



## Appendix I

# Landslide Hazard Assessment

# Executive Summary

This Landslide Hazard Report has been prepared to support Hydro Tasmania's development application for the Tarraleah Redevelopment Project. The report addresses the requirements of the Tasmanian Planning Scheme – State Planning Provisions (SPP), C15 Landslip Hazard Code and the Central Highlands Council Local Provision Schedule (LPS).

The Tarraleah hydropower scheme, constructed during the 1930s, is located at Tarraleah, within the Central Highlands of Tasmania. Hydro Tasmania is proposing to redevelop the scheme to ensure safe and reliable operation to provide the next generation of Tasmanian hydropower, transforming the network to increase capacity, efficiency and flexibility.

The proposed Tarraleah Redevelopment project includes a surface pipeline, pressurised headrace and power tunnels, surge tower and associated pump station, access tunnels, power station and transmission lines. These elements are to be developed following a Final Investment Decision on the Project and the execution of contracts for design and construction.

In preparation for the procurement of the contract, Hydro Tasmania, with support of their Integrated Owners Engineering Team have developed Reference Designs, as well as minimum performance, functional and technical requirements.

## Key Findings

**Hazard Classification:** The majority of the project area is classified as “acceptable” under the Landslip Hazard Code, which is based on Mineral Resources Tasmania hazard zoning. Steeper terrain, such as the Wentworth Hills and Nive River Valley flanks, is rated “low” to “medium” hazard.

- **Landslide Mechanisms:** The report identifies multiple slope movement types including translational and rotational slides, rock topples, solifluction flows, and debris flows. These are mapped to geological features and historical events.
- **Trigger Mechanisms:** Rainfall and groundwater changes are the dominant triggers. Seismic risk is low, and slope modification risks are mitigated through design.
- **Design Mitigation:** The Reference Design locates most infrastructure underground to reduce exposure to slope hazards. Tunnel leakage risks may be addressed through a combination of grouting, monitoring and drainage.
- **Risk Assessment:** Quantitative assessments have been completed using the Australian Geomechanics Society Landslide Risk Management Guidelines (2007) and Hydro Tasmania's Integrated Business Risk Management frameworks.
- **Compliance:** The report demonstrates that a tolerable level of risk can be achieved and maintained over the 80-year design life of the project, in accordance with Tasmanian Planning Scheme and LPS requirements.

## Concluding Remarks

The Tasmanian Planning Scheme – State Planning Provisions calls for works to be undertaken such that a “tolerable level of risk” can be maintained for the life of the Project. The quantitative landslide risk assessment completed for the project demonstrates compliance with this condition can be achieved based on the Reference Design alignment.

This also aligns with Hydro Tasmania's public risk appetite statement<sup>1</sup> “..we have a low appetite for risks that affect the safety of our people and the public, cause damage to the environment, affect our cybersecurity, and which relate to our obligation to comply with laws and regulations.”

In addition, all civil elements (roads, cut slopes, portal cuts etc) included in the final arrangement will be designed to engineering standards and appropriate geotechnical “factors of safety” or where active landslides are encountered, the AGS Guidelines may apply. These will be included by Hydro Tasmania in the contractual requirements for the future contractors who are responsible for the design and construction

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<sup>1</sup> <https://www.hydro.com.au/about-us/our-governance/management-approach>



These provisions direct the works to meet or exceed the requirement for a tolerable level of risk. The Reference Design documentation is prepared to be sufficient to support approvals under the Tasmanian Planning Scheme and Central Highlands Local Provisions Schedule Central Highlands.



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# 1. Introduction

This report has been prepared to assist Hydro Tasmania with the development application submission for the Tarraleah Redevelopment Project (the Project). The project proposes to:

- Construct a pressurised water conveyance tunnel with both upstream headrace and downstream power tunnel portals located at the foot of slopes identified to have existing landslide activity, and
- Construct a transmission line through areas mapped as 'low' and 'medium' landslide hazards.

We understand the Central Highlands Council (CHC) have issued a Request for Information (RFI) for the provision of a Landslide Hazard Report to demonstrate compliance with the relevant provisions of the Landslip Hazard Code. The advice documented herein has been prepared to fulfil the landslide hazard management requirements listed in the following legislation:

- Tasmanian Planning Scheme (TPS) – State Planning Provisions (SPP), C15 Landslip Hazard Code – effective 24 January 2024, Latest amendment 23 October 2024.
- Central Highlands Council – Local Provision Schedule (LPS) 2023, Latest amendment 28 November 2023.
- Tasmanian Government Building Act (2016) - Directors Determination – Landslip Hazard Areas, Latest amendment 8 April 2021.

The TPS SPP Landslip Hazard Code states its purpose is “to ensure that a tolerable risk can be achieved and maintained for the type, scale and intensity and intended life of use or development on land within a landslip hazard area”. This document provides an overarching summary of the site landslide hazards, statement of the assessed quantitative risk and landslide risk management provisions for the project.

This report has been prepared under the direction of Mr Richard Brehaut, Principal Engineering Geologist at PSM. Richard specialises in the development of engineering ground models, terrain analysis and landslide studies.

# 2. Project Description

The Tarraleah hydropower scheme, constructed during the 1930s, is located at Tarraleah, within the Central Highlands of Tasmania. Hydro Tasmania is proposing to redevelop the scheme to ensure safe and reliable operation to provide the next generation of Tasmanian hydropower, transforming our network to increase capacity, efficiency and flexibility.

The proposed Tarraleah Redevelopment project includes a surface pipeline, pressurised headrace and power tunnels, surge tower and associated pump station, access tunnels, power station and transmission lines. These elements are to be developed to a final design following a Final Investment Decision (FID) by Hydro Tasmania. The project has a proposed design life of 80 years.

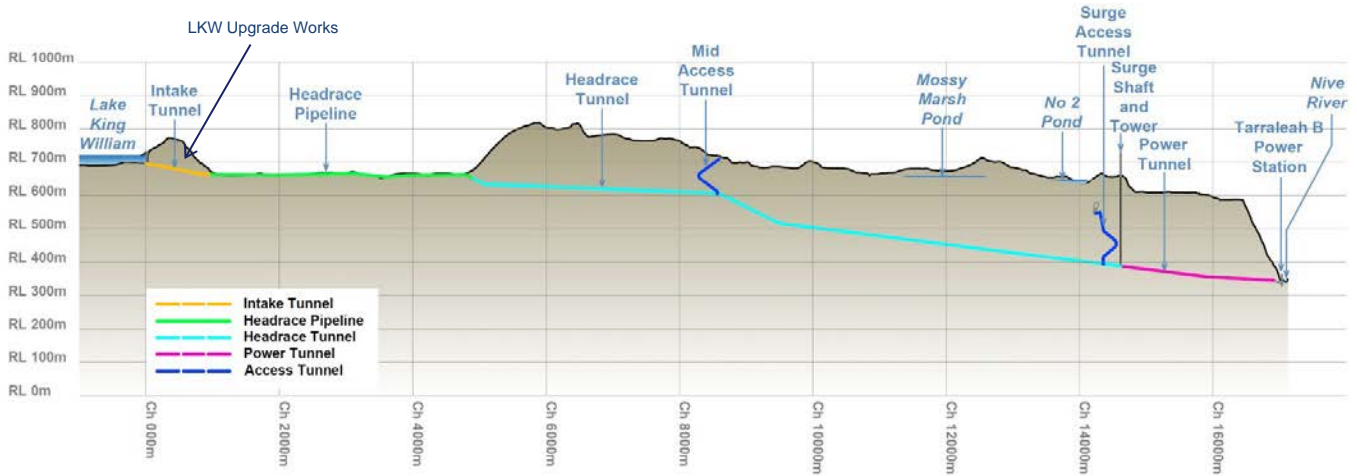
In preparation for the procurement of these contracts, Hydro Tasmania, with support of their Integrated Owners Engineering Team have developed Reference Designs, as well as minimum performance, functional and technical requirements.

The Reference Design arrangement for the Project includes the following components:

- A 4.2 km long surface pipeline connecting to the western portal of the headrace tunnel
- A 9.7 km long headrace tunnel connecting to the power tunnel. The tunnel is proposed to be driven by drill and blast methods, in predominantly hard dolerite with access tunnels provided for construction
- A 270 m surge shaft (proposed raise bore) connecting the headrace tunnel to an approximately 70 m high surge tower
- A pump station with rising main to divert inflowing water from existing surface infrastructure into the surge facilities
- A 2.4 km long power tunnel, connecting the head race tunnel from the surge shaft to the power station. The tunnel is expected to be driven by drill and blast methods
- A surface power station on the Nive River
- Access tunnels

- Two transmission line options to connect the new scheme into the grid
- Siteworks associated with access and egress to the station and headworks infrastructure and construction facilities.

A schematic long section for the Project is provided in Inset 1.



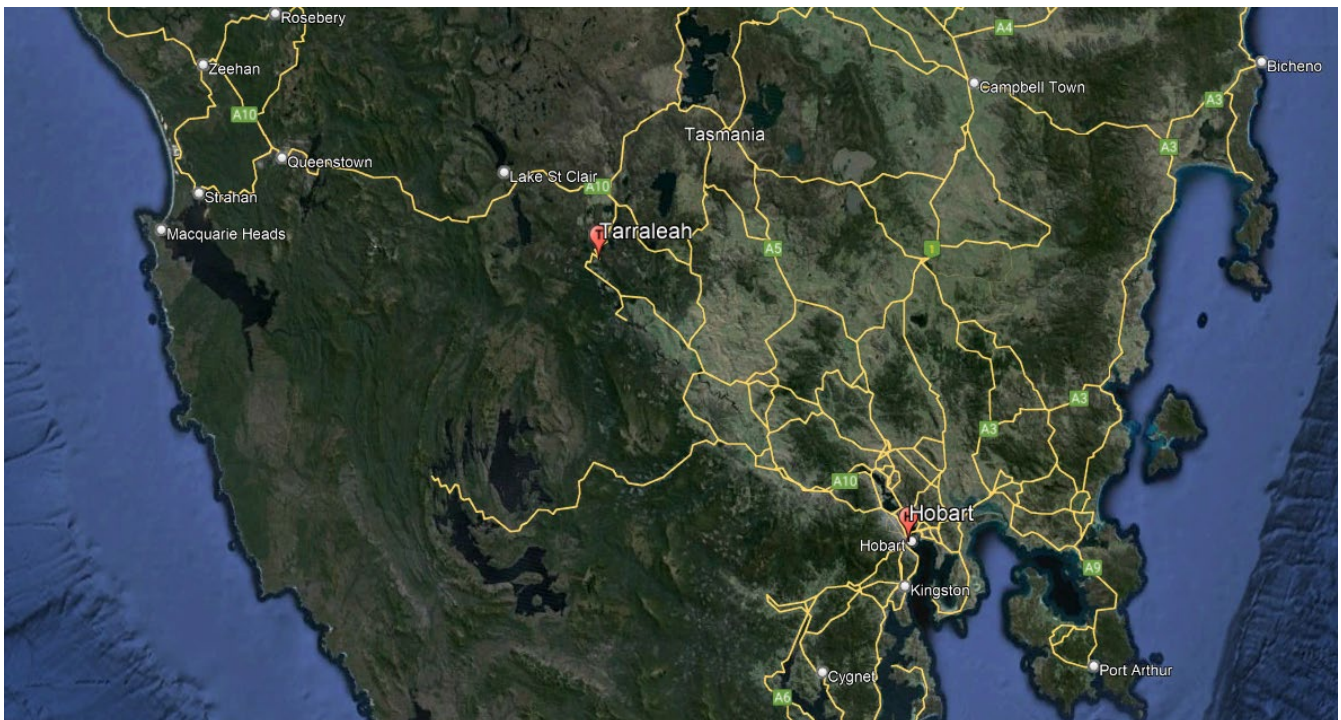
**Inset 1: Schematic long section of the Reference Design alignment.**

