PROPOSED DEVELOPMENT SITE AT

CROKERS HILL, KENNYSWELL ROAD, KILKENNY,

CO KILKENNY

SITE SPECIFIC FLOOD RISK ASSESSMENT

IE CONSULTING

WATER-ENVIRONMENTAL-CIVIL

Integrated Engineering Consulting

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1 Introduction

IE Consulting was requested by Hayes Higgins Partnership, on behalf of Kilkenny County Council, to undertake a Site Specific Flood Risk Assessment (SSFRA) for a proposed residential development site at Crokers Hill, Kennyswell Road, Kilkenny. It is proposed to construct 80 no. residential dwellings and associated infrastructure works at the site.

The purpose of this SSFRA is to assess the potential flood risk to the proposed development site and to assess the impact that development of the site may or may not have on the hydrological regime of the area.

A hydrological engineer from IE Consulting undertook a survey of the site area and surrounding catchment on the 23rd March 2018.

Quoted ground levels or estimated flood levels relate to ordnance datum (Malin) unless stated otherwise.

This flood risk assessment study has been undertaken in consideration of the following guidance document:-

'The Planning System and Flood Risk Management – Guidelines for Planning Authorities' DOEHLG 2009.

2 Proposed Site Description

2.1 General

The proposed development site is located at Crokers Hill, Kennyswell Road, Kilkenny.

The site is bounded to the north by agricultural land, to the south by Kennyswell Road and to the west and east by existing residential dwellings. The total area of the proposed development site is approximately 2.32 hectares.

The location of the proposed development site is illustrated on *Figure 1* below and shown on *Drawing Number IE1607-001-A in Appendix A*.

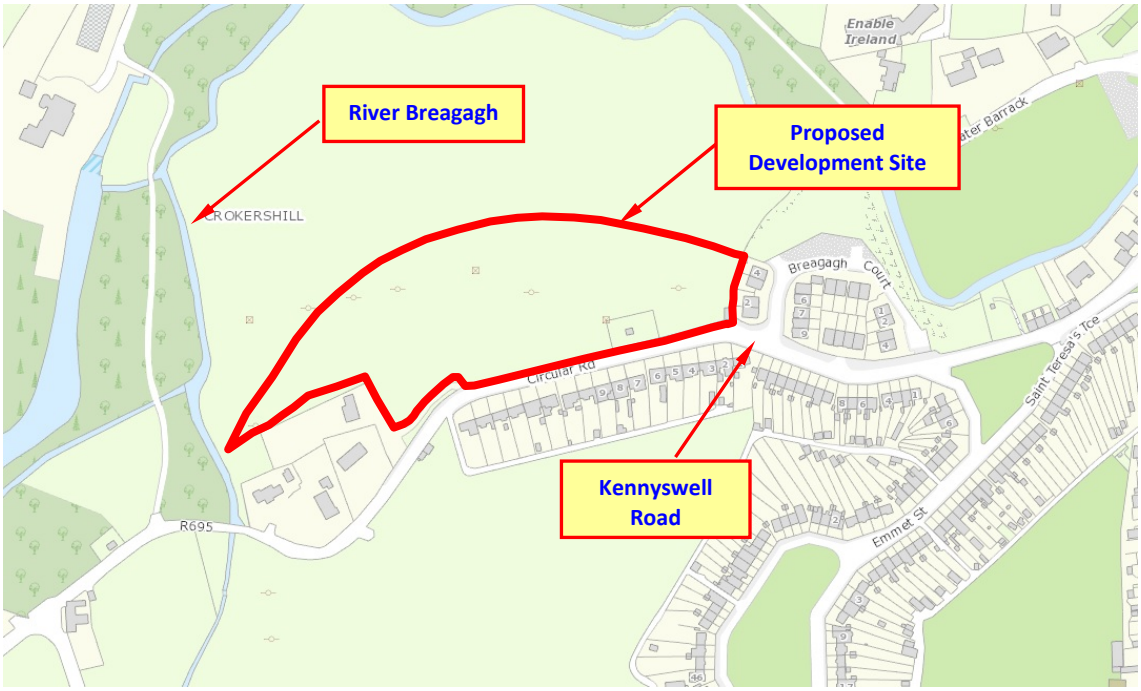


Figure 1 - Site Location

2.2 Existing Topography Levels at Site

The proposed development site slopes moderately to steeply from the northern boundary of the site to the southern boundary of the site at an average gradient of approximately 4.2% (1 in 23).

Existing ground elevations range from approximately 59.59mOD (Malin) in the northern area of the site to 48.43mOD (Malin) in the western area of the site. The lowest topographical elevation within the site where development is proposed is approximately 51.00m OS (Malin).

2.3 Local Hydrology, Landuse & Existing Drainage

The most immediate hydrological feature in the vicinity of the proposed site is the River Breagagh that flows in a north to south and west to east direction beyond the western and northern boundaries of the proposed development site. The catchment area of the River Breagagh was delineated and found to be approximately **57.476km^2** to a point downstream of the site. An assessment of the upstream catchment area of the River Breagagh indicates a predominately rural catchment, with urban development accounting for 1.3% of the total catchment area.

3 Initial Flood Risk Assessment

The flood risk assessment for the proposed development site is undertaken in three principle stages, these being *'Step 1 – Screening', 'Step 2 – Scoping'* and *'Step 3 – Assessing'*.

3.1 Possible Flooding Mechanisms

Table 1 below summarises the possible flooding mechanisms in consideration of the proposed development site:-

Source/Pathway	Significant?	Comment/Reason
Tidal/Coastal	No	The site is not located within a coastal region.
Fluvial	Yes	The River Breagagh is located beyond the western and northern boundaries of the proposed development site.
Pluvial (urban drainage)	Possible	There is existing urban drainage and water supply infrastructure located in the vicinity of site.
Pluvial (overland flow)	No	The site is not surrounded by significantly elevated lands and does not provide an important surface water discharge point to adjacent lands.
Blockage	No	There are no significant hydraulic structures located in the immediate vicinity of the site.
Groundwater	No	There are no significant springs or groundwater discharges mapped or recorded in the immediate vicinity of the site.

Table 1

The primary potential flood risk to the proposed development site can be attributed to an extreme fluvial flood event in the River Breagagh located close to the western boundary of the site. Secondary flood risk can be attributed to a potential surcharge of the urban drainage network or damage to the water supply infrastructure in the vicinity of the site.

In accordance with 'The Planning System and Flood Risk Management – Guidelines for Planning Authorities - DOEHLG 2009' these potential flood risks are analysed in the subsequent 'Screening Assessment' and ''Scoping Assessment'' section of this study report.

4 Screening Assessment

The purpose of the screening assessment is to establish the level of flooding risk that may or may not exist for a particular site and to collate and assess existing current or historical information and data which may indicate the level or extent of any flood risk.

If there is a potential flood risk issue then the flood risk assessment procedure should move to *'Step 2 – Scoping Assessment'* or if no potential flood risk is identified from the screening stage then the overall flood risk assessment can end at *'Step 1'*.

