

Part 8 Proposed Redevelopment of The Wonderful Barn P82024.10

Stage 1 Flood Risk Assessment

Kildare County Council
Part 8

Project number: 60689541
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June 2024

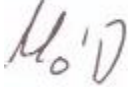
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1. Introduction

1.1 Project Overview

AECOM has been appointed on behalf of the Kildare County Council (KCC) to prepare a Stage 1 Flood Risk Assessment (FRA) report in support of a Part 8 application for the proposed redevelopment of The Wonderful Barn. This FRA is in line with the requirements of “The Planning System & Flood Risk Management Guidelines of Planning Authorities” (Guidelines) as published in November 2009, and the particular requirements of a site-specific Flood Risk Assessment as outlined in Appendix A of the Technical Appendices to those Guidelines.

The assessment is supported by a review of key documents, including but not limited to:

- Action Area Plan for Lands at the Wonderful Barn and Barnhall House;
- Kildare County Development Plan 2023 – 2029;
- Building Regulations Technical Guidance Document H: 2010 – Drainage and Water;
- CIRIA Document C753: 2015 – The SuDS Manual.

Section 1 of this assessment outlines the existing site conditions, including the existing topography and utility information within the area as well as a summary of the proposed development. Details pertaining to the site investigation carried out by IGSL Ltd are also discussed and summarised, with particular focus on ground water conditions for the site. A summary of the proposed site and associated drawings are included in reference to AECOM drawing no. 60689541-AEC-XX-00-00-DR-L-1000.

Section 2 of this assessment outlines the regulatory framework and guidelines related to flood risk management, taking into consideration, all relevant policies and objectives as outlined within the mentioned guidelines above.

Section 3 of this assessment outlines the potential flood risk associated with the development. The assessment has been prepared in support of the development and is in line with the requirements of the Guidelines.

Section 4 of this assessment concludes all relevant findings, providing a detailed analysis of flood risk data and its implications for the proposed development and surrounding areas. This section highlights how the proposed development seeks to mitigate flood risk and provides further recommendations for risk reduction as needed. The section also acknowledges any limitations or uncertainties in the assessment.

The overall objective of this FRA is to identify existing flood risk sources, evaluate potential flood risk, & propose mitigation measures in alignment with regulatory standards.

1.2 Site Background

The Wonderful Barn, located in Leixlip, County Kildare, stands as a significant historical building within Irish history. Erected in 1743 under the supervision of Katherine Conolly, the structure served a dual purpose as a granary and famine relief initiative as part of the expansive Castletown Estate. Its distinctive design, drafted by architect Richard Castle, features a tapering conical silhouette encircled with a spiralling staircase, and stands at 22m tall. Regarded as an emblem of wealth and influence, the Wonderful Barn remains a cherished and important heritage site for Ireland's rich architectural legacy. As such, the Wonderful Barn is seen as a protected national structure by KCC. The Wonderful Barn forms part of Castletown House Estate which is currently under supervision of the Office of Public Works (OPW) (formerly under supervision of the Castletown Foundation) which seek to continue the ongoing restoration of the lands.

1.2.1 Site Location

The subject site is predominantly comprised of soft landscaping, with some hardstanding areas present, which consists of the Wonderful Barn, outhouses, and several allotments. The site is located at The Wonderful Barn, Celbridge Rd, Barnhall, Leixlip, Co. Kildare, adjacent the Kildare-Dublin County border. The subject site spans an approximate area of 218,000 m² (21.8 ha), defined by the red line boundary and is strategically located approximately 1.1 km southwest of Leixlip town centre. The subject site is bounded to the north by Barnhall Meadows road and an existing residential development, to the south by the M4 motorway, to the east by Celbridge Road (R404), and to the west by some residential dwellings and greenfields. Refer to Figure 1.1 for the site location map. The approximate subject site centre can be located at Irish Grid Reference location [E: 299153, N: 235360].

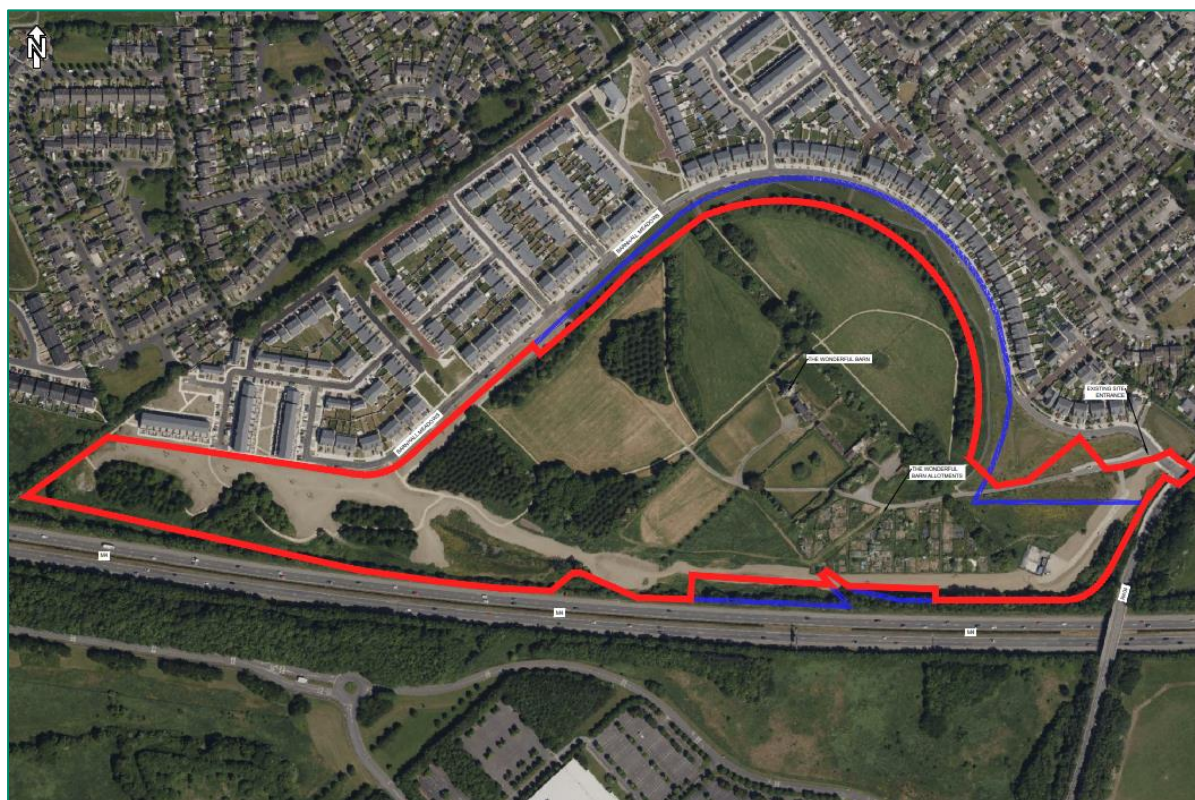


Figure 1.1: Site Location Map (Source: [Google Maps](#))

1.2.2 Topographic Information and Utility Survey

AECOM have been provided with a topographical survey carried out by Murphy Geospatial dated the 22nd of April, 2024. Based on the topographical survey, levels range from approximately 50.5 mOD in the south to 58.2 mOD in the north, with an average gradient of 1:100. The existing levels within the site show a falling trend towards a low point along the southern side of the subject site. It should also be noted in the southwest corner of the site, there is an earth mound with a high point of 56.56 mOD and an infiltration basin that provides drainage for the Barnhill residential development. An additional 2 no. infiltration basins are noted at the northwest of the site and a separate infiltration basin is located at the entrance to the Wonderful Barn. Refer to for the site topographical map. Refer to Figure 1.2 for the site topographical map. Refer to Appendix A for the full topographical survey carried out by Murphy Geospatial.

As part of this assessment, AECOM have been provided with a ground penetration radar (GPR) utility survey to detect, locate, and record all existing utilities within the subject site which was carried out by Murphy Geospatial on the 9th of August 2022, with delivery of drawings received by AECOM on the 12th of October 2022. It must be noted that the survey area extents only covered the existing buildings on site. A full site-wide GPR survey is currently in progress as of the date of this report being issued.

Existing services within the site are summarised based on the Murphy Geospatial report as follows:

- Stormwater sewers were identified running through offsite manholes, but no evidence of drainage pipes found on-site.
- Cables/ducts detected within the survey area connecting to buildings and electrical boxes. No evidence of public lighting or traffic cables found on-site.
- No evidence of water main pipes found on-site. Service records drawings indicate a 250 mm CI pipe crossing the area on the east side, but no clear signal was detected in this area.
- No evidence of cables from Eir, Enet, Virgin Media, or BT found within the survey area.
- No evidence of gas pipes found on-site. GNI records drawings don't show any connections on-site.
- Unidentified services found nearby buildings, with trace lost due to weak signal. Further investigation recommended to verify nature and location through slit trenching.

- Each manhole and inspection cover opened and documented within the survey area. Some manholes couldn't be inspected due to access restrictions/ unable to open, requiring further investigation.



Figure 1.2: Site Topographical Map (Source: Murphy Geospatial)

1.3 Proposed Development

The proposed redevelopment of The Wonderful Barn itself comprises an area of c.19.8sqm and incorporates the renowned protected structure of the Wonderful Barn and its ancillary buildings, all protected structures, including Barnhall House, two dovecotes, a walled garden and two ranges of adjacent courtyards containing former farm buildings and the public parklands enclosed by the M4 motorway to the South, Celbridge Road R404 to the East and suburban residential developments to the North and West.

For illustrations of the proposed development, please refer to Figure 1.3 and Figure 1.4, which show the proposed site layout plan, and the proposed landscape conceptual plan for the development, respectively.

