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Kilkenny County Council
Comhairle Chontae Chill Chainnigh

St. Kieran's Street & Market Square Urban Enhancement Scheme, Kilkenny City

Flood Risk Assessment

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Flood Risk Assessment

Document Control Sheet	
Document Reference	11253- FRA Market Yard Kilkenny
Report Status	Issued
Report Date	August 2022
Current Revision	B
Client:	Kilkenny County Council
Client Address:	County Hall, John Street Lower, Kilkenny City
Project Number	11253

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Revision	Description	Author:	Date	Reviewed By:	Date	Authorised by:	Date
A	Draft	ML	30/09/2021	BM	30/09/2021	BM	30/09/2021
B	Issued	ST	26/08/2022	ML	29/08/2022	JN	29/08/2022

TOBIN Consulting Engineers

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1.0 INTRODUCTION

In September 2021, Kilkenny County Council appointed TOBIN Consulting Engineers to lead a team for the detailed design and construction of the St. Kieran's Street and Market Square Enhancement Scheme, including this Stage 2 Flood Risk Assessment (FRA) for the subject site (see Figure 1-1) at St. Kieran's Street & Market Yard, Kilkenny City, Co. Kilkenny.

The existing Market Square is a small square (approximate area of 140m^2), located towards the northern end of St. Kieran's Street (approximately 300 metres in length and varies in width between 5 and 10m). The square is bounded by St. Kieran's Street and Market Yard Car Park and provides a small refuge for people to sit and relax. The aim of the project is to permanently enhance St. Kieran's Street and an enlarged Market Square with a cyclist and pedestrian focus. The project shall take account of the existing uses of St. Kieran's Street and Market Square while providing for future potential uses. The combined area of the Market Square and the section of Market Yard Car Park to be incorporated into the square will be approximately 1.0ha, and is located adjacent to the western banks of the River Nore.

The proposed Market Square has existing ground levels ranging from approximately 44.7mOD at the north eastern site corner, to approximately 46.9mOD at the existing south western site entrance from St. Kieran's Street. Market Yard Car Park has existing ground levels ranging from approximately 44.1mOD at the south eastern site corner adjacent to the River Nore to 45.8mOD at the north western site entrance. St Kieran's Steet has existing site levels ranging from 45.9mOD at the intersection with the R887, sloping steadily upwards to 48.5mOD at the intersection with Parliament St. A topographic survey of the subject site (proposed Market Square, St. Kieran's Street and Market Yard Car Park) is provided in Appendix 1.

The purpose of this report is to identify, quantify, and communicate the risks of flooding, if any, to the proposed project.

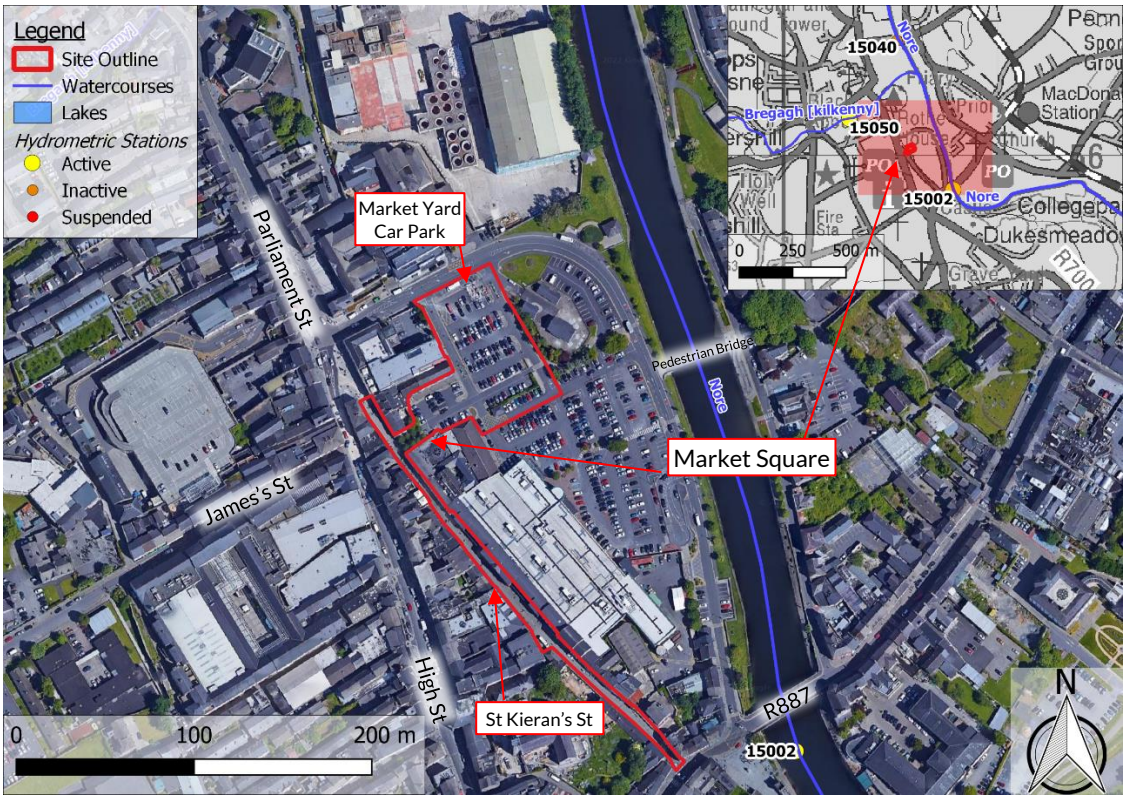

Figure 1-1 Site Location

The proposed development consists of public realm upgrades to St. Kieran's Street and Market Yard which include the following:

- New street furniture e.g. seating, cycle racks, etc.
- Urban Landscaping
- Public Sheltered Areas to facilitate outdoor dining i.e. parasols
- Outdoor Performance Area
- New Lighting
- New Paviours
- Reconfigured parking
- Drainage
- Utilities

2.0 FLOOD RISK MANAGEMENT GUIDANCE

This Strategic Flood Risk Assessment was carried out in accordance with the following flood risk management guidance documents:

- The Planning System and Flood Risk Management Guidelines for Planning Authorities
- Flood Risk Management Climate Change Sectoral Adaptation Plan
- Kilkenny City and County Development Plans

2.1 The Planning System and Flood Risk Management Guidelines

The Planning System and Flood Risk Management Guidelines for Planning Authorities (PSFRM Guidelines) were published in 2009 by the Office of Public Works (OPW) and Department of the Environment, Heritage and Local Government (DoEHLG). Their aim is to ensure that flood risk is considered in development proposals and the assessment of planning applications.

