KILGALLEN & PARTNERS
CONSULTING ENGINEERS

Vantage Data Centres Ltd.

Proposed Industrial Development, DUB13, Profile Park, Grangecastle, Co. Dublin

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Report on Site-Specific Flood Risk Assessment

Vantage Data Centres Ltd.	**Document Ref. No.**	**Kilgallen & Partners** **Consulting Engineers** **Well Road,** **Portlaoise** **Co. Laois**
	22050-R-SSFRA Issue PL2	

REVISION HISTORY

Client	Vantage Data Centres Ltd.
Project	Proposed Industrial Development, DUB13, Profile Park, Grangecastle, Co. Dublin
Title	Report on Site-Specific Flood Risk Assessment

Date	**Detail of Issue**	**Issue No.**	**Origin**	**Checked**	**Approved**
27/10/2022	Approval issue	PL1	CP	PB	PB
03/11/2022	Initial planning issue	PL2	CP	PB	PB

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1. INTRODUCTION

Vantage Data Centres Ltd. ['the Applicant'] intends to apply to South Dublin County Council for planning permission for an industrial development ['the proposed development'] on lands to the south of the New Nangor Road (R134), Dublin 22; and on land within the townlands of Ballybane and Kilbride within Profile Park, Clondalkin, Dublin 22 on an overall site of 3.79hectares ['the Site].

The Applicant appointed Kilgallen and Partners Consulting Engineers to :

- carry out a Site-Specific Flood Risk Assessment ['SSFRA'] for the proposed development in accordance with the 'Planning System and Flood Risk Management – Guidelines for Planning Authorities' ['the Guidelines'];
- prepare a report presenting the findings of the SSFRA to support the application for planning permission;

This is the report referred to above.

2. PROCESS FOR SITE-SPECIFIC FLOOD RISK ASSESSMENT

The initial stage of the SSFRA comprises an assessment of available flood risk data to identify flood risk indicators in the Study Area. If the Site is identified to be at risk of flooding, the SSFRA will proceed to a detailed assessment.

2.1 Potential Sources of Flood Risk

Potential flood risk mechanisms are summarised in Table 2-1.

Source	Mechanism
Fluvial:	Overtopping of Rivers and Streams
Pluvial:	The intensity of rainfall events is such that the ground cannot absorb rainfall run-off effectively or urban drainage systems cannot carry the run-off generated.
Groundwater:	Rising water table
Coastal:	Tidal levels and / or wave action
Infrastructure	Failure of flood protection or drainage infrastructure

Table 2-1 Flood Risk Mechanisms

As an inland site upstream of tidal influences and possible wave action, the Site is not subject to coastal flood risk and so this mechanism does not need to be considered further in this assessment.

The assessment will therefore consider the following mechanisms:

- Fluvial;
- Pluvial;
- Groundwater;
- Drainage Infrastructure *(considered under Section 9 – Residual Flood Risk)*

2.2 Flood Risk Indicators

Indicators of flood risk are identified using available data, most of which is historically derived. Typically, this data is not prescriptive in relation to flood return periods and neither predictive nor inclusive of climate change analysis.

Flood risk indicators include:

- Records available on the OPW's National Flood Risk Website. As part of the National Flood Risk Management Policy, the OPW developed the www.floodinfo.ie web-based data set, which contains

information concerning historical flood data and displays related mapped information and provides tools to search for and display information about selected flood events;
- PFRA & CFRAM mapping produced under the CFRAM programme;
- The Strategic Flood Risk Assessment carried out to inform the making of the Local Area Plan;
- Geological Survey of Ireland (GSI) mapping - Hydrogeological mapping maintained by the GSI and made available through its website www.gsi.ie;
- Ordnance Survey mapping - Ordnance Survey maps include areas which are marked as being "Liable to Floods". Generally, these areas are only shown identified indicatively and suggest historical flooding, usually recurrent. In addition, the maps indicate areas of wet or hummocky ground, bog, marsh, springs, rises and wells as well as surface water features including rivers, streams, bridges, weirs and dams;
- Topographical survey information;
- Records of previous floods from other sources;
- Flood Studies, Reports and Flood Relief Schemes carried out in the vicinity of the Study Area;
- Site Walkover.

2.3 Identification of the Presence and Extent of Fluvial Flood Risk

Where the initial process of examining flood risk indicators demonstrates the existence of a risk of fluvial flooding, the study progresses to the next stage, which is a detailed flood risk assessment. This is based on field measurements and hydrological modelling and enables mapping of the zones of Flood Risk within the Site to be established.

In accordance with the Guidelines, flood risk zones are categorized as follows:

Flood Zone A where the probability of flooding in any year is greater than 1% (i.e. Flood Zone in respect of a flood with a return period of 100years);

Flood Zone B where the probability of flooding in any year is between 0.1% and 1% (i.e. Flood Zone in respect of a flood with a return period of between 100years and 1,000years);

Flood Zone C where the probability of flooding in any year is less than 0.1% (i.e. Flood Zone in respect of a flood with a return period of greater than 1,000years).

2.4 Identification of the Presence and Extent of Pluvial Flood Risk

Where the initial process of examining flood risk indicators demonstrates the existence of a risk of pluvial flooding, the study progresses to the next stage, which is a detailed assessment to establish the extent of pluvial flood risk at the Site.

2.5 Identification of the Presence and Extent of Groundwater Flood Risk

Where the initial process of examining flood risk indicators demonstrates the existence of a risk of flooding from groundwater, the assessment progresses to the next stage, which is a detailed assessment to establish the extent of groundwater flood risk at the Site.

2.6 Assessment of Proposed Development

As described in the previous paragraphs, the first stages of the assessment process are concerned with identifying whether the Site is at risk of pluvial, fluvial or groundwater flooding and establishing the extent of any such flood risks.

The next steps in the assessment process are:

- Determination of the impact that any of the identified flood risks will have on the proposed Development;
- Determination of any impact that the Development itself might have in terms of increasing the level of flood risk elsewhere outside the Site;
- Identification of mitigation measures in respect of any such impacts and identification of any residual risks after those mitigation measures are put in place;
- Applying the Development Management Justification Test if appropriate;
- Providing a conclusion as to the appropriateness of the proposed development in terms of flood risk.

3. SITE DESCRIPTION

Figure 3-1 shows the Site in the context of its immediate surroundings and Figure 3-2 shows the main drainage features and site topography indicatively.

The Site is located in Profile Park Business Park. It is bounded:

- to the north by the R134 New Nangor Road;
- to the east by a distributor road ['Falcon Avenue'] through Profile Park;
- to the west and south by unused agricultural lands which are the site for a recently approved industrial development (Pl Reg. Ref. No. SD21A/0241).

The Site is undeveloped and does not appear to be used for any purpose.

Main Drainage Features

The Baldonnell Stream ['the Stream'] crosses under the Falcon Avenue and enters the Site close to its southern boundary. The Baldonnell Stream flows through the Site for approximately 45m and then exits the Site at its west boundary. 190m downstream of the Site the Stream flows through a short 600mm dia. culvert. 300m downstream of the Site, the Stream discharges to a long twin-pipe culvert.

There is no evidence of pluvial drainage entering the Site.

The vegetation is suggestive of poorly draining upper soils but there is no evidence of standing groundwater.

Topography

The Site can be described as relatively flat, with a general shallow fall from northeast to southwest.

