



**Kegata Ltd.**

**Residential Development, Rosshill, Galway**

**Flood Risk Assessment**



# Residential Development, Rosshill, Galway Flood Risk Assessment

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# 1 Introduction

TOBIN Consulting Engineers were appointed in May 2019 to provide engineering and environmental consultancy services for the proposed residential development at Rosshill, in Galway City (Figure 1.1 & Figure 1.2).

This preliminary Flood Risk Assessment (FRA) has been prepared in accordance with a Stage 2 Initial Flood Risk Assessment as defined by the guidelines produced by the Department of Environment, Heritage and Local Government (DoEHLG), *The Planning and Flood Risk Management Guidelines for Planning Authorities, 2009* as follows:

*“to confirm sources of flooding that may affect a plan area or proposed development site, to appraise the adequacy of existing information and to scope the extent of the risk of flooding which may involve preparing indicative flood zone maps. Where hydraulic models exist the potential impact of a development on flooding elsewhere and of the scope of possible mitigation measures can be assessed. In addition, the requirements of the detailed assessment should be scoped.”*

The proposed residential development is located along the Rosshill Road, just off of the Old Dublin Road (see Figure 1.1). The Galway-Dublin railway line passes along the northern boundary of the site. The site is located in a local depression which extends north of the railway line but is divided by the railway line embankment. The greenfield site is approximately 10.06 ha in area. Existing ground elevations vary from 6.70mOD (localised depression) to 20.62mOD.

The aim of this FRA is to “appraise the adequacy of existing information” (extract from PSFRM Guidelines, see above) to identify the risk, if any, of flooding in relation to the proposed development.

Figure 1.1 – Site Location

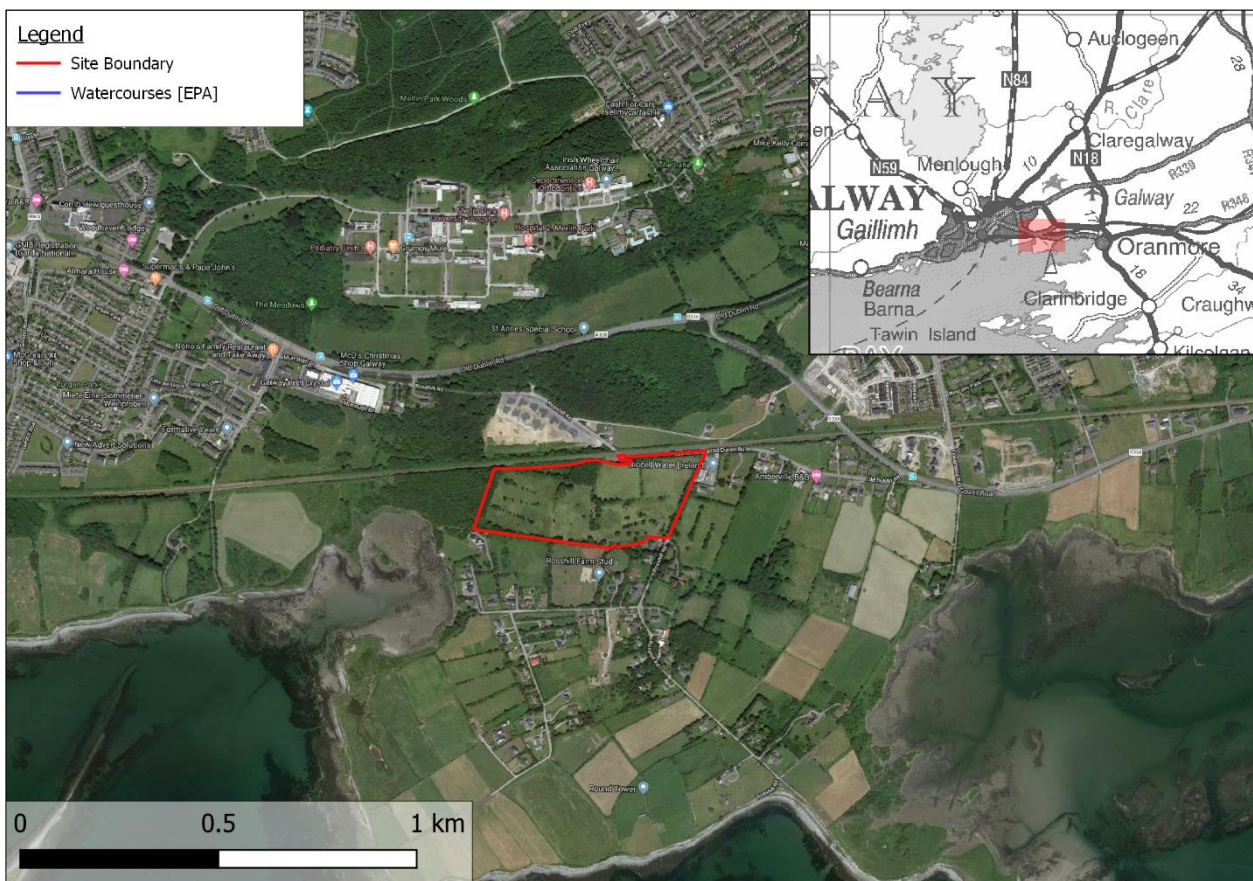


Figure 1.2 - Proposed Site Development Plan



## 2 Historical Flooding & Flood Maps

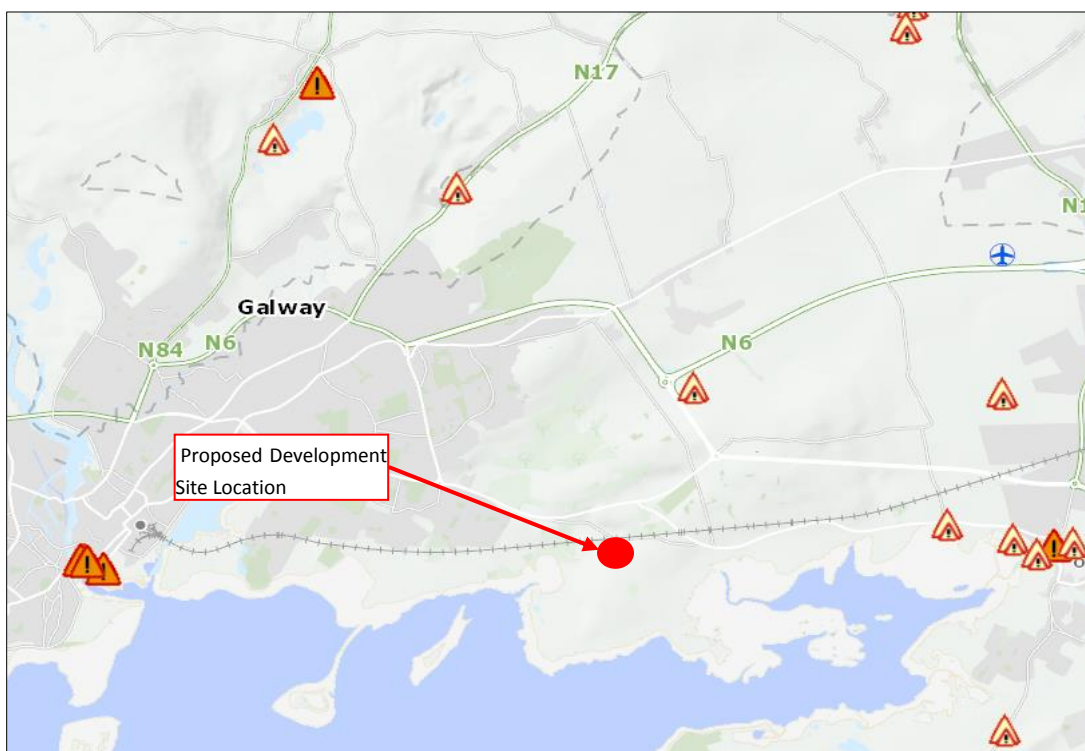
### 2.1 OPW Flood Maps

*Between the years 2004 to 2006 the OPW developed the Flood Hazard Mapping website, [www.floodmaps.ie](http://www.floodmaps.ie), which provided information about the location of known flood events in Ireland and showed supporting information in the form of reports, photos and press articles about those floods. During this time a huge data collection program was undertaken, visiting over 50 organisations (mainly local authorities and national organisations, eg Waterways Ireland, DoEHLG, and Teagasc) to collect and collate a vast array of information about flooding. The type of information varied from photographs of flood events, to consultants' reports, recordings from gauging stations, eyewitness accounts from staff plus letters from members of the public and minutes of meetings with key officials.*

*All this information was reviewed, verified, assessed and catalogued to create a National Flood Data Archive. From this the floods were mapped and uploaded to the website. Since 2006, as flood events occurred or as information was submitted to OPW from different sources, including information from the public, new floods and reports were added to the website on an ongoing basis. Past Flood Event information, which has been submitted to and approved by the OPW, is currently accessible for events which occurred pre Autumn 2014. Information on floods that have occurred since then will be uploaded to the website in due course.<sup>1</sup>*

The OPW's online National Flood Hazard Mapping database ([floodmaps.ie](http://floodmaps.ie)) does not provide any record of flood events occurring at the proposed development site (see Figure 2.1).

