



## **Flood Risk Assessment**

Proposed Amendment Application at Tinahask, Arklow, County Wicklow.

October 2026

**Waterman Moylan Consulting Engineers Limited**

Block S, EastPoint Business Park, Alfie Byrne Road, Dublin 3  
[www.waterman-moylan.ie](http://www.waterman-moylan.ie)



**Client Name:** Castlethorn  
**Document Reference:** 25-035r.005 Flood Risk Assessment  
**Project Number:** 25-035

### Quality Assurance – Approval Status

This document has been prepared and checked in accordance with  
Waterman Group's IMS (BS EN ISO 9001: 2015, BS EN ISO 14001: 2015)

---

| Issue | Date      | Prepared by | Checked by | Approved by                                                                         |
|-------|-----------|-------------|------------|-------------------------------------------------------------------------------------|
| No. 1 | Oct. 2026 | J. Muhia    | I. Worrell |  |

**Comments**

---

## Disclaimer

This report has been prepared by Waterman Moylan, with all reasonable skill, care and diligence within the terms of the Contract with the Client, incorporation of our General Terms and Condition of Business and taking account of the resources devoted to us by agreement with the Client.

We disclaim any responsibility to the Client and others in respect of any matters outside the scope of the above.

This report is confidential to the Client and we accept no responsibility of whatsoever nature to third parties to whom this report, or any part thereof, is made known. Any such party relies on the report at its own risk.

## Content

|           |                                                   |           |
|-----------|---------------------------------------------------|-----------|
| <b>1.</b> | <b>Introduction .....</b>                         | <b>1</b>  |
| <b>2.</b> | <b>Subject Site .....</b>                         | <b>2</b>  |
| 2.1       | Existing Site Location.....                       | 2         |
| 2.2       | Existing Site Description .....                   | 3         |
| 2.3       | Existing Watercourses .....                       | 3         |
| 2.4       | Existing Surface Water Catchment .....            | 4         |
| 2.5       | Proposed Development .....                        | 5         |
| <b>3.</b> | <b>Flood Risk .....</b>                           | <b>7</b>  |
| 3.1       | Introduction .....                                | 7         |
| 3.1.1     | Assessing Likelihood.....                         | 8         |
| 3.1.2     | Assessing Consequence .....                       | 8         |
| 3.1.3     | Assessing Risk.....                               | 8         |
| 3.2       | Flood Zones .....                                 | 9         |
| 3.3       | Sequential Approach and Justification Test.....   | 9         |
| 3.3.1     | Sequential Approach.....                          | 9         |
| 3.3.2     | Justification Test .....                          | 11        |
| 3.4       | Site Specific Flood Risk Assessment Summary ..... | 12        |
| 3.4.1     | Climate Change Allowances .....                   | 12        |
| <b>4.</b> | <b>Coastal Flooding – Irish Sea .....</b>         | <b>14</b> |
| 4.1       | Source .....                                      | 14        |
| 4.2       | Pathway .....                                     | 14        |
| 4.3       | Likelihood .....                                  | 14        |
| 4.4       | Consequence .....                                 | 16        |
| 4.5       | Risk .....                                        | 17        |
| 4.6       | Flood Risk Mitigation Measures .....              | 17        |
| <b>5.</b> | <b>Fluvial Flooding .....</b>                     | <b>18</b> |
| 5.1       | Source .....                                      | 18        |
| 5.2       | Pathway .....                                     | 18        |
| 5.3       | Likelihood .....                                  | 19        |
| 5.4       | Consequence .....                                 | 19        |
| 5.5       | Risk .....                                        | 19        |
| 5.6       | Flood Risk Mitigation Measures .....              | 19        |
| <b>6.</b> | <b>Pluvial .....</b>                              | <b>20</b> |
| 6.1       | Source .....                                      | 20        |
| 6.2       | Pathways & Receptors.....                         | 20        |

|           |                                                                                                  |           |
|-----------|--------------------------------------------------------------------------------------------------|-----------|
| 6.3       | Likelihood .....                                                                                 | 20        |
| 6.3.1     | Surcharging of the proposed internal drainage systems leading to internal flooding ....          | 20        |
| 6.3.2     | Surcharging from the existing surrounding drainage system leads to flooding within the site..... | 20        |
| 6.3.3     | Surface water discharge from the subject site leads to downstream flooding .....                 | 21        |
| 6.3.4     | Overland flooding from surrounding areas flowing onto subject site .....                         | 22        |
| 6.3.5     | Overland flooding from the subject site flowing onto surrounding areas .....                     | 22        |
| 6.4       | Consequence .....                                                                                | 23        |
| 6.5       | Risk .....                                                                                       | 23        |
| 6.6       | Flood Risk Mitigation Measures .....                                                             | 23        |
| 6.7       | Residual Risk .....                                                                              | 24        |
| <b>7.</b> | <b>Groundwater .....</b>                                                                         | <b>25</b> |
| 7.1       | Source .....                                                                                     | 25        |
| 7.2       | Pathway .....                                                                                    | 25        |
| 7.3       | Receptor.....                                                                                    | 25        |
| 7.4       | Likelihood .....                                                                                 | 25        |
| 7.5       | Consequence .....                                                                                | 26        |
| 7.6       | Risk .....                                                                                       | 26        |
| <b>8.</b> | <b>Human / Mechanical Errors .....</b>                                                           | <b>27</b> |
| 8.1       | Source .....                                                                                     | 27        |
| 8.2       | Pathway .....                                                                                    | 27        |
| 8.3       | Receptor.....                                                                                    | 27        |
| 8.4       | Likelihood .....                                                                                 | 27        |
| 8.5       | Consequence .....                                                                                | 27        |
| 8.6       | Risk .....                                                                                       | 27        |
| 8.7       | Flood Risk Mitigation Measures .....                                                             | 27        |
| 8.8       | Residual Risk .....                                                                              | 27        |
| <b>9.</b> | <b>Conclusions and Recommendations .....</b>                                                     | <b>28</b> |

## List of Figures

|                                                                                              |    |
|----------------------------------------------------------------------------------------------|----|
| Figure 2-1: Site Location Map .....                                                          | 2  |
| Figure 2-2: Aerial view of Subject Site (Google Maps).....                                   | 3  |
| Figure 2-3: Subject Site Location relative to Existing Watercourses (Source: EPA Maps) ..... | 4  |
| Figure 2-4: EPA Water Maps Extract - WFD Surface Water Catchment Details .....               | 5  |
| Figure 3-1: Source-Pathway-Receptor S-P-R Model .....                                        | 7  |
| Figure 3-2: Indicative flood zone map extract from the Guidelines (DEHLG/OPW) .....          | 9  |
| Figure 3-3: Sequential Approach Principles in Flood Risk Management .....                    | 10 |
| Figure 3-4: Sequential Approach Mechanisms .....                                             | 10 |
| Figure 3-5: Vulnerability Classes .....                                                      | 11 |
| Figure 3-6: Climate Change Allowances by Vulnerability (SFRA) .....                          | 12 |
| Figure 4-1: Google Earth Extract showing Coastal Flooding Pathway .....                      | 14 |

## List of Tables

|                                                                              |    |
|------------------------------------------------------------------------------|----|
| Table 3-1 Guidelines for Assessing Likelihood .....                          | 8  |
| Table 3-2 3x3 Risk Matrix .....                                              | 8  |
| Table 3-3 Flood Zone Types according to the Guidelines (DEHLG/OPW) .....     | 9  |
| Table 3-4: Matrix of vulnerability vs. flood zone - Justification Test ..... | 12 |
| Table 6-1: Pluvial Pathway and Receptor Summary .....                        | 20 |
| Table 9-1: Summary of Flood Risks for the Site.....                          | 28 |

## Appendices

### A. Overland Flood Route

## 1. Introduction

This report has been prepared by Waterman Moylan Engineering Consultants, on behalf of the Client, Castlethorn, as part of an amendment application for a proposed development of 352 residential units with a creche located at Tinahask, Arklow in County Wicklow. This submission is an amendment to a previously granted scheme under Wicklow County Council Planning Reg. Ref. 24/325.

This Flood Risk Assessment has been carried out in accordance with the DEHLG/OPW Guidelines on the Planning Process and Flood Risk Management published in November 2009. This Assessment identifies and sets out possible mitigation measures against potential risks of flooding from various sources. Sources of possible flooding include coastal/tidal, fluvial (rivers), pluvial (rainfall), groundwater, and human error.