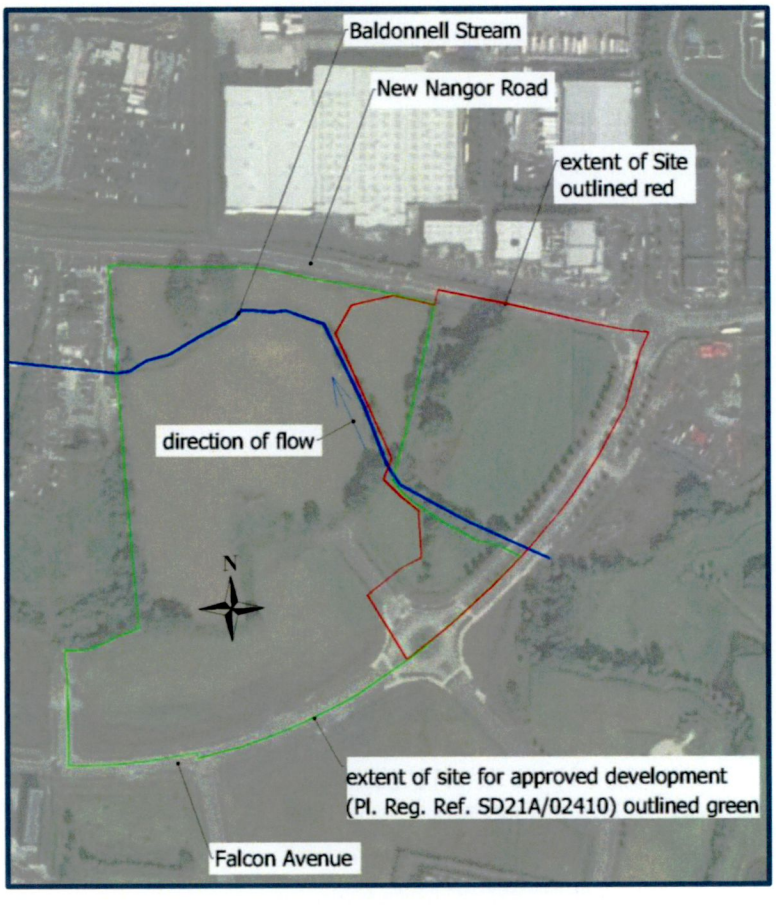

Figure 3-1 Site Context

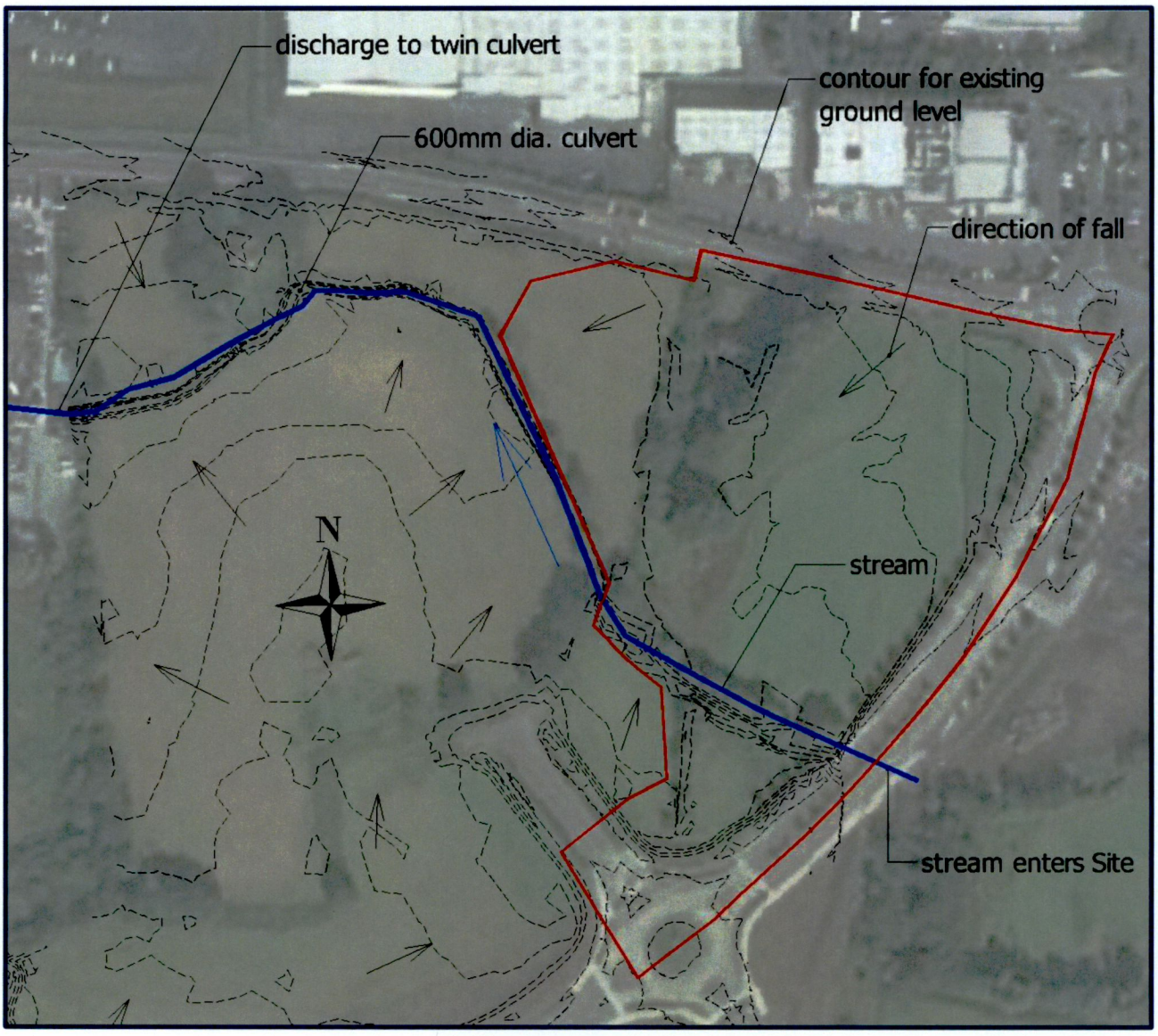

Figure 3-2 Site Topography / Main Drainage Features

4. PROPOSED DEVELOPMENT

4.1 Description

The proposed development comprises industrial buildings, parking areas, circulation roads, ancillary landscaping, drainage (including SUDS measures), services and ancillary Site works.

The development will consist of the demolition of the two storey dwelling (207.35sqm) and associated outbuildings and farm structures (348.36sqm); and the construction of 1 no. two storey data center with plant at roof level and associated ancillary development that will have a gross floor area of 12,893sqm that will consist of the following:

- 1 no. two storey data center (Building 13) with a gross floor area of 12,893sqm. It will include 13 no. emergency back-up generators of which 12 will be double stacked and one will be single stacked within a compound to the south-western side of the data center with associated flues that each will be 22.316m in height and 7 no. hot-air exhaust cooling vents that each will be 20.016m in height;
- the data center will include data storage rooms, associated electrical and mechanical plant rooms, loading bays, maintenance and storage spaces, office administration areas, and plant including PV panels at roof level as well as a separate house generator that will provide emergency power to the admin and ancillary spaces. Each generator will include a diesel tank and there will be a refuelling area to serve the proposed emergency generators;
- The data center will have a primary parapet height of 14.246m above ground level, with plant and screen around plus a plant room above at roof level. The plant room has an overall height of 21.571m;
- Construction of an internal road network and circulation areas, with a staff entrance off Falcon Avenue to the east, as well as a secondary vehicular access for service and delivery vehicles only across a new bridge over the Baldonnel Stream from the permitted entrance as granted under SDCC Planning Ref. SD21A/0241 from the south-west, both from within Profile Park that contains an access from the New Nangor Road (R134);
- Provision of 60 no. car parking spaces (to include 12 EV spaces and 3 disabled spaces), and 34 no. cycle parking spaces;
- Signage (5.7sqm) at first floor level at the northern end of the eastern elevation of the data center building; and
- Ancillary site development works, will include footpaths, attenuation ponds that will include an amendment to the permitted attenuation pond as granted to the north of the Baldonnel Stream under SDCC Planning Ref. SD21A/0241, as well as green walls and green roof. The installation and connection to the underground foul and storm water drainage network, and installation of utility ducts and cables, that will include the drilling and laying of ducts and cables under the internal road network within Profile Park. Other ancillary site development works will include hard and soft landscaping that will include an amendment to the permitted landscaping as granted under SDCC Planning Ref. SD21A/0241, lighting, fencing, signage, services road, entrance gates, and sprinkler tanks.

A schematic layout for the proposed development is shown in Figure 4-1. Relevant proposals for the development are shown on the schedule of documents contained in Appendix A.

