Malachy Walsh and Partners
Engineering and Environmental Consultants

Request for Further Information
Response to Item 2
Carrownagowan Wind Farm (ABP-308799-20)

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Document prepared by	Michael Gill, HES Cormac Murphy, MWP Helen Burman-Roy, MWP
Document checked by	Helen Burman-Roy, MWP Ken Fitzgerald, MWP

Table of Contents

1 INTRODUCTION 1

1.1 Contributors to this Report 1

1.2 Item 2 of ABP letter 2

2 PEAT STABILITY RISK ASSESSMENT REVIEW 3

2.1 Potential Changes to Prevailing Surface Water Flow Patterns 3

2.2 PSRA Review 5

2.3 Climate Change Considerations 7

2.4 Firebreak and Hydrological Links 7

3 OTHER ISSUES RAISED BY THE DEPARTMENT 9

3.1 European Sites – Slieve Bernagh (SAC) 9

3.2 Water Quality 9

3.3 Forestry Replacement Lands 10

4 CONCLUSION 11

List of appendices

Appendix 1 Figures

Figure 8.5 (of original EIAR) Local Hydrology Map
Figure 1.1 Drainage Pathways
Figure 2.1 Large Firebreak separating forestry and SAC

1 INTRODUCTION

Coillte CGA, care of Malachy Walsh and Partners received a request for further information regarding the Carrownagowan Wind Farm application from An Bord Pleanála in a letter dated 23rd February 2021. This report addresses the further information outlined in Item 2 of the letter.

While the primary focus of this report is to address Item 2 of the ABP RFI letter, Item 2 also directs us to review the Departments concerns and respond accordingly. In responding, we have provided a combined response to Item 2 of the ABP letter and related issues raised by the Department (refer to Section 2).

At Section 3 below, we have also included responses to other important issues (Slieve Bernagh SAC, Water Quality, and Replacement Lands) raised by the Department.

1.1 CONTRIBUTORS TO THIS REPORT

This report was completed by Michael Gill, Cormac Murphy and Helen Burman-Roy.

Cormac Murphy, (BE MIEI) is a senior engineer with wide ranging experience in Civil Engineering, from site assessment through to design, tendering, site supervision and inspection. Cormac has specialised in wind farm design and construction with particular emphasis on Peat Stability Assessment and constructability of infrastructure in the peat environment. He has been responsible for the assessment and design of infrastructure on a number of wind farm projects in difficult peat conditions. These have included Tullahennel Wind farm, Co. Kerry, Tievenameenta Wind Farm, Co. Tyrone; Booltiagh Wind Farm Co Clare, Hollyford Wind Farm, Co Tipperary; Ugool and Knockranny, Co Galway; Letteragh, Co Clare. Cormac's extensive experience in construction resulted in his engagement as the Technical Advisor on the construction of several large Wind Farms including Coomacheo and Curragh Wind Farms, Co. Cork, Athea and Dromada Wind Farms, Co. Limerick.

Helen Burman-Roy, (BSc, MSc, PIEMA) is a senior Environmental Consultant with over 20 years commercial experience gained in both the US and Ireland. She is an environmental impact assessment project manager and practitioner having managed EIA projects including Lettercraffroe, Toberatooreen, Scartaglen and Beennanaspuck wind farm projects. She has been a contributing author on numerous EIA projects and has authored numerous specialist reports including land, soils and geology, population and human impact and material assets assessments for infrastructure projects.

Michael Gill, P. Geo. (BA, BAI, Dip Geol., MSc, MIEI) is an Environmental Engineer and Hydrogeologist with over 18 years' environmental consultancy experience in Ireland. Michael has completed numerous hydrological and hydrogeological impact assessments of wind farms and renewable projects in Ireland. He has substantial experience in surface water drainage design and SUDs design and surface water/groundwater interactions. For example, Michael has worked on the EIARs for Oweninny WF, Cloncreen WF, Derrinlough WF and Yellow River WF, and he has also completed hydrological and hydrogeological assessments for over 120 other wind farm-related projects across Ireland. Michael prepared Chapter 8 and Chapter 9 of the submitted EIAR for Carrownagowan WF.

1.2 ITEM 2 OF ABP LETTER

Item 2 of the request for further information from An Bord Pleanála is as follows:

Concerns have also been raised by the Department in relation to changes in patterns of surface water flow and the implications that this may have on the stability of peat soils within the development site. The applicant is requested to review the concerns from the Department in this regard and respond accordingly and provide any additional information in support of their response. Any response should include mapping within clearly identifies streams and the direction of flow and the precise location and composition of fire breaks present on site.

Issues raised in Item 2 of the ABP letter include the following:

- Changes in patterns of surface water flow and the implications that this may have on the stability of peat soils within the development site;
- The applicant is requested to review the concerns from the Department in this regard and respond accordingly and provide any additional information in support of their response; and,
- Any response should include mapping within clearly identifies streams and the direction of flow and the precise location and composition of firebreaks present on site.

We address these issues in Section 2 below.

2 PEAT STABILITY RISK ASSESSMENT REVIEW

We have reviewed the Department's submission, and summarise their concerns with regard to peat stability as follows:

- Changes in patterns of surface water flow may desiccate the peat and cause subsurface water losses, including where hard structures will be emplaced. A detailed map of existing site drainage, and orientation of drainage, should be included;
- Review PSRA with peat slide events from 2020 in mind (i.e., Shass Mountain/Meenbog WF);
- It should also be clarified has climate change being considered in the rainfall prediction rating used in the Hazard Risk Ranking applied in the PSRA; and,
- Reference to firebreak along the southern boundary of the WF site – and assessment of the firebreak in terms of hydrological links in the NIS.