This report provides an assessment of the subject site for flood risk purposes only.

## 2. Subject Site

### 2.1 Existing Site Location

The subject site is located to the southeast of Arklow town at Tinahask Upper in County Wicklow. The site is greenfield in nature bounded by agricultural lands to the north, east and south. The Dublin – Rosslare railway line bounds the site to the west.

The area of the works included in this application measures c. 12.7 hectares (ha). The approximate Irish Grid Co-ordinates of the site are X: 324147; Y: 171932

Refer to the figure below for the location of the subject site.

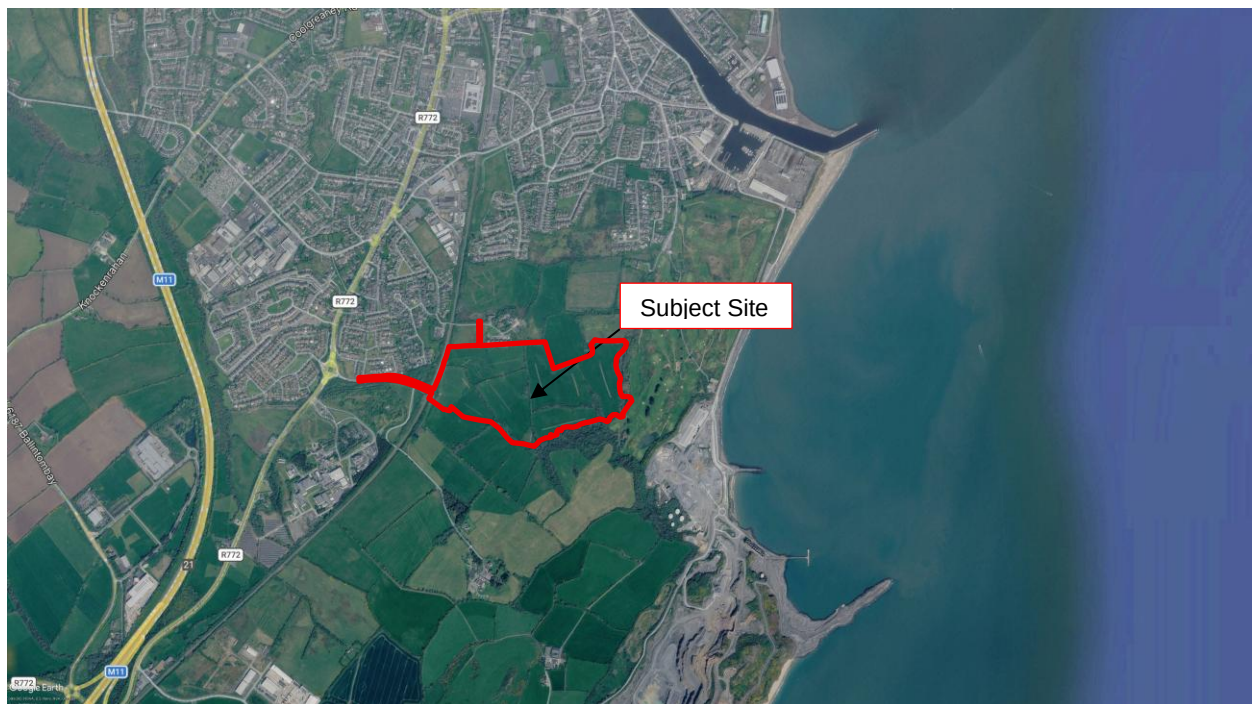


Figure 2-1: Site Location Map

A zoomed-in aerial view of the subject site and surrounds can be seen in Figure 2-2.



Figure 2-2: Aerial view of Subject Site (Google Maps)

## 2.2 Existing Site Description

The existing site is greenfield in nature currently in use for agricultural purposes. There is an existing 2m deep ditch which naturally drains the site running from northwest to east. The site topography falls from west to southeast whilst also locally falling towards the existing ditch line. The highest point on the site is 36.6m AOD along the western boundary, with the lowest surveyed level of 12.0m AOD at the southeastern boundary.

The main vehicular access to the site is via an existing bridge over the Irish Rail line to the southwest of the site. The proposed Southern Port Access Road (SPAR) will form part of the southern boundary of the site. It is proposed to construct approximately 90m of the SPAR as part of this amendment application.

## 2.3 Existing Watercourses

The Environmental Protection Agency (EPA) Water Maps available from their website were consulted to identify the existing watercourses in the vicinity of the subject site. Refer to Figure 2-3 below for an extract of the EPA water map showing the location of the subject site in relation to the existing watercourses in the vicinity of the site.



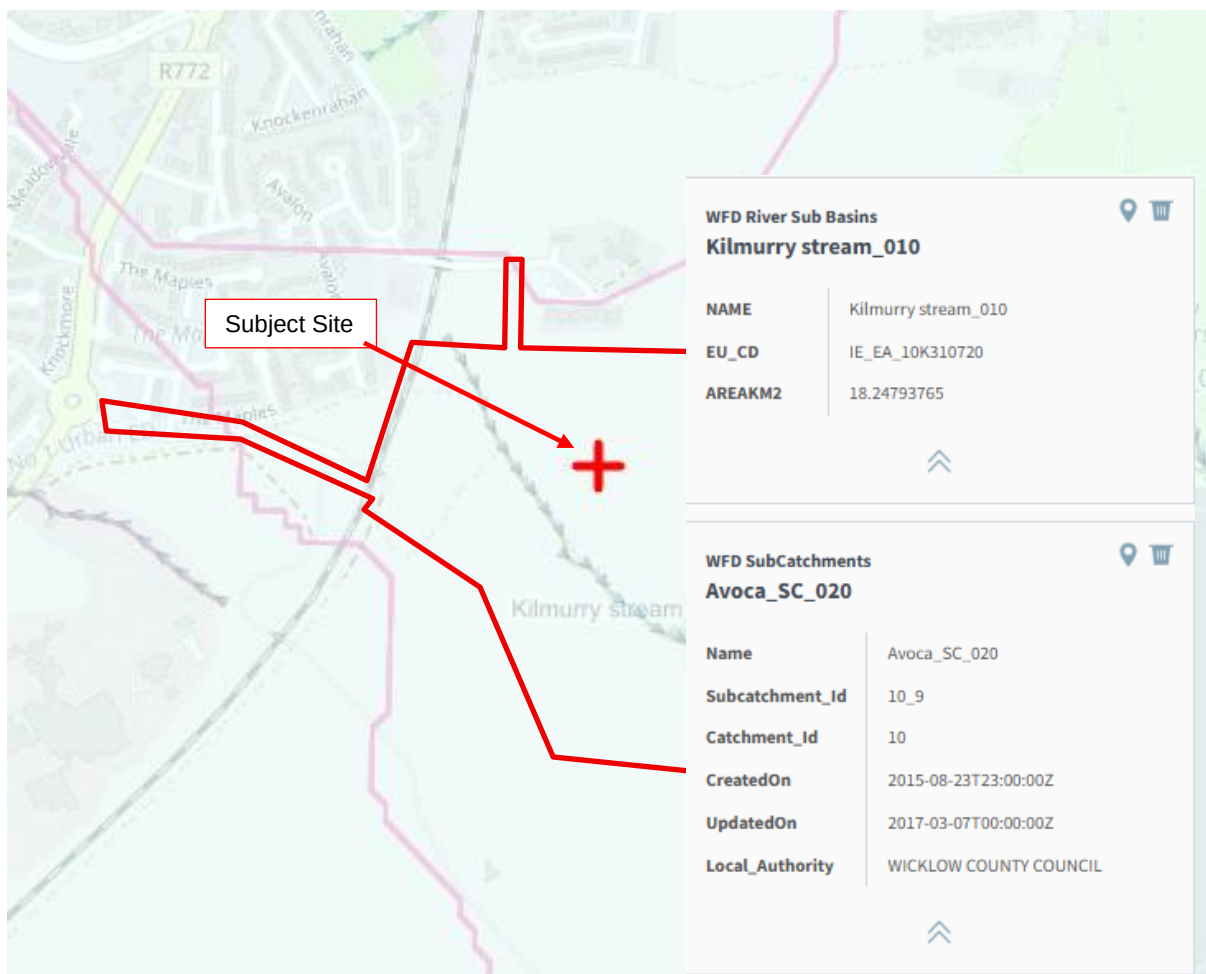


Figure 2-4: EPA Water Maps Extract - WFD Surface Water Catchment Details

The subject site is drained by the Tinahask Lower Stream (recorded as the 'Kilmurry Stream' in EPA Water Framework Directive mapping), which forms part of the wider Avoca River Catchment within the Ovoca-Vartry Management Catchment (Hydrometric Area 10). The Tinahask Lower Stream flows through the site in a northwest to east direction, ultimately discharging to the Irish Sea. The site also has a small pond within a low lying area where water is not free to percolate into the ground due to the underlying sub-soil conditions and where no gravity outfall is available.

