DYRICK HILL WIND FARM LIMITED

DYRICK HILL WIND FARM

CO. WATERFORD

CONSTRUCTION ENVIRONMENTAL MANAGEMENT PLAN (CEMP)

MAY 2023

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DOCUMENT APPROVAL

PROJECT	Dyrick Hill Wind Farm	
CLIENT / JOB NO	Dyrick Hill Wind Farm Limited	6497
DOCUMENT TITLE	Construction Environmental Management Plan	

	Prepared by	**Reviewed /Approved by**
Document Final	Name Ryan Mitchell	Name David Kiely
Date May 2023	Signature RMitchell	Signature David Kiely

DYRICK HILL WIND FARM, CO. WATERFORD

CONSTRUCTION ENVIRONMENTAL MANAGEMENT PLAN

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1 INTRODUCTION

1.1 BACKGROUND TO REPORT

Jennings O'Donovan & Partners Limited, on behalf of EMPower, has prepared this Construction Environmental Management Plan (CEMP) for the construction of the proposed 12 turbine, Dyrick Hill Wind Farm, improvement works to roads to facilitate turbine delivery and the construction of 16.01km of underground electricity to connect the proposed wind farm substation to the National Grid at Dungarvan 110kV substation. The Development, as proposed, has been designed to ensure that any environmental impacts which may arise can be appropriately mitigated such that there will be no likely significant environmental effects.

This document has been prepared on a basis, this document will be further developed and expanded following the appointment of the Contractors for the main construction works. Some items of this CEMP can only be finalised with appropriate input from the Contractors who will actually carry out the main construction works. This CEMP identifies, for the incoming Contractors, the key planning, environmental and contract document constraints that must be adhered to in order to deliver optimum environmental reassurance for the site.

The preparation of this document, and its continued development, is considered to be an appropriate mechanism to address the requirements to of the aforementioned condition to ensure the appropriate management of construction activities in accordance with the relevant environmental requirements.

This document should be read in conjunction with the Appropriate Assessment Screening Report, Natura Impact Statement, Environmental Impact Assessment Report (EIAR), Planning Report, Planning Drawings.

1.2 CONSTRUCTION ENVIRONMENTAL MANAGEMENT PLAN (CEMP): AIMS & OBJECTIVES

This CEMP has been developed in accordance with the Institute of Environmental Management and Assessment Practitioner "*Environmental Management Plans*", Best Practice Series, Volume 12, December 2008.

The principal objective of this CEMP is to avoid, minimise and control adverse environmental impacts associated with the development of the wind farm. As such, the Contractors commit to safeguarding the environment through the identification, avoidance and mitigation of the potential negative environmental impacts associated with the Development.

This CEMP aims to define good practice as well as specific actions required to implement mitigation requirements as identified in the EIS, the planning process and/or other licensing or consenting processes.

The CEMP will be developed further, and/or amended where necessary, to take account of any additional information which may be made available from the detailed design process or site surveys etc.

The CEMP will form part of the main Civil Balance of Plant Construction works Contract as well as the Electrical Balance of Plant Construction works content. The Contractors 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) as required by their Contract.

While this version of the CEMP provides a benchmark for good practice, where avoidance or further minimisation of risks to the environment can be demonstrated through use of alternative methods or improvements to current practices, the Contractors will implement these wherever possible, subject to approval from environmental monitoring personnel.

1.3 CEMP DEVELOPMENT & IMPLEMENTATION

The CEMP has been prepared as part of the planning application for Dyrick Hill Wind Farm. It is a live document on site and will be developed further by the Contractors with site specific method statements and plans as required prior to each phase of the works. It is also effectively a document management system for recording information and data relating to environmental checks, reports, surveys, monitoring data and auditing. Upon completion of the construction works, the Contractors will submit a complete electronic copy of the final CEMP to the client for their records. This final CEMP will include electronic scans of all hard copy reports, data, field records and correspondence which are gathered over the course of the construction works.

While version numbers will remain fixed depending on the stage of the project, it is acknowledged that the CEMP is a continually evolving document which can be updated in part or whole, at any stage of the project. Hence, revision and document distribution records are included at the front of each CEMP document to enable individual documents to be updated at any time. A summary of the CEMP development process and the required input from the main parties involved in the post planning and construction of the wind farm are indicated in **Figure 1.1**. The Contractors will be responsible for further development of the CEMP in line with other relevant licenses and consents. This may involve liaising with statutory bodies where appropriate.

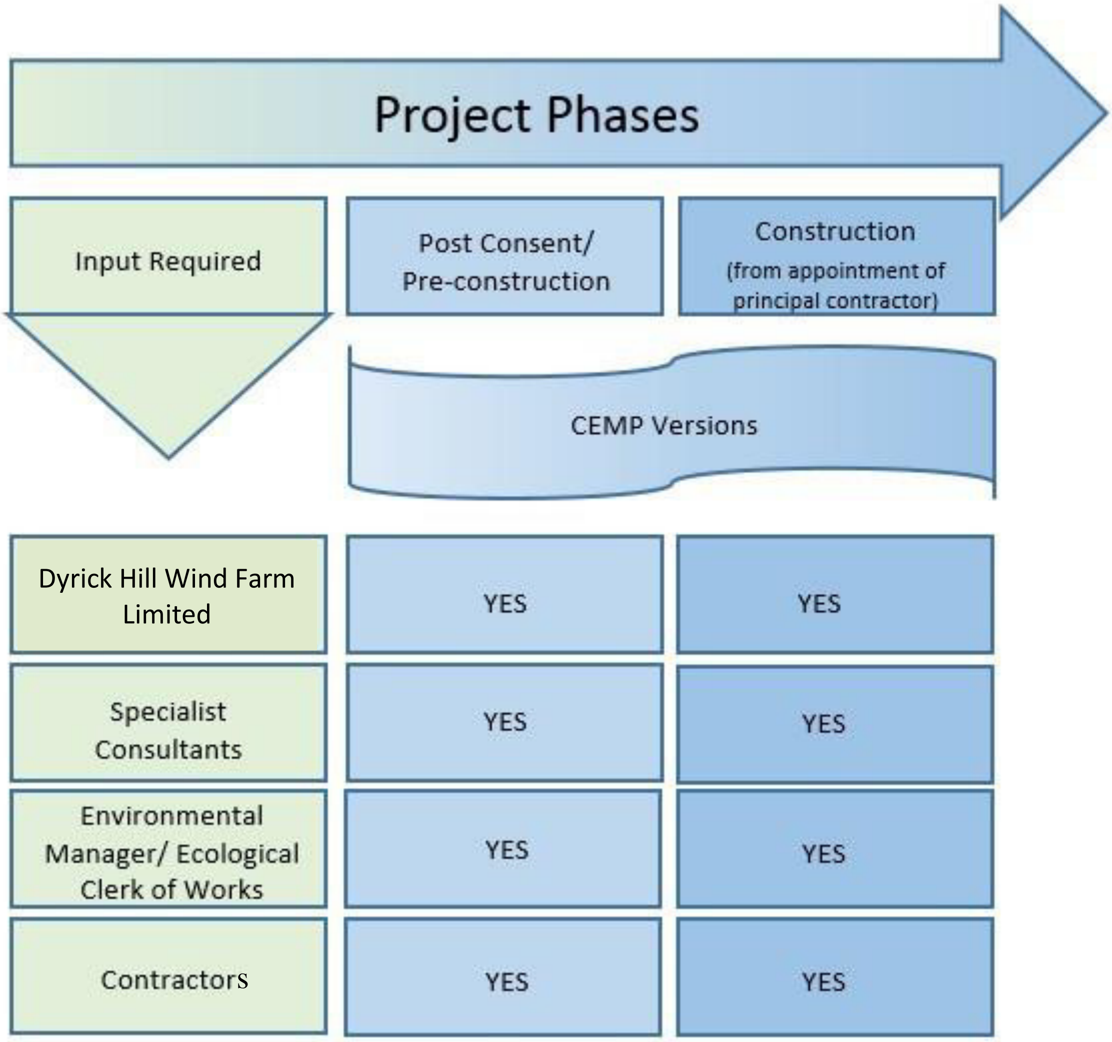

Figure 1.1 Summary of CEMP Development Process

1.4 CEMP ROLES & RESPONSIBILITIES

Prior to commencement of construction works, the Contractors will identify a core Environmental Management Group, comprising of specific project personnel and the Ecological Clerk of Works. 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, including the Resident Engineer and will liaise with other relevant external bodies as required.

The Developer will appoint an Ecological Clerk of Works who will be responsible for coordination, compliance monitoring and continued development of the CEMP and any other surveys, reports or method statements required. The Ecological Clerk of Works will also review the Contractors' method statements and environmental plans as required by the CEMP, carry out compliance auditing during the construction phase and coordinate the Environmental Management Group and required liaisons between EMPower the Contractors, the Planning Authority and other statutory authorities.