2.1 POTENTIAL CHANGES TO PREVAILING SURFACE WATER FLOW PATTERNS

There are two main rivers which flow northwards through the proposed development site, namely the Carrownagowan River and the Coumnagun River, which converge at the centre of the proposed development site to form the Inchaluchoge River. Existing site drainage is described in Chapter 8, Section 8.2.4.1 of the submitted EIAR. Comprehensive mapping and logging of existing site drainage is outlined in the submitted EIAR and is illustrated on Figure 8.5 of the submitted EIAR (Figure 8.5 is included in Appendix 1 for reference). The watercourses illustrated on Figure 8.5 (of the submitted EIAR) are reproduced on the site drainage plans (Drawings 19107-5013 to 19107-5019 inclusive). Drawings 19107-5013 to 19107-5019 inclusive show the orientation and drainage direction across the proposed wind farm site.

As outlined in Chapter 8, Section 8.3.2 of the submitted EIAR, any new or introduced drainage works at the development site are intended to mimic the existing hydrological regime thereby avoiding changes to flow patterns across the site or changes in flow volumes leaving the site. This is a core strategy of the wind farm drainage design. This will be achieved by minimal re-routing of flows from baseline conditions, and by attenuating all surface water runoff from the proposed development footprint and releasing it at the greenfield runoff rate thereby maintaining "normal flows" in downstream watercourses. Ultimately all water entering downstream watercourses would have reached the same watercourse anyway by runoff. There are no design elements that transfers surface water from one catchment to another within the proposed development.

The integration of the wind farm drainage with the existing forestry drainage is a key component of the proposed drainage management within the development. By integration we mean maintaining surface water flowpaths where they already exist, avoiding the creation of new or altered surface water flowpaths, and maintaining the drainage regime (i.e., normal flows) within each forestry compartment. Critically, there will be no alternation of the catchment size contributing to each of the main downstream watercourses. All wind farm drainage water captured within individual site sub-catchments will be attenuated and released via overland dispersal within the same sub-catchments that it was captured, thereby maintaining the existing hydrological regime of the site. This principled approach ensures that proposed surface water drainage around the proposed infrastructure will not result in sub-surface water losses or additional peat drainage/desiccation.

In order to respond to the concerns raised by the Department we used available high-resolution Lidar data to map in more detail potential drainage pathways within the wind farm site. Using these available Lidar data we have mapped potential runoff pathways that are >150m[1] in length. The outcome of this mapping is shown on Figure 1-1. Many of these existing drainage pathways overlap with mapped stream and forestry drainage pathways.

Where drainage pathways cross existing access wind farms roads that are proposed to be upgraded and proposed new wind farm access roads, culverts will be installed to maintain these drainage pathways. There has been no requirement from the above described (Lidar) additional drainage pathway analysis to amend or alter the wind farm layout. This drainage pathway analysis demonstrates that existing drainage patterns at the site can be maintained if the wind farm layout is built. As outlined in the Civil Engineering Chapter of the EIAR (Chapter 3), a fundamental principle of the drainage design is that clean water flowing in the upstream catchment, including overland flow and flow in existing drains, is allowed to bypass the works areas without being contaminated by silt from the works. This will be achieved by intercepting the clean water and conveying it to the downstream side of the works areas either by piping it or diverting it by means of new drains or earth mounds to a suitably sloped area where it is dispersed.

In addition to the above drainage pathway analysis, additional desk based topographical and slope analysis was completed to determine any overlap or proximity to any of the following hydrological features[2]:

- Convex slope, or on a break in slope;
- Areas of excessively wet peat or flushed areas;
- Areas where there is a concentration of springs/seepages;
- Area where tree growth was stunted or poor;
- Any area where peat pipes occur; and
- Flat plateau areas of deep wet peat.

Again, no such areas/features have been found to intersect with the proposed wind farm layout. It should be noted that this assessment was also completed during the layout design process, so we have now checked these conditions for a second time.

Overall, it can therefore be confirmed that there will be no changes in patterns of surface water flow that may desiccate the peat and cause subsurface water losses, including where hard structures will be emplaced during construction or operation of the proposed wind farm. The detailed map of existing site drainage and orientation was submitted with the EIAR in the drainage plans. The additional (repeat) analysis, as described above, did not result in any requirement for an update of the drainage plans as submitted, for the reasons detailed above.

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[1] Through an iterative process we have found that drainage pathways of 150m are optimal for the definition required, based on site scale and site topography.

2 These are commonly referred to contributory causes of landslides in upland blanket bog areas.

2.2 PSRA REVIEW

We have reviewed the PSRA for Carrownagowan WF with reference to the two peat slides mentioned (Shass Mountain and Meenbog WF) by the Department in their submission. A common issue at both the two mentioned sites was the presence of a wet body of soft deep peat, at or close to a convex break in slope.

As noted above, (bullet points) none of the hydrological conditions occur at or in close proximity to the proposed wind farm layout at Carrownagowan.

For the design of the Carrownagowan Wind Farm, MWP adopted a constraints-driven approach to identifying areas suitable for the construction of civil infrastructure associated with wind turbine delivery and erection. The objective was to reduce the site to areas requiring further detailed assessment. To this end MWP buffered all existing watercourses, designated areas, areas of high conservation forestry and areas of ecological interest. Analysis of high-resolution LiDAR data of the entire area with associated high resolution aerial photography was also completed. A ground slope analysis of the entire site was completed using the Lidar data.

