Cush Wind Farm

# Environmental Impact Assessment Report

# Annex 3.4: Planning-Stage Construction & Environmental Management Plan

Cush Wind Limited

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# Contents



# 1.0 Introduction

Galetech Energy Services (GES), on behalf of Cush Wind Limited, has prepared this Planning-Stage Construction & Environmental Management Plan (CEMP) for the construction of the Cush Wind Farm.

## 1.1 Purpose of this Report

This CEMP has been prepared to outline the management of activities during the construction of the project to ensure that all construction activities are undertaken in an environmentally responsible manner. This CEMP summarises the environmental commitments made in respect of the project and the measures to be adopted to ensure compliance with legislation and the requirements of statutory bodies.

This CEMP (Planning-Stage/Preliminary) is a live document and will be updated by the appointed contractor prior to the commencement of development. Prior to the commencement of construction, the updated CEMP will be reviewed by the Environmental Manager (EM) and Ecological Clerk of Works (EcoW), as necessary, to confirm the appropriateness of the measures set out therein. This CEMP will form part of the main civil construction works contract. The contractor will take account of the structure, content, methods and requirements contained within the various sections of this CEMP when further developing this document (to include environmental plans and other related construction management plans and method statements) as required.

## 1.2 Objectives of this CEMP

This CEMP has been developed in accordance with the Institute of Environmental Management and Assessment (IEMA) *Practitioner Environmental Management Plans Best Practice Series Volume 12 (December 2008)* and has been designed to address the proposed environmental construction strategies that are to be implemented in advance of and during the construction of the project.

This CEMP aims to define good working practices as well as specific actions required to implement mitigation requirements as identified in the Environmental Impact Assessment Report (EIAR), Natura Impact Statement (NIS), the planning process, and/or other licensing or consenting processes.

## 1.3 Structure of this CEMP

The CEMP has been structured such that it can be read as consolidated document or as discreet documents addressing specific environmental topics. In particular, we refer to the technical annexes enclosed which address specific matters such as spoil management, surface water management, waste management, and emergency responses.

A copy of the CEMP will be maintained in the site offices for the duration of the construction phase and will be available for review at any time. The contractor's EM will be responsible for the continued development of the CEMP throughout the construction phase.

Where specific construction management plans or method statements are prepared by the contractor, these will be inserted into the relevant section of this CEMP.

## 1.4 Roles & Responsibilities

Cush Wind Limited, and its appointed Project Manager, will be responsible for the overall implementation of the environmental measures and procedures set out in the CEMP. The role of the Project Manager relates to compliance monitoring with the

CEMP and other planning/environmental/licensing requirements. Additionally, the Project Manager shall be empowered to halt works where he/she considers that continuation of the works would be likely to result in a substantial environmental risk.

The Project Manager will also carry out site checks that the works are being undertaken in accordance with the CEMP and will prepare a record of same.

The contractor will appoint an EM who will be responsible for coordination and development of the CEMP and any other surveys, reports or construction management plans necessary for the discharge of the requirements of the CEMP. The EM will also review the contractors construction management plans as required, carry out compliance auditing during the construction phase and coordinate the Environmental Management Group (see below) and required liaisons between Cush Wind Limited, the contractor, and other statutory authorities.

Prior to commencement of construction, the contractor will identify a core Environmental Management Group, comprising of specific project personnel and including the Project Manager, EM, and Ecological Clerk of Works (ECoW). The Environmental Management Group will meet monthly to discuss the monthly environmental report and will advise site personnel on areas where improvements may be made on site. The group will draw on technical expertise from relevant specialists where required and will liaise with other relevant external bodies as required.

### 1.5 Reporting Procedures

Appropriate reporting procedures are key to the proper implementation of the measures outlined within this CEMP and include reporting between parties involved in the construction of the project and also external stakeholders, such as the relevant local authorities.

Emergency and environmental incident reporting procedures are set out in the Environmental & Emergency Response Plan (see **Annex 1**).

## 2.0 Description of the Project

In summary, the project comprises the following main components:-

- 8 no. wind turbines with an overall tip height of 200m, and all associated ancillary infrastructure;
- All associated and ancillary site development, excavation, construction, landscaping and reinstatement works, including provision of site drainage infrastructure and forestry felling.
- Temporary alterations to the turbine component haul route; and,
- Construction of an electricity substation, Battery Electricity Storage System and installation of 5.6km of underground grid connection to facilitate connection of the proposed electricity substation to the existing 110kV substation at Clondallow, County Offaly;

The project site is located in rural Co. Offaly, approximately 4km north of the town of Birr and c. 28km south-west of Tullamore, County Offaly. Off-site and secondary developments; including the forestry replant lands and candidate quarries which may supply construction materials; also form part of the project.

The turbine component haul route, and associated temporary alteration works, are located within counties Galway, Roscommon, Westmeath, and Offaly. It is envisaged

that the turbines will be transported from the Port of Galway, through the counties of Galway, Roscommon, Westmeath and Offaly, to the project site.

Various environmental reports have been prepared in respect of the project and have been utilised in the preparation of this CEMP, including:-

- Environmental Impact Assessment Report (Galetech Energy Services); and
- Natura Impact Statement (SLR Consulting).

## 3.0 General Construction Sequence

The construction phase is likely to last for approximately 15-18 months from commencement of detailed site investigations through to the installation and commissioning of the turbines and ending with site reinstatement and landscaping.

The construction phase of the development will comprise a six day week with normal working hours from 07:00 to 19:00 Monday to Friday and 07:00 to 13:00 on Saturdays. It may be necessary to undertake works outside of these hours to avail of favourable weather conditions (e.g. during time of low wind speed to facilitate turbine erection etc.) or during extended concrete pours (e.g. where turbine foundation pours must be completed within 24 hours). Where construction activities are necessary outside of the normal working hours, local residents and the Planning Authority will receive prior notification.

### 3.1 Construction Method

The construction method will consist of the following general sequence:-

- Preliminary traffic management and surface water protection measures to be implemented;
- Creation of the site entrances, to be commenced and completed, ensuring that adequate visibility splays are provided;
- Progressive installation of surface water protection measures;
- Establishment and continued management of spoil deposition areas;
- Progressive construction of internal on-site access tracks utilising material extracted from on-site, where possible, and imported from local quarries;
- Construction of the temporary construction compounds for offloading materials and equipment, and to accommodate temporary site offices;
- Construction of bunded areas for oil, fuel and lubricant storage tanks;
- As the internal access tracks progress to each turbine location, tree felling will be completed and foundation excavations for the turbines will commence, and foundations laid. The hardstand areas will be constructed as track construction advances;
- Temporary alteration works along the turbine component haul route will be commenced;
- Once the on-site access tracks are completed, the trenching and laying of underground cabling will begin;
- Site preparatory and groundworks associated with the wind farm control building, construction of the building followed by the installation of electrical and ancillary equipment;
- Installation of turbines will commence once the on-site access tracks, hardstands, foundations and drainage measures are in place and the road upgrade works are complete. It is anticipated that each turbine will take approximately one week to install. Two cranes will be used for this operation. As each turbine is completed, the electrical connections will be made;

- Decommissioning of the temporary meteorological mast and installation of the permanent meteorological mast will then take place; and,
- Progressive site reinstatement, restoration and landscaping including re-profiling of spoil deposition areas, removal of turbine storage areas; erection of post-and-wire fencing around turbines, access tracks and at site entrances; decommissioning of construction phase site entrances; establishment of operational site entrances; erection of gates and vegetation at site entrances; and decommissioning of the temporary construction compounds.

The construction method for the proposed substation and grid connection will consist of the following general sequence (to be completed concurrently with wind farm construction):-

- Site preparatory and groundworks associated with the substation compound footprint including control buildings;
- Construction of the IPP and EirGrid buildings;
- Construction of bases or plinths for electrical apparatus, including battery energy storage system containers;
- Erection of palisade fencing around substation;
- Installation of internal and external electrical apparatus in control buildings and within compound area;
- Installation of underground electricity cables (including joint bays and communication chambers,) between substation and Dallow 110kV electricity substation;
- Connection of underground electricity cables to the respective substations;
- Commissioning of electrical apparatus and underground electricity cables; and
- Progressive site reinstatement, restoration, landscaping and planting proposals including the installation of stockproof fencing and the erection of gates.

Once the turbines are installed, and the substation and electrical system completed, the turbines will be tested and commissioned.

In addition to the roles of the EM and ECoW described above, the construction phase will be supervised by a range of environmental and engineering specialist personnel; including a Project Supervisor for the Construction Stage (PSCS), Archaeological Clerk of Works (ACoW), and Geotechnical Clerk of Works (GCoW), among others; who will liaise closely with the appointed contractor's EM to monitor and to ensure that all applicable measures are implemented.

## 3.2 Site Entrances

During the construction phase, 2 no. temporary site entrances will be required to facilitate temporary access to the project site (wind farm), directly opposite each other on either side of the N62. The existing agricultural/forestry entrances at these locations will be upgraded in order to provide the construction phase entrances to the project. Each entrance will be appropriately designed to ensure all visibility splays (sightlines) are provided[1].

Following the construction phase, the specifications of the temporary construction phase site entrances will no longer be needed to accommodate abnormal-sized loads. These entrances will be fenced off and will only be used in rare occasions in the

[1] Visibility onto National Road to be provided in accordance with TII Publication *Geometric Design of Junctions (priority junctions, direct accesses, roundabouts, grade separated and compact grade separated junctions)* – DN-GEO-03060.

event of a major turbine component replacement during the operational phase of development (e.g. replacing a turbine blade or gearbox/generator).

Both operational phase site entrances from the L30033 and L300321 will also be constructed in accordance with the requirements of the Planning Authority regarding the provision of appropriate site visibility splays to ensure traffic safety.

## 3.3 Hardstanding Areas and On-Site Access Tracks

The areas of hardstanding for crane operations and on-site access tracks will generally be constructed as follows:-

- Topsoil and subsoil will be removed and stored in separate mounds in appropriate areas adjacent to the crane site/access tracks;
- Rock/stone will be laid on a geo-textile mat (where required) and compacted in layers to an appropriate depth. The sub-layers of the hardstanding areas and access tracks will be constructed of rock/stone, sourced from local and appropriately licenced quarries, with the upper layer comprising capping material (also sourced locally). All such areas of hardstanding will be permeable to avoid significant volumes of surface water run-off;
- Where access tracks are required to cross manmade drainage ditches, these will be piped or spanned with an appropriate bridging structure. Where access tracks cross a natural watercourse, bottomless culverts will be installed (where possible) to prevent any interference with the hydraulic capacity of the watercourse. Crossing the Rapemills River will be fully clear span, negating the need for any in-river culvert structures; and,
- Areas of temporary hardstanding (for turbine component storage and crane assembly) will be reinstated following the construction phase by removing aggregates, replacing the excavated spoil and reseeding. The crane hardstandings and on-site access tracks will be retained during the operational phase to facilitate access for maintenance personnel and in the event of a major component change-out.

## 3.4 Temporary Construction Compounds

Topsoil will be removed from the required areas and side cast for temporary storage adjacent to the compound areas. The compound bases will be made up of well graded aggregates, compacted as necessary. A designated waste management area and fuels and chemicals storage area will be provided along with site offices, parking, staff welfare facilities and equipment storage areas. The compounds will be fenced with temporary security fencing to restrict access. Following the completion of the construction phase, the temporary construction compounds will be fully removed and the compounds will be reinstated with excavated material and reseeded or allowed to revegetate naturally, where appropriate to do so.

## 3.5 Chemical Storage and Refuelling

Storage areas for oils, chemicals and fuels will comprise bunded areas of hardstand of sufficient capacity within the temporary construction compound. Bunds will have a watertight roof structure and will be supplied by a licensed manufacturer to enable adequate safe storage for the quantities of material required. An adequate supply of spill kits will be readily available in order to clean up any minor spillages should they occur. A hydrocarbon interceptor will be installed within the surface water drainage system during the construction phase to trap any hydrocarbons that may be present. As part of the design process, a 50m buffer has been observed around all surface water features and no fuel/chemicals shall be handled or stored within this zone.

From the construction compound, fuel will be transported to works area by a 4x4 in a double skinned bowser with drip trays under a strict protocol and carried out by suitably trained personnel. The bowser/4x4 will be fully stocked with spill kits and absorbent material, with delivery personnel being fully trained to deal with any accidental spills. The bowser will be bunded appropriately for its carrying capacity. As above, a 50m buffer will be observed around all surface water features and no refuelling will be permitted within this zone.

## 3.6 Construction Waste Management

Waste will be generated during the construction phase and the main items of anticipated construction waste are as follows:-

- Hardcore, stone, gravel, concrete, plaster, topsoil, subsoil, timber, concrete blocks and miscellaneous building materials;
- Waste from chemical portaloo toilets;
- Plastics; and
- Oils and chemicals.

Waste disposal measures proposed include:-

- On-site segregation of all waste materials into appropriate categories including, for example, topsoil, bedrock, concrete, bricks, tiles, oils /diesels, metals, dry recyclables e.g. cardboard, plastic, timber;
- All waste materials will be stored in skips or other suitable and sealed receptacles in a designated area of the construction compound;
- Wherever possible, left over materials (e.g. timber off-cuts) and any suitable demolition materials shall be re-used on-site;
- Uncontaminated excavated material (rock, topsoil, sub-soil, etc.) will be re-used on-site in preference to importation of clean inert fill;
- Bedrock may be encountered during foundation excavation. If bedrock is encountered it will be utilised for infill during construction;
- All waste leaving the site will be transported by permitted contractors and taken to suitably licensed or permitted facilities and will be recycled, recovered or reused, where possible; and
- All waste leaving the site will be recorded in accordance with legal requirements and copies of relevant documentation maintained.

## 3.7 Construction Employment

It is estimated that up to 100 no. people will be employed during the 15-18 month construction phase. The actual number will depend on the activities being undertaken at any given time and will vary throughout the course of the construction programme. Employment will be the responsibility of the construction contractor but it is likely that the workforce will include labour from the local area.

## 3.8 Construction Traffic

Vehicular traffic required for the construction phase is likely to include:-

- Articulated trucks (HGVs) to bring initial equipment onto site and later to bring the turbine components, electrical cables, steel reinforcement for foundations, anemometer mast, and ancillary equipment;
- Tipper trucks and excavation plant involved in site development and excavation works;
- Cranes to erect the turbines;

- Miscellaneous vehicles and handling equipment, including vehicles associated with construction workforce.

Effects from construction traffic could include temporarily increased local traffic levels and traffic noise. Construction traffic on the local road network will be managed in accordance with a Traffic Management Plan and the requirements of the Planning Authority (Authorities). This may include the installation of temporary road signage and traffic lights, as appropriate. Noise arising from construction traffic would be localised, temporary and of a short term duration.

Deliveries of turbine components will take place at times to avoid peak traffic periods, and are likely to occur during night-time hours. All abnormal loads will be accompanied by an advance escort vehicle.

Traffic mitigation measures will be implemented during the construction phase, as follows:-

- Signage at site entrances giving access information;
- Temporary traffic restrictions kept to minimum duration and extent;
- Diversions put in place to facilitate continued use of roads, where restrictions have to be put in place (e.g. along the UGL route) ;
- Construction traffic management – one way systems where possible and strictly enforced speed limits;
- Provision of a designated person to manage access arrangements and act as a point of contact to the public; and
- All temporary road alterations and public road upgrades to be carried out in full consultation with the Planning Authority.

Once the turbines are operational, the traffic movements will be greatly reduced to, on average, once/twice per week by a light commercial vehicle for maintenance purposes. There may be an occasional need to replace some turbine components, but these are unlikely to be frequent.

## 4.0 Environmental Management Measures

### 4.1 'Designed-In' Measures

The following measures will be implemented, as standard, as part of the construction of the project:-

- Vegetation, soil, subsoil and rock (where encountered) removed during the construction of turbine foundations will be side-cast and appropriately stockpiled and, in so far as is practicable, re-used to reinstate the foundation and provide additional ballast. Any excess material arising will be utilised, firstly, for reinstatement purposes elsewhere within the project site (e.g. landscaping of hardstands and access tracks or reinstatement) or, as required, deposited at the dedicated spoil deposition areas;
- Temporary set down areas will be located immediately adjacent to each hardstand during the construction phase to accommodate the temporary storage of turbine components following their delivery to the project site, and crane components during crane assembly. Following the erection of the turbines, these set-down areas will be reinstated with excavated material, re-seeded and allowed to revegetate;
- A geotextile layer may be needed in some locations to avoid any subsequent vehicle access problems. Some cut/fill in the construction of the access tracks will be necessary to ensure that horizontal and vertical alignments are suitable

to accommodate abnormal HGV loads and to provide adequate drainage, however this is unlikely due to the flat nature of the project site. The wind turbine manufacturer shall be consulted during the post-consent detailed design process to ensure that the access tracks are suitable to accommodate turbine components. This may necessitate some immaterial deviations in the precise alignment of the access tracks;

- Following the construction phase, access tracks, passing bays and turning heads that are not required during the operational phase will be reinstated, wherever possible. It is likely, however, that the majority of the tracks will be required during the operational phase for maintenance operations and will be used as part of ongoing agricultural activities within the subject site;
- Where it is necessary for access tracks to cross drains/watercourses, the relevant bodies (e.g. Inland Fisheries Ireland, Office for Public Works (OPW), etc.) will be consulted prior to construction. As appropriate, a Section 50 Licence application will be made to the OPW prior to the installation of culverts/bridging structures over relevant watercourses;
- Site entrances, both construction phase (temporary) and operational, will be constructed in accordance with the requirements of the Planning Authority regarding the provision of appropriate site visibility splays to ensure traffic safety. A Road Safety Audit has been prepared in respect of works at the site entrance locations, as well as the temporary alteration works to the haul route at the N62/N52 Junction;
- The temporary construction compounds have been located and designed such that all cabins, storage containers, waste management facilities and bunded areas will be located a minimum distance of 50m from all natural watercourses in order to minimise the risk of pollution and the discharge of deleterious matter to watercourses. Stormwater which may arise from the roofs of cabins, containers or from sealed bunds will be passed through an oil interceptor prior to being discharged to the local environment;
- Prior to the commencement of development at the site, a detailed Peat and Spoil Management Plan will be prepared following the post-consent detailed design process and will address the re-use, reinstatement, storage and restoration of all material excavated during the construction phase including detailed methodologies regarding the establishment and management of the spoil deposition areas for the project;
- Following the completion of construction, the deposition areas will be graded to match the profile of surrounding land. Works at the spoil deposition areas will be monitored, on a weekly basis during the construction phase and monthly for a 6-month period thereafter, by an appropriately qualified geotechnical engineer;
- In the event that material is generated which is unsuitable for storage within the deposition areas (e.g. tarmac cuttings), this shall be removed from site and disposed of at a licensed waste disposal facility;
- A micrositing allowance of 20m in any direction is proposed for wind turbines in accordance with Section 5.3 of the *Wind Energy Development Guidelines for Planning Authorities 2006*[2]. It is anticipated that the agreed micrositing distance will form a condition accompanying a grant of planning permission. It is also proposed that hardstands, access tracks, meteorological mast, and

[2] Flexibility regarding wind turbine positioning is also referred to at Section 7.5 of the Draft Revised Wind Energy Development Guidelines 2019.

underground cables may be immaterially micro-sited subject to compliance with the mitigation measures included in the EIAR;

- During the delivery of turbine components to site, all HGVs will be accompanied by escort vehicles. An Garda Síochána will also be informed prior to turbine component transportation as it will be necessary to temporarily close junctions as the components pass through;
- Only fully licensed quarries which have been subject to EIA and have appropriate planning permission for the volumes of material to be extracted will be used. These aggregates are slated for extraction in the normal course of the relevant quarry's business and therefore will have no additional likely significant environmental impacts above and beyond those normally entailed in the operation of the quarry;
- All trenching works will be undertaken to ensure that only short sections of trench are open at any one time. Excavated materials will be stored separately (subsoil, topsoil, and aggregates) for use during the reinstatement of the trench/joint bays/communication chambers or disposal to an appropriate licensed facility as necessary;
- Prior to the commencement of construction, a detailed Method Statement will be prepared by the contractor outlining the precise methodology to be put in place during the trenching phase. This Method Statement will be reviewed by the Environmental Manager (EM; to be appointed by the contractor) to ensure that the environmental protective measures to be implemented are suitable and to the required standard;
- All tree felling to be undertaken will be the subject of a felling licence application to the Forest Service in accordance with the Forestry Act 2014 and the Forestry Regulations 2017;
- As described above, trees and hedgerows will be felled and removed to facilitate the physical footprint of the project. The extent of vegetation removal has, by design, been minimised and no vegetation will be unnecessarily removed. As part of the reinstatement process; all forestry felled will be replaced on a like for like basis on the identified replant lands (or an alternative site within the State, subject to necessary consents) and any hedgerow removed in the construction of wind farm infrastructure will be replaced elsewhere within the project site, particularly along arterial access tracks and behind visibility splays;
- A preliminary Surface Water Management Plan (SWMP) has been prepared for the construction phase of the project. This SWMP will be further developed prior to the commencement of development, following the post-consent detailed design process, and will incorporate the precise implementation and siting of surface water management infrastructure;
- The construction phase of the development will comprise a 6-day week with normal working hours from 07:00 to 19:00 Monday to Friday and 07:00 to 13:00 on Saturdays. It may be necessary to undertake works outside of these hours to avail of favourable weather conditions (e.g. during times of low wind speed to facilitate turbine erection etc.) or during extended concrete pours (e.g. where turbine foundation pours must be completed within 24-hours). Where construction activities are necessary outside of the normal working hours, local residents and the Planning Authority will receive prior notification;
- A detailed CEMP will be prepared in advance of all construction activities and will incorporate all mitigation measures proposed in this EIAR;
- The construction phase will be supervised by a range of environmental and engineering specialist personnel; including a Project Supervisor for the

Construction Stage (PSCS), Ecological Clerk of Works (ECoW), Archaeological Clerk of Works (ACoW), and Geotechnical Clerk of Works (GCoW), among others; who will liaise closely with the Environmental Manager to monitor and to ensure that all applicable measures are implemented;

- Following the delivery of turbine components, and following the construction phase, the specifications of the temporary construction phase site entrances will no longer be needed to accommodate abnormal-sized loads. These entrances will be fenced off and will only be used in rare occasions in the event of a major turbine component replacement during the operational phase of development (e.g. replacing a turbine blade or gearbox/generator);
- Following the completion of all turbine component deliveries, the temporary site entrances will be reinstated to their pre-existing condition, including the replanting of all removed hedgerows;
- Where access tracks are required to cross manmade drainage ditches, these will be piped or spanned with an appropriate bridging structure. Where access tracks cross a natural watercourse, bottomless culverts will be installed (where possible) to prevent any interference with the hydraulic capacity of the watercourse. Crossing the Rapemills River will be fully clear span, negating the need for any in-river culvert structures;
- Areas of temporary hardstanding (for turbine component storage and crane assembly) will be reinstated following the construction phase by removing aggregates, replacing the excavated spoil and reseeding. The crane hardstandings and on-site access tracks will be retained during the operational phase to facilitate access for maintenance personnel and in the event of a major component change-out; and
- Waste will be generated during the operational phase including, for example, cooling oils, lubricating oils and packaging from spare parts or equipment. All waste will be removed from site and reused, recycled or disposed of in accordance with best-practice and all regulations at a licensed facility.

## 4.2 Population & Human Health

No measures, specific to population and human health, are necessary during the construction phase. Local residents and communities will be protected through the implementation of measures provided for (and committed to) in other topics including the protection of water quality, minimisation of dust emissions, minimisation of noise emissions, and appropriate traffic management procedures.

## 4.3 Biodiversity

### 4.3.1 Designated Nature Conservation Sites, Fisheries and Aquatic Ecology

Mitigation measures to prevent adverse effects on downstream Natura 2000 sites during construction are provided in full in the Natura Impact Statement (NIS), **Chapter 7** of the EIAR, and at **Section 4.5** below. These will ensure no deterioration in the quality of water entering the River Shannon Callows Special Area of Conservation (SAC), Lough Derg North East Shore SAC, and Middle Callows Special Protection Area (SPA) and will ensure there will be no impacts on any QI habitats and species. The same is true for IEF non-QI aquatic habitats and species.

In order to mitigate potential impacts during the construction phase, best practice construction methods will be implemented in order to prevent water (surface water and groundwater) pollution. Good practice measures will be applied in relation to pollution risk, sediment management and management of surface runoff rates and volumes.

All personnel working on the project will be responsible for the environmental control of their work and will perform their duties in accordance with the requirements and procedures of this CEMP.

During the construction phase, all works associated with the construction of the project will be undertaken in accordance with the guidance contained within CIRIA Document C741 'Environmental Good Practice on Site' (CIRIA, 2015). Any groundwater encountered will be managed and treated in accordance with CIRIA C750, 'Groundwater control: design and practice' (CIRIA, 2016).

*Clear Felling and Surface Water Quality Effects*
*Best practice methods related to water incorporated into the forestry management and mitigation measures have been derived from:-*

- *Department of Agricultural, Food and the Marine (2019) Standards for Felling and Reforestation;*
- *Forestry Commission (2004) Forests and Water Guidelines, Fourth Edition. Publ. Forestry Commission, Edinburgh;*
- *Coillte (2009) Forest Operations and Water Protection Guidelines;*
- *Coillte (2009) Methodology for Clear Felling Harvesting Operations; and,*
- *Forest Service (2000: Forestry and Water Quality Guidelines. Forest Service, DAF, Johnstown Castle Estate, Co. Wexford.*

**Mitigation by Avoidance**

There is a requirement in the *Forest Service Code of Practice* and in the *FSC Certification Standard* for the installation of buffer zones adjacent to aquatic zones at planting stage.

During the construction phase, a self-imposed conservative buffer zone of 50m will be maintained for all Rapemills River and West Galros Stream where possible.

Of the 23 ha proposed for felling, only c.2.5ha are located inside the 50m buffer zone.

The large distance between the majority of the felling areas and sensitive aquatic zones means that any poor quality runoff arising from felling areas can be adequately managed and attenuated prior to even reaching the aquatic buffer zone and primary drainage routes. Where tree felling is required in the vicinity of streams, the additional mitigation measures outlined below will be employed.

**Mitigation by Design**

Mitigation measures which will reduce the risk of entrainment of suspended solids and nutrient release in surface watercourses comprise best practice methods, as follows:-

- Machine combinations (i.e. handheld or mechanical) will be chosen which are most suitable for ground conditions and which will minimise soils disturbance;
- Checking and maintenance of tracks and culverts will be ongoing through any felling operation. No tracking of vehicles through watercourses will occur. Where possible, existing drains will not be disturbed during felling works;
- Ditches which drain from the areas to be felled towards existing surface watercourses will be blocked, and temporary silt traps will be constructed. No direct discharge of such ditches to watercourses will occur. Drains and sediment traps will be installed during ground preparation. Collector drains will be excavated at an acute angle to the contour (~0.3%-3% gradient), to minimise flow velocities. Main drains to take the discharge from collector drains will include water drops and rock armour, as required, where there are steep gradients, and avoid being placed at right angles to the contour;

- Sediment traps will be sited in drains downstream of felling areas. Machine access will be maintained to enable the accumulated sediment to be excavated. Sediment will be carefully disposed of in the spoil disposal areas. All new silt traps will be constructed on even ground and not on sloping ground;
- In areas particularly sensitive to erosion or where felling inside the 50m buffer is required, it will be necessary to install double or triple sediment traps;
- All drainage channels will taper out before entering the 50m buffer zone. This ensures that discharged water gently fans out over the buffer zone before entering the aquatic zone, with sediment filtered out from the flow by ground vegetation within the zone. On erodible soils, silt traps will be installed at the end of the drainage channels, to the outside of the buffer zone;
- Drains and silt traps will be maintained throughout all felling works, ensuring that they are clear of sediment build-up and are not severely eroded. Correct drain alignment, spacing and depth will ensure that erosion and sediment build-up are minimized and controlled;
- Brash or bog mats will be used to support vehicles on soft ground, reducing topsoil and mineral soils erosion and avoiding the formation of rutted areas, in which surface water ponding can occur. Brash mat renewal will take place before they become heavily used and worn. Provision will be made for brash mats along all off-road routes, to protect the soil from compaction and rutting. Where there is risk of severe erosion occurring, extraction will be suspended during periods of high rainfall;
- Timber will be stacked in dry areas, and outside the 50m watercourse buffer. Straw bales and check dams will be emplaced on the down gradient side of timber storage/processing sites;
- Works will be carried out during periods of no, or low, rainfall in order to minimise entrainment of exposed sediment in surface water run-off;
- Checking and maintenance of roads/tracks and culverts will be ongoing through the felling operation;
- Refuelling or maintenance of machinery will not occur within 50m of a watercourse. Mobile bowser, drip kits, qualified personnel will be used where refuelling is required;
- A permit to refuel system will be adopted:
- Branches, logs or debris will not be allowed to build up in aquatic zones. All such material will be removed when harvesting operations have been completed, but care will be taken to avoid removing natural debris deflectors;
- Trees will be cut manually from along streams and using machinery to extract whole trees; and
- Travel will only be permitted perpendicular to and away from surface water features.

**Silt Traps**

Silt traps will be strategically placed down-gradient within forestry drains near streams. The main purpose of the silt traps and drain blocking is to slow water flow, increase residence time and allow settling of silt in a controlled manner.

**Drain Inspection and Maintenance**

The following items will be carried out during pre-felling inspections and regularly thereafter:-

- Communication with tree felling operatives in advance to determine whether any areas have been reported where there is unusual waterlogging or bogging of machines;
- Inspection of all areas reported as having unusual ground conditions;
- Inspection of main drainage ditches and outfalls. During pre-felling inspections, the main drainage ditches will be identified. Where possible, the pre-felling inspection will be carried out during rainfall;
- Following tree felling, all main drains will be inspected to ensure that they are functioning;
- Extraction tracks within 10m of drains will be broken up and diversion channels created to ensure that water in the tracks spreads out over the adjoining ground;
- Culverts on drains exiting the site, if impeded by silt or debris, will be unblocked; and
- All accumulated silt will be removed from drains and culverts, and silt traps, and this removed material will be deposited away from watercourses to ensure that it will not be carried back into the trap or stream during subsequent rainfall.

**Surface Water Quality Monitoring**

Sampling will be completed before, during (if the operation is conducted over a protracted time) and after the felling activity. The 'before' sampling will be conducted within 4-weeks of the felling activity commencing, preferably in medium-to-high water flow conditions. The 'during' sampling will be undertaken once a week or after rainfall events. The 'after' sampling will comprise as many samplings as necessary to demonstrate that water quality has returned to pre-activity status (i.e. where an impact has been shown).

Details of the proposed surface water quality monitoring programme are outlined in the Water Quality Monitoring Plan (**Annex 5**).

The surface water sampling locations used in this EIAR for the project site and grid connection (i.e. SW1 – SW4) will also be used as sampling locations during felling activities.

Also, daily surface water monitoring forms (for visual inspections and field chemistry measurements) will also be utilised at every works site near any watercourse. These will be taken daily and kept on site for record and inspection.

*Earthworks (Removal of Vegetation Cover, Excavations and Stock Piling) Resulting in Suspended Solids Entrainment in Surface Water.*

**Mitigation by Avoidance**

The key mitigation measure during the construction phase is the avoidance of sensitive aquatic areas by using a 50m buffer. From the constraints map (**Annex 7.4**) it is evident that; other than some sections of access tracks, watercourse crossings (4 no.), part of the crane hardstanding of turbine T7, the southern end of the main construction compound and the northern end of the spoil deposition area at turbine T5; the majority of the proposed wind farm infrastructure (including all turbine locations and the spoil deposition areas) is located outside of areas that have been assessed to be hydrologically sensitive. Additional mitigation in the form of double silt fencing will be placed around all infrastructure that encroaches the 50m buffer zone.

Specific mitigation measures, incorporated into the design of the project (embedded mitigation) and through implementation of best practice methodologies (discussed below) will be employed where work inside buffer zones is proposed.

The generally large setback distance from sensitive hydrological features ensures that sufficient space is provided for the installation of drainage mitigation measures (discussed below) and to ensure their effective operation. The proposed buffer zone will ensure:-

- Avoidance of physical damage to watercourses, and associated release of sediment;
- Avoidance of excavations within close proximity to surface water courses;
- Avoidance of the entry of suspended sediment from earthworks into watercourses; and,
- Avoidance of the entry of suspended sediment from the construction phase drainage system into watercourses, achieved in part by ending drain discharge outside the buffer zone and allowing percolation across the vegetation of the buffer zone.

**Mitigation by Prevention**

The following section details the measures which will be put in place during the construction phase to ensure that surface water features are protected from the release of silt or sediment and to ensure that all surface water runoff is fully treated and attenuated to avoid the discharge of dirty water.

Source controls to limit the likelihood for 'dirty water' to occur:-

- Interceptor drains, vee-drains, diversion drains, flume pipes, erosion and velocity control measures such as use of sand bags, oyster bags filled with clean washed gravel, filter fabrics, and other similar/equivalent or appropriate systems;
- Small working areas, covering stockpiles, weathering off stockpiles, cessation of works in certain areas or other similar/equivalent or appropriate measures.

In-Line controls to ensure appropriate management of silt laden water:

- Interceptor drains, vee-drains, oversized swales, erosion and velocity control measures such as check dams, sandbags, oyster bags, straw bales, flow limiters, weirs, baffles, silt bags, silt fences, sedimats, filter fabrics, and collection sumps, temporary sumps/attenuation lagoons, sediment traps, pumping systems, settlement ponds, temporary pumping chambers, or other similar/equivalent or appropriate systems.

Treatment systems to fully attenuate silt laden waters prior to discharge:

Temporary sumps and attenuation ponds, temporary storage lagoons, sediment traps, and settlement ponds, and proprietary settlement systems such as Siltbuster, and/or other similar/equivalent or appropriate systems. It should be noted that an extensive network of bog and forestry drains already exists, and these will be integrated and enhanced as required and used within the wind farm drainage system.

The main elements of interaction with existing drains will be as follows:-

- Apart from interceptor drains, which will convey clean runoff water to the downstream drainage system, there will be no direct discharge (without treatment for sediment reduction and attenuation for flow management) of

runoff from the wind farm drainage into the existing site drainage network. This will reduce the likelihood of any increased risk of downstream flooding or sediment transport/erosion;

- Silt traps will be placed in the existing drains upstream of any streams where construction works is taking place, and these will be diverted into proposed interceptor drains, or culverted under/across the works area; and
- Buffered outfalls, which will be numerous over the site, will promote percolation of drainage waters across vegetation and close to the point at which the additional runoff is generated, rather than direct discharge to the existing drains of the site.

**Water Treatment Train**

While the silt/sediment ponds and lagoons are assessed as providing a sufficient level of protection to avoid any deterioration in downstream water quality; a final line of defence can be provided by a water treatment train such as a 'Siltbuster', if required. If the discharge water from construction areas fails to be of a high quality, then a filtration treatment system (such as a 'Siltbuster' or similar equivalent treatment train [sequence of water treatment processes]) will be used to filter and treat all surface discharge water collected in the dirty water drainage system. This water treatment train will apply for the entirety of the construction phase.

**Silt Fences**

Silt fences will be emplaced within drains down-gradient of all construction areas. Silt fences are effective at removing heavy settleable solids. This will act to prevent entry to watercourses of sand and gravel sized sediment, released from excavation of mineral sub-soils of glacial and glacio-fluvial origin, and entrained in surface water runoff. Inspection and maintenance of these structures during construction phase is critical to their functioning to stated purpose. They will remain in place throughout the entire construction phase. Double silt fences will be emplaced within drains down-gradient of all construction areas inside the 50m hydrological buffer zones to provide an additional layer of protection in these areas.

**Silt Bags**

Silt bags will be used where small to medium volumes of water need to be pumped from excavations. As water is pumped through the bag, most of the sediment is retained by the geotextile fabric allowing filtered water to pass through. Silt bags will be used with natural vegetation filters or sedimats (sediment entrapment mats, consisting of coir or jute matting) placed at the silt bag location to provide further treatment of the water outfall from the silt bag. Sedimats will be secured to the ground surface using stakes/pegs. The sedimat will extend to the full width of the outfall to ensure all water passes through this additional treatment measure.

**Management of Runoff from the Spoil Deposition Areas**

It is proposed that excavated overburden/spoil will be utilised for reinstatement of excavated areas etc. and for landscaping purposes. Excess material, or material which is unsuitable for this purpose, will be stored, permanently, at the dedicated spoil deposition areas.

The main spoil deposition areas are located outside the 50m stream buffer zone**.** A small section of the spoil deposition area at turbine T5 encroaches the 50m buffer zone. Additional mitigation in the form of double silt fencing will be placed around all infrastructure that encroaches the 50m buffer zone.

During the initial placement of spoil in the deposition areas, silt fences, straw bales and biodegradable matting will be used to control surface water runoff. Double silt fencing will be placed along the edge of the bog drain that intercepts the deposition area.

Drainage from the overburden deposition area will ultimately be into to the existing bog drain network where it is proposed that check dams will be installed every 20m or so to create a series of settlement ponds, before being discharged.

Spoil deposition areas will be sealed with a digger bucket and vegetated as soon possible to reduce sediment entrainment in runoff. Once re-vegetated and stabilised, spoil deposition areas will no longer be a likely source of silt laden runoff. Surface water protection infrastructure will be left in place until the areas have stabilised.

**Grid Connection Installation Works**

Temporary silt fencing/silt trap arrangements will be placed within existing roadside/field drainage features along the grid connection route to remove any suspended sediments from the works area. The trapped sediment will be removed and disposed of at an appropriate licenced facility. Any bare-ground will be re-seeded/reinstated immediately and silt fencing temporally left in place if necessary.

**Pre-emptive Site Drainage Management**

The works programme for the initial construction stage of the project will also take account of weather forecasts, and predicted rainfall in particular. Large excavations and movements of soil/subsoil or vegetation stripping will be suspended or scaled back if prolonged or intense rain is forecast. The extent to which works will be scaled back or suspended will relate directly to the amount of rainfall forecast.

The following forecasting systems are available and will be used on a daily basis at the site to direct proposed construction activities:-

- General Forecasts: Available on a national, regional and county level from the Met Eireann website (www.met.ie/forecasts). These provide general information on weather patterns including rainfall, wind speed and direction but do not provide any quantitative rainfall estimates;
- Meteo Alarm: Alerts to the possible occurrence of severe weather for the next 2 days. Less useful than general forecasts as only available on a provincial scale;
- 3 hour Rainfall Maps: Forecast quantitative rainfall amounts for the next 3 hours but does not account for possible heavy localised events;
- Rainfall Radar Images: Images covering the entire country are freely available from the Met Eireann website (www.met.ie/latest/rainfall_radar.asp). The images are a composite of radar data from Shannon and Dublin airports and give a picture of current rainfall extent and intensity. Images show a quantitative measure of recent rainfall. A 3 hour record is given and is updated every 15 minutes. Radar images are not predictive; and,
- Consultancy Service: Met Eireann provide a 24 hour telephone consultancy service. The forecaster will provide interpretation of weather data and give the best available forecast for the area of interest.

Using the safe threshold rainfall values will allow work to be safely controlled (from a water quality perspective) in the event of an impending high rainfall intensity event.

Works will be suspended if forecasting suggests either of the following is likely to occur:-

- >10 mm/hr (i.e. high intensity local rainfall events);
- >25 mm in a 24-hour period (heavy frontal rainfall lasting most of the day); or,
- >half monthly average rainfall in any 7 days.

Prior to works being suspended the following control measures will be completed:-

- Secure all open excavations;
- Provide temporary or emergency drainage to prevent back-up of surface runoff; and,
- Avoid working during heavy rainfall and for up to 24-hours after heavy events to ensure drainage systems are not overloaded.

**Timing of Site Construction Works**

The construction of the site drainage system will be carried out, at the respective locations, prior to other activities being commenced. The construction of the drainage system will only be carried out during periods of, where possible, no rainfall, therefore avoiding runoff. This will avoid the risk of entrainment of suspended sediment in surface water runoff, and transport via this pathway to surface watercourses. Construction of the drainage system during this period will also ensure that attenuation features associated with the drainage system will be in place and functional for all subsequent construction works.

**Monitoring**

Prior to the commencement of project, a detailed Site Drainage Plan and SWMP will be prepared to detail the siting and composition of the surface water management measures. The respective plans, which will form part of a detailed Construction Environmental Management Plan (CEMP), will be prepared prior to the commencement of project.

The CEMP will also include a detailed Water Quality Monitoring Plan for the monitoring of surface waters in the vicinity of the construction site by a designated Environmental Manager. The monitoring programme will comprise field testing and laboratory analysis of a range of agreed parameters. The civil works contractor, who will be responsible for the construction of the site drainage system, and Environmental Manager will undertake regular inspections of the drainage system to ensure that all measures are functioning effectively. The surface water sampling locations used in this EIAR (i.e. SW1 – SW4) will be used during construction activities. Regular inspections of all installed drainage systems will be undertaken, especially after heavy rainfall, to check for blockages, and ensure there is no build-up of standing water in parts of the systems where it is not intended.

Any excess build-up of silt levels that may decrease the effectiveness of the drainage feature, will be removed and disposed of in an appropriate manner.

*Excavation Dewatering and Effects* on Surface Water Quality

The management of excavation dewatering (pumping), particularly in relation to any accumulation of water in foundations or electricity line trenches, and subsequent treatment prior to discharge into the drainage network will be undertaken as follows:-

- Appropriate interceptor drainage, to prevent upslope surface runoff from entering excavations, will be put in place;
- The interceptor drainage will be discharged to the site constructed drainage system or onto natural vegetated surfaces and not directly to surface waters to ensure that Greenfield runoff rates are mimicked;

- If required, pumping of excavation inflows will prevent build-up of water in the excavation;
- The pumped water volumes will be discharged via volume and silt/sediment ponds and settlement lagoons adjacent to excavation areas, or via specialist treatment systems such as a Siltbuster unit;
- There will be no direct discharge to surface watercourses, and therefore no risk of hydraulic loading or contamination will occur;
- Daily monitoring of wind farm excavations by the Environmental Manager will occur during the construction phase. If high levels of seepage inflow occur, excavation work at this location will cease immediately and a geotechnical assessment undertaken; and,
- A mobile 'Siltbuster' or similar equivalent specialist treatment system will be available on-site for emergencies. Siltbusters are mobile silt traps that can remove fine particles from water using a proven technology and hydraulic design in a rugged unit. The mobile units are specifically designed for use on construction-sites. They will be used as final line of defence if needed.

*Release of Hydrocarbons during Construction and Storage*

Mitigation measures proposed to avoid release of hydrocarbons at the site are as follows:-

- The volume of fuels or oils stored on site will be minimised. All fuel and oil will be stored in an appropriately bunded area within the temporary construction compound. Only an appropriate volume of fuel will be stored at any given time. The bunded area will be roofed to avoid the ingress of rainfall and will be fitted with a storm drainage system and an appropriate oil interceptor;
- All bunded areas will have 110% capacity of the volume to be stored;
- On site refuelling of machinery will be carried out using a mobile double skinned fuel bowser. The fuel bowser, a double-axel custom-built refuelling trailer will be re-filled at the temporary compound and will be towed around the site by a 4x4 jeep to where plant and machinery is located. No refuelling will be permitted at works locations within the 50m hydrological buffer. The 4x4 jeep will also be fully stocked with fuel absorbent material and pads in the event of any accidental spillages. The fuel bowser will be parked on a level area in the construction compound when not in use and only designated trained and competent operatives will be authorised to refuel plant on site. Mobile measures such as drip trays and fuel absorbent mats will be used during all refuelling operations to avoid any accidental leakages;
- All plant and machinery used during construction will be regularly inspected for leaks and fitness for purpose;
- Spill kits will be readily available to deal with and accidental spillages;
- All waste tar material arising from road cuttings (from trenching or other works in public roads) will be removed off-site and taken to a licensed waste facility. Due to the potential for contamination of soils and subsoils, it is not proposed to utilise this material for any reinstatement works; and
- An outline emergency plan for the construction phase to deal with accidental spillages is contained within the Planning-Stage CEMP (**Annex 3.4**). This emergency plan will be further developed prior to the commencement of project, and will be agreed with the Planning Authority as part of the detailed CEMP.

*Groundwater and Surface Water Contamination from Wastewater Disposal*

Measures to avoid contamination of ground and surface waters by wastewaters will comprise:-

- Self-contained port-a-loos (chemical toilets) with an integrated waste holding tank will be installed at the site compound, maintained by the providing contractor, and removed from site on completion of the construction works;
- Water supply for the site office and other sanitation will be brought to site and removed after use to be discharged at a suitable off-site treatment location; and,
- No water will be sourced on the site, nor will any wastewater be discharged to the site.

*Release of Cement-Based Products*

The following mitigation measures are proposed to ensure that the release of cement-based products is avoided:-

- No batching of wet-cement products will occur on site. Ready-mixed concrete will be brought to site as required and, where possible, emplacement of pre-cast products will be utilised;
- All watercourse crossings will utilise pre-cast products and the use of wet-cement products within the hydrological buffer will be avoided;
- Where concrete is delivered on site, only the chute will be cleaned, using the smallest volume of water practicable. Chute cleaning will be undertaken at lined cement washout ponds with waters being stored in the temporary construction compound, removed off site and disposed of at an approved licensed facility. No discharge of cement contaminated waters to the construction phase drainage system or directly to any artificial drain or watercourse will be allowed;
- Weather forecasting will be used to ensure that prolonged or intense rainfall is not predicted during concrete pouring activities; and,
- The concrete pour site will be kept free of standing water and plastic covers will be ready in case of sudden rainfall event.
- *Morphological Changes to Surface Water Courses & Drainage Patterns*
- The following mitigation measures are proposed:-
- All proposed new stream crossings will be clear span bridges (bottomless culverts) and the stream beds will remain undisturbed. No in-stream excavation works at the crossing locations are proposed and therefore there will be no impact on the stream at the proposed crossing location;
- All internal wind farm electrical cabling or grid connection cabling will pass above or below the existing culvert and will not directly interfere with the culvert;
- At the time of construction, all guidance/best practice requirements of the OPW or Inland Fisheries Ireland will be incorporated into the design/construction of the proposed watercourse/culvert crossings;
- As a further precaution, in-stream construction work (if/where required) will only be carried out during the period permitted by Inland Fisheries Ireland for in-stream works according to *Guidelines on Protection of Fisheries During Construction Works in and Adjacent to Waters* (2016) (i.e., July to September inclusive). This time period coincides with the period of lowest expected rainfall, and therefore minimum runoff rates. This will minimise the risk of entrainment of

suspended sediment in surface water runoff, and transport via this pathway to surface watercourses (any deviation from this will be done in discussion with the IFI);
- During the near stream construction works (i.e. within the 50m buffer zone), double row silt fences will be emplaced immediately down-gradient of the construction area for the duration of the construction phase;
- The new watercourse crossings at the wind farm site will require a Section 50 license application to the OPW in accordance with the Arterial Drainage Act 1945. The river/stream crossings will be designed in accordance with OPW guidelines/requirements on applying for a Section 50 consent; and,
- No instream works are proposed at the grid connection watercourse crossings.

*Hydrological Effects on Designated Sites*

The proposed mitigation measures for protection of surface water quality, which will include buffer zones and robust drainage control measures (i.e. interceptor drains, swales, silt/settlement ponds, settlement lagoons), will ensure that the quality of runoff from development areas will be very high.

An "*imperceptible, temporary effect*" on local streams and rivers would, if it occurs, be extremely localised and of a very short duration (i.e. hours). Therefore, considering the imperceptible effects on local surface water quality along increased dilution capacity of downstream river waterbodies, significant indirect hydrological or water quality effects on the downstream designated sites will not occur.

### 4.3.2 Habitats

Except for bog woodland (non-Annex I), the majority of the proposed project layout does not overlap with high-value terrestrial habitats and is located almost entirely within commercial conifer or broadleaved plantation, and improved grassland. The grid connection are located almost entirely within existing roads and only small lengths will go through improved grassland. Construction for the majority of the proposed access tracks will mainly involve upgrading existing forestry and farm tracks.

Areas requiring felling to implement bat mitigation buffers has been mainly focused on commercial conifer plantation habitats and small amounts of highly modified/non-native mixed broadleaved woodland. There is also 3.81 ha of bog woodland WN7 to be felled. Also, the lengths of trees and hedgerows to be removed has been minimised.

Any treelines or hedgerows removed will be replaced in-situ elsewhere in the proposed project at appropriate locations (i.e. designed to maximise ecological connectivity and outside of bat mitigation buffers). All new treelines or hedgerows will be planted using native species and in a similar composition to treelines or hedgerows lost.

To avoid widespread disturbance to habitats, access within the proposed project will be restricted to the footprint of the proposed works corridor and no access between different parts of the proposed project will be permitted, except via the proposed works corridor. An Ecological Clerk of Works (ECoW) will be employed throughout the construction phase to ensure that construction activities do not encroach, unnecessarily, into any important habitats.

### 4.3.3 Invasive Plants

In order to prevent the spread of invasive alien species into the working areas of the proposed project site, the following biosecurity protocol shall be adopted at all times throughout the construction process.

**Awareness**

- Prior to working on the Site, all contractors will be briefed on invasive species and will be provided with information on identification, and of the need to prevent further spread of invasive species, as well as details of the biosecurity protocol.
- Any additional positive or suspected identification of invasive non-native species during Site works shall be reported to an ecologist for verification, so that appropriate advice can be given.

**Machinery**

- Cleaning operations will take place in a designated area to prevent further spread.
- Mud and organic debris will not be allowed to accumulate on tracks, tyres or under wheel arches.

**Personnel**

- Personnel shall check and clean their footwear and tools each day before leaving the area to work on other Sites, or other parts of the Site.

### 4.3.4 Birds

To avoid widespread disturbance to birds, access will be restricted to the footprint of the proposed works corridor. Measures proposed in **Chapter 7** of the EIAR and at **Section 4.5**, below, will prevent deterioration of water quality and adverse effects on birds relying on downstream habitats, such as kingfisher.

The following will be implemented to reduce the possibility of damage and destruction (and disturbance to sensitive species) to occupied bird nests:

- clearance of woodlands and uncultivated vegetation i.e. trees and hedgerows (including vegetation removal for creation/maintenance of bat mitigation buffers), will be undertaken outside the main breeding season from March to September inclusive;
- if other site clearance and construction activities are required to take place during the main breeding bird season, pre-commencement survey work will be undertaken to ensure that nest destruction and disturbance is avoided;
- once vegetation has been removed from the works corridor, these areas will be retained in a condition that limits suitability for nesting birds for the remainder of the construction phase e.g. cover for ground nesting species will be made unsuitable for cutting vegetation or tracking over with an excavator; and
- a suitably experienced Ecologist will be employed for the duration of the construction period to make contractors aware of the ornithological sensitivities of the Project and to undertake surveys for nesting birds throughout the construction period, enforcing exclusion areas as required.

### 4.3.5 Terrestrial Mammals (Excluding Bats)

Measures proposed in **Chapter 7** of the EIAR and at **Section 4.5**, below, will prevent deterioration of water quality and adverse effects on mammals relying on downstream habitats, such as otter. Habitat features important for mammals will be

retained as much as possible (e.g. hedgerows, treelines and scrub). While commercial conifer plantation and mixed/broadleaved woodland will be removed, connectivity between woodland linear habitat features has been retained throughout all phases of the proposed project.
A pre-construction walkover survey of the proposed project will be undertaken. This will search for mammal resting/breeding places, which could change over time. If any are identified, then appropriate exclusion zone(s) will be implemented and construction activities timed to avoid sensitive periods, such as the breeding season or hibernation, as relevant.
The following will be implemented to reduce the possibility of direct and indirect effects on mammals:

- limiting constructions works to daylight hours;
- providing exit points for any excavations (e.g. escape planks or spoil runs) so mammals do not become trapped; and
- a suitably qualified Ecologist will be employed for the duration of the construction period to make contractors aware of the mammalian sensitivities of the Proposed Project and to undertake surveys for breeding or resting mammals throughout the construction period, enforcing exclusion areas as required. These are 50 m for red squirrel, 100 m for pine marten, 150 m for otter and 50 m for badger. If in the unlikely event that exclusion zones cannot be implemented, advice will be sought from NPWS, and appropriate mitigation and compensation measures will be put in place and an application will be made to NPWS for a derogation licence if required.

### 4.3.6 Bats

All hedgerows and treelines that will be lost due to construction will be replaced within the Proposed Project. This will ensure that there is no net loss of commuting and foraging routes for bats.