1.5 CEMP STRUCTURE

The CEMP is divided into discrete Sections which are designed to be filed as separate documents / folders if required. A copy of the CEMP documents / folder(s) will be kept in the site offices for the duration of the site works and will be made available for review at any time. The Contractors Ecological Clerk of Works will be responsible for the CEMP and will keep all sections updated throughout the construction phase.

Where a Contractor has standard documents within his own company / corporate Environmental Management Plans which cover a particular requirement of this CEMP, these will either be inserted or cross referenced within the relevant Section of this CEMP.
The CEMP Sections are listed in **Table 1.1** as follows:

Table 1.1: CEMP – Document Structure

Section	Title & Brief Description	Contractors Development Required
1	**Introduction**	No (Information purposes only)
2	**Project Information** Provides details on site location, scheme description and a summary of the environmental sensitivities at the Site (as derived from the Appropriate Assessment Screenings and other information where available).	No (Information purposes only)
3	**Environmental Controls** Provides details on relevant Planning Consent Conditions and mitigation measures outline in the EIAR and NIS. Any documents prepared by EMPower in response to Consent Conditions will be recorded in Table 3.9. Table 3.10 contains a record of all Scheme	**Yes** Any documents prepared by the Contractors in response to Consent Conditions will be recorded by the Contractors in Table 3.9 and inserted in the CEMP where necessary. Any Scheme Amendments and / or Variations

Section	Title & Brief Description	Contractors Development Required
	Amendments and Table 3.11 a Register of Variations.	to the CEMP required during the works will be recorded by the Contractors in Tables 3.2 and 3.3.
3	**Environmental Communications Plan** Contains details on specific requirements relating to: • Contact details for Dyrick Hill Wind Farm Limited, personnel, technical specialists, Contractors personnel, regulators, landowners, other stakeholders etc.; • Meetings, reports and consultations; • Roles and responsibilities; and • General reporting procedures and tasks.	Yes The Contractors will: i) Insert contact information for regulatory authorities and other stakeholders (where not already provided) into Table 4.1 ii) Refer to Table 4.2 for details on requirements for meetings, reports and consultations iii) Insert information on Contractors appointments and responsibilities relating to environmental management and implementation of this CEMP into Table 4.3. iv) Refer to Figure 4.1 for a summary of the main communication lines.
5	**Correspondence, Records, Reports** This Section relates to document control and retention of records. The information at the start of Section 4 provides: • A list of all documents to be retained / filed within the CEMP. Table 5.1 provides a record of all Environmental Consents, Licenses and Permits issued for the project.	**Yes** The Contractors will complete Table 5.1. Throughout the duration of the Contract, the Contractors will insert / file all communication records, data, field records and reports associated with Environmental Management and implementation of this CEMP into this Section 5. This Section may be sub-divided into sub-folders for specific information relating to discrete areas of Environmental Management (such as waste management, pollution prevention, water quality monitoring, ecology etc). Alternatively, this information may be filed within the individual Management Plans in Section 6. The filing method selected by the Contractors will be made explicit at the start of Section 5.

Section	Title & Brief Description	Contractors Development Required
6	**Management Plans & Available Information** Management Plans include the following: • MP1 Environmental (Incident and Emergency) Communication Response Plan (ERP) • MP2 Water Quality Management Plan and Watercourse Crossing Plan (WQMP) • MP3 Surface Water Management Plan • MP4 Spoil Management Plan • MP5 Waste Management Plan • MP6 Decommissioning Plan • MP7 Traffic Management Plan	**Yes** The Contractor is required to develop the Management Plans and/or include additional information or method statements as appropriate and where required by the Contract. The Development of the Management Plans will generate more site specific documents which address particular environmental management procedures applicable for works in specified areas of the Site. These Management Plans form the Contractor's Environmental Plans (for example, Spoil Management Plan). Table 6.1 lists all Management Plans and provides information on Contractors responsibilities.

2 PROJECT INFORMATION

2.1 SITE LOCATION AND SCHEME DESCRIPTION

The proposed Grid Connection passes through the townlands of Broemountain, Lyrattin, Farnane Lower, Farnane Upper, Castlequarter, Mountaincastle South, Carrigaun (Mansfield), Langanoran, Sleadycastle, Knockaunnaglokee, Garryduff, Colligan More, Garryclone, Colliganwood, Ballymacmague North, Ballymacmague South and Killadangan.

Temporary works will be required to accommodate the delivery of the turbine components. These temporary works within the redline boundary on third party lands are included as part of this application and are assessed as part of this EIAR. These are located in the townlands of Lickoran, Lisleagh, Ballynaguilkee Lower, Kilcooney and Clooncogaile,

The Redline Boundary extends to 463ha, and comprises a mixture of farmland, forestry and upland heath. Much of the lands are in private, third-party ownership, while a portion of the site is shared land (commonage).

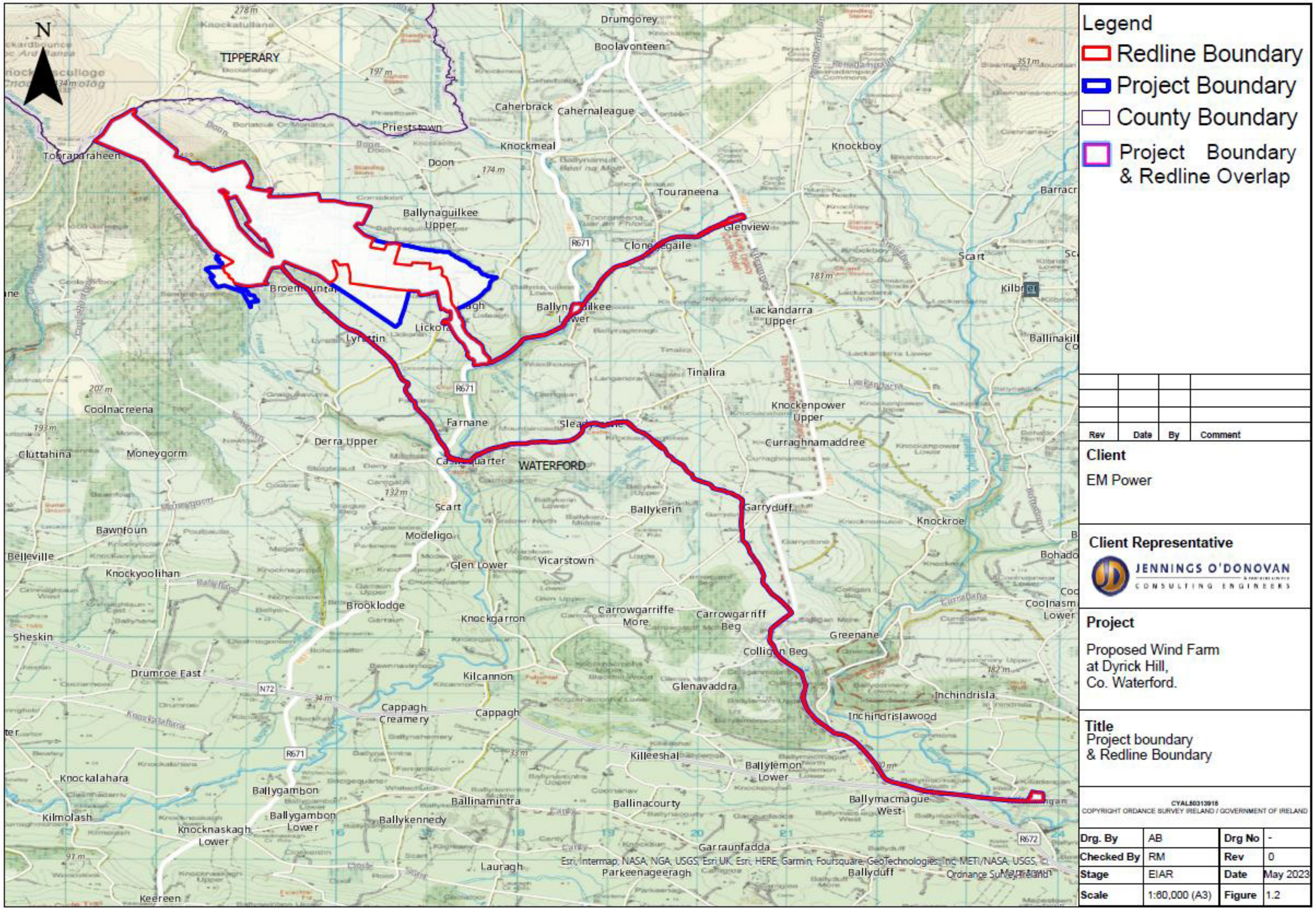

Figure 2.1: Map showing the location of Dyrick Hill Wind Farm and Grid Connection

