CLIMATE RISK ASSESSMENT

THE UNIVERSITY OF QUEENSLAND
AUSTRALIA

DESIGN STANDARDS

DS-17

Document Register

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Disclaimer

Refer to the Disclaimer within the UQ Design Standards.

Reference Documents

Refer to the UQ Design standards for the list of documents and associated standards to be referenced for design work.

The designer is to coordinate between disciplines and standards.

02 Climate Risk Assessment

This section details the framework for ensuring all of university buildings and grounds are designed to be resilient to the effects of climate change.

2.1 What is a climate risk assessment?

A climate risk assessment is an assessment of the physical risks capable of directly impacting the University of Queensland's (UQ) assets and its operations. These risks may result from acute shocks, such as extreme weather events, or chronic stresses caused by changing climate and weather patterns.

These risks may have financial implications for UQ, such as direct damage to assets and indirect impacts from supply chain disruption. Operational and reputational risks related to business continuity and inability to provide critical services to the larger community are also aspects of this work.

2.2 Context

UQ's Sustainability Strategy outlines clear commitments and targets for the University. All new buildings and refurbishments are to be delivered to meet the latest version of UQ's Sustainability Strategy – the project team must read this document in conjunction with the Design Standards.

UQ is committed to ensuring all university grounds and buildings are planned and designed in such a way that makes them resilient to the effects of climate change. A consistent approach to undertaking climate change risk assessments supports this commitment, through establishing a process to identify potential risks and incorporate appropriate design and planning measures to mitigate these.

The project team must communicate with the Sustainability team from UQ's Property and Facilities Division to understand the latest sustainability commitments and resources, including any identified climate-related risks from other projects. The project team will be responsible for ensuring that their design responds to the relevant climate-related risks for their project.

2.3 Overview

This standard outlines the process that should be followed when undertaking a climate change risk assessment. The methodology has been designed to conform with:

- AS5334-2013 Climate change adaptation for settlements and infrastructure – a risk-based approach
- AS/NZS ISO31000-2009 Risk management – principles and guidelines,
- The climate adaptation requirements of the Green Star Buildings – Design & As Built 1.3 Adaptation and Resilience Credit 3, and Green Star Buildings Future Focus.

Overall, the process for the climate change risk assessment includes the following stages:

1. Context
    a. Identify climate hazards and variables
    b. Establish climate change scenarios
    c. Define time horizons

d. Gather climate projections data
e. Complete project screening
2. Risk identification
    a. Identify impact descriptions (direct or indirect)
    b. Classify impact descriptions (project component)
3. Risk analysis
    a. Identify existing controls
    b. Assess impacts for likelihood and consequence
    c. Determine risk ratings
4. Risk treatment
    a. Develop adaptation measures

Ongoing consultation, monitoring and evaluation shall occur throughout. The risk register should be confirmed annually as part of any existing corporate risk management for UQ. Implementation of adaptation actions shall be reviewed and efficacy monitored.

The final risk assessment will be presented in an excel sheet, summarising the outputs of this process. A template is provided in Appendix A and summarised in Figure 1.

Risk Reference	Climate Variable	Climate Hazard	Impact Description	Direct/Indirect Impact	Project Component	Existing Measures (Adaptation Inherant in Design)	2030			2070			Adaptation Measures
							Likelihood	Consequence	Risk Rating	Likelihood	Consequence	Risk Rating	
	Temperature	Increase in hot days and warm spells											
	Precipitation	Increase intensity of extreme rainfall events											
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Eg. 3	Temperature		xx										

Figure 1: Template for risk assessment, with example in red. See Tab 3 of Appendix A Risk Assessment Template

2.4 Applying this standard

This standard shall apply to all new buildings, structures, facilities, landscaping, any major retrofits and agricultural infrastructure projects. The following decision-making tree should be used to determine whether a project will require a climate change risk assessment to be completed.

It is important to note that the process set out in this standard can be appropriately scaled to individual projects by adjusting the volume, granularity and specificity of identified risks and adaptation measures. Large, complex projects are likely to be exposed to diverse direct and indirect climate risks, and as such, will require a more detailed risk assessment and adaptation plan. Projects with less asset components may be exposed to a smaller set of relevant climate-related risks.

