Kilcoolishal Compound FRA

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Abbreviations

AEP ..... Annual Exceedance Probability

CDP ..... County Development Plan

CFRAM ..... Catchment Flood Risk Assessment and Management

DoEHLG ..... Department of the Environment, Heritage and Local Government

FB ..... Freeboard

FFL ..... Finish Floor Levels

FRA ..... Flood Risk Assessment

GSI ..... Geological Survey of Ireland

ICPSS ..... Irish Coastal Protection Strategy Study

ICWWS ..... Irish Coastal Wave and Water Level Modelling Study

NCFHM ..... National Coastal Flood Hazard Mapping

OPW ..... Office of Public Works

PFRA ..... Preliminary Flood Risk Assessment

SFRA ..... Strategic Flood Risk Assessment

SW CFRAM ..... South Western Catchment Flood Risk Assessment and Management

1 Introduction

Under the Planning System and Flood Risk Management Guidelines for Planning Authorities (DoEHLG & OPW, 2009) the proposed development must undergo a Flood Risk Assessment to ensure sustainability and effective management of risk.

1.1 Terms of reference and scope

JBA Consulting was appointed by Cork County council to prepare a Flood Risk Assessment (FRA) that reviews the flood risk of a site for a Greenway Compound located in Kilcoolishal, Glanmire, Co. Cork.

1.2 Flood Risk Assessment; Aims and Objectives

This study is being completed to inform the future development of the site as it relates to flood risk. It aims to identify, quantify, and communicate to Planning Authority officials and other stakeholders the risk of flooding to land, property and people and the measures that would be recommended to manage the risk.

The objectives of this FRA are to:

- Identify potential sources of flood risk;
- Confirm the level of flood risk and identify key hydraulic features;
- Assess potential flood risk management measures that may be appropriate;
- Prepare a report summarising the summarising the findings and outlining the design constraints facing the site.

Recommendations for development have been provided in the context of the OPW / DoECLG planning guidance, "The Planning System and Flood Risk Management". A review of the likely effects of climate change, and the long-term impacts this may have on any development has also been undertaken.

For general information on flooding, the definition of flood risk, flood zones and other terms see 'Understanding Flood Risk' in Appendix A.

1.3 Proposed Development

Refer to Figure 1-1 for the site layout. The proposed development is a Greenway Maintenance Compound on an underutilised site in Kilcoolishal, Glanmire, Co. Cork. The proposed project consists of the development of this disused site as a works compound to house equipment and staff welfare facilities for maintenance works to CCC cycle/pedestrian pathway sites. Site works will include equipment storage shed, staff canteen, toilet, green waste/mulch and material storage bays and electric sliding gate. Having regard to the 'The Planning System and Flood Risk Management-

Guidelines for Planning Authorities 2009' the proposed development is considered a Water-Compatible Development as it falls within the scope of amenity open space and essential facilities.

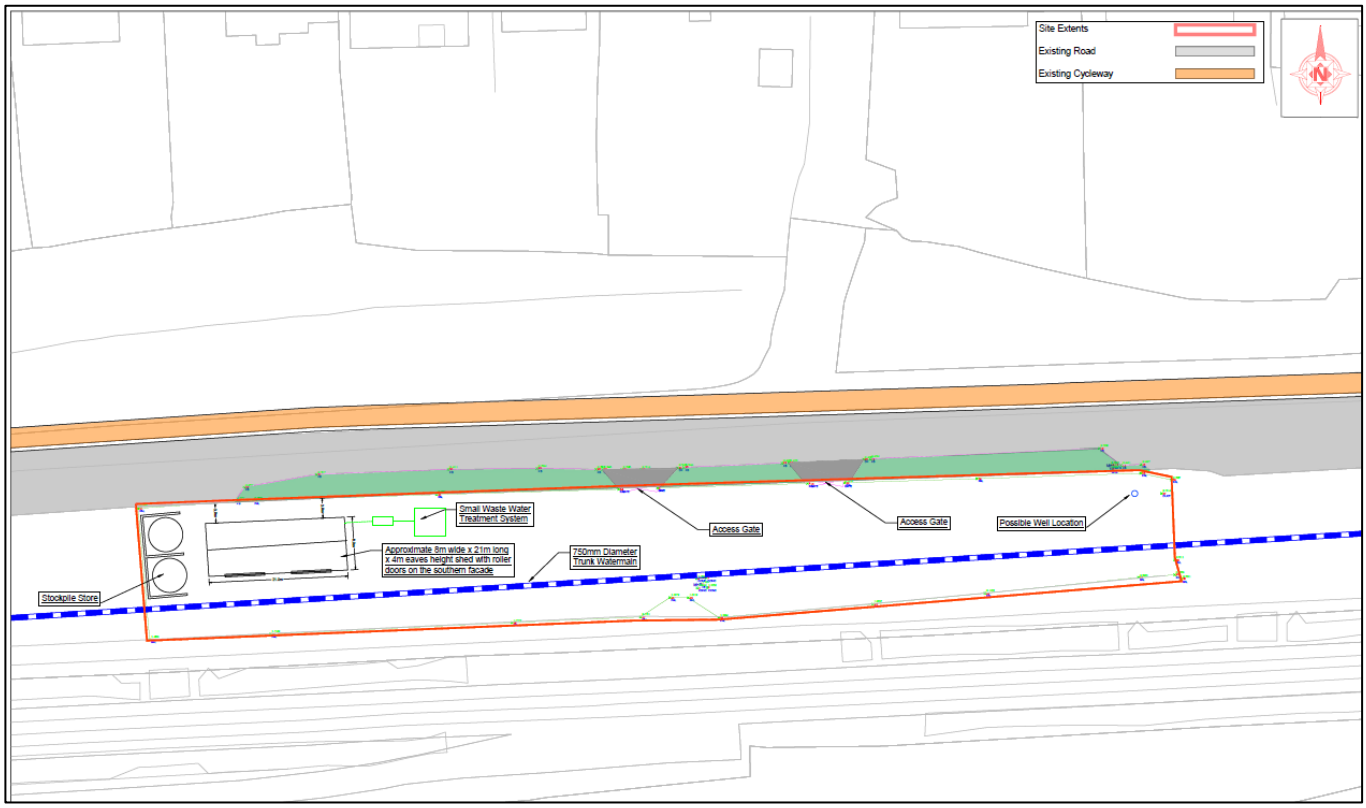


Figure 1-1: Site layout

2 Site Background

2.1 Site Location and Watercourses

The site is located in Kilcoolishal, Glanmire, County Cork and is approximately 6.8km to the Northeast of Cork City. The site is south of the L3004, adjacent to the Cobh train line and the N25 from Dunkettle to Carrigtwohill. The area surrounding the site is a mixture of urban residential and major roads to and from Cork City. At present, the site is an underutilised brownfield site.

The Tibbotstown Stream flows c. 240m east of the site in an easterly direction where it flows into Lough Mahon (Harper's Island). The Rowgarrane stream flows to the west of the site in a southerly direction into Lough Mahon. The Glashaboy River lies approximately 2km to the west, rising in the Nagle Mountains and flowing in a southerly direction into the River Lee at Dunkettle.

Refer to Figure 2-1 for watercourse and site locations.