MWP analysed the historical peatslide at Slieve Bearnagh in 2003 and concluded that the slide was associated with deep peat coincidental with a break in slope. MWP then proceeded to design the site infrastructure to avoid these conditions.

Using the area excluded by buffering and ecological constraints and excluding areas of high slope from the output of the ground slope analysis the remaining areas of the site were the subject of site investigation works including peat probing, shear vane measurements, and trial pitting.

The data from the peat probing was plotted and areas of the site with deep peat (>2.5m) were added to the other constraints for areas for turbine placement.

Overlaying the data from the peat probing and the slope analysis output from the Lidar DEM flat, areas of deeper peat leading to breaks in slope were identified and avoided for new infrastructure.

The iterative approach to infrastructure layout design using ground slope as one of the primary constraint drivers ensured that the infrastructure location would be suitable for development subject to a peat depth-shear strength combination.

In total 790 peat probes were taken across the study area. The maximum peat depth encountered was 4.0m deep, the minimum depth of peaty cover was 0.05m. The average for the data set across the study area was 1.25m. Shear values were collected at 489 probe locations using a hand shear vane with results which range from 4kPa to 62kPa across the site.

MWP then completed a Risk Assessment using the Peatslide Hazard Rating System (PHRS) (Nichol, 2006). The PHRS is a step in the process of peat stability risk assessment (Refer to Volume III, Appendix 9-2 for full assessment). The findings of the PHRS at 24 no. infrastructure locations were that the risk ranged from Negligible (Substation, PMM (Proposed Met Mast), T18, BP1, BP3) through Very Low for the majority of the site to Low (T5 and T14).

MWP completed assessments of the risk presented using the industry best practice guidance of the Scottish Executive (2006) and the revised 2017 Scottish Government guidelines for 'Peat Landslide Hazard and Risk Assessments'. The outcome of the risk assessment was that landslide presented a Negligible to Low Level of risk to the Wind Farm Infrastructure. The layout used for assessment was already constrained by a multidisciplinary analysis of hydrological, geotechnical and ecological constraint as part of the EIA process.

In summary, the peat stability risk assessment completed by MWP was undertaken in a two-step fashion. The initial Peatslide Hazard Rating System was used to define hazard ranking for all elements of the proposed wind farm development. The output of this method of analysis was that the area represented a Negligible to Low Hazard Rating for peatslide. The findings reflect the mitigation by design philosophy adopted in designing the wind farm infrastructure of avoiding areas of steeper slopes from the outset. The Engineering Design Response, per Dr Nichol, for a Low PHRS score is "*Further investigation of the peat slide hazard may be required. Manage by normal slope maintenance procedures*." Further investigations were therefore completed and as such MWP completed ISSA (infinite slope stability analysis) across the whole site, using 790 analysis points, combining peat depth and slope to complete the computational slope stability assessment. The output of the ISSA was that peat landslide presented a Negligible Risk to the infrastructure of the Wind Farm. The two-step approach taken is conservative and gives added confidence by way of parallel outputs.

In reference to the other sites where peat slides occurred, and in respect of the Carrownagowan WF site, we confirm the following:

- The PSRA completed for the Carrownagowan WF site started on a site wide basis, and excluded unsuitable areas for construction using buffering (Table 3-1 of the submitted EIAR), and then by using hydrological constraints and site-specific site investigation data including peat depth and slope analysis.
- None of the hydrological conditions noted in Section 2.1 above occur along or in close proximity to the proposed WF layout.
- Conditions of deep peat, steep slopes were specifically constrained out for infrastructure selection. The combination effect of deep, weak, flat areas of peat leading to breaks in slope, as identified as contributory factors to the recent slides, was analysed and avoided for infrastructure.
- There is no proposal within the wind farm layout to alter or change in any significant manner the existing hydrology of the site, all existing drainage pathways will be maintained. Additional analysis and mapping to illustrate this point has been completed in Section 2.1 above.
- The wind farm is designed to utilise the existing Coillte road and drainage network as much as possible. This is done primarily to reduce the environmental footprint of the wind farm construction. This has the beneficial effect of reducing the peat stability risk associated with construction risk at new work faces.
- The intended turbine bases (19 no.) are distributed across the 750 Ha site area and will not create any significant barrier or blockage to groundwater flow at the site, groundwater will simply flow around these imposed structures during construction and operation, and this very local and slight alteration of groundwater flow at each turbine base will not cause ground instability.

In conclusion MWP specifically designed the site infrastructure to avoid the conditions manifest at the historical slide at Slieve Bearnagh. These same conditions have been identified as contributing to these recent slides above and as such have already been addressed in the PSRA.

2.3 CLIMATE CHANGE CONSIDERATIONS

As the permission being sought is for a 10 year duration to complete construction, climate change considerations have not been explicitly assessed in the submitted PSRA (Appendix 9-2 of the submitted EIAR). The annual rainfall amount is used in the Hazard Rating Criteria (Table 4-1), and at 1414mm/year, this is assessed as moderate. Increasing this annual rainfall amount by 20% (i.e., applying a climate change factor of 1.2 to account for increased frequency of heavy summer rainfall events)[3] would push the Hazard Rating Criteria Score for rainfall up to the next score (27 points). This would have the effect of increasing the Negligible risk level areas to Very Low. None of the Low locations would increase to Low-Moderate and therefore it would not change the output of the existing PSRA.

