

SITE-SPECIFIC FLOOD RISK ASSESSMENT

STRATEGIC HOUSING DEVELOPMENT,
AT TRUSKY EAST, BEARNA
for BURKEWAY HOMES LTD

B861-OCSC-XX-XX-RP-C-0004-A1-C04

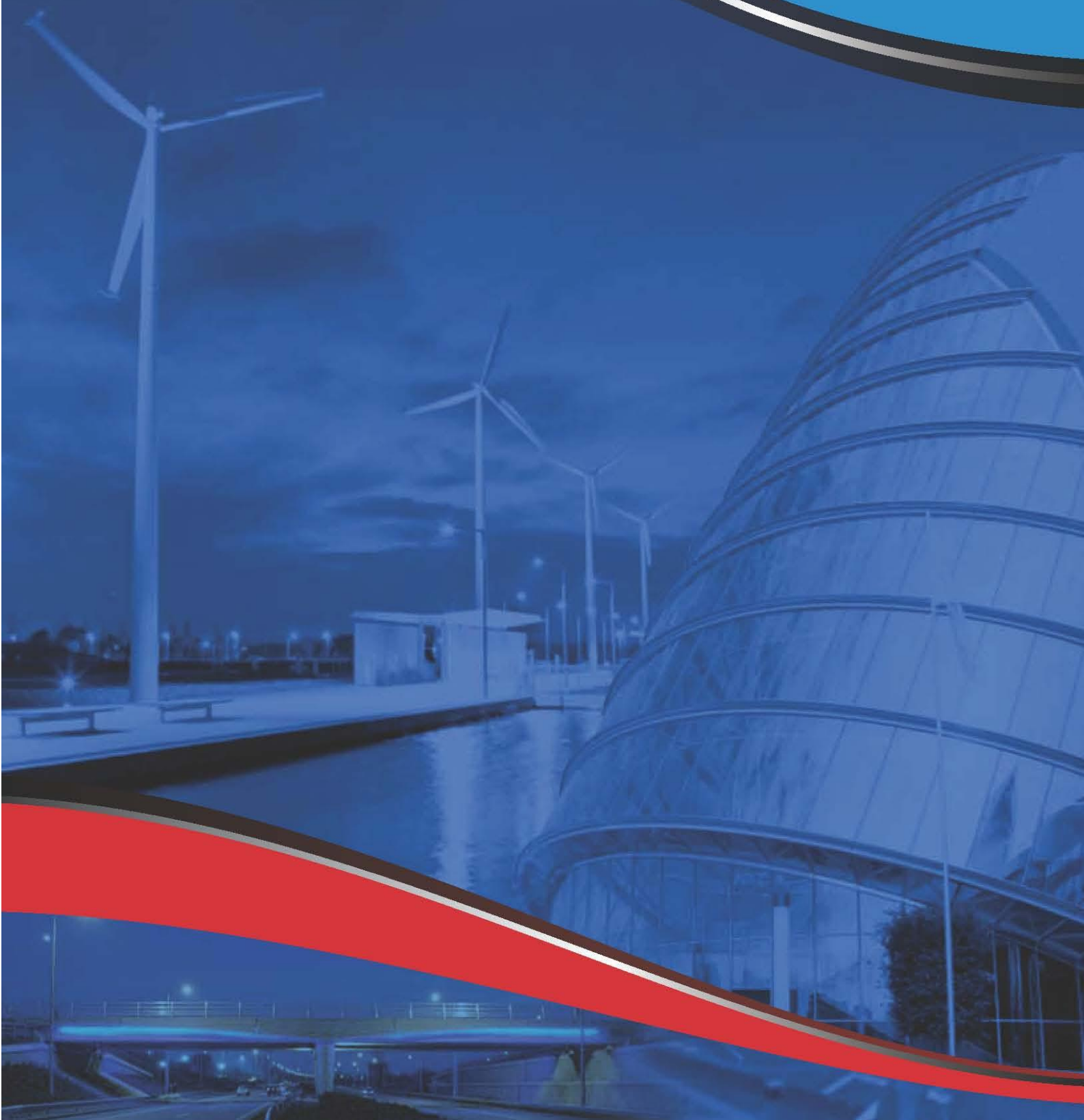
September 2020



OCSC

O'CONNOR | SUTTON | CRONIN

Multidisciplinary
Consulting Engineers



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SITE-SPECIFIC FLOOD RISK ASSESSMENT
STRATEGIC HOUSING DEVELOPMENT AT TRUSKY EAST, BEARNA
PROJECT NO. B861

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1. INTRODUCTION

1.1 O'Connor Sutton Cronin (OCSC) was appointed by Burkeway Homes Ltd to carry out a site-specific flood risk assessment for a proposed development in the townlands of Trusky East, Trusky West, Freeport and Ahaglugger, Bearna, Co. Galway – see **Figure 1**. The proposed development comprises of 121nr residential units, 1nr creche and open space amenity development and ancillary works.



Figure 1: Site Location

- 1.2 The Flood Risk Assessment was conducted in accordance with:
- *The Planning System and Flood Risk Management Guidelines for Planning Authorities* (Department of Environment, Heritage and Local Government and the Office of Public Works, November 2009);
 - Circular PL 2/2014 dated 13th August 2014 from the Department of the Environment, Community and Local Government;

- *C624 Development and Flood Risk* (Construction Industry Research and Information Association, CIRIA, October 2004);
and
- *Galway County Development Plan (GCDP) 2015-2021, as varied.*

1.3 The Flood Risk Assessment was based on the following information:

- Architectural drawings of the development proposals;
- OPW Floodmaps.ie;
- OPW National Preliminary Flood Risk Assessment;
- OPW Irish Coastal Protection Strategy Study;
- Geological Survey of Ireland (GSI) Maps;
- Topographical Survey of the Subject Site and;
- Trusky East Stream Flood Study.

1.4 OCSC carried out an inspection of the site, consisting of a walkover and visual inspection of the stream channel from its source to where it discharges to Galway Bay. A selection of site photographs is provided in **Appendix A**.

2. SITE CONTEXT

2.1 The subject site is located approximately 690m upstream of the North Atlantic Sea at Galway Bay along the course of the Trusky East Stream. The Trusky East Stream (also referred to as Cloghscoltia Stream) runs along the eastern boundary of the subject site, from north to south. Lough Inch is located 2km north west of the subject site and Rusheen Bay is located 1.2km south east – see **Figure 2**.

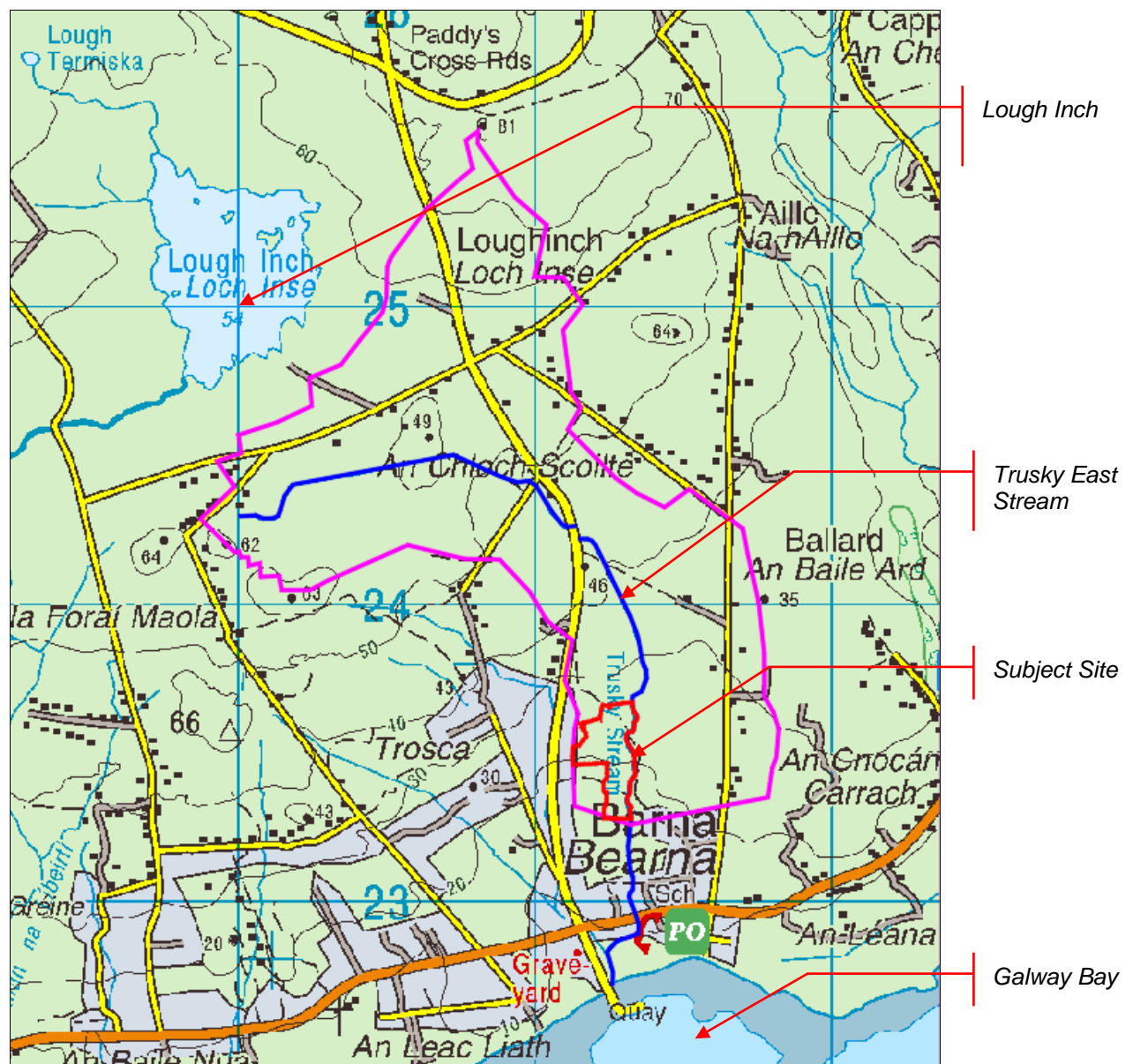


Figure 2: Trusky East Stream Catchment

- 2.2 The site is currently a green field. The site is bounded to the north and east by green fields, agricultural land, to the south by Cnoc Fraoigh and Scath na Mara residential estates and to the west by Cnoc Fraoigh Estate, the West Trusky Road and five residential units that front onto the Trusky Road.
- 2.3 The subject site is accessed through Cnoc Fraoigh residential estate road. The road and footpath level across the entrance of the site vary from 16.16mAOD to 16.084mAOD. The site in general slopes from a high point (20.0mAOD) at the north of the site to a low point (13.5mAOD) in the south. This is excluding stream bed levels which fall from 22.014mAOD in the north to 11.739mAOD as it exits the site along the southern boundary.
- 2.4 The Office of Public Works (OPW) collates available reports on flooding from all sources (e.g. fluvial, pluvial, coastal, infrastructure) on a nationwide basis. The OPW's floodmaps.ie website was consulted to obtain reports of historical flooding within the vicinity of the subject site. There were no recorded flooding events with a 2.5km radius of the subject site – see MapReport in **Appendix B**.
- 2.5 In Variation No.2(a) of Galway County Development Plan 2015-2021 ("the Bearna Plan"), the subject site is partly zoned 'R' for residential development Phase 1 and partly zoned 'OS' for open space/recreation and amenity uses – see **Figure 3** over. Some of the lands zoned 'R' are subject to Objective CCF6, which requires that the development proposal will need to be accompanied by a detailed hydrological assessment and robust SUDS design which demonstrates the capacity to withstand potential flood events to maintain water quality and avoid potential effects to ecological features. All the lands zoned 'OS' within the proposed development site are subject to Objective LU8 – Constrained Land Use Zone ('CL'); DM Guideline FL1 – Flood Zones and Appropriate Land Uses apply to lands zoned CL.

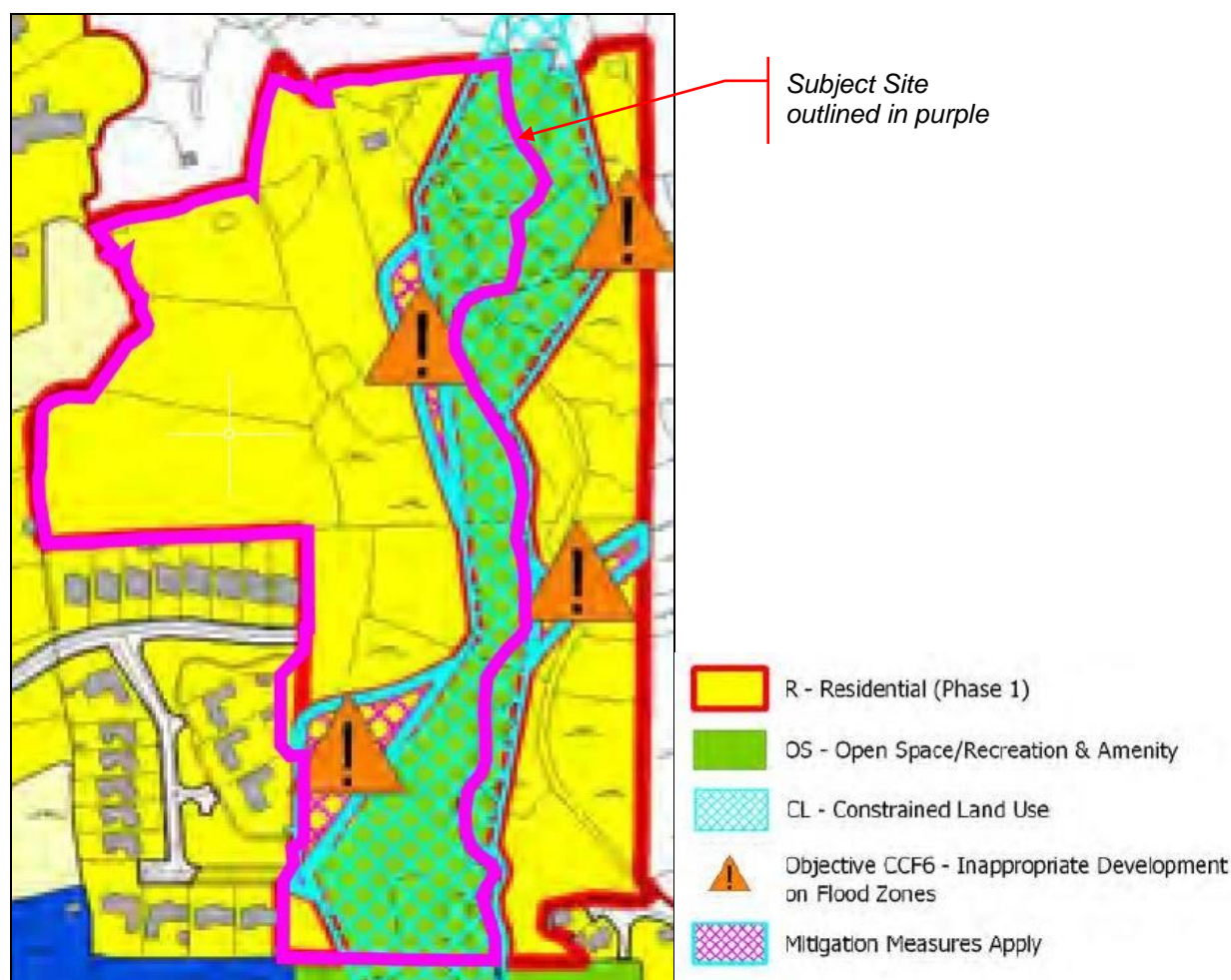


Figure 3: Extract from Variation No.2(a) of GCDP 2015-2021 Land Use Zoning map

2.6 This Site-Specific Flood Risk Assessment (SSFRA), the accompanying *Trusky East Stream Flood Study (Report B861-OCSC-XX-XX-RP-C-0003)* and the *Engineering Services Report (Report B861-OCSC-XX-XX-RP-C-0001)* and associated drawings referenced by these reports are submitted in accordance with Objective CCF6, Objective LU8, and DM Guideline FL1.