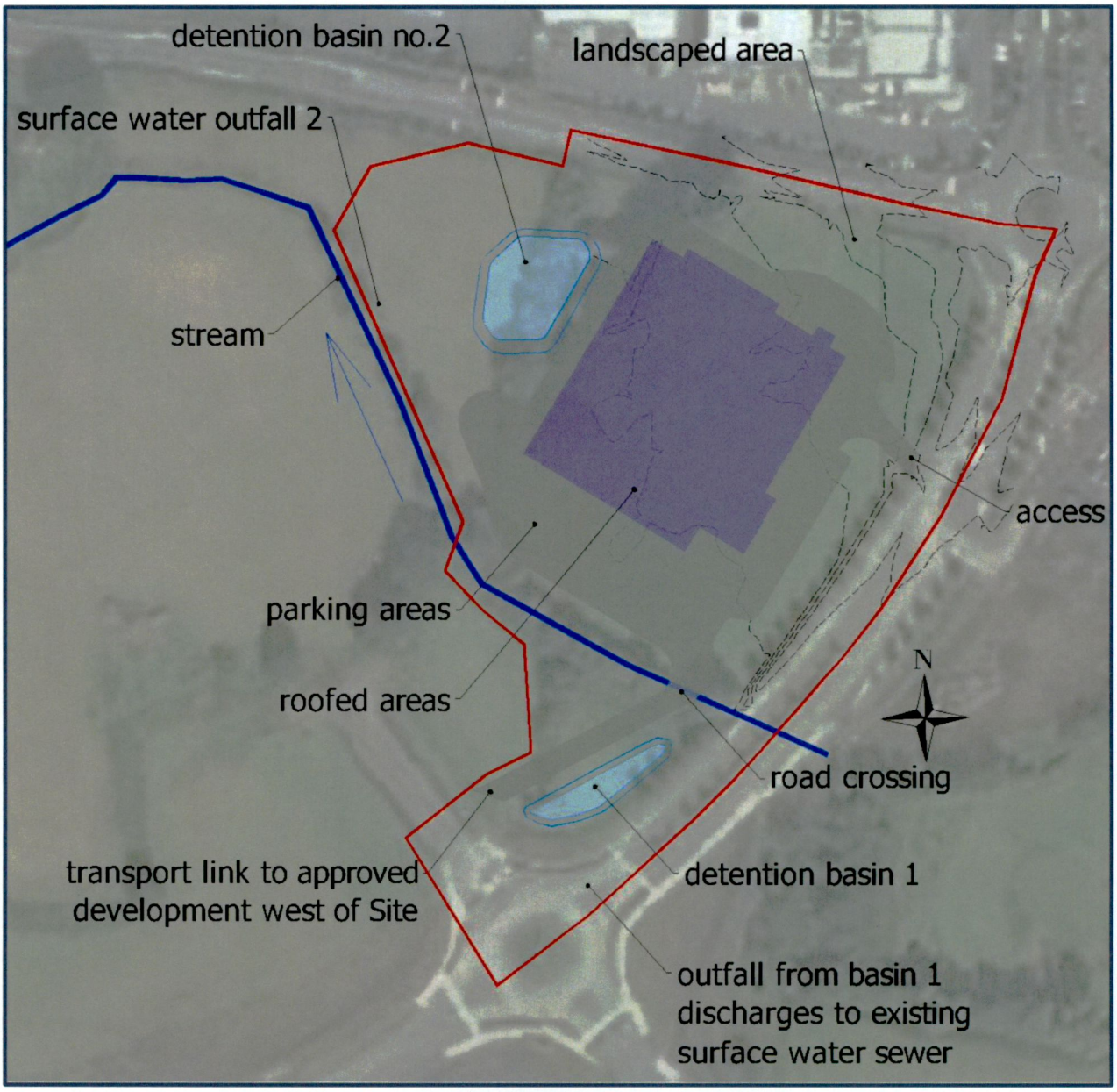

Figure 4-1 Schematic Layout of Proposed Development

4.2 Vulnerability

Table 3.1 of the Guidelines classifies different types of development in terms of their vulnerability to flooding. Figure 4-2 contains an extract from this table which shows industrial development classified as Less Vulnerable. The proposed development is an industrial development and so falls under this classification.

Less vulnerable development	Buildings used for: retail, leisure, warehousing, commercial, industrial and non-residential institutions; Land and buildings used for holiday or short-let caravans and camping, subject to specific warning and evacuation plans; Land and buildings used for agriculture and forestry; Waste treatment (except landfill and hazardous waste); Mineral working and processing; and Local transport infrastructure.

Figure 4-2 Classification of development type by vulnerability to flooding

Table 3.2 of the Guidelines provides a matrix of development vulnerability versus Flood Zone which illustrates the appropriateness of a development type for each Flood Zone. This table is reproduced in Figure 4-3 and shows the Guidelines regards Less Vulnerable development as being appropriate for Sites in Flood Zone B and requiring the Justification Test for Sites in Flood Zone A

	Flood Zone A	Flood Zone B	Flood Zone C
Highly vulnerable development (including essential infrastructure)	Justification Test	Justification Test	Appropriate
Less vulnerable development	Justification Test	Appropriate	Appropriate
Water-compatible development	Appropriate	Appropriate	Appropriate

Table 3.2: Matrix of vulnerability versus flood zone to illustrate appropriate development and that required to meet the Justification Test.

Figure 4-3 Matrix of vulnerability versus Flood Zone

5. FLUVIAL FLOOD RISK – INITIAL ASSESSMENT

5.1 Flood Risk Indicators - Desktop

A number of datasets were interrogated for indicators of fluvial flood risk:

(i) SFRA

Mapping prepared as part of the Strategic Flood Risk Assessment for the South Dublin County Development Plan indicates the Site is not affected by either the 0.1% AEP and 1.0% AEP flood events. The only exception is at the southern corner where the existing Falcon Avenue is shown to be subject to flood risk. An extract from this mapping is shown in Figure 5-1.

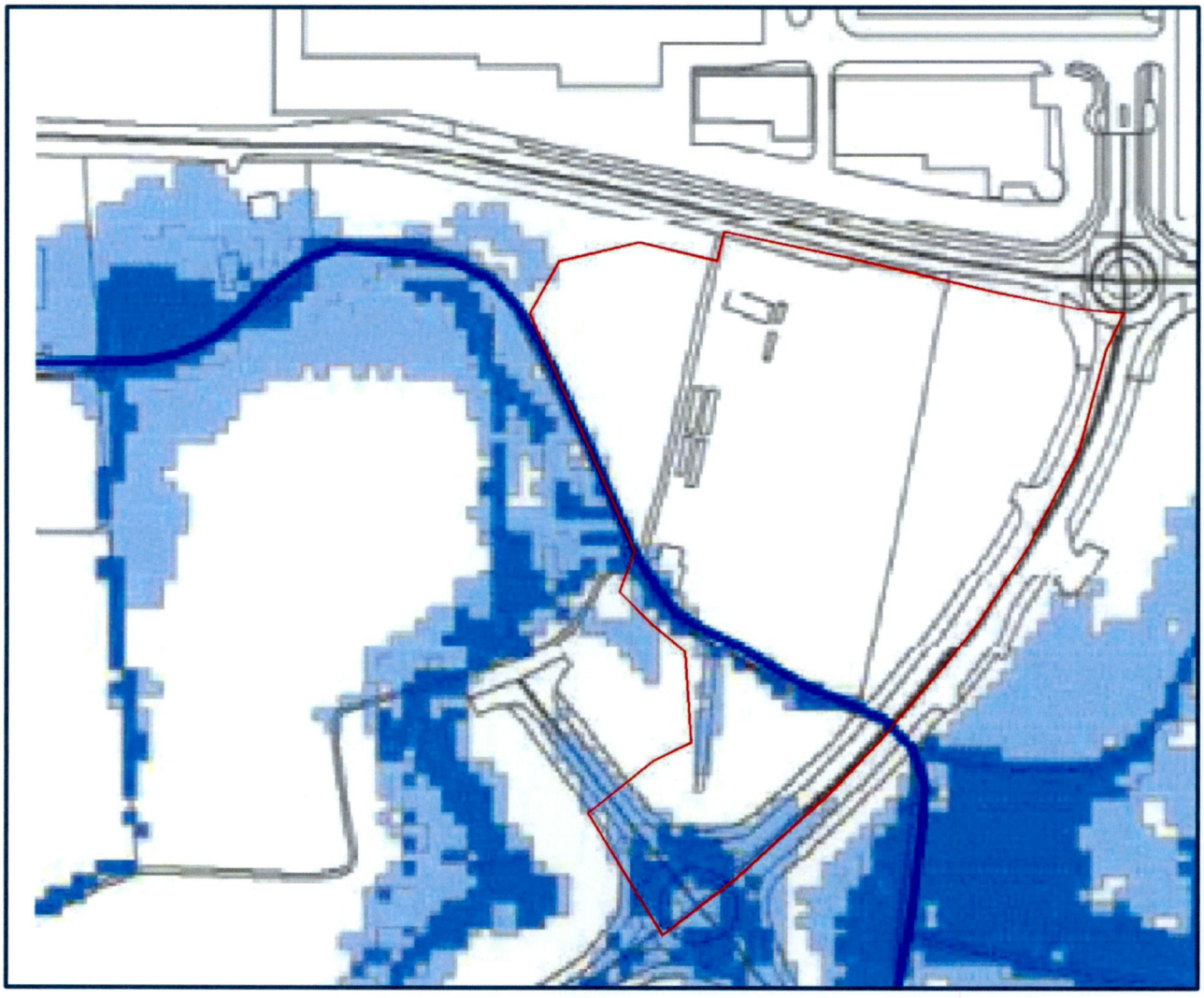

Figure 5-1 Extract from SFRA showing fluvial flood risk at the Site

(ii) OPW National Flood Hazard Mapping Website

The OPW maintains the National Flood Hazard Mapping website (floodinfo.ie) which contains information about locations that may be at risk from flooding. The source of this information includes Local Authorities and other historic records such as newspaper articles and other documentation about reported floods.

The website does not have any records of flooding at this location.

(iii) CFRAM

Mapping prepared as part of the CFRAM programme indicates the Site is not affected by the 0.1% AEP flood event but not the 1.0% AEP event. As with SSFRA mapping, the only exception is at the southern corner where the existing Falcon Avenue is shown to be subject to flood risk. An extract from this mapping is shown in Figure 5-2.

