Technical Note

Project	Ballykett Wind Farm		
Subject	Grid Route Assessment		
To:	Harry Harbison	**Doc Ref.:**	22006-BFA-XX-XX-RP-C-6001-F5
Cc:		**Date**	09/05/2023

1 Executive Summary

As a result of carrying out a technical assessment of 3No. potential grid routes for Ballykett Wind Farm, it has been determined that all three routes are suitable for installation within existing roadways, without the need to traverse any third-party lands.

The three grid route options were assessed using industry standard route assessment criteria and scored via a high-level scoring system, namely:

- Advantageous
- Neutral
- Less Advantageous

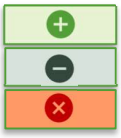


Table 1 below represents the scored assessment of the 3No. routes and determined that Option#1 is the preferred route with Option#2 and Option#3 being comparable from a technical perspective. However, Option#1 is located entirely along lands of "cutover raised peat" and therefore carries a larger risk in terms of ESB engagement, constructability and costs.

ID	Option #1	Option #2	Option #3
Distance	+	×	×
Crossings	+	×	×
Geotechnical	×	−	−
Flood Risk	+	−	−
Existing Utilities	+	−	−

Table 1: Technical assessment summary of the 3No. grid route options

2 Overview

The purpose of this report is to assess 3No. proposed grid connection routes associated with Ballykett Wind Farm. The details of the 3No. grid routes are listed below.

Grid Route ID	Length	Description
Option #1	1.7km	1No. 38kV underground route
Option #2	9.1km	2No. 20kV underground routes
Option #3	11.0km	2No. 20kV underground routes

Table 2: Description of grid route options

A site location map is included in Appendix D of this report illustrating the alignment of each of the grid routes.

Construction risks of underground grid routes are generally related to subsurface and geotechnical issues such as existing utilities, buried structures and varying site conditions. This report has assessed the constructability of each of the routes using the following categories:

1. Crossings – Watercourse, Rail, Motorways etc.
2. Geotechnical – Assessment of expected ground conditions along each route.
3. Flood Risk – Assessment of areas where grid route infrastructure potentially cannot be accessed.
4. Existing Utilities – Gas, Electricity, Watermain etc.

3 Technical Assessment

3.1 Crossings

3.1.1 Watercourses

Ordnance Survey Ireland (OSI) discovery maps were used to determine the number and location of natural watercourse crossings along the routes.

There were no watercourse crossings identified along Option #1.

A total of 14No. Watercourse Crossings between Option #2 and Option #3 were identified and each one checked to determine their suitability for a ducting crossing and a breakdown of these watercourse crossings are provided in Table 3 below.

Grid Route	Culvert Crossings	Bridge Crossings	Total Watercourse Crossings
Option#1	0	0	0
Option#2	6	2	8
Option#3	8	2	10

Table 3: Watercourse crossings summary for each grid route Option.

Details of each watercourse crossing are provided in Appendix A.

3.1.2 Rail

None of the proposed grid route options cross any existing rail lines.

3.1.3 TII Carriageways

3.1.3.1 N68

Both Option #2 and Option #3 will cross the N68 National Road transversely. At the proposed crossing location, the N68 is a single lane carriageway with no hard shoulders and grass verges on both sides.

There is an existing underground ESB cable running longitudinally with the N68 on the southern side of the carriageway. ESB records indicate that the existing cable at this location is part of the power distribution network and not a power supply line from an IPP source. The voltage of this existing line will need to be determined before the appropriate crossing design can be determined (standard safety practice is to install the lower voltage line on top at a given crossing).

TII Standard Construction Details such as CC-SCD-00560 or similar should be used for the detailed design of this crossing.

3.1.3.2 N67

Both Option #2 and Option #3 run longitudinally along the N67 for approximately 500m. There is no hard shoulder along this section of the N67 and a grass verge only on the eastern side. There is a road safety barrier along the eastern edge of the carriage, between the edge of pavement and the grass verge, with the grass verge having a minimum width of approx. 7.5m at its narrowest point (see image below).

Image 3.1.1 – N67 looking south towards Moneypoint. Note the crash barrier eastern side and steep drop western.

It is recommended that consultation between TII and ESB be carried out to determine the appropriate design along this section of road at detailed design stage.

It is envisaged that the design solution along the N67, given the dimensions of the grass verge (500m (L) x 7.5m (W)), will be that joint bays can be located at either end of the N67 and the ducts installed within the grass verge, however, this will be subject to approval from both TII and ESB.

It is noted that there are 2No. culvert crossings along this section of road. The southern most of these culverts is the diverted Mologha River and captured as WC#14 in Appendix A. Due to

the depth these culverts are installed at (discharging below high tide level into the bay) it is envisaged that the proposed grid route will traverse above these culverts should they be present within the eastern verge of the N67. Image 3.1.2 below illustrates the location of these 2No. culverts.

Image 3.1.2 – 2No. culverts discharging to the bay adjacent to the N67

3.2 Geotechnical

Geological Survey Ireland (GSI) mapping were used to assess the expected ground conditions along the various routes.

The assessed quaternary mapping, groundwater vulnerability mapping, subsoil permeability mapping, Teagasc mapping and bedrock mapping have all been included in Appendix B.

3.2.1 Option #1

Option #1 traverses' lands of "cutover/cutaway peat" for its entire length. Ground investigation works will be required at detailed design stage to determine the most appropriate trench detail to be used along this route.

A hydrogeological assessment of this area has determined that bedrock is likely to be in the region of 3.0m – 10.0m below ground level.

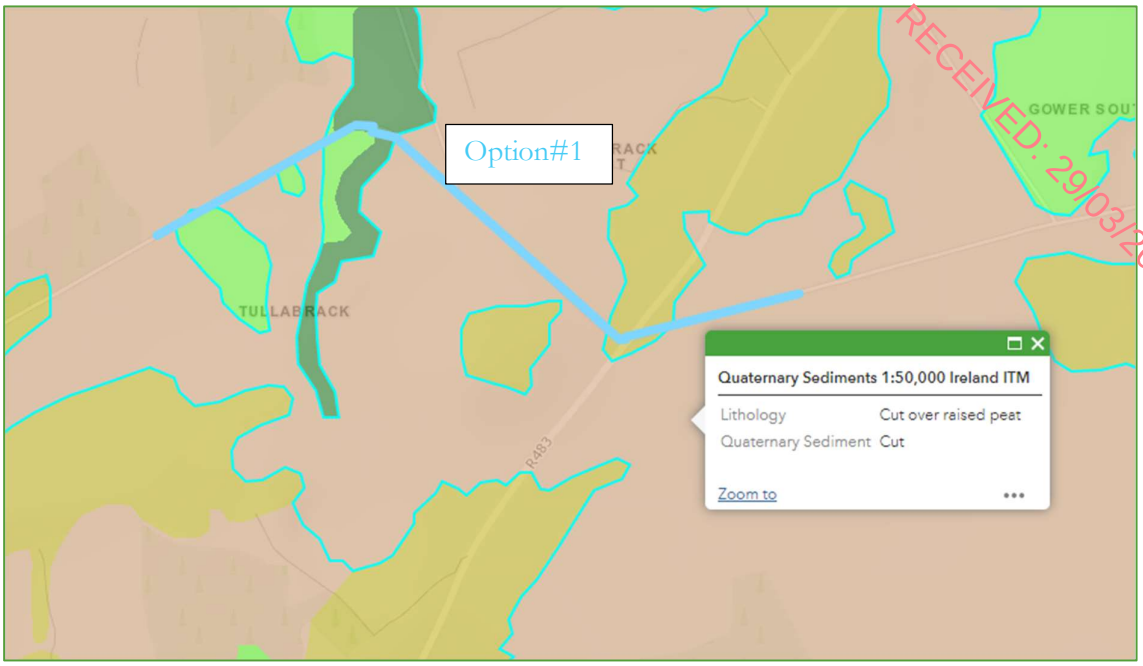


Image 3.2.2: Option#1 located entirely with lands of cut over raised peat.

A site inspection was carried out whereby the following elements were visually assessed only in an attempt to determine the formation type of the road i.e., solid or floating:

- Road conditions.
- Orientation of any surface cracks on the roads surface,
- Embankment strata (where possible).
- Finished floor level of any adjacent buildings; and
- Movement in road caused by passing traffic.