The following information and data was collated as part of the flood risk screening assessment for the proposed development site:-

4.1 OPW/EPA/Local Authority Hydrometric Data

Existing sources of OPW, EPA and local authority hydrometric data were investigated. As illustrated in *Figure 2* below, this assessment has determined that there is one hydrometric gauging stations located on the River Breagagh in the general vicinity of the proposed development site.

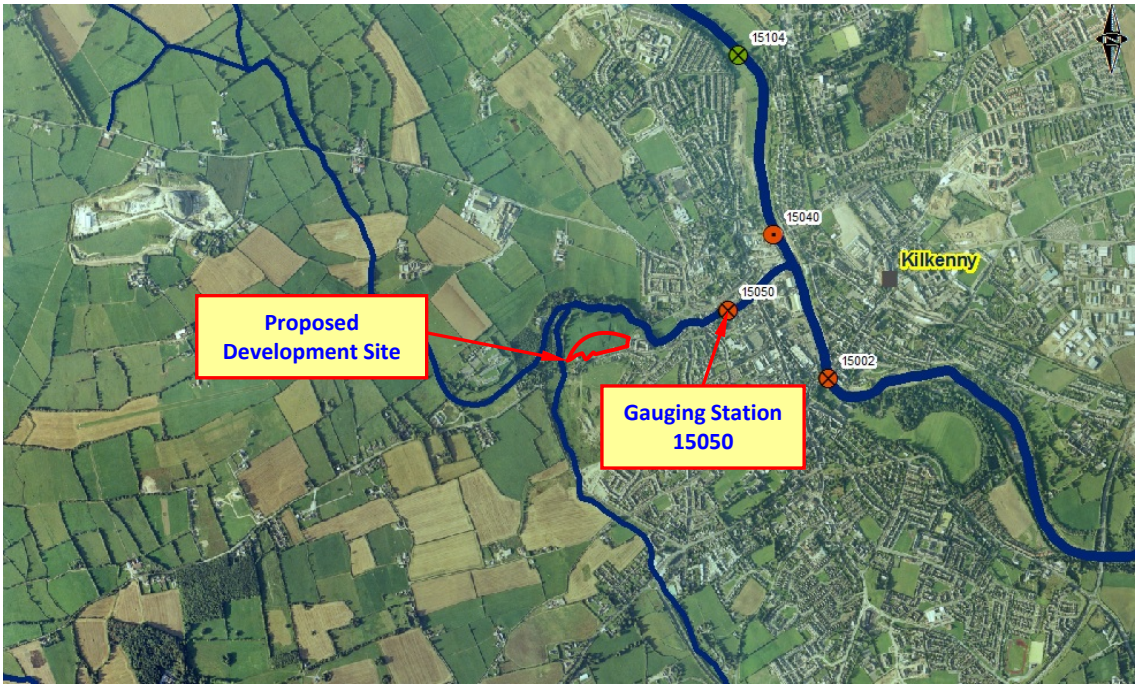


Figure 2 – Hydrometric Gauging Stations

The Register of Hydrometric Stations in Ireland indicates that station 15050 is an autographic recorder station and is currently active. Available hydrometric data for this gauging station was obtained from the OPW. An assessment of the annual maxima data for this station indicates water level recordings and estimated flows for hydrometric years 1995 to 2015.

4.2 OPW PFRA Indicative Flood Mapping

Preliminary Flood Risk Assessment (PFRA) Mapping for Ireland was produced by the OPW in 2011. OPW PFRA indicative flood map number 2019/MAP/137/A illustrates indicative flood zones within this area of County Kilkenny.

Figure 3 below illustrates an extract from the above indicative flood map in the vicinity of the proposed development site.

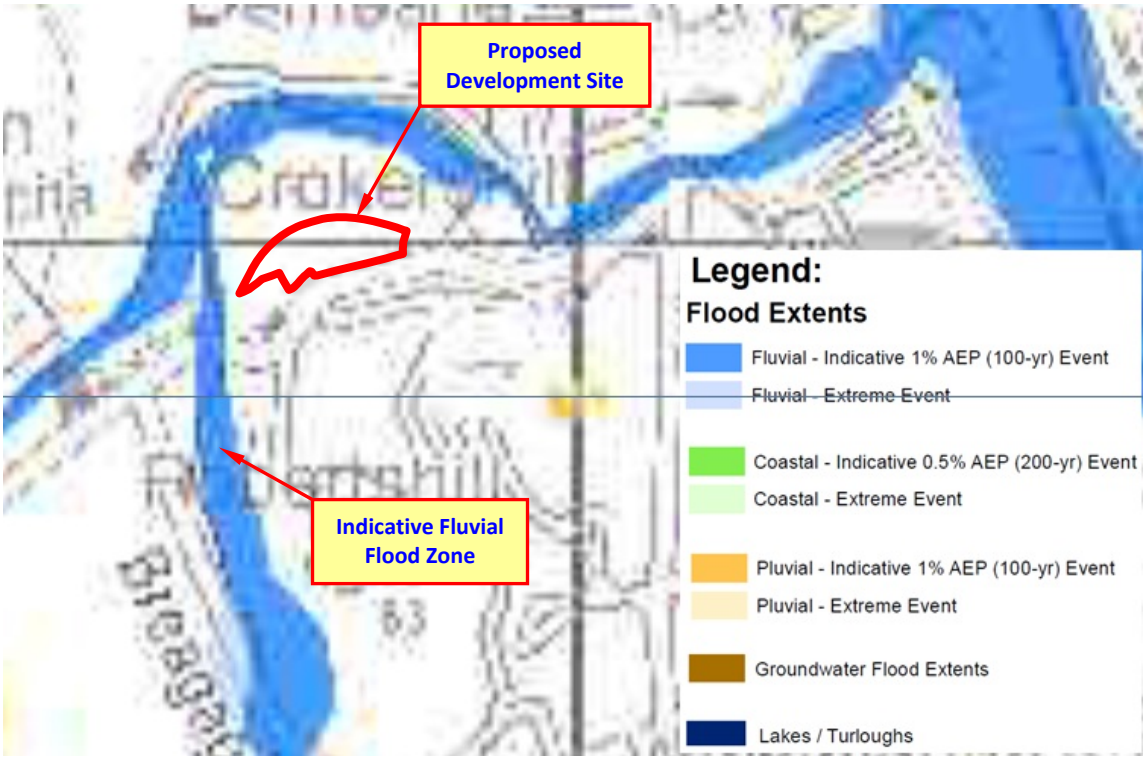


Figure 3 – PFRA Mapping

The PFRA flood mapping indicates no mapped indicative fluvial, pluvial or groundwater flood zones within the boundary of the proposed development.

Figure 4 below illustrates the PFRA indicative flood zones from *Figure 3* overlaid onto higher resolution background mapping.

It should be noted that the indicated extent of flooding illustrated on these maps was developed using a low resolution digital terrain model (DTM) and illustrated flood extents are intended to be indicative only. The flood extents mapped on the PFRA maps are not intended to be used on a site specific basis.