Along the grid connection, immediately in advance of construction works, an ecologist will undertake a comprehensive survey of bridges / structures / trees with moderate to high bat roosting potential (see **Annex 5.3** of the EIAR) and emergence surveys will be carried out to determine if bats are present following Collins (2023) guidelines.

No destruction or disturbance of active bat roosts is predicted. However, given that a period of time is likely to elapse prior to the commencement of construction, it is acknowledged that roosting bats could move and occupy new Potential Roost Features (PRFs), such as ivy clad trees with occasional holes/fissures. Therefore, pre-construction roost surveys will be undertaken to identify and protect any bats occupying roosts in vegetation earmarked for removal.

Any trees identified as supporting moderate to high potential roost features within the works corridor will be targeted with further surveys, including emergence/re-entry surveys and/or roost inspections (using endoscopes and thermal imaging cameras). Surveys will determine occupancy, the type of roost (e.g. maternity, hibernation, mating, transitional), species using the roost and the level of occupancy. Surveys will be conducted by appropriately experienced ecologists.

For any newly occupied roost sites, where vegetation removal is proposed, these surveys will inform a derogation license application process from the NPWS to undertake appropriate mitigation actions, as required, to ensure the conservation of

bats. Such actions could include measures to exclude bats from potential roost holes prior to vegetation removal and provision of alternative roost sites.

Regarding felling of trees with moderate to high potential roost features, if emergence and roost inspection survey fail to detect bats, then 'soft felling' measures will be implemented (BCT, 2018). This will be carried out in suitable weather conditions and at appropriate times of year. Briefly, this involves the following:

- removal of the tree in sections, starting with the top branches and working down the trunk avoiding cutting through cavities;
- lowering of any sections with potential roost features with care, positioning them on the ground with potential entrances to roosts facing upwards to allow bats to exist the roost; and
- leaving these sections in place for at least 24 hours in suitable weather.

For occupied roost sites where no vegetation removal is proposed, an exclusion zone will be implemented to avoid disturbance. This exclusion zone will only be implemented according to when and how the roost is used and will be proportional to the disturbance levels from the construction activity. For example, 30 m is an appropriate exclusion zone for piling. In general the following applies:

- maternity roosts: works will be carried out between 1 October to 1 May inclusive;
- summer roost (not a maternity roost): works will be carried out between 1 September to 1 May inclusive;
- hibernation roost: works will be carried out between 1 May to 1 October inclusive; and
- mating/swarming roost: works will be carried out between 1 November to 1 August inclusive.

The following will also be implemented to reduce the possibility of direct and indirect effects on bat species: no night-time lighting will be used during construction.

### 4.3.7 Other Protected Fauna

Pre-construction checks will be undertaken for spawning frogs if construction works are undertaken in February. Adults and spawn will be translocated under NPWS licence to suitable alternative locations if present. Pitfall traps and drift fences will be used to capture adult frogs.

Amphibian-proof fencing close to any ponds/pools will be used to prevent frogs or smooth newts from accessing any parts of the Proposed Project most hazardous to amphibians during the construction phase.

## 4.4 Land & Soil

### 4.4.1 Peat, Soil, Subsoil and Bedrock Excavation

The excavation of peat, soil, subsoil and bedrock will have a direct effect on the geological environment and no specific mitigation measures are proposed. The excavation and long term storage of materials will be completed in accordance with best practice for the management and treatment of such materials.

### 4.4.2 Erosion of Exposed Peat, Soil and Subsoil at Excavation and Storage Areas

The following avoidance and design measures are proposed to reduce erosion effects at excavation and spoil storage/deposition areas:-

- Mats will be used, as necessary, to support construction plant and machinery on soft ground, thus reducing the likelihood of soil and subsoil erosion and avoiding the formation of rutted areas. This will substantially reduce the likelihood for surface water ponding to occur;
- Excavated material will be side cast and stored temporarily adjacent to excavation areas for use during reinstatement and landscaping. Where material is not required for reinstatement or landscaping, it shall be immediately transported to the spoil deposition areas;
- Silt fences, and all necessary surface water management measures (including upslope interceptor drains), will be installed around all temporary stockpiles to limit movement of entrained sediment in surface water runoff. All slopes will be sealed with the bucket of an excavator;
- In order to minimise erosion during the construction phase, works will not take place during periods of intense or prolonged rainfall (to prevent increased silt laden runoff). Drainage systems, as outlined in **Chapter 7** of the EIAR, will be implemented to limit runoff effects during the construction phase;
- At the designated spoil deposition areas, material will be placed in layers to ensure stability is maintained and works will be undertaken in accordance with best practice construction methodologies. Works at the spoil deposition areas will be monitored, on a weekly basis during the construction phase and monthly for a 6 no. month period thereafter, by an appropriately qualified Geotechnical Engineer. In the event that any ground stability issues arise, the Engineer will have the power to cease works until such time as remedial works have been completed to his/her satisfaction;
- Permanently mounded spoil; for example, berms surrounding turbines and hardstands, berms located along access tracks and at the spoil deposition areas; will be seeded and grassed over at the earliest opportunity to prevent erosion; and,
- The electricity line (grid connection) trench will be reinstated to the required specification and in accordance with landowner requirements and will be reseeded or allowed to vegetate naturally (on agricultural land) or topped with tarmacadam (or similar along public roads) at the earliest opportunity to prevent erosion.

### 4.4.3 Contamination of Soils and Subsoils by leakages, spillages of hydrocarbons or other chemicals

The following measures are proposed to specifically prevent contamination of soils and subsoils:-

- The volume of fuels or oils stored on site will be minimised. All fuel and oil will be stored in an appropriately bunded area within the temporary construction compound. Only an appropriate volume of fuel will be stored at any given time. The bunded area will be roofed to avoid the ingress of rainfall and will be fitted with a storm drainage system and an appropriate oil interceptor;
- All bunded areas will have 110% capacity of the volume to be stored;
- On site re-fuelling of machinery will be carried out using a mobile double skinned fuel bowser. The fuel bowser, a double-axel custom-built refuelling trailer will be re-filled at the temporary compound and will be towed around the site by a 4x4 jeep to where plant and machinery is located. The 4x4 jeep will also be fully stocked with fuel absorbent material and pads in the event of any accidental spillages. The fuel bowser will be parked on a level area in the construction compound when not in use and only designated, trained and competent

operatives will be authorised to refuel plant on site. Mobile measures such as drip trays and fuel absorbent mats will be used during all refuelling operations to avoid any accidental leakages;
- All plant and machinery used during construction will be regularly inspected for leaks and fitness for purpose;
- Spill kits will be available to deal with any accidental spillages within the temporary construction compound and during re-fuelling;
- All waste tar material arising from road cuttings (from trenching in public roads and haul route temporary alteration works) will be removed off-site and disposed of at a licensed waste facility. Due to the potential for contamination of soils and subsoils, it is not proposed to utilise this material for any reinstatement works or to store it within the spoil deposition areas; and
- An emergency plan for the construction phase to deal with accidental spillages accompanies this Planning-Stage Construction and Environmental Management Plan. This emergency plan will be further developed by the contractor prior to the commencement of construction.

### 4.4.4 Land and Land Use

23ha of forestry will be felled to accommodate wind farm infrastructure. However, all tree coverage felled will be replaced at a replanting site(s) which will be subject to technical approval through a separate consenting process. No specific measures, other than best-practice felling and replanting methodologies are proposed.

### 4.4.5 Peat Stability and Failure

The peat stability risk assessment report, which accompanies this EIAR (**Annex 6.1**), provides a number of mitigation/control measures to reduce the potential risk of peat failure at each infrastructure location. Sections of access roads to the nearest infrastructure element will be subject to the same mitigation/control measures that apply to the nearest infrastructure element.

The following control measures incorporated into the construction phase of the project will ensure the management of the risks for this site:

- Appointment of experienced and competent contractors;
- The site will be supervised by experienced and qualified personnel;
- Allocate sufficient time for the project (be aware that decreasing the construction time has the potential to increase the risk of initiating a localised peat movement);
- Prevent undercutting of slopes and unsupported excavations;
- Maintain a managed robust drainage system;
- Prevent placement of loads/overburden on marginal ground;
- Implementation of safety buffers around deep peat areas;
- Adhere to the spoil and peat storage restriction areas detailed in the Geotechnical and Peat Stability Risk Assessment (GDG, 2023);
- Set up, maintain and report findings from monitoring systems as outlined in the Geotechnical and Peat Stability Assessment (FT, 2023);
- Ensure construction method statements are developed and agreed before commencement of construction and are followed by the contractor; and,
- Revise and amend the Construction Risk Register as construction progresses to ensure that risks are managed and controlled for the duration of construction.

## 4.5 Water

### 4.5.1 Clear Felling & Surface Water Quality Effects

Best practice methods related to water incorporated into the forestry management and mitigation measures have been derived from:-

- Department of Agricultural, Food and the Marine (2019) *Standards for Felling and Reforestation*;
- Forestry Commission (2004) *Forests and Water Guidelines, Fourth Edition*. Publ. Forestry Commission, Edinburgh;
- Coillte (2009) *Forest Operations and Water Protection Guidelines*;
- Coillte (2009) *Methodology for Clear Felling Harvesting Operations*; and,
- Forest Service (2000: *Forestry and Water Quality Guidelines*. Forest Service, DAF, Johnstown Castle Estate, Co. Wexford.

#### Mitigation by Avoidance

There is a requirement in the *Forest Service Code of Practice* and in the *FSC Certification Standard* for the installation of buffer zones adjacent to aquatic zones at planting stage. Minimum buffer zone widths recommended in the Forest Service (2000) guidance document *Forestry and Water Quality Guidelines* are detailed at **Table 2**.

| Average slope leading to the aquatic zone | | Buffer zone width on either side of the aquatic zone | Buffer zone width for highly erodible soils |
|---|---|---|---|
| Moderate | (0 – 15%) | 10 m | 15 m |
| Steep | (15 – 30%) | 15 m | 20 m |
| Very steep | (>30%) | 20 m | 25 m |

**Table 2: Minimum Buffer Zone Widths (Forest Service, 2000)**

During the construction phase, a self-imposed conservative buffer zone of 50m will be maintained for all Rapemills River and West Galros Stream where possible. These buffer zones are illustrated at **Chapter 7 - Figure 7.10** of the EIAR.

Of the 23ha proposed for felling, only ~2.5ha are located inside the 50m buffer zone.

The large distance between the majority of the felling areas and sensitive aquatic zones means that any poor-quality runoff arising from felling areas can be adequately managed and attenuated prior to even reaching the aquatic buffer zone and primary drainage routes. Where tree felling is required in the vicinity of streams, the additional mitigation measures outlined below will be employed.

#### Mitigation by Design

Mitigation measures which will reduce the risk of entrainment of suspended solids and nutrient release in surface watercourses comprise best practice methods, as follows:-

- Machine combinations (i.e. handheld or mechanical) will be chosen which are most suitable for ground conditions and which will minimise soils disturbance;
- Checking and maintenance of tracks and culverts will be ongoing through any felling operation. No tracking of vehicles through watercourses will occur. Where possible, existing drains will not be disturbed during felling works;
- Ditches which drain from the areas to be felled towards existing surface watercourses will be blocked, and temporary silt traps will be constructed. No

direct discharge of such ditches to watercourses will occur. Drains and sediment traps will be installed during ground preparation. Collector drains will be excavated at an acute angle to the contour (~0.3%-3% gradient), to minimise flow velocities. Main drains to take the discharge from collector drains will include water drops and rock armour, as required, where there are steep gradients, and avoid being placed at right angles to the contour;

- Sediment traps will be sited in drains downstream of felling areas. Machine access will be maintained to enable the accumulated sediment to be excavated. Sediment will be carefully disposed of in the spoil disposal areas. All new silt traps will be constructed on even ground and not on sloping ground;
- In areas particularly sensitive to erosion or where felling inside the 50m buffer is required, it will be necessary to install double or triple sediment traps;
- All drainage channels will taper out before entering the 50m buffer zone. This ensures that discharged water gently fans out over the buffer zone before entering the aquatic zone, with sediment filtered out from the flow by ground vegetation within the zone. On erodible soils, silt traps will be installed at the end of the drainage channels, to the outside of the buffer zone;
- Drains and silt traps will be maintained throughout all felling works, ensuring that they are clear of sediment build-up and are not severely eroded. Correct drain alignment, spacing and depth will ensure that erosion and sediment build-up are minimized and controlled;
- Brash or bog mats will be used to support vehicles on soft ground, reducing topsoil and mineral soils erosion and avoiding the formation of rutted areas, in which surface water ponding can occur. Brash mat renewal will take place before they become heavily used and worn. Provision will be made for brash mats along all off-road routes, to protect the soil from compaction and rutting. Where there is risk of severe erosion occurring, extraction will be suspended during periods of high rainfall;
- Timber will be stacked in dry areas, and outside the 50m watercourse buffer. Straw bales and check dams will be emplaced on the down gradient side of timber storage/processing sites;
- Works will be carried out during periods of no, or low, rainfall in order to minimise entrainment of exposed sediment in surface water run-off;
- Checking and maintenance of roads/tracks and culverts will be ongoing through the felling operation;
- Refuelling or maintenance of machinery will not occur within 50m of a watercourse. Mobile bowser, drip kits, qualified personnel will be used where refuelling is required;
- A permit to refuel system will be adopted:
- Branches, logs or debris will not be allowed to build up in aquatic zones. All such material will be removed when harvesting operations have been completed, but care will be taken to avoid removing natural debris deflectors;
- Trees will be cut manually from along streams and using machinery to extract whole trees; and
- Travel will only be permitted perpendicular to and away from surface water features.

### Silt Traps

Silt traps will be strategically placed down-gradient within forestry drains near streams. The main purpose of the silt traps and drain blocking is to slow water flow, increase residence time and allow settling of silt in a controlled manner.

### Drain Inspection and Maintenance

The following items will be carried out during pre-felling inspections and regularly thereafter:-

- Communication with tree felling operatives in advance to determine whether any areas have been reported where there is unusual waterlogging or bogging of machines;
- Inspection of all areas reported as having unusual ground conditions;
- Inspection of main drainage ditches and outfalls. During pre-felling inspections, the main drainage ditches will be identified. Where possible, the pre-felling inspection will be carried out during rainfall;
- Following tree felling, all main drains will be inspected to ensure that they are functioning;
- Extraction tracks within 10m of drains will be broken up and diversion channels created to ensure that water in the tracks spreads out over the adjoining ground;
- Culverts on drains exiting the site, if impeded by silt or debris, will be unblocked; and
- All accumulated silt will be removed from drains and culverts, and silt traps, and this removed material will be deposited away from watercourses to ensure that it will not be carried back into the trap or stream during subsequent rainfall.

### Surface Water Quality Monitoring

Sampling will be completed before, during (if the operation is conducted over a protracted time) and after the felling activity. The 'before' sampling will be conducted within 4-weeks of the felling activity commencing, preferably in medium-to-high water flow conditions. The 'during' sampling will be undertaken once a week or after rainfall events. The 'after' sampling will comprise as many samplings as necessary to demonstrate that water quality has returned to pre-activity status (i.e. where an impact has been shown).

Details of the proposed surface water quality monitoring programme are outlined in the Water Quality Monitoring Plan (refer to **Annex 3.4** of the EIAR).

The surface water sampling locations used in this EIAR for the project site and grid connection (i.e. SW1 – SW4) will also be used as sampling locations during felling activities.

Also, daily surface water monitoring forms (for visual inspections and field chemistry measurements) will also be utilised at every works site near any watercourse. These will be taken daily and kept on site for record and inspection.

## 4.5.2 Earthworks (Removal of Vegetation Cover, Excavations and Stock Piling) Resulting in Suspended Solids Entrainment in Surface Water

### Mitigation by Avoidance

The key mitigation measure during the construction phase is the avoidance of sensitive aquatic areas by using a 50m buffer. From the constraints map (**Chapter 7 - Figure 7.10** of the EIAR) it is evident that; other than some sections of access tracks, watercourse crossings (4 no.), part of the crane hardstanding of turbine T7, the southern end of the main construction compound and the northern end of the spoil deposition area at turbine T5; the majority of the proposed wind farm infrastructure (including all turbine locations and the spoil deposition areas) is located outside of areas that have been assessed to be hydrologically sensitive. Additional mitigation in

the form of double silt fencing will be placed around all infrastructure that encroaches the 50m buffer zone.

As described above and at **Chapter 3** o the EIAR, specific mitigation measures, incorporated into the design of the project (embedded mitigation) and through implementation of best practice methodologies (discussed below) will be employed where work inside buffer zones is proposed.

The generally large setback distance from sensitive hydrological features ensures that sufficient space is provided for the installation of drainage mitigation measures (discussed below) and to ensure their effective operation. The proposed buffer zone will ensure:-

- Avoidance of physical damage to watercourses, and associated release of sediment;
- Avoidance of excavations within close proximity to surface water courses;
- Avoidance of the entry of suspended sediment from earthworks into watercourses; and,
- Avoidance of the entry of suspended sediment from the construction phase drainage system into watercourses, achieved in part by ending drain discharge outside the buffer zone and allowing percolation across the vegetation of the buffer zone.

### Mitigation by Prevention

The following section details the measures which will be put in place during the construction phase to ensure that surface water features are protected from the release of silt or sediment and to ensure that all surface water runoff is fully treated and attenuated to avoid the discharge of dirty water.

Source controls to limit the likelihood for 'dirty water' to occur:-

- Interceptor drains, vee-drains, diversion drains, flume pipes, erosion and velocity control measures such as use of sand bags, oyster bags filled with clean washed gravel, filter fabrics, and other similar/equivalent or appropriate systems;
- Small working areas, covering stockpiles, weathering off stockpiles, cessation of works in certain areas or other similar/equivalent or appropriate measures.

In-Line controls to ensure appropriate management of silt laden water:-

- Interceptor drains, vee-drains, oversized swales, erosion and velocity control measures such as check dams, sandbags, oyster bags, straw bales, flow limiters, weirs, baffles, silt bags, silt fences, sedimats, filter fabrics, and collection sumps, temporary sumps/attenuation lagoons, sediment traps, pumping systems, settlement ponds, temporary pumping chambers, or other similar/equivalent or appropriate systems.

Treatment systems to fully attenuate silt laden waters prior to discharge:-

Temporary sumps and attenuation ponds, temporary storage lagoons, sediment traps, and settlement ponds, and proprietary settlement systems such as Siltbuster, and/or other similar/equivalent or appropriate systems.It should be noted for this site that an extensive network of bog and forestry drains already exists, and these will be integrated and enhanced as required and used within the wind farm drainage system. The integration of the existing land drainage network and the proposed wind farm network is common practice in wind energy developments and will also result in benefits to surrounding agricultural lands.

The main elements of interaction with existing drains will be as follows:-

- Apart from interceptor drains, which will convey clean runoff water to the downstream drainage system, there will be no direct discharge (without treatment for sediment reduction and attenuation for flow management) of runoff from the wind farm drainage into the existing site drainage network. This will reduce the likelihood of any increased risk of downstream flooding or sediment transport/erosion;
- Silt traps will be placed in the existing drains upstream of any streams where construction works is taking place, and these will be diverted into proposed interceptor drains, or culverted under/across the works area; and
- Buffered outfalls, which will be numerous over the site, will promote percolation of drainage waters across vegetation and close to the point at which the additional runoff is generated, rather than direct discharge to the existing drains of the site.

### *Water Treatment Train*

While the silt/sediment ponds and lagoons are assessed as providing a sufficient level of protection to avoid any deterioration in downstream water quality; a final line of defence can be provided by a water treatment train such as a 'Siltbuster', if required. If the discharge water from construction areas fails to be of a high quality, then a filtration treatment system (such as a 'Siltbuster' or similar equivalent treatment train [sequence of water treatment processes]) will be used to filter and treat all surface discharge water collected in the dirty water drainage system. This water treatment train will apply for the entirety of the construction phase.

### *Silt Fences*

Silt fences will be emplaced within drains down-gradient of all construction areas. Silt fences are effective at removing heavy settleable solids. This will act to prevent entry to watercourses of sand and gravel sized sediment, released from excavation of mineral sub-soils of glacial and glacio-fluvial origin, and entrained in surface water runoff. Inspection and maintenance of these structures during construction phase is critical to their functioning to stated purpose. They will remain in place throughout the entire construction phase. Double silt fences will be emplaced within drains down-gradient of all construction areas inside the 50m hydrological buffer zones to provide an additional layer of protection in these areas.

### *Silt Bags*

Silt bags will be used where small to medium volumes of water need to be pumped from excavations. As water is pumped through the bag, most of the sediment is retained by the geotextile fabric allowing filtered water to pass through. Silt bags will be used with natural vegetation filters or sedimats (sediment entrapment mats, consisting of coir or jute matting) placed at the silt bag location to provide further treatment of the water outfall from the silt bag. Sedimats will be secured to the ground surface using stakes/pegs. The sedimat will extend to the full width of the outfall to ensure all water passes through this additional treatment measure.

### *Management of Runoff from the Spoil Deposition Areas*

It is proposed that excavated overburden/spoil will be utilised for reinstatement of excavated areas etc. and for landscaping purposes. Excess material, or material which is unsuitable for this purpose, will be stored, permanently, at the dedicated spoil deposition areas.

The main spoil deposition area is located outside the 50m stream buffer zone (refer to **Chapter 7 - Figure 7.10** of the EIAR). A small section of the spoil deposition area at turbine T5 encroaches the 50m buffer zone. Additional mitigation in the form of double silt fencing will be placed around all infrastructure that encroaches the 50m buffer zone.

During the initial placement of spoil in the deposition areas, silt fences, straw bales and biodegradable matting will be used to control surface water runoff. Double silt fencing will be placed along the edge of the bog drain that intercepts the deposition areas.

Drainage from the overburden deposition areas will ultimately be into to the existing bog drain network where it is proposed that check dams will be installed every 20m or so to create a series of settlement ponds, before being discharged.

Spoil deposition areas will be sealed with a digger bucket and allowed to revegetate as soon possible to reduce sediment entrainment in runoff. Once re-vegetated and stabilised, spoil deposition areas will no longer be a likely source of silt laden runoff. Surface water protection infrastructure will be left in place until the areas have stabilised.

*Grid Connection Installation Works*

Temporary silt fencing/silt trap arrangements will be placed within existing roadside/field drainage features along the grid connection route to remove any suspended sediments from the works area. The trapped sediment will be removed and disposed of at an appropriate licenced facility. Any bare-ground will be re-seeded/reinstated immediately and silt fencing temporally left in place if necessary.

*Pre-emptive Site Drainage Management*

The works programme for the initial construction stage of the development will also take account of weather forecasts, and predicted rainfall in particular. Large excavations and movements of soil/subsoil or vegetation stripping will be suspended or scaled back if prolonged or intense rain is forecast. The extent to which works will be scaled back or suspended will relate directly to the amount of rainfall forecast.

The following forecasting systems are available and will be used on a daily basis at the site to direct proposed construction activities:-

- General Forecasts: Available on a national, regional and county level from the Met Eireann website (www.met.ie/forecasts). These provide general information on weather patterns including rainfall, wind speed and direction but do not provide any quantitative rainfall estimates;
- Meteo Alarm: Alerts to the possible occurrence of severe weather for the next 2 days. Less useful than general forecasts as only available on a provincial scale;
- 3 hour Rainfall Maps: Forecast quantitative rainfall amounts for the next 3 hours but does not account for possible heavy localised events;
- Rainfall Radar Images: Images covering the entire country are freely available from the Met Eireann website (www.met.ie/latest/rainfall_radar.asp). The images are a composite of radar data from Shannon and Dublin airports and give a picture of current rainfall extent and intensity. Images show a quantitative measure of recent rainfall. A 3 hour record is given and is updated every 15 minutes. Radar images are not predictive; and,
- Consultancy Service: Met Eireann provide a 24 hour telephone consultancy service. The forecaster will provide interpretation of weather data and give the best available forecast for the area of interest.

Using the safe threshold rainfall values will allow work to be safely controlled (from a water quality perspective) in the event of an impending high rainfall intensity event.

Works will be suspended if forecasting suggests either of the following is likely to occur:-

- >10 mm/hr (i.e. high intensity local rainfall events);
- >25 mm in a 24-hour period (heavy frontal rainfall lasting most of the day); or,
- >half monthly average rainfall in any 7 days.

Prior to works being suspended the following control measures will be completed:-

- Secure all open excavations;
- Provide temporary or emergency drainage to prevent back-up of surface runoff; and,
- Avoid working during heavy rainfall and for up to 24-hours after heavy events to ensure drainage systems are not overloaded.

*Timing of Site Construction Works*

The construction of the site drainage system will be carried out, at the respective locations, prior to other activities being commenced. The construction of the drainage system will only be carried out during periods of, where possible, no rainfall, therefore avoiding runoff. This will avoid the risk of entrainment of suspended sediment in surface water runoff, and transport via this pathway to surface watercourses. Construction of the drainage system during this period will also ensure that attenuation features associated with the drainage system will be in place and functional for all subsequent construction works.

Monitoring

Prior to the commencement of development, a detailed Site Drainage Plan and SWMP will be prepared to detail the siting and composition of the surface water management measures. The respective plans, which will form part of a detailed Construction Environmental Management Plan (CEMP), will be prepared prior to the commencement of development.

The CEMP will also include a detailed Water Quality Monitoring Plan for the monitoring of surface waters in the vicinity of the construction site by a designated Environmental Manager. The monitoring programme will comprise field testing and laboratory analysis of a range of agreed parameters. The civil works contractor, who will be responsible for the construction of the site drainage system, and Environmental Manager will undertake regular inspections of the drainage system to ensure that all measures are functioning effectively. The surface water sampling locations used in this EIAR (i.e. SW1 – SW4) will be used during construction activities. Regular inspections of all installed drainage systems will be undertaken, especially after heavy rainfall, to check for blockages, and ensure there is no build-up of standing water in parts of the systems where it is not intended.

Any excess build-up of silt levels that may decrease the effectiveness of the drainage feature, will be removed and disposed of in an appropriate manner.

### 4.5.3 Excavation Dewatering and Effects on Surface Water Quality

The management of excavation dewatering (pumping), particularly in relation to any accumulation of water in foundations or electricity line trenches, and subsequent treatment prior to discharge into the drainage network will be undertaken as follows:-

- Appropriate interceptor drainage, to prevent upslope surface runoff from entering excavations, will be put in place;

- The interceptor drainage will be discharged to the site constructed drainage system or onto natural vegetated surfaces and not directly to surface waters to ensure that Greenfield runoff rates are mimicked;
- If required, pumping of excavation inflows will prevent build-up of water in the excavation;
- The pumped water volumes will be discharged via volume and silt/sediment ponds and settlement lagoons adjacent to excavation areas, or via specialist treatment systems such as a Siltbuster unit;
- There will be no direct discharge to surface watercourses, and therefore no risk of hydraulic loading or contamination will occur;
- Daily monitoring of wind farm excavations by the Environmental Manager will occur during the construction phase. If high levels of seepage inflow occur, excavation work at this location will cease immediately and a geotechnical assessment undertaken; and,
- A mobile 'Siltbuster' or similar equivalent specialist treatment system will be available on-site for emergencies. Siltbusters are mobile silt traps that can remove fine particles from water using a proven technology and hydraulic design in a rugged unit. The mobile units are specifically designed for use on construction-sites. They will be used as final line of defence if needed.

### 4.5.4 Release of Hydrocarbons during Construction and Storage

Mitigation measures proposed to avoid release of hydrocarbons at the site are as follows:-

- The volume of fuels or oils stored on site will be minimised. All fuel and oil will be stored in an appropriately bunded area within the temporary construction compound. Only an appropriate volume of fuel will be stored at any given time. The bunded area will be roofed to avoid the ingress of rainfall and will be fitted with a storm drainage system and an appropriate oil interceptor;
- All bunded areas will have 110% capacity of the volume to be stored;
- On site refuelling of machinery will be carried out using a mobile double skinned fuel bowser. The fuel bowser, a double-axel custom-built refuelling trailer will be re-filled at the temporary compound and will be towed around the site by a 4x4 jeep to where plant and machinery is located. No refuelling will be permitted at works locations within the 50m hydrological buffer. The 4x4 jeep will also be fully stocked with fuel absorbent material and pads in the event of any accidental spillages. The fuel bowser will be parked on a level area in the construction compound when not in use and only designated trained and competent operatives will be authorised to refuel plant on site. Mobile measures such as drip trays and fuel absorbent mats will be used during all refuelling operations to avoid any accidental leakages;
- All plant and machinery used during construction will be regularly inspected for leaks and fitness for purpose;
- Spill kits will be readily available to deal with and accidental spillages;
- All waste tar material arising from road cuttings (from trenching or other works in public roads) will be removed off-site and taken to a licensed waste facility. Due to the potential for contamination of soils and subsoils, it is not proposed to utilise this material for any reinstatement works; and
- An outline emergency plan for the construction phase to deal with accidental spillages is contained within the Planning-Stage CEMP (**Annex 3.4** of the EIAR). This emergency plan will be further developed prior to the commencement of

development, and will be agreed with the Planning Authority as part of the detailed CEMP.

### 4.5.5 Groundwater and Surface Water Contamination from Wastewater Disposal

Measures to avoid contamination of ground and surface waters by wastewaters will comprise:-

- Self-contained port-a-loos (chemical toilets) with an integrated waste holding tank will be installed at the site compound, maintained by the providing contractor, and removed from site on completion of the construction works;
- Water supply for the site office and other sanitation will be brought to site and removed after use to be discharged at a suitable off-site treatment location; and,
- No water will be sourced on the site, nor will any wastewater be discharged to the site.

### 4.5.6 Release of Cement-Based Products

The following mitigation measures are proposed to ensure that the release of cement-based products is avoided:-

- No batching of wet-cement products will occur on site. Ready-mixed concrete will be brought to site as required and, where possible, emplacement of pre-cast products will be utilised;
- All watercourse crossings will utilise pre-cast products and the use of wet-cement products within the hydrological buffer will be avoided;
- Where concrete is delivered on site, only the chute will be cleaned, using the smallest volume of water practicable. Chute cleaning will be undertaken at lined cement washout ponds with waters being stored in the temporary construction compound, removed off site and disposed of at an approved licensed facility. No discharge of cement contaminated waters to the construction phase drainage system or directly to any artificial drain or watercourse will be allowed;
- Weather forecasting will be used to ensure that prolonged or intense rainfall is not predicted during concrete pouring activities; and,
- The concrete pour site will be kept free of standing water and plastic covers will be ready in case of sudden rainfall event.

### 4.5.7 Morphological Changes to Surface Water Courses & Drainage Patterns

The following mitigation measures are proposed:-

- All proposed new stream crossings will be clear span bridges (bottomless culverts) and the stream beds will remain undisturbed. No in-stream excavation works at the crossing locations are proposed and therefore there will be no impact on the stream at the proposed crossing location;
- All internal wind farm electrical cabling or grid connection cabling will pass above or below the existing culvert and will not directly interfere with the culvert;
- At the time of construction, all guidance/best practice requirements of the OPW or Inland Fisheries Ireland will be incorporated into the design/construction of the proposed watercourse/culvert crossings;
- As a further precaution, in-stream construction work (if/where required) will only be carried out during the period permitted by Inland Fisheries Ireland for in-stream works according to *Guidelines on Protection of Fisheries During Construction Works in and Adjacent to Waters* (2016) (i.e., July to September

inclusive). This time period coincides with the period of lowest expected rainfall, and therefore minimum runoff rates. This will minimise the risk of entrainment of suspended sediment in surface water runoff, and transport via this pathway to surface watercourses (any deviation from this will be done in discussion with the IFI);
- During the near stream construction works (i.e. within the 50m buffer zone), double row silt fences will be emplaced immediately down-gradient of the construction area for the duration of the construction phase;
- The new watercourse crossings at the wind farm site will require a Section 50 license application to the OPW in accordance with the Arterial Drainage Act 1945. The river/stream crossings will be designed in accordance with OPW guidelines/requirements on applying for a Section 50 consent; and,
- No instream works are proposed at the grid connection watercourse crossings.

### 4.5.8 Hydrological Impacts on Designated Sites

The proposed mitigation measures for protection of surface water quality, which will include buffer zones and robust drainage control measures (i.e. interceptor drains, swales, silt/settlement ponds, settlement lagoons), will ensure that the quality of runoff from development areas will be very high.

As stated in **Chapter 7** of the EIAR, an "*imperceptible, temporary effect*" on local streams and rivers would, if it occurs, be extremely localised and of a very short duration (i.e. hours). Therefore, considering the imperceptible effects on local surface water quality along increased dilution capacity of downstream river waterbodies, significant indirect hydrological or water quality effects on the downstream designated sites will not occur.

### 4.5.9 Water Framework Directive Status

No additional targeted measures are required or proposed in respect of the Water Framework Directive (WFD) assessment. The strict implementation of the measures set out in the preceding sections will ensure that the status of both surface water and groundwater bodies in the vicinity of the site will be maintained.

## 4.6 Air Quality & Climate

### 4.6.1 Air Quality

In order to minimise dust emissions during construction, a series of mitigation measures have been prepared in the form of an outline Dust Management Plan. A detailed Dust Management Plan will be formulated prior to the construction phase of the project, and will include the following measures:-

- On-site access tracks and public roads in the vicinity of the site shall be regularly cleaned to remove mud, aggregates and debris and maintained as appropriate. All road sweepers shall be water assisted;
- Any road that has the potential to give rise to fugitive dust shall be regularly watered, as appropriate, during dry and/or windy conditions;
- Public roads in the vicinity of the site shall be regularly inspected for cleanliness and cleaned as necessary;
- In the event of dust nuisance occurring outside the site boundary, movement of materials will be immediately terminated, and satisfactory procedures implemented to rectify the problem before the resumption of operations;

- If issues persist and the above measures are not satisfactorily control dust emissions, a wheel washing system with rumble grids to dislodge accumulated dust and mud prior to leaving the site should be installed;
- During movement of materials both on and off-site, trucks will be stringently covered with tarpaulin at all times. Before entrance onto public roads, trucks will be adequately inspected to ensure no potential for dust emissions;
- Material handling systems and site stockpiling of materials will be designed and laid out to minimise exposure to wind. Water misting or sprays will be used as required if particularly dusty activities are necessary during dry or windy periods; and
- The Dust Management Plan shall be reviewed at regular intervals during the construction phase to ensure the effectiveness of the procedures in place and to maintain the goal of minimisation of dust through the use of best practice and procedures.

### 4.6.2 Climate

Embodied carbon of materials and construction activities will be the primary source of climate impacts during the construction phase. Measures to reduce the embodied carbon of the construction works include:

- Creating a construction program which allows for sufficient time to determine reuse and recycling opportunities;
- Following IEMA mitigation hierarchy;
- Appointing a suitably competent contractor who will undertake waste audits detailing resource recovery best practice and identify materials can be reused/recycled;
- Materials will be reused on site within the new build areas where possible;
- Prevention of on-site or delivery vehicles from leaving engines idling, even over short periods;
- Ensure all plant and machinery are well maintained and inspected regularly;
- Minimising waste of materials due to poor timing or over ordering on site will aid to minimise the embodied carbon footprint of the site; and
- Sourcing materials locally where possible to reduce transport related $CO_2$ emissions.

## 4.7 Landscape

Aside from construction stage mitigation measures to minimise land and vegetation disturbance and dust emissions (which may reduce visual amenity), there are no specific mitigation measures to be implemented.

The appropriate management and reinstatement of excavations, in a timely manner, will ensure that any adverse effects caused, for example at site entrances or road upgrade locations, are minimised insofar as possible. Similarly, the progressive reinstatement and landscaping of the site will remediate any short term adverse effects on the local landscape.

Best practice construction methods including just in time delivery methods to prevent material waste, reuse of on-site materials, where possible; and the minimisation of fuel use, including generators, will reduce construction related climate emissions.

## 4.8 Cultural Heritage

Archaeological, architectural and cultural heritage resources will be protected through the following mitigation and monitoring measures:-

- Archaeological monitoring of all excavations associated with the construction of the wind farm shall be carried out. Monitoring will be carried out under licence to the Department of Housing, Local Government and Heritage and the National Museum of Ireland. Provision will be made for the full excavation and recording of any archaeological features or deposits that may be exposed during monitoring;
- Archaeological monitoring of all excavations associated with the grid connection infrastructure shall be carried out. Monitoring will be carried out under licence to the Department of Housing, Local Government and Heritage and the National Museum of Ireland. Provision will be made for the full excavation and recording of any archaeological features or deposits that may be exposed during monitoring;
- Archaeological monitoring of all excavations within the temporary haul route upgrade works at the N52/N62 junction shall be carried out. Monitoring will be carried out under licence to the Department of Housing, Local Government and Heritage and the National Museum of Ireland. Provision will be made for the full excavation and recording of any archaeological features or deposits that may be exposed during monitoring;
- Archaeological monitoring of all excavations at townland, parish and barony boundaries shall be carried out. Monitoring will be carried out under licence to the Department of Housing, Local Government and Heritage and the National Museum of Ireland. Provision will be made for the full excavation and recording of any archaeological features or deposits that may be exposed during monitoring; and
- Written and photographic records will be created of any townland, parish or barony boundaries that may be impacted on. The written and photographic records will be created in advance of excavations commencing on site.

## 4.9 Noise & Vibration

Construction activities will be completed in accordance with the provisions, where relevant, of *BS 5228-1:2009+A1:2014 Code of practice for noise and vibration control on construction and open sites – Noise* which offers detailed guidance on the control of noise & vibration from demolition and construction activities. The relevant practices to be adopted during construction shall include:-

- Limiting the hours during which site activities likely to create high levels of noise or vibration are permitted;
- Establishing channels of communication between the contractor/developer, Local Authorities and residents;
- Appointing a site representative responsible for matters relating to noise and vibration;
- Monitoring typical levels of noise and vibration during critical periods and at sensitive locations; and
- Keeping site access tracks even to mitigate the potential for vibration from HGVs.

Furthermore, a variety of practical noise control measures will be employed. These include:-

- Selection of plant with low inherent potential for generation of noise and/or vibration;
- Placing of noisy/vibratory plant as far away from sensitive properties as permitted by site constraints, and;
- Regular maintenance and servicing of plant items.

### Noise

The various contractors involved in the construction phase will be obliged, under contract, to take specific noise abatement measures and comply with the recommendations of *BS 5228-1:2009+A1:2014 Code of practice for noise and vibration control on construction and open sites – Noise*. The following list of measures will be implemented, as relevant, to ensure compliance with the relevant construction noise criteria:

- No plant or machinery will be permitted to cause a public nuisance due to noise;
- The best means practicable, including proper maintenance of plant, will be employed to minimise the noise produced by on site operations.
- All vehicles and mechanical plant will be fitted with effective exhaust silencers and maintained in good working order for the duration of the contract;
- Compressors will be attenuated models fitted with properly lined and sealed acoustic covers which will be kept closed whenever the machines are in use and all ancillary pneumatic tools shall be fitted with suitable silencers;
- Machinery that is used intermittently will be shut down or throttled back to a minimum during periods when not in use;
- Any plant, such as generators or pumps, which may be required to operate outside of general construction hours will be surrounded by an acoustic enclosure or portable screen;
- During the course of the construction programme, supervision of the works will include ensuring compliance with the limits developed using methods outlined in *BS 5228-1:2009+A1:2014 Code of practice for noise and vibration control on construction and open sites – Noise*; and
- The hours of construction activity will be limited to avoid unsociable hours where possible. Construction operations, including the delivery of construction materials, shall generally be restricted to between 07:00hrs and 19:00hrs Monday to Friday and between 07:00hrs and 13:00hrs on Saturdays, with no operations on Sundays or public holidays. However, to ensure that optimal use is made of good weather periods, at occasional critical periods within the construction programme (i.e. concrete pours, turbine component deliveries and turbine erection) or in the event of an emergency; activities may be necessary outside out of these hours.

Based on assessment of the geological composition of the site undertaken to date, it is assessed that significant levels of rock are not present and that rock breaking is unlikely to be required. If rock breaking is required, the following measures will be implemented, where necessary, to mitigate noise emissions:-

- Fit suitably designed muffler or sound reduction equipment to the rock breaking tool to reduce noise without impairing machine efficiency;
- Ensure all air lines are sealed;
- Use a dampened bit to eliminate a 'ringing' sound;
- Erect an acoustic screen between compressors or generators and noise sensitive area. When possible, line of sight between top of machine and reception point will be obscured; and
- Enclose the breaker or rock drill in portable or fixed acoustic enclosure with suitable ventilation.

### Vibration

Given the substantial distances between locations where notable levels of vibration may take place (e.g. at turbine locations or extensive use of vibration rollers in access

track construction) and the nearest NSLs, no likely significant effect will be experienced. Therefore, no specific mitigation measures are proposed in respect of vibration.

## 4.10 Transport & Access

In order to ensure the avoidance of significant effects and reduce the predicted magnitude of effects to the greatest possible extent, a suite of mitigation measures are available which will reduce any likely effects during the construction phase. The following mitigation measures will be implemented:-

- Traffic movements will be limited to 07:00-19:00 Monday to Friday and 07:00–13:00 on Saturdays with no movements on Sundays or public holidays. It may be occasionally necessary to undertake works outside of these hours to avail of favourable weather conditions or during extended concrete pours. Where construction activities are necessary outside of the normal working hours, local residents and the Planning Authority will receive prior notification;
- A wheel washing facility will be provided, as necessary, to prevent any debris being transferred from site to the adjacent public roads. All drivers will be required to ensure that their vehicle is free from dirt and stones prior to departure from the project site. Where conditions exist for dust to become friable, techniques such as damping down of the affected areas will be employed and vehicles/loads will be covered to reduce dust emissions;
- A Traffic Management Plan shall be agreed as part of the Construction Environmental Management Plan (CEMP) with the Planning Authority prior to the commencement of development. The Traffic Management Plan shall include *inter alia* confirmed details of construction material haul routes; confirmed details of vehicle specifications; a materials delivery programme; traffic management measures including details of 'Stop/Go' systems, signage, road closures and diversionary routes; and road reinstatement details;
- All works to the public road shall be undertaken in consultation with, and agreed in advance with, the relevant local authority;
- All reasonable steps shall be taken to ensure that only national and regional routes are used to transport all materials to the site, in so far as is possible;
- Prior to, and post, construction; pavement condition surveys will be undertaken along all non-national access routes proposed to be utilised in the delivery of construction materials. Given the high-quality and well-maintained nature of motorways and national routes, it is not assessed as necessary to carry out surveys of these carriageways or structures. Following the completion of the pre-construction survey, any works which are assessed as necessary to facilitate the delivery of components and materials to the project site shall be undertaken, while any deterioration of carriageways or structures identified in the post-construction survey shall be put right at the expense of the developer and to the satisfaction of the relevant local authority;
- Appropriate and adequate signage shall be provided at all entrances providing access, safety and warning information;
- Speed limit compliance; particularly along the L30033, L70151, L701521, and L70152 grid connection route; will be emphasised to all staff and contractors prior to the commencement of construction during site induction, and will be strictly enforced throughout the construction phase;
- Sufficient car parking spaces will be available at the temporary construction compound during the construction phase. Additionally, during construction of the proposed grid connection, it is likely that agricultural premises will be used

for the temporary storage of materials (e.g. ducting, cabling, etc.) and for the parking of construction plant, machinery, and work vehicles (cars, vans, etc.). No parking of cars by persons associated with the project will be permitted on any part of the public road that is not closed to traffic. All staff will be instructed to ensure that private entrances remain unobscured (particularly along the grid connection route);

- Road sweeping, particularly along the proposed grid connection route, will be carried out as appropriate to ensure construction traffic does not adversely affect road conditions;
- Traffic restrictions shall be kept to minimum duration and extent;
- Appropriate traffic management; including maintenance of local access, pedestrian access (where safe to do so) and diversions (where required); shall be implemented to facilitate continued public use of roads where temporary traffic restrictions have to be put in place. Precise details of these measures will be detailed in the Traffic Management Plan to be agreed with the Planning Authority prior to the commencement of development;
- The timing of oversized/abnormal loads shall be agreed with the relevant local authorities and An Garda Síochána, and all relevant licenses and permits shall be obtained in advance. All oversized/abnormal loads shall be accompanied by escort vehicles to ensure the maintenance of public safety;
- Maximum axle loadings for abnormal/oversized loads shall be strictly enforced in accordance with the Road Traffic (Construction and Use of Vehicles) Regulations 2003 (S.I. No. 5 of 2003);
- A designated contact point and coordinator will be put in place to manage all access arrangements and to interface with the public and the respective local authorities; and,
- The site shall be closed, and strictly secured, to the public during the construction phase.

### 4.11 Aviation

As requested by the IAA in its consultation response, a minimum of 30 days prior notification will be provided in respect of the commencement of crane operations at the project site. Additionally, as is best practice and implemented as a general standard, warning lights will be fitted to cranes during the erection of the wind turbines.

### 4.12 Waste Management

The contractor shall ensure that all waste generated at the project site is managed in an appropriate manner. The precise methods to be implemented are detailed in the accompanying Waste Management Plan which shall ensure that waste is managed in accordance with all relevant legislation, best practice methods, and in accordance with the waste management priority hierarchy.

Excavated spoil material, which also constitutes 'waste', shall be managed in accordance with the provisions of the accompanying Spoil Management Plan. Only material which cannot be re-used for reinstatement or landscaping shall be removed from the project site and disposed of at an approved waste management facility.

## 5.0 Implementation of Environmental Management Measures

In the first instance, the construction phase of the project shall be undertaken in strict compliance with all measures set out in the EIAR and NIS; unless where revised or

where required to be revised in order to ensure compliance which a condition of planning consent. All relevant conditions of consent shall be inserted at **Table 1** below.

| Planning Conditions | | |
|---|---|---|
| **Condition No.** | **Content** | **Relevance to Construction Phase (Yes/No)** |
| | | |
| | | |
| | | |
| | | |
| | | |

**Table 1: Planning Conditions**

This CEMP; which will be further developed prior to the commencement of construction; all associated documentation, construction management plans, and construction method statements shall be prepared to ensure strict accordance with each of the measures of the EIAR, NIS, and conditions of consent. As stated at **Section 1.4** above, it will be the responsibility of the EM to ensure coordination between this CEMP, all associated construction management plans & method statements, and the requirements set out in relation to the project.

## 6.0 Communication Plan

Given the multitude of stakeholders to be involved in the construction phase of the project, a clear and concise communications plan will be implemented to ensure that all matters arising are appropriately reported and recorded. The Communications Plan, which will be developed by the contractor will include a reporting strategy including, but not limited to, the following personnel:-

- Cush Wind Limited Project Manager;
- Contractor Project Manager;
- Cush Wind Limited Project Supervisor Construction Phase (PSCS);
- Contractor Site Foreman;
- Environmental Manager;
- Ecological Clerk of Works;
- Geotechnical Clerk of Works; and
- Archaeological Clerk of Works.

Additionally, Cush Wind Limited shall appoint a dedicated Community Liaison Officer (CLO) who shall be responsible for engaging with members of the local community regarding the provision of project updates, etc., and shall also be responsible for relaying any matters raised to the project team.

A list of project contacts, to be developed prior to the commencement of construction and included within the detailed CEMP, shall be made available to all construction staff while a copy shall also be provided at the site offices.

## 7.0 Staff Training & Environmental Awareness

Only staff who have received appropriate training and have the necessary safety training/certification shall be permitted on-site.

All construction phase personnel will receive environmental awareness information as part of their initial site induction. The extent of their induction shall be tailored to the

scope of their work; however, as a minimum, all environmental protection matters will be addressed in full. This will ensure that staff are familiar with environmental obligations associated with the construction process and the procedures and measures to be implemented. Staff will also be advised of the likely effects of any non-compliance with the relevant environmental measure.

As described at **Section 1.4**, the EM shall provide regular environmental updates to personnel and shall advise of any improvements which can be implemented.

Tool box talks will be held by the EM, or other relevant personnel at the commencement of each day or at the commencement of new activities. The aims of the tool box talks are to identify the specific work activities that are scheduled for that day or phase of work. In addition, the necessary work method statements will be identified and discussed. Additionally, any non-compliance with a measures in this CEMP will also be discussed with the aim of avoiding a re-occurrence of the same non-compliance.

## 8.0 Emergency Response Procedures

Prior to the commencement of construction, the contractor shall prepare a comprehensive emergency response procedure to be implemented by on-site personnel. This on-site procedure shall be incorporated within the Environmental & Emergency Response Plan to ensure that appropriate procedures are in place to manage any incident and report same to the relevant stakeholders.

## 9.0 Recording & Reporting

Over the course of the construction phase, a significant volume of reporting will be undertaken to record the activities, methodologies, and measures implemented during the construction phase. With regards to environmental recording, the following is a non-exhaustive list of reports/records which are likely to be appended to the CEMP as the construction phase progresses:-

- Site Sign-In Records;
- Weekly Environmental Reports;
- Monthly Environmental Reports;
- Site Visual Inspection Checklists;
- Environmental Audits;
- Ecological Survey Reports;
- Water Quality Monitoring Reports;
- Archaeological Monitoring Reports;
- Geotechnical Monitoring Reports;
- Traffic Management Plans;
- Waste management documentation;
- All relevant licences, consents, and permits;
- All correspondence (internal and external) regarding environmental matters; and
- Staff Training Records.

## 10.0 Compliance & Review Procedures

### 10.1 Site Inspections & Environmental Audits

Routine inspections of construction activities will be carried out on a daily and weekly basis by the Contractor Project Manager, PSCS, Contractor Site Foreman, EM, and ECoW to ensure all environmental controls, relevant to the construction activities taking place at the time, are in place. Environmental inspections will ensure that the

works are undertaken in accordance with this CEMP and all other relevant documentation.

## 10.2 Auditing

The contractor will be responsible for ensuring that all construction staff are aware of the requirement to, and understand the importance of, strictly implementing the procedures of the CEMP. Environmental audits will be undertaken during the construction phase of the project. In contrast to monitoring and inspection activities, audits are designed to identify the underlying causes of non-compliances, and not to merely detect the non-compliance itself.

Moreover, audits are the means by which system and performance improvement opportunities may be identified. Environmental audits will be carried out by the contractor or by external personnel acting on their behalf. The impartiality and objectivity of the audit process is crucial in the identification of improvements to the activities being undertaken at the project site. Environmental audits will be scheduled and conducted at regular intervals to determine whether the CEMP is being appropriately implemented. The findings of the audits will be provided to the Cush Wind Limited Project Manager, Contractor project Manager, PSCS, EM, and ECoW.

A sample Environmental Audit is included within the accompanying Environmental & Emergency Response Plan.

## 10.3 Environmental Compliance

As has been set out in the preceding sections, construction activities will be continuously and rigorously assessed to ensure that works are undertaken in accordance with the provisions of the detailed CEMP (to be prepared prior to construction). Where an environmental 'event/occurrence' has been identified, the following definitions shall apply:-

- Near-Miss: An event which has not resulted in an adverse environmental effect but which, if not addressed, could re-occur and result in adverse effects;
- Incident: An event which has occurred and which, if un-controlled, could result in substantial effects; however, on-site measures/procedures avoided such effects;
- Exceedance Event: Where an event has resulted in identifiable adverse effects which exceed the appropriate limit value (e.g. a deterioration of downstream water quality below acceptable limits). An exceedance event usually triggers the cessation of particular activities until an investigation has been completed and additional measures implemented; and
- Non-Compliance: The identification of an un-agreed deviation from prescribed procedures/measures set out in this CEMP.

## 10.4 Corrective Actions

A corrective action relates to the implementation of revised measures/procedures to rectify an identified environmental matter/concern/issue. Corrective actions will be implemented by the Contractor Project Manager, as advised by the PSCS and EM,

Corrective actions may be required as a consequence of:-

- Environmental Audits;
- Environmental Inspections; Environmental Monitoring;
- Environmental Incidents; and,
- Environmental Complaints.

A Corrective Action Notice will be used to communicate the details of the action required. A Corrective Action Notice will describe the cause and effect of the environmental issue/concern and will detail the recommended corrective action to be implemented.

If an environmental matter/concern/issue arises which requires immediate intervention; direct communications between the Contractor Project Manager, PSCS and EM will be conducted. A Corrective Action Notice will be completed subsequently.

## Annex 1 –
## Environmental & Emergency Response Plan

Cush Wind Farm

# Planning-Stage Construction & Environmental Management Plan

# Environmental & Emergency Response Plan

Cush Wind Limited

Galetech Energy Services

Clondargan, Stradone, Co. Cavan Ireland

Telephone +353 49 555 5050

www.galetechenergy.com

# Contents



# 1.0 Introduction

Galetech Energy Services (GES), on behalf of Cush Wind Limited, has prepared this Environmental and Emergency Response Plan (EERP) which should be instigated if an emergency or environmental incident occurs either within the project site or elsewhere linked to the construction of the Cush Wind Farm.

