Appendix 4: An Example of the Preliminary Scenario Method for Extreme Rainfall[57]

This Appendix illustrates the application of the preliminary scenario method for extreme rainfall described in Table 5.2. The example is for a site near Timaru. A table showing current design rainfall rates for various durations and return periods was first prepared. Further tables were then developed for percentage increases to the design rainfall rates for low and high temperature change scenarios for 2030. The percentage increase tables were then applied to the first table, to provide low and high scenario tables for actual rainfall rates in 2030. These could be used in, for example, a preliminary examination of the resilience of existing stormwater drainage systems to plausible 2030 extreme rainfall rates.

This appendix does not address uncertainties in the base period design rainfall depth estimates. As mentioned in Section 5,2 it is good practice to consider such uncertainties as part of the assessment of the likely impacts of changes in heavy rainfall.

The following table shows design rainfall depth frequency estimates for Gleniti developed by Opus using data from the period 1977–98. Rainfall is given in millimetres.

Base data, Gleniti

ARI (years) → Duration ↓	2.33	5	10	20	50	100
5 minutes	4	6	12	14	15	23
10 minutes	5	7	13	18	23	25
30 minutes	9	12	16	31	41	60
1 hour	13	18	26	37	47	61
2 hours	18	27	35	43	54	62
6 hours	29	43	56	67	82	94
12 hours	39	55	72	89	112	129
24 hours	53	77	95	112	135	152

From Figure 2.2 of the Guidance Manual, projected annual mean temperature changes for Timaru from the 1990s to the 2030s are 0.2 (low), 0.6 (medium) and 1.3°C (high).

The percentage increases in extreme rainfall for the preliminary screening analyses are obtained by multiplying entries from Table 5.2 by these temperature changes, resulting in the following two tables.[58]

[57] Assistance is acknowledged from Mike Harkness of OPUS.

[58] The column headed 2.33 is obtained by interpolating between two- and five-year values from Table 5.2.

Percent increase in extreme rainfalls, 2030, Gleniti, low scenario

ARI (years) → Duration ↓	2.33	5	10	20	50	100
5 minutes	1.6	1.6	1.6	1.6	1.6	1.6
10 minutes	1.6	1.6	1.6	1.6	1.6	1.6
30 minutes	1.5	1.5	1.5	1.5	1.5	1.5
1 hour	1.4	1.4	1.4	1.5	1.5	1.5
2 hours	1.3	1.3	1.4	1.4	1.4	1.5
6 hours	1.3	1.3	1.3	1.4	1.4	1.4
12 hours	1.2	1.2	1.2	1.3	1.3	1.4
24 hours	1.1	1.1	1.2	1.2	1.3	1.3

Percent increase in extreme rainfalls, 2030, Gleniti, high scenario

ARI (years) → Duration ↓	2.33	5	10	20	50	100
5 minutes	10.4	10.4	10.4	10.4	10.4	10.4
10 minutes	10.4	10.4	10.4	10.4	10.4	10.4
30 minutes	9.7	9.7	9.8	9.9	9.9	10.0
1 hour	9.2	9.2	9.4	9.6	9.7	9.7
2 hours	8.7	8.7	9.0	9.2	9.4	9.5
6 hours	8.2	8.2	8.6	8.9	9.0	9.2
12 hours	7.5	7.6	8.1	8.4	8.6	8.8
24 hours	7.0	7.1	7.7	8.1	8.3	8.6

Actual low and high scenarios for 2030 depth frequency values can now be estimated, as given in the tables below, by adjusting values from the first table in this appendix by the values in the percentage change tables, as follows:

Extreme rainfall rate scenario for 2030, Gleniti, low temperature change scenario

ARI (years) → Duration ↓	2.33	5	10	20	50	100
5 minutes	4	6	12	14	15	23
10 minutes	5	7	13	18	23	25
30 minutes	9	12	16	31	42	61
1 hour	13	18	26	38	48	62
2 hour	18	27	35	44	55	63
6 hours	29	44	57	68	83	95
12 hours	39	56	73	90	114	131
24 hours	54	78	96	113	137	154

Extreme rainfall rate scenario for 2030, Gleniti, high temperature change scenario

ARI (years) → Duration ↓	2.33	5	10	20	50	100
5 minutes	4	7	13	15	17	25
10 minutes	6	8	14	20	25	28
30 minutes	10	13	18	34	45	66
1 hour	14	20	28	41	52	67
2 hours	20	29	38	47	59	68
6 hours	31	47	61	73	90	103
12 hours	42	59	78	97	122	141
24 hours	57	83	103	121	147	165

