 1993 enables the RPS to define the respective responsibilities of regional and territorial councils. It is important to clarify the respective roles of these agencies in order to avoid public confusion and to ensure that natural hazards management is undertaken at optimum efficiency and effectiveness.

While most natural processes that cause coastal hazards originate in the CMA, their adverse effects are usually expressed on the land above Mean High Water Springs (MHWS) where regional councils and TAs both have respective responsibilities. In order to achieve integrated and co-ordinated management of coastal hazards in the Auckland Region, these responsibilities need to be clearly identified.

The ARC will ensure consistency of approach and maintenance of standards across the Region and the development of guidelines and strategies. By virtue of its responsibilities under sections 14 and 15 of the RM Act, the ARC regulates diversions and discharges of stormwater that occur as a result of development. Because of the TAs' involvement in land use planning and the control of building development, it is more appropriate that they control stormwater discharges, subject to attaining standards adopted across the Region. The ARC intends to establish such standards while also continuing to allocate direct control to TAs via the catchment-wide network discharge consents granted under the proposed Auckland Regional Plan: Air, Land and Water. Any such allocations shall be based on the production of integrated catchment management plans produced on a catchment-by-catchment basis.

Responsibility for the construction and maintenance of mitigation works should be borne by the owner or their successors. The relevant consenting authority above MHWS (territorial local authorities) and below MHWS (regional council) should ensure this is undertaken to an adequate standard through resource consent conditions and that appropriate legal mechanisms (such as bonds or covenants) are in place to provide for on-going maintenance of works undertaken by private persons.

The RPS requires that TAs will take responsibility via their district plans for ensuring that redevelopment or intensification is discouraged in known hazard zones. For presently undeveloped areas (e.g., rural), where the land use may change (e.g., urbanised), no new development will be permitted in the 1% AEP flood hazard zone, unless the hazard can be avoided by, for example, setting floor levels above the flood hazard level. Any development that is permitted should not accelerate or worsen the known hazard or divert flow onto other properties. Access to and from buildings should be maintained during flooding for purposes of evacuation.

The community has accepted a level of flood protection equivalent to a 1% AEP for a number of years, and it is considered appropriate to maintain this standard. The RPS policies and methods, formulated under the RMA, take a long term (intergenerational) view and consider a wide range of effects. Therefore it can be more restrictive than the standards imposed under the Building Act.

Traditionally, the management of risk from natural hazards in New Zealand has revolved around mitigation

works, or the physical protection of people, property and the environment from the effects of hazards. A typical response to flood risk, for example, is to attempt to prevent flood events from inflicting damage on the environment. The erection of stopbanks is a classic example. Whilst protection works are generally of immediate success, they only afford protection up to their design capacity. Yet this is frequently ignored by public authorities who at times permit development in areas 'protected' by structural works. The resulting damage when the design capacity of the works is exceeded is often catastrophic.

In the future the approach in the Auckland Region to natural hazard management will be one of emphasising avoidance, or prevention, as opposed to protection. This chapter recognises that hazard events are natural occurrences and that the risk is created by locating activities in inappropriate places. However, where there are existing areas at risk from natural hazards, reduction or mitigation of the risk must be undertaken.

Mitigation works can have significant environmental effects and should be considered as the least desirable option for hazard control, except where there is an unacceptable risk to people and their property, infrastructure, and the environment. In assessing any mitigation works, it is necessary to assess the benefits afforded versus any potential adverse effects on the environment.

Some structures, notably culverts and some bridges, occupy not only the 1% floodplain but parts of the stream channel proper. Depending on their design, they may obstruct flood flows, especially during larger events. The design of these structures needs to ensure that they do not exacerbate the flooding risk.

Piping of streams is generally done to prevent nuisance flooding and removes any flooding hazard up to the capacity of the pipe system. Overland flow paths are then needed for flows from yet larger events in excess of the pipe system capacity. The design of the overland flow paths needs to ensure that the flooding risk is not exacerbated for these events.

Mitigation works such as riparian planting generally improve freshwater habitat and stabilise stream channels. However, they may also modify the stream channel's hydraulic performance in high flows. In particular, riparian planting of bare or grassed stream banks will increase the channel's flow resistance. Planning of

such mitigation works needs to ensure that they do not exacerbate the flooding risk. This may affect the choice of plant species.

Coastal protection measures have the potential to worsen the adverse effects of coastal hazards, and adversely affect many aspects of the coastal environment. Softer solutions (planting, beach nourishment, etc.) often prove to be more effective in mitigating or remedying the adverse effects of hazards and better preserve the natural character, landscape and amenity values of the coastal environment. Coastal protection measures should be avoided unless they are the best practicable option. Refer also to the NZCPS and the Auckland Regional Plan – Coastal.

To implement controls that avoid, reduce, or mitigate the risk and/or effects of natural hazards, an assessment of these hazards must be undertaken. Hazards of a regional scale should be assessed by the regional council and information made available to all. Local hazards that require site specific investigation and that can be addressed through land use planning should be assessed by territorial authorities and information be available at a local or site-specific scale.