## 1.1 Purpose of this Report

Many construction and industrial sites have the potential to cause environmental harm which could pose threat to public health, water supplies and wildlife in the event of an environmental incident. The purpose of this report is to outline how, in the event of an emergency, impacts on humans and the local environment can be limited through quick action.

This EERP forms part of the pre-commencement requirement for the works and outlines conditions of work for staff, and for every contractor or sub-contractor at the site.

This document is a live document which will be updated regularly and forms part of the Planning-Stage Construction Environmental Management Plan (CEMP) for the Cush Wind Farm. Consequently, the majority of specific details can only be provided prior to the commencement of construction activities.

It contains details of:-

- Who should be contacted in an emergency;
- Procedures to be followed in an emergency; and
- Staff responsibilities in an emergency.

## 1.2 Environmental Incident

This EERP should be implemented once there has been an emergency or environmental incident on site or elsewhere linked to the construction of the Cush Wind Farm. Incidents can be a discharge to air, land or water that could cause environmental damage. Causes of environmental incidents on site include:-

- Land Slide;
- Vandalism;
- Fire;
- Leaking plant or equipment;
- Containment Failure;
- Overfilling of containment vessels;
- Discharge of raw or partially treated effluent;
- Wind-blown waste, litter or dust;
- Flooding on site;
- Leaking Portaloo;
- Fuel drips or spills during refuelling;
- Leak from fuel or chemical containers;
- Failure of pumps and pipelines; and
- Contaminated water or sediment/silt entering a waster course or drain.

Any of these incidents could affect drainage systems, surface waters, ecosystems, groundwater and soil. The production of toxic fumes and airborne pollutants could affect air quality which may damage human health, wild and domestic animals and ecosystems.

### 1.3 Reference Documents

The production of this EERP has been supported by current legislation and will be accounted for in the further development of the appointed contractor's detailed CEMP.

Other guidance documents have been used to develop this EERP; including a Planning-Stage Construction & Environmental Management Plan, Spoil Management Plan, Surface Water Management Plan, and Water Quality Management Plan.

## 2.0 Requirements of an EERP

This EERP provides guidance for environmental incidents and includes:-

- Summaries of local environmental sensitivities;
- An outline of the construction works and sources to relevant existing environmental plans;
- Key mapping reference points for the site;
- Contact information for key external bodies and emergency response numbers who will assist in the event of an emergency;
- An identification of key staff and 24-hour contact details for those who will assist in the event of an emergency;
- An identification of Inventory of Pollution Prevention Equipment;
- Details of an Inventory of Chemical Products and Waste Inventory on Site*;
- Details of reporting requirements;
- Details of staff who are trained in the use of spill kits and booms etc.;
- Procedures to be followed in the event of an emergency and an identification of those responsible for re-positioning and moving the plant; and
- A widely available summary sheet for operatives that outlines the key procedures in the event of an emergency.

## 3.0 Description of the Project

Cush Wind Limited intend to construct the Cush Wind Farm which will consist of:-

- 8 no. wind turbines with an overall tip height of 200m, and all associated ancillary infrastructure;
- All associated and ancillary site development, excavation, construction, landscaping and reinstatement works, including provision of site drainage infrastructure and forestry felling.
- Temporary alterations to the turbine component haul route; and,
- Construction of an electricity substation, Battery Electricity Storage System and installation of 5.6km of underground grid connection to facilitate connection of the proposed electricity substation to the existing 110kV substation at Clondallow, County Offaly;

The project site is located in rural Co. Offaly, approximately 4km north of the town of Birr and c. 28km south-west of Tullamore, County Offaly. Off-site and secondary developments; including the forestry replant lands and candidate quarries which may supply construction materials; also form part of the project.

The turbine component haul route, and associated temporary alteration works, are located within counties Galway, Roscommon, Westmeath, and Offaly. It is envisaged that the turbines will be transported from the Port of Galway, through the counties of Galway, Roscommon, Westmeath and Offaly, to the project site.

As well as the reference documents listed in **Section 1.3**, various environmental reports have been prepared for the development including:-

- Environmental Impact Assessment Report (Galetech Energy Services);
- Biodiversity Chapter (SLR Consulting);
- Land & Soil Chapter (Hydro Environmental Services);
- Water Chapter (Hydro Environmental Services); and
- Natura Impact Statement (SLR Consulting).

## 4.0 Incident and Hazard Reporting

To ensure that all environmental incidents or hazards are accurately recorded, a reporting system has been developed. The logging of environmental incident reports will ensure that regular revisions and reviews can be made. In the event of an accident/incident, a blank environmental incident report has been attached on the last page of this report that includes details of all non-compliance and corrective actions carried out as a result of any incidents.

## 5.0 Waste Disposal after Environmental Incidences

In the event of a pollution incident where a spill kit etc. may be used, operatives must dispose of the used equipment by placing them into a sealed bag or container. Used equipment will then be removed from site by a licensed waste contractor to a licensed waste facility.

## 6.0 Site Induction and Toolbox Talks

It is crucial that all contractors, sub-contractors and staff on site are fully familiar with this EERP. Toolbox talks will be regularly given to the workforce on the aspects of health and safety of this project and, during these talks, they will receive regular reminders of the importance of not only the local environment but of the necessary environmental controls that are in place on site.

## 7.0 Summary Sheet for Machinery & Plant Operators

This summary sheet is for all site personnel. A laminated copy will be kept on all site vehicles/machinery.

### 7.1 Procedures for an Incident

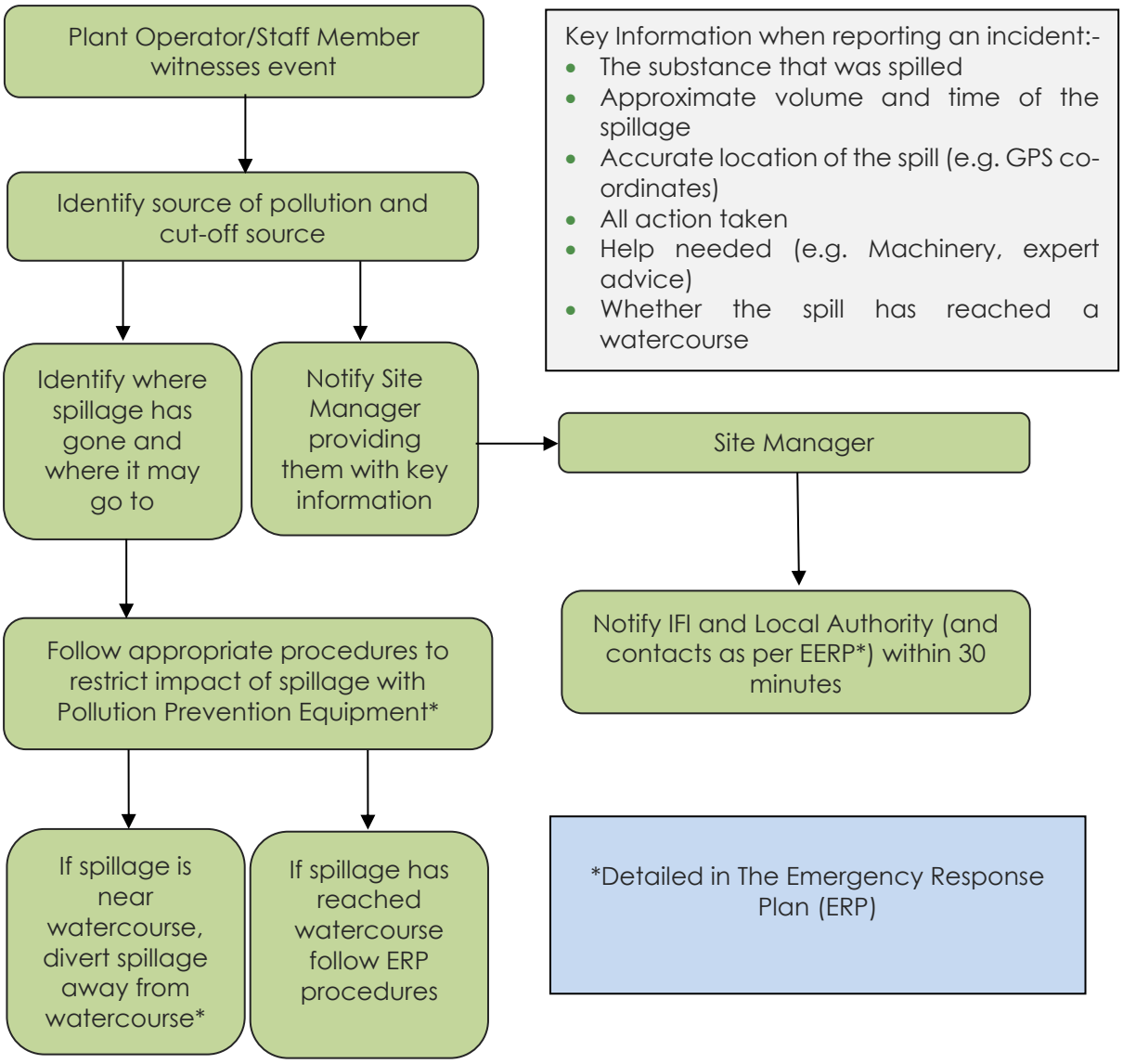
The following procedures are a guide when dealing with incidents. To ensure health and safety for yourself and others, this health and safety guidance should be followed at all times alongside applying common sense:-

1. Identify the source of the spillage and cut off source if possible through closing a valve or righting container etc.;
2. Discontinue all work on site and all operatives will assist in placing spill mats correctly on affected area. Immediately contact Site Manager/ main contact;
3. Identify the spillage route. If spillage is in close proximity to a watercourse (drainage/ditch/river), divert spillage away from the watercourse through the use of absorbent materials from the spill kit;
4. If a watercourse is at risk of contamination from suspended solids from a slope failure, do the following:-
   a. Place straws bales wrapped in geotextile or sand/gravel bags with geotextile curtains immediately in the watercourse(s) at regular intervals downstream from the incident. These sand/straw bags and bales will be removed and replaced with stone filters once water quality is stabilized;
   b. Stone check dams faced with a layer of geotextile will be constructed at critical points along the watercourse; and
   c. Small sumps will be formed intermittently between the check dams to reduce the amount of suspended solids contained in the water;

5. If there has been an Oil spill in the watercourse, do the following:-
   a. Place flexible absorbent booms across the watercourse, ahead of the contamination within a quiet stretch of water;
   b. Place absorbent cushions in the water immediately upstream of these booms as well as downstream of the booms; and
   c. Remove and replace saturated absorbent material as required. Please ensure removed cushions are placed in sealed polythene bags/containers and disposed of by the principal waste contractor;
6. Notify all parties in the order listed overleaf. Notification should be made by one member of staff whilst remaining staff present deal with the spill;
7. Dig up all contaminated ground as soon as possible. All contaminated materials should be placed in sealed polythene bags/containers and disposed of appropriately by a licensed waste contractor; and
8. Complete required record of incident and response into reporting system.

## 8.0 Communication Plan

A detailed Communication Plan will be provided by the Contactor, in liaison with relevant stakeholders, and will be included in the updated EERP prior to the commencement of construction. An outline Communication Plan is set out below.



## 8.1 Environmental Response Plan for Cush Wind Farm

<table>
<tr><th colspan="2">Incident Response Plan for Cush Wind Farm<br>Based on template provided in GPP 21 – Guidance for Pollution Prevention</th></tr>
<tr><td>Site Address:<br>Cush, Galros West, Boolinarig Big, and Eglish, Co. Offaly.<br>Official Company Address:<br>Cush Wind Limited, Greaghcrottagh, Tullyco, Cootehill, Co. Cavan<br><br>Key Holders for site (Name and Contact numbers):</td><td>Coordinates:<br><br>Map references:</td></tr>
<tr><td colspan="2">Overview of the activities on site:<br>Include number of employees at different times of the day:<br><br>Daylight hours:<br><br>Dusk to Dawn<br><br>Weekend Dusk to Dawn:<br><br>Bank Holidays:</td></tr>
<tr><td colspan="2">Description of surrounding area:</td></tr>
<tr><td>Date and Version of the plan:</td><td>Name & position of person responsible for compiling/approving the plan:</td></tr>
<tr><td>Review date:</td><td>Date of next exercise:</td></tr>
<tr><td colspan="2">Objectives of the plan:</td></tr>
<tr><td colspan="2">List of external organisations consulted in the preparation of this plan with contact details:</td></tr>
<tr><td colspan="2">Distribution list of who has received this plan and which version: Please note that it is recommended that you review and revise this plan regularly</td></tr>
</table>

## 8.2 External Contacts

| External Contacts | | |
|---|---|---|
| **Contact** | **Office Hours** | **Out of Office** |
| Emergency Services (Fire/Police/Ambulance) | 999 or 112 | 999 or 112 |
| Local Garda Station | Birr: +353579169710 | |
| Local Hospital: Midland Regional Hospital, Tullamore | 057 932 1501 | |
| Environment Section<br>Offaly County Council<br>Áras an Chontae, Charleville Road,<br>Tullamore,<br>Co. Offaly<br>R35 F893 | 057 934 6800 | |
| EPA Regional Inspectorate Seville Lodge<br>Callan Road<br>Kilkenny | 056 779 6700 | |
| Inland Fisheries Ireland | 01 8842600 | 1890 347 424 (24 hours) |
| ESB | 01 8529534 | |
| Telecommunications – Eircom/Eir | 1800 475475 | |

## 8.3 Internal Contacts

| Internal Contacts | | |
|---|---|---|
| Names and position of staff authorised and trainers to activate and co-ordinate the plan. Staff to be contacted if needed to move or evacuate the site | | |
| Other Staff: | | |
| Managing Director | | |
| Site Manager | | |
| Environmental Manager | | |

## 8.4 Chemical Product & Waste Inventory

| Chemical Product & Waste Inventory | | | | | | |
|---|---|---|---|---|---|---|
| Trade name/ substance | Solid/liquid/gas or powder | UN number | Max amount | Location marked on site plan | Type of Containment | Relevant health & Environmental properties |
| | | | | | | |
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## 8.5 Pollution Prevention Equipment Inventory

| Pollution Prevention Equipment Inventory (On/Off-Site Resources) | | | |
|---|---|---|---|
| Type | Location | Amount | Staff contact |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |

## 8.6 Site Environmental Incident Report Form

| | | | |
|---|---|---|---|
| Site: | | Date: | |
| Time: | | Weather: | |
| Report By: | | Position: | |
| Cush Wind Farm personnel present: | | Position: | |
| Contractor personnel present: | | Position: | |

| |
|---|
| Description of Incident: |

| | |
|---|---|
| Item Spilled: | |
| Estimate of Volume of Spillage: | |

| **List of actions followed once incident was noted** | **Time:** | **Corrective Action** **Action:** | **By:** |
|---|---|---|---|
| Who first observed incident? | | | |
| First action | | | |
| Next action | | | |
| Time Pollution Hotline was contacted | | | |
| Other | | | |

| **Details of Clean-Up contractor or how contamination was removed from site:** | |
|---|---|
| | |
| Details of how this could be avoided in future: | |
| Details of review of internal procedures as result of this incident: | |

Date of Report Completion: _____

| Item | Questions | Yes | No | Corrective Action Action: | By: |
|---|---|---|---|---|---|
| 1. Miscellaneous | | | | | |
| 1.01 | Does the contractor carry out regular internal environment audits on the site? Are recommendations recorded and is corrective action monitored? | | | | |
| 1.02 | Have any environment incidents occurred and have these been reported as per on site procedure? | | | | |
| 1.03 | Does the site induction contain a section on environmental requirements, including spill procedures, and is this communicated effectively? | | | | |
| 2. Land | | | | | |
| 2.01 | Are areas of hard standing (excluding bunded and refuelling areas) appropriately drained? | | | | |
| 2.02 | Have local roads been inspected and cleaned where necessary? | | | | |
| 2.03 | Has all test pitting and soil stripping been monitored by an archaeologist? | | | | |
| 2.04 | Have all site clearance works been checked by an ecologist prior to works? | | | | |
| 3. Materials and Equipment | | | | | |
| 3.01 | Is there knowledge of the IFI Guidelines on protection of Fisheries During Construction Works in and Adjacent to Waters (2016) and OPW Environmental Guidance: Drainage Maintenance & Construction (2019) | | | | |
| 3.02 | Are transformers/generators located in secondary containment bunds? | | | | |
| 3.03 | Are all bunds capable of containing 110% of the | | | | |

| | | | | | |
|---|---|---|---|---|---|
| | volume of the largest container? | | | | |
| 3.04 | Is refuelling carried out in a designated refuelling bay? | | | | |
| 3.05 | Does all site drainage on hard standing drain to an oil interceptor? | | | | |
| 3.06 | Is the designated area for oil, fuel and chemical storage appropriately sited (i.e. on hard standing at least 10m from a watercourse)? | | | | |
| 3.07 | Are there procedures in place to monitor bund integrity and manage bund rainwater levels?<br>Are these followed and recorded? | | | | |
| 3.08 | Is there awareness that oil or residue from contaminated water removed from bunds should be disposed of as special waste and not discharged to land or the water environment? (oil absorbent materials (pads etc.) should be used first) | | | | |
| 3.09 | Are all drums and mobile plant (e.g. generators) placed on drip tray more than 10m from any watercourse? | | | | |
| 3.10 | Is all plant maintained in a good state of leaks?<br>Are there records of this? | | | | |
| 3.11 | Are there adequate spill kits available and stored in close proximity to potential risks? | | | | |
| 3.12 | Are all refuelling browsers double skinned, locked when not in use, and in a good state of repair? | | | | |
| 3.13 | Is there evidence of unmanaged/unrecorded fuel/oil spillages on site? | | | | |

| | | | | | |
|---|---|---|---|---|---|
| 3.14 | Are dry or wet wheel washing facilities fully operational and effective? | | | | |
| 3.15 | If wet wheel washing facilities are required, are these closed systems with no discharge to the water environment? | | | | |
| 3.16 | Are there laboratory certificates (accredited by the Irish National Accreditation Board) to confirm that imported material stone aggregate brought onto site is free from any contamination? | | | | |
| 4. Noise, Dust & Light | | | | | |
| 4.01 | Are there facilities to dampen stockpiles and site working areas/roads to suppress dust? | | | | |
| 4.02 | Are vehicles carrying loose material sheeted at all times? | | | | |
| 4.03 | Are construction works, or deliveries of materials to and from the department, audible at noise sensitive premises? | | | | |
| 4.04 | Has all external construction lighting received the approval of the planning authority? | | | | |
| 5. Waste | | | | | |
| 5.01 | Is the site tidy and free from litter? | | | | |
| 5.02 | Is there evidence of waste beyond the site boundary? | | | | |
| 5.03 | Is waste segregated and kept securely in containers in clearly designated areas? | | | | |
| 5.04 | Does all waste leaving the site have the appropriate duty of care paperwork? | | | | |
| 5.05 | Is all waste leaving the site being taken to an appropriately licensed site? | | | | |

| | | | | | |
|---|---|---|---|---|---|
| 5.06 | Does all special/hazardous waste (e.g. oil contaminated soils, waste oil) have the appropriate Special Waste Consignment Note? | | | | |
| 5.07 | Is material re-used/recycled on site where possible? | | | | |
| 5.08 | Are waste management practices in line with the site waste management plan? | | | | |
| 5.09 | Are relevant Waste Management Exemptions in place for use of waste on site (e.g. use of waste concrete to create foundation sub-base)? | | | | |
| 5.10 | Is there any evidence of burning on site? | | | | |
| 5.11 | Is there any evidence of unlicensed burial of waste? | | | | |
| 6. Water | | | | | |
| 6.01 | Do all discharges to land or watercourses have appropriate authorization from Local Authorities/IFI? | | | | |
| 6.02 | Do all watercourses engineering (bank protection, crossing etc.) have the appropriate authorization from Local Authorities/ IFI? | | | | |
| 6.03 | Do any abstractions from a watercourse or groundwater body have the appropriate authorization from Local Authorities/ IFI? | | | | |
| 6.04 | Has confirmation for the SUDS design for access roads been gained from Local Authorities/ IFI? | | | | |
| 6.05 | Are cut-off ditches installed on the uphill side of the working area to avoid contaminated surface water run-off? | | | | |
| 6.06 | Has vegetation removal/clearance of the site been minimized to | | | | |

| | | | | | |
|---|---|---|---|---|---|
| | avoid unnecessary areas of bare-ground? | | | | |
| 6.07 | Is adequate treatment (e.g. settlement tank/lagoons/discharge to land) provided to prevent silt contaminated water entering watercourses and groundwater? | | | | |
| 6.08 | Has vegetation removal/clearance of the site been minimized to avoid unnecessary areas of bare-ground? | | | | |
| 6.09 | Have buffer-strips been left between working area and watercourses? | | | | |
| 6.10 | Is plant operating in the watercourse? | | | | |
| 6.11 | Have all culverts been installed at the base of stockpiles situated within close proximity to watercourses? | | | | |
| 6.12 | Have silt fences been installed at the base of stockpiles situated within close proximity to watercourses? | | | | |
| 6.13 | Are there adequate controls on site construction roads to minimize sediment runoff into watercourses (in particular, are the adequate flow attention measures within surface drain?) | | | | |
| 6.14 | Are there any sign of decaying straw bales in watercourses? (this could lead to organic pollution of the watercourse) | | | | |
| 6.15 | Are silt traps regularly maintained? | | | | |
| 6.16 | Has ease of maintenance been considered in the design of permanent drainage features? | | | | |
| 6.17 | Is there evidence of contamination of any watercourse (e.g. with oil, | | | | |

| | | | | | |
|---|---|---|---|---|---|
| | sediment, concrete, waste) in the vicinity of the works? | | | | |
| 6.18 | Is monitoring of potential impacts on watercourses carried out on a regular basis and fully recorded? | | | | |
| 6.19 | Are dewatering operations being carried out in such a way to minimize sediment contamination? | | | | |
| 6.20 | Is drainage and run off in concrete batching areas adequate? | | | | |
| 6.21 | Are adequate pollution prevention measures considered and put in place during concrete pours? | | | | |
| 7. Landscape | | | | | |
| 7.01 | Have earthworks been designed to promote successful re-instatement of vegetation? | | | | |
| 7.02 | Are reinstatement and restoration works being implemented in a timely manner as per the requirements of the Contract? | | | | |
| 8. Ecology | | | | | |
| 8.01 | Have storage sites (soil, plant etc.) been sited on areas of lower quality habitat where possible? | | | | |
| 8.02 | Have buffer zones been constructed and maintained around designated protected species exclusion areas (e.g. red squirrel dreys, water vole habitats, otter holts, badger holts etc.)? | | | | |
| 8.03 | Have toolbox talks on the subject of ecology and environmental responsibilities on site been delivered?<br>Have attendance records been maintained for these? | | | | |
| 9. Documentation Check | | | | | |

| | | | | | |
|---|---|---|---|---|---|
| 9.01 | Start-up meeting record | | | | |
| 9.02 | Full contacts list in CEMP | | | | |
| 9.03 | Induction records | | | | |
| 9.04 | Pollution Prevention Measures Register | | | | |
| 9.05 | Geotechnical Risk Register | | | | |
| 9.06 | Weekly meeting minutes | | | | |
| 9.07 | Records of environmental checks and routine monitoring of mitigation measures | | | | |
| 9.08 | Water Quality Monitoring Results | | | | |
| 9.09 | Safety and Environmental Awareness Reports (SEARs). Filed and entered in database? | | | | |
| 9.10 | Safety and Environmental Audit Reports for the site.<br>(If yes, insert date of last audit) | | | | |
| 9.11 | Contractor's Environmental Plans (or Construction Method Statements) | | | | |

# Annex 2 –
# Waste Management Plan

Cush Wind Farm

# Planning-Stage Construction & Environmental Management Plan

# Waste Management Plan

Cush Wind Limited

Galetech Energy Services
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Telephone +353 49 555 5050
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# Contents



# 1.0 Introduction

Galetech Energy Services (GES), on behalf of Cush Wind Limited, has prepared this Waste Management Plan (WMP) to detail the measures to be implemented for the control, management and monitoring of waste associated with the Cush Wind Farm.

## 1.1 Purpose of this Report

The objective of this WMP is to minimise the quantity of waste generated by construction activities, to maximise the use of materials in an efficient manner and to maximise the segregation of construction waste materials on-site to produce uncontaminated waste streams for off-site recycling.

The WMP shall be implemented throughout the construction phase of the development to ensure:-

- That all site activities are effectively managed to minimise the generation of waste and to maximise the opportunities for on-site reuse and recycling of waste materials;
- To ensure that all waste materials are segregated into different waste factions and stored on-site in a managed and dedicated waste storage area; and
- To ensure that all waste materials generated by site activities are removed from site by appropriately permitted waste haulage contractors and that all wastes are disposed of at approved waste licensed / permitted facilities in compliance with the Waste Management Act 1996 and all associated waste management regulations.

## 1.2 Scope & Requirements

This WMP forms part of the pre-commencement requirement for the works and outlines conditions of work for staff, and for every contractor or sub-contractor at the site. The contractor will continually oversee changes to this document and will work alongside the Environmental Manager (EM) prior to any work commencing.

This document is a live document which will be updated regularly and forms part of the Planning-Stage Construction Environmental Management Plan (CEMP) for the Cush Wind Farm. Consequently, the majority of specific details can only be provided prior to the commencement of construction activities.

## 1.3 Waste Policies & Legislation

The Department of the Communications, Climate Action & Environment published *A Waste Action Plan for a Circular Economy – Ireland's National Waste Policy 2020-2025* in 2020. One of its guiding principles is to minimise waste and, therefore, it is key that the contractor has an efficient waste management plan in place.

The European Union (Waste Directive) (Amendment) Regulations 2016 infer a duty on all waste producers to take measures to apply the waste hierarchy priority order. In these Regulations, the "Act of 1996" means the Waste Management Act 1996 (No. 10 of 1996) and '"Principal Regulations" means the European Communities (Waste Directive) Regulations 2011 (S.I. No. 126 of 2011). The "Waste Directive" means Directive 2008/98/EC of the European Parliament and of the Council of 19 November 2019 on waste.

The Waste Management Priority Hierarchy, which contractors are obligated to apply, is as follows:-

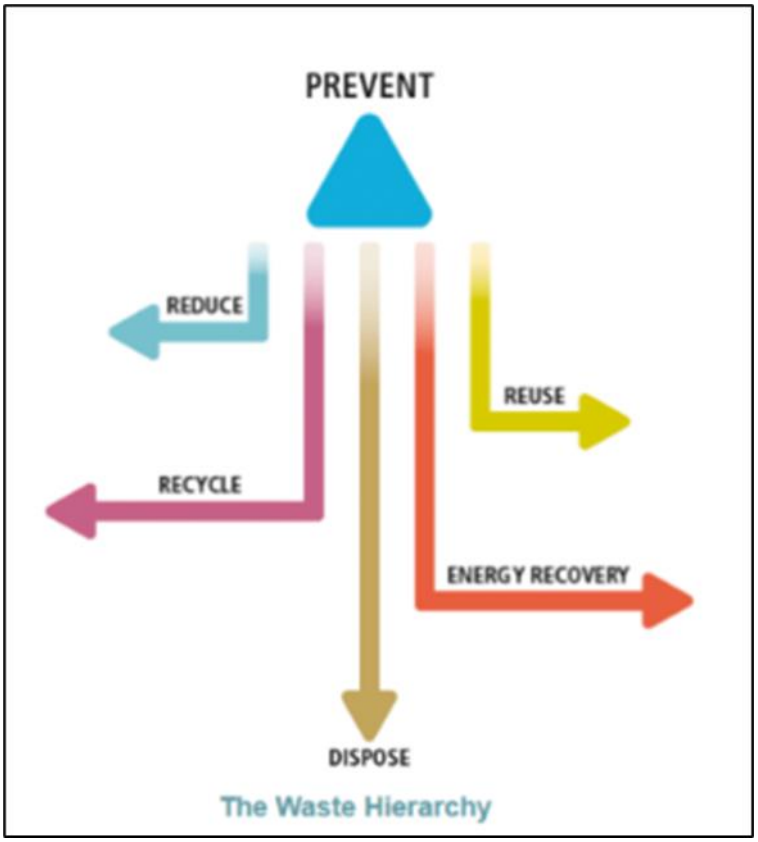


**Figure 1: Waste Management Hierarchy**

The waste management hierarchy shown above applies to all waste, including hazardous waste. The diagram conveys that above all, the prevention of waste production is the top priority.

The PCB/PCT Directive (Directive 96/59/ EC on the disposal of polychlorinated biphenyls and polychlorinated terphenyls) deals with the disposal of certain hazardous chemicals that represent a particular threat to the environment and to human health.

The European Communities (Carriage of Dangerous Goods by Road and Use of Transportable Pressure Equipment) (Amendment) (No. 2) Regulations 2017 (S.I No. 282 of 2017) shall be adhered to in the case of transportation to and from the site of any dangerous goods.

The contractor, in accordance with the abovementioned Directives, is legally required to:-

- Prevent waste disposal constituting a public nuisance through excessive noise levels or unpleasant odours, or to degrade places of special natural interest;
- Prohibit the dumping or uncontrolled disposal of waste;
- Ensure that the disposal and recovery of waste does not present a risk to water, air, soil, plants and animals;
- Ensure that waste treatment operations are licensed ;
- Prepare a Waste Management Plan;
- Require waste collectors to have special authorization and to keep records; and
- Ensure that the waste which cannot be prevented or recovered is disposed of without causing environmental pollution.

The EU Integrated Pollution Prevention and Control (IPPC) Directive (Directive 96/61/EC) provides for a permit system for activities including waste management. In adherence with this Directive, the contractor must:-

- Be in possession of a waste permit for waste disposal; and
- Be prepared at all times for inspection regarding monitoring of waste activities.

### 1.4 Reference Documents

The production of this WMP has been supported by best practice manuals and will be accounted for in the further development of the appointed contractor's detailed CEMP.

Other guidance documents have been used to develop this WMP; including a Planning-Stage Construction & Environmental Management Plan, Spoil Management Plan, Surface Water Management Plan, and Environmental & Emergency Response Plan.

## 2.0 Requirements of a WMP

There are four stages to be followed in the management of waste:-

- Planning;
- Implementation;
- Monitor; and
- Review.

### 2.1 Planning

During the planning/design/development stages of the Cush Wind Farm, the nature of the site has been accounted for as well as the environmental considerations and the design of the project. Insightful planning at the early stages will help minimise the quantity of waste produced.

### 2.2 Implementation

The detailed WMP, to be prepared prior to construction, will implement the management of the following:-

- A brief of waste types expected to be produced;
- Estimates of quantum of each type of waste expected to be produced;
- An explanation of how the contractor aims to minimise the different waste types produced prior to any activity that generates this waste; and
- Procedures for identification of the waste management actions proposed for each different waste type, including re-using, recycling, recovery and disposal (as per the waste hierarchy priorities).

All workers will be fully briefed of waste management procedures and aware of their requirements under the WMP. All site visitors will be briefed on appropriate waste storage and disposal units. Littering will not be tolerated and all personnel will have a duty to challenge those who do not comply with WMP procedures.

### 2.3 Monitoring

#### 2.3.1 Checks and Records

All stores on site of oil, fuel and chemicals should be visually inspected on a regular basis, especially during extreme weather conditions. Visual inspections will reveal evidence of leaks, spills or contamination.

Records of all visual checks must be maintained and be made available upon request for inspection. The topic of waste management will be regularly discussed during team meetings and, as required, waste management practices should be continually revised.

### 2.3.2 Waste Inventory

A waste inventory should be continually updated and will include a list of all waste materials leaving the site for disposal as well as the name of the appropriately licensed operator and intended disposal facility. A waste inventory will be added to this plan by the contractor.

### 2.3.3 Monitoring of WMP

The contractor will appoint the EM to implement and monitor the WMP. The WMP should include an inventory of the types of estimates of the waste to be produced on site. The aim will be to keep the volumes of waste produced below the estimates of waste to be produced. The EM will ensure that a waste audit is carried out every 6-months.

## 2.4 Review

Upon completion of the construction phase, a waste management review will be undertaken. The aim will be to measure compliance with the WMP objectives and to consider lessons learnt. The review will be carried out by the EM in conjunction with the contractor.

# 3.0 General Waste Management Principles

- It is the contractors responsibility to avoid or minimise the volume of waste generated;
- Waste storage and disposal procedures will prevent pollution in compliance with legislation;
- Waste, including spoil, will be stored (regardless of whether it is permanent or temporary storage) a minimum of 10m from nearby watercourses or drain;
- All waste to be transported off-site shall only be removed to a licensed disposal site. Waste control dockets must be produced and filed on site with each load, and must detail:-
  - An adequate description of the waste;
  - Where the waste came from;
  - The appropriate code from the List of Wastes Regulations for the waste (commonly referred to as the EWC code);
  - Information on the quantity and nature of the waste and how it is contained;
  - Names and addresses of the transferor (the person currently in control of the waste) and the transferee (usually either a registered waste carrier or a waste management license holder (waste manager);
  - The Standard Industry Classification (SIC) CODE (2007 or 2003 for hazardous waste only) of the business from where the waste was received;
  - Where applicable, indicate that the waste hierarchy has been complied with;
  - The place, date and time of transfer of the waste. If using a season ticket, the period for which it is valid (i.e. valid from dd/mm/yyyy to dd/mm/yyyy); and
  - If the waste is being taken to landfill the transfer note must also contain details of any treatments or processes that have already been applied;
- Only trained operatives should handle hazardous substances. All stored hazardous waste will be clearly labelled;

- No storage of hydrocarbons or any toxic waste chemicals should occur within 50m of a watercourse/drainage ditch;
- All associated hazardous waste residuals (including use oil spill kits), such as oil, solvents, used absorbent materials on minor oi spills, glue and solvent based paint containers will be stored within appropriately covered skips prior to removal by a suitable Local Authority or EPA approved waste management contractor for off-site treatment/recycling/disposal;
- Rainwater, which has collected within bunded areas used for the storage of oils, chemicals and waste, will be collected and disposed off-site by suitably qualified waste contractors;
- Waste derived from the port-a-cabins (office and canteen facility) on-site will be placed in an appropriately designed waste storage area prior to collection a licensed contractor under the Waste Management Act, 1996;
- Port-a-loos will be regularly maintained by a suitably qualified waste contractor engaged by the supplier;
- Waste storage areas will be clearly located and signed. If space allows key waste streams will be separated;
- All waste should be transported from site at appropriate frequency by a registered waste contractor to prevent over-filling of waste containers; and
- Frequency of Checks: the contractor will ensure that all storage facilities are checked on a weekly basis. The checklist for completion is attached below.

| Waste Checklist | | |
|---|---|---|
| Waste area checked | Date Checked | Checked By |
| General office waste | | |
| Bowser | | |
| Portaloo | | |
| Excavated soil | | |
| Washings | | |
| Concrete | | |
| Oil | | |
| Hazardous Waste | | |

## 4.0 Typical Waste Streams

### 4.1 Waste Inventory

The typical waste arising during the construction of the project is provided below. This inventory will be further expanded upon by the contractor prior to the commencement of construction.

| Material Type | EWC | Predicted Quantity |
|---|---|---|
| Waste from Portaloo | | |
| Concrete | | |
| Hazardous Material (oil contaminated material, oily rags, etc.) | | |
| Timber (pallets, shuttering, cable drums, packaging, etc.) | | |

| | | |
|---|---|---|
| Packaging (paper, plastic, etc.) | | |
| Excavated Material (soil, subsoil, rock, road cuttings, etc.) | | |
| Cable (electrical, etc.) | | |
| Cardboard | | |
| Metals (copper, aluminum, lead, iron, steel, etc.) | | |

## 4.2 Management of Waste

All waste will be segregated and securely stored at the temporary construction compound, in skips and receptacles, which will be covered to protect the contents from the weather. A licensed operator will collect and transfer the skips/receptacles of both recyclable and non-recyclable wastes as they are filled. Where this is not practicable, or where the quantity of waste is small, the contractor will remove the waste to his yard on a daily basis for onward disposal.

A list of licensed operators will be identified provided below.

| Permit Number | Name of Permit Holder | Address of Waste Facility | Type of Waste Permitted |
|---|---|---|---|
| | | | |
| | | | |
| | | | |
| | | | |

# Annex 3 –
# Spoil Management Plan

Cush Wind Farm

# Planning-Stage Construction & Environmental Management Plan

# Spoil & Peat Management Plan

Cush Wind Limited

Galetech Energy Services

Clondargan, Stradone, Co. Cavan Ireland

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www.galetechenergy.com

# Contents



# 1.0 Introduction

Galetech Energy Services (GES), on behalf of Cush Wind Limited, has prepared this Spoil & Peat Management Plan (SPMP) to detail the appropriate management of excavated material arising from the construction of Cush Wind Farm.

## 1.1 Purpose of this Report

This SPMP provides the framework for the management of spoil and peat at the site of Cush Wind Farm for contractors and incorporates the measures set out in the various environmental assessment documents associated with the development. The purpose of this report is to ensure that spoil and peat is managed safely and re-used without resulting in any adverse environmental effects, and to ensure that all spoil handling/management activities are carried out in accordance with best practice methods.

This is a live document and will be updated by the appointed contractor prior to the commencement of development. Prior to the commencement of construction, the updated SPMP will be reviewed by the Environmental Manager (EM) to confirm the appropriateness of the measures set out therein.

## 1.2 Aims of this SPMP

The overall objective of this SPMP is to provide for the appropriate management of excavated material arising from the construction of Cush Wind Farm. In doing so, the re-use of excavated material, locally to its excavation, will be maximised through reinstatement and landscaping proposals.

The reinstatement of excavated materials will occur as close to the site of excavation as possible. Excavated material horizons (topsoil, peat, subsoil, etc.) will be stored separately to ensure appropriate re-use; and will be replaced in sequence and to depths similar to those recorded prior to excavation.

Excavated material may also be used in the landscaping of the site; for example, the creation of berms around crane hardstandings or along access tracks to reduce the visual effects of the infrastructure. Again, material will be placed close to its source and will be placed in a fashion which allows for vegetative re-growth thus allowing for spoil to be assimilated into the local environment.

Notwithstanding the fact that the project site area is generally flat, with little in the way of discernible variation in elevation throughout, this SPMP also includes a series of control measures specifically related to peat, including monitoring measures, which will be implemented during the construction phase of the wind farm and a contingency plan should peat instability/failure occur at the site. As work is carried out on site the contents of the SPMP and its peat stability monitoring programme will be updated, as appropriate.

A detailed engineering construction design must be carried out by the appointed construction stage designer prior to any construction work commencing on site. This must take account of the consented project details and any conditions imposed by that consent. This must include a detailed peat stability assessment to account for any changes in the environment which may have occurred in the time leading up to the commencement of construction and a peat and spoil management plan to allow for the most appropriate geotechnical and environmental led solutions to be developed for the management of peat and spoil.

### 1.3 Reference Documents

The production of this SPMP has been supported by best practice manuals and will be accounted for in the further development of the appointed contractor's detailed Construction & Environmental Management Plan (CEMP).

Other documents have been used to develop this SPMP; including a Planning-Stage CEMP, Surface Water Management Plan, Environmental & Emergency Response Plan, and a Geotechnical Peat Stability Report.

### 1.4 Peat Instability Definition

Peat instability in this SPMP is defined as a mass movement of a body of peat that would have a significant adverse impact on the surrounding environment. Peat instability excludes localised movement of peat that would occur below a floating access track, creep movement or localised erosion type events.

Adherence to the control measures included in this SPMP should reasonably minimise the potential for all such peat movements.

## 2.0 Description of the Project

In summary, the project comprises the following main components:-

- 8 no. wind turbines with an overall tip height of 200m, and all associated ancillary infrastructure;
- All associated and ancillary site development, excavation, construction, landscaping and reinstatement works, including provision of site drainage infrastructure and forestry felling.
- Temporary alterations to the turbine component haul route; and,
- Construction of an electricity substation, Battery Electricity Storage System and installation of 5.6km of underground grid connection to facilitate connection of the proposed electricity substation to the existing 110kV substation at Clondallow, County Offaly;

The project site is located in rural Co. Offaly, approximately 4km north of the town of Birr and c. 28km south-west of Tullamore, County Offaly. Off-site and secondary developments; including the forestry replant lands and candidate quarries which may supply construction materials; also form part of the project.

The turbine component haul route, and associated temporary alteration works, are located within counties Galway, Roscommon, Westmeath, and Offaly. It is envisaged that the turbines will be transported from the Port of Galway, through the counties of Galway, Roscommon, Westmeath and Offaly, to the project site.

As well as the reference documents listed in **Section 1.2**, various environmental reports have been prepared for the development including:-

- Environmental Impact Assessment Report (Galetech Energy Services);
- Biodiversity Chapter (SLR Consulting);
- Land & Soil Chapter (Hydro Environmental Services);
- Water Chapter (Hydro Environmental Services); and
- Natura Impact Statement (SLR Consulting).

## 3.0 Description of Baseline Environment

### 3.1 Site Location

The proposed development site is located in rural Co. Offaly, approximately 4km north of the town of Birr and c. 28km south-west of Tullamore, Co. Offaly. The wind farm will

be located in the townlands of Cush, Galros West, Boolinarig Big, and Eglish Co. Offaly. The proposed temporary haul route alteration works to the N52/562 junction at Kennedy's cross are located in the townland of Ballindown, Co. Offaly.

Current land use within the project site is made up predominantly of peat bogs, agricultural pasture/grassland, and forestry, including commercial and woodland planting (of various species) and scrub. Areas to the north and northwest of the project site comprise cutover private bog; areas to the east and west of the N62 exhibit commercial and woodland forestry plantation; and areas to the south and southeast are predominantly agricultural pasture. The wider landscape is characterised by large tracts of industrial cutaway peatlands and agricultural scrub; however, improved agricultural pasture is dominant in areas bordering the east and west of the project site.

The local area is typical of this part of Ireland, with settlement patterns largely comprising dispersed rural dwellings often accompanied by agricultural holdings and buildings.

## 3.2 Topography

The proposed development site and surrounding topography are typical of the Midlands Region and comprise a generally flat landscape with occasional gentle undulations.

The elevation, across the project site, ranges between approximately 47m and 63m OD (Ordnance Datum). The marginally higher elevations occur in the eastern areas of the site with the overall slope to the west. The most elevated section of the proposed project site is found along the eastern fringes where agricultural grassland rises up to 63m OD (met mast location). The ground slopes in a general westerly direction from this eastern section to the lowest point on the far west of the project site which follows the valley of the Rapemills River.

The underground grid connection route runs in a westerly direction for approximately 5.6km between the electricity substation to the existing 110kV substation at Clondallow, Co. Offaly. The grid connection comprises underground cable to be located predominately within the carriageway of the public road network, with a short section being located within private lands. The ground elevation along the grid connection ranges from approximately 35m OD to 65m OD.

The forestry re-plant lands are almost exclusively agricultural pasture, with fields bounded by hedgerows and treelines. Ground elevations across the re-plant lands range generally between 100m OD and 140m OD.

## 3.3 Geological Environment

Based on the GSI/Teagasc soils mapping (www.gsi.ie) the project site is overlain by cutover bog, with some basic shallow well-drained mineral soils (BminSW) located in the southeast of the project site at 2 no. proposed turbine locations (T7 and T8).

A small area of basic poorly drained mineral soil (BminPD) is mapped towards the centre of the project site along the N62. The grid connection route from the proposed project site pass through areas mapped predominantly as Cut Peat and BminSW. The mapped soil type at the N62/52 junction works along the haul route is Cut Peat.

GSI subsoils mapping (www.gsi.ie) show that the proposed project site is underlain predominantly by cutover peat (Cut) with Gravels derived from Limestones (GLs) mapped on the southeast and southwest of the project site and also underlying

turbine locations T7 and T8. A small pocket of Till derived from Limestones (TLs) is mapped towards the centre of the proposed project site along the N62.

Gravels and eskers are mainly mapped along the grid connection route to the west of the project site. Esker ridges are mapped to coincide with the Gravel deposits at two locations along the proposed route. Area of Fen Peat are mapped in low-lying areas between the Esker ridges.

The proposed 110kV substation, BESS and control building location (grassland) are located where there is a mapped transition from peat (Cut) into Gravels. The subsoil type at the replanting lands is sandstone/shale tills.

### 3.4 Hydrological Environment

On a regional scale, the proposed project site is located within Hydrometric Area 25 (Lower Shannon Catchment) and mainly situated inside the Shannon[lower]_SC_040 sub-catchment (i.e. Rapemills River). The grid connection route extends into the Shannon[lower]_SC_060 (Little Brosna River) sub-catchment.

On a local scale, the Rapemills River (Rapemills_010) rises approximately 8km to the east of the project site and then flows in westerly direction through the project site itself. The Rapemills River then flows into the River Shannon approximately 10.5km downstream of the project site.

Approximately 2.7km of the grid connection is located in the Rapemills River catchment while the other 2.9km is located in the Little Brosna River catchment. The Little Brosna River flows approximately 1km to the southwest of the existing Dallow substation, at Clondallow, before joining the River Shannon a further 12km downstream.

The proposed haul route alteration works at the N52/N62 junction are also located in the Shannon sub-catchment.

## 4.0 General Spoil & Peat Management Proposals

The following are a suite of general measures which will be adhered to in the management of excavated material:-

- All excavated peat and spoil will be either temporarily stockpiled locally at turbine hardstands, or transported immediately on excavation to the spoil deposition area(s);
- Excavated material will be re-used on-site for reinstatement and landscaping insofar as possible (Some of the peat, in particular the acrotelm, i.e. the upper layer of the peat, excavated during construction will be used for landscaping purposes);
- Excavated rock, should any arise, shall be utilised in the construction of access tracks and crane hardstandings;
- Excavated sub-soil shall be prioritised for the reinstatement of infrastructure (e.g. turbine foundations);
- Excavated topsoil shall be prioritised for final landscaping measures (e.g. ground profiling/grading, finishing of berms, etc.);
- Road cuttings, or other unsuitable material, shall not be used for reinstatement and shall be removed from site and disposed of at an approved waste management facility;
- Where excavated material is to be re-used (for reinstatement or landscaping), it shall be side-cast and stored temporarily in an appropriate manner. Where excess material arises which will not be re-used at the excavation location, it

shall be used in the construction of berms or transported to the spoil deposition areas for permanent storage;
- Temporary storage locations shall be appropriately sited to avoid any smothering of important habitats or risk of sediment discharge to watercourses;
- Temporary storage locations will be carefully selected to avoid any ground instability risks;
- The temporary storage locations will be regularly inspected by the EM;
- Where an open ditch is present alongside an existing/proposed floating access track, the ditch shall be filled prior to upgrading/constructing the access track. The ditch shall be filled with suitable drainage stone. As applicable, a perforated pipe shall be laid into a ditch to filling so as to maintain water flow within the ditch;
- No excavations (e.g. drainage, peat cuttings) shall be carried out within 5m distance of a completed floating access track edge, or at a distance determined following inspection. The presence of excavations can destabilise the access track. Temporary excavations shall be excavated in short lengths and backfilled as soon as practicable;
- No stockpiling of materials shall take place on or adjacent to floating access tracks so as to avoid bearing failure of the underlying peat;
- End-tipping of stone onto proposed access tracks during the construction/upgrading of the track shall be carefully monitored to ensure that excessive impact loading, which may adversely affect the underlying peat, is limited;
- Due to the nature of floating access track construction it will be necessary to monitor the settlement/movement of the access track. Survey points will be located along the track at 10m intervals in areas of deep peat (greater than 2m). See further measures included at **Section 8.0** below;
- All excavated peat, not being used for backfill, shall be transported immediately on excavation to one of the designated spoil deposition areas (each spoil deposition area will have a depth of no more than 310mm); and
- Reinstatement/landscaping works will commence as soon as practicable following the completion of individual work streams thus allowing for the timely management of material and early commencement of re-vegetation thus reducing the likelihood of soil erosion or release of silt/sediment.

## 5.0 Estimated Excavation Quantities

On the basis of site investigations undertaken at the project site and the completion of the preliminary project (civil/electrical) design process; estimated volumes of material likely to be excavated during construction have been identified. The project will, should planning permission be granted, be subject to a further detailed design process where the volume of material to be excavated will be further refined. Accordingly, it is important to highlight that the volumes set out below are estimates based on the design process completed to date, the findings of the site investigations, and past experience of similar wind energy developments.

### 5.1 Site Entrances, Access Tracks. Turbine Foundations & Crane Hardstandings

| Project Item | Total Excavated Material ($m^3$) | Peat for Spoil Deposition Areas ($m^3$) | Peat for use in Reinstatement/ Landscaping ($m^3$) | Topsoil & Subsoil for Spoil Deposition Areas ($m^3$) | Topsoil & Subsoil for use in Reinstatement/ Landscaping ($m^3$) | Tar |
|---|---|---|---|---|---|---|
| T1 (Access, hardstand, and foundation) | 12,299 | 7,767 | 3,475 | 424 | 633 | n/a |
| T2 (Access, hardstand, and foundation) | 12,019 | 7,417 | 3,475 | 494 | 633 | n/a |
| T3 (Access, hardstand, and foundation) | 13,696 | 9,559 | 3,475 | 71 | 591 | n/a |
| T4 (Access, hardstand, and foundation) | 13,137 | 8,859 | 3,475 | 212 | 591 | n/a |
| T5 (Access, hardstand, and foundation) | 10,622 | 5,780 | 3,475 | 847 | 520 | n/a |
| T6 (Access, hardstand, and foundation) | 12,019 | 7,459 | 3,475 | 494 | 591 | n/a |
| T7 (Access, hardstand, and foundation) | 8,769 | 2,682 | 3,475 | 2,047 | 565 | n/a |
| T8 (Access, hardstand, and foundation) | 8,628 | 2,682 | 3,475 | 1,906 | 565 | n/a |
| Wind Farm Access Track, including site entrances | 2,293 | 0 | 0 | 0 | 2,293 | n/a |
| Compounds | 900 | 0 | 0 | 700 | 200 | n/a |
| Wind Farm Control Room | 160 | 0 | 0 | 160 | 0 | n/a |
| Met Mast | 60 | 30 | 0 | 30 | 0 | n/a |
| Drainage | 8,700 | 8,700 | 0 | 0 | 0 | n/a |
| Underground Cables | 8,678 | 4,339 | 0 | 0 | 4,339 | n/a |

**Table 1: Estimated Spoil Volumes at Wind Farm Site**

### 5.2 Electrical Substation & Grid Connection

| Project Item | Total Excavated Material ($m^3$) | Peat for Spoil Deposition Areas ($m^3$) | Peat for use in Reinstatement/ Landscaping ($m^3$) | Topsoil & Subsoil for Spoil Deposition Areas ($m^3$) | Topsoil & Subsoil for use in Reinstatement/ Landscaping ($m^3$) | Tar |
|---|---|---|---|---|---|---|
| Substation Compound | 6,708 | 0 | 0 | 4,238 | 2,471 | 0 |
| Grid Connection | 9,528 | 0 | 0 | 8,835 | 146 | 547 |

**Table 2: Estimated Spoil Volumes at Electrical Substation & Grid Connection Route**

### 5.3 Haul Route Upgrade Works

| Project Item | Total Excavated Material ($m^3$) | Peat for Spoil Deposition Areas ($m^3$) | Peat for use in Reinstatement/ Landscaping ($m^3$) | Topsoil & Subsoil for Spoil Deposition Areas ($m^3$) | Topsoil & Subsoil for use in Reinstatement/ Landscaping ($m^3$) | Tar |
|---|---|---|---|---|---|---|
| Upgrade Works | 1,599 | 0 | 0 | 0 | 1,593 | 6 |

**Table 3: Estimated Spoil Volumes at Haul Route Upgrade Locations**

## 6.0 Use of Excavated Material

As outlined above, there are a number of possible uses for excavated material which has no further purpose in the construction process. In accordance with the aims of this SPMP, all usable excavated material will be utilised, in the first instance, for site reinstatement and landscaping purposes.

### 6.1 Reinstatement of Infrastructure

Excavated subsoil and topsoil will, in the first instance, be utilised for the reinstatement of infrastructure including access track edges, crane hardstanding edges, and to provide turbine foundation ballast. Excavated peat from turbine foundation excavations will also be utilised for backfill at turbine foundation locations, where possible. Once again, this will ensure that material is, insofar as is practicable, reinstated at or close to its source location. For site reinstatement works and following the placement of subsoil, a layer of topsoil will be spread across the affected area, graded to match the surrounding ground profile, and re-seeded.

