

August Report -

**PEAT SLIDE EMERGENCY RESPONSE PLAN
FOR RIVERS AT RISK FROM PEAT FAILURE
AS A RESULT OF TREE FELLING OPERATIONS**

GARVAGH GLEBE WIND FARM

Prepared for:

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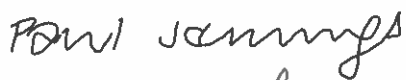
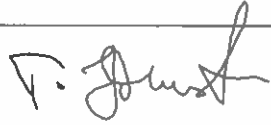

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1 INTRODUCTION

The purpose of this report is to identify the risk to rivers in the vicinity of the Garvagh Glebe North and South sites from peat failure as a result of tree felling operations and to provide mitigation measures in the form of a peat slide emergency response plan.

This report includes the following:

- (1) Identification of rivers at potential risk
- (2) Risk assessment
- (3) Mitigation measures – peat slide emergency response plan

2 RIVERS AT POTENTIAL RISK

The rivers and associated tributaries that may be affected by a peat failure are shown in Appendix A on drawing nos. P378021-F023-014-D-0051 and 052. (Note zones given in drawings relate to the emergency response plan and not the QRA zones.)

For the Garvagh Glebe North site the following rivers and associated tributaries are given:

- Owengar River. This drains the eastern and northeastern part of the site. There are 7 tributaries rising near the site. From the headwaters to where the river enters Lough Allen the estimated river length is 10km.
- Arigna River. This drains the southern part of the site. There is 1 tributary that rises near the site. The tributary flows for about 2km before its confluence with the main river. From the confluence to where the main river enters Lough Allen the estimated river length is 20km.
- Bonet River. This drains the northwestern and western parts of the site. There are 3 tributaries that rise near the site. The tributaries converge after about 2.5km at a location upstream of the public road crossing approx 1 km SW of Killavoggy Bridge. After about a further 10km the combined tributary river enters the main river before flowing into Lough Gill. From the headwaters to where the river enters Lough Gill the estimated river length is 19km.

For the Garvagh Glebe South site the following rivers and associated tributaries are given:

- Owengar River. This drains the northern part of the site. There are 2 tributaries rising near the site. From the headwaters to where the river enters Lough Allen the estimated river length is 10km.
- Arigna River. This drains the southern part of the site. There is 1 tributary that rises near the site, and the main river also passes downslope of the site. The tributary flows for less than 1km before its confluence with the main river. From the confluence to where the main river enters Lough Allen the estimated river length is 19km.

3 RISK ASSESSMENT

3.1 Methodology for Risk Assessment

A risk assessment with respect to peat failure as a result of tree felling has been carried out for the rivers in the vicinity of the proposed wind farm development. This approach follows the guidelines for geotechnical risk management as given in Clayton (2001).

The risk assessment uses the results of the QRA score obtained from AGECE report entitled *Report on Quantitative Risk Assessment of Peat Stability During Tree Felling - Garvagh Glebe Wind Farm* dated July 2009.

3.2 Probability

The likelihood of a hazard (peat failure) occurring has been based on the results of the QRA score. The probability assigned to the QRA score is judged on a qualitative scale (Table 1).

Table 1 Probability Scales

Scale	Risk Rating Without Construction Impact or Appropriate Mitigation Measures	Risk Score	Probability of Failure
1	Not Applicable	< 40 %	Least
2	Negligible	40-50 %	
3	Low	51-60 %	
4	Possible	61-70 %	
5	Very Possible	71-75 %	
6	Likely depending on construction impacts and without appropriate mitigation measures	>75 %	Greatest

3.3 Impact

The severity of the risk posed to nearby rivers is assessed qualitatively in terms of impact. The impact of a peat failure on the river environment within and beyond the immediate wind farm site is assessed based on the potential travel distance of a peat failure. Where a peat failure enters a water course it can travel a considerable distance downstream. Therefore the proximity of a potential peat failure to a river is a significant indicator of the likely potential impact.

The risk is determined based on the combination of hazard and impact. A qualitative scale has been derived for the impact of the hazard based on distance of tree felling to a river (Table 2).