2.1.1 Flood Zones and Vulnerability Classes

The PSFRM Guidelines discuss flood risk in terms of flood zones A, B, and C, which correspond to areas of high, medium, or low probability of flooding, respectively. The extents of each flood zone are based on the Annual Exceedance Probability (AEP) of various flood events.

The PSFRM Guidelines also categorise different types of development into three vulnerability classes based on their sensitivity to flooding. Outdoor developments (such as the works proposed as part of the proposed urban enhancement scheme) are considered "water compatible".

Table 2-1 shows a decision matrix that indicates which types of development are appropriate in each flood zone and when the Justification Test (see Section 2.1.2) must be satisfied. The annual exceedance probabilities used to define each flood zone are also provided.

Table 2-1 Decision Matrix for Determining the Appropriateness of a Development

Flood Zone (Probability)	Annual Exceedance Probability (AEP)	Development Appropriateness		
		Highly Vulnerable	Less Vulnerable	Water Compatible
A (High)	Fluvial & Pluvial Flooding More frequent than 1% AEP	Justification Test	Justification Test	Appropriate
B (Medium)	Fluvial & Pluvial Flooding 0.1% to 1% AEP	Justification Test	Appropriate	Appropriate
C (Low)	Fluvial & Pluvial Flooding Less frequent than 0.1% AEP	Appropriate	Appropriate	Appropriate
Note: Given that coastal flooding is not a potential source of risk to the proposed development, the probabilities for coastal flooding have been omitted from this table.				

2.1.2 The Justification Test

Any proposed development being considered in an inappropriate flood zone (as determined by Table 2-1) must satisfy the criteria of the Justification Test outlined in Figure 2-1 (taken from the PSFRM Guidelines).

Box 5.1 Justification Test for development management (to be submitted by the applicant)

When considering proposals for development, which may be vulnerable to flooding, and that would generally be inappropriate as set out in Table 3.2, the following criteria must be satisfied:

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

The acceptability or otherwise of levels of residual risk should be made with consideration of the type and foreseen use of the development and the local development context.

Note: See section 5.27 in relation to major development on zoned lands where sequential approach has not been applied in the operative development plan.

Refer to section 5.28 in relation to minor and infill developments.

Figure 2-1 Criteria of the Justification Test

2.2 The Flood Risk Management Climate Change Adaptation Plan

The Flood Risk Management Climate Change Sectoral Adaptation Plan was published in 2019 under the National Adaptation Framework and Climate Action Plan. This plan outlines the OPW's approach to climate change adaptation in terms of flood risk management.

This approach is based on a current understanding of the potential impacts of climate change on flooding and flood risk. Research has shown that climate change is likely to worsen flooding through more extreme rainfall patterns, more severe river flows, and rising mean sea levels.

To account for these changes, the Adaptation Plan presents two future flood risk scenarios to consider when assessing flood risk:

- Mid-Range Future Scenario (MRFS)
- High-End Future Scenario (HEFS)

Table 2-2 indicates the allowances that should be added to estimates of extreme rainfall depths, peak flood flows, and mean sea levels for the future scenarios.

Table 2-2 Climate Change Adaptation Allowances for Future Flood Risk Scenarios

Parameter	Mid-Range Future Scenario (MRFS)	High-End Future Scenario (HEFS)
Extreme Rainfall Depths	+ 20%	+ 30%
Peak River Flood Flows	+ 20%	+ 30%
Mean Sea Level Rise	+ 0.5 m	+ 1 m

2.3 Kilkenny City and County Development Plan 2021-2027

The Kilkenny City and County Development Plan for 2021 to 2027 aims to further develop and improve the County in a sustainable manner. Volume 1 Chapter 10 relates to Kilkenny County Council's updated strategy for the management of Infrastructure & Environment, including a section on flood risk management and the revised Strategic Aim, as follows "To ensure a sufficient level of water services within the county for the implementation of the core strategy, provide a framework for the protection of the environment, including water quality, the avoidance of flood risk and the provision of a high-quality telecommunications infrastructure".

The policy and objectives included in the plan related to flooding largely reflect the OPW's recommendations in the PSFRM guidelines and the previous development plans for the City and County.

Appendix 1 of the Strategic Environmental Assessment encapsulates a Strategic Flood Risk Assessment (SFRA) for Kilkenny City and County, prepared to consider flood risk within the Plan boundary. The SFRA highlights the importance of consideration during planning of impacts on flood risk elsewhere, and safe evacuation routes and access for emergency services during a flood event. The subject site is zoned as M2- General Business, to provide for general development, and is located within the area denoted as Flood Zone A; see Figure 2-2. But this proposed urban enhancement scheme includes the provision of outdoor amenities and upgrades, considered "water compatible", so a Justification Test is not needed.