As part of the PSRA the site layout has been checked per BS6031 for a surcharge of 10kPa. This would be the equivalent of a minimum 3.5m of snowfall (approx. density of snow = 200kg/m^3 + 1kg per day on ground). Based on snow depth data to date, MWP are satisfied that this method adequately addresses the impact of climate change on potential snowfall loading.

In relation to drainage surface water on slopes, the PSRA indicates gradients in the study area are such that water does not persist on slopes but during periods of heavy rainfall saturation of the ground occurs. This represents an intermittent rating hazard for the completed assessment. Applying a climate change factor would also not alter this Hazard Rating Criteria Score, and therefore it would not change the output of the existing PSRA.

Hazard Category	Hazard Factor Scores																							
	T1	T2	T3	T4	T5	T6	T7	T8	T9	T10	T11	T12	T13	T14	T15	T16	T17	T18	T19	BP1	BP2	BP3	PMM	Substation
Rainfall and climate (1414mm/year)	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27
Presence of Water on Slope	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9
Peat/Sub-strata interface	9	3	3	3	3	27	9	3	9	27	27	27	27	27	27	27	3	3	27	9	9	9	9	9
Peat profile and thickness	6	11	10	11	32	29	9	14	11	19	24	34	13	34	5	9	4	5	3	3	6	5	5	3
Shear strength of peat	27	34	65	30	81	3	34	42	30	27	30	42	4	65	27	47	3	81	27	3	30	8	9	27
Surface slope gradient and regularity	12	15	20	31	3	14	11	14	5	5	13	15	5	3	10	7	7	7	3	11	5	13	3	9
Geomorphology and Site History	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	3	9	9	3	3	3	3	3
The extent and condition of subterranean drainage pipes	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
Peatslide history	3	3	3	3	3	3	3	3	3	3	3	3	9	9	3	3	3	3	3	3	3	3	3	3
Potential impact of peatslides	9	3	3	9	9	3	9	3	15	3	3	3	15	9	9	9	15	3	9	9	9	3	15	3
Peatslide Hazard Rating Score	**114**	**117**	**152**	**135**	**179**	**127**	**123**	**127**	**121**	**132**	**148**	**172**	**121**	**195**	**129**	**150**	**77**	**150**	**120**	**80**	**104**	**83**	**86**	**96**
Peatslide Hazard Ranking	**2**	**2**	**3**	**2**	**3**	**2**	**2**	**2**	**2**	**2**	**3**	**3**	**2**	**3**	**2**	**3**	**2**	**3**	**2**	**2**	**2**	**2**	**2**	**2**

Figure 1 PSRA Risk Level Table updated for Climate Change

2.4 FIREBREAK AND HYDROLOGICAL LINKS

The firebreaks referred to in the NIS are defined and assessed in Chapter 8, Sections 8.4.2.9 and 8.2.12.1, of the submitted EIAR. An image of the referenced firebreak (south of T3 and T4) is included at Plate 8-1 (Chapter 8 of the submitted EIAR). A similar image is also included in the submitted PSRA

[3] Ireland has seen an increase in average annual national rainfall of approximately 60mm or 5% in the period 1981-2010, compared to the 30- year period 1961-1990. Significant reductions are expected in average levels of annual, spring and summer rainfall. Projections indicate a substantial increase in the frequency of heavy precipitation events in Winter and Autumn (approx. 20%). (Ref: https://www.epa.ie/environment-and-you/climate-change/what-impact-will-climate-change-have-for-ireland/)

(Appendix 9-2 of the submitted EIAR, Figure 2-1, pg 10). This firebreak was highlighted as it is different to the forestry firebreaks within the site and it forms a large boundary to the southwest and to the east, which separates the SAC and the forestry, and it has changed the site hydrology significantly.

The alignment of the firebreak, which largely coincides with the boundary of the Slieve Bernagh SAC, is shown on Figure 2-1. The firebreak can be clearly seen on open-source aerial photography of the area, including the aerial photography used by the Department[4] on its online mapping system.

As described at Section 8.2.12.1 of the EIAR:

> *"There is a significant drainage pathway along the boundary of the Slieve Bernagh Bog SAC to the south of the proposed development site. This drainage pathway is man-made and is the firebreak excavation which runs along the edge of the planted lands and separates the planted lands from the open peatland on higher ground. ….. A similar fire break also occurs along the eastern boundary of the wind farm site".*

The firebreak excavation ranges from 2-3m deep and 8-10m wide (the firebreak was surveyed and inspected by HES during the EIAR baseline characterisation of the site), and mineral soil (i.e., the full peat profile has been removed along the firebreak) is exposed at the base of the firebreak excavation. The firebreak is a definitive slice into the peat mass, and it represents a clear and significant break in the peat mass and its associated hydrology.

The referenced firebreak separates the SAC from the proposed development site. South of T1, T2, T3, T4, T8, T12, T13 the SAC occurs on higher ground above the proposed wind farm site. East of the proposed wind farm site the SAC occurs over the brow of a hill, and the ground within the SAC slopes away from the proposed wind farm site. There is no pathway for a peat slide on the proposed wind farm site to travel towards Slieve Bernagh SAC. It is not physically possible.

Also, at no part of the submitted EIAR, or indeed the assessment completed in Chapter 8, Sections 8.4.2.9 and 8.2.12.1 does it suggest that the firebreak might contain a potential peat slide. The firebreak was referenced with the intention of illustrating the clear and definitive break in the peatland hydrology along the firebreak, and that its presence prevented hydrological impacts from the wind farm construction works from propagating uphill towards the SAC.

