Technical Appendix 9.1: Surface Water Management Plan;

McCloy Consulting

Surface Water Management Plan

Unshinagh Wind Farm

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APPENDICES

1 INTRODUCTION

1.1 Terms of Reference

RES Ltd (RES) has appointed McCloy Consulting Ltd to prepare a Surface Water Management Plan (SWMP) to support a planning application for the proposed Unshinagh Wind Farm.

The purpose of this SWMP assessment is to provide further details of proposed mitigation measures specifically in relation to management of surface water from the developed site if there is initially a perceived risk of deterioration in the Water Framework Directive (WFD) ecological status of any affected waterbody (refer to section 1.3 for further information), which would similarly be reflected as a significant adverse impact in Environmental Impact Assessment terms.

This appendix is intended to supplement the Environmental Impact Assessment Report / Environmental Statement (specifically **Chapter 9: Geology and Water Environment**) submitted in support of the planning application for the proposal.

1.2 Statement of Authority

McCloy Consulting is an independent environmental consultancy specialising in the water environment, with specialist knowledge of hydrological and hydrogeological assessments, sustainable drainage systems (SuDS), drainage, river modelling, and flood risk assessment.

McCloy Consulting has ongoing involvement in numerous geology and water environment studies and Sustainable Drainage Systems (SuDS) projects across the UK and has developed expertise in surface water management for wind farms. The company has successfully designed numerous SuDS/silt management solutions for wind farms in accordance with current best practice guidance. The primary personnel responsible for undertaking this WFD assessment are:

- Iain Muir MSc CEnv MIEnvSc – Project Consultant and Chartered Environmentalist experienced in Environmental Impact Assessment (EIA) specialising in the water environment, undertaking hydrology, water quality and flood risk assessments for major infrastructure projects.
- Kyle Somerville BEng (Hons) CEng MIEI – Associate and Chartered Engineer specialising in hydrology and surface water management for wind farm developments, and has overseen outline and detailed design of surface water management for in excess of thirty onshore wind farm developments in the UK and Ireland.

1.3 Water Framework Directive

The European Water Framework Directive (2000/60/EC) has been transposed into Northern Ireland regulations through The Water Environment (Water Framework Directive) Regulations (Northern Ireland) 2017. The Water (Amendment) (Northern Ireland) (EU Exit) Regulations 2019 ensures that the Water Framework Directive (as transposed) and the various supporting pieces of water legislation continue to operate in Northern Ireland after 1 January 2021[1].

A requirement of the WFD is to attain good ecological water status and that deterioration in the status of water is prevented. The Environmental Impact Assessment Directive (85/337/EEC) requires likely significant environmental impacts to be identified, assessed and mitigated. The Northern Ireland Environment Agency Water Management Unit NIEA:WMU would regard an impact that would compromise achievement of a WFD objectives or result in the deterioration in the status of waters as a significant impact.

Any new development must ensure that this fundamental requirement of the Directive is not compromised. **Chapter 9: Geology and Water Environment** of the ES outlines mitigation measures specifically in relation to management of surface water (detailed further in this SWMP) to prevent deterioration of water quality and quantity. The ES chapter concludes that overall residual effects of the Unshinagh Wind Farm on the water environment are 'not significant', therefore, WFD objectives are deemed to have been satisfied.

[1] https://www.daera-ni.gov.uk/articles/water-framework-directive

2 MITIGATING MEASURES

2.1 Approach

In order to mitigate the potential degradation of surface and groundwater quality and morphology as a result of construction activities associated with the development, mitigation measures are to be implemented during all stages of the construction process.

2.2 Introduction

The construction phase of all projects is a period within which there is increased potential for pollution, in particular silt pollution to local watercourses. The focus of this document is to provide sufficient detail to ensure that water pollution will not occur as a result of construction activities at the site and to minimise the risk of any such occurrence.

Environmental Statement Chapter 9: Geology and Water Environment has identified particular downstream receptors, of significance from a drainage perspective especially watercourses with fisheries potential and should be referred to for a detailed appraisal of the site hydrology and hydrogeology.

The main objectives of the following sections are to demonstrate that sufficient measures have been put in place so as to protect those identified receptors and to ensure that drainage is constructed to relevant guidance and standards, particularly as follows:

- To propose appropriate, robust and buildable SuDS techniques for the prevention of erosion and the removal of silts and pollutants from construction runoff;
- To ensure that permanent drainage at the development is designed to a sufficient hydraulic capacity to contain a pre-determined return period rainfall event;
- To give consideration of the control and monitoring proposals for the dewatering of excavations;
- To ensure that surrounding agricultural lands, heath and peat lands are not negatively affected by surface water runoff from the site;

The drainage design adopts a SuDS approach, using temporary SuDS for the drainage of the temporary works during the construction phase.

Where construction activities near water courses and water bodies are essential, steps have been undertaken to identify sufficient mitigation measures for the protection of the watercourses against pollution and have been presented on drawings accompanying this report within **Annex A** and **Annex B**. Silt management and pollution prevention during all elements of construction has been given due consideration within the design statement and within the scope of the full SuDS design.

This report gives both specific and general details on the drainage method for temporary works, permanent site drainage and pollution prevention measures for silt management.

