Aurizon Berrimah Freight Terminal Expansion

Storm Surge Assessment

Aurizon Operations Ltd

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Revision Record

Revision	Date	Prepared By	Checked By	Authorised By
V1.0	21 August 2023	Deborah Maxwell	Hayden Munck / Helen Doherty	Helen Doherty
V1.1	10 February 2024	Craig Smith	Jill Woodworth	Craig Smith

Basis of Report

This report has been prepared by SLR Consulting NZ Ltd (SLR) with all reasonable skill, care and diligence, and taking account of the timescale and resources allocated to it by agreement with Aurizon Operations Ltd (the Client). Information reported herein is based on the interpretation of data collected, which has been accepted in good faith as being accurate and valid.

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Acronyms and Abbreviations

AHD	Australian Height Datum
ARI	Average Recurrence Interval
HAT	Highest Astronomical Tide
PSSZ	Primary Storm Surge Zone
SSSZ	Secondary Storm Surge Zone

1.0 Introduction

Aurizon Operations Limited (Aurizon) is investigating the extension of the existing Berrimah Freight Terminal at East Arm near Darwin to create a larger terminal with an integrated logistics focus, which provides an ability to service both bulk and containerised freight. The development would provide large container storage area and potential warehousing or colocation with incumbent freight forwarders.

The existing Berrimah Terminal is located on the East Arm, 20km from Darwin City Centre. The terminal runs through Darwin's East Arm to Darwin Port. The existing railway and associated infrastructure divides the East Arm between north and south. The proposed extension would develop the area to the north of the existing infrastructure (**Figure 1**).

This report describes the storm surge risk of the Project site and potential impacts associated with the proposed expansion of the Berrimah Freight Terminal.

Figure 1. Project location.

2.0 Existing environment

The site's topography is presented in **Figure 2** based upon LiDAR derived from surveys between 2001 and 2015. Elevation is typically below 5m AHD, with small areas of residual native cover that reach 15m AHD. This is typically lower in elevation compared to the area to the south which is generally above 10m AHD and has a maximum elevation of 33m AHD. The area immediately adjacent to the Project is generally between 5m AHD and 6m AHD.