Based on the above assessment, it was assessed that the road is likely to be constructed to solid formation and therefore standard trench construction details could be used in these areas.

Should the existing road be floating and the depth of the bog in these areas be >2.0m, the trench design will likely involve the use of geotextiles to support the trench, with the geotextile anchored by the road build-up i.e., "top-hat" trench.

3.2.2 Option #2 & Option #3

For the most part, Option #2 and Option #3 traverse ground of till material. This is beneficial regarding construction methodologies and will offer flexibility at the detailed design stage when designing to avoid existing obstacles encountered along the route.

Option#2 and Option#3 also traverse lands with bedrock outcrop or high bedrock level (0.0m – 3.0m BGL). This could potentially lead to slower and more expensive than average construction in these sections.

However, both Option #2 and Option #3 sporadically traverse small sections of blanket peat (see Image 3.2.1 below) or cutover bog.

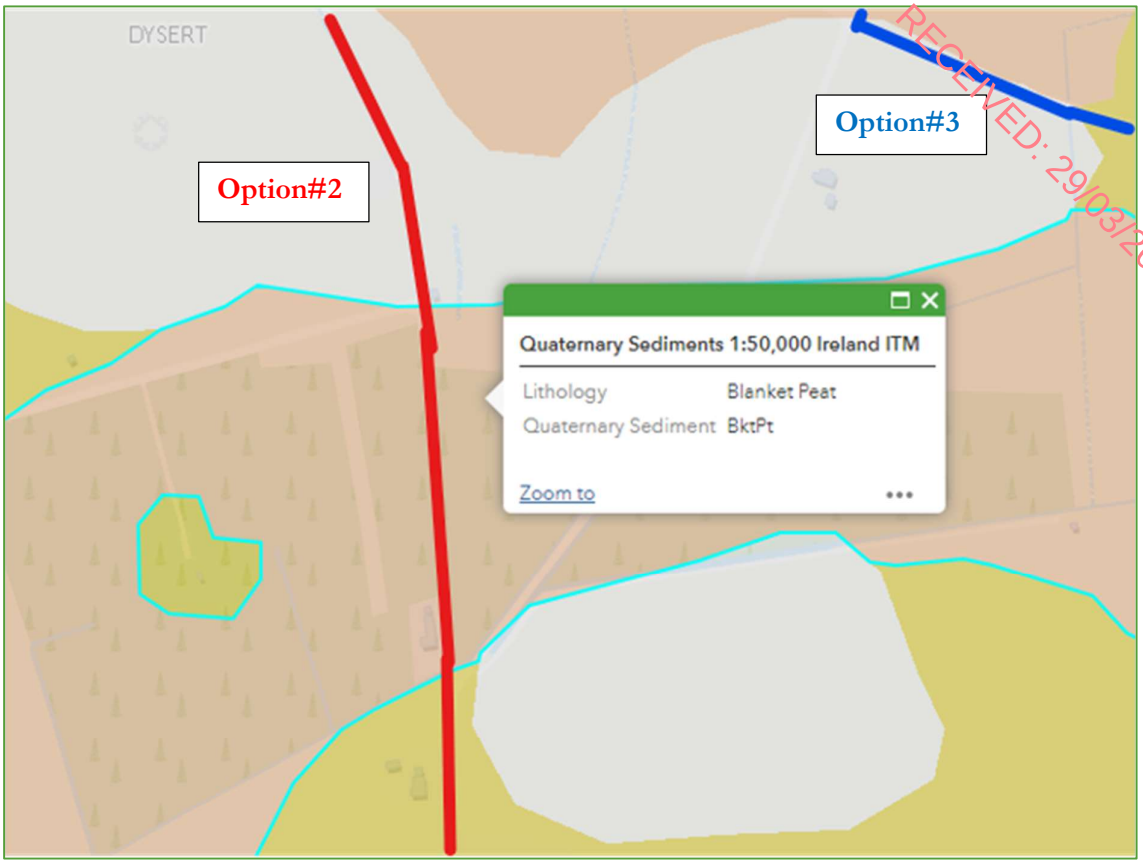


Image 3.2.1: Extract from GSI mapping where Option #2 traverses a small section of blanket peat

A hydrogeological assessment of these bog areas has been carried out and it has determined that bedrock is likely to be shallow and in the region of 0.0m – 3.0m below ground level. The areas of sporadic bog are always immediately adjacent to areas where lithology mapping indicates bedrock outcrop or subcrop. This would reinforce the assumption that bog is likely to be shallow in these sections.

A site inspection was carried out whereby the following elements were visually assessed only in an attempt to determine the formation type of the road i.e., solid or floating:

- Road conditions.
- Orientation of any surface cracks on the roads surface,
- Embankment strata (where possible).
- Finished floor level of any adjacent buildings; and
- Movement in road caused by passing traffic.

Based on the above assessment, it was assessed that the road is likely to be constructed to solid formation and therefore standard trench construction details could be used in these areas.

Should the existing road be floating and the depth of the bog in these areas be >2.0m, the trench design will likely involve the use of geotextiles to support the trench, with the geotextile anchored by the road build-up i.e., "top-hat" trench.

When specifying the use of a "top-hat" trench, it is imperative to note that constructing multiple "top hat" tranches in a single, narrow roadway will be difficult from a constructability point of view and potentially extremely costly.

3.3 Flood Risk

Flood maps (floodinfo.ie) were reviewed to determine the flood risk associated with each of the grid route options.

Where Option #2 transverses watercourse crossing #4 (WC#4), the grid route is within a zone of high probability flooding (1 in 10 year) for approximately 300m. Joint bays should not be located within this section of road.

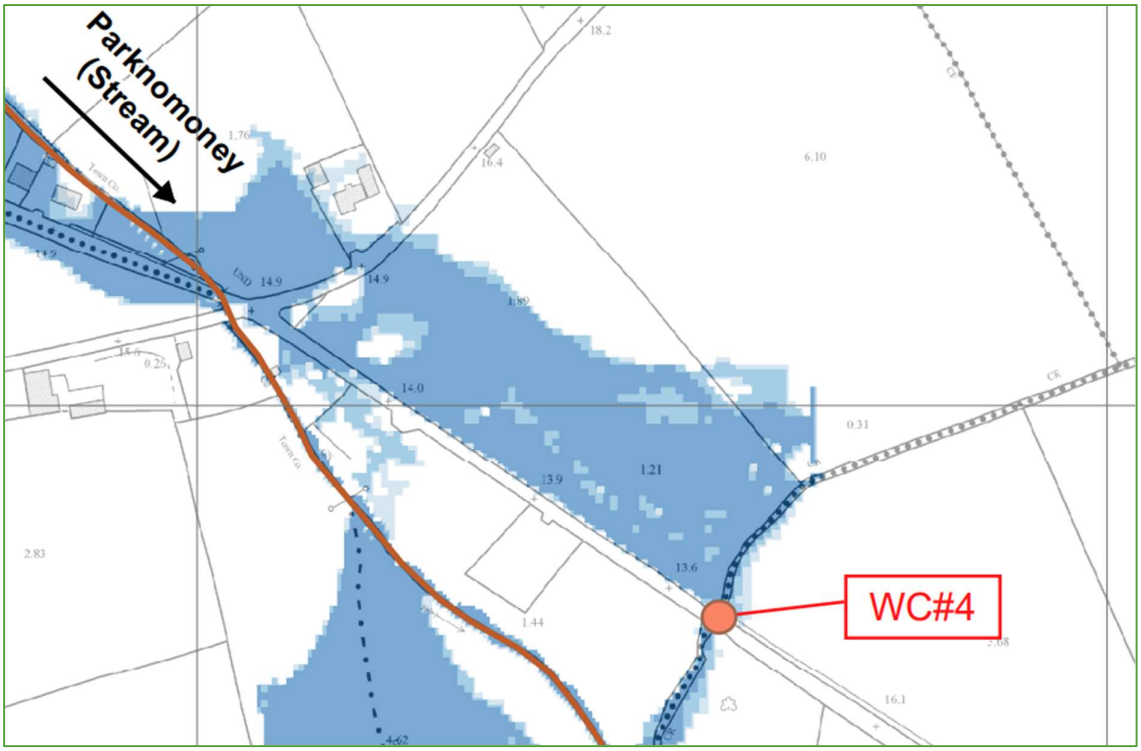


Image 3.3.1 – High probability flooding shown at WC#4.