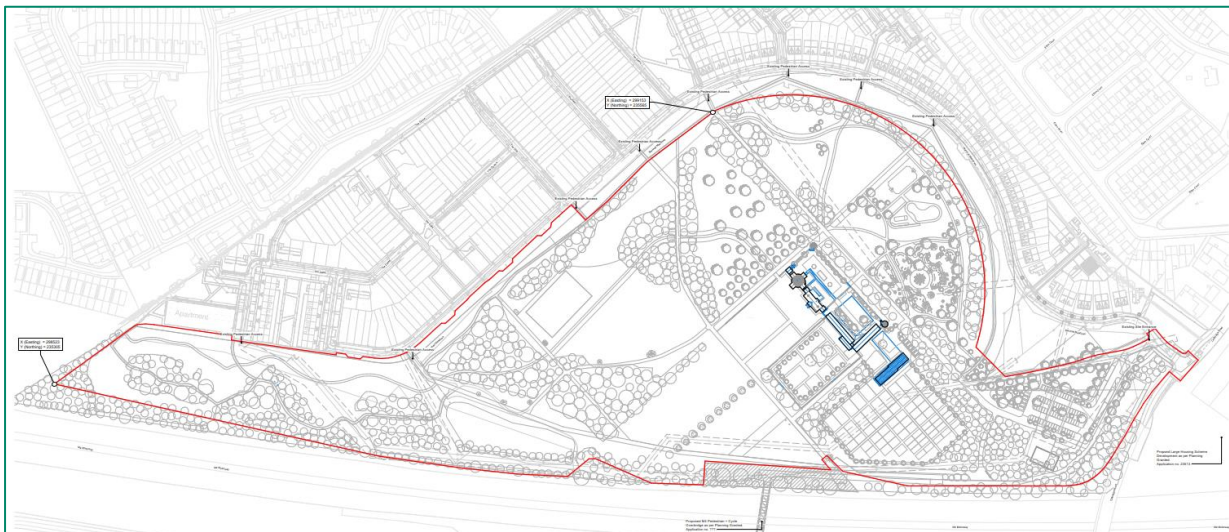


Figure 1.3: Proposed Site Layout Plan (Source: Networks Drawing No. 081002)



Figure 1.4: Landscape Conceptual Plan
(Source: AECOM Drawing No. 60689541-AEC-XX-00-00-DR-L-1000)

The proposed works will protect and enhance the rich architectural heritage and amenity of the Wonderful Barn and adjacent buildings and provide an integrated public amenity park and tourism destination at The Wonderful Barn and associated lands, informed by a detailed conservation and management plan.

The proposed works will comprise of the following:

- Repair, restoration and minor interventions within and to the Wonderful Barn, Barnhall House, two dovecotes, a walled garden and two ranges of adjacent courtyards and former farm buildings to improve and accommodate existing tourist and community amenities and facilities.
- Provision of a 115m² extension to former farm buildings to provide a commercial kitchen and café with southern outlook into the historic walled working vegetable garden amenity.
- Redevelopment of the current 55 no. allotments to realign the plots within the restored historical landscape axes and provide new and improved facilities for the local allotment users.
- Provision of a new 174m² building to the East of the existing building complex which will provide a storage facility to replace an existing container on site, new toilets, kitchenette and workshop facilities for the local allotment user group as well as short term workplace facilities for the KCC Parks Department.
- Provision of water and power outlet market facilities adjacent to the new building to accommodate weekly / monthly local markets.
- Improvements and upgrading of existing pedestrian footways and provision of new pedestrian footways and cycle pathways throughout the site.
- Development of a new pedestrian and cycle link through the Wonderful Barn; a continuation of the pedestrian and cycle link (outside of the project boundary) from Celbridge/Backweston to Leixlip, via Castletown House, through Kildare Innovation Campus (former Hewlett Packard site), across the proposed M4 overpass to the Wonderful Barn and onto Leixlip Town Centre and Leixlip Louisa Bridge Station, in accordance with the requirements of TII publications.
- Protection and reinstatement the axial views between Castletown House and the Wonderful Barn and undergrounding of overhead cables as required to maintain uninterrupted views.
- Protection and reinstatement of the integrity of the historic landscape including the Southern and South-Western formal tree lined avenues and forecourt to Barnhall House, formal planting of the walled garden, formal planting of the historic orchard to the Northwest of the building complex and an historic treeline and hedgerow to the Northern boundary of the courtyards.
- Realignment and improvements to pedestrian, cycle and vehicular access to site.

- Provision of new street furniture, seating and public lighting throughout the parkland.
- Provision of new carpark with 65no. of carparking spaces including 55no. standard bays, 5no. disabled parking bays and 5no. enlarged bays designed for families, 28no. of bike parking spaces and 4no. bus parking spaces.
- Provision of new wayfinding and signage throughout the parkland.
- Provision of all utilities, necessary services, drainage works and associated site works.

Please refer to the statutory Part 8 notices which provide a full description of the proposed development including the breakdown of applicable floor areas.

1.4 Ground Investigations

A site investigation was carried out by IGSL Ltd, with reporting issued to AECOM on the 27th of February 2024. As part of the assessment, the following site investigation methods were undertaken during October and November of 2023 to assess the existing ground conditions and groundwater:

- 11 No. Foundation Inspection Pits
- 2 No. Cable Percussion Boreholes
- 1 No. Terrier Percussive Borehole
- 5 No. Soakaway Tests
- 5 No. Slit Trenches
- 5 No. Plate Load Testing

It was noted that an additional cable percussion borehole was constructed at location BH01A after encountering a shallow obstruction in BH01. Also, terrier percussive borehole BH01B was constructed to allow for the installation of a 50 mm diameter standpipe, which was constructed on the 20th of February 2024. The groundwater level was recorded at two separate instances (the 22nd and 26th of February) and was found to be at 1.05 mBGL and 1 mBGL respectively. Refer to Appendix B for the groundwater monitoring data sheet provided by IGSL Ltd.

Moreover, it was noted that only 2 of the 5 soakaway tests (soakaway test 2 and 4) were found to be successful, with these tests producing infiltration rates of 5.27704×10^{-6} m/sec and 1.98091×10^{-6} m/sec, respectively.

Based on the ground assessments discussed in the site investigations report, the following recommendations were made by IGSL Ltd:

- Ground investigation revealed topsoil to be of a sandy gravelly CLAY, which transitioned to a firmer over-consolidated glacial till at depths between 1.0 to 1.7 mBGL. Historic strip footings were found at depths between 600mm and 900mm below ground level (BGL), situated on firm clay capable of supporting an allowable bearing capacity of 100kPa. Visual observations during trial pitting suggested a safe or allowable bearing capacity of 150 to 175kPa for natural soils at depths of approximately 1.20 to 1.70m. Further investigation, possibly through rotary boreholes, is recommended to obtain the depth to rockhead for further development.
- Shallow groundwater strikes were generally absent from excavations on site, which would indicate that the water table was below the depths of most pits/ trenches (greater than 1 mBGL). Ingress of groundwater was noted in the base of some pits and boreholes, which are summarised in Table 2, Section 3.2.4 of this report. Rapid groundwater rise was observed in boreholes BH01 and BH01A, where groundwater rose from the base (1.8 mBGL and 2.0 mBGL respectively) to 0.5 mBGL, necessitating potential de-watering measures such as sump pumping, and/or perimeter drains. Seasonal variations in groundwater levels should be monitored, with further assessment recommended, particularly during higher groundwater periods.
- Recommended maximum slope angles for temporary and long-term batters in upper medium strength fine-grained soils at angles of 33 degrees and 26 degrees respectively. Trench box support is advised for deep excavation works. Geogrid recommended for slopes at risk of spalling.
- Plate load tests conducted on shallow subsoils indicated California Bearing Ratio (CBR) design values of 0.3 to 8.2%, with recommendations for pavement construction based on test results. Suggestions for capping thickness, sub-base materials, and compaction methods provided in the site investigations report concluded

a CBR design value of <2%, with a minimum 6F capping thickness of 500 to 600mm and a sub-base thickness (UGM) of 150mm is recommended to support the road pavements. The above recommendation should be reassessed, particularly for very low strength subgrade soils.

- Chemical analysis of natural soil samples indicated suitability for buried concrete, with recommended Table C1 Area of Critical Environmental Concern (ACEC) for greenfield sites in BRE SD 1 2005 suitable for use.
- Soil samples were analysed for compliance with landfill directive and Environmental Protection Agency (EPA) guidance. One sample exceeded metal concentration limits for Geochemical Domain 2. Asbestos was not detected in soil samples.

2. Flood Risk Management Guidelines

2.1 The Planning System and Flood Risk Management Plan

In September 2008 “The Planning System and Flood Risk Management Guidelines for Planning Authorities” (Guidelines) were published by the Department of Environment, Heritage, and Local Government in Draft format. In November 2009, the adopted version of the document was published.

The Guidelines provide guidance on flood risk and development. A precautionary approach is recommended when considering flood risk management in the planning system. The core principle of the guidelines is to adopt a risk based sequential approach to managing flood risk and to avoid development in areas that are at risk. The sequential approach is based on the identification of flood zones for river and coastal flooding.

The objective of a site-specific Flood Risk Assessment (FRA) is to assess all types of flood risk to a development. The assessment should investigate potential sources of flood risk and include for the effects of climate change. The assessment is required to examine the impact of the development and the effectiveness of flood mitigation and management procedures proposed. It should also present the residual risks that remain after those measures are put in place.

This approach is based on the identification of flood zones for river and coastal flooding. “Flood Zones” are geographical areas used to identify areas at various levels of flood risk. It should be noted that these do not consider the presence of flood defences, as the risks remain of overtopping and breach of the defences. There are three flood zones defined (refer to Figure 2.1):

Flood Zone A (high probability of flooding) is for lands where the probability of flooding is greatest (greater than 1% or 1 in 100 for river flooding and 0.5% or 1 in 200 for coastal flooding).

Flood Zone B (moderate probability of flooding) refers to lands where the probability of flooding is moderate (between 0.1% or 1 in 1,000 and 1% or 1 in 100 for river flooding and between 0.1% or 1 in 1000 and 0.5% or 1 in 200 for coastal flooding).

Flood Zone C (low probability of flooding) refers to lands where the probability of flooding is low (less than 0.1% or 1 in 1000 for both river and coastal flooding).