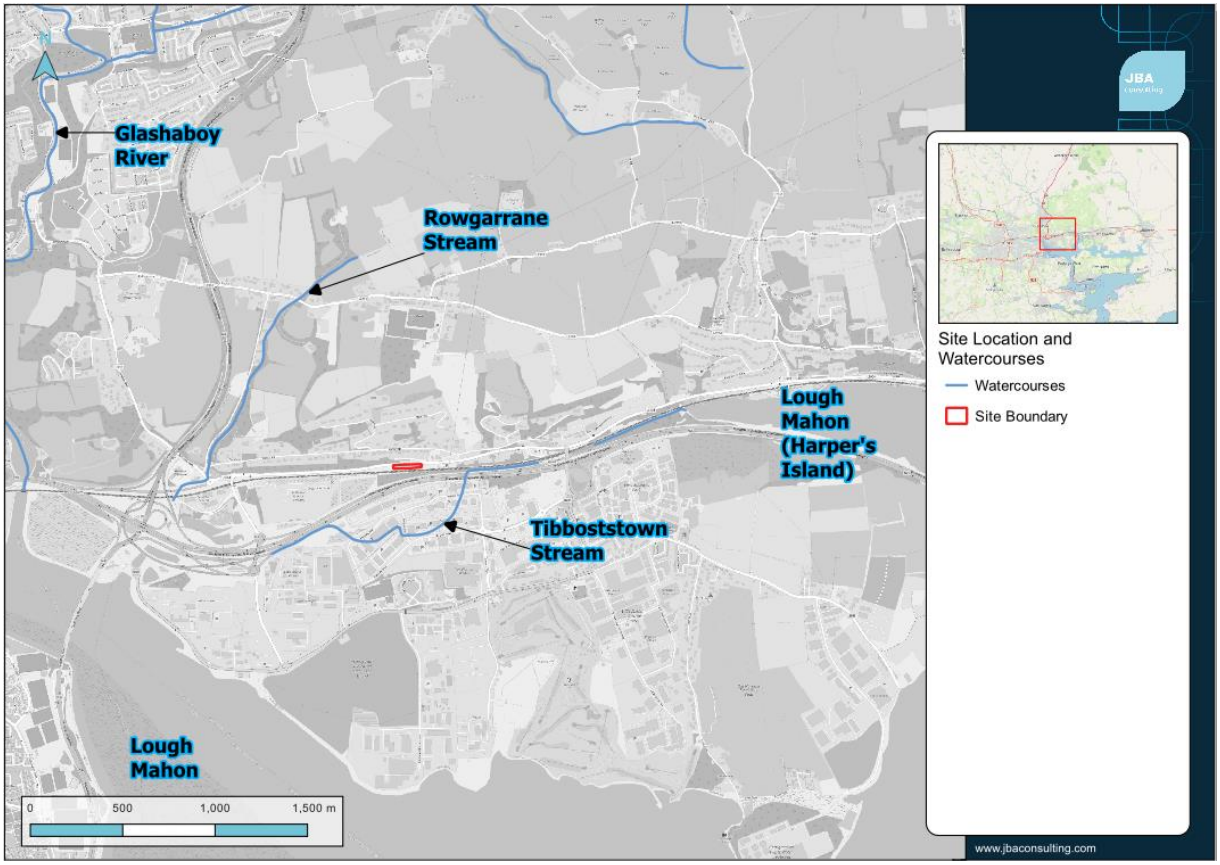


Figure 2-1: Site Location and Watercourses

2.2 Site Geology

The Geological Survey of Ireland (GSI) groundwater and geological maps were reviewed. The underlying bedrock at the site location is Gyleen which consists of sandstone with mudstone & siltstone. The underlying soil at the site is mineral alluvium which may indicate previous flooding, and is of low permeability. The soil at the south of the site is deep well drained alluvium (see Figure 2-3).

The associated groundwater vulnerability, which is a measure of the likelihood of groundwater contamination and is an indicator of groundwater interaction, is classified as 'High'. There are no karst features, also frequently linked to groundwater interaction, at the site or in the surrounding area.

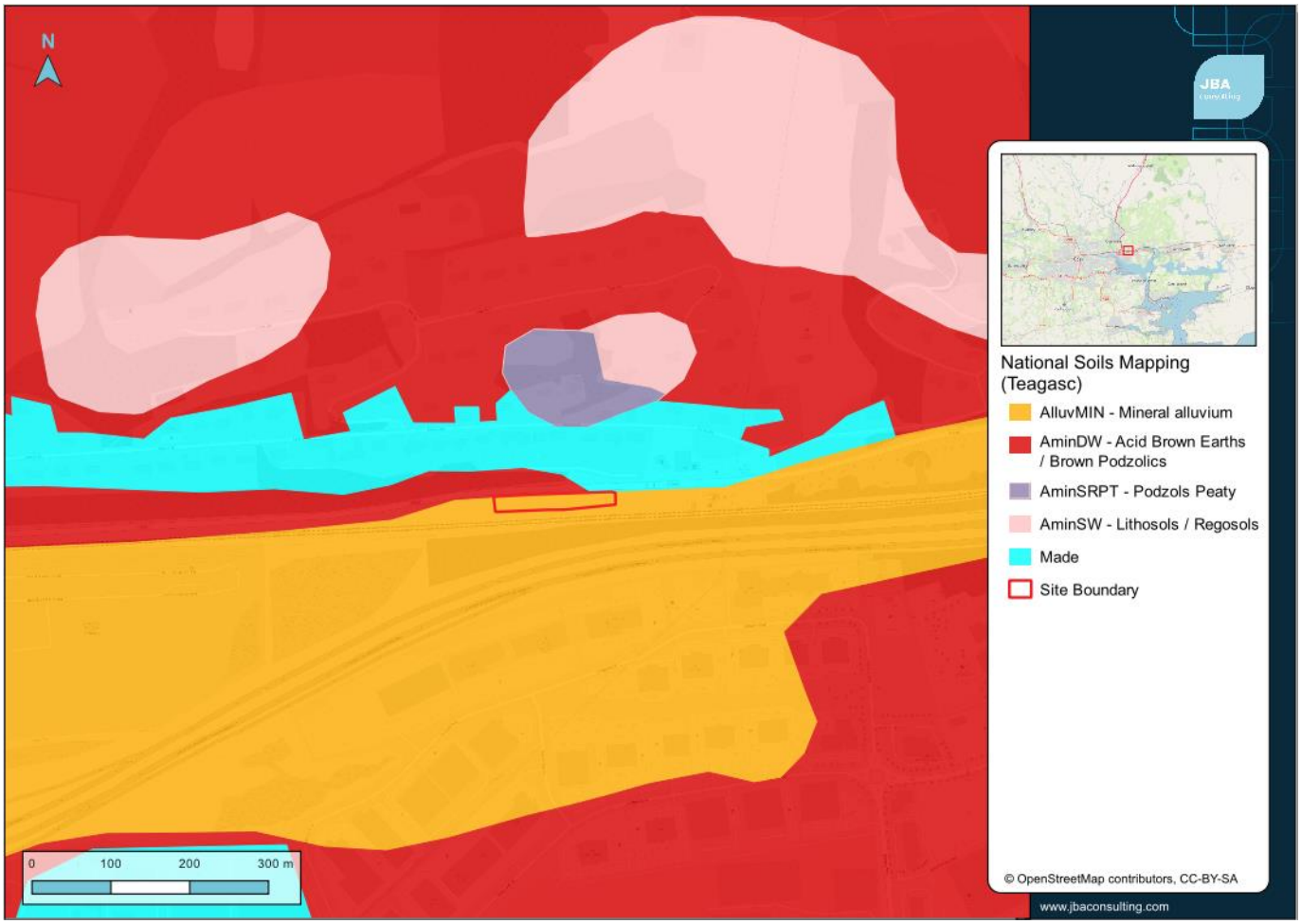


Figure 2-2: Underlying Soils (Teagasc)