The location of rivers is based on topographic maps and supplemented by site observations from walkover survey.

Table 2 Impact Scale

Scale	Criteria	Impact
1	Proposed tree felling greater than 300m from river	Negligible/None
2	Proposed tree felling within 201 to 301m from river	Low
3	Proposed tree felling within 101 to 200m from river	Medium
4	Proposed tree felling within 100m from river	High

3.4 Risk Rating

The degree of risk is determined as the product of probability (P) and impact (I), which gives the Risk Rating (R) as follows:

The Risk Rating is calculated from: $R = P \times I$

The Risk Rating can range from 1 to 20 as shown in Table 3.

Table 3 Risk Rating

		Probability (P)					
		1	2	3	4	5	6
Impact (I)	4	4	8	12	16	20	24
	3	3	6	9	12	15	18
	2	2	4	6	8	10	12
	1	1	2	3	4	5	6

Risk Rating & Control Measures	
17 to 24	Unacceptable: re-location or significant control measures required
10 to 16	Substantial: notable control measures required
5 to 9	Tolerable: only routine control measures required
1 to 4	Trivial: none or only routine control measures required

Note. Where any individual probability is 6 then this defaults to an 'Unacceptable' risk rating irrespective of the impact.

In many cases a simple 4- to 5-level scale is considered sufficient (Clayton, 2001); in this case a 4-level risk scale is used.

Control measures are required to reduce the risk to at least a 'Tolerable' risk rating.

The risk rating is determined for rivers rising in or near the site that may be affected by a potential peat failure as result of tree felling.

3.5 Risk to Rivers

Table 4 shows the calculated risk (R) for the individual rivers for the Garvagh Glebe North and South sites. It is noted that a river may be affected by several zones where tree felling is proposed; therefore the risk for each zone is calculated.

The maximum risk for each river is given as R_{max} . R_{max} will determine the level of mitigation required. R_{max} ranges from nil to 16.

Table 4 Rivers and Risk Rating (R)

Garvagh Glebe North								
Main River	Tributary Reference	QRA Zone	Distance to Tree Felling (m)	P	I	R	Rmax	
Owengar River	1	6	None	4	None	Nil	Nil	
	2	9	None	4	None	Nil	Nil	
	3	4	150	4	3	12	12	
	4	2	<50	3	4	12	16	
		4	<50	4	4	16		
		5	150	4	3	12		
		9	100	4	4	16		
5	1	<10	3	4	12	16		
	2	100	3	4	12			
	5	<10	4	4	16			
6	5a	100	4	4	16	16		
7	5a	<10	4	4	16	16		
Arigna River	1	1	220	3	2	6	12	
		2	220	3	2	6		
		3	300	3	2	6		
		8	<10	3	4	12		
Bonet River	1	3	150 say	3	3	9	16	
		6	<10	4	4	16		
2	3	3	450	3	1	3	16	
		7	<10	4	4	16		
3	3	3	420	3	1	3	12	
		7	150	4	3	12		
		8	80	3	4	12		
Garvagh Glebe South								
Main River	Tributary Reference	Zone	Approximate Distance to Tree Felling (m)	P	I	R	Rmax	
Owengar River	7	1	<100	4	4	16	16	
		8	1	250	3	2	6	12
			2	180	3	3	9	
2	3	3	<10	3	4	12		
		1	<10	3	4	12	12	
			2	<10	3	4		12
3	2	2	450	3	1	3	3	
		3	450	3	1	3		

Notes:

- (1) 'None' means that should there be a failure within the tree felling area then the travel direction of the failure is such that it will not enter the river.
- (2) Approximate distance to streams is based on extent of stream shown on plan and field observations. Given that the location of some stream headwaters is not well defined some distances have been estimated based on best judgment.

4 MITIGATION MEASURES - PEAT SLIDE EMERGENCY RESPONSE PLAN

A summary of the maximum calculated risk (R_{max}) for each river is given in Table 5 together with mitigation measures to be included as part of the emergency response plan.