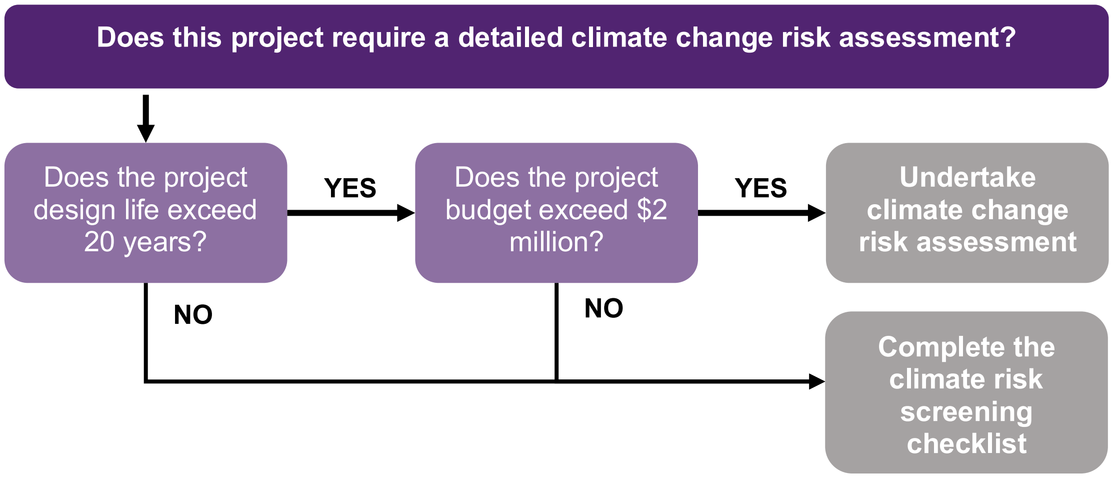

Figure 2: High Level Climate Change Risk Assessment Flowchart

Projects that are not required to complete a climate change risk assessment must still complete a climate risk screening checklist. This ensures that any risks and existing design and management measures are documented.

Climate risk screening checklist

Category	**Screening question**	**Response (Yes/ No)** *Detail if 'Yes'.*	**Evidence** *Historical and projected climate data*	**Risks relevant to the project** *Please list if any.*	**Risk treatments** *Outline design and operational measures for each identified relevant risk.*
Historical events	Has the project area been impacted by climate events in the past? • Bushfire • Extreme rainfall/ flooding • Drought • Heatwaves • Damaging hail/ storm/ winds • Cyclone • Storm surge/ coastal inundation				
Site context	Is the project located within, or adjacent to: • Bushfire prone area, • Flood prone area, • Coastal area?				
Vulnerable people	Will the project accommodate and service vulnerable groups?				

2.5 Methodology

1. Context

a) Identify Climate Variables and Hazards

The climate risk assessment shall include climate hazards only. Natural hazards such as earthquakes are not included. Wherever possible adopt established climate hazards published in International, Australian governments and research organisations, for example Climate Change in Queensland, and CSIRO.

At a minimum the climate risk assessment shall include the following climate variables and hazards:

Climate Variables	Climate Hazards
Temperature	Increase in hot days, warm spells and fewer frost days
	Heat related, and mental health stress on vulnerable students and staff
Precipitation	Increase intensity of extreme rainfall events
	Increase in flood levels
	Drought leading to reduction in soil moisture
	Drought reducing availability of water
Increase in storm intensity	Strong wind, hail, lightning
Sea Level Rise	Reduced capacity of coastal or low-lying drainage networks
	Height of tidal zone
	Storm surge
	Coastal Flooding Warmer more acidic ocean impacting marine research – corals,
Fire Weather	Increased risk of bushfire

The risk assessment may include additional climate hazards and variables should they be deemed relevant to the project and location e.g. Humidity.

These variables and hazards have been prepopulated into the risk assessment template (Appendix A, tab 3, column b and c)

b) Establish climate change scenarios

Climate change scenarios are defined by the Intergovernmental Panel on Climate Change (IPCC) and they are based on the most robust science and modelling that currently exists for understanding of how the world may be impacted by climate change. This modelling is regularly updated, and the most updated scenarios should be used to conduct the analysis. The current prevailing modelling outlines four potential futures called Representative Concentration Pathways (RCPs): RCP2.6, RCP4.5, RCP6.0, and RCP8.5.

RCP8.5 is the most conservative pathway and describes a scenario of ongoing high emissions which would lead to a concentration of carbon dioxide of 936ppm in the year 2100, equivalent to a 3.2 to 5.3 degrees Celsius global average temperature increase above pre-industrial levels. Current emissions are tracking in line with this.

For this reason, all risk assessments for the University of Queensland must use an RCP 8.5 emissions scenario.

The climate projections collated for the University of Queensland (see 1d) are based on a .5 emissions scenario into account.

c) Time Horizons

Time horizons are typically defined by the expected lifecycle of an asset, systems, or specific operational consideration. The expected lifecycle of a building is different than the lifecycle of an infrastructure investment such as a road. The time horizons selected for the risk assessment therefore must align with the lifecycle of the project being assessed.

At a minimum, two-time horizons must be included in all risk assessments. Currently 2030, and 2070 are considered appropriate, but these can be adjusted according to the project requirements.

These time horizons have informed the selection of climate projections (see 1d) and have been prepopulated into the risk assessment template (Appendix A, tab 3, column h-m).

d) Climate Change Projections

Climate change projections help to understand the overall future trends for an area and inform the risk assessment.

An overview of the climate change projections relevant to the University of Queensland Campuses have been collated and are provided in the Climate Risk Assessment Template (Appendix A, tab 1) and shown in Figure 2. These have been collated from Queensland Future Climate Dashboard, based on the selected hazards and variables, RCP Scenario and time horizons.

The projections are organised by three regional plan areas, within which all the University of Queensland Campuses are located. When undertaking a risk assessment the projections related to the regional plan area within which the project site is located should be used.

e) Complete project screening

A project screening is used to understand the site and project specific context to inform the climate risk assessment.

A project screening includes

- A description of the project's location and scope
- Details on the relevant project components that are likely to be impacted by climate change and should therefore be considered in the assessment *e.g. vegetation, minor structures, major structures, building users, operations, electrical infrastructure, pavements.*
- Identification of historical or ongoing climate hazard exposures or considerations unique to the project and site *e.g. historical flooding on the site*

The screening process should be informed by information on historical climate recorded by local weather stations and relevant hazard maps for the area such as flooding and bushfire overlays.