Neither Option #1 nor Option #3 are located within any flooding extents for a low probability flood (1 in 1000 year) event.

Flood maps are included in Appendix C of this document.

The proposed grid routes will be an entirely underground infrastructure and constructed to tie-into existing ground levels. Therefore, the construction of these grid routes is highly unlikely to impact on an existing surface water runoff behaviour and also highly unlikely to directly cause any additional flooding.

3.4 Exiting Utilities

The below commentary is based on a preliminary desktop assessment of existing services along each of the proposed grid route options and shall be confirmed as part of the detailed design stage of the grid routes.

3.4.1 Gas

Gas Networks Ireland mapping was reviewed as part of this assessment and there were no gas mains indicated to be installed along any of the proposed routes.

3.4.2 Electricity

Overhead power lines were observed to be installed in front of all properties located along Option#1, Option#2 and Option#3.

There is an existing underground ESB cable running longitudinally with the N68 on the southern side of the carriageway. ESB records indicate that the existing cable at this location is part of the power distribution network and not a power supply line from an IPP source.

The voltage of this existing line will need to be determined before the appropriate crossing design can be determined (standard safety practice is to install the lower voltage line on top at a given crossing).

Extreme caution shall be taken at detailed design stage when designing the final grid route alignment. It was noted that there are a number of wind farms in the vicinity of Tullabrack Substation and Moneypoint Substation. The underground grid routes of these wind farms may not be recorded within the ESB's existing services drawing checked as part of this desktop study.

3.4.3 Watermain

Images 3.4.1 and 3.4.2 below illustrate the minimum separation distances for MV (20kV) and 38kV underground ducts.

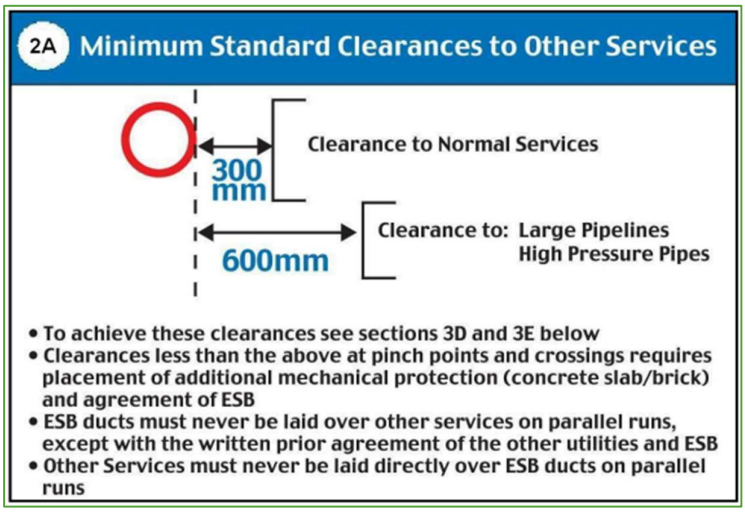


Image 3.4.1: Minimum MV separation distances.

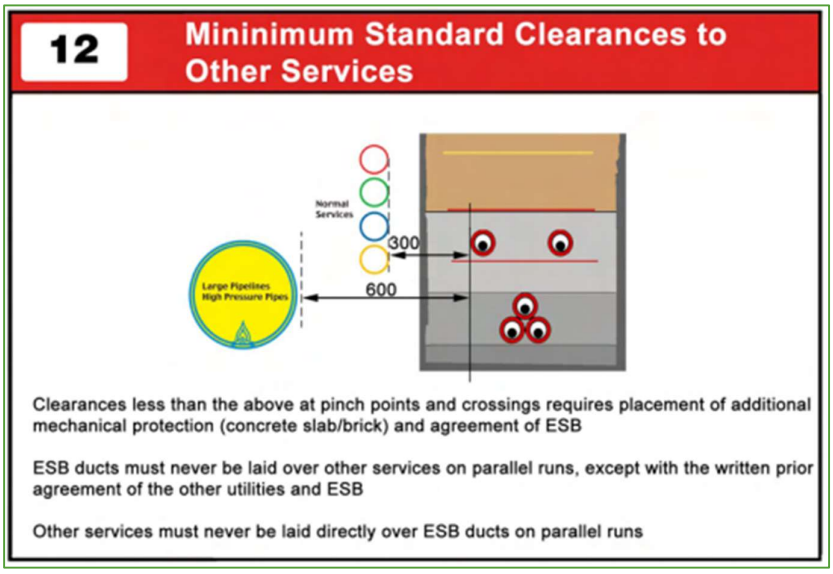
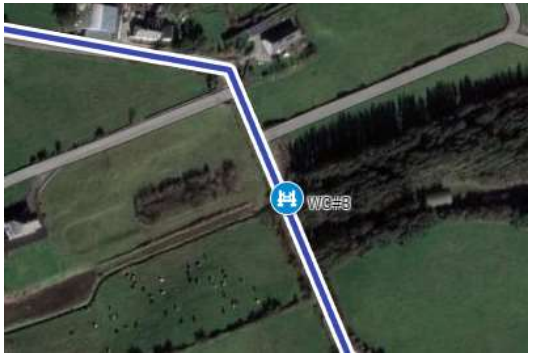
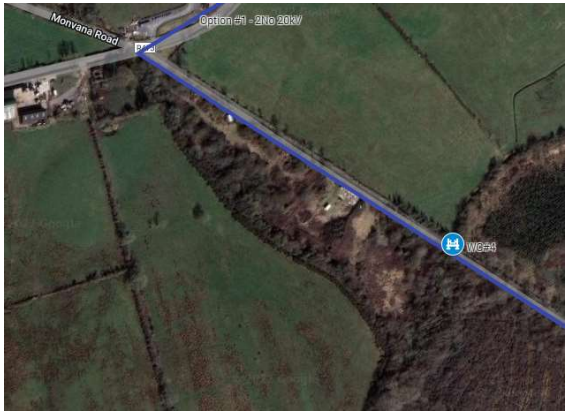


Image 3.4.2: Minimum 38kV separation distances.

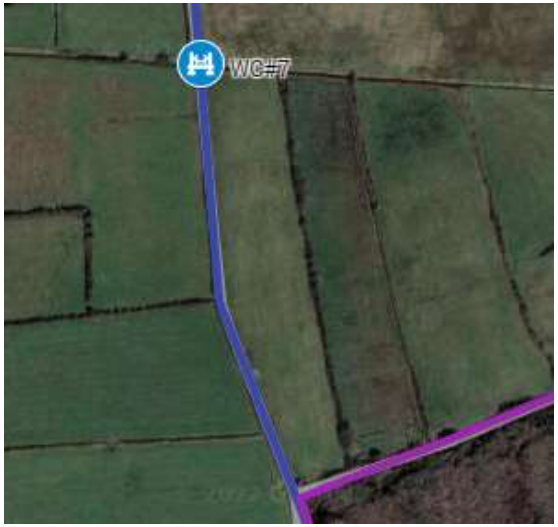
Based on the above, a watermain has the potential to require a separation distance of 600mm from any of the proposed grid route options. However, due to the observed absence of other underground services along any of the proposed grid routes, it is not envisaged that maintaining 600mm separation distance from an encountered high pressure watermain would pose significant problems at detailed design stage.