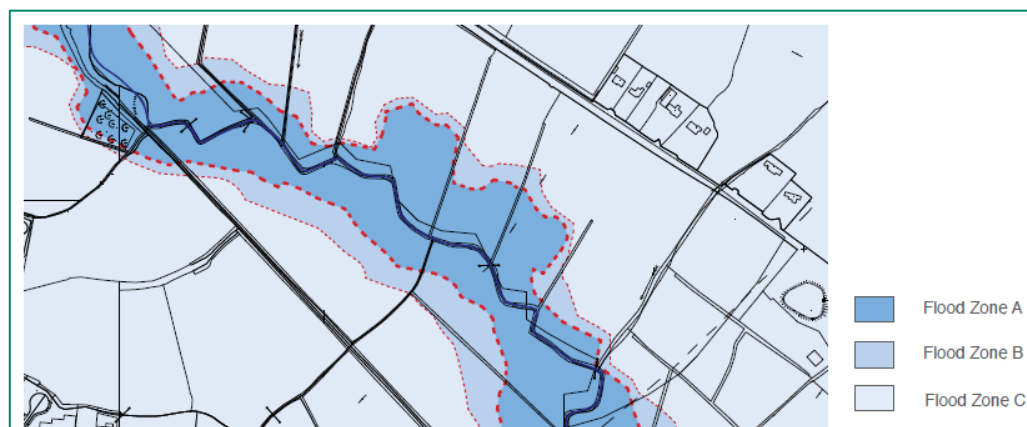


Figure 2.1: Indicative Flood Zone Map (Extract from the Guidelines, Figure 2.3)

Once a flood zone has been identified, the guidelines set out the different types of development appropriate to each zone. Exceptions to the restriction of development due to potential flood risks are provided for through the use of the Justification Test, where the planning need and the sustainable management of flood risk to an acceptable level must be demonstrated. This recognises that there will be a need for future development in existing towns and urban centres that lie within flood risk zones, and that the avoidance of all future development in these areas would be unsustainable.

The Guidelines set out a stage approach to assessment. The stages of assessment are:

Flood Risk Identification (Stage 1) – Identification of any issues relating to the site that will require further investigation through a Flood Risk Assessment.

Initial Flood Risk Assessment (Stage 2) – Involves establishment of the sources of flooding, the extent of the flood risk, potential impacts of the development and possible mitigation measures.

Detailed Flood Risk Assessment (Stage 3) – Assess flood risk issues in sufficient detail to provide quantitative appraisal of potential flood risk to the development, impacts on flooding elsewhere and the effectiveness of any proposed mitigation measures.

This report addresses the requirements of a Stage 1 Site Specific Flood Risk Assessment.

The potential risk to the proposed development associated with each of the following sources of flooding is investigated in this report are as follows:

- Coastal
- Fluvial
- Pluvial
- Groundwater

2.2 Kildare County Development Plan

In preparing this Flood Risk Assessment (FRA), AECOM have taken cognisance of the Kildare County Development Plan 2023 – 2029 (KCDP). The KCDP was adopted by KCC on the 9th of December 2022, coming into effect on 28th of January, 2023. Of particular relevance to the production of this FRA are the core objectives and policies in relation to flood risk management contained in Chapter 6, of the KCDP. The core objectives as set out in Section 6.7 of Chapter 6 of the KCDP can be summarised as follows:

- **IN O31:** Support and cooperate with the OPW in delivering flood relief schemes and measures from the Flood Risk Management Plans and other flood management works.
- **IN O32:** Support the implementation of the EU Flood Risk Directive (2007/60/EC) and the Flood Risk Regulations (SI No 122 of 2010).
- **IN O33:** Manage flood risk according to the Planning System and Flood Risk Management Guidelines.
- **IN O34:** Recognize the role of boglands, rehabilitated peatlands, and wetlands in water filtration and flood patterns, requiring FRA for developments in these areas which are often susceptible to flood risk.
- **IN O35:** Require Flood Risk Assessments for development proposals affecting canals and their infrastructure.
- **IN O36:** Ensure development along urban watercourses complies with Inland Fisheries Ireland Guidance, maintaining a minimum riparian zone.
- **IN O37:** Protect implemented flood relief schemes from inappropriate development.
- **IN O38:** Support Inland Fisheries Ireland's pilot projects for habitat restoration in flood management schemes on the upper Barrow and its tributaries, subject to planning and environmental assessments.

In support of the KCDP, the Strategic Flood Risk Assessment (SFRA) developed by KCC identifies and maps flood risks zones for the county in accordance with the Guidelines, supporting a sequential planning approach and incorporating climate change factors for the High-End Future climate change scenario. Catchment Flood Risk Assessments and Management Studies (CFRAMS) for key watercourses inform zoning and planning, which include Leixlip town, which covers some extent of the subject site.

Further to the above development plan, AECOM have taken cognisance of the Kildare SFRA, which was issued on the 26th of January, 2023. The SFRA provides a background study of the flood risk indicators for the Kildare region as well as indicative Flood Risk Zone mapping. As noted within the SFRA, Leixlip is subject to its own specific SFRA and Local Area Plan (LAP) given its proximity to the River Liffey. The main areas of concern where flood defences have been constructed include the construction of flood defences and upgrades to existing infrastructure at Marshfield House, a protected structure off the banks of the River Liffey and works, including the construction of a new bx culvert on the Silleachain River. At the time of writing, KCC are currently progressing the development of a further Flood Relief Scheme for Leixlip which has not currently been published.

2.3 Leixlip Local Area Plan

As outlined in the SFRA, Leixlip is subject to a standalone Local Area Plan (LAP). To date, the LAP 2020 – 2023 is the latest published version of the LAP, which was adopted on the 16th of December 2019, coming into effect on the 5th of February 2020. The LAP has been extended to the year 2026 following amendments to the LAP which came into effect on the 24th of May 2024.

The LAP provides information on flood risk areas and assists in identifying flood prone areas within Leixlip town. Section 6.3.2 of the SFRA for Leixlip LAP discusses the flood risk associated with The Wonderful Barn and concludes that there is no indication of any significant flood risk in the area. No historic flooding was reported in the area and a review of CFRAM mapping indicated no fluvial risk of flooding, nor significant changes to flood extents due to climate impacts. Refer to Figure 2.2, which provides an extract of the Flood Zones Mapping for the subject site. Refer to Appendix C for the full extents of this map.

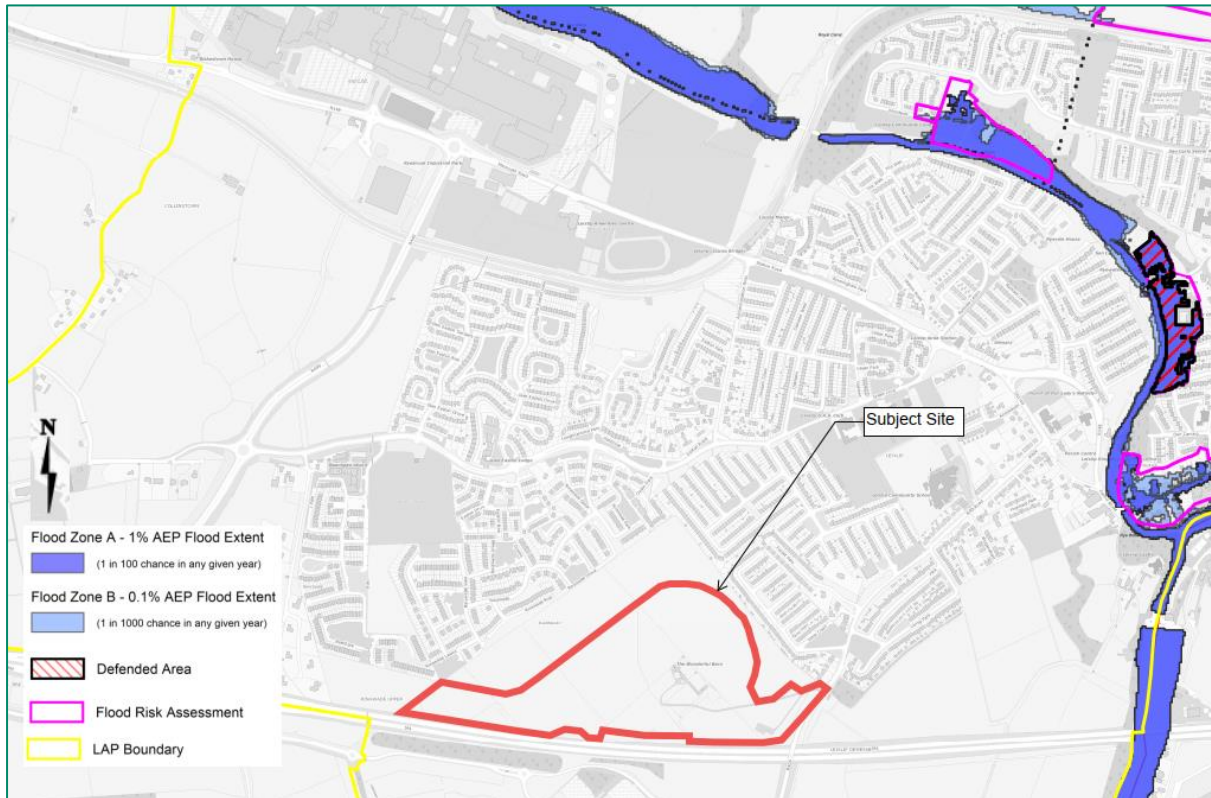


Figure 2.2: Leixlip Flood Zone Mapping (Source: [Leixlip LAP](#))

3. Flood Risk Identification

3.1 Comprehensive Data Analysis

In order to establish the potential flood risk to the development, AECOM have carried out a review of available recorded information on flooding in and around the area of our proposed site. The following sources of information were used to identify flood risk, hazards, and past flooding events:

- Kildare County Development Plan
- Kildare Strategic Flood Risk Assessment
- Leixlip Local Area Plan
- Historic Flood Records (OPW and OSi)
- Catchment Flood Risk Assessment & Management (CFRAM)
- Geological Ground Conditions (GSI)
- Site ground investigation (GI)

3.1.1 OPW Historical Flood Records

The Office of Public Works (OPW) collates available reports of flooding from all sources (e.g., fluvial, pluvial, coastal, etc.) on a nationwide basis. The OPW’s website (www.floodinfo.ie) was consulted to obtain reports of recorded flooding within and surrounding the site. Figure 3.1 is an extract from the mapping available on the OPW database website which displays all recorded historical flood events within a 2.5 km radius of the subject site. Figure 3.1 indicates there is no historic records of flooding in the immediate vicinity of the site. The subject site approximate location is indicated by the red ‘X’. Refer to Appendix D for the OPW summary report for historic flooding in the area.