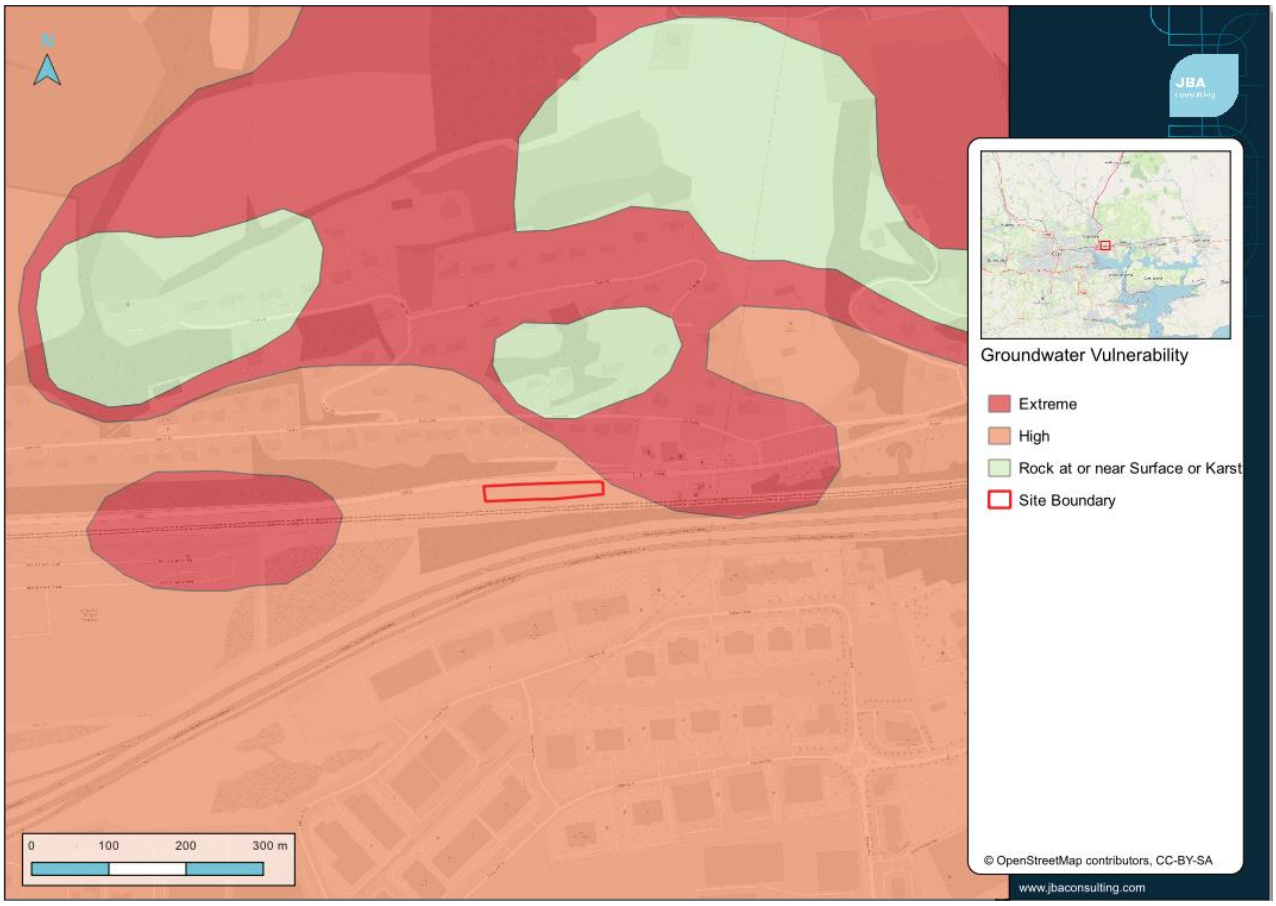


Figure 2-3 Groundwater Vulnerability

2.3 Local Topography

The site is generally flat with a fall from north to south with local topography falling generally towards the south in the area. It has a high point of 3mOD at the northeast of the site, and a low point of 1.46mOD at the southeast of the site. The railway line to the south lies at c. 2.5mOD. Refer to Figure 2-4 for local topography.

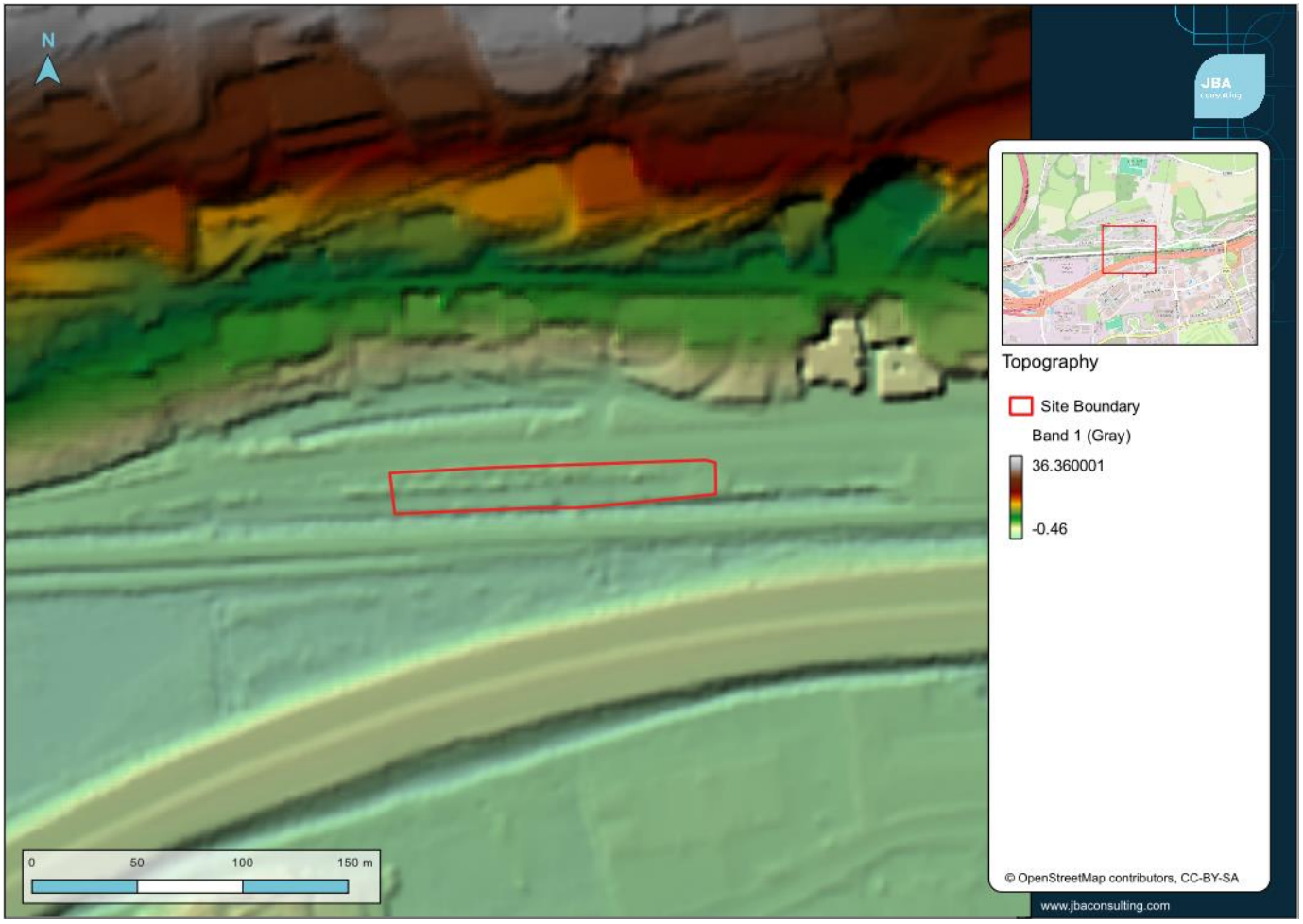


Figure 2-4 Local Topography

3 Flood Risk Identification

An assessment of the potential for and scale of flood risk at the site is conducted using historical and predictive information. This identifies any sources of potential flood risk to the site and reviews historic flood information. The findings from the flood risk identification stage of the assessment are provided in the following sections.