The Project will comprise of the following main components:

- Erection of 12 no. 6.0-7.2 MW wind turbines (Note* this is the current output available for turbines of this size. It is possible that with improvements in technology, the output may increase at the time of construction.) with an overall ground tip height of 185m. The candidate wind turbines will have a 162m rotor diameter and a hub height of 104m.
- Construction of Crane Hardstand areas and Turbine Foundations.
- Construction of new internal site Access Tracks and upgrade of existing site roads, to include passing bays and all associated drainage.
- Construction of a new wind farm site entrance with access onto the R671 regional road in the townlands of Lickoran.
- Improvement of existing site entrance with access onto local roads in the townlands of Broemountain.
- Improvements and temporary modifications to existing public road infrastructure to facilitate delivery of abnormal loads and turbine delivery.
- Construction of one Temporary Construction Compound with associated temporary site offices, parking area and security fencing.
- Development of on-site Borrow Pit.
- Installation of one Permanent Meteorological Mast with an overall height of 104m.
- Development of a site drainage network.
- Construction of one permanent 110 kV Substation.
- All associated Wind Farm Internal Cabling connecting the wind turbines to the wind farm substation.
- All works associated with the connection of the wind farm to the national electricity grid, which will be via 110 kV underground cable connection approximately 16km in length to the existing Dungarvan 110 kV Substation.
- Upgrade works on the Turbine Delivery Route from Waterford Port.
- Ancillary forestry felling to facilitate construction and operation of the Development.

A 15-year planning permission and 40-year operational life from the date of commissioning of the entire wind farm is being sought.

3 ENVIRONMENTAL CONTROLS

This CEMP is informed by Planning Conditions where the Project is granted planning consent, mitigation measures set out in Environmental Impact Assessment Report (2022) and associated documents and by the guidance documents and best practice measures listed below. This CEMP will be adhered to and further developed by the Contactor and will be overseen by the project representative/foreman.

Guidance Documents

- Construction Industry Research and Information Association (CIRIA) (2006) Control of Water Pollution from Construction Sites - Guidance for Consultants and Contractors. CIRIA C532. London.
- CIRIA (2006) Guidance on 'Control of Water Pollution from Linear Construction Projects' (CIRIA Report No. C648, 2006).
- COFORD (2004) Forest Road Manual – Guidelines for the Design, Construction and Management of Forest Roads.
- CIRIA (2015) SuDS Manual, (CIRIA Report C753, 2015)
- Coillte (2009): Forest Operations & Water Protection Guidelines.
- Department of Agriculture, Food and the Marine (2018) DRAFT Plan for Forests & Freshwater Pearl Mussel in Ireland – Consultation Document.
- Forestry Commission (2004) Forests and Water Guidelines, Fourth Edition. Publ. Forestry Commission, Edinburgh.
- Forest Services (2006) Draft Plan for Forestry and Freshwater Pearl Mussel Requirements – Site Assessment and Mitigation Measures.
- Forest Service (2000) Forestry and Water Quality Guidelines. Forest Service, DAF, Johnstown Castle Estate, Co. Wexford.
- IFI (2016) Guidelines on Protection of Fisheries During Construction Works in and Adjacent to Waters.
- GPP1 (2020) Understanding your Environmental Responsibilities – Good environmental Practices, NetRegs.
- GPP 5 (2018) Works and Maintenance In or Near Water, NetRegs.
- GPP21 (2021) Pollution Incident Response Planning, NetRegs.
- GPP 22 (2018) Dealing with Spills, NetRegs.

3.1 HUMAN BEINGS AND COMMUNITY

The assessment set out in **Chapter 5: Population & Human Health** has not identified any likely significant effects from the Development on population or human health. The Development has been assessed as having the potential to result in effects of slight positive, long term impact overall. Cumulative effects are predicted unlikely.

The main mitigation measure is by design or avoidance. A suitable separation distance from turbines and other key infrastructure to properties has been embedded in the EIA Development design. Additional mitigation to protect site personnel and the public will also be implemented in the event of damage to a turbine and subsequent likely turbine or turbine component failure.

These are:

- Turbines will be procured from a reliable manufacturer and will have undergone vigorous safety checks during design, construction, commissioning and operation.
- Physical and visual warnings such as signs will be erected as appropriate for the protection of site personnel and the public.
- Facility for remote turbine deactivation will be provided.
- Access to turbines for site personnel will be restricted in storm events. Where access by site personnel is required safety precautions may include remotely shutting down the turbine, yawing to place the rotor on the opposite side of the tower door and parking vehicles at a distance of at least 100 m from the tower. All personnel will be fitted with appropriate Personal Protective Equipment. Regular maintenance and inspections will take place during the 40-year operational phase. The final turbine model chosen will be in line with International Electrotechnical Commission 61400-1 safety standards. Maintenance visits will take place as needed with the Supervisory Control and Data Acquisition (SCADA) control system monitoring turbine performance remotely. If a fault occurs, then a message is automatically sent to the operations personnel preventing emergency situations. Warning signs and security infrastructure will be in place around the onsite switchgear and control building to provide for public safety.
- Access to the turbines will be via the door at the base of the turbines. The turbine access door will otherwise be securely locked at all times.
- Measures are set out in **Chapter 14: Transport and Transportation** relating to how delivery of goods and services would be managed during works to minimise impacts.

Once the above mitigations are taken into account, the residual risk on population and human health is assessed to be an imperceptible, long-term effect.

3.2 ECOLOGY

All mitigation measures have been developed in the context of national and international legislative guidance for the protection and management of flora, habitats of conservation importance, fauna and aquatic ecological interest.

Guidelines to be adhered to in the delivery of the CEMP and method statements include the following:

- *'Guidelines on protection of fisheries during construction works in and adjacent to waters'* (Inland Fisheries Ireland, 2016)
- *'Guidelines for the treatment of Badgers prior to the construction of National Road Schemes'* (National Roads Authority, 2005)
- *'Guidelines for the protection and preservation of trees, hedgerows and scrub prior to, during and post construction of National Road Schemes'* (National Roads Authority, 2006a)
- '*Guidelines for the treatment of bats during the construction of national road schemes'* (National Roads Authority, 2006b)
- *'Guidelines for the treatment of Otters prior to the Construction of National Road Schemes'* (National Roads Authority, 2006c)
- *'Guidelines for the crossing of watercourses during the construction of national road schemes' (*National Roads Authority*, 2008)*
- *'Guidelines on the Management of Noxious Weeds and Non-Native Invasive Plant Species on National Roads'* (National Roads Authority, 2010)

The description of mitigation measures is provided in terms of mitigation by avoidance, reduction and remediation.

3.2.1 Ecology Mitigation Measures

3.2.1.1 Mitigation by Avoidance

3.2.1.1.1 Protection of Watercourses

The Development has been designed to ensure that an adequate buffer zone is provided for between this infrastructure and watercourses. In addition, the design has sought to minimise the requirement for new watercourse crossings. This has been achieved by restricting the need for watercourse crossing to a total of one new crossing of the Aughkilladoon Stream within the proposed wind farm site, and three crossings along the proposed grid connection route. The buffer zone implemented between all large-scale infrastructure associated with the wind farm site, such as turbines, hardstand, and access tracks are located at distances of over 50m from any watercourses, except for where the Access Track crosses watercourses the Aghkilladoon Stream. In addition, the best practice construction measures that are described above are designed to avoid impacts on areas that are outside the site including watercourses.

A Surface Water Management Plan has been prepared for the proposed wind farm and this plan ensures the implementation of a suite of measures that will avoid negative impacts to water quality and the hydrological regime of the Finisk River.

3.2.1.1.2 Protection of Designated Areas

The project is not located within any designated areas and as such the potential for direct impacts to these areas will be avoided. As set out in the accompanying Natura Impact Statement the principal risk posed by the proposed development to designated areas in the surrounding area relate to indirect impacts arising from negative impacts to water quality and associated adverse effects to freshwater dependent habitats and species. Mitigation measures are set out in **Section 6.7.1.2.1 and Section 6.7.1.3.2** below that aim to protect water quality in receiving watercourses and thereby avoid the potential for adverse effects to the freshwater dependent qualifying habitats and qualifying species of surrounding designated areas.