Figure 2.1 - Extract from National Flood Hazard Mapping database



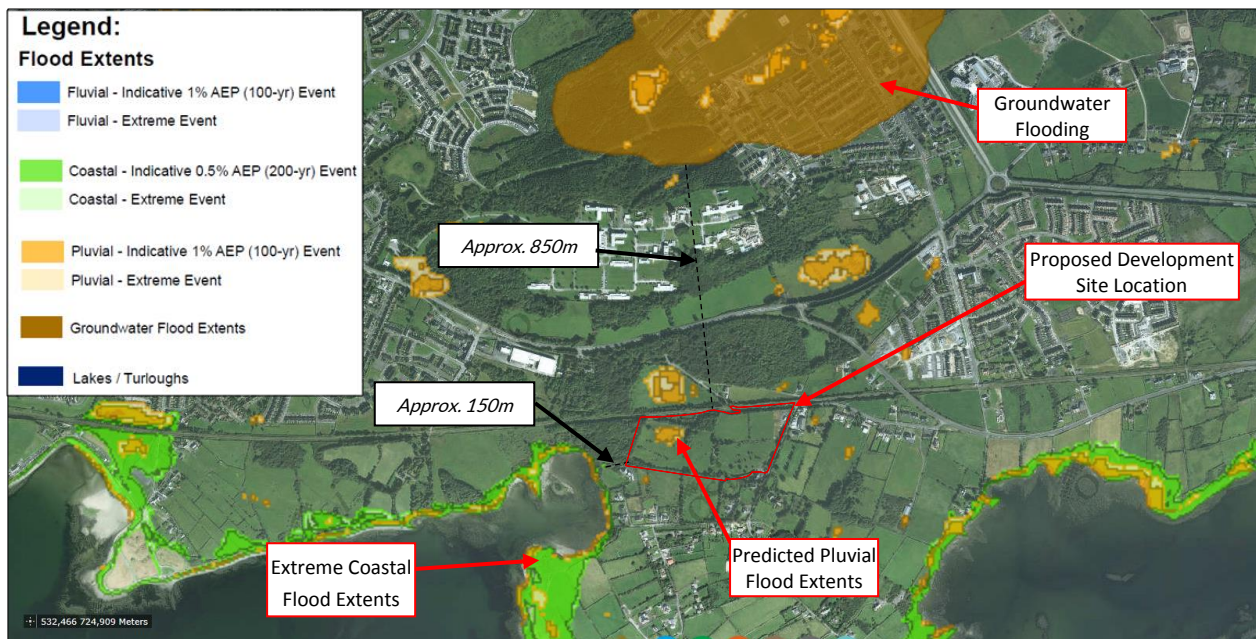
<sup>1</sup> [www.floodmaps.ie](http://www.floodmaps.ie)

## 2.2 OPW Preliminary Flood Risk Assessment (PFRA) Maps

In 2009 the OPW produced a series of maps to assist in the development of a Preliminary Flood Risk Assessment (PFRA) throughout the country. These maps were produced from a number of sources. It should be noted that *“the flood extents shown on these maps are based on broad-scale simple analysis and may not be accurate for a specific location”*<sup>2</sup>.

Figure 2.2 gives an overview of the indicative flood extents in the vicinity of the subject site.

Figure 2.2 - Indicative Flood Mapping from OPW PFRA Study



### Fluvial Flood Risk

The predicted flood extents at the subject site are shown in Figure 2.2. It should be noted that these flood extents are for the current probability of flooding and specifically exclude any allowance for climate change.

The PFRA indicative flood mapping of the area does not identify any areas as being liable to fluvial (river) flooding in the vicinity of the proposed site.

### Pluvial Flood Risk

Pluvial modelling was carried out by HR Wallingford in November 2010 as part of the PFRA study. The 100- and 1000-year flood extents were generated by analysing 1, 3, 6, and 24-hour rainfall events. The design storm rainfall was applied to the National Digital Terrain Model (DTM) with an allowance for infiltration based on the soil type in the area.

The DTM used for the PFRA study's flood plain mapping was generated from RADAR based technology in 2007 and is stated to have a 5m horizontal resolution (re-sampled to 10m resolution) and 0.01m vertical resolution, to a quoted vertical accuracy of 0.5m RMSE<sup>3</sup>. The accompanying report to the PFRA notes that the process *“due to the scale of analysis, has not taken into account local drainage structures such as culverts through embankments or other local drainage that would not be resolved in the DTM at a national scale”*.

<sup>2</sup> The National Preliminary Flood Risk Assessment (PFRA) Overview Report, OPW (March 2012)

<sup>3</sup> National Pluvial Screening Project for Ireland (HR Wallingford, November 2012)



The PFRA pluvial flood maps were also adapted by the OPW to show only the extents where the flood depths were greater than 200mm (on the basis that depths lower than this would not cause significant damage given door-step levels above ground level)<sup>4</sup>.

The analysis carried out by HR Wallingford as part of their PFRA study indicates that pluvial flooding (ponding of surface water) may occur within the proposed residential development site following an extreme rainfall event (see Figure 2.2).

### **Groundwater Flood Risk**

As part of the PFRA study indicative groundwater flood mapping was produced by Mott MacDonald Ltd. A model-based approach to generate groundwater flood extents was not possible due to the lack of available data. Therefore, the following methods were used:

- 1) *“The use of existing mapping of past groundwater flood events (e.g., from 1994/95, and late 2009), developed from ground-based observation, aerial photography or satellite imagery and the maximum extents observed”;*
- 2) *“The delineation of flood extents around turloughs based on an assumed height of flooding of 4m above the base elevation of the turlough (the median of observed ranges) using the OPW’s national DTM, with manual adjustment to ensure pragmatic extents”;*
- 3) *“The use of records of past groundwater flood events to validate or adjust the flood extents derived using the other approaches”.*

*“It should be noted that due to the absence of a model-based approach, only one set of flood extents were generated, with no specific event probability (although where observed flood data was used, these are likely to represent quite extreme events).”<sup>5</sup>*

The PFRA mapping did not indicate any sources of groundwater flooding in the vicinity of the proposed residential development site. The indicative flood mapping shows the proposed site is located approximately 850m from the nearest groundwater flood extents (see Figure 2.2).

### **Coastal Flood Risk**

The PFRA study indicates coastal flood extents in Galway Bay. Based on the PFRA flood mapping (Figure 2.2), the proposed development is located approximately 150m outside of the extreme coastal flood event extents. More detailed analysis and mapping of coastal flooding is available from the Irish Coastal Protection Strategy Study and the Western CFRAM Study; refer to section 2.3 and section 2.4 of this report.

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<sup>4</sup> The National Preliminary Flood Risk Assessment (PFRA) Overview Report (OPW, March 2012)

<sup>5</sup> The National Preliminary Flood Risk Assessment (PFRA) Overview Report (OPW, March 2012)

## 2.3 Irish Coastal Protection Strategy Study

RPS Consulting Engineers, in conjunction with the OPW, undertook a project to develop maps indicating coastal and estuarine areas prone to flooding from the sea. The predicted flood extents which were produced under the Irish Coastal Protection Strategy Study (ICPSS)<sup>6</sup> are based on analysis and modelling. The project included:

- *“Numerical Modelling of combined storm surges and tide levels which was used to estimate extreme water levels along the coastline “*
- *“Statistical extreme value analysis and joint probability analysis to both historic recorded tide gauge data and data generated by numerical modelling, which allowed an estimation of the extreme water levels of defined annual exceedance probability (AEP) to be established along the coastline Calculation of the extent of the predictive flooding, by comparing calculated extreme tide and surge waters levels along the coast with ground level based on a Digital Terrain Model (DTM). “*
- *“Definition of the plan extent of the predictive floodplain, by use of a Digital Terrain Model (DTM) commissioned by the Office of Public Works”*

The ICPSS flood mapping was produced by combining the results of the surge and tide level modelling, the statistical analysis, the DTM. The mapping also incorporates future allowances for both mean sea level rise and glacial isostatic adjustment (GIA). The maps have been produced at a strategic level to provide an overview of coastal flood hazard and risk in Ireland, and minor or local features may not have been included in their preparation.<sup>7</sup>

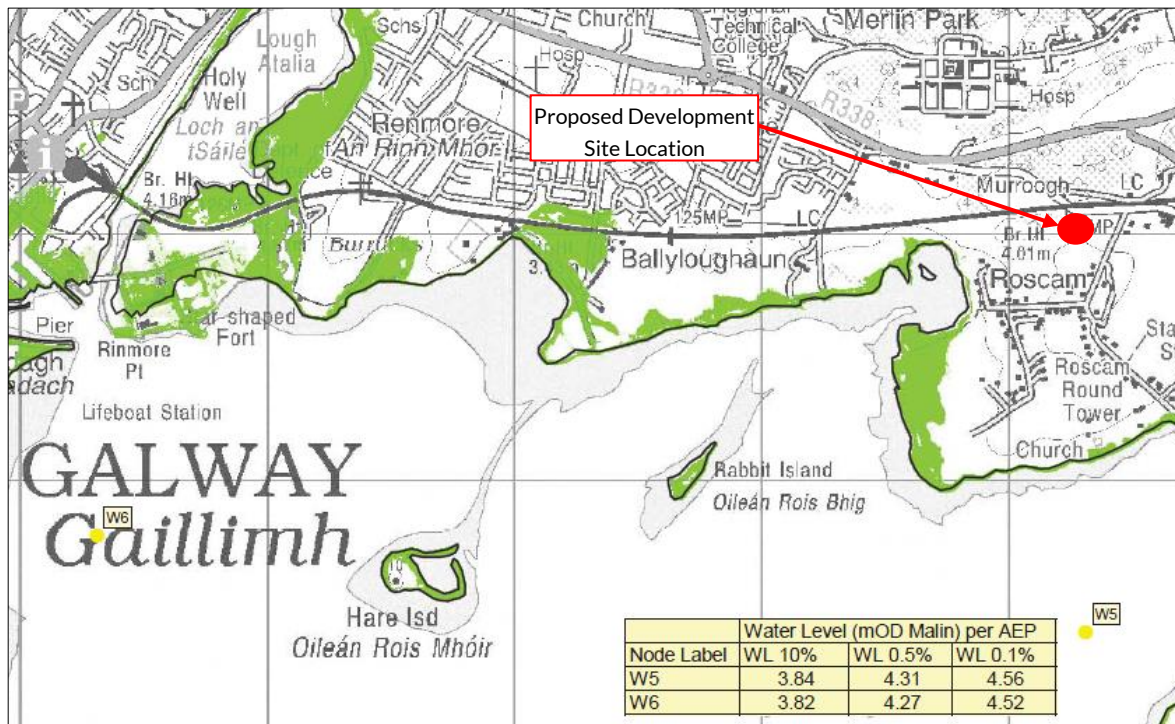
The ICPSS flood mapping for the Mid-Range Future Scenario is shown in Figure 2.3 (see also Appendix A). The proposed development site is located on existing ground with an elevation of between 6.70mOD and 22.62mOD, 1.98 meters above the estimated 1000-year MRFS coastal flood level in Galway Bay of 4.56mOD (Node W5). The mapping indicates that the proposed development site is not likely to be affected by coastal flooding.