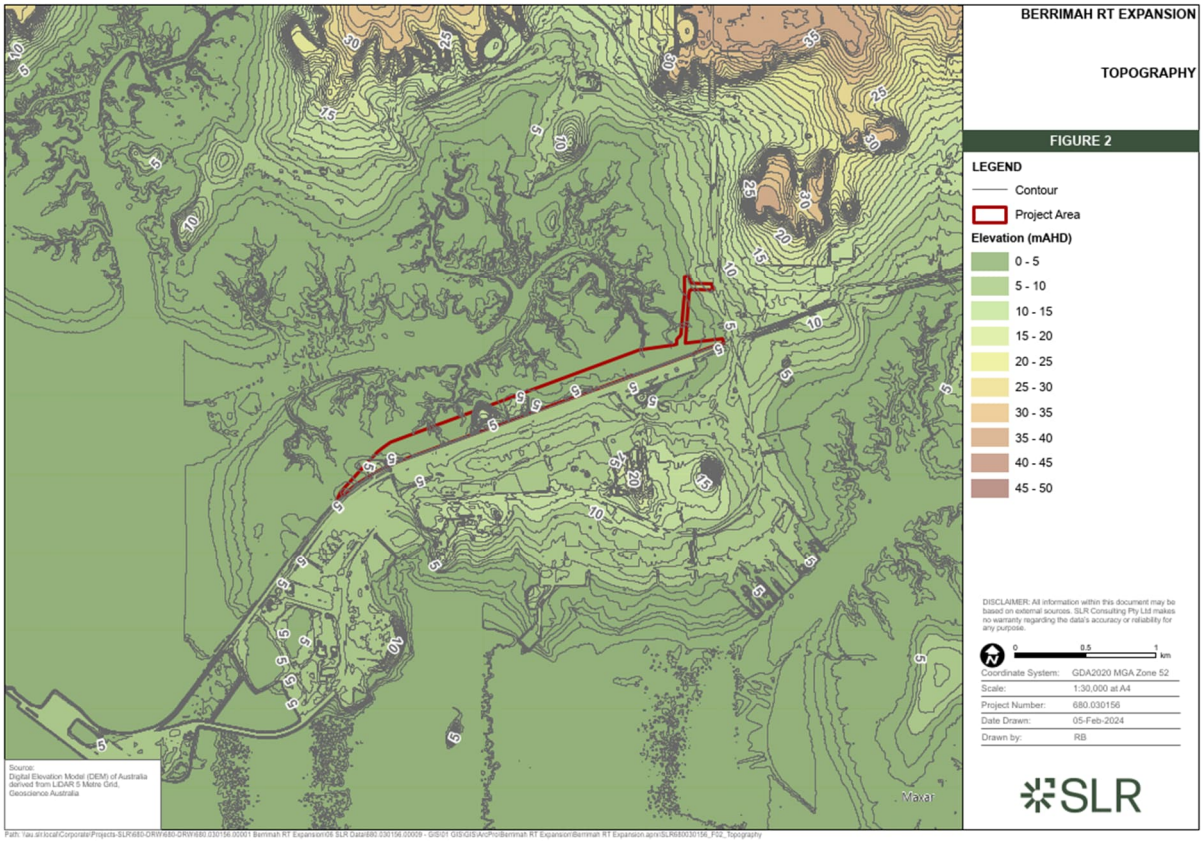


Figure 2. Topography in the vicinity of the Project.

Given the coastal low-lying terrain, the area is at risk from storm surge. A storm surge is an abnormal rise in sea level during a storm. While minor storm surges may occur with most storm events, significant storm surges are generally associated with tropical cyclone activity. The Northern Territory (NT) experiences cyclones, on average, one to two times per year. The most significant was Tropical Cyclone *Tracy* in 1974. Due to the effects of climate change, the predicted increases in cyclone intensity and higher sea levels will increase storm surge frequency and severity.

The extent to which a given portion of the coast may be affected by storm surge resulting from the passage of a tropical cyclone is influenced by many factors such as storm intensity, size, speed and angle of approach to the coast and the coastal bathymetry (SEA, 2010).

Storm surge inundation modelling and mapping was developed for the NT Government by Systems Engineering Australia Pty Ltd (SEA, 2006 and 2010) for two statistical Average

Recurrence Intervals (ARI). This defined the total storm surge hazard due to tropical cyclones in terms of the ocean water level as the combined effects of astronomical tide plus storm surge plus wave setup. It also shows the estimated Highest Astronomical Tide (HAT) extent.

Highest Astronomical Tide is the highest ocean level expected due to any combination of astronomical conditions alone and has an equivalent ARI of approximately 18.6 years. The HAT extent is used in **Figure 3** as the reference for storm surge inundation. It is based on estimates of HAT levels derived from numerical hydrodynamic modelling that has not been verified by long term *in-situ* measurements.

Two storm surge zones are presented. The "Primary Storm Surge Zone" (PSSZ) refers to the extent of inundation for a storm tide event of a 100-year ARI. It is based on a storm surge elevation of 5.1 m AHD. The "Secondary Storm Surge Zone" (SSSZ) refers to the extent of inundation for a storm tide event with a 1000-year ARI and an elevation of 6.4 m AHD. Although the extents do not include the possible effects of very localised wave runup, they do present the combined risk from storm surge with a predicted 0.8 m sea level rise (**Figure 3**).

The extent of the Primary Storm Surge Zone covers most of the northern section of the East Arm, up to the existing Alice Springs Darwin Railway. The railway line and adjacent rail facilities are within the Secondary Storm Surge Zone.