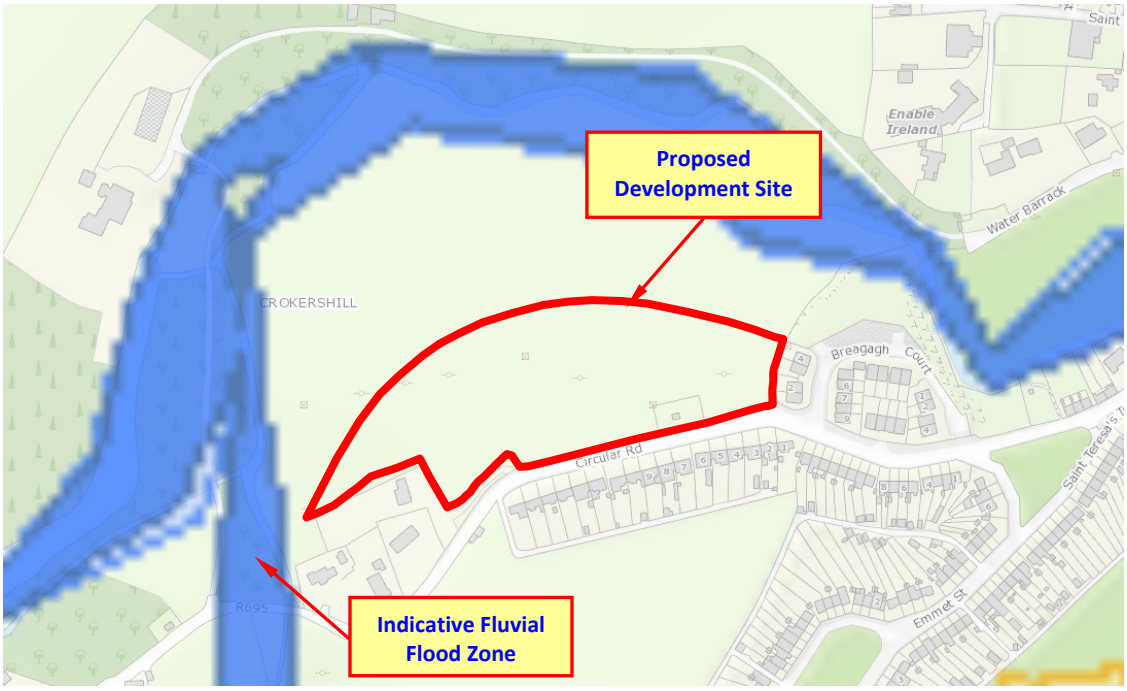


Figure 4 – PFRA Fluvial Mapping

4.3 OPW Flood Maps Website

The OPW Flood Maps Website (www.floods.ie) was consulted in relation to available historical or anecdotal information on any flooding incidences or occurrences in the vicinity of the proposed development site. *Figure 5* below illustrates mapping from the Flood Maps website in the vicinity of the site.

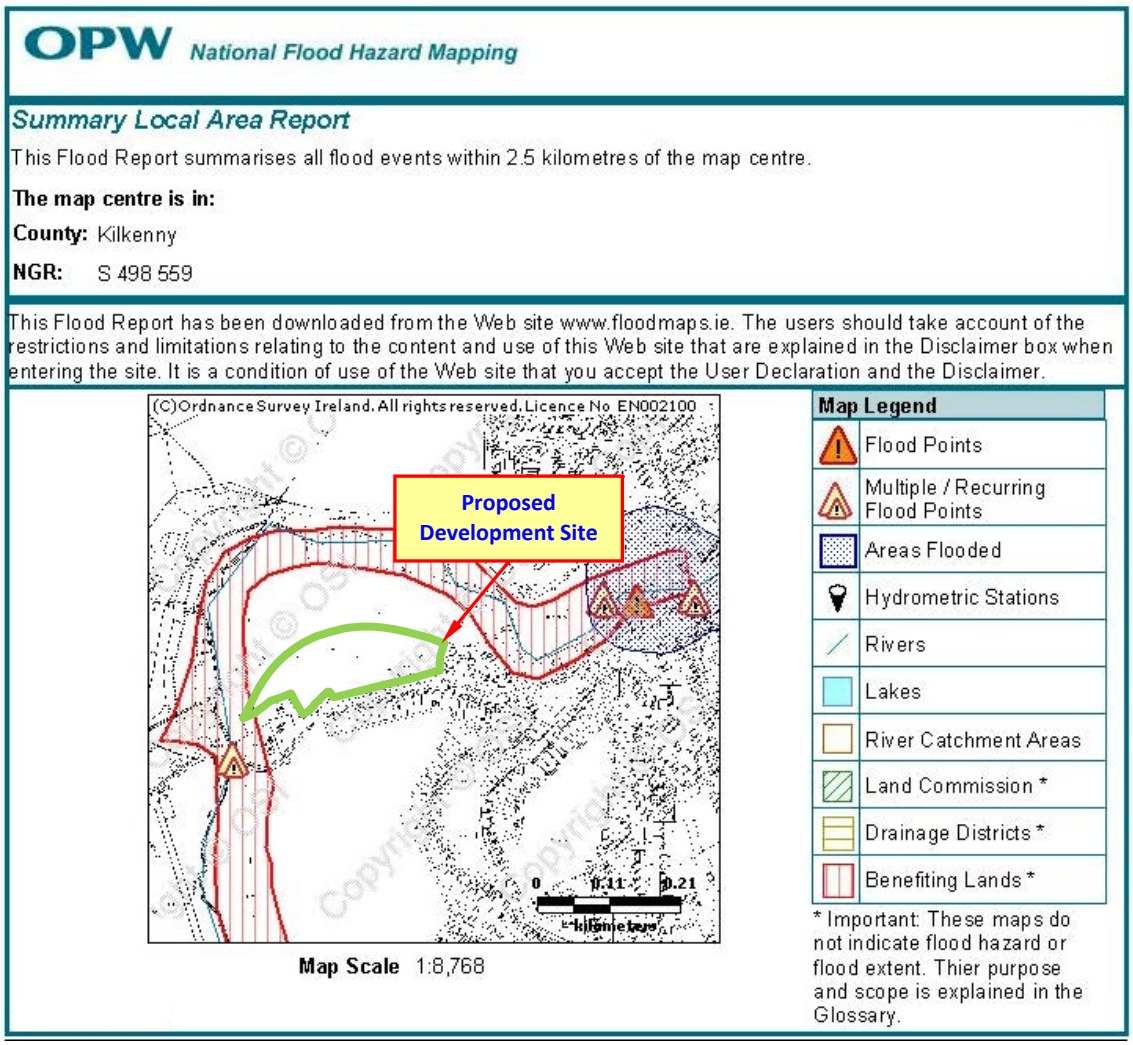


Figure 5 – OPW Flood Maps

Figure 5 above indicates that there are no recorded or anecdotal instances of flooding at or in the immediate vicinity of the proposed development site.

There are recurring flood points mapped to the south-west and east of the proposed development site, however flooding instances at these flood point have not impacted the location of the proposed development site.