2.3 Additional References

This document refers to and should be read in conjunction with the Unshinagh Environmental Statement, in particular:

- Chapter 6: Ecology;
- Chapter 8: Fisheries & Aquatic Ecology;
- Technical Appendix 9.3: Peat Slide Risk Assessment;

Chapters are contained in Volume 2 and Technical Appendices are included within Volume 4 of the ES. In addition; the following accompanying drawings included within Annex A and Annex B of this Technical Appendix:

- SWMP_01 – 18 Preliminary SuDS General Arrangement (Planning Stage Drainage Layout);
- SWMP_20 - 26 Preliminary SuDS Typical Details (Planning Stage Drainage Details).

3 SITE DRAINAGE INFORMATION

3.1 Site Area

The proposed development is located c. 2 km south-west from the village of Carnlough, Co. Antrim. Glenarm is c 3.8 km to the east and Ballymena c. 14 km to the south-west of the site. The survey boundary has an area of approximately 7.77 km^2 (777 ha); the application Site has a total area of approximately 5.2 km^2 (520 ha).

3.2 Topography

The topography of the site predominately falls from north to south and east. From a maximum height of c. 340 m OD at the summit of Binnagee, the fall in gradient through the central section of the site towards Slane Road in the south is gradual. The decrease in height to 167 m OD on Slane Road occurs over c. 5.6 km. The fall in gradient to the east is steeper with a low point of c. 121 m OD on Ballymena Road located c. 2.4 km from the Binnagee summit. The central section is notably flat with a 'bowl' effect of the surrounding higher ground creating a wide boggy area – this area is shown on OSNI mapping as Currigvohil Loughs.

3.3 Site Hydrology

Site hydrology is fully described in the EIAR Chapter that this Plan is intended to support.

NIEA River Water Body dataset boundaries show the site drains to two delineated and named waterbodies. The north of the site drains to Glencloy River water body (UKGBNI1NE040403061) which has an area of 23 km^2, and the south of the site drains via Tricloy Water to Braid River (Aghacully) (UKGBNI1NB030308214) which has an area of 35 km^2.

Desktop catchment analysis, terrain models, and ground truthing, verified that all water features flowing from the north eventually discharge to the North Channel (Irish Sea), whilst those in the south discharge to Braid River and ultimately the River Main into Lough Neagh.

DfI Rivers map of Designations approved by the Drainage Council (NI) indicate there are no designated watercourses within the site boundary. All watercourses within the application area are subject to riparian ownership and maintenance only.

4 SUDS DESIGN APPROACH

4.1 Relevant Guidance and Legislative Requirements

It is proposed that all drainage relating to Unshinagh Wind Farm will be constructed using best practice and in conformance with the requirements of the relevant regulatory authorities. The key legislation and guidance which will be adhered to are defined in the **Environmental Statement Chapter 9: Geology and Water Environment** and are not repeated here.

In order to meet the design criteria and objectives detailed previously in this report and regulatory authority requirements, the following design philosophy has been developed.

4.2 Controlling Runoff

- Track and hardstanding runoff will be handled by sheet flow to trackside ditches or swales.
- Tracks and hardstanding areas are to be constructed from unbound aggregate and are not surfaced, thus helping to reduce runoff volumes. This has been allowed for within the design philosophy through the utilisation of a reduced runoff coefficient of 70 %, and a heavy silt loading assumed as defined by D'Arcy et al (2000), for light industrial and engineering land uses.
- Piped under track drainage will be provided with associated sumps and check dams. The under-track drainage will provide a means for flows to pass from a swale on the uphill side to the downhill side of the slope.
- In cases where the tracks must run significantly downhill, transverse drains (‘grips’) will be constructed where appropriate in the surface of the tracks to divert any runoff flowing down the track into the adjacent drainage ditch/across open ground.
- Rate and volume of runoff will be attenuated using check dams located in trackside swales and ponds located at significant new hardstanding areas. Attenuation features will also reduce flow velocities preventing scour and allow settlement of silts prior to discharge.
- The use of large balancing ponds is to be avoided and there will be no merit in using other methods such as filter drains or hard permeable surfacing due to the lack of infiltration capacity in prevalent soil types.

4.3 Water Quality and Treatment

- Clean / dirty water separation will be maintained on site in all practicable instances. Clean water will be prevented from entering excavations and dirty water drainage swales through use of clean water diversion / cut-off ditches.
- A treatment train will be designed with a minimum of two stages of treatment for polluted runoff from the site during the construction phase.
- All treatment settlement features (check dam backwaters and ponds) are to be designed to offer sufficient retention time to settle out the silt grain sizes anticipated.
- Silt laden runoff within trackside swales will be treated through the provision of small check dams at specified centres along the swales (to be specified as part of detailed design). Note that steeper swale sections will require a greater frequency of check dams.
- Appropriate site management measures will be taken to ensure that runoff from the construction site is not contaminated by fuel or lubricant spillages. Earth spillages into any existing streams will also be avoided. There will be no discharge of trade effluent, sewage effluent or contaminated drainage into any watercourse system or ditch. Any dewatering from excavations will be via surface silt traps, check dams and settlement ponds to ensure sediment does not enter surrounding watercourses.
- Areas stripped of vegetation should be kept to a minimum. Stripped vegetation should be reinstated on slopes as early as possible.