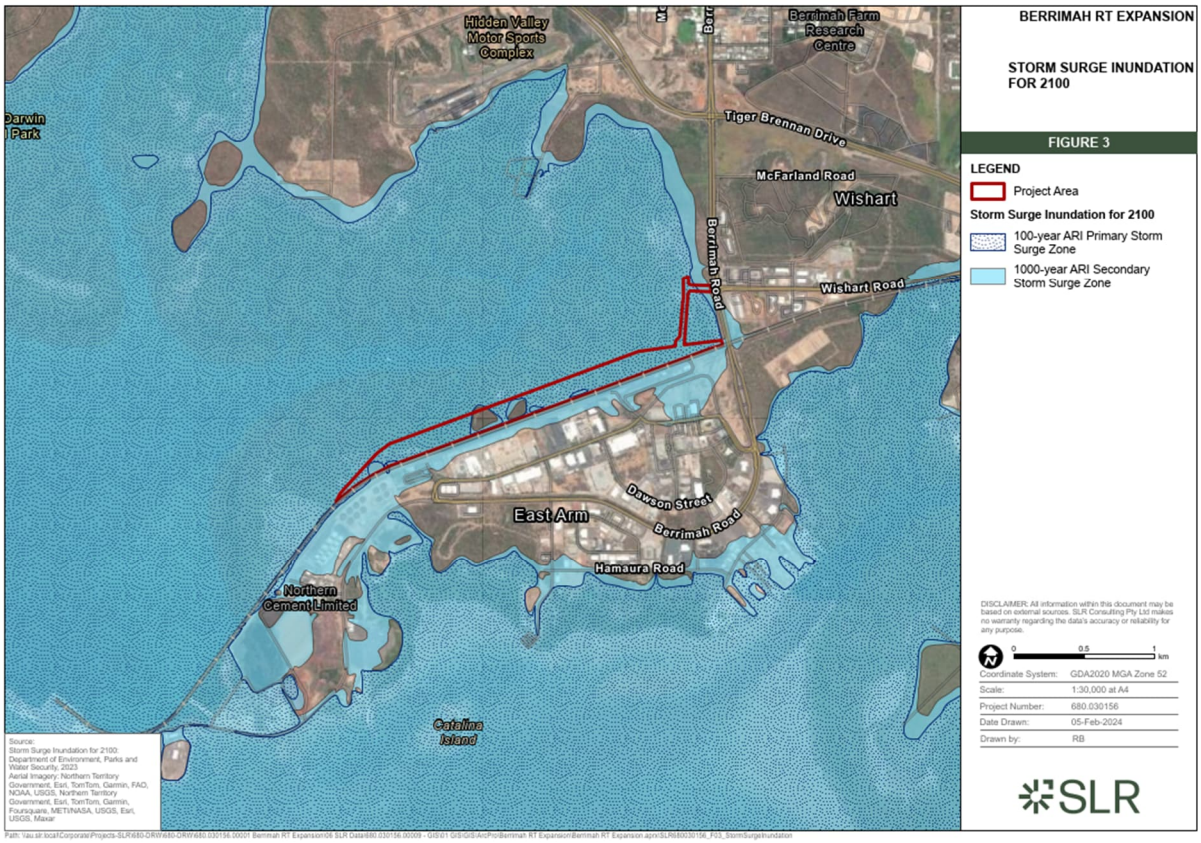


Figure 3. Storm surge inundation for 2100, 100-year ARI Primary Storm Surge Zone and 1000-year ARI Secondary Storm Surge Zone.

For the Darwin region, SEA (2010) show that the predicted 1,000-year surge magnitudes will increase as a result of the assumed increases in tropical cyclone peak intensities. The combined storm tide levels show a general increase in response to the changing climates and sea level rise.

3.0 Potential impacts

The Project lies within the PSSZ. Two small areas of residual native vegetation that have a higher elevation are not within the PSSZ or SSSZ. The existing infrastructure is within the SSSZ, although much of the land south of the existing railway is above both storm surge areas.

The proposed Freight terminal expansion Project will not impact the occurrence or magnitude of storm surges affecting the East Arm. However, the Project would be considered potentially susceptible to storm surge effects due to the Projects coastal location within the PSSZ.

4.0 Management

As noted above, the Project will not impact the frequency or intensity of storm surge.

Currently, the PSSZ is constrained by the outer seawall of the existing freight terminal. The Project will be constructed to the same elevation as the existing freight terminal and therefore finished ground levels will be situated above the 100-year ARI storm surge level and the Project will provide a barrier to storm surge inundation.

The Project will be protected from inundation by the seawall, constructed to withstand the potential for overtopping from storm surges and the potential impacts of sea level rise including climate change effects. In the event of a storm surge overtopping, there will be no additional risk to people and property; the Project is adjacent to existing rail infrastructure that would also have been impacted by overtopping storm surge. Water will drain through the existing and proposed drainage network of the rail terminal site. Although there would be potentially more people in the hazard area, given there is generally advanced weather warning of these events so enough time for people to respond and evacuate.

5.0 Predicted outcomes and commitments

The following commitments are proposed for the project:

- The proposed Project will not impact the occurrence or magnitude of storm surge events.
- Storm surge inundation modelling and mapping indicates the Project is within the PSSZ for a storm tide event of 100-year ARI in the year 2100. There is some existing infrastructure is within the SSSZ. The Project will be constructed to the same elevation as the existing freight terminal, i.e., finished ground levels will be situated