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<sup>6</sup> Irish Coastal Protection Strategy Study, Work Package 9A - Strategic Assessment of Coastal Flooding Extents – Future Scenario

<sup>7</sup> *“The maps have been produced at a strategic level to provide an overview of coastal flood hazard and risk in Ireland, and minor or local features may not have been included in their preparation. A DTM is used to generate the maps, which is a ‘bare earth’ model of the ground surface with the digital removal of man-made and natural landscape features such as vegetation, buildings, bridges and embankments. The mapping process can show some of these man-made features, such as bridges and embankments, as flooded on the flood maps, when in reality they do not flood.”* [Extract from Irish Coastal Protection Strategy Study, Work Package 9A - Strategic Assessment of Coastal Flooding Extents – Future Scenario]

Figure 2.3 – Irish Coastal Protection Strategy Study Flood Extent Mapping



## 2.4 Western CFRAM Study

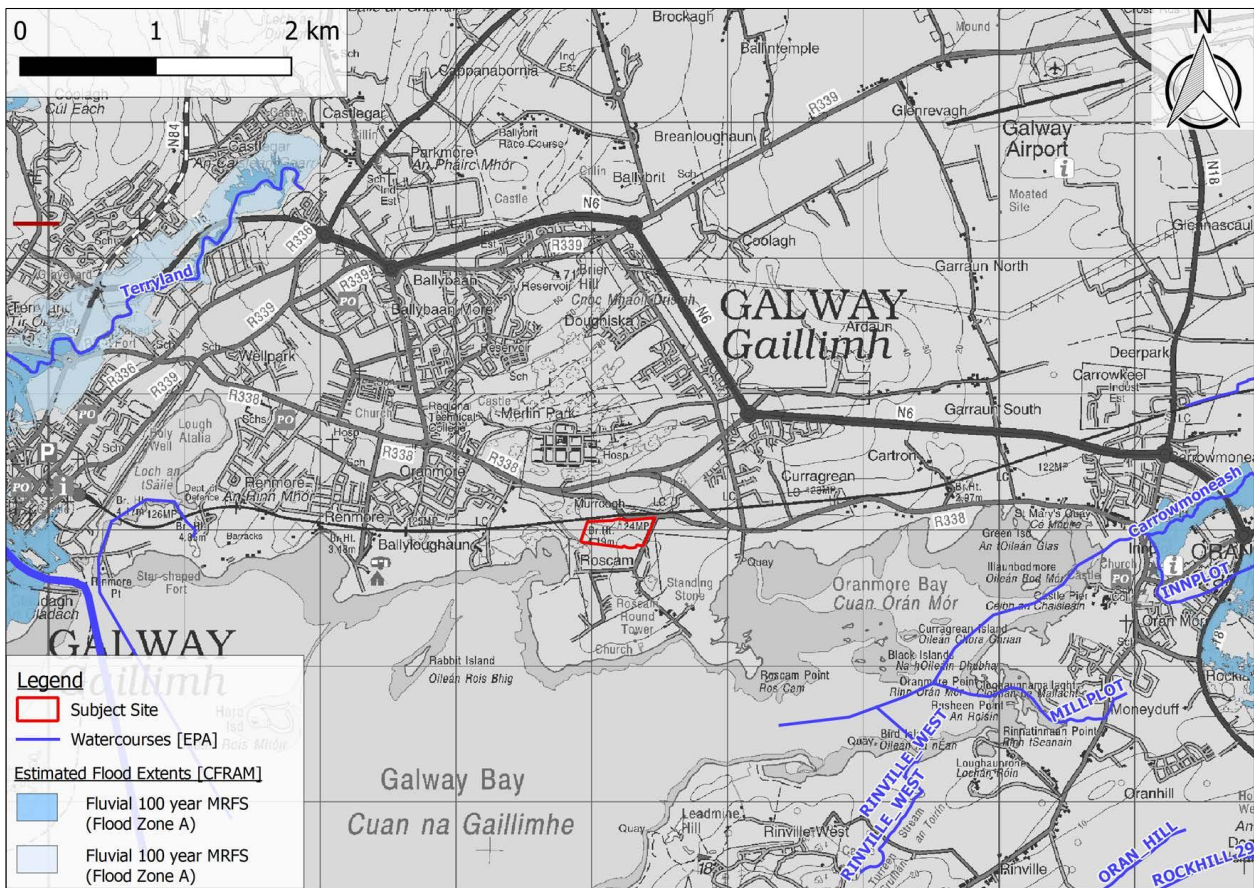
As part of the Western Catchment Flood Risk Assessment and Management (CFRAM) programme, hydraulic modelling of Galway Bay and Galway City's watercourses was carried out by JBA Consulting in 2015. Joint probability analysis was carried out to assess fluvial and coastal flood risk in combination. The final flood extents mapping was published in October 2016.

### Western CFRAM - Fluvial flood risk

The predicted fluvial flood extents during the 100- and 1000-year Mid-Range Future Scenarios (MRFS) are shown in Figure 2.4.

The CFRAM Study flood mapping (see Figure 2.4 and Appendix A) does not identify any fluvial (river) flooding in the vicinity of the proposed site.

Figure 2.4 – Predicted Fluvial Flood Extents, Mid Range Future Scenario (Western CFRAM Study)



## Western CFRAM - Coastal flood risk

The predicted coastal flood extents during the 200- and 1000-year Mid-Range Future Scenarios (MRFS) are shown in Figure 2.5 (see also Appendix A).

It is our understanding that this mapping was produced using a digital terrain model based on a combination of LiDAR and other ground elevation data. The OSI quote the vertical accuracy of LiDAR data as being +/-25cm.

Based on the results of the CFRAM study (Figure 2.5), the proposed residential development site is unlikely to be affected by flooding during the 1000 year MRFS.

Figure 2.5 - Predicted Coastal Flood Extents, Mid Range Future Scenario (Western CFRAM Study)



### 3 Planning & Flood Risk Management Guidelines

This section of the report considers the following plans and guidance documents:

- The Planning System and Flood Risk Management Guidelines (OPW & DOEHLG 2009)
- The Flood Risk Management Climate Change Adaptation Plan (OPW 2015)
- The Galway County Development Plan 2017-2023
- The Galway City Development Plan 2011-2017

#### 3.1 The Planning System & Flood Risk Management Guidelines

The ‘*The Planning System and Flood Risk Management*’ (PSFRM) guidance document, published in 2009 by The Department of Environment, Heritage and Local Government (DoEHLG) and the Office of Public Works (OPW), discuss flood risk in terms of three flood zones. It also identifies vulnerability classes for development in order to define what type of development is suitable within what flood zone and when the Justification Test should be applied.

The flood zones, vulnerability classes and requirement for the Justification Test are summarised in Table 1.

Table 1 Matrix of vulnerability versus flood zone to illustrate appropriate development and that are required to meet the Justification Test (Extract from the PSFRM Guidelines)

Flood Zone	Probability of Flooding (Return Period)	Recommendation based on Vulnerability of Development		
		Highly Vulnerable or Essential Infrastructure	Less Vulnerable	Water Compatible
A	High Probability (more frequent than 1% or 1 in 100-yr for river flooding or 0.5% or 1 in 200 for coastal flooding)	Justification Test	Justification Test	Appropriate
B	Moderate Probability (between 0.1% or 1 in 1000 and 1% or 1 in 100 for river flooding and between 0.1% or 1 in 1000 year and 0.5% or 1 in 200 for coastal flooding)	Justification Test	Appropriate	Appropriate
C	Low Probability (less frequent than 1 in 1000-yr)	Appropriate	Appropriate	Appropriate

The PSFRM Guidelines state that ‘dwelling houses’, such as the proposed development subject of this flood risk assessment, are classified as “highly vulnerable” development in terms of their sensitivity to flooding. The proposed development has been assessed using the 1000-yr flood event.

### 3.2 The Flood Risk Management Climate Change Adaption Plan

The Flood Risk Management Climate Change Adaptation Plan (published May 2015) has been prepared under the remit of the National Climate Change Adaptation Framework. It sets out the policy on climate change adaptation of the Office of Public Works (OPW), the lead agency for flood risk management in Ireland, based on a current understanding of the potential consequences of climate change for flooding and flood risk in Ireland, and the adaptation actions to be implemented by the OPW and other responsible Departments and agencies in the flood risk management sector.

The document recommends two future flood risk scenarios for considering future implications of factors, including climate change, in relation to future flooding. The Mid-Range Future Scenario (MRFS) recommends a “likely” future scenario while the High-End Future Scenario (HEFS) represents a more “extreme” future scenario. Table 2 sets out the allowances for both scenarios.

Table 2 Allowances in Flood Parameters for the Mid-Range and High-End Future Scenarios

Parameter	MRFS	HEFS
Extreme Rainfall Depths	+ 20%	+ 30%
Peak Flood Flows	+ 20%	+ 30%
Mean Sea Level Rise	+ 500 mm	+ 1000 mm
Land Movement	- 0.5 mm / year <sup>1</sup>	- 0.5 mm / year <sup>1</sup>
Urbanisation	<i>No General Allowance – Review on Case-by-Case Basis</i>	<i>No General Allowance – Review on Case-by-Case Basis</i>
Forestation	- 1/6 Tp <sup>2</sup>	- 1/3 Tp <sup>2</sup> + 10% SPR <sup>3</sup>

Note 1: Applicable to the southern part of the country only (Dublin – Galway and south of this)

Note 2: Reduction in the time to peak (Tp) to allow for potential accelerated runoff that may arise as a result of drainage of afforested land

Note 3: Add 10% to the Standard Percentage Runoff (SPR) rate: This allows for temporary increased runoff rates that may arise following felling of forestry.

For the purpose of this flood risk assessment, we have assessed the proposed development against the Mid-Range Future Scenario as it represents a likely future scenario.