3.1 Flood History

Several sources of flood information were reviewed to establish any recorded flood history at, or near, the site. This includes the OPW's website, www.floodinfo.ie, and general internet searches.

3.1.1 Floodmaps.ie

The OPW hosts a national flood hazard mapping website, www.floodinfo.ie, which highlights areas at risk of flooding through the collection of recorded data and observed flood events. There are no flood events reported within 500m of the site boundary. The following past flood events in the surrounding area are shown in Figure 3-1.

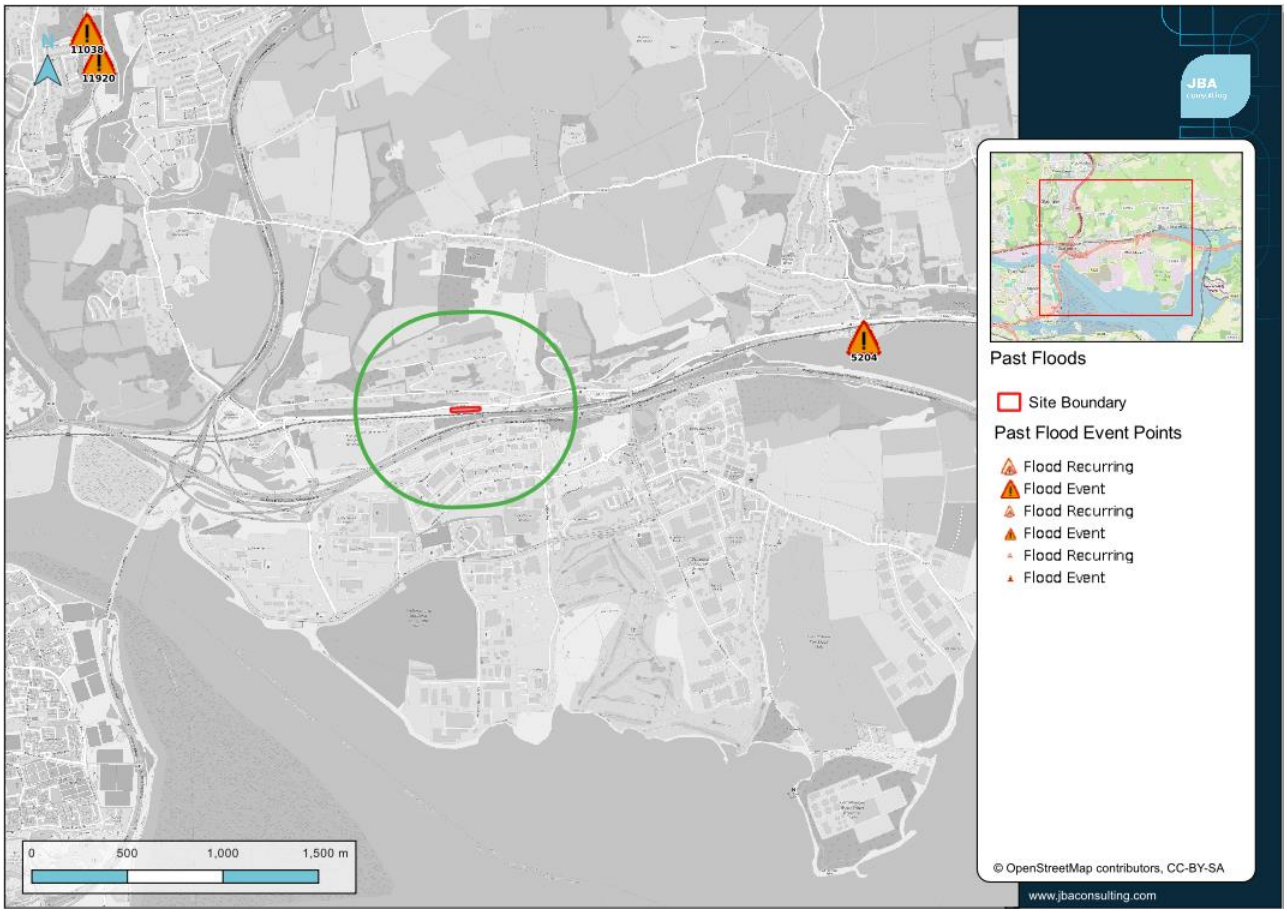


Figure 3-1: Past Flood Event Locations

Review of Figure 3-1 shows several instances of historic flooding within the close to the site, including:

- ID-5204 - House flooding at Glounthaune during October 2004 event, high tides and extreme winds caused flooding.
- ID-11920 - Flood event Riverstown, Glanmire, Co. Cork, 1968/69.
- ID-13729 - Flooding on R639. Large flows in the Glashaboy River caused by heavy rainfall resulted in overflows onto the adjoining R639 between Glanmire Bridge and Riverstown Cross, 19/11/2009.

3.1.2 Internet Searches

An internet search was conducted to gather information about whether or not the site was affected by flooding previously.

In October of 2023 Cork experienced severe flooding during Storm Babet. No sources indicated flooding at the specifically, however, a newspaper article reported that the L-3004-0 from outside the IDA Industrial Estate at Carrigtwohill (at the exit from the Dunkettle to Carrigtwohill dual carriageway at Tullagreen) to Glounthaune (outside the railway station). This would pass the site, however it is unclear which part the road was affected by flooding or what the mechanism of flooding was in this case.

3.2 Predictive Flooding

The area has been a subject of the following predicative flood mapping or modelling studies and other related studies and plans:

- Cork City Development Plan 2022-2028
- Lee Catchment Flood Risk Assessment and Management Study (Lee CFRAMS)
- National Coastal Flood Hazard Mapping
- Irish Coastal Wave and Water Level Modelling Study
- N8 Dunkettle Interchange Upgrade

3.2.1 Cork County Development Plan 2022-2028

Under the development plan the site is unzoned, north of Business and General Employment zoning, and lies in Flood Zone A/B.

The Flood Zones used for the Cork CDP SFRA are a combination of CFRAM flood zones and ICPSS. See Figure 3-2 for zonings and flood zones.

