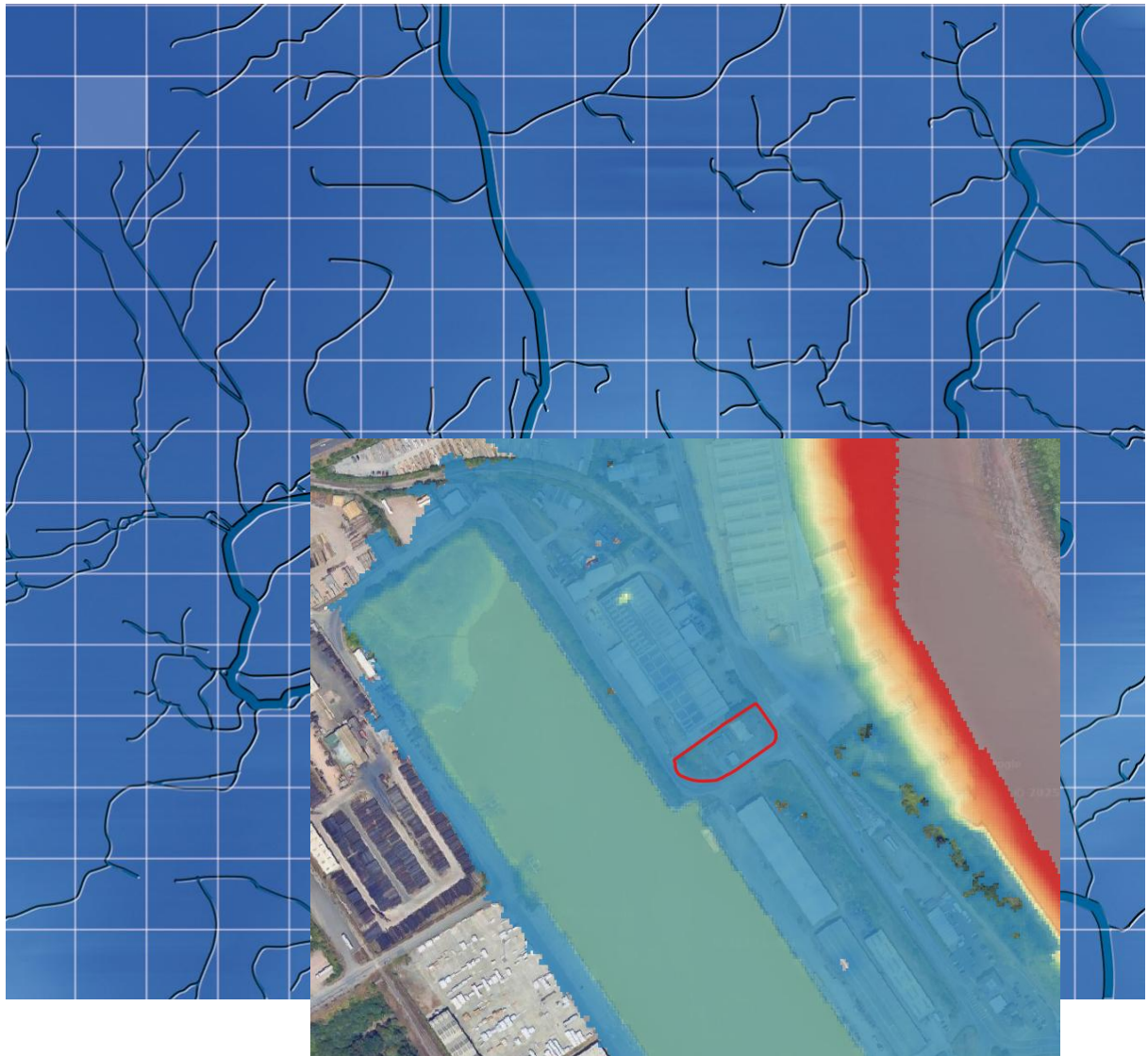


Burroughs

May 2026

Newport Docks Substation

Level 2 Flood Consequence Assessment



Burroughs

Newport Docks Substation Level 2 Flood Consequence Assessment

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For and on behalf of Wallingford HydroSolutions Ltd.

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Newport Docks Substation Level 2 FCA

Flood Risk Overview

	Present Day	Future Risk
Fluvial Flood Risk	L	L
Pluvial Flood Risk	L	L
Tidal Flood Risk	L	M
Confidence in Assessment	M	M

Flood Risk

The present-day risk to the substation is considered to be low. This based on the available modelling data, which indicates the site is flood free during the 0.1% Annual Exceedance Probability (AEP) flood event due to the presence of tidal flood defences. However, the substation is at risk during the design 0.5% AEP tidal event plus climate change event.

Recommended design levels for the site have been informed by a sensitivity analysis of the proposed ground levels for the substation compound. The first option at the site is to raise ground levels across the compound to 9.4 m AOD. Under this scenario, the compound is flooded with the maximum modelled flood level across the site 9.6 m AOD during the 0.5% AEP plus climate change event. For this option, any external critical infrastructure within the substation compound must be raised to a minimum of 10.1 m AOD (the 9.6 m flood level plus the required 500 mm freeboard). The second option is to raise the compound to 9.8 m AOD. In this scenario the substation remains entirely flood-free during the design event and the requirement for elevated individual asset is reduced.

The confidence in the assessment is moderate. It is based on detailed model data obtained from NRW however, the model was developed in 2016 and applies the old 2011 Coastal Design/Extreme Sea Levels dataset. These levels are more extreme than the most recent 2018 update, so the flood levels informing this assessment are considered to present a worst-case scenario.

Risk Management

The switch room building, with a proposed FFL of 10.1 m AOD is flood-free for the design event. The transformers with critical asset level of 10.5 m AOD are also not considered at risk of water damage.

It is recommended that all other external critical assets are raised to 10.1 m AOD (i.e., 500mm above the maximum modelled flood level of 9.6 m AOD). Alternatively, based on the sensitivity analysis the compound may be raised to 9.8 m AOD to achieve a flood-free status and reduce the requirement for any other external critical asset raising.

If a more detailed flood level is required to inform detailed design, then it is recommended that the tidal boundaries in the existing 2016 Wentlooge model is updated and re-run.

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Appendix 1- Topographical Survey

1 Introduction

1.1 Background

Burroughs has commissioned Wallingford HydroSolutions Ltd to complete a Level 2 Flood Consequence Assessment (FCA) for a proposed National Grid Electricity Distribution (NGED) substation at Newport Docks, Pillgwenlly, Newport (NGR: 331624, 185825). This FCA has been developed in accordance with the Technical Advice Note (TAN) 15¹ and assesses all sources of flooding using existing flood risk datasets to support to change of use of existing land from commercial/industrial land into the proposed substation.