There is also an area of '*Benefiting Lands'* mapped within a small area at the south-western corner of the site. 'Benefiting Lands' are defined as *'land that might benefit from the implementation of Arterial (Major) Drainage Schemes (under the Arterial Drainage Act 1945)'* and do not necessarily indicate areas of existing or historical flood risk.

4.4 Ordnance Survey Historic Mapping

Available historic mapping for the area was consulted, as this can provide evidence of historical flooding incidences or occurrences. The maps that were consulted were the historical 6-inch maps (pre-1900), and the historic 25-inch map series.

Figures 6 and *Figure 7* below show the historic mapping for the area of the proposed development site.

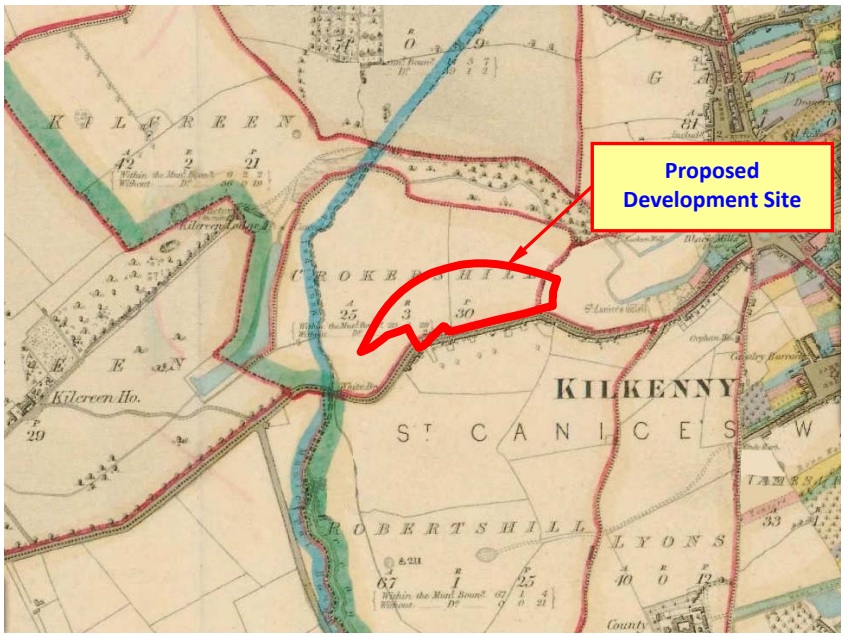


Figure 6 – Historic 6-Inch Mapping

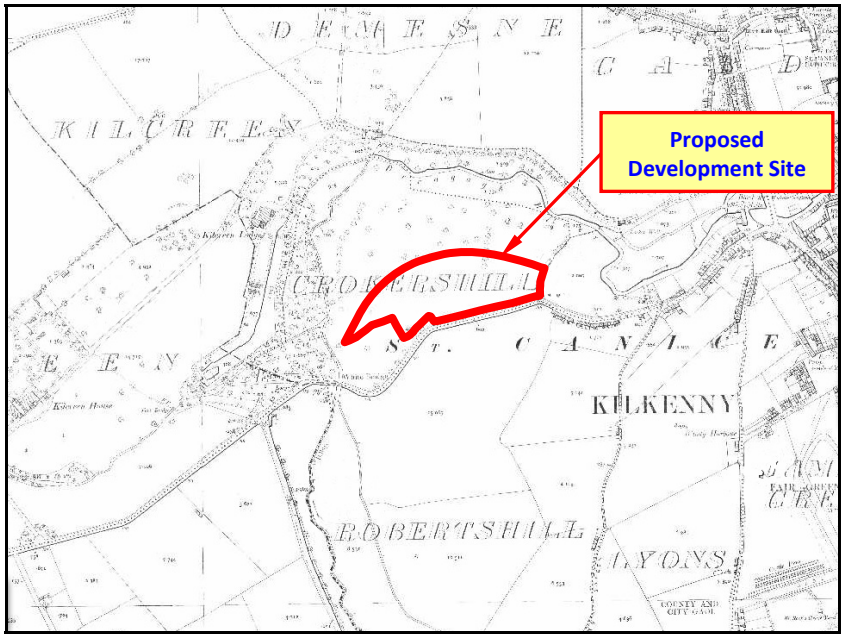


Figure 7 – Historic 25-Inch Mapping

The historic 6 inch and 25 inch mapping does not indicate any historical or anecdotal instances of flooding within or adjacent to the boundary of the proposed development site.

4.5 Geological Survey of Ireland Mapping

The alluvial deposit maps of the Geological Survey of Ireland (GSI) were consulted to assess the extent of any alluvial deposits in the vicinity of the proposed development site. Alluvial deposits can be an indicator of areas that have been subject to flooding in the recent geological past.

Figure 8 below illustrates the sub-soils mapping for the general area of the site.