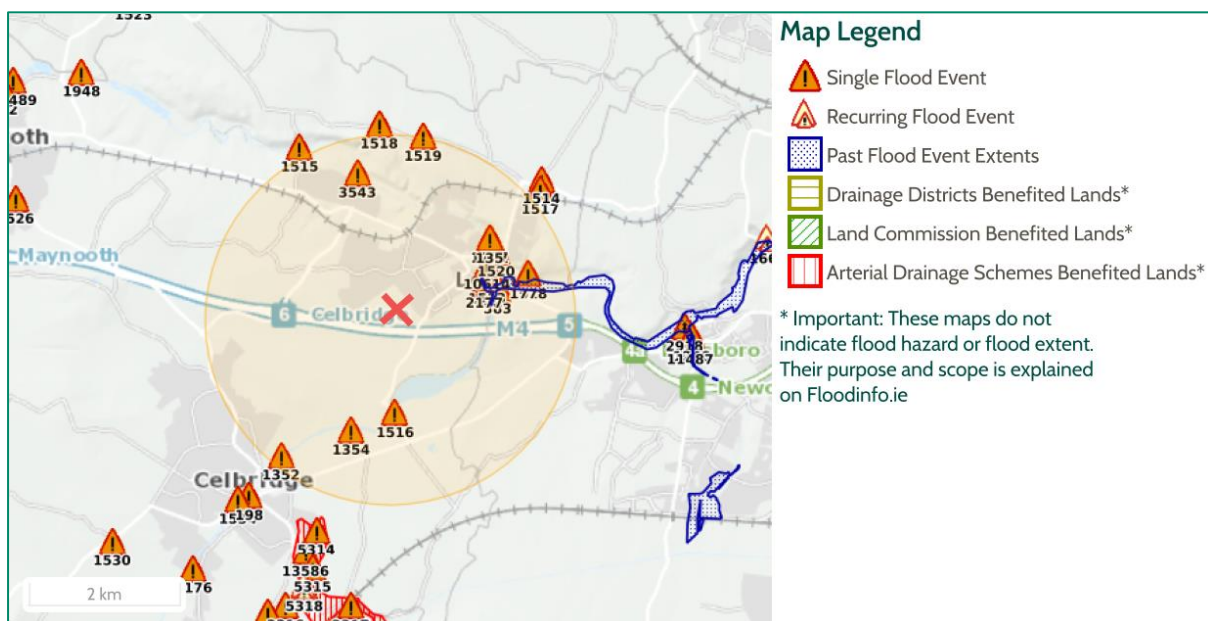


Figure 3.1: OPW Past Flood Events Summary Report (Source: floodinfo.ie)

3.1.2 Catchment Flood Risk Assessment & Management (CFRAM)

The Catchment Flood Risk Assessment & Management (CFRAM) Study, which was developed by the OPW in partnership with other government bodies, is a nationwide implemented program which has been carried out in partnership and collaboration with the water framework directive (WFD) which has been designed to create a series of Preliminary Flood Risk Assessments (PFRA) for the nation as a whole. The CFRAM program main objective is to provide guidance in the reduction and mitigation of flood risk for Irish developments which is achieved in line with the EU Flood Directive 2007.

Fluvial flooding is the result of a river exceeding its capacity and excess of water spilling out onto the adjacent floodplain. The hydraulic model predicts the water levels for several fluvial flood events at given nodes along the River Liffey. Hence, based on these predicted water levels at these nodes, fluvial flood extents associated with the 10% AEP event, 1% AEP event (Flood Zone A), and the 0.1% AEP event (Flood Zone B) are mapped. In essence, the program provides predictive flooding within areas of further assessment from Fluvial and Coastal/Tidal sources.

At the current date, CFRAM fluvial flood extent maps have been published by the OPW as part of the modelling done by CFRAM for the River Liffey and surrounding hinterland. CFRAM mapping has been noted to only cover the eastern section of the subject site. Refer to Figure 3.2 for site location with respect to the known CFRAM flood extent. Refer to Appendix E for the full extents of the CFRAM mapping.

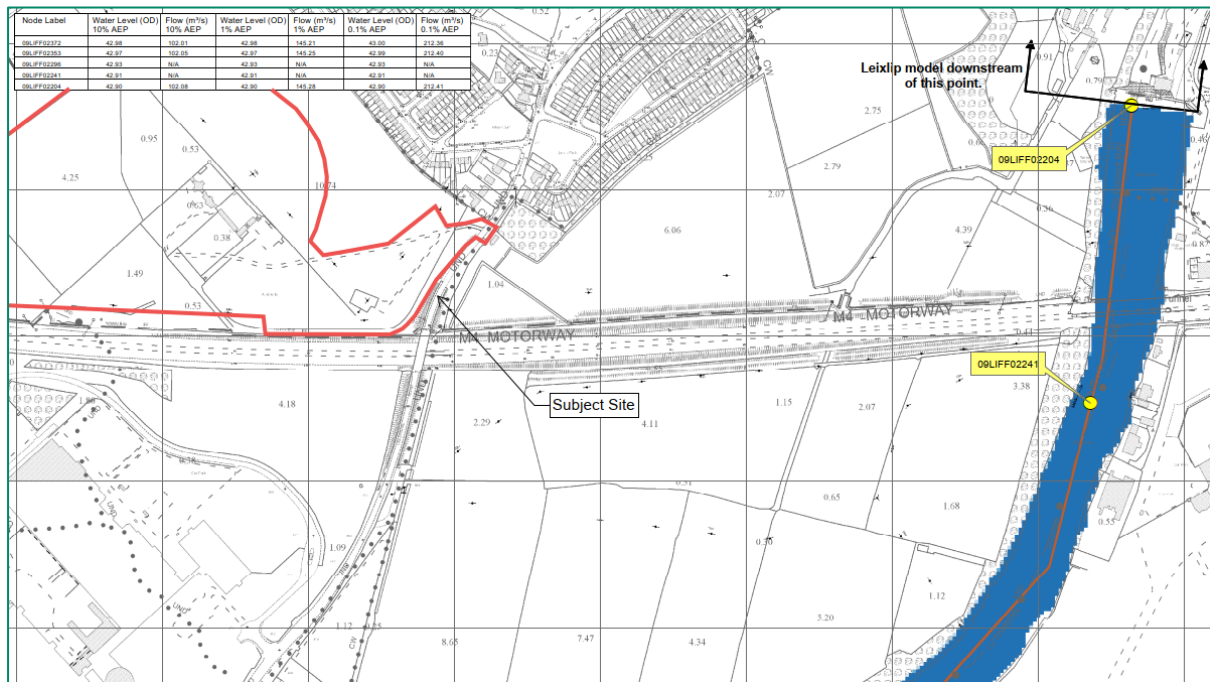


Figure 3.2: CFRAM Fluvial Flood Extents Map (Source: floodinfo.ie)

Table 1 includes the fluvial flood water levels for various Annual Exceedance Probabilities (AEP) at all relevant nodes along the River Liffey.

Table 1. Predicted Fluvial Flood Water Levels in the Vicinity of the Site

Node	Water level (m OD) for 10% AEP	Water Level (m OD) for 1% AEP	Water Level (m OD) for 0.1% AEP
09LIFF02204	42.90	42.90	42.90
09LIFF02241	42.91	42.91	42.91

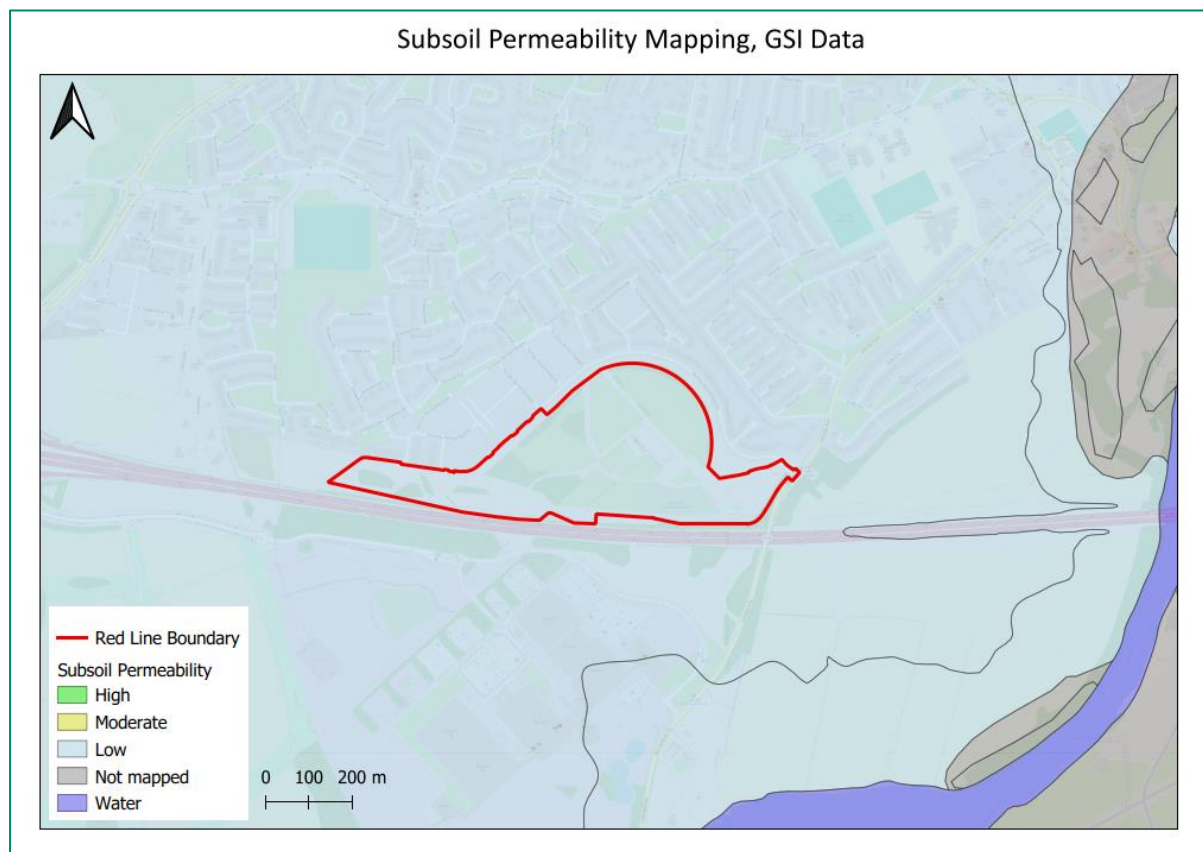
Source: floodmaps.ie

Therefore, based on Present Day CFRAM Fluvial Flood Maps and available AEP nodes, there is negligible risk of flooding due to the distance of the River Liffey from the subject site and the topographic levels. The lowest point in the subject site is approximately 50.5 mOD which is 7.59 m above the closest AEP node, hence, the topographical nature of the site acts as a natural barrier to fluvial flood risk.