2.7 In particular, the Trusky East Stream Flood Study:

- includes a detailed hydrological assessment of the stream catchment.

The Engineering Services Report:

- includes a detailed hydrological assessment of the subject site;
- considers and addresses the impact of climate change;

- includes details of a robust SUDS design.

This SSFRA comprises a detailed Site-Specific Flood Risk Assessment that demonstrates that the proposed development complies with The Planning System and Flood Risk Management Guidelines for Planning Authorities, Circular PL2/2014 & the associated Development Management Justification Test. This report demonstrates:

- (i) the manner in which the "Development Management Justification Test" has been applied on behalf of the developer and should be applied by the Board in considering the planning application; and
- (ii) that the criteria of that Development Management Justification Test are met in respect of the proposed development. This report also considers the impact of climate change in accordance with Objective CCF6.

2.8 This report is a detailed Site-Specific Flood Risk Assessment, carried out in accordance with The Planning System and Flood Risk Assessment Guidelines & Circular PL 2/2014, which assesses the risks of flooding associated with the proposed development. This report will demonstrate that the proposed development will not have adverse impacts or impede access to a watercourse on floodplains or flood protection and management facilities, or increase the risk of flooding to other locations. As outlined later in this report, measures proposed follow best practice in the management of health and safety in relation to flood risk for users and residents of the development.

2.9 This report assesses the vulnerability of the proposed development uses and addresses the Flood Zoning of the subject site. This report is a Site-Specific Flood Risk Assessment, carried out in accordance with The Planning System and Flood Risk Assessment Guidelines & Circular PL 2/2014, which includes a Development Management Justification Test.

2.10 The Bearna Plan also includes a Flood Risk Management map which identifies Indicative Flood Zones – see **Figure 4**. The map shows that the site is partially located in Indicative Flood Zone C and partially within Indicative Flood Zones A&B.

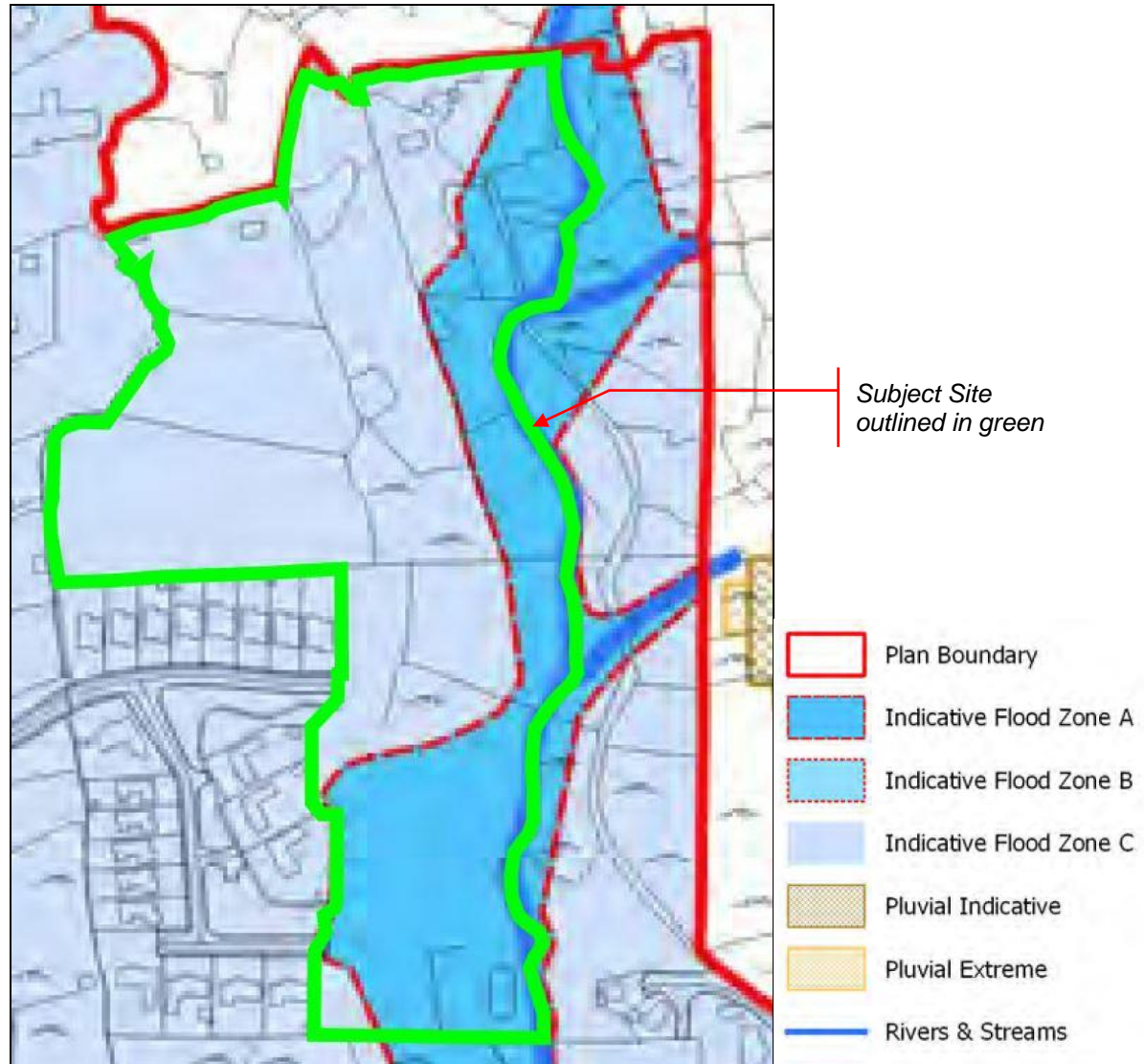


Figure 4: Extract from Variation No.2(a) of GCDP 2015-2021 Flood Risk Management map

3. LEVEL OF SERVICE

- 3.1 The risk of a flood event is a function of the probability of occurrence in any given year. Traditionally, this has been expressed as a return period (e.g. 1-in-100-year return period). However, this has led to misconceptions about the likelihood of repeat occurrences. A less ambiguous expression of probability is the Annual Exceedance Probability (AEP), which may be defined as the probability of a flood event being exceeded in any given year. A 1-in-100-year return period flood event is therefore expressed as a 1% AEP flood event. Likewise, a 1-in-1-year return period flood event is expressed as a 100% AEP flood event.
- 3.2 The *Greater Dublin Strategic Drainage Study* ("the GSDS") (published by the Local Authorities in the Greater Dublin Region) and *The Planning System and Flood Risk Management Guidelines for Planning Authorities* (published by DOEHLG, November 2009) set out the best practice standards for flood risk in Ireland. These are summarised in **Table 1**.

Table 1: Summary of Level of Service

Flooding Source	Drainage	Fluvial (River)	Tidal (Coastal)
Residential	1% AEP	0.1% AEP	0.1% AEP
Commercial	1% AEP	1% AEP	0.5% AEP
Water-compatible	-	>1% AEP	>0.5% AEP

- 3.3 In addition, the GSDS requires that ground floor levels of houses be provided with a 500mm freeboard over the 1% AEP fluvial flood level.
- 3.4 Objective CCF6, the Greater Dublin Strategic Drainage Study and *The Planning System and Flood Risk Management Guidelines for*

Planning Authorities require that account be taken of the effects of climate change over the design life of a development, normally 100 years. Design parameters to take account of climate change were established in the GDSDS. These parameters are set out in **Table 2**.

Table 2: Climate Change - Impact on Design Parameters

Design Category	Impact of Climate Change
Drainage	10% increase in rainfall
Fluvial (River)	20% increase in flood flow

3.5 The Guidelines adopt a sequential approach to managing flood risk by reducing exposure to flooding through land-use planning. The approach adopted by the Guidelines establishes three zones (Guidelines paragraph 2.23) on a sliding scale of flood risk – see **Table 3**.

Table 3: Flood Risk Zones

Zone A	High Probability of Flooding Where the annual probability of flooding is: greater than 1% for fluvial flooding or greater than 0.5% for coastal flooding
Zone B	Moderate Probability of Flooding Where the annual probability of flooding is: between 0.1% and 1% for fluvial flooding or between 0.1% and 0.5% for coastal flooding
Zone C	Low Probability of Flooding Where the annual probability of flooding is: less than 0.1% for fluvial flooding and less than 0.1% for coastal flooding

3.6 Flood risk zones are determined on the basis of the probability of river and coastal flooding only (Guidelines paragraph 2.24). Other

sources of flooding (such as groundwater, infrastructure and pluvial) do not affect the delineation of flood risk zones. These other sources of flooding should be considered and mitigated in design. Flood risk zones are determined on the basis of the current flood risk, i.e. without the inclusion of climate change factors (Guidelines paragraph 2.24).

- 3.7 The Guidelines classify potential development in terms of its vulnerability to flooding. The types of development falling within each vulnerability class are described in Table 3.1 of the Guidelines, which is reproduced in **Table 4** over.

Table 4: Development Vulnerability Class

Vulnerability Class	Land uses and types of development which include:
Highly vulnerable development (including essential infrastructure)	<p>Garda, ambulance and fire stations and command centres required to be operational during flooding;</p> <p>Hospitals;</p> <p>Emergency access and egress points;</p> <p>Schools;</p> <p>Dwelling houses, student halls of residence and hostels;</p> <p>Residential institutions such as residential care homes, children's homes and social services homes;</p> <p>Caravans and mobile home parks;</p> <p>Dwelling houses designed, constructed or adapted for the elderly or, other people with impaired mobility; and</p> <p>Essential infrastructure, such as primary transport and utilities distribution, including electricity generating power stations and sub-stations, water and sewage treatment, and potential significant sources of pollution (SEVESO sites, IPPC sites, etc.) in the event of flooding.</p>
Less vulnerable development	<p>Buildings used for: retail, leisure, warehousing, commercial, industrial and non-residential institutions;</p> <p>Land and buildings used for holiday or short-let caravans and camping, subject to specific warning and evacuation plans;</p> <p>Land and buildings used for agriculture and forestry;</p> <p>Waste treatment (except landfill and hazardous waste);</p> <p>Mineral working and processing; and</p> <p>Local transport infrastructure.</p>
Water-compatible development	<p>Flood control infrastructure;</p> <p>Docks, marinas and wharves;</p> <p>Navigation facilities;</p> <p>Ship building, repairing and dismantling, dockside fish processing and refrigeration and compatible activities requiring a waterside location;</p> <p>Water-based recreation and tourism (excluding sleeping accommodation);</p> <p>Lifeguard and coastguard stations;</p> <p>Amenity open space, outdoor sports and recreation and essential facilities such as changing rooms; and</p> <p>Essential ancillary sleeping or residential accommodation for staff required by uses in this category (subject to a specific warning and evacuation plan).</p>

3.8 The Guidelines direct new development primarily towards areas at low risk of flooding. The Guidelines recognise that flood risks should not be the only deciding factor in zoning for development; the Guidelines recognise that circumstances will exist where development of a site in a floodplain is desirable in order to achieve compact and sustainable development of the core of urban settlements. To allow consideration of such development, the Guidelines provide a Justification Test, which establishes the criteria under which desirable development of a site in a floodplain may be warranted. The decision making process for undertaking a Justification Test is set out in paragraph 3.2, page 23 of the Guidelines and is reproduced in **Figure 5**.

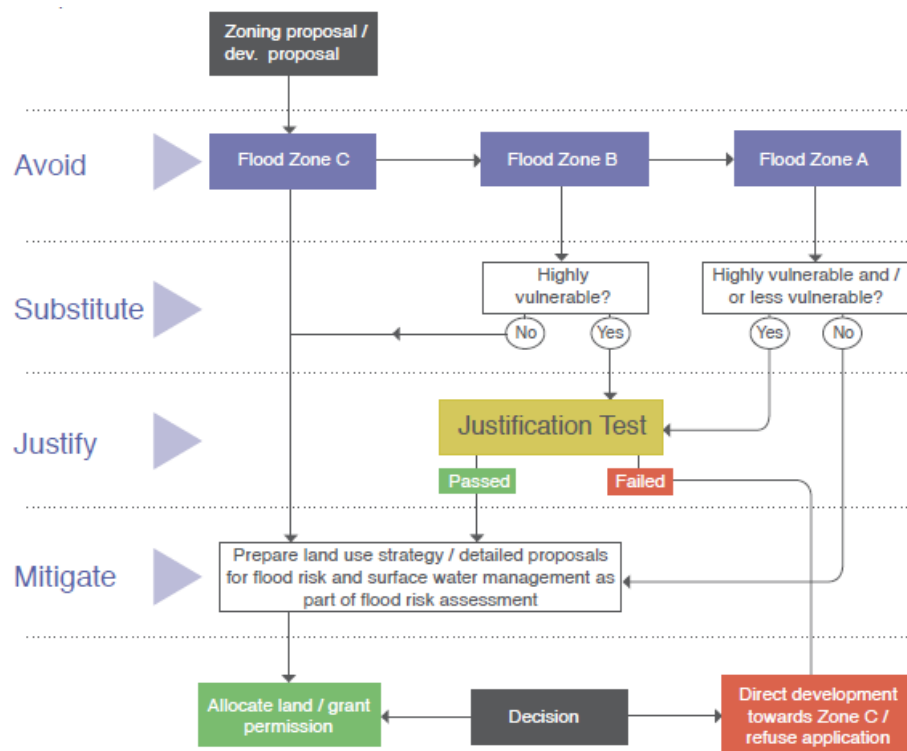


Figure 5: Sequential Approach and Justification Test

3.9 The Justification Test comprises two processes: (1) Justification Test for Development Plans and; (2) Justification Test for Development Management. Paragraph 3.8 of the Guidelines provides that the Development Management Justification Test, described in Chapter 5 of the Guidelines, is used at the planning application stage where it is intended to develop land on Flood Zone

A or B for uses or development vulnerable to flooding that would generally be inappropriate for that land.

3.10 Planning permission is currently being sought for strategic housing development comprising residential development, a creche and open space amenity development. The residential development and the creche are classed as "highly vulnerable development" in accordance with Table 3.1 of the Guidelines, whereas the "open space amenity" aspect of the development falls under the definition of "water compatible development".

3.11 As outlined above, the development site is partially located in Indicative Flood Zone C and partially within Indicative Flood Zones A&B identified in the Flood Risk Management Map in the Bearná Plan. As outlined in Section 4.1 later, *all* buildings are located in Indicative Flood Zone C (on lands zoned "R" that are *not* subject to Objective CCF6). The development proposed in Indicative Flood Zones A&B comprises: open space/amenity on lands zoned "OS"; open space/amenity, car parking and wastewater pumping station ancillary to the residential development on lands zoned "R" and subject to Objective CCF6. Certain of the development in Indicative Flood Zones A&B – specifically on lands zoned "R" and subject to Objective CCF6 – is ancillary to the residential development and, therefore, in accordance with the decision of the High Court in *Heather Hill Management Company CLG v An Bord Pleanála* [2019] I.E.H.C. 450, is considered as "highly vulnerable" development. Therefore, a Development Management Justification Test is required under the Guidelines.