### 6.2 Landscaping & Permanent Storage

Where subsoil and topsoil is not to be used for reinstatement at its source location, a number of permanent storage options are available, as follows:-

- The creation of track-side and hardstanding-side berms. Berms, constructed predominately of subsoil and topped with topsoil, with an approximate height of 1m could be constructed to permanently store material at appropriate access track and hardstand locations (noting, in line with the general measures included at **Section 4.0**, above, no stockpiling of materials shall take place on or adjacent to floating access tracks). The creation of berms, at appropriate locations, aids in the visual assimilation of infrastructure into the landscape and can assist in screening access tracks and hardstandings from view; and

- Permanent storage of material in the spoil deposition areas. While it is estimated that the above reinstatement and landscaping processes will account for substantial volumes of surplus excavated materials; 3 no. dedicated spoil deposition areas will be developed where excess material which cannot be utilised for reinstatement or is unsuitable for landscaping purposes, e.g. peat and peaty topsoil, will, if such a scenario arises, be stored permanently. The location of the deposition areas has been chosen as they each comprise localised flat/level ground, include a general absence of any particular environmental constraints. The 3 no. spoil deposition areas include one main deposition area, located to the north of proposed turbines T1 and T3, and 2 no. smaller deposition areas located at the base of proposed turbines T5 and T6. Spoil and Peat will be transported to these locations where it will be placed in a thin layer (approximately 310mm in depth) in accordance with best-practice methods. Appropriate drainage management measures will be implemented to ensure that the deposited material does not become waterlogged. Following completion, the deposition areas will be graded to match the surrounding ground profile. Works at the deposition areas will be monitored, on a weekly basis during the construction phase and monthly for a six-month period thereafter, by an appropriately qualified geotechnical engineer.

The layout of the deposition areas, including drainage arrangements, is illustrated at **Annex 2** of the Surface Water Management Plan.

### 6.3 Permanent Storage of Peat

As set out above, three locations have been identified as designated spoil deposition areas. The larger of the three area is located on the western side of the project site, with the two smaller areas located on the eastern side of the project site. Each area shall have a perimeter buttress which will contain and ensure the placed peat and spoil remains stable. Prior to the placement of any excavated peat and spoil, the permanent buttresses shall be constructed around the perimeter of the deposition area.

The following recommendations/best practice guidelines for the placement of peat within the deposition areas will be considered and taken into account during construction.

- The placement of excavated peat and spoil is to be avoided without first establishing the adequacy of the ground to support the load;
- The height of the buttresses constructed will be greater than the height of the stored peat and spoil to prevent any surface run-off or saturated peat to flow out (see **Annex 1**);
- An interceptor drain will also be installed upslope of the deposition areas. The drain will divert any surface water away from the deposition area and hence prevent water from ponding in the area;
- Where practical, it should be ensured that the surface of the placed peat and spoil is shaped to allow efficient run-off of surface water. Where possible, shaping of the surface of the peat and spoil should be carried out as placement of peat and spoil within the placement area progresses. This will reduce the likelihood of debris run-off and ensure stability of the placed peat and spoil;
- Where possible, the acrotelm shall be placed with the vegetation part of the sod facing the right way up to encourage growth of vegetation at the surface of the placed peat and spoil within the deposition areas;

- Movement monitoring instrumentation may be required adjacent to the access track where peat has been placed. The locations where monitoring is required will be identified by the designer on site;
- Supervision by a geotechnical engineer or appropriately competent person is recommended for the works; and,
- All the above mentioned general guidelines and requirements should be confirmed by the designer prior to construction.

### 6.4 Disposal Off-Site

Any spoil generated which is unsuitable for reinstatement or landscaping purposes or for storage within berms or the deposition area (e.g. tarmac cuttings from the grid connection installation) shall be removed from site and disposed of at a licensed waste disposal facility.

## 7.0 General Recommendations for Good Construction Practice

To minimise the risk of construction activity causing potential peat instability it is recommended that the Construction Method Statements (CMS) for the project will also take into account, but not be limited, to the general recommendations below together with the specific recommendations above:-

- Avoidance of uncontrolled concentrated water discharge onto peat slopes identified as being unsuitable for such discharge. All water discharged from excavations during work shall be piped over areas specifically assessed as being unsuitable and hence directly into suitable drainage lines;
- Avoidance of unstable excavations. All excavations shall be suitably supported to prevent collapse and development of tension cracks;
- Installation and regular monitoring of geotechnical instrumentation, as appropriate, during construction in areas of possible poor ground, such as deeper peat deposits;
- Site reporting procedures to ensure that working practices are suitable for the encountered ground conditions. Ground conditions to be assessed by suitably experienced geotechnical engineer;
- Regular briefing of all site staff (e.g. toolbox talks) to provide feedback on construction and ground performance and to promote reporting of any observed change in ground conditions; and,
- Routine inspection of wind farm site by Contractor to include an assessment of ground stability conditions (e.g. cracking, excessive floating access track settlement, disrupted surface, closed-up drains) and drainage conditions (e.g. blocked drains, absence of water in previously flowing drains, springs, etc).

## 8.0 Instrumentation

To monitor possible peat movements, it is proposed to install sighting posts upslope and downslope of the access track at staggered intervals at locations where the peat depth is greater than 2m. Additional monitoring locations may be required at infrastructure locations with deeper peat deposits. Details of sighting posts are given below:-

- A line of sighting posts shall comprise:-
  (a) line of wooden stakes (typically 1 to 1.5m long) placed vertically into the peat to form a straight line;
  (b) The sighting line shall comprise 6 no. posts at 5m centres that is a line some 25m long; and,

(c) A string line shall be attached to the first and last posts and all intervening posts shall be adjusted so they are just touching the string line;

- Lines of sighting posts shall be placed across the existing slope about 5m away from the area to be worked. It is recommended that the posts are located along the track at 10m intervals in areas of deep peat (say greater than 2m). Where there are relatively steeper slopes or softer ground a sighting line shall be placed down the slope, or at any location where monitoring would be deemed useful;
- Each line of sighting posts shall be uniquely referenced with each post in the line given a reference. The post reference shall be marked on each post (e.g. reference 1-1, 1-2, 1-3, 1-4, 1-5, 1-6 for posts in line 1);
- The sighting lines shall be monitored at the beginning of each working day, and during the day where considered appropriate (e.g. when working activity is concentrated at a specific location);
- Monitoring of the posts shall comprise sighting along the line and recording any relative movement of posts from the string line;
- Where increased movements are recorded the frequency of monitoring shall be increased; and,
- A monitoring record shall be kept of the date, time and relative movement of each post, if any. This record shall be updated and stored as a spreadsheet.

## 9.0 Contingency Measures

### 9.1 Excessive Movement

Where there is excessive movement or continuing peat movement recorded at a monitoring location or identified at any location within the site but no apparent signs of distress to the peat (e.g. cracking, surface rippling) then the following shall be carried out:-

- All activities (if any) shall cease within the affected area;
- Increased monitoring at the location shall be carried out. The area will be monitored, as appropriate, until such time as movements have ceased; and,
- Re-commencement of activities shall only start following a cessation of movement and agreement with all parties.

### 9.2 Onset of Peat Slide

In the unlikely event where there is the onset or actual detachment of peat (e.g. cracking, surface rippling) then the following shall be carried out:-

- On alert of a peat slide incident, all activities (if any) in the area should cease and all available resources will be diverted to assist in the required mitigation procedures;
- Action will be taken to prevent a peat slide reaching any watercourse. This will take the form of the construction of check barrages on land. Due to the terrain and the inability to predict locations it may not be possible to implement any on-land prevention measures, in this case a watercourse check barrage will be implemented;
- All relevant authorities should be notified if a peat slide event occurs on site; and,
- For localised peat slides that do not represent a risk to a watercourse and have essentially come to rest the area will be stabilised initially by rock infill, if required. The failed area and surrounding area will then be assessed by the engineering staff and stabilisation procedures implemented. The area will be monitored, as appropriate, until such time as movements have ceased.

## 9.3 Check Barrages

Whilst it is not anticipated from the analysis undertaken that a peat slide will occur on site, as a contingency a check barrage procedure is included below.

The check barrage procedure deals with preventing a peat slide from moving downstream within a watercourse. The most effective method of preventing excessive peat slide debris from travelling downstream in a watercourse is the use of a check barrage. A check barrage comprises the placement of rock fill across a watercourse. The check barrage is a highly permeable construction that will allow the passage of water but will prevent peat debris from passing through. Rock fill should comprise well-graded coarse rock pieces from about 300mm up to typically 1000mm.

The size of the barrage will vary depending on the scale of the peat debris to be contained and the geometry of the watercourse at the barrage location. In general, due to the low speed of a peat slide there is generally little impact force and most of the lateral load is due to fluid pressure on the upslope face of the barrage. Typically, the check barrage should fill the entire channel width of the watercourse up to a height of 3 to 4m with a crest width of typically 2m and side slopes of about 45 degrees depending on the geometry of the barrage location.

The check barrage procedure is as follows:-

- Access to the check barrage location shall be along the existing access tracks on the wind farm site and/or along public roads, where possible. When it is necessary to form the barrage then rock fill will be placed across the watercourse to effectively block the passage of peat debris;
- Operatives employed to carry out the construction of the check barrage would need to be inducted by means of a briefing by on-site supervisors as to the proposed location of the check barrage;
- The check barrage provides containment for peat debris in the highly unlikely event of a major peat slide. Further remedial measures, should they be required, will be assessed by the Contractor and the Project Geotechnical Engineer and carried out as soon as physically possible when the location and extent of the failure is established; and,
- Where a barrage was constructed as a precaution and no peat debris reached the watercourse then the barrage should be removed as soon as any measures to prevent further peat sliding is agreed with all parties.

# 10.0 Conclusion

This SPMP has been prepared to detail the appropriate management of material excavated during the construction of the Cush Wind Farm. Overall, it is assessed that there is sufficient capacity within the project to accommodate all excavated material, through re-use and reinstatement, in the first instance, and deposition, where required, such that no significant volume of material will be transported off-site. Excavated material will be utilised in the reinstatement of infrastructure, landscaping, and permanent storage within the spoil deposition areas.

The range of good practice construction measures, including measures relative to working with peat, will be implemented in full. The peat management measures contained within this SPMP include some drainage guidelines for construction works and for management of peat on site. It should be noted that the control of water quality and drainage measures for site is outlined in detail in the relevant chapter of Environmental Impact Assessment Report (EIAR).

This is a live document and will be updated by the appointed contractor prior to the commencement of development. Prior to the commencement of construction, the updated SPMP will be reviewed by the EM to confirm the appropriateness of the measures set out therein.

## Annex 1 –

## Spoil Deposition Area Buttress & Drainage Detail

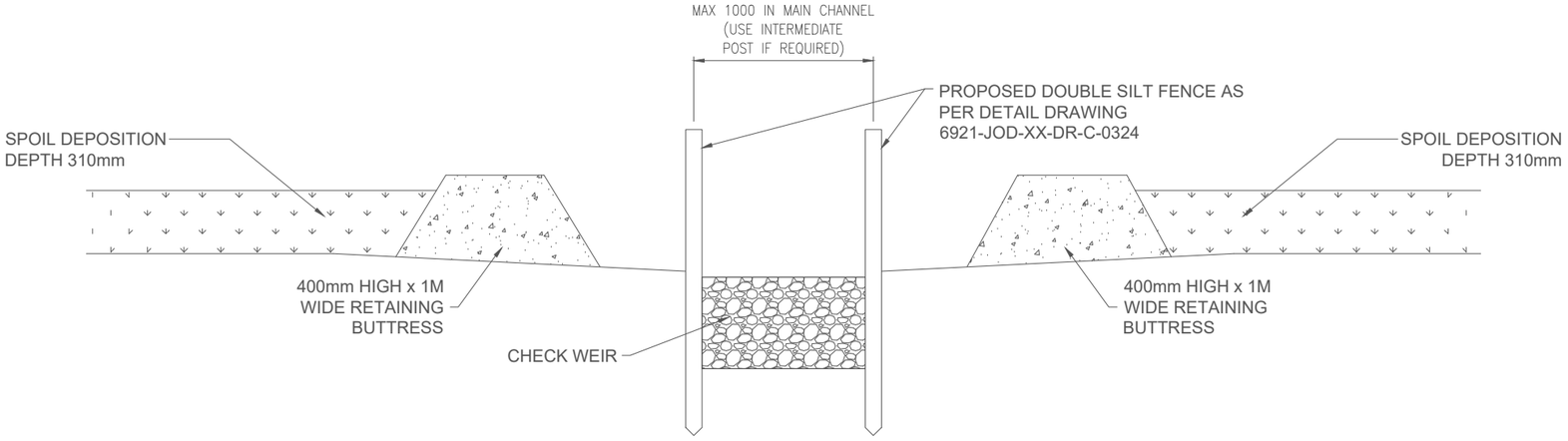


FIGURE 1
SECTION A - A SILT FENCE AT DRAINAGE CHANNEL
SCALE 1:30

Prepared by:

GALETECH
ENERGY SERVICES

**Legend:**

| Date: | Rev: | Description: | Drawn By: |
|---|---|---|---|
| | | | |

Agent Address:

Galetech Energy Services,
Clondargan,
Stradone,
Co. Cavan

Job Title:

Cush Wind Farm

Client:

Cush Wind Ltd

Drawing Title:

Spoil Deposition Area Buttress & Drainage Detail

| Drawing No.: | Revision No.: |
|---|---|
| CUS_PAS_EIAR_018 | 0 |
| **Scale:** | **Date:** |
| (A3) 1:30 | 05/12/2022 |

| Drawn By: | Checked By: | Confirmed By: |
|---|---|---|
| C.M.P | D.O | S.C |

## Annex 4 –
## Surface Water Management Plan

Cush Wind Farm

# Planning-Stage Construction & Environmental Management Plan

# Surface Water Management Plan

Cush Wind Limited

Galetech Energy Services
Clondargan, Stradone, Co. Cavan. Ireland
Telephone +353 49 555 5050
www.galetechenergy.com

# Contents



# 1.0 Introduction

Galetech Energy Services (GES), on behalf of Cush Wind Limited, has prepared this Surface Water Management Plan (SWMP) for the construction and operational phases of the Cush Wind Farm.

## 1.1 Purpose of this Report

This SWMP provides the framework for water management at the site of the Cush Wind Farm for contractors and incorporates the measures set out in the various environmental assessment documents associated with the development. The purpose of this report is to detail the practical implementation of these measures such that the construction and operational phases do not have an adverse effect on water quality.

This is a live document and will be updated by the appointed contractor prior to the commencement of development. Prior to the commencement of construction, the updated SWMP will be reviewed by the Environmental Manager (EM) and Ecological Clerk of Works (EcoW), as necessary, to confirm the appropriateness of the measures set out therein.

This SWMP aims to:-

- Describe environmental sensitives of the site and any applicable buffer zones;
- Describe how the system will operate to minimise modification and disruption to the existing site hydrology;
- Outline the proposed maintenance regime; and
- Outline the proposed drainage management post-construction.

## 1.2 Reference Documents

The production of this SWMP has been supported by best practice manuals and will be accounted for in the further development of the appointed contractor's detailed CEMP.

Other documents have been used to develop this SWMP; including a Planning-Stage Construction & Environmental Management Plan, Spoil Management Plan, and Environmental & Emergency Response Plan.

### 1.2.1 Legislative Background

This report has been prepared in accordance with the following legislation:-

- S.I. 10 of 1972 Dangerous Substances Act, 1972, as amended;
- S.I. No. 293 of 1988 Quality of Salmon Water Regulations;
- S.I. No. 249 of 1989 Quality of Surface Water Intended for Abstraction (Drinking Water);
- S.I. No. 94 of 1997 European Communities (Natural Habitats) Regulations;
- S.I. No. 41 of 1999 Protection of Groundwater Regulations;
- Water Framework Directive (2000/60/EC);
- S. I. No. 600 of 2001 Planning and Development Regulations 2001, as amended;
- S.I. No. 722 of 2003 European Communities (Water Policy) Regulations;
- S.I. 547 of 2008 European Communities (Environmental Liability) Regulations;
- S.I. No. 272 of 2009 European Communities Environmental Objectives (Surface Waters) Regulations;
- S.I. No. 9 of 2010 European Communities Environmental Objectives (Groundwater) Regulations 2010; and
- S.I. No. 350 of 2014 European Union (Water Policy) Regulations 2014.

### 1.2.2 Construction Industry Research & Information Association (CIRIA) Manuals

- CIRIA (Construction Industry Research & Information Association) Report C502 Environmental Good Practice on Site;
- CIRIA 521 - Sustainable Urban Drainage Systems; Design Manual for Scotland and Northern Ireland;
- CIRIA Report C532 Control of Water Pollution from Construction Sites;
- CIRIA Report C648 Control of Pollution from Linear Construction Project Technical Guidance;
- CIRIA Handbook C650 Environmental good practice on site;
- CIRIA Handbook C651 Environmental good practice on site checklist;
- CIRIA Report C609 - SuDS - hydraulic, structural & water quality advice;
- CIRIA Report C697 - The SuDS Manual; and
- Guidelines on Protection of Fisheries during Construction Work in and Adjacent to Water (Inland Fisheries Ireland, January 2016).

## 2.0 Description of the Project

Cush Wind Limited intend to construct the Cush Wind Farm which will consist of:-

- 8 no. wind turbines with an overall tip height of 200m, and all associated ancillary infrastructure;
- All associated and ancillary site development, excavation, construction, landscaping and reinstatement works, including provision of site drainage infrastructure and forestry felling.
- Temporary alterations to the turbine component haul route; and,
- Construction of an electricity substation, Battery Electricity Storage System and installation of 5.6km of underground grid connection to facilitate connection of the proposed electricity substation to the existing 110kV substation at Clondallow, County Offaly;

The project site is located in rural Co. Offaly, approximately 4km north of the town of Birr and c. 28km south-west of Tullamore, County Offaly. Off-site and secondary developments; including the forestry replant lands and candidate quarries which may supply construction materials; also form part of the project.

The turbine component haul route, and associated temporary alteration works, are located within counties Galway, Roscommon, Westmeath, and Offaly. It is envisaged that the turbines will be transported from the Port of Galway, through the counties of Galway, Roscommon, Westmeath and Offaly, to the project site.

As well as the reference documents listed in **Section 1.2**, various environmental reports have been prepared for the development including:-

- Environmental Impact Assessment Report (Galetech Energy Services);
- Biodiversity Chapter (SLR Consulting);
- Land & Soil Chapter (Hydro Environmental Services);
- Water Chapter (Hydro Environmental Services); and
- Natura Impact Statement (SLR Consulting).

## 3.0 Description of Baseline Environment

### 3.1 Site Location

The proposed development site is located in rural Co. Offaly, approximately 4km north of the town of Birr and c. 28km south-west of Tullamore, Co. Offaly. The wind farm will be located in the townlands of Cush, Galros West, Boolinarig Big, and Eglish Co. Offaly.

The proposed temporary haul route alteration works to the N52/562 junction at Kennedy's cross are located in the townland of Ballindown, Co. Offaly.

Current land use within the project site is made up predominantly of peat bogs, agricultural pasture/grassland, and forestry , including commercial and woodland planting (of various species) and scrub . Areas to the north and northwest of the project site comprise cutover private bog; areas to the east and west of the N62 exhibit commercial and woodland forestry plantation; and areas to the south and southeast are predominantly agricultural pasture. The wider landscape is characterised by large tracts of industrial cutaway peatlands and agricultural scrub; however, improved agricultural pasture is dominant in areas bordering the east and west of the project site.

The local area is typical of this part of Ireland, with settlement patterns largely comprising dispersed rural dwellings often accompanied by agricultural holdings and buildings.

## 3.2 Topography

The proposed development site and surrounding topography are typical of the Midlands Region and comprise a generally flat landscape with occasional gentle undulations.

The proposed project site is low lying with topography being slightly undulating to flat and with ground elevations ranging between 47 and 63m OD (Ordnance Datum). The overall slope is to the west.

The most elevated section of the proposed project site is found along the eastern fringes where agricultural grassland rises up to 63m OD (met mast location). The ground slopes in a general westerly direction from this eastern section to the lowest point on the far west of the project site which follows the valley of the Rapemills River.

The underground grid connection (5.6km) follows public roads for 4.7km with an off-road section through private lands for 0.65km. Approximately 200m of the route is in the project site itself. The off-road section of the grid connection is through rough grassland. The existing ESB owned Clondallow 110kV substation is located 1.7km to the southwest of the proposed project site. The ground elevation along the grid connection ranges from approximately 35m OD to 65m OD.

The forestry re-plant lands are almost exclusively agricultural pasture, with fields bounded by hedgerows and treelines. Ground elevations across the re-plant lands range generally between 100m OD and 140m OD.

## 3.3 Hydrological Environment

On a regional scale, the proposed project site is located within Hydrometric Area 25 (Lower Shannon Catchment) and mainly situated inside the Shannon[lower]_SC_040 sub-catchment (i.e. Rapemills River). The grid connection route extends into the Shannon[lower]_SC_060 (Little Brosna River) sub-catchment.

On a local scale, the Rapemills River (Rapemills_010) rises approximately 8km to the east of the project site and then flows in westerly direction through the project site itself. The Rapemills River then flows into the River Shannon approximately 10.5km downstream of the project site.

Approximately 2.7km of the grid connection is located in the Rapemills River catchment while the other 2.9km is located in the Little Brosna River catchment. The Little Brosna River flows approximately 1km to the southwest of the existing Dallow

substation, at Clondallow, before joining the River Shannon a further 12km downstream.

The proposed haul route upgrade works at the N52/N62 junction are also located in the Shannon sub-catchment.

## 3.4 Geological Environment

Based on the GSI/Teagasc soils mapping (www.gsi.ie) the project site is overlain by cutover bog with some basic shallow well-drained mineral soils (BminSW) located in the southeast of the project site at 2 no. proposed turbine locations (T7 and T8).

A small area of basic poorly drained mineral soil (BminPD) is mapped towards the centre of the project site along the N62. The grid connection route from the proposed project site pass through areas mapped predominantly as Cut Peat and BminSW. The mapped soil type at the N62/52 junction works along the haul route is Cut Peat.

GSI subsoils mapping (www.gsi.ie) show that the proposed project site is underlain predominantly by cutover peat (Cut) with Gravels derived from Limestones (GLs) mapped on the southeast and southwest of the project site and also underlying turbine locations T7 and T8. A small pocket of Till derived from Limestones (TLs) is mapped towards the centre of the proposed project site along the N62.

Gravels and eskers are mainly mapped along the grid connection route to the west of the project site. Esker ridges are mapped to coincide with the Gravel deposits at two locations along the proposed route. Area of Fen Peat are mapped in low-lying areas between the Esker ridges.

The proposed 110kV substation, BESS and control building location (grassland) are located where there is a mapped transition from peat (Cut) into Gravels. The subsoil type at the replanting lands is sandstone/shale tills.

## 3.5 Flood Risk Assessment

OPW's River Flood Extents Mapping, National Indicative Fluvial Mapping, Past Flood Event mapping (https://www.floodinfo.ie/map/floodmaps/) and historical mapping (i.e. 6" & 25" base maps) were consulted to identify those areas of the project site which are at risk of fluvial flooding.

Datasets prepared by the OPW identifying land that might benefit from the implementation of Arterial (Major) Drainage Schemes (under the Arterial Drainage Act 1945) indicate areas of the project site are prone to flooding or poor drainage.

No recurring flood incidents within the proposed project site boundary or along the grid connection were identified from OPW's Past Flood Event Mapping. OPW's Past Flood Event Mapping.

The closest mapped recurring flooding event to the overall proposed project is on the Little Brosna approximately 5km downstream of the proposed grid connection.

The closest mapped recurring flooding event to the proposed project site itself is on the Lower Shannon approximately 10.5km downstream of the project site.

There is no text on local available historical 6" or 25" mapping for the proposed project site or grid connection that identify areas that are "prone to flooding".

OPW's River Flood Extents Mapping is currently the most accurate available flood mapping for the country, however this is currently not available for the area of the proposed project site.

OPW National Indicative Fluvial Mapping is available for the area of the proposed project site which shows the estimated 100-year and 1000-year flood zones. The National Indicative Fluvial Mapping is not as accurate as the Flood Extents Mapping and is also not intended to replace site specific flood risk assessments (discussed below).

According to the National Indicative Fluvial Mapping, 1 no. turbine (T2) is located in a 100-year flood zone along with approximately 350m of its proposed connecting spur road from the south. The southern section of the main construction compound (SC1) is also in a mapped 100-year flood zone.

In addition, approximately 370m of the proposed access road between turbines T2 and T4 is also in a mapped 100-year flood zone along with approximately 120m of the proposed access road leading to turbine T1.

All other proposed project infrastructure is mapped above the mapped 1000-year flood level and therefore all infrastructure is located in Flood Zone C (Low Risk).

It is a key design feature of the project to ensure that all surface water runoff is treated (water quality control) and attenuated (water quantity control) prior to diffuse discharge at pre-existing greenfield rates. As such, the mechanism by which downstream flooding, as a result of the project, is prevented and controlled is through avoidance by design.

A Stage 3 Site Specific Flood Risk Assessment (FRA) including flood modelling was completed by HES for the proposed project site in July 2021(refer to **Annex 7.1** of the EIAR). This was done at the time to assess the accuracy of the Preliminary Flood Risk Assessment (PFRA) mapping which was the only available published flood mapping for the area at the time.

The PFRA mapping, which is no longer used, was a national screening exercise, based on preliminary analysis, to identify areas where there may be a significant risk associated with flooding. The mapping was not site specific and had inherited inaccuracies.

Please note that the Site Specific Flood Risk Assessment also overrides the National Indicative Fluvial Mapping in terms of its flood zone mapping accuracy at the project site.

The Stage 3 Site Specific Flood Risk Assessment involved detailed site topographic surveys, use of Lidar data and flood flow modelling of the Rapemills River and floodplain.

Site specific modelled 100-year and 1000-year flood zones were prepared for the project site. A 20% increase in flows is allowed for climate change.

The site specific flood zone modelling shows that proposed turbine location T2 is just outside the 100-year and 1000-year flood zones. Two sections of access road at watercourse crossing locations between turbine locations T2 and T4 (which amounts to approximately 100m of access road) are located within the 100-year and 1000-year flood zone.

Therefore, with the exception of the 100m of this proposed access road, the project site and grid connection are located in Flood Zone C (Low Risk).

Refer to **Annex 7.1** of the EIAR for Stage 3 Site Specific Flood Risk Assessment report.

### 3.6 Nature Conservation Sites

Within the Republic of Ireland, designated sites include Natural Heritage Areas (NHAs), proposed Natural Heritage Areas (pNHAs), candidate Special Areas of Conservation (cSAC), Special Areas of Conservation (SAC) and Special Protection Areas (SPAs).

The project is not located within any designated conservation site.

Designated sites in close proximity to the proposed project site and grid connection include Woodville Woods pNHA (Site Code: 000927), Ross and Glens Eskers pNHA and Ridge Road, SW of Rapemills SAC/pNHA (Site Code: 000919). The junction works at the N52/N62 drains into Woodville Woods pNHA.

The proposed grid connection runs adjacent to Ross and Glens Eskers pNHA.

The abovementioned close proximity designated sites are not water dependant.

The closest SPA to the site is Dovegrove Callows SPA (Site Code: 004137) is adjacent to part of the grid connection on the public road to the south of Dallow substation.

The project site drains to the northwest via the Rapemills River, which passes the All Saints Bog and Esker SAC and pNHA (Site Code: 000566) and the All Saints Bog SPA (Site Code:004103) approximately 3.5km from the project site.

However, there is no surface water connection between the project site and All Saints Bog and Esker SAC as All Saints Bog discharges into Rapemills River and not vice versa.

Groundwater flow in the area of the project site is likely to be westerly towards All Saints Bog and Esker SAC. However, groundwater flow below All Saints Bog will be limited to the deeper glacial deposits which are separated from the overlying bog by very low permeability marl and lacustrine clay deposits which underlies the basin peat in this area.

The Rapemills River ultimately drains into the River Shannon and flows through the River Shannon Calllows SAC (Site Code: 00216) and the Middle Shannon Callows SPA (Site Code:004096), which lie approximately 6.8km northwest of the project site.

## 4.0 Drainage System

### 4.1 Sustainable Drainage System

Surface water is a valuable resource and this should be reflected in the way it is managed. The appropriate management of surface water should be considered at the early stages of the project design process. It is important, particularly on large developments such as the Cush Wind Farm, that the management of surface water is managed in a fashion will prevents significant alterations to the existing hydrological regime whilst ensuring the appropriate drainage of the proposed site.

The project has been designed to implement a Sustainable Drainage System (SuDS) which seeks to:-

- Minimise any change to the surface water and groundwater conditions within the site;
- Avoid sensitive areas where possible by employing hydrological constraints (i.e. buffer zones);
- Replicate the natural drainage of the site;

- Minimise sediment loads in the runoff, with particular attention being given to the construction phase of the project;
- Maintain runoff rates and volumes at Greenfield rates for a range of storm events (to be incorporated into final detailed design); and,
- Avoid high flow velocities internally within new drain networks and at outfall locations to prevent erosion.

The purpose of a SuDS is:-

- To provide sufficient detail to ensure that water pollution will not occur as a result of construction and operational activities at the site and to minimise the risk of any such occurrence;
- To regulate the rate of surface water run-off downslope to prevent scouring and to encourage settlement of sediment locally; and
- To minimise the quantity of sediment laden stormwater and resulting settlement pond sizes by separating 'clean' water from the 'dirty' development runoff.

### 4.1.1 SuDS Design

The overarching objective of the SuDS design is to ensure that all surface water runoff is comprehensively attenuated such that no silt or sediment laden waters or deleterious material is discharged into the local drainage system. While the SuDS is, overall, an amalgamation of a suite of drainage infrastructure; the objectives are straightforward. In summary:-

- All surface water runoff will be directed to specially constructed swales surrounding all areas of ground proposed to be disturbed;
- The swales will direct runoff into silt traps/ponds where silt/sediment will be allowed to settle; and
- Following the settlement of silt/sediment, clean water will be discharged indirectly to the local drainage network via buffered outfalls thus ensuring that no scouring/erosion occurs.

The design criteria for the SuDS is as follows:-

- To minimise alterations to the ambient site hydrology and hydrogeology;
- To provide settlement and treatment controls as close to the site footprint as possible and to replicate, where possible, the existing hydrological environment of the site;
- To minimise sediment loads resulting from the development runoff during the construction phase;
- To preserve greenfield runoff rates and volumes;
- To strictly control all surface water runoff such that no silt or other pollutants shall enter watercourses and that no artificially elevated levels of downstream siltation or no plumes of silt arise when substratum is disturbed;
- To provide appropriate retention times such that and no flooding will occur on local roads in the vicinity of the project site which may cause a traffic hazard;
- To provide settlement ponds to encourage sedimentation and storm water runoff settlement;
- To provide lagoon-type sediment traps which follow a design outlined by Altmuller and Dettmer (2006). The tertiary treatment system of the lagoon maturation ponds will absorb the fine particles, which may not settle in the primary and secondary settlement ponds. These ponds are to be vegetated so

as to perform the role of plant filtration best described on Page 7 of the Altmuller and Dettmer document[1] (see **Annex 1**);
- To reduce stormwater runoff velocities throughout the site to prevent scouring and encourage settlement of sediment locally;
- To manage erosion and allow for the effective revegetation of bare surfaces;
- To control water within the site and allow for the discharge of runoff from the site within the limits prescribed in the Freshwater Pearl Mussel and Salmonid Regulations;
- To ensure that oils, fuels and other contaminants are stored appropriately and bunded to prevent any discharge of such materials. The temporary construction compound, where such oils and fuels will be stored, shall incorporate an oil/petrol interceptor within its drainage system. Similarly, an oil/petrol interceptor shall be installed at the proposed electrical substation;
- Additional drainage measures will only be added as necessary. The dimensions of these features will avoid intercepting large volumes of water;
- Storm water runoff from hardstandings and access tracks will be managed via filter drains consisting of open land drains, swales and settlement ponds/lagoon-type sediment traps. Access tracks and hardstandings will crossfall downslope to mimic the natural drainage patterns of the site.
- Swale/settlement pond vegetation used will be appropriate to the local area;
- Temporary erosion protection together with silt fences may be required until the vegetation becomes established (coir matting or similar);
- Access tracks and hardstandings will be constructed from aggregate and will not be surfaced with bitumen materials, thus helping to reduce runoff volumes. Therefore a reduced runoff coefficient of 50% is applicable;
- An additional 20% will be included to take account for global warming;
- A large portion of the hardstanding construction will be of single sized stone therefore the pore spacing in the hardstanding and road will also act to store and attenuate water;
- Swales will be primarily used to attenuate water and to encourage discharge into the ground locally;
- Outflow points will be taken from the swales into the existing onsite drainage channels. Silt fences will be maintained at the interface between the proposed and existing drainage channels for the duration of the construction phase;
- Stormwater runoff within the swale will be treated through the provision of small silt fences or check dams, within a range depending on local slope of swale;
- The stone used for the construction of the check dams will be washed graded stone with a size range between approximately 5mm and 40mm;
- Swales will provide a flow route in extreme events to carry water to the existing surface water channels across site. It will be necessary to increase the cross sectional area of the swales further downstream of the footprint as larger volumes of stormwater are conveyed;
- Discharging directly back into the surrounding area will assist in maintaining the hydrological characteristics of the site;
- Vegetation will be reinstated on slopes as early as possible;
- Under track drainage will be provided with associated sumps and silt fences. The under track drainage will provide a means for flows to pass from a swale on the uphill side of the slope to the downhill side of the slope.

[1] Altmüller R. & Dettmer, R. (2006*) Successful species protection measures for the Freshwate Pearl Mussel (Margaritifera margaritifera) through the reduction of unnaturally high loading of silt and sand in running waters – Experiences within the scope of the Lutterproject*.

- A sump may be required to collect dewaterings from excavations for turbine foundations; water will subsequently be pumped into the settlement pond system and allowed to settle prior to discharging into the swales;
- All swales and ponds will be kept as shallow as possible so that they do not pose any health and safety risk to plant or personnel;
- Field drains/streams will be piped directly under the track through appropriately sized drainage pipes;
- The Office of Public Works (OPW) will be consulted on all stream crossings through the applications for Section 50 consent, prior to works commencing. The design of these crossings follow guidance from Inland Fisheries Ireland;
- Appropriate site management measures will be taken such that runoff from the construction site is not contaminated by fuel or lubricant spillages;
- There will be no discharge of sewage effluent or contaminated drainage into any watercourse system or ditch; and
- The drainage system will be monitored regularly during the construction phase for effectiveness, and cleaned or unblocked if necessary.

### 4.1.2 SuDS Design Philosophy

The SuDS design principles are as follows:-

| Minimise → | Intercept → | Treat → | Disperse → | Dilute |
|---|---|---|---|---|

#### Minimise

The main principle of this SuDS design is to minimise the volume of 'dirty' water requiring treatment through means of informed, integrated and sustainable drainage design. This is achieved by keeping 'clean' water clean by interception and separation, and by collecting the 'dirty' water and treating it by removing the suspended sediments. The resultant outflow is dispersed across vegetation and will become diluted through contact with the clean water runoff before entering the natural drainage system.

#### Intercept

The key silt/sediment control measure is the separation of construction runoff from the clean water runoff that arises in the undisturbed areas of the project site and surrounding lands. This significantly reduces the volume, and velocity, of dirty water that the control measures are required to manage. To achieve separation, clean water infiltration interception drains are positioned on the upslope and dirty water swales/drains positioned along the verge, with site surfaces sloped towards dirty water swales/drains. The remainder of this clean water will be regularly piped under both the access tracks and dirty water swales/drains to prevent contamination. This process allow for the mimicking the paths which clean water would have taken in the absence of the project.

#### Treat, Disperse, & Dilute

'Dirty water' swales/drains collect all incident rainwater that falls on the development infrastructure and drain into the silt traps/ponds. Following a period of attenuation, during which time all suspended solids will have 'fallen', the treated water is dispersed across vegetation (through buffered outfalls) to further filter the discharge. Dispersal in this manner has the effect of allowing the smaller particle sizes to be taken up by the vegetation.

## 4.2 Design Measures

This SuDS adopts a design for the drainage of the site. The following elements in series are proposed:-

- Areas of ground to be disturbed should be kept to the minimum required;
- Where forestry is to be felled, stumps should be left in the ground (apart from areas for access tracks, site drainage, hardstands and turbine foundations) so as to minimise ground disturbance;
- Open swales for development run-off collection and treatment;
- Infiltration Interception Drains for upslope 'clean' water collection and dispersion;
- Ditches which drain from the area to be felled towards existing surface watercourses will be blocked, and temporary silt traps will be constructed. No direct discharge of such ditches to watercourses will occur. Drains and sediment traps will be installed during ground preparation. Collector drains will be excavated at an acute angle to the contour (~0.3%-3% gradient), to minimise flow velocities. Main drains to take the discharge from collector drains will include water drops and rock armour, as required, where there are steep gradients, and should avoid being placed at right angles to the contour;
- Filtration Check Dams will be installed to reduce velocities along sections of road which run perpendicular to contours;
- Silt/settlement ponds and lagoon-type sediment traps will control and store development runoff to encourage settlement prior to discharge, at greenfield runoff rates, to eliminate any risk to Freshwater Pearl Mussel downstream of the project; and
- Disturbed Sediment Entrainment Mats (SEDIMATS) in all watercourses draining the site (including areas to be clear felled of commercial forestry), to provide further level of protection in relation to silt release.

These measures will provide a comprehensive surface water management train that will avoid any adverse effect on the hydrology of the site and downstream water quality during the construction phase of the project.

### 4.2.1 Infiltration Interceptor Drains

Drainage management will ensure that natural runoff is not permitted to mix with construction runoff from sources such as excavation dewatering or access track runoff. The SuDS design will ensure that infiltration interceptor drains are installed upslope of infrastructure, to intercept and divert clean surface water runoff, prior to it coming in contact with areas of excavation. The contractor will ensure that natural runoff infiltration interceptor drains are installed ahead of earthworks being undertaken.

The purpose of cut-off drainage is to collect clean run-off water on the upstream side of new infrastructure and transfer it such that it can discharge to the downstream side of infrastructure without having to interact with new infrastructure/excavations where it could potentially pick up fine particles.

This will reduce the flow of natural runoff onto any exposed areas of rock and soil, thereby reducing the volume of silt laden runoff capable of being generated at the project site. Natural runoff water, upslope of infrastructure, will be collected in infiltration interceptor drains and be directed away from the earthworks etc. In certain areas, runoff will be passed through sub-surface clean water culverts (e.g. below access tracks or hardstandings) and will be kept separate to drainage provided for

track runoff. The clean water runoff will be discharged downstream of works location and returned to the natural drainage network.

Temporary silt/sediment prevention and erosion protection measures will be provided in all drainage installed in order to mitigate the possibility of erosion and transport of sediment from newly excavated channels which will be formed as part of the construction runoff drainage provisions. All drainage is to be dispersed over vegetated ground as a further filtration method.

The frequency of outflow points will be designed to avoid collection and interception of large catchments creating significant point flows.

### 4.2.2 Swales

Where swales are utilised, it is proposed that rock filled check dams will be installed at a regular frequency, in order to reduce flow velocities and improve conditions for the settlement of solids in transit. Check dams will be constructed from 5-40mm crushed rock locally won, and will constitute the majority of the check dams.

It is intended that these dams will be relatively simple to construct but will provide treatment of construction runoff at source. There will be outflow points from the swales to the existing drainage network to preserve the hydraulic efficiency of the site and to prevent ponding of water. No outflow will be permitted directly into natural watercourses.

### 4.2.3 Filtration Check Dams

The project includes areas where infrastructure and accompanying swales run directly downhill. In such situations, appropriate flow attenuation measures will be installed.

Access tracks will be constructed with an appropriate surface cross slope, so that all storm water flow will be directed towards the constructed grass swales located along track verges. The width and depth of constructed swales will be minimised as far as practical in order to reduce ground disturbance, excavation footprint (and hence volume of excavated materials) and also disruption of local hydrology as far as possible.

Check dams (flow barriers or dams constructed across the drainage channel) will be installed at regular intervals within clean water drains and dirty water swales in order to reduce erosion and allow for greater flow control. Check dams allow for a reduction in the velocity of water and therefore allow settlement of coarser sediment particles as well as silt at low flow conditions. Reduction in flow velocity will also prevent erosion of the drainage channel itself.

The number and location of check dams will be dependent on the slope, flow and volume of water, although the following general rules will be applied:

- The maximum spacing between check dams should be such that the toe of the upstream dam is at the same elevation as the top of the downstream dam;
- The centre of the check dam should be at least 0.2m lower than the outside edges;
- Side slopes should be 1:2 or less;
- Check dams should be keyed at least 0.1m into the drainage channel bottom in order to prevent the dam washing out; and
- Check dams will be maintained and monitored on a regular basis. Sediment should be removed before it reaches one half the original dam height.

### 4.2.4 Silt/Settlement Ponds

Runoff from large areas of hardstanding; including crane hardstandings, temporary construction compound, and electrical substation compound; will be attenuated to mimic natural runoff patterns. To capture runoff generated within the project site, swales (see **Section 4.2.2**) will be utilised to attenuate water and to direct 'dirty' water to silt/settlement ponds, where the flow velocity will reduce to allow sediment and silt to be deposited.

From the silt/settlement ponds, the water will flow through a tertiary treatment system; based on a design from Altmuller and Dettmer (2006); of lagoon-type sediment pond which will absorb the fine particles that may not settle in the primary and secondary settlement ponds.

All swales and ponds 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 0.75m within the settlement ponds.

The settlement ponds are utilised to attenuate rain water runoff rates to that of existing green field rates. In addition, the ponds shall aid the removal of suspended solids from runoff water.

### 4.2.5 Lagoon-type Sediment Ponds

In addition to the silt/settlement ponds, a tertiary treatment system will also be provided to absorb any fine particles that may not settle in the primary and secondary settlement ponds. From the silt/settlement ponds, water will flow through lagoon-type sediment ponds which will be designed with a retention time of 10-days. These ponds; the design of which will be adapted to the characteristics of the project site but based on the principles of Altmuller & Dettmer; will be vegetated so as to perform the role of a 'plant filtration bed' as described at **Annex 1** (pg. 7).

The settlement ponds and lagoon-type sediment traps will assist as part of an overall strategy to remove any risk to FPM downstream of the project site.

Separately, it is also proposed to use Disturbed Sediment Entrainment Mats - SEDIMATS (see http://www.hy-tex.co.uk/ht_bio_sed.html). The use of these mats will provide a further level of protection in relation to silt release.

### 4.2.6 Planning-Stage Design of Surface Water Management System

A planning-stage drainage/surface water management system has been designed by Jennings O'Donovan & Partners, enclosed at **Annex 2** hereto, and includes preliminary specifications for surface water management infrastructure particularly in relation to the appropriate sizing of silt/settlement ponds. Details of the sizing of each silt/settlement pond, which have been informed by rainfall data for the project site (see **Annex 3**), are provided at **Table 1** below.

| Pond Reference (SP) | Development Area ($m^2$) | Length (m) | Width (m) | Depth (m) | Overall Volume of Silt Pond ($m^3$) | Settling Velocity m/s <0.0016 | Settling Duration Hours >4hrs |
|---|---|---|---|---|---|---|---|
| 1 | 950 | 8 | 2.8 | 0.75 | 16.8 | 0.0004 | 5.43 |
| 2 | 800 | 8 | 2.8 | 0.75 | 16.8 | 0.0003 | 6.45 |
| 3 | 450 | 4 | 2.8 | 0.75 | 8.4 | 0.0002 | 5.73 |
| 4 | 1750 | 9 | 4.5 | 0.75 | 30.4 | 0.0005 | 5.33 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 5 | 650 | 6 | 2.8 | 0.75 | 12.6 | 0.0003 | 5.95 |
| 6 | 3100 | 14 | 5.2 | 0.75 | 54.6 | 0.0007 | 5.41 |
| 7 | 1700 | 9 | 4.5 | 0.75 | 30.4 | 0.0005 | 5.48 |
| 8 | 1700 | 9 | 4.5 | 0.75 | 30.4 | 0.0005 | 5.48 |
| 9 | 500 | 6 | 2.8 | 0.75 | 12.6 | 0.0002 | 7.73 |
| 10 | 1150 | 8 | 3.6 | 0.75 | 21.6 | 0.0004 | 5.77 |
| 11 | 825 | 8 | 2.8 | 0.75 | 16.8 | 0.0004 | 6.25 |
| 12 | 550 | 6 | 2.8 | 0.75 | 12.6 | 0.0002 | 7.03 |
| 13 | 330 | 4 | 2.8 | 0.75 | 8.4 | 0.0001 | 7.81 |
| 14 | 1125 | 8 | 3.6 | 0.75 | 21.6 | 0.0004 | 5.89 |
| 15 | 425 | 4 | 2.8 | 0.75 | 8.4 | 0.0002 | 6.07 |
| 16 | 1050 | 8 | 3.6 | 0.75 | 21.6 | 0.0004 | 6.31 |
| 17 | 2500 | 12 | 5.2 | 0.75 | 46.8 | 0.0006 | 5.75 |
| 18 | 1500 | 10 | 3.6 | 0.75 | 27.0 | 0.0005 | 5.52 |
| 19 | 2000 | 12 | 4.5 | 0.75 | 40.5 | 0.0005 | 6.22 |
| 20 | 1500 | 10 | 3.6 | 0.75 | 27.0 | 0.0005 | 5.52 |
| 21 | 1100 | 8 | 3.6 | 0.75 | 21.6 | 0.0004 | 6.03 |
| 22 | 925 | 8 | 2.8 | 0.75 | 16.8 | 0.0004 | 5.57 |
| 23 | 650 | 6 | 2.8 | 0.75 | 12.6 | 0.0003 | 5.95 |
| 24 | 550 | 6 | 2.8 | 0.75 | 12.6 | 0.0002 | 7.03 |
| 25 | 550 | 6 | 2.8 | 0.75 | 12.6 | 0.0002 | 7.03 |
| 26 | 1500 | 10 | 3.6 | 0.75 | 27.0 | 0.0005 | 5.52 |
| 27 | 1500 | 10 | 3.6 | 0.75 | 27.0 | 0.0005 | 5.52 |
| 28 | 1750 | 12 | 3.6 | 0.75 | 32.4 | 0.0006 | 5.68 |
| 29 | 1750 | 12 | 3.6 | 0.75 | 32.4 | 0.0006 | 5.68 |
| 30 | 700 | 6 | 2.8 | 0.75 | 12.6 | 0.0003 | 5.52 |
| 31 | 700 | 6 | 2.8 | 0.75 | 12.6 | 0.0003 | 5.52 |
| 32 | 1500 | 10 | 3.6 | 0.75 | 27.0 | 0.0005 | 5.52 |
| 33 | 1600 | 12 | 3.6 | 0.75 | 32.4 | 0.0005 | 6.22 |
| 34 | 1600 | 12 | 3.6 | 0.75 | 32.4 | 0.0005 | 6.22 |
| 35 | 500 | 6 | 2.8 | 0.75 | 12.6 | 0.0002 | 7.73 |
| 36 | 1200 | 10 | 2.8 | 0.75 | 21.0 | 0.0005 | 5.37 |
| 37 | 720 | 6 | 2.8 | 0.75 | 12.6 | 0.0003 | 5.37 |
| 38 | 1600 | 12 | 3.6 | 0.75 | 32.4 | 0.0005 | 6.22 |
| 39 | 1450 | 10 | 3.6 | 0.75 | 27.0 | 0.0005 | 5.72 |
| 40 | 650 | 6 | 2.8 | 0.75 | 12.6 | 0.0003 | 5.95 |
| 41 | 500 | 6 | 2.8 | 0.75 | 12.6 | 0.0002 | 7.73 |
| 42 | 200 | 4 | 2.8 | 0.75 | 8.4 | 0.0001 | 12.89 |
| 43 | 500 | 6 | 2.8 | 0.75 | 12.6 | 0.0002 | 7.73 |
| 44 | 600 | 6 | 2.8 | 0.75 | 12.6 | 0.0003 | 6.45 |
| 45 | 650 | 5 | 2.8 | 0.75 | 10.5 | 0.0003 | 4.96 |
| 46 | 1600 | 12 | 3.6 | 0.75 | 32.4 | 0.0005 | 6.22 |
| 47 | 1500 | 10 | 3.6 | 0.75 | 27.0 | 0.0005 | 5.52 |
| 48 | 1650 | 12 | 3.6 | 0.75 | 32.4 | 0.0006 | 6.03 |
| 49 | 400 | 4 | 2.8 | 0.75 | 8.4 | 0.0002 | 6.45 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 50 | 600 | 6 | 2.8 | 0.75 | 12.6 | 0.0003 | 6.45 |
| 51 | 1100 | 10 | 2.8 | 0.75 | 21.0 | 0.0005 | 5.86 |
| 52 | 500 | 6 | 2.8 | 0.75 | 12.6 | 0.0002 | 7.73 |
| 53 | 250 | 4 | 2.8 | 0.75 | 8.4 | 0.0001 | 10.31 |
| 54 | 350 | 4 | 2.8 | 0.75 | 8.4 | 0.0002 | 7.37 |
| 55 | 350 | 4 | 2.8 | 0.75 | 8.4 | 0.0002 | 7.37 |
| 56 | 500 | 6 | 2.8 | 0.75 | 12.6 | 0.0002 | 7.73 |
| 57 | 500 | 6 | 2.8 | 0.75 | 12.6 | 0.0002 | 7.73 |
| 58 | 500 | 6 | 2.8 | 0.75 | 12.6 | 0.0002 | 7.73 |
| 59 | 1250 | 8 | 3.6 | 0.75 | 21.6 | 0.0004 | 5.30 |
| 60 | 3300 | 14 | 5.6 | 0.75 | 58.8 | 0.0007 | 5.47 |
| 61 | 550 | 6 | 2.8 | 0.75 | 12.6 | 0.0002 | 7.03 |
| 62 | 500 | 6 | 2.8 | 0.75 | 12.6 | 0.0002 | 7.73 |
| 63 | 500 | 6 | 2.8 | 0.75 | 12.6 | 0.0002 | 7.73 |
| 64 | 400 | 4 | 2.8 | 0.75 | 8.4 | 0.0002 | 6.45 |
| 65 | 1550 | 10 | 3.6 | 0.75 | 27.0 | 0.0005 | 5.35 |
| 66 | 1500 | 10 | 3.6 | 0.75 | 27.0 | 0.0005 | 5.52 |
| 67 | 1500 | 10 | 3.6 | 0.75 | 27.0 | 0.0005 | 5.52 |
| 68 | 750 | 8 | 2.8 | 0.75 | 16.8 | 0.0003 | 6.88 |
| 69 | 1000 | 10 | 2.8 | 0.75 | 21.0 | 0.0004 | 6.45 |
| 70 | 500 | 6 | 2.8 | 0.75 | 12.6 | 0.0002 | 7.73 |
| 71 | 900 | 8 | 2.8 | 0.75 | 16.8 | 0.0004 | 5.73 |
| 72 | 1350 | 10 | 3.6 | 0.75 | 27.0 | 0.0005 | 6.14 |
| 73 | 400 | 4 | 2.8 | 0.75 | 8.4 | 0.0002 | 6.45 |
| 74 | 100 | 4 | 2.8 | 0.75 | 8.4 | 0.0000 | 25.78 |
| 75 | 750 | 8 | 2.8 | 0.75 | 16.8 | 0.0003 | 6.88 |
| 76 | 800 | 8 | 2.8 | 0.75 | 16.8 | 0.0003 | 6.45 |
| 77 | 2400 | 12 | 5.2 | 0.75 | 46.8 | 0.0006 | 5.99 |
| 78 | 2400 | 12 | 5.2 | 0.75 | 46.8 | 0.0006 | 5.99 |
| 79 | 1200 | 10 | 2.8 | 0.75 | 21.0 | 0.0005 | 5.37 |
| 80 | 3100 | 14 | 5.6 | 0.75 | 58.8 | 0.0007 | 5.82 |
| 81 | 2400 | 12 | 5.2 | 0.75 | 46.8 | 0.0006 | 5.99 |
| 82 | 750 | 8 | 2.8 | 0.75 | 16.8 | 0.0003 | 6.88 |
| 83 | 1350 | 10 | 3.6 | 0.75 | 27.0 | 0.0005 | 6.14 |
| 84 | 2300 | 12 | 4.5 | 0.75 | 40.5 | 0.0006 | 5.40 |
| 85 | 2300 | 12 | 4.5 | 0.75 | 40.5 | 0.0006 | 5.40 |
| A | 1800 | 12 | 3.6 | 0.75 | 32.4 | 0.0006 | 5.68 |
| B | 1800 | 12 | 3.6 | 0.75 | 32.4 | 0.0006 | 5.68 |
| C | 1800 | 12 | 3.6 | 0.75 | 32.4 | 0.0006 | 5.68 |
| D | 1800 | 12 | 3.6 | 0.75 | 32.4 | 0.0006 | 5.68 |
| E | 1100 | 8 | 3.6 | 0.75 | 21.6 | 0.0004 | 6.03 |
| F | 1750 | 12 | 3.6 | 0.75 | 32.4 | 0.0006 | 5.68 |
| G | 1100 | 8 | 3.6 | 0.75 | 21.6 | 0.0004 | 6.03 |
| H | 1750 | 12 | 3.6 | 0.75 | 32.4 | 0.0006 | 5.68 |

**Table 1: Silt/Settlement Pond Specifications**

Prior to the commencement of development, the appointed contractor; in conjunction with the project design team, EM, and ECoW; shall prepare a detailed SWMP which shall detail the precise specifications and locations of all surface water management infrastructure to be installed.