### 3.3 Galway County Development Plan (2015-2021)

Chapter 8 of the 2015-2021 County Development Plan (CDP) deals with the area of flood risk.

The following are the key policies described in the CDP pertaining to flood risk:

**Policy FL 1** *“It is the policy of Galway County Council to support, in co-operation with the OPW, the implementation of the EU Flood Risk Directive (2007/60/EC), the Flood Risk Regulations (SI No. 122 of 2010) and the DEHLG/OPW publication The Planning System and Flood Risk Management Guidelines (2009) (and any updated/superseding legislation or policy guidance). Galway County Council will also take account of the Shannon International and Western Catchment Flood Risk Assessment and Management Studies.”*

**Policy FL 4** *“The Council shall implement the key principles of flood risk management set out in the Flood Risk Management Guidelines as follows:*

- (a) Avoid development that will be at risk of flooding or that will increase the flooding risk elsewhere, where possible;*
- (b) Substitute less vulnerable uses, where avoidance is not possible; and*
- (c) Mitigate and manage the risk, where avoidance and substitution are not possible.*

*Development should only be permitted in areas at risk of flooding when there are no alternative, reasonable sites available in areas at lower risk that also meet the objectives of proper planning and sustainable development.*

*Development in areas which have the highest flood risk should be avoided and/or only considered in exceptional circumstances (through a prescribed Justification Test) if adequate land or sites are not available in areas which have lower flood risk.”*

A Stage 1 Strategic Flood Risk Assessment (SFRA) was carried out as part of the 2015-2021 Galway County Development Plan. The SFRA notes that the Western CFRAM study identified Galway City as one of the areas for further study. The findings of the CFRAM study are detailed in Section 2.4 of this Flood Risk Assessment report.

### 3.4 Galway City Development Plan

Sections 9.3 of the 2017-2023 Galway City Development Plan deal with the assessment of flood risk.

The key policies in the City Development Plan relevant flood risk assessment are given below:

*Support, in co-operation with the OPW, the implementation of EU Flood Risk Directive (2007/60/EC), the Flood Risk Regulations (SI no. 122 of 2010), the DECLG and OPW Guidelines for Planning Authorities, the Planning System and Flood Risk Management (2009), updated/superseding legislation or departmental guidelines and have regard to the findings and relevant identified actions of the future Corrib Catchment Flood Risk Assessment and Management (CFRAM) Study, as the study progresses and incorporate these into the Development Plan, where appropriate.*

*Have regard to the recommendations of the Strategic Flood Risk Assessment (SFRA) for the Galway City Development Plan 2017-2023 in the assessment of development in identified areas of flood risk (See Figure 3.1).*



*Restrict the location of structures other than structures with essential links to the waterway and public utilities within 10 metres of the River Corrib in G agricultural zoned lands.*

*Protect and promote sustainable management and uses of water bodies and watercourses from inappropriate development, including rivers, streams, associated undeveloped riparian strips, wetlands and natural floodplains.*

*Ensure flood risk is addressed in any future local area plans, framework plans and masterplans in the city and have regard to the findings of the Strategic Flood Risk Assessment for Three Local Area Plans 2012 in the preparation of LAPs for Ardaun, Headford Road area, and Murrough.*

*Require a site-specific Flood Risk Assessment (FRA) for planning applications in identified areas at risk of flooding, where appropriate, in accordance with the recommendations of the Strategic Flood Risk Assessment (SFRA) for the Galway City Development Plan 2017-2023.*

*Facilitate sustainable flood defence and coastal protection works in order to prevent flooding and coastal erosion, subject to environmental, visual and built heritage considerations.*

*Ensure any proposal aimed at alleviating flooding will be subject to Appropriate Assessment in accordance with Article 6 of the EU Habitats Directive, where appropriate.*

*Ensure the use of SUDS, sustainable urban drainage systems, wherever practical, in the design of development to reduce the rate and quantity of surface water run-off.*

*Ensure new development, where appropriate, is designed and constructed to meet the flood design standards outlined under Section 11.27 Flood Risk Management and the recommendations of the Strategic Flood Risk Assessment (SFRA) for the Galway City Development Plan 2017-2023.*

*Have regard to the findings of the OPW's Irish Coastal Protection Strategy Study (2013) of the west coast.*

*Continue to protect the coastal area and foreshore and avoid inappropriate development in areas at risk of coastal erosion and/or would cause and escalate coastal erosion in adjoining areas.*

*Protect and maintain, where feasible, undeveloped riparian zones and natural floodplains along the River Corrib and its tributaries.*

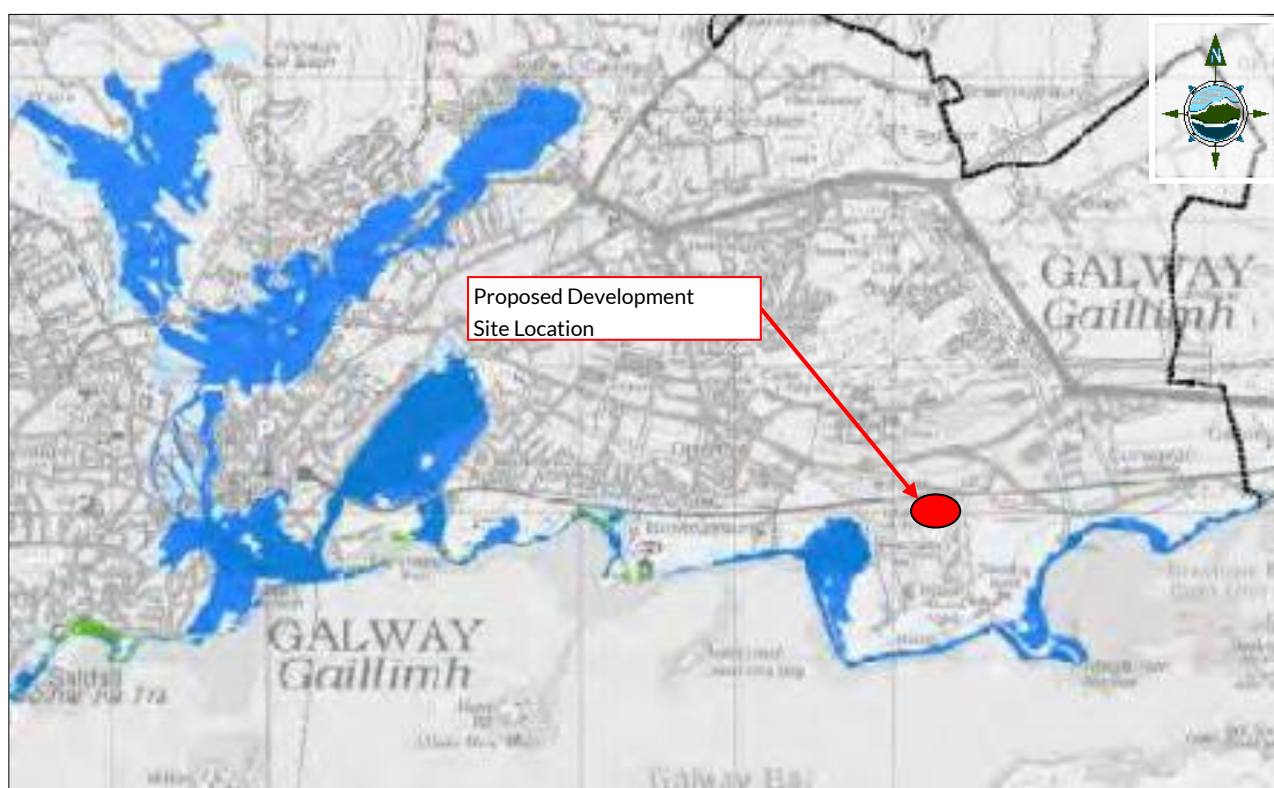
The design standards outlined under Section 11.27 Flood Risk Management in the Galway City Development Plan (as referenced above) are as follows:

- *Where development is proposed in identified flood risk areas under Western CFRAM, the type or nature of the development needs to be carefully considered and the potential risks mitigated and managed through on-site location, layout and design of the development to reduce flood risk to an acceptable level.*
- *Development shall have regard to the flood resilient design guidance and flood mitigation measures in the City Council's Strategic Flood Risk Assessment for Galway City Development Plan 2017-2023*
- *In identified flood risk areas, Flood Zone A or B, it will be necessary to carry out a Site-Specific Flood Risk Assessment (FRA), appropriate to the scale and nature of the development and the risks arising. Proposals shall demonstrate appropriate mitigation and management measures in the layout and design of development.*
- *All proposed development must consider the impact of surface water flood risk in drainage design. Consideration should be given in the design of new development to the incorporation of SUDS. The drainage design should ensure no increase flood risk to the site or downstream catchment.*

- *Development proposals in identified flood risk areas shall consider and incorporate the potential impacts of climate change and residual risk into development layout and design.*
- *In areas of identified flood risk all developments including minor works and changes of use should include an appropriate level of FRA. This assessment must demonstrate that the development would not increase flood risk in the context of use, emergency access and infrastructure. Development should demonstrate principles of flood resilient design.*

A Strategic Flood Risk Assessment (SFRA)<sup>8</sup> was completed by JBA in 2015 to accompany the City Development Plan. The SFRA largely summarises the recommendations of the OPW's Planning System and Flood Risk Management guidance document. The SFRA Flood Zone mapping (Figure 3.1) was taken from the Western CFRAM Study, which has been reviewed in Section 2.4 of the report.

Figure 3.1 - Galway City SFRA "Flood Zone Mapping"



<sup>8</sup> Galway City Development Plan, Strategic Flood Risk Assessment, JBA Consulting (December 2015)

## 4 Flood Risk Assessment

Referring to Section 3.1 of this report, the proposed residential development is classified as “highly vulnerable” in terms of its sensitivity flooding. The PSFRM guidance document recommends that such developments be constructed in flood zones C, i.e. that there is less than a 0.1% probability of the site flooding. Accordingly, the proposed development has been assessed against a 1,000-year flood event (i.e. 0.1% Annual Exceedance Probability).

### 4.1 Fluvial Flood Risk

There are no rivers or streams evident in the vicinity of the site.

