MILFORD OPPORTUNITIES PROJECT

PRELIMINARY CLIMATE CHANGE RISK ASSESSMENT

17 APRIL 2024

FOR INTERNAL USE

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PRELIMINARY CLIMATE CHANGE RISK ASSESSMENT

Milford Opportunities Project

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EXECUTIVE SUMMARY

WSP has delivered a qualitative Climate Change Risk Assessment (CCRA) for Milford Opportunities Project (MOP). The assessment was tailored to suit the level of information available at this stage of the project (feasibility and business case phase). Consequently, the assessment of exposure and vulnerability to climate hazards is considered preliminary.

Climate scenario RCP 8.5 over two future timeframes: mid-century (2050) and late century (2100) and present day was represented through historical climate data. Climate projections and hazards for MOP have been taken Climate Change in Fiordland and Mt Aspiring National Parks - Localised Projections (DOC 2020)[1] and from Southland Climate Change Impact Assessment, NIWA Project: ENS18504, August 2018. Sea level rise was not included in the localised projections report; thus, NZ SeaRise Maps were considered.

In general terms, extreme weather events – high wind, storms and heavy rainfall – are common climate hazards to all locations assessed. Risk from the exposure to these climate hazards will increase over time reaching high and extreme levels in late century at some locations.

Risk of coastal flooding from sea level rise will increase over time in Milford Sound Piopiotahi, increasing the exposure and vulnerability of elements-at-risk. It is expected that this risk will reach high levels at the end of the century. Vertical Land Movement (VLM) was considered as recommended by best practice.

The number of frost nights is projected to decrease over time. As an indication of winter temperatures becoming milder, this has been used to infer a reduction in snow and ice accumulation in the study area, which may lead to a reduction in avalanche risk if less snowfall occurs, however, the effects of climate change on avalanche risk is complex and therefore a multi-hazard assessment is needed at a later stage to understand this risk in more detail, particularly at Nodes 6 and 7.

Multi-hazard assessment could also inform the effects of climate change on slope instability (rockfall/landslide//tree slide/debris flow) and its link with heavy rainfall events. This is of particular interest given the expected increase in extreme events towards the end of the century.

Recommendations:

It is recommended that a detailed CCRA is completed in subsequent Stages, including a more detailed vulnerability assessment to understand the sensitivity and adaptive capacity of assets. To refine risk prioritisation further, an assessment of consequence (i.e. impact significance or value) can also be completed.

Detailed risk assessments can be informed by deeper analysis of climate-related hazard data, including coastal inundation, flood modelling and slope instability. This will support design teams in identifying appropriate asset locations, structural requirements, ground floor levels and stormwater network capacity. Subsequent design phases should prioritise appropriate mitigation measures that will ensure any residual risk is acceptable.

Asset criticality should be considered in future assessments and design measures to improve adaptive capacity, either through embedded design decisions or adaptive design where the asset can be modified or upgraded at a planned point in time. With a view of what assets are critical,

[1]Climate Change in Fiordland and Mt Aspiring National Parks, Localised projections to support post-February 2020 SSI flood recovery efforts. Department of Conservation, 2020.

MOP can ensure that key assets are designed for 1% AEP (1 in 100-year storm) events or coastal inundation under a RCP 8.5 scenario, including vertical land movement. Assets with 50 to a 100-year design life should be prioritised, while other assets will be able to adapt over time.

1 PROJECT BACKGROUND

1.1 INTRODUCTION

Natural variations have always played a part in our climate and will continue to do so.

New Zealand is observing changes such as sea-level rise and higher temperatures. There are more frequent extreme weather events occurring such as the Auckland Anniversary floodings and Cyclone Gabrielle. In February 2020, Fiordland experienced an extreme event, where rainfall occurred over several days, with prolonged periods of heavy rain, causing flooding and slips. This event resulted in considerable damage to SH94 as well as to Department of Conservation (DOC) recreation and biodiversity infrastructure.

With more extreme weather, the changes in climate are impacting the Fiordland region today and are projected to become more extreme and frequent in the future. Understanding priority climate risks will support Milford Opportunities Project (MOP) in developing adaptive responses to build resilience into its future investment plans.

This report provides a summary of the preliminary assessment of climate change risk for the MOP. It includes a qualitative desktop review of climate hazards impacting the area and this work should be used to inform a more detailed assessment and potential adaptation and resilience strategies at future stages of the MOP.

1.2 SCOPE AND BOUNDARIES

The purpose of this work was to deliver a qualitative Climate Change Risk Assessment (CCRA) for MOP at this early stage of the Milford Opportunities Project. The assessment was tailored to suit the level of information available at this stage of the project (feasibility and business case development phase). Consequently, the assessment of climate hazards is considered preliminary. The scope of this CCRA was discussed and agreed with the MOP Project Manager.

This high-level desktop assessment considered physical climate risks to proposed assets and infrastructure (refer to Section 2.1.2 Elements at Risk) that are part of the MOP Masterplan, included in the following locations:

- Te Anau Hub
- Node 1 - Te Rua-O-Te Moko Fiordland National Park Entrance
- Node 2 – Eglinton Reveal
- Node 3 – Te Huakahue Knobs Flat
- Node 4 – Ōtāpara Cascade Creek
- Node 5 – The Divide Whakatipu Trails Head
- Node 6 – Gertrude Valley
- Node 7 – Cleddau Cirque
- Milford Sound Piopiotahi Hub

The assessment was informed by the current climate baseline and future projections of a number of climate variables/climate hazards, being:

- Precipitation - heavy rain days,
- Temperature - dry days, hot days and annual average frost nights.
- Sea level rise; and
- High winds and storm.

Slope instability risk (rockfall, debris flow, treefall, landslide) is a cascading effect resulting from the interactions of diverse factors therefore not assessed as part of this CCRA. Heavy rainfall events that could have a potential effect upon slope instability risk shall be considered as indicative for mid and late century only. For present day please refer to

The MOP is in an early project planning stage; therefore, this CCRA provides a proportionate approach. A high emission scenario: RCP 8.5 was used as a precautionary approach, recommended by MfE for preliminary CCRA's. As the project moves into more detailed business case phases, and more information becomes available, a more detailed CCRA can be completed, using additional scenarios such as, RCP 4.5.

1.3 EXCLUSIONS AND ASSUMPTIONS

The scope does not include assessing socio-economic projections, such as future changes in population, gross domestic product and other economic, land use or employment variables.

At this stage of the business case the project has limited information available on design details (and sometimes location), therefore, this assessment has assumed mitigation was not yet included in the design of proposed infrastructure.

Risks to domains within the National Climate Change Risk Assessment Framework were also excluded, i.e. the human, economy, natural environment, and governance domains.

This CCRA focused on the proposed infrastructure within each location. Existing infrastructure was excluded. Given the stage where the project is at, individual assets were not assessed (Assets were grouped in categories, as per agreed scope).

Cascading and compounding effects have also been excluded.