### 3. Project Setting

#### 3.1 Location and Geography

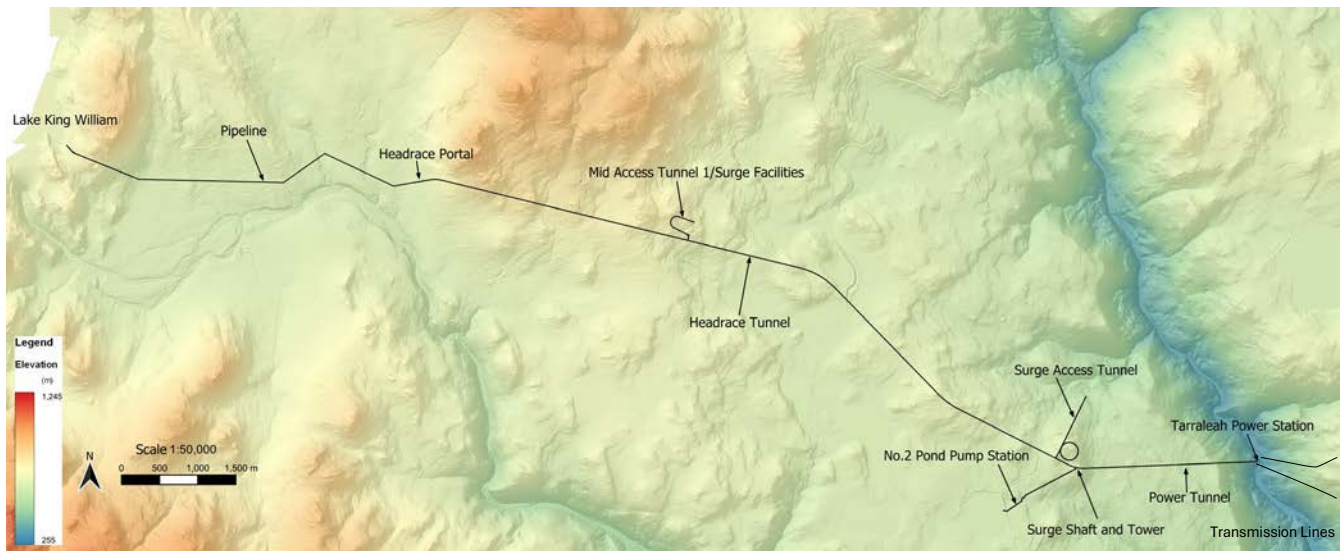
Tarraleah is located approximately 100 kilometres northwest of Hobart in the Central Tablelands of Tasmania (Inset 2). The project corridor is primarily characterised by gently undulating topography across the Tarraleah Plateau with rolling dolerite slopes before the terrain steepens into the Nive River Valley. The Wentworth hills encroach on the western margins of the alignment from the north. The remaining project alignment is bound by Lake King William to the west, Derwent River to the south and the Nive River in the east.

The project alignment is presented on a Digital Elevation Model (DEM) of the Tarraleah region in Inset 3 and more broadly in Appendix A. The smoothed surface profiles of the lower hillsides are consistent with glacial ice carving.



**Inset 2: Location plan for Tarraleah in the central tablelands of Tasmania approximately 100 km northwest of Hobart.**





**Inset 3: Digital Elevation Model (DEM) of the Tarraleah Project Area.**

### 3.1.1 Climate and Rainfall

Tarraleah resides in a high precipitation, cool-temperate climatic region of central Tasmania. Tarraleah is subject to seasonal temperature variation, in which the summer months are warm whilst during winter, it is not uncommon to experience occasional snow fall. Available temperature data shows that on average the mean maximum summer temperature occurs in February (mean range of 7.1° - 19.9°C) whilst in winter, the coldest month on average is July (mean range of 0.4° to 8.3°C). This information shows there is potential for large temperature differentials within a 24-hour period.

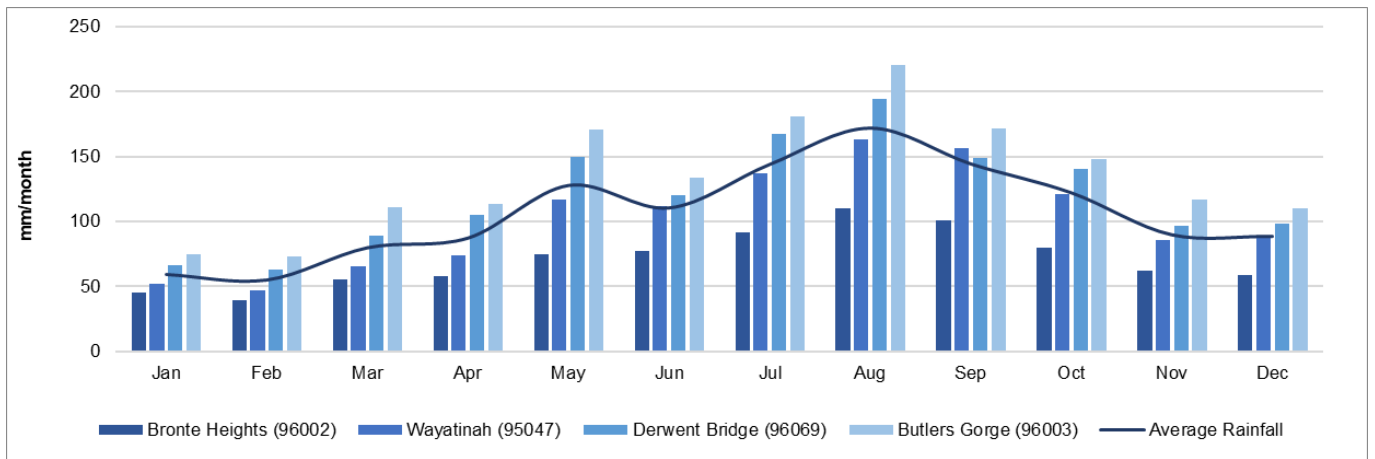
Inset 4 presents the recent (2000 to 2022) monthly mean precipitation data, averaged across 4 catchment climate stations, including:

- Butlers Gorge (96003), 1.5 km to the Southeast of Lake King Willam outlet
- Derwent Bridge (96069), 14.5 km to the North of Lake King William outlet
- Wayatinah (95047), 11.5 km to the South of Tarraleah Power Station
- Bronte Heights (96002), 17.2 km to the north of Tarraleah Power Station.

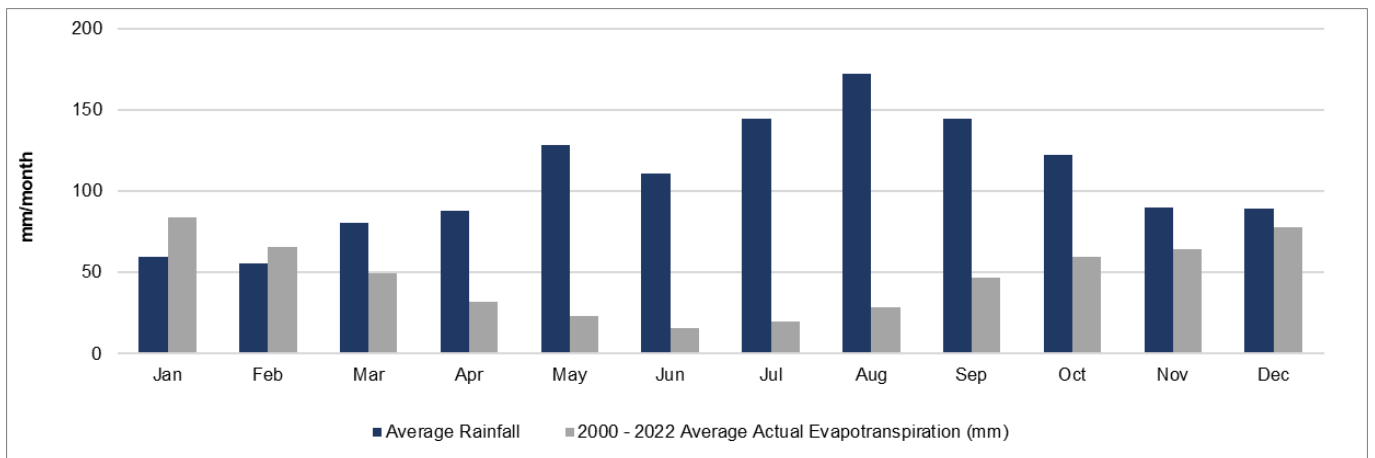
Total mean annual precipitation (2000 to 2022) is recorded at 1,274 mm. The data reflects an orographic rainfall pattern where stations in the west regularly recorded higher amounts of rainfall than stations in the east due to the prevailing westerly weather patterns.

A localised analysis of precipitation in the project area is presented in Inset 5, which considers precipitation data from against mean actual evapotranspiration (AET) calculated using the Terrestrial Ecosystem Research Network (TERN) CRMSET algorithm. The algorithm uses reflective remotely sensed indices from Sentinel-2 and Landsat datasets to estimate AET from potential evapotranspiration (PET), calculated using daily gridded BoM meteorological data. The calculated mean AET is representative of a 105 km<sup>2</sup> area which captures the entire project alignment and local groundwater recharge areas. Total mean annual AET is recorded at 566 mm.

