

Project

Mixed-use Development, Castleforbes, Sheriff St Upper, Dublin 1

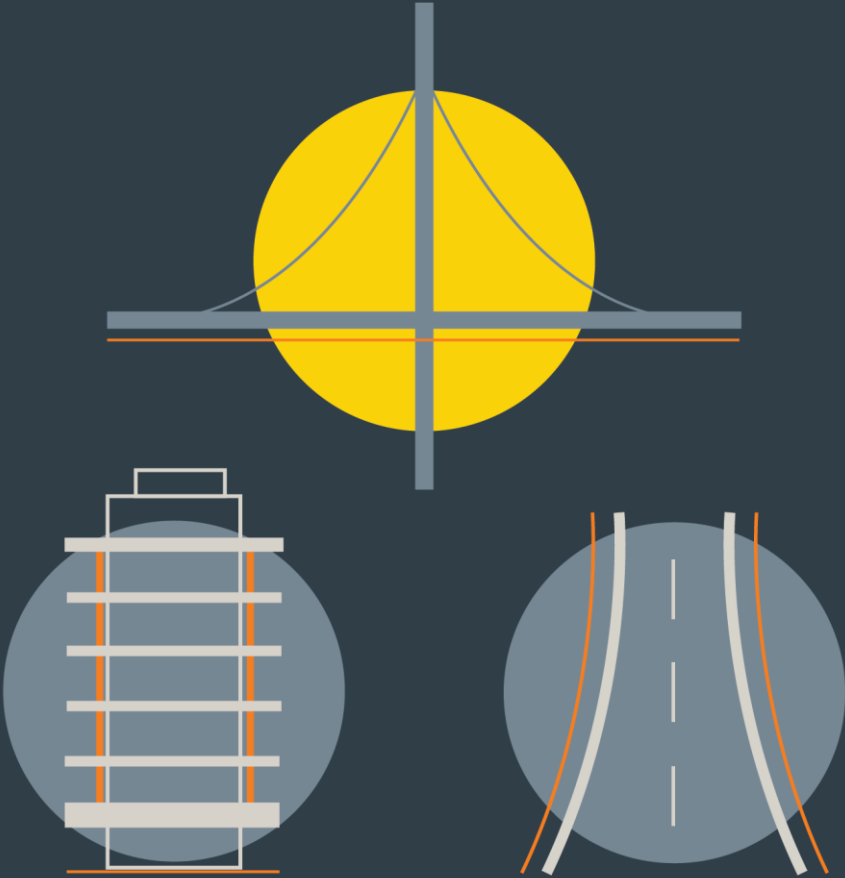
Report Title

Site Specific Flood Risk Assessment

Client

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1.0 INTRODUCTION

1.1 Background

DBFL Consulting Engineers were commissioned by the applicant to prepare a Site Specific Flood Risk Assessment (SSFRA) for the proposed mixed-use development, on a site which forms part of the Castleforbes Business Park, Sheriff St Upper, Dublin 1.

This SSFRA was prepared to comply with current planning legislation and forms part of proposed planning application for the subject site.

1.2 Objectives

The objectives of this report are to inform the planning authority regarding flood risk for the potential development of the lands. The report will assess the site and development proposals in accordance the requirements of “*The Planning System and Flood Risk Management Guidelines for Planning Authorities*”.

The report will provide the following:

- The site’s flood zone category.
- Information to allow an informed decision of the planning application in the context of flood risk.
- Appropriate flood risk mitigation and management measures for any residual flood risk

1.3 Flood Risk Assessment Scope

This SSFRA relates only to the proposed development site in the vicinity of Castleforbes and its immediate surroundings. This report uses information obtained from various sources, together with an assessment of flood risk for the existing land and proposed development. The report follows the requirements of ‘*The Planning System & Flood Risk Management – Guidelines for Planning Authorities*’, (referred to as the *Guidelines* for the remainder of this report).

1.4 Existing Site

The proposed site is located in Dublin 1, in the North Dock area of Dublin City, approximately 1.4km north-east of the City Centre as shown in Figure 1-1. The site is approximately 2.02Ha which forms part of the Castleforbes Business Park, Sheriff Street Upper, Dublin 1 (D01 VX48). The site is currently occupied by several warehouses and associated yards.

The site is bound by East Road to the west, an Irish Water pump station and CIE lands to the north, and Sheriff Street Upper to the south.

As per Dublin City Councils development plan, the site has been zoned Z14, to seek the social, economic and physical development and/or rejuvenation of an area with *mixed use, of which residential and “Z6” would be the predominant uses.*

Generally, the site is relatively flat with a slight fall from the south to north of the site.

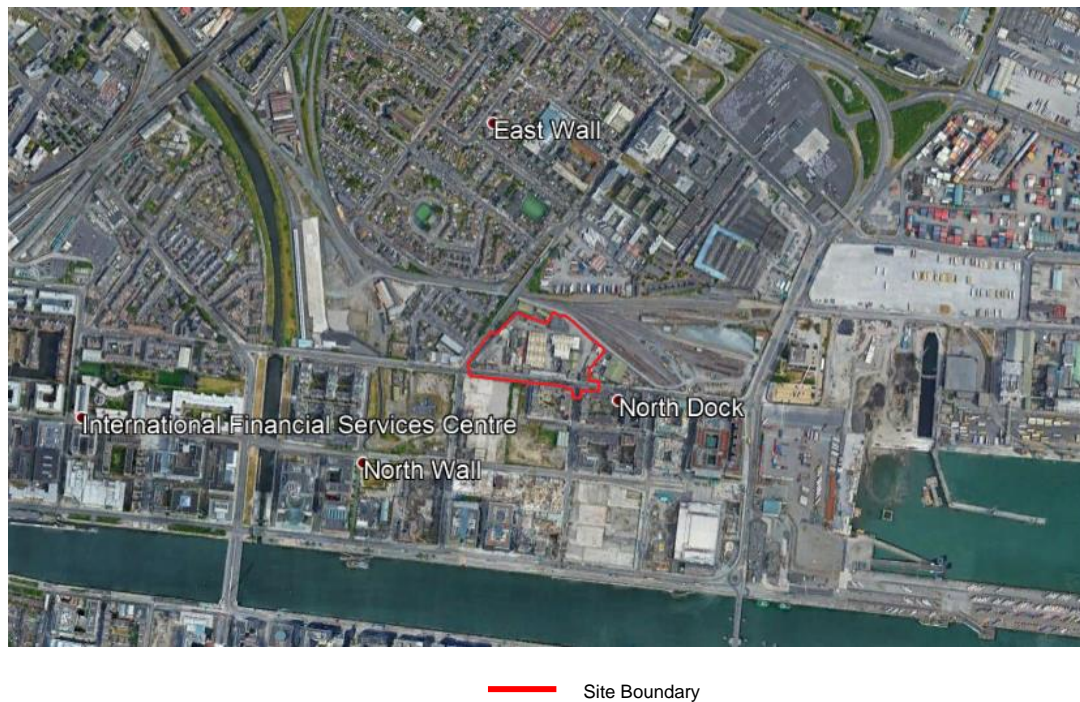


Figure 1-1: Site Location (Site Boundary Indicative Only)

There are no watercourses in the immediate vicinity of the site and the site is located approximately 1.1km southwest of the Irish Sea at East Point. The nearest EPA designated watercourses are the River Liffey 400m to the south of the subject site and the River Tolka 820m to the north of the site as shown in Figure 1-2.

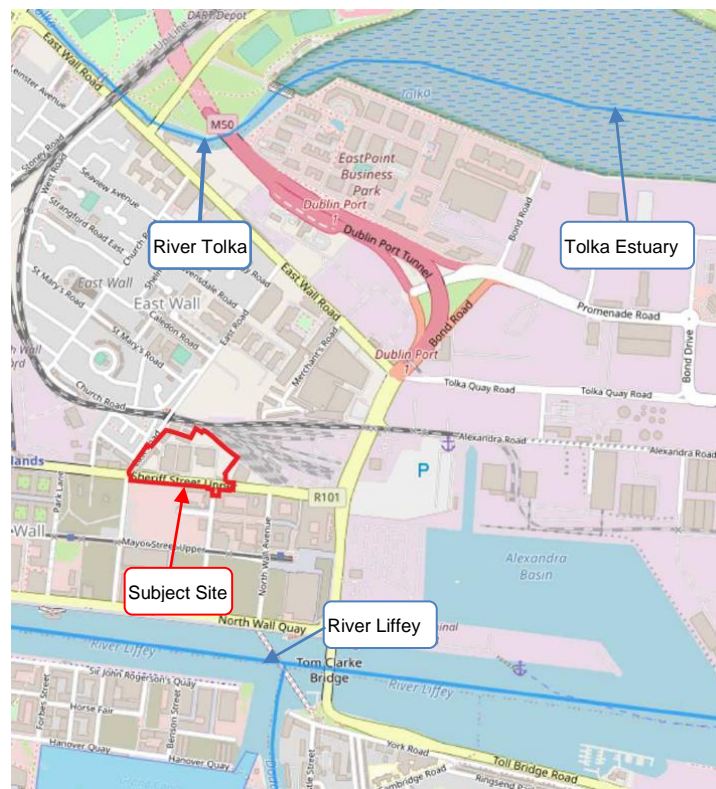


Figure 1-2: Extract from EPA online mapping

1.5 Proposed Development

The development will consist of the demolition of all structures on the site and the construction of a mixed use development set out in 9 no. blocks, ranging in height from 1 to 18 storeys, above part basement/upper ground level, to accommodate 702 no. residential units (comprising 100 studios, 406 no. 1 bed units, 169 no. 2 bed units, 15 no. 3 bed units, 8 no. duplex units and 4 no. live/work units), retail, creche, cultural space and residential tenant amenity. The site will accommodate car parking spaces, bicycle parking, storage, services and plant areas. The residential buildings are arranged around a central open space (at ground level) and raised residential courtyards at upper ground level over part basement level. Ground floor level uses located onto Sheriff Street and into the central open space include a cultural building and live/work office space. Two vehicular access points are proposed along Sheriff Street, and the part basement car parking is split into two areas accordingly, accommodating 1,040 bicycle parking spaces (including 30 no. disable spaces), 179 car parking spaces, plant, storage areas and other associated facilities. The main pedestrian access is located centrally along Sheriff Street with additional access points from East Rd and from the eastern end of Sheriff Street. The application also includes for a pocket park on the corner of Sheriff Street and East Rd to be provided as a temporary development prior to additional future development on this part of the site.

2.0 PLANNING GUIDELINES & FLOOD RISK ASSESSMENT

2.1 The Planning System and Flood Risk Management, Guidelines for Planning Authorities

The FRM Guidelines provide “mechanisms for the incorporation of flood risk identification, assessment and management into the planning process...”. They ensure a consistent approach throughout the country requiring identification of flood risk and flood risk assessment to be key considerations when preparing development plans, local area plans and planned development.

“The core objectives of The FRM Guidelines are to:

- Avoid inappropriate development in areas at risk of flooding;
- Avoid new developments increasing flood risk elsewhere;
- Ensure effective management of residual risks for development permitted in floodplains;
- Avoid unnecessary restriction of national, regional or local economic and social growth;
- Improve the understanding of flood risk among relevant stakeholders; and
- Ensure the requirements of EU and national law in relation to the natural environment and nature conservation are complied with for flood risk management.”