1.4 SITE DESCRIPTION

The Milford Road (State Highway 94) from Te Anau to Milford Sound Piopiotahi is a scenic journey in Te Rua-O-Te Moko Fiordland National Park, New Zealand. The highway travels through mountainous terrain with dense beech forest and steep glacial valleys with several tourist attractions along its length. As part of the MOP, seven key 'Nodes' and two 'Hubs' have been identified. These are accompanied by short stops, walking/biking tracks, accommodation locations, and viewpoints. These sites are defined as the CCRA study area.

Figure 1: Milford Corridor, Hubs and Nodes Plan.

Figure 1: MOP Masterplan Outline (Source: *A Masterplan for Milford Sound Piopiotahi and The Journey, 3 May 2021, Stantec, Boffa Miskell)*

2 CLIMATE CHANGE RISK ASSESSMENT

This section provides a summary of how the CCRA was undertaken, including how the elements-at-risk were identified and the way risks were assessed.

The RCP 8.5 climate scenario was used to assess risk over two future timeframes: mid-century (2050) and late century (2100). Present day was represented through historical climate data. A climate change risk register was produced for each Hub and Node. The risk register includes all the relevant assets (or 'elements-at-risk') for each area and associated climate hazards.

2.1 METHODOLOGY

The CCRA took an exposure and vulnerability approach, as outlined in Figure 2 below. This framework aligns with the guidance for Climate Change Risk Assessment frameworks.

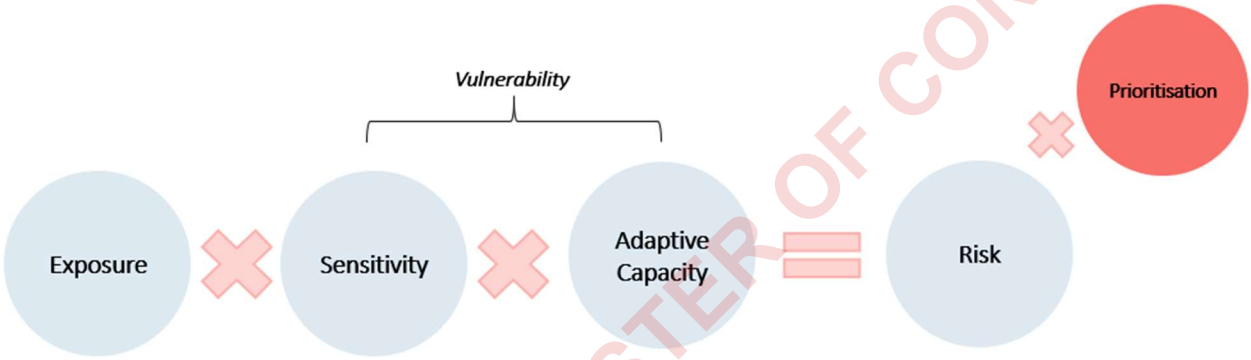

Figure 2: Exposure and Vulnerability assessment approach

2.1.1 RISK FRAMEWORK

An exposure - vulnerability risk framework was used to produce an overall risk rating for each element-at-risk, considering the following matrix. The exposure and vulnerability rating scales were taken from the Ministry for Environments Guide to Local Climate Change Risk Assessments.

Table 1 - Risk Framework

Risk		Vulnerability				
		1 - Extreme	2 - High	3 - Moderate	4 - Low	0 - N/A
Exposure	4 - Low	Moderate	Low	Low	Low	N/A
	3 - Moderate	High	Moderate	Moderate	Low	N/A
	2 - High	Extreme	High	Moderate	Moderate	N/A
	1 - Extreme	Extreme	Extreme	High	High	N/A
	0 - N/A	N/A	N/A	N/A	N/A	N/A

2.1.1.1 Exposure

Exposure refers to the presence of people, livelihoods, species or ecosystems, environmental functions, services, and resources, infrastructure, or economic, social, or cultural assets in places and settings that could be adversely affected by a climate hazard (IPCC, 2014). Exposure was informed by the climate projections considering the following exposure rating scale:

Table 2 - Exposure Ratings

EXPOSURE RATINGS	
Ref	**Definition**
1 - Extreme	>75% of sector or element in subdistrict is exposed to the hazard and/or several small communities are 100% exposed.
2 - High	50–75% of sector or element in subdistrict is exposed to the hazard and/or a small number of small communities are 100% exposed.
3 - Moderate	25–50% of sector or element in subdistrict is exposed to the hazard.
4 - Low	5–25% of sector or element in subdistrict is exposed to the hazard.

2.1.1.2 Vulnerability

Vulnerability refers to the propensity or predisposition to be adversely affected by a climate hazard. Vulnerability encompasses a variety of concepts, including sensitivity to harm, and lack of capacity to adapt (or adaptive capacity) (IPCC, 2014).

Due to limited asset and design information, vulnerability was informed by generic asset information and professional judgement. It is a qualitative and indicative assessment of sensitivity and adaptive capacity, and both components are uncertain at this stage, A four-point scale for each was used. A conservative approach has been used, particularly regarding adaptive capacity because we have assumed no risk mitigation at this stage. When a more

detailed CCRVA is undertaken at later stages of the MOP project, evidence that influences the adaptive capacity of an element at risk can be provided to inform a more detailed vulnerability assessment.

Table 3 - Vulnerability Ratings

Vulnerability			Adaptive capacity			Vulnerability score
			Low	Medium	High	
			L	M	H	Extreme
Sensitivity	Low	1	L1	M1	H1	High
	Moderate	2	L2	M2	H2	Moderate
	High	3	L3	M3	H3	Low
	Extreme	4	L4	M4	H4	

2.1.2 *ELEMENTS-AT-RISK*

The first step in assessing the risks from climate change was to identify 'what' could be at risk within MOP. These are known as 'elements-at-risk'. Based on the information on proposed infrastructure contained within Appendix 2 of the *MOP Stage 2 Infrastructure Assessment Report*, Stantec 2021. Elements-at-risk were classified in three main categories: Buildings, Transport Infrastructure and General Infrastructure (as shown in Table 1, below). This categorisation was discussed and agreed through conversations with MOP's Senior Project Manager for Infrastructure Engineering and project leads.

Table 4. Agreed elements-at-risk categorisation.

BUILDINGS	TRANSPORT INFRASTRUCTURE	GENERAL INFRASTRUCTURE
Accommodation (visitors, staff)	Transport interchange/Bus terminal	Flood protections
Visitor Centres	Bus layover area, hop on/off	Avalanche/Rockfall protections
Shelters	Carparks	Observation points, viewing platforms, Viewing areas. Treetop viewing structure.
Refuges	Foreshore infrastructure (terminals, ramps, jetties, kayaks, etc.) Marine interface & viewing deck.	Camping Grounds
Entrance	Tracks, trails & walks within the Node areas only.[2]	Water and electricity infrastructure
Public toilets	Cable car	
Hut & Facilities	Air/flying infrastructure	

[2] Tracks and cycle trails are considered transport infrastructure and have been assessed as part of each node.