The Project Screening Template must be completed for all projects prior to undertaking the risk assessment and can be found in Appendix A, Tab 2. and Figure 3

RCP8.5 BoM/ CSIRO	Southeast Queensland		Wide Bay Burnett Region		Central Queensland Region		Qualitative Description
	2030	2070	2030	2070	2030	2070	
Temperature							
Mean Temperature (°C change)	0.9	2.8	1	2.7	0.98	2.9	Extreme temperatures are projected to increase at a similar rate to mean temperature, with a substantial increase in the temperature reached on hot days, the frequency of hot days, and the duration of warm spells (very high confidence).
Mean maximum daily temperature annual (°C change)	0.96	3.1	0.98	3	1	3	
Mean minimum daily temperature annual (°C change)	0.93	2.8	0.95	2.9	0.99	3	
Annual Hot days (change days)	3.4	20	6.5	29	14	47	
Heatwave Duration Wet Season (Change Days)	0.35	4.1	0.44	4.3	0.56	4.4	
Heatwave Frequency Wet Season (change days)	4.1	28	4.1	29	2.3	28	
Rainfall							
Annual Rainfall volume (mm) (change mm)	0.07	-1	0	-0.06	-0.02	-0.02	Natural climate variability is projected to remain the major driver of rainfall changes in the next few decades. Models show a range of results, with little change or decrease being more common particularly in winter and spring. Given the uncertainty in rainfall projections, the Australian Rainfall and Runoff Guidelines reccomend considering a 5% inrease in rainfall intensity for every degree Celicius of local warming. Projecting changes in the frequency and duration of drought is difficult. However, by late this century, under a high emissions scenario, it is likely that the south of the state will experience more time in drought. Impact assessment in this region should consider the risk of both a drier and wetter climate.
Annual extremely wet day precipitation (change mm)	8.9	-26	-3.5	-34	-16	-32	
Duration of Droughts (24mth season mth change)	-0.92	3.5	1.1	3.5	2.9	4.6	
Frequency of Severe Droughts (24mth season - change in mths)	0.05	0.56	0.12	0.56	0.12	0.53	
Fire							
Number of severe fire danger days	*n/a*	*n/a*	*n/a*	*n/a*	*n/a*	*n/a*	Fire weather is a measure of fuel dryness and hot, dry, windy conditions. Climate change is likely to result in harsher fire weather in the future. here is high confidence that climate change will result in a harsher fire-weather climate in the future. However, there is low confidence in the magnitude of that change because of the significant uncertainties in the rainfall projection.
Wind							
Wind Speed (%change)	*-0.35*	*-0.14*	*-0.18*	*-0.13*	*0.04*	*-0.35*	
Sea Level Rise							
Sea Level Rise	*n/a*	*n/a*	*n/a*	*n/a*	*n/a*	*n/a*	For 1966 to 2009, the average rate of relative sea-level rise for Australia, from observations along the coast, was 1.4 mm/year. Sea level is projected to rise by 0.8m above present day levels by 2100. Higher sea levels will increase the risks of coastal hazards such as storm tide inundation.There is very high confidence in future sea-level rise. By 2030 the projected range of sea-level rise for the cluster coastline is 0.08 to 0.18m above the 1986–2005 level, with only minor differences between emission scenarios. As the century progresses, projections are sensitive to concentration pathways. By 2090, the high emissions case (RCP8.5) a rise of 0.44 to 0.87 m. Under certain circumstances, sea-level rises higher than these may occur.
Humidity							
Relative Humidity	*-0.01*	*-1*	*-0.24*	*-1.3*	*-0.47*	*-1.4*	

Projected Values are based on modelling for the Wider Regional Plan area. Historcial climate data and local trends for the subject site should be considered when undertaking the risk assessment.

Figure 2 Climate Projections - from Appendix A, Tab 1

Project name	
Location	
Scope	

Project Component	Indicative life of project component
E.g. Vegetation, Minor Structures, Building Users, Operations, Maintenance Staff, Major Structures, Pavements, Electrical Infrastructue	*e.g. 20, 30. 50. 100 years*

Climate hazard	Screening question	Response	Screening outcome
Extreme heat events	Does the project have cooling requirements that will impact on its operation or functionality, and is there a history of extreme heat events impacting on the operation or functionality of similar facilities in the project vicinity?		
Flooding/drainage	Is the project within or adjacent to a flood zone/area with a flooding overlay?		
	Is there a history of flooding in the area?		
	Are there waterways within or adjacent to the project area?		
	Has flood risk has considered Australian rainfall and Runoff (AR&R) 2016, six-part test for consideration of climate risk for flood immunity and increasing rainfall intensity?		
	Has AR&R 2019 been used for drainage design to date(e.g. IFD data)?		
	Does the facility rely heavily on water availability, and is there a history of lack of water impacting on the operation or functionality of similar facilities in the project vicinity?		
Sea level rise	Is the project within or adjacent to coastal areas and contain asset components that might be impacted by sea level rise or storm surge?		
	Does the project contain components whose function/design life may be compromised by changes in groundwater levels or salinity?		
Bushfire	Is the project within or adjacent to an area with a bushfire planning overlay?		
	Is there a history of bushfires in the area?		
	Are there significant stands of vegetation/vegetation corridors near to the project site?		
	Is urban/residential development planned in the area (i.e. there will be a reduction in vegetation in the area over time)?		
	Will the operation or functionality of the project and its users be impacted by smoke from surrounding bushfires?		
Extreme Storm Events	Have past extreme climate events caused physical damage or impacted the operations and maintenance of similar assets or supporting infrastructure within the asset location? To what extent?		
	Does the project contatain an inherent level of tolerance to extrme events or is it likely that its use or function would be impacted by extreme events?		