Based on the above, and given the details already provided in Chapter 8 of the submitted EIAR, there is no further mitigation necessary to address the concerns raised by the Department regarding the presence of the firebreak.

[4] https://dahg.maps.arcgis.com/apps/webappviewer/index.html?id=8f7060450de3485fa1c1085536d477ba

3 OTHER ISSUES RAISED BY THE DEPARTMENT

3.1 EUROPEAN SITES – SLIEVE BERNAGH (SAC)

The concerns raised regarding Slieve Bernagh SAC (slope stability, and hydrological connections) are addressed above at Section 2.2 and Section 2.4.

3.2 WATER QUALITY

Lough O'Grady pNHA (001019) and Doon Lough NHA (000337) are characterised in terms of hydrological connection to the proposed development in Chapter 8 (Water), Table 8-15, of the submitted EIAR. For clarity we have reproduced the relevant rows of Table 8-15 here:

Doon Lough NHA	3.5km as the crow flies, and 7.64km along the Ballymacdonnell River/Owenogarney River.	The Owenogarney and Killuran river both discharge into Doon Lough. Potential impacts via surface water on Doon Lough NHA are assessed in Section 8.6.1.9.	Likely, but significant distance between the proposed development site and Doon Lough, as well as low transmissivity in underlying bedrock aquifer means that potential for impacts via groundwater are very low, and can be screened out at this point.
Lough O'Grady pNHA	c. 4.9km to north of T9 c. 7.7km to north of Grid Connection	An unnamed stream flows north from the site entrance, and crosses the TDR, and flows on to enter Lough O'Grady. Potential impacts via surface water on Lough O'Grady pNHA are assessed in Section 8.6.1.9.	Likely, but there is a significant distance between the proposed development site and Lough O'Grady and only minor works proposed within the catchment to this unnamed stream (i.e., a short section of the TDR and site entrance road upgrade works).

At Section 8.6.2.9 of Chapter 8 of the submitted EIAR, the pre-mitigation potential impact on Doon Lough NHA and Lough O'Grady pNHA are assessed as "*Negative, indirect, imperceptible, short term, unlikely impact on down-gradient water quality and designated sites (Lough Derg, Doon Lough, and Lough O'Grady).*"

Notwithstanding this pre-mitigation assessment, the following surface water quality protection mitigation is outlined in Chapter 8, Section 8.5.1.9.1 of the submitted EIAR:

- Drainage control measures (i.e., interceptor drains, swales, stilling ponds) will ensure that the quality of runoff from proposed development areas will be very high;
- Mitigation for surface water quality protection are outlined in Section 8.5.1.1, Section 8.5.1.2, Section 8.5.1.4, Section 8.5.1.5, Section 8.5.1.6, and Section 8.5.1.7. These include detailed surface water protection mitigation for:
  - Clear felling of Coniferous Plantation
  - Earthworks (Removal of Vegetation Cover, Excavations and Stock Piling) Resulting in Suspended Solids Entrainment in Surface Waters
  - Excavation Dewatering and Potential Impacts on Surface Water Quality
  - Potential Release of Hydrocarbons during Construction and Storage
  - Groundwater and Surface Water Contamination from Wastewater Disposal
  - Release of Cement-Based Products

In addition, a Construction and Environmental Management Plan (CEMP) is provided at Appendix 3-1 of the submitted EIAR, and a Surface Water Management Plan (SWMP) is provided at Appendix 3-2 of the submitted EIAR. Detailed drainage plans for the proposed development are also included on Drawings 19107-5013 to 19107-5019 inclusive.

In our opinion there is clear and comprehensive assessment of the designated sites referenced by the Department, and the submitted EIAR (and CEMP and SWMP) already outlines very clear mitigation to protect downstream watercourses from any potential threat to water quality associated with mobilisation of peat soils.

The 75m buffer zone, increased from the standard 50m buffer zone, was a primary constraint used from the beginning of the site layout design. Detailed drainage plans for the proposed development are included on Drawings 19107-5013 to 19107-5019 and these demonstrate clearly how the proposed development footprint relates to the 75m buffer zone. Drawing 19107-5019 already demonstrates how this 75m buffer is achieved for the proposed locations of the Construction Compounds (1 and 2) and the proposed Visitor Building. In our opinion no further drawings are necessary to illustrate this point.

Our assessment of Residual Effects on Potential Hydrological Impacts on Designated Sites is presented at Section 8.6.1.9 of Chapter 8 of the submitted EIAR. There we conclude that no significant effects will occur, and we cross-reference the suite of mitigation (listed in the bullet points above) that are intended to prevent water quality impacts on downstream receiving waters which include the referenced designated sites (Doon Lough NHA and Lough O'Grady pNHA).

3.3 FORESTRY REPLACEMENT LANDS

Characterisation of the soils and geology and water environment at the replacement lands forestry sites are provided in Chapters 8 and 9 of the submitted EIAR.

Both sites referenced in the Department's letter are existing forestry sites, and their replanting was subject to assessment and licencing by the Forest Service.

At the Cooraclare site all forestry planting works was completed in line with the requirements of Forestry FWPM Guidelines[5], and all other best practice water quality protection mitigation for forestry works[6] .

