INFRASTRUCTURE

Project

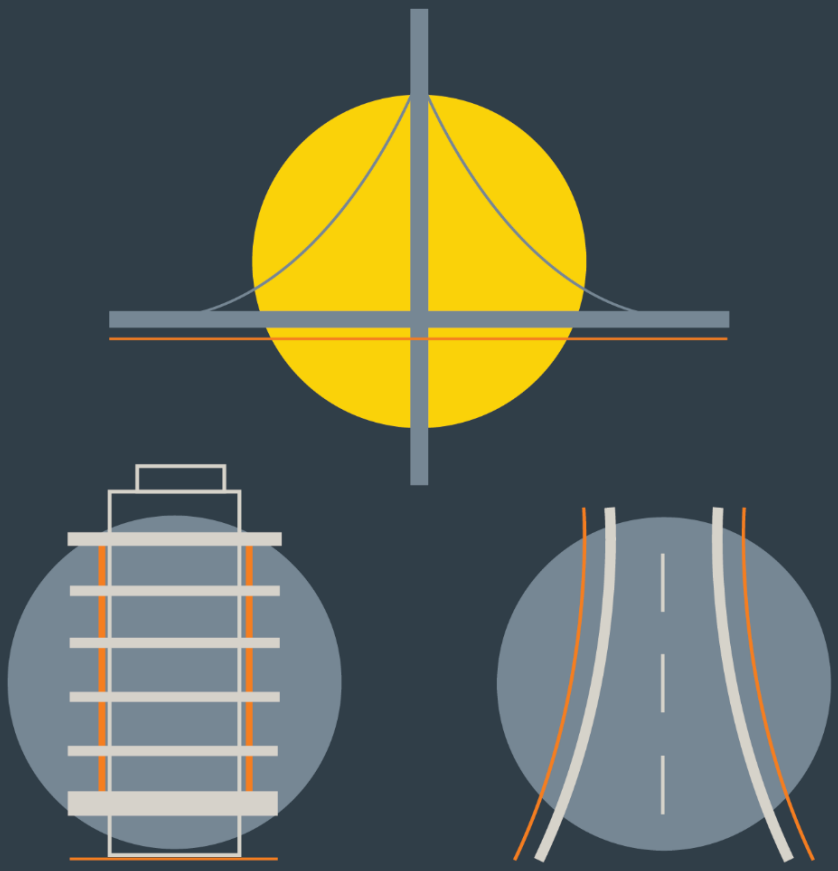
Residential Development at Roebuck Road, Clonskeagh, Dublin 14

Report Title

Site Specific Flood Risk Assessment

Document Reference

210013-DBFL-XX-XX-RP-C-0001



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DBFL CONSULTING ENGINEERS

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Contents

1 Introduction

1.1 Background

DBFL Consulting Engineers were commissioned by the Applicant, Dun Laoghaire-Rathdown County Council (DLRCC), to prepare a Site Specific Flood Risk Assessment (SSFRA) for the proposed residential development at the junction of White Oaks and Roebuck Road, Clonskeagh, Dublin 14.

The application site is a brownfield site, comprises approximately of 0.068 hectares and has been used in recent years as a car park – see Figure 1 below.

The site is bordered to the northwest by an open watercourse and residential development, to the south by the White Oaks Tudor Homes residential development and to the southeast by White Oaks Road and a car wash. The site is bordered to the northeast by Roebuck Road (R825) and has vehicular access from White Oaks on its south eastern border.

The existing site slopes at an approximate gradient of 1:65 from southwest to northeast with the Dodder River located approximately 1.0km to the northwest of the site and the Irish Sea approximately 2.4km to the east.

Figure 1: Site Location, Roebuck Road, Clonskeagh, Dublin 14

The proposed residential development consists of 4 no. housing units within a 3 storey development on the site. The associated site and infrastructural works including watermains, foul and surface water drainage, SUDS features, parking facilities, bin store, landscaping, boundary walls and fences.

This SSFRA was prepared to comply with the current planning legislation, in particular the recommendations of *"The Planning System & Flood Risk Management – Guidelines for Planning Authorities".*

The DLRCC County Development Management Plan 2016-2022 has been referenced for the completion of this document, specifically Section 5.2.5 – Flood Risk and Section 8.2.10.4 – Flood Risk Management.

The DLRCC Draft County Development Plan 2022-2028, although not currently approved, has also been reviewed in compiling this report.

1.2 Objectives

The objective of this report is to inform the planning authority regarding flood risk for the proposed development of residential units on the subject site. The report assesses the site and development proposals in accordance with the requirements of "*The Planning System and Flood Risk Management Guidelines for Planning Authorities*".

The report clarifies the site's flood zone category and presents information which would facilitate an informed decision on the planning application in the context of flood risk. The report also outlines appropriate flood risk mitigation and management measures for any residual flood risk.

2 Planning System & Flood Risk Management Guidelines

2.1 General

"The Planning System and Flood Risk Management Guidelines for Planning Authorities", November 2009 and its technical appendices outline the requirements for a site specific flood risk assessment.

Residential development is classified as "highly vulnerable development" according to Table 3.1 of the guidelines. Table 3.2 of the guidelines indicates that this type of development is appropriate and compatible with Flood Zone C i.e. outside the 1000 year (0.1% AEP) flood extents.

Highly vulnerable development may also be compatible with Flood Zone Category B depending on its performance in a site justification test. Therefore, as part of the sequential approach mechanism of the guidelines, a justification test is only required if 'highly vulnerable development' is proposed in Flood Zone B.

2.2 Flood Risk Assessment Stages

This site specific risk assessment will initially use flood risk information to determine the flood zone category of the site and to check if the Guidelines Sequential Approach has been applied or if a justification test is required - refer to Figure 2 below for details. Flood risk is normally assessed by a flood risk identification stage followed by an initial flood risk assessment. A more detailed flood risk assessment stage may then follow which includes an assessment of surface water management, flood risk and mitigation measures to be applied.

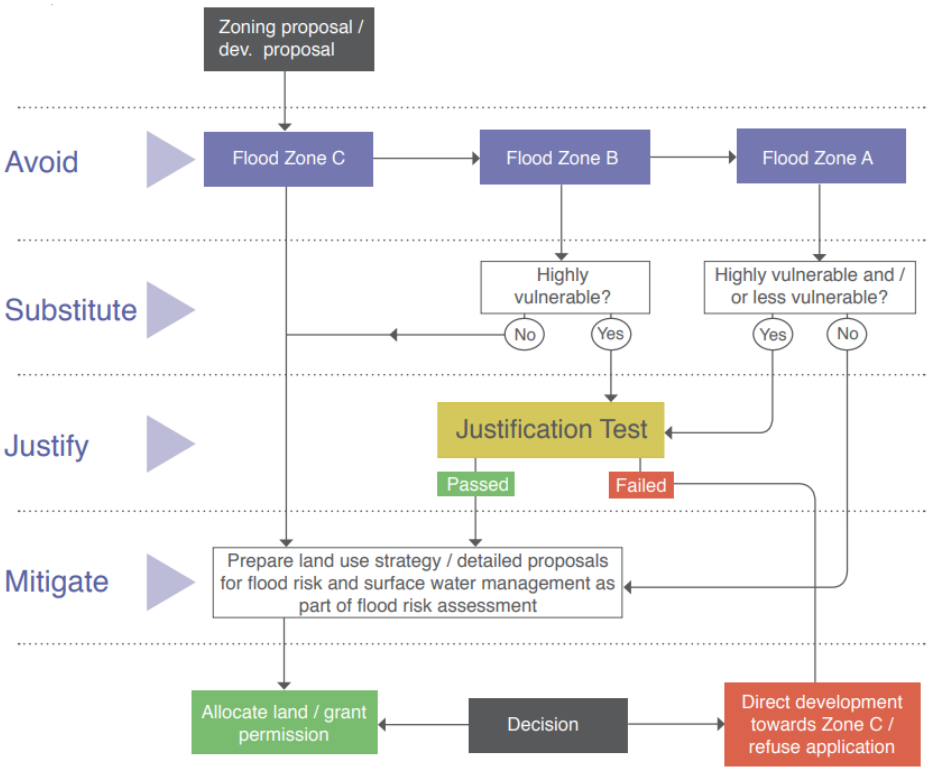


Figure 2: Sequential Approach mechanism in the Planning Process

3 Flood Risk Identification Stage

3.1 General

The initial flood risk identification stage uses existing information to identify and confirm whether there may be flooding or surface water management issues for the lands in question that warrant further investigation.