Figure 3 Project Screening Template - Appendix A, Tab 2

2) Risk Identification

a) Develop Impact Descriptions

Impact descriptions describe the potential impacts climate projections will have on the project over the time horizons.

Impact descriptions should be developed against each climate hazard and considered in relation to the different project components. Where multiple project components exist for an impact, the impact should be duplicated.

Stakeholder engagement should inform the development of the impact descriptions to determine to most important impacts for the University of Queensland and the project. Representation is needed across design, operational and strategic disciplines.

Risk Impact Descriptions should be developed and populated in the Climate Risk Assessment (See Appendix A, Tab 3, Column D) and Figure 4.

b) Classify Impact Descriptions

Each impact description shall also be classified as a **direct or indirect impact** and against the **project component** it impacts – See Figure 5.

Direct & Indirect Impacts:

Column E (Appendix A, Tab 3) should be updated to classify each impact description as direct or indirect. The following definitions can be used to guide classification.

- *Direct:* A climate attributable impact on a system or organisation that causes damage, extra costs, accelerated deterioration or disruption of services provided. *E.g. Increased storm or flood damage to buildings*.
- *Indirect:* A climate attributable impact on another system or organisation, which disrupts the direct supply of goods or services that your system or organisation critically relies upon, thereby adversely impacting on your system or organisation. *E.g. power supply interruptions caused by excessive power demand during periods of extreme temperatures.*

Project Components

Column F (Appendix A, Tab 3) should be updated to classify each impact description against the project components it may impact. Where an impact description may impact multiple project components, the impact description should be duplicated, and the risk assessment carried out for each project component.

Risk Reference	Climate Variable	Climate Hazard	Impact Description	Direct/Indirect Impact	Project Component	Existing Measures (Adaptation Inherent in Design)	2030 Likelihood	2030 Consequence	2030 Risk Rating	2070 Likelihood	2070 Consequence	2070 Risk Rating	Adaptation Measures
	Temperature	Increase in hot days and warm spells											
	Precipitation	Increase intensity of extreme rainfall events											
	Precipitation	Increase in flood levels											
	Precipitation	Drought leading to reduction in soil moisture											
	Precipitation	Drought reducing availability of water											
	Sea Level Rise	Reduced capacity of coastal or low lying drainage networks											
	Sea Level Rise	Height of tidal zone											
	Sea Level Rise	Storm Surge											
	Sea Level Rise	Coastal Flooding											
	Fire Weather	Increased Risk of Bushfire											
	Precipitation, Wind, Temperature	Increase in storm intensity - Strong wind, hail, lightening											
	Example												
Eg. 1	Temperature	Increase in hot days and warm spells	Death of vegetation		Vegetation		Possible	Moderate	Medium	Likely	Moderate	Medium	Selection of native heat resistent vegetation
Eg. 2	Temperature		Heating of materials on handrails and panels, leading to safety risk for footpath users, i.e. burns.		Minor Structure		Likely	Moderate	Medium	Almost Certain	Moderate	High	Use of materials that can withstand high temperatures
Eg. 3	Temperature												

Figure 4 Impact Description - See Appendix A, Tab 3

Risk Reference	Climate Variable	Climate Hazard	Impact Description	Direct/Indirect Impact	Project Component	Existing Measures (Adaptation Inherent in Design)	2030 Likelihood	2030 Consequence	2030 Risk Rating	2070 Likelihood	2070 Consequence	2070 Risk Rating	Adaptation Measures
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Figure 5 Classify Impact Descriptions - See Appendix A, Tab 3

3) Risk Analysis

a) Identify Existing Controls

Existing controls refer to measures that are currently in place to minimise the consequences of an impact. These typically reflect business as usual or minimum standards that projects are already expected to incorporate.

A review of current standards and engagement with various technical experts will help to understand and identify existing standardised controls.

Existing controls should be listed against each impact statement to understand the current context and determine additional adaptation measures that will be required. Additional adaptation measures are considered after the risk assessment is complete (See 2.124)

Column G (Appendix A, Tab 3) should be populated with the existing controls, against each risk. See Figure 6.

b) Assign likelihood and consequence scorings

Risk is defined as a combination of the likelihood of an occurrence and the consequence of that occurrence.

Likelihood refers to the chance of the impact happening.

Consequence reflects the characteristics of the project and how prepared it is to cope with a specific event

Each impact description shall be assigned a likelihood and consequence score, specific to the project and assessed over all time periods that relate to the life of the project component. This should be scored against 2030 and 2070 (Appendix A, tab 3, columns H-M). See Figure 7.

A qualitative approach should be used to assess and assign scores. The information within the project screening tool (Appendix A, Tab 2 or Figure 3) and the climate projections (Tab 1 or Figure 2) should be interpreted to identify relevant trends in likelihood and consequence.