## 5.0 Construction Phase Measures

In the first instance, the project seeks to avoid adverse effects on surface water through avoidance. In particular, the project has sought to avoid direct interactions with watercourses; through minimising the number of watercourse crossings and the implementation of a 50m buffer zone around natural watercourses. The design of the project has, where possible, sought to avoid this buffer area.

Best practice measures are also proposed to minimise impacts to water quality, as follows:-.

- All site personnel will be made aware of their environmental responsibilities at the site;
- Contractors will be required to include contingency plans to deal with spillages, should they occur;
- Land disturbance will be kept to minimum and disturbed areas will be stabilised as soon as possible;
- In principle, soil excavation should be undertaken during dry periods, whenever possible;
- Site visits by a Design Engineer will be undertaken at various stages of the construction process to ensure that the SuDS scheme is being constructed and implemented appropriately; and
- In order to verify the efficacy of pollution prevention works during construction, water quality monitoring will be undertaken by a suitably qualified EM, prior to, during and post completion of construction works. This will include all watercourses within the catchment of the construction area. The monitoring will comprise visual and hydrochemistry monitoring, as described in detail in the Water Quality Monitoring Plan.

Finally, all mitigation measures proposed in the Water chapter of the EIAR will be implemented in full, as set out in the following sections.

### 5.1 Clear Felling & Surface Water Quality Effects

Best practice methods related to water incorporated into the forestry management and mitigation measures have been derived from:-

- Department of Agricultural, Food and the Marine (2019) *Standards for Felling and Reforestation*;
- Forestry Commission (2004) *Forests and Water Guidelines, Fourth Edition*. Publ. Forestry Commission, Edinburgh;
- Coillte (2009) *Forest Operations and Water Protection Guidelines*;
- Forest Services (Draft) Forestry and Freshwater Pearl Mussel Requirements – Site Assessment and Mitigation Measures;
- Coillte (2009) *Methodology for Clear Felling Harvesting Operations*; and,
- Forest Service (2000: *Forestry and Water Quality Guidelines*. Forest Service, DAF, Johnstown Castle Estate, Co. Wexford.

### 5.1.1 Mitigation by Avoidance

There is a requirement in the *Forest Service Code of Practice* and in the *FSC Certification Standard* for the installation of buffer zones adjacent to aquatic zones at planting stage. Minimum buffer zone widths recommended in the Forest Service (2000) guidance document *Forestry and Water Quality Guidelines* are detailed below.

| Average slope leading to the aquatic zone | | Buffer zone width on either side of the aquatic zone | Buffer zone width for highly erodible soils |
|---|---|---|---|
| Moderate | (0 – 15%) | 10 m | 15 m |
| Steep | (15 – 30%) | 15 m | 20 m |
| Very steep | (>30%) | 20 m | 25 m |

During the construction phase, a self-imposed conservative buffer zone of 50m will be maintained for all streams.

The large distance between the majority of the felling areas and sensitive aquatic zones means that any poor quality runoff arising from felling areas can be adequately managed and attenuated prior to even reaching the aquatic buffer zone and primary drainage routes. Where tree felling is required in the vicinity of streams, the additional mitigation measures outlined below will be employed.

### 5.1.2 Mitigation by Design

Mitigation measures which will reduce the risk of entrainment of suspended solids and nutrient release in surface watercourses comprise best practice methods, as follows:-

- Machine combinations (i.e. handheld or mechanical) will be chosen which are most suitable for ground conditions and which will minimise soils disturbance;
- Checking and maintenance of tracks and culverts will be ongoing through any felling operation. No tracking of vehicles through watercourses will occur. Where possible, existing drains will not be disturbed during felling works;
- Ditches which drain from the areas to be felled towards existing surface watercourses will be blocked, and temporary silt traps will be constructed. No direct discharge of such ditches to watercourses will occur. Drains and sediment traps will be installed during ground preparation. Collector drains will be excavated at an acute angle to the contour (~0.3%-3% gradient), to minimise flow velocities. Main drains to take the discharge from collector drains will include water drops and rock armour, as required, where there are steep gradients, and avoid being placed at right angles to the contour;
- Sediment traps will be sited in drains downstream of felling areas. Machine access will be maintained to enable the accumulated sediment to be excavated. Sediment will be carefully disposed of in the spoil disposal areas. All new silt traps will be constructed on even ground and not on sloping ground;
- In areas particularly sensitive to erosion or where felling inside the 50m buffer is required, it will be necessary to install double or triple sediment traps;
- All drainage channels will taper out before entering the 50m buffer zone, where possible. This ensures that discharged water gently fans out over the buffer zone before entering the aquatic zone, with sediment filtered out from the flow by ground vegetation within the zone. On erodible soils, silt traps will be installed at the end of the drainage channels, to the outside of the buffer zone;

- Drains and silt traps will be maintained throughout all felling works, ensuring that they are clear of sediment build-up and are not severely eroded. Correct drain alignment, spacing and depth will ensure that erosion and sediment build-up are minimized and controlled;
- Brash mats will be used to support vehicles on soft ground, reducing topsoil and mineral soils erosion and avoiding the formation of rutted areas, in which surface water ponding can occur. Brash mat renewal will take place before they become heavily used and worn. Provision will be made for brash mats along all off-road routes, to protect the soil from compaction and rutting. Where there is risk of severe erosion occurring, extraction will be suspended during periods of high rainfall;
- Timber will be stacked in dry areas, and outside the 50m watercourse buffer. Straw bales and check dams will be emplaced on the down gradient side of timber storage/processing sites;
- Works will be carried out during periods of no, or low, rainfall in order to minimise entrainment of exposed sediment in surface water run-off;
- Checking and maintenance of roads/tracks and culverts will be ongoing through the felling operation;
- Refuelling or maintenance of machinery will not occur within 100m of a watercourse. Mobile bowser, drip kits, qualified personnel will be used where refuelling is required;
- A permit to refuel system will be adopted:
- Branches, logs or debris will not be allowed to build up in aquatic zones. All such material will be removed when harvesting operations have been completed, but care will be taken to avoid removing natural debris deflectors;
- Trees will be cut manually from along streams and using machinery to extract whole trees; and
- Travel will only be permitted perpendicular to and away from surface water features.

#### 5.1.2.1 Silt Traps

Silt traps will be strategically placed down-gradient within forestry drains near streams. The main purpose of the silt traps and drain blocking is to slow water flow, increase residence time and allow settling of silt in a controlled manner.

#### 5.1.2.2 Drain Inspection and Maintenance

The following items will be carried out during pre-felling inspections and regularly thereafter:-

- Communication with tree felling operatives in advance to determine whether any areas have been reported where there is unusual waterlogging or bogging of machines;
- Inspection of all areas reported as having unusual ground conditions;
- Inspection of main drainage ditches and outfalls. During pre-felling inspections, the main drainage ditches will be identified. Where possible, the pre-felling inspection will be carried out during rainfall;
- Following tree felling, all main drains will be inspected to ensure that they are functioning;
- Extraction tracks within 10m of drains will be broken up and diversion channels created to ensure that water in the tracks spreads out over the adjoining ground;
- Culverts on drains exiting the site, if impeded by silt or debris, will be unblocked; and

- All accumulated silt will be removed from drains and culverts, and silt traps, and this removed material will be deposited away from watercourses to ensure that it will not be carried back into the trap or stream during subsequent rainfall.

#### 5.1.2.3 Surface Water Quality Monitoring

Sampling will be completed before, during (if the operation is conducted over a protracted time) and after the felling activity. The 'before' sampling will be conducted within 4-weeks of the felling activity commencing, preferably in medium-to-high water flow conditions. The 'during' sampling will be undertaken once a week or after rainfall events. The 'after' sampling will comprise as many samplings as necessary to demonstrate that water quality has returned to pre-activity status (i.e. where an impact has been shown).

Details of the proposed surface water quality monitoring programme are outlined in the Water Quality Monitoring Plan.

The surface water sampling locations used in this EIAR for the wind farm site (i.e. SW1 – SW2) will also be used as sampling locations during felling activities.

Also, daily surface water monitoring forms (for visual inspections and field chemistry measurements) will also be utilised at every works site near any watercourse. These will be taken daily and kept on site for record and inspection.

## 5.2 Earthworks (Removal of Vegetation Cover, Excavations and Stock Piling) Resulting in Suspended Solids Entrainment in Surface Water

### 5.2.1 Mitigation by Avoidance

The key mitigation measure during the construction phase is the avoidance of sensitive aquatic areas by using a 50m buffer. From the constraints map (**Chapter 7** of the EIAR) it is evident that; other than some sections of access tracks, watercourse crossings (4 no.), part of the crane hardstanding of turbine T7, the southern end of the main construction compound and the northern end of the spoil deposition area at turbine T5; the majority of the proposed wind farm infrastructure (including all turbine locations and the spoil deposition areas) is located outside of areas that have been assessed to be hydrologically sensitive. Additional mitigation in the form of double silt fencing will be placed around all infrastructure that encroaches the 50m buffer zone.

As described above and at **Chapter 3**, specific mitigation measures, incorporated into the design of the project (embedded mitigation) and through implementation of best practice methodologies will be employed where work inside buffer zones is proposed.

The generally large setback distance from sensitive hydrological features ensures that sufficient space is provided for the installation of drainage mitigation measures (discussed below) and to ensure their effective operation. The proposed buffer zone will ensure:-

- Avoidance of physical damage to watercourses, and associated release of sediment;
- Avoidance of excavations within close proximity to surface water courses;
- Avoidance of the entry of suspended sediment from earthworks into watercourses; and,
- Avoidance of the entry of suspended sediment from the construction phase drainage system into watercourses, achieved in part by ending drain discharge outside the buffer zone and allowing percolation across the vegetation of the buffer zone.

### 5.2.2 Mitigation by Prevention

The following section details the measures which will be put in place during the construction phase to ensure that surface water features are protected from the release of silt or sediment and to ensure that all surface water runoff is fully treated and attenuated to avoid the discharge of dirty water.

Source controls to limit the likelihood for 'dirty water' to occur:-

- Interceptor drains, vee-drains, diversion drains, flume pipes, erosion and velocity control measures such as use of sand bags, oyster bags filled with clean washed gravel, filter fabrics, and other similar/equivalent or appropriate systems;
- Small working areas, covering stockpiles, weathering off stockpiles, cessation of works in certain areas or other similar/equivalent or appropriate measures.

In-Line controls to ensure appropriate management of silt laden water:-

- Interceptor drains, vee-drains, oversized swales, erosion and velocity control measures such as check dams, sandbags, oyster bags, straw bales, flow limiters, weirs, baffles, silt bags, silt fences, sedimats, filter fabrics, and collection sumps, temporary sumps/attenuation lagoons, sediment traps, pumping systems, settlement ponds, temporary pumping chambers, or other similar/equivalent or appropriate systems.

Treatment systems to fully attenuate silt laden waters prior to discharge:-

Temporary sumps and attenuation ponds, temporary storage lagoons, sediment traps, and settlement ponds, and proprietary settlement systems such as Siltbuster, and/or other similar/equivalent or appropriate systems.It should be noted for this site that an extensive network of bog and forestry drains already exists, and these will be integrated and enhanced as required and used within the wind farm drainage system. The integration of the existing land drainage network and the proposed wind farm network is common practice in wind energy developments and will also result in benefits to surrounding agricultural lands.

The main elements of interaction with existing drains will be as follows:-

- Apart from interceptor drains, which will convey clean runoff water to the downstream drainage system, there will be no direct discharge (without treatment for sediment reduction and attenuation for flow management) of runoff from the wind farm drainage into the existing site drainage network. This will reduce the likelihood of any increased risk of downstream flooding or sediment transport/erosion;
- Silt traps will be placed in the existing drains upstream of any streams where construction works is taking place, and these will be diverted into proposed interceptor drains, or culverted under/across the works area; and
- Buffered outfalls, which will be numerous over the site, will promote percolation of drainage waters across vegetation and close to the point at which the additional runoff is generated, rather than direct discharge to the existing drains of the site.

#### 5.2.2.1 Water Treatment Train

While the silt/sediment ponds and lagoons are assessed as providing a sufficient level of protection to avoid any deterioration in downstream water quality; a final line of defence can be provided by a water treatment train such as a 'Siltbuster', if required. If the discharge water from construction areas fails to be of a high quality, then a

filtration treatment system (such as a 'Siltbuster' or similar equivalent treatment train [sequence of water treatment processes]) will be used to filter and treat all surface discharge water collected in the dirty water drainage system. This water treatment train will apply for the entirety of the construction phase.

#### 5.2.2.2 Silt Fences

Silt fences will be emplaced within drains down-gradient of all construction areas. Silt fences are effective at removing heavy settleable solids. This will act to prevent entry to watercourses of sand and gravel sized sediment, released from excavation of mineral sub-soils of glacial and glacio-fluvial origin, and entrained in surface water runoff. Inspection and maintenance of these structures during construction phase is critical to their functioning to stated purpose. They will remain in place throughout the entire construction phase. Double silt fences will be emplaced within drains down-gradient of all construction areas inside the 50m hydrological buffer zones to provide an additional layer of protection in these areas.

#### 5.2.2.3 Silt Bags

Silt bags will be used where small to medium volumes of water need to be pumped from excavations. As water is pumped through the bag, most of the sediment is retained by the geotextile fabric allowing filtered water to pass through. Silt bags will be used with natural vegetation filters or sedimats (sediment entrapment mats, consisting of coir or jute matting) placed at the silt bag location to provide further treatment of the water outfall from the silt bag. Sedimats will be secured to the ground surface using stakes/pegs. The sedimat will extend to the full width of the outfall to ensure all water passes through this additional treatment measure.

#### 5.2.2.4 Management of Runoff from Spoil Deposition Areas

It is proposed that excavated overburden/spoil will be utilised for reinstatement of excavated areas etc. and for landscaping purposes. Excess material, or material which is unsuitable for this purpose, will be stored, permanently, at the dedicated spoil deposition areas.

The main spoil deposition area is located outside the 50m stream buffer zone. A small section of the spoil deposition area at turbine T5 encroaches the 50m buffer zone. Additional mitigation in the form of double silt fencing will be placed around all infrastructure that encroaches the 50m buffer zone.

During the initial placement of spoil in the deposition areas, silt fences, straw bales and biodegradable matting will be used to control surface water runoff. Double silt fencing will be placed along the edge of the bog drain that intercepts the deposition areas.

Drainage from the overburden deposition areas will ultimately be into to the existing bog drain network where it is proposed that check dams will be installed every 20m or so to create a series of settlement ponds, before being discharged.

Spoil deposition areas will be sealed with a digger bucket and allowed to revegetate as soon possible to reduce sediment entrainment in runoff. Once re-vegetated and stabilised, spoil deposition areas will no longer be a likely source of silt laden runoff. Surface water protection infrastructure will be left in place until the areas have stabilised.

#### 5.2.2.5 Grid Connection Installation Works

Temporary silt fencing/silt trap arrangements will be placed within existing roadside/field drainage features along the grid connection route to remove any

suspended sediments from the works area. The trapped sediment will be removed and disposed of at an appropriate licenced facility. Any bare-ground will be re-seeded/reinstated immediately and silt fencing temporally left in place if necessary.

#### 5.2.2.6 Pre-emptive Site Drainage Management

The works programme for the initial construction stage of the development will also take account of weather forecasts, and predicted rainfall in particular. Large excavations and movements of soil/subsoil or vegetation stripping will be suspended or scaled back if prolonged or intense rain is forecast. The extent to which works will be scaled back or suspended will relate directly to the amount of rainfall forecast.

The following forecasting systems are available and will be used on a daily basis at the site to direct proposed construction activities:-

- General Forecasts: Available on a national, regional and county level from the Met Eireann website (www.met.ie/forecasts). These provide general information on weather patterns including rainfall, wind speed and direction but do not provide any quantitative rainfall estimates;
- Meteo Alarm: Alerts to the possible occurrence of severe weather for the next 2 days. Less useful than general forecasts as only available on a provincial scale;
- 3 hour Rainfall Maps: Forecast quantitative rainfall amounts for the next 3 hours but does not account for possible heavy localised events;
- Rainfall Radar Images: Images covering the entire country are freely available from the Met Eireann website (www.met.ie/latest/rainfall_radar.asp). The images are a composite of radar data from Shannon and Dublin airports and give a picture of current rainfall extent and intensity. Images show a quantitative measure of recent rainfall. A 3 hour record is given and is updated every 15 minutes. Radar images are not predictive; and,
- Consultancy Service: Met Eireann provide a 24 hour telephone consultancy service. The forecaster will provide interpretation of weather data and give the best available forecast for the area of interest.

Using the safe threshold rainfall values will allow work to be safely controlled (from a water quality perspective) in the event of an impending high rainfall intensity event.

Works will be suspended if forecasting suggests either of the following is likely to occur:-

- >10 mm/hr (i.e. high intensity local rainfall events);
- >25 mm in a 24-hour period (heavy frontal rainfall lasting most of the day); or,
- >half monthly average rainfall in any 7 days.

Prior to works being suspended the following control measures will be completed:-

- Secure all open excavations;
- Provide temporary or emergency drainage to prevent back-up of surface runoff; and,
- Avoid working during heavy rainfall and for up to 24-hours after heavy events to ensure drainage systems are not overloaded.

#### 5.2.2.7 Timing of Site Construction Works

The construction of the site drainage system will be carried out, at the respective locations, prior to other activities being commenced. The construction of the drainage system will only be carried out during periods of, where possible, no rainfall, therefore avoiding runoff. This will avoid the risk of entrainment of suspended sediment in surface water runoff, and transport via this pathway to surface watercourses.

Construction of the drainage system during this period will also ensure that attenuation features associated with the drainage system will be in place and functional for all subsequent construction works.

### 5.2.3 Monitoring

Prior to the commencement of development, a detailed Site Drainage Plan and SWMP will be prepared to detail the siting and composition of the surface water management measures. The respective plans, which will form part of a detailed Construction Environmental Management Plan (CEMP), will be prepared prior to the commencement of development.

The CEMP will also include a detailed Water Quality Monitoring Plan for the monitoring of surface waters in the vicinity of the construction site by a designated Environmental Manager. The monitoring programme will comprise field testing and laboratory analysis of a range of agreed parameters. The civil works contractor, who will be responsible for the construction of the site drainage system, and Environmental Manager will undertake regular inspections of the drainage system to ensure that all measures are functioning effectively. The surface water sampling locations used in this EIAR (i.e. SW1 – SW4) will be used during construction activities. Regular inspections of all installed drainage systems will be undertaken, especially after heavy rainfall, to check for blockages, and ensure there is no build-up of standing water in parts of the systems where it is not intended.

Any excess build-up of silt levels that may decrease the effectiveness of the drainage feature, will be removed and disposed of in an appropriate manner.

## 5.3 Excavation Dewatering and Effects on Surface Water Quality

The management of excavation dewatering (pumping), particularly in relation to any accumulation of water in foundations or electricity line trenches, and subsequent treatment prior to discharge into the drainage network will be undertaken as follows:-

- Appropriate interceptor drainage, to prevent upslope surface runoff from entering excavations, will be put in place;
- The interceptor drainage will be discharged to the site constructed drainage system or onto natural vegetated surfaces and not directly to surface waters to ensure that Greenfield runoff rates are mimicked;
- If required, pumping of excavation inflows will prevent build-up of water in the excavation;
- The pumped water volumes will be discharged via volume and silt/sediment ponds and settlement lagoons adjacent to excavation areas, or via specialist treatment systems such as a Siltbuster unit;
- There will be no direct discharge to surface watercourses, and therefore no risk of hydraulic loading or contamination will occur;
- Daily monitoring of wind farm excavations by the Environmental Manager will occur during the construction phase. If high levels of seepage inflow occur, excavation work at this location will cease immediately and a geotechnical assessment undertaken; and,
- A mobile 'Siltbuster' or similar equivalent specialist treatment system will be available on-site for emergencies. Siltbusters are mobile silt traps that can remove fine particles from water using a proven technology and hydraulic design in a rugged unit. The mobile units are specifically designed for use on construction-sites. They will be used as final line of defence if needed.

## 5.4 Release of Hydrocarbons during Construction and Storage

- The volume of fuels or oils stored on site will be minimised. All fuel and oil will be stored in an appropriately bunded area within the temporary construction compound. Only an appropriate volume of fuel will be stored at any given time. The bunded area will be roofed to avoid the ingress of rainfall and will be fitted with a storm drainage system and an appropriate oil interceptor;
- All bunded areas will have 110% capacity of the volume to be stored;
- On site refuelling of machinery will be carried out using a mobile double skinned fuel bowser. The fuel bowser, a double-axel custom-built refuelling trailer will be re-filled at the temporary compound and will be towed around the site by a 4x4 jeep to where plant and machinery is located. No refuelling will be permitted at works locations within the 50m hydrological buffer. The 4x4 jeep will also be fully stocked with fuel absorbent material and pads in the event of any accidental spillages. The fuel bowser will be parked on a level area in the construction compound when not in use and only designated trained and competent operatives will be authorised to refuel plant on site. Mobile measures such as drip trays and fuel absorbent mats will be used during all refuelling operations to avoid any accidental leakages;
- All plant and machinery used during construction will be regularly inspected for leaks and fitness for purpose;
- Spill kits will be readily available to deal with and accidental spillages;
- All waste tar material arising from road cuttings (from trenching or other works in public roads) will be removed off-site and taken to a licensed waste facility. Due to the potential for contamination of soils and subsoils, it is not proposed to utilise this material for any reinstatement works; and
- An outline emergency plan for the construction phase to deal with accidental spillages is contained within the Planning-Stage CEMP (**Annex 3.4**). This emergency plan will be further developed prior to the commencement of development, and will be agreed with the Planning Authority as part of the detailed CEMP.

### 5.4.1 Mitigation by Best Practice

Environmental management guidelines from the EPA guidance document *Environmental Management in the Extractive Industry* in relation to groundwater protection will be implemented during the construction phase, particularly the best practice measures relating to oil and fuels.

## 5.5 Groundwater and Surface Water Contamination from Wastewater Disposal

Measures to avoid contamination of ground and surface waters by wastewaters will comprise:-

- Self-contained port-a-loos (chemical toilets) with an integrated waste holding tank will be installed at the site compound, maintained by the providing contractor, and removed from site on completion of the construction works;
- Water supply for the site office and other sanitation will be brought to site and removed after use to be discharged at a suitable off-site treatment location; and,
- No water will be sourced on the site, nor will any wastewater be discharged to the site.

## 5.6 Release of Cement-Based Products

The following mitigation measures are proposed to ensure that the release of cement-based products is avoided:-

- No batching of wet-cement products will occur on site. Ready-mixed concrete will be brought to site as required and, where possible, emplacement of pre-cast products, will take utilised;
- All watercourse crossings will utilise pre-cast products and the use of wet-cement products within the hydrological buffer will be avoided
- Where concrete is delivered on site, only the chute will be cleaned, using the smallest volume of water practicable. Chute cleaning will be undertaken at lined cement washout ponds with waters being stored in the temporary construction compound, removed off site and disposed of at an approved licensed facility. No discharge of cement contaminated waters to the construction phase drainage system or directly to any artificial drain or watercourse will be allowed;
- Weather forecasting will be used to ensure that prolonged or intense rainfall is not predicted during concrete pouring activities; and
- The concrete pour site will be kept free of standing water and plastic covers will be ready in case of sudden rainfall event.

## 5.7 Morphological Changes to Surface Water Courses & Drainage Patterns

The following mitigation measures are proposed:-

- All proposed new stream crossings will be clear span bridges (bottomless culverts) and the stream beds will remain undisturbed. No in-stream excavation works at the crossing locations are proposed and therefore there will be no impact on the stream at the proposed crossing location;
- All internal wind farm electrical cabling or grid connection cabling will pass above or below the existing culvert and will not directly interfere with the culvert;
- At the time of construction, all guidance/best practice requirements of the OPW or Inland Fisheries Ireland will be incorporated into the design/construction of the proposed watercourse/culvert crossings;
- As a further precaution, in-stream construction work (if/where required) will only be carried out during the period permitted by Inland Fisheries Ireland for in-stream works according to *Guidelines on Protection of Fisheries During Construction Works in and Adjacent to Waters* (2016) (i.e., July to September inclusive). This time period coincides with the period of lowest expected rainfall, and therefore minimum runoff rates. This will minimise the risk of entrainment of suspended sediment in surface water runoff, and transport via this pathway to surface watercourses (any deviation from this will be done in discussion with the IFI);
- During the near stream construction works (i.e. within the 50m buffer zone), double row silt fences will be emplaced immediately down-gradient of the construction area for the duration of the construction phase;
- The new watercourse crossings at the wind farm site will require a Section 50 license application to the OPW in accordance with the Arterial Drainage Act 1945. The river/stream crossings will be designed in accordance with OPW guidelines/requirements on applying for a Section 50 consent; and,
- No instream works are proposed at the grid connection watercourse crossings.

## 6.0 Operational Phase Measures

Following the completion of construction and the re-vegetation of disturbed ground, the generation of 'dirty' water runoff will be significantly diminished. It is important to reiterate that areas of hardstanding will be impermeable and the majority of incident rainfall will percolate naturally to ground.

Infiltration interceptor drains will be retained for the duration of the project to ensure that up-slope ('clean') runoff is directed away from site infrastructure and managed in an appropriate manner.

Swales and check dams (i.e. for the management of 'dirty' water) shall be retained for the duration of the project. The swales, having become vegetated, and check dams will act as a filtration feature for the low volume of surface water runoff arising and will be sufficient to ensure the avoidance of any deleterious matter being discharged to downstream watercourses. Accordingly, it is proposed that the silt/settlement ponds and lagoon-type sediment ponds will be decommissioned 1-year following the completion of construction. This period will ensure that the swales have become sufficiently vegetated to filter any silt/sediment which may arise.

The following measures will also be implemented.

### 6.1 Progressive Replacement of Natural Surface with Lower Permeability Surfaces

The operational phase drainage system of the project is described below:-

- Interceptor drains will be installed up-gradient of all infrastructure to collect clean surface runoff, in order to minimise the amount of runoff reaching areas where suspended sediment could become entrained. It will then be directed to areas where it can be re-distributed over the ground by means of a level spreader;
- Swales/road side drains will be used to collect runoff from access tracks, turbine hardstanding areas and substation compound areas which may contain entrained suspended sediment, and channel it to settlement ponds for sediment settling;
- Transverse drains ('grips') will be constructed, where appropriate, in the surface layer of access tracks to divert any runoff into swales/track side drains;
- Check dams will be used along sections of access tracks drains to intercept silts at source. Check dams will be constructed from a 40mm non-friable crushed rock or similar;
- Swales and check dams will buffer volumes of runoff discharging from the drainage system during periods of high rainfall, by retaining water until the storm hydrograph has receded, thus reducing the hydraulic loading to watercourses; and,
- Settlement ponds will be designed in accordance the greenfield runoff rate requirements; and,
- Imported rock for construction purposes and road surfacing will be strong, well-graded limestone which will be resistant to erosion and have a low likelihood to generate fines in hardstand runoff.

The operation of the underground grid connection will not result in any likely hydrological or water quality effects and therefore do not require mitigation measures.

## 6.2 Hydrocarbons Spillages/Leakages

Mitigation measures relating to oils and fuels are as follows:-

- Fuels stored on site will be minimised. Any storage areas will be bunded appropriately for the fuel storage volume for the time period of the construction;
- The substation transformer and oil storage tanks will be located in a concrete bund, impervious to rainwater ingress, capable of holding 110% of the stored oil volume.
- Turbine transformers will be located within the turbines, and any leaks will be fully contained within the turbine thus eliminating any pathway for leakages to affect land and soil.
- Maintenance vehicles will be regularly inspected for leaks and fitness for purpose; and
- An emergency plan for the operational phase to deal with accidental spillages will be contained within an Operational-Phase Environmental Management Plan. Spill kits will be available to deal with accidental spillages.

## 6.3 Increased Flood Risk due to Development in Fluvial Flood Zones

The design criteria implemented as part of the SuDS are as follows:-

- To minimise alterations to the ambient site hydrology and hydrogeology;
- To provide settlement and treatment controls as close to the site footprint as possible and to replicate, where possible, the existing hydrological environment of the site;
- To minimise sediment loads resulting from the development run-off during the construction phase;
- To preserve greenfield runoff rates and volumes;
- To strictly control all surface water runoff such that no silt or other pollutants shall enter watercourses and that no artificially elevated levels of downstream siltation or no plumes of silt arise when substratum is disturbed;
- To provide settlement ponds to encourage sedimentation and storm water runoff settlement;
- To reduce stormwater runoff velocities throughout the site to prevent scouring and encourage settlement of sediment locally;
- To manage erosion and allow for the effective revegetation of bare surfaces;
- To manage and control water within the site and allow for the discharge of runoff from the site below the MAC of the relevant surface water regulation value; and,
- The high sensitivity of downstream receptors along with WFD status.

### *Flood Resilience Measures*

The site-specific flood zone modelling shows that only short sections of proposed access road at 2 no. watercourse crossing locations will potentially be affect by fluvial flooding. One crossing is on the Rapemills River itself and the second is a large land drain on the south of the site which drains into the Rapemills River.

For these new crossing works a consent will be sought under Section 50 of the Arterial Drainage Act, 1945 to install a new culvert/bridge with the hydraulic capacity to accommodate a 100-year flood flows while maintaining at least a 300mm freeboard above the flood level.

The proposed access road surface level will be close or at the existing ground level to prevent obstruction of surface water flow paths.

### 6.4 Turbine Foundation Piling and Hydrogeological Effects

The proposed mitigation measures designed for the protection of downstream surface water quality and groundwater quality within the peat bog will be implemented at all construction work areas. Mitigation measures for sediment control, control of hydrocarbons during construction works, and control of cement-based products, as set out above, will be implemented in full.

Proposed mitigation measures relative to piling works will comprise:

- Strict QA/QC procedures for piling works will be followed;
- Piles will be kept vertical during piling works;
- Good workmanship will be employed during all piling works; and,
- Where required use bentonite seal to prevent upward/downward movement of surface water/groundwater.

## 7.0 Decommissioning Phase Measures

Prior to decommissioning works, a detailed Decommissioning Plan will be developed to detail the methods and measures to be adopted during that phase of works. The Decommissioning Plan will avail of, and implement, prevailing best practice measures including surface water protection methods.

It is likely that the methods adopted will be similar to those presented above in respect of the construction phase but of a reduced scale. Regardless of the specific practices and methods to be adopted; the overall objective will be the prevention of any silt, sediment or deleterious matter being discharged from the site such that could cause a deterioration in downstream water quality.

## 8.0 Conclusion

This SWMP has been prepared to detail the practical implementation of surface water management infrastructure to address the requirements of measures set out in the EIAR. This is a live document and will be updated by the appointed contractor prior to the commencement of development. Prior to the commencement of construction, the updated SWMP will be reviewed by the Environmental Manager (EM) and Ecological Clerk of Works (EcoW), as necessary, to confirm the appropriateness of the measures set out therein.

The SWMP incorporates the principles of SuDS; with the overall objective of ensuring that no silt, sediment or other material is discharged from the site to surrounding drainage features; to ensure that the project does not adversely affect the drainage regime within the project site and in its vicinity.

The proposed SuDS comprises drainage infrastructure to intercept and direct 'clean' incidental runoff away from works locations; and a separate surface water management train to effectively control manage and treat 'dirty' water runoff from the works areas. Given the connectivity of the project site to a designated conservation site for Freshwater Peal Mussel, the surface water management train is supplemented by a further lagoon-type sediment ponds with a retention period of 10-days thus encouraging settlement of any silt/sediment prior to discharge.

The efficacy of the measures set out in this SWMP will be regularly monitored and will be supported by water quality monitoring as set out in the Water Quality Monitoring Plan.

## Annex 1 –

## Altmuller & Dettmer Research Paper

**Foreword and acknowledgment**

This pdf-file is the English version of an article which is published with three other articles dealing with species and biotope protection for the freshwater pearl mussel *Margaritifera margaritifera* in Lower Saxony, North Germany (see: http://www.nlwkn.niedersachsen.de/master/C35794242_N14750639_L20_D0_I5231158.html). With this pdf-file we want to give our non-German speaking colleagues an opportunity to read about the chance to do something for this endangered mussel species in Europe.

To get a good readable English text we are very glad to have our Irish friends and colleagues EVELYN MOORKENS and IAN KILLEEN on our side in our efforts to help *Margaritifera*, and we are very thankful to them for helping us in bringing our “Denglish” to a readable English version.

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# Successful species protection measures for the Freshwater Pearl Mussel (*Margaritifera margaritifera*) through the reduction of unnaturally high loading of silt and sand in running waters
## – Experiences within the scope of the Lutterproject -

by Reinhard Altmüller and Rainer Dettmer

**Contents**



## 1 Introduction and Objectives

The conservation of freshwater pearl mussels [FPM] (*Margaritifera margaritifera*) and thick-shelled river mussels (*Unio crassus*) is a task of european importance (Habitats Directive, Water Framework Directive). This task can only be solved by cooperative efforts of all groups and institutions that are involved with running waters.

All conservation efforts in the past for these two mussel species were focused on maintaining high water quality. For the FPM it is a requirement as all known populations of FPM live only in running waters with the highest water quality. For the thick-shelled river mussel this requirement is as well documented by the fundamental investigations from HOCHWALD (1997). But the question does arise as to whether there are more important factors for the survival of the thick-shelled river mussel than water quality alone. This species was widely distributed in Lower Saxony, for example the river Weser from the city Hannoversch-Münden

(in the south of Lower Saxony) to the city of Bremen (367 km to the north) in very different ecological conditions.

For the FPM, we have been able to clearly demonstrate that in addition to the best water quality, a naturally very low level of fine sediments is characteristic to an intact, recruiting FPM environment After leaving their host fish the young Freshwater Pearl mussels (only 0.5 mm long) live in the hollow system (=Interstitium) between gravel and stones, well protected against water current. The present day high amounts of input and load of fine materials in running waters resulting from current landuse clog up the interstitium and suffocate the typical freshwater organisms living there, including, the young FPM. Because of the failure of young mussels to survive, the FPM was threatened with extinction in the Lutter river and is threatened with extinction all over Europe in human populated regions. If the load of fine material is reduced to naturally occurring amounts, even brooks with overaged FPM populations can recover and numerous young mussels can survive and grow. This has been successfully demonstrated within the lutterproject (ABENDROTH 1993, ALTMÜLLER & DETTMER 2000, ALTMÜLLER 2005). The lutterproject is situated at the south edge of the Lüneburg Heath (Germany, Lower Saxony). It is a nature conservation project led by the counties of Celle and Gifhorn to restore the heather brook Lutter. The reason and main target organism is the freshwater pearl mussel. This very successful nature conservation project was made possible through the financial support of the German Federal Agency for Nature Conservation within the scope of its programme concerning riparian land (SCHERFOSE *et al*. 1996) by the Ministry for Environment of Lower Saxony and of the financial and manpower support of the counties of Celle and Gifhorn.

For successful measures to be taken to reduce unnaturally high sediment load it is necessary to know the origin of the sediment. Apart from the necessity to analyse the specific sediment origin throughout the catchment there are some general experiances and information knowledge. The experiences of unnaturally high loading in the Lutter catchment was reported by ALTMÜLLER & DETTMER (1996). The experiences of unnaturally high loading in the Lutter catchment was reported by ALTMÜLLER & DETTMER (1996). This paper showed that soil erosion and fish pond waste were important contributers to the high loading of fine sediments in running waters.

Since 1996 more knowledge and experience has been gained about the reasons for the unnaturally high load of fine material, which are described herein. All observations and measurements have been carried out to determine the reasons of the extreme sediment input to running waters and to find workable countermeasures.

## 2 Study of sediment levels entering the Lutter - an example from the Endeholz Ditch

Within the scope of the measurement program „quantifying load of sand and mud in heather creeks“ a sediment trap was installed in the Endeholz Ditch. The Endeholz Ditch is a small tributary of the Lutter river which has a catchment size of about 2.38 $km^2$ (HEUER-JUNGEMANN i. lit). Originally it was a small creek which has been extended to form a drainage ditch. About 10 m above it’s confluence with the Lutter river a wooden box was installed in the river bottom (Fig. 1).

Fig. 1: Sediment trap in the Endeholz Ditch to quantify the load of fine sediments. The wooden box (Size: 2 m long, 1 m wide, 0.5 m deep) is open on the top. The sandy material which is mostly transported by rolling over the substrate, along with organic material is deposited in and caught by the box. The sand ripples which are seen in Fig. 1 on the left are typical of an unnaturally high sandy load and are more characteristic of a beach than the bottom of a natural heather creek.

From the end of 1991 to mid 2002 the sediment trap was emptied every week by young men who were doing their civilian service[1] (Zivildienstleistende = ZDL) in the nature conservation specialist agency of Lower Saxony. The amount of deposited material was measured as exactly as possible (Fig. 2).

Fig. 2: Sediment trap in the Endeholz Ditch just before the confluence with the Lutter river (background) with the mound of sandy and organic material which was taken out of the trap from 1991 to 03. April 1998. The size of the mound shows the large amount of material carried by this small ditch.

[1] The sample collection within the measurement program „quantifying load of sand and mud in heather creeks“ has been done by the ZDL of the nature conservation agency. The following ZDL beared the main responsibility: Carsten Brauns (1991), Gundolf Reichert (1991/92), Gerrit Grannas (1992/93), Dierk Rischbieter (1993/94), Moritz Haupt (1994/95), Niels Ubbelohde (1995/96), Tobias Polch (1996/97), Michael Koslowski (1997/98), Gunther May (1998/99), Bernhard Schwarz (1999/2000) Arnold Ziesche (2000/01) und Michael. Herbst (2001/02).

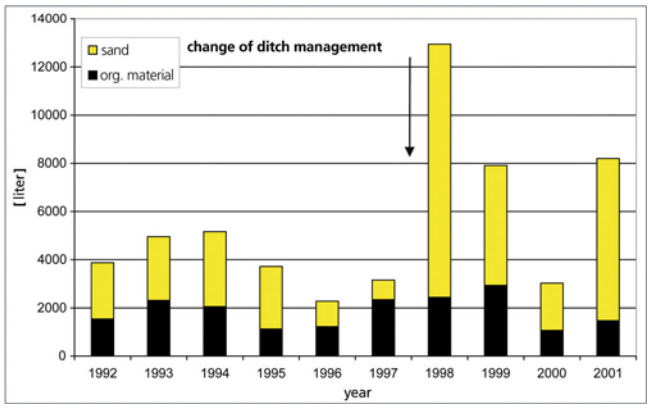


Fig 3: Annual sum of sediment load in the Endeholz Ditch. The change in the method of ditch management from hand clearance to machine clearance from the end of 1997 had a damaging effect on the ditch bottom and its banks, and the sediment load increased significantly. The amount of load after the maintenance of the ditch by machines was much higher than is shown in the figure as the sediment trap overflowed in the first weeks after that occasion.

In Fig 3 the result of weekly emptying the sediment trap is shown as annual sums. The change of load amount from about 3.2 $m^3$ in the year 1997 to about 12.9 $m^3$ in the year 1998. Up to 1997 management of the Endeholz Ditch was carried out by hand but from autumn 1997 it was was done using an excavator. The effect of the excavator was to loosen the sand from the banks and bed of the ditch and to transport it downstream. The authors only heard of this change from the young men who were doing their civilian service, who suddenly every week had to remove more than one $m^3$ out of the sediment trap. The figures 4 to 6 show the effect of this change.

Fig. 4: The Endeholz Ditch in spring of 1998 after management by machines. On the right side the excavated material can be seen. The river bottom is exclusively sand. The ripples are characteristic of the moving sand.


Fig. 5: Mouth of the Endeholz Ditch to the Lutter river in April 1994. At this time very little sand was transported into the Lutter river.


Fig. 6: Mouth of the Endeholz Ditch to the Lutter river on 03.04.1998. The large mass of sand which has been transported into the Lutter river after management of the ditch by machines is clearly seen. The sand which is seen here wasn't caught in the sediment trap 10 m upstream, because the trap was full. Therefore, the amount of load shown in Figure 3 for 1998 is an underestimate.

## 3 Reduction of unnaturally high sand load through installation of sediment traps and monitoring by photo documentation

The input of unnaturally high load of fine sediments in running waters can arise from several different sources depending on the type of land use. Therefore different measures are required to reduce the input. Erosion from farmland results in a considerable loss of valuable soil, therefore it makes sense for farmers to increase their efforts to minimize this loss. In spite of the efforts of the farmers, there will be soil conditions (for example directly after

ploughing) when heavy rainfall will bring high amounts of erosion. There needs to be methods utilised that will reliably prevent harmful input of fine sediments in all situations.

Once it was recognised that the unnaturally high sand load from drainage ditches which flow into the Lutter and its tributaries was the essential reason for the absence of FPM reproduction, sediment traps and plant beds were designed to stop the problem. Sediment traps are created by widening and deepening the drainage ditches. This causes the flow velocity in the area to be reduced so that the sand, silt and coarse organic material is deposited and can be excavated with ease. The function can be demonstrated by taking the sediment trap near the village of Bargfeld as an example. A photo series shows the origin of the sandy load and the successful disposal of these pollutants by the use of the sediment trap.

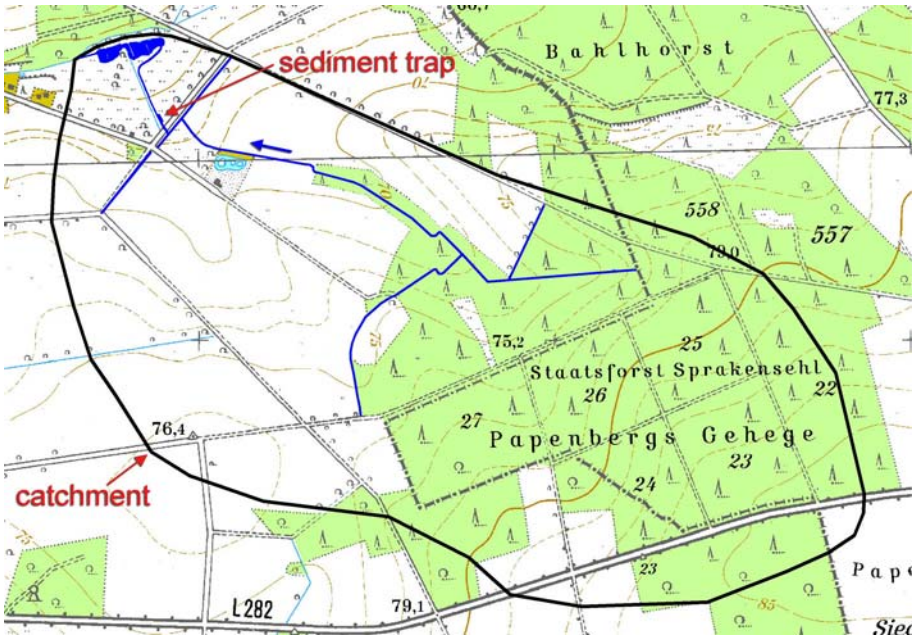


Fig.7: The sediment trap of Bargfeld (in the picture top on the left side) . The sediment trap is situated near a road and, therefore it is within easy and cost-effective reach by machines to empty it.

The sediment trap of Bargfeld (Fig. 7) (WIDRINKA in litt.) receives material from a catchment of about 2 km², of which about 50 % is farmland. This area is almost completely drained and the drainage ditches are cleaned out by machines every year as part of the obligations of water maintenance. The sandy soils are very thin and lay on impervious glacial till. Because of this they can hold and store only small amounts of water. So the drainage ditches are constantly water-bearing only in wet years. In „normal“ years they dry out in summertime.

As with all other cases within the Lutterproject, this sediment trap is situated for ecological reasons directly downstream of the part of the drainage ditch that is under periodic maintenance. So the total sand load of the entire stretch upstream can be caught. The riverbed downstream is not under water maintenance - only the vegetation above water level is cut, in exceptional circumstances. Being permanently water-bearing, the strech downstream of the sediment trap is free of unnatural sediment loads and can develop in a near-natural way.

For economic reasons the sediment trap is built near a road in order to reach it easily with machines for excavation. The system of water management is shown in Fig. 7 and 8. The water which comes from the farmland flows into ditches near the road, crosses the road (red arrow) and flows to the north north-west (nnw) into the little creek called “Köttelbeck” in the

region of “Langenfeld”. In this ditch a sediment trap was built near the road in the winter of 1998/99.

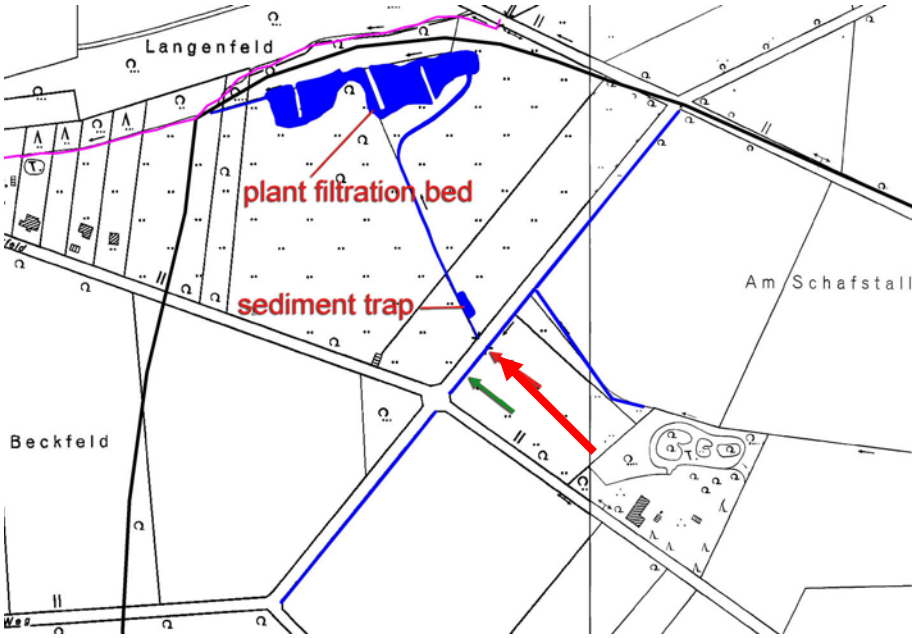


Fig. 8: The complete system, comprising the sediment trap and the plant-bed situated at the lower end of the catchment. The water from the drainage ditches first enters the the sediment trap and then flows through the plant filtration bed. This is a secondary system to absorb the fine particles, which are so small that they do not settle in the sediment trap.

Fig. 9: View in flow direction of the „Sediment trap Bargfeld“ in summer of 1999 about one year after completion and after the first time of excavation. In front of the left side the mouth of the drainage ditch can be seen. At the far end on the left of the sediment trap the drainage ditch continues its flow through dense vegetation.

In winter 2004/2005 the function of this sediment trap was documented photographically. It should be pointed out that there is a time difference between “cause of the unnaturally high load” (this means: ditch management) and “occurrence of the sand downstream” (this means: in the sediment trap).

The following photo series clearly show the effect of ditch management by machines, the successive transport of sand and the function of the sediment trap.

**Photo series 1 (Fig. 10a-d)**
The position of the photographer is about at the top of the red arrow in Fig. 8. For an illustration of the situation in autumn, a picture was taken in autumn of 2005. (Fig. 10a).


Fig. 10: Drainage ditch running parallel to the farm road. For position of the photographer see Fig. 8, top of the red arrow, view direction: sw.
Fig. 10a: Situation before the annual ditch maintenance (12.11.2005).
Fig. 10b: directly after maintenance by machines (21.11.2004).
Fig 10c: More than one month after maintenance at 30.12.2004 . Additional sand is transported in this stretch.
Fig. 10d: At 16. 03. 2005, most of the sand which was loosened during clearance is washed away. It remains a stony and gravely river bed as is typical for natural creeks in this region.

**Photo series 2, Fig. 11a – 11 d:** Position of the photographer the same as in fig. 9, south of the sediment trap. View direction: north in flow direction of the drainage ditch.


Fig. 11: Sediment trap ”Bargfeld”.
Fig. 11a: the sediment trap on 30 12. 2004. No sand has reached the sediment trap, more than five weeks after the ditch clearance and only 30 m downstream of position fig. 9 and 10. Only after two months (fig.: 11b, 22.01.2005), the amount of transported sand becomes more visible and then more evident two weeks later (fig. 11c, 06.02.2005). One month later (fig. 11d, at 16. 03. 2005) the sand transportation in the drainage ditch has been completed and the sand has reached the sediment trap. The plant has done its job. The sediment trap is approximately one third full, equivalent to about 50 m³. At this time the drainage ditch is already washed free of sandy material (see fig. 10d). Without the sediment trap the mass of sand would have been transported downstream to the Lutter River where it would have infiltrated and overlayed the naturally stony and gravely river bed similar to the situation visible in fig. 10b and 10c. Also, without the sediment trap there would be no evidence of the quantity of sand that was mobilised by only one episode of ditch management by machine.

Both photo series demonstrate and explain one origin of unnaturally high sand load in a small drainage ditch in a low gradient area. It is a stark demonstration of the ecological problem present for the FPM. They also show that the chances to minimize this source of threat for the biocoenosis of running waters is relatively easy when located at the right place. Additionally they show that one needs a sediment trap to demonstrate the huge amounts of sand which can be contributed to a natural creek by one small drainage ditch. At the same point on the drainage ditch the situation can look stable for a long time (Fig. 10b and 10c). However, the sand passes over this area and, therefore one is unable to formulate an impression of the quantity of the sand that has passed through.

The sediment trap Bargfeld is an example of how unnatural sand input is prevented from entering natural running waters within the Lutterproject. Installation of sediment traps in each of the numerous drainage ditches within the catchment of the Lutter River was reliant on the fact that the areas were purchased by the project management. Then a procedure was developed to get permission to install the sediment traps. The realization of all the necessary projects took a very long time - from 1989 up to the present (2006). Therefore the input of sand could only be reduced in successive stages. The effect to the biocoenoses of all these measures therefore could only arise after the gradual improvement of the ecological conditions.

## 4 Accelerated reduction of fine sediment load by the use of a mill pond as a sediment trap

The reduction of fine sediment load in the lower reaches of the Lutter River got an important boost through purchasing the rights to an old Mill in the village of Eldingen by the lutterproject management. The remaining semi natural streches of the river Lutter lie downstream of this mill. In the summer of 1989 the owner of the mill was informed about the problems the pearlmussels had with mobilized sediments coming from the mill pond. After this he kindly agreed not to drain off the mill pond. Previously, the mill weir had been raised during flood events to preserve the buildings. The effect or success of not raising the weir is shown in figure 12. After purchasing the watermill in 1992, the water level of the mill pond has been permanently lowered as far as it was possible, so that the water could pass the mill even in flood without damaging the buildings (See 12b). Since then the mill pond has never been emptied and it acts as a very large sediment trap. The accumulated sand and mud has been taken out by the use of a suction dredge. To date, about 6,800 $m^3$ of sand and mud have been pumped out (personal communication: government of the county of Celle and engineering office HEIDT & PETERS, Celle).


Fig. 12: Back water of the mill of Eldingen just before (left) and just after (right) the notary certification of the contract of sale. Prior to 1992, large quantities of sediments had already accumulated in the backwater of the mill (right picture).