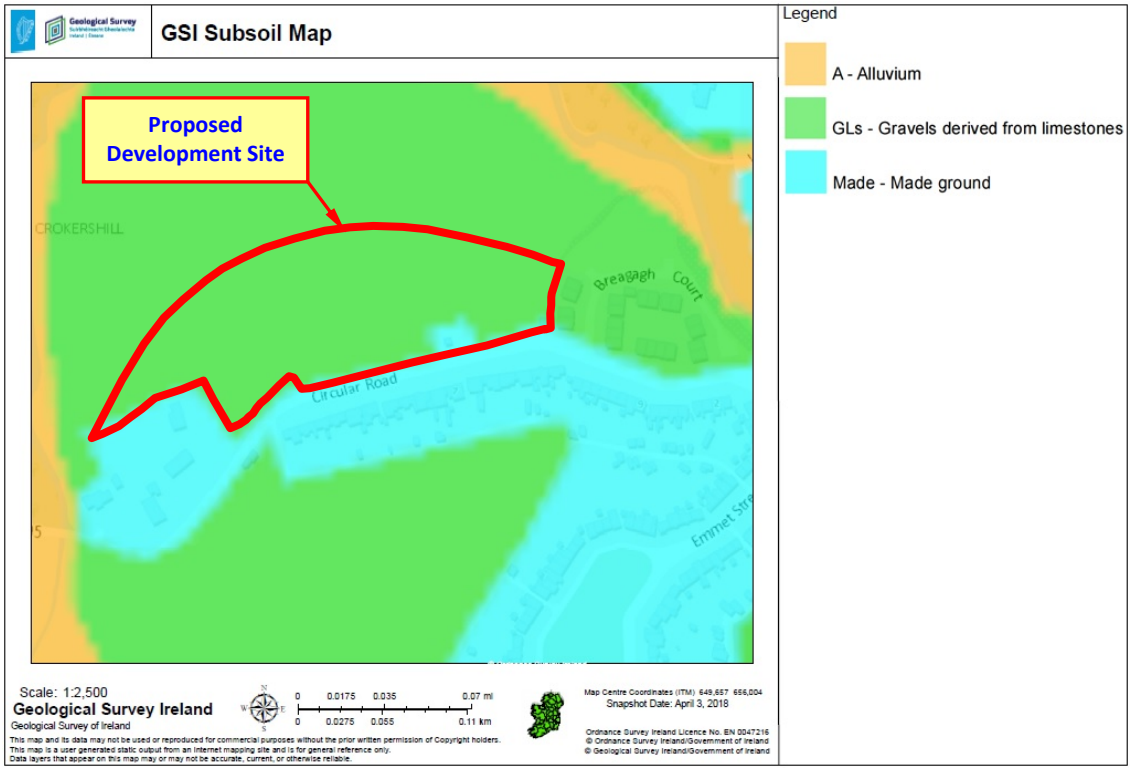


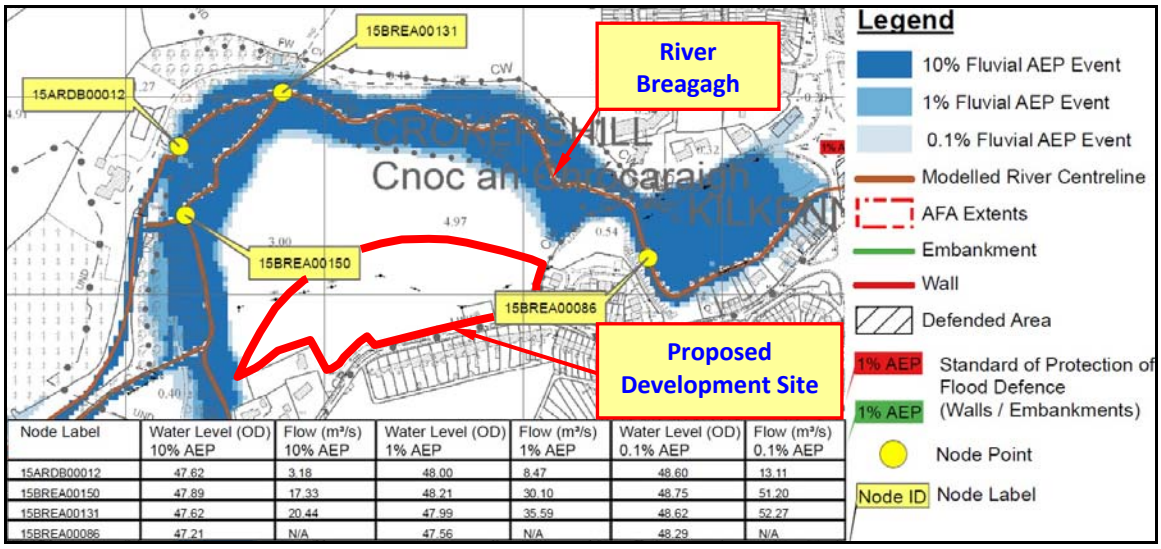
Figure 8 – GSI Subsoil Mapping

Figure 8 above indicates that the proposed development site is largely underlain by Gravel derived from limestones and is also underlain by a small area of made ground. No alluvial deposits are mapped within the boundary of the site.

4.6 South Eastern CFRAM Study

The South Eastern Region Catchment Flood Risk & Management Study (CFRAMS) has been undertaken by the OPW and the Final version of the flood maps were issued in July 2016. Flood risk extent and depth maps for further assessment areas within Kilkenny have also been produced. OPW CFRAMS predictive flood map number *O15KIY__EXFCD_F0_06* illustrates predictive extreme fluvial flood extent zones associated with the Breagagh River in the vicinity of the proposed development site.

Figure 9 below (extracted from CFRAMS flood map *O15KIY__EXFCD_F0_06*), illustrates the predicted extreme 10% AEP (1 in 10 year), 1% AEP (1 in 100 year) or 0.1% AEP (1 in 1000 year) fluvial flood extents in the vicinity of the proposed development site.



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
15ARDB00012	47.62	3.18	48.00	8.47	48.60	13.11
15BREA00150	47.89	17.33	48.21	30.10	48.75	51.20
15BREA00131	47.62	20.44	47.99	35.59	48.62	52.27
15BREA00086	47.21	N/A	47.56	N/A	48.29	N/A

Figure 9 – CFRAMS Fluvial Flood Maps

Figure 9 above indicates that the proposed development site would be not be significantly impacted due to a 0.1% AEP (1 in 1000 year) fluvial flood event in the River Breagagh.

The CFRAMS flood map also provides information on predicted flood levels & flood volumes for 10% AEP, 1% AEP and 0.1% AEP fluvial flood events at various node points along the River Breagagh. As illustrated in *Figure 9* above, the node point closest to the proposed development site is referenced as node point *15BREA00150*. Details of the predicted extreme fluvial flood levels & flood volumes for the CFRAMS node points in the general vicinity of the proposed development site are listed in *Table 2* below, which has been extracted from CFRAMS flood map reference *O15KIY__EXFCD_F0_06.*

Node Label	Water Level (mOD) 10% AEP	Flow (m3/s) 10% AEP	Water Level (mOD) 1% AEP	Flow (m3/s) 1% AEP	Water Level (mOD) 0.1% AEP	Flow (m3/s) 0.1% AEP
15ARDB00012	47.62	3.18	48.00	8.47	48.60	13.11
15BREA00150	47.89	17.33	48.21	30.10	48.75	51.20
15BREA00131	47.62	20.44	47.99	35.59	48.62	52.27
15BREA00086	47.21	N/A	47.56	N/A	48.29	N/A

Table 2 – CFRAMS Fluvial Map - Predicted Flood Level & Flood Volumes

5 Scoping Assessment

The purpose of the scoping stage is to identify possible flood risks and to implement the necessary level of detail and assessment to assess these possible risks, and to ensure these can be adequately addressed in the flood risk assessment. The scoping exercise should also identify that sufficient quantitative information is already available to complete a flood risk assessment appropriate to the scale and nature of the development proposed.

The above screening assessment indicates that the primary flood risk to the proposed development site can be attributed to a potential fluvial flooding from the River Breagagh close to the western boundary of the proposed development site. Secondary flood risk can be attributed to a surcharge in the urban drainage network or from damage to the water supply infrastructure located close to the southern boundary of the site.

In consideration of the information collated as part of the screening exercise, and the availability of other information and data specific to the proposed site, it is considered that sufficient quantitative information to complete an appropriate flood risk assessment can be derived from the information collated as part of the screening exercise alone. In particular, the final flood extent and depth maps for the area produced as part of the South Eastern CFRAM study, dated July 2016, are based on the results of detailed hydraulic modelling undertaken along the reach of the River Breagagh in the vicinity of the site, and therefore provide an accurate delineation of flood zones and prediction of flood depths at the site location.

Secondary flood risk can be attributed to a potential surcharge of the urban drainage network or damage to the water supply infrastructure in the vicinity of the site.

The particular flood risk to the proposed development site is assessed in the subsequent 'Assessing Flood Risk' stage of this study report.