## 2.5 Proposed Development

- The proposed development comprises amendments to the Large-scale Residential Development permitted under WCC Reg. Ref. 24/325 consisting 352no. residential units proposed in a mix of houses and apartment units comprising 334no. houses (44no. 2-bedroom, 241no. 3-bedroom and 49no. 4-bedroom) ranging from 2 to 3 storeys, 18no. apartments (6no. 1-bedroom and 12no. 2-bedroom) in 1no. 4 storey building, 1no. creche (c. 711 sqm) at ground floor of apartment Block A; and all associated and ancillary site development works including on site attenuation, hard and soft landscaping and

boundary treatment works, including public open space; communal open space, public lighting; surface car parking; bicycle parking store for apartment units; 4no. ESB substations; bin stores; vehicular access via existing Northwood Road and railway overbridge from Knockmore roundabout. The proposed development also includes road upgrade works to the existing railway overbridge and the western approach to same including the provision of a 2.5m footpath, 6m carriageway, safety barrier improvement works and other ancillary works required to facilitate these elements.

### 3. Flood Risk

#### 3.1 Introduction

The flood risk assessment of a development should be carried out in accordance with the Planning System and Flood Risk Management Guidelines for Planning Authorities (2009), published by the Department of Environment, Heritage and Local Government in conjunction with the Office of Public Works (EHLG/OPW). This document will be referred to as the 'Guidelines (EHLG/OPW)' in this report.

The types of possible flooding to be considered in the identification and assessment of flood risk are described in Chapter 2 of the Guidelines (EHLG/OPW) and are summarised below:

- Coastal – flooding from higher sea levels than normal
- Fluvial – flooding from watercourses
- Pluvial – flooding from heavy rainfall/surface water
- Ground Water – flooding from springs / raised groundwater
- Human/mechanical error – flooding due to human or mechanical error

Each type will be investigated from a Source, Pathway and Receptor perspective, followed by an assessment of the likelihood of a flood occurring, and the possible consequences. An illustration of this model can be seen in Figure 3-1, taken directly from the Guidelines (EHLG/OPW).

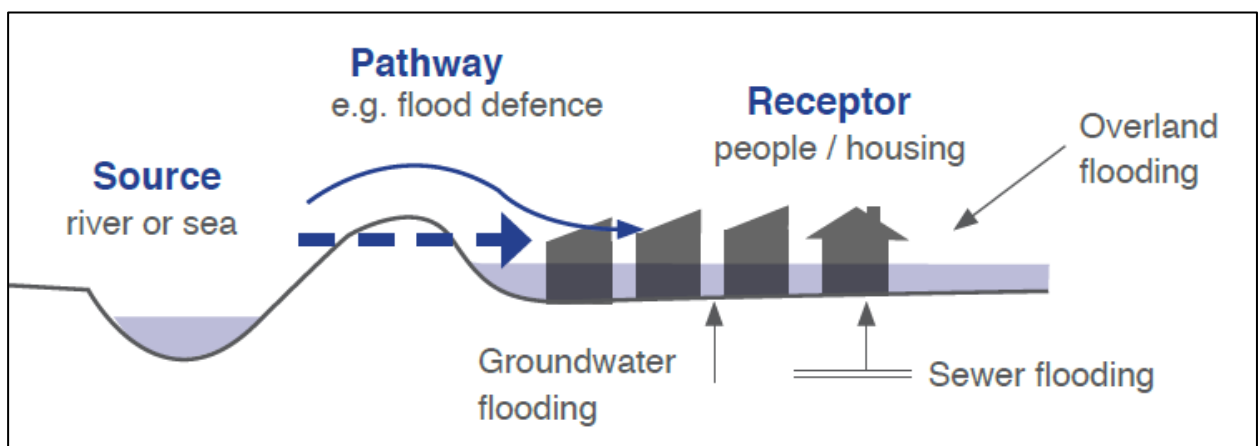


Figure 3-1: Source-Pathway-Receptor S-P-R Model

A flood risk assessment combines these above components and maps or describes the risks on a spatial scale so that the consequences can then be analysed.

The likelihood and the consequences of flooding (overall risk) fall into three categories; low, moderate and high, as described in the Guidelines (EHLG/OPW) and set out in Table 3-1.

The aim of a flood risk assessment is to establish the risk of flooding for a subject site, this can be assessed using two components, summarised below:

**Flood Risk = Likelihood of flooding X Consequences of flooding**

### 3.1.1 Assessing Likelihood

The likelihood of flooding falls into the categories of low, moderate and high, which are described in the Guidelines (EHLG/OPW) as follows:

**Table 3-1 Guidelines for Assessing Likelihood**

| LIKELIHOOD | LOW                | MODERATE                  | HIGH               |
|------------|--------------------|---------------------------|--------------------|
| Coastal    | Probability < 0.1% | 0.5% > probability > 0.1% | Probability > 0.5% |
| Fluvial    | Probability < 0.1% | 1.0% > probability > 0.1% | Probability > 1.0% |
| Pluvial    | Probability < 0.1% | 1.0% > probability > 0.1% | Probability > 1.0% |

Note: Probability denotes the likelihood of occurrence in a given year.

For groundwater flooding and flooding from human/mechanical error, the limits of probability are not defined and therefore professional judgement is used. However, the likelihood of flooding is still categorised as low, moderate and high for these components.

### 3.1.2 Assessing Consequence

There is no defined method used to quantify a value for the consequences of a flooding event. Therefore, in order to determine a value for the consequences of a flooding event, the elements likely to be adversely affected by such flooding will be assessed, with the likely damage being stated, and professional judgement will be used to determine a value for consequences. Consequences will also be categorized as low, moderate, and high.

### 3.1.3 Assessing Risk

Based on the determined 'likelihood' and 'consequences' values of a flood event and the above equation of Flood Risk = Likelihood of flooding X Consequences of flooding, the 3x3 Risk Matrix seen in Table 3-2 will then be used to determine the overall risk of a flood event.

**Table 3-2 3x3 Risk Matrix**

|            |          | CONSEQUENCES       |               |                     |
|------------|----------|--------------------|---------------|---------------------|
|            |          | LOW                | MODERATE      | HIGH                |
| LIKELIHOOD | LOW      | Extremely Low Risk | Low Risk      | Moderate Risk       |
|            | MODERATE | Low Risk           | Moderate Risk | High Risk           |
|            | HIGH     | Moderate Risk      | High Risk     | Extremely High Risk |

## 3.2 Flood Zones

Flood zones are used to identify the likelihood, and therefore vulnerability, of flooding in a particular area. The zones are geographical areas with associated ranges of the likelihood of flooding and are essential in the creation of flood risk management plans. According to the Guidelines (DEHLG/OPW) flood zones can be categorised into 3 types or levels of flood zones, namely:

Table 3-3 Flood Zone Types according to the Guidelines (DEHLG/OPW)

| Type          | Description                                                                  | Probability of flooding                                                                                                            |
|---------------|------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------|
| <b>Zone A</b> | Where the probability of flooding from rivers and the sea is <u>highest</u>  | Greater than 1% (1:100 year) for fluvial flooding, or greater than 0.5% (1:200 year) for coastal flooding                          |
| <b>Zone B</b> | Where the probability of flooding from rivers and the sea is <u>moderate</u> | Between 0.1% (1:1000 year) & 1% (1:100 year) for fluvial flooding, and 0.1% (1:1000 year) & 0.5% (1:200 year) for coastal flooding |
| <b>Zone C</b> | Where the probability of flooding from rivers and the sea is <u>low</u>      | Less than 0.1% (1:1000 year) for both fluvial and coastal flooding                                                                 |

Flood zone maps are used to establish the level of flooding for a site, an example of this can be seen in the indicative map shown in Figure 3-2.