3.2 Information Resources Consulted

Information sources consulted for the identification exercise and assessment are outlined in Table 1 below. Further details on information found within these sources is noted in the following sections.

Information Source	Comments	Assessment
Predictive and historic flood maps, fluvial, coastal, pluvial and groundwater flood maps available on www.floodinfo.ie	OPW flood maps www.floodinfo.ie and ECFRAMS website consulted.	A flood event was recorded on 11th of June 1963 in proximity to the site. Refer to appendix C. The accompanying report states that the flooding was concluded to be pluvial and classified as approaching a 1 in 100 year storm event. The proposed development is located outside the extents of the 1 in 1000 year (0.1% AEP) of the River Dodder catchment. Although the subject site is located within the River Dodder catchment the water course traversing its western boundary is not a tributary of the river Dodder, but discharges to the Elm Park Stream, which ultimately discharges to Dublin Bay. Therefore there is no direct pathway from the River Dodder to our site. The watercourses noted are the nearest shown on ECFRAMS maps. The River Dodder is located approx. 0.9km to the northwest of the site and the Elm Park Stream is approx. 1km to the northeast. The site is located approximately 2.4km from the coast and outside tidal flooding extents.
Management areas available on www.floodinfo.ie	OPW flood plans www.floodinfo.ie website consulted.	There were no OPW land commission schemes or benefitting land zones within the subject site's boundary.
Topographical maps	OSI Maps consulted, site topography analysed.	Topographical survey carried out by BPM Surveys LTD show an open water course running along the rear of the development. It is approximately 1 – 1.5m in width and approx. 1.5m deep. It flows in a southwest to northeast direction. Refer to Appendix D for a copy of the site survey. Refer to section 4.0 of this report for further information on a high level review of this existing watercourse.
Information on existing public sewerage condition and performance	GDSDS performance maps for existing sewerage in the vicinity of the subject site examined.	GDSDS flood mapping does not extend to this area of Dublin. DLRCC notes that there is a number of existing stormwater sewers in the area that discharge into this open water course running along the rear of the site. See Appendix B for existing drainage maps.
Groundwater maps of the Geological Survey of Ireland	GSI maps consulted	No karst features are in this area. The site consists primarily of made ground.

Table 1: Information Sources Consulted

3.2.1 OPW Predictive, Historic, Benefitting Lands Maps, Flood Hazard Information

The OPW website *www.floodinfo.ie* indicates that there are no OPW land commission schemes or benefitting land zones within the boundary of the subject site.

There was a flood event recorded in close proximity to the proposed site in June 1963. The flooding here was attributed to the River Dodder sub-catchment; however, the subject site was not affected by these events, as stated above there is no direct pathway from the River Dodder to the existing open watercourse running along the site boundary. There are no recorded flood events noted within the site. Please refer to Appendix C for flood report and further information on the 1963 flood occurrence on Roebuck Road and Appendix A for OPW ECFRAMS maps. Refer to figure 3 below illustrates the location of the note past flood event (1963)

Figure 3: Past flooding event and proposed site location.

3.2.2 Previous Flood Risk Assessments & Predictive Flood Maps

The OPW recently completed the Eastern Catchment Flood Risk and Management Study (ECFRAMS) to fulfil the requirements of the EU Floods Directive (2007/60/EC). The ECFRAM was commissioned in June 2011 with the aim of the study to identify areas at risk from flooding and hence develop flood risk management options for 'at risk' areas. The ECFRAM Programme included three main stages; the Preliminary Flood Risk Assessment (2011), Flood Risk and Hazard Mapping (late 2014) and flood Risk Management Plans (2016).

From the Flood Risk and Hazard Mapping information the appropriate Flood Zone (A,B or C) can be identified for any subject site. The relevant flood map for the proposed development for Fluvial Flood Zone Mapping has been completed and is included in Appendix A of this report. This mapping shows that the proposed development is located outside the extents of the 1 in 1000 year (0.1% AEP) of the Dodder River catchment and therefore is considered to be located in **Zone C**.

3.2.3 Tidal Flood Maps

The subject site is located approximately 2.4km west of the coast and therefore is not at risk of tidal flooding.

3.2.4 Other Sources

Other information sources were consulted to determine if there was any additional flood risk to the site, these included;

- Topographical surveys of the area

  No evidence of flooding was found within the proposed boundary of development. There is an existing open watercourse traversing the boundary at the rear of the site. The invert of this watercourse is approximately 1.5m below existing ground level of the site. A number of existing surface water sewers within the adjacent network discharge to this open watercourse according to Irish Water records. From the existing drainage records it can be seen that there is a minimum of 4 existing stormwater sewers discharging into the open water course upstream of the proposed development.

  This watercourse is culverted within a 1050mm pipe under Roebuck road to the north of the subject site and flows in a north easterly direction. It is also culverted upstream of the proposed site by a 525mm diameter concrete culvert according to existing Irish Water records. It is bordered by a retaining wall and timber screen along its western bank with residential development behind and is banked to the east with trees along its edge. Refer to figure 4 below for site location. The Dodder River is located approximately 1km to the northwest of the subject site. Refer to appendix B for Irish Water existing drainage records.

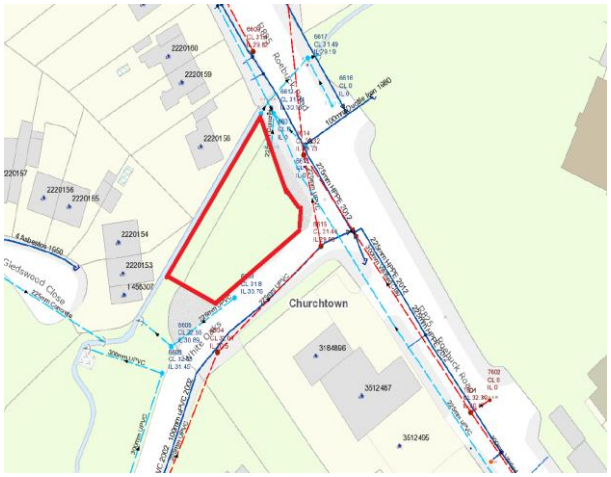


Figure 4: Existing Watercourse and Site Location – (Irish Water records).

- Flood defence information -
  No defences are present or proposed within the subject site or in the vicinity of the site.
- Ground Investigation data -
  - No karst features are present in this area.
  - The site consists primarily of made ground.
  - The groundwater vulnerability is low.
  - The site is located on a locally important aquifer with bedrock which is generally unproductive except for local zones.
- Existing Local Authority Flooding Records -
  There is no further information from the local council records regarding flooding. As noted above, refer to Appendix C for existing local authority flooding records.