At the Trillickacurry site, Derrymore Bog lies to the east of the proposed replanting lands, and the bog itself is modified significantly from previous peat cutting activities. The replanting lands are below the high bog, and other than existing drainage there is very limited potential for hydrological impact on the bog from the replacement planting works. As stated above the replanting was subject to assessment and licencing by the Forest Service.

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[5] *Forest Services (Draft, undated): Forestry and Freshwater Pearl Mussel Requirements – Site Assessment and Mitigation Measures.*
[6] *Forest Service, 2000: Forestry and Water Quality Guidelines. Forest Service, DAF, Johnstown Castle Estate, Co. Wexford.*

4 CONCLUSION

The response to the request for further information focused on the four key items below. A concluding statement is provided for each item.

Changes in patterns of surface water flow may desiccate the peat and cause subsurface water losses, including where hard structures will be emplaced	The Engineering design measures at the Carrownagowan site are intended to mimic the existing hydrological regime thereby avoiding changes to flow patterns across the site or changes in flow volumes leaving the site. The wind farm layout has been checked a second time for sensitive hydrological features and no such areas /features have been found to intersect with the proposed wind farm.
Review PSRA with peat slide events from 2020 in mind (i.e., Shass Mountain/Meenbog WF)	Regarding the recent peat slides (Shass Mountain and Meenbog WF), MWP specifically designed the site infrastructure to avoid the conditions manifest at the historical slide at Slieve Bearnagh. These same conditions have been identified as contributing to these recent slides and as such have already been addressed in the PSRA. The peat stability risk assessment completed by MWP was undertaken using a two-step approach which is conservative and gives added confidence by way of parallel outputs.
It should also be clarified has climate change being considered in the rainfall prediction rating used in the Hazard Risk Ranking applied in the PSRA	Applying a climate change factor, increasing annual rainfall by 20% would push the Hazard Rating Criteria Score up to the next score (27 points), which only changes the negligible category to very low. However, it would not change the output of the existing PSRA. Similarly, applying a climate factor during periods of heavy rainfall saturation of the ground would not change the existing PSRA.
Reference to firebreak along the southern boundary of the WF site – and assessment of the firebreak in terms of hydrological links	This firebreak was highlighted as it is different to the standard forestry firebreaks within the site and it forms a large boundary to the southwest and to the east, which separates the SAC and the forestry, and it has already changed the site hydrology significantly. The firebreak excavation ranges from 2-3m deep and 8-10m wide, and mineral soil is exposed at the base of the firebreak excavation. The firebreak is a definitive slice into the peat mass, and it represents a clear and significant break in the peat mass and its associated hydrology.

The detailed hydrological assessment by HES is based on 18 years' expertise and experience in hydrological investigation of upland areas and over 120 other wind farm sites.

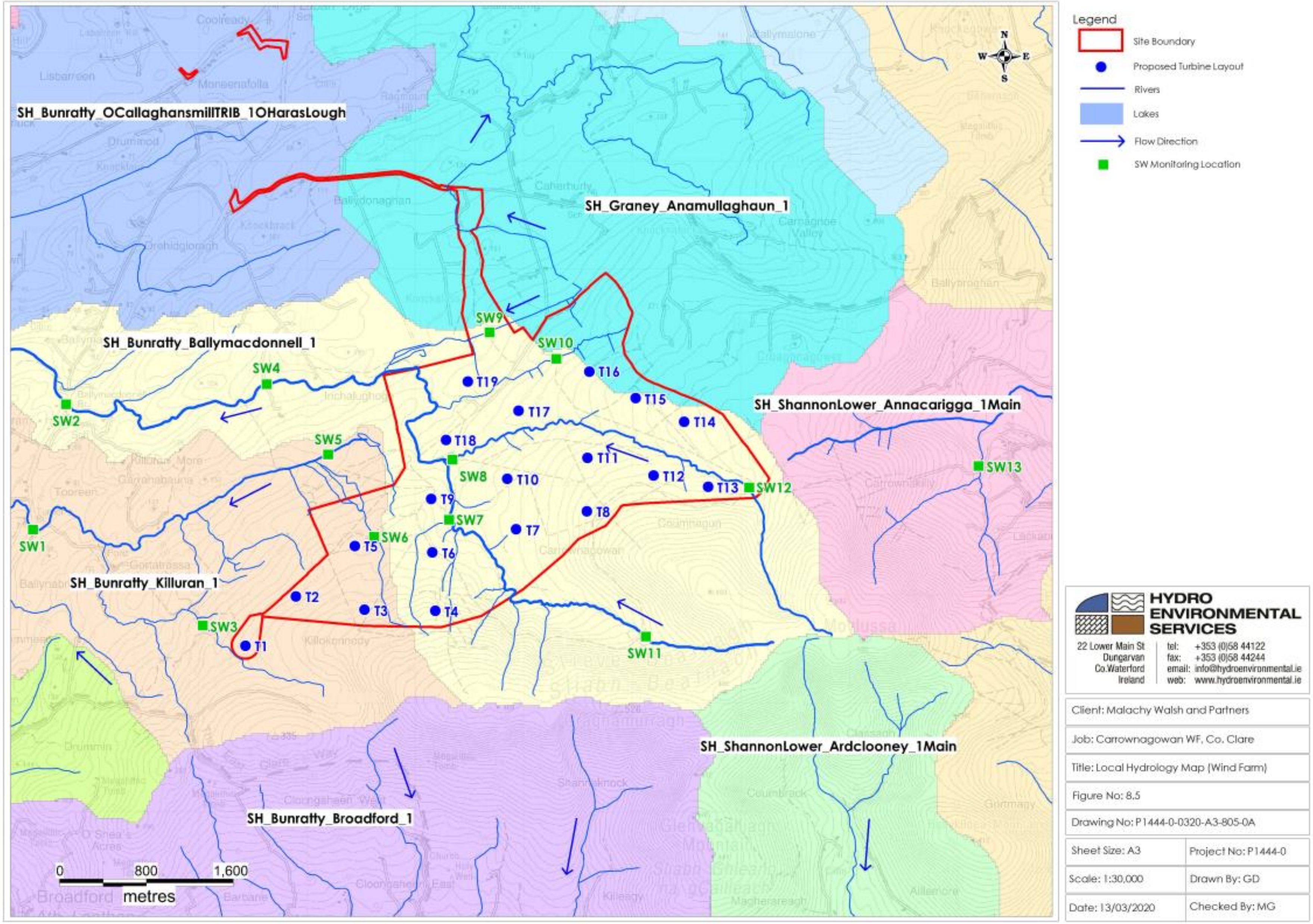
The conservative approach taken to the wind farm design by MWP is based on expertise and over 15 years' experience gained in the construction of wind farms on peat soils in upland areas.