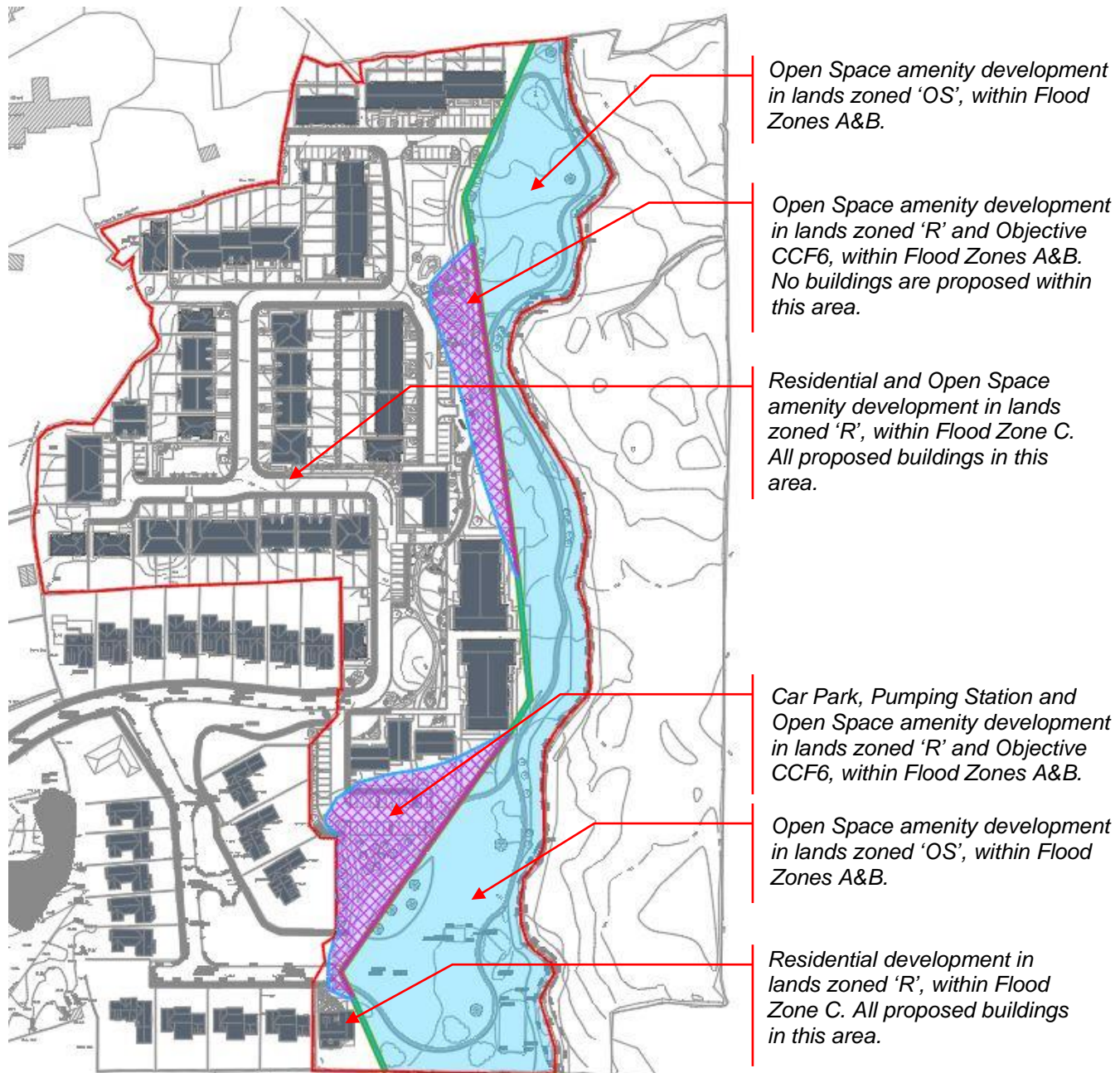


Figure 6: Proposed Development Layout with Development Plan Zoning

3.12 Further, as part of the development site is subject to Objective CCF6, a Development Management Justification Test is required under the provisions of Objective CCF6 of the Bearna Plan (Variation No.2(a) Galway County Development Plan 2015-2021).

3.13 Adopting a conservative approach in order to ensure the most robust assessment, and regardless of the different land-use zoning applicable to different portions of the proposed development site

and the different uses that are proposed, the Development Management Justification Test should be applied in relation to the proposed development as a whole and not only those aspects of the development that are considered "highly vulnerable" and are located in Flood Zones A&B.

3.14 Section 5 demonstrates how the criteria of the Development Management Justification Test are met in respect of the proposed development.

4. FLOOD RISKS & MITIGATION MEASURES

4.1 Fluvial Flooding

4.1.1 The Trusky East Stream / Cloghscoltia Stream originates approximately 1.4km northwest of the subject site and enters the site at the northern boundary. The catchment is rural in character, with mixed agriculture being the predominant land use. The stream is un-gauged. After exiting the site at the southern boundary, the stream becomes culverted 150m south of the site as it passes beneath the R336 road then joins with the Trusky West Stream prior to discharging into Galway Bay at Bearna Harbour.

4.1.2 According to the Western CFRAM Site Assessment (see extract in **Appendix C**), it has been suggested that the risk of flooding is as a result of blockage of the small culvert under the R336 Road; however, the Western CFRAM Site Assessment report states that "water would likely flow over R336 and only cause limited property impact".

4.1.3 Whilst accepting and applying the Indicative Flood Zones identified in the Development Plan and taking cognisance of the source data for the Indicative Flood Zones, in addition, in order to ensure the most robust assessment, it was considered necessary to quantify the fluvial flood risk by detailed hydrological assessment and hydraulic modelling in order to inform scheme design and flood risk management measures. OCSC undertook a flood study of the Trusky East Stream; report on same is provided under separate cover as part of the current planning application (**Report B861-OCSC-XX-XX-RP-C-0003**).

4.1.4 The assessment detailed in that report provides quantitative analysis and predicted flood water levels, for use in scheme design. The analysis identifies the predicted flood extent for the 1.0%AEP and 0.1%AEP flood events, based on a computational modelling.

The analysis shows that, at four locations within the subject site, the predicted flood extent actually extends into areas shown to be within Indicative Flood Zone C in the Flood Risk Management map (Variation No.2(a) Galway County Development Plan 2015-2021 Bearna Plan); these locations are in fact subject to flooding in the 100-year and 1000-year return period events and, accordingly, appropriate mitigation measures will be required – see **Figure 7**.



Figure 7: Indicative Flood Zones and Predicted flood extent

4.1.5 The entirety of the area of the proposed development site zoned 'OS' will be developed as new open space amenity. This area is entirely within Indicative Flood Zones A&B identified in the Bearná Plan. There are no proposals to raise ground levels in this area. The following is proposed on OS zoned lands: ground cultivation; sowing of wildflower meadow; sowing of grass for grass pathways; planting of trees, hedgerows, waterside planting, native and naturalised planting; erection of post and chainlink fence; surface water drainage; and the decommissioning of an existing wastewater treatment works. The proposed fence line runs generally parallel with the direction of flow and so does not comprise a barrier to flood conveyance along the route of the stream. Where proposed trees, hedgerows and fence are located within the predicted flood extent, they will displace flood storage volume provided by the existing floodplain. It is therefore proposed to provide compensatory storage on a direct "level-for-level" basis, in accordance with CIRIA C624 and the Flood Risk Management Guidelines; details of the proposed compensatory storage is shown on **Drawing B861-OCSC-XX-XX-DR-C-2802**.

4.1.6 There are two areas within the subject site that are zoned 'R' where the Objective CCF6 applies. Both of these areas of lands are entirely within Indicative Flood Zones A&B identified in the Bearná Plan. The first, more northerly, of these two areas will be developed for open space amenity only; it is not proposed to provide buildings in this area. There are no proposals to raise ground levels in this area. The proposals for this area include items such as trees, park benches and playground equipment. Where these proposed items are located within the predicted flood extent, they will displace flood storage volume provided by the existing floodplain. It is therefore proposed to provide compensatory storage on a direct "level-for-level" basis, in accordance with CIRIA C624 and the Flood Risk Management Guidelines; details of the proposed compensatory storage is shown on **Drawing B861-OCSC-XX-XX-DR-C-2802**.

4.1.7 The second, more southerly, of the two areas zoned 'R' where the Object CCF6 applies will be developed for open space/amenity, car parking and wastewater pumping station ancillary to the residential development. The provision of the car park will entail some re-profiling of existing ground levels; the road alignment drawing for this car park (**Drawing B861-OCSC-XX-XX-DR-C-0107**) indicates fill not exceeding 47mm and cut exceeding 400mm. The proposals also include tree planting within this area. The wastewater pumping station will be largely below ground, with associated kiosks above ground. However, none of this area is located within the predicted flood extent and so the proposed works in this area will result in no displacement of flood storage. The ground level at the location of the wastewater pumping station is more than 500mm above the adjacent 1.0%AEP flood level; no further measure is required to manage fluvial flood risk at the pumping station.

4.1.8 The remainder of the site is zoned 'R' (where Objective CCF6 does not apply). This portion of the site is entirely within Indicative Flood Zone C identified in the Bearná Plan. However, as discussed earlier in Section 4.1.4, there are four locations where the predicted flood extent extend into this area. At three of these locations, the proposals provide open space amenity development with no proposals to raise ground levels or provide items such as trees, park benches, etc. At the fourth location, which corresponds to Chainage 44-58m on road alignment BL07, the proposals entail ground level raising, which will displace flood storage volume provided by the existing floodplain. It is therefore proposed to provide compensatory storage on a direct "level-for-level" basis, in accordance with CIRIA C624 and the Flood Risk Management Guidelines; details of the proposed compensatory storage is shown on **Drawing B861-OCSC-XX-XX-DR-C-2802**.

4.1.9 Compensatory storage is permitted as a mitigation measure in *The Planning System and Flood Risk Management, Guidelines for Planning Authorities* (DOEHLG and OPW, Nov 2009) where it is

described in Appendix Section 3.3 – see extract in **Figure 8**. The proposed “level-for-level” direct compensatory storage is to be provided in accordance with the recommendations of CIRIA C624. Details of the proposed compensatory storage are shown on **Drawing B861-OCSC-XX-XX-DR-C-2802**.

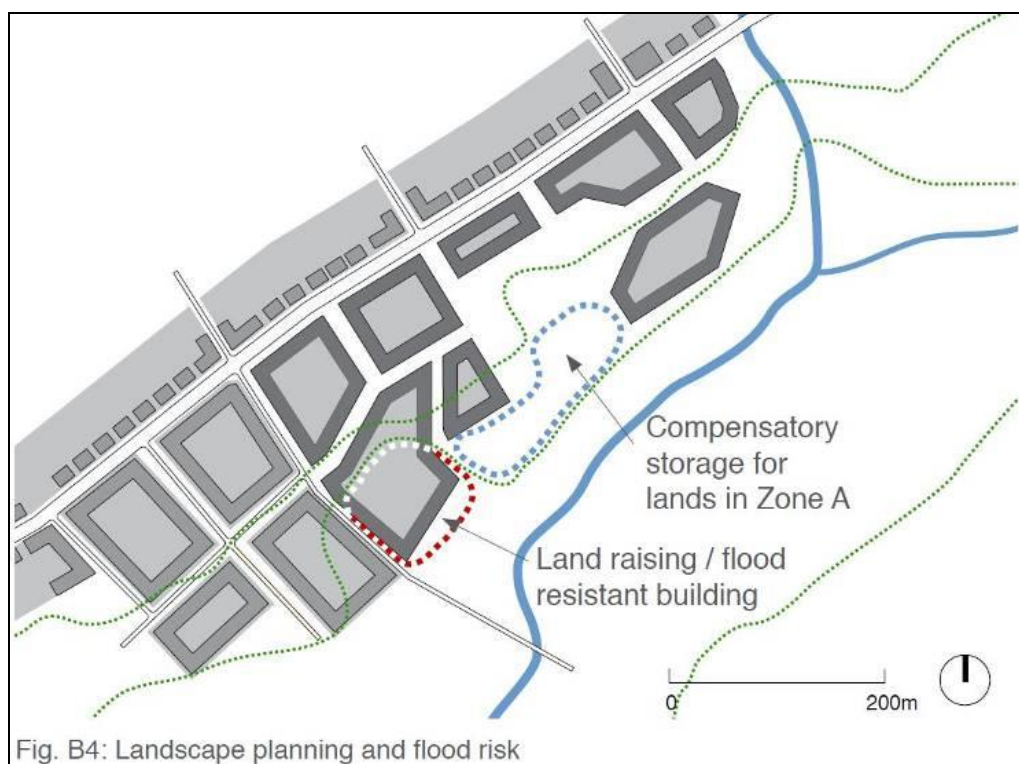


Figure 8: Extract from 2009 Planning Guidelines

4.1.10 All proposed buildings will be located *exclusively within* (a) lands zoned 'R' (and not subject to Objective CCF6) and (b) Indicative Flood Zone C (as identified in Variation No.2(a) Galway County Development Plan 2015-2021 Bearna Plan); and *outside* (c) the predicted flood extent for the 0.1% AEP flood event (refer to **Report B861-OCSC-XX-XX-RP-C-0003**). The architectural drawings for the proposed development (refer to **Drawing 924-MDO-ZZ-ZZ-DR-A-011001**), show the proposed ground floor Finished Floor Levels. These floor levels have been selected to provide at least 500mm freeboard over the adjacent 1.0%AEP flood water levels, in accordance with GSDS recommendations.

- 4.1.11 The stream is separated from the main construction footprint by over 10m at its nearest point. However, the construction works also involve the discharge of surface water from the proposed development to the Trusky Stream. This involves, the installation of two precast concrete headwalls withing the banks of the stream at the location of the two surface water outfalls. There will also be some minor landscaping works including the planting of native species and the construction of a boundary fence along the stream banks. Vehicular and pedestrian access to the stream and floodplain is available within the proposed development where the open space adjoins proposed footpaths and roads. These measures ensure ease of access for inspection and maintenance of the watercourse and floodplain. Likewise, access for emergency services is also facilitated. Maintenance of the stream will be infrequent however sections of the fence will be temporarily demountable where vehicular access is required. The fence can be reinstated following completion of the works.
- 4.1.12 It is concluded that the site of the proposed development is partially within Indicative Flood Zones A&B for fluvial flooding and partially within Indicative Flood Zone C (as identified in Variation No.2(a) Galway County Development Plan 2015-2021 Bearna Plan), in accordance with *The Planning System and Flood Risk Management Guidelines for Planning Authorities*. In addition, part of the development site is subject to Objective CCF6. Therefore, a Development Management Justification Test is required, both pursuant to the Bearna Plan and the 2009 Guidelines. Mitigation measures in the form of direct "level-for-level" compensatory storage are included in the proposed development; details of the proposed compensatory storage is shown on **Drawing B861-OCSC-XX-XX-DR-C-2802**.

4.2 Tidal Flooding

- 4.2.1 The nearest tidal source, Galway Bay, is located approximately 690m downstream of the proposed development along the course of the Trusky East Stream.
- 4.2.2 The OPW produced Coastal Flood maps in phase 4 of the *Irish Coastal Protection Strategy Study (ICPSS)*. Low-lying lands below 4.2m O.D. Malin, between the Bearna Pier and the Oranmore Coast road (R338) are at risk from flooding by tidal inundation during storm surge events. To date the highest storm event recorded reached a flood level of c. 3.6m O.D. in the Claddagh Basin and a similar level at the Oranmore tidal gauge. The existing R336 Spiddal Road is sufficiently elevated as not to be at risk from Coastal Flooding with the lowest road elevation (in the vicinity of the Bearna Stream crossing) above 6m O.D. Malin.
- 4.2.3 Based on the ICPSS maps prepared by RPS on behalf of the OPW in 2010 shown in **Appendix D** as well as the preliminary flood risk assessment maps (Figure AII.19 PFRA Flood Risk Areas - Central West (E)) contained in **Appendix E**, the subject site is out of the extreme coastal flood extents.
- 4.2.4 Based on these maps, it is concluded that the site of the proposed development is within Flood Zone C for tidal flooding, in accordance with *The Planning System and Flood Risk Management Guidelines for Planning Authorities* (see Section 4.1 in relation to fluvial flooding).

4.3 Pluvial Flooding

4.3.1 The OPW's Western CFRAM Flood Risk Review determined that due to recent improvements to the surface water drainage network in the surrounding area that Bearna was at a low frequency of pluvial flooding. The site visit and walkover of the proposed development and surrounding area has confirmed the assessment of the potential risk to the site from pluvial flooding as negligible.

4.3.2 Variation No.2(a) Galway County Development Plan 2015-2021 ("the Bearna Plan") includes a Flood Risk Management map which identifies areas prone to pluvial flooding – see **Figure 9**. The map shows no areas of pluvial flooding within the subject site.