2.1.3 CLIMATE HAZARDS

Climate hazards were initially discussed with MOP's Senior Project Manager for Infrastructure Engineering and Department of Conservations' (DOC) subject matter experts (SME's). The hazards included in the scope of this assessment are largely consistent with hazards assessed in the previously undertaken localised projections report "Climate Change in Fiordland and Mt Aspiring National Parks". Climate hazards included are shown in Table 5.:

Table 5. Climate hazards assessed in this CCRA

CLIMATE HAZARDS	RISK
Heavy rain days	Flood risk, slope instability (landslide, debris flow, rockfall, treefall)[3]
Higher Temperature - Dry days	Drought
Hot days - days when max temp. exceeds 25°C	Hot days, Wildfires
Frost nights - minimum temperature is below 0°C.	Avalanche – preliminary screening only
Sea level rise - long-term increase in the average level of the ocean	Coastal flooding
High winds and storms	Preliminary screening only

2.1.4 CLIMATE SCENARIOS

The main measure of climate change relates to greenhouse gas emissions in the atmosphere, which has been modelled by the Intergovernmental Panel on Climate Change (IPCC) to generate four Representative Concentration Pathways (RCPs). These are greenhouse gas concentration trajectories for different emissions scenarios to the end of the century.

RCP 8.5 was used for this CCRA. This represents a 'high emissions' scenario and is recommended by MfE for preliminary CCRA's. As the project moves into more detailed business case phases, a more robust risk assessment can be completed (i.e: using additional scenarios such as RCP 4.5).

2.1.5 TIMEFRAMES

Three timeframes were considered for this assessment: present day, mid-century (2040 – 2050) and late century (2090 – 2100), in line with MfE recommendations. The purpose of looking at these three timeframes was to identify and inform how exposure may change across different planning horizons.

- Present day (past 10–20 years). The impacts already occurring from climate change are a starting point for considering the urgency of the risks.

[3] Slope instability risk (rockfall, debris flow, treefall, landslide) is a cascading effect resulting from the interactions of diverse factors not assessed as part of this CCRA. Therefore, heavy rainfall events that could have a potential effect upon slope instability should be considered as indicative. This has been assessed for mid and late century. For present day refer to the Natural Hazard Assessment Report, Part A: Preliminary Screening Analysis.

- Mid-century: (2040-2050). This covers the next few cycles of council long-term plans, 30 years local government infrastructure strategies, asset management plans and longer terms granted for resource consent.
- Late-century (2090-2100): Typically used as the juncture for detailed climate change projections. With infrastructure often having a 50–100-year design life, it is important to understand long term risk.

2.1.6 CLIMATE PROJECTIONS

Climate projections and hazards for MOP have been taken from Climate Change in Fiordland and Mt Aspiring National Parks, DOC 2020[4], and from NIWA; Southland Climate Change Impact Assessment[5].

Sea level rise was not included in localised projections report, thus NZ SeaRise Maps were used to inform the CCRA (Takiwa - Map Page) for this CCRA.

The following table provides a summary of RCP 8.5 projections for these hazards over two future timeframes: mid-century (2050) and late century (2100) and present day; represented through historical climate data.

[4] Department of Conservation, 2020. Climate Change in Fiordland and Mt Aspiring National Parks, Localised projections to support post-February 2020 SSI flood recovery efforts.

[5] NIWA; Southland Climate Change Impact Assessment, NIWA Project: ENS18504, August 2018.

Table 6. Climate Hazards Projections for Milford and Fiordland[6]

Climate Hazard	Potential risks	Climate Projection Indicator	Present day	Mid-century RCP 8.5	Late-century RCP 8.5
Higher temperatures - Dry days & Hot days • Higher mean temperatures • Heatwaves (land) • Drought • Wildfires	• Increase in hot days increasing human discomfort. • Overheating of infrastructure assets resulting in failures e.g. overheating pumps • Increased irrigation requirements for landscaping • Deficit in soil moisture resulting in landscape degradation and soil erosion. • Slope destabilisation	• Annual mean temp • Number of heatwave days per annum • Annual mean minimum temperature • Number of dry days per annum	• Annual mean temperature 14-16 °C (18-20 in summer, 8-10 in winter) • Annual mean minimum temperature 8-10 °C. • Dry days 145 • 10-20 Heatwave days	• Increase by 1.0-1.5°C • Annual mean minimum temp increase 0.5-1.0 °C. • Heatwave days increase by 10-20 days. • Dry days decrease from 145 to 138. • Fire danger and drought risk decrease	• Annual mean temperatures projected to be around 2.0-2.5°C • Minimum temperature Increase 1.5-2.0 °C. • Heatwave days increase by 40-60 days. • Increase 20-50 hot days.
Low temperatures - Frost nights[7] Frost Nights is the number of days per year where the minimum daily temperature is below 0°C. Annual average frost night has been used to infer this assessment.	• Reduction of permanent ice-covered areas. • Less snow coverage or reduced lying snow days. • Changes in avalanche risk.	• Annual average number of frost nights • how many times the minimum temperature threshold 0°C (not by how much) is exceeded in a	• 40-100 Frost nights per year (using annual average as indicator).	• Annual average number of frost nights decrease by 10-20 days per year. • Fewer days of snow are likely.	• Annual average number of frost nights will decrease by between 20 to 50 days per year. • Fewer days of snow are likely.

[6] Consequences of the risks hasn't been assessed at this stage, but the effects are described here for context.

[7] The number of frost nights indicator does not take into account the altitude and is used to infer change to climate over time and not a site-specific conclusion of there being no frost, i.e. -0C temperatures may occur at higher altitude that aren't reflected in the climate indicator considered.

		year (annual average)			
Sea level rise Sea level rise refers to the long-term increase in the average level of the ocean.	• Coastal flooding, tidal shifts, storm surge • Sedimentation • Rising groundwater levels. • Saltwater inundation • Coastal erosion • Property loss / stranded assets	• Meters above sea level	• New Zealand wide average of 1.8mm/year relative sea level rise to 2015	• Projected Sea level rise of 0.23m.	• Projected Sea level rise of 0.79m.
Heavy Rain High intensity rainfall • Extreme rainfall events. • Pluvial (urban flash) flooding • Fluvial (river) flooding	• Property damage or loss • Washout and undermining of existing structures e.g. bridges and stop banks. • Slope instability (landslide, debris flow, rockfall, treefall) • Undermining of stormwater infrastructure. • Damage to transmission lines	• Annual number of heavy rain days.	• Annual rainfall increases from 1,000-2,000 mm to > 6,000 mm)[8]. • 30-50 heavy rain days per year (>50mm).	• Annual number of heavy rain days increase by 5-15 days. • 1 in 50 years rainfall: ➢ 1-hr duration event +11% ➢ 24-hr duration event +7% ➢ 5-day duration event +5% • Projected rainfall depth increase:12%	• Annual number of heavy rain days to increase by 5-15 days. • 1 in 50 years rainfall: • 1-hr duration event +35% • 24-hr duration event +22% • 5-day duration event +15% • Projected rainfall depth increase:35%
Extreme weather events • High winds • Storms • Convective weather events	• Damage to building and infrastructure elements e.g. roofs, bridges, walking/cycle tracks. • Damage to transmission lines resulting in power cuts.	• Annual number of extreme events	• Heavy rainfall event occurred in Feb 2020 is increasingly likely. • In a 24hr-period. Milford received 566 mm.	• The potential erosion and inundation of coastal areas caused by a significant storm event will be enhanced under future sea-level rise projections.	