An initial scoring may be undertaken by a specialist working on the project, but this should be reviewed through stakeholder engagement with representation of disciplines working on the project, including design, operational and strategic staff.

A likelihood and consequence matrix and a matrix to combine the risk and likelihood scores is provided to help guide the assessment (Appendix A, tab 4) See Figure 8.

Note: Typically, a consequence score will remain consistent over all time periods, unless the severity of the impact increases (e.g. cyclones, intense rainfall event) or the number of people using the asset increases (as more people will be affected).

Consequence should be assessed against environmental, social, and financial outcomes. The highest score across any category should be used as the final consequence score.

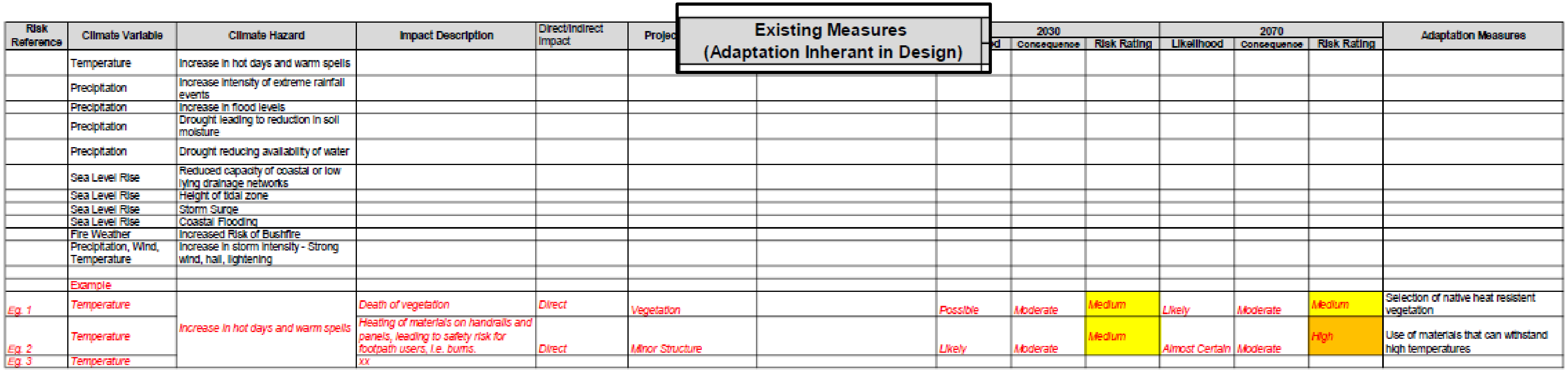

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Figure 6 Identify Existing Measures - See Appendix A, Tab 3

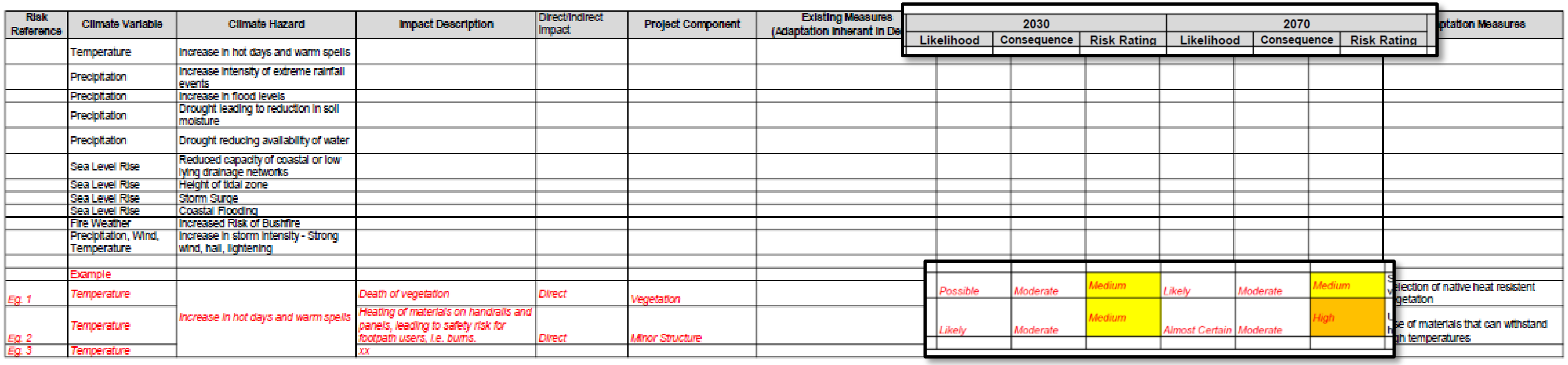

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Figure 7 Likelihood, Consequence and Risk Scoring - See Appendix A, Tab 3

Likelihood Scale			
Level	Descriptor	Description	Recurrent risk
A	Almost Certain	Event is almost certain to occur (90% probability) within the next 12 months or is imminent.	May occur several times per year
B	Likely	Event is likely to occur within the next 12 months (greater than 60% probability).	May arise about once per year
C	Possible	Event is possible within the next 12 months (30% probability) OR, has a reasonable chance (more than 50% probability) of occurring in next 3 years.	May arise once in 10 years
D	Unlikely	Event is not likely to occur in a given year (less than 30% probability).	May arise once in 10 to 25 years
E	Very Unlikely	The event may occur in exceptional circumstances (less than 1% probability) within the next 3 years).	Unlikely during the next 25 years