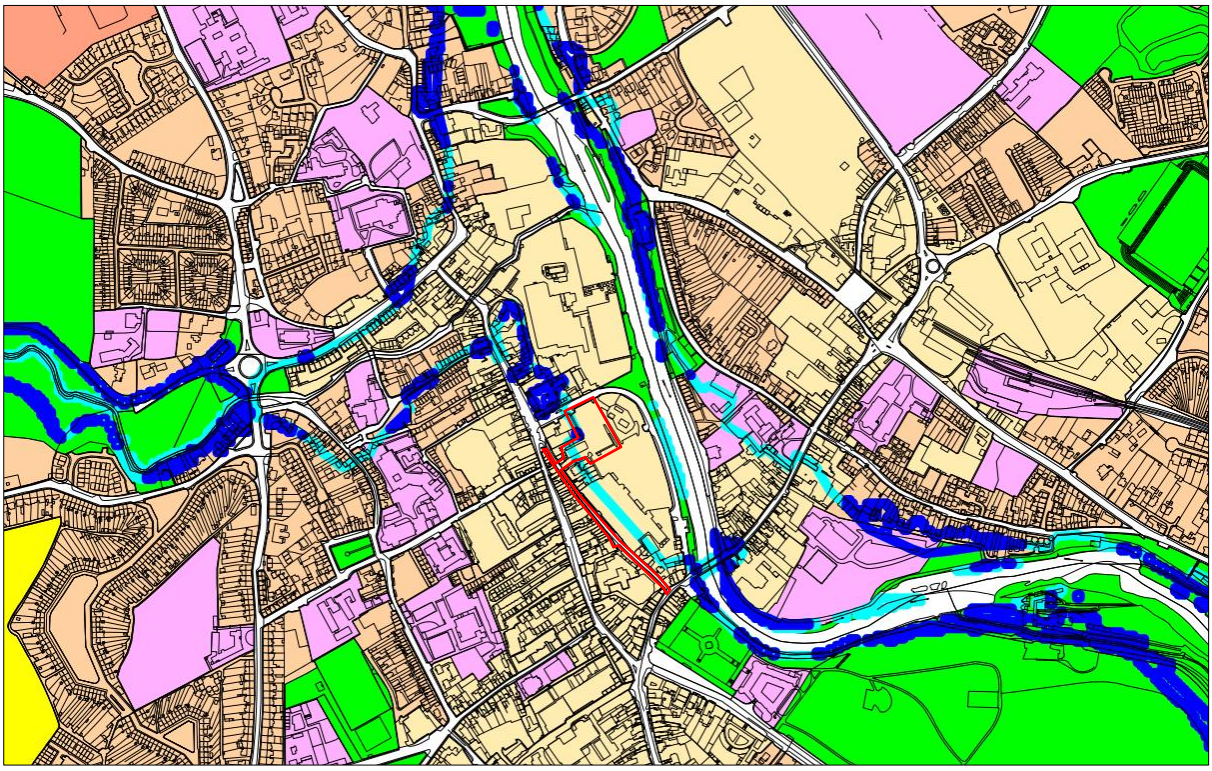

Figure 2-2 Kilkenny City- Areas of Flood Risk on Proposed Draft Zoning Map [excerpt of Figure 23b]

3.0 INITIAL FLOOD RISK ASESSMENT

3.1 Past Flood Events

The OPW's National Flood Information Portal[1] provides past flood event mapping with records of flooding reports, meeting minutes, photos, and/or hydrometric data.

Based on the flood map shown in Figure 3-1, Kilkenny City and the River Nore have a history of flooding and several historical and recurring events have been reported in the vicinity of the subject site. The Kilkenny City Flood Relief Scheme Engineering Report[2] outlines historic flood events in Kilkenny City, and the subsequent works to address flooding in the area.

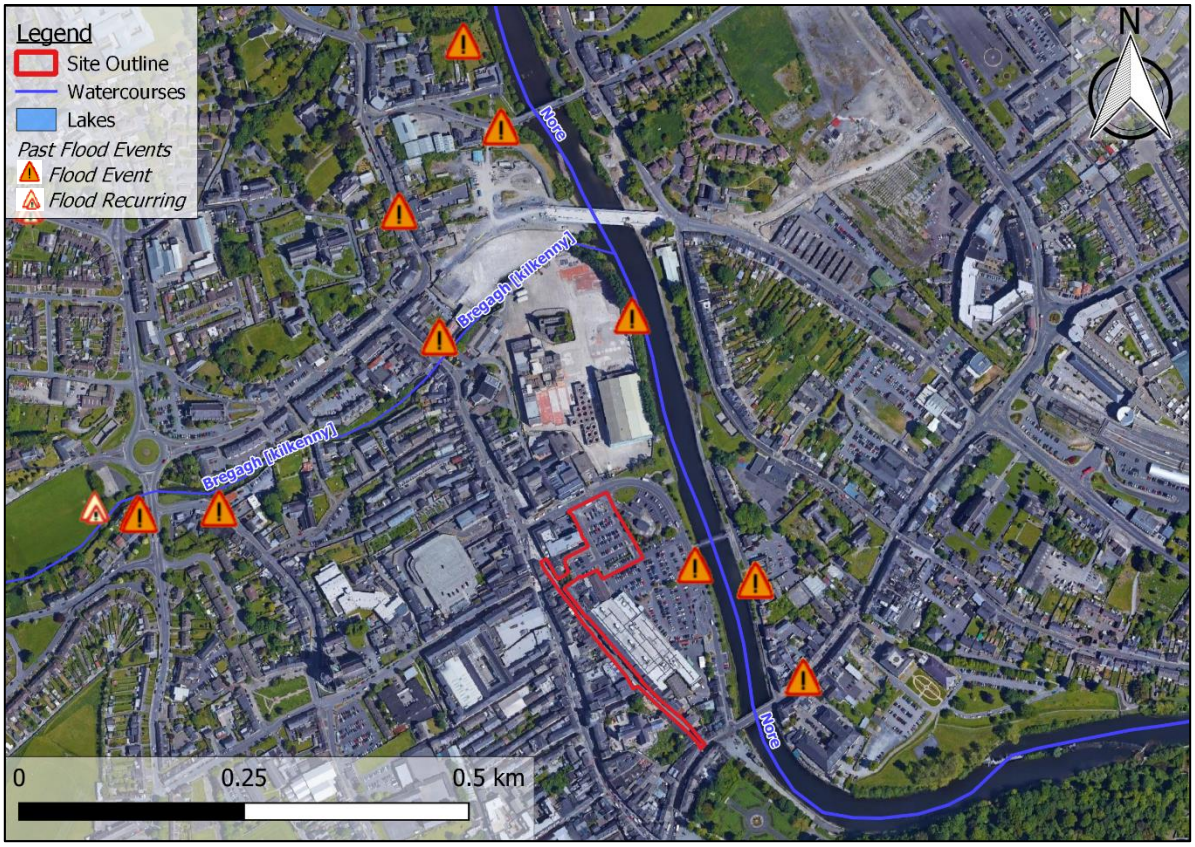

Figure 3-1 OPW Flood Map of Past Flood Events

[1] floodinfo.ie

[2] Kilkenny City Flood Relief Scheme Engineering Report, OPW (May 1999)

3.2 OPW Preliminary Flood Risk Assessment (PFRA) Study

In 2009, the OPW produced a series of maps to assist in the development of a broad-scale FRA throughout Ireland. These maps were produced from several sources.

The OPW's National Preliminary Flood Risk Assessment (PFRA) Overview Report from March 2012 noted that *"the flood extents shown on these maps are based on broad-scale simple analysis and may not be accurate for a specific location"*[3].