As these pumped out masses of sediments are not washed downstream, they have not covered the natural river bottom and killed the typical biocoenosis. On the contrary, the sand masses which covered the stony and gravely river bottom up to this time were successively washed away so that gravel and stones appeared again at the surface. Fig. 13 shows how much the quantity of sediment drift has been reduced by this action. In the year 1968 under leadership of BISCHOFF a small bypass was built in a narrow curve of the Lutter about seven kilometres downstream of the mill of Eldingen. About 5 - 10 % of the Lutter water runs through this bypass. In January of 1991 a sediment trap like the one shown in fig. 1 was built in this bypass. This sediment trap has been emptied weekly since then. Fig. 13 shows the annual sum of the sediment drift from 1991 to 2006. The sum of rainfall has been measured in the private „weather station“ of the first author, which is located about 5 km from the sediment trap. The high rainfall in winter 1993/94 gave rise to a corresponding high flow in

the Lutter, and produced very high sediment drift. In 1994 up to 19 $m^3$ sand was removed from the sediment trap. This equates to about 190 - 380 $m^3$ sand transport in the Lutter. As with the trap in the Endeholz ditch, this sediment trap also overflows in the weeks with the highest sand transport. As the fine sand fraction doesn't deposit, the real amount of transported material is even higher than has been measured.

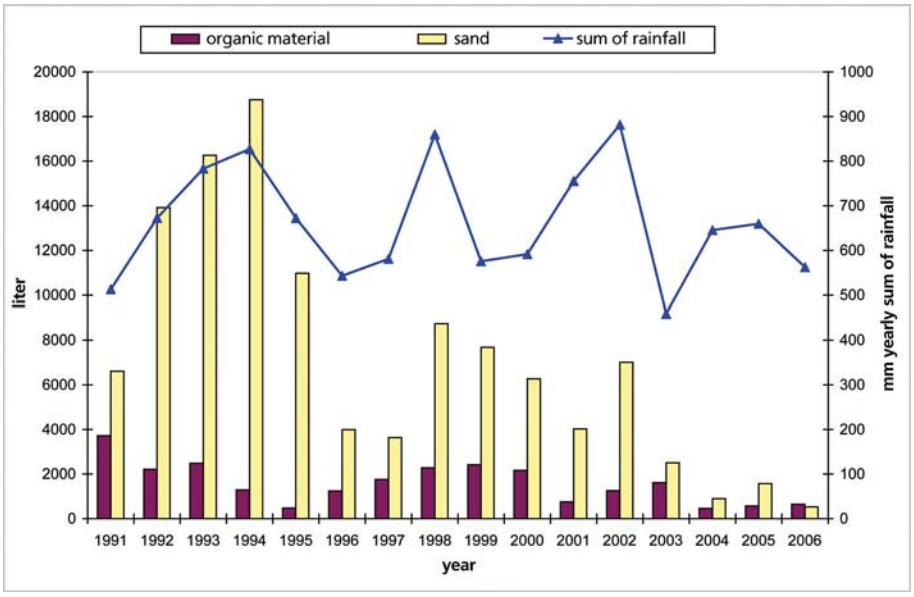


Fig. 13: Trend of sediment transportation in the Lutter. The amount has been measured in a sediment trap as shown in fig. 1. The success of the sediment trap "mill pond" and of the sediment traps in the drainage ditches is clearly seen.

Initially the upper reaches of the c. seven kilometre long stretch downstream of the mill were washed free from overlaying sand. The stony and gravely substrate emerged again and could be colonized by the typical Flora and Fauna. The typical inhabitants of a natural brook reacted immediately to this naturally recovered structure of the river bottom. An example of this phenomenon was the new high reproduction of minnows (*Phoxinus phoxinus*).

## 5 Successes for the biocoenosis of the brook

### 5.1 Example minnows (*Phoxinus phoxinus*)

Minnows are typical and numerous inhabitants of waters with stony gravely bottom and / or shores. In the lower reaches of the river Lutter downstream of the mill of Eldingen they had only seldom been caught by annual electro fishing, which had been carried out since 1985. This changed after the transport of fine sediments was stopped in summer 1992. The winter flood in 1993/94 then washed out the sand, which had previously covered the stony gravely river bottom (ALTMÜLLER & DETTMER 1996). The minnows reacted immediately to this and reproduced very successfully. Given their former rareness the sudden appearance of breeding minnows was very surprising. It was also confirmation that the large amounts of sand were the greatest remaining problem for the river ecosystem.
Minnows spawn in gravel material and prefer a grain size of 2 cm in diameter (BLESS 1992), and they spawn in sections with high current. While spawning the Minnow -♀ inject their eggs between the gravel (Fig. 14). The eggs cling on to the gravel because of their adhesive surface. Here they are protected against voracious individuals of the same species and are supplied by a circulation of oxygen rich water. After about a one week's embryonic development the hatched out fish larvae migrate as deep as possible into the substrate, most likely to escape the suction from the turbulent water above them. They are supported by a yolk sac and are not able to swim (benthic phase). They hide in narrow niches between stones where the current is at its lowest (Fig. 15). Here they are most protected. However,

these are also the parts of the river bed that are first clogged if sediments are brought into the river - which is fatal for the inhabitants. After development within the substrate the minnow larvae migrate upwards through the interstitium into the open water (pelagic phase, free swimming larvae).

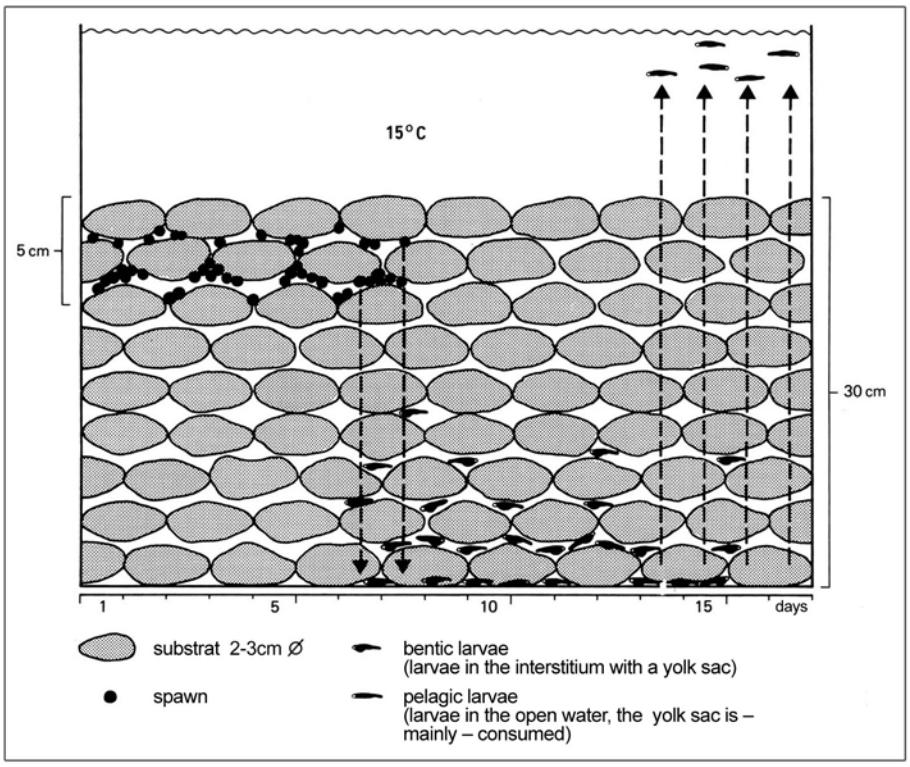


Fig. 14: Time table (Tage = days) of the space used by juvenile stages of minnows at 15 °C water temperature (after experiments in an aquarium). The aquarium is filled with a 30 cm thick gravel layer in a size which minnow-♀ prefer. For explanation see text (Figure adapted slightly from BLESS 1992).

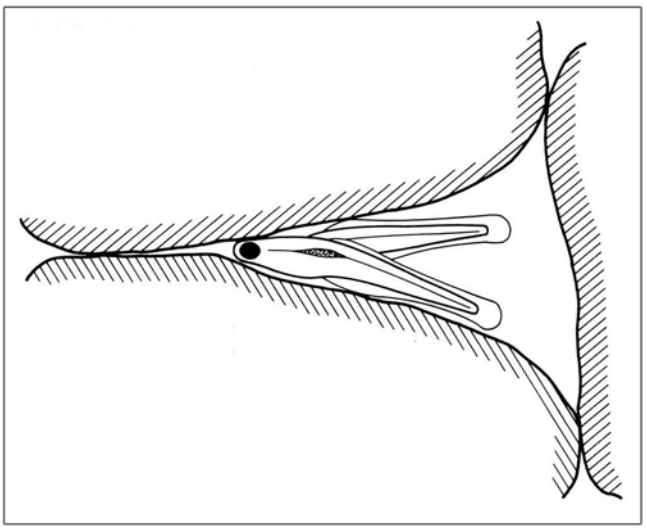

Fig. 15: Minnow larvae hide into narrow niches made by the gravel, probably to protect themselves against upward suction by the current. Here (as deep as possible in the bottom in the narrow niches formed by the gravel) the suction power is lowest and so is the danger of washout (after BLESS 1992).

The following graphs (Fig. 16a-e) show the minnow population in the lower reaches of the river Lutter downstream the mill of Eldingen. In the graphs the number of minnows per 100

metres is shown within each of the randomly selected fishing sectors. The sectors which have not been fished are marked. It can be clearly seen that the minnows - starting in the upper reaches - successively colonized (or re colonized) the river Lutter. Minnows are now (in 2006) again the typical and most numerous inhabitants of the river, and always accompany the author during the snorkelling surveys to investigate the pearl mussel population.

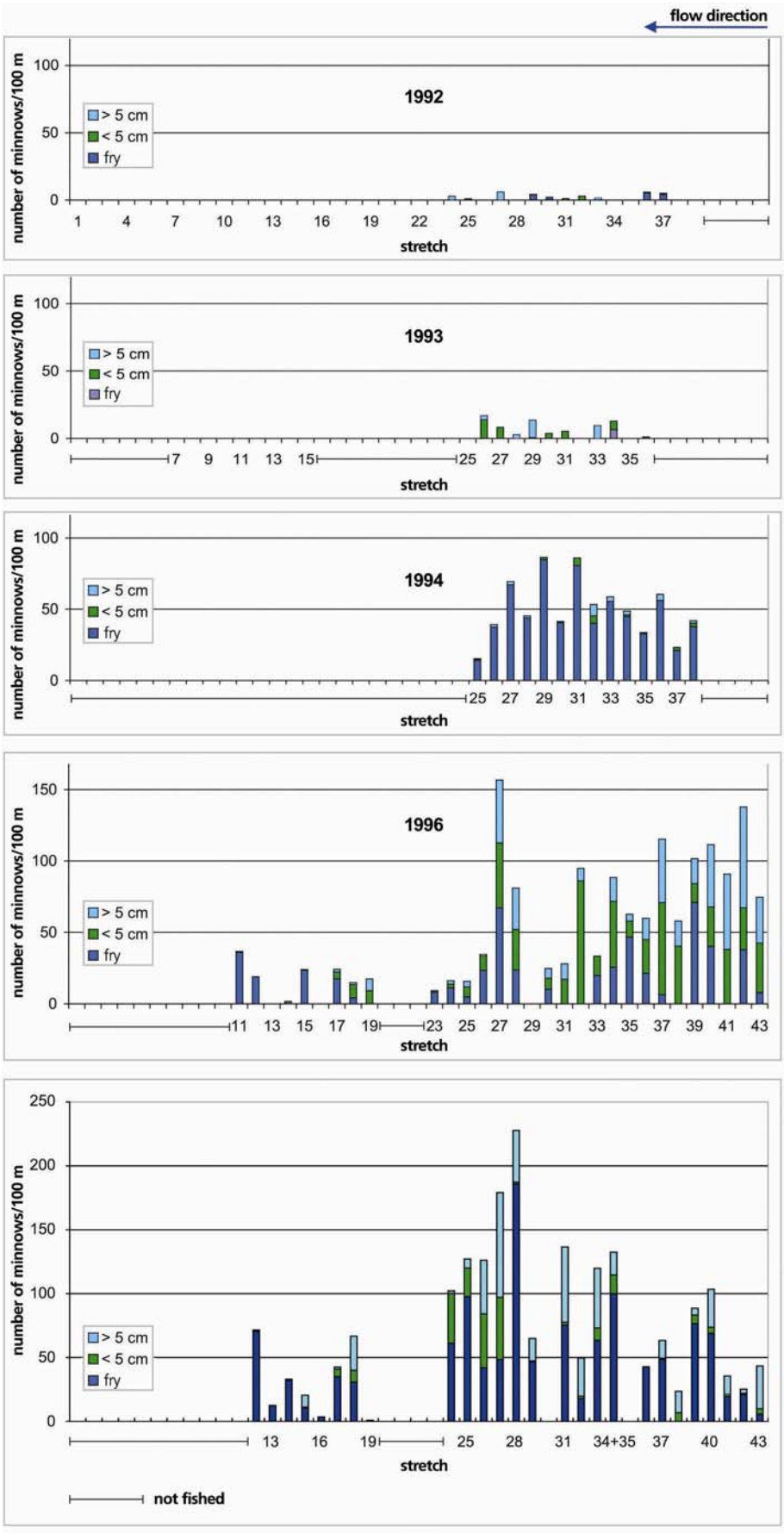


Fig. 16a-e: Development of the minnow population in the natural lower reaches of the river Lutter in the years 1992 - 1998. Sectors which were not investigated by electro fishing are shown by a line. Abschnitt = stretch; nicht befischte = not fished.

## 5.2 Example of the Freshwater Pearl Mussel

As the rate of growth of the FPM is very slow and the young mussels spend at least the first 5 years of their life hidden in the river bed substrate, the success of the measures for the species and biotope protection for the FPM (the target species), could only be shown after several years.

In the river Lutter the young FPM need to reach the age of about seven years before they are big enough to emerge from the gravel into the flowing water to get more water through their gills for better oxygen and food supply. It is only then that they can be seen by the investigator without destroying their habitat by dredging.

Fig. 17: River bottom of the Lutter with an adult FPM and three young mussels which are not easily seen between the gravel.

The first shells of young mussels were found in 1997, and the mussel population has been investigated by snorkelling annually since 2000.

The results of these investigations are shown in figure 18. In 2006 more than 83 % of the total of about 7,400 FPM in the river Lutter are younger than 20 years. This success is in great contrast to the fact that all other european freshwater pearl mussel populations in human settled regions are without successful reproduction and therefore they are threatened with extinction (GEIST 2005).

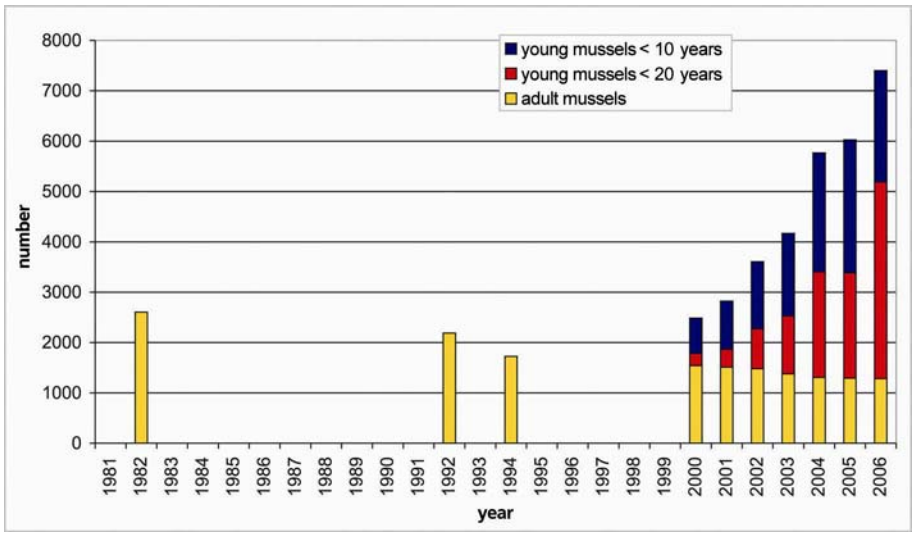


Fig. 18: Population development of the Freshwater Pearlmussels in the river Lutter. This positive trend is due to the reduction of the anthropogenic sand load since the upstream mill pond has not been drained off and therefore the sediments are no longer washed out of the mill pond.

The long term survival of the FPM population in the river Lutter was given additional hope with the verification of the presence of young brown trout (*Salmo trutta f. fario*) in 2005 and 2006, which were naturally infected with FPM glochidia. (Fig. 19). Since the year 2003 no brown trout have been artificially infected with larva (glochidia) of the FPM in the natural lower reaches of the river Lutter. Furthermore, given that the oldest of the young FPM came to mature age and in view of such a large number of young mussels, natural infection of brown trout should be possible. However, to be certain of this, the artificial infection of brown trout with FPM glochidia must be stopped. The young infected brown trout which were found in 2005 and 2006 live in reaches of the river Lutter where only a few old FPM can be found. These few individuals produce too few glochida to successfully infect brown trout. The high number of glochida necessary for an intensive infection can only come from the high number of young mussels which are maturing at present.

The age composition of the infected brown trout is very interesting. Most of the infected fish examined in May of 2006 were born the previous year. They had been infected at an age of only a few months old. During the periods of artificial infection, fish this young were not utilised as they are very sensitive and easily damaged.

Fig. 19: Young brown trout of 2005 with nearly ripe young freshwater pearl mussels in the gills (light points) (result of electro fishing for monitoring - 07.05.2006). The glochidia are derived from young mussels which have matured after successful species and biotope protection measures. They will build up the F2 generation, but any success cannot be proven for another 5 – 7 years.

## 6 Conclusion and outlook on the future

Unnaturally high sediment load, produced by human land use and other activities, considerably affects running waters and their biocoenosis. Most of the running waters of the northern german lowland are in this damaged condition.

Taking the example of the river Lutter and its ecologically very demanding resident population of freshwater pearl mussel, it has been shown that there are indeed opportunities for restoration and, within this, chances of survival even for very demanding species which once were typical and abundant. This is dependent upon water quality not being reduced by waste water or unnaturally high input of nutrients, that there is still the original or a near-natural river bottom, and no unnatural sediment input.

The nature conservation measures for the freshwater pearl mussel in the catchment of the river Lutter were only made possible by the considerable funds made available for the Lutter Project, and by the goodwill, trust and cooperation of everyone involved in the project (ALTMÜLLER 2005).

The experiences and knowledge from the Lutter Project should be used not only for freshwater pearl mussel conservation measures in other catchments, they should be used in general for river conservation, development and restoration measures.

Anthropogenically derived high sediment load clogs the lattice system (Interstitium) between sand, gravel and stones so that the typical animals living there die. Furthermore, sediment covers continously, in a rolling movement – like shifting sand dunes – even in a river bottom that was originally stable.

Each river bottom that is mainly stable is colonized by organisms almost on the surface. Where there is light and nutrient, algae may grow, but even small animals colonise a stable bottom in huge numbers or they live burrowed by themselves in the upper film. Even these less demanding surface organisms are suffocated by shifting sediment dunes, as well as those that live in the deeper interstitium.

As with the reduction of nutrient load, the reduction of fine sediment load must become a general requirement within running water restoration and protection work and a common goal of water and nature conservation.

In every case the place for reducing the unnaturally high load should be located as close as possible to the source of the problem. Erosion is harmful to a farmer’s business and, therefore, it is in every farmer’s interest to take all known and possible steps to reduce erosion and preserve economic viability. The most important measure is to have as complete a soil cover as possible. However in the course of a year their may be a phase without soil cover for arable farmland. For this period of time it is necessary to take precautionary measures on all sites which are at risk from erosion. For some farmers this precaution may seem to be excessive, because incidents of erosion are relatively few in number and with long periods between, and may even discourage some farmers from taking precautionary measures because of economic impact. However, even a single high erosion incident can bring major sediment input which can severely damage running waters and their very long lived biocoenosis.

Within the sphere of the Lutter project with maintenance of waters, especially management of drainage ditches, and the resultant sediment load, from an economic point of view it is indispensable to install sediment catchers in all drain ditches. In time it is possible to take out of the waters both the sediments which are mobilized by ditch management and those which are coming from erosion and/or other origins.

The excavation of the sediment traps can be done within the yearly maintenance of waters without any significant increase in cost, provided that the sediment trap is located where it will have maximum effect and its dimensions are big enough. However, the emptying of the sediment traps has to be done with care or else they will refill very quickly and then overflow. Special responsibility for the correct management of the sediment traps has to be taken by the association that also maintains the waters and manages the ditches.

The measures of nature and water protection that are described in this article especially apply to the preservation and recovery of the freshwater pearl mussel. But all measures together already contribute towards fulfilling targets set within several Directives of the European Parliament. So the restoration work on the lower reaches of the river Lutter are very successfull species and habitat conservation projects within the European Habitats Directive but also within the European Water Framework Directive to achieve good ecological conditions:

- Within the European Habitats Directive the habitat 3260 „Water courses of plain to montane levels with the *Ranunculion fluitantis* and *Callitricho-Batrachion* vegetation " have been brought into favourable conservation status (Annex I, Directive 92/43/EWG)
- the populations of the freshwater pearl mussel, the Green Club-tailed Dragonfly (*Ophiogomphus cecilia*) and the Bullhead (*Cottus gobio*) has been brought into favourable conservation status (Annex II, Directive 92/43/EWG).

Within the European Water Framework Directive (Directive 2000/60/EC) the recovered stretch of the river Lutter, or rather the condition of it, was brought into a good status, i.e. the hydromorphological characteristics and the physico-chemical quality elements.

In addition to the above, the special feature of this water protection, water conservation and nature conservation project is that there are only small follow-up costs and also no costs to manage a specific state of cultural landscape.

## 7 Table of the colleagues involved in the species protection measures for the freshwater pearl mussel

The results of electrofishing and the success of the species protection measures that are described here has been achieved by enthusiastic friends of nature, generally in their free time. The spawning time of the FWP-♀ is not predictable. Therefore in summer from mid-July all private appointments had to be subordinate to the life history of the mussels. In the following all attendees of the species protection measures for the freshwater pearl mussel in Lower Saxony (also in the rivers Lachte and Bornbach) are listed in alphabetic order.

Reinhard Altmüller, Wolf-Dietrich Bischoff, Dietrich Blanke, Ulli Brandt, Rainer Dettmer, Frauke und Heiner Drögemüller, Christian Gietz, Otto Golze, Günter Grein, Roger Günsel, Stefan Heitz, Iris Herrmann, Thomas Herrmann, Matthias Holsten, Renate und Stefan Hölter, Lennart, Manuel und Norbert Horny, Gerd Hübner, Thomas Kaiser, Heinrich Klaholt, Andreas Knoop, Ernst und Ole Kohls, Henning Köneke, Gabi Kremming, Jens Kubitzki, Peter Lorz, Hans-Jürgen Löther, Sonja Lüßmann, Christian Makala, Anna, Hans und Moritz Menneking, Lars und Wolfgang Mosel, Annette Most, Dirk Mundt, Matthias Olthoff, Sören Ostermann, Ulrich Pittius, Gabriele Potabgy, Anke Preiß, Manfred Rasper, Günter, Ronja und Vigdis Ratzbor, Dierk Rischbieter, Thomas Schick, Gudrun Schmal, Daniel Schneider, Burkhard und Ulrich Schnepper, Peter Sellheim, Brigitte Steinhardt, Egon Steinkraus, Agnes Steinmann, Andreas Thiess, Frank, Hans-Hermann und Holger Trumann, Wieland Utermark, Günther Wilkens.

In addition to the young men listed an page 3 who made their civilian service (ZDL) were the following ZDL involved in the species protection measures and the surveys:

Thomas Clavier, Carsten Dettmann, Michael Friese, Thorben Fründt, Michael Geilke, Manfred Grenz, Günther Hansen, Horst Hildebrandt, Markus Kietz, Thomas Klug, Andreas Nitschke, Ulrich Söffker und Alexander Wiebe.

## 8 Summary

The freshwater pearl mussel was formerly abundant in running waters of the „Lüneburg Heath“, a north eastern landscape in Lower Saxony in the North of Germany. Using the example of the remaining freshwater pearl mussel population in the river Lutter it has been shown that good water quality alone is not enough for its survival. The unnaturally high amounts of load (sand and silt) are harmful substances for the river biocoenosis. Only after the reduction of these high amounts of load could typical fish such as minnows (*Phoxinus phoxinus*) naturally reproduce. Also, it is only after the reduction of the huge load that the relief measures which focused on artificially infecting wild living brown trout (*Salmo trutta* f. *fario*) with glochidia became successful with young mussels surviving and growing. Currently the next mussel generation has started to grow up without any artificial help.

With the installation of sediment traps in all drainage ditches a method has been developed and used, which can help to reduce the problems with unnaturally high load of fine sediment and which may be applied across Europe.

Some targets of the European Habitats Directive and of the European Water Framework Directive are shown to be achievable.

## 9 Literature:

ABENDROTH, D. (1993): Errichtung und Sicherung schutzwürdiger Teile von Natur und Landschaft mit gesamtstaatlich repräsentativer Bedeutung. Projekt Lutter: Die Lutter - ein Heidefließgewässer in den Landkreisen Celle und Gifhorn, Niedersachsen. – Natur und Landschaft 66 (1): 24 - 28.

ALTMÜLLER, R. (2005): Erfolgskontrollen im Naturschutzgroßprojekt "Lutter" unter besonderer Berücksichtigung der Flussperlmuschel und einiger Fischarten.– In: NICLAS, G. & V. SCHERFOSE (Hrsg.): Erfolgskontrollen in Naturschutzgroßvorhaben des Bundes. Teil I: Ökologische Bewertung. – Naturschutz und Biologische Vielfalt 22: 115 - 135.

ALTMÜLLER, R. & R. DETTMER (1996): Unnatürliche Sandfracht in Geestbächen – Ursachen, Probleme und Ansätze für Problemlösungen - am Beispiel der Lutter. – Inform.d. Naturschutz Niedersachs. 16, Nr. 5 (5/96): 222 -237.

ALTMÜLLER, R. & R. DETTMER (2000): Erste Erfolge beim Arten- und Biotopschutz für die Flussperlmuschel (*Margaritifera margaritifera* L.) in Niedersachsen. – Natur und Landschaft 75 (9/10): 384 -388.

BLESS, R. (1992): Einsichten in die Ökologie der Elritze *Phoxinus phoxinus* (L.). Praktische Grundlagen zum Schutz einer gefährdeten Fischart. – Schr.-Reihe für Landschaftspflege und Naturschutz 35, 68 S.; Bonn-Bad Godesberg.

EUROPÄISCHE UNION (23.10. 2000): Richtlinie 2000/60/EG des Europäischen Parlaments und des Rates vom 23. Oktober 2000 zur Schaffung eines Ordnungsrahmens für Maßnahmen der Gemeinschaft im Bereich der Wasserpolitik. – Amtsblatt der Europäischen Gemeinschaften DE: L 327/1 -L 327/72.

GEIST, J. (2005): Conservation Genetics and Ecology of European Freshwater Pearl Mussels *(Margaritifera margaritifera* L.). – Diss. Univ. München, Wiss.-Zentr. Weihenstephan für Ernährung, Landnutzung und Umwelt, 121 S.

HOCHWALD, S. (1997): Das Beziehungsgefüge innerhalb der Größenwachstums- und Fortpflanzungsparameter bayerischer Bachmuschelpopulationen (*Unio crassus* Phil. 1788) und dessen Abhängigkeit von Umweltparametern. – Diss. Univ. Bayreuth, Bayreuther Forum Ökologie, Bd. 50, 163 S.

RAT DER EUROPÄISCHEN GEMEINSCHAFTEN (1992): Richtlinie92 / 43 / EWG Des Rates vom 21. Mai 1992 zur Erhaltung der natürlichen Lebensräume sowie der wildlebenden Tiere und Pflanzen. – 1992: L 206/7 -L 206/50.

SCHERFOSE, V., A. HAGIUS, C. KLÄR, G. NICLAS, J. SAUERBORN, B. SCHWEPPE-KRAFT & U. STEER (1996): Förderprogramm zur Errichtung und Sicherung schutzwürdiger Teile von Natur und Landschaft mit gesamtstaatlich repräsentativer Bedeutung. Naturschutzgroßprojekte und Gewässerrandstreifenprogramm. – Natur und Landschaft 71 (7/8): 283 -286.

**The authors**

Dr. Reinhard Altmüller, born 1948, studied biology and read for his doctorate at the Georg-August-Universität at Göttingen. Since 1976 he has been responsible for Invertebrates at the Lower Saxony Specialist Agency for Nature Conservancy. One focus of his job has been to investigate the organisms of running waters, especially the freshwater pearl mussel, and the development of ways to improve their habitats.

Rainer Dettmer, born 1955, studied biology at Hanover. In his dissertation he investigated the biology of the freshwater pearl mussel (1982). Since then he has worked on the biology and conservation of naiads and other limnological questions, especially electro fishing, funded by different institutions (TiHo Hannover, Lower Saxony State Agency for Ecology, NLWKN, Nature Conservation Organisations, Nature Conservation Council).

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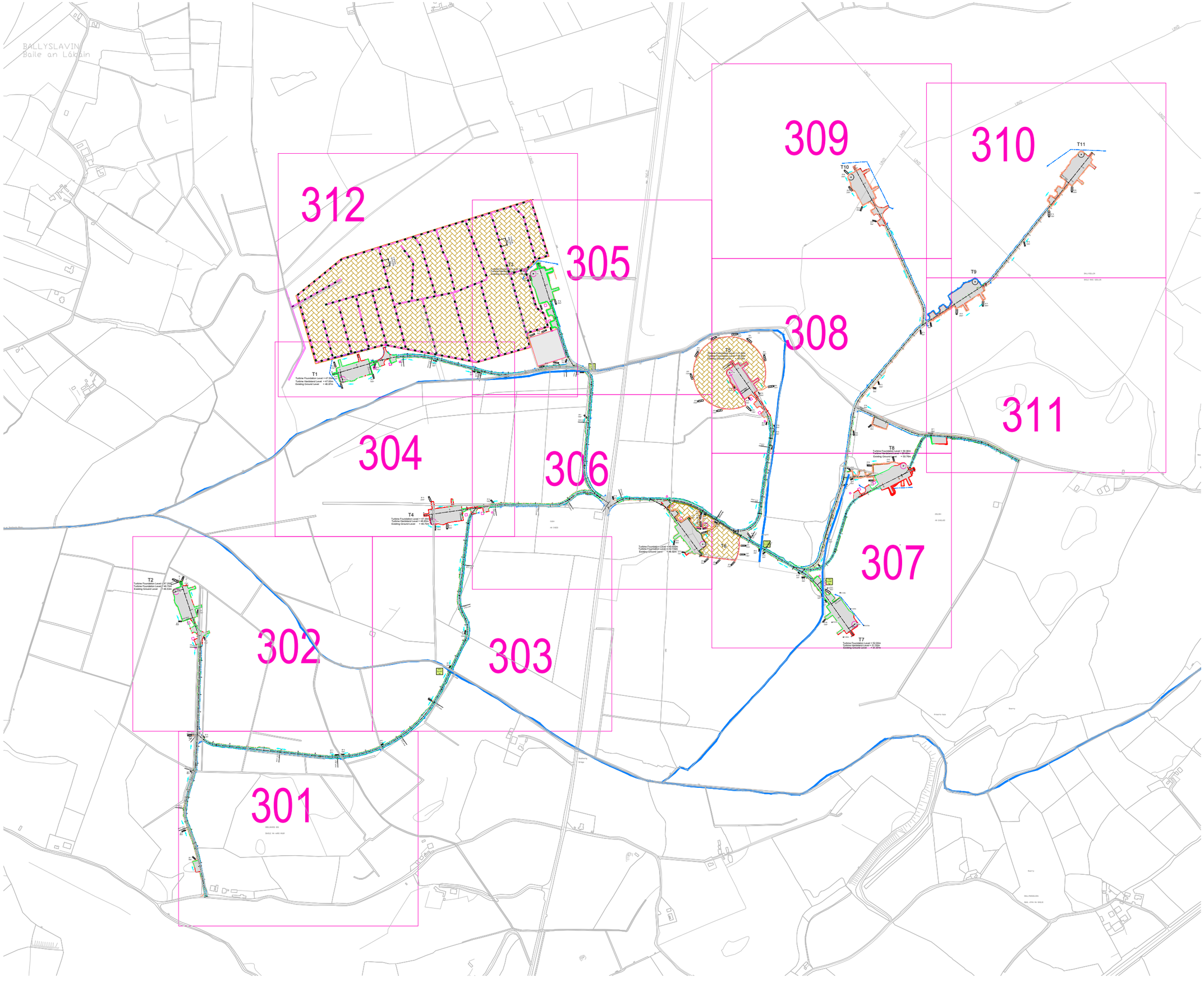
## Annex 2 –

## Planning-stage Drainage/Surface Water Management System

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Legend

- Proposed Access Road in Cut
- Proposed Access Road in Fill
- Proposed Hardstand
- Proposed Clean Water Drainage
- Proposed Dirty Water Drainage
- SP 12 550m² — Stilling Pond Number, Catchment Area & Flow Direction
- Proposed Culvert to Existing Open Drain
- Spoil Deposition Area

N



| rev. | modifications | by | date |
|---|---|---|---|
| P01.3 | Silt Ponds added to Spoil Deposition Areas, Drainage Table Updated | AMcC | 23.11.23 |
| P01.2 | Spoil Deposition Areas Updated | AMcC | 13.11.23 |
| P01.1 | Issued For Comment | AMcC | 13.04.23 |

Client: Cush Wind Farm

Project: Cush Wind Farm, Co Offlay.

Stage: Planning

Title: **Drainage Layout Keyplan**

Scales: 1:10,000 (A3)

| Surveyed | Prepared By | Checked | Date |
|---|---|---|---|
| | AMcC | JMcE | 16.04.2023 |


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| Job No. | Drawing no. | Revision |
|---|---|---|
| 6921 | 6921-JOD-XX-DR-C-0300 | P01.3 |


| Pond Ref. SP | Development Area ($m^2$) | Dim. length (m) | Dim. Width (m) | Dim. Depth (m) |
|---|---|---|---|---|
| 1 | 950 | 8 | 2.8 | 0.75 |
| 2 | 800 | 8 | 2.8 | 0.75 |
| 3 | 450 | 4 | 2.8 | 0.75 |
| 4 | 1750 | 9 | 4.5 | 0.75 |
| 5 | 650 | 6 | 2.8 | 0.75 |
| 6 | 3100 | 14 | 5.2 | 0.75 |
| 7 | 1700 | 9 | 4.5 | 0.75 |
| 8 | 1700 | 9 | 4.5 | 0.75 |
| 9 | 500 | 6 | 2.8 | 0.75 |
| 10 | 1150 | 8 | 3.6 | 0.75 |
| 11 | 825 | 8 | 2.8 | 0.75 |
| 12 | 550 | 6 | 2.8 | 0.75 |
| 13 | 330 | 4 | 2.8 | 0.75 |
| 14 | 1125 | 8 | 3.6 | 0.75 |
| 15 | 425 | 4 | 2.8 | 0.75 |
| 16 | 1050 | 8 | 3.6 | 0.75 |
| 17 | 2500 | 12 | 5.2 | 0.75 |
| 18 | 1500 | 10 | 3.6 | 0.75 |
| 19 | 2000 | 12 | 4.5 | 0.75 |
| 20 | 1500 | 10 | 3.6 | 0.75 |
| 21 | 1100 | 8 | 3.6 | 0.75 |
| 22 | 925 | 8 | 2.8 | 0.75 |
| 23 | 650 | 6 | 2.8 | 0.75 |
| 24 | 550 | 6 | 2.8 | 0.75 |
| 25 | 550 | 6 | 2.8 | 0.75 |
| 26 | 1500 | 10 | 3.6 | 0.75 |
| 27 | 1500 | 10 | 3.6 | 0.75 |
| 28 | 1750 | 12 | 3.6 | 0.75 |
| 29 | 1750 | 12 | 3.6 | 0.75 |
| 30 | 700 | 6 | 2.8 | 0.75 |
| 31 | 700 | 6 | 2.8 | 0.75 |
| 32 | 1500 | 10 | 3.6 | 0.75 |
| 33 | 1600 | 12 | 3.6 | 0.75 |
| 34 | 1600 | 12 | 3.6 | 0.75 |
| 35 | 500 | 6 | 2.8 | 0.75 |
| 36 | 1200 | 10 | 2.8 | 0.75 |
| 37 | 720 | 6 | 2.8 | 0.75 |
| 38 | 1600 | 12 | 3.6 | 0.75 |
| 39 | 1450 | 10 | 3.6 | 0.75 |
| 40 | 650 | 6 | 2.8 | 0.75 |
| 41 | 500 | 6 | 2.8 | 0.75 |
| 42 | 200 | 4 | 2.8 | 0.75 |
| 43 | 500 | 6 | 2.8 | 0.75 |
| 44 | 600 | 6 | 2.8 | 0.75 |
| 45 | 650 | 5 | 2.8 | 0.75 |
| 46 | 1600 | 12 | 3.6 | 0.75 |
| 47 | 1500 | 10 | 3.6 | 0.75 |
| 48 | 1650 | 12 | 3.6 | 0.75 |
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| 50 | 600 | 6 | 2.8 | 0.75 |
| 51 | 1100 | 10 | 2.8 | 0.75 |
| 52 | 500 | 6 | 2.8 | 0.75 |
| 53 | 250 | 4 | 2.8 | 0.75 |
| 54 | 350 | 4 | 2.8 | 0.75 |
| 55 | 350 | 4 | 2.8 | 0.75 |
| 56 | 500 | 6 | 2.8 | 0.75 |
| 57 | 500 | 6 | 2.8 | 0.75 |
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| 59 | 1250 | 8 | 3.6 | 0.75 |
| 60 | 3300 | 14 | 5.6 | 0.75 |
| 61 | 550 | 6 | 2.8 | 0.75 |
| 62 | 500 | 6 | 2.8 | 0.75 |
| 63 | 500 | 6 | 2.8 | 0.75 |
| 64 | 400 | 4 | 2.8 | 0.75 |
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| 66 | 1500 | 10 | 3.6 | 0.75 |
| 67 | 1500 | 10 | 3.6 | 0.75 |
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| 69 | 1000 | 10 | 2.8 | 0.75 |
| 70 | 500 | 6 | 2.8 | 0.75 |
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| 76 | 800 | 8 | 2.8 | 0.75 |
| 77 | 2400 | 12 | 5.2 | 0.75 |
| 78 | 2400 | 12 | 5.2 | 0.75 |
| 79 | 1200 | 10 | 2.8 | 0.75 |
| 80 | 3100 | 14 | 5.6 | 0.75 |
| 81 | 2400 | 12 | 5.2 | 0.75 |
| 82 | 750 | 8 | 2.8 | 0.75 |
| 83 | 1350 | 10 | 3.6 | 0.75 |
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| F | 1750 | 12 | 3.6 | 0.75 |
| G | 1100 | 8 | 3.6 | 0.75 |
| H | 1750 | 12 | 3.6 | 0.75 |

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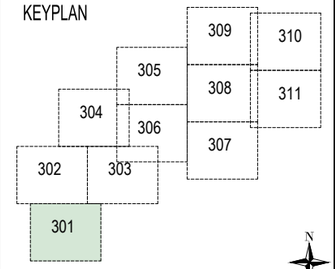
- Proposed Access Road in Fill
- Proposed Hardstand
- Proposed Clean Water Drainage
- Proposed Dirty Water Drainage
- SP 12 550m² — Stilling Pond Number, Catchment Area & Flow Direction
- Proposed Culvert to Existing Open Drain

KEYPLAN






| rev. | modifications | by | date |
|---|---|---|---|
| P01.2 | Silt Ponds added to Spoil Deposition Areas, Drainage Table Updated | AMcC | 23.11.23 |
| P01.1 | Issued For Comment | AMcC | 13.04.23 |

Client: Cush Wind Farm

Project: Cush Wind Farm, Co Offlay.

Stage: Planning

Title: **Drainage Layout Plan**
**Sheet 1 of 11**

Scales: 1:2000 (A3)

| Surveyed | Prepared By | Checked | Date |
|---|---|---|---|
| | AMcC | JMcE | 16.04.2023 |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| Job No. | Drawing no. | Revision |
|---|---|---|
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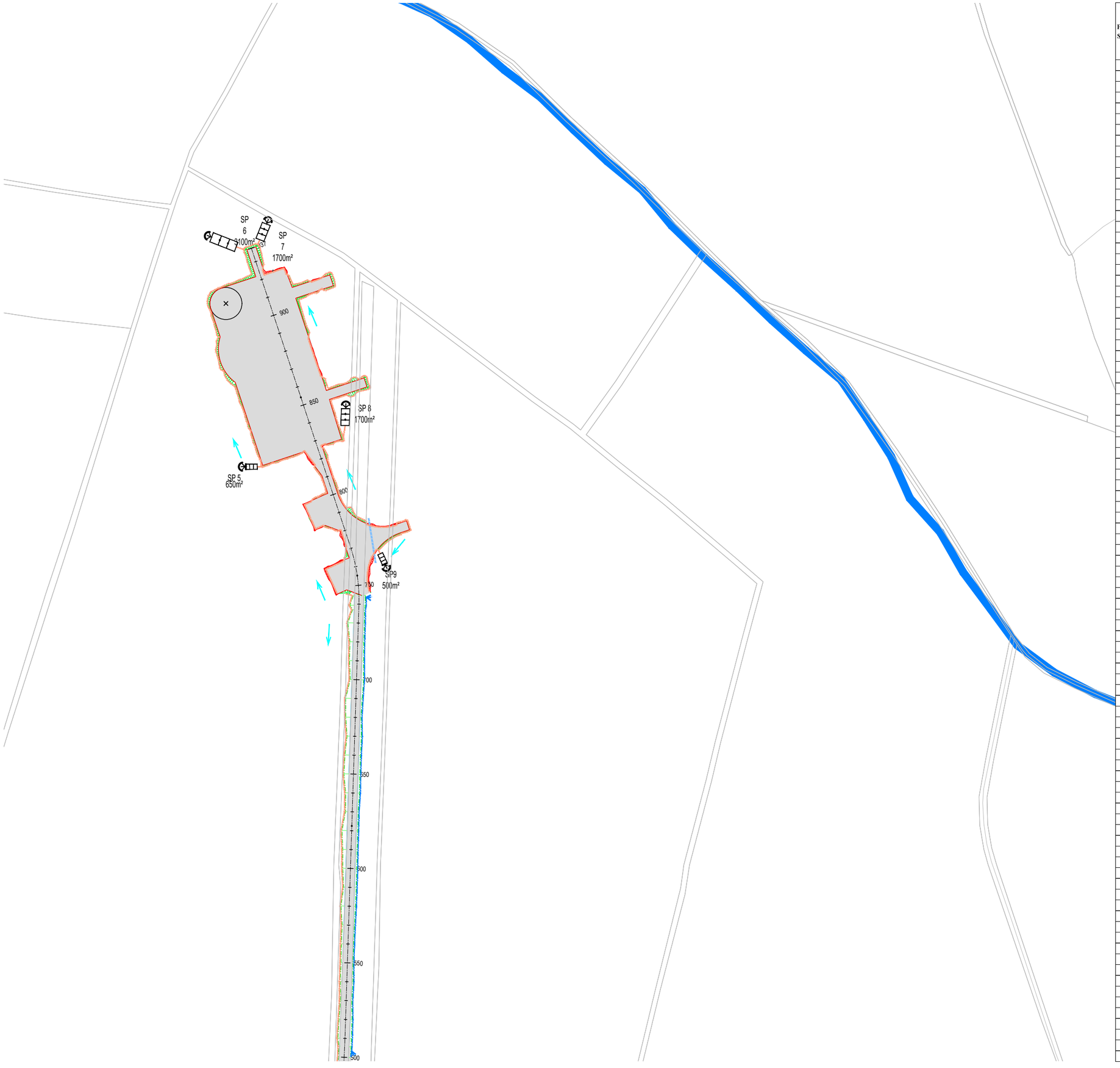


| Pond Ref. SP | Development Area ($m^2$) | Dim. length (m) | Dim. Width (m) | Dim. Depth (m) |
|---|---|---|---|---|
| 1 | 950 | 8 | 2.8 | 0.75 |
| 2 | 800 | 8 | 2.8 | 0.75 |
| 3 | 450 | 4 | 2.8 | 0.75 |
| 4 | 1750 | 9 | 4.5 | 0.75 |
| 5 | 650 | 6 | 2.8 | 0.75 |
| 6 | 3100 | 14 | 5.2 | 0.75 |
| 7 | 1700 | 9 | 4.5 | 0.75 |
| 8 | 1700 | 9 | 4.5 | 0.75 |
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| 10 | 1150 | 8 | 3.6 | 0.75 |
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| 17 | 2500 | 12 | 5.2 | 0.75 |
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| 22 | 925 | 8 | 2.8 | 0.75 |
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| 25 | 550 | 6 | 2.8 | 0.75 |
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| 27 | 1500 | 10 | 3.6 | 0.75 |
| 28 | 1750 | 12 | 3.6 | 0.75 |
| 29 | 1750 | 12 | 3.6 | 0.75 |
| 30 | 700 | 6 | 2.8 | 0.75 |
| 31 | 700 | 6 | 2.8 | 0.75 |
| 32 | 1500 | 10 | 3.6 | 0.75 |
| 33 | 1600 | 12 | 3.6 | 0.75 |
| 34 | 1600 | 12 | 3.6 | 0.75 |
| 35 | 500 | 6 | 2.8 | 0.75 |
| 36 | 1200 | 10 | 2.8 | 0.75 |
| 37 | 720 | 6 | 2.8 | 0.75 |
| 38 | 1600 | 12 | 3.6 | 0.75 |
| 39 | 1450 | 10 | 3.6 | 0.75 |
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| 41 | 500 | 6 | 2.8 | 0.75 |
| 42 | 200 | 4 | 2.8 | 0.75 |
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| 51 | 1100 | 10 | 2.8 | 0.75 |
| 52 | 500 | 6 | 2.8 | 0.75 |
| 53 | 250 | 4 | 2.8 | 0.75 |
| 54 | 350 | 4 | 2.8 | 0.75 |
| 55 | 350 | 4 | 2.8 | 0.75 |
| 56 | 500 | 6 | 2.8 | 0.75 |
| 57 | 500 | 6 | 2.8 | 0.75 |
| 58 | 500 | 6 | 2.8 | 0.75 |
| 59 | 1250 | 8 | 3.6 | 0.75 |
| 60 | 3300 | 14 | 5.6 | 0.75 |
| 61 | 550 | 6 | 2.8 | 0.75 |
| 62 | 500 | 6 | 2.8 | 0.75 |
| 63 | 500 | 6 | 2.8 | 0.75 |
| 64 | 400 | 4 | 2.8 | 0.75 |
| 65 | 1550 | 10 | 3.6 | 0.75 |
| 66 | 1500 | 10 | 3.6 | 0.75 |
| 67 | 1500 | 10 | 3.6 | 0.75 |
| 68 | 750 | 8 | 2.8 | 0.75 |
| 69 | 1000 | 10 | 2.8 | 0.75 |
| 70 | 500 | 6 | 2.8 | 0.75 |
| 71 | 900 | 8 | 2.8 | 0.75 |
| 72 | 1350 | 10 | 3.6 | 0.75 |
| 73 | 400 | 4 | 2.8 | 0.75 |
| 74 | 100 | 4 | 2.8 | 0.75 |
| 75 | 750 | 8 | 2.8 | 0.75 |
| 76 | 800 | 8 | 2.8 | 0.75 |
| 77 | 2400 | 12 | 5.2 | 0.75 |
| 78 | 2400 | 12 | 5.2 | 0.75 |
| 79 | 1200 | 10 | 2.8 | 0.75 |
| 80 | 3100 | 14 | 5.6 | 0.75 |
| 81 | 2400 | 12 | 5.2 | 0.75 |
| 82 | 750 | 8 | 2.8 | 0.75 |
| 83 | 1350 | 10 | 3.6 | 0.75 |
| 84 | 2300 | 12 | 4.5 | 0.75 |
| 85 | 2300 | 12 | 4.5 | 0.75 |
| A | 1800 | 12 | 3.6 | 0.75 |
| B | 1800 | 12 | 3.6 | 0.75 |
| C | 1800 | 12 | 3.6 | 0.75 |
| D | 1800 | 12 | 3.6 | 0.75 |
| E | 1100 | 8 | 3.6 | 0.75 |
| F | 1750 | 12 | 3.6 | 0.75 |
| G | 1100 | 8 | 3.6 | 0.75 |
| H | 1750 | 12 | 3.6 | 0.75 |

NOTES:

1 FIGURED DIMENSIONS ONLY TO BE TAKEN FROM THIS DRAWING.
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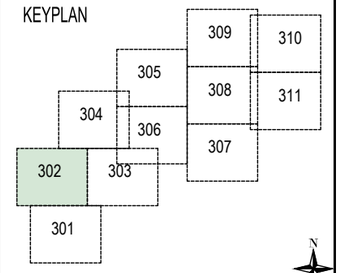
Legend

- Proposed Access Road in Cut
- Proposed Access Road in Fill
- Proposed Hardstand
- Proposed Clean Water Drainage
- Proposed Dirty Water Drainage
- SP 12 550m² — Stilling Pond Number, Catchment Area & Flow Direction
- Proposed Culvert to Existing Open Drain

KEYPLAN






| rev. | modifications | by | date |
|---|---|---|---|
| P01.2 | Silt Ponds added to Spoil Deposition Areas, Drainage Table Updated | AMcC | 23.11.23 |
| P01.1 | Issued For Comment | AMcC | 13.04.23 |

Client: Cush Wind Farm

Project: Cush Wind Farm, Co Offlay.