Figure 3-2: Indicative flood zone map extract from the Guidelines (DEHLG/OPW)

## 3.3 Sequential Approach and Justification Test

### 3.3.1 Sequential Approach

A sequential approach to planning is a vital tool in ensuring that development, particularly new development, is first and foremost directed towards the land that is at low risk of flooding. Sequential approaches are already established and working effectively in other areas in the plan-making and development management processes. The sequential approach principles are described in Figure 3-3, taken from the

Guidelines (DEHLG/OPW). The sequential approach should be applied to all stages of the planning and development management process, particularly the planning stage. The mechanism for use of the sequential approach can be seen in Figure 3-4.

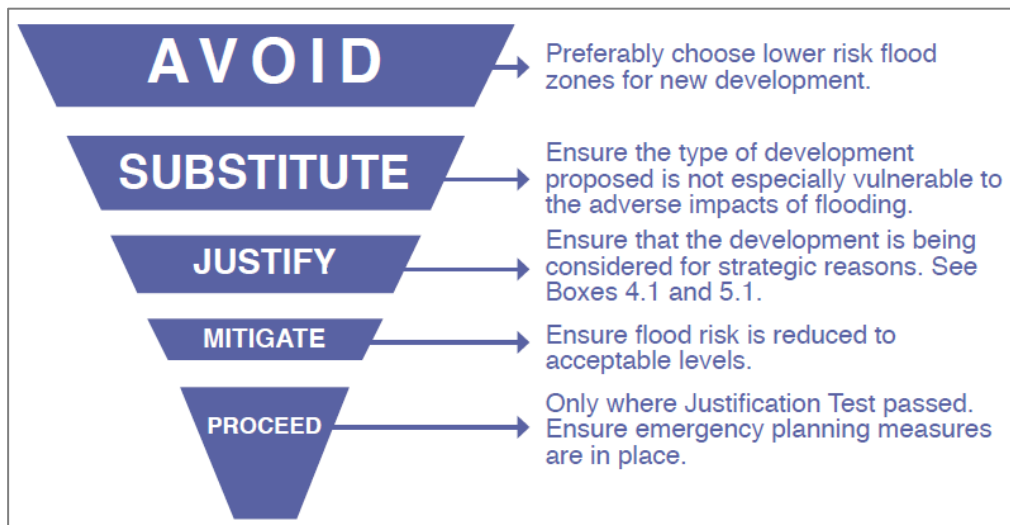


Figure 3-3: Sequential Approach Principles in Flood Risk Management

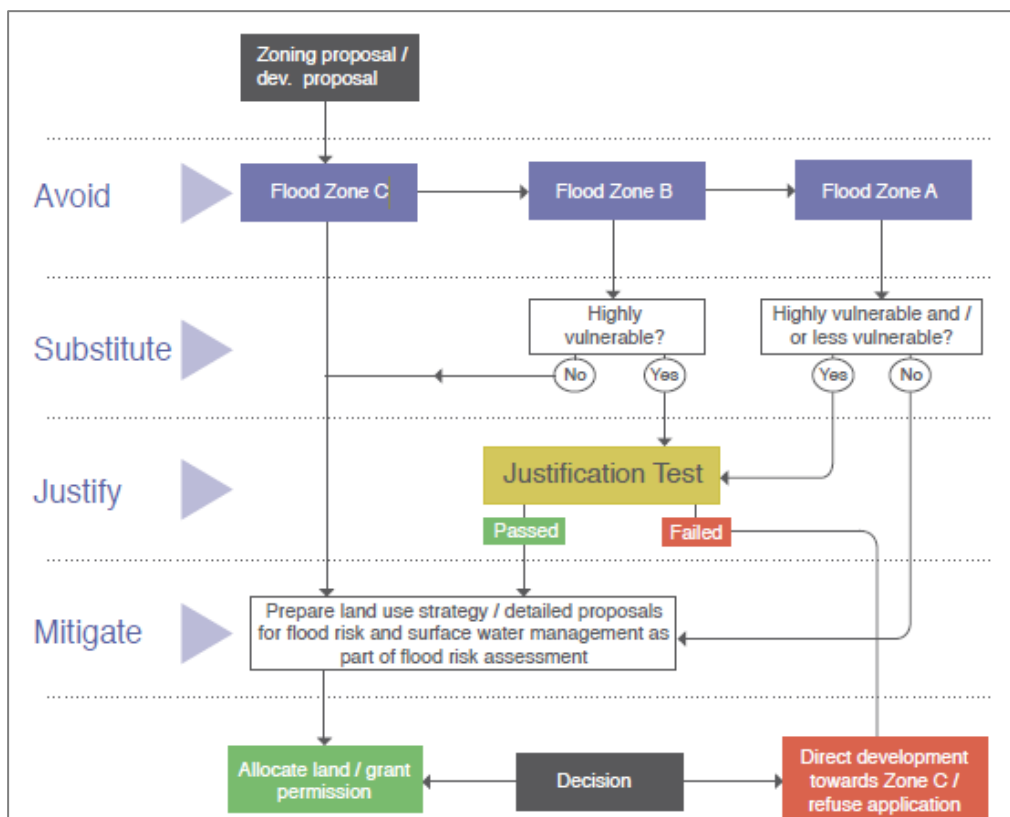


Figure 3-4: Sequential Approach Mechanisms

If the subject site does not fall within the 'Avoid' or 'Substitute' tiers of the sequential approach principle, a Justification test is required.

### 3.3.2 Justification Test

A matrix of vulnerability versus flood zone clearly outlines which types of development require a Justification Test. The vulnerability of a site is categorized into 3 levels, highly vulnerable, less vulnerable, and water compatible. Figure 3-5 taken from the Guidelines (DEHLG/OPW) illustrates these categories.

| Vulnerability class                                                       | Land uses and types of development which include*:                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
|---------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Highly vulnerable development (including essential infrastructure)</b> | <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> |
| <b>Less vulnerable development</b>                                        | <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>                                                                                                                                                                                                                                                                                                                                                                |
| <b>Water-compatible development</b>                                       | <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>                                                                                                                                                           |

\*Uses not listed here should be considered on their own merits

Figure 3-5: Vulnerability Classes

The resulting matrix of vulnerability vs. flood zone, taken from the Guidelines (DEHLG/OPW), illustrates which type of developments require a Justification Test, and can be seen below.

- **The Subject Site's Vulnerability Class**

As this subject site falls within the 'Highly-vulnerable development' category according to Figure 3-5, when assessing the matrix vs. vulnerability of the development – with a Flood Zone C development – it is considered to be an “appropriate” development and therefore does not require a Justification Test to be completed. Refer to Table 3-4 for the matrix of vulnerability vs. flood zone relevant to the subject site.

Table 3-4: Matrix of vulnerability vs. flood zone - Justification Test

| Type                          | Flood Zone A       | Flood Zone B       | Flood Zone C |
|-------------------------------|--------------------|--------------------|--------------|
| Highly vulnerable development | Justification Test | Justification Test | Appropriate  |
| Less vulnerable development   | Justification Test | Appropriate        | Appropriate  |
| Water compatible development  | Appropriate        | Appropriate        | Appropriate  |

Thus, it is considered an appropriate development and **does not require a Justification Test** or further flood mitigation measures other than what is described in this report.

Details pertaining to the Flood Zone of the subject site, Flood Zone C, are discussed in detail in the sections that follow in this report.

### 3.4 Site Specific Flood Risk Assessment Summary

#### 3.4.1 Climate Change Allowances

As stipulated by the Wicklow County Development Plan 2022-2028 Strategic Flood Risk Assessment (SFRA), the following allowances shown in Figure 3-6 apply to vulnerable developments for climate change allowance.

Table 4-1: Climate Change Allowances by Vulnerability and Flood Source

| Development vulnerability                                                                  | Fluvial climate change allowance (increase in flows) | Tidal climate change allowance (increase in sea level) | Storm water / surface water |
|--------------------------------------------------------------------------------------------|------------------------------------------------------|--------------------------------------------------------|-----------------------------|
| Less vulnerable                                                                            | 20%                                                  | 0.5m (MRFS)                                            | 20% increase in rainfall    |
| Highly vulnerable                                                                          | 20%                                                  | 0.5m (MRFS)                                            |                             |
| Critical or extremely vulnerable (e.g. hospitals, major sub-stations, blue light services) | 30%                                                  | 1.0m (HEFS)                                            | 30% increase in rainfall    |

Figure 3-6: Climate Change Allowances by Vulnerability (SFRA)

The subject site falls under the 'highly vulnerable' category, resulting in the following climate change allowances applying to the subject site, as per Figure 3-6.

