DREENACREENIG WEST WIND FARM LIMITED

Dreenacreenig West Wind Farm Control Building

Flood Risk Assessment

APRIL 2017

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DOCUMENT APPROVAL

PROJECT	Dreenacreenig West Wind Farm	
CLIENT / JOB NO	Dreenacreenig West Wind Farm Limited.	4636
DOCUMENT TITLE	Flood Risk Assessment	

	Prepared by	**Reviewed/Approved by**
Document R0	Name Oisín *O'Connor*	Name John McElvaney
Date 3/4/2017	Signature	Signature

DREENACREENIG WEST WIND FARM 20kV SUBSTATION

FLOOD RISK ASSESSMENT

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FLOOD RISK ASSESSMENT

1.0 INTRODUCTION

Jennings O'Donovan (JOD) have been appointed by Dreenacreenig West Wind Farm Limited to prepare and submit a Flood Risk Assessment for the Wind Farm Control building and ESBN 20kV Substation.

The Dreenacreenig West Wind Farm 20kV substation is being constructed as part of the grid connection for the Dreenacreenig West Wind Farm. The proposed Substation/Control Building site is situated in the townland of Dreenacreenig West which approximately 5km north of Drimoleague village, County Cork.

The development consists of a 20kV substation with a windfarm control building which will be required for the control and metering of electricity produced by the proposed Dreenacreenig West Wind Farm. The proposed building is a single storey building 17.1m long x 8.8m wide x 6.278m high (to ridge level). The floor area is 151m2. The building is classed as high risk industrial. The building is constructed from in-situ concrete with Type A Tanking Foundation, solid concrete blockwork construction with solid concrete floors, in-situ concrete ceiling, timber rafters and slate finish to the roof.

Planning permission for the proposed works has been granted by An Bord Pleanála under planning reference nr Ref. PL 88.239767

This Flood Risk Assessment is prepared in accordance with *'The Planning System and Flood Risk Management – Guidelines for Planning Authorities*' issued by the Department of Environment, Heritage and Local Government (DEHLG) in November, 2009.

A risk assessment from fluvial, surface water and ground water sources was assessed based on site data, local knowledge and reference to the OPW Flood Data

1.2 Scope

This Flood Risk Assessment is based on the following:

- Department of Environment, Heritage and Local Government guidelines for Planning Authorities covering Flood Risk Management.
- Risk of flooding to the proposed Substation from flood flow from neighbouring watercourses
- Risk of flooding resulting from rainfall
- Risk of flooding from groundwater generated on site

In addition to the above, the study also examined any possible impact the Substation construction may have on the existing drainage regime locally adjacent to the proposed wind farm site. The impacts addressed under this heading comprise:

- The impact of surface water runoff from the site on the flow regimes in neighbouring watercourses
- Loss of floodplain
- Review of historical flood records
- Impact of Construction Work required for the Substations on the existing drainage regime on the site and adjacent land with particular reference to existing drainage channels and impact, if any, on local floodplain

2.0 DEHLG PLANNING GUIDELINES

The Department of Environment, Heritage and Local Government issued guidelines to Planning Authorities in 2009 with reference to Flood Risk Management.

The Guidelines cover the existing developments within the area and flood risk in Ireland They provide a system for the integration of flood risk assessment into the planning system. The objective is to ensure that flood risk must be considered with future development within all County Development Plans under the following:

- Avoid inappropriate development in areas at risk of flooding.
- Avoid new developments increasing flood risk elsewhere.

- Ensure effective management of residual risks for development permitted in floodplains.

The DEHLG set out a sequence whereby any possible flood risk is established from existing and proposed developments as follows:

Stage 1: Flood Risk Identification

Identify whether there may be possible flooding or surface water management issues related to either the area of regional planning guidelines, Local Authority Development Plans and Local Area Plans or from a proposed development site that may warrant further investigation at the appropriate lower level plan or planning applications level;

Stage 2: Initial Flood Risk Assessment

Confirm any 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; and

Stage 3: Detailed Flood Risk Assessment

Assess flood risk issues in sufficient detail and to provide a quantitative appraisal of potential flood risk to a proposed or existing development or land to be zoned, of its potential impact on flood risk elsewhere and of the effectiveness of any proposed mitigation measures.

The Guidelines identify proposed developments proposed under 3 headings rated on the degree of flooding:

i. Highly vulnerable development,
ii. Less vulnerable development and
iii. Water Compatible development.