The key principles of The FRM Guidelines are to apply the Sequential Approach to the planning process i.e.;

- “Avoid the risk, where possible,
- Substitute less vulnerable uses, where avoidance is not possible, and
- Mitigate and manage the risk, where avoidance and substitution are not possible.”

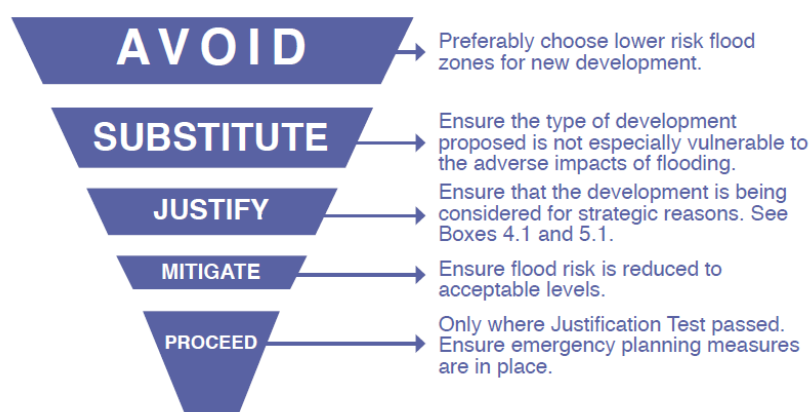


Figure 2-1 - Sequential Approach Principles in Flood Risk Management

Where the *Sequential Test's* **avoid** and **substitute** principals are not appropriate then the FRM Guidelines propose that a *Justification Test* be applied to assess the appropriateness, or otherwise, of particular developments that are being considered in areas of moderate or high flood risk.

2.2 Flood Risk Assessment

The assessment of flood risk requires an understanding of where water comes from (the source), how and where it flows (the pathways) and the people and assets affected by it (the receptors).

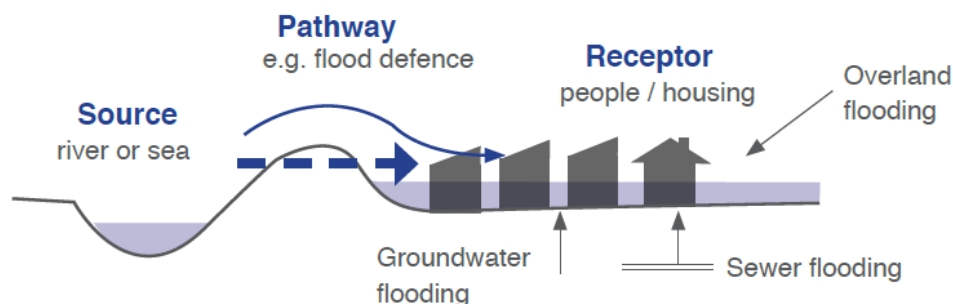


Figure 2-2 - Source-Pathway-Receptor Model

The principal sources are rainfall or higher than normal sea levels. The principal pathways are rivers, drains, sewers, overland flow and river and coastal floodplains and their defence assets. The receptors can include people, their property and the environment. All three elements are examined as part of the flood risk assessment including the vulnerability and exposure of receptors to determine potential consequences. Mitigation measures typically used in development management can reduce the impact of flooding on people and communities e.g. by blocking or impeding pathways. The planning process is primarily concerned with the location of receptors and potential sources and pathways that might put those receptors at risk.

Risks to people, property and the environment should be assessed over the full range of probabilities, including extreme events. Flood risk assessment should cover all sources of flooding, including effects of run-off from a development locally and beyond the development site.

2.2.1 Flood Risk Assessment Stages

The FRM Guidelines outline that a staged approach should be adopted when carrying out a flood risk appraisal or assessment. "These stages are:

- *Stage 1 Flood risk identification*
- *Stage 2 Initial flood risk assessment*
- *Stage 3 Detailed flood risk assessment*

The FRA Guidelines require a SSFRA be undertaken to assess flood risk for individual planning applications. This SSFRA comprises Stages 1, 2 and 3 involving both identification and more detailed assessment of flood risks and surface water management related to the planned development site.

2.3 Flood Zones

The FRM Guidelines use flood zones to determine the likelihood of flooding and for flood risk management within the planning process. The three flood zones levels are:

- Flood Zone A – where the probability of flooding from rivers and the sea is highest (greater than 1% AEP (Annual Exceedance Probability) or 1 in 100 for river flooding);
- Flood Zone B – where the probability of flooding from rivers and the sea is moderate (between 0.1% AEP or 1 in 1000 and 1% AEP or 1 in 100 for river flooding); and
- Flood Zone C – where the probability of flooding from rivers and the sea is low (less than 0.1% AEP or 1 in 1000 for both river and coastal flooding). Flood Zone C covers all areas outside zones A and B.

The FRM Guidelines categorises all types of development as either;

- Highly Vulnerable e.g. dwellings, hospitals, fire stations, essential infrastructure,
- Less Vulnerable e.g. retail, commercial or industrial buildings, local transport infrastructure.
- Water Compatible e.g. flood infrastructure, docks, amenity open space.

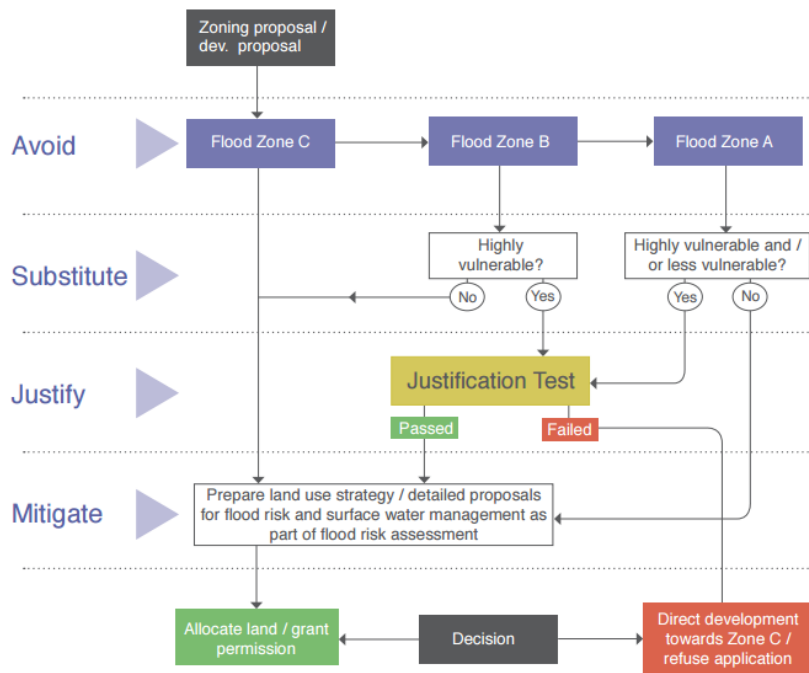


Figure 2-1: Sequential Approach mechanism in the Planning Process

The Sequential Approach restricts development types to occur within the flood zone appropriate to their vulnerability class, see Table 2-1.

	Flood Zone A	Flood Zone B	Flood Zone C
Highly vulnerable development (including essential infrastructure)	Justification Test	Justification Test	Appropriate
Less vulnerable development	Justification Test	Appropriate	Appropriate
Water-compatible development	Appropriate	Appropriate	Appropriate

Figure 2-2 – Table 3.2 from the FRA guidelines - Matrix of Vulnerability versus Flood Zone to illustrate appropriate development and that required to meet the Justification Test

2.4 Proposed Development’s Vulnerability

The proposed type of development for this site is to be a mixed use of residential, enterprise and commercial. Enterprise and commercial are categorised by the Guidelines as **less vulnerable developments** and appropriate to be located within Flood Zone B and C. Residential developments are categorised as **highly vulnerable** and appropriate to be located just within Flood Zone C. To provide highly vulnerable and less vulnerable type development within Flood Zone A requires a **Justification Test** to be completed to justify development in this moderate flood risk area.

2.5 Site Specific Flood Risk Assessment for Development

The FRM Guidelines require a SSFRA to “gather relevant information sufficient to identify and assess all sources of flood risk and the impact of drainage from the proposal”. It should “quantify the risks and the effects of any necessary mitigation, together with the measures needed or proposed to manage residual risks”. It considers the nature of flood hazard, taking account of the presence of any flood risk management measures such as flood protection schemes and how development will reduce the flood risk to acceptable levels. A detailed assessment for a development application should conclude that core flood risk elements of the Justification Test are passed and that residual risks can be successfully managed with no unacceptable impacts on adjacent lands.

2.5.1 SSFRA Key Outputs

Key outputs of an SSFRA are:

- Plans showing the site and development proposals including its relationship with watercourses and structures which may influence local hydraulics;
- Surveys of site levels and comparison of development levels relative to sources of flooding and likely flood water levels;
- Assessments of:
 - Potential sources of flood risk;
 - Existing flood alleviation measures;

-
- Potential impact of flooding on the site.
 - How the layout and form of the development can reduce those impacts, including arrangements for safe access and egress.
 - Proposals for surface water management and sustainable drainage.
 - The effectiveness and impact of any mitigation measures.
 - The residual risks to the site after the construction of any necessary measures and the means of managing those risks; and
 - How flood risks are managed for occupants / employees of the site and its infrastructure.

3.0 STAGE 1 FLOOD RISK IDENTIFICATION

3.1 Available Flood Risk Information

The initial flood risk identification stage uses existing information to identify and confirm whether there may be flooding or surface water management issues for the lands in question that may warrant further investigation.

To initially identify potential flood risks for the subject site and surrounding area, a number of available data sources were consulted, these are listed in Table 3-1.

Table 3-1: Review of Available Flood Risk Information

	Information Source	Coverage	Quality	Confidence	Identified Flood Risks	Flood Risk
Primary Data Source & Modelled Data	OPW ECFRAM - Fluvial	Regional	High	High	Flood maps indicates that the development site is in Flood Zone C (not at risk of fluvial flooding).	X
	OPW ECFRAM - Tidal	Regional	High	High	Tidal Flooding Map identifies site to be outside of the indicated 0.5% AEP event coastal flood zone.	X
	ICPSS	Nationwide	High	High	ICPSS maps indicated that the subject site is within the tidal floodplain for the 0.5% AEP, although protected by defences.	✓
	DCC Development Plan SFRA	Local	High	High	Proposed development site within Flood Zone A and within the Defended Area.	✓
Secondary Data Source	Walkover Survey	Local	Varies	Varies	Container/trailer park covering most of the site area. No evidence of flooding. All drainage is underground. Levels within the site fall from north to south.	X
	OPW Historic Flood Records	Nationwide	Varies	Varies	No records of flooding on site.	X
	Historic OSI Maps	Nationwide	Moderate	Low	None.	X
	EPA Ex. Rivers	Nationwide	Moderate	Moderate	No designated River / Stream in site.	X
	Drainage Records	County	Moderate	Moderate	No Irish Water drainage assets running through site.	X
	Geological Survey Ireland Maps	Nationwide	Moderate	Low	Made Ground on site cohesive deposits (CLAY and SAND).	X
	Topographic Survey	Local	High	High	Site relatively flat with slight fall from south to north. Levels range from 2.13m AOD to 0.62m AOD.	X

3.2 Identified Flood Risks/Flood Sources

3.2.1 OPW Predictive, Historic & Benefiting Lands Maps & Flood Hazard Information

From consultation of flood information from the OPW's floodmaps.ie website the site has not suffered from flooding in the past. A review of this report shows that there have been 21 flood events recorded within 2.5km of the site since 1954. However, there are no records of the site itself having been flooded. Nevertheless, there was a significant road flooding on Church Street on 1st February 2002 which had a recorded tide level of 2.95m AOD. The temporary and permanent flood works on the Royal Canal at Spencer Docks have prevented this happening since, the recorded high tide of 3.014m AOD on the 3rd of January 2014 did not produce any significant flooding in the vicinity of the site.