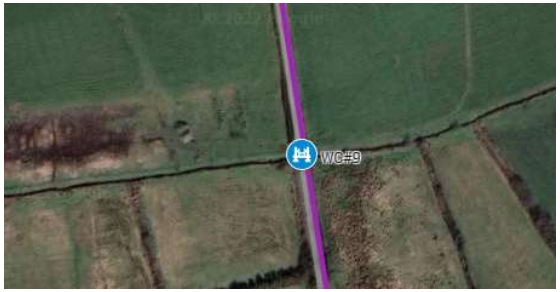
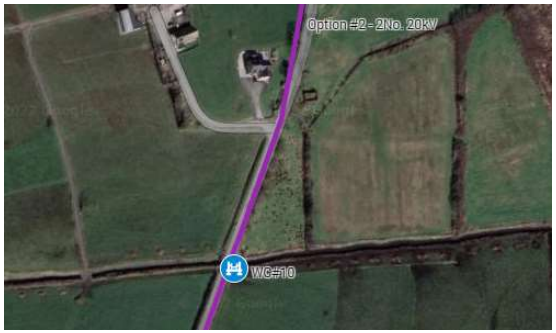
Appendix A – Watercourse Crossing Details

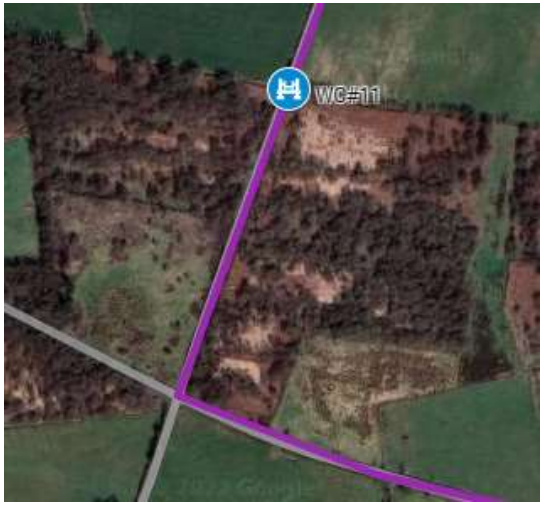
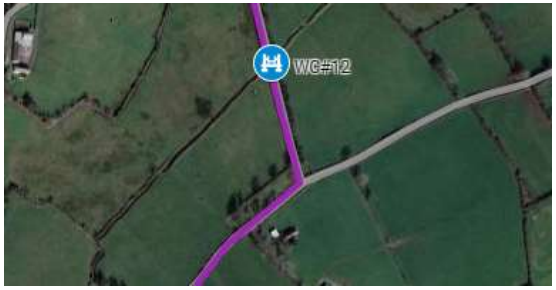
ID	Location	Streetview	Notes
WC#1			**Route:** Option #2 & Option #3 **Type:** Culvert **Cover:** 750mm **Ducts:** 2No. 125mm uPVC **Method:** Trench in verge. 525mm (W) x 225mm (H)
WC#2			**Route:** Option #2 & Option #3 **Type:** Bridge **Cover:** 370mm **Ducts:** 2No. 125mm uPVC **Method:** Trench in roadway. 525mm (W) x 225mm (H); or open crossing

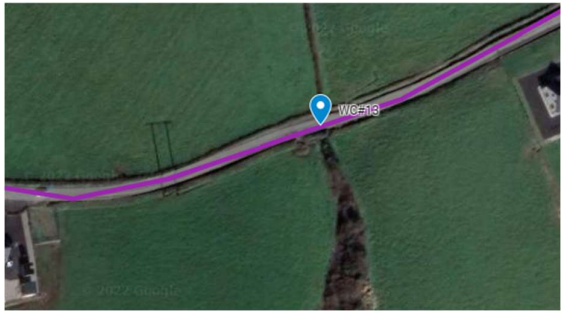
WC#3			**Route:** Option #2 & Option #3 **Type:** Culvert **Ducts:** 2No. 125mm uPVC **Method:** Trench in verge. 525mm (W) x 225mm (H)
WC#4			**Route:** Option #2 **Type:** Bridge **Cover:** 100mm **Ducts:** 2No. 125mm uPVC **Method:** Trench in roadway. 525mm (W) x 225mm (H); or open crossing

WC#5			**Route:** Option #2 **Type:** Culvert **Cover:** 800mm **Ducts:** 2No. 125mm uPVC **Method:** Trench in verge. 525mm (W) x 225mm (H)
WC#6			**Route:** Option #2 **Type:** Culvert **Cover:** 1200mm **Ducts:** 2No. 125mm uPVC **Method:** Trench in verge. 525mm (W) x 225mm (H)

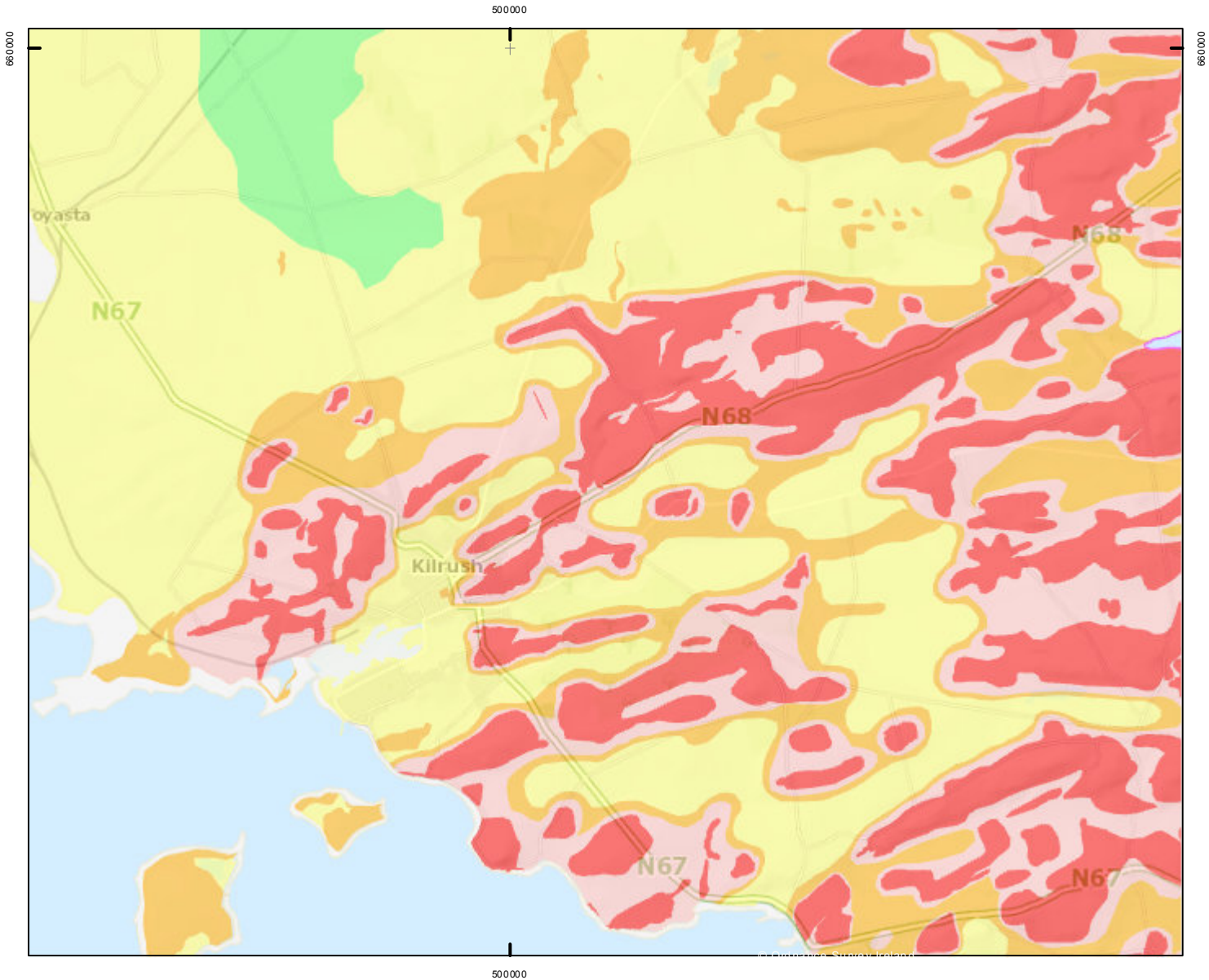
WC#7			**Route:** Option #2 **Type:** Culvert **Cover:** 1900mm **Ducts:** 2No. 125mm uPVC **Method:** Trench in verge. 525mm (W) x 225mm (H)
WC#8			**Route:** Option #3 **Type:** Bridge **Cover:** 350mm **Ducts:** 2No. 125mm uPVC **Method:** Trench in carriageway. 525mm (W) x 225mm (H). or open crossing