Essential infrastructure such as Electricity Substations is classed as highly vulnerable development.

The Guidelines classify Land areas within three flood zones based on the probability of flooding. Flood zones are defined as follows in the Guidelines:

Zone A is at highest risk. In any one year, Zone A has a 1 in 100 year (1%) chance of flooding from rivers and a 1 in 200 year (0.5%) chance of flooding from the sea.

Zone B is at moderate risk. The outer limit of Zone B is defined by the 1 in 1,000 year (or 0.1%) flood from rivers and the sea.

Zone C is at low risk. In any one year, Zone C has less than 1 in 1,000 year (<0.1%) chance of flooding from rivers, estuaries or the sea.

In the identification of flood zones, no account should be taken of any flood relief walls or embankments.

	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 1: Matrix of Vulnerability versus flood zone to illustrate appropriate development and that required to meet the Justification Test (reproduced from Table 3.2 of Ref 1).

Table 1 above, which is reproduced from the guideline document to Planning Authorities in relation to Flood Risk Management states that essential infrastructure, including electricity substation should be located within Flood Zone C. Section 4 of this Flood Risk Assessment document will consider the Flood Zone assignment for the proposed site. The table also refers to the use of a Justification Test under certain circumstances. In cases where there are insufficient sites available to locate a development in the appropriate low flood risk zone, the guideline document allows for consideration of sites

within flood risk zones. A Justification Test is then required to assess such proposals in the light of proper planning and sustainable development objectives.

This report considers the Flood Risk of the proposed substation in relation to Stages 1 and 2 of the staged approach outlined above.

3.0 PROPOSED SUB-STATION SITE

The substation site is located within the wind farm site, approximately 500m from local public road in the Dreenacreenig West Townland. Access to the proposed substation is via the proposed windfarm road network. The current use of the site is agricultural grassland and is occupied by habitats of low ecological value, with mature hedgerows as site boundaries. There is a commercial forestry to the north of the site. The site is relatively elevated at approx. 240m AOD, located on the Mountain side with a summit height of 402m AOD. The site slope upwards in Northerly direction at approx. 1/12

4.0 FLOODING RISK

The Risk of Flood to the site shall be assessed in relation to the following criteria:

- Fluvial Risk; Inundation from flow from neighbouring watercourses, streams or rivers
- Pluvial Risk: Flooding due to direct rainfall
- History of Flooding
- Available Predictive Flood Risk Mapping
- Impact of presence of the Substation on the existing local drainage/flood risk regime down slope of the site

4.1 Fluvial Flood Risk

Study of the location of the proposed substation development confirms that there will be no impact from the discharge of waters from streams or rivers in close proximity to the site due to the elevated level of the windfarm site and the topography of the surrounding lands. The site is elevated between two water courses as identified on the OPW flood map below.