3.3 Source-Pathway-Receptor Model

A Source-Pathway-Receptor model was produced to summarize the possible sources of floodwater, the people and assets (receptors) that could be affected by potential flooding (with specific reference to the proposals) and the pathways by which flood water from an event exceeding 0.1%AEP (Annual Exceedance Probability) and 1% AEP storms could reach the receptors – see Table 2 below. This table provides the probability and magnitude of the sources, the performance and response of pathways and the consequences to the receptors in the context of the development proposal. These sources, pathways and receptors will be assessed further in the initial flood risk assessment stage.

Source	Pathway	Receptor	Likelihood	Impact	Risk
Tidal	Tidal flooding from coast 2.4km away.	**Residents (people)** development, **visitors** and the **buildings** themselves and other **property** such as **vehicles** located in parking areas.	Remote	High	Very Low
Fluvial	Flooding from adjacent watercourse on western boundary.	**Residents (people)** development, **visitors** and the **buildings** themselves and other **property** such as **vehicles** located in car park areas.	Possible	High	Moderate
Surface Water - Pluvial	Flooding from surcharging of the development's drainage systems.	**Residents (people)** development, **visitors** and the **buildings** themselves and other **property** such as **vehicles** located in car park areas.	Possible	High	Moderate
Surface Water - Pluvial	Flooding from internal sources – overland flows.	**Residents (people)** development, **visitors** and the **buildings** themselves and other **property** such as **vehicles** located in car park areas.	Possible	High	Moderate
Surface Water - Pluvial	Flooding from external sources – overland flows.	**Residents (people)** development, **visitors** and the **buildings** themselves and other **property** such as **vehicles** located in car park areas.	Possible	High	Moderate
Groundwater flooding	Rising Ground water level on site.	**Residents (people)** development, **drainage infrastructure**, **visitors** and the **buildings** themselves and other **property** such as **vehicles** located in car park areas.	Remote	High	Very Low
Human or Mechanical Error (Pluvial)	Permeable paving and Hydrobrake.	Areas of development draining to the surface water network; **Residents (people)** development, **visitors** and the **buildings** themselves and other **property** such as **vehicles** located in car park areas.	Possible	High	Moderate

Table 2: Source-Pathway-Receptor Analysis

As can be seen from the table above there is a moderate risk of fluvial and pluvial flooding of the existing and proposed drainage systems and from the adjacent watercourse within the site due to potential surcharging and blockage of the existing open watercourse and culvert to the east of the proposed site and the proposed new drainage system.

Consequently, an initial flood risk assessment will follow to provide further detail on the causes, effects and possible mitigation measures for the types of flooding identified above.

4 Initial Flood Risk Assessment

The flood risks to the proposed residential development, identified from Stage 1 are a moderate risk of pluvial flooding of the site from the potential surcharging and blockage of the new drainage network and existing watercourse which is culverted under Roebuck Road to the north of the site, along with a moderate flood risk due to a blockage or mechanical failure of the proposed drainage network and associated attenuation system.

The drainage system has the potential to cause local flooding unless it is designed in accordance with the regulations e.g. Greater Dublin Strategic Drainage Study (GDSDS) and to take account of flood exceedance for storms return periods exceeding 1%AEP (Annual Exceedance Probability) plus 20 % climate change.

Proper operation and maintenance of the drainage system should also be implemented to reduce the risk of human or mechanical error causing pluvial flood risk from blockages etc.

The watercourse and culvert will require a frequent maintenance programme to ensure the continued flow of the existing stream. Preventing blockages in the open section or the culvert are equally important in preventing the rise of the water level.

The following is a high level review of the existing watercourse, its capacity to drain its contributing catchment and the impact of the proposed development on this watercourse. The existing catchment area (shown in red in Figure 5) is drained by a series of existing surface water sewers that discharge into the open watercourse running along the rear of the proposed site. The Irish Water records (pdfs) containing the catchment area in question were brought into CAD and scaled to match the topographical survey drawing file, from this an approximate area for the catchment was calculated. See figure 5 below for details of the approximate catchment area.

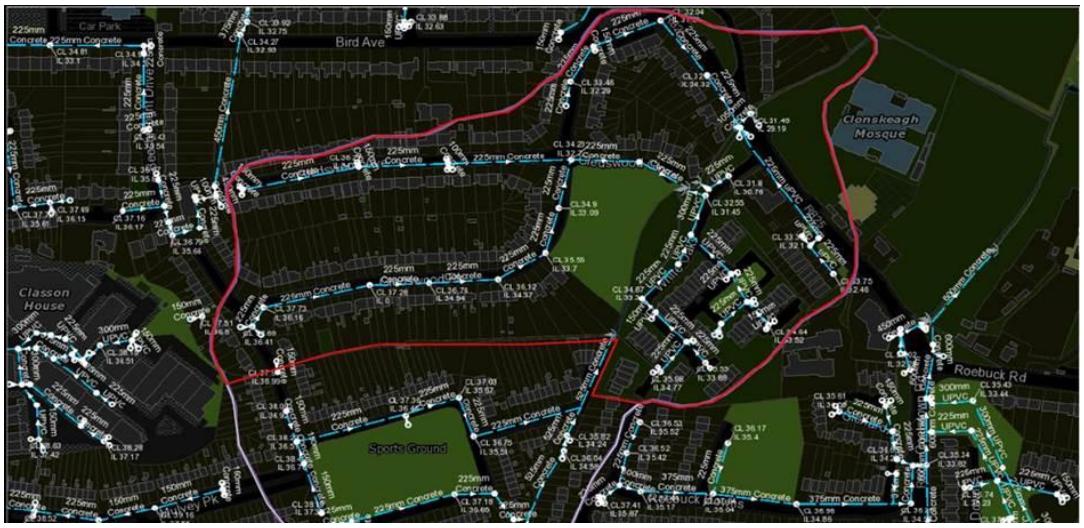


Figure 5: Existing Catchment Area – (Irish Water records)

Prior to the open watercourse noted above the surface water runoff from the proceeding catchment areas is conveyed through the 525mm diameter concrete culvert upstream. Refer to Figure 6 below for location.