Stage: Planning

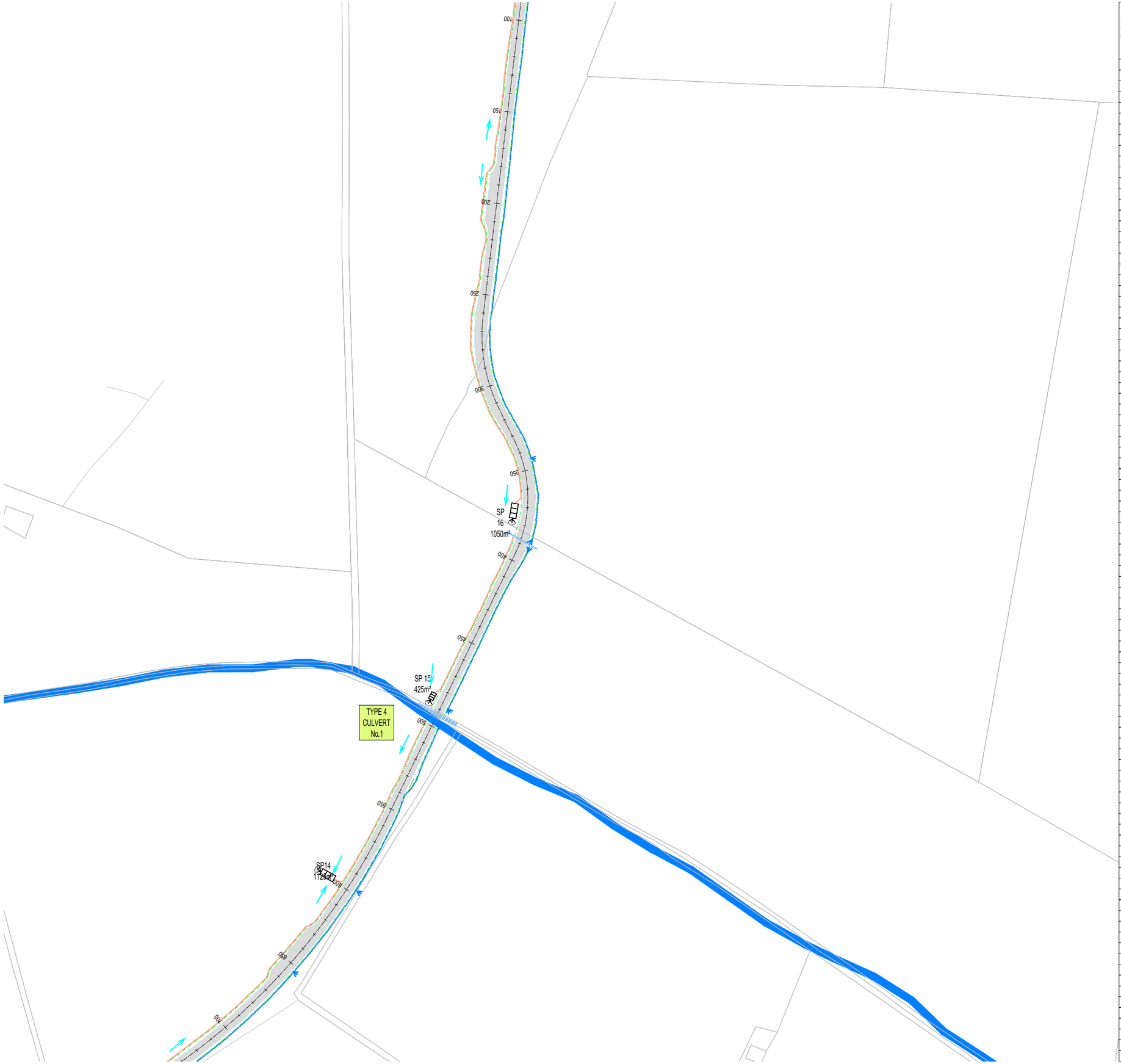
Title: **Drainage Layout Plan**
**Sheet 2 of 11**

Scales: 1:2000 (A3)

| Surveyed | Prepared By | Checked | Date |
|---|---|---|---|
| | AMcC | JMcE | 16.04.2023 |



| Job No. | Drawing no. | Revision |
|---|---|---|
| 6921 | 6921-JOD-XX-DR-C-0302 | P01.3 |




| Pond Ref. SP | Development Area ($m^2$) | Dim. length (m) | Dim. Width (m) | Dim. Depth (m) |
|---|---|---|---|---|
| 1 | 950 | 8 | 2.8 | 0.75 |
| 2 | 800 | 8 | 2.8 | 0.75 |
| 3 | 450 | 4 | 2.8 | 0.75 |
| 4 | 1750 | 9 | 4.5 | 0.75 |
| 5 | 650 | 6 | 2.8 | 0.75 |
| 6 | 3100 | 14 | 5.2 | 0.75 |
| 7 | 1700 | 9 | 4.5 | 0.75 |
| 8 | 1700 | 9 | 4.5 | 0.75 |
| 9 | 500 | 6 | 2.8 | 0.75 |
| 10 | 1150 | 8 | 3.6 | 0.75 |
| 11 | 825 | 8 | 2.8 | 0.75 |
| 12 | 550 | 6 | 2.8 | 0.75 |
| 13 | 330 | 4 | 2.8 | 0.75 |
| 14 | 1125 | 8 | 3.6 | 0.75 |
| 15 | 425 | 4 | 2.8 | 0.75 |
| 16 | 1050 | 8 | 3.6 | 0.75 |
| 17 | 2500 | 12 | 5.2 | 0.75 |
| 18 | 1500 | 10 | 3.6 | 0.75 |
| 19 | 2000 | 12 | 4.5 | 0.75 |
| 20 | 1500 | 10 | 3.6 | 0.75 |
| 21 | 1100 | 8 | 3.6 | 0.75 |
| 22 | 925 | 8 | 2.8 | 0.75 |
| 23 | 650 | 6 | 2.8 | 0.75 |
| 24 | 550 | 6 | 2.8 | 0.75 |
| 25 | 550 | 6 | 2.8 | 0.75 |
| 26 | 1500 | 10 | 3.6 | 0.75 |
| 27 | 1500 | 10 | 3.6 | 0.75 |
| 28 | 1750 | 12 | 3.6 | 0.75 |
| 29 | 1750 | 12 | 3.6 | 0.75 |
| 30 | 700 | 6 | 2.8 | 0.75 |
| 31 | 700 | 6 | 2.8 | 0.75 |
| 32 | 1500 | 10 | 3.6 | 0.75 |
| 33 | 1600 | 12 | 3.6 | 0.75 |
| 34 | 1600 | 12 | 3.6 | 0.75 |
| 35 | 500 | 6 | 2.8 | 0.75 |
| 36 | 1200 | 10 | 2.8 | 0.75 |
| 37 | 720 | 6 | 2.8 | 0.75 |
| 38 | 1600 | 12 | 3.6 | 0.75 |
| 39 | 1450 | 10 | 3.6 | 0.75 |
| 40 | 650 | 6 | 2.8 | 0.75 |
| 41 | 500 | 6 | 2.8 | 0.75 |
| 42 | 200 | 4 | 2.8 | 0.75 |
| 43 | 500 | 6 | 2.8 | 0.75 |
| 44 | 600 | 6 | 2.8 | 0.75 |
| 45 | 650 | 5 | 2.8 | 0.75 |
| 46 | 1600 | 12 | 3.6 | 0.75 |
| 47 | 1500 | 10 | 3.6 | 0.75 |
| 48 | 1650 | 12 | 3.6 | 0.75 |
| 49 | 400 | 4 | 2.8 | 0.75 |
| 50 | 600 | 6 | 2.8 | 0.75 |
| 51 | 1100 | 10 | 2.8 | 0.75 |
| 52 | 500 | 6 | 2.8 | 0.75 |
| 53 | 250 | 4 | 2.8 | 0.75 |
| 54 | 350 | 4 | 2.8 | 0.75 |
| 55 | 350 | 4 | 2.8 | 0.75 |
| 56 | 500 | 6 | 2.8 | 0.75 |
| 57 | 500 | 6 | 2.8 | 0.75 |
| 58 | 500 | 6 | 2.8 | 0.75 |
| 59 | 1250 | 8 | 3.6 | 0.75 |
| 60 | 3300 | 14 | 5.6 | 0.75 |
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| 65 | 1550 | 10 | 3.6 | 0.75 |
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| 71 | 900 | 8 | 2.8 | 0.75 |
| 72 | 1350 | 10 | 3.6 | 0.75 |
| 73 | 400 | 4 | 2.8 | 0.75 |
| 74 | 100 | 4 | 2.8 | 0.75 |
| 75 | 750 | 8 | 2.8 | 0.75 |
| 76 | 800 | 8 | 2.8 | 0.75 |
| 77 | 2400 | 12 | 5.2 | 0.75 |
| 78 | 2400 | 12 | 5.2 | 0.75 |
| 79 | 1200 | 10 | 2.8 | 0.75 |
| 80 | 3100 | 14 | 5.6 | 0.75 |
| 81 | 2400 | 12 | 5.2 | 0.75 |
| 82 | 750 | 8 | 2.8 | 0.75 |
| 83 | 1350 | 10 | 3.6 | 0.75 |
| 84 | 2300 | 12 | 4.5 | 0.75 |
| 85 | 2300 | 12 | 4.5 | 0.75 |
| A | 1800 | 12 | 3.6 | 0.75 |
| B | 1800 | 12 | 3.6 | 0.75 |
| C | 1800 | 12 | 3.6 | 0.75 |
| D | 1800 | 12 | 3.6 | 0.75 |
| E | 1100 | 8 | 3.6 | 0.75 |
| F | 1750 | 12 | 3.6 | 0.75 |
| G | 1100 | 8 | 3.6 | 0.75 |
| H | 1750 | 12 | 3.6 | 0.75 |

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Legend

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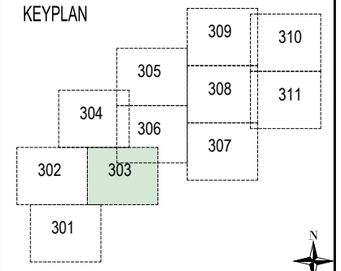
- Proposed Hardstand
- Proposed Clean Water Drainage
- Proposed Dirty Water Drainage
- SP 12 550m² — Stilling Pond Number, Catchment Area & Flow Direction
- Proposed Culvert to Existing Open Drain

KEYPLAN






| rev. | modifications | by | date |
|---|---|---|---|
| P01.2 | Silt Ponds added to Spoil Deposition Areas, Drainage Table Updated | AMcC | 23.11.23 |
| P01.1 | Issued For Comment | AMcC | 13.04.23 |

Client: Cush Wind Farm

Project: Cush Wind Farm, Co Offlay.

Stage: Planning

Title: **Drainage Layout Plan**
**Sheet 3 of 11**

Scales: 1:2000 (A3)

| Surveyed | Prepared By | Checked | Date |
|---|---|---|---|
| | AMcC | JMcE | 16.04.2023 |



| Job No. | Drawing no. | Revision |
|---|---|---|
| 6921 | 6921-JOD-XX-DR-C-0303 | P01.2 |

| Pond Ref. SP | Development Area ($m^2$) | Dim. length (m) | Dim. Width (m) | Dim. Depth (m) |
|---|---|---|---|---|
| 1 | 950 | 8 | 2.8 | 0.75 |
| 2 | 800 | 8 | 2.8 | 0.75 |
| 3 | 450 | 4 | 2.8 | 0.75 |
| 4 | 1750 | 9 | 4.5 | 0.75 |
| 5 | 650 | 6 | 2.8 | 0.75 |
| 6 | 3100 | 14 | 5.2 | 0.75 |
| 7 | 1700 | 9 | 4.5 | 0.75 |
| 8 | 1700 | 9 | 4.5 | 0.75 |
| 9 | 500 | 6 | 2.8 | 0.75 |
| 10 | 1150 | 8 | 3.6 | 0.75 |
| 11 | 825 | 8 | 2.8 | 0.75 |
| 12 | 550 | 6 | 2.8 | 0.75 |
| 13 | 330 | 4 | 2.8 | 0.75 |
| 14 | 1125 | 8 | 3.6 | 0.75 |
| 15 | 425 | 4 | 2.8 | 0.75 |
| 16 | 1050 | 8 | 3.6 | 0.75 |
| 17 | 2500 | 12 | 5.2 | 0.75 |
| 18 | 1500 | 10 | 3.6 | 0.75 |
| 19 | 2000 | 12 | 4.5 | 0.75 |
| 20 | 1500 | 10 | 3.6 | 0.75 |
| 21 | 1100 | 8 | 3.6 | 0.75 |
| 22 | 925 | 8 | 2.8 | 0.75 |
| 23 | 650 | 6 | 2.8 | 0.75 |
| 24 | 550 | 6 | 2.8 | 0.75 |
| 25 | 550 | 6 | 2.8 | 0.75 |
| 26 | 1500 | 10 | 3.6 | 0.75 |
| 27 | 1500 | 10 | 3.6 | 0.75 |
| 28 | 1750 | 12 | 3.6 | 0.75 |
| 29 | 1750 | 12 | 3.6 | 0.75 |
| 30 | 700 | 6 | 2.8 | 0.75 |
| 31 | 700 | 6 | 2.8 | 0.75 |
| 32 | 1500 | 10 | 3.6 | 0.75 |
| 33 | 1600 | 12 | 3.6 | 0.75 |
| 34 | 1600 | 12 | 3.6 | 0.75 |
| 35 | 500 | 6 | 2.8 | 0.75 |
| 36 | 1200 | 10 | 2.8 | 0.75 |
| 37 | 720 | 6 | 2.8 | 0.75 |
| 38 | 1600 | 12 | 3.6 | 0.75 |
| 39 | 1450 | 10 | 3.6 | 0.75 |
| 40 | 650 | 6 | 2.8 | 0.75 |
| 41 | 500 | 6 | 2.8 | 0.75 |
| 42 | 200 | 4 | 2.8 | 0.75 |
| 43 | 500 | 6 | 2.8 | 0.75 |
| 44 | 600 | 6 | 2.8 | 0.75 |
| 45 | 650 | 5 | 2.8 | 0.75 |
| 46 | 1600 | 12 | 3.6 | 0.75 |
| 47 | 1500 | 10 | 3.6 | 0.75 |
| 48 | 1650 | 12 | 3.6 | 0.75 |
| 49 | 400 | 4 | 2.8 | 0.75 |
| 50 | 600 | 6 | 2.8 | 0.75 |
| 51 | 1100 | 10 | 2.8 | 0.75 |
| 52 | 500 | 6 | 2.8 | 0.75 |
| 53 | 250 | 4 | 2.8 | 0.75 |
| 54 | 350 | 4 | 2.8 | 0.75 |
| 55 | 350 | 4 | 2.8 | 0.75 |
| 56 | 500 | 6 | 2.8 | 0.75 |
| 57 | 500 | 6 | 2.8 | 0.75 |
| 58 | 500 | 6 | 2.8 | 0.75 |
| 59 | 1250 | 8 | 3.6 | 0.75 |
| 60 | 3300 | 14 | 5.6 | 0.75 |
| 61 | 550 | 6 | 2.8 | 0.75 |
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| 63 | 500 | 6 | 2.8 | 0.75 |
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| 65 | 1550 | 10 | 3.6 | 0.75 |
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| 67 | 1500 | 10 | 3.6 | 0.75 |
| 68 | 750 | 8 | 2.8 | 0.75 |
| 69 | 1000 | 10 | 2.8 | 0.75 |
| 70 | 500 | 6 | 2.8 | 0.75 |
| 71 | 900 | 8 | 2.8 | 0.75 |
| 72 | 1350 | 10 | 3.6 | 0.75 |
| 73 | 400 | 4 | 2.8 | 0.75 |
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| 76 | 800 | 8 | 2.8 | 0.75 |
| 77 | 2400 | 12 | 5.2 | 0.75 |
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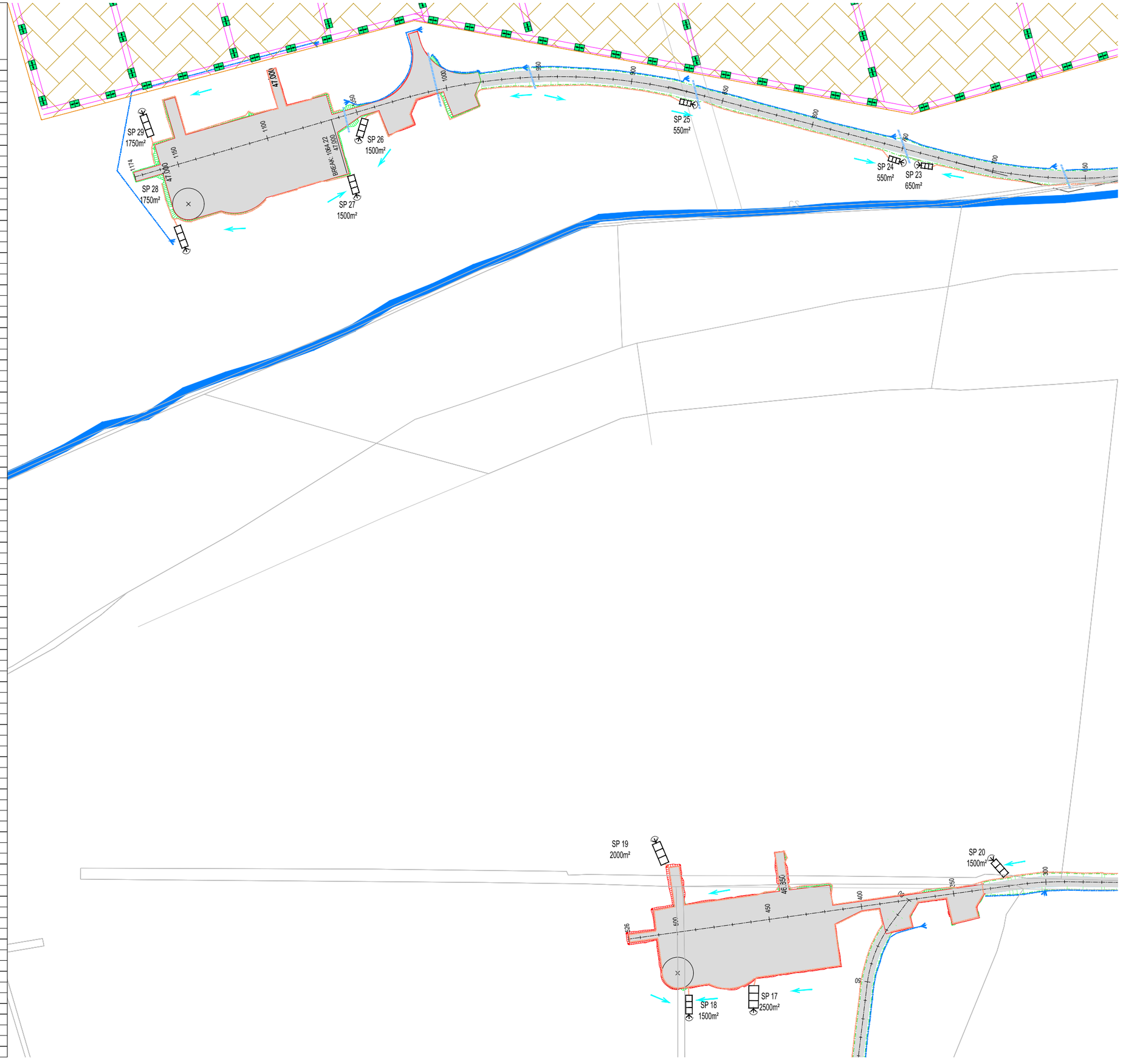
| 84 | 2300 | 12 | 4.5 | 0.75 |
| 85 | 2300 | 12 | 4.5 | 0.75 |
| A | 1800 | 12 | 3.6 | 0.75 |
| B | 1800 | 12 | 3.6 | 0.75 |
| C | 1800 | 12 | 3.6 | 0.75 |
| D | 1800 | 12 | 3.6 | 0.75 |
| E | 1100 | 8 | 3.6 | 0.75 |
| F | 1750 | 12 | 3.6 | 0.75 |
| G | 1100 | 8 | 3.6 | 0.75 |
| H | 1750 | 12 | 3.6 | 0.75 |

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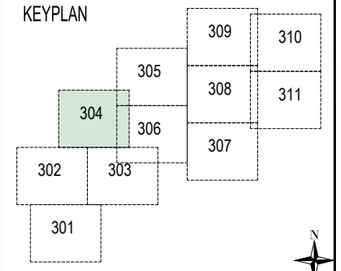
- SP 12 550m² — Stilling Pond Number, Catchment Area & Flow Direction
- Proposed Culvert to Existing Open Drain
- Spoil Deposition Area

KEYPLAN






| rev. | modifications | by | date |
|---|---|---|---|
| P01.3 | Silt Ponds added to Spoil Deposition Areas, Drainage Table Updated | AMcC | 23.11.23 |
| P01.2 | Spoil Deposition Areas Updated | AMcC | 13.11.23 |
| P01.1 | Issued For Comment | AMcC | 13.04.23 |

Client: Cush Wind Farm

Project: Cush Wind Farm, Co Offlay.

Stage: Planning

Title: **Drainage Layout Plan**
**Sheet 4 of 11**

Scales: 1:2000 (A3)

| Surveyed | Prepared By | Checked | Date |
|---|---|---|---|
| | AMcC | JMcE | 16.04.2023 |


JENNINGS O'DONOVAN & PARTNERS
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FINISKLIN,
SLIGO,
IRELAND.
TEL. (0035371) 9161416.
FAX. (0035371) 9161080.
Email. info@jodireland.com
Web. www.jodireland.com

| Job No. | Drawing no. | Revision |
|---|---|---|
| 6921 | 6921-JOD-XX-DR-C-0304 | P01.3 |


| Pond Ref. SP | Development Area ($m^2$) | Dim. length (m) | Dim. Width (m) | Dim. Depth (m) |
|---|---|---|---|---|
| 1 | 950 | 8 | 2.8 | 0.75 |
| 2 | 800 | 8 | 2.8 | 0.75 |
| 3 | 450 | 4 | 2.8 | 0.75 |
| 4 | 1750 | 9 | 4.5 | 0.75 |
| 5 | 650 | 6 | 2.8 | 0.75 |
| 6 | 3100 | 14 | 5.2 | 0.75 |
| 7 | 1700 | 9 | 4.5 | 0.75 |
| 8 | 1700 | 9 | 4.5 | 0.75 |
| 9 | 500 | 6 | 2.8 | 0.75 |
| 10 | 1150 | 8 | 3.6 | 0.75 |
| 11 | 825 | 8 | 2.8 | 0.75 |
| 12 | 550 | 6 | 2.8 | 0.75 |
| 13 | 330 | 4 | 2.8 | 0.75 |
| 14 | 1125 | 8 | 3.6 | 0.75 |
| 15 | 425 | 4 | 2.8 | 0.75 |
| 16 | 1050 | 8 | 3.6 | 0.75 |
| 17 | 2500 | 12 | 5.2 | 0.75 |
| 18 | 1500 | 10 | 3.6 | 0.75 |
| 19 | 2000 | 12 | 4.5 | 0.75 |
| 20 | 1500 | 10 | 3.6 | 0.75 |
| 21 | 1100 | 8 | 3.6 | 0.75 |
| 22 | 925 | 8 | 2.8 | 0.75 |
| 23 | 650 | 6 | 2.8 | 0.75 |
| 24 | 550 | 6 | 2.8 | 0.75 |
| 25 | 550 | 6 | 2.8 | 0.75 |
| 26 | 1500 | 10 | 3.6 | 0.75 |
| 27 | 1500 | 10 | 3.6 | 0.75 |
| 28 | 1750 | 12 | 3.6 | 0.75 |
| 29 | 1750 | 12 | 3.6 | 0.75 |
| 30 | 700 | 6 | 2.8 | 0.75 |
| 31 | 700 | 6 | 2.8 | 0.75 |
| 32 | 1500 | 10 | 3.6 | 0.75 |
| 33 | 1600 | 12 | 3.6 | 0.75 |
| 34 | 1600 | 12 | 3.6 | 0.75 |
| 35 | 500 | 6 | 2.8 | 0.75 |
| 36 | 1200 | 10 | 2.8 | 0.75 |
| 37 | 720 | 6 | 2.8 | 0.75 |
| 38 | 1600 | 12 | 3.6 | 0.75 |
| 39 | 1450 | 10 | 3.6 | 0.75 |
| 40 | 650 | 6 | 2.8 | 0.75 |
| 41 | 500 | 6 | 2.8 | 0.75 |
| 42 | 200 | 4 | 2.8 | 0.75 |
| 43 | 500 | 6 | 2.8 | 0.75 |
| 44 | 600 | 6 | 2.8 | 0.75 |
| 45 | 650 | 5 | 2.8 | 0.75 |
| 46 | 1600 | 12 | 3.6 | 0.75 |
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| 56 | 500 | 6 | 2.8 | 0.75 |
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| 59 | 1250 | 8 | 3.6 | 0.75 |
| 60 | 3300 | 14 | 5.6 | 0.75 |
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| 64 | 400 | 4 | 2.8 | 0.75 |
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| E | 1100 | 8 | 3.6 | 0.75 |
| F | 1750 | 12 | 3.6 | 0.75 |
| G | 1100 | 8 | 3.6 | 0.75 |
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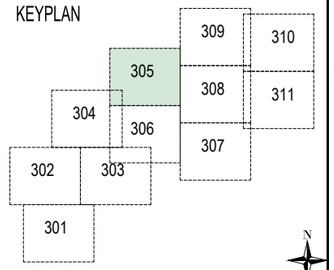
- SP 12 550m² — Stilling Pond Number, Catchment Area & Flow Direction
- Proposed Culvert to Existing Open Drain
- Proposed Double Silt Fence As Detail Drawing 6921-JOD-XX-DR-C-0324
- Proposed Drainage Check Weir ( 20m Intervals) As Detail Drawing 6921-JOD-XX-DR-C-0321
- Proposed Spoil Deposition Area

KEYPLAN






| rev. | modifications | by | date |
|---|---|---|---|
| P01.3 | Silt Ponds added to Spoil Deposition Areas, Drainage Table Updated | AMcC | 23.11.23 |
| P01.2 | Spoil Deposition Areas Updated | AMcC | 13.11.23 |
| P01.1 | Issued For Comment | AMcC | 13.04.23 |

Client: Cush Wind Farm

Project: Cush Wind Farm, Co Offlay.

Stage: Planning

Title: **Soil Deposition Area**
**Silt Fencing Layout Plan**

Scales: 1:2500 (A3)

| Surveyed | Prepared By | Checked | Date |
|---|---|---|---|
| | AMcC | JMcE | 24.04.2023 |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Web. www.jodireland.com

| Job No. | Drawing no. | Revision |
|---|---|---|
| 6921 | 6921-JOD-XX-DR-C-0305 | P01.3 |

| Pond Ref. SP | Development Area ($m^2$) | Dim. length (m) | Dim. Width (m) | Dim. Depth (m) |
|---|---|---|---|---|
| 1 | 950 | 8 | 2.8 | 0.75 |
| 2 | 800 | 8 | 2.8 | 0.75 |
| 3 | 450 | 4 | 2.8 | 0.75 |
| 4 | 1750 | 9 | 4.5 | 0.75 |
| 5 | 650 | 6 | 2.8 | 0.75 |
| 6 | 3100 | 14 | 5.2 | 0.75 |
| 7 | 1700 | 9 | 4.5 | 0.75 |
| 8 | 1700 | 9 | 4.5 | 0.75 |
| 9 | 500 | 6 | 2.8 | 0.75 |
| 10 | 1150 | 8 | 3.6 | 0.75 |
| 11 | 825 | 8 | 2.8 | 0.75 |
| 12 | 550 | 6 | 2.8 | 0.75 |
| 13 | 330 | 4 | 2.8 | 0.75 |
| 14 | 1125 | 8 | 3.6 | 0.75 |
| 15 | 425 | 4 | 2.8 | 0.75 |
| 16 | 1050 | 8 | 3.6 | 0.75 |
| 17 | 2500 | 12 | 5.2 | 0.75 |
| 18 | 1500 | 10 | 3.6 | 0.75 |
| 19 | 2000 | 12 | 4.5 | 0.75 |
| 20 | 1500 | 10 | 3.6 | 0.75 |
| 21 | 1100 | 8 | 3.6 | 0.75 |
| 22 | 925 | 8 | 2.8 | 0.75 |
| 23 | 650 | 6 | 2.8 | 0.75 |
| 24 | 550 | 6 | 2.8 | 0.75 |
| 25 | 550 | 6 | 2.8 | 0.75 |
| 26 | 1500 | 10 | 3.6 | 0.75 |
| 27 | 1500 | 10 | 3.6 | 0.75 |
| 28 | 1750 | 12 | 3.6 | 0.75 |
| 29 | 1750 | 12 | 3.6 | 0.75 |
| 30 | 700 | 6 | 2.8 | 0.75 |
| 31 | 700 | 6 | 2.8 | 0.75 |
| 32 | 1500 | 10 | 3.6 | 0.75 |
| 33 | 1600 | 12 | 3.6 | 0.75 |
| 34 | 1600 | 12 | 3.6 | 0.75 |
| 35 | 500 | 6 | 2.8 | 0.75 |
| 36 | 1200 | 10 | 2.8 | 0.75 |
| 37 | 720 | 6 | 2.8 | 0.75 |
| 38 | 1600 | 12 | 3.6 | 0.75 |
| 39 | 1450 | 10 | 3.6 | 0.75 |
| 40 | 650 | 6 | 2.8 | 0.75 |
| 41 | 500 | 6 | 2.8 | 0.75 |
| 42 | 200 | 4 | 2.8 | 0.75 |
| 43 | 500 | 6 | 2.8 | 0.75 |
| 44 | 600 | 6 | 2.8 | 0.75 |
| 45 | 650 | 5 | 2.8 | 0.75 |
| 46 | 1600 | 12 | 3.6 | 0.75 |

| Pond Ref. SP | Development Area ($m^2$) | Dim. length (m) | Dim. Width (m) | Dim. Depth (m) |
|---|---|---|---|---|
| 47 | 1500 | 10 | 3.6 | 0.75 |
| 48 | 1650 | 12 | 3.6 | 0.75 |
| 49 | 400 | 4 | 2.8 | 0.75 |
| 50 | 600 | 6 | 2.8 | 0.75 |
| 51 | 1100 | 10 | 2.8 | 0.75 |
| 52 | 500 | 6 | 2.8 | 0.75 |
| 53 | 250 | 4 | 2.8 | 0.75 |
| 54 | 350 | 4 | 2.8 | 0.75 |
| 55 | 350 | 4 | 2.8 | 0.75 |
| 56 | 500 | 6 | 2.8 | 0.75 |
| 57 | 500 | 6 | 2.8 | 0.75 |
| 58 | 500 | 6 | 2.8 | 0.75 |
| 59 | 1250 | 8 | 3.6 | 0.75 |
| 60 | 3300 | 14 | 5.6 | 0.75 |
| 61 | 550 | 6 | 2.8 | 0.75 |
| 62 | 500 | 6 | 2.8 | 0.75 |
| 63 | 500 | 6 | 2.8 | 0.75 |
| 64 | 400 | 4 | 2.8 | 0.75 |
| 65 | 1550 | 10 | 3.6 | 0.75 |
| 66 | 1500 | 10 | 3.6 | 0.75 |
| 67 | 1500 | 10 | 3.6 | 0.75 |
| 68 | 750 | 8 | 2.8 | 0.75 |
| 69 | 1000 | 10 | 2.8 | 0.75 |
| 70 | 500 | 6 | 2.8 | 0.75 |
| 71 | 900 | 8 | 2.8 | 0.75 |
| 72 | 1350 | 10 | 3.6 | 0.75 |
| 73 | 400 | 4 | 2.8 | 0.75 |
| 74 | 100 | 4 | 2.8 | 0.75 |
| 75 | 750 | 8 | 2.8 | 0.75 |
| 76 | 800 | 8 | 2.8 | 0.75 |
| 77 | 2400 | 12 | 5.2 | 0.75 |
| 78 | 2400 | 12 | 5.2 | 0.75 |
| 79 | 1200 | 10 | 2.8 | 0.75 |
| 80 | 3100 | 14 | 5.6 | 0.75 |
| 81 | 2400 | 12 | 5.2 | 0.75 |
| 82 | 750 | 8 | 2.8 | 0.75 |
| 83 | 1350 | 10 | 3.6 | 0.75 |
| 84 | 2300 | 12 | 4.5 | 0.75 |
| 85 | 2300 | 12 | 4.5 | 0.75 |
| A | 1800 | 12 | 3.6 | 0.75 |
| B | 1800 | 12 | 3.6 | 0.75 |
| C | 1800 | 12 | 3.6 | 0.75 |
| D | 1800 | 12 | 3.6 | 0.75 |
| E | 1100 | 8 | 3.6 | 0.75 |
| F | 1750 | 12 | 3.6 | 0.75 |
| G | 1100 | 8 | 3.6 | 0.75 |
| H | 1750 | 12 | 3.6 | 0.75 |

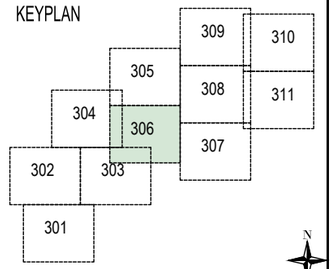

NOTES:

1 FIGURED DIMENSIONS ONLY TO BE TAKEN FROM THIS DRAWING.
2 ALL DRAWINGS TO BE CHECKED BY THE CONTRACTOR ON SITE.
3 ENGINEER TO BE INFORMED OF ANY DISCREPANCIES BEFORE ANY WORK COMMENCES.
4 THIS DRAWING TO BE READ IN CONJUNCTION WITH ALL OTHER RELEVANT DRAWINGS AND SPECIFICATIONS.

## Legend

- Proposed Access Road in Cut
- Proposed Access Road in Fill
- Proposed Hardstand
- Proposed Clean Water Drainage
- Proposed Dirty Water Drainage
- SP 12 550m² — Stilling Pond Number, Catchment Area & Flow Direction
- Proposed Culvert to Existing Open Drain
- Spoil Deposition Area

KEYPLAN






| rev. | modifications | by | date |
|---|---|---|---|
| P01.3 | Silt Ponds added to Spoil Deposition Areas, Drainage Table Updated | AMcC | 23.11.23 |
| P01.2 | Spoil Deposition Areas Updated | AMcC | 13.11.23 |
| P01.1 | Issued For Comment | AMcC | 13.04.23 |

Client: Cush Wind Farm

Project: Cush Wind Farm, Co Offlay.

Stage: Planning

Title: **Drainage Layout Plan**
**Sheet 6 of 11**

Scales: 1:2000 (A3)

| Surveyed | Prepared By | Checked | Date |
|---|---|---|---|
| | AMcC | JMcE | 16.04.2023 |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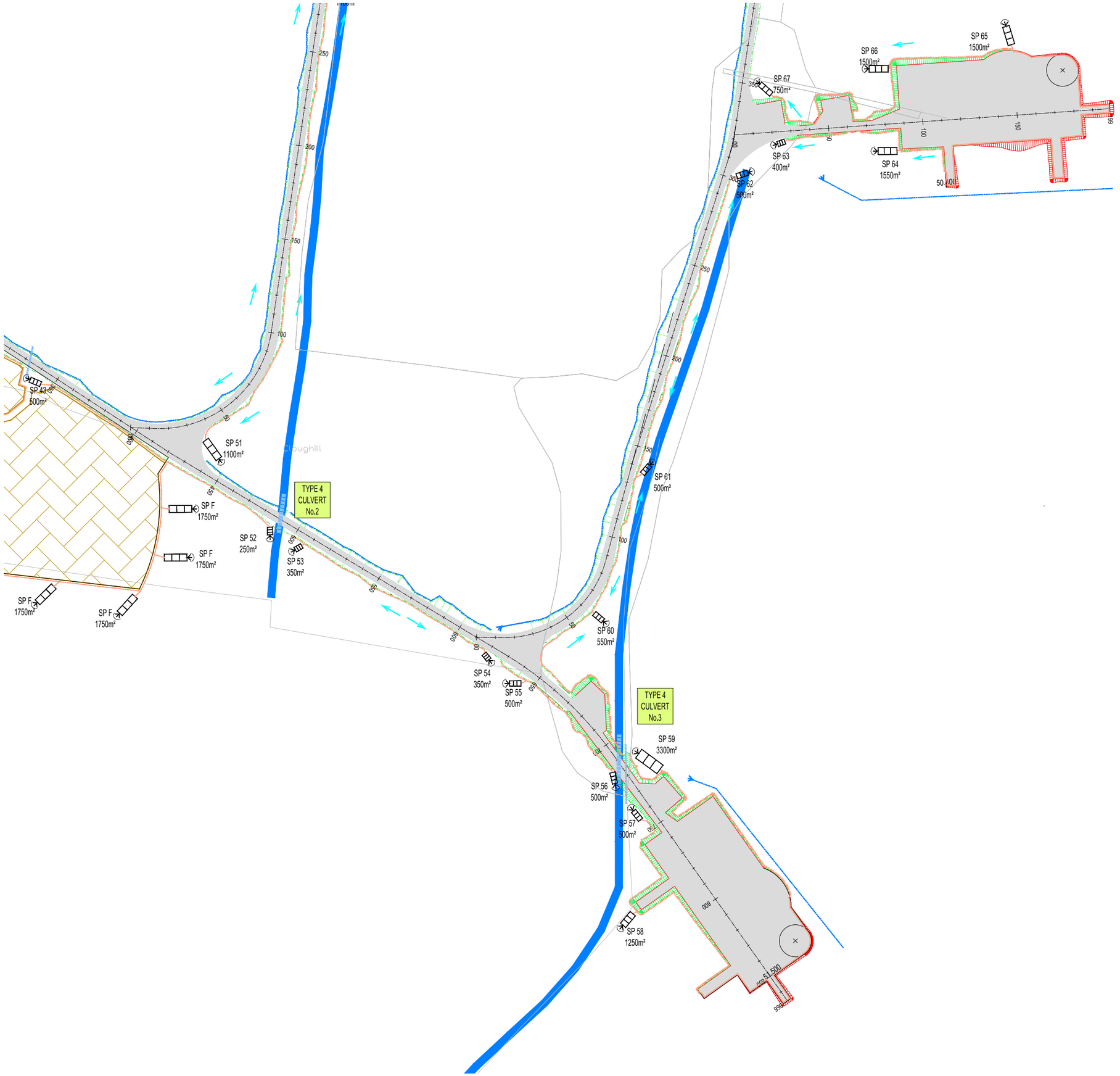
| Job No. | Drawing no. | Revision |
|---|---|---|
| 6921 | 6921-JOD-XX-DR-C-0306 | P01.3 |




| Pond Ref. SP | Development Area ($m^2$) | Dim. length (m) | Dim. Width (m) | Dim. Depth (m) |
|---|---|---|---|---|
| 1 | 950 | 8 | 2.8 | 0.75 |
| 2 | 800 | 8 | 2.8 | 0.75 |
| 3 | 450 | 4 | 2.8 | 0.75 |
| 4 | 1750 | 9 | 4.5 | 0.75 |
| 5 | 650 | 6 | 2.8 | 0.75 |
| 6 | 3100 | 14 | 5.2 | 0.75 |
| 7 | 1700 | 9 | 4.5 | 0.75 |
| 8 | 1700 | 9 | 4.5 | 0.75 |
| 9 | 500 | 6 | 2.8 | 0.75 |
| 10 | 1150 | 8 | 3.6 | 0.75 |
| 11 | 825 | 8 | 2.8 | 0.75 |
| 12 | 550 | 6 | 2.8 | 0.75 |
| 13 | 330 | 4 | 2.8 | 0.75 |
| 14 | 1125 | 8 | 3.6 | 0.75 |
| 15 | 425 | 4 | 2.8 | 0.75 |
| 16 | 1050 | 8 | 3.6 | 0.75 |
| 17 | 2500 | 12 | 5.2 | 0.75 |
| 18 | 1500 | 10 | 3.6 | 0.75 |
| 19 | 2000 | 12 | 4.5 | 0.75 |
| 20 | 1500 | 10 | 3.6 | 0.75 |
| 21 | 1100 | 8 | 3.6 | 0.75 |
| 22 | 925 | 8 | 2.8 | 0.75 |
| 23 | 650 | 6 | 2.8 | 0.75 |
| 24 | 550 | 6 | 2.8 | 0.75 |
| 25 | 550 | 6 | 2.8 | 0.75 |
| 26 | 1500 | 10 | 3.6 | 0.75 |
| 27 | 1500 | 10 | 3.6 | 0.75 |
| 28 | 1750 | 12 | 3.6 | 0.75 |
| 29 | 1750 | 12 | 3.6 | 0.75 |
| 30 | 700 | 6 | 2.8 | 0.75 |
| 31 | 700 | 6 | 2.8 | 0.75 |
| 32 | 1500 | 10 | 3.6 | 0.75 |
| 33 | 1600 | 12 | 3.6 | 0.75 |
| 34 | 1600 | 12 | 3.6 | 0.75 |
| 35 | 500 | 6 | 2.8 | 0.75 |
| 36 | 1200 | 10 | 2.8 | 0.75 |
| 37 | 720 | 6 | 2.8 | 0.75 |
| 38 | 1600 | 12 | 3.6 | 0.75 |
| 39 | 1450 | 10 | 3.6 | 0.75 |
| 40 | 650 | 6 | 2.8 | 0.75 |
| 41 | 500 | 6 | 2.8 | 0.75 |
| 42 | 200 | 4 | 2.8 | 0.75 |
| 43 | 500 | 6 | 2.8 | 0.75 |
| 44 | 600 | 6 | 2.8 | 0.75 |
| 45 | 650 | 5 | 2.8 | 0.75 |
| 46 | 1600 | 12 | 3.6 | 0.75 |
| 47 | 1500 | 10 | 3.6 | 0.75 |
| 48 | 1650 | 12 | 3.6 | 0.75 |
| 49 | 400 | 4 | 2.8 | 0.75 |
| 50 | 600 | 6 | 2.8 | 0.75 |
| 51 | 1100 | 10 | 2.8 | 0.75 |
| 52 | 500 | 6 | 2.8 | 0.75 |
| 53 | 250 | 4 | 2.8 | 0.75 |
| 54 | 350 | 4 | 2.8 | 0.75 |
| 55 | 350 | 4 | 2.8 | 0.75 |
| 56 | 500 | 6 | 2.8 | 0.75 |
| 57 | 500 | 6 | 2.8 | 0.75 |
| 58 | 500 | 6 | 2.8 | 0.75 |
| 59 | 1250 | 8 | 3.6 | 0.75 |
| 60 | 3300 | 14 | 5.6 | 0.75 |
| 61 | 550 | 6 | 2.8 | 0.75 |
| 62 | 500 | 6 | 2.8 | 0.75 |
| 63 | 500 | 6 | 2.8 | 0.75 |
| 64 | 400 | 4 | 2.8 | 0.75 |
| 65 | 1550 | 10 | 3.6 | 0.75 |
| 66 | 1500 | 10 | 3.6 | 0.75 |
| 67 | 1500 | 10 | 3.6 | 0.75 |
| 68 | 750 | 8 | 2.8 | 0.75 |
| 69 | 1000 | 10 | 2.8 | 0.75 |
| 70 | 500 | 6 | 2.8 | 0.75 |
| 71 | 900 | 8 | 2.8 | 0.75 |
| 72 | 1350 | 10 | 3.6 | 0.75 |
| 73 | 400 | 4 | 2.8 | 0.75 |
| 74 | 100 | 4 | 2.8 | 0.75 |
| 75 | 750 | 8 | 2.8 | 0.75 |
| 76 | 800 | 8 | 2.8 | 0.75 |
| 77 | 2400 | 12 | 5.2 | 0.75 |
| 78 | 2400 | 12 | 5.2 | 0.75 |
| 79 | 1200 | 10 | 2.8 | 0.75 |
| 80 | 3100 | 14 | 5.6 | 0.75 |
| 81 | 2400 | 12 | 5.2 | 0.75 |
| 82 | 750 | 8 | 2.8 | 0.75 |
| 83 | 1350 | 10 | 3.6 | 0.75 |
| 84 | 2300 | 12 | 4.5 | 0.75 |
| 85 | 2300 | 12 | 4.5 | 0.75 |
| A | 1800 | 12 | 3.6 | 0.75 |
| B | 1800 | 12 | 3.6 | 0.75 |
| C | 1800 | 12 | 3.6 | 0.75 |
| D | 1800 | 12 | 3.6 | 0.75 |
| E | 1100 | 8 | 3.6 | 0.75 |
| F | 1750 | 12 | 3.6 | 0.75 |
| G | 1100 | 8 | 3.6 | 0.75 |
| H | 1750 | 12 | 3.6 | 0.75 |

NOTES:

1 FIGURED DIMENSIONS ONLY TO BE TAKEN FROM THIS DRAWING.
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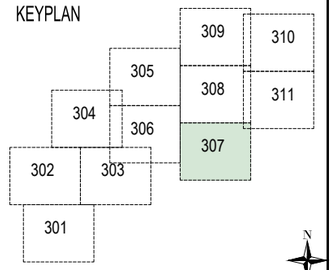
Legend

- Proposed Access Road in Cut
- Proposed Access Road in Fill
- Proposed Hardstand
- Proposed Clean Water Drainage
- Proposed Dirty Water Drainage
- SP 12 550m² — Stilling Pond Number, Catchment Area & Flow Direction
- Proposed Culvert to Existing Open Drain
- Spoil Deposition Area

KEYPLAN






| rev. | modifications | by | date |
|---|---|---|---|
| P01.3 | Silt Ponds added to Spoil Deposition Areas, Drainage Table Updated | AMcC | 23.11.23 |
| P01.2 | Spoil Deposition Areas Updated | AMcC | 13.11.23 |
| P01.1 | Issued For Comment | AMcC | 13.04.23 |

Client: Cush Wind Farm

Project: Cush Wind Farm, Co Offlay.

Stage: Planning

Title: **Drainage Layout Plan Sheet 7 of 11**

Scales: 1:2000 (A3)

| Surveyed | Prepared By | Checked | Date |
|---|---|---|---|
| | AMcC | JMcE | 16.04.2023 |



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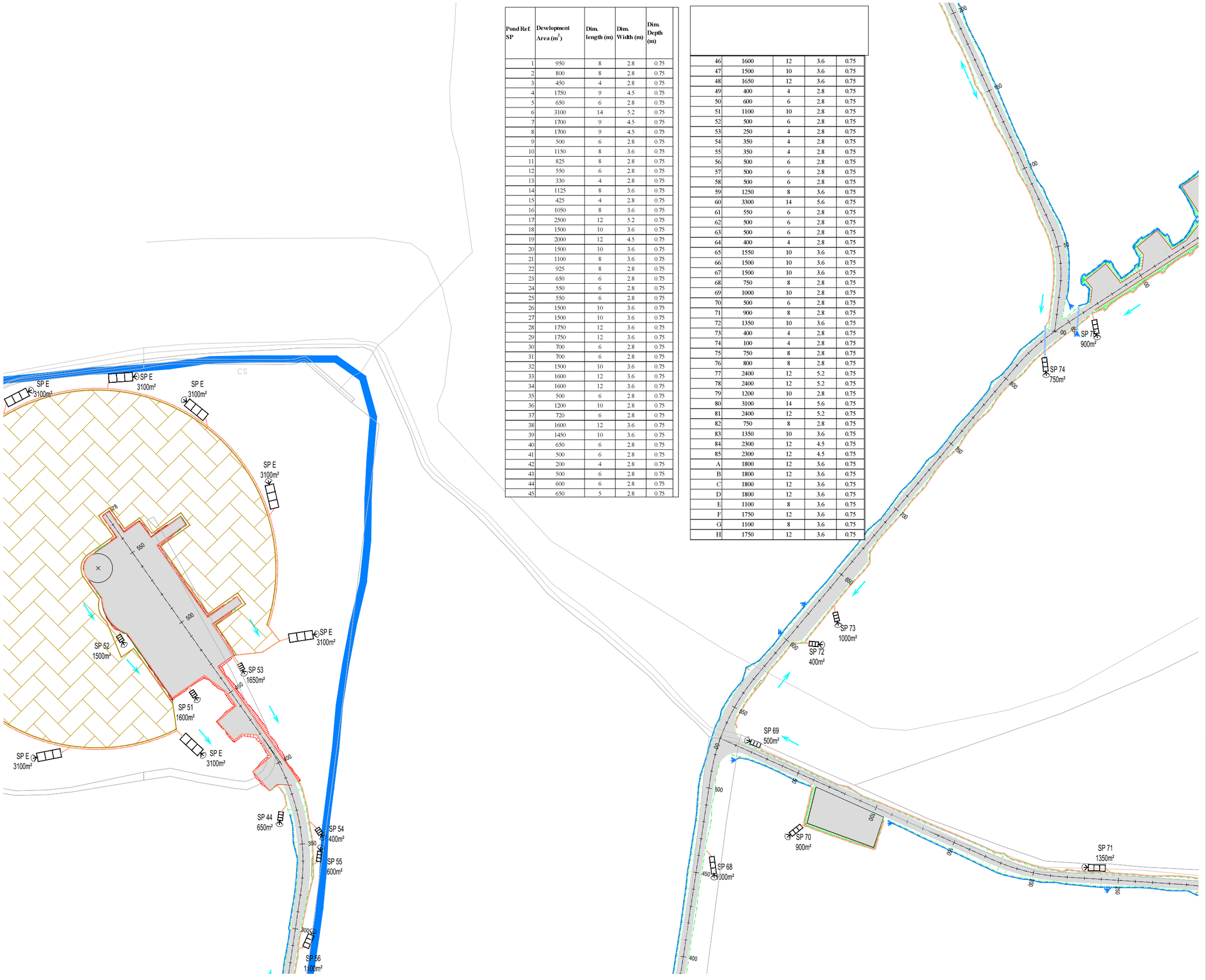
Web. www.jodireland.com

| Job No. | Drawing no. | Revision |
|---|---|---|
| 6921 | 6921-JOD-XX-DR-C-0307 | P01.3 |

| Pond Ref. SP | Development Area ($m^2$) | Dim. length (m) | Dim. Width (m) | Dim. Depth (m) |
|---|---|---|---|---|
| 1 | 950 | 8 | 2.8 | 0.75 |
| 2 | 800 | 8 | 2.8 | 0.75 |
| 3 | 450 | 4 | 2.8 | 0.75 |
| 4 | 1750 | 9 | 4.5 | 0.75 |
| 5 | 650 | 6 | 2.8 | 0.75 |
| 6 | 3100 | 14 | 5.2 | 0.75 |
| 7 | 1700 | 9 | 4.5 | 0.75 |
| 8 | 1700 | 9 | 4.5 | 0.75 |
| 9 | 500 | 6 | 2.8 | 0.75 |
| 10 | 1150 | 8 | 3.6 | 0.75 |
| 11 | 825 | 8 | 2.8 | 0.75 |
| 12 | 550 | 6 | 2.8 | 0.75 |
| 13 | 330 | 4 | 2.8 | 0.75 |
| 14 | 1125 | 8 | 3.6 | 0.75 |
| 15 | 425 | 4 | 2.8 | 0.75 |
| 16 | 1050 | 8 | 3.6 | 0.75 |
| 17 | 2500 | 12 | 5.2 | 0.75 |
| 18 | 1500 | 10 | 3.6 | 0.75 |
| 19 | 2000 | 12 | 4.5 | 0.75 |
| 20 | 1500 | 10 | 3.6 | 0.75 |
| 21 | 1100 | 8 | 3.6 | 0.75 |
| 22 | 925 | 8 | 2.8 | 0.75 |
| 23 | 650 | 6 | 2.8 | 0.75 |
| 24 | 550 | 6 | 2.8 | 0.75 |
| 25 | 550 | 6 | 2.8 | 0.75 |
| 26 | 1500 | 10 | 3.6 | 0.75 |
| 27 | 1500 | 10 | 3.6 | 0.75 |
| 28 | 1750 | 12 | 3.6 | 0.75 |
| 29 | 1750 | 12 | 3.6 | 0.75 |
| 30 | 700 | 6 | 2.8 | 0.75 |
| 31 | 700 | 6 | 2.8 | 0.75 |
| 32 | 1500 | 10 | 3.6 | 0.75 |
| 33 | 1600 | 12 | 3.6 | 0.75 |
| 34 | 1600 | 12 | 3.6 | 0.75 |
| 35 | 500 | 6 | 2.8 | 0.75 |
| 36 | 1200 | 10 | 2.8 | 0.75 |
| 37 | 720 | 6 | 2.8 | 0.75 |
| 38 | 1600 | 12 | 3.6 | 0.75 |
| 39 | 1450 | 10 | 3.6 | 0.75 |
| 40 | 650 | 6 | 2.8 | 0.75 |
| 41 | 500 | 6 | 2.8 | 0.75 |
| 42 | 200 | 4 | 2.8 | 0.75 |
| 43 | 500 | 6 | 2.8 | 0.75 |
| 44 | 600 | 6 | 2.8 | 0.75 |
| 45 | 650 | 5 | 2.8 | 0.75 |
| 46 | 1600 | 12 | 3.6 | 0.75 |
| 47 | 1500 | 10 | 3.6 | 0.75 |
| 48 | 1650 | 12 | 3.6 | 0.75 |
| 49 | 400 | 4 | 2.8 | 0.75 |
| 50 | 600 | 6 | 2.8 | 0.75 |
| 51 | 1100 | 10 | 2.8 | 0.75 |
| 52 | 500 | 6 | 2.8 | 0.75 |
| 53 | 250 | 4 | 2.8 | 0.75 |
| 54 | 350 | 4 | 2.8 | 0.75 |
| 55 | 350 | 4 | 2.8 | 0.75 |
| 56 | 500 | 6 | 2.8 | 0.75 |
| 57 | 500 | 6 | 2.8 | 0.75 |
| 58 | 500 | 6 | 2.8 | 0.75 |
| 59 | 1250 | 8 | 3.6 | 0.75 |
| 60 | 3300 | 14 | 5.6 | 0.75 |
| 61 | 550 | 6 | 2.8 | 0.75 |
| 62 | 500 | 6 | 2.8 | 0.75 |
| 63 | 500 | 6 | 2.8 | 0.75 |
| 64 | 400 | 4 | 2.8 | 0.75 |
| 65 | 1550 | 10 | 3.6 | 0.75 |
| 66 | 1500 | 10 | 3.6 | 0.75 |
| 67 | 1500 | 10 | 3.6 | 0.75 |
| 68 | 750 | 8 | 2.8 | 0.75 |
| 69 | 1000 | 10 | 2.8 | 0.75 |
| 70 | 500 | 6 | 2.8 | 0.75 |
| 71 | 900 | 8 | 2.8 | 0.75 |
| 72 | 1350 | 10 | 3.6 | 0.75 |
| 73 | 400 | 4 | 2.8 | 0.75 |
| 74 | 100 | 4 | 2.8 | 0.75 |
| 75 | 750 | 8 | 2.8 | 0.75 |
| 76 | 800 | 8 | 2.8 | 0.75 |
| 77 | 2400 | 12 | 5.2 | 0.75 |
| 78 | 2400 | 12 | 5.2 | 0.75 |
| 79 | 1200 | 10 | 2.8 | 0.75 |
| 80 | 3100 | 14 | 5.6 | 0.75 |
| 81 | 2400 | 12 | 5.2 | 0.75 |
| 82 | 750 | 8 | 2.8 | 0.75 |
| 83 | 1350 | 10 | 3.6 | 0.75 |
| 84 | 2300 | 12 | 4.5 | 0.75 |
| 85 | 2300 | 12 | 4.5 | 0.75 |
| A | 1800 | 12 | 3.6 | 0.75 |
| B | 1800 | 12 | 3.6 | 0.75 |
| C | 1800 | 12 | 3.6 | 0.75 |
| D | 1800 | 12 | 3.6 | 0.75 |
| E | 1100 | 8 | 3.6 | 0.75 |
| F | 1750 | 12 | 3.6 | 0.75 |
| G | 1100 | 8 | 3.6 | 0.75 |
| H | 1750 | 12 | 3.6 | 0.75 |



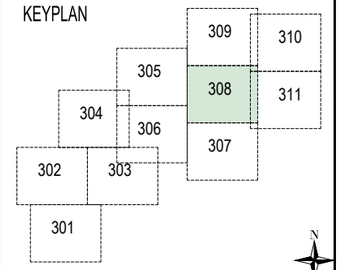

NOTES:

1 FIGURED DIMENSIONS ONLY TO BE TAKEN FROM THIS DRAWING.
2 ALL DRAWINGS TO BE CHECKED BY THE CONTRACTOR ON SITE.
3 ENGINEER TO BE INFORMED OF ANY DISCREPANCIES BEFORE ANY WORK COMMENCES.
4 THIS DRAWING TO BE READ IN CONJUNCTION WITH ALL OTHER RELEVANT DRAWINGS AND SPECIFICATIONS.