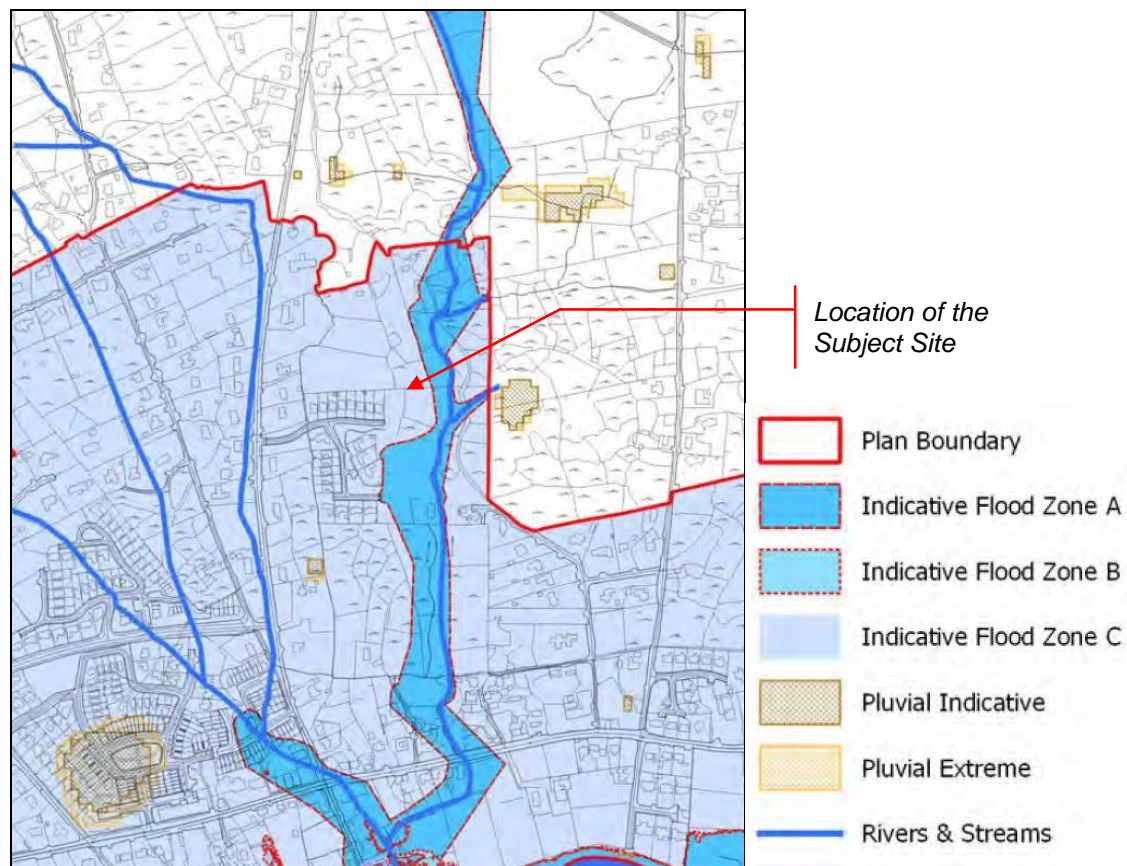


Figure 9: Extract from Variation No.2(a) of GCDP 2015-2021 Flood Risk Management map

4.3.3 Photographs of flooding at the existing Cnoc Fraoigh housing estate were previously submitted to An Bord Pleanála as part of a submission on a previous planning application for development at the subject site (ref. ABP-300009-17). These photographs (included in **Appendix G**) show flooding at the southeast corner of the existing Cnoc Fraoigh estate; this is the lowest point in the existing estate. Topographical survey information for the existing Cnoc Fraoigh estate and the subject site shows that an area of high ground is located between the southeast corner of the existing Cnoc Fraoigh estate and the Trusky East Stream channel – see **Figure 10** over. This high ground is visible in the photographs and would prevent water flowing from the Cnoc Fraoigh estate into the Trusky East Stream. By careful design of new development road levels, this flooding in the Cnoc Fraoigh estate will be relieved by provision of an overland flow route along new development roads and open space to the stream.

4.3.4 There are reports of ponding occurring on the site during periods of heavy rainfall. The topographical survey illustrates an undulating topography with localised low spots that might become filled with water during heavy rainfall. The proposed layout ensures that there are clear overland flow routes and that there are no low points on the site in which run-off can become trapped and pond, causing flooding.

4.3.5 Hence the risk of pluvial flooding is negligible and no further mitigation measures are required.

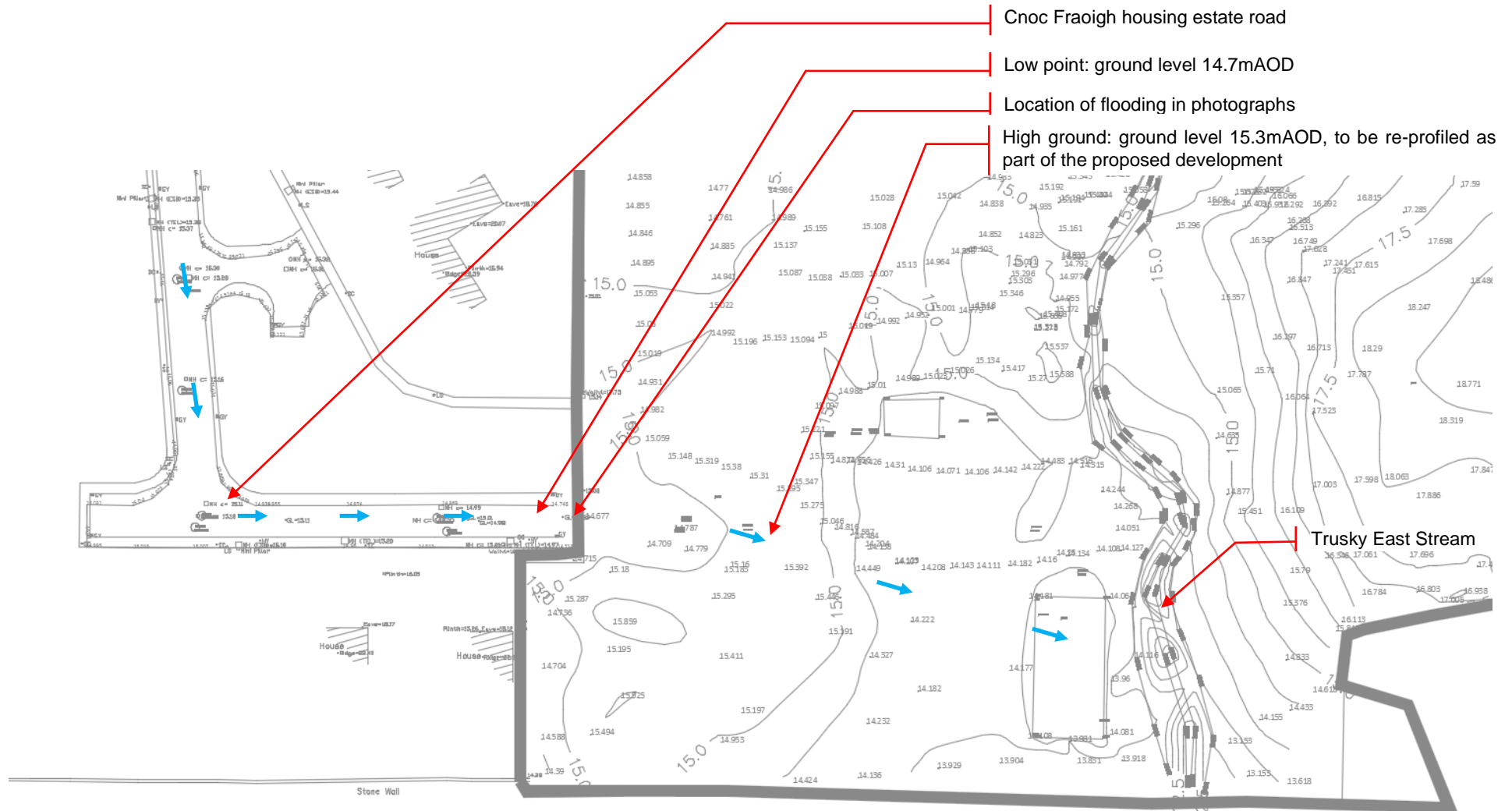


Figure 10: Extract of Topographical Survey

4.4 Proposed Drainage Infrastructure

4.4.1 The proposed drainage infrastructure, as detailed on **Drawing B861-OCSC-XX-XX-DR-C-0500** and in the **Engineering Services Report B861-OCSC-XX-XX-RP-C-0001**, has been so designed to accommodate rainfall run-off up to and inclusive of the 1.%AEP rainfall event, inclusive of recommended allowance for climate change. The design of the proposed drainage adheres to the hydraulic performance criteria set out in the *Greater Dublin Strategic Drainage Study* and in the *Building Regulations Part H*, in order to achieve self-cleansing velocity, minimising the potential for blockages leading to flooding.

4.4.2 To mitigate the potential possible flood risk in the receiving watercourse, the surface water runoff will be reduced to pre-development green-field run-off rates. The proposed drainage system incorporates Sustainable Drainage Systems (SuDS) that will control the discharge rate through the use of a vortex flow control device (*Hydrobrake* or similar), which will reduce the volumetric runoff from the site. The surface water drainage system provides a minimum freeboard of 500mm to finished floor levels from the 1% AEP design top water level in the attenuation facilities.

4.4.3 The wastewater drainage infrastructure includes a new pumping station in an area of the site zoned 'R' where the Objective CCF6 applies to replace an existing wastewater treatment works within an area of the site zoned 'OS'. The new pumping station will include duplicate pumps in alternating duty-standby arrangement and will include an emergency storage tank providing 24-hour capacity, in accordance with Irish Water requirements; these measures effectively mitigate the risk of flooding from the pumping station arising from a potential interruption of service.

4.4.4 The design of drains has been compiled using the Micro Drainage WinDes Program using the Modified Rational Method in accordance with EN752. The proposed drainage system achieves self-cleansing velocity throughout, minimising the potential for blockage leading to flooding. Further details of these measures are provided in the ***Engineering Services Report B861-OCSC-XX-XX-RP-C-0001***.

4.4.5 In circumstances where the proposed drainage system is constructed as designed (in accordance with the relevant standards and regulations), the flood risks arising from the proposed drainage infrastructure will be negligible and no further mitigation is required.

4.5 Groundwater Flooding

- 4.5.1 The OPW's *Draft Preliminary Flood Risk Assessment* (DPFRA) includes an assessment of groundwater flood risk. The DPFRA flood risk map included in **Appendix F** indicates no groundwater flood risk to the site.
- 4.5.2 According to data obtained from the *Geological Survey of Ireland* (<http://www.gsi.ie>), the subject site is located on shallow rock or bedrock outcrop over a bedrock of megacrystic-porphyritic granite. It is located on a poor aquifer with bedrock which is generally unproductive except for local zones. The groundwater vulnerability assessment of the site indicates that the area has rock at or near the surface (Code X) (see **Appendix H**).
- 4.5.3 There is no record of groundwater flooding for the subject site.
- 4.5.4 The probability of groundwater rising above ground levels is considered extremely low. In any such event, water would follow overland flow routes (see **Section 4.3**) and not collect at or near proposed buildings.
- 4.5.5 It is concluded therefore that the flood risk represented by ground water is negligible and no further mitigation is required.

5. JUSTIFICATION TEST

5.1 Overview

5.1.1 As outlined in Section 3 above, in accordance with the Planning Guidelines on *The Planning System and Flood Risk Management* and pursuant to Objective CCF6 of the Bearna Plan, a Development Management Justification Test (hereinafter referred to as “the Justification Test”) is required in respect of the proposed development.

5.1.2 Adopting a conservative approach in order to ensure the most robust assessment, and regardless of the different land-use zoning applicable to different portions of the proposed development site and the different uses that are proposed, the Justification Test should be applied in relation to the proposed development as a whole and not only those aspects of the development that are considered “highly vulnerable” and are located in Flood Zones A&B.

5.1.3 In accordance with Section 5.15 of the Guidelines, the planning authority (or, in this case, An Bord Pleanála) must be satisfied that the proposed development satisfies all of the criteria of the Justification Test as it applies to development management as outlined in Box 5.1 of the Guidelines. Section 5.2 of this report demonstrates the manner in which the criteria in Box 5.1 are satisfied in respect of the proposed development.

5.2 Development Management Justification Test

DEVELOPMENT MANAGEMENT JUSTIFICATION TEST

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.

Yes:

Under the Bearna Plan, adopted as Variation No.2(a) Galway County Development Plan 2015-2021, the subject site has been partly zoned 'R' for residential development Phase 1 and partly zoned 'OS' for open space/recreation and amenity uses. All of the lands zoned 'OS' within the subject site are also identified as being under Constrained Land Use. There are two areas within the lands zoned 'R' where Objective CCF6 applies. The Planning Report and Statement of Consistency demonstrates how the proposed development complies with the zoning for the proposed development site.

All the lands zoned 'OS' within the proposed development site are subject to Objective LU8 – Constrained Land Use Zone ('CL'); DM Guideline FL1 – Flood Zones and Appropriate Land Uses apply to lands zoned CL. The area of the proposed development site subject to land-use zoning objective 'OS' will be developed as new open space amenity; this area is entirely within Indicative Flood Zones A&B (as identified in the Bearna Plan). There are no proposals to raise ground levels in this area. The following is proposed on OS zoned lands: ground cultivation; sowing of wildflower meadow; sowing of grass for grass pathways; planting of trees, hedgerows, waterside planting, native and naturalised planting; erection of post and chainlink fence; surface water drainage; and the decommissioning of an existing wastewater treatment works. The proposed fence line runs generally parallel with the direction of flow and so does not comprise a barrier to flood conveyance along the route of the stream. Where proposed trees, hedgerows and fence line are located within the predicted flood extent, they will displace flood storage volume

provided by the existing floodplain. It is therefore proposed to provide compensatory storage on a direct "level-for-level" basis, in accordance with CIRIA C624 and the Flood Risk Management Guidelines; details of the proposed compensatory storage is shown on **Drawing B861-OCSC-XX-XX-DR-C-2802**.

Two parts of the subject lands that have been zoned 'R' for residential development Phase 1 are also subject to Objective CCF6 and requiring Mitigation Measures. Both of these areas of lands are entirely within Indicative Flood Zones A&B identified in the Bearna Plan. The first, more northerly, of these areas will be developed for open space amenity only; this area is entirely within Indicative Flood Zones A&B (as identified in Variation No.2(a) Galway County Development Plan 2015-2021 Bearna Plan). It is not proposed to provide buildings in this area. There are no proposals to raise ground levels in this area. The proposals for this area include items such as trees, park benches and playground equipment. Where these proposed items are located within the predicted flood extent, they will displace flood storage volume provided by the existing floodplain. It is therefore proposed to provide compensatory storage on a direct "level-for-level" basis, in accordance with CIRIA C624 and the Flood Risk Management Guidelines; details of the proposed compensatory storage is shown on **Drawing B861-OCSC-XX-XX-DR-C-2802**.

The second, more southerly, of these areas will be developed for open space/amenity, car parking and wastewater pumping station ancillary to the residential development; this area is entirely within Indicative Flood Zones A&B (as identified in Variation No.2(a) Galway County Development Plan 2015-2021 Bearna Plan). The provision of the car park will entail some re-profiling of existing ground levels; the road alignment drawing for this car park (**Drawing B861-OCSC-XX-XX-DR-C-0107**) indicates fill not exceeding 47mm and cut exceeding 400mm. The proposals also include tree planting within this area. The wastewater pumping station will be largely below ground, with associated kiosks above ground. However, none of this area is located within the predicted flood extent and so the

proposed works in this area will result in no displacement of flood storage. The ground level at the location of the wastewater pumping station is more than 500mm above the adjacent 1.0%AEP flood level; no further measure is required to manage fluvial flood risk at the pumping station.

The remainder of the subject lands are zoned 'R' for residential development Phase 1 (where Objective CCF6 does not apply); this area is entirely within Indicative Flood Zone C (as identified in Variation No.2(a) Galway County Development Plan 2015-2021 Bearnna Plan). However, as discussed earlier in Section 4.1.4, there are four locations where the predicted flood extent extend into this area. At three of these locations, the proposals provide open space amenity development with no proposals to raise ground levels or provide items such as trees, park benches, etc. At the fourth location, which corresponds to Chainage 44-58m on road alignment BL07, the proposals entail ground level raising, which will displace flood storage volume provided by the existing floodplain. It is therefore proposed to provide compensatory storage on a direct "level-for-level" basis, in accordance with CIRIA C624 and the Flood Risk Management Guidelines; details of the proposed compensatory storage is shown on **Drawing B861-OCSC-XX-XX-DR-C-2802**.