Where there is a risk of flooding, this risk has been quantified with the existing datasets and any associated limitations with the assessment have been identified. The target level of protection for the substation is the 0.5% Annual Exceedance Probability (AEP) plus climate change event. This will be referred to as the 'design event'.

Where applicable, recommendations for improving our understanding of flood risk and/or managing the risk has also been included in this report.

1.2 Project Scope

The scope of the FCA includes:

- Liaison with Natural Resources Wales (NRW) to obtain available detailed hydraulic modelling
- Where appropriate, liaise with the Lead Local Flood Authority (LLFA) and NRW Internal Drainage District to obtain any additional local flood risk data
- Review the location of the substation with respect to nearby watercourses, topographic features and constraints
- Identify any recorded historic flood events affecting the site
- Assess flood risk from fluvial, pluvial and reservoir or defence breach
- Identify a design flood level for the 0.1% Annual Exceedance Probability (AEP) Flood Event, along with any limitations in this design flood level (i.e., 1 in 1000yr flood event)
- Where appropriate, make recommendations on how confidence in the design flood level can be improved and, if applicable, make recommendations for managing flood risk

1.3 Report Structure

This FCA follows the structure summarised below:

- 1 - Introduction (this section)
- 2 - Sources of Information
- 3 - Site Description
- 4 - Flood Risk
- 5 - Risk Management

¹ Planning Policy Wales. Technical Advice Note (TAN) 15: development, flooding and coastal erosion. Welsh Government. March 2025.

2 Sources of Information

The sources of information that have been used in this assessment are summarised in Table 1.

Table 1 – Sources of Information

Data Source	Details
Natural Resources Wales - National Flood Risk Data	Flood Risk Mapping Data ² , including fluvial, pluvial, tidal, reservoir and other flood management features such as historic flooding, flood defences, flood storage areas and areas benefiting from defences.
Natural Resources Wales - Local Flood Risk Data	NRW has provided the 2016 Caldicot and Wentlooge Coastal Models ³ and outputs.
Lead Local Flood Authority	Newport City Council, which operates as the LLFA, has not been contacted as the flood risk affecting the site is from main river and tidal flooding which is the responsibility of NRW.
Internal Drainage District	The substation is not located within a NRW Internal Drainage District.
LiDAR data	LiDAR Data ⁴ of the site and immediate area at 1m resolution.
Topographical Survey	Topographical survey and PAS128 survey data for the Alexandra docks and East Way Road ⁵
Site Layout	Proposed new planning application drawing showing new primary substation compound and land ownership ⁶ .
Updated site levels agreed with National Grid Electricity Distribution (NGED)	Correspondence with NGED related to levels of general compound and key electrical infrastructure.

² Natural Resources Wales (2025). *Flood Map for Planning - WMS Mapping Service, various links*. Accessed June 2025.

³ CaldicotAndWentlooge_5_V1.0_2016. JBA consulting. June 2016

⁴ Welsh Government LiDAR Tile Catalogue (2022). <https://datamap.gov.wales/maps/lidar-viewer/view#/>. Accessed June 2025.

⁵ Topographical survey and PA128 survey. Lucion Survey Ltd. April 2025. Drawing No. 670414 0

⁶ Alexandra Docks 33/11kV substation. National Grid. March 2025. Drawing No. AXD0001

3 Site Description

3.1 General Location Plan

The proposed substation site is located at an existing commercial and industrial area in Newport Docks, Pillgwenyll, Newport, see Figure 1. The site is located on the eastern side of the Newport Docks along East Bank Road and is directly adjacent to the North Dock waterbody. South of the site is the North Quay and extended dockside infrastructure that continues towards the operational areas of Newport Docks.

3.2 Topography

The existing topographic survey of the site covers the entirety of the proposed site, and it includes the existing infrastructure at the site. Ground levels provided in the survey data appear to correlate well to LiDAR data which is shown in Figure 2. This is based on a direct comparison between the two datasets. The topographical survey is provided in Appendix 1.

Based on the LiDAR data, both the site and the immediate surrounding area are relatively flat, with less 0.50 m between the maximum (9.33 m AOD) and the minimum (8.85 m AOD) ground levels within the site.

3.3 Nearby Watercourses

The closest watercourse is the River Usk which flows southerly approximately 175 m east of the site, Figure 1. The Ebbw River also flows southerly approximately 1 km west of the site. These rivers continue south into the Severn Estuary approximately 5 km south of the site. The North Dock – a large water basin within the port area – is also directly adjacent to the site.

The River Usk and Severn Estuary are significant tidal features influencing local flood risk and as such are included in the national flood map for rivers and sea held by the NRW. The mapping indicates site lies within the NRW Flood Zones. NRW also have additional model data covering this area allowing for further analysis of flood risk to the site.