Fluvial Flood Risk

The OPW's Eastern CFRAM study produced flood risk maps and the assessment of fluvial flood plains over the eastern region of Ireland. As part of this study both the Liffey and the Tolka were assessed, the site falls between the two watercourses and is out of the fluvial flood extents of both these water courses, as can be seen in Figure 3-1.

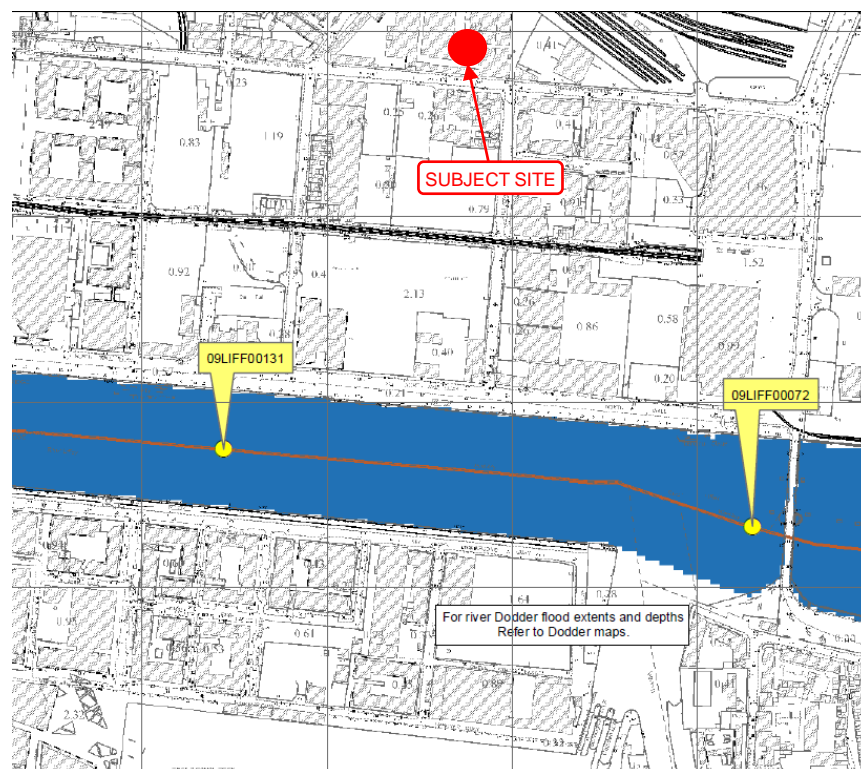


Figure 3-1: Extent of Fluvial Flood Risk (extract from CFRAMs Liffey Fluvial Flood Extents)

Tidal Flood Risk

The OPW ECFRAM coastal flood risk analysis for 0.5% and 0.1% AEP return periods show the site is outside the extents of the 0.5% AEP coastal flood event as seen in Figure 3-2 and takes into the account the flood defence works completed in Spencer Dock in 2009. This is considered more detailed and up to date than the ICPSS map which indicates the site is located within the 0.5% AEP coastal flood event zone (see section 3.2.3).

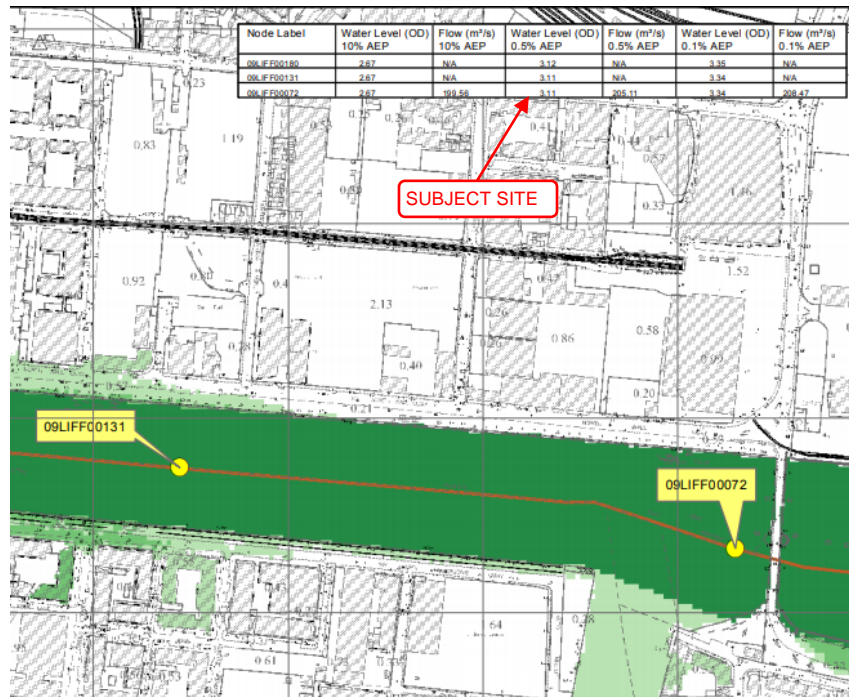


Figure 3-2: Extent of Tidal Flood Risk (extract from CFRAMs LiffeyTidal Flood Extents)

Pluvial Flood Risk

Furthermore, the OPW's ECFRAM Study also assessed effects of pluvial flooding in the area. The Pluvial maps of Dublin City as part of the OPW Flood Resilient City Programme show the site has a moderate pluvial flood risk (refer to Figure 3-3).

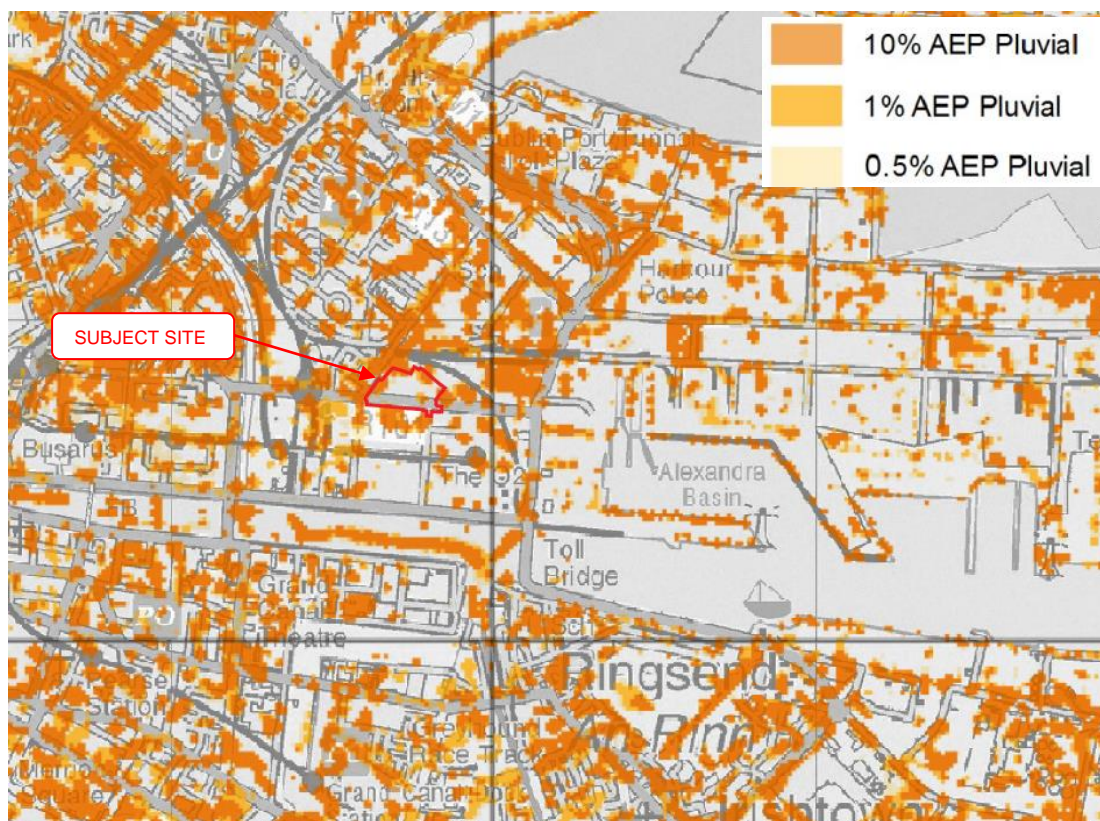


Figure 3-3: Extent of Pluvial Flood Risk (extract from Dublin City - Pluvial Flood Extents Map)

3.2.2 Dublin County Council Strategic Flood Risk Assessment

Appendix 7 of the Dublin City Development Plan 2016-2022 comprises the Strategic Flood Risk Assessment (SFRA) which uses the draft ECFRAM mapping as its basis for identifying areas at flood risk. The SFRA identifies the subject site as “Site: 3. Liffey: O’Connell Bridge to Tom Clarke Bridge” category, refer to Figure 3-4 for extents of flood risk identified by the SFRA.

Within same, it is noted that the proposed development site is located within Flood Zone A, i.e. high probability of flooding. However, the flood zone is also protected by flood defences as shown in Figure 3-4 and Figure 3-5.