Legend

- Proposed Access Road in Cut
- Proposed Access Road in Fill
- Proposed Hardstand
- Proposed Clean Water Drainage
- Proposed Dirty Water Drainage
- SP 12 550m² — Stilling Pond Number, Catchment Area & Flow Direction
- Proposed Culvert to Existing Open Drain
- Spoil Deposition Area

KEYPLAN






| rev. | modifications | by | date |
|---|---|---|---|
| P01.3 | Silt Ponds added to Spoil Deposition Areas, Drainage Table Updated | AMcC | 23.11.23 |
| P01.2 | Spoil Deposition Areas Updated | AMcC | 13.11.23 |
| P01.1 | Issued For Comment | AMcC | 13.04.23 |

Client: Cush Wind Farm

Project: Cush Wind Farm, Co Offlay.

Stage: Planning

Title: **Drainage Layout Plan Sheet 8 of 11**

Scales: 1:2000 (A3)

| Surveyed | Prepared By | Checked | Date |
|---|---|---|---|
| | AMcC | JMcE | 16.04.2023 |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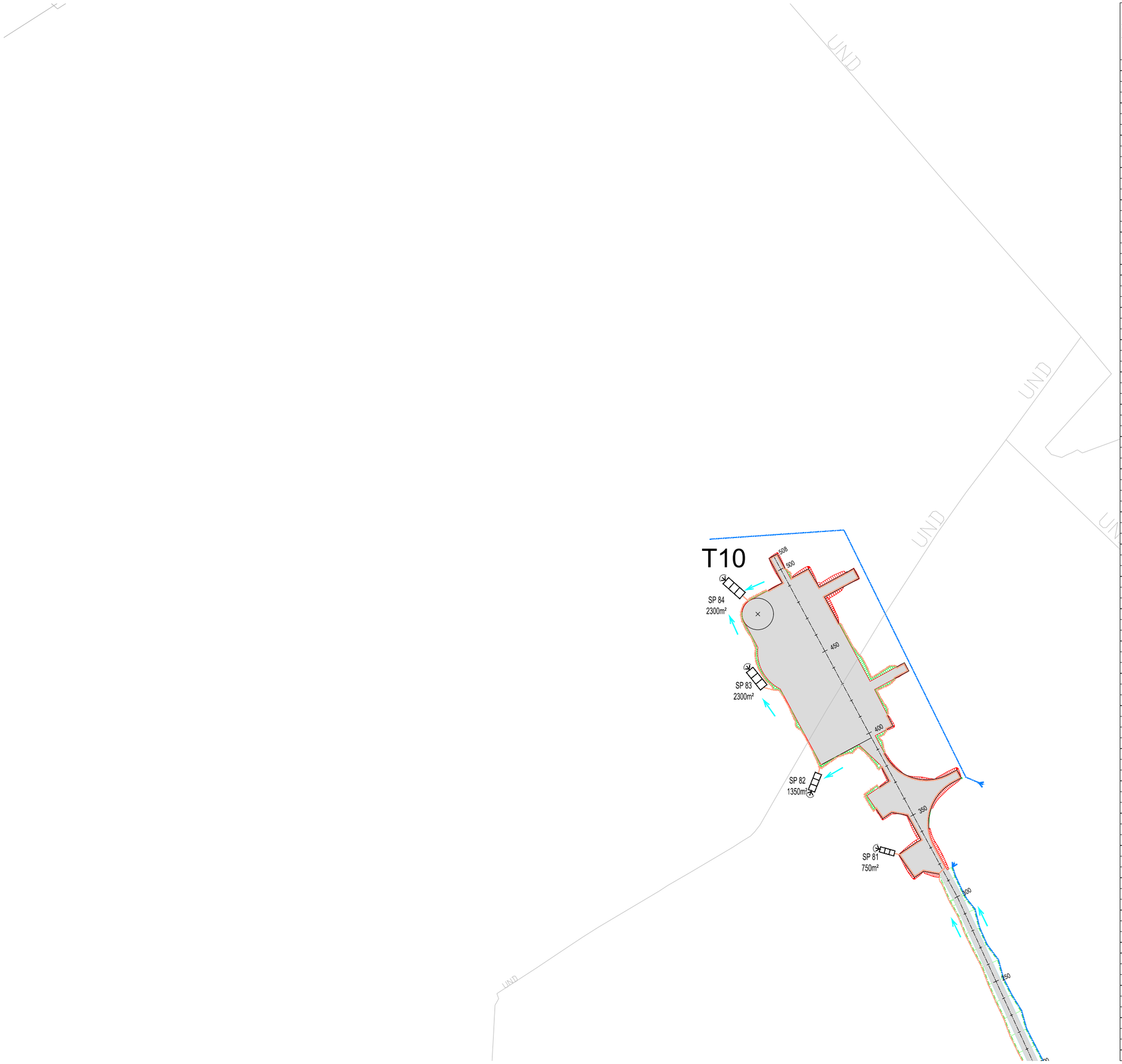
| Job No. | Drawing no. | Revision |
|---|---|---|
| 6921 | 6921-JOD-XX-DR-C-0308 | P01.3 |




| Pond Ref. SP | Development Area ($m^2$) | Dim. length (m) | Dim. Width (m) | Dim. Depth (m) |
|---|---|---|---|---|
| 1 | 950 | 8 | 2.8 | 0.75 |
| 2 | 800 | 8 | 2.8 | 0.75 |
| 3 | 450 | 4 | 2.8 | 0.75 |
| 4 | 1750 | 9 | 4.5 | 0.75 |
| 5 | 650 | 6 | 2.8 | 0.75 |
| 6 | 3100 | 14 | 5.2 | 0.75 |
| 7 | 1700 | 9 | 4.5 | 0.75 |
| 8 | 1700 | 9 | 4.5 | 0.75 |
| 9 | 500 | 6 | 2.8 | 0.75 |
| 10 | 1150 | 8 | 3.6 | 0.75 |
| 11 | 825 | 8 | 2.8 | 0.75 |
| 12 | 550 | 6 | 2.8 | 0.75 |
| 13 | 330 | 4 | 2.8 | 0.75 |
| 14 | 1125 | 8 | 3.6 | 0.75 |
| 15 | 425 | 4 | 2.8 | 0.75 |
| 16 | 1050 | 8 | 3.6 | 0.75 |
| 17 | 2500 | 12 | 5.2 | 0.75 |
| 18 | 1500 | 10 | 3.6 | 0.75 |
| 19 | 2000 | 12 | 4.5 | 0.75 |
| 20 | 1500 | 10 | 3.6 | 0.75 |
| 21 | 1100 | 8 | 3.6 | 0.75 |
| 22 | 925 | 8 | 2.8 | 0.75 |
| 23 | 650 | 6 | 2.8 | 0.75 |
| 24 | 550 | 6 | 2.8 | 0.75 |
| 25 | 550 | 6 | 2.8 | 0.75 |
| 26 | 1500 | 10 | 3.6 | 0.75 |
| 27 | 1500 | 10 | 3.6 | 0.75 |
| 28 | 1750 | 12 | 3.6 | 0.75 |
| 29 | 1750 | 12 | 3.6 | 0.75 |
| 30 | 700 | 6 | 2.8 | 0.75 |
| 31 | 700 | 6 | 2.8 | 0.75 |
| 32 | 1500 | 10 | 3.6 | 0.75 |
| 33 | 1600 | 12 | 3.6 | 0.75 |
| 34 | 1600 | 12 | 3.6 | 0.75 |
| 35 | 500 | 6 | 2.8 | 0.75 |
| 36 | 1200 | 10 | 2.8 | 0.75 |
| 37 | 720 | 6 | 2.8 | 0.75 |
| 38 | 1600 | 12 | 3.6 | 0.75 |
| 39 | 1450 | 10 | 3.6 | 0.75 |
| 40 | 650 | 6 | 2.8 | 0.75 |
| 41 | 500 | 6 | 2.8 | 0.75 |
| 42 | 200 | 4 | 2.8 | 0.75 |
| 43 | 500 | 6 | 2.8 | 0.75 |
| 44 | 600 | 6 | 2.8 | 0.75 |
| 45 | 650 | 5 | 2.8 | 0.75 |
| 46 | 1600 | 12 | 3.6 | 0.75 |
| 47 | 1500 | 10 | 3.6 | 0.75 |
| 48 | 1650 | 12 | 3.6 | 0.75 |
| 49 | 400 | 4 | 2.8 | 0.75 |
| 50 | 600 | 6 | 2.8 | 0.75 |
| 51 | 1100 | 10 | 2.8 | 0.75 |
| 52 | 500 | 6 | 2.8 | 0.75 |
| 53 | 250 | 4 | 2.8 | 0.75 |
| 54 | 350 | 4 | 2.8 | 0.75 |
| 55 | 350 | 4 | 2.8 | 0.75 |
| 56 | 500 | 6 | 2.8 | 0.75 |
| 57 | 500 | 6 | 2.8 | 0.75 |
| 58 | 500 | 6 | 2.8 | 0.75 |
| 59 | 1250 | 8 | 3.6 | 0.75 |
| 60 | 3300 | 14 | 5.6 | 0.75 |
| 61 | 550 | 6 | 2.8 | 0.75 |
| 62 | 500 | 6 | 2.8 | 0.75 |
| 63 | 500 | 6 | 2.8 | 0.75 |
| 64 | 400 | 4 | 2.8 | 0.75 |
| 65 | 1550 | 10 | 3.6 | 0.75 |
| 66 | 1500 | 10 | 3.6 | 0.75 |
| 67 | 1500 | 10 | 3.6 | 0.75 |
| 68 | 750 | 8 | 2.8 | 0.75 |
| 69 | 1000 | 10 | 2.8 | 0.75 |
| 70 | 500 | 6 | 2.8 | 0.75 |
| 71 | 900 | 8 | 2.8 | 0.75 |
| 72 | 1350 | 10 | 3.6 | 0.75 |
| 73 | 400 | 4 | 2.8 | 0.75 |
| 74 | 100 | 4 | 2.8 | 0.75 |
| 75 | 750 | 8 | 2.8 | 0.75 |
| 76 | 800 | 8 | 2.8 | 0.75 |
| 77 | 2400 | 12 | 5.2 | 0.75 |
| 78 | 2400 | 12 | 5.2 | 0.75 |
| 79 | 1200 | 10 | 2.8 | 0.75 |
| 80 | 3100 | 14 | 5.6 | 0.75 |
| 81 | 2400 | 12 | 5.2 | 0.75 |
| 82 | 750 | 8 | 2.8 | 0.75 |
| 83 | 1350 | 10 | 3.6 | 0.75 |
| 84 | 2300 | 12 | 4.5 | 0.75 |
| 85 | 2300 | 12 | 4.5 | 0.75 |
| A | 1800 | 12 | 3.6 | 0.75 |
| B | 1800 | 12 | 3.6 | 0.75 |
| C | 1800 | 12 | 3.6 | 0.75 |
| D | 1800 | 12 | 3.6 | 0.75 |
| E | 1100 | 8 | 3.6 | 0.75 |
| F | 1750 | 12 | 3.6 | 0.75 |
| G | 1100 | 8 | 3.6 | 0.75 |
| H | 1750 | 12 | 3.6 | 0.75 |

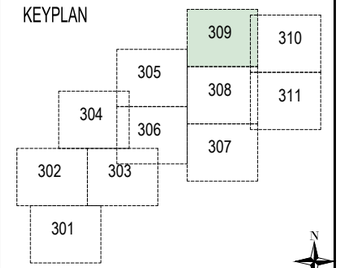
NOTES:

1 FIGURED DIMENSIONS ONLY TO BE TAKEN FROM THIS DRAWING.
2 ALL DRAWINGS TO BE CHECKED BY THE CONTRACTOR ON SITE.
3 ENGINEER TO BE INFORMED OF ANY DISCREPANCIES BEFORE ANY WORK COMMENCES.
4 THIS DRAWING TO BE READ IN CONJUNCTION WITH ALL OTHER RELEVANT DRAWINGS AND SPECIFICATIONS.

Legend

- Proposed Access Road in Cut
- Proposed Access Road in Fill
- Proposed Hardstand
- Proposed Clean Water Drainage
- Proposed Dirty Water Drainage
- SP 12 550m² — Stilling Pond Number, Catchment Area & Flow Direction
- Proposed Culvert to Existing Open Drain

KEYPLAN






| rev. | modifications | by | date |
|---|---|---|---|
| P01.2 | Silt Ponds added to Spoil Deposition Areas, Drainage Table Updated | AMcC | 23.11.23 |
| P01.1 | Issued For Comment | AMcC | 13.04.23 |

Client: Cush Wind Farm

Project: Cush Wind Farm, Co Offlay.

Stage: Planning

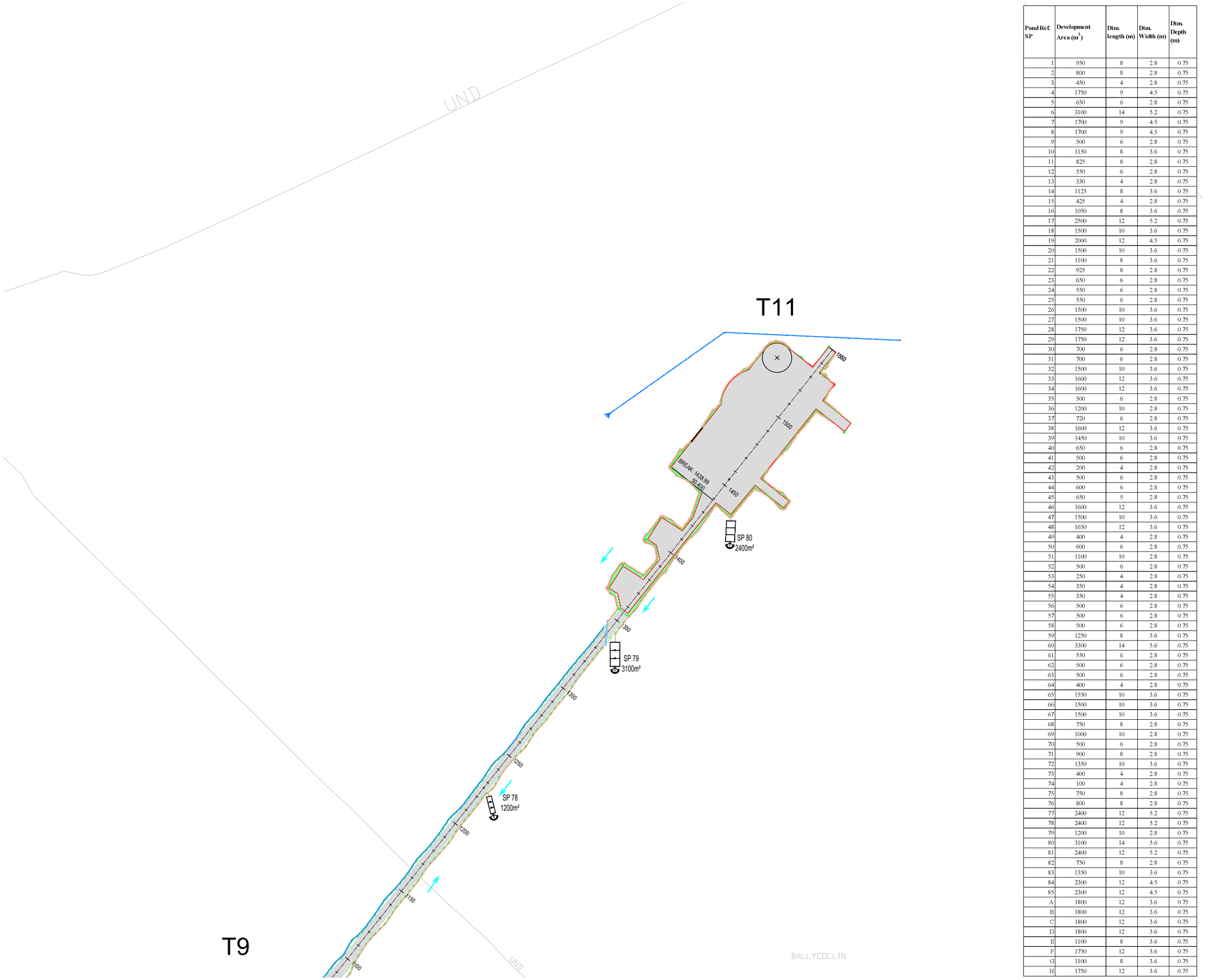
Title: **Drainage Layout Plan**
**Sheet 9 of 11**

Scales: 1:2000 (A3)

| Surveyed | Prepared By | Checked | Date |
|---|---|---|---|
| | AMcC | JMcE | 16.04.2023 |



| Job No. | Drawing no. | Revision |
|---|---|---|
| 6921 | 6921-JOD-XX-DR-C-0309 | P01.2 |




| Pond Ref. SP | Development Area ($m^2$) | Dim. length (m) | Dim. Width (m) | Dim. Depth (m) |
|---|---|---|---|---|
| 1 | 950 | 8 | 2.8 | 0.75 |
| 2 | 800 | 8 | 2.8 | 0.75 |
| 3 | 450 | 4 | 2.8 | 0.75 |
| 4 | 1750 | 9 | 4.5 | 0.75 |
| 5 | 650 | 6 | 2.8 | 0.75 |
| 6 | 3100 | 14 | 5.2 | 0.75 |
| 7 | 1700 | 9 | 4.5 | 0.75 |
| 8 | 1700 | 9 | 4.5 | 0.75 |
| 9 | 500 | 6 | 2.8 | 0.75 |
| 10 | 1150 | 8 | 3.6 | 0.75 |
| 11 | 825 | 8 | 2.8 | 0.75 |
| 12 | 550 | 6 | 2.8 | 0.75 |
| 13 | 330 | 4 | 2.8 | 0.75 |
| 14 | 1125 | 8 | 3.6 | 0.75 |
| 15 | 425 | 4 | 2.8 | 0.75 |
| 16 | 1050 | 8 | 3.6 | 0.75 |
| 17 | 2500 | 12 | 5.2 | 0.75 |
| 18 | 1500 | 10 | 3.6 | 0.75 |
| 19 | 2000 | 12 | 4.5 | 0.75 |
| 20 | 1500 | 10 | 3.6 | 0.75 |
| 21 | 1100 | 8 | 3.6 | 0.75 |
| 22 | 925 | 8 | 2.8 | 0.75 |
| 23 | 650 | 6 | 2.8 | 0.75 |
| 24 | 550 | 6 | 2.8 | 0.75 |
| 25 | 550 | 6 | 2.8 | 0.75 |
| 26 | 1500 | 10 | 3.6 | 0.75 |
| 27 | 1500 | 10 | 3.6 | 0.75 |
| 28 | 1750 | 12 | 3.6 | 0.75 |
| 29 | 1750 | 12 | 3.6 | 0.75 |
| 30 | 700 | 6 | 2.8 | 0.75 |
| 31 | 700 | 6 | 2.8 | 0.75 |
| 32 | 1500 | 10 | 3.6 | 0.75 |
| 33 | 1600 | 12 | 3.6 | 0.75 |
| 34 | 1600 | 12 | 3.6 | 0.75 |
| 35 | 500 | 6 | 2.8 | 0.75 |
| 36 | 1200 | 10 | 2.8 | 0.75 |
| 37 | 720 | 6 | 2.8 | 0.75 |
| 38 | 1600 | 12 | 3.6 | 0.75 |
| 39 | 1450 | 10 | 3.6 | 0.75 |
| 40 | 650 | 6 | 2.8 | 0.75 |
| 41 | 500 | 6 | 2.8 | 0.75 |
| 42 | 200 | 4 | 2.8 | 0.75 |
| 43 | 500 | 6 | 2.8 | 0.75 |
| 44 | 600 | 6 | 2.8 | 0.75 |
| 45 | 650 | 5 | 2.8 | 0.75 |
| 46 | 1600 | 12 | 3.6 | 0.75 |
| 47 | 1500 | 10 | 3.6 | 0.75 |
| 48 | 1650 | 12 | 3.6 | 0.75 |
| 49 | 400 | 4 | 2.8 | 0.75 |
| 50 | 600 | 6 | 2.8 | 0.75 |
| 51 | 1100 | 10 | 2.8 | 0.75 |
| 52 | 500 | 6 | 2.8 | 0.75 |
| 53 | 250 | 4 | 2.8 | 0.75 |
| 54 | 350 | 4 | 2.8 | 0.75 |
| 55 | 350 | 4 | 2.8 | 0.75 |
| 56 | 500 | 6 | 2.8 | 0.75 |
| 57 | 500 | 6 | 2.8 | 0.75 |
| 58 | 500 | 6 | 2.8 | 0.75 |
| 59 | 1250 | 8 | 3.6 | 0.75 |
| 60 | 3300 | 14 | 5.6 | 0.75 |
| 61 | 550 | 6 | 2.8 | 0.75 |
| 62 | 500 | 6 | 2.8 | 0.75 |
| 63 | 500 | 6 | 2.8 | 0.75 |
| 64 | 400 | 4 | 2.8 | 0.75 |
| 65 | 1550 | 10 | 3.6 | 0.75 |
| 66 | 1500 | 10 | 3.6 | 0.75 |
| 67 | 1500 | 10 | 3.6 | 0.75 |
| 68 | 750 | 8 | 2.8 | 0.75 |
| 69 | 1000 | 10 | 2.8 | 0.75 |
| 70 | 500 | 6 | 2.8 | 0.75 |
| 71 | 900 | 8 | 2.8 | 0.75 |
| 72 | 1350 | 10 | 3.6 | 0.75 |
| 73 | 400 | 4 | 2.8 | 0.75 |
| 74 | 100 | 4 | 2.8 | 0.75 |
| 75 | 750 | 8 | 2.8 | 0.75 |
| 76 | 800 | 8 | 2.8 | 0.75 |
| 77 | 2400 | 12 | 5.2 | 0.75 |
| 78 | 2400 | 12 | 5.2 | 0.75 |
| 79 | 1200 | 10 | 2.8 | 0.75 |
| 80 | 3100 | 14 | 5.6 | 0.75 |
| 81 | 2400 | 12 | 5.2 | 0.75 |
| 82 | 750 | 8 | 2.8 | 0.75 |
| 83 | 1350 | 10 | 3.6 | 0.75 |
| 84 | 2300 | 12 | 4.5 | 0.75 |
| 85 | 2300 | 12 | 4.5 | 0.75 |
| A | 1800 | 12 | 3.6 | 0.75 |
| B | 1800 | 12 | 3.6 | 0.75 |
| C | 1800 | 12 | 3.6 | 0.75 |
| D | 1800 | 12 | 3.6 | 0.75 |
| E | 1100 | 8 | 3.6 | 0.75 |
| F | 1750 | 12 | 3.6 | 0.75 |
| G | 1100 | 8 | 3.6 | 0.75 |
| H | 1750 | 12 | 3.6 | 0.75 |

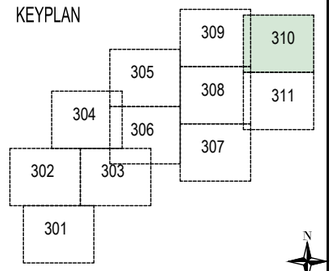
NOTES:

1 FIGURED DIMENSIONS ONLY TO BE TAKEN FROM THIS DRAWING.
2 ALL DRAWINGS TO BE CHECKED BY THE CONTRACTOR ON SITE.
3 ENGINEER TO BE INFORMED OF ANY DISCREPANCIES BEFORE ANY WORK COMMENCES.
4 THIS DRAWING TO BE READ IN CONJUNCTION WITH ALL OTHER RELEVANT DRAWINGS AND SPECIFICATIONS.

Legend

- Proposed Access Road in Cut
- Proposed Access Road in Fill
- Proposed Hardstand
- Proposed Clean Water Drainage
- Proposed Dirty Water Drainage
- SP 12 550m² — Stilling Pond Number, Catchment Area & Flow Direction
- Proposed Culvert to Existing Open Drain

KEYPLAN






| rev. | modifications | by | date |
|---|---|---|---|
| P01.2 | Silt Ponds added to Spoil Deposition Areas, Drainage Table Updated | AMcC | 23.11.23 |
| P01.1 | Issued For Comment | AMcC | 13.04.23 |

Client: Cush Wind Farm

Project: Cush Wind Farm, Co Offlay.

Stage: Planning

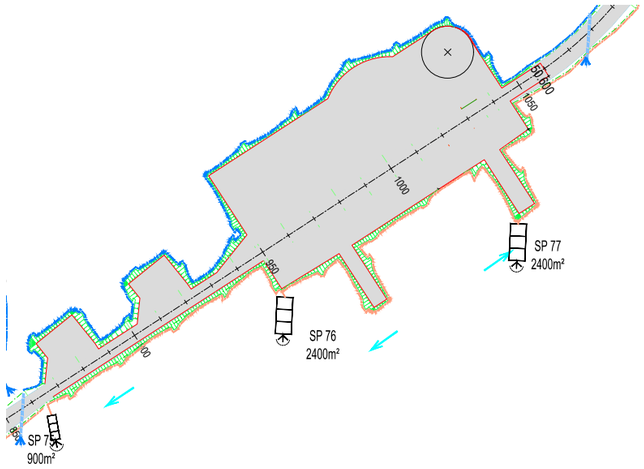
Title: **Drainage Layout Plan**
**Sheet 10 of 11**

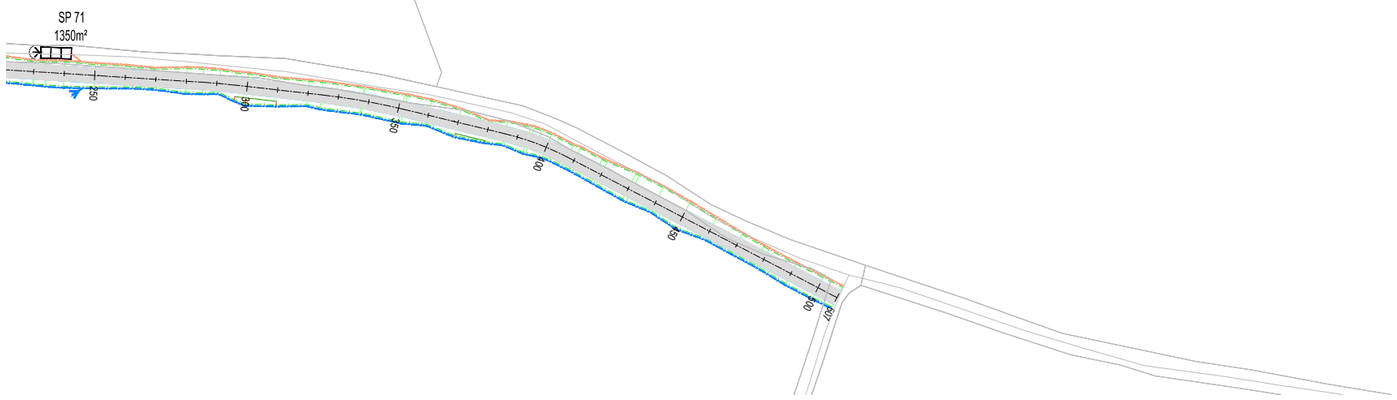
Scales: 1:2000 (A3)

| Surveyed | Prepared By | Checked | Date |
|---|---|---|---|
| | AMcC | JMcE | 16.04.2023 |



| Job No. | Drawing no. | Revision |
|---|---|---|
| 6921 | 6921-JOD-XX-DR-C-0310 | P01.2 |

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| Pond Ref. SP | Development Area ($m^2$) | Dim. length (m) | Dim. Width (m) | Dim. Depth (m) |
|---|---|---|---|---|
| 1 | 950 | 8 | 2.8 | 0.75 |
| 2 | 800 | 8 | 2.8 | 0.75 |
| 3 | 450 | 4 | 2.8 | 0.75 |
| 4 | 1750 | 9 | 4.5 | 0.75 |
| 5 | 650 | 6 | 2.8 | 0.75 |
| 6 | 3100 | 14 | 5.2 | 0.75 |
| 7 | 1700 | 9 | 4.5 | 0.75 |
| 8 | 1700 | 9 | 4.5 | 0.75 |
| 9 | 500 | 6 | 2.8 | 0.75 |
| 10 | 1150 | 8 | 3.6 | 0.75 |
| 11 | 825 | 8 | 2.8 | 0.75 |
| 12 | 550 | 6 | 2.8 | 0.75 |
| 13 | 330 | 4 | 2.8 | 0.75 |
| 14 | 1125 | 8 | 3.6 | 0.75 |
| 15 | 425 | 4 | 2.8 | 0.75 |
| 16 | 1050 | 8 | 3.6 | 0.75 |
| 17 | 2500 | 12 | 5.2 | 0.75 |
| 18 | 1500 | 10 | 3.6 | 0.75 |
| 19 | 2000 | 12 | 4.5 | 0.75 |
| 20 | 1500 | 10 | 3.6 | 0.75 |
| 21 | 1100 | 8 | 3.6 | 0.75 |
| 22 | 925 | 8 | 2.8 | 0.75 |
| 23 | 650 | 6 | 2.8 | 0.75 |
| 24 | 550 | 6 | 2.8 | 0.75 |
| 25 | 550 | 6 | 2.8 | 0.75 |
| 26 | 1500 | 10 | 3.6 | 0.75 |
| 27 | 1500 | 10 | 3.6 | 0.75 |
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| 33 | 1600 | 12 | 3.6 | 0.75 |
| 34 | 1600 | 12 | 3.6 | 0.75 |
| 35 | 500 | 6 | 2.8 | 0.75 |
| 36 | 1200 | 10 | 2.8 | 0.75 |
| 37 | 720 | 6 | 2.8 | 0.75 |
| 38 | 1600 | 12 | 3.6 | 0.75 |
| 39 | 1450 | 10 | 3.6 | 0.75 |
| 40 | 650 | 6 | 2.8 | 0.75 |
| 41 | 500 | 6 | 2.8 | 0.75 |
| 42 | 200 | 4 | 2.8 | 0.75 |
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| 47 | 1500 | 10 | 3.6 | 0.75 |
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| 49 | 400 | 4 | 2.8 | 0.75 |
| 50 | 600 | 6 | 2.8 | 0.75 |
| 51 | 1100 | 10 | 2.8 | 0.75 |
| 52 | 500 | 6 | 2.8 | 0.75 |
| 53 | 250 | 4 | 2.8 | 0.75 |
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| 55 | 350 | 4 | 2.8 | 0.75 |
| 56 | 500 | 6 | 2.8 | 0.75 |
| 57 | 500 | 6 | 2.8 | 0.75 |
| 58 | 500 | 6 | 2.8 | 0.75 |
| 59 | 1250 | 8 | 3.6 | 0.75 |
| 60 | 3300 | 14 | 5.6 | 0.75 |
| 61 | 550 | 6 | 2.8 | 0.75 |
| 62 | 500 | 6 | 2.8 | 0.75 |
| 63 | 500 | 6 | 2.8 | 0.75 |
| 64 | 400 | 4 | 2.8 | 0.75 |
| 65 | 1550 | 10 | 3.6 | 0.75 |
| 66 | 1500 | 10 | 3.6 | 0.75 |
| 67 | 1500 | 10 | 3.6 | 0.75 |
| 68 | 750 | 8 | 2.8 | 0.75 |
| 69 | 1000 | 10 | 2.8 | 0.75 |
| 70 | 500 | 6 | 2.8 | 0.75 |
| 71 | 900 | 8 | 2.8 | 0.75 |
| 72 | 1350 | 10 | 3.6 | 0.75 |
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| 74 | 100 | 4 | 2.8 | 0.75 |
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| 80 | 3100 | 14 | 5.6 | 0.75 |
| 81 | 2400 | 12 | 5.2 | 0.75 |
| 82 | 750 | 8 | 2.8 | 0.75 |
| 83 | 1350 | 10 | 3.6 | 0.75 |
| 84 | 2300 | 12 | 4.5 | 0.75 |
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| C | 1800 | 12 | 3.6 | 0.75 |
| D | 1800 | 12 | 3.6 | 0.75 |
| E | 1100 | 8 | 3.6 | 0.75 |
| F | 1750 | 12 | 3.6 | 0.75 |
| G | 1100 | 8 | 3.6 | 0.75 |
| H | 1750 | 12 | 3.6 | 0.75 |

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Legend

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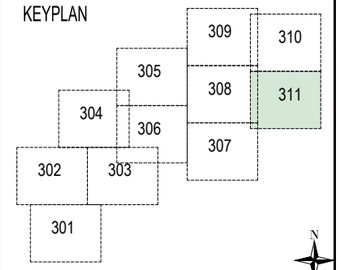
- Proposed Access Road in Fill
- Proposed Hardstand
- Proposed Clean Water Drainage
- Proposed Dirty Water Drainage
- SP 12 550m² — Stilling Pond Number, Catchment Area & Flow Direction
- Proposed Culvert to Existing Open Drain

KEYPLAN






| rev. | modifications | by | date |
|---|---|---|---|
| P01.2 | Silt Ponds added to Spoil Deposition Areas, Drainage Table Updated | AMcC | 23.11.23 |
| P01.1 | Issued For Comment | AMcC | 13.04.23 |

Client: Cush Wind Farm

Project: Cush Wind Farm, Co Offlay.

Stage: Planning

Title: **Drainage Layout Plan**
**Sheet 11 of 11**

Scales: 1:2000 (A3)

| Surveyed | Prepared By | Checked | Date |
|---|---|---|---|
| | AMcC | JMcE | 16.04.2023 |


JENNINGS O'DONOVAN & PARTNERS
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FINISKLIN,
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TEL. (0035371) 9161416.
FAX. (0035371) 9161080.
Email. info@jodireland.com
Web. www.jodireland.com

| Job No. | Drawing no. | Revision |
|---|---|---|
| 6921 | 6921-JOD-XX-DR-C-0311 | P01.2 |


## NOTES:

1 FIGURED DIMENSIONS ONLY TO BE TAKEN FROM THIS DRAWING.
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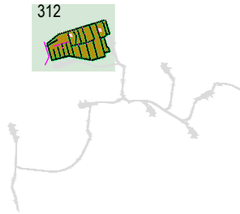
4 THIS DRAWING TO BE READ IN CONJUNCTION WITH ALL OTHER RELEVANT DRAWINGS AND SPECIFICATIONS.

## Legend

- Proposed Access Road in Cut
- Proposed Access Road in Fill
- Proposed Hardstand
- Proposed Clean Water Drainage
- Proposed Dirty Water Drainage
- SP 12 / 550m² — Stilling Pond Number, Catchment Area & Flow Direction
- Proposed Culvert to Existing Open Drain
- Proposed Double Silt Fence — As Detail Drawing 6921-JOD-XX-DR-C-0324
- Proposed Drainage Check Weir ( 20m Intervals) — As Detail Drawing 6921-JOD-XX-DR-C-0321
- Proposed Spoil Deposition Area

## KEYPLAN






| | | | |
|---|---|---|---|
| P01.3 | Spoil Deposition Area Updated | AMcC | 13.11.23 |
| P01.2 | Issued For Comment, Site layout revised and drainage revised accordingly | AMcC | 04.09.23 |
| P01.1 | Issued For Comment | AMcC | 13.04.23 |
| P01.1 | Issued For Comment | AMcC | 13.04.23 |
| rev. | modifications | by | date |

Client: Cush Wind Farm

Project: Cush Wind Farm, Co Offlay.

Stage: Planning

Title: **Soil Deposition Area**
**Silt Fencing Layout Plan**

Scales: 1:2500 (A3)

| Surveyed | Prepared By | Checked | Date |
|---|---|---|---|
| | AMcC | JMcE | 24.04.2023 |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Email. info@jodireland.com
Web. www.jodireland.com

| Job No. | Drawing no. | Revision |
|---|---|---|
| 6921 | 6921-JOD-XX-DR-C-0312 | P01.3 |

## Annex 3 –
## Rainfall Data

Met Eireann
Return Period Rainfall Depths for sliding Durations
Irish Grid: Easting: 207791, Northing: 210074,

| | Interval | | Years | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DURATION | 6months, | 1year, | 2, | 3, | 4, | 5, | 10, | 20, | 30, | 50, | 75, | 100, | 150, | 200, | 250, | 500, |
| 5 mins | 2.6, | 3.7, | 4.4, | 5.4, | 6.1, | 6.6, | 8.4, | 10.5, | 11.9, | 13.9, | 15.7, | 17.1, | 19.3, | 21.0, | 22.5, | N/A , |
| 10 mins | 3.6, | 5.2, | 6.1, | 7.5, | 8.5, | 9.2, | 11.7, | 14.6, | 16.6, | 19.4, | 21.9, | 23.8, | 26.9, | 29.3, | 31.3, | N/A , |
| 15 mins | 4.2, | 6.1, | 7.2, | 8.8, | 10.0, | 10.8, | 13.8, | 17.2, | 19.5, | 22.8, | 25.7, | 28.0, | 31.6, | 34.5, | 36.8, | N/A , |
| 30 mins | 5.5, | 7.8, | 9.0, | 11.0, | 12.2, | 13.3, | 16.6, | 20.3, | 22.8, | 26.4, | 29.6, | 32.0, | 35.8, | 38.8, | 41.3, | N/A , |
| 1 hours | 7.1, | 9.9, | 11.4, | 13.6, | 15.0, | 16.2, | 19.9, | 24.0, | 26.8, | 30.6, | 34.0, | 36.6, | 40.6, | 43.7, | 46.3, | N/A , |
| 2 hours | 9.3, | 12.6, | 14.3, | 16.8, | 18.5, | 19.8, | 23.9, | 28.4, | 31.4, | 35.5, | 39.1, | 41.8, | 46.0, | 49.2, | 51.8, | N/A , |
| 3 hours | 10.9, | 14.5, | 16.3, | 19.1, | 20.8, | 22.2, | 26.6, | 31.4, | 34.4, | 38.7, | 42.4, | 45.2, | 49.5, | 52.7, | 55.4, | N/A , |
| 4 hours | 12.2, | 16.0, | 18.0, | 20.8, | 22.7, | 24.1, | 28.7, | 33.6, | 36.8, | 41.1, | 44.9, | 47.8, | 52.1, | 55.4, | 58.1, | N/A , |
| 6 hours | 14.2, | 18.4, | 20.5, | 23.6, | 25.6, | 27.1, | 31.9, | 37.1, | 40.4, | 44.8, | 48.7, | 51.6, | 56.0, | 59.4, | 62.1, | N/A , |
| 9 hours | 16.6, | 21.2, | 23.5, | 26.8, | 28.9, | 30.5, | 35.5, | 40.9, | 44.3, | 48.9, | 52.8, | 55.8, | 60.3, | 63.7, | 66.4, | N/A , |
| 12 hours | 18.6, | 23.4, | 25.8, | 29.3, | 31.5, | 33.1, | 38.3, | 43.8, | 47.3, | 52.0, | 56.0, | 59.0, | 63.5, | 66.9, | 69.6, | N/A , |
| 18 hours | 21.7, | 27.0, | 29.5, | 33.2, | 35.5, | 37.2, | 42.7, | 48.4, | 51.9, | 56.7, | 60.7, | 63.8, | 68.3, | 71.7, | 74.4, | N/A , |
| 24 hours | 24.3, | 29.8, | 32.5, | 36.2, | 38.7, | 40.5, | 46.0, | 51.8, | 55.4, | 60.3, | 64.3, | 67.4, | 71.9, | 75.3, | 78.0, | 87.1, |
| 2 days | 30.8, | 36.9, | 39.9, | 43.9, | 46.5, | 48.4, | 54.2, | 60.2, | 63.9, | 68.8, | 72.9, | 75.9, | 80.4, | 83.7, | 86.4, | 95.2, |
| 3 days | 36.4, | 43.0, | 46.1, | 50.5, | 53.2, | 55.2, | 61.3, | 67.5, | 71.3, | 76.3, | 80.5, | 83.6, | 88.1, | 91.5, | 94.1, | 103.0, |
| 4 days | 41.4, | 48.5, | 51.8, | 56.3, | 59.2, | 61.3, | 67.6, | 74.1, | 78.0, | 83.1, | 87.4, | 90.5, | 95.1, | 98.5, | 101.2, | 110.2, |
| 6 days | 50.6, | 58.3, | 61.9, | 66.9, | 69.9, | 72.2, | 79.0, | 85.8, | 89.9, | 95.3, | 99.7, | 103.0, | 107.7, | 111.2, | 114.0, | 123.2, |
| 8 days | 59.0, | 67.3, | 71.2, | 76.4, | 79.7, | 82.1, | 89.2, | 96.4, | 100.6, | 106.2, | 110.8, | 114.2, | 119.1, | 122.7, | 125.6, | 134.9, |
| 10 days | 66.8, | 75.7, | 79.8, | 85.4, | 88.8, | 91.3, | 98.7, | 106.2, | 110.6, | 116.4, | 121.1, | 124.6, | 129.6, | 133.3, | 136.2, | 145.7, |
| 12 days | 74.4, | 83.7, | 88.0, | 93.8, | 97.4, | 100.0, | 107.7, | 115.4, | 120.0, | 125.9, | 130.8, | 134.3, | 139.5, | 143.2, | 146.2, | 155.8, |
| 16 days | 88.8, | 98.9, | 103.6, | 109.8, | 113.6, | 116.4, | 124.6, | 132.7, | 137.5, | 143.7, | 148.8, | 152.5, | 157.8, | 161.7, | 164.8, | 174.7, |
| 20 days | 102.5, | 113.3, | 118.3, | 124.9, | 128.9, | 131.8, | 140.4, | 148.9, | 153.9, | 160.3, | 165.6, | 169.4, | 174.9, | 178.9, | 182.0, | 192.2, |
| 25 days | 119.0, | 130.6, | 135.9, | 142.8, | 147.1, | 150.2, | 159.2, | 168.0, | 173.2, | 179.9, | 185.3, | 189.3, | 194.9, | 199.1, | 202.3, | 212.7, |

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

# Annex 5 –
# Water Quality Monitoring Plan

Cush Wind Farm

# Planning-Stage Construction & Environmental Management Plan

# Water Quality Monitoring Plan

Cush Wind Limited

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# Contents



# 1.0 Introduction

Galetech Energy Services (GES), on behalf of Cush Wind Limited, has prepared this Water Quality Monitoring Plan (WQMP) to outline the procedures to be followed during the monitoring of surface waters prior to, during and post-construction of the Cush Wind Farm.

## 1.1 Purpose of this Report

Many construction and industrial sites have the potential to cause a deterioration in downstream water quality through pollution events from hydrocarbons and siltation/sedimentation. The purpose of this report is to verify the efficacy of pollution prevention and mitigation measures implemented at the Cush Wind Farm during construction.

This is a live document and will be updated by the appointed contractor prior to the commencement of development. Prior to the commencement of construction, the updated WQMP will be reviewed by the Environmental Manager (EM) and Ecological Clerk of Works (EcoW), as necessary, to confirm the appropriateness of the measures set out therein.

## 1.2 Requirement for Water Quality Monitoring

As described above, construction activities associated with the development of a wind farm can give rise to a risk of pollution. A deterioration in downstream water quality could arise from:-

- Land Slide;
- Fire;
- Leaking plant or equipment;
- Containment Failure;
- Overfilling of containment vessels;
- Wind-blown waste, litter or dust;
- Flooding on site;
- Leaking Portaloo;
- Fuel drips or spills during re-fuelling;
- Leak from fuel or chemical containers; and
- Failure of pumps and pipelines.

Any of these incidents could affect downstream surface waters which, in turn, could result in adverse effects on aquatic species and habitats.

## 1.3 Reference Documents

The production of this WQMP has been supported by best practice manuals and will be accounted for in the further development of the appointed contractor's detailed CEMP.

Other guidance documents have been used to develop this WQMP; including a Planning-Stage Construction & Environmental Management Plan, Spoil Management Plan, Surface Water Management Plan, and Environmental & Emergency Response Plan.

# 2.0 Description of the Project

Cush Wind Limited intend to construct the Cush Wind Farm which will consist of:-

- 8 no. wind turbines with an overall tip height of 200m, and all associated ancillary infrastructure;

- All associated and ancillary site development, excavation, construction, landscaping and reinstatement works, including provision of site drainage infrastructure and forestry felling.
- Temporary alterations to the turbine component haul route; and,
- Construction of an electricity substation, Battery Electricity Storage System and installation of 5.6km of underground grid connection to facilitate connection of the proposed electricity substation to the existing 110kV substation at Clondallow, County Offaly;

The project site is located in rural Co. Offaly, approximately 4km north of the town of Birr and c. 28km south-west of Tullamore, County Offaly. Off-site and secondary developments; including the forestry replant lands and candidate quarries which may supply construction materials; also form part of the project.

The turbine component haul route, and associated temporary alteration works, are located within counties Galway, Roscommon, Westmeath, and Offaly. It is envisaged that the turbines will be transported from the Port of Galway, through the counties of Galway, Roscommon, Westmeath and Offaly, to the project site.

As well as the reference documents listed in **Section 1.3**, various environmental reports have been prepared for the development including:-

- Environmental Impact Assessment Report (Galetech Energy Services);
- Biodiversity Chapter (SLR Consulting);
- Land & Soil Chapter (Hydro Environmental Services);
- Water Chapter (Hydro Environmental Services); and
- Natura Impact Statement (SLR Consulting).

## 3.0 Responsibilities

### 3.1 Contractor

The appointed Contractor will be responsible for employing an independent Environmental Manager (EM) to undertake all water quality monitoring and sampling prior to, during, and post-construction.

### 3.2 Environmental Manager

The independent EM, appointed prior to construction, will be responsible for the implementation and coordination of the methods set out in this WQMP. Prior to construction, the Contractor will be instructed to provide a 'schedule of work' to the EM at the beginning of each week to determine the intensity of monitoring required.

The EM will prepare and deliver site induction and training to all construction personnel, in liaison with the Project Manager and Contractor.

The EM will:-

- Undertake specific monitoring activities and reporting in accordance with best practice;
- Undertake weekly visual inspections for signs of ground damage or solids escaping to nearby drainage features watercourses in vicinity of construction works;
- Undertake weekly visual inspections of the installed surface water management system (e.g. silt traps, silt ponds, settlement lagoons, check dams, and buffered outfalls) and other drainage features for evidence of contaminated run-off or drainage system failure;

- Collection and analysis of water samples at monitoring locations (upstream & downstream of the project site). The selection of water monitoring locations will be agreed with the local authority prior to the commencement of construction;
- Attend critical work phases including installation/construction of watercourse crossings, turbine foundation concrete pours, and grid connection Horizontal Direction Drilling (HDD) works.

## 4.0 Water Sampling Methodology

The collection and analysis of water samples at the monitoring locations (i.e. upstream & downstream of project site) will be completed prior to, during and post-construction. The precise scope of monitoring will agreed with the local authority prior to commencement of construction works.

With respect to the proposed felling works, it is proposed that 1 no. round of sampling will be undertaken within 4-weeks of the commencement of felling which will provide a set of baseline results against which all subsequent samples can be assessed. Weekly-sampling will then be completed for the duration of the felling activities; while a minimum of 1 no. round of sampling will be completed following the felling operations. Sampling locations SW1 and SW2, as outlined in **Chapter 7** of the EIAR, will be selected as sampling locations for felling operations.

Additionally, daily surface water monitoring forms (for visual inspections and field chemistry measurements) will also be utilised at every works site near any watercourse. These will be taken daily and kept on site for record and inspection

With regards general construction activity, it is proposed that 1 no. round of sampling will be undertaken prior to the commencement of development which will provide a set of baseline results against which all subsequent samples can be assessed. Monthly-sampling will then be completed for the duration of the construction phase; while a further 1 no. round of sampling will be completed following the completion of construction and reinstatement activities. Sampling locations SW1-SW4, as outlined in **Chapter 7** of the EIAR, will be selected as sampling locations for the duration of the construction phase.

As a minimum, the general monitoring programme will include:-

- 1 no. baseline sample (by the EM);
- Daily visual observation in areas of high construction activity (by a suitably trained staff-member) or during high rainfall periods to identify any evidence of siltation, oil or silt. Visual inspections will include details of the colour of the water at the time of inspection;
- Weekly visual inspections and monthly field hydrochemistry (by the EM); and
- One round of post construction monitoring (by the EM).

Monitoring locations will be identified through grid reference, photographic record and indicated on a drawing. Each location will be marked on the ground (stake/post) to ensure that the correct location is sampled each time during repeat sampling locations.

For the duration of the monitoring period, sample locations shall be consistently identified and any additional locations will be recorded and a photograph taken at the time of sampling.

'Control' sample locations may also be included in the scope of any monitoring.

### 4.1 Hydrochemistry

In addition to the visual inspections described above, all water samples will be subject to hydrochemistry analysis. The parameters to be analysed will be agreed with the local authority prior to the commencement of construction, and may include:-

- pH;
- Temperature;
- Total Suspended Solids (TSS);
- Dissolved Organic Carbon (DOC);
- Conductivity;
- Dissolved Oxygen (DO);
- Total Oxidized Nitrogen (TON);
- Ammoniacal Nitrogen;
- Ammonia;
- Potassium;
- Phosphate;
- Biological Oxygen Demand (BOD);
- Chemical Oxygen Demand (COD); and
- Total Petroleum Hydrocarbons (TPH) (Construction Phase only).

## 5.0 Reporting

Each month, the EM will prepare a report on the results of the water quality monitoring. The results will assist in determining the requirements for improvements in drainage, surface water management, and pollution prevention measures.

The EM will also present the results to staff and construction personnel to ensure full awareness of any necessary improvements. This shall be done at monthly-meetings and reported within the overall Monthly Environmental Report to be prepared by the EM. The monthly reports on water quality will be provided to Cush Wind Limited and will be made available to the local authority, as may be necessary.

The monthly reports on water quality will consider all visual, field monitoring and results of laboratory analysis undertaken that month. Reports will describe how the results compare with baseline data as well as previous monthly reports on water quality. The reports will describe whether any deterioration or improvement in water quality has been observed and whether any effects are attributable to construction activities and what remedial measures or corrective actions have been, or are required to be, implemented.

Upon completion of all post-construction monitoring, the EM will prepare a final report on water quality. This will detail the overall performance against baseline data, details on any impacts attributed to construction works and recommendations for remedial works if required. The final report will be provided to the local authority.

## 6.0 Emergency Response

In the event that a pollution incident arises from construction works; such as that resulting from a spill or accidental release of chemicals, oils and fuels or concrete effluent; which threatens to enter, or has entered, a watercourse, additional sampling and analysis of surface water samples will be undertaken to determine the level of impact and whether remedial measures are required.

Where a pollution incident has occurred as a result of construction works, the EM will consult with the local authority to determine sampling requirements and any

additional survey requirements. Where it is demonstrated that the pollution occurred as a result of non-compliance with measures set out in project documentation (including the Environmental Impact Assessment Report, Natura Impact Statement, Construction Environmental Management Plan, and Surface Water Management Plan), the costs of any additional sampling or remedial measures shall be borne, in full, by the Contractor.