In the unlikely event of a peat failure and as part of the emergency response measures it is intended to provide barrages at accessible locations on all rivers, that is the Owengar, Arigna and Bonet River as follows:

- The Owengar River already has existing barrages erected following the previous failure in 2008. Several other areas have been identified where barrages can be readily constructed where tributaries pass below public roads.
- On the Arigna River a barrage is proposed to be located to the west of the Garvagh Glebe North site. At this location there is sufficient space to store peat debris. A further barrage can be constructed to the northwest of the Garvagh Glebe South site, where the tributary river passes under a public road.
- The Bonet River tributaries converge upstream of the public road crossing approx 1 km SW of Killavoggy Bridge; it is proposed to locate a barrage downstream of the public road. At this location there is sufficient space to store peat debris. An additional barrage and peat storage area is proposed for the northern tributary of the Bonet River.

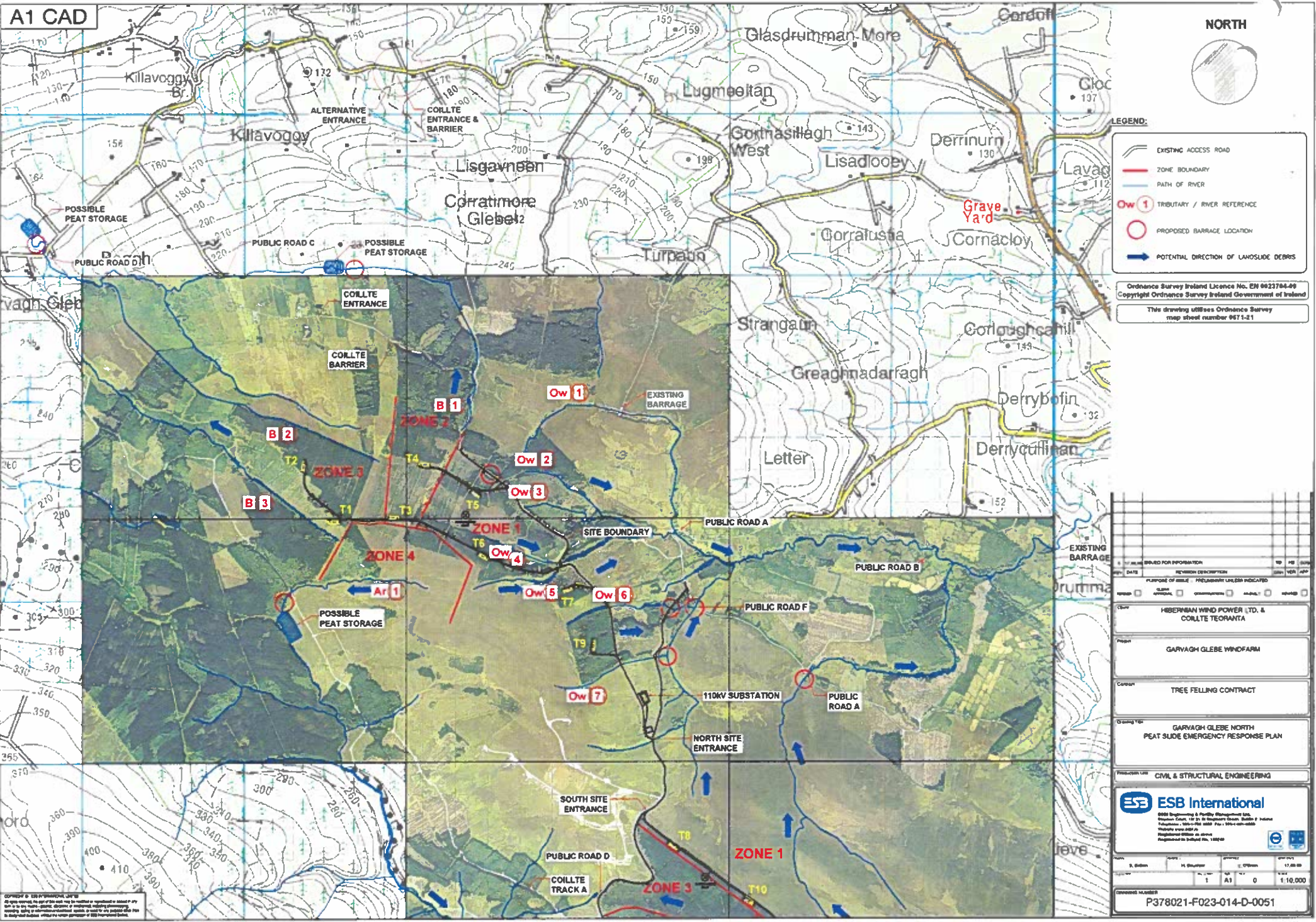
Details of location and implementation of mitigation measures is given on drawings in Appendix A and the Emergency Response Plans for Garvagh Glebe North and South in Appendix B.