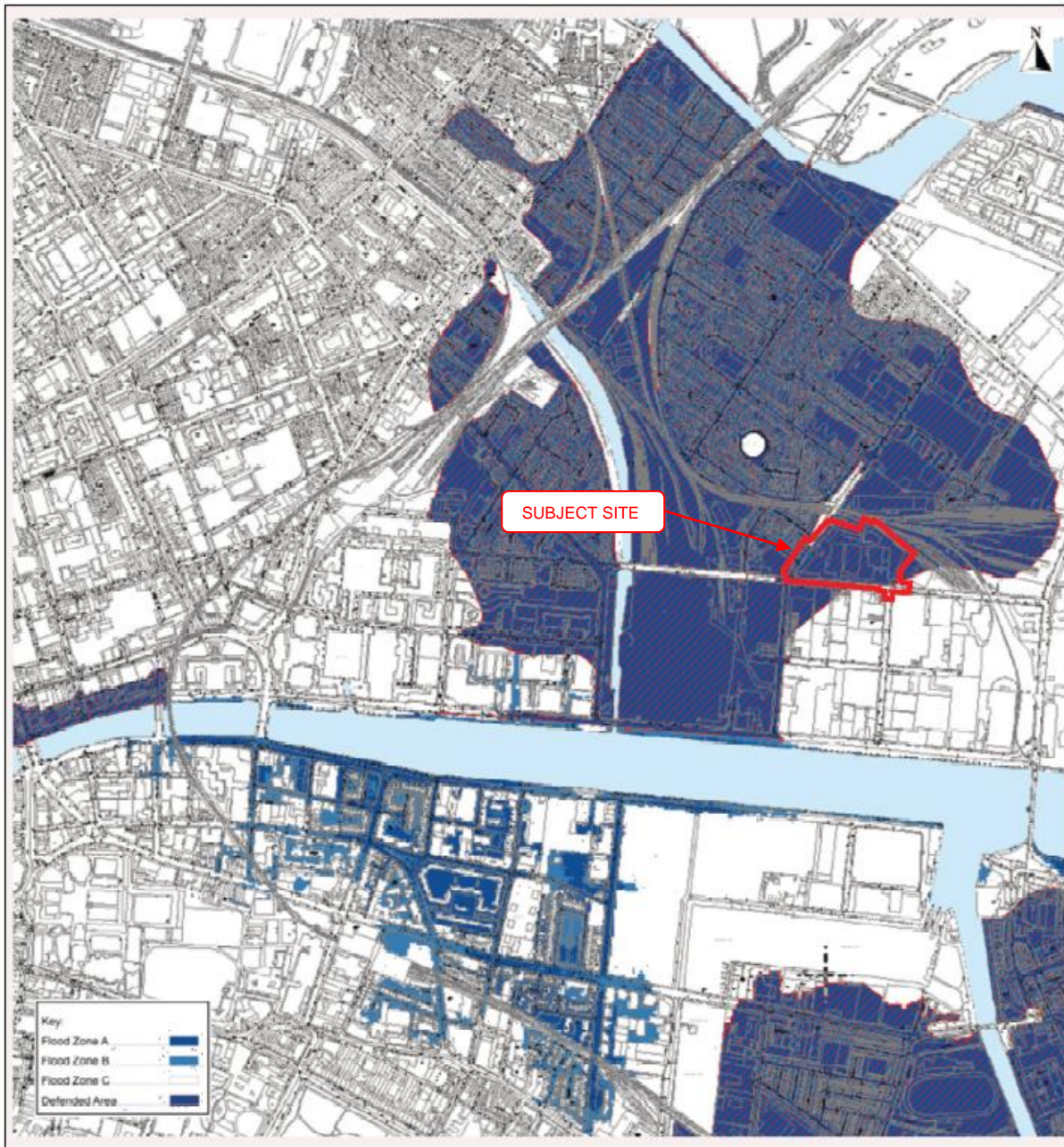


Figure 3-4: Extract from DCC Strategic Flood Risk Assessment, Development Plan 2016-2022, Estimated Flood Extents

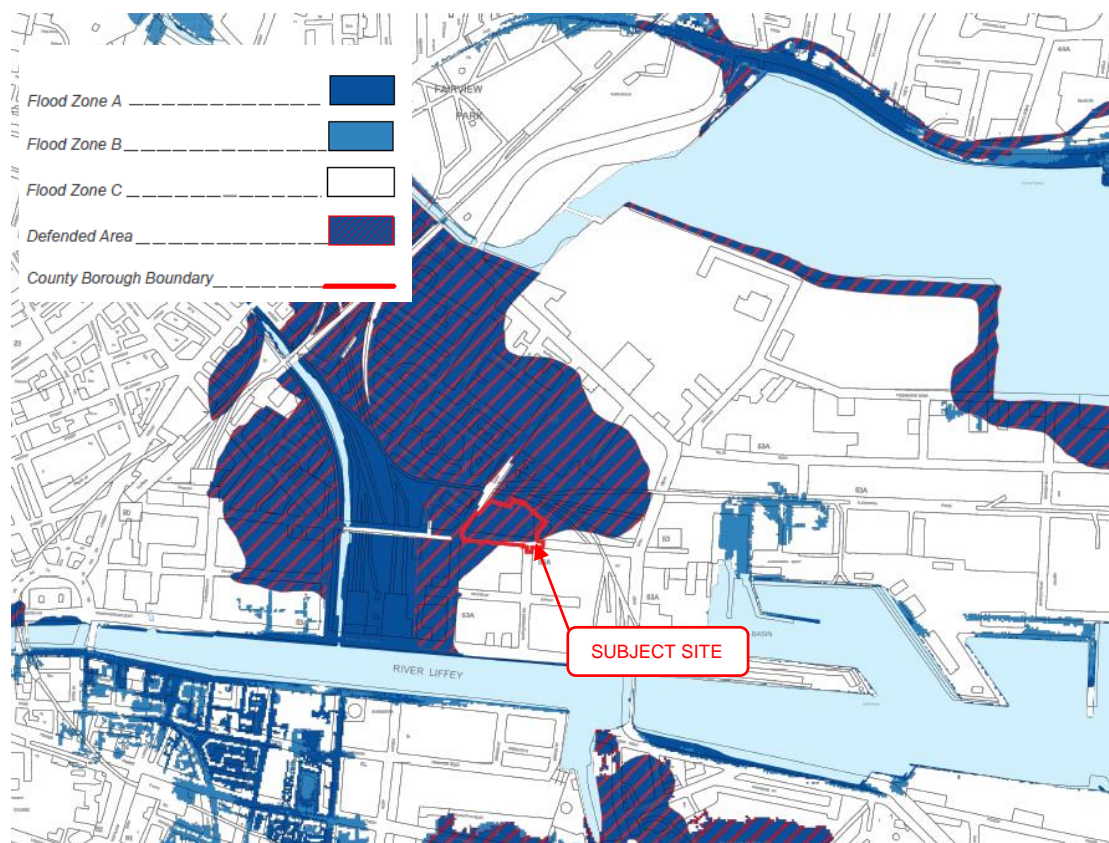


Figure 3-5: Extract from DCC Strategic Flood Risk Assessment indicating Defended Areas

3.2.3 Irish Coastal Protection Strategy Study (ICPSS)

After reviewing the ICPSS coastal flood extents maps, it can be seen that the subject site is within the modelled flood extent for the 0.5% AEP event, i.e. the subject site is within Flood Zone A as shown in Figure 3-6.

The maps included within the Irish Coastal Protection Strategy Study are 'predictive' flood maps, as they provide predicted flood extent and other information for a 'design' flood event that has an estimated probability of occurrence. The maps have been produced at a strategic level to provide an overview of coastal flood hazard and risk in Ireland, and minor or local features such as flood defence schemes which might affect a coastal flood, have not been included in their preparation.

It is important to note therefore that although the subject site is located within the coastal flood extent for the 0.5% AEP event, the ICPSS flood extent maps do not consider the existing flood defences which defend this area.

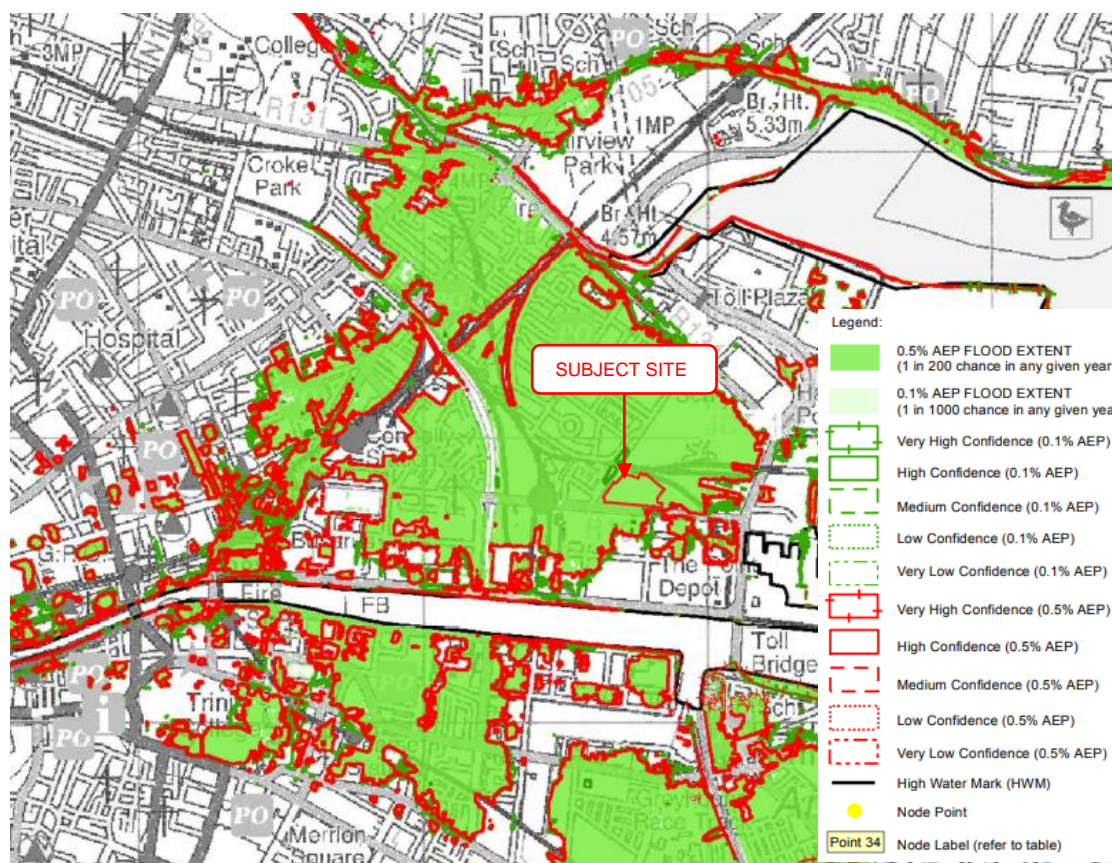


Figure 3-6: Extract from ICPSS 1 in 200-year tidal flood extent map

3.2.4 Topographical Survey

After reviewing the Topographical survey, the subject site is relatively level, with a slight fall from south to north. The existing topography levels range from 2.97m AOD at the existing entrance to a low point at the northern part of the site at 0.48m AOD.

3.2.5 Walkover Survey

From a walkover of the site, it is clear that the subject site which is currently used as a warehouse and yard, is relatively flat and no evidence of flooding or flow paths are evident on site. Levels on Sheriff Street Upper are higher than the subject site to the south of subject site and fall from south to north towards the CIE boundary. The walkover survey confirmed the proposed development site is as expected and ties in with the topographical survey.

3.2.6 Other Sources

Other information sources were consulted to determine if there was any additional flood risk to the subject site, these included:

- Soil data from GSI – The entire site consists of made ground soils on gravels on clay.
- Groundwater information from GSI – There are no records of any karst features in the locality and there is no record of evidence of groundwater flooding for the proposed site.

- Groundwater information from OPW's Draft Preliminary Flood Risk Assessment – The flood risk map indicates no groundwater flood risk to the site or to the surrounding area.
- Existing Local Authority Drainage Records – The surrounding area predominately uses a combined drainage network. To the south of the development an existing 990mm diameter combined sewer that services the site which runs along Sheriff St Upper from east to west before turning down East Road towards the existing Irish Water pumping station to the north of the development.

As part of DBFL's wider discussions with Brendan Colgan of DCC for the larger Castleforbes masterplan it was noted that the overflow that runs down Sheriff St Upper is used as the main pumping main for East Road Pumping Station and therefore can be classed as combined, although is only used in heavy rainfall events. No other Local Authority drainage infrastructure appears to exist in the vicinity of the site.