- Fluvial flooding = +20%
- Coastal flooding = +0.5m (MRFS)
- Surface water network design = +20%

## 4. Coastal Flooding – Irish Sea

### 4.1 Source

Coastal flooding occurs due to elevated sea levels, mainly driven by storm surges. This results in the overflowing of the sea or tidally influenced rivers onto the land. This type of flooding is primarily influenced by high tides and storm surges, which are caused by factors like low atmospheric pressure and strong winds, along with wave action.

### 4.2 Pathway

The Irish Sea is approximately 400m east of the subject site. The pathway from the Irish Sea would be overland, via the road network and through built-up residential areas. Refer to Figure 4-1 for an extract of a Google Earth image showing the theoretical coastal flooding pathway from the Irish Sea to the proposed development.



Figure 4-1: Google Earth Extract showing Coastal Flooding Pathway

### 4.3 Likelihood

The OPW National Coastal Flood Hazard Mapping (NCFHM) provides predictive extreme coastal flood levels for node points along the Irish coast. At Node Point SE18, located close to the subject site near Arklow, the predicted extreme tidal water level for the present-day 0.1% AEP (1-in-1000-year) event is 1.76m OD (Malin), rising to 2.26m OD (Malin) under the mid-range future climate change scenario. The

existing site levels for the subject site are between 21.50m and 41.20m OD (Malin). The lowest site level is therefore approximately 19.24m above the highest predicted extreme tidal flood level, inclusive of an allowance for climate change. As site levels significantly exceed the predicted extreme tidal flood levels for the area, the risk of coastal flooding is considered negligible.

Furthermore, the Wicklow County Development Plan 2022-2028 SFRA flood map and the Arklow Local Planning Framework 2026 have been consulted for the area, an extract of which is shown in Figure 4-2, below. As can be seen from the map below, the site falls within Flood Zone C according to the SFRA flood data, where the probability of flooding from coastal sources is considered to be low.

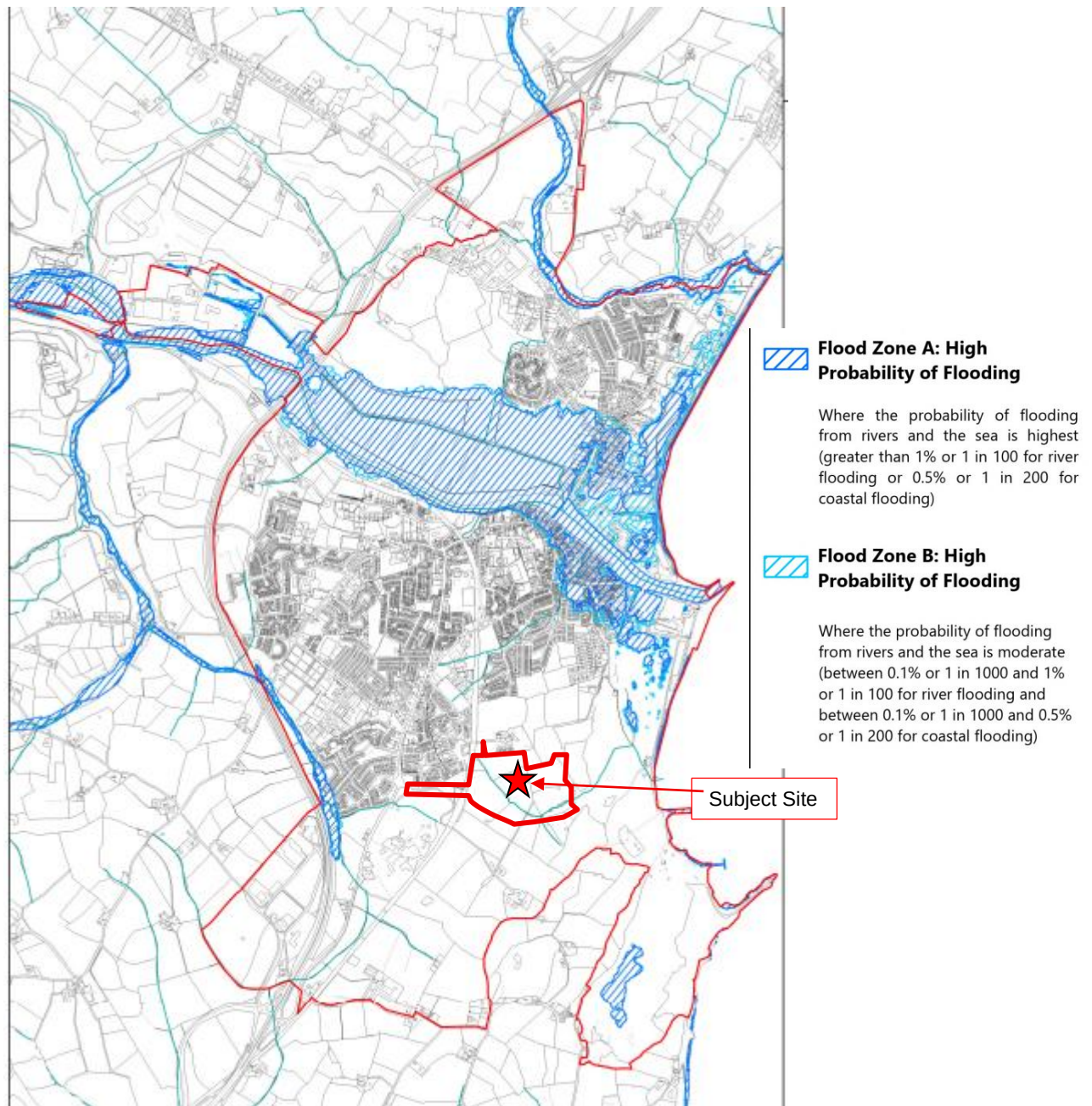


Figure 4-2: Wicklow County Development Plan 2022-2028 SFRA Flood Map  
The likelihood of flooding from coastal sources is thus considered negligible.

#### 4.4 Consequence

Considering the likelihood of flooding is negligible, the consequence is thus considered negligible.

## **4.5 Risk**

With a negligible likelihood and consequence of flooding from coastal sources, the resultant risk is considered to be negligible for the subject development.

## **4.6 Flood Risk Mitigation Measures**

As the risk is considered low, there are no mitigation measures required.

## 5. Fluvial Flooding

### 5.1 Source

Fluvial flooding is caused by rivers, watercourses, or ditches exceeding their capacity and excess water spilling out onto the adjacent floodplain.

### 5.2 Pathway

The potential pathway for fluvial flooding to the subject development would be overland from the Tinahask Lower Stream (recorded as the 'Kilmurry Stream' in EPA Water Framework Directive mapping), which runs through the subject development. Refer to Figure 5-1 for the location of the Stream as shown in the EPA.