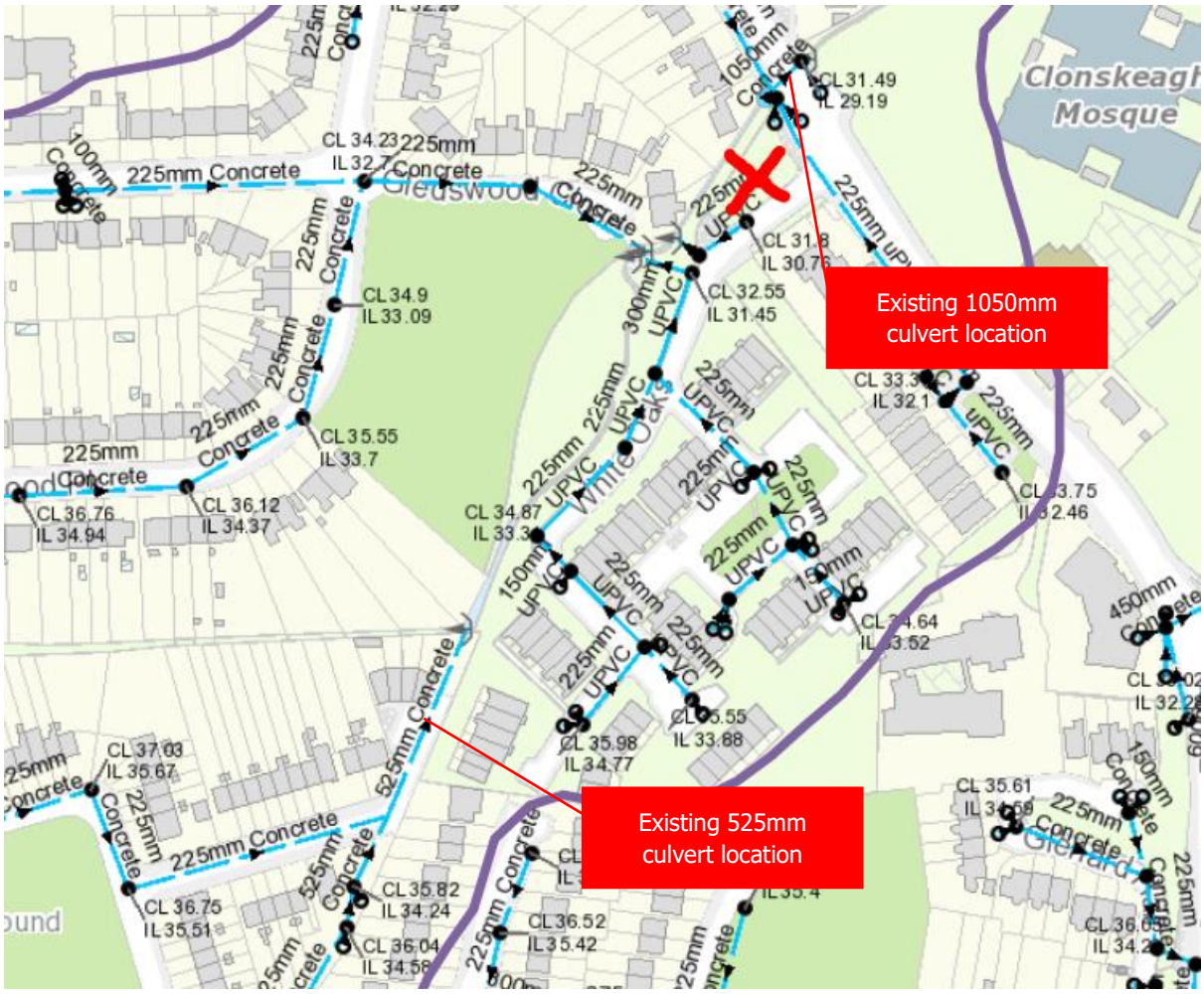


Figure 6: Existing culvert location

Approx. Catchment Area: 20.21 Hectares x 0.70 = 14.147 Hectares

0.70 = Runoff co-efficient (0.70 was used as I is considered a conservative representation of the hardstanding surfacing of the catchment)

Site Coordinates: Eastings: 317648 Northings: 229653

Using the rational method in order to determine the approx. discharge/ flow rate of this catchment area.

Q = 2.78 x C x I x A

Q: Flow in l/s

Coefficient: 2.78

C: Constant 1

I: Rainfall Intensity (mm/hr)

A: Catchment Area in Hectare

Rainfall Return Period (used proposed site coordinates):

(M5/60) = 17.8mm/hr (using site coordinates)

Q = 2.78 x 1 x 17.8 x 14.47

Q = 716 l/s

Rainfall Return Period(used proposed site coordinates):

(M100/60) = 43.7mm/hr (using site coordinates)

Q = 2.78 x 1 x 43.7 x 14.47

Q = 1,758 l/s

There is an existing 525mm diameter culvert prior to this watercourse as noted previously. No gradient can be determined as invert levels are not shown on the public records, therefore a gradient of 1:200 is assumed in order to be conservative. Refer to figure 6 below.

Capacity of existing 0.525m diameter culvert upstream of site: (calculated using the Colebrook-White equation in simplified usage mode)

V = 444.04 l/s

Therefore it can be deduced that the maximum flow in the watercourse at the rear of our site is approximately equal to 444.04 + 1758 =

V = 2,202.04 l/s

Using the same capacity check outlined above the approximate capacity of the culvert under Roebuck Road was found.

Diameter: 1.050m

Length: 15.7m

Pipe Volume: $\pi r^2 x$ L = 3.14 x $.525^2$ x 15.7 = 13.6m^3

Fall: 0.26m (invert levels provided in survey)

V = 5,186.27 l/s

Using these high level calculations it can be determined there is sufficient capacity in the culvert under beneath Roebuck Road, even with a 50% blockage.

Further study was undertaken on the available information regarding the watercourse itself. The average cross-sectional area was found to be approximately 5.67m^2. This cross-sectional area would be equal to that of a 2.5m diameter pipe and if blocked/throttled at 50% the flow could be deemed to be the equivalent of a 1.25m diameter pipe, which would still have sufficient capacity to accommodate the

anticipated flow. Please note, as survey info for only one side of the watercourse's banks is available, the area is an approximation and average of the cross-sectional area at 3no. locations along its length. Further survey and study will be required to determine with accuracy the flow capacity in the watercourse and this information should be viewed as a high level guide.

4.1 Fluvial Flooding

The Source-Pathway-Receptor model identified that there could be potential for fluvial flood risk within the development site related to the backing up of the Elm Park Stream. The open watercourse is a tributary of the Elm Park Stream, which discharges directly into the South Dublin Bay Special Area of Conservation.

Suitable Finished Floor Levels should be designed for the site to ensure that they are more than 300mm higher than the nearest known flood level and the proposed attenuated water level for a 1in100yr storm event plus 20% for climate change, whichever is higher.

The culvert running below the Roebuck road, if blocked could cause flooding whether from full or partial obstruction. Additionally due to this watercourse being a tributary to the Elm Park Stream, if the stream backups the water level in the culvert and watercourse will rise. However, as noted above in the high level capacity check it has been concluded that a fifty percent orifice obstruction would still leave the culvert running under Roebuck Road with adequate capacity for expected flowrates.

4.2 Pluvial Flooding

There are currently no roads proposed for this development. This means that there is no pluvial flood risk due to overland flow from roads within the site. Proposed levels within the site boundary have been calculated as such to reduce likelihood of pluvial flooding from the existing White Oaks Road, additionally this section of the site is made up of permeable paving. There is a small amount of hardstanding to the rear of the dwellings, these will fall out to the filter drains to the rear of the housing units.

Proper operation and maintenance of the drainage system should also be implemented to reduce the risk of human or mechanical error causing pluvial flood risk from blockages etc.

4.3 Flood Zone Category

Following the assessment of the flood risks to the site and the available information, it is considered that the proposed site is located within **Flood Zone Category C** as defined by the Guidelines and as indicated by the ECFRAMS maps – refer to Appendix A.

Therefore, the proposed residential development on the subject site is appropriate for this flood zone category, and a justification test is not required.

5 Detailed Flood Risk Assessment Stage

5.1 General

As a justification test is not required, a detailed flood risk assessment must be carried out which considers moderate pluvial flood risk in relation to the following;

- Proposed surface water management measures.
- Flood exceedance.
- Impact of proposals on flood risk to adjacent areas.
- Effects of climate change.
- Access and egress during flood events
- Residual risks.
- Effectiveness of any flood mitigation measures.

5.2 Proposed Surface Water Management Measures

The following approach and parameters should be used;

- Drainage design should consist of Sustainable Drainage systems (SUDS) with roof downpipes, gullies, pipes, manholes, attenuation systems and discharge control at outlets;
- SUDS systems should be provided including permeable paving and filter drains, depending on the architect's layout and DLRCC Drainage Departments agreement
- Attenuation system designed for 1 in 100 year storm event + climate change;
- Climate change factor of 20% has been applied;
- Site discharge rate should be controlled to Greater Dublin Strategic Drainage Study (GDSDS) standards and will be agreed with DLRCC Drainage Department
- Overland flow routes should be designed to direct surface flows away from buildings.
- Watercourse and culvert maintenance programme to be implemented in line with the requirements of DLRCC.