Generally, development of land, and the form in which it takes place, is allowed through the district plan and/or resource consents. The Building Act (2004) requires a building consent authority to refuse consent if land is subject to, or could worsen, a natural hazard unless adequate provision has been made to protect the property or restore any damage. In order to effectively control the impact of natural hazards on the environment, TAs must ensure that risks, and likely effects of locally important natural hazards are defined prior to development, and measures adopted to deal with these. A number of techniques have been developed for assessing and controlling these hazards including:

- Flood routing and flood plain delineation procedures. (Most consulting firms have standard or proprietary programmes for this.)
- Calculating runoff quantities and flow rates. (ARC has developed a methodology set out in Technical Publication 108: "Guidelines for Stormwater Runoff Modelling in the Auckland Region".)
- Coastal erosion sensitivity indexes and hazard mapping techniques. (DoC has established methodologies and national databases in this area.)

- Geotechnical instability assessments including seismic response. (Standard, internationally used engineering and geological tests are available.)
- Sea level rise estimates. (Intergovernmental Panel on Climate Change (IPCC) provides estimates of the rise in global mean sea level. The ARC provides information on the best available local estimates.)

Many of these techniques have been developed by central government organisations for national use, and these are recommended as initial starting points for analysis. Other methodologies are easily obtained through universities or consulting firms. (The ARC has in the past provided a lead in the preparation of flood management plans and intends to continue this approach for coastal, seismic and atmospheric hazards.)

It is important for TAs to prioritise assessments and controls towards natural hazards that pose the greatest risk and are best able to be addressed through planning and engineering techniques. TAs should utilise local Civil Defence and Emergency Management assessments to determine which hazards pose the greatest risk within their city or district. Information on risk assessment methodology can be found in the Hazard Guideline No. (ARC Technical Publication No. 106). For this reason, Policy 11.4.1 does not preclude, restrict or prevent any TA from requiring the protection of floors, not otherwise defined as a habitable floor, of new buildings within urban areas from any adverse effects of a 1% AEP flood hazard event.

Other hazards such as seismic events, volcanism, severe meteorological conditions, tsunami and sea level rise also pose threats to the Regional environment. The scale and locale of effects of these are comparatively difficult to determine and therefore should be considered on a regional scale. The ARC will provide guidance on assessment and avoidance or mitigation techniques to the Region on these hazards, develop a regional natural hazards database, and establish risk assessment models for this purpose.

TAs will also develop local databases for the purpose of maintaining property specific hazards information in an accessible format for both staff and the general public, including the production of Land Information Memorandums and Project Information Memorandums. It is not the intention of these methods to require TAs to undertake more information gathering on natural hazards than what currently occurs.

The issue of climate change and its predicted impacts, including sea level rise, intensification and increasing regularity of extreme weather events, has national as well as Regional significance. The ARC will actively encourage national research in this area.

Generally it is considered that planning and engineering controls can be exercised through district plans and resource consents to ensure:

- Restriction of development from zones which have active hazards (e.g., coastal cliff tops and cliff bases or stream banks). In many locations this can be done through establishing coastal and riparian setbacks, to allow retirement of land to natural vegetation.
- Development is not adversely affected by hazards (e.g., requiring engineering stability reports and designs).
- Development does not increase the risk and adverse effects of hazards (e.g., enforcing strict vegetation clearance controls, ensuring floor heights of buildings are above flood levels of concern, controlling development in areas which have potential problems such as land instability).
- Use of vegetative techniques wherever possible to reduce hazard risks and/or effects of hazards (maintaining appropriate vegetation in catchments, planting of coastal cliffs or sand dunes).

In dealing with natural hazards where little information is available, it is considered prudent to use a precautionary approach, e.g., the NZCPS policies. This is particularly important when dealing with the effects of global climate change and subsequent sea level rise trends. Further, in light of MfE documents discussing global climate issues, the most recent estimates from the Inter-governmental Panel on Climate Change, as well as national and regional estimates, will be used in determining the likely change in sea level.

Civil Defence Emergency Management plans and educational strategies are considered important components of dealing with the effects of natural hazards especially those that occur infrequently and in unpredictable or widespread locations. Both the regional and territorial authorities will co-operate in Civil Defence Emergency Management planning as stipulated in the CDEM Act (2002), across the 4Rs; Risk Reduction, Readiness, Response and Recovery.

11.5 Environmental Results Anticipated

- (a) The impacts of natural hazards on people, property, infrastructure, and the environment will be avoided or mitigated.
- (b) The costs to the community of dealing with the effects of natural hazards will be reduced.
- (c) improved public awareness of the potential risks posed by natural hazards.
- (d) The adverse effects of natural hazard mitigation measures on the environment will be avoided or mitigated.

11.6 Monitoring

- (i) Regular monitoring of compliance with conditions on Regional resource consents, including comprehensive diversion and discharge consents, will be undertaken to ensure that flooding problems caused by new development are avoided.
- (ii) The establishment of monitoring procedures will provide warning of volcanism and a record of the Region's seismicity, so as to facilitate contingency procedures and minimise adverse effects.
- (iii) Coastal hazard assessment procedures will assist in the identification of coastal hazard zones and act as a base line for the avoidance of development in hazard areas.