4.4 Preserving Hydrology and Groundwater Recharge / Amenity & Biodiversity

- Drainage design will ensure natural streams are piped directly through appropriately sized drainage pipes on their original alignment.
- Runoff from new hardstanding areas will be collected and attenuated before discharge to receiving drainage networks.

4.5 Summary

The proposed SuDS design provides a surface water management train that will seek to mitigate potentially adverse impacts on the hydrology of the Development

Application of the above design philosophy in the detailed design and construction of site-specific elements is considered in the following sections of this report.

5 DRAINAGE DESIGN PHASE - DETAILED CONSIDERATIONS

5.1 Preamble

The following key considerations have been identified in the preliminary design of hydrology and drainage (including foul) for the site in order to preserve water quality, downstream hydrology and preserve stream morphology. These issues and development of suitable mitigating measures will be given further consideration during the detailed design stage of the project.

- Identification of watercourse crossings and drainage paths across the site;
- Sizing and definition of hydraulic capacity requirements for watercourse crossings;
- Requirement for fish passes / consideration of migratory fish;
- Detailed design of track and hardstanding drainage and silt management;
- Separation of 'clean' and 'dirty' water;
- Spoil storage;
- Management and discharge of runoff in areas of upland heath and in areas of improved grassland and peat land;
- Requirement for attenuation storage;
- Definition of Buffer Zones.

Note that the infrastructure layout and associated SUDS design prepared for purposes of Planning is preliminary only. Post consent, track layout design and associated SuDS design will be further developed to minimise and mitigate for the effects of pollution to all local watercourses.

Preliminary drainage layout is shown on accompanying drainage management drawings **SWMP_01 to 18** within **Annex A.**

5.2 Watercourses and Watercourse Crossings

5.2.1 Identification of Watercourse Crossings

Watercourses significant for purposes of environmental design have been identified within the Hydrology Assessment undertaken for the Environmental Statement for the project. Sensitive water features on the site comprise natural watercourses and main flowing drains.

- Six crossings of significant watercourses are required to allow development
- Fourteen crossings of minor watercourses are proposed to allow development

Additional consideration will be given to design of drainage crossings at detailed (post-planning) design stage, including other drainage crossings where other drainage crossings may be ditches and drains as encountered alongside existing roads tracks and field boundaries or moorland / peatland drainage.

Works to watercourse crossings will be subject to authorisation by DfI Rivers under Schedule 6 of the Drainage (Northern Ireland) Order 1973.

5.2.2 Design of Watercourse Crossings

Full design of watercourse crossings will be undertaken at detailed design stage, post planning consent. Outline designs sufficient to allow assessment of environmental effects have been prepared as part of this assessment.

The following guidance has been adhered to in the outline design and will be similarly applied in the detailed design of watercourse crossings:

- Hydrological assessments made using a number of methods including Flood Estimation Handbook to determine the design flow;
- SNIFFER WFD 111 documents;
- CIRIA Culvert design and operation guide (C689);

- Fisheries considerations shall incorporate guidance stated in Loughs Agency Guidelines for Fisheries Protection during Development Works (2011) and Scottish Executive (2002) River Crossings and Migratory Fish: Design Guidance (where appropriate).

Watercourse crossings on the site shall comprise conventional closed culverts, with the requirement for bottomless culverts on 5 no. of the significant watercourses driven by consideration of fish passage determined in conjunction with the site-specific fisheries assessment included with the Environmental Statement.

Factors considered in the design and orientation of all watercourse crossings includes:

- Crossing direction to generally be perpendicular with access track direction, therefore minimising the length of stream affected;
- Consideration of the passage of out-of-bank flood flows;
- Crossings are generally located in an area where bank slopes are the shallowest available, thus reducing the potential for runoff to carry sediment into the watercourse.
- Additional mitigation will be designed to prevent pollution of the watercourse during the construction of the watercourse crossing to reduce residual risk; comprising the temporary installation of silt fences in the stream channel downstream or similarly effective measures.
- Typical in-channel silt fence arrangements are shown on drawing **SWMP_20** included in **Annex B.**

5.2.2.1 Bottomless Culvert Crossings

Bottomless culvert crossings will be utilised at 5 no. significant watercourses, to ensure that the stream bed and bank remains undisturbed / intact and negate the need for in-channel works in order to preserve fish habitat and will avoid introducing structures that would inhibit fish passage.

A bottomless culvert crossing detail representing an outline design is shown on drawing **SWMP_26** included in **Annex B.**

5.2.2.2 Culvert Crossings

Conventional piped or closed bottom culverts are proposed at minor water features (based on site observations and catchment size < 0.3 km^2), and at water features where the requirement to maintain fish habitat in the channel has been determined to be not applicable within **Chapter 8: Fisheries & Aquatic Ecology**. These crossings and other culverts for surface flood conveyance or similar, shall be piped or box culverts.