3.2.1.1.3 Protection of Important Habitats

The Development will result in the loss of areas of Annex I dry heath habitat. It is essential that the direct loss of dry heath habitat is fully minimised (notably also taking account of the international/national nature conservation value of these habitats) and so mitigation by avoidance is essential to limit such losses within the footprint of the Development, and its zone of influence. Mitigation in this respect is:

- The full extent of the infrastructure footprint will be marked out prior to the commencement of works, with an appropriately robust and visible fencing / marker system. Where this meets Annex I habitats, this will also be the full extent of the works corridor, with no machinery access (access will only be allowed on foot and only for the purposes of silt / pollution control if required), storage or other works allowed outside this area.
- The efficacy and coherence of the marker system (and required remediation) will form an essential part of the Site operations.
- A pre-construction Invasive Species Survey will be conducted during the optimal growing season (May to August immediately prior to works occurring at this site for the Development) and shall include data on all locations, extents and potential construction impacts in relation to scheduled and non-scheduled Alien Invasive Species (IAS). This survey will be completed along with reporting on the best course of action to be implemented to avoid the spread of such IAS on the Site or further afield. The management of IAS identified as occurring within the proposed development site will

be undertaken in accordance with best practice management guidelines as set out in the TII guidelines "The Management of Noxious Weeds and Non-Native Invasive Plant Species on National Roads" (2010).

3.2.1.1.4 Protection of Important Mammal Species

The Ecological Clerk of Works for the construction phase will complete a pre-construction survey of the construction footprint in order to confirm the continued absence of mammal breeding and resting places within the construction footprint and within 50m of the construction footprint or identify the presence of newly established breeding/resting places. Based upon the results of these surveys, the ECoW will establish whether or not there is a need at that stage for the implementation of further mitigation measures and the requirement for protected species licences. An example of where such a need could arise is where a badger sett becomes established along or in the immediate vicinity of a hedgerow that will be intersected by the proposed access track.

3.2.1.1.5 Protection of Bats

Any trees and treelines along approach roads and planned site access tracks will be retained unless felling is unavoidable. Retained trees should be protected from root damage by an exclusion zone of at least 7 metres or equivalent to canopy height. Such protected trees will be fenced off by adequate temporary fencing prior to other works commencing.

No structures will be demolished as part of the construction phase of the proposed development and there will be no disturbance to confirmed bat roost structures occurring within and adjacent to the proposed wind farm site boundary.

3.2.1.1.6 Protection of Herpetofauna

The Ecological Clerk of Works for the construction phase will complete a survey of the construction footprint during spring (late February / March / early April) ahead of the proposed works in order to identify any key amphibian breeding areas. This will allow wildlife barriers to be installed where necessary to minimise impacts upon such features where these are likely to be indirectly affected by the works.

3.2.1.2 Mitigation by Design

3.2.1.2.1 Protection of Watercourses

An Ecological Clerk of Works ("ECoW") will be employed from the commencement to completion of construction works, including Access Tracks, On-site Substation and Control

Building, Temporary Construction Compound, Turbine Hardstands and Turbine Foundations and Wind Farm Internal Cabling works at a minimum. Primary roles for the ECoW will include the setting out and monitoring of the working corridor and review of pollution control measures and working practices during the active construction period as well as ad hoc input into site remediation.

For the construction of culverts, all activities must adhere to IFI, (2016) Guidelines on Protection of Fisheries during Construction Works in and Adjacent to Waters. Section 9 Planning, Design and Construction Issues details on Best Practice guidance for the installation of culverts on watercourses.

All measures outlined in the accompanying SWMP will be fully implemented by the contractor and will be agreed to with the planning authority in advance of construction activities. The objective of the SWMP is to prevent pollution to watercourses and adverse impacts to sensitive fauna. The SWMP has provided sufficient detail so that all activities that could potentially lead to negative impacts on water quality have been identified. The SWMP is based upon a detailed understanding of the hydrology, hydrogeology and geology within and surrounding the proposed wind farm extension.

All watercourses draining the Site will be examined on a repeated scheduled timeframe (i.e. daily/weekly/fortnightly etc.) as deemed appropriate by the Contractor, Planning Authority, NPWS and Inland Fisheries Ireland. A log will be kept of these examinations and a water sampling protocol to monitor key water quality parameters will be established in agreement with the NPWS and Inland Fisheries Ireland. The monitoring protocol will be devised so that sediment release (should it occur) from the Site is detected at an early stage. Sediment release to the above watercourses from the site will be restricted to <25mg/l as per the Salmonid Water Regulations.

Method statements outlining the approach to all surface watercourse crossing will be approved in advance with Inland Fisheries Ireland.

Disturbance to natural drainage features will be avoided during the construction phase of the Development. The design of the Development has allowed for the establishment of a 50m wide watercourse buffer zone during the construction phase.

Uncontaminated surface runoff will be diverted away from construction areas through the installation of interceptor drains up-gradient of construction areas.

Drainage waters originating in construction areas will be collected in a closed system and treated prior to controlled, diffuse release. Drainage waters from construction areas will be managed through a series of treatment stages that include swales, check dams and settlement/attenuation ponds along with other pollution control measures such as silt fences and silt mats.

A three-stage treatment train will be employed to capture, retain and treat discharges during the construction phase. This treatment train is also proposed for discharges from hard surfaces that will be installed as a result of the Development.

Settlement/attenuation ponds will be used to attenuate and treat runoff. A detailed pre-construction peat stability assessment has considered the appropriate location of settlement/attenuation ponds so that these facilities will not increase the risk of slope failure. These will have permanent open water to minimise the risk of sediment washout. Settlement/attenuation pond side slopes will be constructed at shallow grades such as 1 in 3 side slope. Settlement/attenuation ponds will be designed so that outflows are spread diffusely over a wider area so that increases in run-off can be mitigated. Erosion control and detention ponds will be regularly maintained during the construction phase.

Standing water from excavations will not be pumped directly into watercourses. Where dewatering of excavations is required, water will be pumped to the head of a treatment train in order to receive full treatment prior to discharge.

Roadside drains will be shallow with moderate gradients to prevent scouring. In steep areas check dams (possibly in conjunction with settlement ponds and / or cross drains) may be necessary to reduce flow rate.

Oil fuel will be stored within containment areas and emergency response measures for oil spillage on site will be prepared.

Refuelling of plant during construction will be carried out at a designated area, a minimum of 50m from watercourses. Drip trays and spill kits will be available on site. Maintenance of all plant and machinery will be undertaken off-site. Only emergency break-down maintenance will be carried out on site.

Cement will be mixed within containment areas and if Readymix vehicles are used these will be washed in the same area and the water cycled.

All vehicles transporting materials to and from the Site will store materials in a contained load so that the potential for emissions or spillage is reduced during journeys and bridge crossing over watercourses. The measures outlined in the UK's Planning Policy Guidance No. 26: Dealing with Spillages on Highways (a Good Practice Guidance notes proposed of the UK EA/SEPA/EHS) will be adhered to in the event of a spillage or accident during the transportation of materials.

All construction personnel will be trained in pollution incident control response. An emergency response plan has been prepared as part of the CEMP for the proposed development and information outlining response procedures and contingency plans to contain pollution, as set out in the CEMP, will be made available on site.

Access Tracks and turning areas will be confined to areas of shallow peat where possible and will be constructed on a geotextile layer. These areas will also be kept as level as possible to avoid fast run-off. This can be achieved by following contours where possible.

At the proposed spoil storage area, impermeable berms will be put in place surrounding peat spoil receptor cells. The berms will be established in advance of the deposition of peat surplus material. The berms will be designed to account for a bulking factor of 10% of the surplus peat material to be disposed in these areas. In addition, all existing drainage ditch outflows from cutover blanket bog that will be used as receptor cells for surplus peat will be blocked in advance of the deposition of any surplus material within these cells. This will prevent the ongoing loss of water from these cut areas to receiving lakes to the north and south and also prevent the migration of peat spoilt material from the cells to these lakes.