Appendix 1
Figures:

Figure 8.5 (of original EIAR) Local Hydrology Map

Figure 1.1 Drainage Pathways

Figure 2.1 Large Firebreak separating forestry and SAC



SH_Bunratty_OCallaghansmillTRIB_1OHarasLough
SH_Graney_Anamullaghaun_1
SH_Bunratty_Ballymacdonnell_1
SH_ShannonLower_Annacarigga_1Main
SH_Bunratty_Killuran_1
SH_ShannonLower_Ardclooney_1Main
SH_Bunratty_Broadford_1
T1
T2
T3
T4
T5
T6
T7
T8
T9
T10
T11
T12
T13
T14
T15
T16
T17
T18
T19
SW1
SW2
SW3
SW4
SW5
SW6
SW7
SW8
SW9
SW10
SW11
SW12
SW13
0 800 1,600
metres
Legend
Site Boundary
Proposed Turbine Layout
Rivers
Lakes
Flow Direction
SW Monitoring Location
HYDRO ENVIRONMENTAL SERVICES
22 Lower Main St
Dungarvan
Co.Waterford
Ireland
tel: +353 (0)58 44122
fax: +353 (0)58 44244
email: info@hydroenvironmental.ie
web: www.hydroenvironmental.ie
Client: Malachy Walsh and Partners
Job: Carrownagowan WF, Co. Clare
Title: Local Hydrology Map (Wind Farm)
Figure No: 8.5
Drawing No: P1444-0-0320-A3-805-0A
Sheet Size: A3
Project No: P1444-0
Scale: 1:30,000
Drawn By: GD
Date: 13/03/2020
Checked By: MG