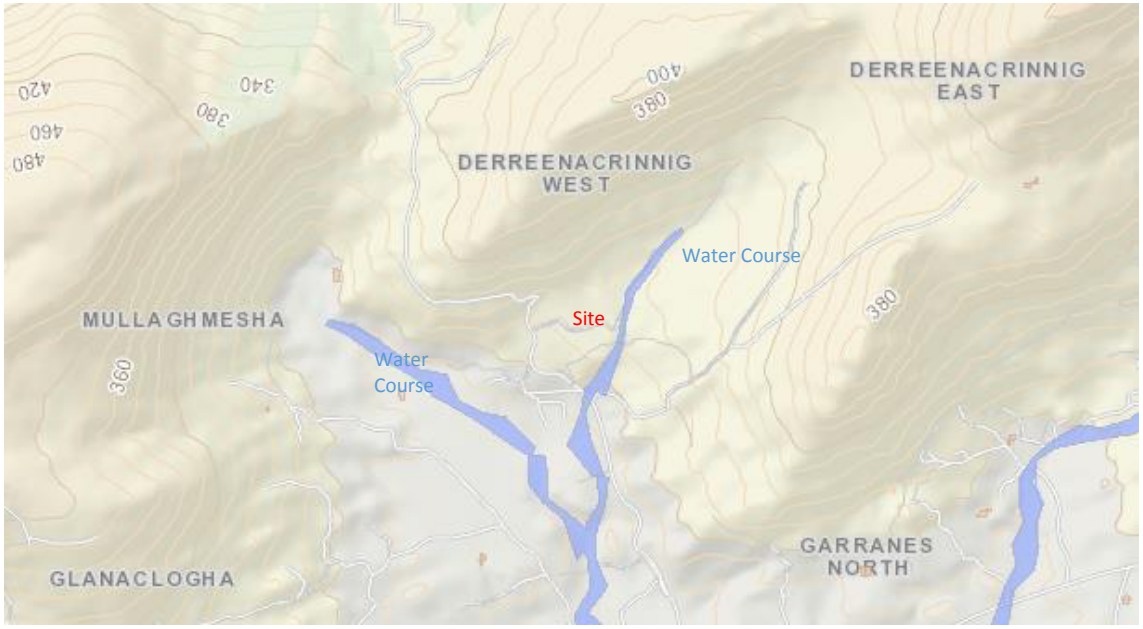


Fig 4.1 OPW Flood Map 1-1000 year flood

- Water Course to the East of the Site. 50m – East – 1 in 1000 year flood 235m AOD
- Water Course to the West of the Site. 184m East – 1 in 1000 year flood 215m AOD

Considering the water course 50m to the East of the site is quite close to the 1000 year flood level a more detailed analysis is required. The catchment of the watercourse upstream was plotted and the area determined at 111 hectors. The invert level of the adjacent stream was surveyed to be 237.897m. Annual flood flow was calculated using IH124 Qbar Greenfield runoff estimation. A Growth curve factor if 2.76 was applied to account for a 1/1000 year flood..

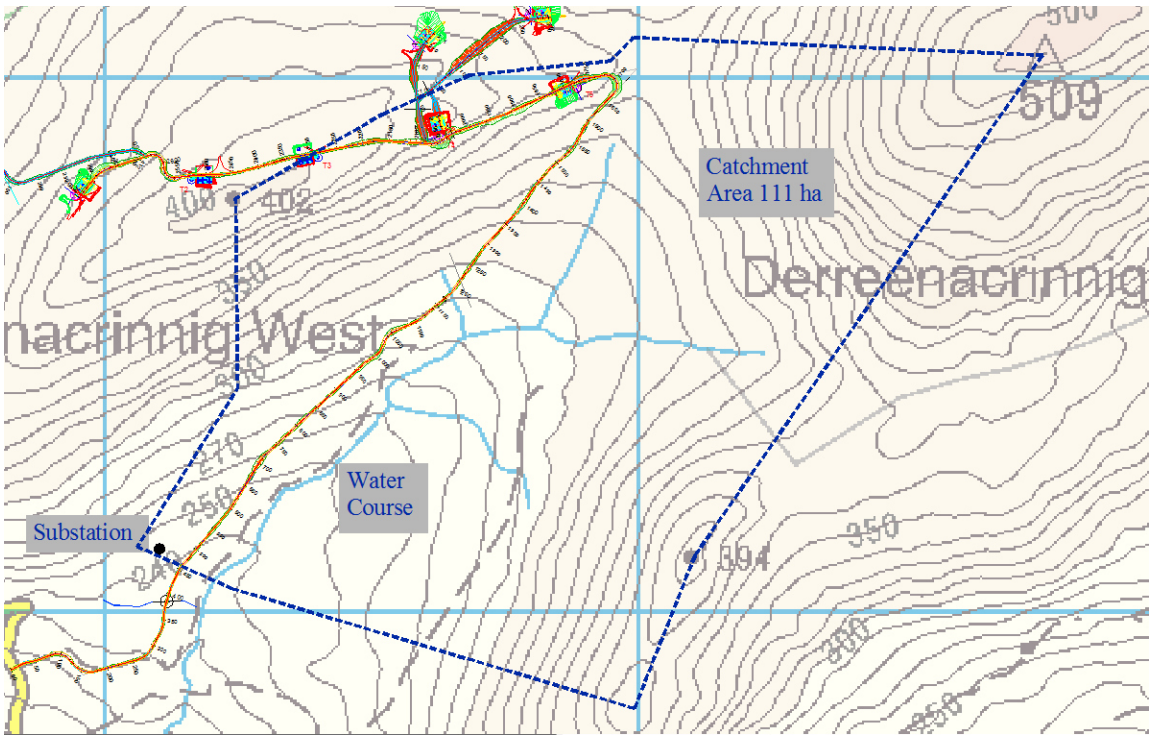


Fig 4.2 Water Course Catchment Area

The resulting flood level was calculated at 238.59m. The proposed level of the substation in 242.826m AOD, which is 4.236m above the 1 in 1000 year predicted flood level. In this regard it is not envisaged that there is a risk of fluvial flooding on the proposed site. This identified the site as located within Zone C - at low Risk