Design requirements will be imposed to ensure that culverts are installed at a level lower than existing bed levels in order to create a "stilling" effect and reduce potential for increased local flow velocities in the culvert in addition to promoting the formation of a natural substrate within the culvert. Mitigation of construction of the culvert within watercourses is discussed further in Section 6.2.2.

A typical culvert representing an outline design is shown on drawing **SWMP_25** included in **Annex B.**

5.2.3 Preservation of Overland Flow Routes

Where appropriate, on areas of heath on the relatively elevated areas of the Site, overland flow will be preserved by the provision of under-track cross drainage (cross drains) at regular intervals and at all natural depressions and flow collection points.

Conventional cross drains sizes will be confirmed at detailed design stage and increased locally at all points where water would tend to accumulate due to land drainage or natural drainage paths. Frequency and location of specific cross drains will be specified following inspection of topographical data, with cross drain frequency dictated by:

- Terrain gradients lateral to the proposed access track;
- Terrain gradients longitudinal to the proposed track;
- Location of natural depressions and points of flow collection.

5.2.4 Water Feature Buffer Zones

Buffer zones to water features have been established for the Site within **Chapter 9: Geology and Water Environment** for the project and are shown on accompanying drainage management drawings **SWMP_01 - 18** within **Annex A.**

Infrastructure designed to lie outwith stated hydrological buffer zones comprises those elements of the works associated with significant earthworks, and greatest potential for spillage or leakage of chemical pollutants, i.e.:

- All turbine bases, met mast foundations, crane pads, and associated working areas including spoil storage areas.
- Areas designated for temporary or permanent spoil management or storage.
- Substation buildings and compounds, temporary construction compounds, fuel and chemical storage areas, and any other platforms.

Buffers would be imposed during the construction phase in order to limit the types of construction activities permissible in proximity to water. Where the local site environment requires additional protection (e.g. steep slopes or lack of vegetation between construction corridor and watercourse) the buffer zone will be increased or stringent mitigation measures introduced. Buffer areas will act as riparian zones allowing filtration and settlement, minimising sediment transport, attenuating flows and maximising infiltration.

All turbines and infrastructure are outside the recommended buffers (other than unavoidable watercourse crossings) as described in **Chapter 3**: **Design Evolution & Alternatives**.

5.3 Temporary Drainage

5.3.1 Clean / Polluted Water Separation

Drainage management will ensure that clean water is not permitted to mix with contaminated water from sources such as excavation dewatering or track runoff, where "clean water" should be interpreted as natural surface runoff unaffected by construction / earthworks runoff.

Design will ensure that upslope cut off ditches are to be installed in order to intercept and divert clean upslope surface water runoff flowing overland prior to it coming in contact with areas of excavation. Design will ensure that clean water cut off ditches are installed ahead of main earthworks wherever practical. This is intended to reduce the flow of clean water onto any exposed areas of rock and soil, thereby reducing the amount of potential silt laden runoff requiring treatment.

Installed drainage will allow provision for clean water intercepted in cut-off ditches to pass through and under track structures separate to drainage provided for track runoff.

Temporary silt / pollution prevention and scour protection measures will be provided in artificial clean water drainage installed in order to mitigate potential for scouring and transport of sediment from newly excavated channels.

Diversion drainage is to discharge either to existing watercourse channels (via silt removal features) or be dispersed over vegetated ground. Diversions are to be designed to avoid collection and interception of large catchments creating significant point flows, with associated risks due to scour and hydraulic capacity.

5.4 Track Drainage

5.4.1 Trackside Drainage

The cross fall on the track will be aligned to divert "dirty" surface water (i.e. contaminated surface water from track surface or excavations) into trackside swales by overland sheet flow or via track surface grips.

The swale and track shoulder will be vegetated as soon as possible after construction, in order to reduce potential for runoff from exposed aggregates and clays, and promote removal of suspended solids within runoff by filtration in vegetation. Any vegetation used will be appropriate to the local area. Temporary erosion protection may be required until the vegetation becomes established (coir matting or similar).

All swales will be kept as shallow as possible so that they pose no health and safety risk to plant or personnel. Maximum depth of standing water will be limited to 0.5m within the ponds and 0.3m within the swales.

Drainage swales shall be designed to satisfy the following conveyance and water quality criteria:

- Hydraulic conveyance of runoff appropriate to the protection of the surrounding land use, with additional consideration of effect of a 100-yr (flood protection) event (i.e. exceedance event);
- Store treatment volume (T_v) (15 mm rainfall on drained area).

Under-track piped drainage crossings will be provided to allow up-slope swales to drain to the down slope side. Crossings will be provided at regular intervals (to be determined at detailed design stage) and at all localised low points. Outlets from crossing pipes shall generally coincide with swale breakouts.

Note that dirty water under track crossings and breakouts are to be maintained separate from clean water crossings (see Section 5.3.1).

Where appropriate on areas of upland heath, there will be regular outflow points ("breakouts") from the swales throughout the SuDS system to eliminate the potential for the generation of large flows at single outflow points. This will assist the drainage network in maintaining the natural hydrological response displayed by the natural catchment. Outflows will be directed away from watercourses and across open vegetation to increase the drainage path and buffer zone between the point of discharge and the watercourse.