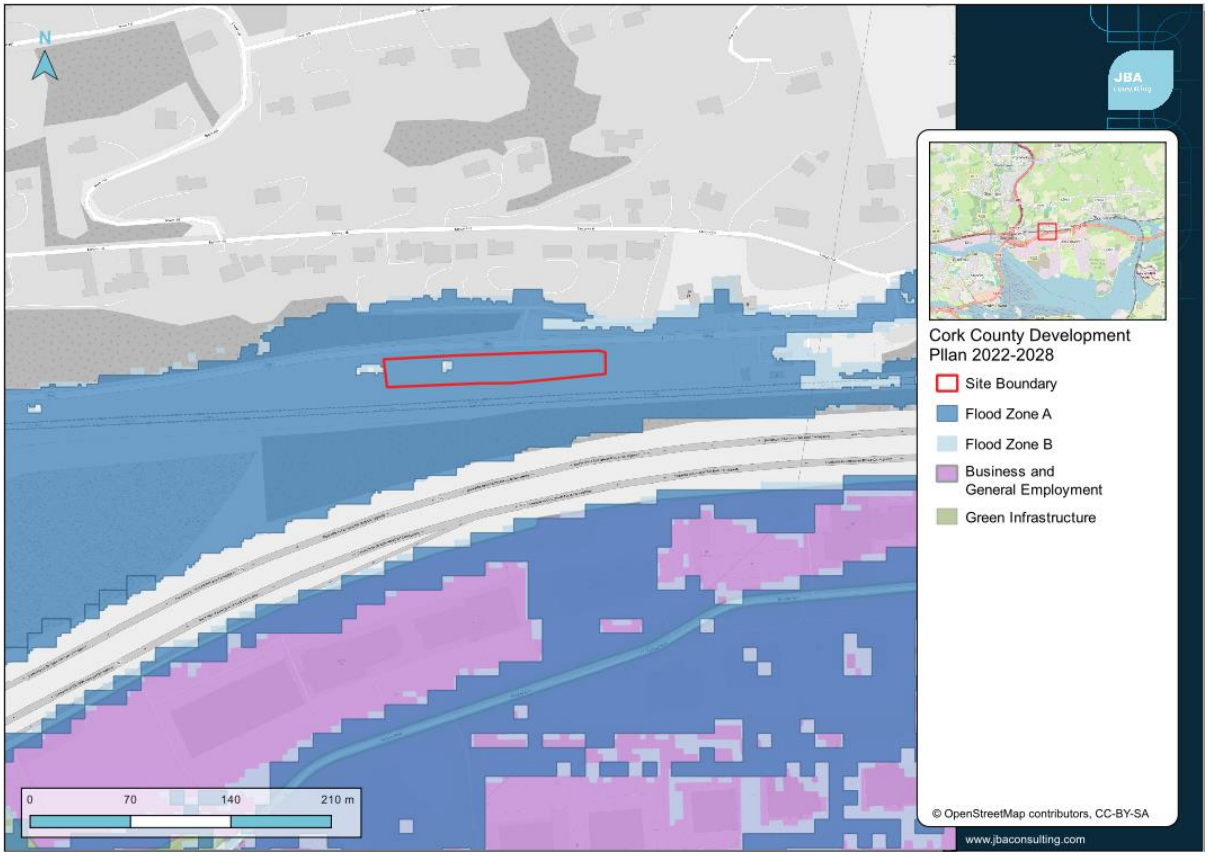


Figure 3-2 Cork County Development Plan 2022-2028

3.2.2 Lee Catchment Flood Risk Assessment and Management Study (Lee CFRAM)

The primary source of data with which to identify flood risk to the site is the Lee Catchment Flood Risk Assessment and Management Study (Lee CFRAM Study). The Lee CFRAM Study commenced in 2006. The Lee CFRAM was one of three pilot studies carried out as part of the requirements outlined in the EU Floods Directive. Work on the study commenced in August 2006 and continued until publication of the Catchment Flood Risk Management Plan in mid-2010.

The CFRAM consists of detailed hydraulic modelling of Lee River and its tributaries and coastline and flood extent maps for the fluvial and tidal scenarios have been completed. The relevant flood maps are available on the OPW www.floodinfo.ie website and can be viewed on public consultation website.

Fluvial and tidal flood maps have since been finalised for Lee catchment and an extract covering the site is presented in Figure 3-3.Review of the CFRAM mapping shows that the site is outside of any fluvial extents. The site lies within the 1% AEP and 0.1% AEP events for tidal extents and therefore is located in Flood Zone A with high probability of flooding. Note that this modelling was completed before any updates to the Dunkettle interchange and under the CFRAM analysis detailed surveys have not been taken of the culvert system between the intertidal ponds. Therefore, the CFRAM coastal outlines are considered conservative in this case.

The depth map pictured in Figure 3-4 shows depths of up to 1m at the site.

Figure 3-3 Lee CFRAM Flood Extents

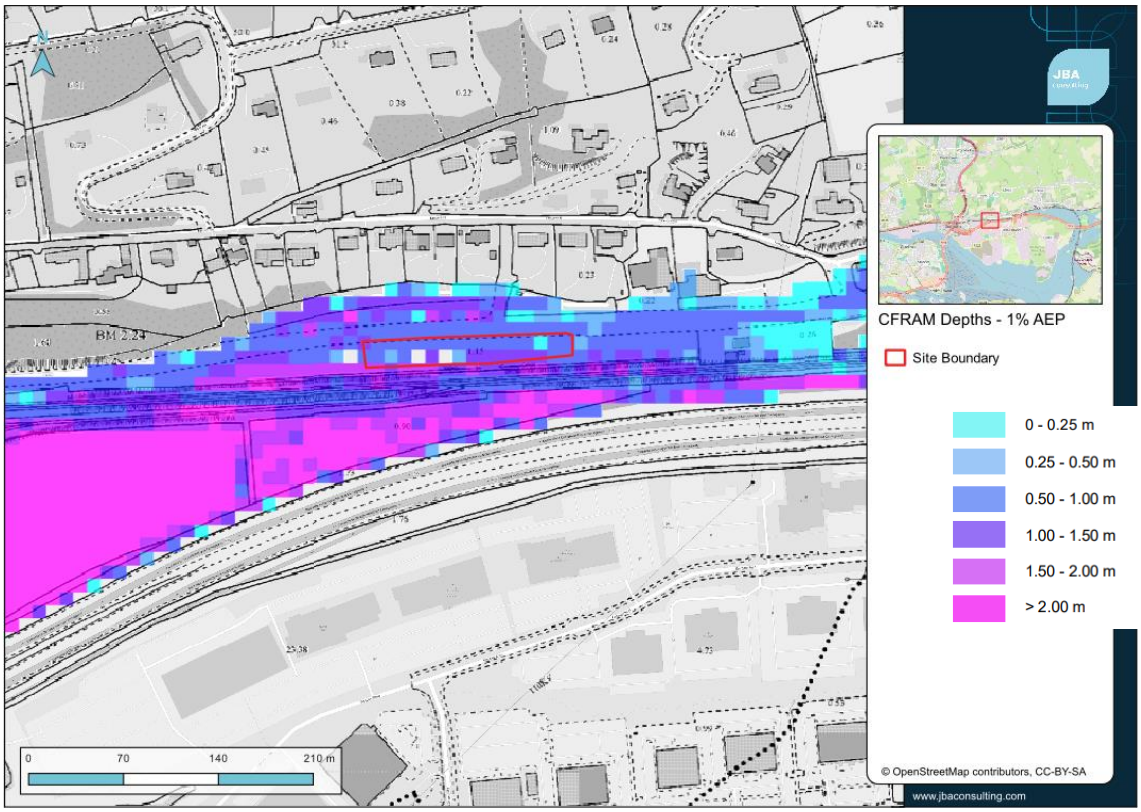


Figure 3-4 Lee CFRAM depths

3.2.3 National Coastal Flood Hazard Mapping

The National Coastal Flood Hazard Mapping (NCFHM) study is an important source of information for the site and supersedes the previous ICPSS study. This study involved the projection of coastal flood levels inland onto the DTM; however, it is not as detailed as the 2D hydrodynamic modelling undertaken as part of the CFRAM study. Inundation can occur from high tides and storm surges. Wave action will not be significant at this sheltered location. Flood maps are publicly available for 10%, 0.5% and 0.1% AEP coastal flood events. The Irish Coastal Wave and Water Level Modelling Study water levels were used as the input data set for this study, as outlined in Section 3.2.3.