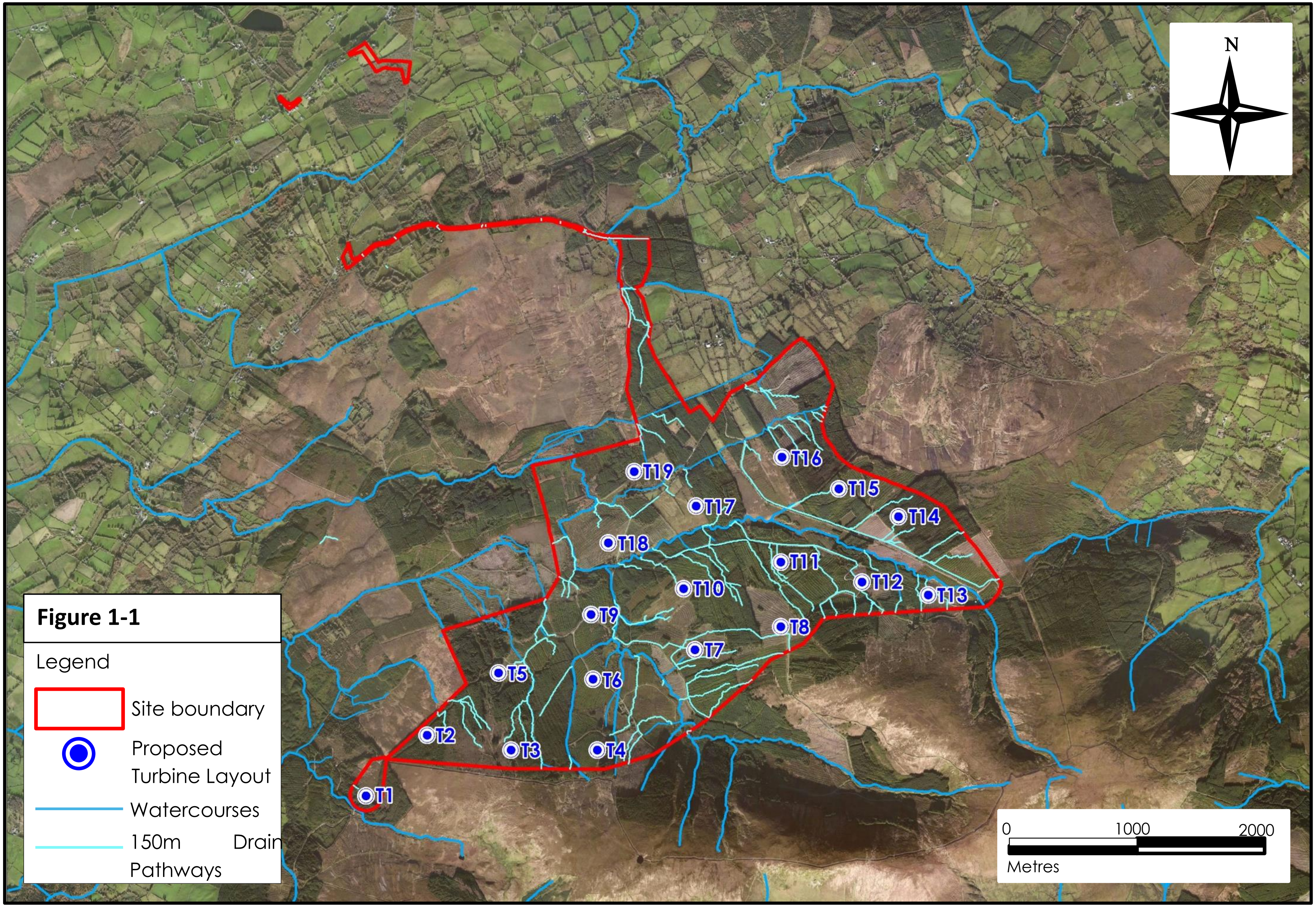


Figure 1-1

Legend

Site boundary

Proposed Turbine Layout

Watercourses

150m Drain Pathways

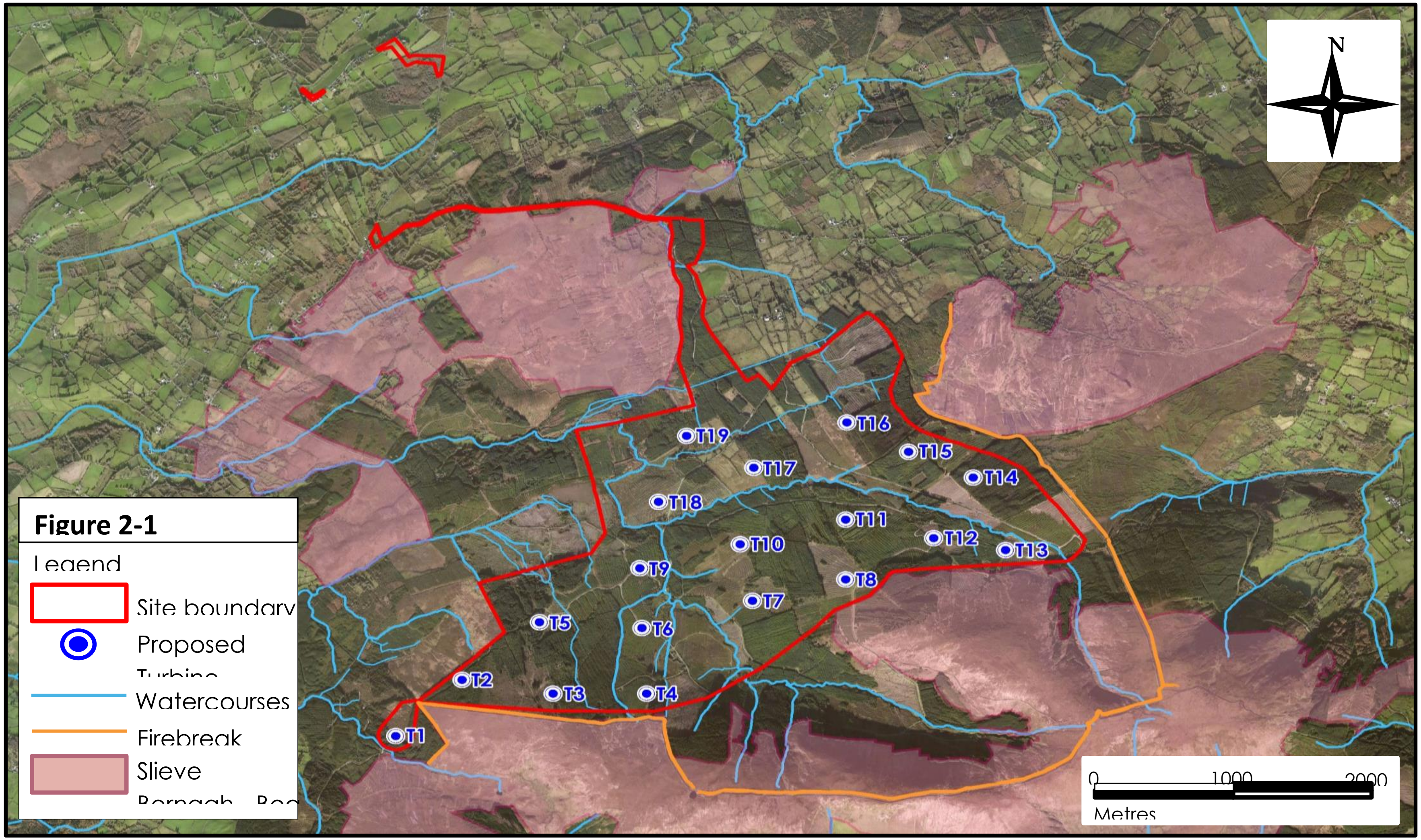


Figure 2-1
Legend
Site boundary
Proposed Turbine
Watercourses
Firebreak
Slieve
N
0
1000
2000
Metres
T1
T2
T3
T4
T5
T6
T7
T8
T9
T10
T11
T12
T13
T14
T15
T16
T17
T18
T19