3.2.1.2.2 Prevention of Spread of Invasive Alien Species

The presence of the non-native invasive species *Fallopia japonica* and *Prunus laurocerasus* within the proposed development site provides the potential for the spread of this species by the proposed works. These species is invasive and out-compete native flora to form mono-specific stands. Their presence along watercourses is particularly significant, as contaminated soil or vegetative material washed from an infected area can result in the spread of this species downstream. Appropriate mitigation measures including management and control measures are required at all sites within the proposed works area where this species is encountered for the prevention of spread of these species. The mitigation measures for the control of invasive species will follow the TII guideline document *The Management of Invasive Alien Plan Species on National Roads – Technical Guidance* (TII, 2020). A summary of the physical and chemical control measures for *Fallopia japonica* are as follows:

- Where feasible, preference should be given to treating Japanese knotweed in its original location to limit the risk of further spread of the plant.
- Physical methods of IAPS control include cutting, digging or excavating, hoeing and pulling by hand.
- Where cut, pulled or mown IAPS material arises, its disposal shall not lead to a risk of further spread
- Particular care shall be taken near watercourses as water is an effective conduit for the dispersal of plant fragments and seeds.
- particular care is required in relation to the disposal of Japanese and other knotweed species. Where burial is being used to dispose of these species, a non-persistent herbicide shall be applied to the infestation prior to excavation. The material shall then be excavated and subsequently buried to a minimum depth of 5m. The waste shall be covered with a proprietary root barrier membrane layer and infilled with a minimum 5m depth of uncontaminated soil.
- Any geotextile membranes used for burial must be undamaged, sealed securely, have a manufacturer's guarantee that it will remain intact for at least 50 years, and be UV resistant. Where burial to a depth of 5m is not possible, the infestation shall be treated with a non-persistent herbicide prior to excavation, excavated and then completely encapsulated in a proprietary root barrier membrane cell. The upper surface of the cell shall be buried to a depth of at least 2m with uncontaminated soil.
- Treat with glyphosate. Glyphosate is a broad-spectrum herbicide and, as such, is potentially damaging to non-target plants.
- Great care is, therefore, necessary when applying this herbicide
- effective control of Japanese knotweed may be achieved by biannual (summer and autumn) foliar glyphosate applications or by annual application of glyphosate in autumn (after the flowering period but prior to senescence) using stem injection (at high concentrations) or foliar spray (Jones, et al., 2018).
- The use of herbicides containing the active ingredients aminopyralid and fluroxypyr are not to be used for stands of Fallopia japonica occurring in close proximity to watercourses and wetland habitats.

- The application of herbicides and pesticides shall not be undertaken in the following conditions:
  - Windy weather where there is a risk of spray drift occurring
  - During or preceding rainfall which can result in the chemical being washed off
  - During periods of particularly cold weather which can reduce the plant's ability to uptake the chemical

A summary of the physical and chemical control measures for *Prunus laurocerasus* are as follows:

- Cutting – anytime of the year. This approach can be very labour intensive and does not kill the plant. Regular follow up is required to deal with re-growth.
- Uprooting - anytime of the year. Small plants can be pulled by hand while large stems can be cut and the roots grubbed out by winch or machine.
- Mulch matting - anytime of the year. This approach can be labour intensive and regular follow up is required to deal with re-growth.
- Bud-rubbing – spring to autumn. This approach can be labour intensive and regular follow up is required to deal with re-growth.
- Glyphosate – during the active growth in late spring or summer. Spot treatment of stands of *Prunus laurocerasus* on site.
- Triclopyr - during the active growth in late spring or summer. Spot treatment of stands of *Prunus laurocerasus* on site.

Due to the legislative requirements to control the spread of noxious weeds and non-native invasive plant species, it is important that any activities associated with the planning, construction and operation of wind farm developments comply with the requirements of the Wildlife Acts, 1976-2012. Regulations 49 and 50 of the European Communities (Birds and Natural Habitats) Regulations 2011 (S.I. 477 of 2011) include legislative measures to deal with the dispersal and introduction of Invasive Alien Species (IAS), which are listed in the Third Schedule of the regulations. Regulation 49 deals with the Prohibition on introduction and dispersal of certain species while Regulation 50 relates to Prohibition on dealing in and keeping certain species.

The introduction and/or spread of invasive species such as Himalayan Balsam, Giant Rhubarb or Rhododendron for example, could result in the establishment of invasive alien species and this may have negative effects on the surrounding environs. Appropriate spread prevention measures have been incorporated into the design of the project. The following measures address potential effects associated with the construction phase of the project:

- Good construction site hygiene will be employed to prevent the introduction and spread of problematic invasive alien plant species (e.g. Himalayan Balsam, Japanese Knotweed etc.) by thoroughly washing vehicles prior to leaving any site.
- All plant and equipment employed on the construction site (e.g. excavator, footwear, etc.) will be thoroughly cleaned down using a power washer unit prior to arrival on site to prevent the spread of invasive plant species
- All washing will be undertaken in areas with no potential to result in the spread of invasive species. This process will be detailed in the contractor's method statement.
- Any soil and topsoil required on the site will be sourced from a stock that has been screened for the presence of any invasive species and where it is confirmed that none are present.
- All planting and landscaping associated with the Development shall avoid the use on invasive shrubs such as Rhododendron.

3.2.1.3 Mitigation by Reduction

3.2.1.3.1 Protection of important habitats

A site-specific CEMP will be implemented to ensure that potential adverse impacts to upland watercourses flowing through the site are avoided. Minimum buffer zones will be implemented between areas associated with the construction of Turbine Foundations and streams/eroding gullies, except where stream crossings are required.

Within the Broemountain Commonage Area site operatives, plant and machinery will be restricted to the footprint of the proposed development construction boundary and will not be permitted to encroach upon adjacent lands. This will reduce the potential for damage and disturbance to heath, acid grassland and mosaic habitats.

3.2.1.3.2 Protection of Watercourses

All elements of the SWMP and the mitigation measures outlined in Chapter 9 to reduce the amount of silt-laden water generated within the construction footprint will be implemented. These measures will include the provision of clean water catch drains upslope of construction areas and the minimisation of excavation footprints and the time excavations and surfaces are left exposed and denuded.

3.2.1.4 Offsetting

3.2.1.4.1 Habitat restoration

The northwest section of the proposed wind farm site at Broemountain as well as the Waterford Wetland Sites 173 and 239 that occur within the proposed development site provide significant opportunities for habitat restoration and enhancement. A Habitat Management Plan is provided as **Appendix 6.4** and all measures set out in this plan will be implemented as part of the Development. The restoration of areas of dry heath and unimproved acid grassland and the implementation of measures such as the control of grazing will aim to achieve the restoration and enhancement of an area of approximately 12 ha of dry heath habitat as well as improving conditions within the Waterford Wetland Habitat Lisleagh Mountains (Site Code: 173) through the provision of appropriate grazing management.

New hedgerow planting, consisting of native species and of local Waterford/Irish provenance will be provided within the proposed wind farm site to offset the loss of approximately 1.38km of hedgerow to the footprint of the proposed development. The corridors of proposed new hedgerow planting are outlined in **Appendix 6.4** and amount to approximately 3.65km of new hedgerow. The planting of this hedgerow and their successful establishment during the operation phase of the proposed wind farm site will result in an overall net increase of approximately 1.3km of hedgerow habitat within the proposed wind farm site. This will have the potential to represent a significant positive effect for hedgerow and the fauna that rely upon this habitat.

An ECoW will be appointed prior to the commencement of construction. The ECoW will be an ecologist with experience of baseline ecological surveys, pre-construction surveys and construction phase supervision. The ECoW will be responsible for completing pre-construction surveys and supervising construction works and advising on the implementation of biodiversity enhancement measures that will be commenced during the construction phase.

3.2.2 Monitoring

Pre-construction confirmatory surveys required in advance of the construction phase will include as a minimum:

- Otter surveys along the Finisk River. Surveys to be completed will pay particular attention to identifying the presence/absence of otter holts/couches within 150m of the proposed wind farm infrastructure. In the event that otter holts or couches identified within 150m of the proposed development the status of the breeding/resting place will be confirmed. Where the holt/couch is identified as a breeding site, then, in the absence of a derogation licence, no works will be permitted to proceed within a 150m radius of the breeding place, whilst it is still actively used as a breeding site. In the event that a non-breeding active holt or couch is identified within 50m of the proposed development, then, in the absence of a derogation licence, no works will be permitted to proceed within a 50m radius of the non-breeding but active holt or couch.

- Non-native invasive plant species surveys: An up-to-date confirmatory non-native invasive plant species survey of the Site and adjacent areas will be completed during the growing season immediately prior to the commencement of construction works.
- Confirmatory surveys for the presence of plant species of conservation interest. These surveys shall be completed during the growing season immediately prior to the commencement of the construction phase. The surveys shall be completed to identify the presence of any new stands of rare or threatened species as listed in **Section 6.4.3** above. In the event that new stands of these species are identified as occurring within the footprint of the proposed wind farm, stands of these plants will be required to be translocated to a suitable receptor area either within the proposed development site or an alternative suitable location. Such translocations will only be permitted to proceed upon receipt of a derogation licence.
- The ECoW will ensure that best practice construction methods and mitigation measures detailed in this EIAR and accompanying planning documentation including the CEMP and NIS are implemented in full.
- The ECoW will be responsible for ensuring that the construction phase contractor is aware of key biodiversity receptors. The ECoW will inspect the construction works throughout the construction phase and will pay particular attention to the implementation of all biodiversity related mitigation measures.
- The ECoW will provide monitoring inspection reports during the construction phase and will also provide a close-out report following the completion of the contract construction works.
- Where necessary the ECoW will liaise with relevant authorities such as Waterford County Council, the IFI and the NPWS with respect to construction phase activities that relate to biodiversity.
- As part of the ECoW terms of appointment, the ECoW will be vested with the authority to stop works where activities have been identified on site that are not in accordance with the mitigation measures outlined in this EIAR, the NIS and/or the CEMP prepared for the planning application for the proposed development.