[8] Site-specific rainfall intensity rates have been considered to reflect gradient across the corridor (drier at Te Anau Hub)

3 RISK ASSESSMENT

3.1 RESULTS

This section presents the findings of the preliminary Climate Change Risk Assessment (CCRA) for the MOP Masterplan.

In summary, extreme weather events – including high winds, storm and heavy rainfall – impact all locations, and the risk of occurrence is projected to increase over time, reaching high and extreme level by the end of the century in some locations, particularly in those where historically impacts have been recorded (i.e.: flooding at Node 4 - Cascade Creek). Sea level rise will increase over time, impacting assets and infrastructure in Milford Sound Hub. Exposure to these climate hazards will increase over time, reaching high and extreme levels.

For assessment details please refer to Appendix A, Risk Register.

3.1.1 TE ANAU HUB

Extreme weather (high winds and storms) and heavy rain events represent the highest risk at this location. While current risk levels for these hazards are moderate, it is expected that their frequency and intensity will increase over time, and the risk would become high by late century.

Although temperatures will be higher, the expected increase in rainfall will reduce the number of dry days, reducing the risk of drought and wildfires. It is important to recognise that due to variability of rainfall, occasional dry periods will occur, during which drought and wildfire risk may be higher.

The number of hot days (temperature >25°C) will increase towards the end of the century, changing the risk from low currently to moderate, increasing the cooling requirements in buildings (i.e.: HVAC Systems).

This location has predominantly wide and flat conditions, therefore, avalanche risk is not applicable at this location.

Given the location of Te Anau Hub (inland), sea level rise is not applicable.

Table 7. Risk Summary -Te Anau Hub

			SEA LEVEL RISE	RAIN		TEMPERATURE		Lower Temperature	Extreme Weather
LOCATION	Element at Risk		Coastal Inundation	Heavy Rain / Flooding	Heavy Rain / Slope Instability	Dry days/Drought	Hot days	Frost Nights - Avalanche	High winds / Storms
Te Anau HUB	BUILDINGS	Current Year	N/A	Moderate	N/A	Low	Low	Low	Moderate
	TRANSPORT INFRASTRUCTURE	Current Year	N/A	Moderate	N/A	Low	Low	Low	Moderate
	GENERAL INFRASTRUCTURE	Current Year	N/A	Moderate	N/A	Low	Low	Low	Moderate
	BUILDINGS	Mid-century	N/A	Moderate	N/A	Low	Moderate	Low	Moderate
	TRANSPORT INFRASTRUCTURE	Mid-century	N/A	Moderate	N/A	Low	Moderate	Low	Moderate
	GENERAL INFRASTRUCTURE	Mid-century	N/A	Moderate	N/A	Low	Moderate	Low	Moderate
	BUILDINGS	Late-century	N/A	High	N/A	Low	Moderate	Low	High
	TRANSPORT INFRASTRUCTURE	Late-century	N/A	High	N/A	Low	Moderate	Low	High
	GENERAL INFRASTRUCTURE	Late-century	N/A	High	N/A	Low	Moderate	Low	High

3.1.2 NODE 1 - TE RUA-O-TE MOKO FIORDLAND NATIONAL PARK ENTRANCE

Extreme weather (high winds and storms) and heavy rain events represent the highest risk at this location. While current risk levels for these hazards are moderate, it is expected that their frequency and intensity will increase towards the end of the century and the risk will be high.

Although temperatures will be higher, the expected increase in rainfall will reduce the number of dry days, reducing the risk of drought and wildfires. It is important to recognise that due to variability of rainfall, occasional dry periods will occur, during which drought and wildfire risk will be higher.

The number of hot days (temperature >25°C) will increase towards the end of the century, changing the risk from low currently to moderate.

This location has predominantly wide and flat conditions, therefore, avalanche risk is not applicable at this location.

Given the location of Node 1 – Te Rua-o-Te Moko Fiordland National Park Entrance (inland), sea level rise is not applicable.

Table 8 – Risk Summary - Te Rua-o-Te Moko Fiordland National Park Entrance

			SEA LEVEL RISE	RAIN		TEMPERATURE		Lower Temperature	Extreme Weather
LOCATION	Element at Risk		Coastal Inundation	Heavy Rain / Flooding	Heavy Rain / Slope Instability	Dry days/Drought	Hot days	Frost Nights - Avalanche	High winds / Storms
NODE 1 - Gateaway	BUILDINGS	Current Year	N/A	Moderate	N/A	Low	Low	Low	Moderate
	TRANSPORT INFRASTRUCTURE	Current Year	N/A	Moderate	N/A	Low	Low	Low	Moderate
	GENERAL INFRASTRUCTURE	Current Year	N/A	Moderate	N/A	Low	Low	Low	Moderate
	BUILDINGS	Mid-century	N/A	Moderate	N/A	Low	Moderate	Low	Moderate
	TRANSPORT INFRASTRUCTURE	Mid-century	N/A	Moderate	N/A	Low	Moderate	Low	Moderate
	GENERAL INFRASTRUCTURE	Mid-century	N/A	Moderate	N/A	Low	Moderate	Low	Moderate
	BUILDINGS	Late-century	N/A	High	N/A	Low	Moderate	Low	High
	TRANSPORT INFRASTRUCTURE	Late-century	N/A	High	N/A	Low	Moderate	Low	High
	GENERAL INFRASTRUCTURE	Late-century	N/A	High	N/A	Low	Moderate	Low	High

3.1.3 NODE 2 – EGLINTON REVEAL

Extreme weather (high winds and storms) and heavy rain events represent the highest risk at this location. While current risk levels for these hazards are moderate, it is expected that their frequency and intensity will increase towards the end of the century and the risk will be high.

Although temperatures will be higher, the expected increase in rainfall will reduce the number of dry days, reducing the risk of drought and wildfires. It is important to recognise that due to variability of rainfall, occasional dry periods will occur, during which drought and wildfire risk will be higher.

The number of hot days (temperature >25°C) will increase towards the end of the century changing the risk from low currently to moderate.

This location has predominantly wide and flat conditions, therefore, avalanche risk is not applicable at this location.

Given the location of Node 2 – Eglinton Reveal (inland), sea level rise is not applicable.