CFRAMS Map *O15KIY__EXFCD_F0_06* indicates that a very minor portion of the western boundary of the site would be impacted due to a 0.1% AEP (1 in 1000 year) fluvial flood event in the River Breagagh. The quantity of flood inundation is considered to be imperceptible and in addition the area impacted by the 0.1% AEP (1 in 1000 year) fluvial flood event is designated as open space, all proposed development is located within Flood Zone'C'. Therefore flood risk from the River Breagagh is considered to be LOW.

In this regard no further assessment of potential primary direct fluvial flood risk to the proposed development site is required.

Development of the site is not expected to result in a significant adverse impact to the hydrological regime of the area or to increase flood risk elsewhere.

6 Assessing Flood Risk

Flood risk from a particular watercourse is normally assessed for a 1% AEP (1 in 100 Year) and a 0.1% AEP (1 in 1000 Year) flood event, in accordance with most county development plans and in accordance with the DOEHLG guidelines *'The Planning System and Flood Risk Management Guidelines'*.

The following sections of this study report present an analysis and assessment of the potential primary and secondary flood risk to the proposed development site.

6.1 Assessment of Primary Flood Risk

The primary potential flood risk to the proposed development site can be attributed to an extreme fluvial flood event in the River Breagagh.

OPW CFRAMS Map *O15KIY__EXFCD_F0_06* indicates that the proposed development site would not be impacted due to a 10% AEP (1 in 10 year), 1% AEP (1 in 100 year) or 0.1% AEP (1 in 1000 year) fluvial flood event in the River Breagagh. Topographical survey information for the proposed development site indicates that the lowest topographical elevation within the boundary of the site where development is proposed is approximately 51.00m OD. The predicted 0.1% AEP (1 in 1000 year) flood level in the River Breagagh in the vicinity of the site is 48.75m OD (CFRAMS Node Point 15BREA00150). The lowest topographical elevation within the site is there approximately 2.25m above the 0.1% AEP fluvial flood level.

The proposed development site is therefore not at risk of fluvial flooding from the River Breagagh. A small area at the south-western corner of the proposed development site may potentially be impacted by fluvial flooding, however no development is proposed at this location.

There are no significant or restrictive hydraulic structures located in the immediate vicinity of the proposed development site.

In this regard no further assessment of primary potential fluvial flood risk to the proposed development site is required.

Overall the fluvial flood risk to the proposed development site is ***LOW***. Development of the site is not expected to result in a significant adverse impact to the hydrological regime of the area or to increase flood risk elsewhere.

6.2 Assessment of Secondary Flood Risk

Pluvial - Urban Drainage/Water Supply Infrastructure

Secondary and residual flood risk can also be attributed to a potential surcharge of the urban drainage network and /or damage to the water supply infrastructure in the general vicinity of the site. A drainage and water supply infrastructure map was obtained from Murphy Surveys, an extract of which is illustrated in *Figure 10* below. The following infrastructure has been identified in the vicinity of the proposed development site:

- 100mm foul sewer located close to the southern boundary of the site.
- 150mm combined sewer located close to the southern boundary of the site.
- 225mm combined sewer located close to the southern boundary of the site.
- Two no. water-mains located close to the southern boundary of the site.
- One 150mm water-main located within the southern boundary of the site.

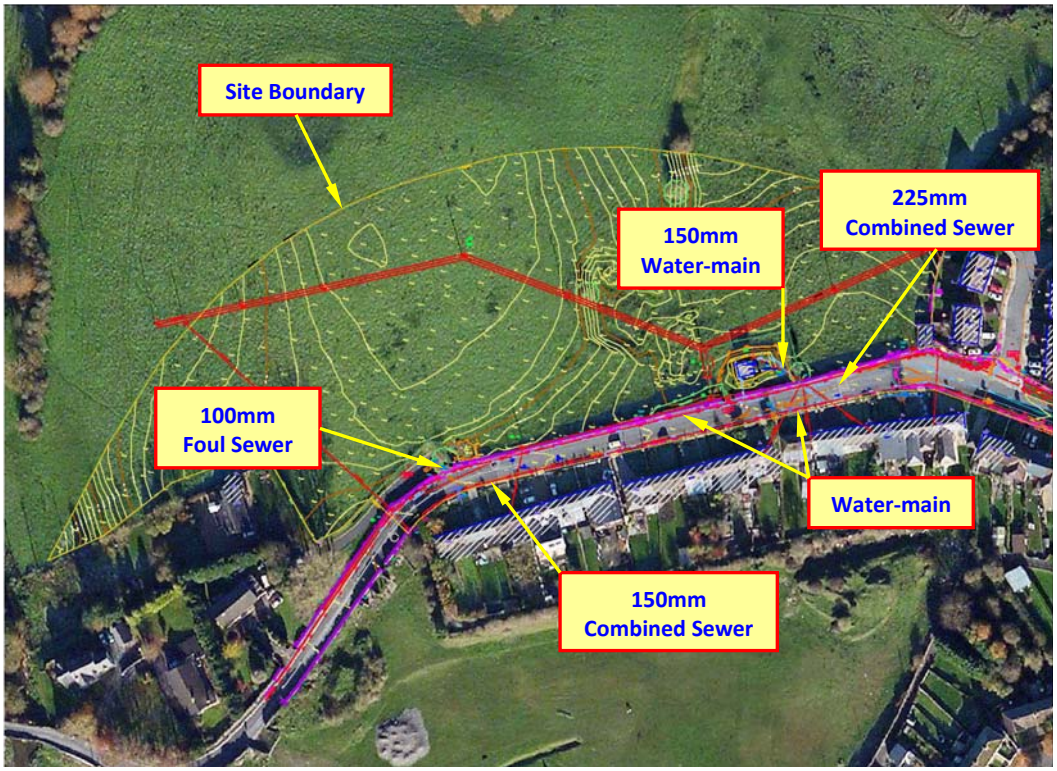


Figure 10 – Urban Drainage and Water Supply Records

It is anticipated that any flooding due to a surcharge of the foul/combined sewer manholes/gullies or damage to the water-mains would likely cause flood water to spill out onto Kennyswell Road adjacent to the southern boundary of the site. These waters are anticipated to flow in both an easterly and westerly direction parallel to the site depending on which side of the road crest (56.15m OD – High Point) the surcharge occurs. There are no low points present on Kennyswell Road and so it is predicted that there will be no ponding adjacent to the site. As illustrated in *Figure 11* and *Figure 12* below, due to the moderate slope of Kennyswell Road, flood waters will flow away from the site. The footpath falls away from the entrance to the site and therefore any secondary flood waters are unlikely to spill directly into the site and likewise any flood water from the 150mm water main within the site would flow out and away from the site unimpeded when the existing wall is removed. Therefore surcharging flood water from the urban drainage and water supply infrastructure is not expected to present a significant secondary pluvial flood risk to the proposed development site.