Limitations on potential sources of error associated with the PFRA maps include:

- Assumed channel capacity (due to absence of channel survey information)
- Absence of flood defences and other drainage improvements and channel structures (bridges, weirs, culverts)
- Local errors in the national Digital Terrain Model (DTM)

Figure 3-2 provides an overview of the fluvial, coastal, pluvial, and groundwater indicative flood extents in the vicinity of the subject site.

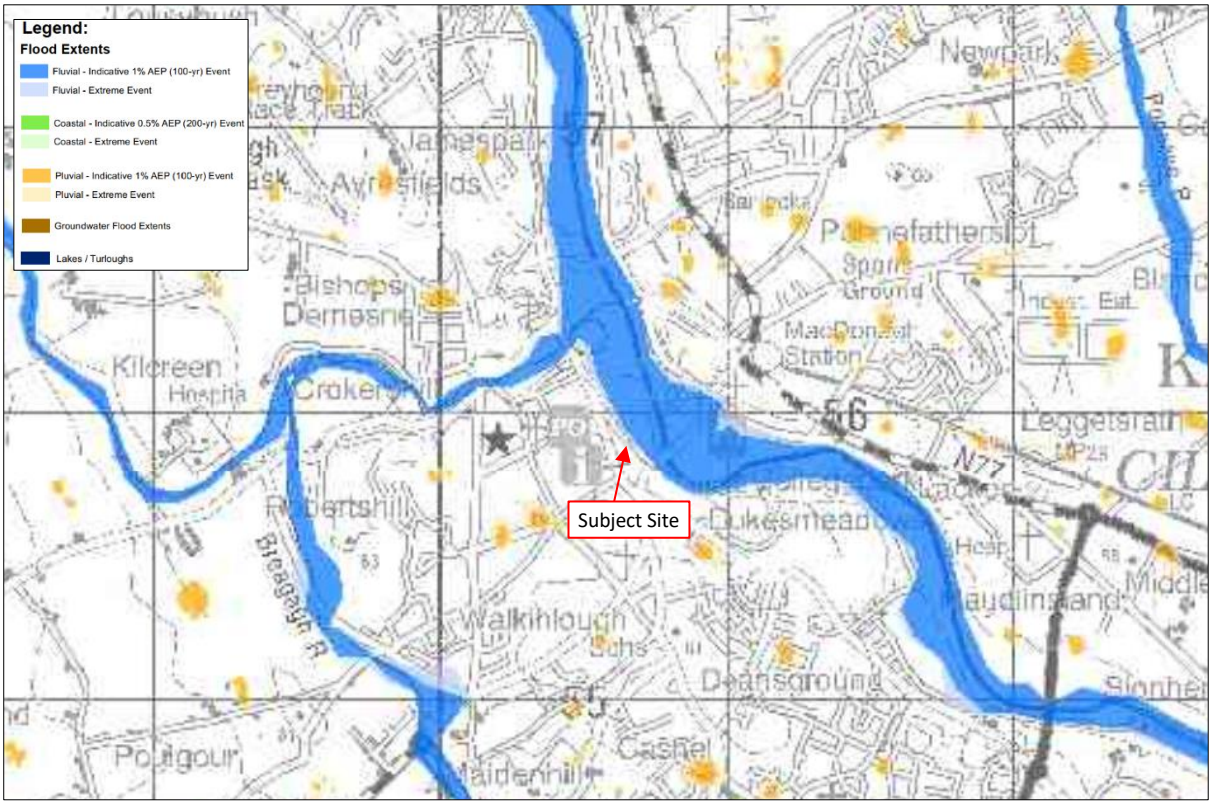

Figure 3-2 Indicative Flood Mapping [extract from PFRA Map 137]

Improved hydraulic modelling was carried out through the Catchment Flood Risk Assessment and Management Study (CFRAM) in 2015 (discussed in Section 3.3) and is considered more accurate than the PFRA study as it utilised surveyed river geometry, including the recently completed flood relief works.

[3] The National Preliminary Flood Risk Assessment (PFRA) Overview Report, OPW (March 2012)

3.3 Catchment Flood Risk Assessment and Management Study

In 2015, the OPW produced flood maps[1] as part of the Catchment Flood Risk Assessment and Management (CFRAM) Study. The flood extents in these maps are based on detailed modelling of Areas for Further Assessment identified by the National Preliminary Flood Risk Assessment.

CFRAM mapping of the existing 100-Year and 1000-Year fluvial flood extents, presented in Figure 3-3, indicates the subject site is within the defended area, protected up to the 1% AEP event.

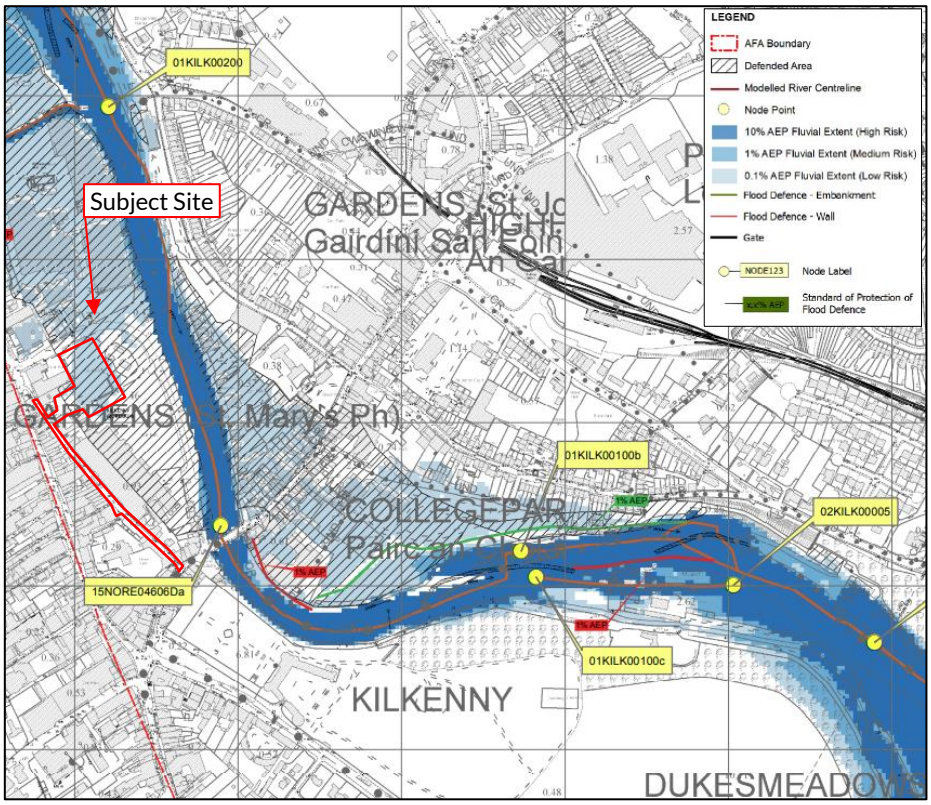

Figure 3-3 South Eastern CFRAM Existing Fluvial Flood Extents[4]