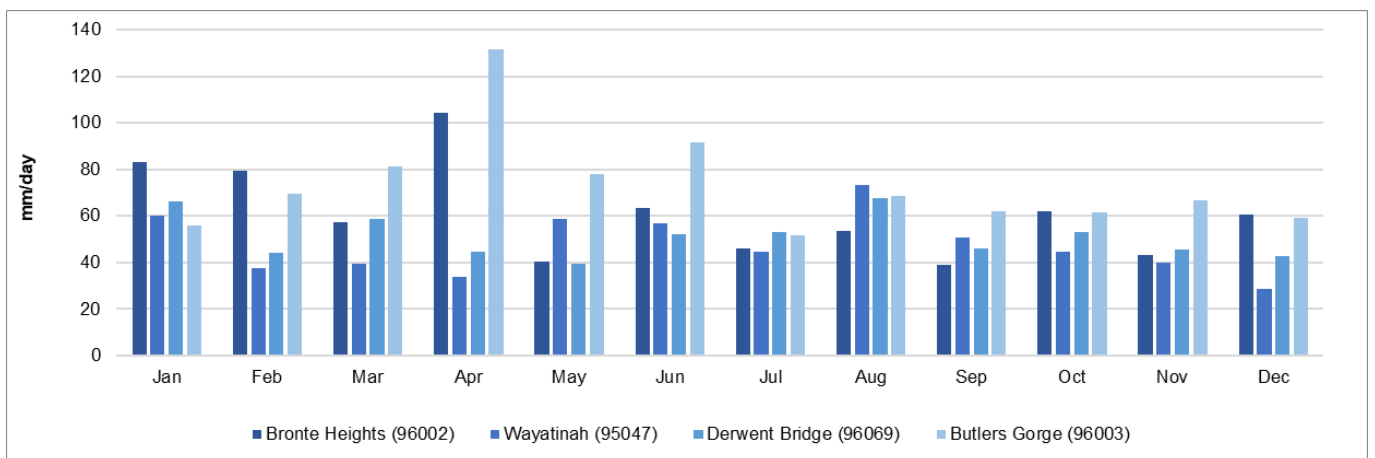
Short term rainfall intensity (Inset 6) is presented as maximum single day rainfall events per month. The data indicates the maximum rainfall intensity expected at the project setting which is used to inform potential surface flow flood risk. A maximum single day rainfall of 132 mm (Butlers Gorge (96003) in April of 1960) signifies that there is moderate risk to the project during construction of surface flooding and water flow into excavations.



**Inset 4: 2000 to 2022 monthly mean precipitation for catchment wide weather stations.**



**Inset 5: 2000 to 2022 monthly mean precipitation (all stations combined) and estimated actual evapotranspiration (AET).**



**Inset 6: 1910 to 2022 short term rainfall intensity (maximum single day rainfall per month).**

### 3.2 Quaternary Glaciation

Tasmania’s Pleistocene glacial history is well documented (Corbett et al, 2014) with numerous glacial cycles (thought to be more than ten) resulting in extreme changes in climatic conditions around the Tasmanian central plateau and adjacent melt water streams. The project site is located to the southeast of the central plateau within the zone of established glacial ice limits, Inset 7.

During the Pleistocene multiple glacial and interglacial cycles resulted in river downcutting to form the north easterly dipping slope extending from the Tarraleah sub alpine plateau at 585mRL to the Nive River at 345mRL. The dolerite plateau extending to the west and north of Tarraleah is covered by glacial moraine with swamp deposits developed





**Table 1: Summary of Tectono-Stratigraphic Evolution, Tarraleah Area (Stuart-Smith, 2023)**

Period	Stratigraphy	Event	Description
Holocene 0 – 20ka	Alluvium, Colluvium, Swamp deposits	Erosion, Fluvial deposition, landslides	Continuing erosion of riverbanks. Deposition of gravels, cobbles and boulders in riverbeds. Colluvial deposits and Landslides further developed on flanks of steep ridges and Nive and Derwent River valleys. Continuing deposition of organic-rich fine-grained sediments in plateau swamps developed on plateau.
Quaternary 20ka – 2Ma	Glacial cover sequence	Erosion and Glaciogenic deposition	Several glacial and periglacial events involving erosion and frequent changes in climate. Erosion of dolerite plateau with removal of basalt and any remaining Triassic sediments above the dolerite. Deposition of extensive moraine and outwash gravels. Development of swamps in low-lying areas on the plateau.
Tertiary 2Ma- 30 Ma	Alluvium	Erosion, fluvial deposition	Weathering and erosion, and continued development of the Nive and Derwent Rivers. Nive River shifts to NE margin of basalt flows cutting down up to 100m lower than the earlier paleochannel. Remanent Fluvial boulder gravel deposits preserved on terraces in the Nive River Valley. Erosion of basalt sequence and any Triassic units above the main dolerite sill. Formation of the slopes of the present river valleys with initiation of some landslides on valley sides.
Early Tertiary (Eocene to Miocene) 21- 36Ma	Unnamed basalt, 'Tarraleah Beds'	Volcanism and fluvio-lacustrine deposition	Deposition of basal fluvial sand and gravels overlain by basalt flows intercalated with fluvial sand and fine-grained lacustrine sediments. Basaltic sequence filled paleo-channels and overtopped onto dolerite plateau. Possible uplift of Wentworth Hills and tilting to SE.
Early Tertiary (Eocene)		Erosion	Formation of 350 m deep paleo-Nive River gorge at Tarraleah with tributary paleochannel at Mossy Marsh.
Latest Cretaceous/ Tertiary (Paleocene)		Deformation	NE-SW extension, Extensive faulting in dolerite by normal reactivation of NW-trending subvertical joints. NE and E-W trending joints reactivated as strike-slip structures. Formation of Nive River Graben.
Mid Jurassic to Latest Cretaceous 65 – 180 Ma		Erosion	Prolonged weathering and erosion. Formation of an extensive erosion surface.
Middle Jurassic 180 Ma	Dolerite	Intrusion	Uplift and extensive intrusion of dolerite sills and dykes. Formation of contraction cooling joints. Minor normal faulting. Sill, locally ~ 350m thick, intrudes Early Triassic sediments.
Latest Triassic – Early Jurassic 180 - 205Ma		Deformation	SW-NE compression, uplift and erosion. NW-trending open folding and faulting of Permo-Triassic sediments.
Early Triassic 230 – 250 Ma	Upper Parmeener Supergroup	Fluvial deposition	Deposition of pebbly lithic sandstone, quartz sandstone, siltstone and mudstone.
Permian	Lower Parmeener Supergroup		Undifferentiated sediments

## 4. Data and Information

Geotechnical site investigation data compiled by Entura / Hydro Tasmania prior to the project feasibility phases in 2019 are termed 'historic' data. Data acquired by Entura during the feasibility study and Entura / PSM within this Reference Design phase, is termed 'recent' data.

Recent project data has been collected and presented in accordance with Australian Standard AS1726-2017: *Geotechnical Site Investigations*.

**Due to the commercially sensitive nature of documentation prepared as part of the project procurement, inclusion of specific details in this report is limited due to probity considerations.**

### 4.1 Geotechnical Data Report

All geotechnical data collated for, and used to inform the geotechnical interpretation of ground conditions for the project is presented within the accompanying Geotechnical Data Report (GDR).

A review of the wider Tarraleah Redevelopment project area identified several existing geotechnical studies including:

- 148 x Cored Boreholes, for a total of 9250m of core drilled and maximum depth of 400m
- 104 x Test Pits
- 13 x Hollow Flight Auger
- 54 x Water Monitoring Instrumentation installed (i.e., Standpipes and Vibrating Wire Piezometers).

Table 2 outlines documented site investigations completed between 1950 and 2024 with a breakdown of available data and associated data confidence.

**Table 2: Available Site Investigations**

Investigation Area	Author	Year	Available Data	Data Confidence
Mossy Marsh Tunnel and No. 2 Canal	Hydro-electric commission	1950 – 1955	<ul style="list-style-type: none"> <li>• PDF handwritten logs in feet</li> <li>• No core photographs</li> <li>• Approximated collar locations or no data</li> <li>• Test pit locations identified by location but no construction records</li> </ul>	Low
Mossy Marsh Seismic Survey	Mineral Resources Tasmania	1952	<ul style="list-style-type: none"> <li>• Seismic Survey in feet</li> </ul>	Low
Tarraleah Pipeline (Penstocks)	Hydro-electric commission	1971 – 1972	<ul style="list-style-type: none"> <li>• PDF borehole logs originally logged in feet</li> <li>• Core photographs</li> <li>• Collar details (some approximated)</li> </ul>	Medium
Tarraleah Power Station	Hydro-electric commission	1986 – 1992	<ul style="list-style-type: none"> <li>• Collar details</li> <li>• PDF borehole logs</li> <li>• Core photographs</li> </ul>	Medium
Tarraleah Pipeline (Penstocks)	Pitt & Sherry	2009	<ul style="list-style-type: none"> <li>• PDF field logs</li> <li>• No core photographs</li> <li>• Approximate collar locations</li> </ul>	Medium
Tungatinah Redevelopment	Entura	2011	<ul style="list-style-type: none"> <li>• Collar and construction details</li> <li>• PDF handwritten borehole logs with photographs</li> <li>• PDF handwritten test pit logs with photos</li> <li>• Laboratory testing</li> </ul>	Medium
Mossy Marsh Dam	Entura	2012	<ul style="list-style-type: none"> <li>• Location plan with approximate hole locations</li> <li>• PDF handwritten test pit logs with photographs</li> </ul>	Medium



Investigation Area	Author	Year	Available Data	Data Confidence
			<ul style="list-style-type: none"> <li>Laboratory testing</li> </ul>	
Tarraleah Switchyard	Entura	2012	<ul style="list-style-type: none"> <li>Approximate collar location</li> <li>PDF handwritten test pit log with photographs</li> </ul>	Medium
Tarraleah Pipeline (Penstocks)	Entura	2015	<ul style="list-style-type: none"> <li>Location plan with collar locations</li> <li>PDF handwritten borehole log with photographs</li> <li>Laboratory testing</li> </ul>	Medium
Tarraleah Pipeline (Penstocks)	Entura	2016	<ul style="list-style-type: none"> <li>Location map with approximate coordinates</li> <li>Vibrating wire piezometer installation records</li> </ul>	Medium
Tarraleah Redevelopment – Feasibility	Entura	2019	<ul style="list-style-type: none"> <li>Collar and construction details</li> <li>PDF borehole logs with core photographs</li> <li>PDF handwritten test pit logs with photographs</li> <li>PDF handwritten auger logs with photographs</li> <li>Laboratory testing</li> </ul>	High
Tarraleah Pipeline (Penstocks)	Entura	2019	<ul style="list-style-type: none"> <li>Collar and construction details</li> <li>PDF borehole log with core photographs</li> <li>Laboratory testing</li> </ul>	High
Tarraleah Redevelopment – Mossy Marsh Pond and Tarraleah Pond No. 2	Entura	2021	<ul style="list-style-type: none"> <li>Collar locations</li> <li>PDF handwritten test pit logs with photographs</li> <li>Laboratory testing</li> </ul>	High
Tarraleah Redevelopment – Pre FID Stage 1	PSM/Entura	2022	<ul style="list-style-type: none"> <li>Collar and construction details</li> <li>PDF borehole logs with core photographs</li> <li>PDF test pit logs with photographs</li> <li>Laboratory testing</li> </ul>	High
Tarraleah Redevelopment	GBG	2022	<ul style="list-style-type: none"> <li>Geophysics survey</li> </ul>	High
Tarraleah Redevelopment	Mineral Resources	2022 / 2023	<ul style="list-style-type: none"> <li>Mineralogy</li> <li>XRD</li> </ul>	High
Tarraleah Redevelopment	SCT	2023	<ul style="list-style-type: none"> <li>In-situ stress testing</li> </ul>	High
Tarraleah Redevelopment – Pre FID Stage 2 and 3	PSM/Entura	2023/ 2024	<ul style="list-style-type: none"> <li>Collar and construction details</li> <li>PDF borehole logs with core photographs</li> <li>PDF test pit logs with photographs</li> <li>Laboratory testing</li> </ul>	High

## 4.2 Geotechnical Interpretive Report

A project Geotechnical Interpretive Report (GIR) has been compiled based on geological and geotechnical data including information documents provided by Hydro Tasmania (i.e., site investigations and associated geotechnical studies) and published literature listed above.