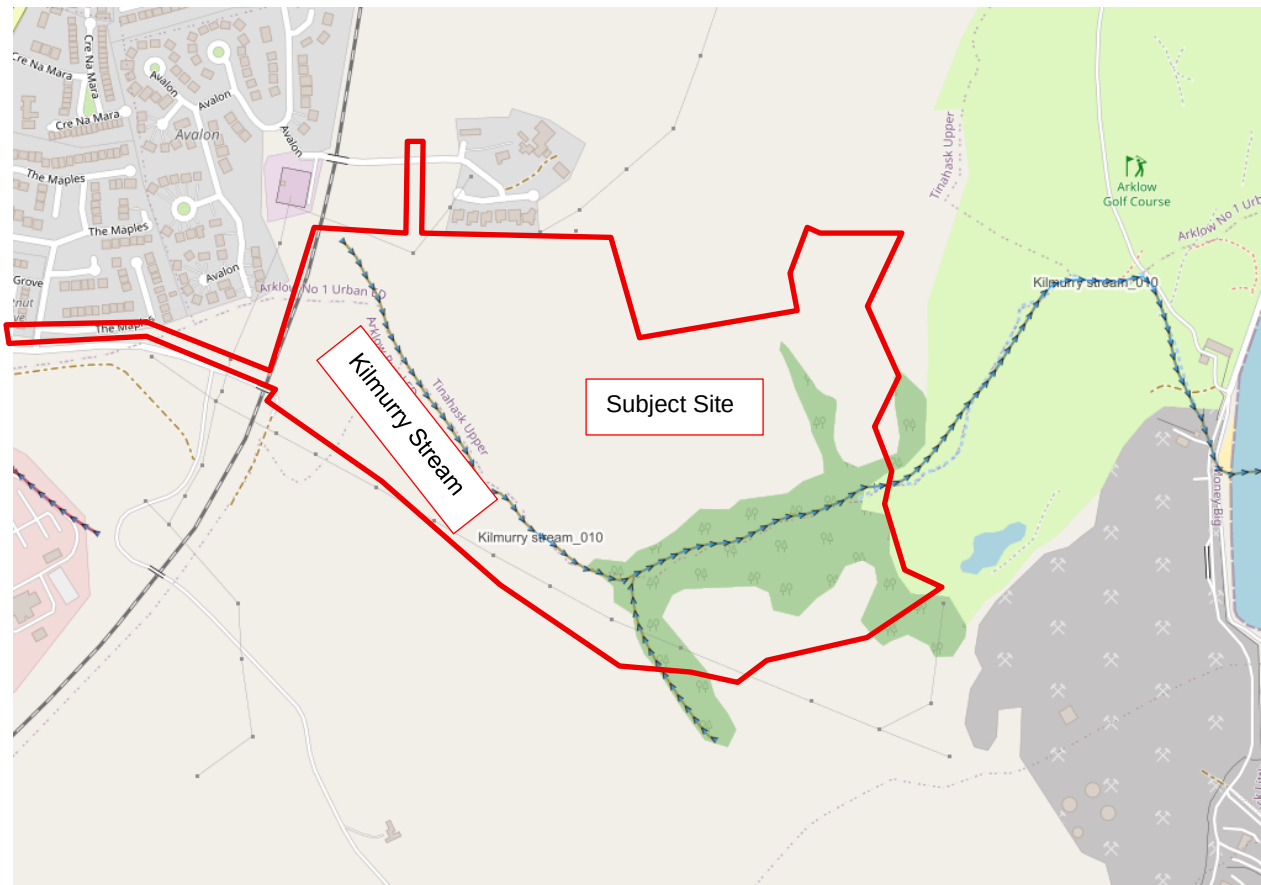


Figure 5-1: Location of Tinahask Lower Stream Relative to Proposed Development (Source: EPA Online GIS Maps)

### **5.3 Likelihood**

As shown in Figure 4-2, the site lies outside Flood Zones A and B as mapped in the Wicklow County Development Plan 2022–2028 SFRA. The site is therefore located within Flood Zone C, where the probability of fluvial flooding is low (less than 0.1% AEP, or 1 in 1000 years).

Currently, the Tinahask Lower Stream has no flows entering from upstream of the subject site. The channel is typically dry for most of the year, only conveying flow during and following periods of rainfall, when it drains towards the Irish Sea.

Considering that any potential flood pathway from the Tinahask Lower Stream to the site would require overland flow travelling from north to south across elevated ground levels, the likelihood of flooding from this source is considered to be moderate.

### **5.4 Consequence**

The consequence of fluvial flooding at the subject site would consist of flooding of the open green space areas, houses and infrastructure. The consequence of this flooding is considered to be moderate.

### **5.5 Risk**

With a moderate likelihood and moderate consequence of flooding from fluvial sources, referring to Table 3-2 3x3 Risk Matrix, the resultant risk is considered to be moderate for the subject development.

### **5.6 Flood Risk Mitigation Measures**

As the risk is considered moderate, the following mitigation measures are proposed. The upper section of the Tinahask Lower Stream, which receives no flows from further upstream, will be backfilled, thereby removing this flood pathway. The lower section of the watercourse will be retained and will form part of the site's surface water discharge point, with outflow restricted to the greenfield runoff rate. As no watercourse will pass through any of the proposed houses or site infrastructure, the risk of fluvial flooding is reduced to low.

## 6. Pluvial

### 6.1 Source

The source of pluvial flooding is heavy rainfall.

### 6.2 Pathways & Receptors

During periods of extreme prolonged rainfall, pluvial flooding may occur through the following pathways:

Table 6-1: Pluvial Pathway and Receptor Summary

|   | Pathway                                                                                                                                | Receptor                                                                            |
|---|----------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|
| 1 | Surcharging of the proposed internal drainage systems during heavy rain events leading to internal flooding.                           | Proposed development – internal roads, footpaths, cycle lanes and green space areas |
| 2 | Surcharging from the existing surrounding drainage system leads to flooding within the subject site by surcharging surface water pipes | Proposed development – internal roads, footpaths, cycle lanes and green space areas |
| 3 | Surface water discharging from the subject site to the existing drainage network leads to downstream flooding                          | Downstream properties and public roads                                              |
| 4 | Overland flooding from surrounding areas flowing onto the subject site                                                                 | Proposed development – internal roads, footpaths, cycle lanes and green space areas |
| 5 | Overland flooding from the subject site flowing onto surrounding areas                                                                 | Downstream properties and roads                                                     |

### 6.3 Likelihood

#### 6.3.1 Surcharging of the proposed internal drainage systems leading to internal flooding

The proposed on-site surface water drainage network has been designed to accommodate storm events up to and including a 1 in 100-year storm with a 20% allowance for climate change, with the proposed mitigation measures in place, the residual risk of flooding is considered to be low.

#### 6.3.2 Surcharging from the existing surrounding drainage system leads to flooding within the site

A pluvial flood map for Wicklow County Council is included in the Strategic Flood Risk Assessment prepared by Wicklow County Council. The figure below, extracted from the SFRA, illustrates the predicted flood depths across Dublin during the 1% AEP (1-in-100-year) pluvial flood event with a 3-hour storm duration.

The subject site, as indicated below, is located within an area identified as having a low susceptibility to pluvial flooding, with the mapping indicating minimal anticipated flood depths during such an event.