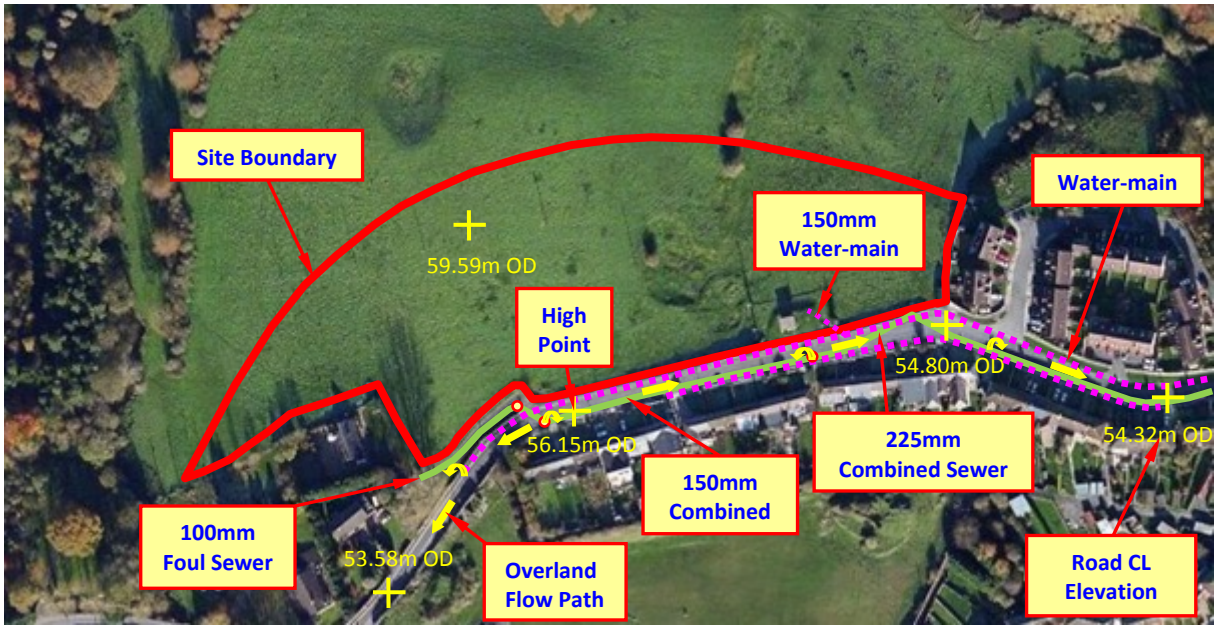


Figure 11 – Overland Flow Paths

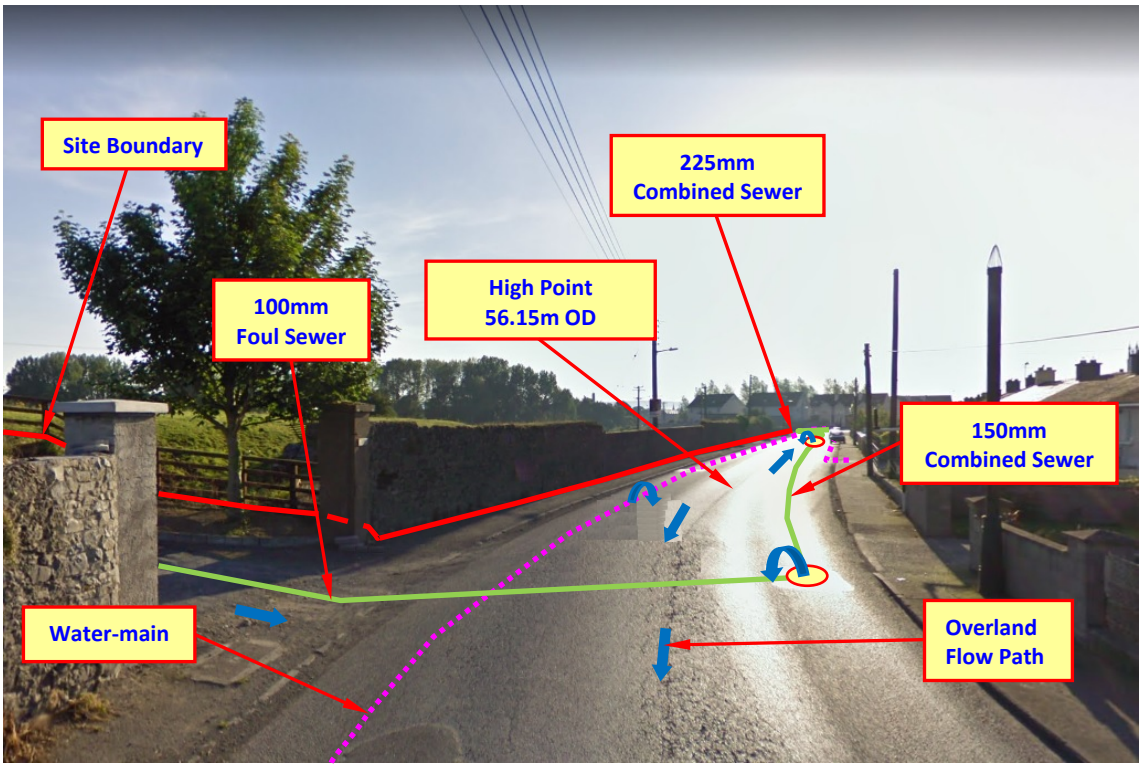


Figure 12 – Overland Flow Paths- Kennyswell Road

7 Proposed Development in the Context of the Guidelines

In the context of the *'Planning System and Flood Risk Management Guidelines, DOEHLG, 2009'* three flood zones are designated in consideration of flood risk to a particular development site.

Flood Zone 'A' – where the probability of flooding from rivers and watercourses is the highest (greater than 1% or 1 in 100 year for river and watercourse flooding and 0.5% or 1 on 200 for coastal or tidal flooding).

Flood Zone 'B' – where the probability of flooding from rivers and watercourses is moderate (between 0.1% or 1 in 1000 year for river and watercourse flooding and 0.5% or 1 on 200 for coastal or tidal flooding).

Flood Zone 'C' – where the probability of flooding from rivers and watercourses is low or negligible (less than 0.1% of 1 in 1000 year for both river and watercourse and coastal flooding). *Flood Zone 'C'* covers all areas that are not in *Zones 'A'* or '*B*'.

The *'Planning System and Flood Risk Management Guidelines'* list the planning implications for each flood zone, as summarised below:-

Zone A – High Probability of Flooding. Most types of development would not be considered in this zone. Development in this zone should be only be considered in exceptional circumstances, such as in city and town centres, or in the case of essential infrastructure that cannot be located elsewhere, and where the *'Planning System and Flood Risk Management Guidelines'* justification test has been applied. Only water-compatible development, such as docks and marinas, dockside activities that require a waterside location, amenity open space and outdoor sports and reaction would be considered appropriate in this zone.

Zone B – Moderate Probability of Flooding. Highly vulnerable development such as hospitals, residential care homes, Garda, fire and ambulance stations, dwelling houses, strategic transport and essential utilities infrastructure would generally be considered inappropriate in this zone, unless the requirements of the justification test can be met. Less vulnerable development such as retail, commercial and industrial uses and recreational facilities might be considered appropriate in this zone. In general however, less vulnerable development should only be considered in this zone if adequate lands or sites are not available in *Zone 'C'* and subject to a flood risk assessment to the appropriate level of detail to demonstrate that flood risk to the development can be adequately managed and that development in this zone will not adversely affect adjacent lands and properties.