- Historic Maps – no evidence of flooding or marsh areas within the site.

3.3 Source-Pathway-Receptor Model

A Source-Pathway-Receptor model was produced to summarise the possible sources of floodwater, the people and assets (receptors) that could be affected by potential flooding (with specific reference to the proposals), see Table 3-2. It provides the probability and magnitude of the sources, the performance and response of pathways and the consequences to the receptors in the context of the mixed-use development proposal. These sources, pathways and receptors will be assessed further in the initial flood risk assessment stage.

Table 3-2: Source-Pathway-Receptor Analysis

Source	Pathway	Receptor	Likelihood	Impact	Risk
Tidal	Subject site within the defended flood extents for the 0.5% AEP if a breach or overtopping of flood defences occurs.	Future Development	Very remote	High	Medium
Fluvial	Proposed development site within Flood Zone C (low risk of fluvial flooding).	-	Remote	-	-
Surface Water Drainage (Pluvial)	Flooding from the surcharging of the development's drainage systems.	Future development	Possible	Low	Low
Groundwater flooding	Rising GWL on the site	Future development	Remote	Low	Low
Infrastructural - Human or Mechanical Error	Blockage of new drainage network.	Areas of development draining to the surface water network	Possible	Low	Low

The following paragraph provides a summary of the results of this Source-Pathway-Receptor flooding model for the subject site.

3.4 Source-Pathway-Receptor Model Results

As it can be seen in the flooding analysis, the proposed development site is not at risk from fluvial flooding. However, there is a low risk of groundwater flooding. This type of flooding occurs when water levels in the ground rise above surface levels. Prolonged storm events together with medium and/or high tides may increase the existing groundwater level on site. Considering the geology and topography of the subject site, and the proposed development will be raising the low points of the site for the ground floor level, the possibility of groundwater rising above ground floor level is considered low.

There is also a low risk of pluvial flooding due to the potential surcharging and blockage of the new drainage network. Lastly there is a medium risk associated with Tidal flooding, due to the site being identified in Flood Zone A within the ICPSS, although it must be noted that the Dublin City Council's SFRA also identifies that this flood risk area benefits from being defended zone and therefore flood risk for the development site is considerably lowered.

Consequently, an initial flood risk assessment will follow to provide further detail on the causes, effects and possible mitigation measures for the sources of flood risk identified above.

4.0 STAGE 2 INITIAL FLOOD RISK ASSESSMENT STAGE

The main sources of flood risk identified from Stage 1 are:

- A low pluvial flood risk associated with the proposed developments proposed drainage network.
- A low groundwater flood risk associated with the groundwater levels encountered in the site investigation.
- A moderate risk of Tidal flooding associated with an extreme sea level rise.

4.1 Initial Tidal Flood Risk Assessment

As stated above, the 1 in 200-year (0.5% AEP) tidal flood extent map estimated as part of the Irish Coastal Protection Strategy Study (ICPSS) for the area around the subject site indicates that the proposed development site is within the modelled flood extent. This indicates that the site of the proposed development is within Flood Zone A for tidal flooding, in accordance with the Planning System and Flood Risk Management Guidelines for Planning Authorities.

The ICPSS mapping indicates the 200-year design tidal water level in the vicinity of the subject site as 3.07m AOD as shown in Table 4-1.

Table 4-1: Design tidal water level within the vicinity of site

Annual Exceedance Probability (AEP)	10%	0.5%	0.1%
Return Period	10 years	200 years	1000 years
Point 22 – Water Level	2.67m AOD	3.07m AOD	3.28m AOD

It is important to note that The Planning System and Flood Risk Management Guidelines for Planning Authorities ignore the presence of flood defences when defining flood zones. As outlined previously, the proposed development site is in an area protected by flood defence works on the Royal Canal at Spencer Dock and along the Tolka.

As a result of climate change, the sea level is expected to gradually rise in the future. As the proposed development is a mixed-use development, it is proposed that all highly vulnerable development (i.e. residential dwellings) are located above the 1 in 200 coastal flood level including an allowance for climate change, with an appropriate freeboard in accordance with the DCC SFRA.

Yearly high tides are approximately 2.5m AOD and the highest recorded tide was 3.014m AOD on 3rd January 2014.

4.2 Initial Pluvial Flood Risk Assessment

The Source-Pathway-Receptor model identified that there could be potential for pluvial flood risk within the development site related to the future drainage networks serving the proposed development.

These have potential to cause local flooding unless they are designed in accordance with the regulations e.g. GDSDS and to take account of flood exceedance e.g. for storms return periods over 1% AEP. However, this is not an issue for the subject development as the proposed drainage system has been designed in accordance with current requirements of the GDSDS (i.e. 2-year, 30 year no flooding on site & check at 100 year for surcharging, storage, flood routing & freeboard to FFLs).

Pluvial flood risk associated with the proposed development has been addressed in detail within DBFL Infrastructure Design Report 180159-Rep-101. The pluvial risk has been mitigated for the proposed via:

- New drainage collection system incorporating SUDS features.
- Surface water network capacity to be designed in accordance with GDSDS recommendations and DCC requirements and incorporate 20% climate change.
- Existing runoff rates will be reduced by the provision of a co-ordinated surface water network incorporating SuDS elements at different stages with attenuated outlet (“hydrobrake optimum” or similar approved as a flow control device). This is designed to restrict discharges to 3.6 l/s for the contributing catchment.
- An adequately sized attenuation facility to cater for retained flood volumes. This is designed for the 1 in 100-year storm plus 20% allowance for climate change.

Proper operation and maintenance of the drainage system should also be implemented in accordance with the CIRIA 753, The SuDS Manual, to reduce the risk of human or mechanical error causing pluvial flood risk from blockages, etc.

4.3 Initial Groundwater Flood Risk Assessment

The Source-Pathway-Receptor model identified that there could be potential for groundwater flood risk on the proposed site due to low existing levels at the Irish Water pump station boundary to the north of the development.

Further to this, no known groundwater flooding has occurred in the vicinity of the site and as part of the development proposals the lower areas of the site will be raised. The flood risk associated with Groundwater will not be increased due to the development proposals and can be deemed as low.

4.4 Flood Zone Category

Following the assessment of the flood risk to the site and the available information it is considered that the proposed development site is located within a defended portion of the 0.5% AEP coastal flood zone event, i.e. Flood Zone A, as defined by the Guidelines and indicated by the Irish Coastal Protection Strategy Study.

Both Pluvial and groundwater have been assessed as being low and no further assessment is deemed necessary.

As the proposed development has a moderate tidal flood risk on site, this document will therefore further assess the viability and vulnerability of the proposed development in regard to this source of flooding.

5.0 STAGE 3 DETAILED FLOOD RISK ASSESSMENT

The detailed Flood Risk assessment stage will look more closely how the proposed development will mitigate flood risk from the identified source.

In regard to the moderate tidal flood risk, the detailed flood risk assessment stage will assess this in relation to the following:

- Proposed development plans (FFLs, site vulnerability, building extents).
- Impact of proposed development on adjacent properties.
- In relation to the objectives set out in the DCC SFRA justification test.
- Any residual risks
- Flood exceedance.

5.1 Detailed Tidal Flood Risk Assessment

As stated in section 1.5, the proposed development is to construct a mixed-used development comprising of apartments, retail space, office space, a creche, and amenities for tenants.

The initial flood risk assessment assessed the risk associated with the 1 in 200-year tidal flood event as the principle source of the flooding on the site.

It should be noted that the retail space, office space and amenities are categorised by the Guidelines as 'less vulnerable' development and appropriate to be located within Flood Zone A if the justification test is passed (refer to section 5.2). The apartment units of the development are categorised as 'highly vulnerable' development and must be located above the appropriate flood level (plus freeboard and climate change) in accordance with Dublin City Councils' Strategic Flood Risk Assessment.

The ICPSS mapping indicated that the 200-year design tidal water level in the vicinity of the subject site as 3.07m AOD. Existing topography levels along Sheriff St Upper at the access to the site vary between 2.0m AOD and 3.2m AOD as shown in Figure 5-1.



Figure 5-1: Existing road and boundary levels in the vicinity of the proposed development site

According to the DCC SFRA, the minimum finished floor level for a ‘highly vulnerable’ development should be the 1 in 200-year tidal flood level, with a suitable allowance for climate change and a suitable freeboard. The freeboard should be at least 300mm but in tidal risk areas could be higher, particularly where wave action or combined fluvial/tidal events are present. In this case, as there is not a combined fluvial/tidal event and that wave action would not be present as source of flooding is not coastal tidal, the freeboard has been maintained at 300mm.

The lowest proposed ground floor level is 2.65m AOD however the facilities at the ground floor are categorised by the Guidelines as ‘less vulnerable’ development and are appropriate to be located within Flood Zone A if the justification test is passed (refer to section 5.1).

To take a conservative approach and to be consistent with the adjacent North Lotts and Grand Canal Dock SDZ, the 0.1% AEP flood level and a 300mm freeboard has been used to calculate the minimum level for ‘Highly vulnerable’ development throughout the proposed site as can be seen in Table 5-1.

Table 5-1: Minimum FFL for ‘highly vulnerable’ development

0.1% AEP flood level	Climate change allowance	Freeboard	Minimum FFL of ‘highly vulnerable development’
3.28m AOD	+0.5m	+0.3m	4.08m AOD

Due to other development requirements, all proposed highly vulnerable development will be set at a minimum of 4.10m AOD which is in exceedance again of the above calculated.

The ground floor level of 2.65m AOD is below the 10% AEP flood level (2.67m AOD), however the site is within an area that is defended against flooding up to the 1% AEP flood level. Only ‘less vulnerable’ development will be set at less than 4.10m AOD, with all highly vulnerable development having a finished floor level of 4.10m AOD or more. This conservative approach will ensure that all highly vulnerable development will be located at a safe level.

The live/work units, that have been included as part of the development proposals, are entered at the ground floor level (2.56m AOD), however the residential portion of these units are all located above 4.10m AOD while the commercial portion (less vulnerable) is at ground floor level.

5.2 Justification Test

As part of the Dublin City Development Plan Strategic Flood Risk Assessment, a number of sites were identified as being within Flood Zones A and B and Justification Tests for development plans undertaken for those not zoned for a flood compatible land use to confirm their specific zoning objectives. The proposed development is located adjacent to one of these sites (Site 3. Liffey: O’Connell Bridge to Tom Clarke Bridge (see Appendix D)) and although being located within a zone that benefits from flood defence measures (as shown in the DCC SFRA) it is located

within the ICPSS flood extents. Therefore, to take a conservative approach, the Justification test for Development Plans was undertaken.

As part of the requirements of the Justification Test and the Planning System and Flood Risk Management Guidelines, the proposed development must satisfy the Justification Test for development management as follows:

1. The subject lands have been zoned or otherwise designated for the particular use or form of development in an operative development plan, which has been adopted or varied taking account of these.

As stated previously, the site has been zoned Z14 within the DCC Development Plan 2016-2022, to seek the social, economic and physical development and/or rejuvenation of an area with mixed use, of which residential and “Z6” – to provide for the creation and protection of enterprise and facilitate opportunities for employment creation – would be predominant uses.