The Western CFRAM Study indicative flood mapping of the area does not show the subject site as being liable to fluvial (river) flooding.

### 4.2 Groundwater Flood Risk

Based on a review of the PFRA study and GSI mapping of karst features in the area (Figure 4.1), there is no evidence to suggest groundwater flooding at the proposed development site.

Figure 4.1 - Karst features in vicinity of proposed site [GSI database]



### 4.3 Pluvial Flood Risk

Pluvial modelling carried out by HR Wallingford as part of the PFRA study indicated that the proposed site may be liable to pluvial flooding, see Figure 2.2. Potential mitigation measures to minimize the risk of pluvial flood flooding are outlined in Section 4.7.

## 4.4 Coastal Flood Risk

Based on the coastal flood mapping produced by the Irish Coastal Protection Strategy Study (see Figure 2.3) and the Western CFRAM Study (see Figure 2.5) the estimated risk of coastal flooding to the site is minimal.

The ICPSS flood mapping for Mid-Range Future Scenario is shown in Figure 2.3. The proposed development site is located on existing ground with an elevation of between 6.70mOD and 22.62mOD. The finished floor levels of the proposed development are between 9.30mOD and 20.65mOD.

The predicted 1000-year MRFS coastal flood level in Galway Bay is 4.56mOD (Figure 2.3), 4.74 meters below the finished floor level of the proposed residential development.

Due to the proximity of the site to Galway Bay, coastal flooding was examined as a potential risk to the proposed development. Modelling of coastal flood risk along the west coast has been carried out as part of the following studies:

- Irish Coastal Protection Strategy Study (ICPSS) (see Section 2.3)
- Western Catchment Flood Risk Assessment and Management (CFRAM) Study (see Section 2.4)

### **Irish Coastal Protection Strategy Study (ICPSS)**

As part of the *Irish Coastal Protection Strategy Study* (ICPSS) in 2012, RPS carried out hydraulic modelling of tidal and storm surge flooding along the west coast of Ireland, including Galway Bay. For a mid-range future scenario (MRFS), the study predicted 200 year and 1000 year water levels of 4.31mOD and 4.56mOD respectively. This includes a 500mm allowance for rise in sea level due to climate change. The ICPSS flood extents map indicates that the 1,000 year MRFS flood remains approximately 150m from site (see Figure 2.3).

The proposed development site is located on existing ground with an elevation of between 6.70mOD and 22.62mOD, which are at least 2.14mOD above the 1,000-year MRFS flood level of 4.56mOD predicted by the ICPSS. The finished floor levels of the proposed development are between 9.30mOD and 20.65mOD.

The ICPSS model calibration report also states that “the overall tolerance for the south west, west, north west and Shannon Estuary extreme water levels is considered to be  $\pm 180\text{mm}$ ”.

### **Western Catchment Flood Risk Assessment and Management (CFRAM) Study**

JBA Consulting developed coastal models of the floodplain beyond the coastline as part of the modelling phase of the Western CFRAM Study.

A 2D cell size of 4m was used to represent the coastal domain. The active model area was determined using the LIDAR data for the Area for Further Analysis (AFA). Areas of high ground were deemed 'natural boundaries' and serve well as model extents.<sup>9</sup>

Figure 2.5 shows the flood extents predicted by the Western CFRAM Study at the proposed residential development site. The coastal flood extents shown by the CFRAM mapping adjacent to the proposed site location is comparable with that shown by the ICPSS mapping (see Figure 2.3). The CFRAM study predicts that coastal flooding will not extend to the proposed site during the 1,000 year event.

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<sup>9</sup> Western CFRAM UoM 30 – Corrib Hydraulic Modelling Report: Volume 2c – Galway City

## Coastal Flood Level

The flood level based on the 1,000-year flood event, as recommended for residential developments (i.e. “Highly Vulnerable Developments”), is summarised in Table 3. An estimate of the 200 year flood level is also provided.

Table 3 Estimated Design Coastal Flood Level

Description	200-year flood	1,000-year flood
Flood Level <sup>1</sup>	3.81mOD	4.06mOD
Allowance for 95% Confidence <sup>1</sup>	0.18m	0.18m
Allowance for MRFS Mean Sea Level Rise <sup>2</sup>	0.5m	0.5m
<b>Estimated Flood Level</b>	<b>4.49mOD</b>	<b>4.74mOD</b>
Allowance for MRFS Land Movement <sup>2</sup>	0.03m	0.03m
Freeboard <sup>3</sup>	0.30m	0.30m
<b>Estimated Flood Level + Freeboard</b>	<b>4.82mOD</b>	<b>5.07 mOD</b>

**Note 1:** Design flood level, and allowance for 95% confidence, is taken from Irish Coastal Protection Strategy Study (ICPSS) (see Section 2.3).

**Note 2:** Allowance for mean sea level rise and land movement taken from the Flood Risk Management Climate Change Adaptation Plan (May 2015) (see Section 3.2). Allowance for land movement was taken as 0.5mm per year for 60 years.

**Note 3:** Freeboard taken from the Multi-Coloured Manual (2010) produced by the Flood Hazard Research Centre (FHRC), Appendices to Chapter 4: Flood damage to residential properties and related social impacts. The manual indicates damage is incurred for residential properties for flood levels at and above 0.3m below ground floor level.

The minimum existing ground levels on the Rosshill site are 6.54mOD, i.e. 1.47m above the proposed 1,000-year MRFS coastal flood level of 5.07mOD (see Table 3). It is proposed that road levels within the Rosshill site will be raised to at least 7.20mOD, and finished floor levels will be raised to at least 9.30mOD.

Based on the proposed levels at the site, the development is not predicted to flood during a 1 in 1,000 year MRFS coastal flood event.

It should be noted that the above levels relate to coastal flooding only. Other flood sources (i.e. pluvial and groundwater) are discussed in the relevant sections of this report.

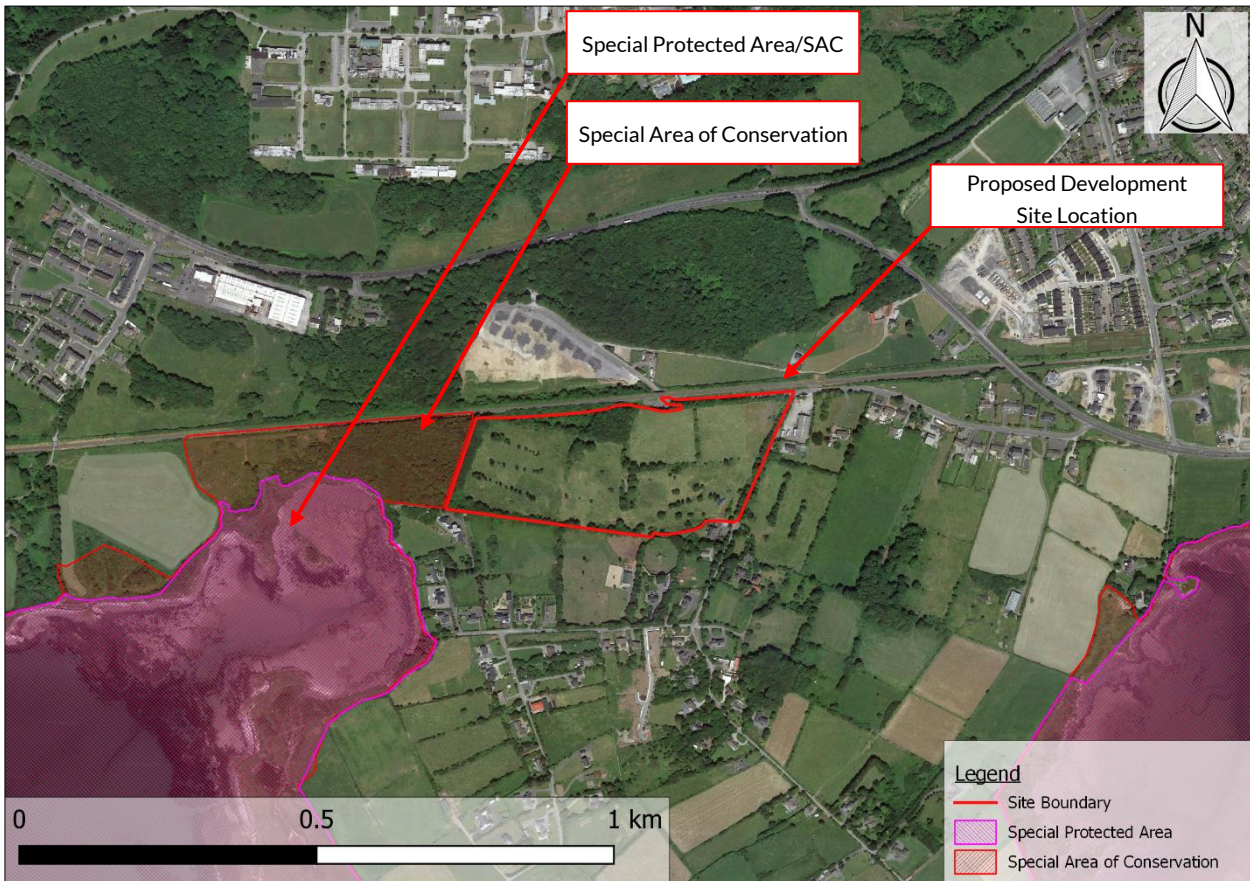
## 4.5 Impact of the Development Elsewhere

The proposed residential development is located along the Rosshill Road, just off the Old Dublin Road (Figure 4.2). The Galway-Dublin railway line passes along the northern boundary of the site and a Special Area of Conservation is located on the western side of the site (Figure 4.2).

It is predicted that the proposed development is not at risk from fluvial flooding during the 1000-year mid-range future scenario. Therefore, the development will not affect floodplain storage or obstruct the flow path of any existing watercourses.

Surface water arising onsite will be managed by a dedicated storm water drainage system designed by TOBIN Consulting Engineers. The site drainage will include measures in accordance with the requirements of SUDS to limit runoff from the development to greenfield runoff rates. On this basis, it is predicted that the proposed development will not contribute towards flood risk elsewhere in the area.