Table 9. Risk Summary - Node 2 – Eglinton Reveal

			SEA LEVEL RISE	RAIN		TEMPERATURE		Lower Temperature	Extreme Weather
LOCATION	Element at Risk		Coastal Inundation	Heavy Rain / Flooding	Heavy Rain / Slope Instability	Dry days/Drought	Hot days	Frost Nights - Avalanche	High winds / Storms
Node 2 - Eglinton	BUILDINGS	Current Year	N/A	Moderate	N/A	Low	Low	Low	Moderate
	TRANSPORT INFRASTRUCTURE	Current Year	N/A	Moderate	N/A	Low	Low	Low	Moderate
	GENERAL INFRASTRUCTURE	Current Year	N/A	Moderate	N/A	Low	Low	Low	Moderate
	BUILDINGS	Mid-century	N/A	Moderate	N/A	Low	Moderate	Low	Moderate
	TRANSPORT INFRASTRUCTURE	Mid-century	N/A	Moderate	N/A	Low	Moderate	Low	Moderate
	GENERAL INFRASTRUCTURE	Mid-century	N/A	Moderate	N/A	Low	Moderate	Low	Moderate
	BUILDINGS	Late-century	N/A	High	N/A	Low	Moderate	Low	High
	TRANSPORT INFRASTRUCTURE	Late-century	N/A	High	N/A	Low	Moderate	Low	High
	GENERAL INFRASTRUCTURE	Late-century	N/A	High	N/A	Low	Moderate	Low	High

3.1.4 NODE 3 – TE HUAKAUE KNOBS FLAT[9]

Te Huakaue Knobs Flat side of the node is already a heavily modified grassy clearing, well sheltered by beech forest. Extreme weather (high winds and storms) and heavy rainfall events are the hazards that represent the highest threat at this location particularly in relation to flooding a debris flow risk from Kiosk Creek and Waterfall Creek which are tributaries of the Eglinton River.

While current risk levels for extreme weather (high winds and storms) and heavy rainfall events are moderate, it is expected that frequency and intensity of these events increases over time, increasing the level of flooding risk to infrastructure and assets to high over time.

It is also important to note that extreme weather and heavy rainfall events may also contribute to destabilising slopes and given the existing conditions at this location, an increase in the frequency and intensity of climate events over time could potentially see an increase in debris flow.

Risk from higher temperatures is expected to be lower than those of extreme weather and rainfall. Although temperature will be higher, the expected increase in rainfall will reduce the number of dry days, reducing the risk of drought and wildfires. It is important to recognise however, that, given the natural variability of rainfall, occasional dry periods will occur, over which drought and wildfire risk will be higher.

The number of hot days (temperature >25°C) will increase towards the end of the century, changing the risk from low currently to moderate, increasing the cooling requirements in buildings (i.e.: HVAC Systems).

[9] This assessment takes Mirror Lakes (short stop) into consideration.

This location has predominantly wide and flat conditions, therefore, avalanche risk is not applicable at this location.

Given the location of Node 3 – Te Huakaue Knobs Flat (inland), sea level rise is not applicable.

Table 10. Risk Summary - Node 3 – Te Huakaue Knobs Flat

			SEA LEVEL RISE	RAIN		TEMPERATURE		Lower Temperature	Extreme Weather
LOCATION	Element at Risk		Coastal Inundation	Heavy Rain / Flooding	Heavy Rain / Slope Instability	Dry days/Drought	Hot days	Frost Nights - Avalanche	High winds / Storms
Node 3 - Knobs Flats	BUILDINGS	Current Year	N/A	Moderate	N/A	0	Low	#N/A	#N/A
	TRANSPORT INFRASTRUCTURE	Current Year	N/A	Moderate	N/A	0	Low	0	0
	GENERAL INFRASTRUCTURE	Current Year	N/A	Moderate	N/A	0	Low	0	0
	BUILDINGS	Mid-century	N/A	Moderate	Moderate	Moderate	Low	#N/A	#N/A
	TRANSPORT INFRASTRUCTURE	Mid-century	N/A	Moderate	Moderate	Moderate	Low	0	0
	GENERAL INFRASTRUCTURE	Mid-century	N/A	Moderate	Moderate	Moderate	Low	0	0
	BUILDINGS	Late-century	N/A	High	High	High	Low	0	0
	TRANSPORT INFRASTRUCTURE	Late-century	N/A	High	High	High	Low	0	0
	GENERAL INFRASTRUCTURE	Late-century	N/A	High	High	High	Low	#N/A	#N/A

3.1.5 NODE 4 – ŌTĀPARA CASCADE CREEK

Extreme weather (high winds and storms) and heavy rainfall events represent the biggest threats at this location. Given the proximity to the confluence of Cascade Creek and the upper Eglinton River and low-lying areas, current flood risk levels are considered to be moderate. It is anticipated, however, that flood risk reaches extreme levels by the end of the century, as the frequency and intensity of extreme events increases over time.

It is also important to note that extreme weather (high winds and storms) and heavy rainfall events may also contribute to destabilize slopes and given that landslide hazards and debris flow hazards are also known to occur in the area, an increase in the frequency and intensity of these climate events over time could potentially see an increase in these risks.

Risk from higher temperatures is expected to be lower than those of extreme weather and rainfall. Although temperature will be higher, the expected increase in rainfall will reduce the number of dry days, reducing the risk of drought and wildfires. It is important to recognise however, that, given the natural variability of rainfall, occasional dry periods will occur, over which drought and wildfire risk will be higher.

The number of hot days (temperature >25°C) will increase towards the end of the century, changing the risk from low currently to moderate, increasing the cooling requirements in buildings (i.e.: HVAC Systems).

This location has predominantly wide and flat conditions, therefore, avalanche risk is not applicable at this location.

Given the location of Node 4 – Ōtāpara Cascade Creek / Mistake Creek (inland), sea level rise is not applicable.

Table 11. Risk Summary - Node 4 – Ōtāpara Cascade Creek

			SEA LEVEL RISE	RAIN		TEMPERATURE		Lower Temperature	Extreme Weather
LOCATION	Element at Risk		Coastal Inundation	Heavy Rain / Flooding	Heavy Rain / Slope Instability	Dry days/Drought	Hot days	Frost Nights - Avalanche	High winds / Storms
Node 4 - Cascade Creek	BUILDINGS	Current Year	N/A	Moderate	N/A	Low	Low	Low	Moderate
	TRANSPORT INFRASTRUCTURE	Current Year	N/A	Moderate	N/A	Low	Low	Low	Moderate
	GENERAL INFRASTRUCTURE	Current Year	N/A	Moderate	N/A	Low	Low	Low	Moderate
	BUILDINGS	Mid-century	N/A	High	High	Low	Moderate	Low	High
	TRANSPORT INFRASTRUCTURE	Mid-century	N/A	High	High	Low	Moderate	Low	High
	GENERAL INFRASTRUCTURE	Mid-century	N/A	High	High	Low	Moderate	Low	High
	BUILDINGS	Late-century	N/A	Extreme	Extreme	Low	Moderate	Low	Extreme
	TRANSPORT INFRASTRUCTURE	Late-century	N/A	Extreme	Extreme	Low	Moderate	Low	Extreme
	GENERAL INFRASTRUCTURE	Late-century	N/A	Extreme	Extreme	Low	Moderate	Low	Extreme

3.1.6 NODE 5 – THE DIVIDE / WHAKATIPU TRAILS HEAD

Extreme weather (high winds and storms) and heavy rainfall events represent the biggest threats at this node, considering both The Divide and the Whakatipu Trail Head locations. Current flood risk levels for this hazard is considered to be moderate.