2. The proposal has been subject to an appropriate flood risk assessment that demonstrates:

- (i) The development proposed will not increase flood risk elsewhere and, if practicable, will reduce overall flood risk;

Yes, the development proposals include for a sustainable approach in surface water management, including the use of various SUDS features detailed in the development’s Infrastructure Design Report, reducing the peak flow rate of surface water to calculated greenfield run-off rates. This will reduce flows and increase capacity in the Public drainage network and have a net benefit for the surrounding area.

- (ii) The development proposal includes measures to minimise flood risk to people, property, the economy and the environment as far as reasonably possible;

Yes, the development ensures all ‘highly vulnerable’ development is located at a minimum floor level of 4.10m, which includes for a climate change allowance and freeboard. The lower ‘less vulnerable’ development will include measures to minimise flood risk such as the use of demountable flood barriers, for enterprise and café accesses if required.

- (iii) The development proposed includes measures to ensure that residual risks to the area and/or development can be managed to an acceptable level as regards the adequacy of existing flood protection measures or the design, implementation and funding of any future flood risk management measures and provisions for emergency services access; and

Yes, the nature of the proposed development will mean the development will be managed and that staff will ensure, that, in the highly unlikely event that

the flood defences were breached then residents and workers could be alerted and evacuate to a designated safe area.

- (iv) The development proposed addresses the above in a manner that is also compatible with the achievement of wider planning objectives in relation to development of good urban design and vibrant and active streetscapes.

Yes, the proposed development is in accordance with the planning objectives and in accordance with the Planning System and Flood Risk Management Guidelines.

All of the above points have been addressed throughout this flood risk assessment and within the design of the development. The following sections of this SSFRA, will go through, the key points, mitigation measures and residual risks associated with the development to demonstrate that flood risk has been reduced to an acceptable level and how the justification requirements have been met.

5.3 Residual Risks

Remaining residual flood risk, following the initial assessment include the following:

- Pluvial flooding from the drainage system related to blockage.
- Pluvial flooding from the development's drainage system for the 0.5% AEP tidal event.
- Defence failure (overtopping or breach of the flood defences by a flood that exceeds the design level of the defence).

5.4 Mitigation Measure

5.4.1 Proposed Mitigation Measures

Proposed mitigation measures to address residual flood risk are summarised below:

- All proposed highly vulnerable development will be set above the 1 in 1000-year tidal flood level including an allowance for climate change and an appropriate freeboard: 3.28m AOD (for the 1 in 1000year tidal flood level in the vicinity of the subject site) + 0.3 (freeboard) + 0.5 (climate change) = 4.08m AOD.
- Any development below this level will be designed to be flood resilient in accordance with the Dublin City council's Code of Practice for Flood Resilience and Adaptation Measures to minimise damage. Some techniques used include:
 - Structural walls and columns designed for short-term immersion;
 - As much as possible, the location of the main electrical circuitry and other utilities should be located above the 0.1% AEP design level and that sockets and electrical connections are located 1m above floor level to give a level of protection.

- Materials, details and finishes are selected and designed for durability and ease of maintenance and be considered flood resilient.
- Advanced warning systems such as alarms or notifications will be implemented where possible for users and workers to be alerted of any imminent flood warnings. Depending on the level of warning, advice on appropriate action will be given to those residents with car parking spaces in the undercroft. This will aid in the reduction of damage by allowing residents to move vehicles out of the development.
- The proposed drainage system to be maintained on a regular basis to reduce the risk of a blockage.
- In the event of storms exceeding the 100-year design capacity of the drainage system, then possible flood routing for overland flows towards Sheriff Street Upper and CIE lands should not be blocked.

5.4.2 Effectiveness of Mitigation Measures

It is considered that the flood risk mitigation measures once fully implemented are sufficient to provide a suitable level of protection to the proposed development.

The proposed development will not increase the run-off rates when compared with the existing site and satisfies the requirement of the SFRA to reduce flooding and improve water quality.

5.5 Flood Exceedance

In the case that that an exceedance storm event occurs, in excess of the 1% AEP. The development's layout is designed to ensure over-land flows are directed away from the buildings. In larger than the 100-year storm events, there will be additional volume within the surface water network which will be able to surcharge before flooding. When this tolerance has been exceeded the attenuation storage features will flood and overtop, with overland flows expected to pass from the site onto Sheriff Street Upper following the topography of the land (refer to Figure 5-2).



Figure 5-2: Overland flow path

6.0 CONCLUSION

The SSFRA concludes the following:

- This Site Specific Flood Risk Assessment for the proposed development at Castleforbes was undertaken in accordance with the requirements of the “Planning System and Flood Risk Management Guidelines for Planning Authorities”, November 2009.
- The proposed type of development for this site is to be a mixed-use residential development with retail space, office space, a creche, and amenities. The retail space, office space and amenities are categorised by the Guidelines as **less vulnerable** development and appropriate to be located within Flood Zone A if the requirements of the Justification Test are met. Apartment units are habitable and are categorised as **highly vulnerable** development and must be located above Flood Zone A.
- The development passes the Justification Test in accordance with Box 5.1 of the Guidelines and the proposed development is deemed appropriate to be located within Flood Zone A on the basis that the mitigation measures stipulated within justification are met.
- The proposed development site is within Flood Zone A for tidal flooding according to the ICPSS, however, the site is located in an area that benefits from flood defence measures, therefore the SSFRA has assessed the residual risks associated with breach of these defences.
- As part of the mitigation measures to reduce the associated Flood risk for site users was by ensuring all ‘highly vulnerable’ finished floor levels are located above the 0.1% AEP flood level, in addition to a climate change allowance and a conservative freeboard, giving a minimum FFL for this type of development of 4.08m.
- As part of the proposals all highly vulnerable development (apartment units) will be located at a minimum of 4.10m AOD.
- A possible source of flood risk from the surcharging or blockage of the development’s drainage system has been identified. This risk is mitigated by suitable design of the drainage network (as detailed in DBFL Infrastructure Design Report 180159-Rep-101), regular maintenance and inspection of the network and establishment of exceedance overland flow routes.
- The development’s drainage design includes for a 20% climate change allowance. The proposed development will not increase run-off rate when compared with the existing site and satisfies the requirement of the SFRA to reduce flooding and improve water quality.

Appendix A

OPW Flood Hazard Report

Summary Local Area Report

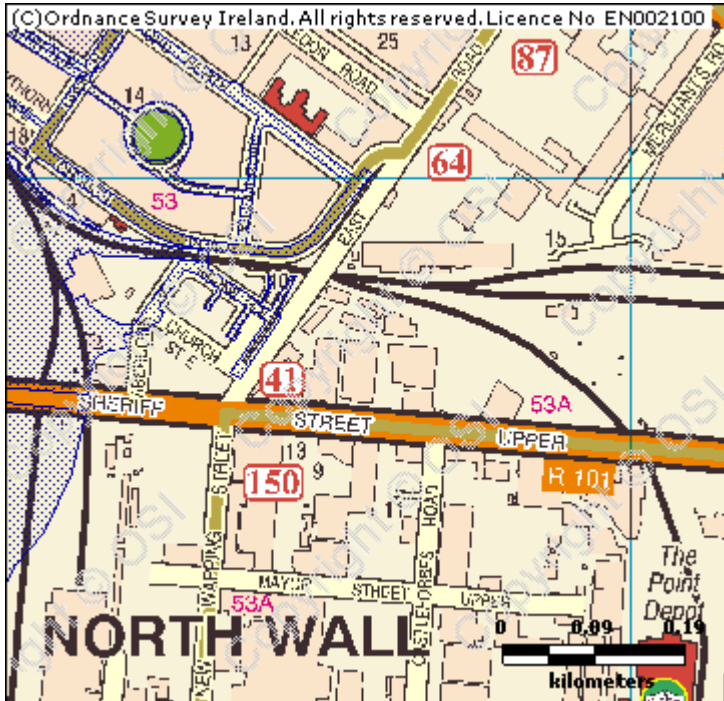
This Flood Report summarises all flood events within 2.5 kilometres of the map centre.

The map centre is in:

County: Dublin

NGR: O 177 348

This Flood Report has been downloaded from the Web site www.floodmaps.ie. The users should take account of the restrictions and limitations relating to the content and use of this Web site that are explained in the Disclaimer box when entering the site. It is a condition of use of the Web site that you accept the User Declaration and the Disclaimer.



Map Scale 1:7,745

Map Legend	
	Flood Points
	Multiple / Recurring Flood Points
	Areas Flooded
	Hydrometric Stations
	Rivers
	Lakes
	River Catchment Areas
	Land Commission *
	Drainage Districts *
	Benefiting Lands *

* Important: These maps do not indicate flood hazard or flood extent. Their purpose and scope is explained in the Glossary.

28 Results

	1. Flooding at Bessborough Avenue, North Strand, Dublin 3 on 24th Oct 2011 County: Dublin	Start Date: 24/Oct/2011 Flood Quality Code:3
Additional Information: Reports (1) More Mapped Information		
	2. Tolka December 1954 County: Dublin	Start Date: 08/Dec/1954 Flood Quality Code:1
Additional Information: Photos (2) Reports (13) Press Archive (9) More Mapped Information		
	3. Tolka November 2002 County: Meath, Dublin	Start Date: 13/Nov/2002 Flood Quality Code:1
Additional Information: Photos (126) Reports (9) Videos (3) Press Archive (13) More Mapped Information		
	4. Dublin City Tidal Feb 2002 County: Dublin	Start Date: 01/Feb/2002 Flood Quality Code:1
Additional Information: Photos (32) Reports (10) Press Archive (27) More Mapped Information		
	5. Tolka Richmond Road Drumcondra Nov 2000 County: Dublin	Start Date: 05/Nov/2000 Flood Quality Code:3

Additional Information: Reports (5) Press Archive (5) More Mapped Information



6. Tolka Richmond Road August 1986

Start Date: 25/Aug/1986

County: Dublin

Flood Quality Code:1

Additional Information: Reports (4) More Mapped Information



7. Tolka Nov 1965

Start Date: 25/Nov/1965

County: Dublin

Flood Quality Code:3

Additional Information: Photos (2) Reports (6) Press Archive (2) More Mapped Information