Based on this updated CFRAM mapping, the subject site as located within Flood Zone B, outside of the 1% AEP fluvial flood extent. The CFRAM study estimates that water levels at the downstream R887 bridge for the current 1% and 0.1% AEP events of 43.94mOD and 44.65mOD, respectively (reference node 15NORE04606Da), and at the upstream confluence with the River Bregagh of 44.55mOD and 45.38mOD (reference node 01KILK00200). Existing ground elevations at the subject site range from approximately 44.1mOD to 48.5mOD.

The South Eastern CFRAM Study did not include an assessment of the impact of climate change on flood risk in the area.

[4] South Eastern CFRAM Study Map No: O15KIY_EXFCD_F0_10 (25 July 2016)

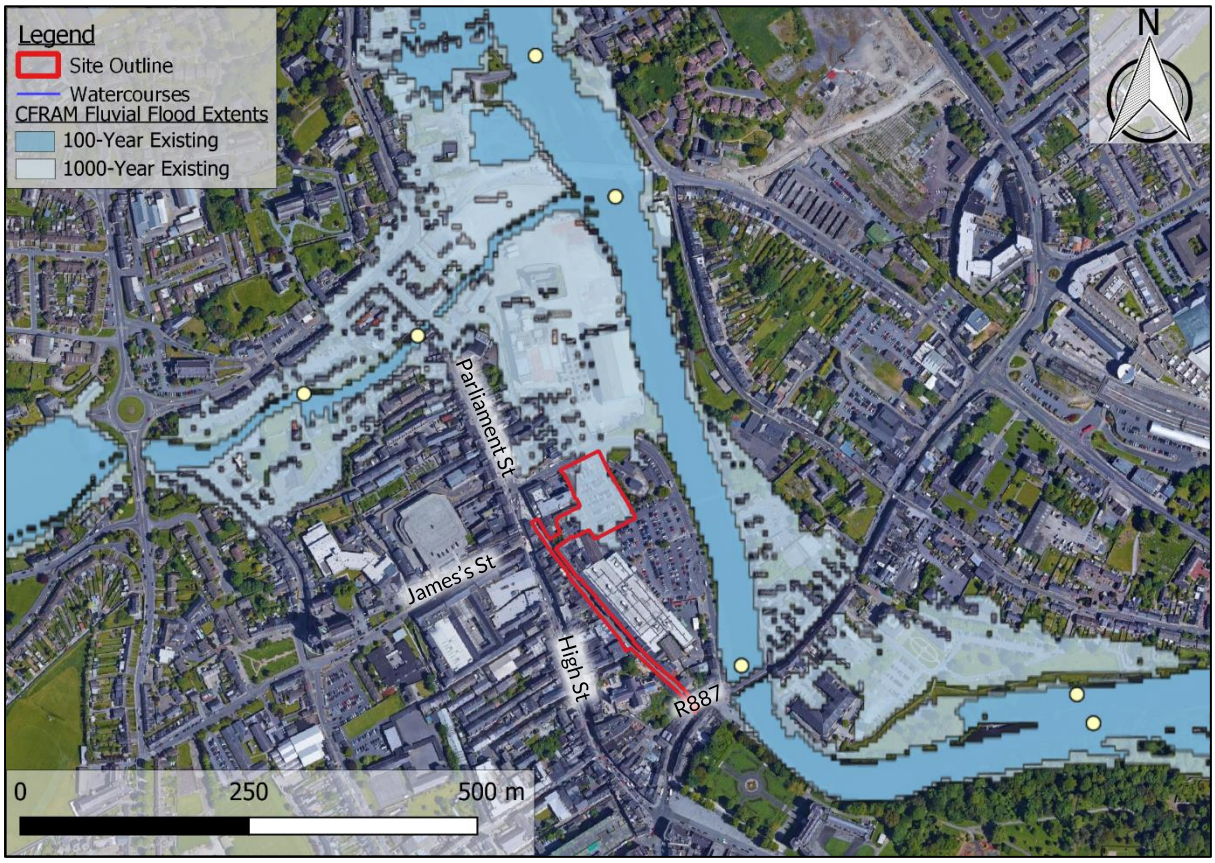

Figure 3-4 South Eastern CFRAM Study Fluvial Flood Extents

3.4 Geological Survey Ireland Mapping

The Geological Survey Ireland (GSI) provides mapping[5] with data related to Ireland's subsurface. Based on the map shown in Figure 3-5, the St. Canice Well (Spring) is located approximately 580m from the site. There are no karst features (caves, springs, turloughs, etc.) in the surrounding 500m area.

As shown in Figure 3-5, as part of their recent GW Flood project, the GSI identified some lands northwest of Kilkenny City which may be liable to groundwater flooding. It is estimated that the extents of this flooding (approx. 200m from the subject site) will not impact the proposed development.

Older hydraulic modelling completed by HR Wallingford as part of the PFRA project (see Figure 3-2) did not indicate any groundwater flooding in the vicinity of the subject site.

Based on area topography, any groundwater arising at these features would drain towards adjacent watercourses and are, therefore, not considered a flood risk to the subject site.