WC#9			**Route:** Option #3 **Type:** Culvert **Cover:** 800mm **Ducts:** 2No. 125mm uPVC **Method:** Trench in verge. 525mm (W) x 225mm (H)
WC#10			**Route:** Option #3 **Type:** Culvert **Cover:** 1500mm **Ducts:** 2No. 125mm uPVC **Method:** Trench in verge. 525mm (W) x 225mm (H)

WC#11			**Route:** Option #3 **Type:** Culvert **Cover:** 2200mm **Ducts:** 2No. 125mm uPVC **Method:** Trench in verge. 525mm (W) x 225mm (H)
WC#12			**Route:** Option #3 **Type:** Culvert **Cover:** 1300mm **Ducts:** 2No. 125mm uPVC **Method:** Trench in verge. 525mm (W) x 225mm (H)

WC#13			**Route:** Option #3 **Type:** Box Culvert **Cover:** 250mm **Ducts:** 2No. 125mm uPVC **Method:** Trench in verge. 525mm (W) x 225mm (H)
WC#14			**Route:** Option #2 & #3 **Type:** Culvert **Cover:** Unknown (discharge is beneath high tide level in bay) **Ducts:** 2No. 125mm uPVC **Method:** Trench in verge. 525mm (W) x 225mm (H)

Geological Survey Ireland Public Data



Legend

Groundwater Vulnerability

- Rock at or near Surface or Karst
- Extreme
- High
- Moderate
- Low
- Water

Scale: 1:54,308

Geological Survey Ireland

N W E S

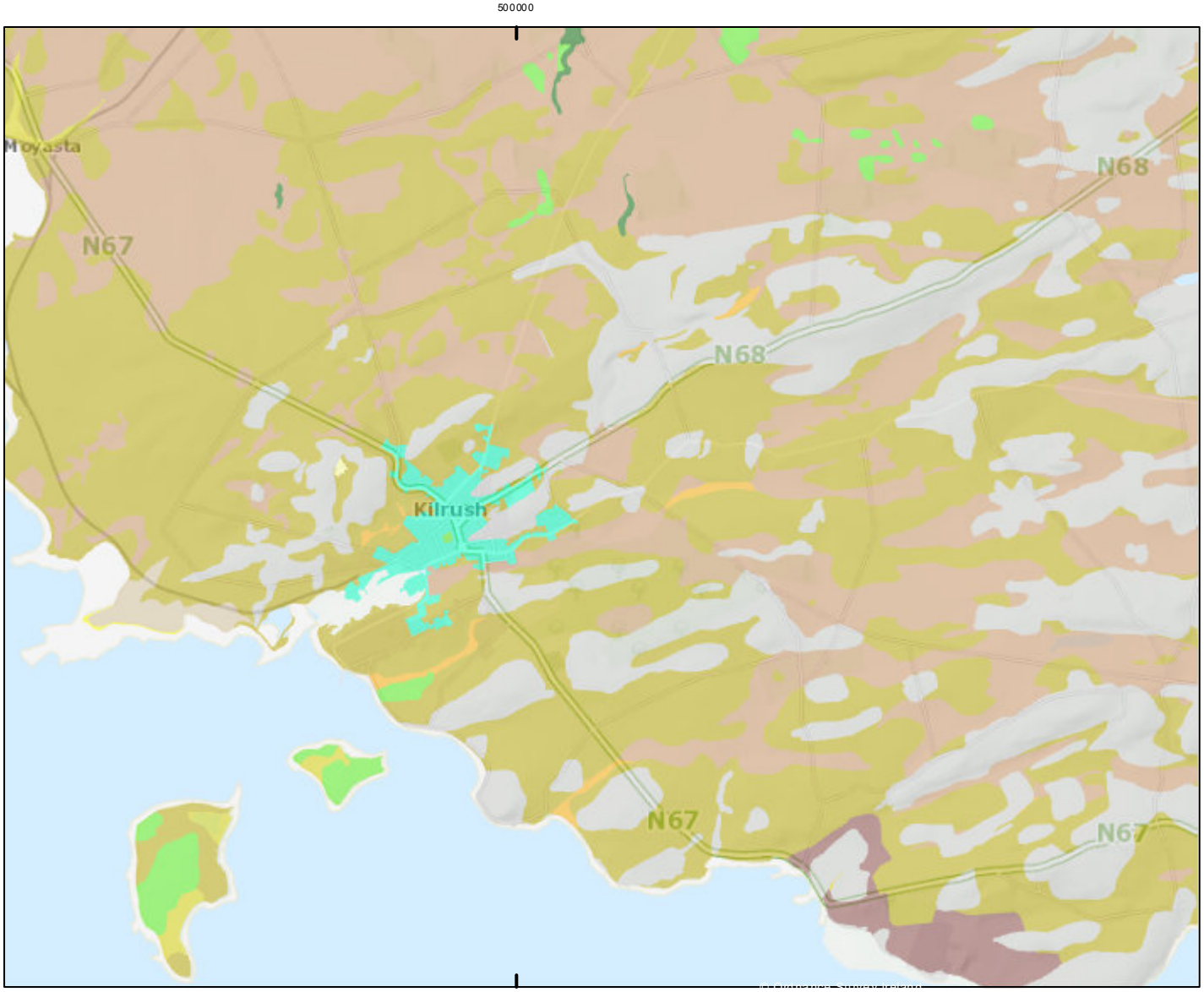
0 0.375 0.75 1.5 mi

0 0.5 1 2 km

Map Centre Coordinates (ITM) 500,833 656,081

22/10/2022, 12:14:55

Geological Survey Ireland Public Data



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Geological Survey Ireland

0 0.375 0.75 1.5 mi

0 0.5 1 2 km

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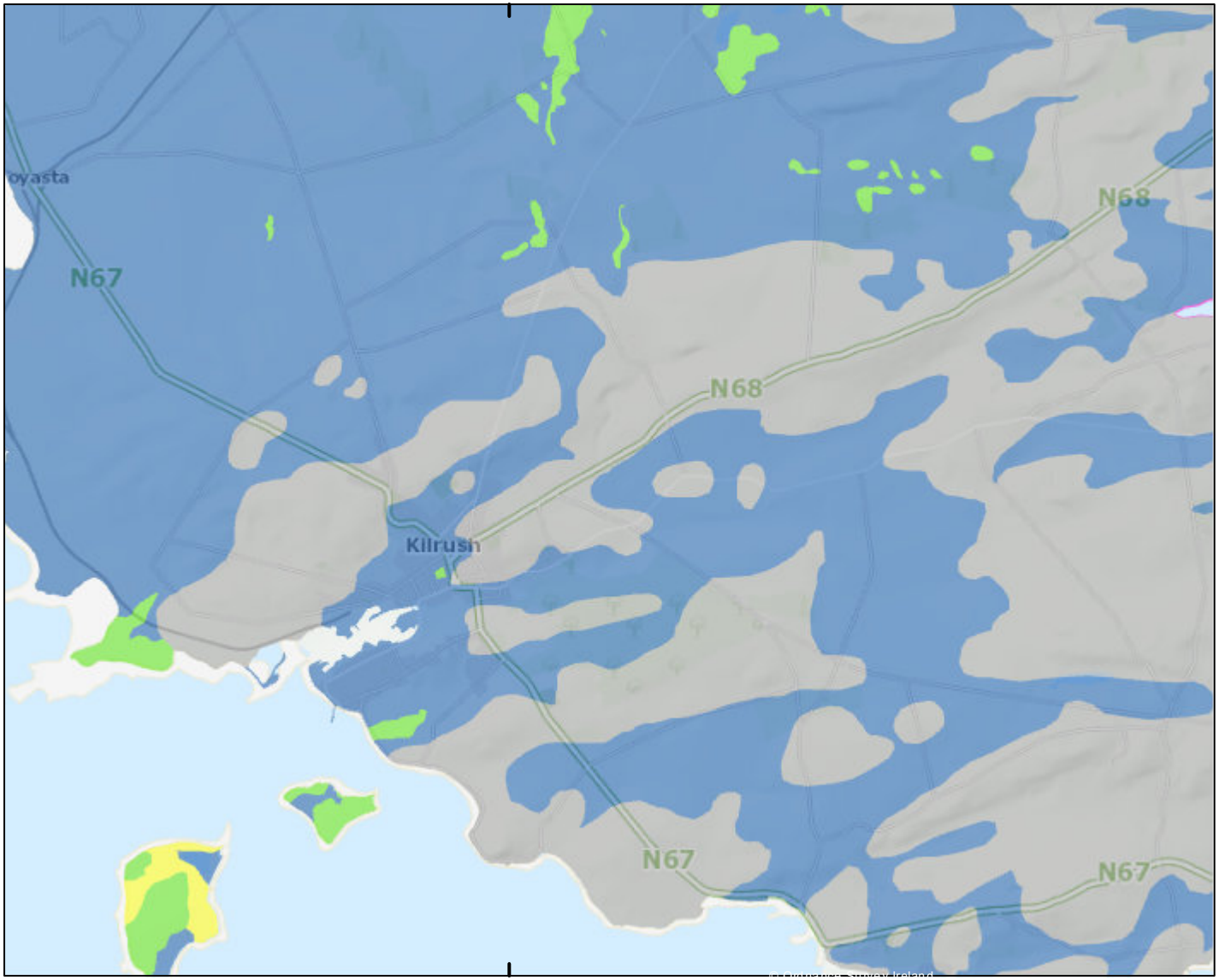
Legend