8. Tolka September 1946

Start Date: 20/Sep/1946

County: Dublin

Flood Quality Code:3

Additional Information: Reports (10) More Mapped Information



9. Tolka September 1931

Start Date: 03/Sep/1931

County: Dublin

Flood Quality Code:3

Additional Information: Reports (10) Press Archive (1) More Mapped Information



10. Tolka November 1915

Start Date: 12/Nov/1915

County: Dublin

Flood Quality Code:3

Additional Information: Reports (10) More Mapped Information



11. Tolka November 1901

Start Date: 12/Nov/1901

County: Dublin

Flood Quality Code:3

Additional Information: Reports (9) More Mapped Information



12. Tolka November 1898

Start Date: 23/Nov/1898

County: Dublin

Flood Quality Code:3

Additional Information: Reports (9) More Mapped Information



13. Tolka October 1880

Start Date: 28/Oct/1880

County: Dublin

Flood Quality Code:3

Additional Information: Reports (7) More Mapped Information



14. Fenian Street June 1963

Start Date: 11/Jun/1963

County: Dublin

Flood Quality Code:3

Additional Information: Reports (3) Press Archive (2) More Mapped Information



15. Ringsend June 1963

Start Date: 11/Jun/1963

County: Dublin

Flood Quality Code:3

Additional Information: Reports (3) Press Archive (2) More Mapped Information



16. Grafton Street June 1963

Start Date: 11/Jun/1963

County: Dublin

Flood Quality Code:3

Additional Information: Reports (3) Press Archive (2) More Mapped Information



17. North Strand Road June 1963

Start Date: 11/Jun/1963

County: Dublin

Flood Quality Code:3

Additional Information: Reports (3) Press Archive (2) More Mapped Information













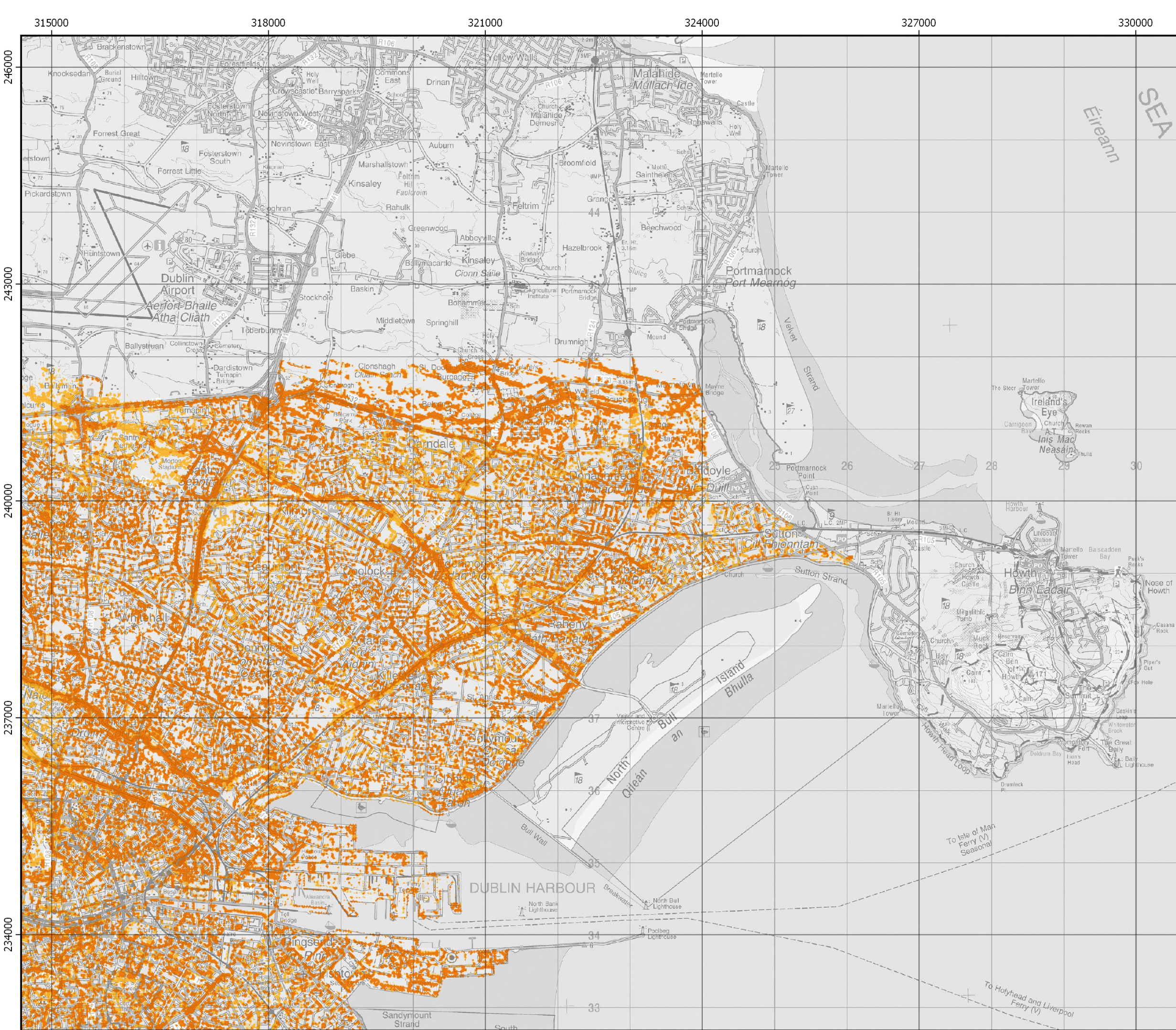
18. Flooding at Herbert Cottages, Ballsbridge, Dublin 4 on 24th
Oct 2011
County: Dublin

Start Date: 24/Oct/2011

Flood Quality Code:2

Additional Information: Reports (1) More Mapped Information

	19. Flooding at ESB Sportsco, Ringsend, Dublin 4 on 24th Oct 2011 County: Dublin	Start Date: 24/Oct/2011 Flood Quality Code:2
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	20. Flooding at Bath Avenue, Sandymount, Dublin 4 on 24th Oct 2011 County: Dublin	Start Date: 24/Oct/2011 Flood Quality Code:2
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	21. Flooding at Railway Cottages, Ballsbridge, Dublin 4 on 24th Oct 2011 County: Dublin	Start Date: 24/Oct/2011 Flood Quality Code:2
	Additional Information: Reports (1) More Mapped Information	
	22. Flooding at Havelock Square, Sandymount, Dublin 4 on 24th Oct 2011 County: Dublin	Start Date: 24/Oct/2011 Flood Quality Code:2
	Additional Information: Reports (1) More Mapped Information	
	23. Clontarf Rd Seaview Avenue August 2004 County: Dublin	Start Date: 23/Aug/2004 Flood Quality Code:3
	Additional Information: Reports (3) More Mapped Information	
	24. Clontarf Oulton road area August 2004 County: Dublin	Start Date: 23/Aug/2004 Flood Quality Code:3
	Additional Information: Reports (1) More Mapped Information	
	25. Clontarf Kincora Park August 2004 County: Dublin	Start Date: 23/Aug/2004 Flood Quality Code:3
	Additional Information: Reports (2) More Mapped Information	
	26. Dodder Oct 1987 County: Dublin	Start Date: 21/Oct/1987 Flood Quality Code:4
	Additional Information: Photos (3) More Mapped Information	
	27. Bath Avenue June 1963 County: Dublin	Start Date: 11/Jun/1963 Flood Quality Code:2
	Additional Information: Photos (1) Reports (2) More Mapped Information	
	28. Tolka April 1909 County: Dublin	Start Date: 03/Apr/1909 Flood Quality Code:4
	Additional Information: Reports (4) More Mapped Information	



- LEGEND**
- 10% AEP Pluvial
 - 1% AEP Pluvial
 - 0.5% AEP Pluvial

IMPORTANT USER NOTE:
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 OF USE THAT ACCOMPANY THIS MAP.



OPW
 Office of Public Works
 The Office of Public Works

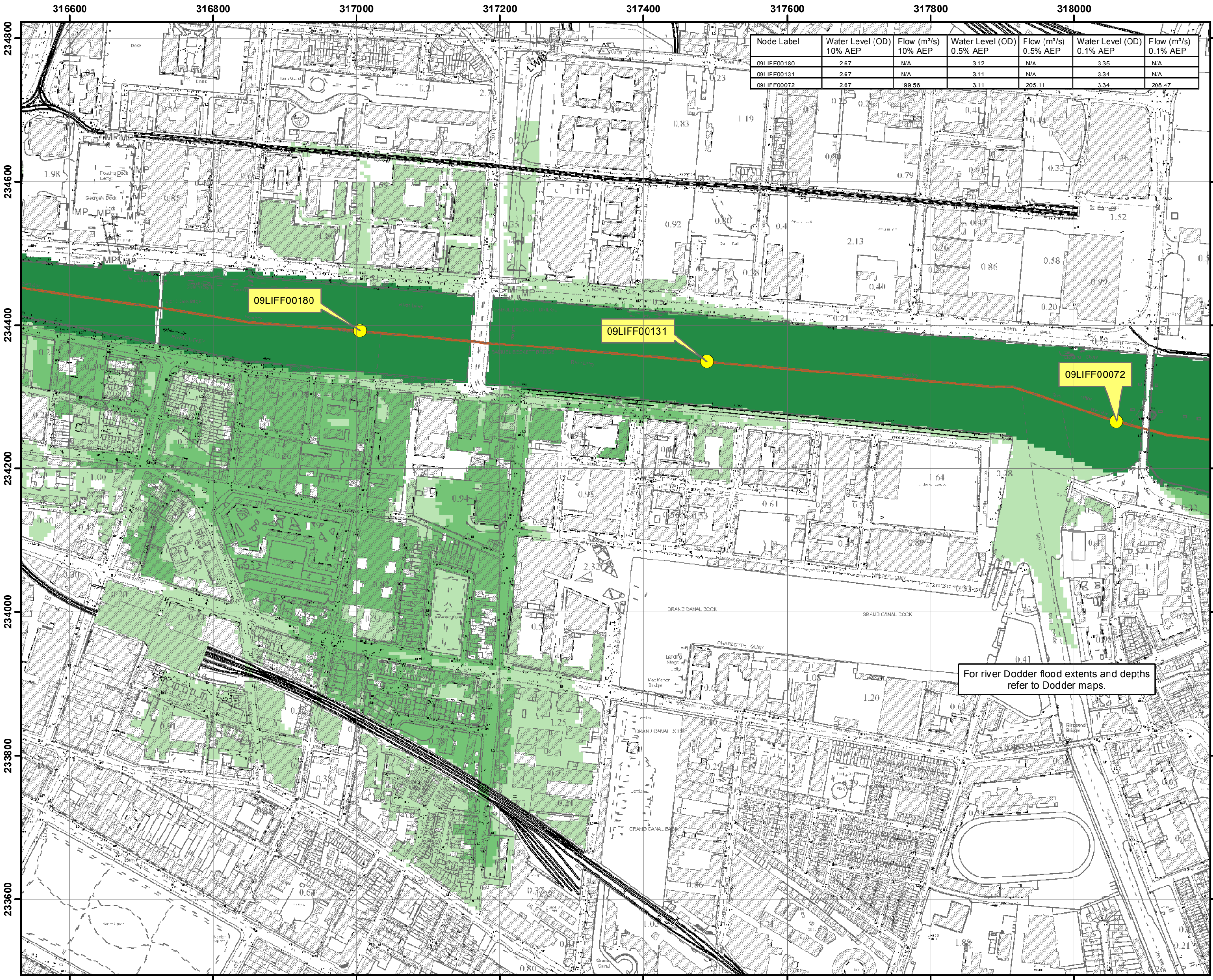


**Comhairle Cathrach
 Baile Atha Cliath
 Dublin City Council**

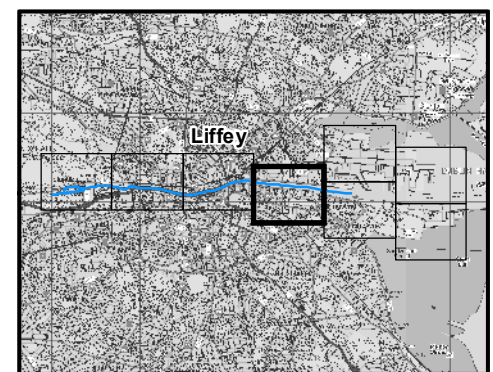
The Office of Public Works
 Jonathan Swift Street
 Trim
 Co. Meath