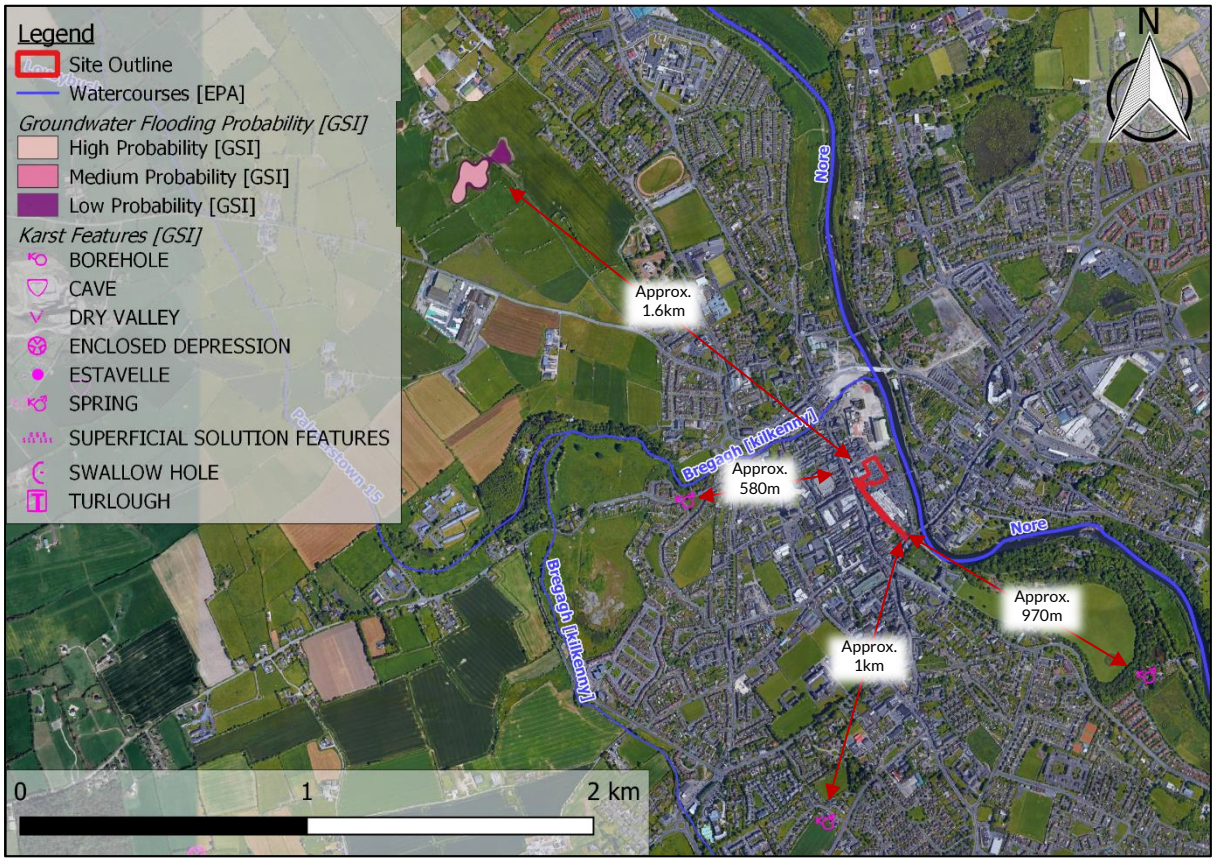

Figure 3-5 GSI Mapping of Karst Features and Indicative Groundwater Flood Mapping

[5] https://www.gsi.ie/en-ie/data-and-maps/Pages/default.aspx

3.5 OPW Arterial Drainage and Flood Relief Schemes

The Kilkenny Flood Relief Scheme was initiated in 1995, and completed in 2005, comprising of flood defence walls, embankments, and channel conveyance improvements (river widening and deepening, associated drainage works) within Kilkenny City[6]. The scheme provides protection for the 100-Year fluvial flood arising from the River Nore and River Breagagh[7], and is maintained by the OPW.

As shown in Figure 3-6, flood relief scheme measures include channel works and embankments at the adjacent watercourses. As outlined in Figure 3-3, the subject site is within the area benefiting from these flood defences and is protected up to the 1% AEP event.

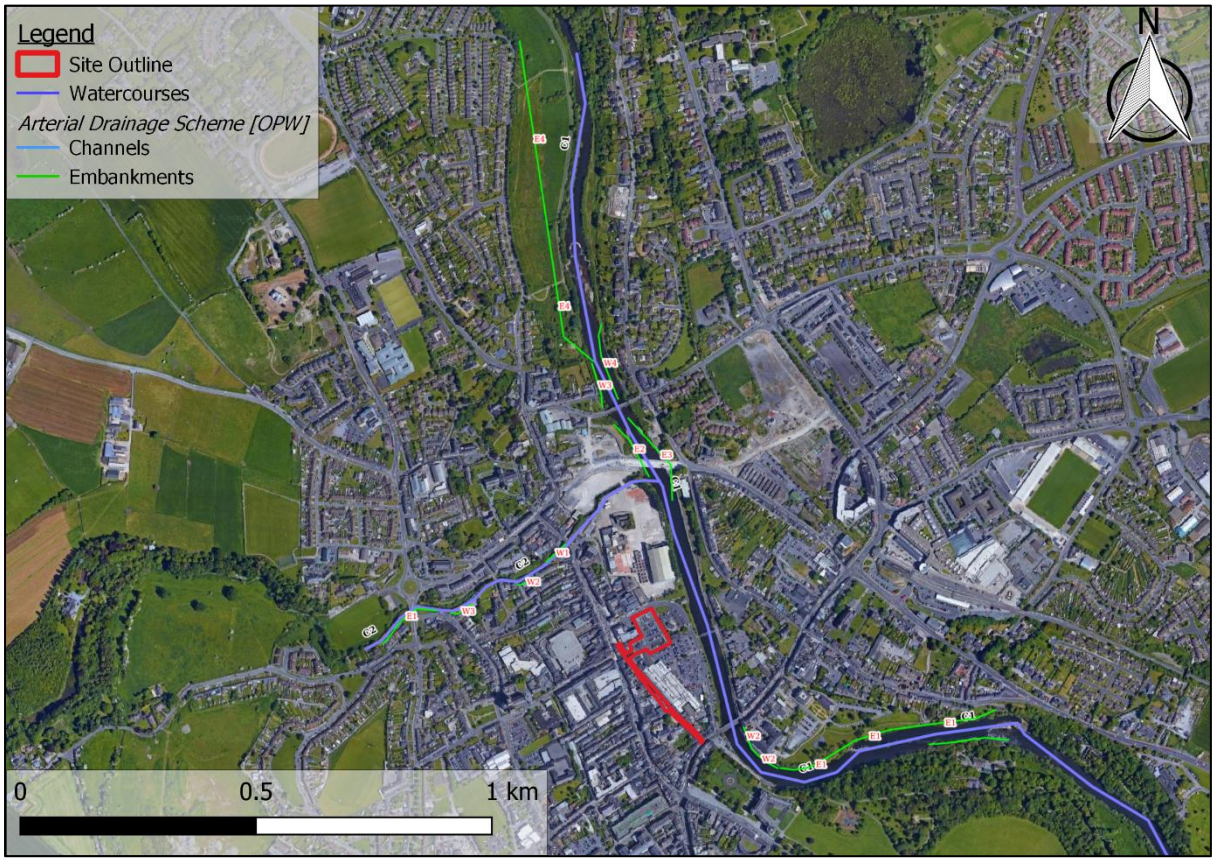

Figure 3-6 OPW Kilkenny Flood Relief Scheme Measures

[6] Kilkenny City Flood Relief Scheme Engineering Report, OPW (May 1999)