Geological Survey Ireland Public Data



Legend

Subsoil_Permeab...

- High
- Moderate
- Low
- Water
- Not mapped

Scale: 1:54,308

Geological Survey Ireland

0 0.375 0.75 1.5 mi

0 0.5 1 2 km

Map Centre Coordinates (ITM) 500,833 655,893

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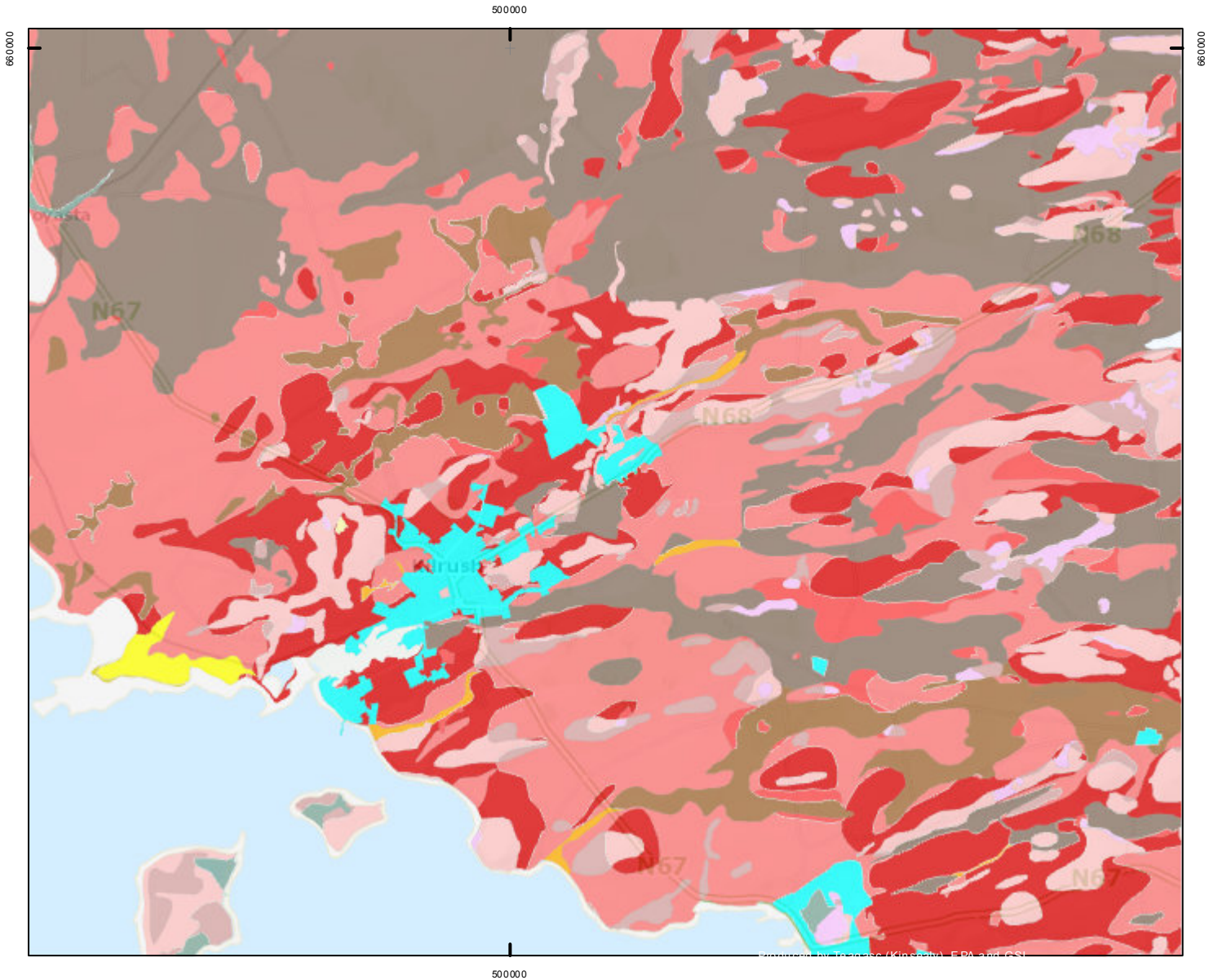
Geological Survey Ireland Public Data



Legend

TEAGASC_Soils_50K...

- AminDW - Deep well drained mineral (Mainly acidic)
- AminPD - Mineral poorly drained (Mainly acidic)
- AminPDPT - Peaty poorly drained mineral (Mainly acidic)
- AminSW - Shallow well drained mineral (Mainly acidic)
- AminSP - Shallow poorly drained mineral (Mainly acidic)
- AminSPPT - Shallow peaty poorly drained mineral (Mainly acidic)
- AminSRPT - Shallow, rocky, peaty/non-peatymi... complexes (Mainly acidic)
- BminDW - Deep well drained mineral (Mainly basic)
- BminPD - Mineral poorly drained (Mainly basic)
- BminPDPT - Peaty poorly drained mineral (Mainly basic)
- BminSW - Shallow well drained mineral (Mainly basic)
- BminSP - Shallow poorly drained mineral (Mainly basic)
- BminSPPT - Shallow peaty poorly drained mineral (Mainly basic)
- BminSRPT - Shallow, rocky, peaty/non-peatymi... complexes (Mainly basic)
- BktPt - Blanket peat
- FenPt - Fen peat
- RsPt - Raised Peat
- Cut - Cutover/cutaway peat
- AlluvMIN - Alluvial (mineral)
- AlluvMRL - Alluvial (marl)
- Lac - Lacustrine type soils
- Scree - Scree
- AeoUND - Aeolian undifferentiated
- MarSands - Marine sand and gravel
- MarSed - Marine/estuarine sediments
- Made - Made ground
- Water - Water
- Unclass