All proposed buildings will be located *exclusively* within (a) lands zoned 'R' (and not subject to Objective CCF6) and (b) Indicative Flood Zone C (as identified in Variation No.2(a) Galway County Development Plan 2015-2021 Bearnna Plan); and *outside* (c) the predicted flood extent for the 0.1% AEP flood event (refer to **Report B861-OCSC-XX-XX-RP-C-0003**). The architectural drawings for the proposed development (refer to **Drawing 924-MDO-ZZ-ZZ-DR-A-011001**), shows the proposed ground floor Finished Floor Levels. These floor levels have been selected to provide at least 500mm freeboard over the adjacent 1.0%AEP flood water levels, in accordance with GSDSDS recommendations

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

Yes: The current report comprises a detailed site-specific flood risk assessment for the subject site.

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

Yes: The current report comprises a detailed site-specific flood risk assessment for the subject site that identifies and recommends mitigation measures to avoid an increase in flood risk elsewhere.

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

Yes:

All proposed buildings will be located *exclusively within* (a) lands zoned 'R' (and not subject to Objective CCF6) and (b) Indicative Flood Zone C (as identified in Variation No.2(a) Galway County Development Plan 2015-2021 Bearna Plan); and *outside* (c) the predicted flood extent for the 0.1% AEP flood event (refer to **Report B861-OCSC-XX-XX-RP-C-0003**).

The architectural drawings for the proposed development (refer to **Drawing 924-MDO-ZZ-ZZ-DR-A-011001**), show the proposed ground floor Finished Floor Levels. These floor levels have been selected to provide at least 500mm freeboard over the adjacent 1.0%AEP flood water levels, in accordance with GSDSDS recommendations.

The proposed development will include proposals such as trees, park benches, fence and playground equipment and some minor re-profiling of existing ground levels (for car park and access road) within the predicted flood extents. It is therefore proposed to provide compensatory storage on a direct "level-for-level" basis, in accordance with CIRIA C624 and the Flood Risk Management Guidelines; details of the proposed compensatory storage is shown on **Drawing B861-OCSC-XX-XX-DR-C-2802**.

The proposed drainage infrastructure, as detailed on **Drawing B861-**

OCSC-XX-XX-DR-C-0500 and in the **Engineering Services Report B861-OCSC-XX-XX-RP-C-0001**, has been so designed to accommodate and rainfall run-off up to and inclusive of the 100-year return period event. The design of the proposed drainage adheres to the hydraulic performance criteria set out in the *Greater Dublin Strategic Drainage Study* and in the *Building Regulations Part H*, in order to achieve self-cleansing velocity, minimising the potential for blockages leading to flooding.

To mitigate the potential possible flood risk in the receiving watercourse, the surface water runoff will be reduced to pre-development green-field run-off rates.

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

Yes:

There are no flood defences (i.e. walls and embankments) proposed and therefore there are no residual risks associated with flood defences. All proposed finished floor levels and all vehicular and pedestrian access/egress routes will be above the 0.1%AEP fluvial and tidal flood levels. Therefore, access for emergency services will not be impeded as a result fluvial or tidal flooding.

The type of development proposed is residential. The context is that the development is a contiguous extension of existing residential development at a location between existing development and the Trusky East Stream, which is a fluvial flood hazard. As all proposed finished floor levels and all vehicular and pedestrian access/egress routes will be above the 0.1%AEP fluvial and tidal flood levels, the residual risk to the proposed development of fluvial or tidal flooding is less than 0.1%AEP. This is equivalent to the

definition of Flood Zone C, in which it is appropriate to locate highly vulnerable development, and therefore the residual risk is acceptable for the expected residential use of the proposed development.

To mitigate the potential possible flood risk in the receiving watercourse, the surface water runoff will be reduced to pre-development green-field run-off rates.

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

Yes:

The site currently accommodates poor quality agricultural within the area of the Bearná Plan, which is targeted for growth in the in the Galway County Development Plan 2015-2021 and is therefore underutilised. The proposed residential development provides a high density compact urban scheme and open space amenity provision.

The recommended mitigation measures are contained within the development site and do not impact on the flood risk to adjacent properties. The mitigation measures have no adverse impact on the character of the proposed development.

Conclusion: The proposed development passes the Development Management Justification Test.

6. CONCLUSIONS AND RECOMMENDATIONS

6.1.1 This report identifies the flood risks at the proposed development site at Bearnna, Co. Galway. Planning permission is currently being sought for residential development, a creche and open space amenity development. The residential development and the creche are classed as "highly vulnerable development" in accordance with Table 3.1 of the Guidelines and the open space amenity development is classified as "water compatible development". As outlined in section 3, a Development Management Justification Test is required in respect of the proposed development. Adopting a conservative approach in order to ensure the most robust assessment, and regardless of the different land-use zoning applicable to different portions of the proposed development site and the different uses that are proposed, the Development Management Justification Test should be applied in relation to the proposed development as a whole. Section 5 of this report demonstrates how the criteria of the Development Management Justification Test are met in respect of the proposed development.

6.1.2 Variation No.2(a) Galway County Development Plan 2015-2021 ("the Bearnna Plan") includes a Flood Risk Management map, which establishes "Indicative Flood Zones" at the subject site. The map indicates that the lands zoned 'OS' are within Indicative Flood Zones A&B. The map indicates that two areas of lands zoned 'R' are within Indicative Flood Zones A&B and are subject to Objective CCF6. The remainder of the lands zoned 'R' are within Indicative Flood Zone C.

6.1.3 To inform the site-specific flood risk assessment, a detailed hydrological assessment and hydraulic modelling was undertaken to quantify the fluvial flood risk at the subject site. The analysis shows that, at four locations within the subject site, the predicted flood extent extend into areas shown to be within Indicative Flood

Zone C in the Flood Risk Management map (Variation No.2(a) Galway County Development Plan 2015-2021 Bearna Plan).

- 6.1.4 The proposals include new items such as trees, hedgerows, fence, park benches, playground equipment and a short length of new road construction within the predicted flood extent. These will result in incidental loss of flood storage volume, which can be mitigated by provision of direct "level-for-level" compensatory storage.
- 6.1.5 Compensatory storage is permitted as a mitigation measure in *The Planning System and Flood Risk Management, Guidelines for Planning Authorities* (DOEHLG and OPW, Nov 2009) where it is described in Appendix Section 3.3. The proposed "level-for-level" direct compensatory storage is to be provided in the proposed development in accordance with the recommendations of CIRIA C624 – details are shown on **Drawing B861-OCSC-XX-XX-DR-C-2802**.
- 6.1.6 All proposed buildings will be located *exclusively within* (a) lands zoned 'R' (and not subject to Objective CCF6) and (b) Indicative Flood Zone C (as identified in Variation No.2(a) Galway County Development Plan 2015-2021 Bearna Plan); and *outside* (c) the predicted flood extent for the 0.1% AEP flood event (refer to **Report B861-OCSC-XX-XX-RP-C-0003**). The architectural drawings for the proposed development (refer to **Drawing 924-MDO-ZZ-ZZ-DR-A-011001**), show the proposed ground floor Finished Floor Levels. These floor levels have been selected to provide at least 500mm freeboard over the adjacent 1.0%AEP flood water levels, in accordance with GSDSDS recommendations.
- 6.1.7 Tidal/coastal flooding risk has been assessed and found to be not present at the subject site.

6.1.8 The provision of a robust drainage network and the design of roads to provide overland flow routes away from existing and proposed buildings, as detailed on **Drawings B861-OCSC-XX-XX-DR-C-0500** and **B861-OCSC-XX-XX-DR-C-0106** and in the **Engineering Services Report B861-OCSC-XX-XX-RP-C-0001**, will mitigate the risk of pluvial flooding.

6.1.9 In circumstances where the proposed drainage system is constructed as designed (in accordance with the relevant standards and regulations), the flood risks arising from the proposed drainage infrastructure will be negligible and no further mitigation is required.

6.1.10 The flood risk represented by ground water is negligible and no further mitigation is required.

APPENDIX A

Site Visit Photographs











APPENDIX B

OPW Floodmaps.ie MapReport

Summary Local Area Report

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

The map centre is in:

County: Galway

NGR: M 232 233

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



Map Scale 1:35,176

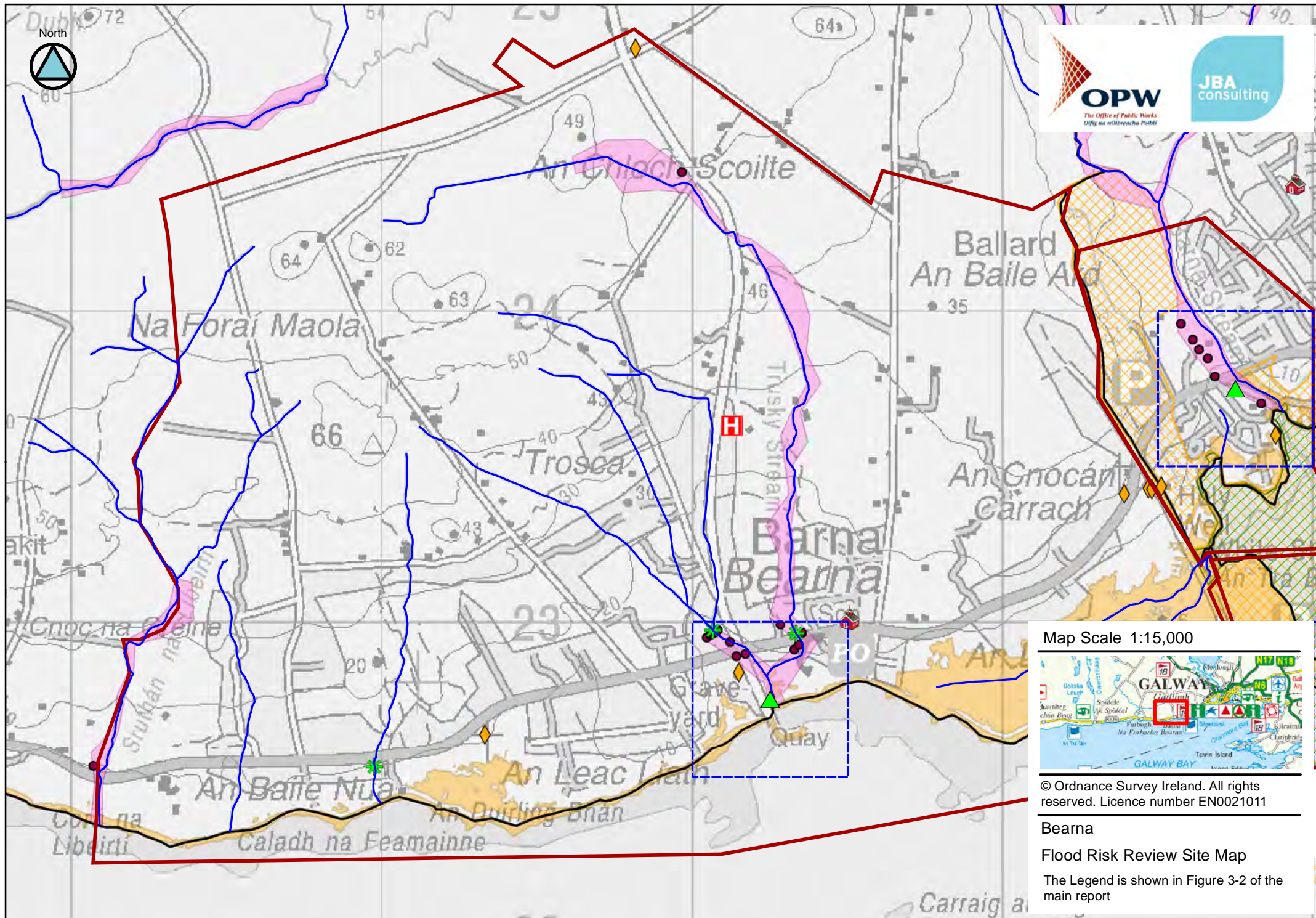
Map Legend	
	Flood Points
	Multiple / Recurring Flood Points
	Areas Flooded
	Hydrometric Stations
	Rivers
	Lakes
	River Catchment Areas
	Land Commission *
	Drainage Districts *
	Benefiting Lands *

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

0 Results

APPENDIX C

OPW Western CFRAM Bearna Site Assessment Report



Map Scale 1:15,000



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**Barna
Flood Risk Review Site Map**

The Legend is shown in Figure 3-2 of the main report

SITE ASSESSMENT



Job Title: Western CFRAM	JBA Job number: 2011s5232
	Sheet number: 1 of 5
Site Name: Bearna	UM Approval: Chris Smith

Name: Bearna	County: Galway	HA: 31	Unique ID: 310515												
Source of Flooding (Fluvial / Tidal): Fluvial		Type: Risk Review													
Visit By: Chris Smith		Date of Visit: 31/08/2011													
PFRA Data / Comments (taken from 110310_Final Database): <i>Predictive assessment indicates potentially significant flood risk exists (FRI Total > 250). No other strong evidence to indicate that the area is prone to significant flood risk. Risk Review and possible local study / minor works - Not an APSR</i>															
PFRA Database Comments (taken from 110309_ALL_VAL - Post Round Two - MA.mdb): <i>OPW comments No comment.</i> <i>LA comments Surface water drainage scheme complete-Fluvial, perhaps tidal-Question whether it is an APSR</i>															
Watercourses / Flood Sources: Trusky Stream to west of village and Cloghscoltia watercourse to west. They converge to the south of the R336 before flowing into the harbour.															
Maps: See Flood Risk Review Map below.															
Flood Outlines and Receptors: Total FRI score of 300, all receptors are listed in the table below with the majority of the score been formed from residential properties at fluvial risk in the 10% AEP flood outline. <table border="1"><tr><td>ID_1</td><td>31,471</td></tr><tr><td>Name</td><td>Bearna</td></tr><tr><td>TOTAL_FLUV</td><td>300</td></tr><tr><td>Res_tot_prob_F_S</td><td>200</td></tr><tr><td>Com_tot_prob_F_C</td><td>100</td></tr><tr><td>Total FRI Score</td><td>300</td></tr></table>				ID_1	31,471	Name	Bearna	TOTAL_FLUV	300	Res_tot_prob_F_S	200	Com_tot_prob_F_C	100	Total FRI Score	300
ID_1	31,471														
Name	Bearna														
TOTAL_FLUV	300														
Res_tot_prob_F_S	200														
Com_tot_prob_F_C	100														
Total FRI Score	300														
Comment on Flood Outlines: The PFRA mapping indicates only a small number of properties at risk and that they are at risk in high frequency flooding, 10% AEP. The flood outlines are made up of straight lines and right angles suggesting they are not very accurate. The site visit suggested that flooding in a 10% AEP event is unlikely. Properties are located close to the watercourses but culverts may limit the amount of flow reaching those areas. Communication with local resident suggested drainage scheme had been completed on the western watercourse diverting flows through a culvert and discharging near the harbour.															
Defence Assets and Structures: There are no formal flood defence assets. There did not appear to be any informal defences either protecting properties. There are several culverts in Bearna which carry the watercourse under houses and the R336 road.															
Flood alleviation works Minor works drainage scheme has been completed on Trusky Stream.															

Job Title:	Western CFRAM	JBA Job number:	2011s5232
		Sheet number:	2 of 5
Site Name:	Bearna	UM Approval:	Chris Smith

Environmental Impacts & Opportunities:
 Being situated on Galway Bay coastline, this AFA borders the Galway Bay Complex SAC and pNHA and Inner Galway Bay SPA, with small areas of the site falling within the AFA boundary. Galway Bay Complex SAC is designated for a range of coastal habitats, some freshwater habitats (e.g. turloughs, alkaline fens, and calcareous fens), semi-natural dry grasslands and juniper formations. The coastal habitats are likely to be of low vulnerability to flooding as they are naturally subject to tidal influence and likewise the freshwater habitats are tolerant of periodic/regular inundation, although prolonged or extreme flooding could have an adverse impact. The semi-improved dry grasslands and juniper formations are habitats not tolerant of flooding. The site is also important for Seal and Otter, which are likely to be of low vulnerability to flooding, although flooding of holts could have a significant impact.