Typical trackside swale arrangements are shown on **SWMP_01 to 18** within **Annex A** and track drainage details are shown on **SWMP_21 and SWMP_22** in **Annex B.**

5.4.2 Drainage Grips

Drainage grips may be installed on the track surface where deemed a requirement in order to direct runoff into trackside drainage or to downslope settlement / filtration features. Positioning of grips will be determined at detailed design stage and on an observational basis during construction, however in general the need for grips will be greatest in areas on steep longitudinal track gradient.

Installation of grips will prevent extensive rutting of the track structure and aids drainage of the track surface, which in turn reduces potential for trafficking of the surface to cut the track and generate silt.

Drainage grips will generally comprise a steel channel section installed flush to the track surface, with concrete haunching as may be required in areas of heavy trafficking.

5.4.3 Runoff Attenuation

Runoff from large hardstanding areas such as the site compound, turbine hardstandings, and substation will be attenuated to mimic natural runoff patterns. Flow rates from tracks will be reduced through use of attenuating check dams within swales installed adjacent to all hardstanding areas, providing immediate attenuation "at source", with pass-forward flow rate reduced by filtration and temporary detention.

Frequent breakouts from swales to discharge accumulated runoff overland at regular frequencies will further encourage attenuation of runoff peaks by dispersing runoff over vegetation where losses would be expected by vegetative retention, transpiration, and infiltration.

Attenuation will utilise shallow ponds to aid removal of suspended solids. Calculations for the determination of storage requirements will be undertaken at detailed design stage. Preliminary calculations are included in **ES Technical Appendix 9.2 – Flood Risk and Drainage Assessment**, and attenuation features are shown on **SWMP_01 to 18** within **Annex A** and track drainage details are shown on **SWMP_21 and 22** in **Annex B.** An attenuation basin detail is included on **SWMP_15** in **Annex B.**

Consideration will be given to the potential for further storage features across the site.

5.5 Management of Suspended Solids

Runoff from the site shall be required to ensure that water quality in the receiving watercourses, including those draining to areas of fisheries interest, is not adversely affected in terms of key water quality parameters. The primary means by which the development could cause adverse effect is by release of suspended solids.

Detailed drainage design shall ensure that settlement and filtration of runoff from the site is designed such that the water quality standard is preserved.

5.5.1 Check Dams

Initial treatment will be provided "at source" by check dams installed within trackside swales at regular frequencies, in order to reduce flow velocities and improve conditions for the settlement of solids in transit.

Check dams shall ideally be of stone formation however compacted clay check dams may be used should suitable stone be unavailable locally.

Where stone is used, the aggregate used to form check dams will be a small 'clean' graded stone. On steeper slopes the check dams will be anchored using larger stone placed on the downhill side of the check dam to prevent washing away of the smaller graded stone. The frequency of the check dams will be determined at detailed design stage.

The check dams will serve dual functions, by both removing and settling out silts and reducing flow velocities, therefore mitigating against the effects of erosion within the swale and improving the design life of end of line infiltration features.

Where feasible and where observed site conditions allow, the frequency of installed check dams may be reduced post-construction phase, due to reduced silt loading anticipated following completion of construction activities and reduced site traffic.

Typical swale check dam arrangements are shown on track drainage drawings **SWMP_21** and **SWMP_22** in **Annex B.**

5.5.2 Settlement Ponds

All locations where significant accumulations of dirty water discharge in the vicinity of watercourses will pass through one or a sequence of settlement lagoons in order that suspended solid concentrations released can demonstrably be shown to have no detrimental effect to downstream fish life.

Temporary and permanent settlement lagoons shall be sized to allow treatment of the levels of silt and suspended solids anticipated in construction phase and operational phase runoff respectively and shall be informed by intrusive site investigation post consent.

Where runoff contains solids unlikely to settle adequately in conventional settlement lagoons, it shall be subject to additional treatment by flocculent. In such a scenario, secondary lagoons or a containerised system would be used in which flocculent dosing and final settlement would occur. Particular requirements for flocculent dosing (in terms of type of dosing, concentration, flocculent type etc) would be determined on an observational basis to suit the nature of suspended solids within the runoff measured on site. Treated water from settlement ponds would be discharged over intact vegetation for further treatment.

Typical settlement lagoon arrangements are shown on drawing **SWMP_23** included in **Annex B.**

5.5.3 Vegetative Filtration

In areas not classified as improved agricultural grassland; all runoff from swales, ponds, or other pumped discharges will be dispersed over undisturbed intact vegetation, nominally over agreed riparian watercourse buffer zones, in order to allow vegetative filtration of runoff prior to water entering the receiving watercourse.

5.5.4 Dewatering and Washout Pits

Washout pits to be located local to significant excavations will be designed to accommodate the anticipated volume of contaminated water to be removed from the excavation, either through unavoidable surface water runoff or accumulation of shallow groundwater. Washout pits shall be sized to accommodate the volume for a period until such times as the water has been clarified, with the water subsequently pumped out and into the site drainage system.