The GIR is presents the geotechnical interpretation for the Project including the information used, the development of the interpretation from a regional scale to individual project elements including the development of project specific model components and culminates in the presentation of a geotechnical interpretation for each project element.

This has been achieved by characterising the components of the Engineering Ground Model into project specific soil and rock mass unit classifications and structural geology domains.

Ground investigation data is presented and interpreted relative to those units and domains that occur across the project area to inform the characterisation and/or design parameters for each unit and domain.

The report concludes with the presentation of a geotechnical interpretation for the project alignment. Commentary is also provided on design considerations for each element of the project works. This includes advice regarding geotechnical risks and uncertainties including geohazards.

### 4.3 Hydrogeological Interpretive Report

A Hydrogeological Interpretive Report (HIR) has been prepared to inform Hydro Tasmania of the hydrogeological conditions for the Project and provide context regarding civil construction and environmental risks predominantly associated with the Project tunnels. It is based on review of existing geological, geotechnical, and hydrogeological data, from site investigations. The hydrogeological information comprises:

- The hydrogeological setting
- Organisation of relevant site investigation data for application in hydrogeological assessments
- A hydrogeological conceptual model, including:
  - Definition of surface water catchment boundaries and flow systems
  - Characterisation of groundwater recharge sources:
    - Direct recharge from rainfall
    - Losing streams, that is recharge to aquifer via infiltration and percolation from streams
    - Perched water bodies, that is recharge to aquifer via infiltration and percolation from perched water bodies
  - Baseline water table elevations with relationship to surface waters
  - Groundwater to surface water interactions, that is baseflow contributions to stream flow
  - Conceptualisation of dolerite fracture zone characteristics, including definition of local and catchment-scale flow
  - Conceptualisation of palaeovalley aquifer characteristics, including definition of anisotropy and heterogeneity
  - Development of Hydrogeological Rock Mass Units (HRMUs) with applied hydraulic properties.
- Conceptual hydrogeological cross sections to inform numerical modelling
- Surface water and groundwater quality
- Numerical groundwater modelling informed by the conceptual model, including:
  - Steady-state calibration
  - Baseline water balance
  - Potential groundwater inflow ranges during tunnel driving
  - Drawdown developed during tunnel excavation
  - Potential development of springs during conveyance operation
  - Potential tunnel water loss ranges during conveyance operation
  - Potential elevated pore pressures within the Tarraleah hillside during operation.

## 5. Landslide Hazards

### 5.1 Landslip Hazard Codes

Landslip hazard bands developed by MRT and referenced in the TPS SPP have been reproduced for the Project area in Appendix A. These bands reflect the outcome of a qualitative desktop assessment for the susceptibility of slopes based on geology, soil types, and steepness, and if the land has been or is a landslip. The planning maps have different hazard bands for the susceptibility of the land to landslip which is grouped into the following categories:

- Acceptable
- Low
- Medium
- Medium Active
- High

The majority of the project area is located on the gently inclined Tarraleah plateau. Due to the benign nature of this terrain, it is “not rated”, therefore being attributed an “acceptable” hazard band. Areas with more prominent relief and steeper terrain are classified with a combination of “low” to “medium” susceptibility hazard bands. These include:

- The flanks of the Wentworth Hills in the west
- The Niver River Valley to the east.

The two respective transmission line options (Northern and Southern) both ascend the eastern slope flanks of the Nive Valley before continuing along rolling terrain within the respective easements.

## 5.2 Active Slope Processes

Portions of the Project area founded in steeper terrain have a documented history of landsliding resulting in numerous instabilities across a range of scales which include the following mechanisms:

- Translational Debris and Rockslides
- Rotational Debris and Earthslides
- Rock Topple
- Solifluction Flows
- Debris flows and floods.

Whilst additional slope movement types cannot be discounted, based on the observed engineering geological conditions the mechanisms listed above are assessed to be the most likely to occur within the Reference Design alignment. We note the term “landslide” is used in this instance as an overarching slope movement term. Inset 8 outlines a series of sketches showing specific landslide movement types.

Understanding the mechanisms controlling stability, including the relative age and rate of slope failure, provides valuable perspective when assessing future detachment probabilities, event magnitudes and travel distances. As part of the engineering geological model development “geological indicators” were identified that may contribute to the development and triggering of landslide mechanisms. These indicators include:

- Lithostratigraphy changes including rock mass character and strength
- Geomorphological signatures including scarps, tension cracks, debris runout and hummocky ground
- Changes in the patterns of geological structure including:
  - Relative orientations
  - Increased persistence or aperture
  - Reduction in spacing.
- Zones of increased weathering or erosion through physical or chemical processes
- Presence of and changes in groundwater seepage throughout the hill slope.

The penstocks and associated anchor blocks from the original conveyance are founded at surface and form a fundamentally rigid, linear structure that is sensitive to slope movements. The Reference Design has attempted to mitigate the risk of landslides in locating the infrastructure for the project underground. Tunnel access portals, power station and portions of the respective transmission line easements are the primary components exposed to landslide hazards, but these elements have been configured so as not include large scale excavates or slope modifications.

The Redevelopment has the potential to introduce an additional landslide trigger whereby leakage from the power tunnel results in elevated pore pressures within the hillside rock mass. Due to the depth of influence, tunnel leakage has the potential to exceed the impact of high intensity / long duration rainfall events which has the potential to remobilise ancient deep-seated mechanisms. This has been considered as part of the underground works design for the power tunnel on approach to the proposed power station.

Material		ROCK	DEBRIS	EARTH
Movement type				
FALLS		<p>Rock fall</p>	<p>Debris fall</p>	<p>Earth fall</p>
		<p>Rock topple</p>	<p>Debris topple</p>	<p>Earth topple</p>
SLIDES	Rotational	<p>Single rotational slide (slump)</p>	<p>Multiple rotational slide</p>	<p>Successive rotational slides</p>
	Translational (Planar)	<p>Rock slide</p>	<p>Debris slide</p>	<p>Earth slide</p>
SPREADS	<p>e.g. cambering and valley bulging</p>			<p>Earth spread</p>
FLOWS		<p>Solifluction flows (Periglacial debris flows)</p>	<p>Debris flow</p>	<p>Earth flow (mud flow)</p>
	COMPLEX	<p>e.g. Slump-earthflow with rockfall debris</p>	<p>e.g. composite, non-circular part rotational/part translational slide grading to earthflow at toe</p>	

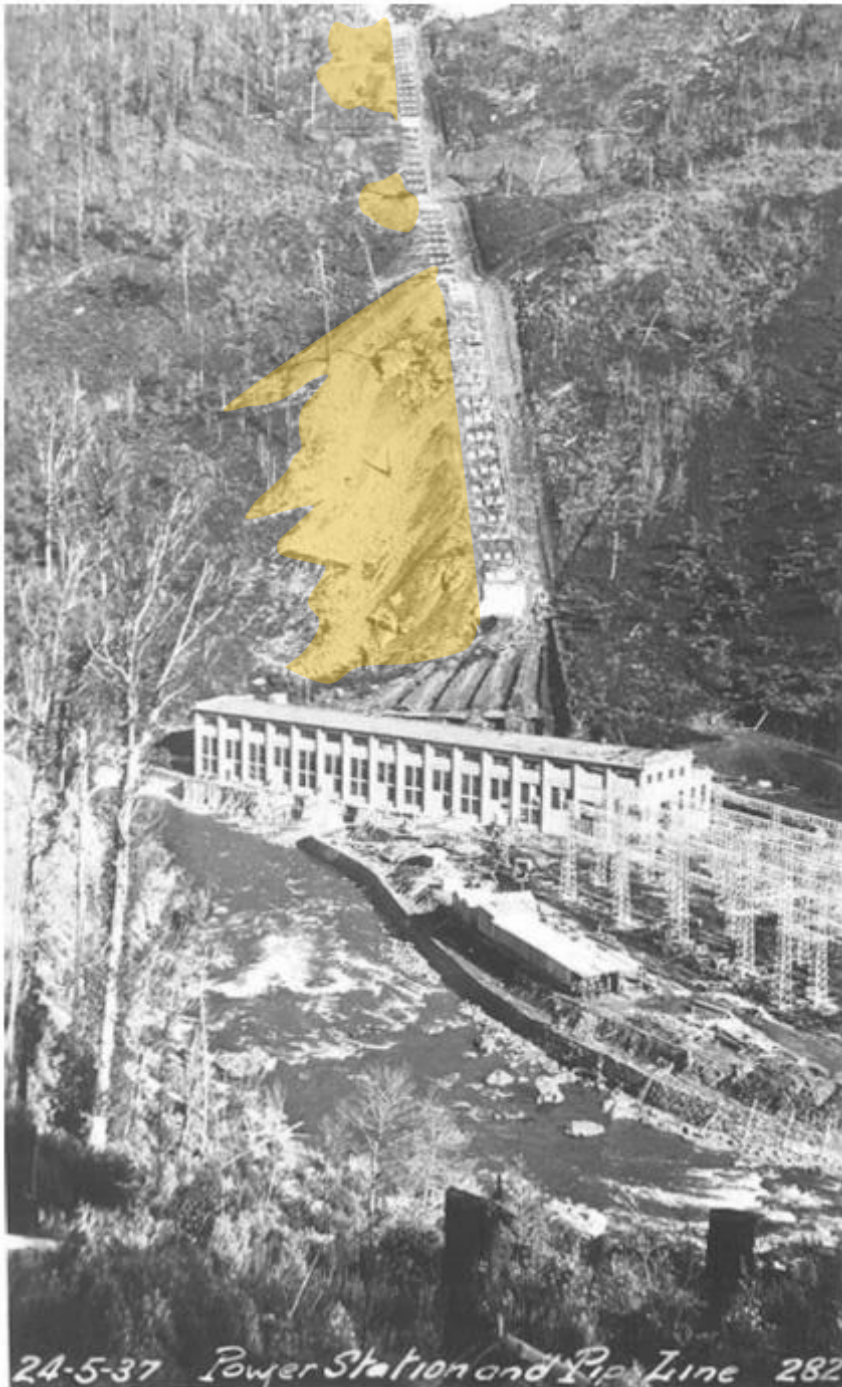
Inset 8: Schematic of landslide types (from the British Geological Survey).