Consequence Scale					
Level	Descriptor	Consequence	Environmental	Social	Financial
1	Insignificant	No change, limited impacts	No adverse effect on natural environment	No adverse human health effects or complaints.	Insignificant financial loss
2	Minor	Localised service disruption. No permanent damage. Some minor restoration work required. Lifespan reduced by 10-20%	Minimal effects on the natural environment.	Short-term disruption to employees, residents or businesses. Slight adverse human health effects or general amenity issues. Negative reports in local media.	Additional operational costs. Minor financial loss
3	Moderate	Widespread damage and loss of service. Damage recoverable by maintenance and minor repair. Partial loss of local infrastructure. Lifespan reduced by 20-50%.	Some damage to the environment, including local ecosystems. Some remedial action may be required	Frequent disruptions to employees, residents or businesses. Adverse human health effects. Negative reports in state media.	Moderate financial loss
4	Major	Extensive damage requiring extensive repair. Lifespan reduced by >50%.	Significant effect on the environmental and local ecosystems. Remedial action likely to be required.	Permanent physical injuries and fatalities may occur from an individual event. Negative reports in national media. Public debate about performance.	Major financial loss
5	Catastrophic	Permanent damage and/or loss of service Retreat and translocation of development.	Very significant loss to the environment. May include localised loss of species, habitats or ecosystems. Extensive remedial action essential to prevent further degradation. Restoration likely to be requirement.	Severe adverse human health effects – leading to multiple events of total disability or fatalities. Emergency response. Negative reports in international media.	Significantly high financial loss

Note: the highest score across consequence categories should be inputted into the risk assessment

Overall Risk Rating							
			Consequence				
			1	2	3	4	5
			Insignificant	Minor	Moderate	Major	Catastrophic
Likelihood	A	Almost Certain	Low	Medium	High	Extreme	Extreme
	B	Likely	Low	Medium	Medium	High	Extreme
	C	Possible	Low	Low	Medium	High	High
	D	Unlikely	Low	Low	Medium	Medium	High
	E	Very Unlikely	Low	Low	Low	Medium	Medium

Figure 8 Risk Matrices –Appendix A, Tab 4

4. Risk treatment

a) Develop adaptation measures

Adaptation measures must be identified for all impact descriptions with a final risk score of medium and above. These should be inputted into the risk assessment (see Appendix A, tab 3 and Figure 9) and taken forward for future planning and design considerations.

When identifying adaptation actions, it is **essential** to clearly detail which risks the action is addressing. Adaptation actions can often address multiple risks. In this case, all risks should be outlined

Adaptation Measures are not intended to dictate what the design responses should be, but to ensure climate change risk are appropriately considered.

Adaptation measures will typically fall into three categories:

1. Operational:
    - Policies & procedures;
    - Programs (maintenance, inspections, monitoring); and
    - Responses to early warning systems.

Note: It is recommended that operational controls be reviewed at regular intervals (i.e. 5 yearly), following critical incidents or emergency events, or when new climate data becomes available.

2. Assets and equipment:
    - Design for future climate (withstand changes, Annual Rainfall and Runoff (ARR), temp, bushfire, etc.);
    - Design for controlled failure;
    - Design for retrofit/upgrade;
    - Equipment (pumps, backup generators/batteries, solar infrastructure etc); and
    - Early warning systems.

3. Training and capacity building:
    - Around policies (heatwaves, bushfire equipment operations, train speeds);
    - Rapid incident response (flood, signal failure, power outage); and
    - Individual projects should expand on the provided actions, giving more detail, or include potential additional adaptation actions relevant to the design phase.

Adaptation measures should fall across and combine responses from all three categories. Strong adaptation measures also look to deliver broader outcomes beyond climate adaptation. Attention should be given to how measures may also reduce climate emissions, improve biodiversity and deliver on broader objectives of the University of Queensland.

Risk Reference	Climate Variable	Climate Hazard	Impact Description	Direct/Indirect Impact	Project Component	Existing Measures (Adaptation Inherant in Design)	2030			2070			Adaptation Measures
							Likelihood	Consequence	Risk Rating	Likelihood	Consequence	Risk Rati	
	Temperature	Increase in hot days and warm spells											
	Precipitation	Increase intensity of extreme rainfall events											
	Precipitation	Increase in flood levels											
	Precipitation	Drought leading to reduction in soil moisture											
	Precipitation	Drought reducing availability of water											
	Sea Level Rise	Reduced capacity of coastal or low lying drainage networks											
	Sea Level Rise	Height of tidal zone											
	Sea Level Rise	Storm Surge											
	Sea Level Rise	Coastal Flooding											
	Fire Weather	Increased Risk of Bushfire											
	Precipitation, Wind, Temperature	Increase in storm intensity - Strong wind, hail, lightening											
	Example												
Eg. 1	*Temperature*		*Death of vegetation*	*Direct*	*Vegetation*		*Possible*	*Moderate*	*Medium*	*Likely*	*Moderate*	*Medium*	Selection of native heat resistent vegetation
Eg. 2	*Temperature*	*Increase in hot days and warm spells*	*Heating of materials on handrails and panels, leading to safety risk for footpath users, i.e. burns.*	*Direct*	*Minor Structure*		*Likely*	*Moderate*	*Medium*	*Almost Certain*	*Moderate*	*High*	Use of materials that can withstand high temperatures
Eg. 3	*Temperature*		*xx*										

Figure 9 Adaptation Measures - Appendix A, Tab 3

Appendix A: Climate change risk assessment framework

1. Climate context

Projected Values are based on modelling for the Wider Regional Plan area. Historical climate data and local trends for the subject site should be considered when undertaking the risk assessment.