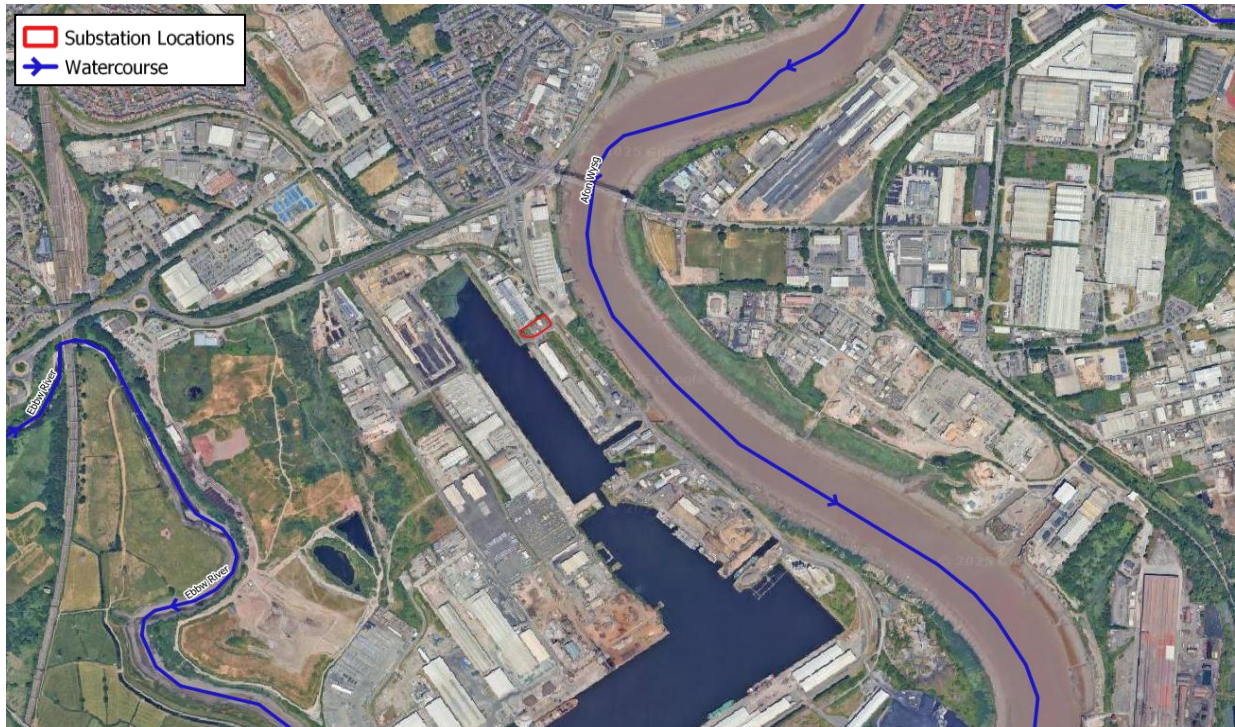


Figure 1 - Site Location

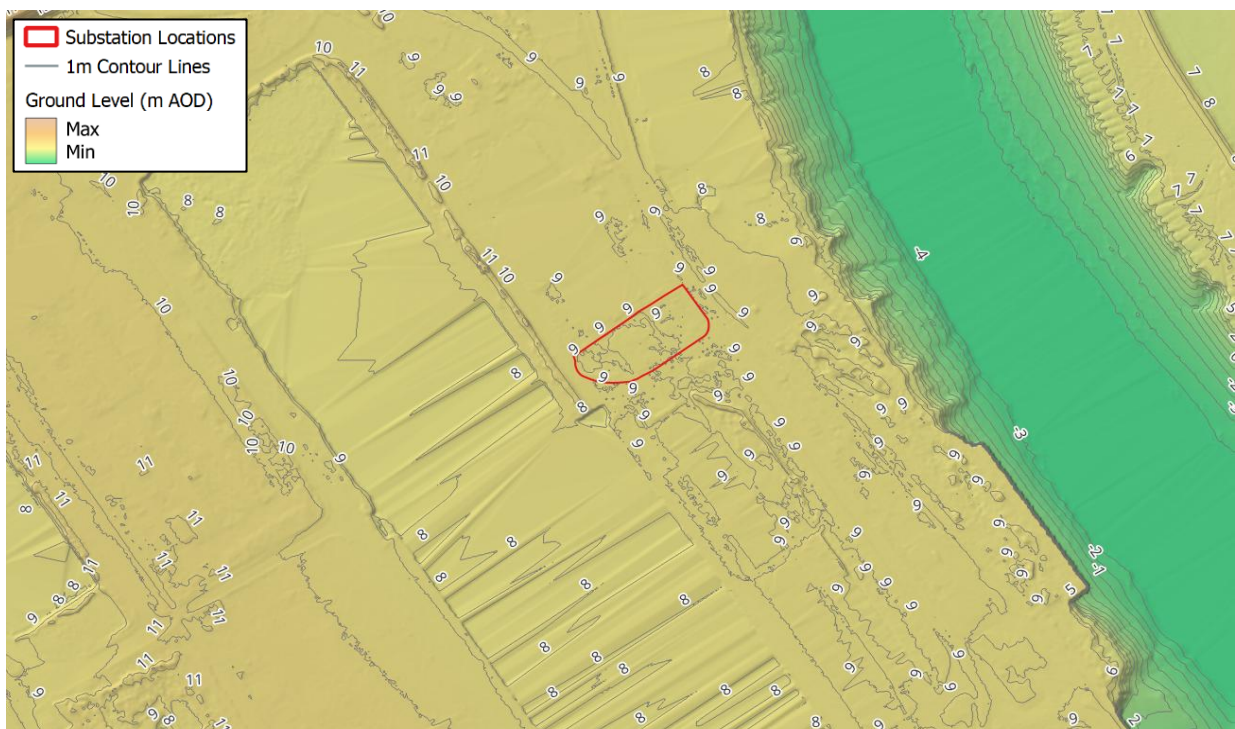


Figure 2 - Topography

3.4 Identified Assets and associated Critical Levels

The key assets from the proposed substation have been identified based on the latest substation layout, see Figure 3.

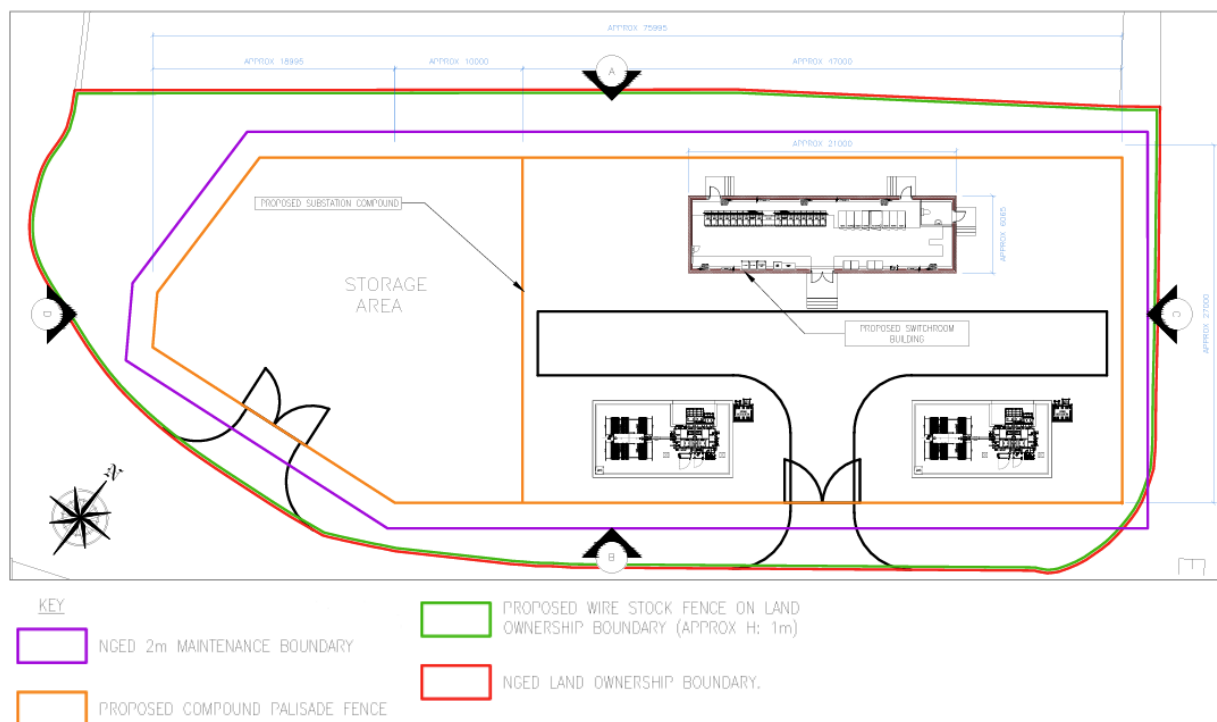


Figure 3 – Proposed Site Layout

Current spot levels at these assets have been derived based on the topographical survey data. The proposed levels at these assets have been confirmed following design coordination with National Grid Electricity Distribution (NGED). Table 2 provides a summary of the levels associated with the identified assets. The spot level locations are shown in Figure 4.