5.3 Assessment of Flood Risk

5.3.1 Flood Exceedance – Pluvial

<u>Flooding from existing ditches</u>

There is an existing watercourse that runs to the rear of the site, that flows through the culvert running beneath the Roebuck Road. This watercourse is known to drain a number of existing stormwater sewers upstream of the development. Consistent maintenance of the watercourse and the downstream culvert

will need to be implemented in order to ensure no blockage/obstruction causes water levels to rise and potentially impact the proposed development.

Flooding from overland flows

Site levels have been designed such that any overland flow caused by flooding from the site drainage system, or from surface water that fails to enter the site drainage system in extreme events, will not flood buildings or footpaths.

Flooding from surcharging of the development's drainage systems

The surface water system has been designed so that no flooding occurs throughout the site for the design return period of 1 in 100 years. The attenuation system should be sized for a 1 in 100-year return period, which exceeds the requirements of the GDSDS and will be designed using the current rainfall depth values available from Met Eireann including a 20% increase for the effects of climate change.

5.3.2 Flood Exceedance – Fluvial

The possibility of fluvial flooding is moderate due to possibility of blockage/ obstruction of the existing open watercourse adjacent to the site and the culvert under Roebuck.

5.3.3 Flood Exceedance – Groundwater

As mentioned above, there are no karst features in this area. The site consists primarily of made ground. The groundwater vulnerability is low and there is a locally important aquifer. Bedrock is generally unproductive except for local zones. There is also no evidence of groundwater flooding of the subject site. Therefore, the possibility of groundwater flooding is very low. A site/ground investigation will be carried out on the site prior to development.

5.3.4 Human or Mechanical Error – Pluvial

If SUDs and attenuation infrastructure is not adequately cleaned and maintained, there is a risk that they would become a throttle and cause flooding upstream.

5.4 Access & Egress During Flood Events

During flood events, access and egress would need to be maintained and overland flow routes and extents would need to be carefully planned. All habitable spaces will be located more than 300mm above the top water levels for attenuation systems for the 1 in 100 year event and should be at no perceivable risks of flooding.

5.5 Mitigation Measures

Proposed mitigation measures to address residual flood risks are summarized below;

Mitigating Measure M1: The proposed drainage system including the attenuation system should be maintained on a regular basis to reduce the risk of a blockage.

Mitigating Measure M2: Overland flow routes for pluvial events should not be built on or become blocked off. Overland flow routes should be designed to direct to water compatible development areas and to other open space areas away from dwellings.

Mitigating Measure M3: Sustainable Urban Infrastructure: the development should include SUDS features e.g. permeable paving, filter drains etc. incorporating interception and storage.

Mitigating Measure M4: A culvert blockage assessment and management strategy to be put in place to ensure the open water course does not surcharge.

6 Residual Risks

Remaining residual flood risks, following the detailed assessment and mitigation measures include the following;

- Pluvial flooding from the drainage system related to a pipe blockage or from flood exceedance.
- Pluvial flooding from the development's drainage system for storms in excess of the 1 in 100 year design capacity.
- Pluvial flooding as a result of a blockage in the culvert under Roebuck Road which could cause a throttling effect on discharge from the open watercourse bounding the proposed site.
- Pluvial flooding as a result of debris build up in the existing open water course running along the rear of the proposed development.

7 Conclusion

This Site Specific Flood Risk Assessment for the proposed residential development was undertaken in accordance with the requirements of the *"Planning System and Flood Risk Management Guidelines for Planning Authorities"*, November 2009. Following the flood risk assessment stages, it was determined that the proposed site is within **Flood Zone C** as defined by the Guidelines and based on the ECFRAMS mapping. Therefore, the development of housing on the subject site is appropriate for the site's flood zone category and a justification test as outlined in the Guidelines is not required. The Guidelines sequential approach is met with the 'Justify' & 'Mitigate' principals being achieved.

The proposed flood mitigation measures outlined in Section 5.5 should be implemented. It is considered that the flood risk mitigation measures once fully implemented are enough to provide a suitable level of protection to the proposed development and will not cause an increased risk of flooding to external properties or to the downstream surface water system.

A regularly maintained water course and accompanying culvert would ensure that the water level remains at safe levels. Blockage remains the biggest risk in terms of an extreme flood event. The consistent removal of blockages to the culvert and maintenance of the plant life on the bank of the culvert will be the most effective in preventing flooding to the site. The high level review carried out in section 4.0 outlines that the existing culvert has sufficient capacity to drain its catchment and the proposed development.

A regularly maintained drainage system would ensure that the network remains effective and in good working order should a large pluvial storm occur. In the event of extreme pluvial flooding then overland flood routes would direct water towards the open space areas.

Should extreme fluvial/pluvial flooding occur in excess of the development's drainage capacity i.e. exceeding 1%AEP, then overland flood routes towards the on-site open spaces would protect the development.

While the development constitutes 'highly vulnerable' development, it is appropriate for this flood zone and the scheme will be designed to ensure that the risk of flooding of the development is reduced as far as is reasonably practicable. The development does not increase the risk of flooding to adjacent areas and roads once mitigation measures are implemented.

APPENDIX A

OPW Flood Maps

N

DSS1_4435

10% Flow = 11.546 m^3/s
1% Flow = 27.713 m^3/s
0.1% Flow = 51.208 m^3/s

DSS1_4240

DSS1_4085

DSS1_4053

DSS1_3920

DSS1_3803

DSS1_3785

DSS1_3738

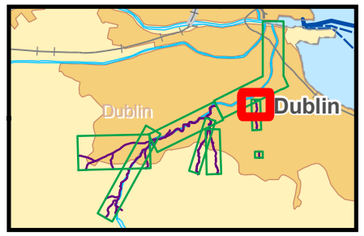
DSS1_3720

DSS1_3620

SITE LOCATION
(APPROXIMATE)

Node Label	Water Level (mOD) per AEP		
	WL 10%	WL 1%	WL 0.1%
DSS1-3620	37.53	37.67	38.09
DSS1-3720	36.88	37.41	38.19
DSS1-3738	36.71	37.22	38.09
DSS1-3785	35.24	36.25	37.85
DSS1-3803	34.75	35.50	35.84
DSS1-3920	33.22	33.80	34.36
DSS1-4053	31.51	32.06	33.39
DSS1-4085	29.83	30.65	31.18
DSS1-4240	26.66	27.50	28.34
DSS1-4435	24.93	26.16	27.63

Location Plan:



Legend:

- 10 % AEP Flood Extent (1 in 10 chance in any given year)
- 1 % AEP Flood Extent (1 in 100 chance in any given year)
- 0.1 % AEP Flood Extent (1 in 1000 chance in any given year)
- Defended Area
- High Confidence (<20m) (10% AEP)
- Medium Confidence (<40m) (10% AEP)
- Low Confidence (>40m) (10% and 0.1% AEP)
- High Confidence (<20m) (1% AEP)
- Medium Confidence (<40m) (1% AEP)
- Low Confidence (>40m) (1% AEP)
- River Centreline
- Node Point
- OS_2975 Node Label (refer to table)
- Flow reporting location
- 10% Flow = 1.20 1% Flow = 1.56 0.1% Flow = 2.17 Peak flow during design flood extent

USER NOTE:

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

Client:

Dublin City Baile Átha Cliath | South Dublin County Council | Dún Laoghaire-Rathdown County Council Comhairle Contae Dhún Laoghaire-Ráth an Dúin | OPW

Project:

DODDER CATCHMENT FLOOD RISK ASSESSMENT AND MANAGEMENT STUDY

Map:

PRESENT DAY DUNDRUM SLANG

Map Type: FLOOD EXTENT

Source: FLUVIAL FLOODING

Map Area: URBAN AREA

Scenario: CURRENT

Drawn By :	A.A.B	Date :	26 November 2010
Checked By :	A.J.	Date :	26 November 2010
Approved By :	A.G.B	Date :	26 November 2010

DSS/EXT/UA/CURS/105

Map Series : Page 3 of 3

Drawing Scale : 1: 5,000 **Plot Scale :** 1:1 @ A3

0 0.1 0.2
Kilometers

RPS Consulting Engineers
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TEL : 028 9066 7914
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APPENDIX B

Irish Water Existing Drainage Records

Roebuck Road

03/04/2019 12:16:16

Legend

Stormwater Gravity Mains (Irish Water Owned)
- Surface

Stormwater Gravity Mains (Non-Irish Water Owned)
- Surface

Storm Manholes
- Cascade
- Catchpit
- Hatchbox
- Lamphole
- Standard
- Other; Unknown

Storm Inlets
- Gully
- Standard
- Other; Unknown

Storm Fittings
- Vent/Col
- Other; Unknown

Storm Discharge Points
- Outfall
- Overflow
- Soakaway
- Other; Unknown
- Storm Culverts
- Storm Clean Outs
- Storm Water Network Junctions
- Storm Network Structures
- Storm System Valves
- Stormwater Weirs
- Storm Open Drains
- Stormwater Chambers
- Kisok
- Storm Casings
- SUDsArea
- Storm Detention Areas

Sewer Gravity Mains (Irish Water owned)
- Combined
- Foul
- Overflow
- Unknown

Sewer Gravity Mains (Non-Irish Water owned)
- Combined
- Foul
- Overflow
- Unknown

Irish Water gives this information as to the position of its underground network as a general guide only on the strict understanding that it is based on the best available information provided by each Local Authority in Ireland. It should not be relied upon in the event of excavations or other works being carried out in the vicinity of the network. The onus is on the parties carrying out the works to ensure the exact location of the network is identified prior to mechanical works being carried out. Service pipes are not generally shown but their presence should be anticipated.

UISCE ÉIREANN : IRISH WATER

"Gas Networks Ireland (GNI), their affiliates and assigns, accept no responsibility for any information contained in this document concerning location and technical designation of the gas distribution and transmission network ("the Information"). Any representations and warranties express or implied, are excluded to the fullest extent permitted by law. No liability shall be accepted for any loss or damage including, without limitation, direct, indirect, special, incidental, punitive or consequential loss including loss of profits, arising out of or in connection with the use of the Information (including maps or mapping data). NOTE: DIAL BEFORE YOU DIG Phone 1850 427 747 or e-mail dig@gasnetworks.ie – The actual position of the gas/electricity distribution and transmission network must be verified on site before any mechanical excavating takes place. If any mechanical excavation is proposed, hard copy maps must be requested from GNI re gas. All work in the vicinity of the gas distribution and transmission network must be completed in accordance with the current edition of the Health & Safety Authority publication, 'Code of Practice For Avoiding Danger From Underground Services' which is available from the Health and Safety Authority (1890 28 93 89) or can be downloaded free of charge at www.hsa.ie."

APPENDIX C

Previous Flood Event

IM 72/71

METEOROLOGICAL SERVICE

INTERNAL MEMORANDUM

Rainfall in the Dublin Area on 11th June, 1963.

- by -

W.A. Morgan, M.Sc.

Issued: Aug '71

Rainfall in the Dublin Area on 11th June 1963

- by -

W.A. Morgan

During the period 9th to 11th, June 1963 winds were mainly easterly and light in strength; thunderstorms were widespread. Over the east coast on 11th, air temperatures near the ground rose appreciably during the morning. A cold front moving eastwards across the country reached the east coast by about midday, accentuated the unstable atmospheric conditions in the east and triggered off violent thunderstorm activity in the Dublin area.

Amounts of rainfall recorded over the 24 hour period beginning at 9h. G.M.T. on 11th June, 1963 at rainfall stations in or near the Dublin area, are given in Table I.

Table I

STATION	Rainfall	STATION	Rainfall
	mm.		mm.
Arus an Uachtarain	13.8	Glenasmole (Castlekelly)	41.9
Baily (Danesfort)	2.0	Glenasmole	
Baldonnel Airport	11.0	(Superintendent's Lodge)	53.9
Dalkey (Torca)	4.1	Glenasmole (Waterworks)	49.3
Dublin Airport	15.5	Glencullen (Tibradden)	18.1
" (Ballsbridge Show Grounds)	97.8	Howth Castle	1.8
" (Ballymun Ave.)	24.0	Killiney (Tedburn)	2.5
" (Clontarf)	43.9	Kinsaley (Agr. Inst.)	13.9
" (Glasnevin)	18.8	Leixlip	15.6
" (Merrion Sq.)	48.7	Lusk G.S.	3.5
" (Phoenix Park)	11.2	Lusk (Nevitt)	11.2
" (Trinity Coll.)	37.4	Peamount	12.5
" (Upr. O'Connell St.)	27.5	Rathcoole G.S.	18.6
Dun Laoghaire (Harbour Yard)	15.5	Rathfarnham Castle	44.2
" " (People's Park)	10.4	Rush G.S.	4.0
Garristown G.S.	9.8	Skerries (Milverton Hall)	5.6
		Stillorgan (Vartry House)	33.0

From the very considerable flooding that occurred in the area between Dundrum, Blackrock and Sandymount and the high value recorded at Ballsbridge it was clear that this area must have had exceptionally high rainfall but the only available record in the area was that for Ballsbridge. In consequence an appeal was made through the daily newspapers for any readings that might have been made by private individuals. A number of replies were received and are summarised below.

(1) Weston Park, Churchtown.
Rainfall 9¼ inches (235.0 mm) measured in a can. Estimated true fall at least 6¾ inches (171.5 mm). Period over which rain was collected 1000h. to 1900h. G.M.T.

(2) Blackheath Park, Clontarf.
Rainfall 2.13 inches (54.1 mm) measured in a raingauge. Period over which rain was collected 0900h. on 11th to 0900h. G.M.T. on 12th.

(3) Mather Road N., Mount Merrion.
Rainfall measured in a raingauge. The amounts recorded over different periods were:

23h. on 10th to	1350h. G.M.T. on 11th	3.25	ins	(82.6mm)
1350h. " 11th "	1455h. G.M.T. " 11th	3.25	"	(82.6mm)
1455h. " " "	1600h. G.M.T. " "	0.65	"	(16.5mm)
1600h. " " "	2300h. G.M.T. " "	0.10	"	(2.5mm)
Total:		7.25	"	(184.2mm)

(4) Lea Road, Sandymount.
Rainfall of depth 6½ inches measured by means of bucket. Equivalent rainfall 3.6 inches (91.4mm). Period over which rain was collected "early morning" to 1800h. G.M.T. on 11th.

(5) Glenaulin, Foster Avenue, Mount Merrion.
Rainfall measured in a glass tank. The amounts recorded over different periods were:
1000h. to 1600h. G.M.T. on 11th 5.60 inches (142.2mm)
2100h. to 2300h. G.M.T. on 11th 0.26 inches (6.6mm)
2300h. on 10th to 2300h. G.M.T. on 11th 5.86 inches (148.8mm)

(6) Marlborough Road, Donnybrook.
Rainfall 131mm. (5.16 ins) measured by means of bucket. Period over which rain was collected 1200h. to 1700h. G.M.T.

(7) Waltham Terrace, Blackrock.
Rainfall 5.9 inches (149.9mm) measured by means of bucket. Period over which rain was collected dusk on 10th to dusk on 11th.