5.6 Temporary Spoil Management

Management of spoil, including temporary and permanent spoil generated from excavations, will be considered as part of a Construction Method Statement to be approved by the planning authority prior to construction. Site and drainage design would ensure the following in terms of drainage for temporary spoil management areas:

- There will be no depositing of material within the watercourse buffer zones.
- Spoil shall be placed in such a manner so as to ensure no ponding of surface water on top of spoil heaps. Temporary spoil should be graded to ensure that all direct precipitation will run directly off the surface.
- Temporary spoil deposition areas will be designed to ensure that natural flow paths (drainage channels) are not be altered or blocked by deposited spoil.
- Spoil heaps in the vicinity of watercourses would be surrounded on the low side with silt fences in order to trap fine sediment in runoff.

5.7 Foul Drainage

In order to prevent the requirement for a discharge of treated effluent of poor quality to a watercourse or percolation to groundwater that may cause nutrient enrichment of habitats, foul water from temporary compounds and the permanent substation will drain to temporary or permanent chemical facilities.

There will be no treated foul water discharge from the facilities. Emptying of chemical facilities (by tanker or similar) will be undertaken by a licensed haulier and waste will be disposed of at a suitable licensed waste disposal facility.

Detailed foul design (to establish suitability of cesspool or septic tank etc.) will be determined at detailed design stage incorporating results from percolation tests.

6 CONSTRUCTION PHASE – DETAILED CONSIDERATIONS

Specific requirements to be imposed on any Contractor involved in the construction of the scheme will be further detailed in a Construction Method Statement to be approved by NIEA / the relevant local planning authority prior to construction.

All site personnel will be made aware of their environmental responsibilities at the site induction prior to being allowed to work on site, and through the production of a Method Statement, outlining Environmental Requirements for Sub-Contractors, which will include environmental emergency response procedures to deal with spillages, should they occur.

This section of the report outlines the steps which will be undertaken during the construction phase of the project to ensure compliance with relevant best practice guidance stated in **ES Chapter 9**. Site visits by the SuDS Engineer will be agreed in advance and will be undertaken at various stages of the construction process to ensure that the proposed SuDS scheme is being constructed in line with the design.

Essential mitigation measures relevant to controlling erosion and runoff from construction of the SuDS are described in NIEA's Guidance for Pollution Prevention and Pollution Prevention Guidance notes.

6.1 Planning and Phasing of Drainage Works

6.1.1 Site-Wide Requirements

Temporary or permanent drainage and silt management features (SuDS) will be constructed prior to earthworks (including preliminary or enabling works) proceeding to construct any linear works (tracks / hardstanding areas / cable routes), turbine bases, and other infrastructure. Drainage will be provided to temporary works and reinstated to suit the final footprint of the completed development.

Temporary measures may include:

- Temporary silt fences erected in areas where risk of pollution to watercourses has been identified e.g. watercourse crossing locations and areas where tracks or other infrastructure lie within watercourse buffer zones.
- Upslope cut-off drainage channels approximately parallel to the proposed track alignment installed in advance of any excavated cuttings for the track or turbine hardstanding areas. This will prevent washout by surface flows of exposed clays in excavations and fine sediments in track makeup, and increase efficiency of silt removal in future trackside drainage swales.
- Watercourses, drains, natural flow paths and cut-off drain outlet locations should be identified and charted, in order to ensure that piped crossings can be installed in advance of or adjacent to the track construction.
- Settlement ponds should be constructed in advance of commencing excavations for foundations and at any other locations identified as required at detailed design stage.
- Trackside drainage swales should be installed in parallel with track construction. Note that this may require that drainage swales are reformed on an ongoing basis as temporary track alignments are modified to their eventual finished design level.

In addition, spoil management is to be planned in advance of earthworks and on an ongoing basis, in order to allow planning of drainage required in advance of spoil being deposited.

Suitable prevention measures should be in place at all times to prevent the conveyance of silts to receiving watercourses.

6.1.2 Timing of Works

Works on the site likely to cause a high risk to surface water will be programmed so as to avoid unfavourable prevailing ground conditions and high volumes or extended periods of seasonal rainfall. Site clearance will take place in advance of construction works.

6.2 Specific Construction Phase Measures

6.2.1 Working in the Vicinity of Water / Buffer Zones

Construction buffer zones to drainage features will be set as stated within **Chapter 9: Geology and Water Environment** and are shown on the accompanying Drainage Management Drawings within **Annex A.**

The following procedures apply to the general construction activities either within watercourses or in the vicinity of watercourses (i.e. within buffer zones):

- Due cognisance will be given to the prevailing ground conditions and season when programming the execution of the works, in order to seek to undertake the works in a period with low potential to cause introduction of silt laden runoff to on site water features.
- Works will plan so that trackside drains do not discharge directly into watercourses, but rather through a buffer area of adequate width or via a constructed settlement feature such as pond or sequence of silt fences.
- Cement and concrete will be kept outwith buffer zone to avoid contamination of watercourses.
- Runoff from excavations will NOT be pumped directly to watercourses. Where dewatering of excavations is required, water shall be pumped to the head of a treatment train (swale, basin, or detention pond) in order to receive full treatment prior to re-entry to the natural drainage system.
- SuDS treatment techniques will be utilised to remove silts from runoff prior to the discharge of flows over open vegetated areas.