Table 2 - Summary of Spot Levels

ID	Asset Description	Source	Surveyed Ground Level (m AOD)	Post-development levels [†] (m AOD)
1	Switch room building (FFL)	Topographic Survey	9.1	10.1
2	Transformer 1 (Critical Level*)	Topographic Survey	9.2	10.5
3	Transformer 2 (Critical Level*)	Topographic Survey	9.0	10.5
4	Car park, storage and general compound	Topographic Survey	9.1	Min. 9.4 / Max. 9.8

* The transformers will have a top of foundation slab level of 9.5 m AOD. They will also have 1m of built-in flood resilience, resulting in a critical asset level of 10.5 m AOD.

† The post-development levels are discussed in more detail in section 5.3. The minimum and maximum levels stated for the general compound (ID:4) are detailed in the sensitivity analysis (section 5.3.1).



Figure 4 - Location of Assets

4 Flood Risk

4.1 Historical Flooding

NRW has no record of historic flooding at the location of the substation. The closest record of flooding is 1.0 km to the southeast of the substation. This event occurred in December 1981 and was associated with the River Usk.

4.2 Fluvial Flood Risk

The national Flood Map for Planning (FMfP) for rivers and sea held by NRW indicates the substation site lies within Flood Zone 3, i.e., has a 1.0% or 0.5% chance of flooding each year from rivers or the sea, respectively, without accounting for flood defences, see Figure 5. The watercourses associated with the mapped flood extent are the River Usk and Severn Estuary, which are significant tidal features known for influencing local flood risk. Therefore, the site is not considered to be at risk of fluvial flooding and the flood risk indicated by the FMfP is associated with the tidal flood risk from the River Usk and Severn Estuary. Tidal flood risk is discussed in section 4.4.

4.3 Flood Defence Infrastructure

The site is adjudged not to be protected by the earth embankment coastal frontage defences based on it not lying within the TAN15 Defended Zones. However, results from the detailed model informing the FMfP in this location (see section 4.4) suggest that the earth embankment could be offering a significant level of protection to the site. There are also some raised walls at Alexandra Docks which may offer some further protection for the site from flooding originating from the North Dock. Based on the Flood Risk Assessment Wales (FRAW) Map⁷, the standard of protection provided by the embankment coastal frontage defences is 200, i.e., they protect against a 0.5% AEP tidal event.

4.4 Tidal Flood Risk

The review of the NRW FMfP indicated the site is at risk of flooding from the River Usk and Severn Estuary during a 0.5% AEP tidal event.

To improve understanding and quantify the tidal flood risk at the proposed site, model data was requested from NRW. In response, NRW provided the 2016 Caldicot and Wentlooge Coastal Models³ which informs the FMfP at the site.

Figure 6 shows the Wentlooge Model results for the baseline 0.1% AEP event. Unlike the FMfP this considers the impact of defences and indicates that the site is not at risk of flooding during this event with the local flood defences in place. Therefore, suggesting that the site benefits from the coastal frontage defences and formal defences along the River Usk despite it not being shown to be in a TAN15 Defended Zone.

However, Figure 7 shows the site to be at risk for the design 0.5% AEP plus climate change event when considering sea level rise allowances up to 2125. This covers the expected design life of the substation. Under these future conditions, the defences are overtopped and the site is shown to be completely inundated, with a maximum modelled flood level of 9.7 m AOD.

⁷ Flood and Coastal Erosion Risk Maps. Natural Resources Wales (NRW). May 2025. Available at: <https://flood-risk-maps.naturalresources.wales/?locale=en>

4.5 Pluvial Flood Risk

NRW's FMfP for surface water and small watercourses shows the site is not at risk of flooding from these sources, see Figure 8. The closest mapped pluvial flood extent is approximately 55 m northeast of the site.

4.6 Reservoir Breach Flood Risk

The NRW online Flood Risk from Reservoir map does not show the substation to be at risk of reservoir flooding. The closest mapped flood extent is approximately 80 m east of the site and is associated with a failure of the Llandegfedd reservoir.

4.7 Flood Warning Service

The substation is not located within a NRW Flood Warning Area.