RCP8.5 BoM/ CSIRO	Southeast Queensland Region		Wide Bay Burnett Region		Central Queensland Region		Qualitative Description
	2030	2070	2030	2070	2030	2070	
Temperature							
Mean Temperature (°C change)	0.9	2.8	1	2.7	0.98	2.9	Extreme temperatures are projected to increase at a similar rate to mean temperature, with a substantial increase in the temperature reached on hot days, the frequency of hot days, and the duration of warm spells (very high confidence).
Mean maximum daily temperature annual (°C change)	0.96	3.1	0.98	3	1	3	
Mean minimum daily temperature annual (°C change)	0.93	2.8	0.95	2.9	0.99	3	
Annual Hot days (change days)	3.4	20	6.5	29	14	47	
Heatwave Duration Wet Season (Change Days)	0.35	4.1	0.44	4.3	0.56	4.4	
Heatwave Frequency Wet Season (change days)	4.1	28	4.1	29	2.3	28	
Rainfall							
Annual Rainfall volume (mm) (change mm)	0.07	-1	0	-0.06	-0.02	-0.02	Natural climate variability is projected to remain the major driver of rainfall changes in the next few decades. Models show a range of results, with little change or decrease being more common particularly in winter and spring. Given the uncertainty in rainfall projections, the Australian Rainfall and Runoff Guidelines recommend considering a 5% increase in rainfall intensity for every degree Celicius of local warming. Projecting changes in the frequency and duration of drought is difficult.
Annual extremely wet day precipitation (change mm)	8.9	-26	-3.5	-34	-16	-32	

RCP8.5 BoM/ CSIRO	Southeast Queensland Region		Wide Bay Burnett Region		Central Queensland Region		Qualitative Description
	2030	2070	2030	2070	2030	2070	
Duration of Droughts (24mth season mth change)	-0.92	3.5	1.1	3.5	2.9	4.6	However, by late this century, under a high emissions scenario, it is likely that the south of the state will experience more time in drought. Impact assessment in this region should consider the risk of both a drier and wetter climate.
Frequency of Severe Droughts (24mth season - change in mths)	0.05	0.56	0.12	0.56	0.12	0.53	
Fire							
Number of severe fire danger days	*n/a*	*n/a*	*n/a*	*n/a*	*n/a*	*n/a*	Fire weather is a measure of fuel dryness and hot, dry, windy conditions. Climate change is likely to result in harsher fire weather in the future. here is high confidence that climate change will result in a harsher fire-weather climate in the future. However, there is low confidence in the magnitude of that change because of the significant uncertainties in the rainfall projection.
Wind							
Wind Speed (%change)	*-0.35*	*-0.14*	*-0.18*	*-0.13*	*0.04*	*-0.35*	
Sea Level Rise							
Sea Level Rise	*n/a*	*n/a*	*n/a*	*n/a*	*n/a*	*n/a*	For 1966 to 2009, the average rate of relative sea-level rise for Australia, from observations along the coast, was 1.4 mm/year. Sea level is projected to rise by 0.8m above present day levels by 2100. Higher sea levels will increase the risks of coastal hazards such as storm tide inundation.There is very high confidence in future sea-level rise. By 2030 the projected range of sea-level rise for the cluster coastline is 0.08 to 0.18m above the 1986–2005 level, with only minor differences between emission scenarios. As the century progresses, projections are sensitive to concentration pathways. By 2090, the high emissions case (RCP8.5) a rise of 0.44 to 0.87 m. Under certain circumstances, sea-level rises higher than these may occur.
Humidity							
Relative Humidity	*-0.01*	*-1*	*-0.24*	*-1.3*	*-0.47*	*-1.4*	

2. Project Screening

Project name	
Location	
Scope	

Project Component	Indicative life of project component
E.g. Vegetation, Minor Structures, Building Users, Operations, Maintenance Staff, Major Structures, Pavements, Electrical Infrastructure	*e.g. 20, 30. 50. 100 years*

Climate hazard	Screening question	Response	Screening outcome
Extreme heat events	Does the project have cooling requirements that will impact on its operation or functionality, and is there a history of extreme heat events impacting on the operation or functionality of similar facilities in the project vicinity?		
Flooding/ drainage	Is the project within or adjacent to a flood zone/area with a flooding overlay?		
	Is there a history of flooding in the area?		