(8) Clay Farm, Sandyford.
Rainfall measured in a raingauge. The amounts recorded over different periods were
1200 G.M.T. to 1215h. G.M.T. on 11th 7.2mm (0.28 inches)
2100 G.M.T. on 10th to 2100h. G.M.T. on 11th 13.0mm (0.51 inches)

Additional information obtained as a result of personal inspection of the different sites by a member of the Meteorological Service, is given below:

Rainfall for 19 Weston Park, Churchtown

1. The can, which leaked slightly was cylindrical, with diameter 8 inches and height $11^3/8$ inches. It was exposed on top of a dwarf-wall 1 ft. 3 ins. high and at a distance of 8 ft. 6 ins. from the back wall of a two storied house. The reading of 9¼ inches (235.0 mm) for the period 11 a.m. to 8 p.m. would have been affected by some insplashing from the nearby house, insplashing from the top of the dwarf-wall on which the can stood, and outsplashing from the can itself. It is not possible to assess with certainty the magnitude of these effects but it is considered that Mr. Beatty's estimate of the true rainfall as at least 6¾ ins. (171.5mm) was conservative. This is understandable as Mr. Beatty is an engineer concerned with design of drainage schemes.

2. Rainfall at 39, Blackheath Park, Clontarf.

Rainfall was measured from a standard 5" diameter gauge of shallow type funnel. The exposure was rather sheltered on the North and West sides, but otherwise satisfactory.

3. Rainfall for 10 Mather Road N., Mount Merrion.

Rainfall was measured by means of a conventional type raingauge, which had a standard exposure on a lawn surface at the rear of Mr. Coleman's residence.

4. Rainfall for 6 Lea Road, Sandymount.

A bucket which was dry before the storm was filled to within 4 inches of the rim, and represented a fall of 3.6 ins. (91.4 mm). There would have been some loss by outsplashing.

5. Rainfall at Glenaulin Foster Avenue, Mount Merrion.

Rainfall was measured in a rectangular glass tank which had been emptied by Mr. Farrell on the morning of the thunderstorm. The tank measured 12 ins. x 8 5/8 ins. and was 17 7/8 ins. high. Since the depth of rainfall was measured as less than 6 ins. (152.4 mm), it seems improbable that any appreciable loss occurred through outsplashing.

However the site of the tank was shaded by a large tree 40 feet high, 15 feet away.

6. Rainfall at 30, Marlborough Road, Donnybrook.

Rainfall was collected in a bucket which was well exposed in a garden. The amount collected was measured and the equivalent depth of rain computed by a member of the staff of the Meteorological Service.

7. Rainfall at 21 Waltham Terrace, Blackrock.

Rainfall was collected in a bucket standing close to the wall of the garage attached to the house and directly under a small window-ledge, which protruded 2½ ins. from the wall.

The reading is probably over-estimated due to insplashing from the wall and, to a greater extent, dripping from the window-ledge. It would be impossible to obtain a close estimate of this contribution but it is thought that the over-estimate would be of the order of 20% which would result in a corrected value of about 4.9 ins. (124.5 mm).

8. Rainfall at Clay Farm, Sandyford.

Rainfall was read from a cylindrical gauge of 5½ ins. diameter exposed with the rim 12 ins. above a lawn surface. The raingauge was almost surrounded by trees, some of which were only 12 ft. away, and may have caused some sheltering of the gauge.

The rainmeasure, which had been graduated by the observer, was tested against a standard measure and found to read 3% high giving a corrected value of 12.6 mm. (0.50 ins.).

The maximum amounts of rainfall (in millimetres) recorded in periods from 5 minutes to 24 hours at stations equipped with rain recorders are given in Table 2.

Table 2

STATION	PERIOD										
	Minutes				Hours						
	5	10	15	30	1	2	3	4	6	12	24
Baldonnel	2.0	2.8	3.5	5.3	5.4	5.4	5.4	5.4	9.7	10.9	11.0
Dublin Airport	3.0	4.7	6.6	8.2	8.5	10.0	12.6	14.2	14.4	15.5	15.5
Dublin City											
Ballsbridge	4.2	8.2	12.1	23.8	46.2	78.1	92.5	93.5	95.1	97.8	97.8
Clontarf	4.2	8.1	10.2	18.1	27.4	34.1	38.1	39.5	42.1	43.9	43.9
Howth	0.1	0.2	0.3	0.4	0.5	0.9	0.9	0.9	0.9	1.0	1.1
Glasnevin	3.2	3.8	5.2	7.7	10.1	10.3	16.1	16.3	16.5	18.8	18.8
Merrion Sq.	5.5	8.7	12.8	23.4	36.4	39.4	44.6	45.7	45.8	48.6	48.7
Upr. O'Connell Street	3.8	6.0	7.2	11.1	15.6	16.4	23.1	23.3	23.4	27.4	27.4
Glenasmole	7.4	12.0	15.0	23.6	26.0	26.3	28.6	28.8	34.6	49.2	49.3
Kinsaley	1.3	2.0	2.6	4.3	6.0	8.9	10.4	11.3	13.0	13.9	13.9
Leixlip	5.4	7.6	9.4	10.8	11.1	11.1	12.5	12.8	14.5	15.6	15.6

The records available for the period of 24 hours beginning at 9h G.M.T. on 11th June, 1963 permit of the distribution of rainfall to be mapped and this is given in Fig. 1. At Ballsbridge the rate of rainfall was almost constant over the hour from 13.50h G.M.T. to 14.50h G.M.T. Records for other near city stations show that the maximum rate of fall over one hour also occurred in or about the same time. The fall of 3.25 inches measured at Mount Merrion between 13.50h G.M.T. and 14.55h G.M.T. indicates that at least 3.0 inches fell there in a period of one hour from 13.50h G.M.T. A map showing distribution of maximum rainfall over one hour based on this and other values given in Table 2 is shown in Fig. 2.