[7] OPW Nore Flood Risk Management Plan (2018)

3.6 National Parks & Wildlife Services Designated Sites

The National Parks & Wildlife Service (NPWS) is responsible for the designation of prime wildlife conservation areas in the country, inline with the EU Habitats Directive[8]. Special Protection Areas (SPAs) are designated under the EU Birds Directive (2009/147/EC) for the protection of listed rare and vulnerable species, regularly occurring migratory species, and wetlands, while Special Areas of Conservation (SACs) protect significant Irish habitats and species.

As shown in Figure 3-7, the subject site is located adjacent to the River Nore SPA (004233), designated to protect the habitat of the Kingfisher[9], and the River Barrow and River Nore SAC (002162), which encompasses 22 qualifying interests, including 2 priority habitats under the Habitats Directives[10].

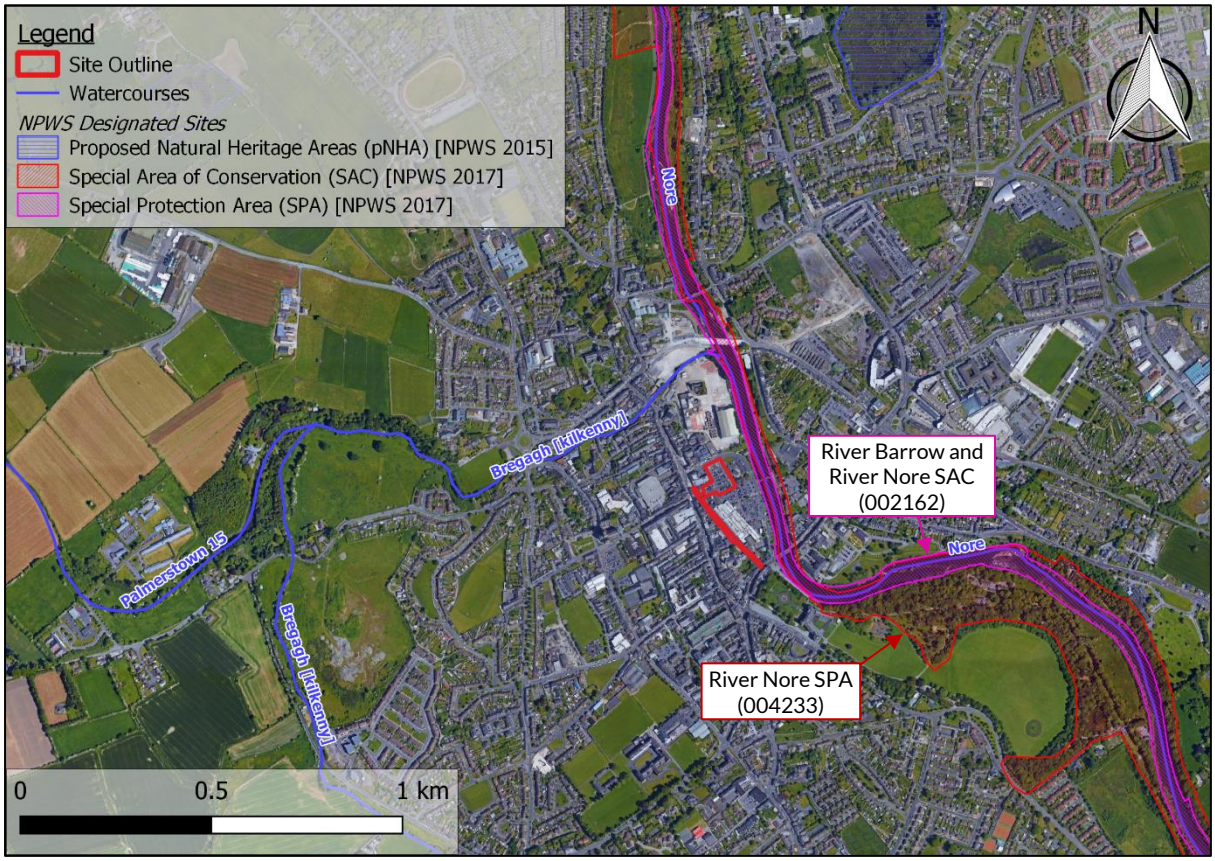

Figure 3-7 National Parks & Wildlife Services Designated Sites

[8] https://www.npws.ie/protected-sites

[9] NPWS (2021) Conservation objectives for River Nore SPA [004233]. Generic Version 8.0. Department of Housing, Local Government and Heritage

[10] NPWS (2011) Conservation Objectives: River Barrow and River Nore SAC 002162. Version 1.0. National Parks and Wildlife Service, Department of Arts, Heritage and the Gaeltacht

4.0 DETAILED FLOOD RISK ASESSMENT

With reference to the PSFRM Guidelines, the proposed outdoor urban enhancement works are classified as "water compatible" in terms of sensitivity to flooding. As such, the proposed St. Kieran's Street & Market Square scheme may be constructed in any Flood Zone (A, B or C).

4.1 Fluvial Flooding

The subject site is located within Kilkenny City centre, adjacent to the western banks of the River Nore.

Based on the results of OPW modelling (PFRA, CFRAM) and the works of the Kilkenny Flood Relief Scheme, the subject site is protected to the 1% AEP fluvial event. The majority of the subject site is further located outside the predicted 0.1% AEP flood extents, however an area of the existing car park and proposed Market Yard Square may be liable to an extreme event (see Figure 3-2, Figure 3-3, Figure 3-4).