Given that the frequency and intensity of extreme events are expected to increase towards the end of the century; the expected level of flooding risk to elements-at-risk will increase too, to extreme levels over time. This is particularly relevant for the Whakatipu Trails Head located by the Hollyford River, which is more exposed.

Complementarily, it is important to note that extreme weather and heavy rainfall events may also contribute to destabilize slopes and given that landslide hazards, rockfall and debris flow hazards are known to occur in the area (there is also evidence of active debris flows in the gully located to the west of the site), an increase in the frequency and intensity of these climate events over time could potentially see an increase in these risks.

Risk from higher temperatures is expected to be lower than those of extreme weather and rainfall. Although temperature will be higher, the expected increase in rainfall will reduce the number of dry days, reducing the risk of drought and wildfires. It is important to recognise however, that, given the natural variability of rainfall, occasional dry periods will occur, over which drought and wildfire risk will be higher.

The number of hot days (temperature >25°C) will increase towards the end of the century, changing the risk from low currently to moderate.

Existing conditions around this location suggest that avalanche risk is low for the whole period assessed., however there are avalanche paths traversed by the Hinepipiwai Lk Marian Track.

Given the location of Node 5 – The Divide / Whakatipu Trails Head (inland), sea level rise is not applicable.

Table 12. Risk Summary - Node 5 – The Divide/ Whakatipu Trails Head

			SEA LEVEL RISE	RAIN		TEMPERATURE		Lower Temperature	Extreme Weather
LOCATION	Element at Risk		Coastal Inundation	Heavy Rain / Flooding	Heavy Rain / Slope Instability	Dry days/Drought	Hot days	Frost Nights - Avalanche	High winds / Storms
Node 5 - The Divide	BUILDINGS	Current Year	N/A	Moderate	N/A	Low	Low	Low	Moderate
	TRANSPORT INFRASTRUCTURE	Current Year	N/A	Moderate	N/A	Low	Low	Low	Moderate
	GENERAL INFRASTRUCTURE	Current Year	N/A	Moderate	N/A	Low	Low	Low	Moderate
	BUILDINGS	Mid-century	N/A	High	High	Low	Moderate	Low	High
	TRANSPORT INFRASTRUCTURE	Mid-century	N/A	High	High	Low	Moderate	Low	High
	GENERAL INFRASTRUCTURE	Mid-century	N/A	High	High	Low	Moderate	Low	High
	BUILDINGS	Late-century	N/A	Extreme	Extreme	Low	Moderate	Low	Extreme
	TRANSPORT INFRASTRUCTURE	Late-century	N/A	Extreme	Extreme	Low	Moderate	Low	Extreme
	GENERAL INFRASTRUCTURE	Late-century	N/A	Extreme	Extreme	Low	Moderate	Low	Extreme

3.1.7 NODE 6 – GERTRUDE VALLEY

Node 6 –Gertrude Valley is one of the two nodes that are exposed to avalanche risk within the Milford corridor. Currently Node 6 –Gertrude Valley has a high exposure and a moderate risk to avalanche. It is important to note that this risk is currently managed at this node as part of the Milford Road Alliance Avalanche Programme.

The effects of climate change on avalanche risk are complex and conditioned by a number of factors such as temperature fluctuation and precipitation, among others. For the purpose of this preliminary CCRA, when considering the average number of frost nights per year as an indicator of avalanche risk, and the projected reduction towards the end of the century, it is possible to infer a reduction in the amount of ice and snow accumulated in the study area, which may lead to a reduction in avalanche risk over time.

In consideration of the multiple factors contributing to avalanche risk a more detailed CCRA should inform the technical hazards study at future project stages.

Extreme weather (high winds and storms) and heavy rain currently have moderate risks at this location but given that the frequency and intensity of these events are expected to increase towards the end of the century; the level of risk to elements-at-risk is expected to increase as well to extreme levels.

It is important to note that extreme weather and heavy rainfall events may also contribute to increase the risk of slope instability and given that landslide hazards, rockfall and debris flow hazards are known to occur in the area, an increase in the frequency and intensity of these climate events over time could potentially see an increase in these risks.

Risk from higher temperatures is expected to be lower than those of extreme weather and rainfall. Although temperature will be higher, the expected increase in rainfall will reduce the number of dry days, reducing the risk of drought and wildfires. It is important to recognise however, that, given the natural variability of rainfall, occasional dry periods will occur, over which drought and wildfire risk will be higher.

The number of hot days (temperature >25°C) will increase towards the end of the century, changing the risk from low currently to moderate.

Given the location of Node 6 – Gertrude Valley (inland), sea level rise is not applicable.

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Table 13. Risk Summary - Node 6 – Gertrude Valley

			SEA LEVEL RISE	RAIN		TEMPERATURE		Lower Temperature	Extreme Weather
LOCATION	Element at Risk		Coastal Inundation	Heavy Rain / Flooding	Heavy Rain / Slope Instability	Dry days/Drought	Hot days	Frost Nights - Avalanche	High winds / Storms
Node 6 - Gertrude Valley	BUILDINGS	Current Year	N/A	Moderate	N/A	Low	Low	Moderate	Moderate
	TRANSPORT INFRASTRUCTURE	Current Year	N/A	Moderate	N/A	Low	Low	Moderate	Moderate
	GENERAL INFRASTRUCTURE	Current Year	N/A	Moderate	N/A	Low	Low	Moderate	Moderate
	BUILDINGS	Mid-century	N/A	High	High	Low	Moderate	Moderate	High
	TRANSPORT INFRASTRUCTURE	Mid-century	N/A	High	High	Low	Moderate	Moderate	High
	GENERAL INFRASTRUCTURE	Mid-century	N/A	High	High	Low	Moderate	Moderate	High
	BUILDINGS	Late-century	N/A	Extreme	Extreme	Low	Moderate	Low	Extreme
	TRANSPORT INFRASTRUCTURE	Late-century	N/A	Extreme	Extreme	Low	Moderate	Low	Extreme
	GENERAL INFRASTRUCTURE	Late-century	N/A	Extreme	Extreme	Low	Moderate	Low	Extreme

3.1.8 NODE 7 – CLEDDAU CIRQUE[10]

Node 7 – Cleddau Cirque is one of the two nodes that are exposed to avalanche risk within the Milford corridor. Currently Cleddau Cirque has a high exposure and a moderate risk to avalanche. It is important to note that this risk is currently managed at this node as part of the Milford Road Alliance Avalanche Programme.