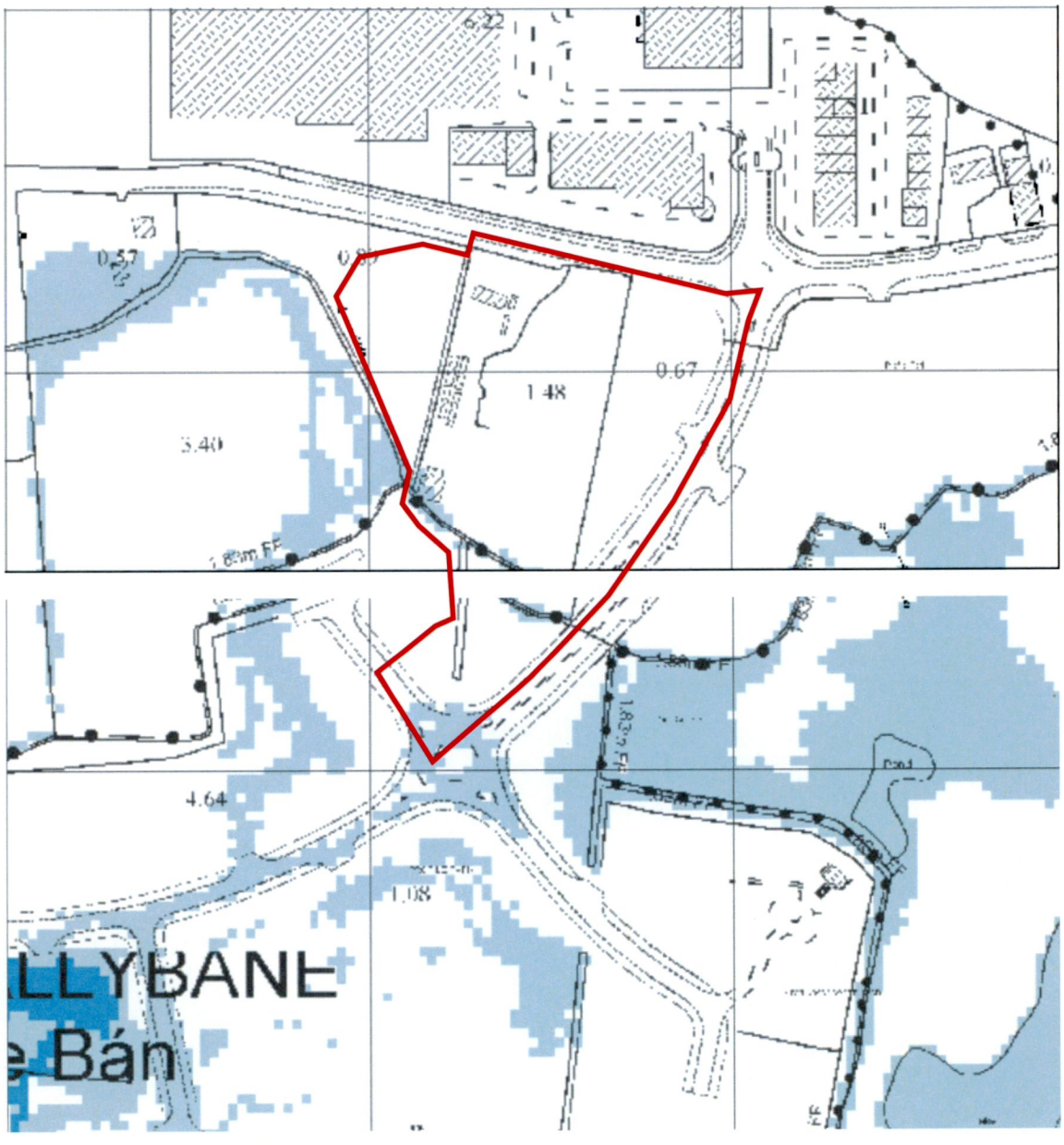

Figure 5-2 Extract from CFRAM mapping showing fluvial flood risk at the Site

(iv) Ordnance Survey Mapping

Figure 5-3 shows the historic 25" OS mapping for the Site and its immediate surroundings. There is no indication of flood risk at the Site.

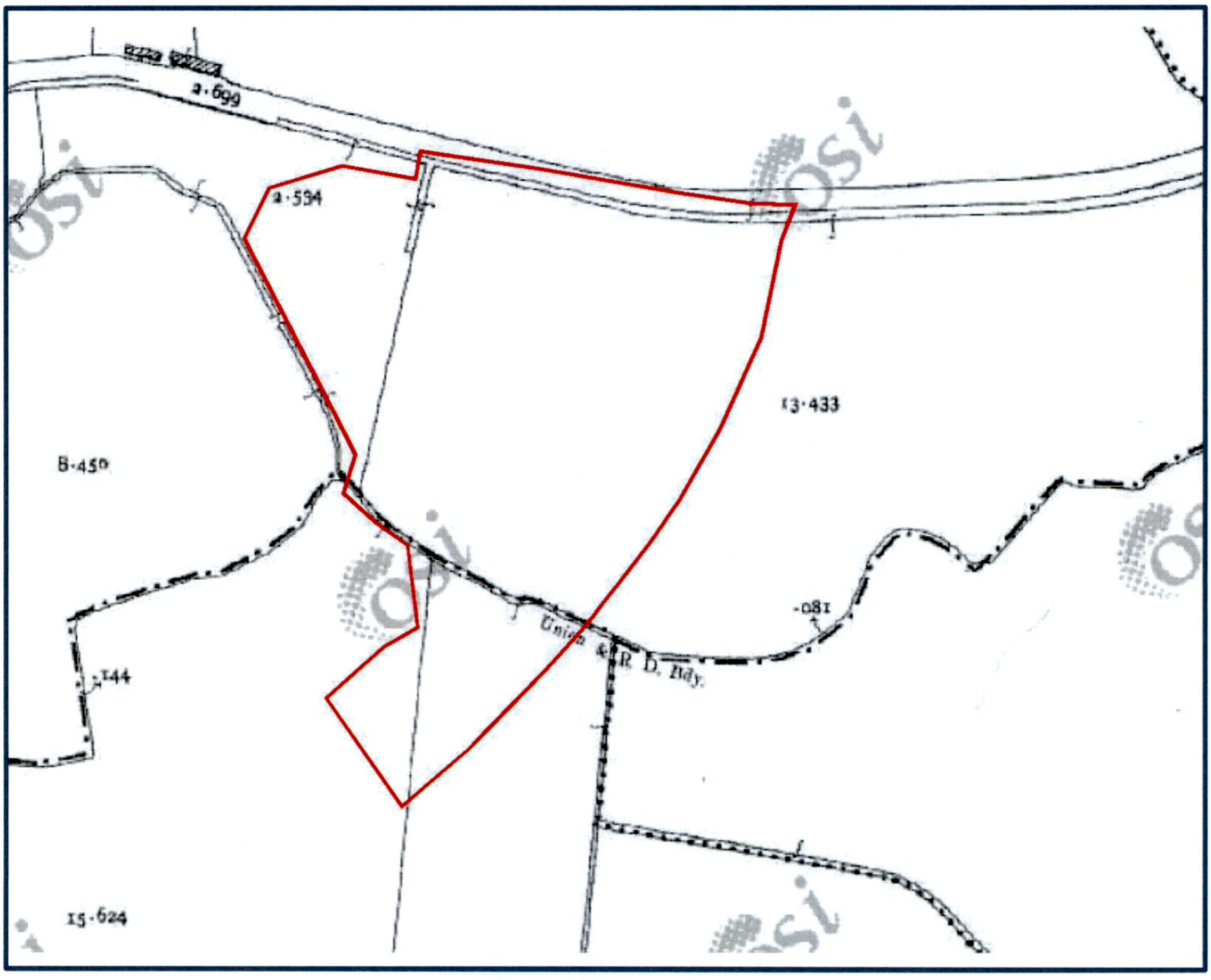

Figure 5-3 Historic OS Map

5.2 Flood Risk Indicators - Site Walkover

The Baldonnell Stream ['the Stream'] crosses under the Falcon Avenue through a twin-pipe culvert, each pipe 1400mm diameter, and enters the Site close to its southern boundary.

The Baldonnell Stream flows through the Site for approximately 45m and then exits the Site at its west boundary.

190m downstream of the Site the Stream flows through a short 600mm dia. culvert.

300m downstream of the Site, the Stream discharges to a long twin-pipe culvert. The inlet to this culvert is poorly constructed and hydraulically inefficient; it was observed that in addition to the pipes, the gaps between the pipes also provides a flow path for the stream to discharge to.

A visual assessment of the channel of the stream suggests the twin-pipe culvert will have a significantly lower hydraulic capacity than the channel.

Figure 5-4 View of Site at East Boundary from North

Figure 5-5 View of Site at West Boundary from North

Figure 5-6 View of Site at West Boundary from South

Figure 5-7 Upstream View of Culvert under Falcon Avenue

Figure 5-8 Typical View of Stream Channel through Site

Figure 5-7 Typical Section of Stream Channel downstream of Site

Figure 5-8 Inlet to twin-pipe culvert

5.3 Initial Assessment

The indicators described in Section 5.1 suggest the Site is not at significant risk from fluvial flooding. However, the Site Walkover suggests the Site may be at risk of flooding caused by inadequate hydraulic culvert capacity downstream of the Site.