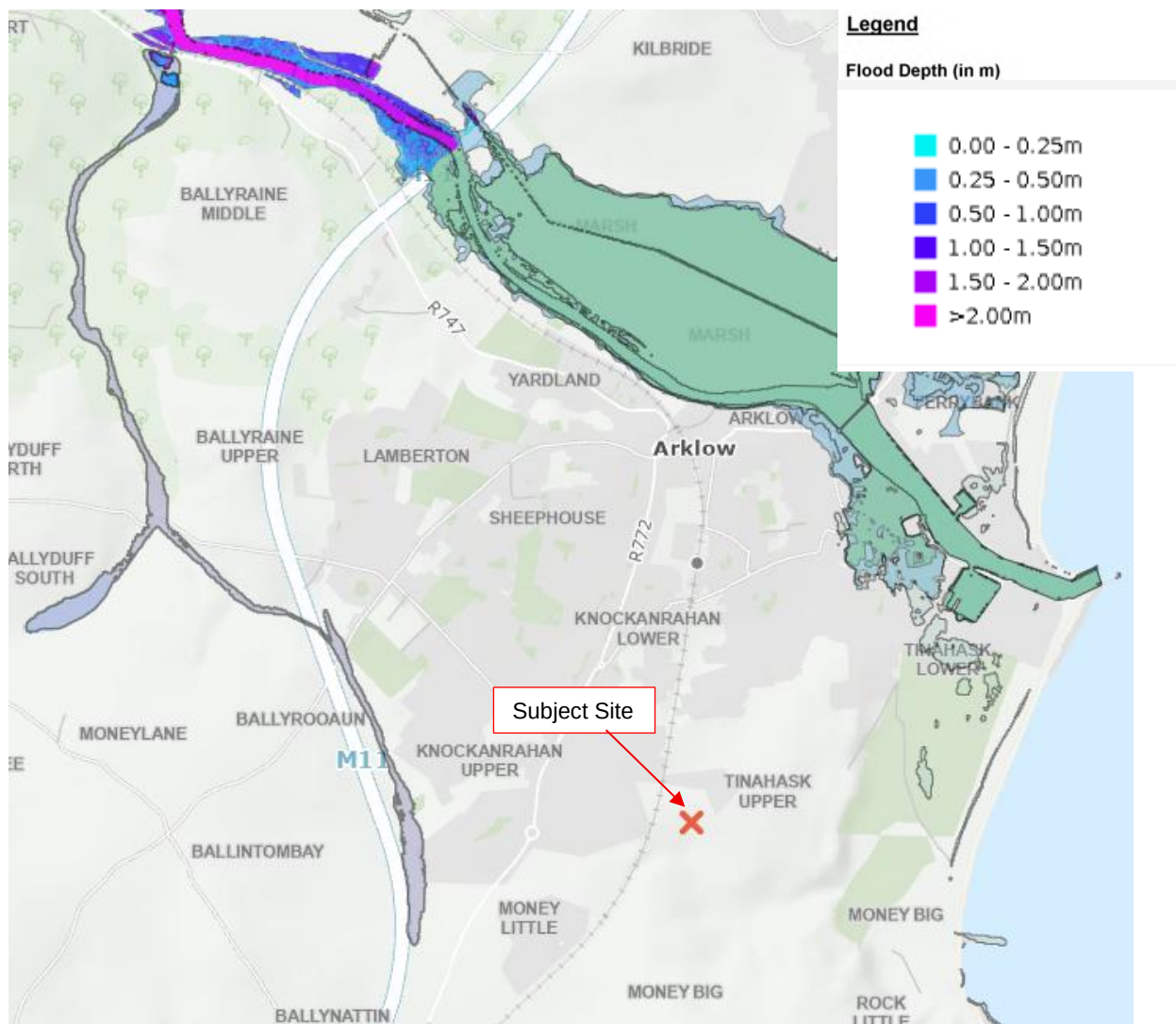


Figure 6- 1: Pluvial Flood Depth Map 1% AEP (Annual Exceedance Probability)

The subject development will be designed to ensure appropriate designed drainage networks and flood exceedance routes exist to ensure pluvial flooding is mitigated. The risk of flooding from surcharging of the existing surrounding drainage systems is considered to be low in likelihood.

### 6.3.3 Surface water discharge from the subject site leads to downstream flooding

The site will be designed with nature-based sustainable urban drainage (SuDS) features where possible. It is proposed to incorporate permeable paving/surfacing, bio-retention areas & rain gardens/swales throughout the development. The surface water network will be fitted with a flow control device upstream of the connection point into the existing Tinahask Lower Stream. The restricted flow will ensure the surface water discharge is equal to or less than the greenfield rate before discharging to the stream, thereby limiting the impact of the proposed development on downstream properties.

Considering the surface water network will be designed to accommodate the required flood flows (1-in-100-Year flood event plus 20% climate change), will capture and attenuate runoff via SuDS features, and will restrict the outflow to the greenfield runoff rate, there is a low likelihood of the subject site causing flooding from surface water discharge on-site.

#### 6.3.4 Overland flooding from surrounding areas flowing onto subject site

The OPW Past Flood Event Local Area Summary Report identifies all flood events within the immediate vicinity of the subject site, refer to Figure for an extract of this information. There are several past flood events within a 2.5 km radius of the subject site. None of these events encroach on the proposed development site. It is therefore considered that there is a low likelihood of flooding from surrounding areas.

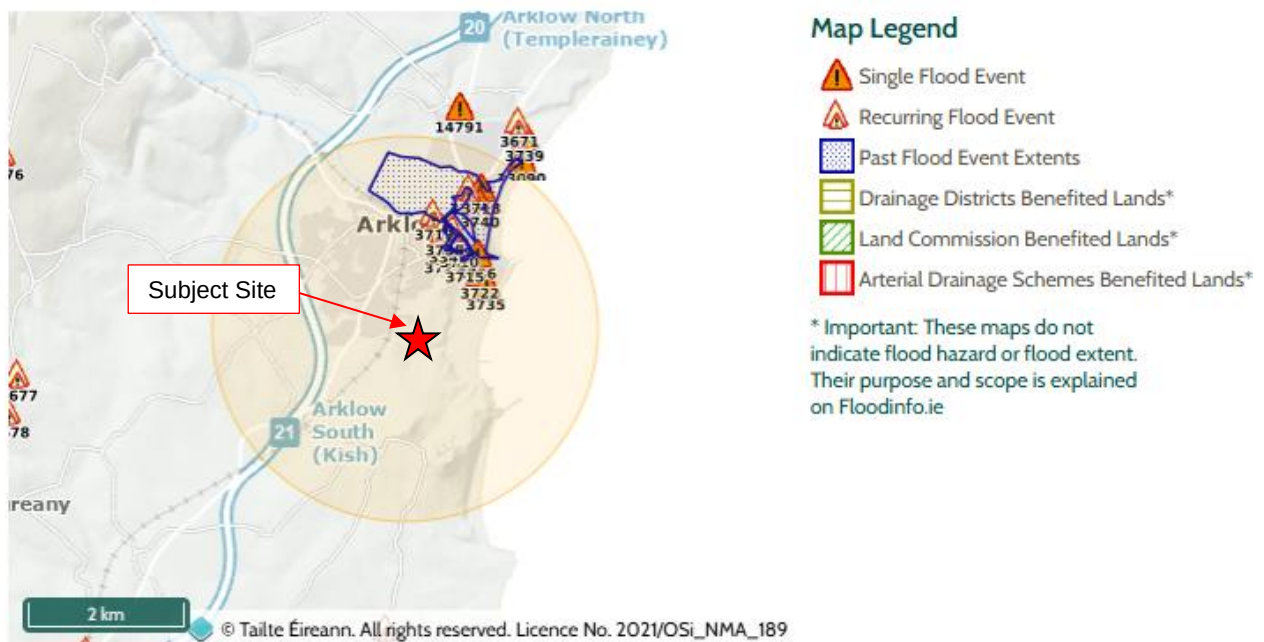


Figure 6-2 Historic Flood Events in the vicinity of the Subject Development

#### 6.3.5 Overland flooding from the subject site flowing onto surrounding areas

The onsite drainage network has been designed to adequately capture and convey the 1-in-5-year flood event. Additionally, the network has been designed to attenuate runoff up to the 1-in-100-year extreme storm event including 20% for climate change. The proposed surface water network has also been designed with various sustainable urban drainage (SuDS) features which will capture, slow, and convey the surface water runoff from the subject development into the existing Tinahask Lower Stream. The network includes a flow control device and will ensure the subject developments surface water runoff is restricted to the greenfield runoff rate of the site.

Considering the current surface water runoff rate of the greenfield site is unrestricted, the proposal to capture, slow, and restrict the developments surface water runoff is an improvement on the existing

conditions and will positively affect the surrounding sites/neighbours and downstream properties and surface water network.

The likelihood of overland flooding from the subject site is considered to be low.

## **6.4 Consequence**

The consequence of surface water flooding arising from the 5 pathway types mentioned above is **low**.

## **6.5 Risk**

Referencing Table 3-2 3x3 Risk Matrix, the following risks are noted for the 5 pathway types:

### **6.5.1 Surcharging of the proposed on-site drainage systems**

With a low likelihood and low consequence of flooding the site from surcharging the on-site drainage system, the resultant risk is extremely low.

### **6.5.2 Surcharging from the existing surrounding drainage system**

With a low likelihood and low consequence of flooding the site from the existing surface water network, the resultant risk is extremely low.

### **6.5.3 Surface water discharging from the subject site**

With a low likelihood and low consequence of flooding downstream of the site due to excess discharge surface water from the site, the resultant risk is extremely low.

### **6.5.4 Overland flooding from surrounding areas**

With a low likelihood and low consequence of overland flooding from surrounding areas, the resultant risk is extremely low.

### **6.5.5 Overland flooding from the subject site**

With a low likelihood and low consequence of overland flooding from the subject site, the resultant risk is extremely low.

## **6.6 Flood Risk Mitigation Measures**

The following are flood risk management strategies proposed to minimise the risk of pluvial flooding for each risk:

### **6.6.1 Surcharging of the proposed on-site drainage systems**

None required.

### **6.6.2 Surcharging from the existing surrounding drainage systems**

None required.

### **6.6.3 Surface water discharging from the subject site**

None required.

#### 6.6.4 Overland flooding from surrounding areas

None required.

#### 6.6.5 Overland flooding from the subject site

None required.

### 6.7 Residual Risk

The development incorporates appropriate mitigating measures including ensuring buildings are constructed at appropriate finished floor levels, an adequate flood route is available along the internal roads network, the proposal of various SuDS features, and an adequately sized surface water network.

As a result of the design measures detailed above, there is a low residual risk of flooding from each of the pluvial pathways mentioned above.

## 7. Groundwater

### 7.1 Source

During periods with prolonged rainfall, the groundwater can rise towards ground level.