The Inner Galway Bay SPA is designated for several species of seabird and wader. The impact of flooding on these SPA species is in general low, although some seabirds and wading species could be adversely impacted upon by inundation of intertidal feeding and roosting areas which require populations to move elsewhere.

27 monuments fall within the AFA.

Floodmaps.ie Data
 There is no recorded historical flooding on the site.

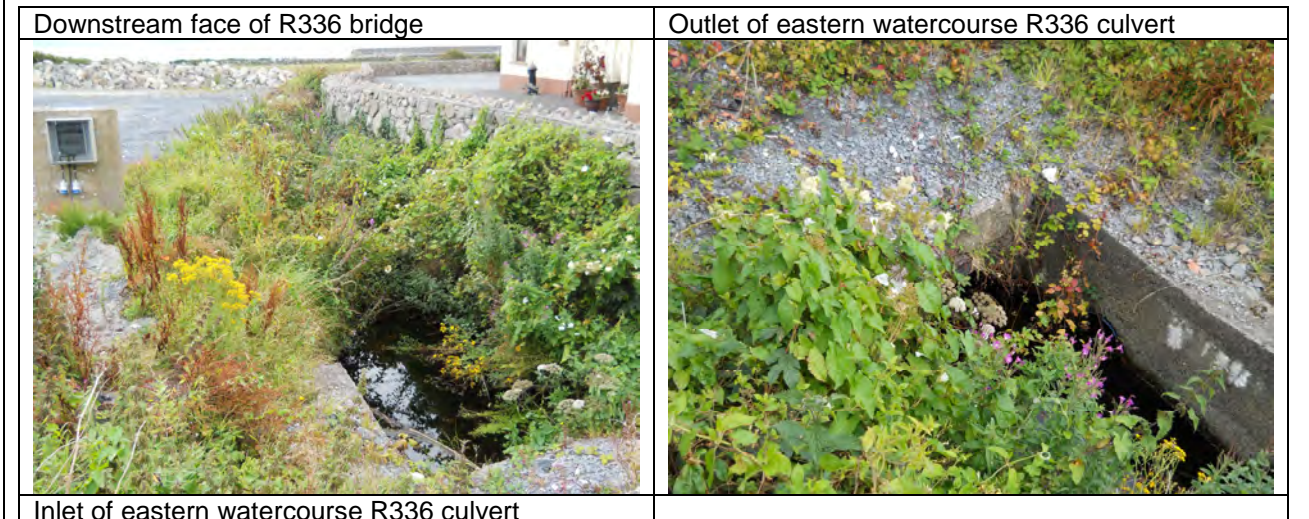
Other Relevant Information (e.g. web search, SFRA, other OPW studies and supplied data):
 Nothing found.

Discussions with Key Stakeholders:
 Progress group meeting reviewed the site and agreed there was not enough risk to take forward as an AFA.

Local resident mentioned some local flooding of land upstream of R336 on Cloghscoltia watercourse but not property flooding. Also mentioned some drainage works undertaken on Trusky Stream which outfall just upstream of the harbour. Previous to these works there had been flooding to one property.

Site Visit Findings:

Eastern Watercourse - Cloghscoltia
 Very small and overgrown watercourse. Small culvert under R336. Local suggestion of flooding to agricultural land upstream of this culvert. Risk from this watercourse is very limited. Blockage of culvert may result in localised flooding but water would likely flow over R336 and only cause limited property impact.



SITE ASSESSMENT

Job Title: Western CFRAM	JBA Job number: 2011s5232
Site Name: Bearna	Sheet number: 3 of 5
	UM Approval: Chris Smith





Western Watercourse – Trusky Stream

Watercourse is culverted and emerges for a short section in housing estate on upstream side of R336. Flows entering the open section will be limited by incoming culvert. Blockage on the screened inlet may cause flooding in this area but likely to be fairly localised.

Watercourse emerges for a short distance upstream of the R336 before flowing through a short culvert under the road. Blockage may cause risk to small number of properties in vicinity and the road. May also allow flow down road towards harbour.

Local resident suggested drainage works had been undertaken on this watercourse, involving new drainage pipe discharging excess flows near harbour.

Short open section in housing estate	Short open section in housing estate – showing inlet back into culverted system
	
Inlet of R336 culvert	Outlet of R336 culvert

SITE ASSESSMENT



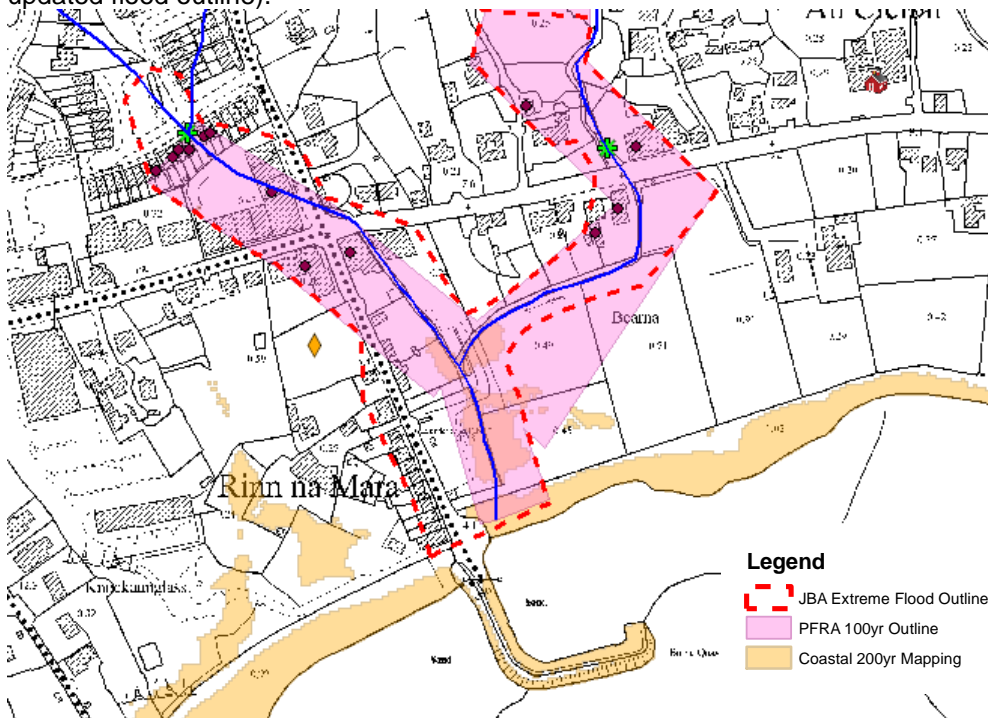
Job Title: **Western CFRAM**
Site Name: **Bearna**

JBA Job number: 2011s5232
Sheet number: 4 of 5
UM Approval: Chris Smith



Downstream section from confluence to harbour

Few properties in this area and watercourse is set a lower level in fields before outfall under bridge into harbour. Possible flow route along road to harbour if water is out of bank at the R336 junction which could impact an additional 10 properties. Drainage works in this area should limit this to an extreme event (see updated flood outline).



OSi Licence No. EN 0021011

SITE ASSESSMENT



Job Title: Western CFRAM	JBA Job number: 2011s5232
Site Name: Bearna	Sheet number: 5 of 5
	UM Approval: Chris Smith

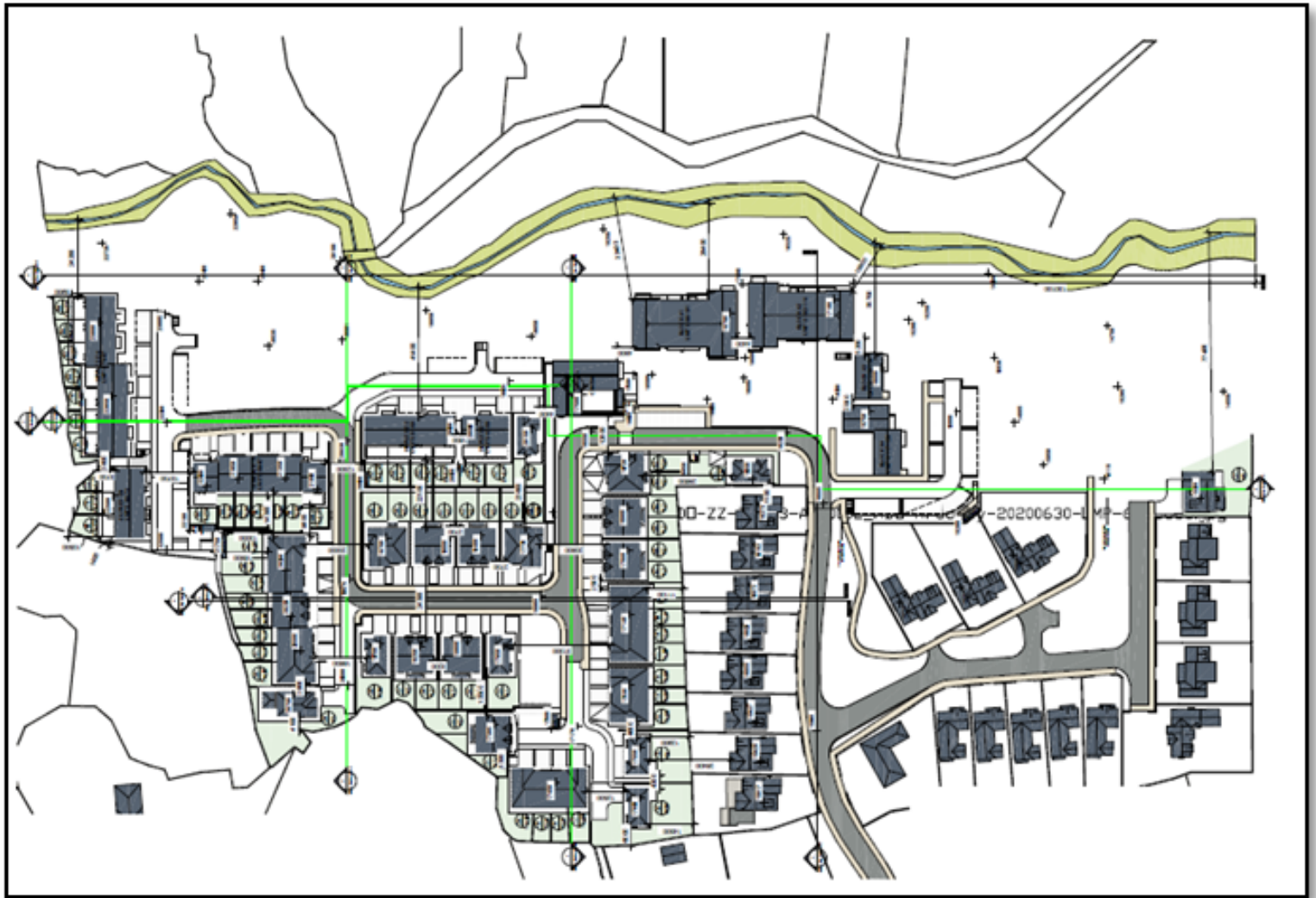
<p>View downstream towards harbour</p> 	<p>Coastline to west</p> 
<p>Bearna harbour</p> 	<p>Bridge where watercourse flows into harbour</p> 

Summary:
 Very limited receptors and flooding unlikely in 10% AEP flood event as suggested in PFRA, not least because drainage works have been carried out recently. Reducing property scores by a factor of 10 to reflect lower frequency of flooding suggests a FRI score below 50 and under the significance threshold.

Recommended FRR Status	Non AFA
-------------------------------	----------------

APPENDIX D

Architectural Layout Plan

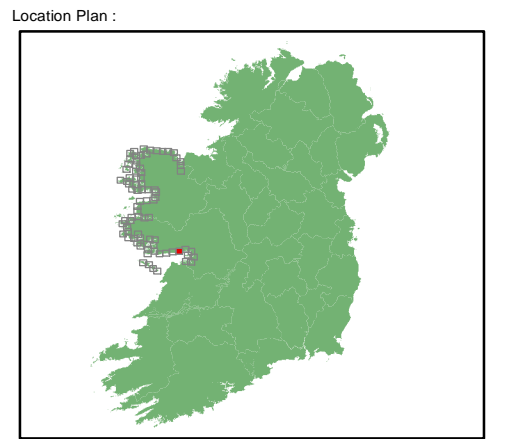
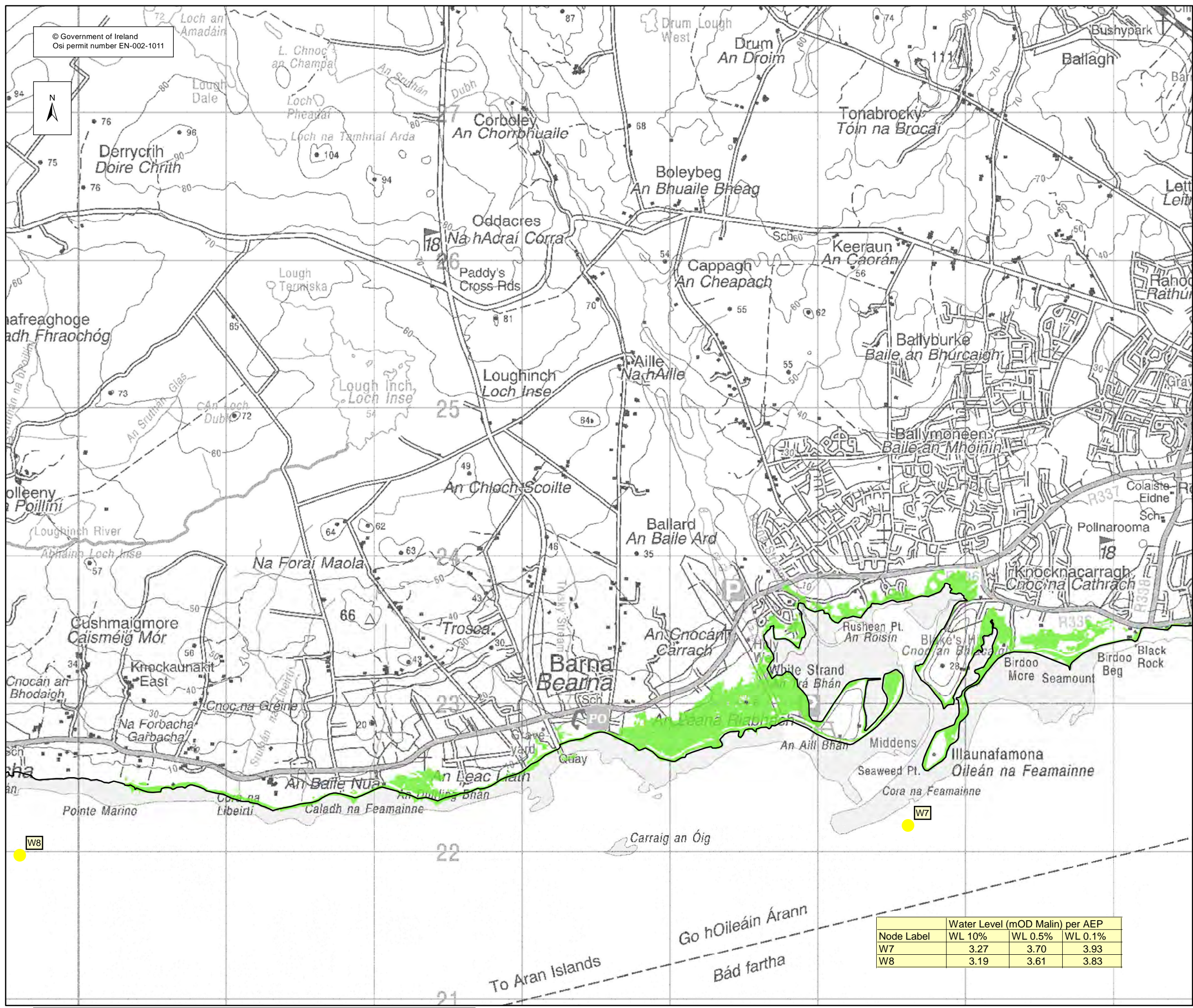


Proposed Site Layout

APPENDIX E

OPW's ICPSS Flood Risk Assessment Maps

© Government of Ireland
 Osi permit number EN-002-1011



EXTENT MAP

Legend:

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

USER NOTE:
 USERS OF THESE MAPS SHOULD REFER TO THE DETAILED DESCRIPTION OF THEIR DERIVATION, LIMITATIONS IN ACCURACY AND GUIDANCE AND CONDITIONS OF USE PROVIDED AT THE FRONT OF THIS BOUND VOLUME. IF THIS MAP DOES NOT FORM PART OF A BOUND VOLUME, IT SHOULD NOT BE USED FOR ANY PURPOSE.