Accordingly, it is the conclusion of this SSFRA that detailed assessment of fluvial flood risk is appropriate.

6. FLUVIAL FLOOD RISK – DETAILED ASSESSMENT

6.1 Estimating Peak Flood Flows

The catchment area for the stream, shown outlined orange on Figure 6-1, measures 1.0 km^2.

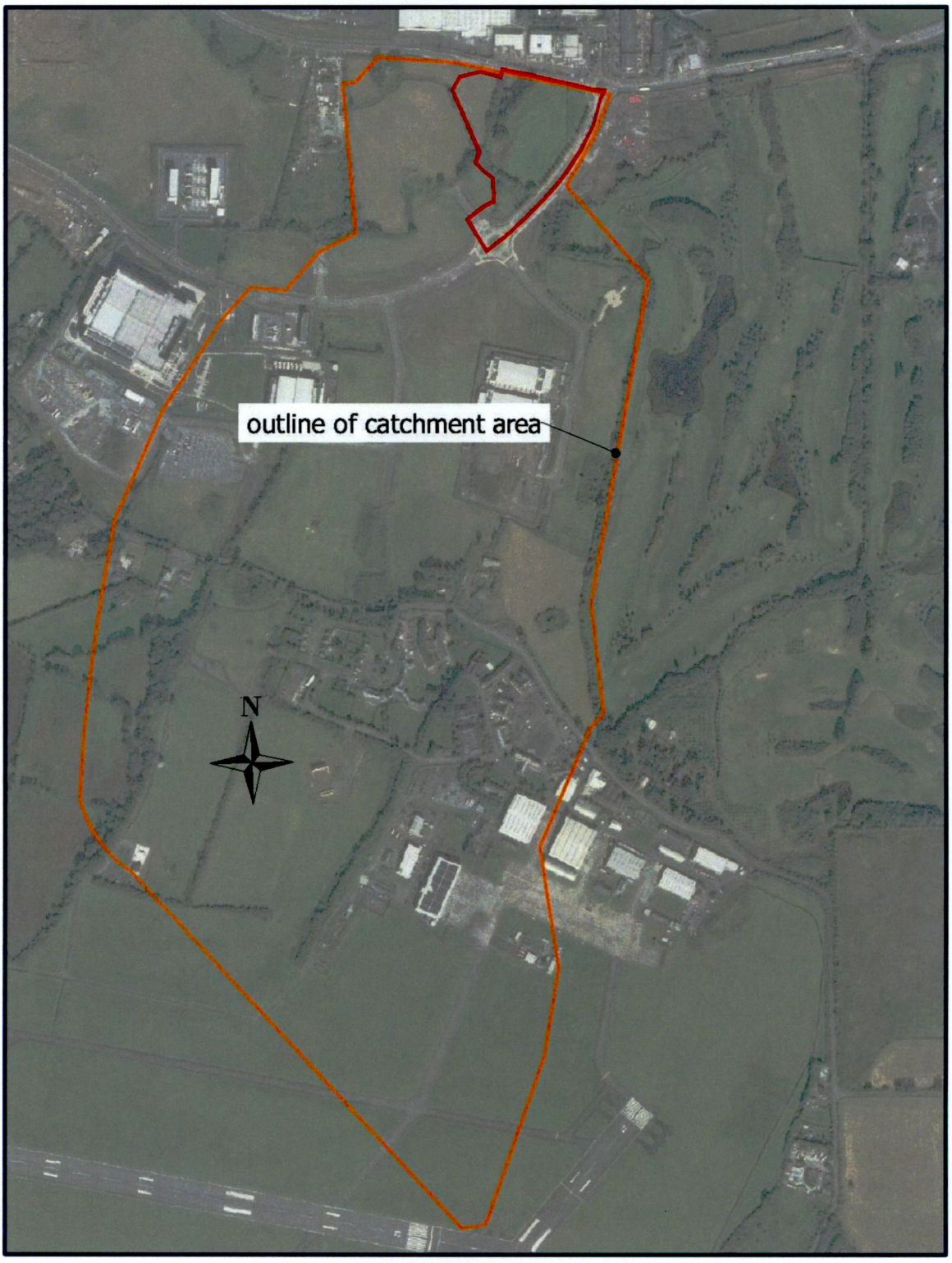

Figure 6-1 Catchment Area for Stream

The OPW provides a Web Portal for estimating peak flood flows in natural catchments (Flood Studies Update (FSU) Web Portal). While the use of this portal is generally considered best practice for the estimation of flood flows, the portal advises particular caution where peak flows are being estimated for catchments of less than 25km^2. Accordingly, peak flood flows were estimated using statistical methods for ungauged small catchments.

Table 6-1 shows a number of Physical Catchment Descriptors taken from the FSU portal that were used to estimate peak flood flows.

PCD	Value	
BFISOIL	0.5199	
SAAR	714.82	mm
FARL	1	
DRAIND	0.721	km/km^2
S1085	0.1	m/km
ARTDRAIN2	0	
ARTDRAIN2	0	
URBEXT	0.3589	

Table 6-1 Physical Catchment Descriptors from FSU Web Portal

Initially, various alternative statistical methods were used and the results of these are reproduced in Table 6-2 (details of these calculations are included in Appendix B). All flow estimates include a climate change factor of 20%.

Typically, peak flow estimates for the 1% AEP flood event are below 1.0m^3/s. The only exception is the flow estimate given by IH124 which is over three times the next greatest estimate and not consistent with the size of the catchment and the drainage infrastructure in the area. IH124 it generally considered to over-estimate peak flood flows *{WP4.2 Flood Estimation in Small and Urbanised Catchments – OPW 2012}*. Therefore, the IH124 flow estimate will not be used and instead the flow estimates used will be the next greatest; i.e. those given by the FEH-Statistical method.

Method	1% AEP	0.1% AEP
	m^3/s	m^3/s
IH124	2.79	3.69
FSU Update	0.47	0.64
FSU-3V	0.14	0.18
FSU_7V	0.37	0.51
FEH-Statistical	0.89	1.20

Table 6-2 Estimates for Peak Flood Flows

6.2 Pre-development Hydrological Model

A hydrological model was prepared to simulate flow patterns during the 1% and 0.1% AEP rainfall events. This model was developed using the River and Flood Analysis module of the industry standard package Infrastructure Ultimate Design Suite produced by Autodesk. The hydrological modelling within this module is itself based on the HEC-RAS modelling software produced by the US Army Corps of Engineers.

The module calculates flood risk zones for the catchment based on the peak flood flows and the following:

- a terrain model created using topographical survey data;
- dimensions of culverts and other drainage structures;
- appropriate values for the roughness coefficient 'Manning's n' as determined from visual inspection of the Site.

Culvert downstream of Site

As described above, the stream is culverted downstream of the Site. This culvert comprises two 600mm diameter pipes at its inlet. A CCTV survey of the culvert revealed that one of the pipes changes to 450mm diameter approximately 20m from the inlet. Furthermore, both pipes show significant blockages that greatly reduce the capacity of the culvert; the extent of these blockages was such that the survey could not be completed for the full length of the culvert.

In regard to this culvert, the hydraulic models assumes:

- the culvert comprises a 600mm dia. pipe and 450mm dia. pipe for its entire length;
- the culvert will be cleared of all obstructions and maintained free of debris / deposition throughout the operational life of the proposed development;
- the maximum depth of deposition in the culvert will be 100mm.

Pre-Development Fluvial Flood Risk Zones at the Development Site

The map in Figure 6-2 shows the existing fluvial flood risk zones determined using the hydrological model described above. Peak water levels are as follows:

- 1.0% AEP Flood Event 72.15 m;
- 0.1% AEP Flood Event 72.53 m.

The Site was found to be not affected by either 1% or 0.1% AEP flood risk zones.