According to the NCFHM, the site is subject to flood risk from both the 0.5% AEP and 0.1% AEP coastal flood events (see Figure 3-2). The NCFHM extents are based on the undefended scenario, and therefore do not take account of any flood protection structures. The main flow path from Lough Mahon to the site via the Dunkettle Intertidal lagoon system and associated culvert system have not been included within the study. Therefore, the NCFHM is only an indicative assessment of flood risk for further study. Furthermore, the system does not account for the updated Dunkettle interchange. The NCFHM data has been used to develop the Cork County Development Plan 2022 - 2028.

Figure 3-5: National Coastal Flood Hazard Mapping

3.2.4 Irish Coastal Water Level and Wave Modelling Study

The Irish Coastal Wave and Water level Modelling Study (ICWWS) provides an estimate of extreme water levels around the coast of Ireland. The ICWWS provides the underlying flood levels that were used in the projection modelling under the National Coastal Flood Hazard Mapping.

This data is an update of the extreme water level estimation undertaken as part of the Irish Coastal Protection Strategy Study (ICPSS). Flood levels are publicly available for the present-day sea levels as well as the Mid-Range Future Scenario (MRFS) and High-End Future Scenario (HEFS), for a range of AEPs.

A review shows that the nearest node point with water levels is approx. 3km from the site (see Figure 3-6). The water level estimations are displayed in Table 3-1. The ICWWS provides the underlying flood levels that were used in the projection modelling under the National Coastal Flood Hazard Mapping. These levels are slightly higher than those used in the CFRAM study.

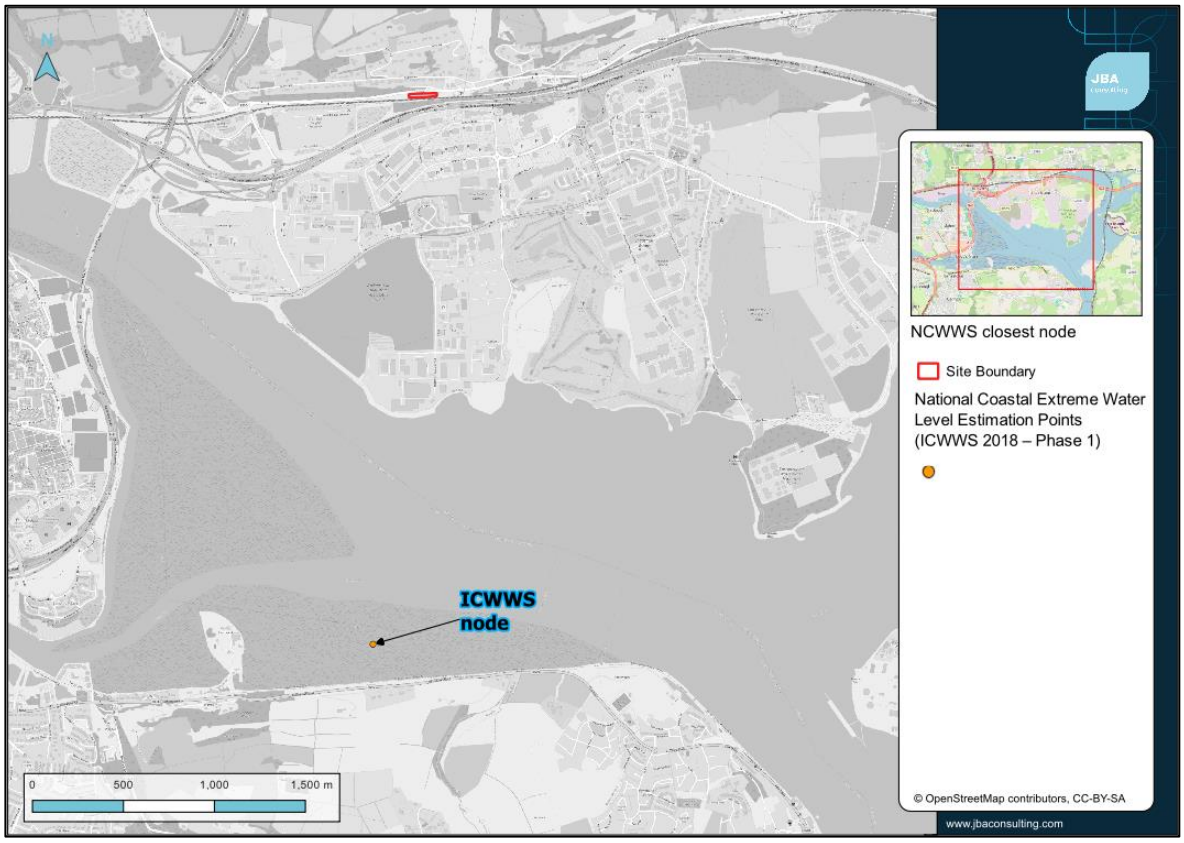


Figure 3-6: Irish Coastal Level and Wave Modelling Study (ICWWS)

Table 3-1: ICWWS levels to mOD, and IPCSS Present Day levels

AEP	Water Level (mOD)			ICPSS
	Present Day	MRFS	HEFS	Present Day
10%	2.76	3.26	3.76	2.60
0.5%	3.12	3.62	4.12	2.89
0.1%	3.31	3.81	4.31	3.04

3.2.5 N8 Dunkettle Interchange upgrade

A detailed Flood Risk assessment for the proposed design for the Dunkettle Interchange, Co Cork was carried out as part of the project. The aim of the FRA was to ensure that the revised Dunkettle interchange and additional road network is not impacted by, or results in, an increase in flood risk within the intertidal pond area. The model is the most up to date study close to the site, with all culverts connecting the intertidal lagoons represented in the model, as well as changes to the Dunkettle interchange which include compensatory storage and which would be absent in CFRAM or NCFHM modelling. This will give more accurate predicted water levels at the site pending final published results.

3.3 Flood Sources

The initial stage of a Flood Risk Assessment requires the identification of and consideration of probable sources of flooding. Following the initial phase of this Flood Risk Assessment, it is possible to summarise the level of potential risk posed by each source of flooding. The flood sources are described below.

3.3.1 Fluvial

Fluvial flooding is the result of river levels rising and flowing out of bank, across lands that are usually dry. The fluvial map from the CFRAM has been reviewed and the site is not at risk from fluvial sources.

3.3.2 Coastal

The site is located approximately 1.5km away from Lough Mahon but is circa100m away from the nearest of the intertidal lagoons linked to Lough Mahon. Review of the CFRAM study indicates that the site is at risk of tidal flooding. This has also been confirmed by the NCFHM study which used extreme water levels derived from the ICWWS. These levels are slightly higher than those in the CFRAM study.