Elmwood House
 74 Boucher Road
 Belfast
 BT 12 6RZ
 Northern Ireland



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

Project:
IRISH COASTAL PROTECTION STRATEGY STUDY - PHASE IV

Map:
WEST COAST FLOOD EXTENT MAP

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

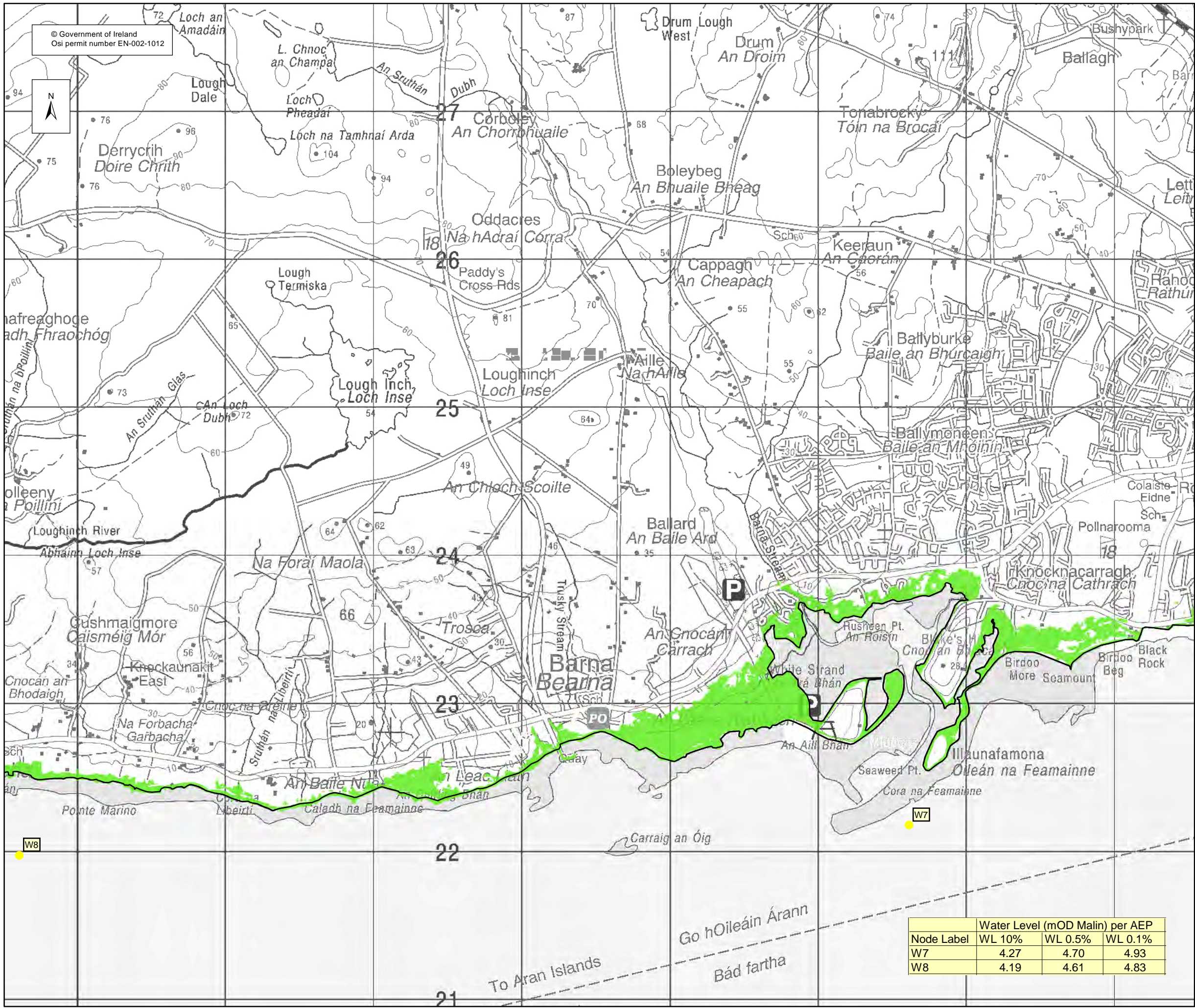
Figure By: PJW Date: JUN 2011
 Checked By: JMC Date: JUN 2011

Node Label	Water Level (mOD Malin) per AEP		
	WL 10%	WL 0.5%	WL 0.1%
W7	3.27	3.70	3.93
W8	3.19	3.61	3.83

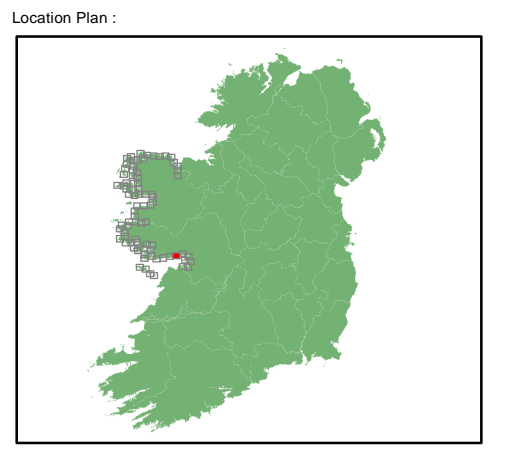
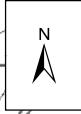


Figure No.: **W / RA / EXT / 11** Revision: **1**

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



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EXTENT MAP

Legend:

- 0.5% AEP FLOOD EXTENT (1 in 200 chance in any given year)
- 0.1% AEP FLOOD EXTENT (1 in 1000 chance in any given year)
- High Water Mark (HWM)
- Node Point
- W 15 Node Label (refer to table)

USER NOTE :

USERS OF THESE MAPS SHOULD REFER TO THE DETAILED DESCRIPTION OF THEIR DERIVATION, LIMITATIONS IN ACCURACY AND GUIDANCE AND CONDITIONS OF USE PROVIDED AT THE FRONT OF THIS BOUND VOLUME. IF THIS MAP DOES NOT FORM PART OF A BOUND VOLUME, IT SHOULD NOT BE USED FOR ANY PURPOSE.



Elmwood House
 74 Boucher Road
 Belfast
 BT 12 6RZ
 Northern Ireland



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

Project :
IRISH COASTAL PROTECTION STRATEGY STUDY - PHASE IV

Map :
WEST COAST FLOOD EXTENT MAP

Map Type : FLOOD EXTENT
 Source : TIDAL FLOODING
 Map area : RURAL AREA
 Scenario : HIGH END FUTURE SCENARIO

Figure By : PJW Date : Oct 2012
 Checked By : JMC & JR Date : Oct 2012

Node Label	Water Level (mOD Malin) per AEP		
	WL 10%	WL 0.5%	WL 0.1%
W7	4.27	4.70	4.93
W8	4.19	4.61	4.83

Figure No. :
W / RA / EXT / HEFS / 11

Revision :
0

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

APPENDIX F

Preliminary Flood Risk Assessment

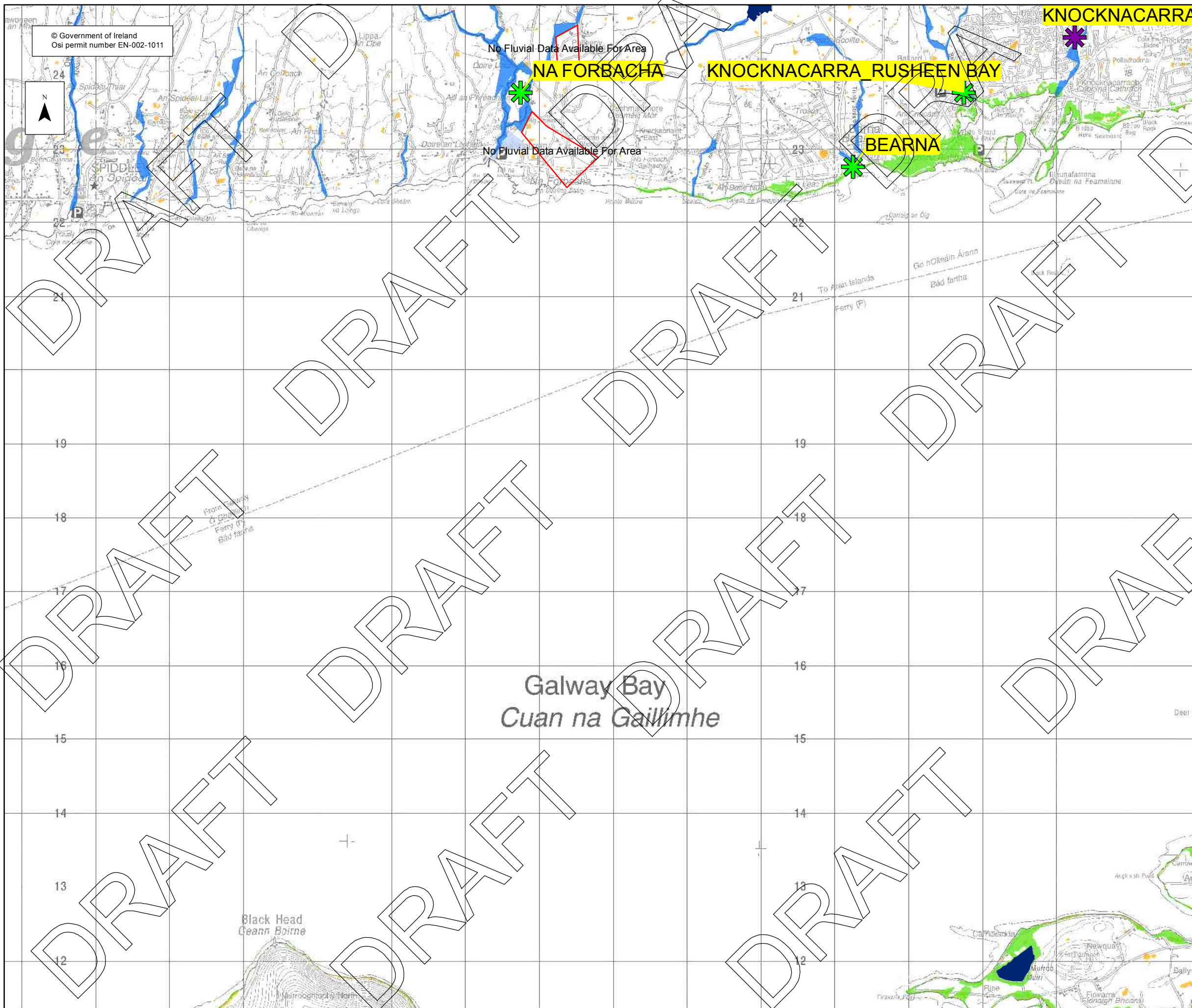
Figure AII.19 PFRA Flood Risk Areas – Central West (E)



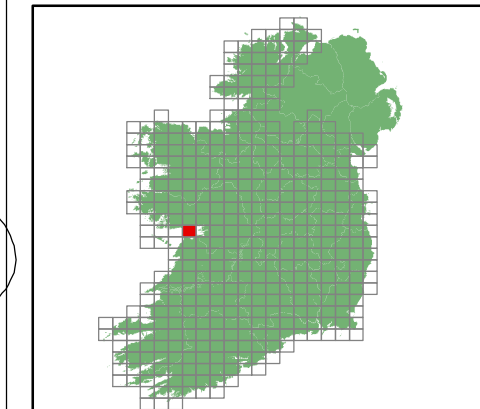
Figure AII.19 PFRA Flood Risk Areas - Central West (E)

APPENDIX G

OPW Preliminary Flood Risk Assessment



Location Plan :



Legend:

Flood Extents

- Fluvial - Indicative 1% AEP (100-yr) Event
- Fluvial - Extreme Event
- Coastal - Indicative 0.5% AEP (200-yr) Event
- Coastal - Extreme Event
- Pluvial - Indicative 1% AEP (100-yr) Event
- Pluvial - Extreme Event
- Groundwater Flood Extents

Lakes / Turloughs

- Lakes / Turloughs

PFRA Outcomes

- ✱ Probable Area for Further Assesment
- ✱ Possible Area for Further Assesment

Important User Note:

The flood extents shown on these maps are based on broad-scale simple analysis and may not be accurate for a specific location. Information on the purpose, development and limitations of these maps is available in the relevant reports (see www.cfram.ie). Users should seek professional advice if they intend to rely on the maps in any way.

If you believe that the maps are inaccurate in some way please forward full details by contacting the OPW (refer to PFRA Information leaflets or 'Have Your Say' on www.cfram.ie).

Office of Public Works
Jonathon Swift Street
Trim
Co Meath
Ireland



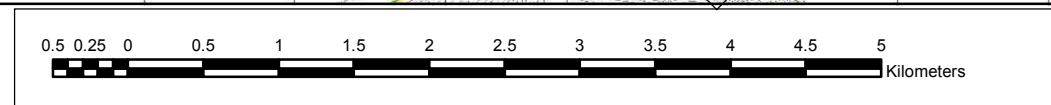
Project :
PRELIMINARY FLOOD RISK ASSESSMENT (PFRA)