3.1.3 Geological Soil Conditions

The Geological Survey of Ireland (GSI) published data has been used in this study to get an indication of the geological soil conditions, most notably, the subsoil permeability and any potential groundwater vulnerability based on GSI records. The Groundwater Vulnerability map (Groundwater Data Viewer) shows land areas where groundwater can be easily contaminated. It also shows areas where it is very well protected by the natural subsoil layers.

Groundwater flooding can occur during lengthy periods of heavy rainfall, typically during later winter/early spring when the groundwater table is already high. If the groundwater level rises above surface level, it can pond at local points and cause periods of flooding. Of particular note, subsoil permeability is useful in determining the filtration characteristics of the soil. AECOM have reviewed the mapping for the subsoil permeability within the site. Figure 3.3 is an extract from the GSI mapping which shows the site to have low permeability across the full extent of the subject site as well as the immediate surrounding area.



If geologists find features in the landscape like sinkholes or sinking streams ('karst' features), these are outlined as being extremely vulnerable. Where the water table is close to the surface in sand and gravel aquifers, groundwater vulnerability is also extremely vulnerable. Four groundwater vulnerability categories are defined by the DELF/EPA/GSI (1999):

- Extreme (E)
- High (H)
- Moderate (M)
- Low (L)

The vulnerability follows the vulnerability mapping criteria:

Depth to rock	Hydrogeological Requirements for Vulnerability Categories				
	Diffuse recharge			Point Recharge	Unsaturated Zone
	high permeability (sand/gravel)	Moderate permeability (sandy subsoil)	low permeability (clayey subsoil, clay, peat)	(swallow holes, losing streams)	(sand & gravel aquifers <u>only</u>)
0–3 m	Extreme	Extreme	Extreme	Extreme (30 m radius)	Extreme
3–5 m	High	High	High	N/A	High
5–10 m	High	High	Moderate	N/A	High
>10 m	High	Moderate	Low	N/A	High

i N/A = not applicable.
 ii Release point of contaminants is assumed to be 1–2 m below ground surface.
 iii Permeability classifications relate to the engineering behaviour as described by BS5930.
 iv Outcrop and shallow subsoil (i.e. generally <1.0 m) areas are shown as a sub-category of extreme vulnerability.
 (amended from Deakin and Daly (1999) and DELG/EPA/GSI (1999))

Figure 3.4: Vulnerability Mapping Criteria (adapted from DELG/EPA/GSI, 1999)

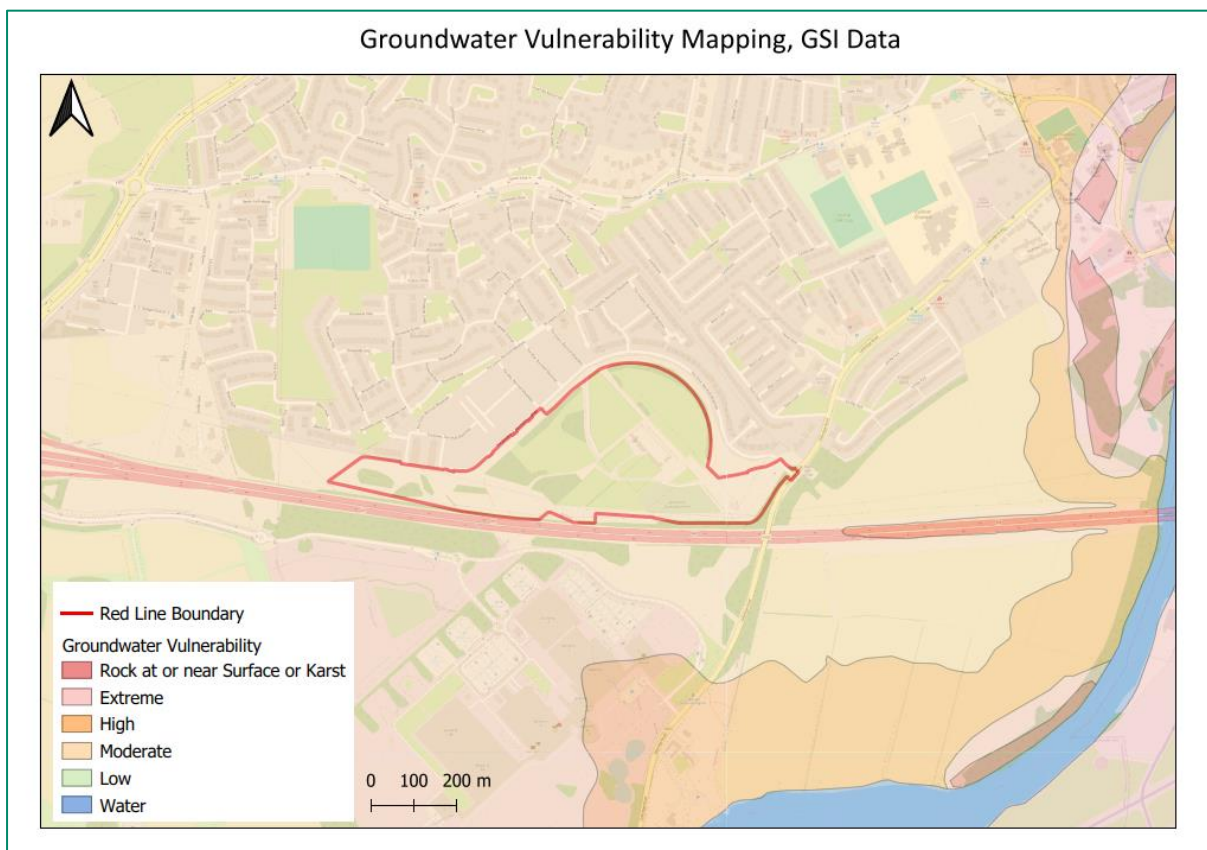


Figure 3.5: Groundwater Vulnerability Map (Source: GSI)

The proposed development is located within a moderate vulnerability classification as seen in Figure 3.5, however, based on ground investigations as discussed in Section 1.4 of this report, the recommendations based on the IGSL Ltd report should still be considered as part of planning and development.

3.2 Potential Flood Risk Sources

When carrying out a flood risk assessment all potential flood risks and sources of flood water at the site should be considered. In general, the relevant flood sources are:

- **Coastal/Tidal:** flooding caused by sea levels which are higher than normal, resulting in sea water overflowing onto the land.
- **Fluvial:** flooding because of a river exceeding its capacity, with excess water spilling out onto the adjacent floodplain.
- **Pluvial:** flooding from rainfall-generated overland flows which arise before run-off can enter any watercourse or sewer. It is usually associated with high intensity rainfall.
- **Groundwater:** flooding which occurs when the natural underground drainage system cannot drain rainfall away quick enough, causing the water table to rise above the ground surface.

3.2.1 Coastal/ Tidal Flood Risk

Coastal or tidal flooding occurs when sea levels rise above normal levels, leading to the inundation of coastal areas. It is typically a result of various factors, including high tides and/or storm surges. Given the location of the subject site, the subject site is at low vulnerability of flooding. The nearest approximate distance from the coastline to the subject site is approximately 24 km.

3.2.2 Fluvial Flood Risk

Fluvial flooding is primarily caused by the flooding of rivers and streams. Fluvial flooding is the result of a river exceeding its capacity and excess water spilling out on to the adjacent floodplain. Mapping published by the OPW and CFRAM mapping is used to evaluate the fluvial flood risk to the subject site.

Based on the background data reviewed, there are consistent trends that confirm the subject site is located within Flood Zone C.

3.2.3 Pluvial Flood Risk

Pluvial flooding is the result of excess rainfall-generated runoff which cannot enter the drainage network and therefore ponds in low lying areas. It is usually associated with high intensity rainfall. Flood risk from pluvial sources exists in all areas. The OPW provides PFRA mapping for pluvial flood events, as well as pluvial flooding probabilities. There is no recorded significant pluvial flooding within, and around the subject site.

3.2.4 Groundwater Flood Risk

Groundwater flooding can occur during lengthy periods of heavy rainfall, typically during later winter/early spring when the groundwater table is already high. If the groundwater level rises above surface level, it can pond at local points and cause periods of flooding. Of particular note, subsoil permeability is useful in determining the filtration characteristics of the soil. The Groundwater Data Viewer (GSI) online maps were reviewed and noted that the subject site is classified as low subsoil permeability and moderate vulnerability as mentioned in Section 3.1.3 of this assessment.

Based on findings from the GI, where in-situ monitoring was undertaken in BH01 and BH01A, the standard penetration test (SPT) recorded an N value of greater than 50 blows which likely implies a very dense/ stiff soil, which would be a characteristic of a low permeability soil as noted in the GSI records. Low natural infiltration rates were confirmed during the 5 no. soakaway tests that were carried out as part of the investigation. Based on the infiltration tests carried out, good infiltration was observed on site (Soakaway 2 & 4 passed).