3.2.3 Post-construction phase monitoring

3.2.3.1 Habitats

Post construction phase monitoring will be completed as per the specification for monitoring set out in the Habitat Management Plan in **EIAR Appendix 6.4**.

3.2.3.2 Bats

Post construction phase monitoring for bats will be completed as per the specification for monitoring set out in **EIAR Appendix 6.2**.

Ornithology Mitigation Measures

- This is in line with best practice recommendations for mitigation measures in regard to birds and wind farms as recommended by statutory bodies such as English Nature and the Royal Society for the Protection of Birds (Drewitt, A. L. and Langston, R. H., 2006).

- Construction operations will take place during the hours of daylight to minimise disturbances to roosting birds, or active nocturnal bird species. This is in line with best practice recommendations for mitigation measures in regard to birds and wind farms as recommended by statutory bodies such as English Nature and the Royal Society for the Protection of Birds (Drewitt and Langston, 2006). Limited operations such as concrete pours, turbine erection and installation of the grid connection may require night-time operating hours; these works will be supervised by the project ecologist/ECoW.

- Toolbox talks will be undertaken with construction staff on disturbance to key species during construction. This will help minimise disturbance. This is in line with best practice recommendations for mitigation measures with regard to birds and wind farms as recommended by statutory bodies such as English Nature and the Royal Society for the Protection of Birds (Drewitt and Langston, 2006).

- Where/if removed or altered, re-instated hedgerows will be planted with locally sourced native species. This will result in habitat enhancement for local species of conservation importance such as meadow pipit. This is in line with best practice recommendations for mitigation measures in regard to birds and wind farms as recommended by statutory bodies such as English Nature and the Royal Society for the Protection of Birds (Drewitt and Langston, 2006).

- A re-confirmatory survey (March/April) will be conducted of the proposed turbine locations to assess any evidence of target species activity or occupation of new territories (e.g. in the case of breeding snipe). Should any nesting locations be recorded, works at these locations will be restricted to outside the breeding season (March 1st to August 31st inclusive) or until chicks are deemed to have fledged (following monitoring).

- No construction works shall be undertaken within the common area (Turbine 10, 11, 12 and 13) during the winter season. Preconstruction surveys for golden plover occupancy within the commonage area shall inform this restriction period typically between the months of October and March annually.

- The use of “white lights” on the turbines will not occur as these can attract night flying birds such as migrants, and insects, which in turn can attract bats. Certain turbines will be illuminated with medium intensity fixed red obstacle lights of 2000 candelas where required by the IAA Lighting will be fitted with baffles to ensure that the light is directed skywards and will not be discernible from the ground.

- The following mitigation measure will be implemented to avoid disturbance to golden plover, lapwing and any other special conservation interest bird species of Dungarvan Harbour SPA or any other SPAs in the wider region, in the event that they are found to rely on the project site prior to or during the construction phase. Pre-construction surveys and ongoing construction phase bird monitoring will be completed to identify the presence of golden plover and any other special conservation interest bird species at the project site. In the event that wintering special conservation interest bird species of the Dungarvan Harbour SPA, such as golden plover are found to rely on the project site during the construction phase, works will be restricted from the areas that are being relied upon by these species. A buffer area of 500m will be established around areas that have been identified as being relied upon by wintering populations of golden plover or any other special conservation interest bird species of this SPA. This 500m buffer distance is line with the maximum buffer distance set out by Goodship & Furness (2022) for golden plover.

3.3 SOILS AND GEOLOGY

The following section details the environmental control measures which must be incorporated into the Contractors’ Construction Method Statement (CMS) to ensure the protection of soils and geology. In addition, a Spoil Management Plan and a Waste Management Plan (see

Management Plans 4 and 5 respectively) have been prepared which provide further details of control measures and monitoring procedures.

3.3.1 Subsoil and Bedrock Removal – Mitigation Measures

Mitigation by Avoidance

The proposed turbines and infrastructure layout was dictated to a large degree by steep slopes and shallow bedrock as specific geotechnical constraints. within the chosen Site, areas of shallow bedrock were identified, and the infrastructure design sought to avoid those areas as much as possible. Mitigation through design is especially applicable in the risk to human health during a project due to the risk of landslips or ground instability and this shall be exercised to minimise the negative risks present.

Mitigation by Good Practices

- Best practice (as defined by IWEA and Scottish Best Practice Guidelines) will be applied during construction which will minimise the amount of soil and rock excavation.

- Excavated soil and rock will only be moved short distances from the point of extraction and will be used locally for Site Access Track construction or landscaping. Landscaping areas will be sealed and levelled using the back of an excavator bucket to prevent erosion.

- In order to reduce the impacts associated with the use of off-site quarries, an on-site borrow pit will be developed which will reduce transport distances in addition to noise and dust hazards associated with off-site quarries. In order to reduce the impacts associated with the on-site borrow pit, rock use will be reduced and re-used wherever possible. On completion of the construction phase, the borrow pit will be backfilled and returned, as close as possible, to its pre-development state.

Mitigation by Reuse

- Soil and rock will be re-used for construction of Site Access Tracks wherever possible. The bedrock will comprise predominantly sandstone and siltstone which, when crushed and graded, should provide a good sub-base for Site Access Track construction.

- The topsoil will be reused on Site for landscaping purposes around infrastructure and adjacent to access tracks. These measures will prevent the erosion of exposed areas of overburden in the short and long term.

- Volumes of soil/rock and topsoil are shown in **Spoil Management Plan**. The calculated surplus (approximately 55,000m^3 of subsoil/rock and 3,500m^3 of topsoil will be used for reinstatement of the borrow pit (approximate dimensions 127m x 127m x 2m deep).

Mitigation by Remediation

On completion of the construction stage, any areas not required for operation will e reinstated. This will include the Temporary Construction Compound, turning areas and materials storage areas. Granular material will be removed as required and reinstated with topsoil in keeping with the adjacent soils. The surplus volumes of subsoil/rock and topsoil will be used for reinstatement of the borrow pit. Drainage will be reinstated in order to minimise future erosion of the soils and restore the pre-development state of the environment (see **Surface Water Management Plan**).

3.3.2 Storage and Stockpiles – Mitigation Measures

Mitigation by Avoidance and Good Practice

- Best practice as described in the IWEA and Scottish Best Practice Guidelines will be applied during construction which will minimise the amount of soil and rock excavation and therefore also reduce storage and stockpile requirements.
- A temporary spoil stockpile will be located adjacent to the T09 access track, approximately 200m east of turbine T09.
- Topsoil will only be moved short distances from the point of extraction and will be used locally for landscaping. Landscaping areas will be sealed and levelled using the back of an excavator bucket to prevent erosion.

Mitigation by Reduction

Whenever possible, soil and rock will be re-used on the Site immediately, thereby reducing the need for double handling, which will also reduce the requirement to stockpile soils. Excavated soil and rock will be used immediately for Site Access Track construction. Whenever possible stockpiles will be avoided to prevent instability.

The **Spoil Management Plan** identifies volumes and types of materials arising, temporary stockpiling locations, routes for reuse and remediation, requirements in terms of logistics and considerations in terms of timing and planning of movements of material.

3.3.3 Vehicular Movements – Mitigation Measures

Mitigation by Avoidance and Good Practice

- Best practice as described in the IWEA and Scottish Best Practice Guidelines will be applied during construction which will minimise double handling, again reducing the Site traffic.
- Excavated topsoil will only be moved short distances from the point of extraction and will be used locally for landscaping, thus again reducing the on-Site traffic.
- Excavated soil and rock will be used for Site Access Track construction as close to the source of extraction as possible.

3.3.4 Ground Stability – Mitigation Measures

Mitigation by Avoidance and Good Practice

- careful design of the wind farm has reduced the amount of construction required in areas of steep slopes and other areas of potential ground instability.
- careful design of the wind farm has reduced the amount of construction required in areas of steep slopes and other areas of potential ground instability.

Mitigation by Reduction

The temporary storage of construction materials, equipment, and earth materials will be kept to an absolute minimum during the construction phase of the Development.

Example: The excavation material for the construction of Site Access Roads will not progress ahead of actual track construction (as discussed under mitigation addressing vehicular movements), therefore minimising the volume of arisings to be managed. Areas for permanent deposit of material e.g., backfill adjacent to constructed infrastructure, will be identified and suitable material deposited as it becomes available. These efficiencies can be seen in the **Spoil Management Plan**.