Works within the subject site, and within the floodplain will predominantly consist of the upgrading of surfacing materials and reconfiguring parking areas and public spaces, with most engineering works below ground. The public realm improvements will not involve major level changes and will improve site drainage, and therefore will not exacerbate flood risk elsewhere.

Therefore, it is estimated that risk of fluvial flooding associated with the proposed scheme is minimal.

4.2 Pluvial Flooding

Based on the indicative pluvial flood mapping presented in the OPW Preliminary Flood Risk Assessment, it is estimated that the subject site is not at risk from pluvial flooding during an extreme 0.1% AEP pluvial flood event (see Figure 3-2).

The proposed urban enhancement scheme includes the provision of drainage works, including a drainage investigation of existing infrastructure and design of a new drainage system suitable to public spaces used by pedestrians and cyclists and the aesthetic nature of the area.

The landscaping and topography of the developed site will provide safe exceedance flow paths and prevent surface water ponding to minimise residual risks associated with an extreme flood event or a scenario where the stormwater drainage system becomes blocked.

The drainage investigation found there is adequate drainage provision found on St. Kieran's Street, Market Square, and the adjacent Market Yard car park areas, with gullies provided in various locations. The main issue with the current arrangement is settlement of some of the existing paviours which have altered the low points in the paving, resulting in stormwater runoff not reaching all of the gullies, rendering them ineffective. Proposed pavement improvements and reprofiling of the paved surface will ensure that water is drained to these gullies. As the design of the adjacent Market Yard car park is proposed to be a shared pedestrian and vehicle surface, at grade with the Market Square, the existing gullies would need to be raised or relocated depending on final design levels. It is also important to note that drainage from the entire area discharges to a combined sewer which in turn discharges to Market Yard Pumping Station from where it is pumped to Purcellsinch Waste Water Treatment Works.

Therefore, it is estimated that risk of pluvial flooding associated with the proposed development is minimal.

4.3 Groundwater Flooding

Based on a review of Geological Survey Ireland (GSI) subsurface mapping of karst features, historic and predicted groundwater flooding in the area (Figure 3-5), and the PFRA study (Figure 3-2), there is no evidence to suggest liability to groundwater flooding at the proposed development site.

4.4 Coastal Flooding

The subject site in Kilkenny is located more than 40km inland, with site elevations in the region of 45mOD. The nearest predicted 0.1% AEP MRFS coastal flood level at Waterford is estimated by the Irish Coastal Protection Strategy Study (ICPSS) to be approximately 3.4mOD[11]; therefore, it is estimated that the lands are not at risk of coastal flooding.

4.5 The Justification Test

With reference to the PSFRM Guidelines, the proposed outdoor urban enhancement works are classified as "water compatible" in terms of sensitivity to flooding.

Based on the findings of this Flood Risk Assessment, the subject site is primarily located in Flood Zone A, i.e. there is less than a 0.1% Annual Exceedance Probability (AEP) of pluvial/fluvial/groundwater flooding, and less than a 0.5% AEP of coastal flooding; however portions of the subject site are located within Flood Zone B, where the site is protected up to the 1% AEP event, but may be liable to fluvial flooding in an 0.1% AEP extreme event.

As the Planning System and Flood Risk Management Guidelines consider water compatible developments appropriate in any flood zone (Flood Zone A, B, C), the Justification Test does not need to be applied.

[11] Irish Coastal Protection Strategy Study—Phase III, Figure No: S / RA / EXT / MRFS / 12A (December 2011)

5.0 CONCLUSIONS

TOBIN Consulting Engineers were appointed by Kilkenny County Council in September 2021 to undertake the detailed design, tender and construction of this public realm enhancement project at St. Kieran's Street & Market Square, Kilkenny City, Co. Kilkenny.

The proposed urban enhancement scheme includes the provision of outdoor amenities and upgrades, considered "water compatible" in terms of their sensitivity to flooding under the Planning System and Flood Risk Management (PSFRM) Guidelines (OPW/DoEHLG, 2009). The proposed works are therefore considered appropriate in any flood zone (Flood Zone A, B or C).

Fluvial Flooding:

The subject site is located adjacent to the banks of the River Nore, within the benefitting lands of the Kilkenny Flood Relief Scheme.

Based on the results of hydraulic modelling carried out as part of the OPW's CFRAM programme, an area of the existing car park and proposed Market Yard Square may be liable to an extreme 0.1% AEP fluvial event, and is therefore located in Flood Zone B.

St. Kieran's Street and the majority of the Market Yard Square and Car Park are located in Flood Zone C, where there is less than an 0.1% AEP of fluvial flooding.

The public realm improvements are considered "water compatible" in terms of their sensitivity to flooding, and are not predicted to impact flood risk elsewhere; therefore, it is estimated that risk of fluvial flooding associated with the proposed scheme is minimal.

Pluvial Flooding:

Based on the indicative pluvial flood mapping presented in the OPW Preliminary Flood Risk Assessment, it is estimated that the subject site is not at risk from pluvial flooding.

The proposed urban enhancement scheme includes the provision of drainage works, including a drainage investigation of existing infrastructure and design of an improved drainage system and site grading.

The landscaping and topography of the site will provide safe exceedance flow paths and prevent surface water ponding to minimise residual risks associated with extreme flooding or blockage of the stormwater drainage system, minimizing the potential for pluvial, fluvial, groundwater and coastal flooding.

Groundwater Flooding:

There is no evidence to suggest groundwater as a potential source of flood risk to the proposed development site.

Coastal Flooding:

The site is not at risk of coastal flooding due to its elevation and distance inland.

Based on the findings of this Flood Risk Assessment, the subject site is appropriately located in Flood Zones B and C in accordance with the Planning System and Flood Risk Management Guidelines.

Appendix 1

Topographic Survey

All dimensions to be checked on site. Figured dimensions take preference over scaled dimensions. Any errors or discrepancies to be reported to the Surveyors. This drawing may not be edited or modified by the recipient.

A1

OVERALL KEY PLAN

Not to Scale

PARTIAL SITE LAYOUT

SCALE 1:250

REV	DATE	REV BY	DESCRIPTION
-	-	-	-

STATUS

PROJECT

PROJECT ADDRESS

DWG TITLE

DWG NO

REV -

JOB NO

SCALE @ A1 1:250

DATE

DRN SS

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