Map :
PFRA Indicative extents and outcomes
- Draft for Consultation

Figure By : PJW Date : July 2011
Checked By : MA Date : July 2011

Figure No. : 2019 / MAP / 209 / A Revision : 0

Drawing Scale : 1:50,000 Plot Scale : 1:1 @ A3

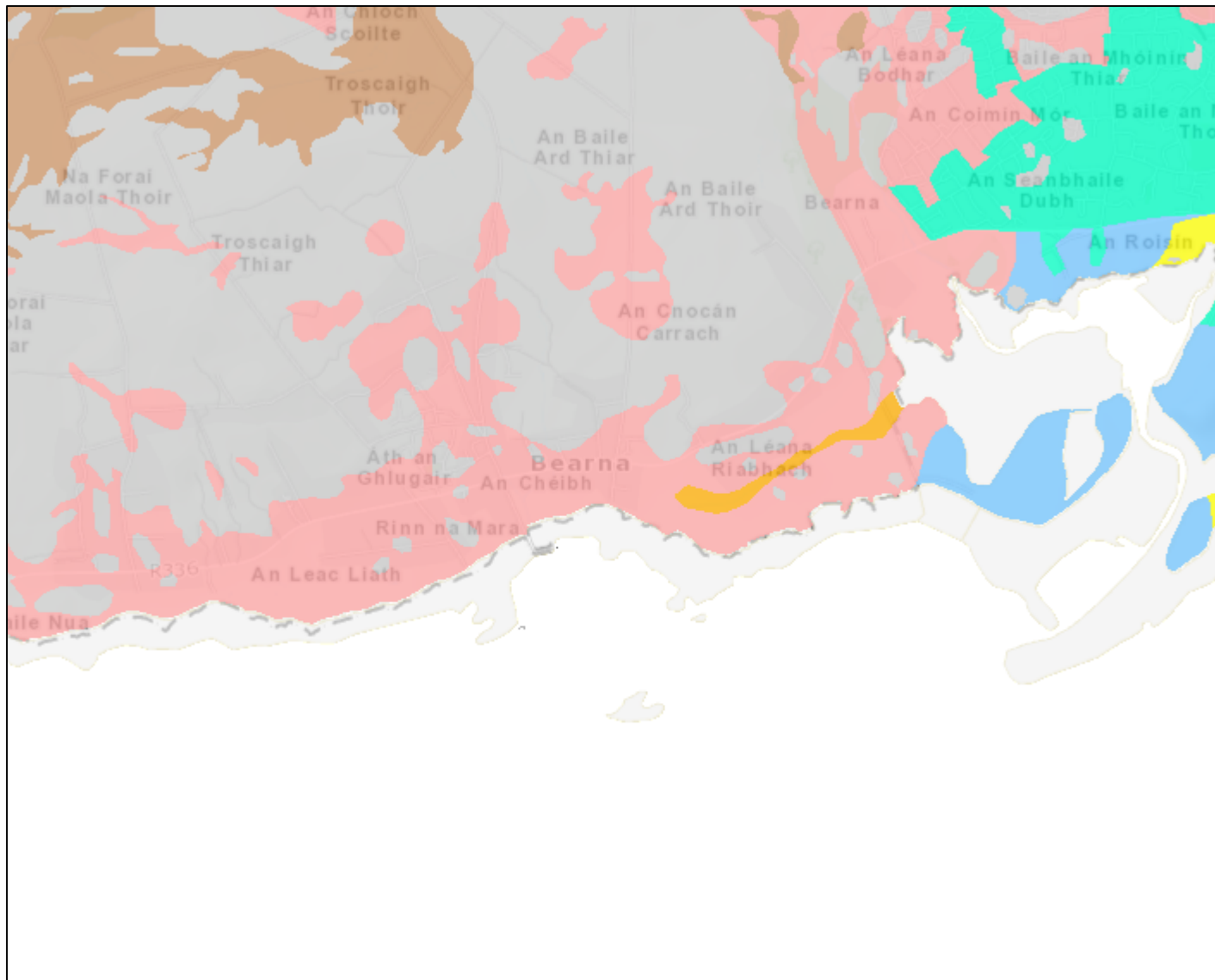


APPENDIX H

Geological Survey of Ireland Maps

Quarternary Sediments

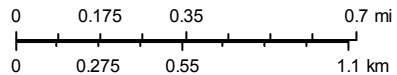
Legend



Scale: 1:25,000
Geological Survey Ireland

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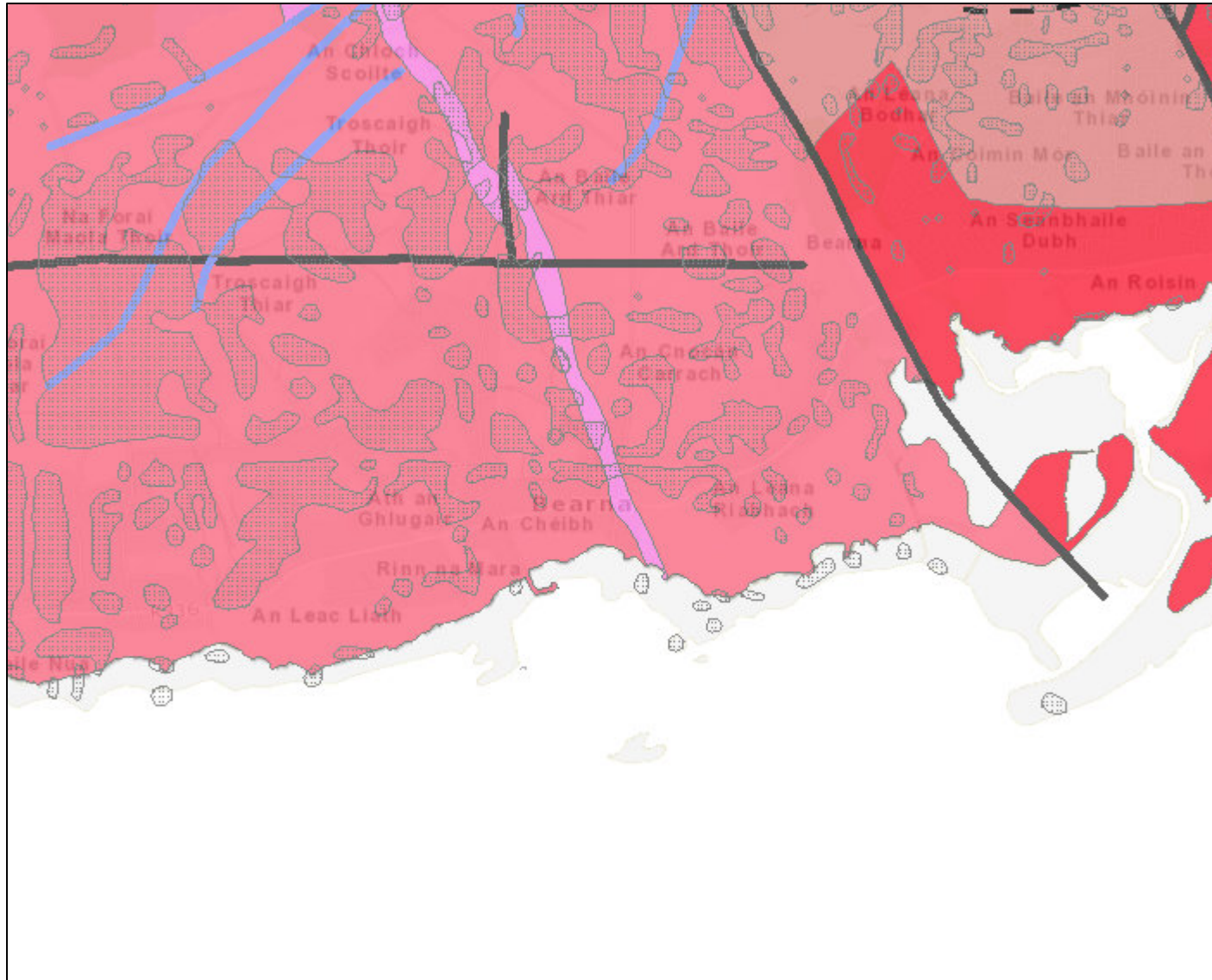
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Map Centre Coordinates (ITM) 523,563 722,870
22/05/2020, 04:31:59

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Bedrock



Legend

Structural Symbols 100K ITM 2018

- <all other values>
- ↑ Dip of bedding or main foliation, old GSI data
- ↔ First foliation parallel to bedding
- ↗ Foliation trend, Thorr and Rosses Granites
- ⊕ Horizontal Bedding
- ↖ Strike and dip of bedding, right way up
- ↗ Strike and dip of bedding, way up
- ↖ unknown
- ↗ Strike and dip of first foliation
- ↖ Strike and dip of overturned bedding
- ↗ Strike and dip of second foliation
- ↖ Strike and dip of third foliation
- ↗ Strike and plunge of first generation fold axis
- ↖ Strike and plunge of second generation fold axis
- ↗ Strike and plunge of third generation fold axis
- ⊕ Strike of vertical bedding/foliation
- ⊕ Strike of vertical first foliation

Bedrock Outcrops
100 ITM 2018

Bedrock Linework 100k ITM 2018

- ◆ Anticlinal Axis
- ◆ Antiformal axis
- Aquifer Boundary
- - Area
- Coal seam
- Dyke
- Fault

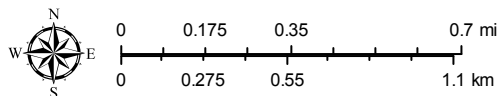
- Ghost Line
- Goniatite marine band (R1-R4)
- Lithological boundary offshore
- Metadolerite sheet, mainly sills
- Paleogene/ Tertiary Dyke
- Synclinal Axis
- Synformal axis
- Tectonic Slide, barbs on hanging-wall
- Thin stratigraphical unit, diagrammatic
- Thrust, barbs on hanging-wall side
- Tuff band
- Unconformity, dots on younger side
- X-Section

Scale: 1:25,000

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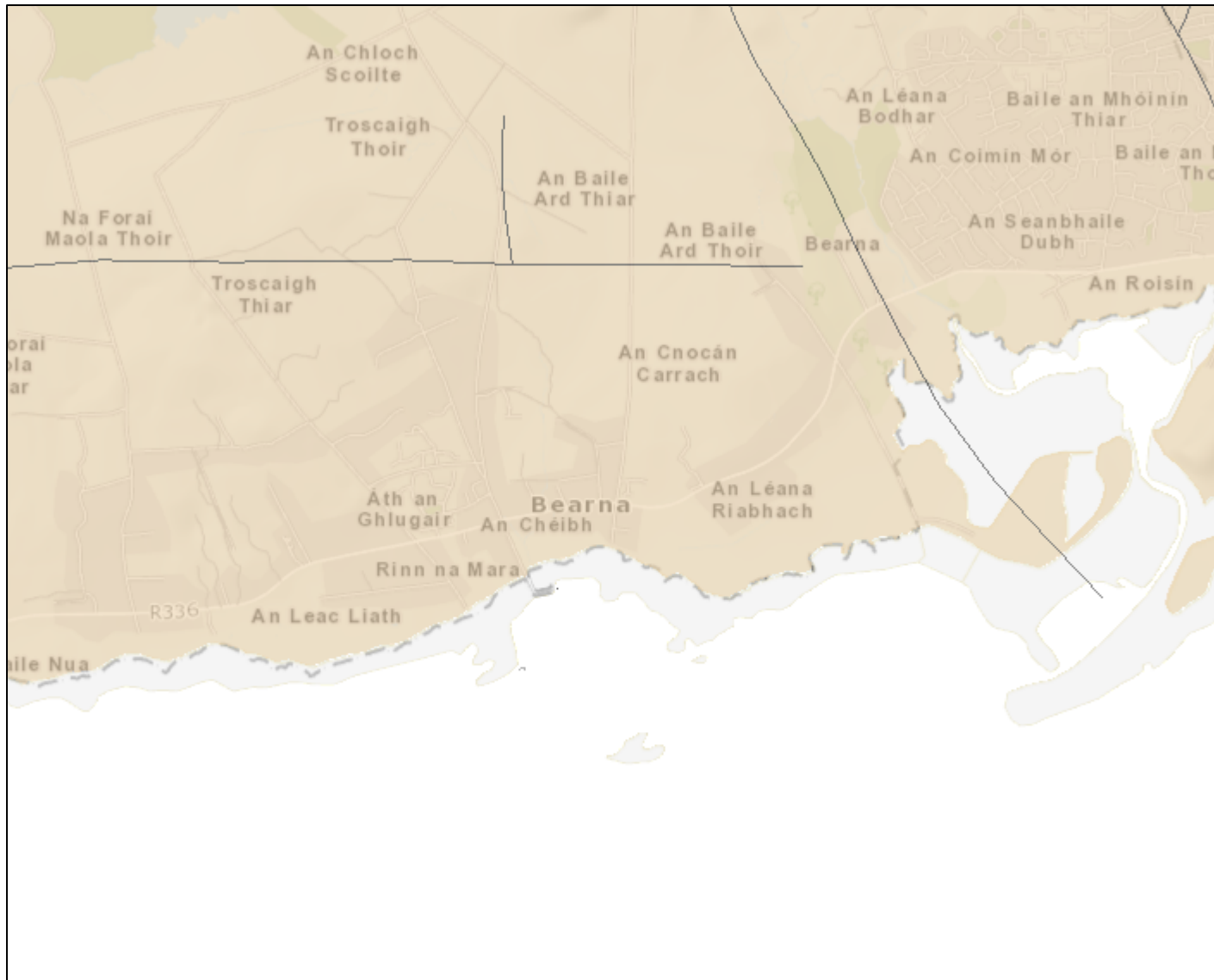
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Groundwater Aquifer and Karst







Legend

Karst Landforms

-  Borehole
-  Cave
-  Dry Valley
-  Enclosed Depression
-  Spring
-  Superficial Solution Features
-  Swallow Hole
-  Turlough

 Traced Underground Connections

Gravel Aquifer

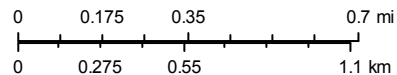
-  Locally important gravel aquifer
-  Regionally important gravel aquifer
-  Bedrock Aquifer
-  Faults

Scale: 1:25,000

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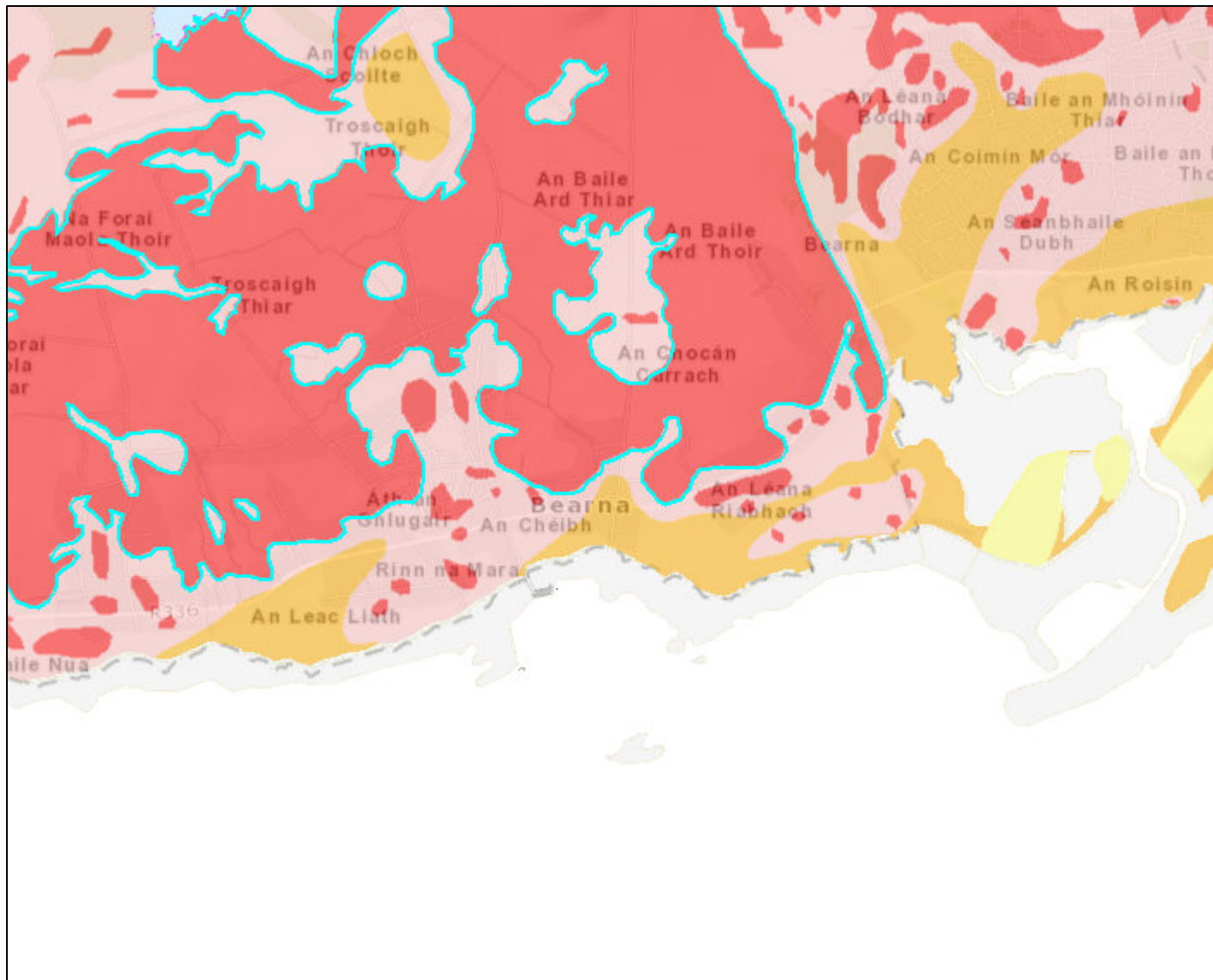
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Groundwater Vulnerability

Legend National Groundwater Vulnerability Ireland

- Rock at or near
- Surface or Karst
- Extreme
- High
- Moderate
- Low
- Water

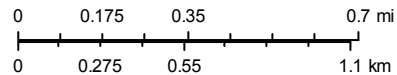


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OCSC

O'CONNOR | SUTTON | CRONIN

Multidisciplinary
Consulting Engineers

9 Prussia Street
Dublin 7
Ireland

T | +353 (0)1 8682000
F | +353 (0)1 8682100
W | www.ocsc.ie

Dublin | London | Abu Dhabi | Belfast | Cork | Galway | Glasgow | Libya | Poland | Romania | Russia