4.2 Pluvial Flood Risk

Overall, the proposed infrastructural development requires relatively large adjustment of existing the site levels. The site layout on Fig 4.2 and site section on Fig 4.3 demonstrate there are minor adjustments to be made at the proposed site. Levels as shown on Fig 4.2 and Fig 4.3 below indicate a fall across the existing site from southeast to Northwest to north of approximately 11m over 60m i.e. 1:5

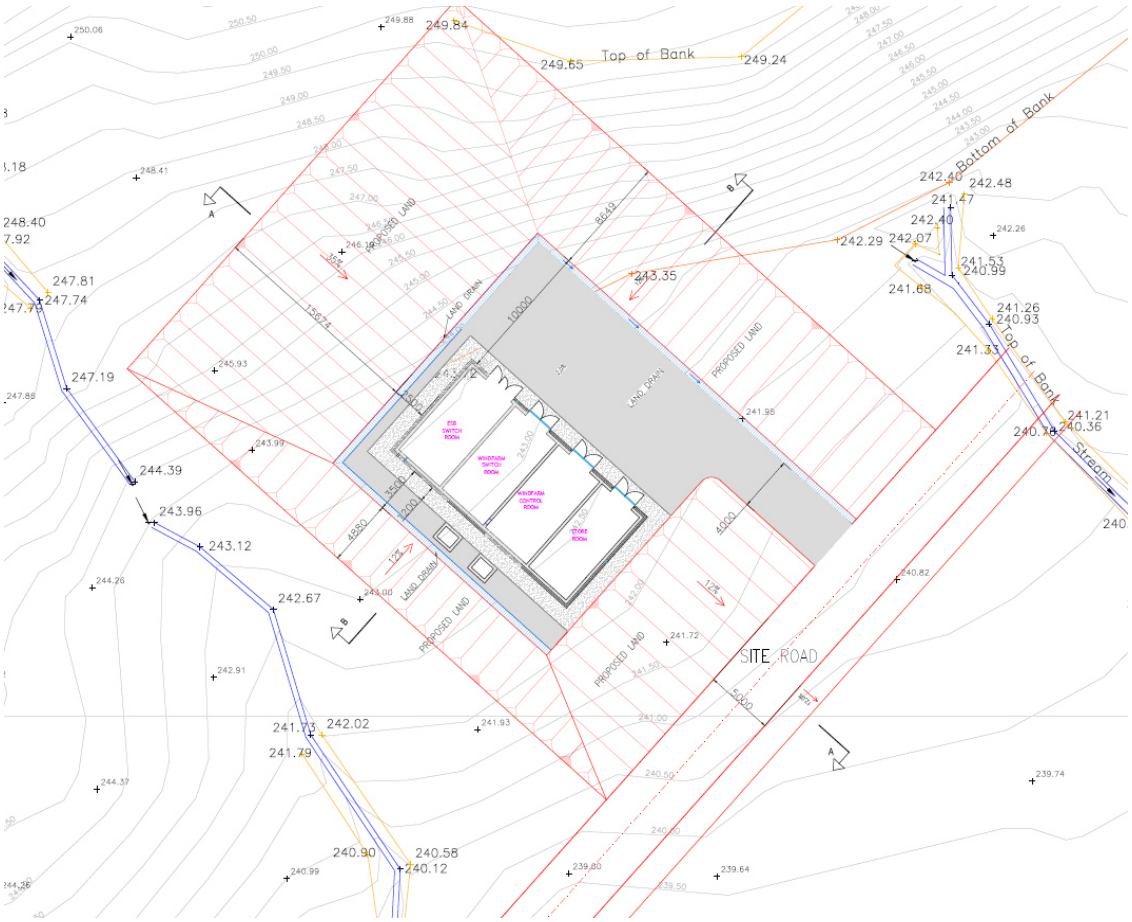


Fig 4.3 Site Layout Plan

In order to provide a level platform, for the required building and hardstand area, the northwest side of the site will be reduced in level while the southeast side will not change in level. The required level adjustment is approx. 2m as outlined in figure 4.3 below.