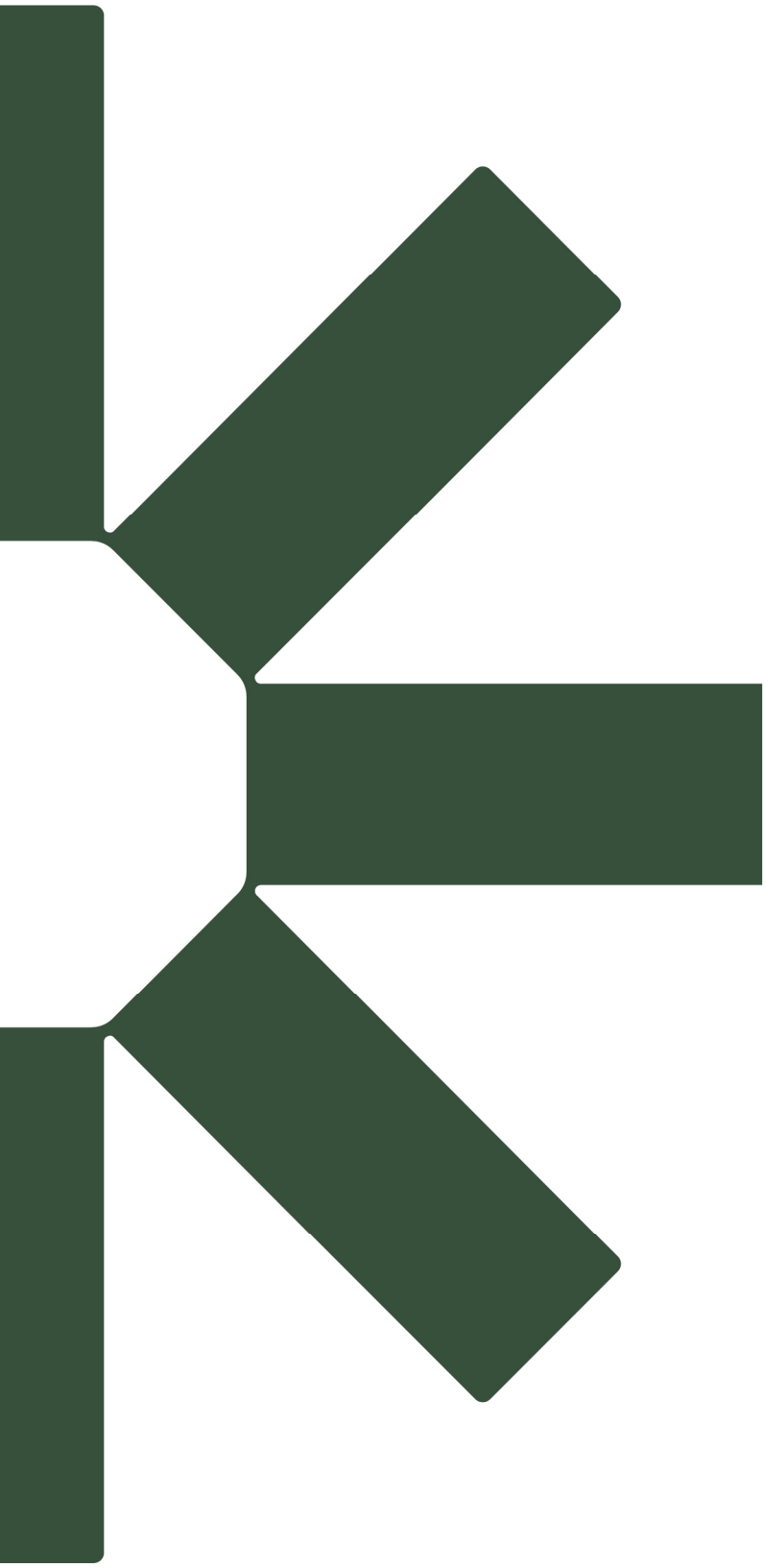
above the 100-year ARI storm surge level, which will provide a barrier to storm surge inundation.

- Any overtopping of hardstand areas will present no additional risk to people and property. Water would be drained through the existing and proposed drainage network of the rail terminal site.
- The potential for overtopping from storm surges, particularly in cyclonic conditions, and the potential impacts of climate change and sea level rise, will be considered in the detailed design of the Berrimah Terminal Expansion Project to ensure that appropriate immunity is achieved in the final construction.

6.0 References

SEA (2006) High Resolution Storm Tide and Climate Change Impacts Study - 2010. Prepared by Systems Engineering Australia Pty Ltd for NT Department of Lands and Planning, SEA Report J0911-PR001B, 83pp.

SEA (2010) Darwin Storm Tide Mapping Study 2010. Prepared by Systems Engineering Australia Pty Ltd for NT Emergency Services, SEA Report J0606-PR001C, 119pp, Nov. SEA, 2006 and 2010



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