Table 2 summarises where excavations encountered water ingress. The bedrock, which is assumed to be around 2.0m deep, likely contains groundwater under confined piezometric pressure. When the boreholes (BH01 and BH01A) penetrated this confined aquifer, the water under pressure rises quickly, causing rapid ingress. While most shallow pits were dry, minor seepages were recorded in some locations greater than 1.0m depth. Therefore, observations of groundwater presence is highly dependent on the depth of the excavations. Shallow pits (generally less than 1.0m deep) remained mostly dry as per the GI report, while deeper boreholes (around 2.0m deep) encountered significant rapid groundwater ingress.

Table 2. Water measurements in on-site exploratory holes

Exploratory Hole	Water struck (mBLG)	Stratum Description	Rate of Flow	Remarks
FP/TP07	0.8	Firm brown sandy gravelly CLAY with a medium cobble content (MADE GROUND)	-	Appeared in base
FP/TP11	0.7	Firm greyish brown sandy gravelly CLAY with root hairs and a medium cobble content	Seepage	-
STAP05	2.0	Firm to stiff brown mottled dark grey sandy gravelly CLAY with a medium cobble content	Seepage	Appearing at base of dig
ST03	2.0	Firm and firm to stiff brown slightly sandy gravelly CLAY with a high cobble content	-	Appearing at base of dig
ST04	2.0	Firm and firm to stiff brown slightly sandy gravelly CLAY with a high cobble content	-	Appearing at base of dig
ST05	1.4	Firm brown sandy gravelly CLAY with medium cobble content	Rapid	Appearing at base of dig
BH01	2.0	Firm dark brown sandy gravelly CLAY	Rapid	Rose to 0.5 mBGL in 5 minutes
BH01A	1.8	Firm dark brown sandy gravelly CLAY	Rapid	Rose to 0.5 mBGL in 5 minutes
BH01B	-	-	-	Monitoring records show groundwater at 1.05m and 1.0m BGL post fieldworks

Source: IGSL GI Report

4. Flood Risk Assessment Conclusion

The Stage 1 FRA for the proposed redevelopment of The Wonderful Barn, conducted by AECOM on behalf of KCC has been prepared in accordance with “The Planning System & Flood Risk Management Guidelines of Planning Authorities” published in November 2009. Key findings from the assessment can be summarised as follows:

- Topographical and Utility Survey: The site shows a general slope from north to south, with an average gradient of 1:100 and a low point at approximately 50.5 mOD in the south, providing a natural drainage path towards the south (M4). Existing utilities within the site were mapped, revealing stormwater sewers and electrical ducts but no foul water drainage pipes, water mains, public lighting, gas pipes, or cables from various service providers.

Section 3 and 4 of this assessment were prepared for the purposes of assessing the flood risk to the proposed development and noted the following conclusions:

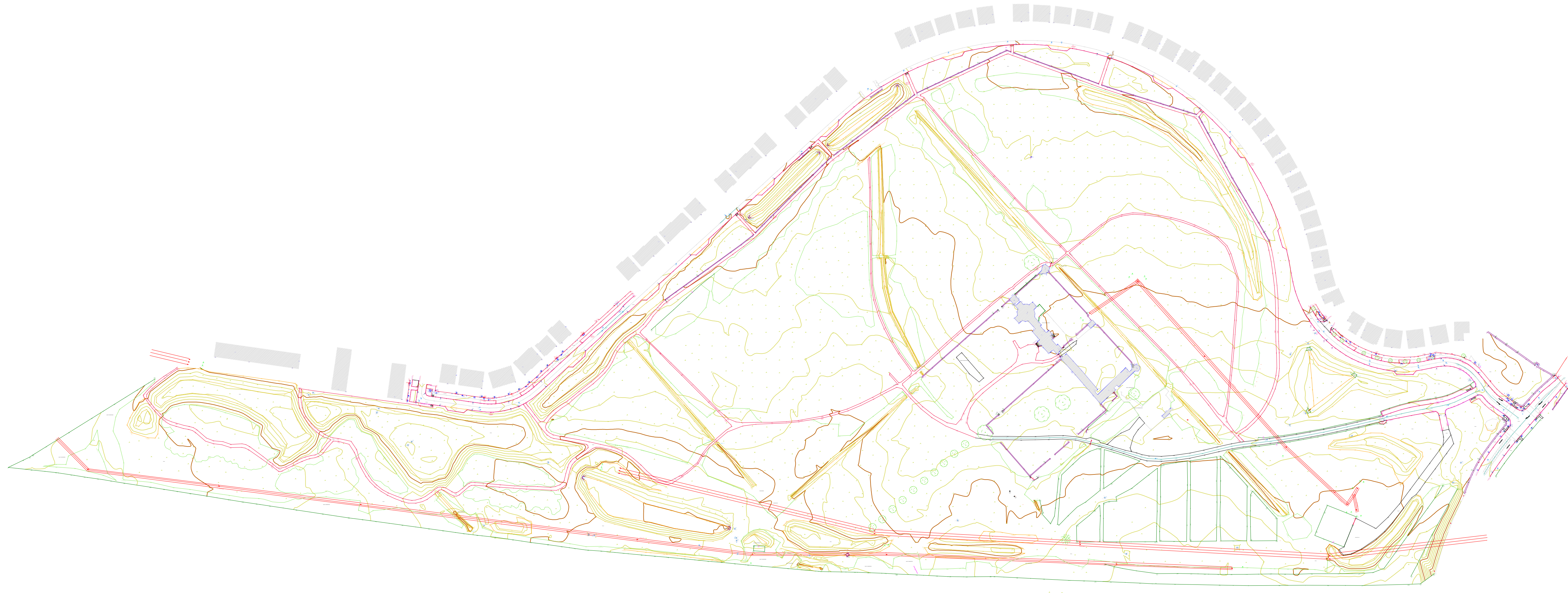
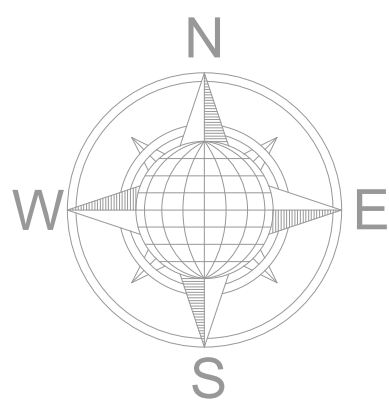
- Based on the information reviewed, AECOM have concluded that coastal or tidal flooding can be considered as a negligible source of flood risk for the subject site.
- Fluvial flooding from the River Liffey is the closest potential fluvial flood risk source to the site. Based on the material reviewed as part of this document and the analysis undertaken, it has been concluded that the subject site is classified as Flood Zone C.
- Based on the available data, there is no recorded pluvial flooding data for the subject site or surrounding vicinity. In accordance with The Planning System & Flood Risk Guidelines, the proposed drainage network has been designed to cater for suitable surface water runoff during significant rainfall events. To further mitigate against pluvial flood risk, an effective surface water strategy will be developed for the site which includes a 30% increase for Climate Change.
- During excavation of exploratory holes, as per the GI, most shallow pits and excavations (less than 1.0m deep) generally remained dry, indicating a low water table at these depths. This suggests a low risk of groundwater flooding from shallow sources under typical conditions. However, for deeper excavations, as recorded in BH01 and BH01A, the rapid rise in water levels in the boreholes, from 2.0 mBGL to 0.50 mBGL in five minutes, indicates the presence of groundwater under significant confined piezometric pressure at depths around 2.0m. This points to a potential risk of groundwater being present during deep excavations.

The proposed development has been classified as being located within Flood Zone C. In accordance with The Planning System and Flood Risk management Guidelines 2009 (Guidelines), no Justification Test for the development is required.

Based on the conclusions above the following recommendations have been made:

- Ground conditions include sandy gravelly CLAY transitioning to over-consolidated glacial till with historic strip footings capable of supporting an allowable bearing capacity of 100kPa. The groundwater level was measured on two separate occasions in the long-term standpipe on the 22nd and 26th of February, and was found to be at 1.05 mBGL and 1 mBGL respectively. A suitable SuDS strategy should be developed in accordance with KCC guidelines prepared in cognisance of groundwater levels and based where groundwater was observed on site. Drainage outfall levels from site should not be in excess of the calculated QBar, and appropriate control measures should be implemented.
- To further mitigate against flood risk, an effective surface water strategy and SuDS strategy will be developed for the site which includes a 30% increase for Climate Change.
- Suitable Method Statements should be prepared for deep excavations to include the potential risk for groundwater ingress.
- It is recommended that additional long term groundwater monitoring is undertaken, and the proposed SuDS features are checked at detailed design stage to ensure they are located above the associated groundwater level.