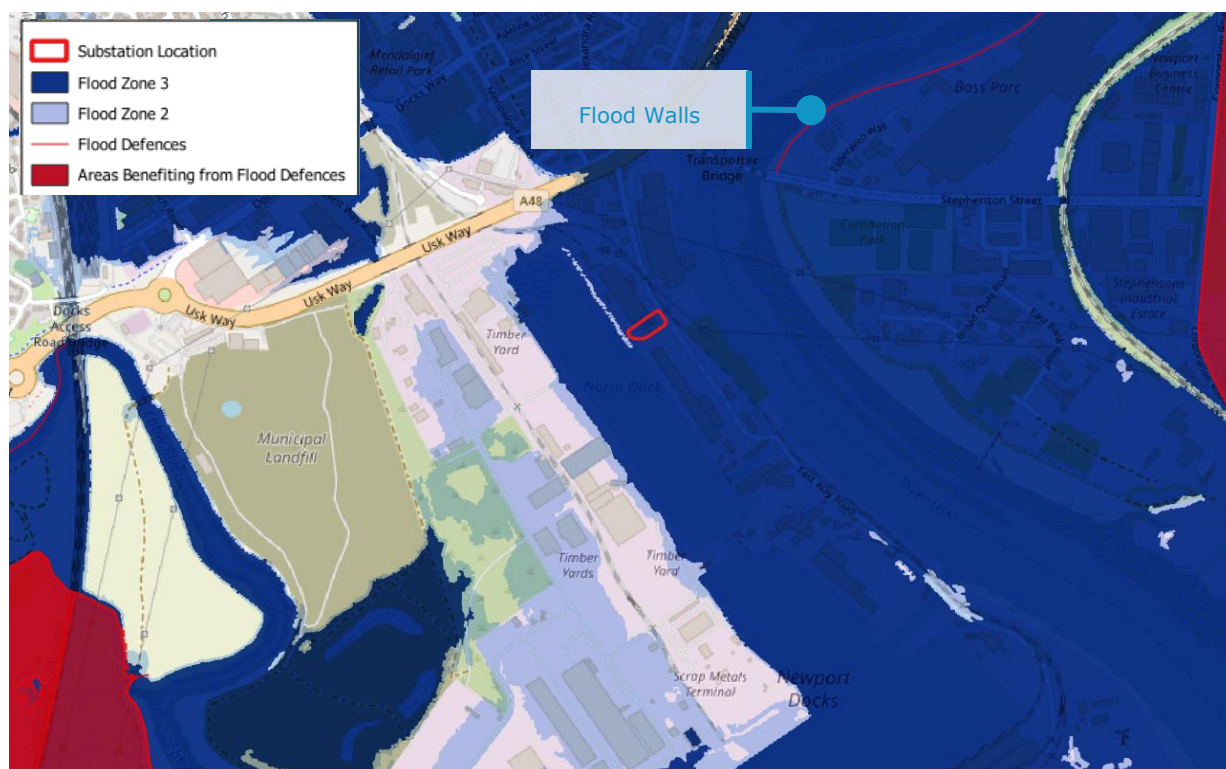


Figure 5 – Rivers and Sea Flood Map (Un defended)

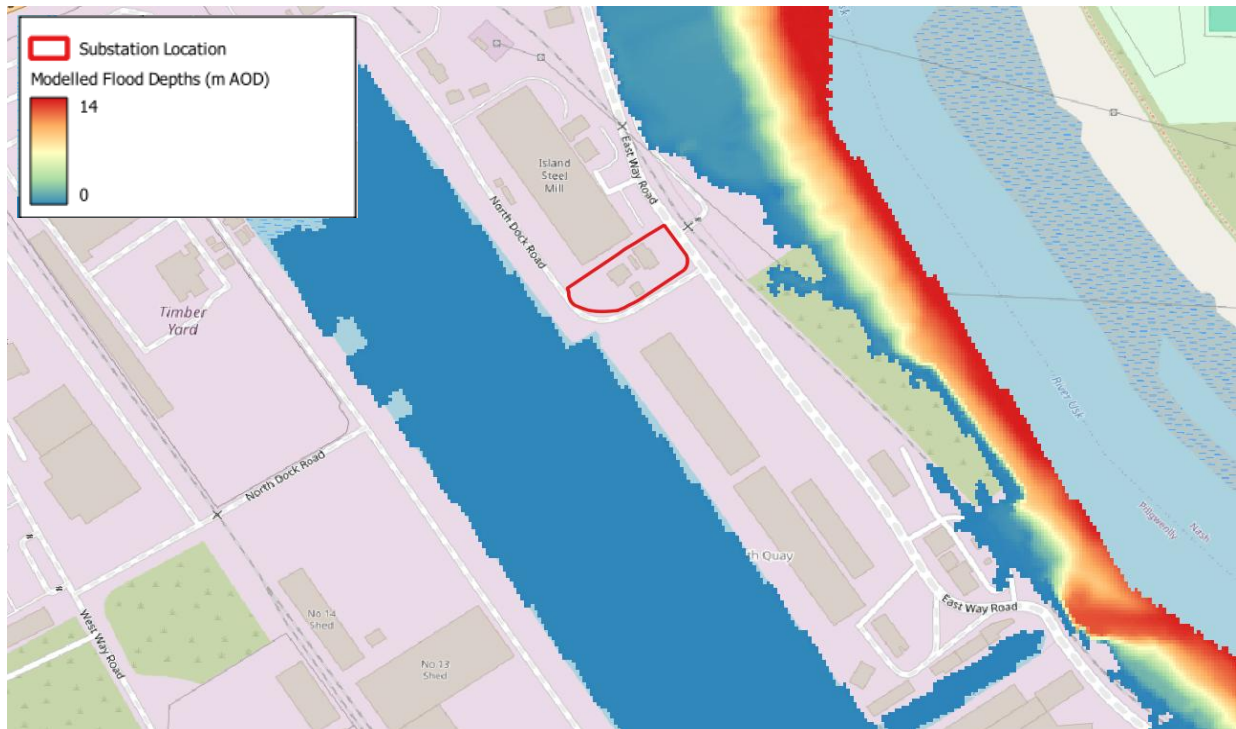


Figure 6 – 2016 Wentlooge Baseline Model Results (Defended 0.1% AEP Tidal event)

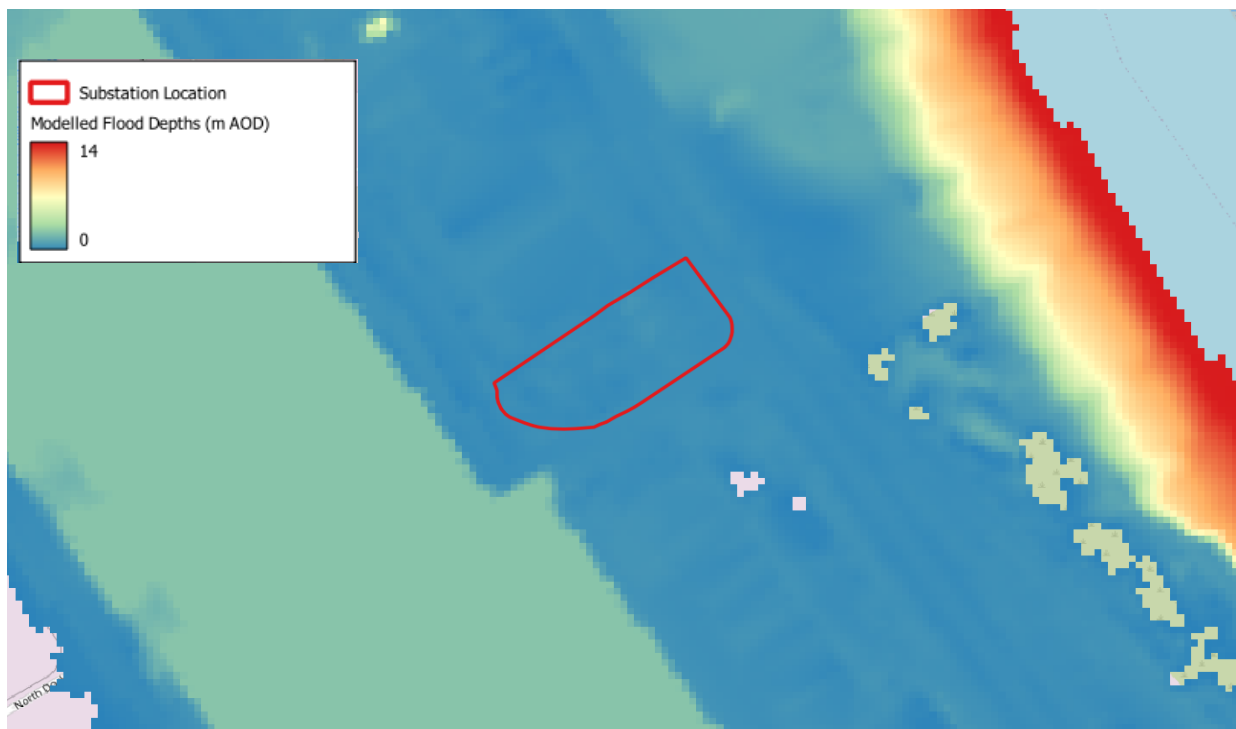


Figure 7 – 2016 Wentlooge Baseline Model Results (Defended 0.5% AEP + CC tidal event)