1:25,000

DUBLIN

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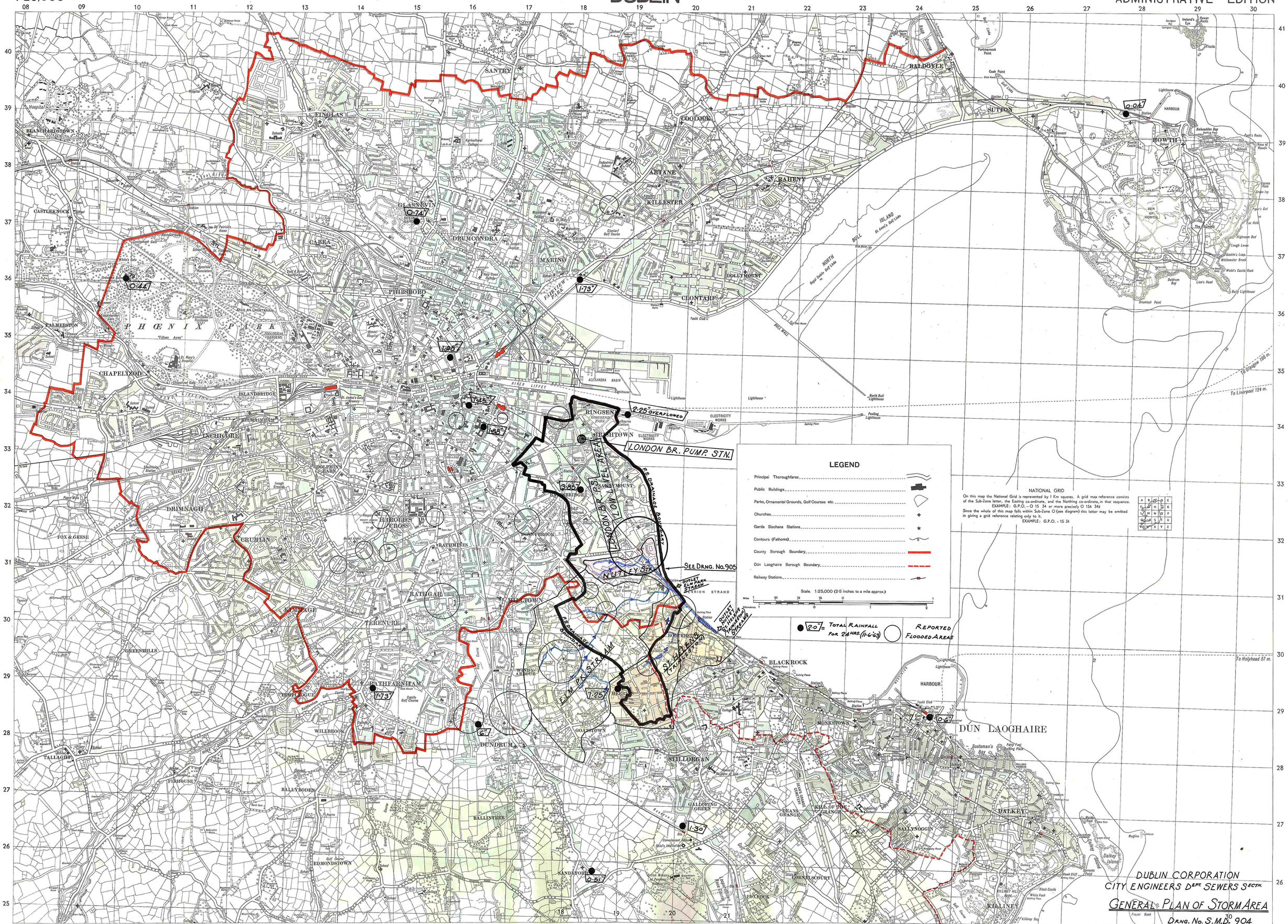

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GENERAL PLAN OF STORM AREA

DRNG. No. S.M.D. 904

Revised in 1936-37.
Revised from Air Photographs 1958.

Compiled, Printed and Published by the Director at the Ordnance Survey Office, Dublin. 1959.

Price 8/- Net. Paper Flat.

APPENDIX D

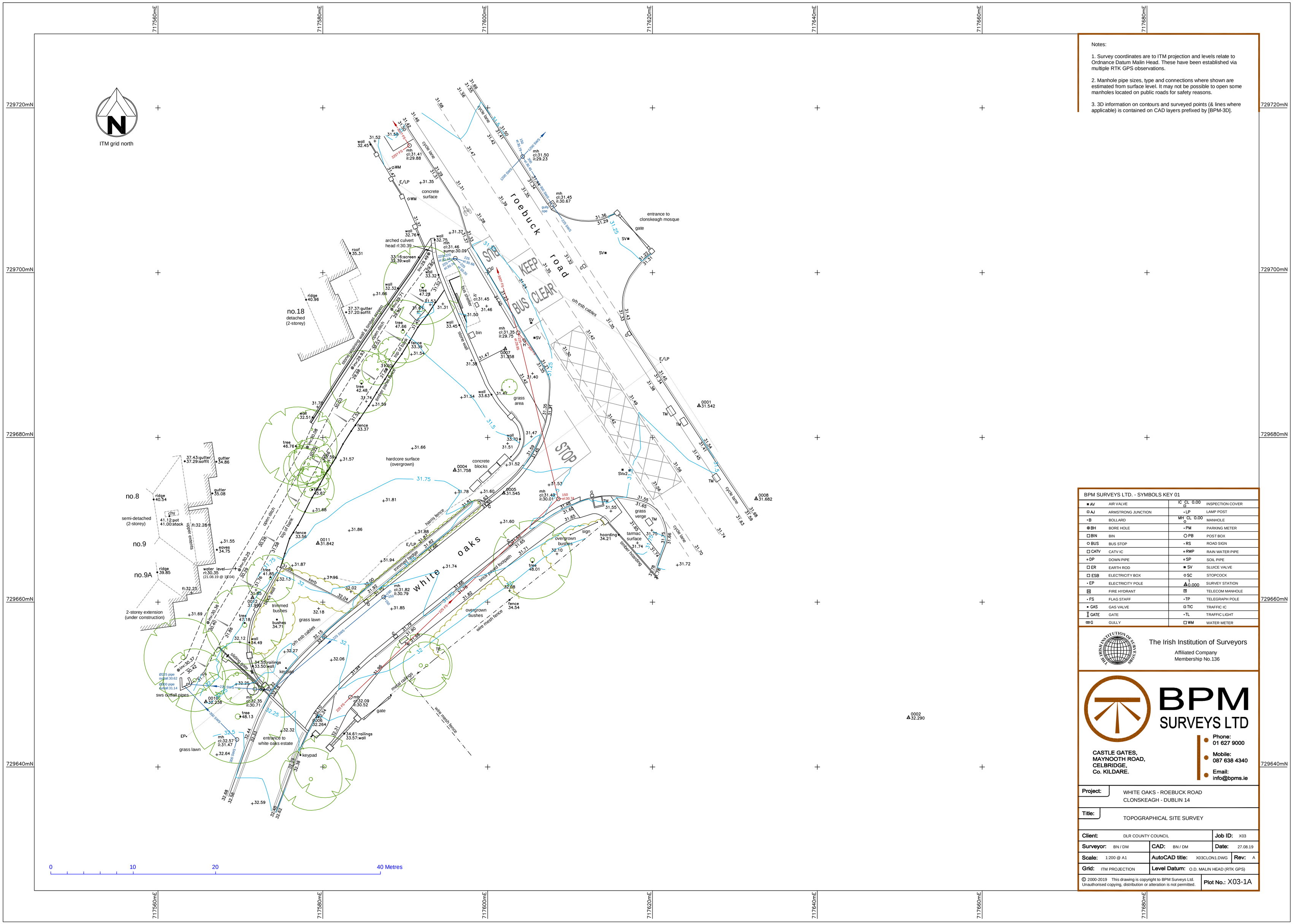
Topographical Survey

Notes:

1. Survey coordinates are to ITM projection and levels relate to Ordnance Datum Malin Head. These have been established via multiple RTK GPS observations.

2. Manhole pipe sizes, type and connections where shown are estimated from surface level. It may not be possible to open some manholes located on public roads for safety reasons.

3. 3D information on contours and surveyed points (& lines where applicable) is contained on CAD layers prefixed by [BPM-3D].



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AJ	ARMSTRONG JUNCTION	LP	LAMP POST
B	BOLLARD	MH CL 0.00	MANHOLE
BH	BORE HOLE	PM	PARKING METER
BIN	BIN	PB	POST BOX
BUS	BUS STOP	RS	ROAD SIGN
CATV	CATV IC	RWP	RAIN WATER PIPE
DP	DOWN PIPE	SP	SOIL PIPE
ER	EARTH ROD	SV	SLUICE VALVE
ESB	ELECTRICITY BOX	SC	STOPCOCK
EP	ELECTRICITY POLE	0.000	SURVEY STATION
	FIRE HYDRANT		TELECOM MANHOLE
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Client:	DLR COUNTY COUNCIL	Job ID:	X03
Surveyor: BN / DM	CAD: BN / DM	Date:	27.08.19
Scale: 1:200 @ A1	AutoCAD title: X03CLON1.DWG	Rev:	A
Grid: ITM PROJECTION	Level Datum: O.D. MALIN HEAD (RTK GPS)		

Plot No.: X03-1A