Appendix A – Topographical Survey



LEGEND
Street furniture & Services

Over Head Wires (LUAS) - Pylon ESB	Bus Stop	Road Sign	Phone Box
Flowbed	Bus Stop	Bench Seat	Duct
Pipe	Beacon	Kiosk	Gas Cover
Lift	Beacon	Guilty	CP Box
Barrier	Counter Cover	Waste Bin	Waste Bin
Pump	Box Hole	Hydrant	Hydrant
Trail Pit	Electricity Pole	Fire Hydrant	Fire Hydrant
Bus/Tram Shelter	Telegraph pole	ESB Box	ESB Box
Postbox	OCS Pole	ESB Inspection Cover	ESB Inspection Cover
Valve - General	OCTV Camera Pole	Traffic Control Box	Traffic Control Box
Water Valve	Lamp Post	LUAS Technical Cubicle	LUAS Technical Cubicle
Gas Valve	Food Manhole	Ticket Vending Machine	Ticket Vending Machine
Blow Valve	Surface Water MH	Water Meter Cover	Water Meter Cover
Air Valve	Manholes	Telecom Inspection Cover	Telecom Inspection Cover
Street Cook	Air Conditioning Vents	Monument / Toilets	Monument / Toilets
C P Post	Services Inspection Cover	Tank Storage	Tank Storage
Marker Post	Traffic Inspection Cover	Basement - IM1 Cover & Pip	Basement - IM1 Cover & Pip
Traffic light	Cable TV Inspection Cover	Dished Aerial Mark	Dished Aerial Mark
Parking Meter	ESAT Inspection Cover	Stay for pole	Stay for pole
Plane Aerial Mark	NTL Inspection Cover	Pipe Protection	Pipe Protection
Smart Card Validator	Encom Inspection Cover	Washout	Washout
Unknown Valve	Roading Eye		

Natural Features

Surface Change	Water Level	Golf
Land Drain	Crown Level	Fair Way
Bottom of Slope	Invert level	Green
Top of Slope	Bed Level	Tree Box
Ditch	Spotlight	Other
Water Edge / Lake / Pond		Survey Station
Hedge / Trees Dip Line / Vegetation		Photo point
Tree Deciduous		Top of Tree

Built Features

Roads & Road Markings

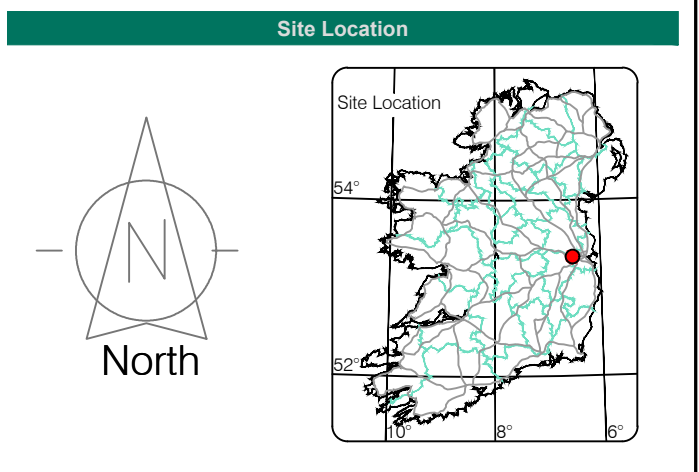
Building	Fence	Floor Level
Edge of Road	Gate	Apex Height
Kerb Bottom	Road Centreline	Eaves Height
Kerb Top	Top of Wall	Parapet Height
Bridge Abutment	Hoarding	Soffit Elevation
Bridge Deck	Property Line	Shop Level
Bridge Parapet	Road Scar	Concrete Pad
Building Flagpole	Top of Fence	Track
Footpath / Platform Train & Tram	Wall / Raising Wall	
Damp Proof Course / Verge	Railway / Tram Rail / Grating / Ramp	
Bridge Pier / Wall & Gate Pillar / LUAS Trackbed	Building Canopy / Roof / Overhang	
Cycleway / Private Landing Area		

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The Client must promptly notify the Company of any errors in mapping of which it becomes aware. If misleading, inaccurate or otherwise inappropriate information is brought to the Company's attention or the Company itself identifies any such inaccuracy or error in a survey, it shall use its reasonable endeavours to fix or remove it and, if necessary in certain instances, the Company being on notice of any such misleading, inaccurate or otherwise inappropriate information, it will re-conduct the survey and reproduce the data to the specified scale or accuracy.



Revisions

Rev	Description	Surveyed by	Drawn by	Checked by
0	First Issue	MC - 09/04/2024	MC - 18/04/2024	PK, SD - 22/04/2024

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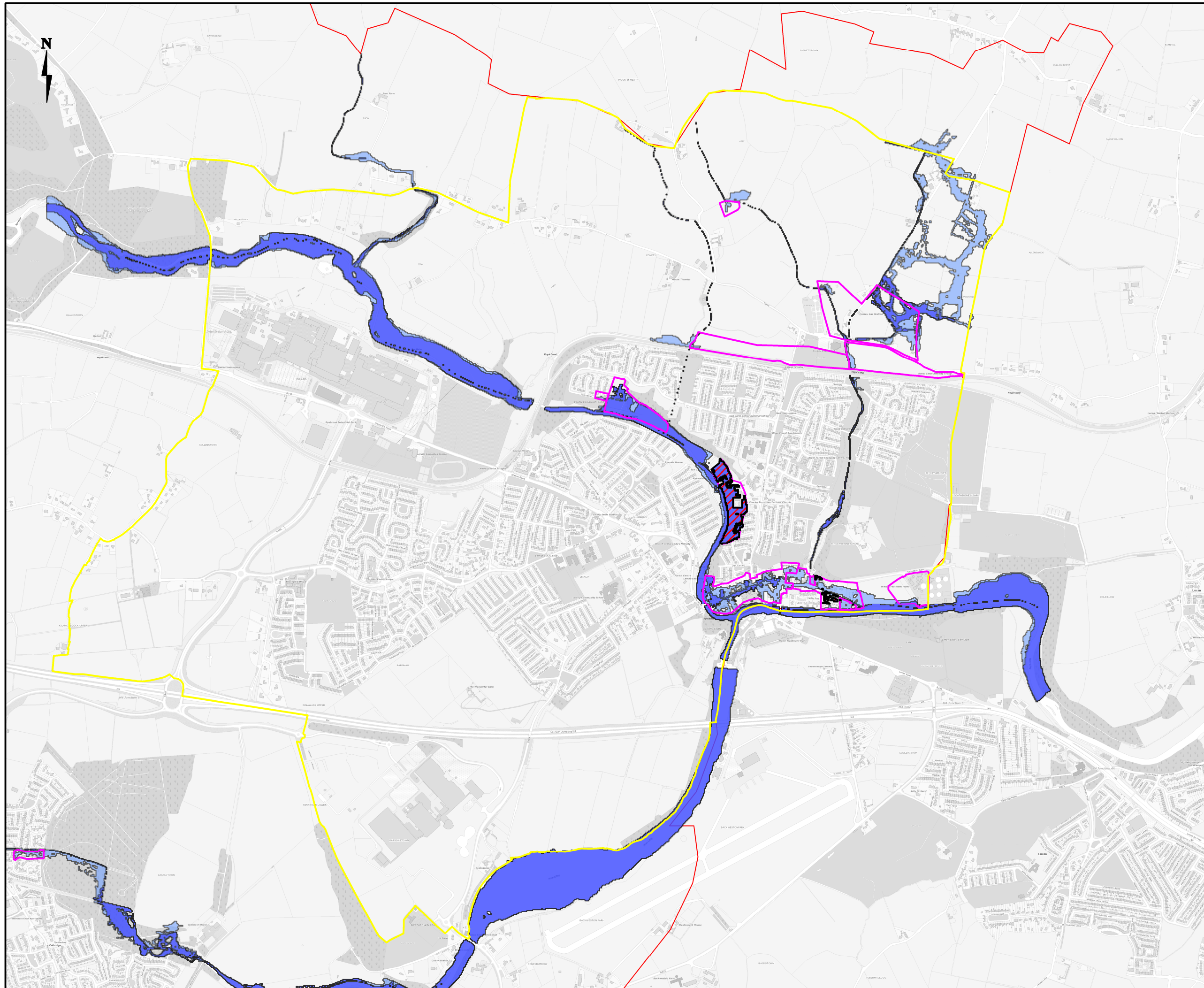
THE SURVEY ASSOCIATION
SCSI
RICS

Offices in London, Birmingham, Manchester, Glasgow, Dublin, Cork, Kildare, Cologne, Barcelona, Geneva

Client	Metropolitan Workshop
Project	Wonderful Barn Additional Survey
Description	Topographical Survey
Survey Grid	ITM15
Survey Datum	Malin Head
RICS Band	Band E
Presentation Scale	NTS@A1
MGS Project ID	57199
Drawing Number	MGS57199_T_ITM_Rev0-00

Appendix B – Groundwater Monitoring Data Sheet

Appendix C – Leixlip Flood Zone Mapping



Legend

- Flood Zone A - 1% AEP Flood Extent
(1 in 100 chance in any given year)
- Flood Zone B - 0.1% AEP Flood Extent
(1 in 1000 chance in any given year)
- Defended Area
- Flood Risk Assessment
- LAP Boundary

Client
Kildare County Council



Project
Strategic Flood Risk Assessment

Title
Leixlip



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Issue Details			
Drawn by: BT	Project No. MDW0751		
Checked by: VMcA	File Ref. MDW0751Mi0004		
Approved by: PM	Drawing No. Mi0004	Rev. F01	
Scale: 1:18,000 @ A3	Date: 22/03/2019		

Notes

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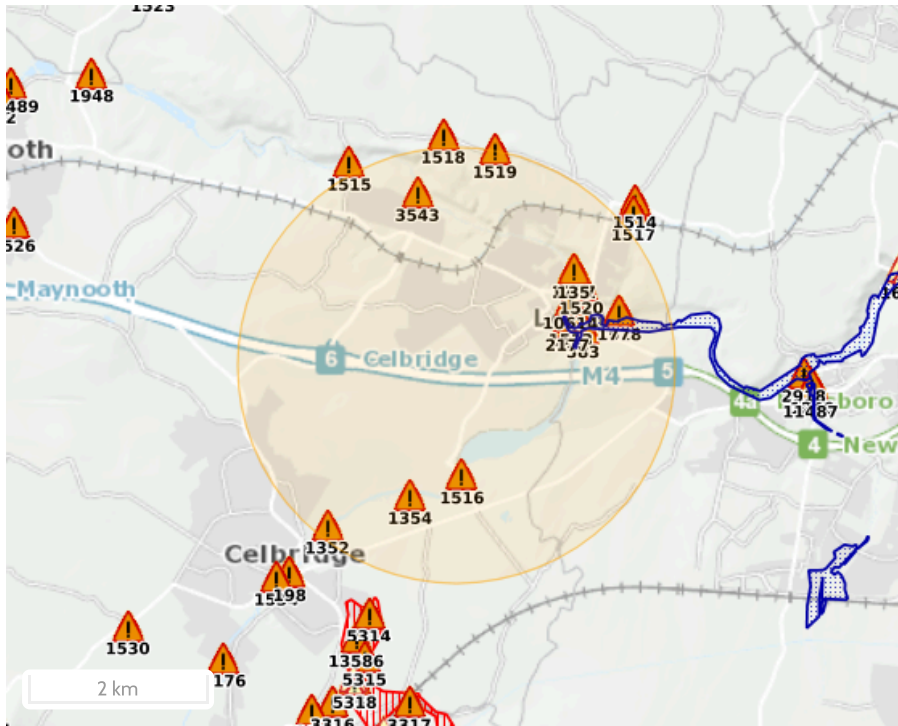
Appendix D – OPW Past Flood Event Summary Report



Report Produced: 5/6/2024 10:35

This Past Flood Event Summary Report summarises all past flood events within 2.5 kilometres of the map centre.