In the event that a specific short-term risk to water quality is identified on site, specific localised measures will be implemented including:

- Placing temporary filtration silt fences within drainage channels where siltation is observed.
- Installing temporary constructed settlement features such as sumps or settlement ponds / lagoons where required.

6.2.2 Watercourse Crossings

Residual risk to watercourses specific to the construction stage will be fully addressed in the Contractor's construction method statement and, in addition to those points outlined in Section 5.2.2, will include the following:

- Works to install all crossings shall be programmed to coincide with a period of anticipated low drain flow and firm ground conditions in order to minimise potential for silt laden runoff draining toward the stream.
- For closed crossings (culverts) the channel will be dammed upstream of the proposed culvert location using sandbags or similar in order to provide a dry working environment at the culvert location. Dammed flows will be pumped out of channel and returning directly to the drain shortly downstream of the culvert location. Erosion protection shall be placed at the point of pump return. All pumping will be controlled on a contractor permit-to-pump scheme, such that pumping operations can be carefully planned, installed and monitored.
- Geotextile silt fences shall be installed adjacent to the drain bank upstream and downstream of the culvert location in order to filter contaminated runoff that may be caused by plant movement associated with the culvert installation. A sequence (minimum 2 no.) in-channel geotextile check dams will be installed within the drain channel downstream of the culvert location and downstream of the pump-return.
- The culvert comprising pre-cast concrete or pre-formed plastic pipes shall be installed and backfilled with suitable aggregate. Headwalls and scour protection to the drain bed shall be formed at the culvert inlet and outlet using dry formed components (lean-mix concrete-filled sandbags or similar). Washed gravel or pebbles (including if feasible that material recovered from the natural substrate excavated to permit the culvert installation) shall be introduced to cover and protect the extent of the drain channel affected by excavations. No wet concrete or cementitious material shall be required to be used within the channel.
- Over pumping and upstream dams shall be removed and water permitted to pass through the culvert. Downstream in-channel filtration check dams shall be retained and renewed as necessary in order to trap sediment until any residual washout of sediment from the exposed excavation has stabilised to a normal (pre-construction) level.

- Geotextile or equivalent splash-guards shall be erected to the track embankment over the culvert or clear span crossing prior to trafficking.

6.2.3 Turbine Bases and Crane Pads

Excavated turbine foundations are likely to result in large volumes of displaced excavated material as spoil, as well as concrete operations. Specific measures are therefore required to manage potential for silt laden runoff from spoil, silt laden runoff from pumped dewatering, and cementitious contamination in pumped dewatering from turbine bases.

Concrete will not be allowed to enter watercourses under any circumstances, and drainage from excavations in which concrete is being poured will not be discharged directly into existing watercourses without appropriate treatment. Delivery trucks, tools and equipment will be cleaned at designated washout areas located conveniently and within a controlled area of the construction compound. Runoff from wash-out areas will be appropriately stored within bunded containers and removed off-site by an appropriate waste disposal company. In addition the following drainage measures will apply;

- Installation of cut-off drains around the working areas to intercept clean surface runoff and divert it around and away from the works.
- Minimising the stockpiling of materials and locating essential stockpiles outside any watercourse buffer zone.
- Polluted (silt laden) water collected in the base of any excavation would be gathered in a sump, and pumped at a low flow rate into either the mini-settlement pond or track swale for treatment. Dewatering of excavations direct to watercourses will not be permitted.
- The foundation working areas should be re-vegetated as soon as possible after construction.

6.2.4 Cable Trenches

It is noted that where feasible, the design of cable trench alignment will avoid the creation of preferential flow routes. The following shall apply to the construction of all cable trenches at the site:

- To minimise impacts from disturbance, cables will be laid in small trenches along the side of access tracks, as far as possible.
- Due cognisance will be given to the prevailing ground conditions and season when programming the execution of the works, in order to seek to undertake the works in a period with low potential to cause introduction of silt laden runoff from excavations.
- Excavation of cable trenches will be carried out over short distances, with frequent backfilling of trenches, in order to minimise opportunity for the ingress of water into open trenches.
- Temporary silt traps will be provided in longer trench runs and on steeper slopes.
- Where constructed trackside swales are disturbed by cable installation, swale slopes will be correctly reinstated post infilling of the cable trench.

6.2.5 Dewatering

In order to control dewatering activities and to ensure that all dewatering allows for pollution prevention measures, a permit-to-work system will be imposed on the Contractor, particularly to ensure pumped dewatering from excavations is controlled. A permit will be required to be issued to a competent person prior to allowing any specific dewatering to commence.

6.2.6 Use of Flocculant

The use of flocculant is generally discouraged where possible in favour of using conventional settlement techniques to remove suspended solids, due to the preference to avoid introducing artificial chemicals to the surface water environment.

Where flocculant is ultimately required on a temporary basis, due to the presence of extremely fine particles within clays or aggregates that cannot be effectively removed using filtration or settlement ponds or where a particular pollution risk is observed due to weather conditions, then it will be installed at settlement lagoons per the detail shown on drawing **SWMP_23** in **Annex B.**

Flocculant would generally be installed in solid form in a culvert with water allowed to flow around the flocculant block. A datasheet for the flocculant type preferred, comprising a cationic polyacrylamide, is included in **Annex C**, confirming that the product is non-toxic – refer specifically to datasheet Section 12.