Figure 8 - Pluvial Flood Map

5 Risk Management

5.1 Worst Case Flood Risk

Reviewing the available data has identified that the substation is at greatest risk from a tidal flood event.

5.2 Target Level of Protection

Model data received from NRW predicts the site to be inundated during the design 0.5% AEP plus climate change tidal event. The levels from this event are adopted as the target level of protection for the site.

5.3 Design Flood Level

Post-development modelling was undertaken considering the 0.5% AEP + climate change tidal event. The results of this modelling are used to assess whether the proposed ground raising at the site is sufficient to mitigate flood risk impacts, whilst not causing third party detriment. For the post-development modelling:

- The formation levels must be suitable to accommodate a minimum construction make up of 750 mm across the compound. The depth of granular material has been informed by preliminary hydraulic calculations, ensuring sufficient attenuation for the 1.0% AEP plus 40% climate change storm event.
- The finished floor level of the switch room building was raised 1.0 m above the existing ground level to 10.1 m AOD (i.e., 0.7 m above the proposed ground level of 9.4m AOD).
- The foundation slab level for transformers was raised to 9.5 m AOD.

Figure 9 shows the post-development results based on the proposed ground levels. The switch room building is flood free for the 0.5% AEP + CC event; however, the wider compound is flooded. This is because the maximum flood level is 9.6 m AOD which exceeds the proposed compound level of 9.4 m AOD. The transformers are inundated above their slab level however they will have 1m of built in flood resilience, leading to an effective critical asset level of 10.5 m AOD. Therefore, like the switch room building they will remain largely flood free.

5.3.1 Sensitivity Analysis – Ground Raising Limits

To determine the ground raising required to protect all infrastructure on site from water damage, iterative modelling was undertaken. This started at the minimum limit (9.4 m AOD), which relates to the model run detailed above. For this scenario, any external critical infrastructure within the substation compound must be raised to a minimum of 10.1 m AOD (the 9.6 m flood level plus the required 500 mm freeboard⁸).

The maximum limit identified to ensure the compound remains entirely flood free was 9.8 m AOD. At this upper limit, the general substation compound is protected from tidal inundation during the 0.5% AEP + climate change design event (see Figure 10). This significantly reduces the required raising for any other critical assets. Table 3 summarises the results of each model run.

⁸ National Grid Electricity Distribution. Company Directive Standard Technique: SD2A/1. 132kV Connections – Guidance Document. November 2024.

Table 3 – Results summary for sensitivity analysis

Scenario	Proposed Compound Level (m AOD)	Max. Flood Depth (m)/Flood Level (m AOD)	Outcome
Minimum Level	9.4	~0.2/9.6	Inundated. Assets are at risk (except transformers).
Maximum Level	9.8	-	Protected. Compound remains dry.

It should be noted that the design flood level of 10.1 m AOD in the minimum level scenario, is considered conservative. This is because the climate change tidal boundary used in the 2016 Wentlooge Model was based on extreme sea level and estuary boundaries values that were part of the 2011 Coastal Design/Extreme Sea Levels datasets⁹. This contains higher peak tidal levels (8.48 m AOD) than those in the more recent 2018 dataset¹⁰ (8.33 m AOD) for the coastal boundary closest to Newport. As a result, the more recent 2018 data could potentially lead to lower modelled flood levels across the site.

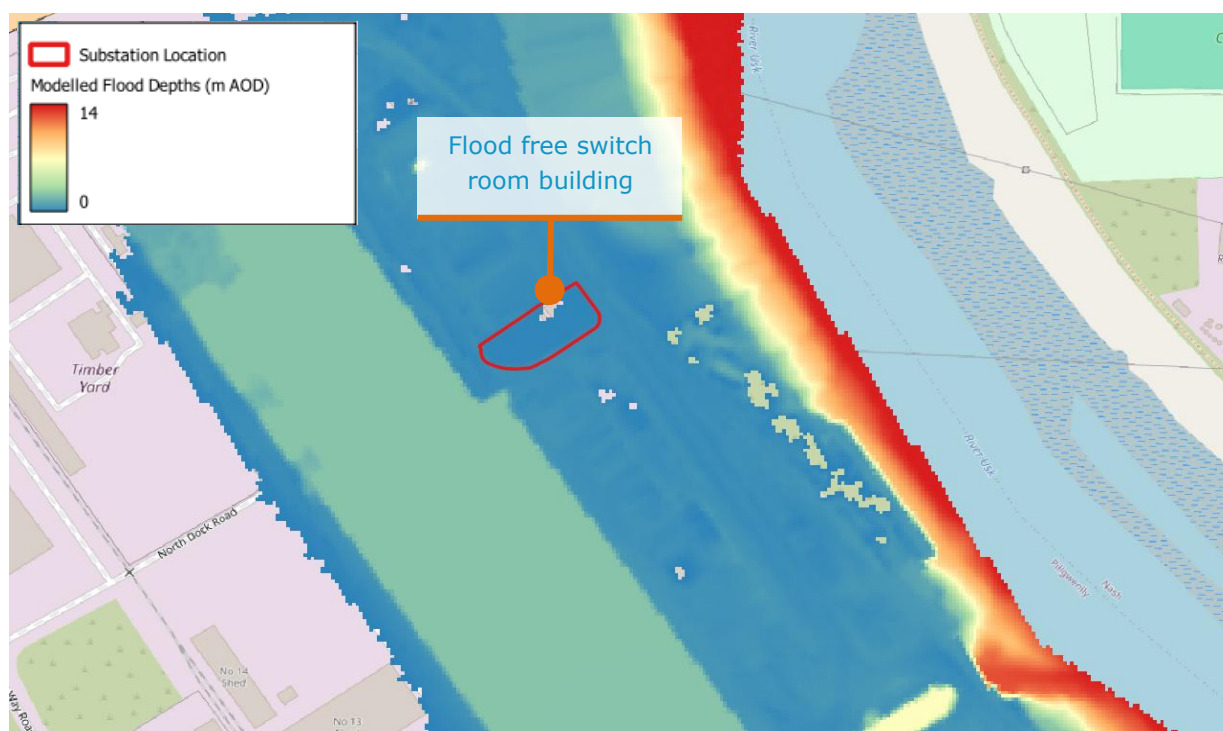


Figure 9 – 2016 Wentlooge Post-development Model Results (0.5% AEP + CC Tidal Event) – Minimum Ground Raising Limit Scenario

⁹ Coastal Design – Extreme Sea Levels (2011) - Archived data. Natural Resources Wales (NRW). 2016.