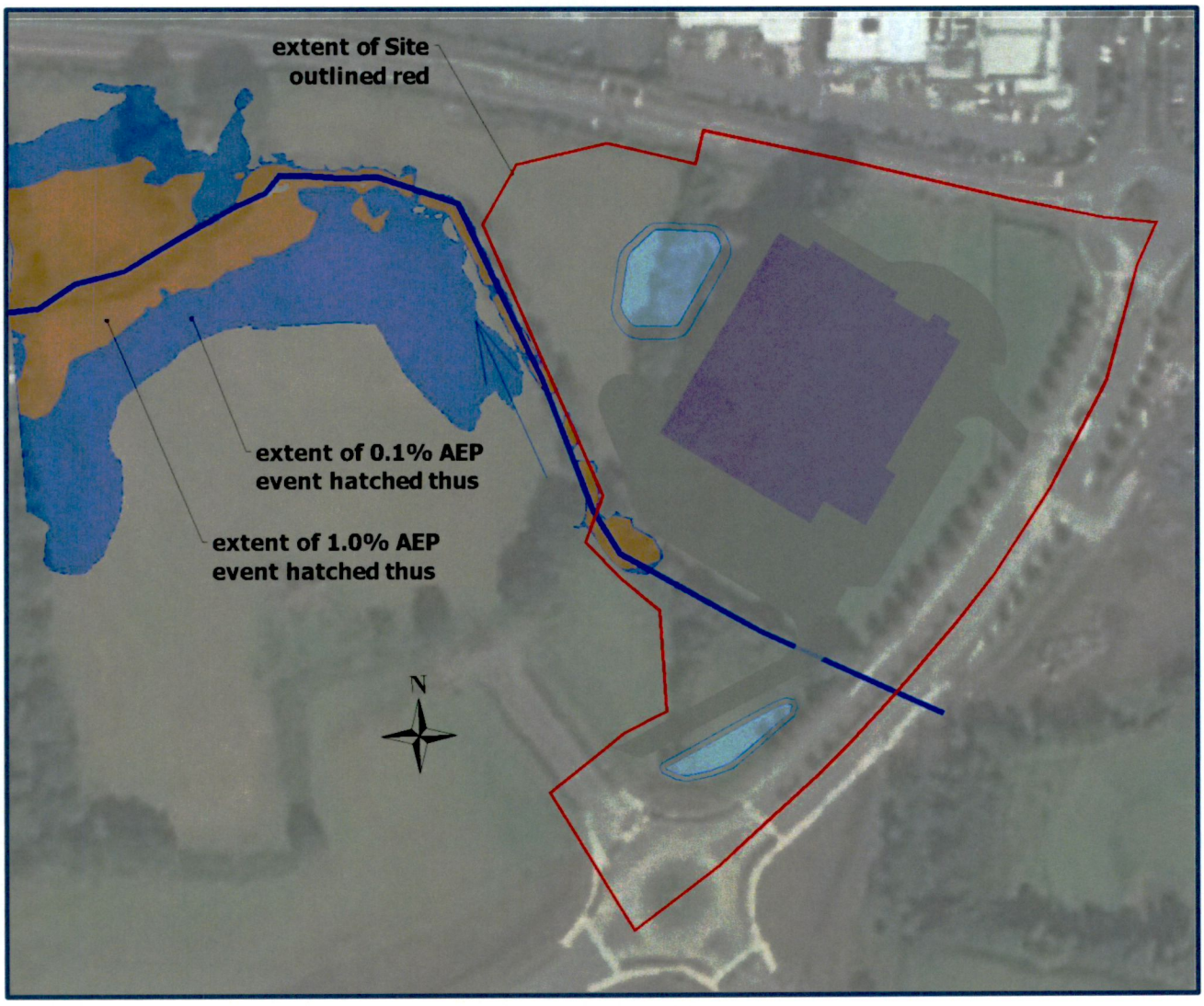

Figure 6-2 Fluvial flood risk zones - Pre-Development

6.3 Development Proposals - Surface Water Drainage

The surface water drainage system for the proposed development has been designed by Pinnacle Consulting Engineers who have provided design calculations demonstrating compliance with the Greater Dublin Strategic Drainage Study in the schedule of documents listed in Appendix A.

Full compliance with GDSDS ensures the drainage system ensures the flood regime in the receiving stream will not be affected, thus not giving rise to flood risk elsewhere.

6.4 Development Proposals - Road crossing of Baldonnell Stream

As described in Section 5.2, the Stream crosses under the Falcon Avenue through a twin-pipe culvert, each pipe 1400mm diameter. The proposed road crossing is 20m downstream from the Falcon Avenue culvert.

Figure 6-3 shows a box culvert to convey the Stream under the proposed crossing.

The internal dimensions of the box culvert are 1.4m in height and 3.5m in width and it thus has a significantly greater hydraulic capacity than that of the Falcon Avenue culvert.

To meet the requirements of the Office of Public Works (OPW) for granting Section 50 approval under the Arterial Drainage Act, culverts are typically required to have a minimum 300mm clearance between the 1% AEP water level and the soffit of the culvert. Figure 6-3 shows the box culvert will have 650mm clearance between the 1% AEP water level and the soffit level, thus comfortably exceeding OPW requirements.

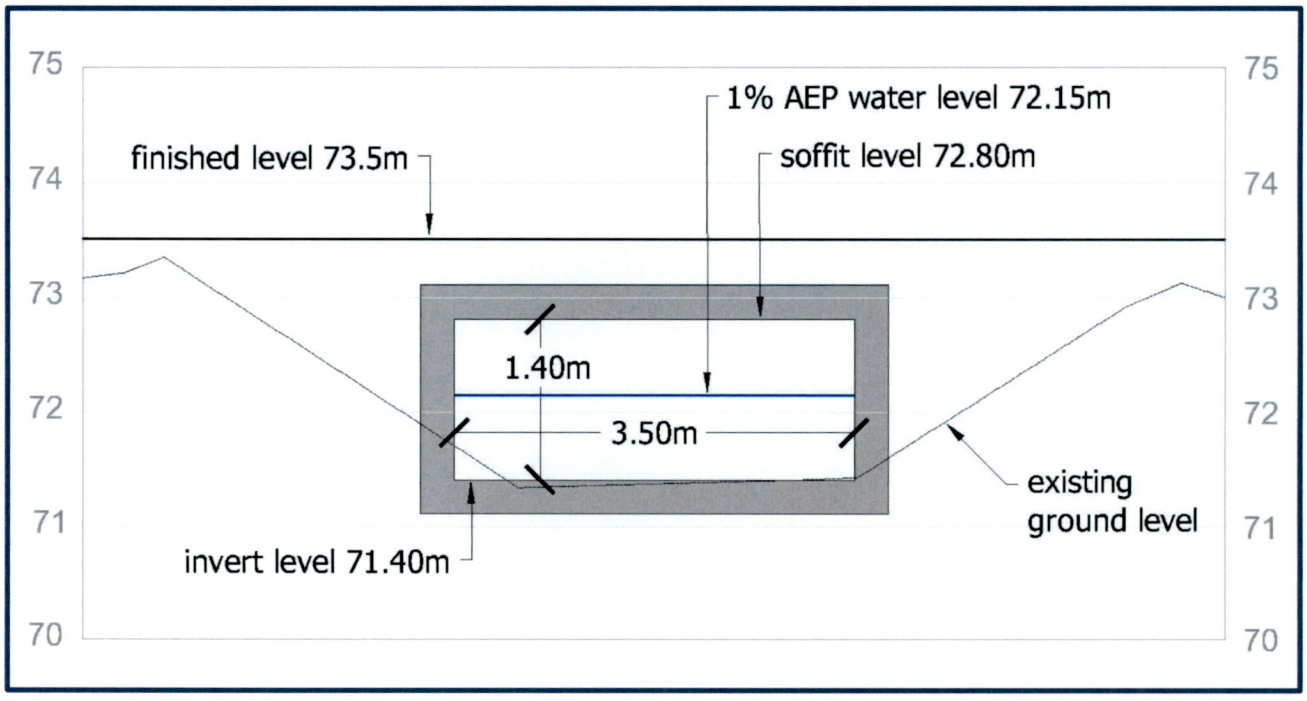

Figure 6-3 Fluvial flood risk zones - Pre-Development

6.5 Conclusion of Detailed Assessment of Fluvial Flood Risk

The proposed development will not be at risk of flooding from fluvial sources and will not give rise to fluvial flood risk elsewhere.

7. FLOOD RISK FROM GROUNDWATER

7.1 Flood Risk Indicators - Desktop

Various datasets were interrogated for indicators of flood risk from Ground Water. These comprise:

(i) *OPW National Flood Hazard Mapping*

Records from the National Flood Hazard Mapping website maintained by the OPW do not contain any evidence of flood events at the Site associated with fluctuations in groundwater level;

(ii) *Geological Survey of Ireland (GSI)*

The GSI maintains a web portal that provides data for Groundwater (https://www.gsi.ie), including groundwater flooding data.

The portal does not show any groundwater flooding at or in the vicinity of the Site.

The portal indicates the Site to be in an area of high groundwater vulnerability with subsoils of low permeability.

(iii) *Historical Ordnance Survey Mapping*

Historical OS maps shows a well immediately northwest of the Site. No other information is available for this well. There is no indication of springs at the Site.