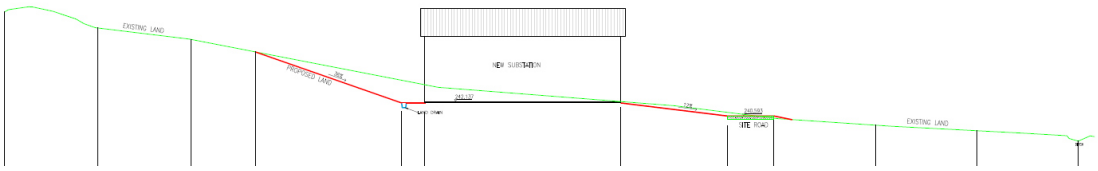


Fig 4.4 Proposed Northwest to Southeast Site Section

On completion of the excavations rain water runoff can be expected to enter the site northern elevation. This presents a risk of pluvial flooding of the site. A land drain shall be required to be constructed on the edge of the site on the upslope side of the building.

4.3 Groundwater Flood Risk

An elevated water table can lead to building flooding. No signs of an elevated water table were identified in the site data received. As an ESBN requirement, all sumps and pits on the 20kV control building shall be tanked below ground level. Where trench/pits within buildings contain sumps c/w automated pumps installed, the pumps shall be connected to the drainage network via a trapped gully constructed external to the building to prevent any building flooding due to elevated water tables.

As the proposed construction requires the reduction in the existing ground level to the southeast of the site, there is possibility that subterranean water courses may be interrupted. In the event that water courses are interrupted a perimeter drain will be required to divert subterranean water courses around the compound, to avoid any elevation of the water table.

4.4 Review of OPW Flood Risk Mapping

The OPW is the national authority for the implementation of the EU Directive on the Assessment and Management of Flood Risks (2007/60/EC) which was transposed into Irish Law by the EU (Assessment and Management of Flood Risks) Regulations S1 122 of 2010. The main objective of the Catchment-based Flood Risk Assessment and Management (CFRAM) Programme is to achieve the requirements of the EU 'Floods' Directive. As set out in section 4.1 the proposed site was reviewed in consultation with the OPW flood risk mapping.

4.5 Impact of Development on Current Flood Regime at Site

4.5.1 Site Surface Water Runoff Impact

All surface runoff from the site will be collected in a dedicated drainage network. Attenuation of discharges from the site will be undertaken using best practice measures to preserve the current general storm water flow regime. These measures will include as appropriate, the provision of on-site storage and the management of discharges. The use of permeable ground surfaces will be used where possible.

4.5.2 Loss of Floodplain

The location of the Substation site is not located within a floodplain.

5.0 HISTORIC FLOODS

The location of the Substation Site is located in an area not prone to flooding. Following examination of the site and local knowledge, along with review of the National Flood Hazard Mapping, OPW, it is noted that no record of flooding has occurred at this location.

6.0 CLIMATE CHANGE

Recent studies carried out by the EPA Strive Programme 2007 – 2013 have indicated that predictions of increased rainfall in Ireland will increase over the Winter periods by 10% while reductions of the order of 12 – 17% is projected to occur over the Summer months. The development footprint required for the Substation is relatively small. A large percentage of the site shall be finished with permeable pavements. The proposed disposal of rain water shall be discharge to ground water. The drainage system shall be designed to include an addition 10% capacity to account for predicted increases in rainfall.

7.0 CONCLUSION

The proposed development of the Dreenacreenig West Substation within the overall Wind Farm project is small. The planned construction works required will need to include a drainage system to ensure that all storm water generated on site shall be collected and disposed/ discharged to the existing drainage system responsibility.

Overall, the project, following construction, will have no impact on any Flood Zone and is located in a Flood Zone C - low risk area, as per the DEHLG guidelines and in this regard in not prone to flooding.

During the construction and operation of the Dreenacreenig West Substation there will be no risk of fluvial flooding, either within the overall site or down slope of the development due to the development. There is small risk of Pluvial flooding due to overland flow from a small area of catchment to the south of the site. With the construction of an adequate drainage system the risk can be mitigated.