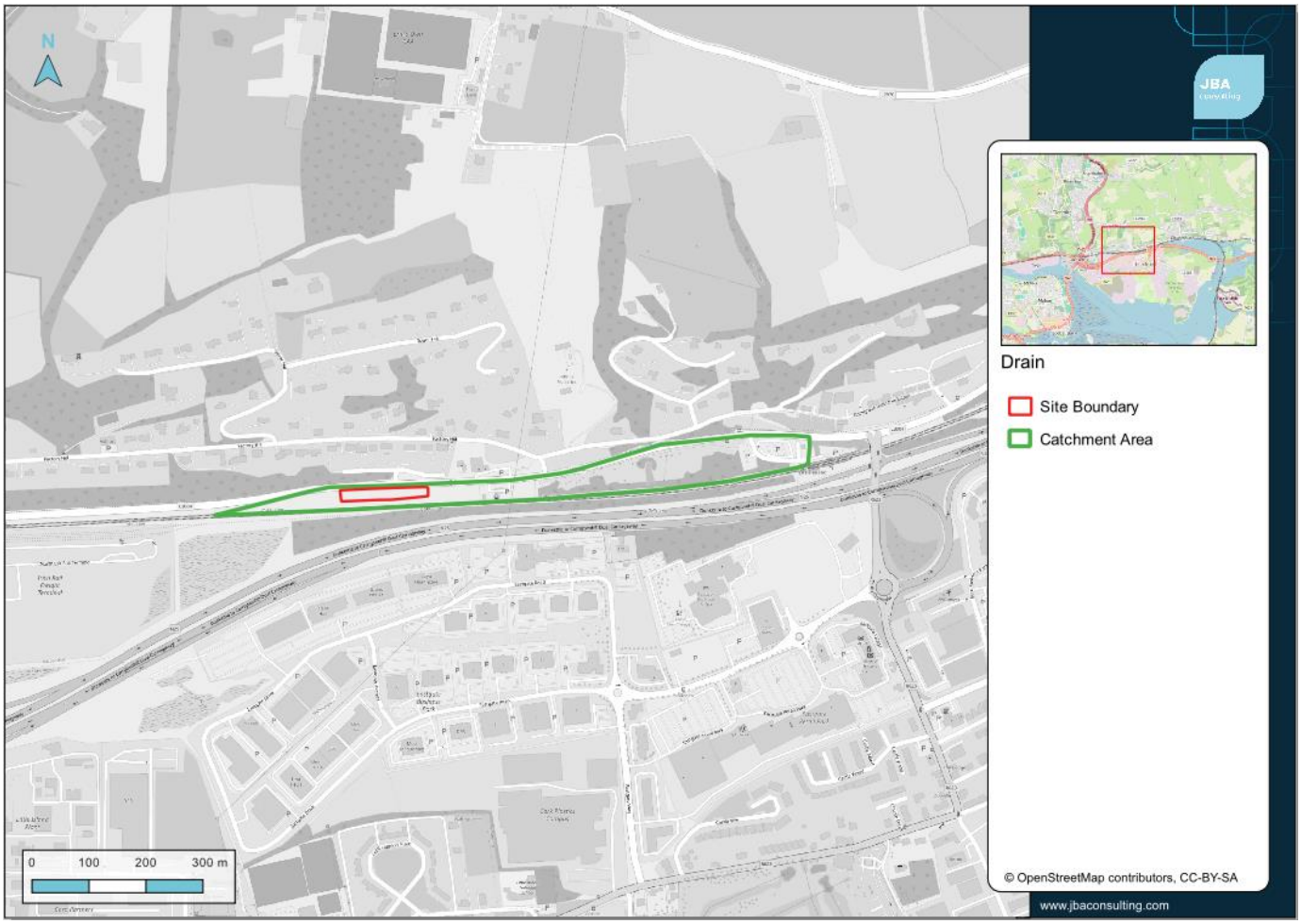
The Dunkettle Interchange upgrades include changes to the existing drainage culvert network as well as the construction of new culverts and compensatory storage. These details are not represented in the CFRAM or NCFHM studies.

3.3.3 Pluvial/Surface Water

Pluvial flooding is the result of rainfall-generated overland flows that arise before run-off can enter a watercourse or sewer. Review of the past flood events information does not indicate that the site has experienced historic flooding. The site is brownfield, and the surface water will be attenuated to local drainage channels adjacent to the site and Cobh railway. Based on review of the available information, the development proposal is not at risk of pluvial flooding.

3.3.3.1 Drainage Ditch at Southern Boundary of Site

There is a drainage ditch at the southern boundary of the site that connects to both the Iarnród Éireann intertidal pond to the southwest and the estuary to the east. The drain is c. 2m below ground levels at the site and has flapped outfalls at both ends that prevents backflow of tidal waters into the drain. The catchment size of the drain is small, at c. 0.049km^2 and it is not expected to pose a risk to the site with proper operation of flap valves at the outfalls.



3.3.4 Groundwater

Groundwater flooding results from high sub-surface water levels that impact upper levels of the soil strata and overland areas that are normally dry. Groundwater flood risk is found to be 'High' by the GSI mapping. Review of the gsi.ie web portal confirms that no karst features are located in the area surrounding the site.

In summary, there is no known risk of groundwater flooding in this area, and it has been screened out at this stage.

4 Flood Risk

This section of the report will assess the likelihood of flooding at the site and any additional considerations regarding flood risk.

The main source of risk to the site is tidal flooding. The CFRAM mapping is the best available data at this time and shows the site to be in Flood Zone A. The CFRAM study does not represent culverts or intertidal lagoons in detail. This indicates that the CFRAM modelling is conservative, and it is likely that in reality the railway will act as a barrier against the flow of tidal floodwaters on to the site The closest flood relief scheme to the site is located in Glanmire is currently under construction, however this does not protect the site and is only along the Glashaboy river.

The N8 Dunkettle Interchange Upgrade hydraulic model is the most robust model at this time and will supersede other coastal models upon release of public data. This model uses detailed surveys and cross sections of the culverts as well as post development scenarios showing updates to the interchange which include upgrades to existing culverts, new culverts and compensatory storage.

There is a drain immediately south of the site that connects the intertidal pond through a small culvert. The drain outfalls to the east to the nearby intertidal pond and west towards the estuary via flap valves. This has not been taken into account in any modelling study, however due to the small catchment size it is not expected to pose an immediate risk to the site with full operation of flapped outfalls.

4.1 Mitigation

The ground levels at the site range from 1.46mOD at the southwest of the site to 3mOD at the northwest of the site. The railway to the south of the site may act as a barrier to flood waters coming from the intertidal ponds, but this is as yet unconfirmed.

Given that the CFRAM is the best available data at this time, the proposed mitigation options focus on warning/evacuation of the site and ensuring that the building materials and wastewater treatment system at the site are resistant and resilient to the impacts of flooding. This will ensure risk to people and property is appropriately managed.

The L-3004 has been flooded in the past which may leave the site inaccessible, so an Emergency Flood Response Plan has also been suggested as a precautionary measure. This will ensure risk to people and property is appropriately managed. Should the site flood, the risk of debris escaping from the site is low as the site is fully enclosed and gated.

4.1.1 Flood Resilient Building Construction

Design for flood resilient construction accepts that floodwater will enter buildings and provides for this in the design and specification of internal buildings and finishes. These measures limit damage caused by floodwater and also allow for relatively quick recovery.

Flood resilient constriction should be implemented, which could be achieved by using wall and floor materials that can be cleaned and dried relatively easily, provided that the substrate materials are also resilient.

Electronics, appliances and water sensitive fittings should be kept as high as practicable above FFLs. It would be advisable to keep these fittings at least 2m above finished floor levels to account for extreme water depths in the unlikely event that the flapped outfalls to the drain fail and allow the drain to overtop and let tidal waters on to the site. Any fuel/oil or hazardous material storage should also be kept at or above this level. Non return valves on the surface water/foul system may also be appropriate.

It is essential that the wastewater treatment facility is a suitable level above ground (or is in a sealed unit) to protect against inundation due to failure of the flapped outfalls on the nearby drain. This may present some significant design challenges and/or require pumping. Any WC facility within the building would need to have a non return valve fitted. The same would apply to any sinks.