Mitigation by Remediation

Remediation of soils will include the deposit of suitable material where required. This will include replacement of soils / subsoils in line with baseline conditions. Remediated areas will be managed and monitored in terms of reestablishment of vegetated cover.

In the unlikely event that a slope stability issue does arise on the Site during the construction or operational phases of the Development, given the variable potential extent of associated impacts, remediation will be assessed, prescribed and monitored by a suitably qualified geotechnical engineer/engineering geologist on a case-by-case basis.

Emergency Response

Emergency responses to potential stability incidents have been assessed (**EIAR Chapter 5: Human Health and Population**) and established to form part of **Management Plan 1, Emergency Response Plan** before construction works initiate.

- In particular, catch fences and other physical barriers (i.e. concrete blocks) will be on Site and available in sufficient quantities to be used in the event of ground instability. A plan will be made to prevent or divert any landslide away from protected areas (NHA, SPA and/or SAC).
- Detailed emergency response protocols are specified in the **Management Plan 1: Emergency Response Plan**.

3.3.5 Soil Contamination – Mitigation Measures

Mitigation by Avoidance

Protecting soils from spills will in turn mitigate against the potential for contaminates reaching watercourses, mitigation measures for contaminants are presented in detail in **EIAR Chapter 9: Hydrology and Hydrogeology**.

Mitigation by Reduction

- Excess packaging and other materials will be discarded appropriately at the Temporary Construction Compound before advancing to the destined construction area.
- Any vehicles coming onto the Site will be required to be inspected and cleaned before leaving the Temporary Construction Compound and before advancing to the destined construction area.
- Precast concrete will be used wherever possible i.e., formed offsite. Where the use of precast concrete is not possible the following mitigation measures outlined in section 3.4 Hydrology and Drainage will apply.

Mitigation by Remediation

Any and all contaminants will be removed from the Site in an appropriate manner when ever produced or observed; and transported and disposed of in accordance with hazardous waste as per **Management Plan 5: Waste Management Plan**.

Emergency Response

Hydrocarbon spill or leak – Hydrocarbon contamination incidents will be dealt with immediately as they arise. Hydrocarbon spill kits will be prepared and kept in vehicles associated with the construction phase of the Development. Spill kits will also be established at proposed construction areas, for example, a spill kit will be established and mobilised as part of the turbine erection materials and equipment. Suitable receptacles for hydrocarbon contaminated materials will also be at hand.

Significant hydrocarbon spill or leak – In the event of a significant or catastrophic hydrocarbon spillage, emergency responses will be escalated accordingly. Escalation can include measures such as the installation of temporary sumps, drains or dykes to control the flow or migration of hydrocarbons, excavation and disposal of contaminated material.

Cementitious material – Cement / concrete contamination incidents will be dealt with immediately as they arise. Spill kits will also be established at proposed construction areas, for example, a spill kit will be established and mobilised as part of the turbine erection materials and equipment. Suitable receptacles for cementitious materials will also be at hand.

Emergency contact numbers for the Local Authority Environmental Section, Inland Fisheries Ireland, the Environmental Protection Agency and the National Parks and Wildlife Service will be displayed in a prominent position within the vicinity of works. Additionally, emergency responses, including methodologies, are specified in the **Management Plan 1: Emergency Response Plan.**

In the event of a significant contamination or pollution incident e.g., discharge or accidental release of hydrocarbons / fuel to surface water systems, contamination occurrences will be addressed immediately, this includes the cessation of works in the area of the spillage until the issue is resolved. The relevant authorities, noted above and stakeholders will also be promptly informed.

3.3.6 Grid Connection Excavation – Mitigation Measures

- The timing of grid connection cable laying will be carried out during metrologically dry seasons/periods.
- An Ecological Clerk of Works (ECoW) will be onsite in order to lessen environmental disruption and ensure site integrity is maintained. The ECoW will also be responsible for routine environmental monitoring and report writing.

- excavated material will be temporarily stockpiled adjacent to the section of trench, with appropriate material used as backfill.
- Excess/unsuitable material will be immediately removed and disposed of at a licenced waste disposal facility.
- Appropriate siltation measures, as per the measures set out in the subsequent sections below will be put in place prior to excavations.
- Stockpiles will be temporarily stored a minimum of 25m back from rivers/streams on level ground with a silt barrier installed at the base.
- For all grid connection trenching along the local road, any unsuitable backfill material excavated will be immediately taken away from the works area in trucks and disposed of under license to an authorised waste disposal facility. This will prevent any contaminated run-off to roadside drains during heavy rainfall.

3.4 HYDROLOGY AND DRAINAGE

The following section details environmental control measures which will be implemented on site in relation to hydrology and drainage and provide the framework within which the targeted CMS must be prepared. In addition, a Water Quality Management Plan and Watercourse Crossing Plan and a Surface Water Management Plan have been prepared (see **Management Plans 2** and **3** respectively) which provide further details of control measures and monitoring procedures.

3.4.1 Surface Water Quality Monitoring

The Contractors are solely responsible for pollution prevention for the duration of the contract and until such time as permanent measures, such as permanent drainage and silt mitigation controls, are deemed to be adequate and appropriately constructed.

In order to verify the efficacy of pollution prevention and mitigation works during construction, Water Quality Monitoring is required to be undertaken by a suitably qualified Environmental Consultant(s) (qualified to minimum of degree level with a minimum of 5 years' relevant experience), 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, hydrochemistry and grab sample monitoring and is detailed in **Management Plan 2 Water Quality Management Plan and Watercourse Crossing Plan**.

3.4.2 Site Drainage

Details of the Site drainage can be found in **Management Plan 3: Surface Water Management Plan**. The design criteria for the Sustainable Drainage Systems (SuDS) design are as follows:

- To select and install drainage.
- 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 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 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 the problems of 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 Salmonid Regulations.

3.4.2.1 *Mitigation*

Design Phase

Mitigation by Avoidance

- A process of "mitigation by avoidance" was undertaken by the EIA team during the design of the turbine and associated infrastructure layout. Arising from the results of this study, a constraints map was produced that identifies areas where hydrological / hydrogeological constraints could make parts of the Site less suitable for development. The constraints map is presented in **Figure 9.8a**.
- Ecoquest limited, in consultation with the design team has reviewed the layout plan and has identified it as the best layout design available for protecting the existing hydrological regime of the Site, while at the same time incorporating and overlaying engineering and other environmental constraints as detailed in this EIAR.

Constraints

As part of mitigation by avoidance during the design phase of the Development, surface water, and drainage buffer zones were established where applicable.

- 50m Surface Water Buffer Zone - Mapped surface water features i.e. mapped streams, rivers, lakes. Source for mapped surface water features; EPA. It is noted through experience and consultation with Inland Fisheries Ireland on other windfarm developments that their recommendation has typically been for a minimum 15m buffer zone from all watercourses to be implemented. Implementation of a 50m buffer zone can therefore be considered to be a conservative approach.

Groundwater buffer zones are dependent on the characteristics of the receptor e.g., private well, or public supply source protection zone, and the characteristics of the underlying geology and associated aquifer e.g., poor unproductive aquifer, or regionally important karstified aquifer. Recommended groundwater buffer zones range from e.g., 15m (exclusion zone karst swallow holes) to entire catchments (source protection in regionally important karstified aquifer) depending on site specific characteristics. For the purpose of this assessment the following conservative approach has been applied:

- 100m Groundwater Buffer Zone – Groundwater abstraction points in relation to proposed access tracks and cable trenches i.e., shallow excavation. Source for mapped abstraction points: GSI. Not applicable, none within 100m of the Site. Applicable to the grid connection and turbine delivery routes.
- 250m Groundwater Buffer Zone – Groundwater abstraction points in relation to proposed borrow pits and foundations. Source for mapped abstraction points: GSI. Not applicable, none within 250m of the Site.
- There are no source protection areas or karst features in the vicinity of the proposed development.

Some of the Development infrastructure footprint will fall within buffer zones due to the unique and limiting circumstances associated with the Site and the Development, including; constraints related to other environmental disciplines including; ecology, ornithology, etc.; restricted due to the proposed infrastructure itself whereby the proposed turbines require a minimum distance from each other to ensure the potential for wind turbulence impacting on downwind locations is minimised.