Appendix A

1/1000 Flood level Calculation data

1. $QBAR_{Rural}$ – Greenfield Runoff Rate
2. Met Eireann – Rainfall Return Period Data
3. 1/1000 year Growth Curve
4. 1/1000 year flood level calculation

HR Wallingford
Working with water

Greenfield runoff estimation for sites

Site name:	Dreenacreenig West WF
Site location:	Dreenacreennig West, Drimolegue

This is an estimation of the greenfield runoff rate limits that are needed to meet normal best practice criteria in line with Environment Agency guidance "Preliminary rainfall runoff management for developments", W5-074/A/TR1/1 rev. E (2012) and the CIRIA SUDS Manual (2007). It is not to be used for detailed design of drainage systems. It is recommended that every drainage scheme uses hydraulic modelling software to finalise volume requirements and design details before drawings are produced.

Site coordinates

Latitude:	51.73993° N
Longitude:	9.1197° W

Reference:	gc1w26znzw4b / 111
Date:	30 Mar 2017

Site characteristics

Total site area	111	ha
Significant public open space	0	ha
Area positively drained	111	ha

Methodology

Greenfield runoff method	IH124

Qbar estimation method	Calculate from SPR and SAAR
SPR estimation method	Calculate from SOIL type
SOIL type	4
HOST class	N/A
SPR	0.47

Hydrological characteristics

	Default	Edited	
SAAR	1564	1905	mm
M5-60 Rainfall Depth	20	20	mm
'r' Ratio M5-60/M5-2 day	0.2	0.2	
FEH/FSR conversion factor	1	1	
Hydrological region	13	13	
Growth curve factor: 1 year	0.85	0.85	
Growth curve factor: 10 year	1.4	1.36	
Growth curve factor: 30 year	1.65	1.66	
Growth curve factor: 100 year	1.95	2.04	

Greenfield runoff rates

	Default	Edited	
Qbar	1,257.39	1,583.76	l/s
1 in 1 year	1,068.78	1,346.20	l/s
1 in 30 years	2,074.70	2,629.05	l/s
1 in 100 years	2,451.91	3,230.88	l/s

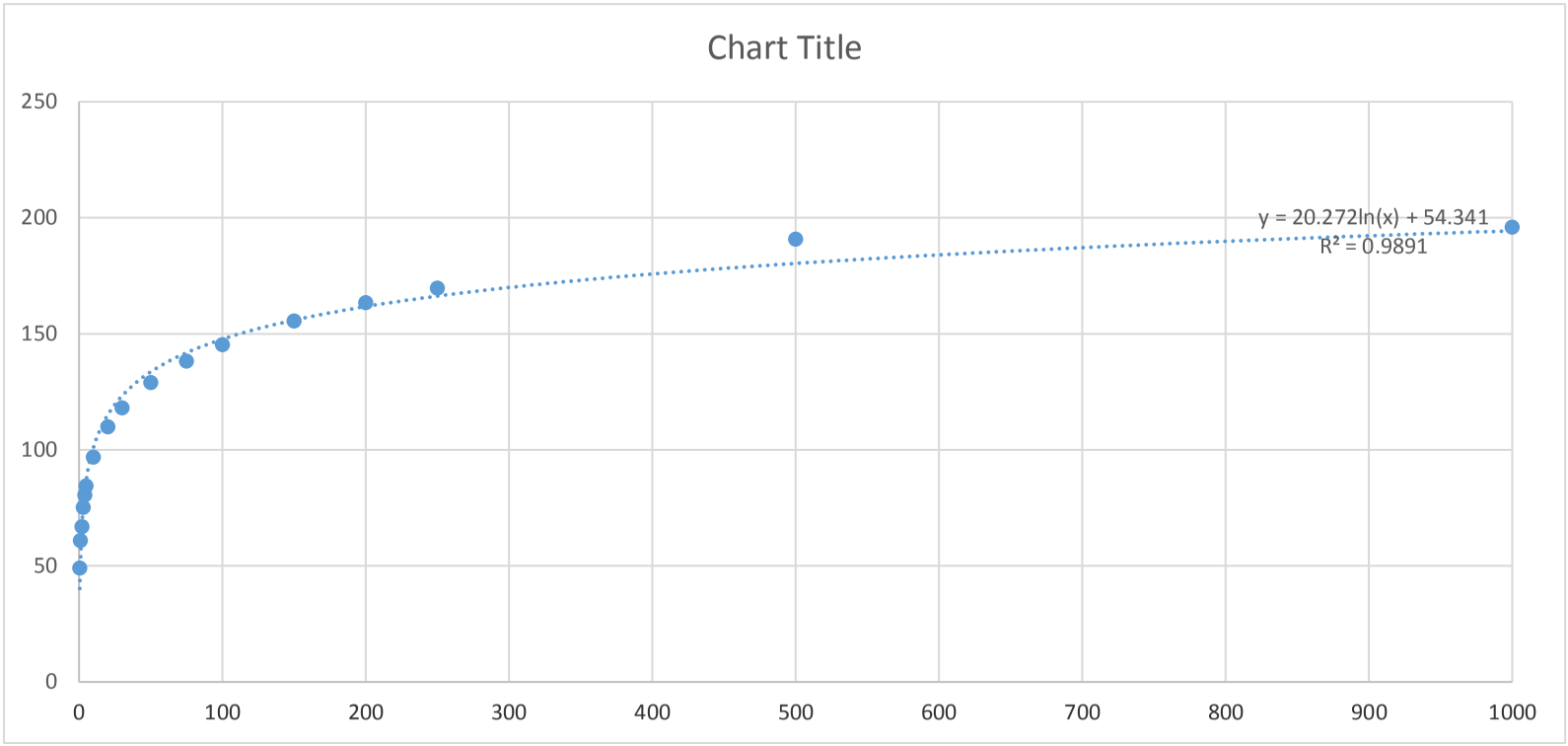
Please note that a minimum flow of 5 l/s applies to any site