Scale: 1:54,308

Geological Survey Ireland

N W E S

0 0.375 0.75 1.5 mi

0 0.5 1 2 km

Map Centre Coordinates (ITM) 500,833 656,081

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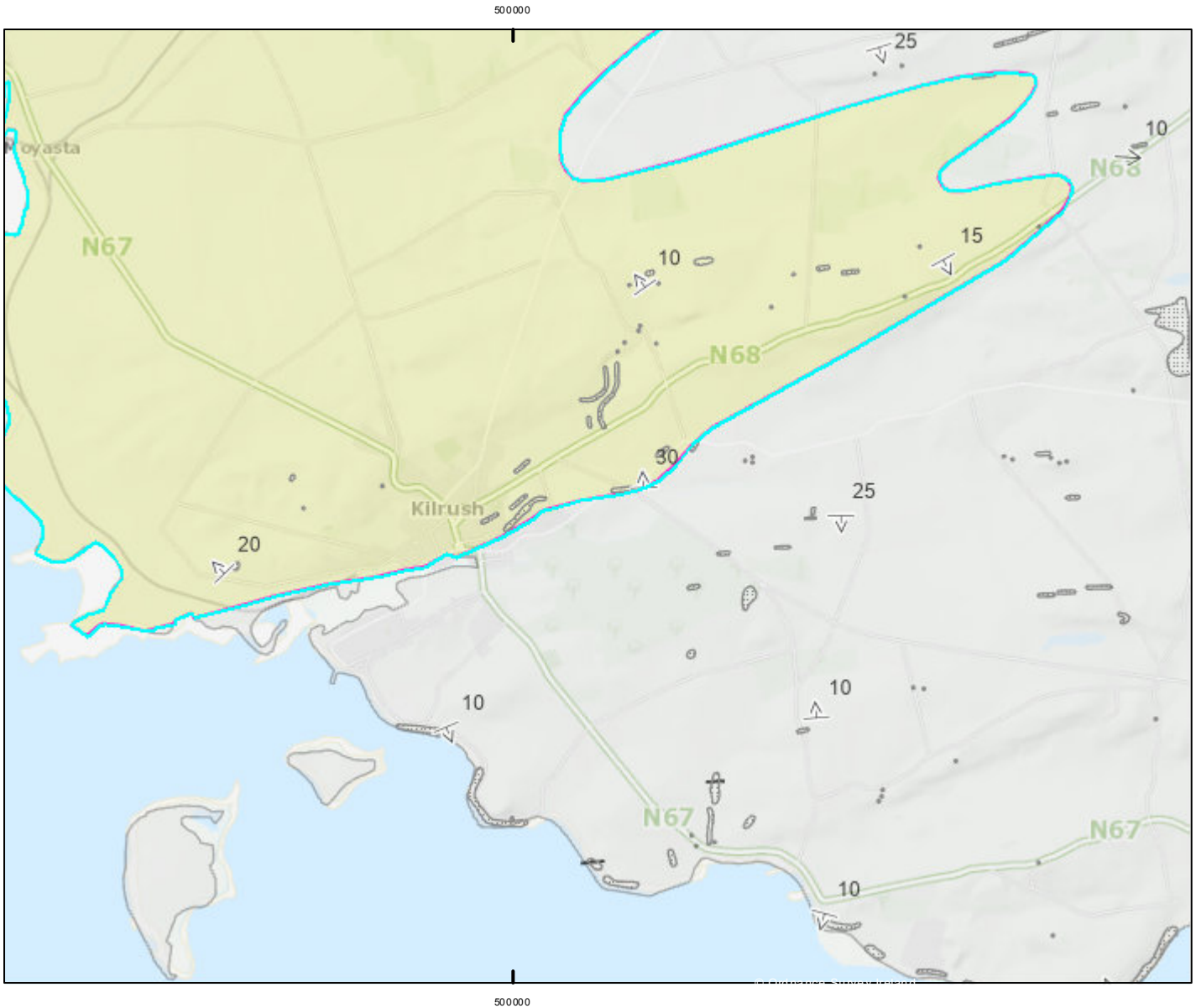
Appendix B – GSI Mapping

Geological Survey Ireland Public Data



Scale: 1:54,308

Geological Survey Ireland

N W E S

0 0.375 0.75 1.5 mi

0 0.5 1 2 km

Map Centre Coordinates (ITM) 500,726 655,453

21/10/2022, 16:49:24

Legend

Structural Symbols 100K ITM 2018

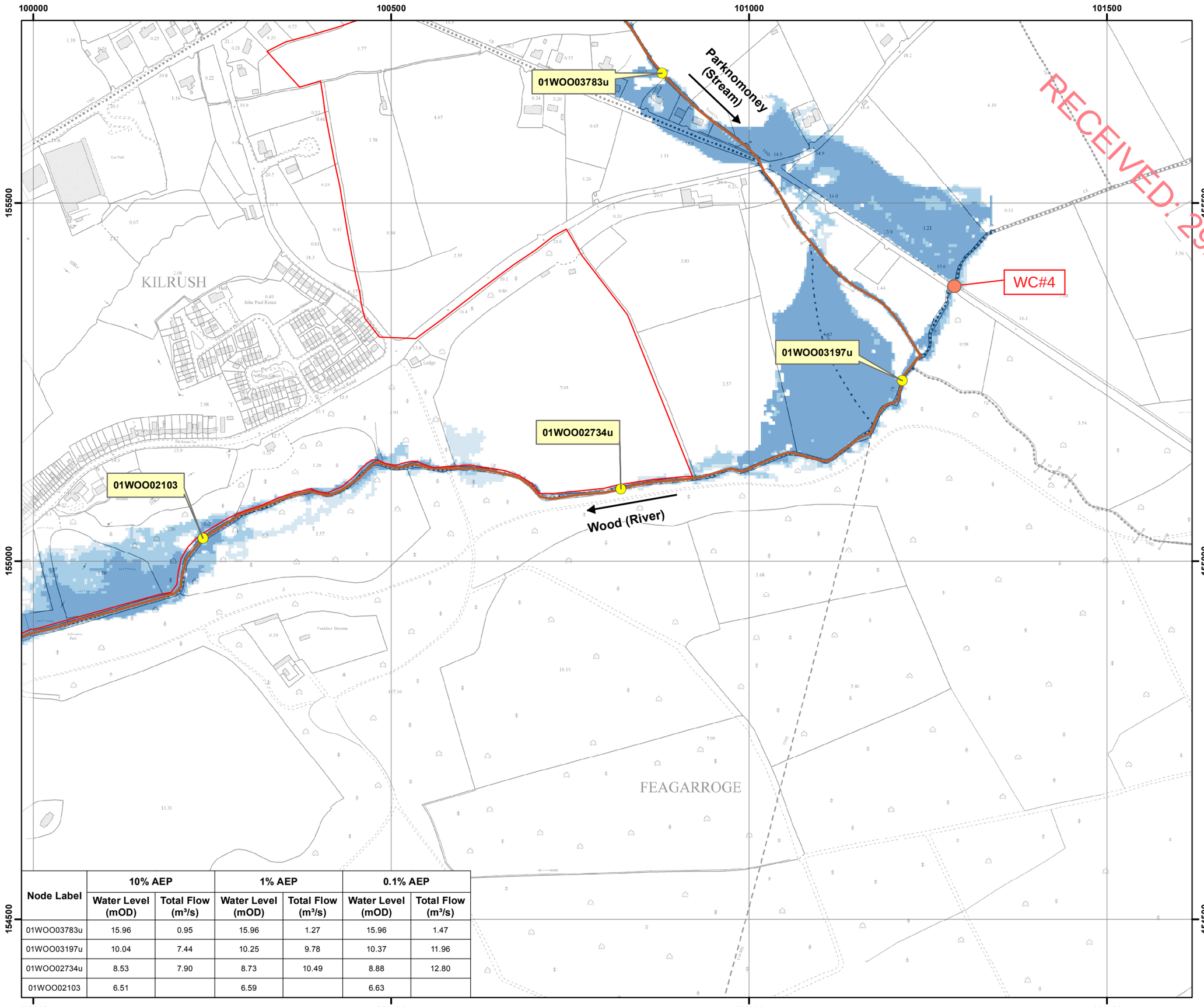
- Dip of bedding or main foliation, old GSI data
- First foliation parallel to bedding
- Foliation trend, Thorr and Rosses Granites
- Horizontal Bedding
- Strike and dip of bedding, right way up
- Strike and dip of bedding, way up unknown
- Strike and dip of first foliation
- Strike and dip of overturned bedding
- Strike and dip of second foliation
- Strike and dip of third foliation
- Strike and plunge of first generation fold axis
- Strike and plunge of second generation fold axis
- Strike and plunge of third generation fold axis
- Strike of vertical bedding/foliation
- Strike of vertical first foliation
- <all other values>

- Bedrock Outcrops 100 ITM 2018

Bedrock Linework 100k ITM 2018

- Anticlinal Axis
- Antiformal axis
- Aquifer Boundary
- Area
- Coal seam
- Dyke
- Fault
- Ghost Line
- Goniatite marine band (R1-R4)
- Lithological boundary offshore
- Metadolerite sheet, mainly sills
- Paleogene/ Tertiary Dyke
- Synclinal Axis
- Synformal axis
- Tectonic Slide, barbs on hanging-wall
- Thin stratigraphical unit, diagrammatic
- Thrust, barbs on hanging-wall side
- Tuff band
- Unconformity, dots on younger side
- X-Section