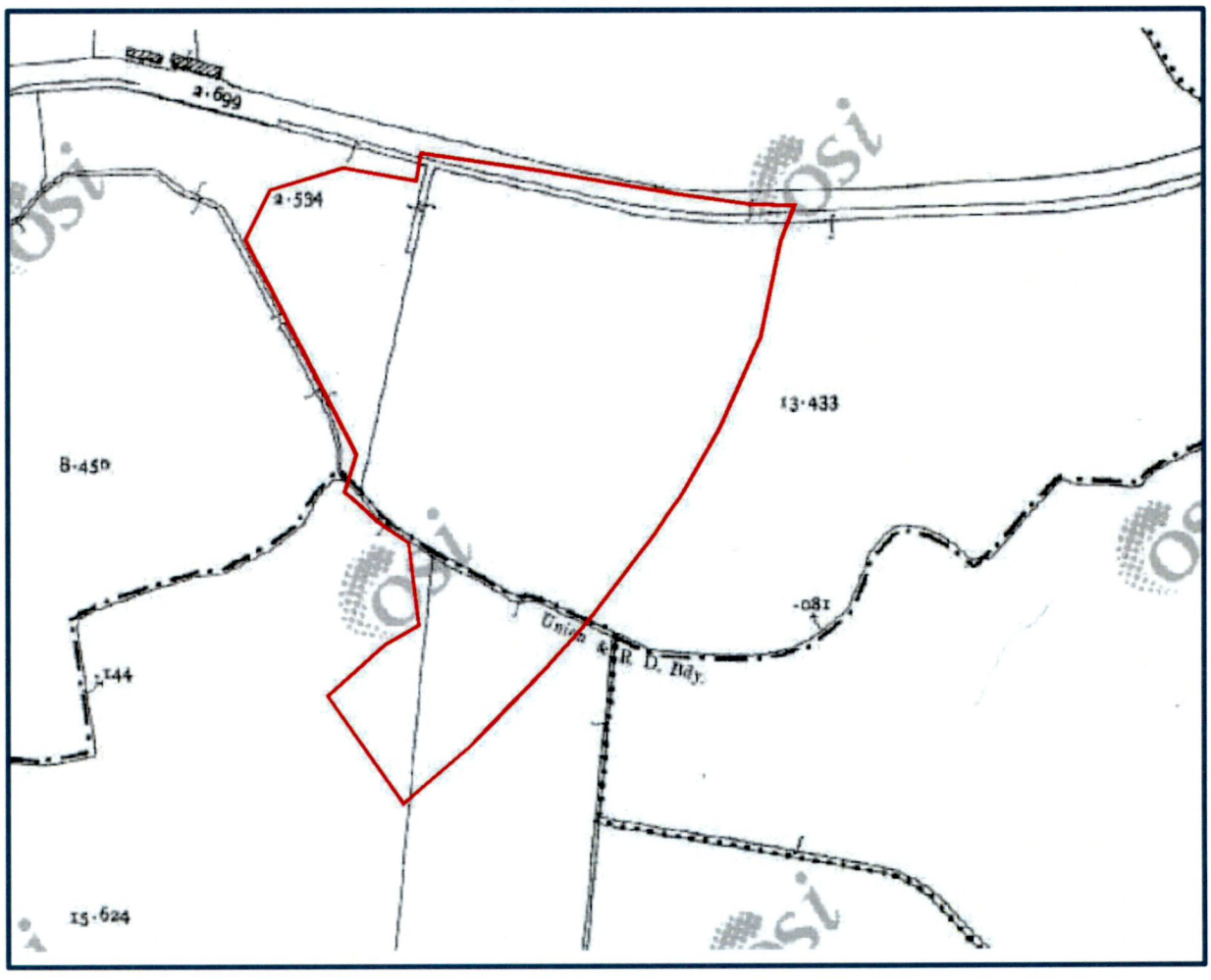

Figure 7-1 Historic OS Mapping

(iv) Ground Investigation
A ground investigation at the Site encountered groundwater generally between 1.0m and 2.0m blow existing ground level.

(v) Topography
The topography of the Site does not include localised low-lying areas that would give rise to groundwater ponding to a significant depth.

7.2 Flood Risk Indicators – Site Walkover

No evidence of flood risk from groundwater was observed during a Site walkover.

7.3 Initial Assessment

The ground investigation did encounter water-bearing strata relatively close to the surface however all indicators suggest the Site is not at risk from groundwater flooding. Detailed assessment of flood risk from this mechanism is not required.

8. PLUVIAL FLOOD RISK

8.1 Flood Risk Indicators - Desktop

A number of datasets were interrogated for indicators of pluvial flood risk:

(i) SFRA

The Strategic Flood Risk Assessment for the South Dublin County Council does not contain any information regarding pluvial flood risk at the Site.

(ii) OPW National Flood Hazard Mapping Website

The OPW maintains the National Flood Hazard Mapping website (floodinfo.ie) which contains information about locations that may be at risk from flooding. The source of this information includes Local Authorities and other historic records such as newspaper articles and other documentation about reported floods. This source does not register any previous flood events associated with pluvial flood risk at the Site.

(iii) CFRAM study programme undertaken by the OPW

Maps prepared for the CFRAM study programme do not show any pluvial flood risk at the Site.

(iv) Urban Drainage Systems

The Site is not affected by urban drainage systems that would give rise to overland flow across the Site.

8.2 Flood Risk Indicators – Site Walkover

No indicators of pluvial flood risk were observed during a site walkover

8.3 Surface water drainage system for the proposed development

The surface water drainage system for the proposed development has been designed by Pinnacle Consulting Engineers to comply with the Greater Dublin Strategic Drainage Study.

Full compliance with GDSDS ensures the drainage system will have sufficient capacity to accommodate rainfall events up to 1% AEP (including climate change) without causing pluvial flood risk within the development and without leading to an increase in pluvial flood risk elsewhere

8.4 Initial Assessment

Based on the indicators described in Section 8.1, on the site walkover described in Section 8.2 and the design of the surface water drainage system as described in Section 8.3, the initial assessment indicates the Site is not at risk from pluvial flooding and further assessment is not required.

9. RESIDUAL FLOOD RISK

Residual risk is the risk that remains after all mitigation measures to reduce the frequency of flooding have been taken.

9.1 Flood Risk Management Plan

The assessment to this point has found the proposed development is not at risk of flooding. However, all developments include some element of residual flood risk that must be addressed during their operational lives; for example the failure of building drainage due to lack of maintenance.

To address this residual risk, it is recommended that a Site-Specific Flood Risk Mitigation Plan prepared in accordance with the Guidelines is implemented throughout the operational life of the proposed development.

9.2 Blockage in culvert immediately downstream of the Site

As described already, the stream is culverted downstream of the Site. This culvert comprises two 600mm diameter pipes at its inlet. A CCTV survey of the culvert revealed that one of these pipes changes to 450mm diameter approximately 20m from the inlet. Furthermore, the CCTV survey found both pipes to have significant blockages that greatly reduce the overall capacity of the culvert; the extent of these blockages was such that the survey could not be completed for the full length of the culvert.

Therefore, the condition and size of the culvert downstream of the blockages is unknown and there is potential, for example in the event of culvert collapse, of the stream surcharging within the Site to a level exceeding that predicted by the hydrological models. To mitigate this risk, it is recommended that an overflow be constructed from the Site which would allow such excess to discharge to the stream immediately downstream of the Nangor Road. Subject to the capacity being available, this overflow could possibly discharge to existing surface water drainage in the Nangor Road but a dedicated surface water pipe might be required from the Site to a new outfall downstream of the Nangor Road.

The Flood Risk Mitigation Plan described in Section 9.1 must include should include a maintenance regime for all drainage features within the Site and for regular inspection of drainage features immediately upstream and downstream of the Site.

10. MINIMUM FINISHED LEVELS

In order to ensure that elements of development of the Site not compatible with water (i.e. roads, buildings etc.) are not at risk of flooding, the Guidelines recommend that floor levels and road levels be kept above the 1% AEP flood level with an appropriate allowance for freeboard.

A freeboard of 500mm is appropriate for floor levels and a freeboard of 250mm is appropriate for road levels.

The maximum water level during the 1% AEP flood event is 72.15m. The minimum floor level is 74.00m and the minimum parking level is 73.45m and so both meet the recommendations of the Guidelines.

11. DEVELOPMENT MANAGEMENT JUSTIFICATION TEST

A Development Management Justification Test was carried out in respect of the proposed development in accordance with Section 5.15 of the Flood Risk Management Guidelines and incorporating the findings of the subject FRA. Table 11.1 presents the results of this test which conclude that the proposed development satisfies the criteria of the Justification test.

1.1	*The subject lands have been zoned or otherwise designated for the particular use or form of development in an operative development plan, which has been adopted or varied taking account of these Guidelines.*	
	Yes	
1.2	*The proposal has been subject to an appropriate flood risk assessment which demonstrates that :*	
	(i)	*the proposed development will not increase flood risk elsewhere and, if practicable, will reduce overall flood risk;*
		Yes
	(ii)	*the proposed development includes measures to minimise flood risk to people, property, the economy and the environment as far as reasonably possible;*
		The proposed development includes proposals for treating and controlling surface water discharge which, will minimise flood risk to people, property, the economy and the environment as far as reasonably possible.
	(iii)	*the proposed development 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;*
		The proposed development does not impact on any existing flood protection measures and will not prevent possible future flood risk management measures.
	(iv)	*the proposed development addresses the above in a manner that is also compatible with the achievement of wider planning objectives in relation to development of good urban design and vibrant and active streetscapes.*
		Yes.