The effects of climate change on avalanche risk are complex and conditioned by a number of factors such as temperature fluctuation and precipitation, among others. For the purpose of this preliminary CCRA, when considering the number of frost nights per year as an indicator of avalanche risk, and

[10] This assessment takes The Chasm (short stop) into consideration.

the projected reduction towards the end of the century, it is possible to infer a reduction in the amount of ice and snow accumulated in the study area, which may lead to a reduction in avalanche risk over time.

In consideration of the multiple factors contributing to avalanche risk a more detailed CCRA should inform the technical hazards study at future project stages.

Extreme weather (high winds and storms) and heavy rain currently have moderate risks at this location but given that the frequency and intensity of these events are expected to increase towards the end of the century; the level of risk to elements-at-risk is expected to increase as well to extreme levels, as exposure and vulnerability to climate hazards increase over time.

It is important to note that extreme weather and heavy rainfall events may also contribute to increase the risk of slope instability and given that landslide hazards, rockfall and debris flow hazards are known to occur in the area, an increase in the frequency and intensity of these climate events over time could potentially see an increase in these risks.

Risk from higher temperatures is expected to be lower than those of extreme weather and rainfall. Although temperature will be higher, the expected increase in rainfall will reduce the number of dry days, reducing the risk of drought and wildfires. It is important to recognise however, that, given the natural variability of rainfall, occasional dry periods will occur, over which drought and wildfire risk will be higher.

The number of hot days (temperature >25°C) will increase towards the end of the century, changing the risk from low currently to moderate, increasing the cooling requirements in buildings (i.e.: HVAC Systems).

Given the location of Node 7 - Cleddau Cirque (inland), sea level rise is not applicable.

Table 14. Risk Summary - Node 7 – Cleddau Cirque

			SEA LEVEL RISE	RAIN		TEMPERATURE		Lower Temperature	Extreme Weather
LOCATION	Element at Risk		Coastal Inundation	Heavy Rain / Flooding	Heavy Rain / Slope Instability	Dry days/Drought	Hot days	Frost Nights - Avalanche	High winds / Storms
Node 7 Cleddau Cirque	BUILDINGS	Current Year	N/A	Moderate	N/A	Low	Low	Moderate	Moderate
	TRANSPORT INFRASTRUCTURE	Current Year	N/A	Moderate	N/A	Low	Low	Moderate	Moderate
	GENERAL INFRASTRUCTURE	Current Year	N/A	Moderate	N/A	Low	Low	Moderate	Moderate
	BUILDINGS	Mid-century	N/A	High	High	Low	Moderate	Moderate	High
	TRANSPORT INFRASTRUCTURE	Mid-century	N/A	High	High	Low	Moderate	Moderate	High
	GENERAL INFRASTRUCTURE	Mid-century	N/A	High	High	Low	Moderate	Moderate	High
	BUILDINGS	Late-century	N/A	Extreme	Extreme	Low	Moderate	Low	Extreme
	TRANSPORT INFRASTRUCTURE	Late-century	N/A	Extreme	Extreme	Low	Moderate	Low	Extreme
	GENERAL INFRASTRUCTURE	Late-century	N/A	Extreme	Extreme	Low	Moderate	Low	Extreme

3.1.9 MILFORD SOUND PIPIOTAHI HUB

The Milford Sound Piopiotahi Hub is the only location within the Milford Corridor to be exposed to Sea Level Rise. Given historical records of flooding at high spring tides at the Cleddau delta and current existing conditions, risk is considered to be moderate. Sea rise projections (including vertical land movement) towards the end of the century will raise risk up to extreme levels.

Extreme weather (high winds and storms) currently has moderate risk at this location; however, this is expected to reach extreme levels by late century. Similarly, flooding risk levels from extreme precipitation events are considered to be moderate, however future projections suggest that elements-at-risk will be more exposed to flooding from the Cleddau River over time, reaching extreme levels towards the end of the century.

It is important to note that extreme weather and heavy rainfall events may also contribute to increase the risk of slopes instability and given the evidence of rockfall and landslides at Freshwater and Deepwater basins, an increase in the frequency and intensity of climate events could potentially increase the risk of slope instability too.

Risk from higher temperatures is expected to be lower than those of extreme weather and rainfall. Although temperature will be higher (hot days), the expected increase in rainfall will reduce the number of dry days, reducing the risk of drought and wildfires. It is important to recognise however, that, given the natural variability of rainfall, occasional dry periods will occur, over which drought and wildfire risk will be higher.

The number of hot days (temperature >25°C) will increase towards the end of the century, changing the risk from low currently to moderate, increasing the cooling requirements in buildings (i.e.: HVAC Systems).

Given the existing conditions around this location, avalanche risk is not applicable.

Table 15. Risk Summary – Milford Sound Piopiotahi Hub

			SEA LEVEL RISE	RAIN		TEMPERATURE		Lower Temperature	Extreme Weather
LOCATION	Element at Risk		Coastal Inundation	Heavy Rain / Flooding	Heavy Rain / Slope Instability	Dry days/Drought	Hot days	Frost Nights - Avalanche	High winds / Storms
Milford Sound Piopiotahi HUB	BUILDINGS	Current Year	Moderate	Moderate	N/A	Low	Low	Low	Moderate
	TRANSPORT INFRASTRUCTURE	Current Year	Moderate	Moderate	N/A	Low	Low	Low	Moderate
	GENERAL INFRASTRUCTURE	Current Year	Moderate	Moderate	N/A	Low	Low	Low	Moderate
	BUILDINGS	Mid-century	High	High	High	Low	Moderate	Low	High
	TRANSPORT INFRASTRUCTURE	Mid-century	High	High	High	Low	Moderate	Low	High
	GENERAL INFRASTRUCTURE	Mid-century	High	High	High	Low	Moderate	Low	High
	BUILDINGS	Late-century	Extreme	Extreme	Extreme	Low	Moderate	Low	Extreme
	TRANSPORT INFRASTRUCTURE	Late-century	Extreme	Extreme	Extreme	Low	Moderate	Low	Extreme
	GENERAL INFRASTRUCTURE	Late-century	Extreme	Extreme	Extreme	Low	Moderate	Low	Extreme

4 SUMMARY AND NEXT STEPS

The MOP Masterplan site is already exposed to different climate hazards, and these will change overtime. Climate projections suggest a higher frequency and intensity of extreme events, increasing the risk to some elements-at-risk in certain locations. In general terms, extreme weather events – high wind, storms and heavy rainfall – are common climate hazards to all locations assessed. Risk from the exposure to these climate hazards will increase over time reaching high and extreme levels for some risks, in some locations, increasing the risk of natural hazards as a result of climate change. This is consistent with national projections.

Node 6 – Gertrude Valley and Node 7 – Cleddau Cirque, are the only locations where avalanche hazard has been identified, however, the number of frost nights per year are expected to decrease over time. It is, therefore, possible to infer a reduction in the amount of ice and snow accumulated in the study area, which may lead to a reduction in avalanche risk in the mid and end of the century.