Zone C – Low to Negligible Probability of Flooding. Development in this zone is appropriate from a flood risk perspective. Developments in this zone are generally not considered at risk of fluvial flooding and would not adversely affect adjacent lands and properties from a flood risk perspective.

In the context of the *'Planning System and Flood Risk Management Guidelines, DOEHLG, 2009'* this Site Specific Flood Risk Assessment has determined that the area of the site where development is proposed falls within Flood Zone 'C'. There is a small area at the south western corner of the site that may fall within Flood Zone 'A' and Flood Zone 'B', however is development is proposed at this location of the site.

In accordance with the *'Planning System & Flood Risk Management Guidelines, DOEGLG, 2009'* the development as proposed is considered to be appropriate from a flood risk perspective and is not subject to the requirements of the Justification Test.

8 Summary Conclusions

In consideration of the findings of this site specific flood risk assessment and analysis the following conclusions are made in respect of the proposed development site:-

- *A Site Specific Flood Risk (SSFRA) assessment, appropriate to the type and scale of the development proposed, and in accordance with 'The Planning System and Flood Risk Management Guidelines – DoEHLG-2009' has been undertaken.*
- *The proposed development site has been screened, scoped and assessed for flood risk in accordance with the above guidelines.*
- *The primary flood risk to the proposed site can be attributed to a fluvial flood event in the River Breagagh beyond the western boundary of the site. The site is not at risk of pluvial or groundwater flooding.*
- *The 1 in 100 year (1% AEP) and 1 in 1000 year (0.1% AEP) fluvial flood levels in the River Breagagh in the vicinity of the site are predicted as 48.210m OD (Malin) and 48.750m OD (Malin) respectively.*
- *The lowest topographical elevation within the boundary of the site where development is proposed is approximately 51.00m OD, which is approximately 2.25m above the 0.1% AEP fluvial flood level.*
- *The area of the site where development is proposed falls within Flood Zone 'C'.*
- *There is a small area at the south western corner of the site that may fall within Flood Zone 'A' and Flood Zone 'B', however is development is proposed at this location of the site.*
- *Secondary flood risk to the site can be attributed to a potential surcharge of the urban drainage and water supply infrastructure located in the vicinity of the site. It is anticipated that the any flooding due to a surcharge of the foul/combined sewers or damage to the water mains located in Kennyswell Road adjacent to the southern boundary of the site would likely spill out onto Kennyswell road and flow in both an easterly and westerly direction away from the proposed development site.*
- *Overall, the flood risk to the proposed development site is **LOW**.*
- *Development of the site is not expected to result in an adverse impact to the hydrological regime of the area or to increase flood risk elsewhere and is therefore considered to be appropriate from a flood risk perspective.*

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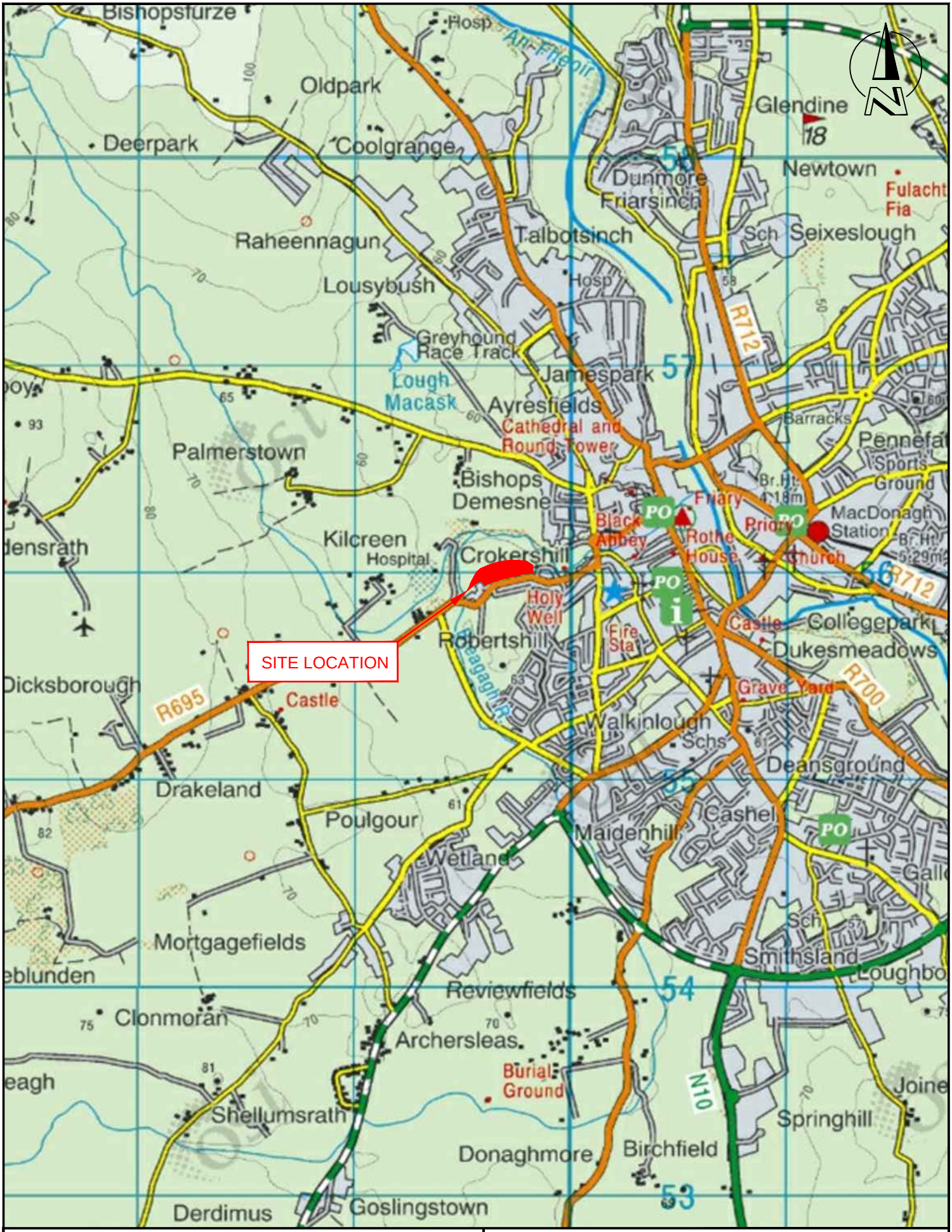
APPENDIX A

Drawing Number IE1607-001-A



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Project Title:	FLOOD RISK ASSESSMENT
Project Address:	CROKERS HILL, KENNYSWELL ROAD, KILKENNY
Client:	KILKENNY COUNTY COUNCIL (C/O HHP)
Drg. Title:	SITE LOCATION MAP

Dwg.Scale:	Date:	Dwg.No:	Job No:	Revision:	Dwg.By:
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