Appendix 5: Climate Change in Plans – Checklist for Contents

Statute	Name of plan	Duration of plan	Purpose	Checklist for contents
Local Government Act 2002	Long Term Council Community Plan	10 years, but reviewed every three years. Can be changed at the same time as an annual plan is prepared.	Describe community outcomes for the district or region. Provide a long-term focus for local authority decisions. Provide financial estimates to manage council/ community assets.	• Are the long term implications of climate change identified anywhere in relation to community outcomes? Is any statement clear and able to be measured or monitored? If not, is there a comment as to why not? • How is the time frame of climate change effects handled? Is there adequate explanation of the need to act within the framework of the current plan, although effects may only be apparent during future plans? • Are adaptive responses to potential climate changes identified in relation to specific assets or activities (water supply, wastewater, stormwater, roading, pest management, parks and reserves management etc)? Are these specific and targeted to the asset? • If a change in level of service, or additional capacity is planned due to climate change (i.e. beyond the level of service or capacity based on other considerations), is this explicit and explained? • Are other programmes or plans relating to climate change identified (e.g. biosecurity, biodiversity) and details and budgets specified? • Is a monitoring regime relating to the aspect involving a climate change response identified and mechanisms, costs and duration foreshadowed? • Are the levels of uncertainty involved in the forecasts of climate change explained, and an estimate of the uncertainty provided?
	Annual Plan	Annual	Support the Long Term Council Community Plan in integrated decision-making and co-ordination of the local authority resources; and provide an annual budget and funding impact statement for the local authority.	• Are budget requirements in relation to climate change responses identified in the Long Term Council Community Plan explicitly followed through – generally in relation to development/maintenance/ management of specific assets? – in terms of any investigation or research needs for the year? – in terms of ongoing monitoring?

Statute	Name of plan	Duration of plan	Purpose	Checklist for contents
	Annual Report	Annual	A report on the Annual Plan, measuring activities and expenditure against desired community outcomes and sustainable development	• Are any specific annual plan provisions relating to climate change reported appropriately, including asset management? • If the expected outcome has not been achieved, has this been explained?
Resource Management Act 1991	Regional Policy Statement	10 years, but can be reviewed or changed at any time.	Achieve the sustainable and integrated management of natural and physical resources, by providing an overview of a region's resource management issues, policies and methods	• Is climate change and its effects identified as a regional issue requiring a response? • Does the policy statement explain the national policy context? • Does the regional policy statement specify the time horizon for different types of decisions on climate change and its effects? • Does the regional policy statement give pointers for the formulation of regional and district plan contents relating to managing the effects of climate changes? • Are the respective roles and responsibilities of the regional and district councils in managing natural hazards in the region set out? • Does the regional policy statement promote consistency of approach towards climate change by local authorities within the region and across boundaries with neighbouring regions? • Does the regional policy statement promote public education as a method of response to climate change and its effects? • Does the regional policy statement promote avoidance or limitation of damage and costs from natural hazards, including those exacerbated by climate change, such as: – sea level rise – increased rainfall intensity – increased incidence of severity or drought – wind events? • Does the regional policy statement include any provisions for monitoring effects of climate change, and any relevant statements of environmental outcomes?

Statute	Name of plan	Duration of plan	Purpose	Checklist for contents
	Regional plans	10 years, but can be reviewed or changed at any time.	Achieve the integrated management of natural and physical resources; managing and controlling land for soil erosion and natural hazards; managing and controlling water resources and beds of rivers and lakes; and managing and controlling the coastal marine area	Depending on the plan ... • Is climate change and its implications identified as an issue? If it is not, is there a valid explanation as to why not? • Is the approach and policy for climate change consistent with the regional policy statement? • Are there one or more objectives relating to climate change, which are adequately explained and integrated with policy and rules? • If there are rules or methods which relate to or rely on climate change as a partial or complete justification for their existence (e.g. water allocation, flood design clearances, prohibiting building areas), is the provision clearly explained? • Are there any decision-making criteria related to taking the implications of climate change into account? Are these explained? • Are there any provisions for monitoring relevant to climate change effects, and any relevant statements of environmental outcomes as a result of the provision? • Is there a specific commitment that the council will keep up-to-date with changing understanding of climate change and its implications?
	District plans	10 years, but can be reviewed at any time.	Integrated management of the effects of use, development and protection of a district's natural and physical resources; and control of land in relation to natural hazards	• Is climate change identified as an issue in the district plan with adequate explanations? • How is the issue expressed in terms of objectives and policies? • Is the approach and policy for climate change consistent with the regional policy statement? • Have areas of enhanced risk (e.g. hazard zones, building lines) due to climate change been identified, with appropriate policy and rules? • Do the decision-making criteria relating to natural hazards refer to climate change and its implications?

Statute	Name of plan	Duration of plan	Purpose	Checklist for contents
Civil Defence Emergency Management Act 2002	Civil Defence Emergency Management Group Plan	5 years, but can be reviewed sooner.	Developing an integrated community-based response to the sustainable management of hazards	• Has the risk management analysis taken into account changes due to climate change? • Does the recognition of the effects of climate change reflect the current level of uncertainty in the region and adopt a cautious approach as a result? If not, is this explained? • Does the plan include a specific commitment to keep up-to-date with changing understanding of climate change and its implications, including any relevant local monitoring or liaison?
Plans under other legislation, and/or plans which have no specific statutory basis	For example, Reserve Management Plans, Asset Management Plans, Catchment Management Plans, Landcare and Biosecurity Management Plans	Usually no set times. Plans should state their review periods.	A range of purposes. Plans should explain their purpose through stated objectives and policies.	Depending on the plan ... • Are there any statements or provisions relating to climate change and managing the effects? • If there are, are these appropriately linked to aspects of the plan that have long-term consequences (e.g. a Reserve Management Plan may appropriately incorporate climate change considerations in relation to species choice for major planting programmes, or recognition of increased drought or flooding in design and subsequent maintenance costs of playing fields; Asset Management Plans may include expectations of changed levels of service needed in the future due to climate change; Landcare Plans may identify aspects such as reduced soil moisture in an area and promote a gradual shift in types of production/management as a response). • What monitoring regimes are incorporated?