Figure 4.2 - SAC/SPA Mapping (Extract from National Parks and Wildlife Services)



## 4.6 The Justification Test

The Planning System and Flood Risk Management Guidelines set out guidance for the application of the Justification Test to assess the appropriateness of developments being proposed in areas of flood risk.

Based on the results of this flood risk assessment, it is predicted that the proposed development site may be liable pluvial flooding (ponding of surface water) following an extreme rainfall event (see Figure 2.2).

Box 5.1 in Section 5.15 of the Planning and Flood Risk Management Guidelines for Planning Authorities, 2009 states that *“When considering proposals for development, which may be vulnerable to flooding, and that would generally be inappropriate as set out in Table 3.2, the following criteria must be satisfied:”*

1. *The subject lands have been zoned or otherwise designated for the particular use or form of development in an operative development plan, which has been adopted or varied taking account of these Guidelines*
2. *The proposal has been subject to an appropriate flood risk assessment that demonstrates:*

- I. *The development proposed will not increase flood risk elsewhere and, if practicable, will reduce overall flood risk;*
  - II. *The development proposal includes measures to minimise flood risk to people, property, the economy and the environment as far as reasonably possible;*
  - III. *The development proposed includes measures to ensure that residual risks to the area and/or development can be managed to an acceptable level as regards the adequacy of existing flood protection measures or the design, implementation and funding of any future flood risk management measures and provisions for emergency services access; and*
  - IV. *The development proposed addresses the above in a manner that is also compatible with the achievement of wider planning objectives in relation to development of good urban design and vibrant and active streetscapes.*
3. *The acceptability or otherwise of levels of residual risk should be made with consideration of the type and foreseen use of the development and the local development context.*

### **Justification Test**

1. The subject lands have been zoned or otherwise designated for the particular use as per the Galway City Development Plan 2017-2023
2. Referring specifically to the flood risk issues, this flood risk assessment demonstrates that:
  - I. The development proposed will not increase flood risk elsewhere (see Section 4.5).
  - II. The development proposal includes measures to minimise flood risk to people, property, the economy and the environment as described in Section 4.7.
  - III. The development proposed includes measures to ensure that residual risks to the area and/or development can be managed to an acceptable level (see Section 4.7).

## **4.7 Flood Risk Mitigation Measures**

Pluvial flooding has been identified as the primary cause for potential flooding at the proposed development site location. As per Section 6.9.1 of the Strategic Flood Risk Assessment developed as part of the Galway City Development Plan 2017-2023; *“To address flood risk in the design of new development a risk based approach should be adopted to locate more vulnerable land use i.e. residential housing to higher ground while water compatible development i.e. car parking, recreational space can be located in higher flood risk areas.”*

Appendix A (Drawing no. 3 and drawing no. 4) of this report shows the topography of the proposed development site. Existing levels show a low point within the development site which corresponds with the area indicated as potentially liable to pluvial flooding on the PFRA Flood Mapping, Figure 2.2.

### **Mitigation measures**

- Site drainage and storm water storage will be provided to cater for surface water runoff for a design return period 100-year storm event. The storm networks on the western section have been designed to a 1 in 1000 year flood event.
- Surface water runoff from the site will be limited to greenfield runoff rates by the proposed surface water management system in accordance with the SUDS design principals.
- The landscaping and topography of the developed site shall provide safe exceedance flow paths in the event of extreme flood events or in the case of a blockage of the drainage system, to minimise risks to people and property.
- In an extreme weather event, overflow from the attenuation tank will exit via a high-level overflow to a detention basin located at the north west corner of the proposed development site. During extreme rainfall events, any surface water runoff which exceeds the underground site drainage capacity shall be permitted to flow through a defined flow path to the detention.

## 5 Conclusion

TOBIN Consulting Engineers were appointed in May 2019 to provide engineering and environmental consultancy services for the proposed residential development at Rosshill, in Galway City (Figure 1.1 & Figure 1.2).

The Flood Risk Assessment (FRA) undertook a review of:

- OPW Flood Hazard mapping
- OPW Preliminary Flood Risk Assessment (PFRA) Study
- The Planning System & Flood Risk Management (PSFRM) Guidelines
- Flood Risk Management Climate Change Adaptation Plan
- Galway County Development Plan (2015-2021);
- Galway City Development Plan (2017-2023);
- Western CFRAM Study;
- Irish Coastal Protection Strategy Study;

With reference to the PSFRM guidelines, the proposed residential development is classified as a “highly vulnerable development” in terms of its sensitivity to flooding. Such developments are considered appropriate within Flood Zone C, i.e. in areas not liable to flooding during a 1-in-1000 year Mid-Range Future Scenario.

The outcome of the Flood Risk Assessment is summarised as follows:

### **Fluvial Flooding**

Based on the results of the PFRA (Figure 1.1) and Western CFRAM study (Figure 2.4) it is predicted that the subject site is not liable to fluvial (river) flooding during a 1000 year MRFS.

It is therefore estimated that the risk of fluvial flooding to the development is minimal.

### **Groundwater Flooding**

Based on a review of the PFRA study and GSI mapping of karst features in the area, there is no evidence to suggest groundwater flooding at the site. It is estimated that the risk of groundwater flooding to the proposed development is minimal.

### **Pluvial Flooding**

Pluvial modelling carried out by HR Wallingford as part of the PFRA study indicated that the proposed site may be liable to pluvial flooding, see Figure 2.2. Potential mitigation measures to minimize the risk of pluvial flood flooding are as follows.

- Site drainage and storm water storage will be provided to cater for surface water runoff for a design return period 100-year storm event. The storm networks on the western section have been designed to a 1 in 1000-year flood event.
- Surface water runoff from the site will be limited to greenfield runoff rates by the proposed surface water management system in accordance with the SUDS design principals.
- The landscaping and topography of the developed site shall provide safe exceedance flow paths in the event of extreme flood events or in the case of a blockage of the drainage system, to minimise risks to people and property.
- In an extreme weather event, overflow from the attenuation tank will exit via a high-level overflow to a detention basin located at the north west corner of the proposed development site. During extreme rainfall events, any surface water runoff which exceeds the underground site drainage capacity shall be permitted to flow through a defined flow path to the detention.



## **Coastal Flooding**

The minimum existing ground levels on the Rosshill site are 6.70mOD, i.e. 1.63m above the estimated 1,000-year MRFS coastal flood level of 5.07mOD (Table 3). It is proposed that road levels within the Rosshill site will be raised to at least 7.2mOD, and finished floor levels will be raised to at least 9.30mOD.

Based on the proposed levels at the site, the development is not predicted to flood during a 1 in 1,000 year MRFS coastal flood event.

It is estimated that the risk of flooding the proposed residential development will be minimal, and it is predicted that the development will not increase the risk of flooding elsewhere.

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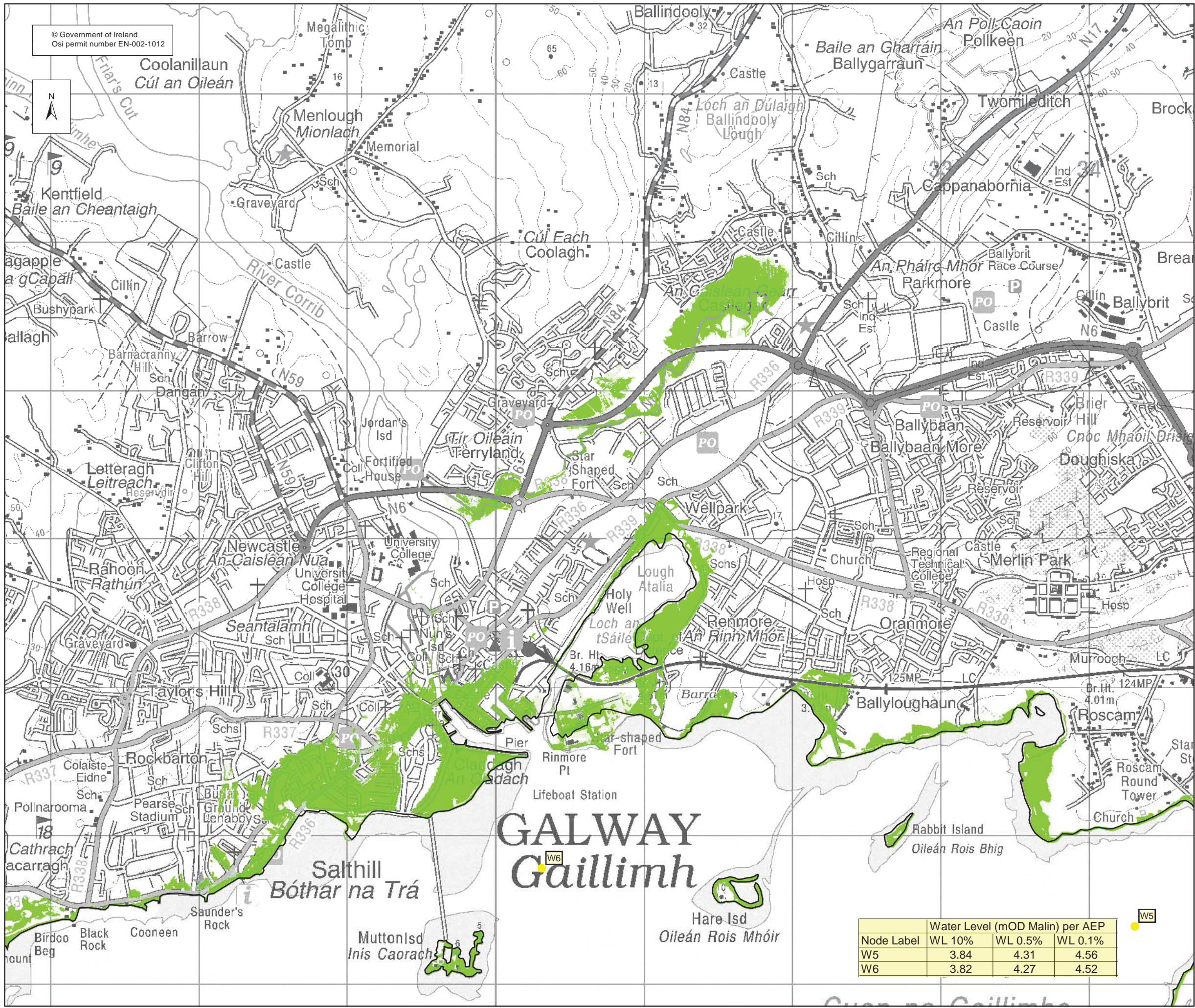
## Appendix 1 - Drawings