Note that mitigation measures to reduce the risk of peat failure as result of tree felling operation are included in AGECE report entitled *Report on Quantitative Risk Assessment of Peat Stability During Tree Felling - Garvagh Glebe Wind Farm* dated July 2009.

Table 5 Rivers and Mitigation Measures

Garvagh Glebe North					
Main River	Tributary Reference	Rmax	Mitigation Measures Required	Mitigation Measures	
Owengar River	1	Nil	No	Refer to drawing no. P378021-F023-014-D-0051	
	2	Nil	No		
	3	12	Yes		
	4	16	Yes		
	5	16	Yes		
	6	16	Yes		
	7	16	Yes		
Arigna River	1	12	Yes		
Bonet River	1	16	Yes		
	2	16	Yes		
	3	12	Yes		
Garvagh Glebe South					
Main River	Tributary Reference	Rmax	Mitigation Measures Required		Mitigation Measures
Owengar River	7	16	Yes	Refer to drawing no. P378021-F023-014-D-0052	
	8	12	Yes		
Arigna River	2	12	Yes		
	3	3	No		

APPENDIX A



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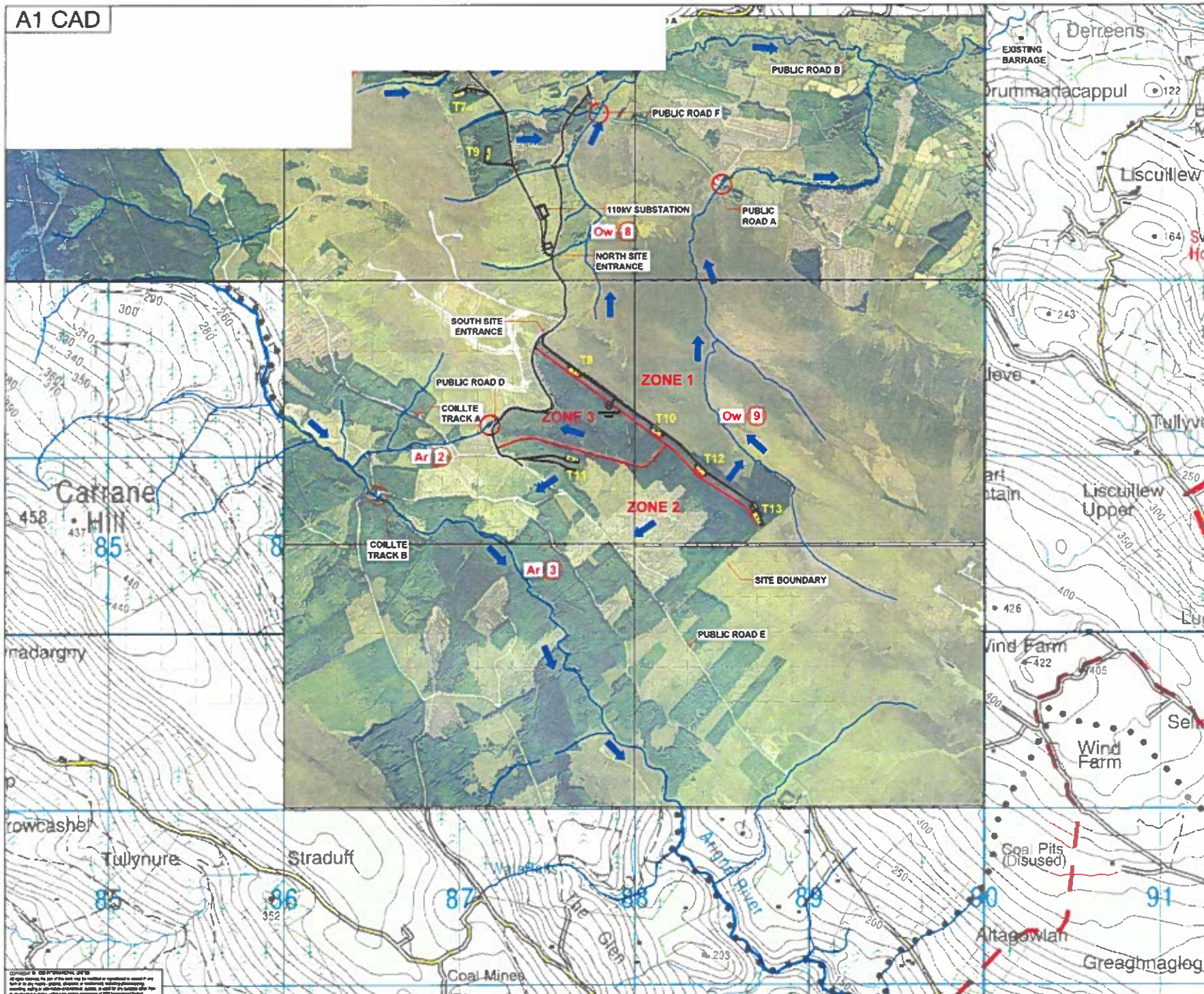
NORTH