## 5.3 Slope Evolution and Relative Movement History

### 5.3.1 Tarraleah Hillside

Excavation of the Penstock foundations occurred during the 1930s to establish a construction corridor down the Tarraleah hillside. Construction photography (Photo 1) captures an example of excavated material side cast down slope. Review of the site DEM indicates that this material largely remains in storage on the slope as uncontrolled fill. Minor surficial debris slides are documented within the slopes adjacent to the penstock alignment between construction and the 1970s and is susceptible to remobilisation during high rainfall events.

Vehicle tracks developed for construction and maintenance access have also been cut into the slope over time. These are noted to divert and concentrate surface water runoff with the potential to saturate isolated portions of the slope. There is established precedent for uncontrolled surface water run off to act as a triggering mechanism for point release instabilities as documented by G Hale in the 1971 penstock landslide report (Photo 2).



**Photo 1:** Oblique view looking up penstock alignment from left bank of the Nive River during construction in 1937. Side case spoil from foundation excavations highlighted in orange.



**Photo 2: View looking down penstock alignment following release of a localised mudslide/debris flow on the downslope side of the penstocks in 1971 (highlighted red). Photo source: Geologist\_Landslip at Tarraleah Penstock\_17 Jan 1972.pdf.**

Additional images captured during the construction period show the hillside with relatively sparse mature vegetation, a distinct contrast from the towering radiata and eucalypt trees present today. Photo 3 provides a benchmark for the geomorphic slope evolution where multiple medium scale landslides are preserved with discernible head scarps and subsequent downslope colluvial lobes. These observations help to inform and calibrate estimates for detachment probability and recurrence intervals for similar sizes events within the slope.

Construction of the Lyell Highway occurred during development of the hydroelectric scheme and involved a cut and fill excavation to allow the road to side down the Tarraleah hillside toward the south before crossing the Nive River. The road traverses through the stratigraphic profile with exposures of Tertiary Basalt and a small interval of Tertiary Sediments before the Jurassic Dolerite is encountered from approximately 465 mRL. The alignment crosses a number of postulated structural lineaments and a complex zone of large ancient landslides.

Impacts of the road relating to potential slope instabilities and landslide hazards includes diversion and concentration of surface water flow from upslope sources and sheeting down pavement. Review of the LiDAR DEM also indicates a portion of the excavated material may have been side cast with localised areas of accumulation resulting in increased slope gradient and loading adjacent to the road crest.

The road is reported to have experienced multiple episodes of minor instability (slumping, cracking, displacement, and mudslides) with the most recent failure occurring in 2009 following a heavy rain event (Photo 4). We understand this instability was investigated with an engineering geology model and subsequent remediation advice provided by Pitt and Sherry.



**Photo 3:** Oblique view of the wider Tarraleah slope during penstock construction in 1937. Note the lack of mature vegetation on the slope. Localised shallow debris slide highlighted in red and provide context for slope evolution and detachment timing.



**Photo 4:** View looking northwest of 2009 remediated failure beneath Lyell Highway. Timber posts presumably installed as part of these works are heavily degraded. A distinctive benched profile is visible downslope. Note cubic rock block in foreground of photograph is associated with an isolated mechanism.

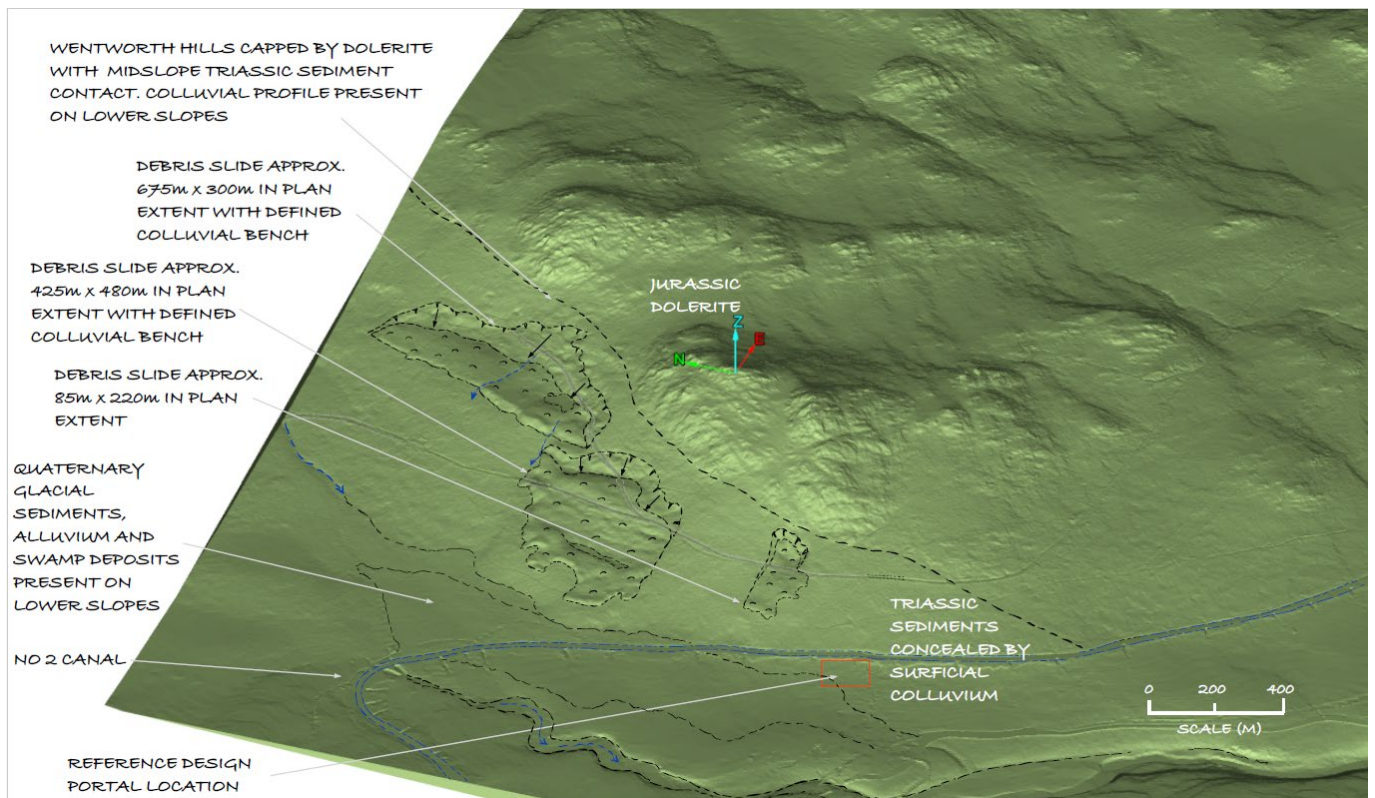
### 5.3.2 Wentworth Hills

At the western portal of the headrace tunnel, the southwestern margin of the Jurassic Dolerite sill is exposed on the flanks of the Wentworth Hills where it overlies Triassic sediments of the Upper Parmeener Supergroup in the west and north (Butlers Gorge area and along the flanks of the Wentworth Hills). A colluvial profile overlies the lower flanks of the Wentworth Hills concealing the discordant contact between the Jurassic Dolerite and Triassic Sediments.

Review of LiDAR DEM topography for the area immediately north of the western head race portal identified three distinct debris slides, Inset 9. These are characterised by arcuate head scarps ranging in width from 85 m to in excess of 650 m with vertical offsets of up to 40 m. The corresponding low angle colluvial bench profiles beneath extend downslope between approximately 200m and 500 m. The mechanisms are interpreted to be structurally controlled where sliding commonly develops within the predominantly fine-grained sandstone and siltstone. Steep to subvertical orthogonal joint planes allow surface water runoff to concentrate within the during periods of heavy rainfall leading to elevated pore water pressure and triggering slope movements.

Detachment histories are unknown with no documented evidence of recent movement. Forestry access tracks have been constructed through the slide mass and head scarps of the existing features on the slope which are otherwise vegetated.

During operation, there is potential for increased pore pressures should leakage occur from the tunnel and charge the slope. Due to the increased landslide susceptibility of the Triassic Sediments this will need to be managed as part of the design process, relating to the tunnel plug in the upper head race tunnel. The reference design headrace tunnel portal is located at the foot of the slope, beneath the existing No. 2 canal. The overhead exposure at this location is reduce (relative to site further to the north) due to the morphology of the Wentworth Hills and corresponding discordant contact.



**Inset 9:** Oblique view of lower slopes of Wentworth Hills DEM looking northeast. Debris slide signatures illustrated in surficial colluvium based on desk study, review of LiDAR and supplementary field observations.

## 5.4 Trigger Mechanisms

Potential triggering mechanisms identified as part of the broader landslide hazard assessment for the Project include:

- Rainfall
- Changes in groundwater condition (Pore Pressure)
- Seismic loading
- Slope modification

The following sub-sections discuss specific elements known to influence landslide activity.