Irish Coastal Protection Strategy Study Flood Extent Mapping

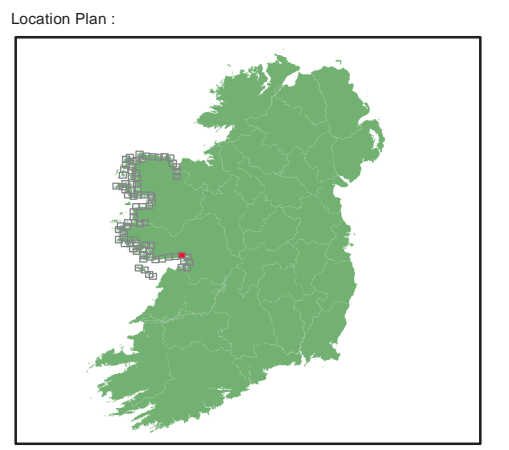
Predicted Coastal Flood Extents, Mid Range Future Scenario (Western CFRAM Study)

Part 1 Site Layout Plan

Part 2 Site Layout Plan



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 Osi permit number EN-002-1012



**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 :**

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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 : MID RANGE FUTURE SCENARIO

Figure By : PJW Date : Dec 2012

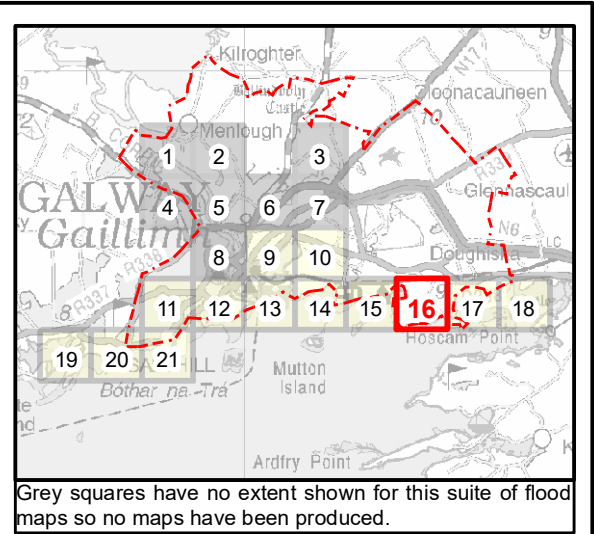
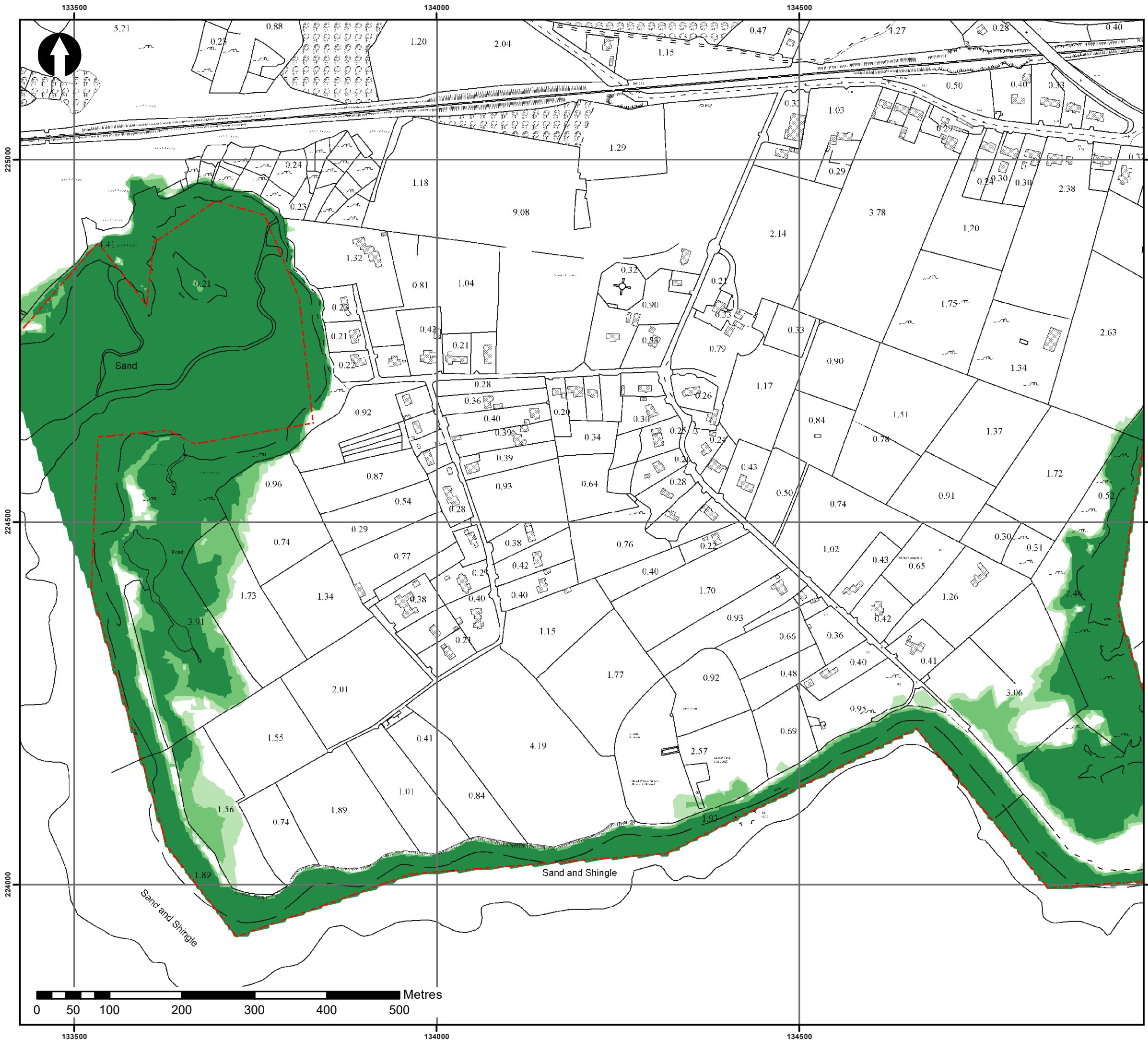
Checked By : JMC & JR Date : Dec 2012

Node Label	Water Level (mOD Malin) per AEP		
	WL 10%	WL 0.5%	WL 0.1%
W5	3.84	4.31	4.56
W6	3.82	4.27	4.52

Figure No. :  
**W / RA / EXT / MRFS / 10**

Revision :  
**1**

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



Grey squares have no extent shown for this suite of flood maps so no maps have been produced.

- AFA Boundary
- Modelled River Centreline
- 10% AEP Tidal Extent
- 0.5% AEP Tidal Extent
- 0.1% AEP Tidal Extent

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**OPW**  
Oifig na nOibreacha Poblaithe  
The Office of Public Works

The Office of Public Works  
Jonathan Swift Street  
Trim  
Co. Meath

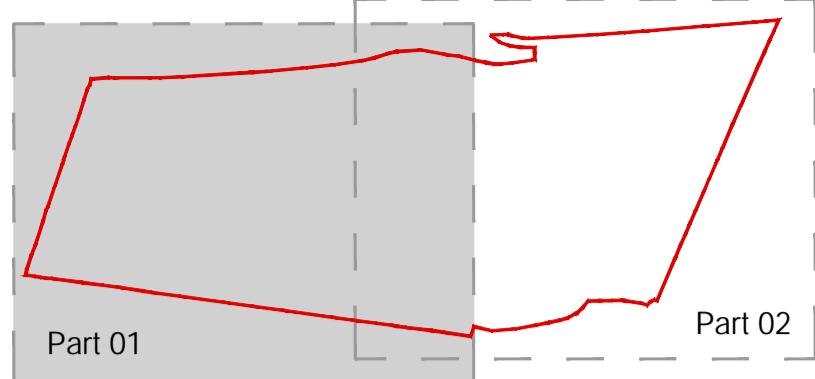
**JBA**  
consulting

JBA Consulting  
24 Grove Island  
Corbally  
Limerick, Ireland

**WESTERN**  
**CFRAM**  
**STUDY**  
CATCHMENT FLOOD RISK  
ASSESSMENT AND MANAGEMENT

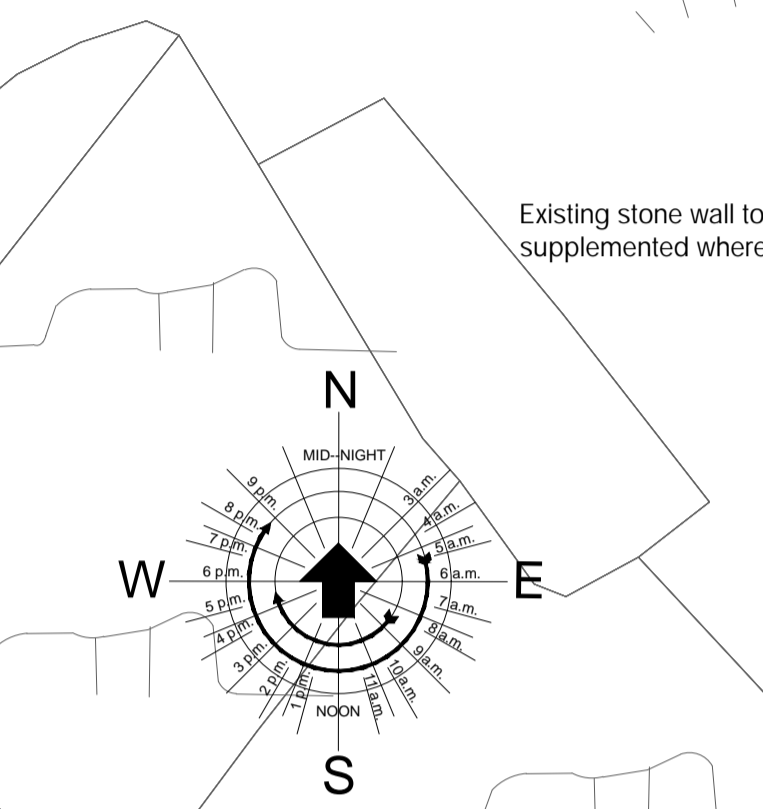
Map: Galway City Flood Extent		Final
Map Type: Flood Extent		
Map Area: HPW	Source: Coastal	Scenario: Current
Drawn by: KF	Date: Apr 2017	<b>1:5,000</b>
Checked by: TS	Date: Apr 2017	
Approved by: JC	Date: Apr 2017	
Map No: W30GLW_EXCCD_F1		Sheet: 16 of 21