4.1.2 Emergency Flood Response Plan

Tidal surge is able to be forecast with a significant lead-in time to allow adequate provision for evacuation of the site and installation of resistance measures at entrances to the site.

A Flood Emergency Response Plan for the site is recommended to set out the procedure and ensure the safety of site users and staff. The plan should outline contingency measures such as the timely evacuation of the site prior to the onset of flooding. Cork City Council should be consulted in relation to the plan and how it is implemented. A full plan should be drafted for the site once the planning permission is approved. The conclusion presented in Section 5 of this report should be carefully considered while making a plan.

4.1.3 Surface Water Management

To manage water runoff on the site, the on-site Wastewater Treatment Systems will be installed. All surface water runoff from hard surfacing areas will also be managed on the site by the on-site Wastewater Treatment Systems.

The system must be in full compliance with the guidance and codes of practice as specified in the Cork City Development Plan 2022-2028 SFRA.

5 Conclusion

JBA Consulting has undertaken a Flood Risk Assessment for the construction of a greenway compound in Kilcoolishal, Co. Cork. The main watercourses in the area Lough Mahon and the Tibbotstown stream to the east. Review of the available data and flood mapping shows that coastal flooding from the Lough and associated intertidal pools are the main source of flood risk to the site. The drain at the site has flapped outfalls and a small catchment area, this is unlikely to cause pluvial flooding, however there is a residual risk of failure of the flapped outfalls. This is dealt with through emergency planning and preparedness.

Having regard to the 'The Planning System and Flood Risk Management- Guidelines for Planning Authorities 2009' the proposed development, for a greenway maintenance and storage compound, is considered a Water-Compatible Development. The proposed development reflects a type of development that falls within the scope of amenity open space and associated essential facilities. As noted in the guidelines, this can include changing facilities which would require water and wastewater services in a similar nature and scope to the staff welfare facilities proposed as part of this application.

Flood risk information in the area is provided by the CFRAM (fluvial & coastal), the NCFHM (coastal) studies. According to the datasets the site is located in Flood Zone A/B and there is no flood relief scheme that covers the site. The CFRAM and NCFHM studies have no detailed representations of culverts or intertidal ponds included in the modelling and so, are considered conservative, and it is suggested that the railway acts as a barrier to tidal floodwaters. The Dunkettle Interchange Upgrade model will show water levels and risk in more detail; however, results and published reports are pending. In the meantime the assessment of risk and all proposed mitigation is in relation to the risk set out by the CFRAM.

It is not feasible to raise FFLs of the compound to the standard of 500mm freeboard above the 0.5% coastal plus climate change event, so risks should be managed through resilience measures, as well as warning and preparedness as set out in Section 4.1 of this report. It is essential that the wastewater treatment facility is a suitable level above ground (or is in a sealed unit) to protect against inundation due to failure of the flapped outfalls on the nearby drain.

Due to the risk of the L-3004 becoming inaccessible, risks should be limited by warning and preparedness as set out in Section 4.1.2 of this report.

There is no risk of pluvial (surface water) or fluvial (river) flood risk identified at the site and the small wastewater treatment facility will handle stormwater drainage on site. The new building would not increase surface water risk as it will be built on existing

hardstanding ground and is managed by discharging to the existing local stormwater drains.

The Flood Risk Assessment was undertaken in accordance with 'The Planning System and Flood Risk Management' guidelines and is in agreement with the core principles contained within.

A Understanding Flood Risk

Flood risk is generally accepted to be a combination of the likelihood (or probability) of flooding and the potential consequences arising. Flood risk can be expressed in terms of the following relationship: Flood Risk = Probability of Flooding x Consequences of Flooding

A.1 Probability of Flooding

The likelihood or probability of a flood event (whether tidal or fluvial) is classified by its Annual Exceedance Probability (AEP) or return period (in years). A 1% AEP flood has a 1 in 100 chance of occurring in any given year.

In this report, flood frequency will primarily be expressed in terms of AEP, which is the inverse of the return period, as shown in the table below and explained above. This can be helpful when presenting results to members of the public who may associate the concept of return period with a regular occurrence rather than an average recurrence interval and is the terminology which will be used throughout this report.

Table A-1: Conversion between return periods and annual exceedance probabilities

Return period (years)	Annual exceedance probability (%)
2	50
10	10
50	2
100	1
200	0.5
1000	0.1

A.2 Flood Zones

Flood Zones are geographical areas illustrating the probability of flooding. For the purposes of the Planning Guidelines, there are 3 types or levels of flood zones, A, B and C.

Table A-2: Flood Zones

Zone	Description
Flood Zone A	Where the probability of flooding is highest; greater than 1% (1 in 100) from river flooding or 0.5% (1 in 200) for coastal/tidal flooding.
Flood Zone B	Moderate probability of flooding; between 1% and 0.1% from rivers and between 0.5% and 0.1% from coastal/tidal.
Flood Zone C	Lowest probability of flooding; less than 0.1% from both rivers and coastal/tidal.

It is important to note that the definition of the flood zones is based on an undefended scenario and does not take into account the presence of flood protection structures such as flood walls or embankments. This is to allow for the fact that there is a residual risk of flooding behind the defences due to overtopping or breach and that there may be no guarantee that the defences will be maintained in perpetuity.

A.3 Consequence of Flooding

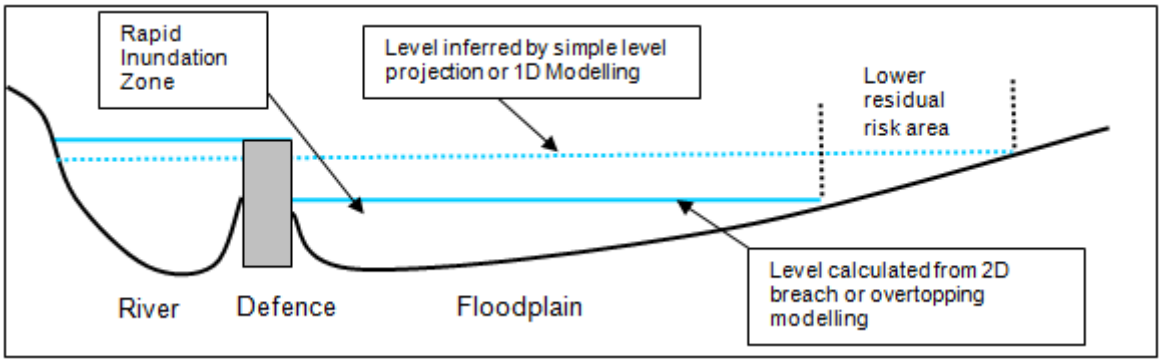
Consequences of flooding depend on the hazards caused by flooding (depth of water, speed of flow, rate of onset, duration, wave-action effects, water quality) and the vulnerability of receptors (type of development, nature, e.g. age-structure, of the population, presence and reliability of mitigation measures etc.).

The 'Planning System and Flood Risk Management' provides three vulnerability categories, based on the type of development, which are detailed in Table 3.1 of the Guidelines, and are summarised as:

- Highly vulnerable, including residential properties, essential infrastructure and emergency service facilities;
- Less vulnerable, such as retail and commercial and local transport infrastructure;
- Water compatible, including open space, outdoor recreation and associated essential infrastructure, such as changing rooms.

A.4 Residual Risk

The presence of flood defences, by their very nature, hinder the movement of flood water across the floodplain and prevent flooding unless river levels rise above the defence crest level, or a breach occurs. This is known as residual risk.



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