Climate hazard	Screening question	Response	Screening outcome
	Are there waterways within or adjacent to the project area?		
	Has flood risk has considered Australian rainfall and Runoff (AR&R) 2016, six-part test for consideration of climate risk for flood immunity and increasing rainfall intensity?		
	Has AR&R 2019 been used for drainage design to date(e.g. IFD data)?		
	Does the facility rely heavily on water availability, and is there a history of lack of water impacting on the operation or functionality of similar facilities in the project vicinity?		
Sea level rise	Is the project within or adjacent to coastal areas and contain asset components that might be impacted by sea level rise or storm surge?		
	Does the project contain components whose function/design life may be compromised by changes in groundwater levels or salinity?		
Bushfire	Is the project within or adjacent to an area with a bushfire planning overlay?		
	Is there a history of bushfires in the area?		

Climate hazard	Screening question	Response	Screening outcome
	Are there significant stands of vegetation/vegetation corridors near to the project site?		
	Is urban/residential development planned in the area (i.e. there will be a reduction in vegetation in the area over time)?		
	Will the operation or functionality of the project and its users be impacted by smoke from surrounding bushfires?		
Extreme Storm Events	Have past extreme climate events caused physical damage or impacted the operations and maintenance of similar assets or supporting infrastructure within the asset location? To what extent?		
	Does the project contain an inherent level of tolerance to extreme events or is it likely that its use or function would be impacted by extreme events?		

3. Risk Assessment

Climate Variable	Climate Hazard	Impact Description	Direct/ Indirect Impact	Project Component	Existing Measures (Adaptation Inherent in Design)	2030			2070			Adaptation Measures
						Likelihood	Consequence	Risk Rating	Likelihood	Consequence	Risk Rating	
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	Drought reducing availability of water											
Sea Level Rise	Reduced capacity of coastal or low lying drainage networks											
	Height of tidal zone											
	Storm Surge											
	Coastal Flooding											
Fire Weather	Increased Risk of Bushfire											
Precipitation, Wind, Temperature	Increase in storm intensity - Strong wind, hail, lightening											

Climate Variable	Climate Hazard	Impact Description	Direct/ Indirect Impact	Project Component	Existing Measures (Adaptation Inherent in Design)	2030			2070			Adaptation Measures
						Likelihood	Consequence	Risk Rating	Likelihood	Consequence	Risk Rating	

Example

Temperature	*Increase in hot days and warm spells*	*Death of vegetation*	*Direct*	*Vegetation*		*Possible*	*Moderate*	*Medium*	*Likely*	*Moderate*	*Medium*	Selection of native heat resistent vegetation
		Heating of materials on handrails and panels, leading to safety risk for footpath users, i.e. burns.	*Direct*	*Minor Structure*		*Likely*	*Moderate*	*Medium*	*Almost Certain*	*Moderate*	*High*	Use of materials that can withstand high temperatures
		xx										

4. Risk Matrix

Likelihood Scale			
Level	Descriptor	Description	Recurrent risk
A	Almost Certain	Event is almost certain to occur (90% probability) within the next 12 months or is imminent.	May occur several times per year
B	Likely	Event is likely to occur within the next 12 months (greater than 60% probability).	May arise about once per year
C	Possible	Event is possible within the next 12 months (30% probability) OR, has a reasonable chance (more than 50% probability) of occurring in next 3 years.	May arise once in 10 years
D	Unlikely	Event is not likely to occur in a given year (less than 30% probability).	May arise once in 10 to 25 years
E	Very Unlikely	The event may occur in exceptional circumstances (less than 1% probability) within the next 3 years).	Unlikely during the next 25 years

Overall Risk Rating							
			Consequence				
Likelihood			1	2	3	4	5
			Insignificant	Minor	Moderate	Major	Catastrophic
	A	Almost Certain	Low	Medium	High	Extreme	Extreme
	B	Likely	Low	Medium	Medium	High	Extreme
	C	Possible	Low	Low	Medium	High	High
	D	Unlikely	Low	Low	Medium	Medium	High
	E	Very Unlikely	Low	Low	Low	Medium	Medium

Consequence Scale					
Level	**Descriptor**	**Consequence**	**Environmental**	**Social**	**Financial**
1	Insignificant	No change, limited impacts	No adverse effect on natural environment	No adverse human health effects or complaints.	Insignificant financial loss
2	Minor	Localised service disruption. No permanent damage. Some minor restoration work required. Lifespan reduced by 10-20%	Minimal effects on the natural environment.	Short-term disruption to employees, residents or businesses. Slight adverse human health effects or general amenity issues. Negative reports in local media.	Additional operational costs. Minor financial loss
3	Moderate	Widespread damage and loss of service. Damage recoverable by maintenance and minor repair. Partial loss of local infrastructure. Lifespan reduced by 20-50%.	Some damage to the environment, including local ecosystems. Some remedial action may be required	Frequent disruptions to employees, residents or businesses. Adverse human health effects. Negative reports in state media.	Moderate financial loss
4	Major	Extensive damage requiring extensive repair. Lifespan reduced by >50%.	Significant effect on the environmental and local ecosystems. Remedial action likely to be required.	Permanent physical injuries and fatalities may occur from an individual event. Negative reports in national media. Public debate about performance.	Major financial loss
5	Catastrophic	Permanent damage and/or loss of service Retreat and translocation of development.	Very significant loss to the environment. May include localised loss of species, habitats or ecosystems. Extensive remedial action essential to prevent further degradation. Restoration likely to be requirement.	Severe adverse human health effects – leading to multiple events of total disability or fatalities. Emergency response. Negative reports in international media.	Significantly high financial loss