Met Eireann
Return Period Rainfall Depths for sliding Durations
Irish Grid: Easting: 111249, Northing: 51763,

	Interval		Years												
DURATION	6months,	1year,	2,	3,	4,	5,	10,	20,	30,	50,	75,	100,	150,	200,	250,	500,
5 mins	3.4,	4.2,	4.6,	5.1,	5.5,	5.8,	6.6,	7.5,	8.1,	8.8,	9.4,	9.9,	10.6,	11.1,	11.6,	N/A ,
10 mins	4.7,	5.8,	6.4,	7.1,	7.7,	8.0,	9.2,	10.5,	11.2,	12.3,	13.1,	13.8,	14.8,	15.5,	16.1,	N/A ,
15 mins	5.5,	6.8,	7.5,	8.4,	9.0,	9.5,	10.8,	12.3,	13.2,	14.4,	15.5,	16.2,	17.4,	18.3,	19.0,	N/A ,
30 mins	7.7,	9.5,	10.4,	11.7,	12.6,	13.2,	15.1,	17.1,	18.4,	20.1,	21.6,	22.7,	24.3,	25.5,	26.5,	N/A ,
1 hours	10.7,	13.3,	14.6,	16.4,	17.5,	18.4,	21.1,	23.9,	25.7,	28.1,	30.1,	31.6,	33.9,	35.5,	36.9,	N/A ,
2 hours	14.9,	18.5,	20.3,	22.8,	24.4,	25.6,	29.4,	33.4,	35.8,	39.1,	42.0,	44.1,	47.2,	49.6,	51.5,	N/A ,
3 hours	18.1,	22.5,	24.7,	27.7,	29.7,	31.2,	35.7,	40.5,	43.5,	47.5,	51.0,	53.5,	57.4,	60.2,	62.6,	N/A ,
4 hours	20.8,	25.8,	28.3,	31.8,	34.1,	35.8,	41.0,	46.5,	50.0,	54.6,	58.5,	61.5,	65.9,	69.1,	71.8,	N/A ,
6 hours	25.2,	31.4,	34.4,	38.7,	41.4,	43.5,	49.8,	56.5,	60.7,	66.3,	71.1,	74.7,	80.0,	84.0,	87.2,	N/A ,
9 hours	30.7,	38.1,	41.8,	47.0,	50.3,	52.8,	60.5,	68.7,	73.7,	80.6,	86.4,	90.7,	97.2,	102.1,	106.0,	N/A ,
12 hours	35.2,	43.8,	48.0,	53.9,	57.7,	60.6,	69.5,	78.8,	84.7,	92.5,	99.2,	104.1,	111.6,	117.2,	121.7,	N/A ,
18 hours	42.8,	53.2,	58.3,	65.5,	70.1,	73.6,	84.4,	95.8,	102.9,	112.4,	120.5,	126.5,	135.6,	142.3,	147.8,	N/A ,
24 hours	49.1,	61.0,	66.9,	75.2,	80.5,	84.5,	96.9,	110.0,	118.1,	129.0,	138.3,	145.3,	155.6,	163.4,	169.7,	190.8,
2 days	63.9,	77.6,	84.3,	93.5,	99.4,	103.8,	117.3,	131.3,	139.9,	151.4,	161.1,	168.3,	179.0,	187.0,	193.4,	214.7,
3 days	76.7,	91.9,	99.2,	109.3,	115.7,	120.4,	134.9,	149.7,	158.9,	171.0,	181.1,	188.6,	199.7,	208.0,	214.6,	236.6,
4 days	88.4,	104.9,	112.7,	123.6,	130.4,	135.4,	150.8,	166.5,	176.0,	188.7,	199.3,	207.1,	218.6,	227.2,	234.0,	256.6,
6 days	109.9,	128.6,	137.4,	149.5,	157.1,	162.7,	179.6,	196.7,	207.1,	220.8,	232.1,	240.5,	252.8,	261.8,	269.1,	292.9,
8 days	129.9,	150.5,	160.2,	173.4,	181.6,	187.7,	205.9,	224.2,	235.3,	249.9,	261.9,	270.8,	283.7,	293.2,	300.8,	325.7,
10 days	148.9,	171.2,	181.7,	195.8,	204.6,	211.1,	230.5,	250.0,	261.7,	277.0,	289.7,	299.0,	312.5,	322.5,	330.4,	356.3,
12 days	167.3,	191.2,	202.3,	217.3,	226.7,	233.5,	254.0,	274.5,	286.8,	302.8,	316.0,	325.7,	339.8,	350.1,	358.3,	385.1,
16 days	202.7,	229.4,	241.7,	258.4,	268.6,	276.2,	298.6,	320.8,	334.1,	351.4,	365.6,	376.0,	391.0,	402.0,	410.8,	439.2,
20 days	236.9,	266.1,	279.5,	297.6,	308.7,	316.8,	340.9,	364.7,	378.8,	397.2,	412.3,	423.3,	439.2,	450.8,	460.0,	489.8,
25 days	278.7,	310.7,	325.3,	344.9,	356.9,	365.7,	391.6,	417.1,	432.3,	451.8,	467.9,	479.5,	496.3,	508.6,	518.3,	549.7,