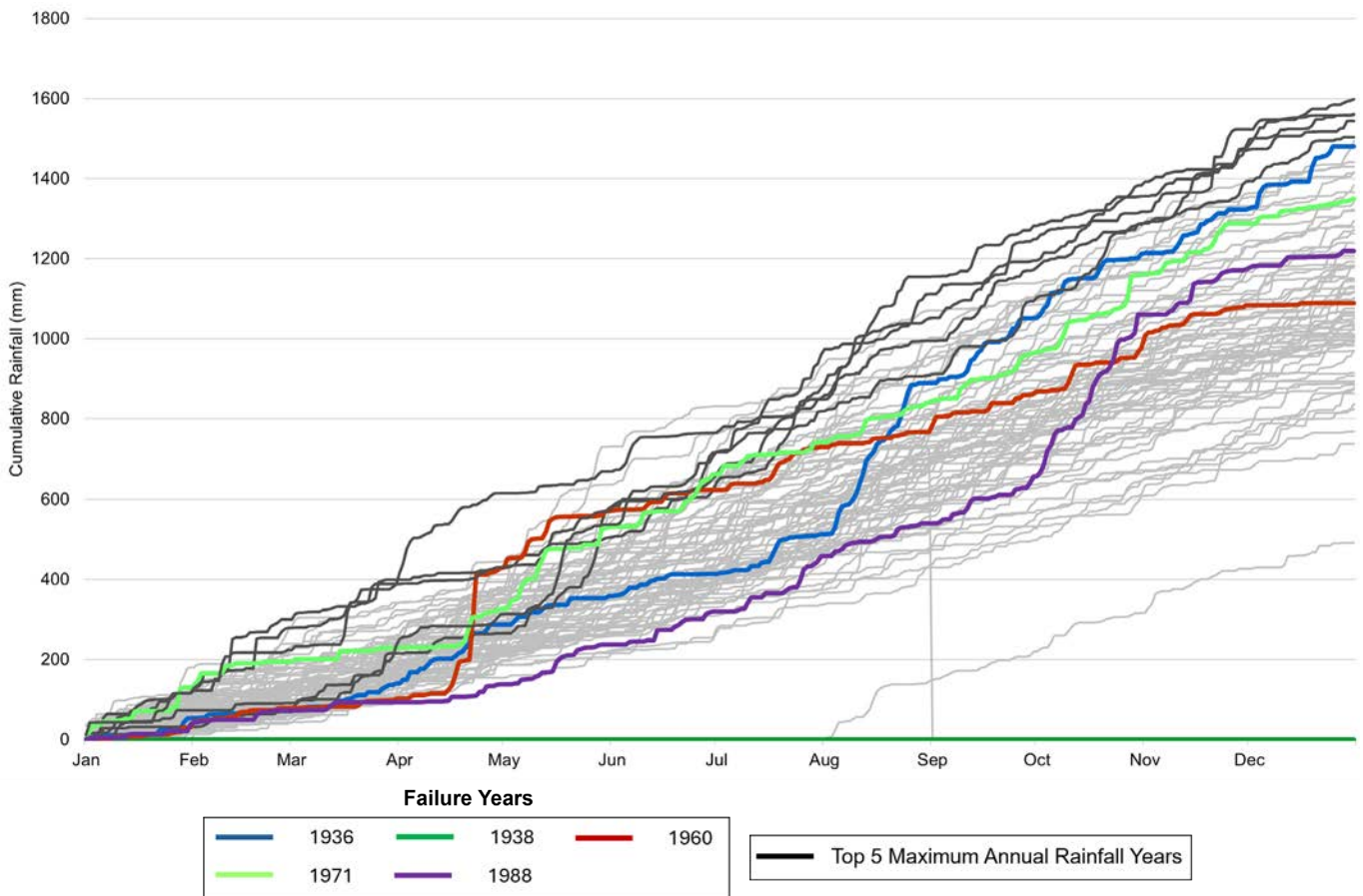
### 5.4.1 Rainfall

Intense or prolonged rainfall resulting in elevated pore water pressures are an established trigger mechanism for debris slide, flow and flood hazards. If uncontrolled, subsequent surface water runoff can also generate immense erosion potential, particularly on the steep slopes of the Tarraleah hillside.

As discussed in Section 3.1, Tarraleah is in a high precipitation, cool-temperate climatic region of central Tasmania with a mean annual rainfall of approximately 1160 mm and a peak daily total of 132 mm. While winter months are associated with high precipitation there does not appear to be an established seasonal or climatic trends that can be associated with landslide occurrence.

#### 5.4.1.1 Annual Cumulative

Inset 10 presents cumulative annual rainfall data between 1936 and 2012 (Tarraleah Village Station (95018)). The solid black lines represent the five highest annual recorded rainfall years. Interestingly, the coloured lines represent years where historic landslide activity is recorded on the Tarraleah hillside.



**Inset 10:** Cumulative annual rainfall since 1936. Coloured lines – indicate years in which failures occurred on the Tarraleah Hillside. Black lines – indicate the 5 highest annual rainfall years (1946, 1948, 1964, 1975, and 1996). Note 1938 (dark green line) has no associated rainfall data.

The event year series do exhibit intense rainfall over shorter time periods of time. In 1936 approx. 400 mm of rainfall fell in roughly three and a half weeks, in 1960 approx. 300 mm of rain fell over a period of 7 days, and in 1988, approx. 500 mm of rain occurred in the month of October. Unfortunately, the exact dates of the 1936, 1938, and 1960 slides are unknown, but the 1988 slide occurred on 18 October, placing it at the latter stages of the intense rainfall that occurred that month. Through this analysis, these relatively short but intense periods of rainfall act as a trigger mechanism and may be a more reliable indicator for predicting potential/future landslides.

#### 5.4.1.2 Intensity-Frequency-Duration (IFD)

Looking at rainfall over short time periods, Intensity–Frequency–Duration (IFD) curves provide a statistically-based estimate of the likelihood of a specific rainfall depth being recorded at a particular location within a defined time duration i.e. the probability of an amount of rain in a certain time period (burst rainfall).

This is generally classified by an Annual Exceedance Probability (AEP) or Exceedances per Year (EY):

- Annual exceedance probability (AEP): the probability or likelihood of an event occurring or being exceeded within any given year, expressed as a percentage
- Exceedances per year (EY): the number of times an event is likely to occur or be exceeded within any given year.

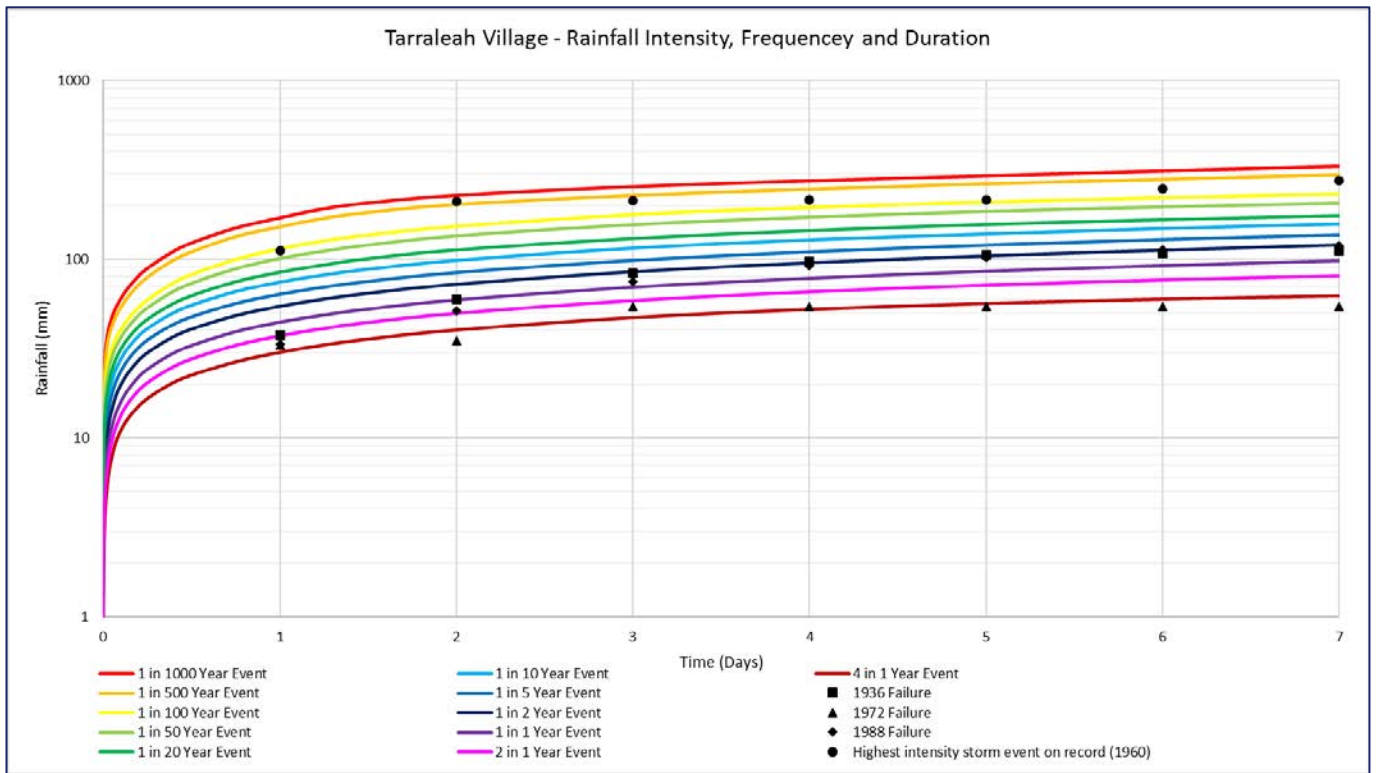
There are five broad classes of design rainfalls that are currently used for engineering design purposes, generally categorised by frequency of occurrence:

1. Very Frequent – 12 EY to 1 EY.
2. Frequent – 1 EY to 10% AEP.
3. Infrequent – 10% to 1% AEP.
4. Rare – 1 in 100 AEP (1%) to 1 in 2000 AEP.
5. Extreme – >1 in 2000 AEP.

IFD curves do not take into account the probability of cumulative rainfall occurring (leading to high antecedent totals) but rather the probability of the maximum burst intensity of a rainfall event occurring. IFD charts, therefore, provide valuable context when assessing and calibrating past events or considering potential future events. This is particularly important when using rainfall as a proxy for landslide triggers. Inset 11 presents the current published IFD curve for Tarraleah Village BOM Station. We note that IFD charts can be produced for specific locations as required and have been used as a point of reference for analysis within this assessment.

Base on the available records we conclude the following:

- The hillside has only experienced a single 1:500-year event in the last 100 years (1960)
- Other documented landslide events with rainfall data occurred with equivalent to less than 1:10-year intensities.
- Larger antecedent rainfall over extended periods (see Inset 10) are interpreted to have greater influence on landslide occurrence and individual storm events.



**Inset 11: Intensity–Frequency–Duration Plot for Tarraleah.**

### 5.4.1.3 Climate Change

Climate change is acknowledged to increase the potential for increased intensity and duration rainfalls events to occur more frequently. This is supported by observations made in Hydro Tasmania’s review a recent rock fall event on the No.1 Canal.

“.. Rainfall data from two monitoring stations have been reviewed, namely the Tarraleah Sewerage Ponds (located nearby with data available from Jan 2017) and Butlers Gorge (located 20kms away with data available from 1941). Upon reviewing the Tarraleah Sewerage Ponds station, the following conclusions were made about the rainfall in 2025:

- 2025 experienced the wettest September since 2017 and it was 40mm wetter than the previous maximum recorded in 2017.
- 2025 experienced the wettest September and October total rainfall since 2017 even with 15 days remaining until the end of October.
- Based only on the first 15 days of October in 2025, it has been the 3rd wettest October since 2017 with 15 days remaining until the end of October.

Furthermore, upon reviewing the Butlers Gorge station, September 2025 was the 3<sup>rd</sup> wettest month on that particular rainfall record...”

### 5.4.2 Groundwater

Rainfall and subsequent surface water runoff resulting in elevated pore water pressures are considered to be the dominant trigger mechanism at the site for both debris flow and debris sliding hazards within the Project area.

If the existing Tarraleah surface conveyance or proposed pressurised conveyance as part of the Redevelopment project was to provide a leakage pathway to charge the local aquifer system above baseline levels. There is potential for elevated pore water pressure to be exerted within the near surface rock mass. A change to the phreatic surface has the potential to trigger landslide hazards if not suitably managed or mitigated. This risk has been identified as part of the design process and where necessary, will be mitigated through a combination of the following measures:

- Grouting during tunnel excavation and installation of primary ground support to reduce potential leakage during operation
- Ongoing monitoring of groundwater throughout operations



- Provisions for installation of drainage measures within susceptible slopes to manage pore water pressures.

Both leakage and changes to pore water pressure will be monitored via a piezometer network installed throughout the project area. This will allow changes to the baseline condition to be identified, providing the ability to adapt to potential risks if required based on a series of trigger thresholds and associated actions.

### 5.4.3 Seismic Loading

A site-specific seismic hazard assessment has been completed for the Nive River<sup>2</sup>. The results from the assessment indicate that the horizontal component Peak Ground Accelerations (PGA's) for the site are very low, Table 3. This level of seismic shaking is unlikely to trigger landslide hazards in the local terrain.