This report has been downloaded from www.floodinfo.ie (the "Website"). The users should take account of the restrictions and limitations relating to the content and use of the Website that are explained in the Terms and Conditions. It is a condition of use of the Website that you agree to be bound by the disclaimer and other terms and conditions set out on the Website and to the privacy policy on the Website.








Map Legend

- Single Flood Event
- Recurring Flood Event
- Past Flood Event Extents
- Drainage Districts Benefited Lands*
- Land Commission Benefited Lands*
- Arterial Drainage Schemes Benefited Lands*

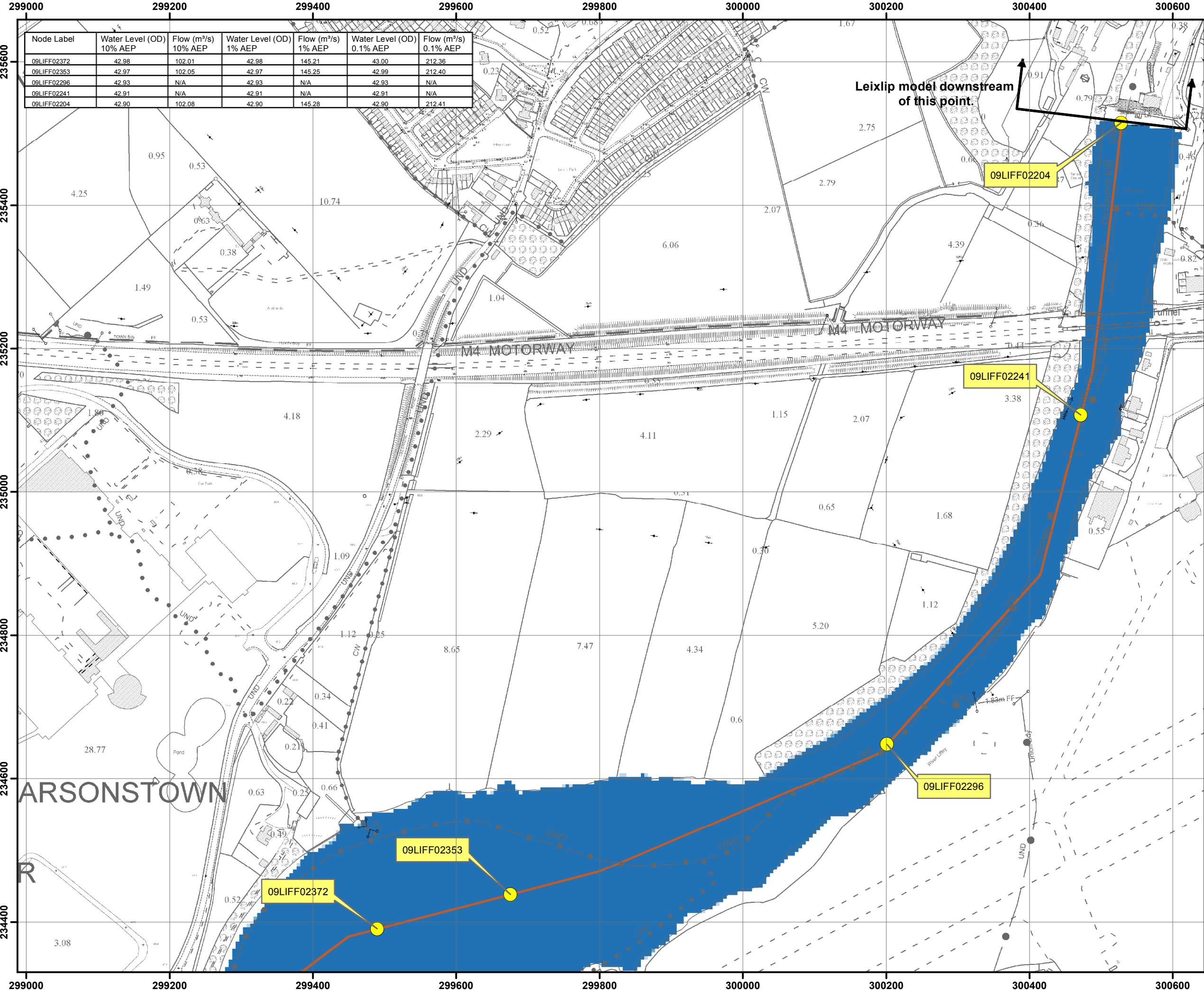
* Important: These maps do not indicate flood hazard or flood extent. Their purpose and scope is explained on Floodinfo.ie

18 Results

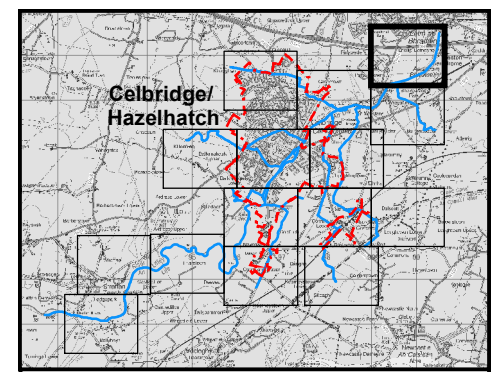
Name (Flood_ID)	Start Date	Event Location
1. Liffey Lower - Dec 1954 (ID-241) Additional Information: Reports (5) Press Archive (2)	08/12/1954	Area
2. Liffey Shinkeen confluence Nov 2000 (ID-1354) Additional Information: Reports (3) Press Archive (6)	05/11/2000	Approximate Point
3. Silleachain Mill Lane Leixlip Nov 2000 (ID-1778) Additional Information: Reports (1) Press Archive (1)	05/11/2000	Approximate Point
4. Ryewater Leixlip Bridge Dec 1954 (ID-2177) Additional Information: Reports (5) Press Archive (3)	08/12/1954	Exact Point
5. Ryewater upstream Leixlip Nov 2000 (ID-3543) Additional Information: Reports (1) Press Archive (8)	05/11/2000	Exact Point
6. Liffey Leixlip November 2000 (ID-8) Additional Information: Reports (2) Press Archive (9)	06/11/2000	Approximate Point

Name (Flood_ID)	Start Date	Event Location
7.  Ryewater Leixlip Distillery Dec 1954 (ID-135) Additional Information: Reports (3) , Press Archive (2)	08/12/1954	Approximate Point
8.  Liffey Nov 1965 (ID-323) Additional Information: Reports (4) , Press Archive (0)	17/11/1965	Approximate Point
9.  Liffey Nov 1968 (ID-324) Additional Information: Reports (2) , Press Archive (0)	31/10/1968	Approximate Point
10.  Liffey Celbridge Nov 2000 (ID-1352) Additional Information: Reports (3) , Press Archive (6)	05/11/2000	Approximate Point
11.  Silleachain Mill Lane Leixlip Nov 2002 (ID-1512) Additional Information: Reports (3) , Press Archive (0)	14/11/2002	Approximate Point
12.  Ryewater Buckley's Lane, Leixlip Nov 2002 (ID-1513) Additional Information: Reports (3) , Press Archive (1)	14/11/2002	Approximate Point
13.  Liffey Barnhall Road Bridge Nov 2002 (ID-1516) Additional Information: Reports (3) , Press Archive (1)	14/11/2002	Approximate Point
14.  Confey Road Nov 2002 (ID-1519) Additional Information: Reports (2) , Press Archive (1)	14/11/2002	Approximate Point
15.  Ryewater Dúncarraig, Leixlip Nov 2002 (ID-1520) Additional Information: Reports (4) , Press Archive (0)	14/11/2002	Approximate Point
16.  Ryewater Leixlip Nov 2000 (ID-1777) Additional Information: Reports (4) , Press Archive (2)	05/11/2000	Approximate Point
17.  Ryewater Leixlip 15 August 2008 (ID-10614) Additional Information: Reports (1) , Press Archive (0)	14/08/2008	Approximate Point
18.  Ryewater Rye River Apartments Nov 2002 Leixlip (ID-1521) Additional Information: Reports (5) , Press Archive (0)	14/11/2002	Approximate Point

Appendix E – CFRAM Fluvial Flood Map



Node Label	Water Level (OD) 10% AEP	Flow (m³/s) 10% AEP	Water Level (OD) 1% AEP	Flow (m³/s) 1% AEP	Water Level (OD) 0.1% AEP	Flow (m³/s) 0.1% AEP
09LIFF02372	42.98	102.01	42.98	145.21	43.00	212.36
09LIFF02353	42.97	102.05	42.97	145.25	42.99	212.40
09LIFF02296	42.93	N/A	42.93	N/A	42.93	N/A
09LIFF02241	42.91	N/A	42.91	N/A	42.91	N/A
09LIFF02204	42.90	102.08	42.90	145.28	42.90	212.41



IMPORTANT USER NOTE:
THE VIEWER OF THIS MAP SHOULD REFER TO THE DISCLAIMER, GUIDANCE NOTES AND CONDITIONS OF USE THAT ACCOMPANY THIS MAP.

Legend

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

FINAL

REV: 01	NOTE: Model update on Crippaun watercourse	DATE: 15/05/2017
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Map:
Celbridge Fluvial Flood Extents

Map Type:	EXTENT
Source:	FLUVIAL
Map Area:	HPW
Scenario:	CURRENT
Drawn By:	F.M.C. Date: 19 May 2017
Checked By:	S.P. Date: 19 May 2017
Approved By:	G.G. Date: 19 May 2017

Drawing No.: **E09CEL_EXFCD_F1_11**
Map Series: Page 11 of 15
Drawing Scale: 1:5,000 @A3