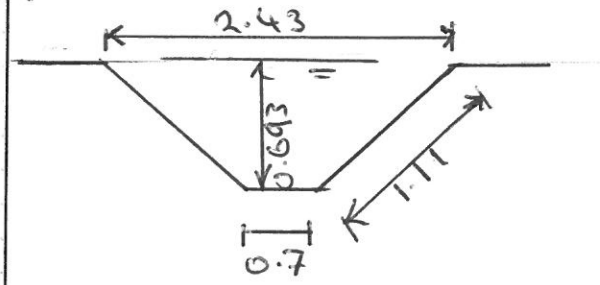
NOTES:
N/A Data not available
These values are derived from a Depth Duration Frequency (DDF) Model
For details refer to:
'Fitzgerald D. L. (2007), Estimates of Point Rainfall Frequencies, Technical Note No. 61, Met Eireann, Dublin',
Available for download at www.met.ie/climate/dataproducts/Estimation-of-Point-Rainfall-Frequencies_TN61.pdf

Year	24hr mm
0.5	49.1
1	61
2	66.9
3	75.2
4	80.5
5	84.5
10	96.9
20	110
30	118.1
50	129
75	138.3
100	145.3
150	155.6
200	163.4
250	169.7
500	190.8
1000	196



Calculation Sheet	Job No.	Sheet No.	Rev.	Date
		of		
	Member / Location			
	Drg. Ref.			
Job Title: 1/1000 Flood calculation.	Design by: OOC		Check by: JME	

Reference	Calculation	Result / Comment
	1/100 Flood Flow 3.2 m³/s Qbar. 2.76 m³/s 1/1000 year. 4.37 m³/s Q = AV Find V. Mannings Equation $V = 1/n \times M^{2/3} \times \sqrt{i}$ n = 0.023 i/33. D = 0.693	D = 0.693



A = 1.085 m²

P = 2.92 m

$M = \frac{A}{P}$

V = 4.0369

Qt = 4.382 m³/s

Invert Level. 237.897

\+ D 0.693

1000 Flood Level 238.590m OD

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