Table 11.1 Justification Test

12. SUMMARY AND CONCLUSION

12.1 Summary

This report presents the findings of a Site-specific flood risk assessment (SSFRA) carried out by Kilgallen and Partners in regard to proposed development on lands to the south of the New Nangor Road (R134), Dublin 22 and on land within the townlands of Ballybane and Kilbride within Profile Park, Clondalkin, Dublin 22 on an overall site of 3.79hectares ['the Site].

The SSFRA was carried out in accordance with the document *'Planning System and Flood Risk Management – Guidelines for Planning Authorities'* ['the Guidelines'].

Initial assessment

For an inland Site of this nature and for which there are no existing flood defence mechanisms that could affect flood risk at the Site, the potential flood risk mechanisms are Fluvial, Pluvial, Groundwater and failure of drainage infrastructure (assessed as a residual risk).

Initial assessment of existing flood risk indicators indicate the Site is not at risk from either Pluvial or Groundwater flooding. The designers of the surface water drainage system have confirmed the surface water drainage system for the proposed development is designed in accordance with the Greater Dublin Strategic Drainage Study and so will be sufficient to ensure surface water run-off from the proposed development will cause flood risk within the proposed development and will not give rise to flood risk elsewhere.

Initial assessment of flood risk indicators suggest the Site could be at risk from Fluvial Flooding during the 1.0% AEP and 0.1% AEP events. Accordingly, a detailed assessment of fluvial flood risk was carried out.

Detailed assessment of fluvial flood risk

The detailed assessment of fluvial flood risk confirmed the Site is not affected by Flood Risk Zone A (the 1% AEP flood event) and to a greater extent by Flood Risk Zone B (the 0.1% AEP flood event).

The surface water drainage system for the proposed development has been designed by Pinnacle Consulting Engineers in compliance with the Greater Dublin Strategic Drainage Study. Full compliance with GDSDS ensures the drainage system ensures the flood regime in the receiving stream will not be affected, thus not giving rise to flood risk elsewhere.

The proposed development includes a road crossing of the Falcon Avenue culvert. A box culvert with internal dimensions of 1.4m in height and 3.5m can installed at this crossing and would provide a significantly greater hydraulic capacity than that of the Falcon Avenue culvert and comfortably exceed OPW requirements for clearance between the soffit level of the culvert and the 1% AEP water level.

Finished levels for buildings and roads in the proposed development provide an appropriate freeboard above the 1% AEP water level in accordance with the Guidelines.

The detailed assessment of fluvial flood risk concluded the proposed development will not be at risk of flooding from fluvial sources and will not give rise to fluvial flood risk elsewhere.

Recommendations arising from assessment of residual flood risk

All developments include some element of residual flood risk that must be addressed during their operational life. To address this residual risk, it is recommended that a Site-Specific Flood Risk Mitigation Plan prepared in accordance with the Guidelines is implemented throughout the operational life of the proposed development. This plan should include a maintenance regime for all drainage features within the Site and for regular inspection of drainage features immediately upstream and downstream of the Site.

A CCTV survey of a culvert downstream of the Site revealed significant blockages that greatly reduce its capacity. The detailed fluvial flood risk assessment carried out for this report assumed the culvert is cleared of all obstructions and maintained free of debris / deposition throughout the operational life of the proposed development. However, the condition and size of the culvert downstream of the blockages is unknown and there is potential, for example in the event of culvert collapse, of the stream surcharging to the Site to a level exceeding that predicted by the hydraulic model. To mitigate this risk, it is recommended that an overflow be constructed from the Site which would allow such excess to discharge to the stream immediately downstream of the Nangor Road. Subject to the capacity being available, this overflow could possibly discharge to existing surface water drainage in the Nangor Road but a dedicated surface water pipe might be required from the Site to a new outfall downstream of the Nangor Road.

Justification Test

The proposed development was subject to and passed the Development Management Justification Test.

12.2 Conclusion

Assuming the implementation of the recommendations arising from this assessment, the proposed development is not at risk of flooding and will not increase flood risk elsewhere. The proposed development is therefore appropriate from a flood risk perspective.

Appendix A

Schedule of Relevant Planning Documents

PINNACLE CONSULTING ENGINEERS

DUB13-DR-SP-C124-V2-WS3-PIN-PROPOSED LEVELS & WATERMAIN LAYOUT

DUB13-DR-UG-C127-V2-WS3-PINPROPOSED DRAINAGE LAYOUT

DUB13-DR-SP-C130-V2-WS3-PIN-EXTERNAL WORKS LAYOUT

DUB13-RP-00-C001-V1-WS3-PIN

Appendix B

Estimation of Run-off from Stream Catchment

IH124 Estimation of Q_{100} and Q_{1000}			
$Q_{BAR\ RURAL} = 0.00108 \times AREA^{0.89} \times SAAR^{1.17} \times SOIL^{2.17}$			
Characteristic	**Value**	**Unit**	**Source**
Area (A)	1.0	km^2	FSU
Average Annual Rainfall (SAAR)	715	mm	FSU
G1 % =	0	%	Fig I 4.18
G2 % =	0	%	Fig I 4.18
G3 % =	0	%	Fig I 4.18
G4 % =	0	%	Fig I 4.18
G5 % =	100	%	Fig I 4.18
Soil index (G) =	0.50	%	
$Q_{BAR\ RURAL}$ =	0.52	m3/sec	
CWI =	106.3		Fig I 6.62
CIND =	45.96		Eqn 7.2
NC =	0.75		Eqn 7.3
URBAN =	0.4		FSU
$Q_{BAR\ URBAN}$ / $Q_{BAR\ RURAL}$ =	1.367		Eqn 7.4
Q_{BAR} =	0.717	m3/sec	
Q_{100} / Q_{BAR} (Ireland)	1.96		FSR - Ireland
$Q_{1,000}$ / Q_{BAR} (Ireland)	2.6		FSR - Ireland
Q_{100} =	1.406	m3/sec	
$Q_{1,000}$ =	1.865	m3/sec	
Factorial Error Factor =	1.651		Page 37 IOH124
Climate Change Factor =	1.2		FRMG
Q_{100} =	**2.79**	**m3/sec**	
$Q_{1,000}$ =	**3.69**	**m3/sec**	

FSU Update estimation of Q_{100} & Q_{1000}			
Characteristic	**Value**	**Unit**	**Source**
Area	1.0	km^2	FSU Portal
SAAR	715	mm	FSU Portal
BFI_{soil}	0.520		FSU Portal
FARL	1.0		FSU Portal
S1085	0.10	m/km	FSU Portal
$QMED_{rural}$	0.09	m3/s	
URBEXT	0.36		FSU Portal
$QMED_{urban}$	0.14		
Climate Change Factor	1.2		OPW
Q_{100} / $QMED_{rural}$	2.77		FSU Portal
Q_{1000} / $QMED_{rural}$	3.74		FSU Portal
Q_{100}	**0.473**	**m3/sec**	
$Q_{1,000}$	**0.639**	**m3/sec**	

FSU-3V estimation of Q_{100} & Q_{1000}			
Characteristic	**Value**	**Unit**	**Source**
Area	1.0	km^2	FSU Portal
BFI_{soil}	0.520		FSU Portal
SAAR	715	mm	FSU Portal
QMED	0.041	m3/s	
Climate Change Factor	1.2		OPW
Q_{100} / QMED	2.77		
Q_{1000} / QMED	3.74		
Q_{100}	**0.136**	**m3/sec**	
$Q_{1,000}$	**0.183**	**m3/sec**	

FSU-7V estimation of Q_{100} & Q_{1000}			
Characteristic	**Value**	**Unit**	**Source**
Area	1.0	km^2	FSU Portal
BFI_{soil}	0.520		FSU Portal
SAAR	715	mm	FSU Portal
FARL	1.0		FSU Portal
DRAIND	0.72	km/km^2	
S1085	0.10	m/km	FSU Portal
ARTDRAIN	0.00		
$QMED_{rural}$	0.072	m3/s	
URBEXT	0.36		FSU Portal
$QMED_{urban}$	0.11		
Climate Change Factor	1.2		OPW
Q_{100} / $QMED_{rural}$	2.77		FSU Portal
Q_{1000} / $QMED_{rural}$	3.74		FSU Portal
Q_{100}	**0.375**	**m3/sec**	
$Q_{1,000}$	**0.506**	**m3/sec**	

FEH-Statistical estimation of Q_{100} & Q_{1000}			
Characteristic	**Value**	**Unit**	**Source**
Area	1.0	km^2	FSU Portal
SAAR	715	mm	FSU Portal
FARL	1.0		FSU Portal
BFI_{soil}	0.520		FSU Portal
QMED	0.27	m3/s	
Climate Change Factor	1.2		OPW
Q_{100} / QMED	2.77		FSU Portal
Q_{1000} / QMED	3.74		FSU Portal
Q_{100}	**0.885**	**m3/sec**	
$Q_{1,000}$	**1.195**	**m3/sec**	