**Table 3: PGA Values for Selected Return Periods (AECOM, 2022)**

Return Period (years)	Peak Ground Acceleration (g)	Probability of Exceedance in 50 years (%)
475	0.01040	10
1000	0.01825	5
2000	0.03025	2.5
5000	0.05635	1

### 5.4.4 Slope Modification

Potential excavations related to the Tarraleah Redevelopment Project will include geotechnical design input to manage ongoing stability, including material placement and the location of stockpiles and therefore will not present the same level of risk that may have been associated with the construction of the Tarraleah Power Station (TAPS).

Based on the Project's Reference Design, no bulk excavations or surcharge loads (spoil piles, or scheme infrastructure) have been included in areas that could be susceptible to slope instability through landsliding. Excavations related to construction of temporary works elements will need to be adequately designed by the contractor to manage slope stability throughout the duration of the works.

## 6. Landslide Risk Assessment

### 6.1 Previous Assessments

Numerous slope risk assessments have been completed on the Tarraleah Hillside since the construction of the penstocks in the 1930's. These assessments predominantly focused on the slope movement processes with the potential to impact the existing penstocks, anchor blocks or associated structures, and did not consider the proposed redevelopment.

### 6.2 Tarraleah Redevelopment

As stated in Section 4, **due to the commercially sensitive nature of documentation completed as part of the project procurement, inclusion of specific details is limited due to probity considerations.**

A quantitative landslide risk assessment has been completed for the Tarraleah Redevelopment project in accordance with AGS (2007) for the main project elements. The study includes a detailed analysis of the following:

- Hazard identification
- Frequency analysis
  - Landslide inventory (historical analysis)
  - Geological emplacement
  - Geomorphological evolution
  - Predictive hydrogeological flow modelling
  - Rainfall and groundwater monitoring records

<sup>2</sup> AECOM, Tarraleah Redevelopment: Separable Portion 1: Nive River. Probabilistic Seismic Hazard Assessment dated 10 October 2022.



- Consequence analysis
  - Elements at risk
  - Probability of spatial impact
  - Temporal spatial probability
  - Vulnerability
- Risk estimation
  - Individual and societal risk to life during construction and operation phases
- Risk management and mitigation

In a parallel study completed by Hydro Tasmania, using inputs from the quantitative landslide risk assessment, the broader business risk was assessed using the Integrated Business Risk Management (IBRM) framework. The IBRM defines common consequence descriptions to enable the tolerable exposure of their power generation infrastructure to be assessed against an annualised probability of damage relative to the following business risks:

- Health and Safety (Risk to life)
- Natural Environment
- Social and Cultural Heritage
- Reputational
- Legal and Compliance
- Economic
- Strategic Initiatives
- Project Delivery

Both the AGS (2007) landslide risk assessment and the IBRM review of potential consequences demonstrated that a tolerable risk level could be maintained for risk to life (individual and societal) and associated business risks throughout the 80 year design life of the project.

## 7. Landslide Management – Hydro Tasmania

Hydro Tasmania’s assets are exposed to several natural hazards (bushfire, extreme rainfall events, landslides, etc.) due to the geographically diverse locations that the assets are located within and the fact that Hydro Tasmania takes advantage of rapid changes in elevation for efficient power generation.

For potential landslides on the Tarraleah hillside (the land between Tarraleah Village and the Power Station) which supports the six above ground penstocks that transfer the water from Lake King William to the power station, the management of the natural hazard is through a combination of routine monitoring, surveillance and maintenance activities.

Societal risk within the station and compound is managed by minimising the exposure of operators/maintainers with personnel only on site for operations and maintenance activities. The site is not permanently staffed with the nearby Tungatinah Power Station being permanently manned during working hours.

Table 4 summarises Hydro Tasmania’s current landslide management practices.

**Table 4: Hydro Tasmania Landslide Risk Management - Tarraleah Hillside**

Activity	Frequency	Details
<b>Inspections</b>		
Routine visual Inspection of the hillside/penstocks	Fortnightly and post large rainfall events	Inspection by trained operator utilising binoculars and drones.
Routine Engineering Inspection	Annual inspection	Inspection by civil engineer
Detailed Engineering Inspection	5 Yearly and post extreme rainfall events	Inspection by senior geotechnical engineer
Special Engineering Inspection	Post Extreme Event	Inspection by specialist team
<b>Monitoring</b>		
Rainfall	Remotely monitored rainfall gauge	Telemetered rainfall gauge at Tarraleah village with trigger alerts/alarms
Groundwater	Remotely monitored groundwater	Telemetered 5 vibrating wire piezometers with trigger alerts/alarms
Deformation	5 Yearly detailed survey	Undertaken by licensed surveyor
Seismicity	Remotely monitored seismograph	Telemetered seismograph at Tarraleah with trigger alerts/alarms
Data review	Monthly, Annually and Five Yearly	Monthly by civil engineer, annually by geotechnical engineer and 5 Yearly by senior geotechnical engineer
<b>Maintenance</b>		
Vegetation maintenance	Annually and post large rainfall events	
Drainage	Annually and post large rainfall events	Routine maintenance and cleaning of surface drains and swales/sub surface pipelines

## 8. Conclusions and Compliance with Planning Codes

The proposed Tarraleah Redevelopment project includes a surface pipeline, pressurised headrace and power tunnels, surge tower and associated pump station, access tunnels, power station and transmission lines. These elements are to be developed following a financial investment decision on the Project and execution of contracts for the final design and construction.

In preparation for the procurement of this contract, Hydro Tasmania, with support of their integrated owners engineering team have developed a Reference Design and minimum performance, functional and technical requirements to be met by the works. The project has a proposed design life of 80 years.

The majority of the Project area is located on the gently inclined Tarraleah plateau. Due to the benign nature of this terrain it is “not rated”, therefore being attributed an “acceptable” hazard band, based on the Mineral Resources Tasmania hazard zoning. Areas with more prominent relief, including the flanks of the Wentworth Hills in the west and Nive River Valley to the east presents steeper terrain and are classified with combination of “low” to “medium” susceptibility hazard bands.

Portions of the project area founded in steeper terrain have a documented history of landsliding resulting in numerous instabilities across a range of scales which include the following mechanisms:

- Translational Debris and Rockslides
- Rotational Debris and Earthslides
- Rock Topple
- Solifluction Flows

- Debris flows and floods.

The TPS SPP calls for works to be undertaken such that a “tolerable level of risk” can be maintained for the life of the Project. The quantitative landslide risk assessment completed for the project in accordance with AGS (2007) demonstrates compliance with this condition can be achieved based on the Reference Design alignment.

This also aligns with Hydro Tasmania’s public risk appetite statement<sup>3</sup> “*we have a low appetite for risks that affect the safety of our people and the public, cause damage to the environment, affect our cybersecurity, and which relate to our obligation to comply with laws and regulations.*”

In addition, all civil elements (roads, cut slopes, portal cuts, transmission line towers etc) included in the final arrangement will be designed to engineering standards and appropriate geotechnical “factors of safety” or where active landslides are encountered, the AGS guideline may apply. These will be included by Hydro Tasmania in the contractual requirements for the future contractors who are responsible for the design and construction.

These provisions direct the works to meet or exceed to requirement for a tolerable level of risk. The Reference Design documentation is prepared to be sufficient to support approvals under both the local and the state planning schemes (LPS and SPP).

## 8.1 Tasmanian Planning Scheme Requirements

The following sub sections provide our concluding responses to specific requirements stated within C15 of the SPP in relation to the proposed Tarraleah Redevelopment Project.

### 8.1.1 C15.3.1

Table 5 provides a structured response to the use standards and building works development standards performance criteria (C15.3.1)

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<sup>3</sup> <https://www.hydro.com.au/about-us/our-governance/management-approach>

**Table 5: Response to SPP C15.3.1 Requirements**

SPP Requirement	Response (Tarraleah Redevelopment)
(i) Whether the use or development is likely to cause or contribute to a landslip event on the site or adjacent land	The project is not expected to materially cause or contribute to landslip events beyond the baseline condition. Potential increases in pore water pressure from tunnel leakage can be managed through a combination of grouting, drainage, and monitoring. Off-site impacts are expected to be negligible.
(ii) Whether the use or development can achieve and maintain a tolerable risk for the intended life of the development, having regard to:	The project is designed to maintain tolerable risk over its 80-year life, consistent with AGS (2007) landslide risk guidelines and Hydro Tasmania’s IBRM framework.
a. Nature, intensity & duration of the use	Hydropower generation is long-term and continuous; risk is tolerable under design measures.
b. Type, form & duration of any development	Predominantly underground conveyance tunnels with surface facilities at either end of the project alignment. All civil elements (roads, cut slopes, portal cuts etc) will be designed to engineering standards and appropriate geotechnical “factors of safety”.
c. Likely change in risk across life of development	During operations (following rebound of the groundwater table post construction), the landslide risk is expected to remain consistent through the design life.
d. Ability to adapt to change in risk	Ongoing monitoring of asset function during operation – response protocols permit adaptation if required.
e. Ability to maintain access to utilities & services	The alignment layout ensures uninterrupted access to utilities to avoid service isolation.
f. Need for on-site landslip reduction/protection measures	Engineering controls will be considered during detailed design (geotechnical safety factors, grouting, drainage and slope stabilisation where required).
g. Need for beyond-site reduction/protection measures	No beyond-site works anticipated; off-site risk negligible.
h. Landslip management plan in place	Hydro Tasmania implements an established landslide management program: inspections, monitoring, and maintenance.
(iii) Any advice on ongoing management	Ongoing landslide risk management will follow Hydro Tasmania’s established program, including inspections, rainfall and groundwater monitoring, vegetation and drainage maintenance, and defined response protocols.
(iv) Matters required by Performance Criteria	<ul style="list-style-type: none"> <li>• <b>C15.5.1 (Use in hazard area):</b> Tolerable risk is expected to be achieved.</li> <li>• <b>C15.6.1 (Buildings/works):</b> Civil works designed to geotechnical standards.</li> <li>• <b>C15.7.1 (Subdivision):</b> This performance criteria is not applicable to proposed development</li> </ul>



## 8.1.2 C15.5 and C15.6

Table 6 provides a structured response to the use standards and building works development standards performance criteria (C15.5 and C15.6).