¹⁰ Coastal Design Sea Levels - Coastal Flood Boundary Estuary Boundaries (2018). Environment Agency. 2021. Available at: <https://www.data.gov.uk/dataset/73834283-7dc4-488a-9583-a920072d9a9d/coastal-design-sea-levels-coastal-flood-boundary-extreme-sea-levels-2018>

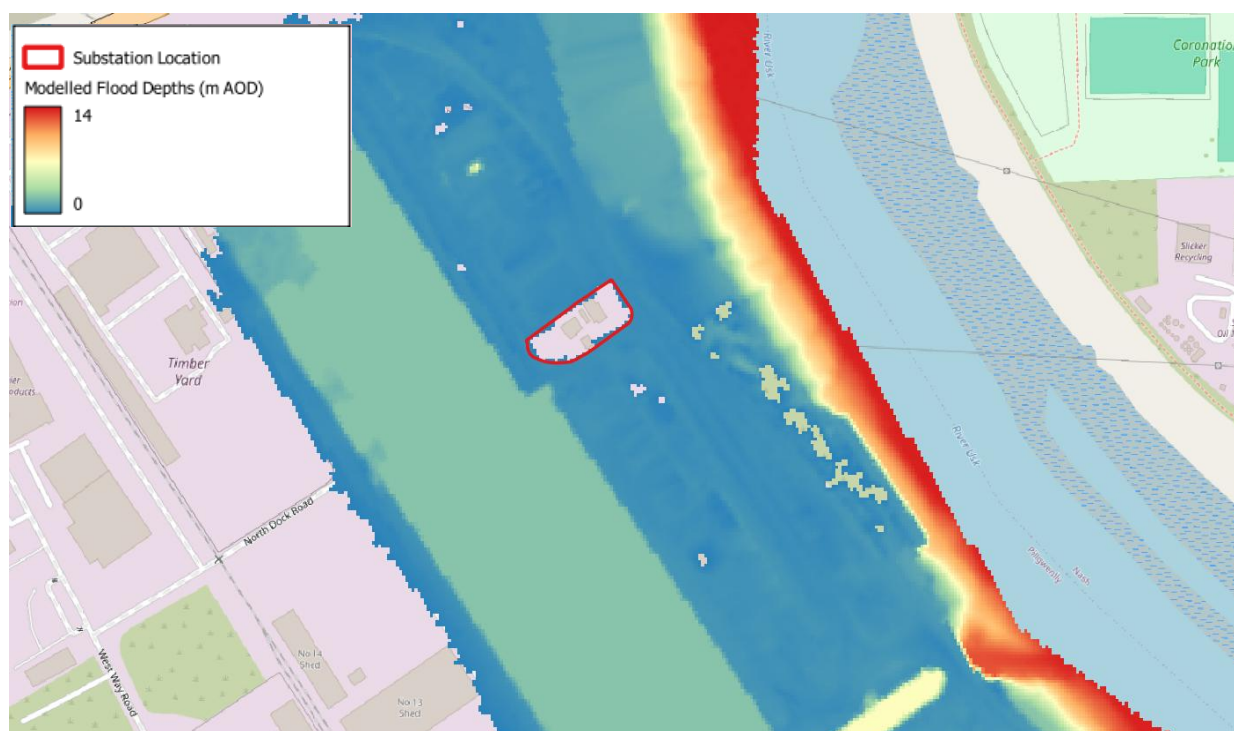


Figure 10 - 2016 Wentlooge Post-development Model Results (0.5% AEP + CC Tidal Event) – Maximum Ground Raising Limit Scenario

5.3.2 Depth Change Analysis

A depth change analysis was also undertaken to assess whether there are any third-party impacts resulting from the proposed ground raising at the site. The results from the depth change analysis for the minimum and maximum scenarios are shown in Figure 11 and Figure 12 respectively. These indicate flood depth reductions of up to 500 mm within the substation boundary for the minimum scenario compared to the baseline. For the maximum scenario, the site is now flood-free, indicative of flood depth reductions of approximately 700mm. The depth-change plots also show that there are no third-party impacts associated with the proposed ground raising scenarios.