# PART 01- SITE LAYOUT PLAN



02 Location key  
Scale: n.t.s

NOTE : PLEASE REFER TO ENGINEERS DRAWINGS & REPORTS FOR SERVICE CONNECTION DETAILS



Provision for Greenway cycle network as per Galway development plan 2017-2023

LEGEND  
Site boundary outlined in red

OVERALL SITE AREA : 100,693 sqm :- 10.069HA :- 24.881 Acre  
 Verges to Old Dublin Road & Rosshill Rd. : 3,381 sqm :- 0.338 HA  
 Junction Land : 628 sqm :- 0.063 HA  
 RA zoned Land to west boundary : 1,292 sqm :- 0.129 HA  
**Developable Area : 95,392 sqm :- 9.539 HA :- 23.572 Acre**

Galway City Council Development plan 2017-2023:  
 Site zoned Low Density Residential (LDR)

**RESIDENTIAL TOTAL NO. OF UNITS = 342**  
**Density:**  
**35.8 Units per Ha - Residential Density (342 total units on 9.539 ha.)**  
**14.5 Units per Acre - Residential Density (342 total units on 23.572 acre)**

Plot ratio : 0.36 :1 (max allowable 0.46:1)  
 Site Coverage : 15.34%  
**45.9% Apartments = 157 Units**  
**54.1% Houses = 185 Units**

**Residential Dwelling Units:**  
 Type 'A-A6' - 4 bed Semi-Detached - Circa 125.4 sqm TOTAL 36 UNITS  
 Type 'A2' - 4 bed Detached - Circa 125.4sqm TOTAL 02 UNITS  
 Type 'B-B7' - 3 bed Semi-D - Circa 110.4 sqm TOTAL 24 UNITS  
 Type 'C-C8' - 3 bed Semi-D - Circa 108.2 sqm TOTAL 44 UNITS  
 Type 'C-C10' - 3 bed Terrace - Circa 108.2 sqm TOTAL 63 UNITS  
 Type 'D' - 2 bed Terrace - Circa 84.4 sqm TOTAL 06 UNITS  
 Type 'E' - 3 bed Long semi-D - Circa 107 sqm TOTAL 05 UNITS  
 Type 'F' - 4 bed Long semi-D - Circa 129.8 sqm TOTAL 05 UNITS  
**TOTAL UNITS ON SITE = 185 UNITS**

**Apartment Units:**  
 Type '1A-1D' - 1 bed Apartment - Circa 49.2sqm (varies) TOTAL 038 UNITS  
 Type '2A-2N'- 2 bed Apartment - Circa 78sqm(varies) TOTAL 119 UNITS  
**TOTAL UNITS ON SITE = 157 UNITS**

Public open space requirement over developable area: 15% - 14,309sqm  
 Public open space provided- Over 21,533sqm - 22.57%  
 (above 10m wide/ 200sqm & reasonably level usable space)  
 Overall Green and landscaped space across the site: 25,130sqm - 25.8%

**Overall site Mix:**  
 038 no. 1 Bedroom units 11.1%  
 125 no. 2 Bedroom units 36.5%  
 136 no. 3 Bedroom units 39.8%  
 043 no. 4 Bedroom units 12.6%  
 100%  
**Mix by type:**  
 157 Apartments 45.9%  
 069 Terraces 20.2%  
 114 Semi-Detached 33.3%  
 002 Detached 00.6%  
 100%

01 PART 01 Site Layout Plan  
 Scale: 1:500

# PART 01- SITE LAYOUT PLAN

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 13. Proprietary items shall be fixed in strict accordance with manufacturers instructions.  
 14. Sites of proprietary items shall be checked with manufacturer and checked for compliance with design detail.  
 15. Contractor is responsible for procuring any proprietary items required/specified with due attention to lead-in times ensuring compliance with programme dates.

No.	Date	Comments	By
REVISIONS			

No.	Date	Comments	By
REVISIONS			

Scale: 1:500  
 Drawing Purpose: PLANNING  
 Project: Proposed Development at Rosshill, Galway City  
 Client: Kegata Ltd.  
 Date: December 2019  
 Drawn by: sor  
 Checked by: JOM

File Ref: 3.09  
 Subject: PART 01 - SITE LAYOUT PLAN - FINALISED RED LINE  
 Project No: 18128  
 Drawing No: 3003  
 Rev: -  
 Ground Floor, Block 3, Galway Technology Park, Parkmore, Galway, Republic of Ireland  
 T: +353 (0)91 771033  
 E: info@onm.ie  
 W: onm.ie  
**O'Neill | O'Malley Ltd.**  
 Architecture + Project Management



PART 02 - SITE LAYOUT PLAN

Rosshill Railway Bridge  
(Protected structure  
RPS 8806, NIAH  
30409423)

BM 10.13

SITE NOTICE LOCATION

EXISTING ENTRANCE  
to be closed to traffic  
and area finished in  
accordance with GCC  
requirements (shown  
hatched in Cyan).

LEGEND  
Site boundary outlined in red

OVERALL SITE AREA : 100,693 sqm :- 10.069HA :- 24.881 Acre  
Verges to Old Dublin Road & Rosshill Rd. : 3,381 sqm :- 0.338 HA  
Junction area : 628 sqm :- 0.063 HA  
RA zoned Land to west boundary : 1,292 sqm :- 0.129 HA  
Developable Area : 95,392 sqm :- 9.539 HA :- 23.572 Acre

Galway City Council Development plan 2017-2023:  
Site zoned Low Density Residential (LDR)

**RESIDENTIAL TOTAL NO. OF UNITS = 342**  
Density:  
35.8 Units per Ha - Residential Density (342 total units on 9.539 ha.)  
14.5 Units per Acre - Residential Density (342 total units on 23.572 acre)

Plot ratio : 0.36 :1 (max allowable 0.46:1)  
Site Coverage : 15.34%

45.9% Apartments = 157 Units  
54.1% Houses = 185 Units

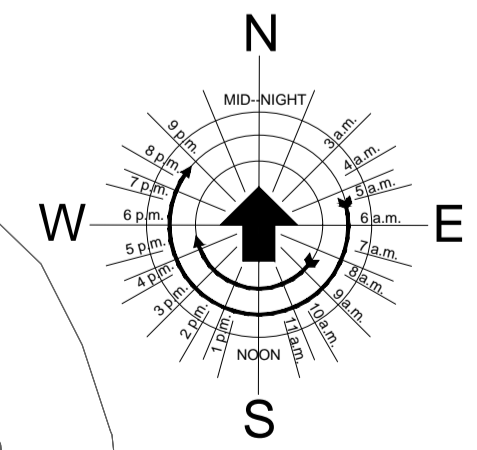
**Residential Dwelling Units:**

Type 'A-A6'	- 4 bed Semi-Detached	- Circa 125.4 sqm	TOTAL 36 UNITS
Type 'A2'	- 4 bed Detached	- Circa 125.4sqm	TOTAL 02 UNITS
Type 'B-B7'	- 3 bed Semi-D	- Circa 110.4 sqm	TOTAL 24 UNITS
Type 'C-C8'	- 3 bed Semi-D	- Circa 108.2 sqm	TOTAL 44 UNITS
Type 'C-C10'	- 3 bed Terrace	- Circa 108.2 sqm	TOTAL 63 UNITS
Type 'D'	- 2 bed Terrace	- Circa 84.4 sqm	TOTAL 06 UNITS
Type 'E'	- 3 bed Long semi-D	- Circa 107 sqm	TOTAL 05 UNITS
Type 'F'	- 4 bed Long semi-D	- Circa 129.8 sqm	TOTAL 05 UNITS
<b>TOTAL UNITS ON SITE =</b>			<b>185 UNITS</b>

**Apartment Units:**

Type '1A-1D'	- 1 bed Apartment	- Circa 49.2sqm (varies)	TOTAL 038 UNITS
Type '2A-2N'	- 2 bed Apartment	- Circa 78sqm(varies)	TOTAL 119 UNITS
<b>TOTAL UNITS ON SITE =</b>			<b>157 UNITS</b>

Public open space requirement over developable area: 15% - 14,309sqm  
Public open space provided- Over 21,533sqm - 22.57%  
(above 10m wide/ 200sqm & reasonably level usable space)  
Overall Green and landscaped space across the site: 25,130sqm - 25.8%



**Overall site Mix:**

038 no. 1 Bedroom units	11.1%
125 no. 2 Bedroom units	36.5%
136 no. 3 Bedroom units	39.8%
043 no. 4 Bedroom units	12.6%
	100%

**Mix by type:**

157 Apartments	45.9%
069 Terraces	20.2%
114 Semi-Detached	33.3%
002 Detached	00.6%
	100%

NOTE : PLEASE REFER TO ENGINEERS DRAWINGS & REPORTS FOR SERVICE CONNECTION DETAILS

PART 02 - SITE LAYOUT PLAN

PART 02 Site Layout Plan  
Scale: 1:500

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No.	Date	Comments	By	No.	Date	Comments	By
REVISIONS							

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Client: Kegata Ltd.  
Date: December 2019  
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