### 7.2 Pathway

The pathway for groundwater flooding is from the ground. Note that although groundwater flooding is typically considered to be when the water table rises above the ground surface, underground services and building foundations could also be affected by high water tables that do not reach the ground surface.

### 7.3 Receptor

The receptors for ground water flooding would be underground services within the subject site.

### 7.4 Likelihood

According to the Geological Survey Ireland (GSI) groundwater flooding map, no flooding of this type has occurred at the subject site. Refer to Figure 7-1 below for details.



Figure 7- 1: Groundwater Flooding Probability Maps

There is also no known history of groundwater/ springs seeping through ground in this area. However, it is possible for ground water to rise and cause potential flooding on site during prolonged wet periods. The consequence of groundwater flooding would be some minor temporary seepage of groundwater through the ground around the proposed buildings and landscaped areas. There is a low risk of groundwater flooding.

Any SUDS features being installed to within 1m depth recorded groundwater levels will be lined with an impermeable membrane. This will prevent the ingress of groundwater into suds features which would cause SUDS features to flood and surcharge the surface drainage network. Upon implementing the above measures, there is extremely low residual risk of flooding from groundwater.

## **7.5 Consequence**

There is a moderate consequence from groundwater flooding which may include temporary water seepage through the ground onto the proposed roads.

## **7.6 Risk**

Given a low likelihood and moderate consequence, referring to Table 3-2 3x3 Risk Matrix, the resulting risk is considered low. No flood mitigation measures are required.

## **8. Human / Mechanical Errors**

### **8.1 Source**

This surface water network within the subject site is the source of possible flooding from the system if it was to become blocked.

### **8.2 Pathway**

The pathway is via surface water manholes within the development during an extreme storm event.

### **8.3 Receptor**

If the proposed private drainage system blocks this could lead to possible flooding within the subject site.

### **8.4 Likelihood**

There is a high possibility of flooding on the subject site if the surface water network was to block.

### **8.5 Consequence**

The consequence of such flooding would include flooding within the open spaces, the internal footpaths, and the cycle lanes of the subject site. This is considered to be a moderate risk.

### **8.6 Risk**

Referencing Table 3-2 3x3 Risk Matrix, with a high likelihood and moderate consequence, there is a high risk of surface water overflowing within the development, should the surface water network block.

### **8.7 Flood Risk Mitigation Measures**

The following flood mitigation measures have been implemented for the development:

- An adequate overland flood route has been designed within the subject site. Surface water runoff will be conveyed safely away from buildings and structures and onto the external roads network in the event of a surface water network surcharge.
- The FFLs of the buildings are typically designed above the adjacent external road levels.
- Various SUDS features are proposed throughout the development to assist in flood mitigation and collection, conveyance, and temporary storage of surface water runoff.
- The surface water network must be inspected and maintained to ensure blockages do not occur.

### **8.8 Residual Risk**

As a result of the flood risk management outlined above, there is a low residual risk of overland flooding from human/mechanical error.

## 9. Conclusions and Recommendations

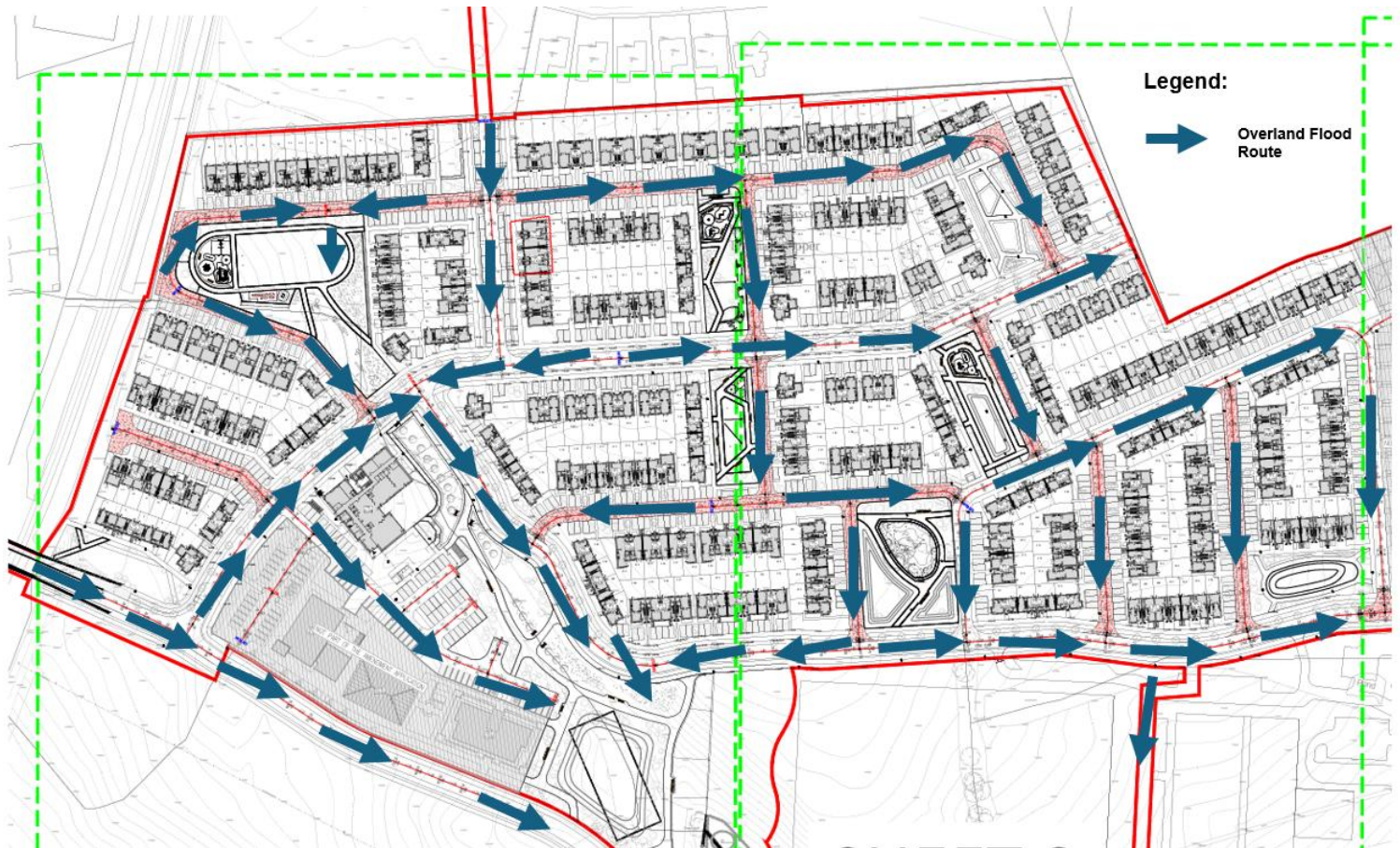
The subject site has been analysed for risks from tidal and fluvial flooding, pluvial flooding, groundwater, and drainage system failures due to human error or mechanical system failure. Table 9-1 below presents the various residual flood risks involved. As the flood risk from all sources can be mitigated, reducing the flood risk to low or very low, the proposed development is considered acceptable in terms of flood risk.

Table 9-1: Summary of Flood Risks for the Site

| Source                          | Pathway                             | Receptor             | Likelihood | Consequence | Risk          | Mitigation Measure                                                                   | Residual Risk     |
|---------------------------------|-------------------------------------|----------------------|------------|-------------|---------------|--------------------------------------------------------------------------------------|-------------------|
| <b>Coastal</b>                  | Overland from East                  | Proposed Development | Negligible | Negligible  | Negligible    | None needed                                                                          | <b>Negligible</b> |
| <b>Fluvial</b>                  | Overland from North                 | Proposed Development | Moderate   | Moderate    | Moderate      | Section of stream to be backfilled; remainder to discharge at greenfield runoff rate | <b>Low</b>        |
| <b>Pluvial</b>                  | Private and Public Drainage Systems | Proposed Development | Low        | Low         | Extremely Low | None needed                                                                          | <b>Low</b>        |
| <b>Ground Water</b>             | Ground                              | Proposed Development | Low        | Moderate    | Low           | None needed                                                                          | <b>Low</b>        |
| <b>Human / Mechanical Error</b> | Drainage network                    | Proposed Development | High       | Moderate    | High          | Appropriate drainage design, setting FFLs & overland flood routing                   | <b>Low</b>        |

## APPENDICES

## A. Overland Flood Route



# UK and Ireland Office Locations