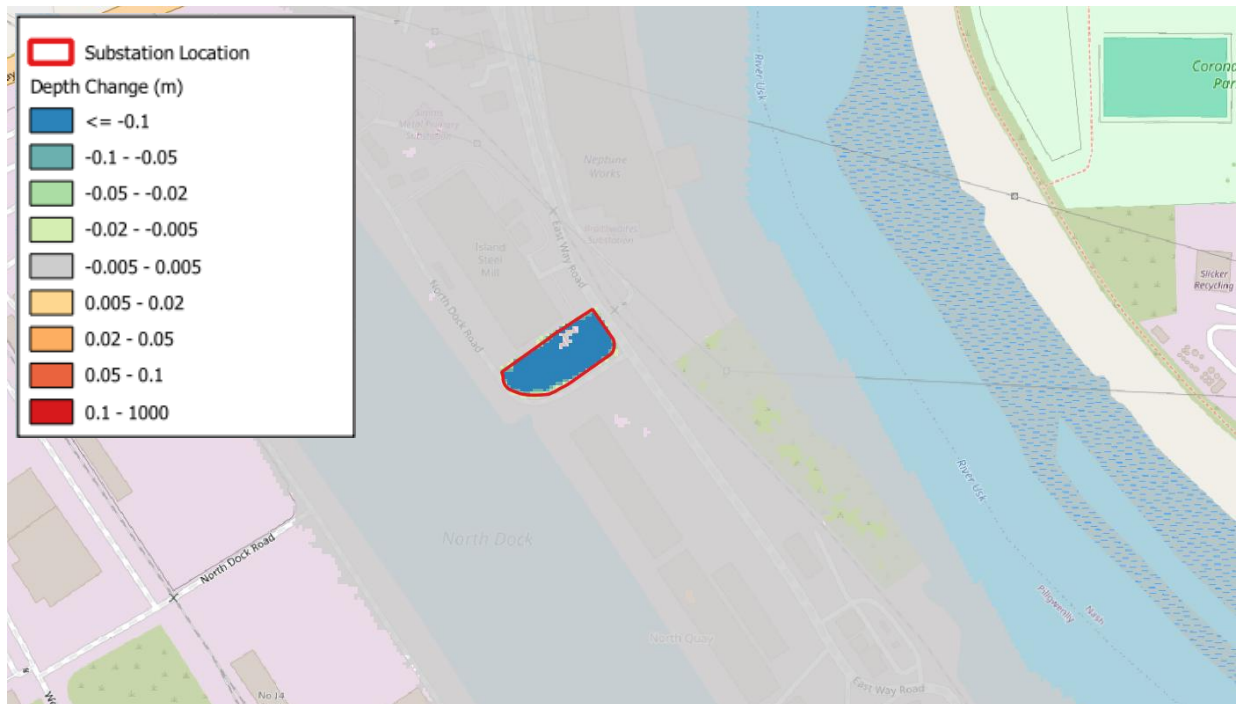


Figure 11 – Depth Change Analysis 0.5% AEP + CC tidal event (Baseline vs. Post-development – Min. Limit Scenario)

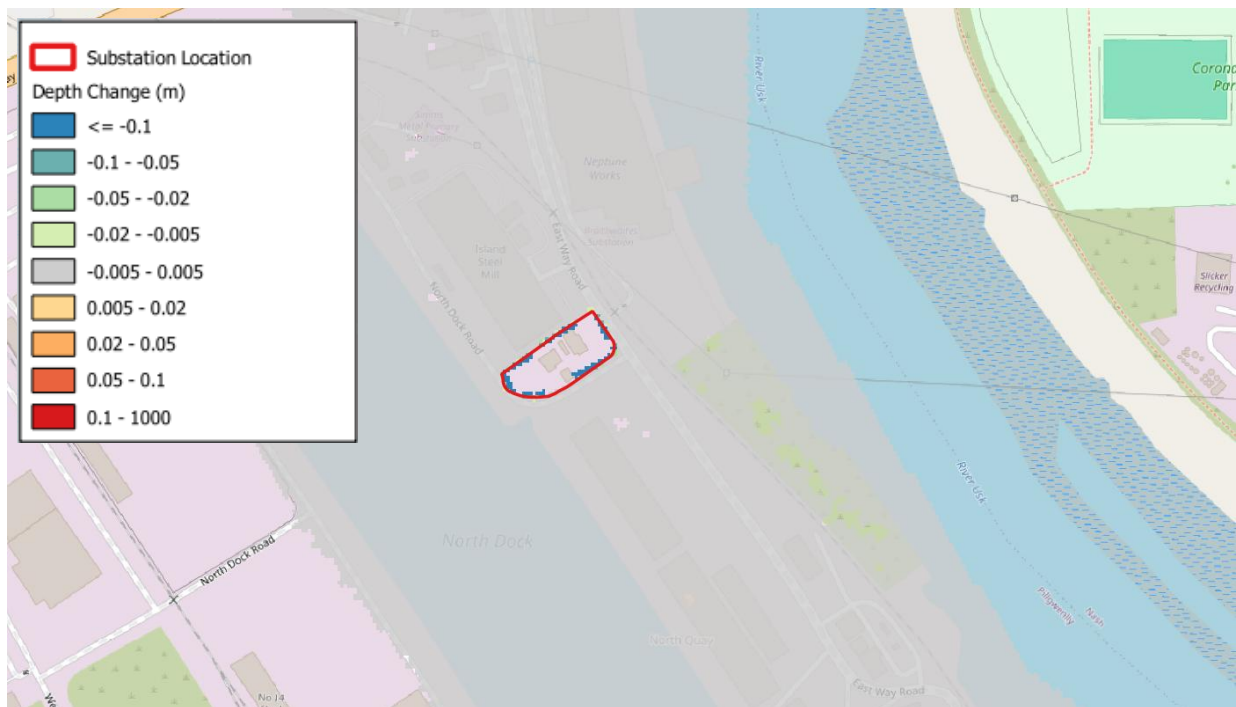


Figure 12 – Depth Change Analysis 0.5% AEP + CC tidal event (Baseline vs. Post-development – Max. Limit Scenario)

5.4 Limitations

The Key limitations associated with the derivation of the design flood level include;

- The design flood level should be compared against the critical asset level (typically the lowest point of electrical risk) to determine if any intervention is required.
- For this assessment, the modelled flood level within the substation is based on the 2011 Coastal Design/Extreme Sea Levels datasets and hence represents a conservative assessment of flood risk.
- LiDAR Data which is used for the model DTM introduces a certain degree of uncertainty, typically $\pm 50\text{mm}$. The ground raisings incorporated in the post-development modelling are also based on the LiDAR levels.
- A 500mm freeboard is added to the modelled level to derive a design flood level.

5.5 Flood Protection Options

Based on the design flood level and the subsequent sensitivity analysis regarding the substation compound ground raising, the following protection strategy is recommended:

- Option A – minimum ground raising (9.4 m AOD) sensitivity testing indicates that if the general compound is raised to a lower limit of 9.4 m AOD, the area remains susceptible to inundation up to 9.6 m AOD. However, the switch room building and transformers with critical asset levels of 10.1 m AOD and 10.5 m AOD respectively are not at risk of water damage. To mitigate the risk to any other external critical assets, they must be raised to 10.1 m AOD, providing the required 500 mm freeboard.
- Option B – maximum ground raising (flood-free limit) sensitivity testing confirms that raising the general compound up to 9.8 m AOD results in the substation being entirely flood-free during the design event. Under this scenario, the raised ground acts as the primary defence, and the requirement for elevated individual asset is reduced.
- Alternatively, any other external infrastructure could be protected by a bund designed to a minimum crest level of 10.1 m AOD. This would protect the assets ensuring they remain free from water damage.

5.6 Recommendations and the Confidence in Flood Risk

There is moderate confidence in the assessment whilst it has been informed by detailed model data, which was produced in 2016.

Although flood levels could differ from the estimated design flood level, there is still high confidence that if the switch room and critical assets are raised up to 10.1 m AOD they will remain flood-free. As mentioned, the design flood is conservative being based on the higher levels in the 2011 Coastal Design/Extreme Sea Levels dataset.

If the client requires greater confidence in the design flood level to justify the recommendations in Section 5.5, then it is recommended that a study is undertaken to update the existing water level (HT) tidal boundaries to obtain modelled flood levels applying the latest climate change allowances.

Appendix 1 – Topographical Survey