- LEGEND:
- EXISTING ACCESS ROAD
 - ZONE BOUNDARY
 - PATH OF RIVER
 - TRIBUTARY / RIVER REFERENCE
 - PROPOSED BARRAGE LOCATION
 - POTENTIAL DIRECTION OF LAHOSLIDE DEBRIS

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DATE	REVISION DESCRIPTION	TD	HD	APP
PURPOSE OF ISSUE: PRELIMINARY (UNLESS INDICATED)				
Client:	HIBERNIAN WIND POWER LTD. & COLLITE TEORANTA			
Project:	GARVAGH GLEBE WINDFARM			
Contract:	TREE FELLING CONTRACT			
Drawing No.:	GARVAGH GLEBE NORTH PEAT SLIDE EMERGENCY RESPONSE PLAN			
Discipline:	CIVIL & STRUCTURAL ENGINEERING			
ESB International 6000 Engineering & Facility Management Ltd. Corporate Centre, 100 St. Stephens Green, Dublin 2, Ireland Telephone: +353 (0)1 4088 1000 Fax: +353 (0)1 4088 1001 Website: www.esb.ie Registered Office as above Registered in Ireland No. 10000				
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Project No.:	P378021-F023-014-D-0051	Revision:	0	

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- LEGEND:**
- EXISTING ACCESS ROAD
 - ZONE BOUNDARY
 - PATH OF RIVER
 - Ow 1 TRIBUTARY / RIVER REFERENCE
 - PROPOSED BARRAGE LOCATION
 - POTENTIAL DIRECTION OF LANDSLIDE DEBRIS

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1		PURPOSE OF DRAWING - PRELIMINARY LIAISON INDICATED			

CLIENT: HIBERNIAN WIND POWER LTD. & COLLTE TEORANTA

PROJECT: GARVAGH GLEBE WINDFARM

CONTRACT: TREE FELLING CONTRACT

DRAWING NO.: GARVAGH GLEBE SOUTH PEAT SLIDE EMERGENCY PLAN

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APPENDIX B

Emergency Response (Peat Slide)

Garvagh Glebe North

Drawing P378021-F023-014-D-0051 shows Zones, the location of the Turbines, the likely direction of movement of peat in the event of a peat slide occurring, the watercourses that will be affected and the locations of barrages built in the area to contain previous peat slides for the Garvagh Glebe North site.