Extreme weather and heavy rainfall events may contribute to slope instability (rockfall, debris flow, landslide). Therefore, an increase in the frequency and intensity of climate events overt time could potentially increase the risk of slope instability. The consequence of debris flow from destabilised slopes has not been considered at this stage and should be included in future, more detailed climate and hazard assessments to inform design.

Milford Sound Piopiotahi Hub is the only location exposed to sea level rise. Current coastal flooding risk level is considered to be moderate, however, this will increase over time as sea level rises. Risk will be extreme by the end of the century.

Although temperature will increase over time, drought and wildfire risk is considered to be low across all locations mainly because of the increase in precipitation along the corridor. Increase in number of hot days (temperature >25°C) may increase the cooling requirements in buildings (HVAC Systems). Risk related to higher temperatures range from low to moderate towards the end of the century.

Next Steps

This CCRA assessed climate risks to the MOP hubs, nodes and short stops described in the MOP Masterplan. Based on the preliminary assessment of the elements-at-risk proposed within the Masterplan, it is recommended that high and extreme risks are prioritised for further, more detailed analysis and mitigation in design be assessed and developed in subsequent project stages.

A multi-hazard assessment approach, with additional climate-related data is recommended to understand risks associated with avalanche or other slope stability matters which are complex hazards with a number of variables influencing them. Avalanche risk has not been comprehensively assessed here and this CCRA presented cold temperatures as an indicator of change in that climate variable which will influence snow and ice accumulation.

The assessment was scoped to suit the level of information available at this stage of the project (feasibility and business case phase). Consequently, the assessment of exposure and vulnerability to climate hazards is considered preliminary. It is recommended that a detailed CCRA is completed in subsequent Stages, for those elements at risk that are shown to have a high or extreme risk, including a more detailed vulnerability assessment to understand the sensitivity and adaptive capacity of proposed infrastructure and assets. To refine risk prioritisation further, an assessment of consequence (i.e. impact significance or value) may be completed. Future assessments may also explore additional climate scenarios such as RCP 4.5.

The climate projections presented in this CCRA should inform a deeper analysis of hazards, including coastal inundation and flood modelling by the relevant technical teams as part of the MOP design. This will support design development in identifying appropriate asset locations, structural requirements, ground floor levels and stormwater network capacity. Subsequent design phases should prioritise appropriate mitigation measures that will ensure any residual risk is acceptable.

Asset criticality should be considered in future assessments and design measures to improve adaptive capacity, either through embedded design decisions or adaptive design, for example where the asset can be modified or upgraded at a planned point in time.

With a view of what assets are critical, MOP can ensure that key assets are designed for 1% AEP (1 in 100-year storm) events or coastal inundation under a RCP 8.5 scenario. Assets with 50 to a 100-year design life should be prioritised, while other assets will be able to adapt over time.

5 LIMITATIONS

This Physical Climate Risk Assessment ('Risk Assessment') has been prepared by WSP New Zealand Limited ('WSP') exclusively for the Milford Opportunities Project ('Client') in relation to preparing Climate Change Risk Assessment ('CCRA') for the Milford Opportunities Project Masterplan ('Purpose') and in accordance with the Sustainability Scope Reverse Brief, dated 09/01/2024. WSP accepts no liability whatsoever for any reliance on or use of this Risk Assessment, in whole or in part, for any use or purpose other than the Purpose or any use or reliance on the Risk Assessment by any third party. Unless WSP agrees otherwise in writing, any use or any reliance on this Risk Assessment by a third party is at its sole risk without recourse to WSP. Third parties must make their own enquiries and obtain independent advice in relation to any matter dealt with or any conclusion expressed in this Risk Assessment.

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APPENDIX A

RISK REGISTER

Attached

APPENDIX B

DEFINITIONS[11]

For the purposes of this report, the following definitions have been considered:

CONCEPT	DEFINITION
Physical risks	Are those resulting from climate change hazards. These can be acute, such as increasingly extreme weather (e.g., cyclones, droughts, floods). They can also arise from longer-term (chronic) shifts in precipitation, temperature, sea-level rise, and more variable weather patterns.
Elements-at-risk	Refers to the people or systems affected by a physical risk – e.g., assets, ecosystems, cultural taonga, infrastructure.
Climate-related Hazard	Are defined as natural or human induced climate-related events, such as flood, wildfire, extreme heat, that can occur at the site. The changes in intensity and probability over time of these events are influenced by climate change.
Opportunities	Refers to the positive outcomes that may arise from a changing climate. consequences are dependent on the vulnerability of exposed assets or individuals. This report is primarily concerned with the risk posed to visitors at each proposed site that has been defined in the Milford Opportunities Project Master Plan.
Exposure	Exposure refers to the presence of people, livelihoods, species or ecosystems, environmental functions, services, and resources, infrastructure, or economic, social, or cultural assets in places and settings that could be adversely affected by a climate hazard (IPCC, 2014).
Vulnerability	Vulnerability refers to the propensity or predisposition to be adversely affected by a climate hazard. Vulnerability encompasses a variety of concepts, including sensitivity to harm, and lack of capacity to adapt (or adaptive capacity) (IPCC, 2014).
Adaptive capacity	Refers to the ability of the site to adjust to climate hazard-related events, to moderate potential damages, to take advantage of opportunities, or to cope with the consequences.

[11] *Ministry for the Environment. 2021. He kupu ārahi mō te aromatawai tūraru huringa āhuarangi ā-rohe / A guide to local climate change risk assessments. Wellington: Ministry for the Environment (where not stated).*

BIBLIOGRAPHY

- Ministry for the Environment 2018. Climate Change Projections for New Zealand: Atmosphere Projections Based on Simulations from the IPCC Fifth Assessment, 2nd Edition. Wellington: Ministry for the Environment.
- NIWA. Southland climate change impact assessment report - August 2018.
- Risk Exposure Assessment of DoC coastal locations to flooding from the sea
- Ministry for the Environment. 2021. He kupu ārahi mō te aromatawai tūraru huringa āhuarangi ā-rohe / A guide to local climate change risk assessments. Wellington: Ministry for the Environment
- Department of Conservation 2020. Climate change in Fiordland and Mt Aspiring National Parks, Localised projections to support post-Februry 2020 SSI flood recovery efforts.
- Ministry for the Environment. 2022. Interim guidance on the use of new sea-level rise projections. Wellington: Ministry for the Environment.
- Southland Region Climate Change Projections. Localised climate change projections to support impact assessment and enable informed decision making.
- NIWA. Coastal Flooding Exposure Under Future Sea-level Rise for New Zealand. Prepared for The Deep South Challenge
- Ministry for the Environment 2017. Coastal Hazards and Climate Change. Guidance for Local Government
- Ministry for the Environment. 2020. National Climate Change Risk Assessment for Aotearoa New Zealand: Main report – Arotakenga Tūraru mō te Huringa Āhuarangi o Āotearoa: Pūrongo whakatōpū. Wellington: Ministry for the Environment.