Dublin City Council
 Civic Offices
 Wood Quay
 Dublin 8

Project:	
DUBLIN PLUVIAL STUDY (FloodResilientCity)	
Map:	DUBLIN CITY - PLUVIAL FLOOD EXTENT MAP
Map Type:	EXTENT - 180min Rainfall
Source:	PLUVIAL
Map Area:	URBAN
Scenario:	CURRENT
Drawn by:	IH
Checked by:	MC
Approved by:	JM
Map No.:	E09DCC_EXPDCD_F0_02
Revision:	F0
Map Scale:	1:50,000
Plot Scale:	1:1 @ A3



Node Label	Water Level (OD) 10% AEP	Flow (m ³ /s) 10% AEP	Water Level (OD) 0.5% AEP	Flow (m ³ /s) 0.5% AEP	Water Level (OD) 0.1% AEP	Flow (m ³ /s) 0.1% AEP
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09LIFF00131	2.67	N/A	3.11	N/A	3.34	N/A
09LIFF00072	2.67	199.56	3.11	205.11	3.34	208.47



IMPORTANT USER NOTE:
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Legend

- 10% Tidal AEP Event
- 0.5% Tidal AEP Event
- 0.1% Tidal AEP Event
- Modelled River Centreline
- AFA Extents
- Node Point
- Node ID
- Node Label

FINAL

REV:	NOTE:	DATE:
01	Amendments to Flood Extents.	05/12/16



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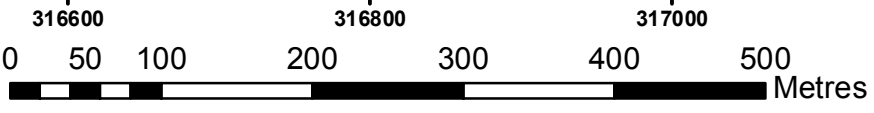
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Source: TIDAL	
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Scenario: CURRENT	
Drawn By : C.C.	Date : 9 May 2017
Checked By : A.S.	Date : 9 May 2017
Approved By : S.P.	Date : 9 May 2017

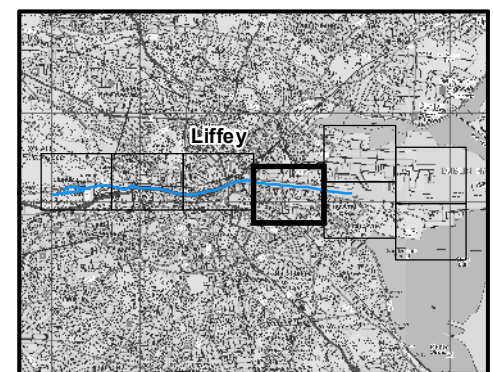
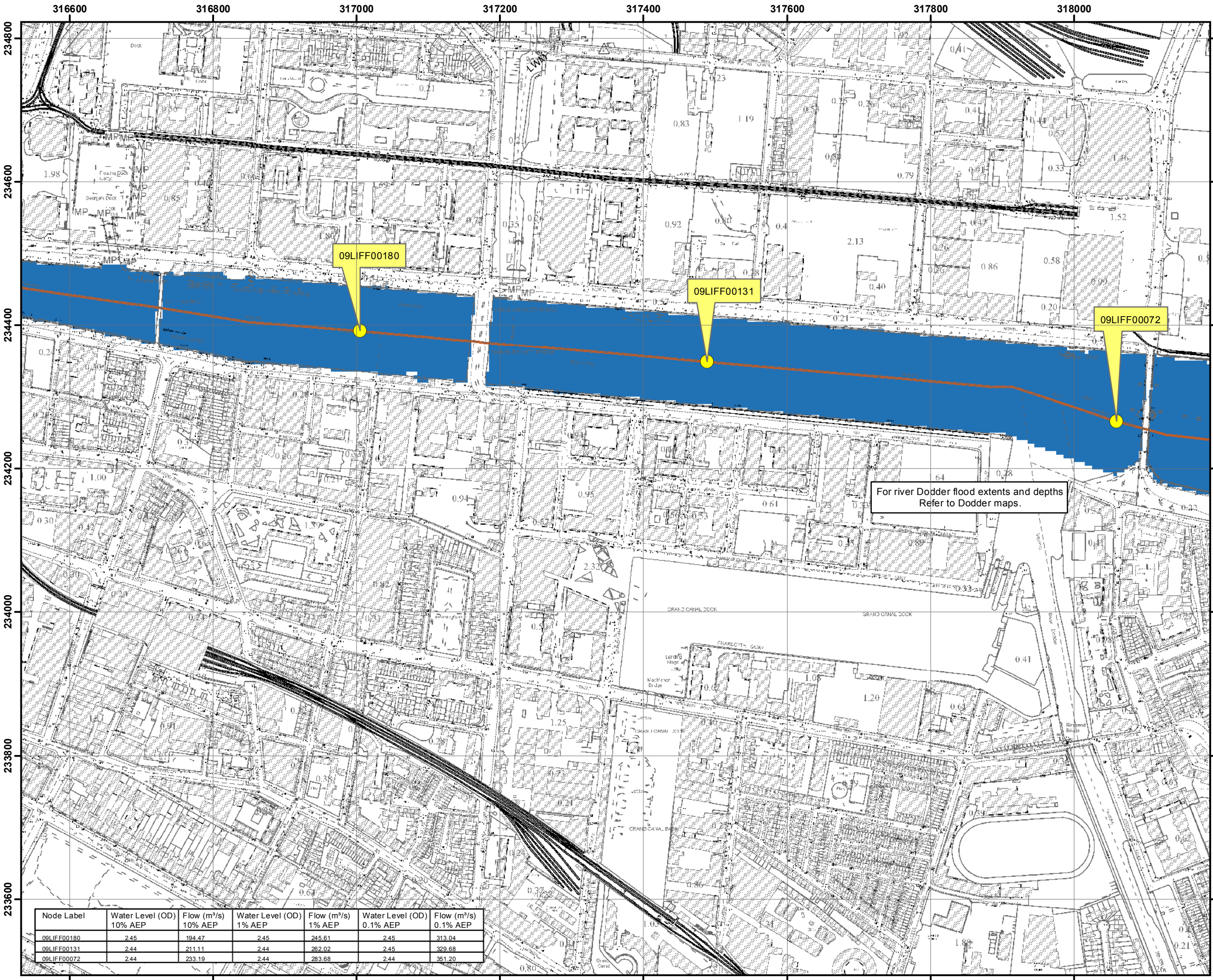
Drawing No. :
E09LIF_EXCCD_F1_04

Map Series : Page 4 of 8

Drawing Scale : 1:5,000 @ A3

For river Dodder flood extents and depths refer to Dodder maps.





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- Legend**
- 10% Fluvial AEP Event
 - 1% Fluvial AEP Event
 - 0.1% Fluvial AEP Event
 - Modelled River Centreline
 - AFA Extents
 - Node Point
 - Node ID

For river Dodder flood extents and depths Refer to Dodder maps.

FINAL

REV: 01	NOTE: Amendments to Flood Extents.	DATE: 05/12/16
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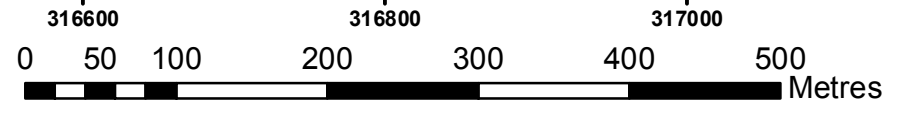
The Office of Public Works
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Elmwood House
74 Boucher Road
Belfast
BT12 6RZ

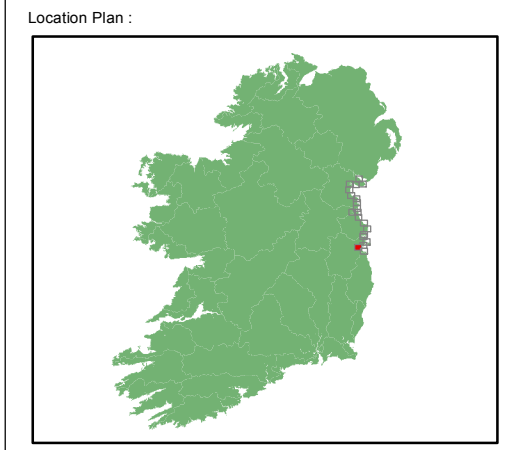
T +44(0) 28 90 667914
F +44(0) 28 90 668286
W www.rpsgroup.com
E ireland@rpsgroup.com

Map:	
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Map Type: EXTENT	
Source: FLUVIAL	
Map Area: HPW	
Scenario: CURRENT	
Drawn By: C.C.	Date: 9 May 2017
Checked By: A.S.	Date: 9 May 2017
Approved By: S.P.	Date: 9 May 2017
Drawing No.: E09LIF_EXFCD_F1_04	
Map Series: Page 4 of 8	
Drawing Scale: 1:5,000 @ A3	

Node Label	Water Level (OD)		Flow (m ³ /s)		Water Level (OD)		Flow (m ³ /s)	
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09LIFF00131	2.44	211.11	2.44	262.02	2.45	329.68		
09LIFF00072	2.44	233.19	2.44	283.68	2.44	351.20		



NOTE: MORE DETAILED MAPS SHOWING
 COMBINED TIDAL AND FLUVIAL FLOOD
 HAZARD FOR PART OF THIS AREA
 (DODDER CATCHMENT ONLY)
 HAVE BEEN PREPARED UNDER THE
 RIVER DODDER CATCHMENT
 FRAM STUDY. PLEASE REFER TO
 WWW.DUBLINCITY.IE/PAGES/DODDERFLOODINGSTUDY.ASPX
 FOR MORE INFORMATION



EXTENT MAP

- Legend:
- 0.5% AEP FLOOD EXTENT
(1 in 200 chance in any given year)
 - 0.1% AEP FLOOD EXTENT
(1 in 1000 chance in any given year)
 - Very High Confidence (0.1% AEP)
 - High Confidence (0.1% AEP)
 - Medium Confidence (0.1% AEP)
 - Low Confidence (0.1% AEP)
 - Very Low Confidence (0.1% AEP)
 - Very High Confidence (0.5% AEP)
 - High Confidence (0.5% AEP)
 - Medium Confidence (0.5% AEP)
 - Low Confidence (0.5% AEP)
 - Very Low Confidence (0.5% AEP)
 - High Water Mark (HWM)
 - Node Point
 - Point 34 Node Label (refer to table)

USER NOTE:
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 DESCRIPTION OF THEIR DERIVATION, LIMITATIONS IN
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 Northern Ireland



Office of Public Works
 17-19 Lower Hatch Street
 Dublin 2
 Ireland

Project:
**IRISH COASTAL PROTECTION STRATEGY
 STUDY - PHASE III**

Map:
NORTH EAST COAST FLOOD EXTENT MAP

Map Type: FLOOD EXTENT
 Source: TIDAL FLOODING
 Map area: RURAL AREA
 Scenario: CURRENT

Figure By: PJW Date: Jan 2010
 Checked By: JMC Date: Jan 2010

Figure No.:
NE / RA / EXT / 19

Revision
1

Drawing Scale: 1:25,000 Plot Scale: 1:1 @ A3

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