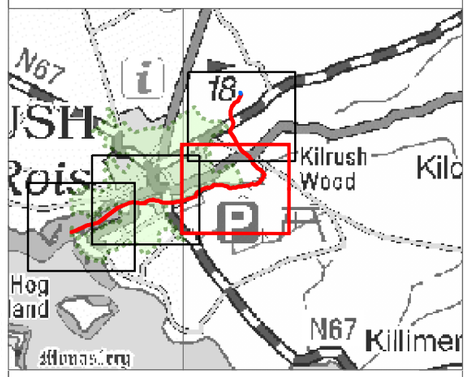
Appendix C – Flood Maps



Node Label	10% AEP		1% AEP		0.1% AEP	
	Water Level (mOD)	Total Flow (m³/s)	Water Level (mOD)	Total Flow (m³/s)	Water Level (mOD)	Total Flow (m³/s)
01WOO03783u	15.96	0.95	15.96	1.27	15.96	1.47
01WOO03197u	10.04	7.44	10.25	9.78	10.37	11.96
01WOO02734u	8.53	7.90	8.73	10.49	8.88	12.80
01WOO02103	6.51		6.59		6.63	

0 50 100 200 300 400 500 Meters

Location Plan:



Legend:

- Nodes
- Model Reach
- AFA Boundary
- Defence: Wall
- Defence: Embankment
- Defended Area

10% AEP Fluvial Flood Extent
(1 in 10 chance in any given year)

1% AEP Fluvial Flood Extent
(1 in 100 chance in any given year)

0.1% AEP Fluvial Flood Extent
(1 in 1000 chance in any given year)

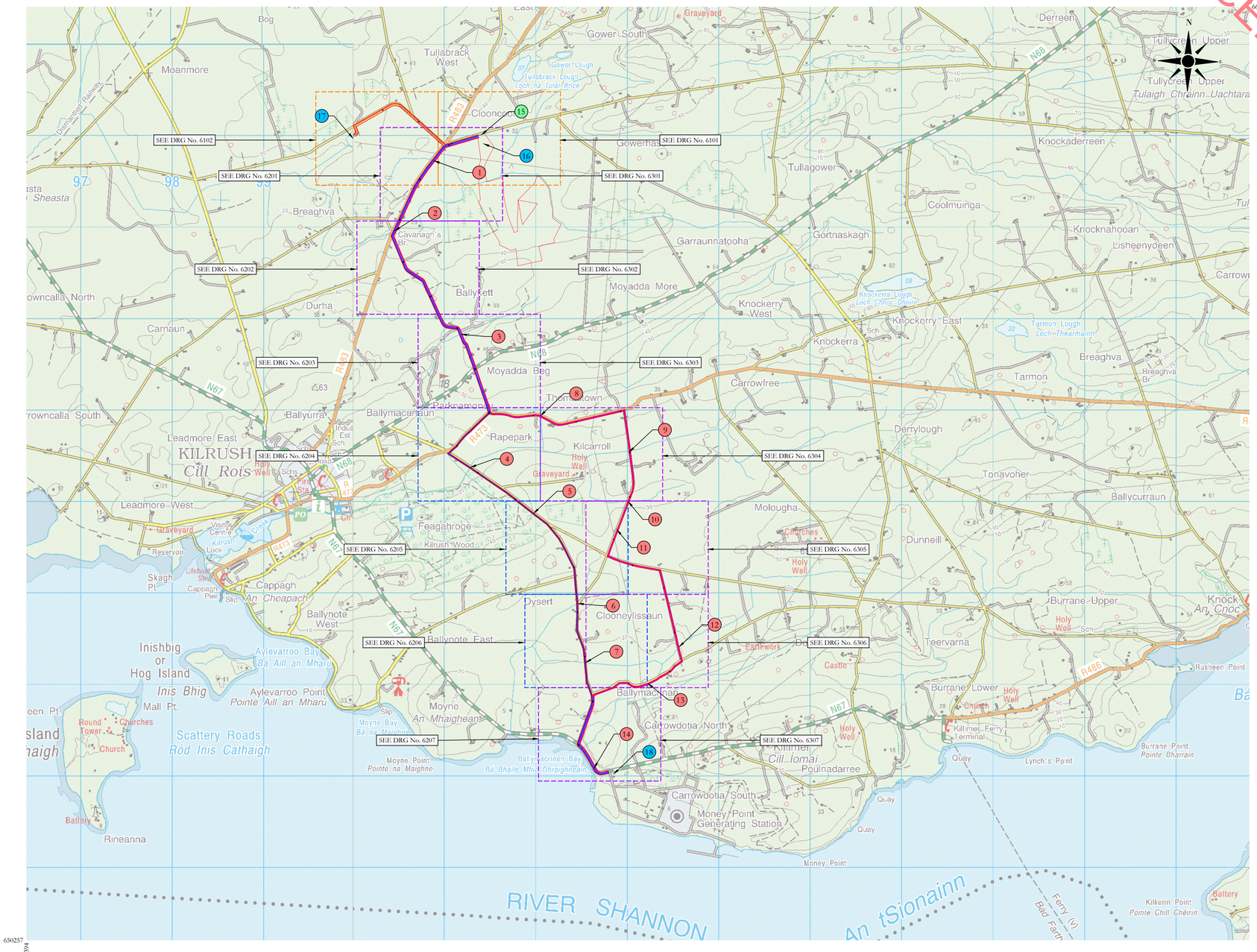
IMPORTANT USER NOTE:
THE VIEWER OF THIS MAP SHOULD REFER TO THE DISCLAIMER, GUIDANCE NOTES AND CONDITIONS OF USE THAT ACCOMPANY THIS MAP.

The Office of Public Works
Jonathan Swift Street
Trim
Co. Meath
C15 NX36

Merrion House
Merrion Road
Dublin 4
D04 R2C5

Project:		SHANNON CFRAM STUDY
Map Type:		EXTENT
Source:		FLUVIAL
Area:		KILRUSH
Scenario:		EXISTING
Drawn by:	GH	Date: JUNE 2016
Checked by:	AC	Date: JUNE 2016
Reviewed by:	MC	Date: JUNE 2016
Approved by:	PS	Date: JUNE 2016
Map Number:		S27KIH_EXFCD_F1_02
Sheet: 2 of 4		Revision: 0
Map Scale: 1: 5,000		Plot Scale: 1:1 @ A3

Appendix D – Site Location Map



GENERAL NOTES

KEYED NOTES

1. WATERCROSSING #1
2. WATERCROSSING #2
3. WATERCROSSING #3
4. WATERCROSSING #4
5. WATERCROSSING #5
6. WATERCROSSING #6
7. WATERCROSSING #7
8. WATERCROSSING #8
9. WATERCROSSING #9
10. WATERCROSSING #10
11. WATERCROSSING #11
12. WATERCROSSING #12
13. WATERCROSSING #13
14. WATERCROSSING#14
15. SITE ENTRANCE
16. BALLYKETT WIND FARM SUBSTATION
17. TULLABRACK SUBSTATION
18. MONEYPOINT SUBSTATION

LEGEND

- GRID ROUTE OPTION 1 - 38kV
- GRID ROUTE OPTION 2 - 20kV
- GRID ROUTE OPTION 3 - 20kV
- SITE BOUNDARY

Rev	Description	Date
P4	ADDED WC#14	08/05/23
P3	GENERAL REVISION	28/03/23
P2	REVISED ROUTE OPTION NAMES	17/02/23
P1	FIRST ISSUE	17/11/22

Suitability Status:
PLANNING

Client:
GREENSOURCE SUSTAINABLE DEVELOPMENTS

Job Title:
BALLYKETT WIND FARM

Drawing Title:
GRID CONNECTION ROUTE
SITE LOCATION

Originator:	Drawn by:	Checked by:	Scale:	Date:	Sheet:
BFA	M.B.	B.F.	1:25000	09/11/22	A1

bfa consulting

Dwg No:	Rev:
22006-BFA-XX-XX-DR-C-6001	P4