In the event of a peat slide, the priority is to ensure that there is no injury caused to construction workers onsite, local people living or using roads in the area and that pollution of nearby watercourses does not occur. The following steps are to be taken in response to a peat slide occurring.

Emergency Actions

1. Whoever discovers the peat slide - immediately contact the Site Manager.
2. Secure local roads in the area at the required locations to ensure that local traffic cannot move into the path of the slide.

Zone 1 – Public Road A and B

Zone 2 – Public Road C and D

Zone 3 – Public Road D

3. Account for all personnel working in the area – ESBI Safety Officer.
4. Utilise all personnel on site to contain the peat slide as required.
5. Move any plant in the area of the peat slide to a safer area.
6. Track movement of the peat slide either by following on foot or by viewing from a highpoint –attempt to predict its path.
7. The Site Manager or his nominee alerts the following:-
 - Gardai 071-9648002**
 - Leitrim Co Co (Drumahare) Area Engineer, P Mc Shera 071-9164109**
 - ESBI Head Office 01-7038000 (J Connolly)**
8. Review Peat stability on site with the objective of constructing barrages in the path of the peat slide. (Ideally in a Narrow Valley with Plant Access close by and Flat Area for emergency repository)
9. Consider additional Barrage construction downstream of the peat slide.

Garvagh Glebe South

Drawing P378021-F023-014-D-0052 shows Zones, the location of the Turbines, the likely direction of movement of peat in the event of a peat slide occurring, the watercourses that will be affected and the locations of barrages built in the area to contain previous peat slides for the Garvagh Glebe South site.

In the event of a peat slide, the priority is to ensure that there is no injury caused to construction workers onsite, local people living or using roads in the area and that pollution of nearby watercourses does not occur. The following steps are to be taken in response to a peat slide occurring.

Emergency Actions

10. Whoever discovers the peat slide - immediately contact the Site Manager.
11. Secure local roads in the area at the required locations to ensure that local traffic cannot move into the path of the slide.

Zone 1 – Public Road A, B and F

Zone 2 – Between Public Road D and E

Zone 3 – Public Road D

12. Account for all personnel working in the area – ESBI Safety Officer.
13. Utilise all personnel on site to contain the peat slide as required.
14. Move any plant in the area of the peat slide to a safer area.
15. Track movement of the peat slide either by following on foot or by viewing from a highpoint –attempt to predict its path.
16. The Site Manager or his nominee alerts the following:-
 - Gardai 071-9648002**
 - Leitrim Co Co (Drumahare) Area Engineer, P Mc Shera 071-9164109**
 - ESBI Head Office 01-7038000 (J Connolly)**
17. Review Peat stability on site with the objective of constructing barrages in the path of the peat slide. (Ideally in a Narrow Valley with Plant Access close by and Flat Area for emergency repository)
18. Consider additional Barrage construction downstream of the peat slide.

Emergency Provisions to be In Place On Site

1. Maintain a minimum 3000 m³ Emergency Supply of shale at all times on site.
2. An off site Emergency Stockpile to be made available at short notice from Kerrigan's Quarries, Drumkeerin (about 6 miles from Garvagh Glebe site) Kerrigan Quarries will mobilise additional transport, if required.
3. Diesel Bowser will be always be available and fuelled up at the end of each working day.
4. A supply of 30m ropes/life buoys in plant engaged in active earthworks construction to aid the rescue and retrieval of persons at risk of entrapment or engulfment.
5. A trailer containing pallets, planks, ropes etc. will be on site so that in the event of a peat slide these could be transported immediately to an area if any personnel were to become engulfed / trapped.
6. Sufficient Mobile Tower Lighting available from November to February due to fewer hours of daylight. (servicing both site and public roads)
7. ESBI will have keys to all Coillte barriers / gates available.
8. A laminated copy of page 1 of the emergency plan and drawings P378021-F026-01-D-0051 & 0052 are placed in each excavator, truck, and jeep etc. working on the Garvagh Glebe site.
9. Emergency Drill to take place in order to familiarise site staff with plan.