Use of flocculant, which will be on a temporary basis-only, will be strictly regulated with a permit scheme to be put in place and competent person installed to oversee installation, monitoring and removal of flocculant. The permit scheme will record the location, time and date of installation, date of removal, and the quantity of product used, and this schedule will be maintained for inspection by the interested regulatory body, nominally NIEA:WMU.

Flocculant would be required to be removed immediately upon reduction of the observed pollution risk that prompted its use.

6.2.7 Excavated Track Drainage

Excavated type tracks are initially expected to be used in all instances at the site. Where this construction type is specified, all track runoff (polluted water) would be directed to flow to track-side drainage channels as per Section 5.4, to be installed as tracks are constructed.

Due to anticipated low rates of infiltration and high ground water tables, as is common in predominately peat conditions, it is likely across the majority of the site that flows will not percolate through the base of the swale and will therefore be discharged from the swale via frequent spillways created through the embankments on the downhill sides of the access tracks.

Drainage swales and track shoulders will be re-vegetated as soon as feasible after completion of the track and drainage across the site. Typical drainage installation for excavated tracks is shown on drawing **SWMP_21** in **Annex B.**

6.2.8 Floated Track Drainage

Where a floating type track construction is specified, existing drainage paths are not to be unnecessarily re-routed or changed. Existing drainage paths and overland flow-routes should be maintained through the placement of drainage pipes at existing land drainage locations and/or at regular intervals.

Track runoff will be directed over the edge of the track structure to discharge across existing vegetation to allow filtration / settlement of suspended solids. Typical drainage installation for floated tracks is shown on drawing **SWMP_22** in **Annex B.**

7 MAINTENANCE

7.1 Construction Phase

The following is intended to inform the detailed drainage / SuDS maintenance manual for the construction phase.

It is envisaged that an Engineer specialising in surface water management and SuDS would be required to undertake regular site inspections during the construction phase of the wind farm, in order to validate that any detailed SuDS design and associated requirements to ensure construction methods are adhered to on site, and in order to identify areas where additional or enhanced mitigation is required.

In addition to the regular site inspections carried out by the Engineer, the following construction inspections will be undertaken during the construction phase of the project. The list is not exhaustive and should be added to as per the requirements of the site.

7.1.1 Swales / Check Dams

- All check dams and settlement basins to be checked weekly in dry weather and daily during periods of heavy rainfall via a walkover survey during the construction phase. Excess trapped silt to be removed and disposed of/ re-used as may be agreed with relevant authorities.
- Where check dams have become fully blocked with silt, they should be replaced. Procedure for replacement of the check dam as follows:
  - silt deposits to be removed from the upstream side of check dams.
  - removed silt to be buried or re-used by spreading in an area of the site where surface runoff will not convey silt deposits back to a watercourse.
  - where there are regular incidents of check dam blockage further check dams to be installed (every 15-20 m intervals) within the swales.
- Monitor side slopes of swales and basins and reinstate any areas of slope slippage by battering back or otherwise as may be appropriate;
- Should there be noticeable effects of erosion along the swales or at discharge points, suitable erosion protection measures such as placement of large stones or erosion protection textiles should be installed at the area affected;
- Any temporarily stored or stockpiled material will be placed in a manner to ensure stability and set back sufficiently far such that in the case of unforeseen collapse, spoil would not cause infilling of swales.

7.1.2 Settlement / Detention Basins

- Basin inlets to be cleared of debris.
- Silt in aggregate forebays to be removed by excavator and disposed of. Any aggregate removed to be replaced with clean stone.
- Any flow control device (orifice, weir or similar) to be checked and cleared of any debris.

7.2 Operational Phase

A post construction phase maintenance manual will be produced upon production of as built drainage survey for the site. This maintenance manual will contain recommendations identified above, augmented with further drainage findings collected during the construction phase which are deemed to assist in provision of long-term drainage management for the site.

8 SUMMARY AND CONCLUSION

8.1 Assessment of Post-Construction WFD Status

As noted at the outset of this document (**section 1.3**), although the UK has now exited the EU, the Water (Amendment) (Northern Ireland) (EU Exit) Regulations 2019 ensures that the Water Framework Directive (as transposed) and the various supporting pieces of water legislation continue to operate in Northern Ireland after 1 January 2021[2]. Therefore, there remains a fundamental requirement to attain good ecological water status and that deterioration in the status of water is prevented.

Chapter 9: Geology and Water Environment of the ES outlines mitigation measures specifically in relation to management of surface water (detailed further in this SWMP) to prevent deterioration of water quality and quantity. As the ES chapter concludes that overall residual effects of the Unshinagh Wind Farm on the water environment are 'not significant', WFD objectives are deemed to have been satisfied.

8.2 Conclusion

Following incorporation of site-wide general binding mitigation control measures, NIEA approved Guidance for pollution prevention (GPPs) and pollution prevention guidelines (PPGs), and site specific mitigation, no adverse effect is anticipated to the Water Framework Directive classification of the affected waterbodies caused by the Unshinagh Wind Farm Development.

[2] https://www.daera-ni.gov.uk/articles/water-framework-directive