**Table 6: Response to SPP C15.5 and C15.6 Requirements**

SPP Clause & Context	Performance Criteria (P-*)	Response (Tarraleah Redevelopment)
C15.5 – Use Standards	—	—
P1.1	Use within landslip hazard area must: (a) regard type, form & duration of use; and (b) be backed by a hazard report showing risk is negligible or tolerable.	(a) Hydropower generation is long-term, continuous, and essential; (b) Hazard Report (Quantitative landslide risk assessment undertaken in accordance with AGS (2007)) demonstrates tolerable risk over the 80-year design life can be maintained.
P1.2	If landslip measures beyond site are required, written consent of affected landowners is needed.	No external protection measures are expected to be required; site-contained engineering controls will suffice.
P2	For critical uses – must demonstrate continued functioning during an event and minimal impact on infrastructure.	While not formally a ‘critical use’, the project is resilient by design and will maintain safe operation, service access and monitoring systems.
P3	For hazardous uses – must consider safety of people, property, and environment.	Not applicable – the project does not involve hazardous storage; residual landslip risk is mitigated by design and monitoring.
P4	For vulnerable uses – must consider evacuation, self-protection, and emergency plans.	Not applicable – not a vulnerable use.
C15.6 – Building & Works Standards	—	—
P1.1	Works must (a) consider type, form, scale & duration; (b) assess risk increase; (c) include authority advice; (d) be supported by a hazard report.	(a) Infrastructure is appropriately scaled and durable; (b) no need for extraordinary measures; (c) design complies with geotechnical standards and authority guidance; (d) Hazard Report supports conclusions.
P1.2	Report must show buildings/works don’t cause or contribute to landslip on or off site.	Engineering design ensures stability, with drainage and structural safeguards; no destabilising impacts expected.
P1.3	If external measures needed, written consent from affected owners required.	Not applicable – no off-site protection measures required.

Yours Sincerely



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ASSOCIATE ENGINEERING GEOLOGIST



**RICHARD BREHAUT**  
PRINCIPAL ENGINEERING GEOLOGIST

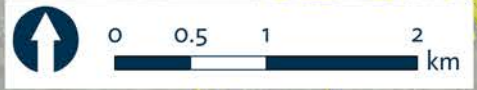
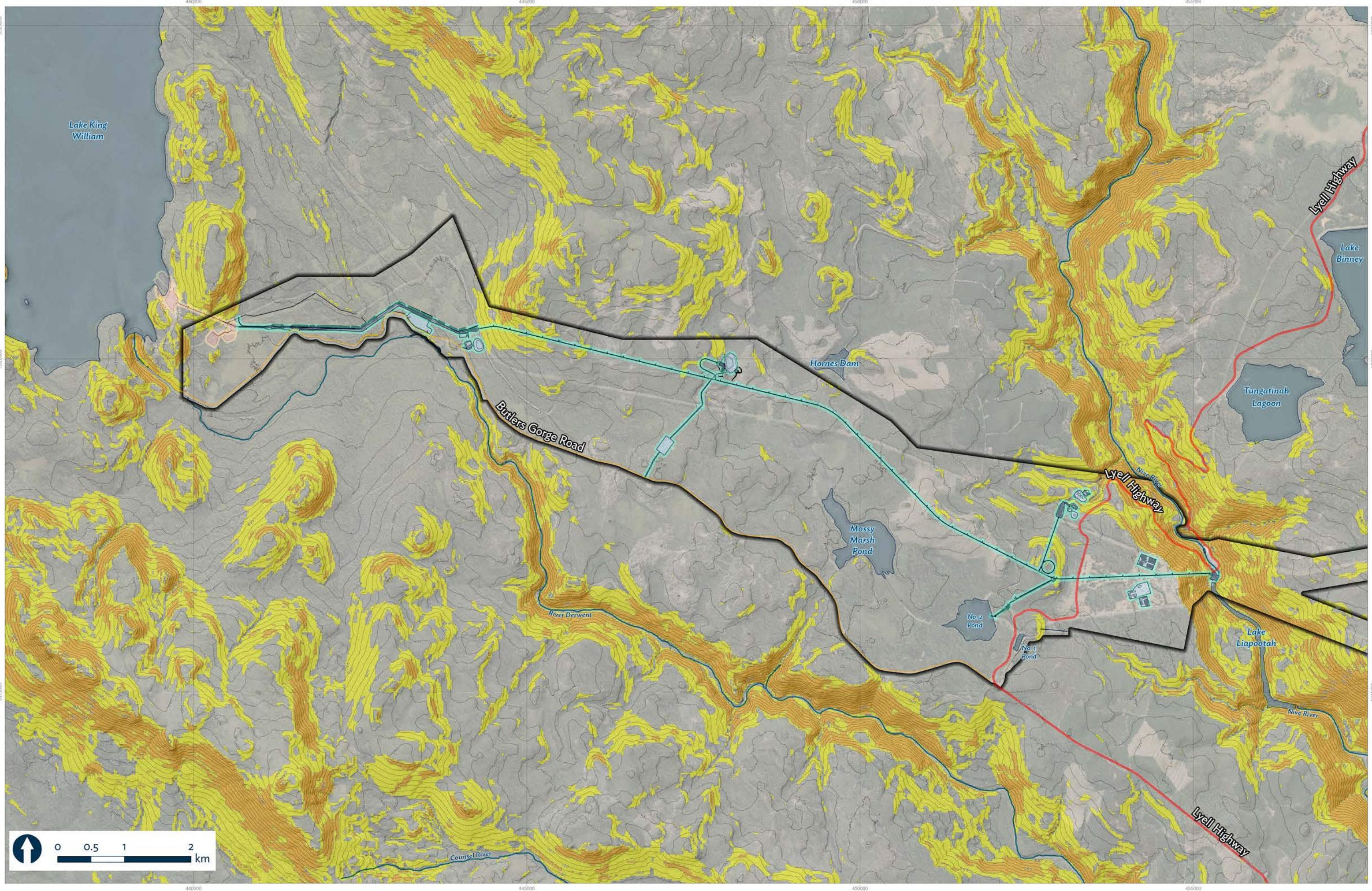
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# Appendix A

## Landslide Hazard Maps

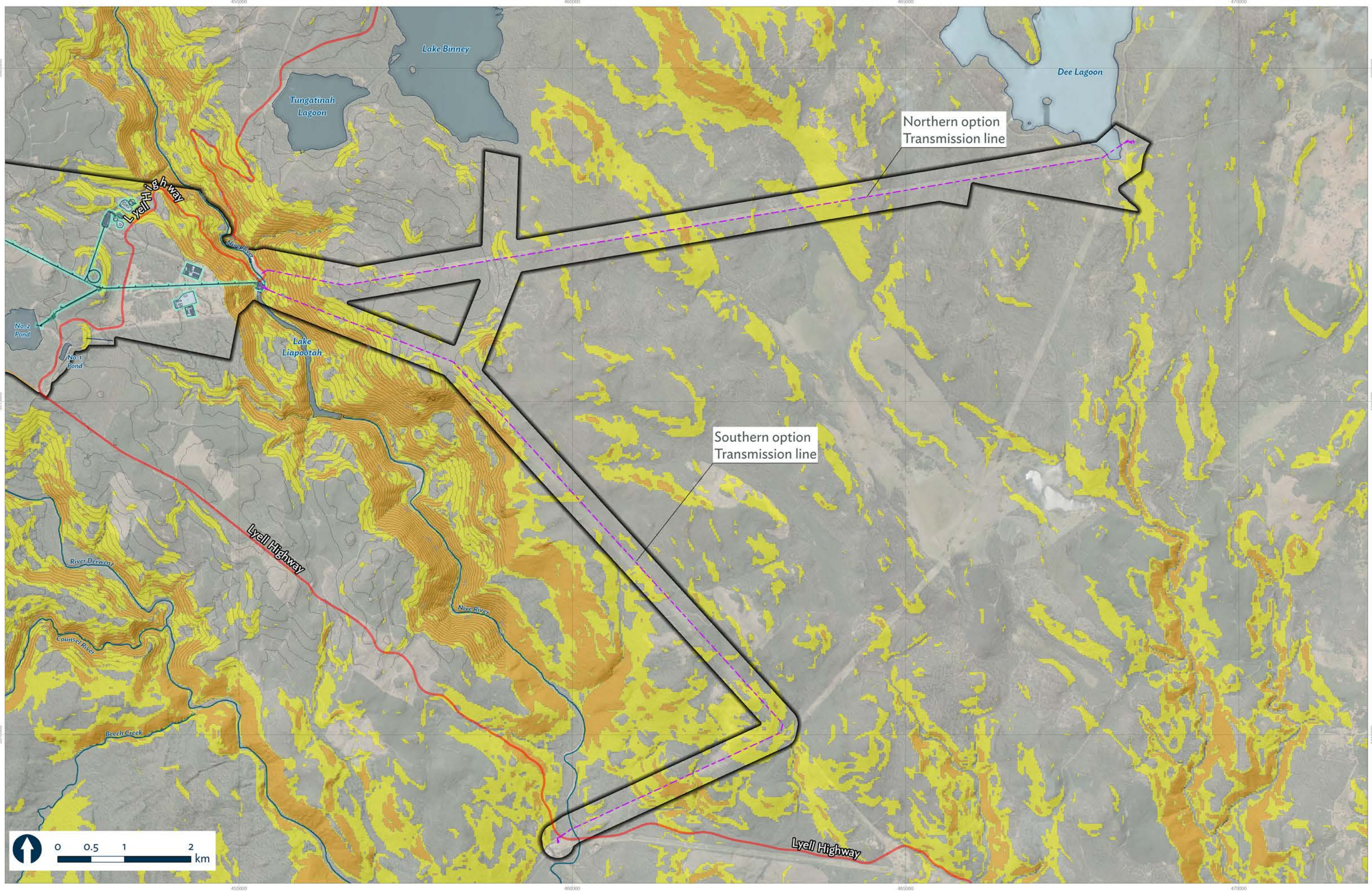




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 Verified by: S. Casartelli  
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 Revision: 2  
 Scale: 1:50,000 @A3  
 GDA2020 MGA Zone 55  
 \*Intended to be printed at A3\*

- |  |   |  |
|--|---|--|
| <ul style="list-style-type: none"> <li><span style="display: inline-block; width: 15px; height: 10px; border: 1px solid black; margin-right: 5px;"></span> Lake King William Upgrade Works</li> <li><span style="display: inline-block; width: 15px; height: 10px; border: 1px dashed black; margin-right: 5px;"></span> Tarraleah Redevelopment - Reference Design</li> <li><span style="display: inline-block; width: 15px; height: 10px; border: 2px solid black; margin-right: 5px;"></span> Tarraleah Project Area</li> </ul> | <ul style="list-style-type: none"> <li><span style="display: inline-block; width: 15px; height: 10px; background-color: yellow; margin-right: 5px;"></span> Low</li> <li><span style="display: inline-block; width: 15px; height: 10px; background-color: orange; margin-right: 5px;"></span> Medium</li> </ul> | <ul style="list-style-type: none"> <li><span style="display: inline-block; width: 15px; border-bottom: 1px solid black; margin-right: 5px;"></span> Local Road</li> <li><span style="display: inline-block; width: 15px; border-bottom: 2px solid red; margin-right: 5px;"></span> National/State Highway</li> </ul> |
|--|---|--|



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Date: 11/12/2025  
 Prepared by: A. Wahyudi  
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- Alignment:**
- Lake King William Upgrade Works
  - Tarraleah Redevelopment - Reference Design
  - Tarraleah Project Area
- Landslip Hazard Bands**
- Low
  - Medium
- Other Features:**
- Local Road
  - National/State Highway
  - Transmission line option