Figure 3.1: Constraints map

3.4.3 Excavation Works

- Management of excavated material will adhere to the measures related to the management of temporary stockpiles outlined in **Chapter 8: Soils and Geology**;
- No permanent or semi-permanent stockpiles will remain on the Site during the construction or operational phase of the Development. Excess spoil is to be taken to the designated borrow pit at the Site;
- Suitable locations for temporary stockpiles will be identified on an individual basis. The suitability of any particular location will consider Site specific characteristics, including;
  - The location of drainage networks in the vicinity;
  - The slope, incline and topography of the downgradient area; and,
  - Any other relevant characteristics which are likely to facilitate or increase the potential for entrainment by surface water runoff.
- Construction activities will not be carried out during periods of sustained significant rainfall events, or directly after such events. This will allow sufficient time for work areas to drain excessive surface water loading and discharge rates to be reduced;
- Following heavy rainfall events, and before construction works recommence, the Site will be inspected and any required corrective measures implemented;
- An emergency response plan will be developed for the construction phase of the project. The plan, at a minimum, will involve 24-hour advance meteorological forecasting linked to a trigger-response system. When a pre-determined rainfall trigger level is exceeded such as a very heavy rainfall at >25mm/hr, planned responses will be undertaken. These responses will include cessation of construction until the storm event, including storm runoff, has ceased;
- Sediment fencing will be erected along proximal and paralleling areas of watercourses, channels and drains spanned by the works to reduce the potential for sediment laden run-off to reach sensitive receptors;
- No direct flow paths between stockpiles and watercourses will be permitted at the Site;
- Excavated material will be backfilled to the excavation or transported to the spoil storage area as soon as is reasonably practicable to prevent long duration storage at the Site which increases the risk of adverse effects on aquatic environments; and,
- All mitigation measures related to surface water quality will be implemented before excavation works commence.

Excavation Dewatering Mitigation Measures

- Management of excavations will adhere to the measures outlined in **Chapter 8: Soils and Geology**. Areas of subsoils to be excavated will be drained ahead of excavation works. This will reduce the volumes of water encountered during excavation works and will therefore reduce the volume of water that is required to be dewatered whilst excavations are being carried out;

- Engineered drainage and attenuation features outlined in the **Surface Water Management Plan** will be established ahead of excavation works;
- Dewatering pumping rates will be controlled by an inline gate valve or similar infrastructure which will facilitate a reduction of loading on the receiving environment, thus enhancing the attenuation and settlement of suspended solids;
- The direct discharge of dewatered loads to surface waters will not be permitted under any circumstances;
- All dewatering will follow a strict procedure of pumping to a settlement tank and then to a dewatering bag, or settlement ponds prior to discharging to receiving environment for overland flow;
- Geofabric lined settlement ponds will buffer the run-off discharging from the drainage system which will reduce the hydraulic loading to watercourses. Settlement ponds will be designed to reduce flow velocity to 0.3 m/s at which velocity silt settlement generally occurs. In areas of the Site where the placement of settlement ponds is not feasible, other mitigation measures described below will be implemented;
- Check dams will be constructed across drains and will reduce the velocity of run-off which will in turn promote settlement of solids upstream of potential surface water receivers. An additional benefit of check dams is that they will reduce the potential for erosion of drains. Rock filter bunds may be used for check dams. Wood or hay bales can also be used if properly anchored. It is recommended that multiple check dams are installed, particularly in areas immediately down gradient of construction areas;
- Overland flow paths of the final dewatered discharge will be maximised to the greatest practical extent to avoid prematurely draining to drainage channels or surface waters. This approach will allow for enhanced settling out of suspended solids entrained in the run-off;
- All pumps, tanks, settlement ponds, dewatering bags and check dams used in the dewatering process will be regularly inspected and maintained as necessary to ensure surface water run-off is appropriately treated;
- Sediment fencing will be installed up gradient of water courses which may receive the final overland flow;
- The final treated dewatered discharge will be directed towards heavily vegetated areas to allow for further natural filtration of suspended solids;

- A programme of water quality monitoring will be implemented during the construction phase which is outlined in detail in **CEMP Management Plan 2 – Water Quality Management Plan and Watercourse Crossing Plan**;
- No extracted or pumped water will be discharge directly to the surface water network associated with the Site (this in accordance with the *Local Government (Water Pollution) Act 1977* as amended); and,
- Any discharges of sediment treated water should meet the requirements of the *Surface Water Regulations 2009*, as amended.

3.4.3.1 Construction Water Management, Dewatering, Treatment & Discharge of Trade Effluent

Mitigation measures to reduce the potential for adverse impacts arising from dewatering activities include the following:

- Management of excavations will adhere to the measures outlined in **Chapter 8: Soils and Geology**. Areas of subsoils to be excavated will be drained ahead of excavation works. This will reduce the volumes of water encountered during excavation works and will therefore reduce the volume of water that is required to be dewatered whilst excavations are being carried out;
- Engineered drainage and attenuation features outlined in the **Surface Water Management Plan** attached as **Appendix 2.1** will be established ahead of excavation works;
- Dewatering pumping rates will be controlled by an inline gate valve or similar infrastructure which will facilitate a reduction of loading on the receiving environment, thus enhancing the attenuation and settlement of suspended solids;
- The direct discharge of dewatered loads to surface waters will not be permitted under any circumstances;
- All dewatering will follow a strict procedure of pumping to a settlement tank and then to a dewatering bag, or settlement ponds prior to discharging to receiving environment for overland flow;
- Geofabric lined settlement ponds will buffer the run-off discharging from the drainage system which will reduce the hydraulic loading to watercourses. Settlement ponds will be designed to reduce flow velocity to 0.3 m/s at which velocity silt settlement generally occurs. In areas of the Site where the placement of settlement ponds is not feasible, other mitigation measures described below will be implemented;
- Check dams will be constructed across drains and will reduce the velocity of run-off which will in turn promote settlement of solids upstream of potential surface water

receivers. An additional benefit of check dams is that they will reduce the potential for erosion of drains. Rock filter bunds may be used for check dams. Wood or hay bales can also be used if properly anchored. It is recommended that multiple check dams are installed, particularly in areas immediately down gradient of construction areas;

- Overland flow paths of the final dewatered discharge will be maximised to the greatest practical extent to avoid prematurely draining to drainage channels or surface waters. This approach will allow for enhanced settling out of suspended solids entrained in the run-off;
- All pumps, tanks, settlement ponds, dewatering bags and check dams used in the dewatering process will be regularly inspected and maintained as necessary to ensure surface water run-off is appropriately treated;
- Sediment fencing will be installed up gradient of water courses which may receive the final overland flow;
- The final treated dewatered discharge will be directed towards heavily vegetated areas to allow for further natural filtration of suspended solids;
- A programme of water quality monitoring will be implemented during the construction phase which is outlined in detail in **EIAR Section** Error! Reference source not found.;
- No extracted or pumped water will be discharge directly to the surface water network associated with the Site (this in accordance with the *Local Government (Water Pollution) Act 1977* as amended); and,
- Any discharges of sediment treated water should meet the requirements of the *Surface Water Regulations 2009*, as amended.

3.4.3.2 Release and Transport of Suspended Solids Proposed Mitigation Measures

The following mitigation measures to reduce potential impacts from the release of suspended solids to the surface waters will be implemented:

- Collector drains and soil berms will be implemented to direct and divert surface water runoff from construction areas such as temporary stockpiles into established settlement ponds, buffered discharge points and other surface water runoff control infrastructure. This planning and placement of these control measures will be of fundamental importance, especially for the areas where works within the 50m buffer zone will be unavoidable which is discussed in **EIAR Section** Error! Reference source not found.;
- Sediment control fences will be implemented significantly upgradient of potential receiving waters and as part of the drainage network. Sediment control fences will also be established upgradient of the Site's pre-existing natural and artificial drains. This

practice will reduce the potential for elevated suspended solids entrained in surface water runoff to discharge to surface waters;

- Multiple silt fences will be used in drains discharging to the surface water network. This will be especially important for the areas where works within the 50m buffer zone will be unavoidable which is discussed in **EIAR Section 9.5.1.2**;
- The drainage, attenuation and other surface water runoff management systems will be installed prior to the commencement of construction activities. Whenever possible, drainage and attenuation control measures will be installed during seasonally dry conditions to limit the potential for sediment laden run-off to discharge to surface waters during the installation of these measures;
- Surface water runoff will be discharged to land via buffered drainage outfalls that will contain hardcore material of similar composition to the geology of the bedrock at the Site. This mitigation measure will promote the capture and retention of suspended sediment;
- Buffered drainage outfalls also promote sediment percolation through vegetation in the buffer zone, reducing sediment loading to adjacent watercourses and avoiding direct discharge to the watercourse;
- Buffered drainage outfalls will be placed outside of the 50m buffer zone and will not be positioned in areas with extensive erosion and degradation;
- A relatively high number of discharge points will be established to decrease the loading on any one particular outfall;
- Discharging at regular intervals mimics the natural hydrology by encouraging percolation and by decreasing individual hydraulic loadings from discharge points;
- This site-specific CEMP mandates regular inspections and maintenance of pollution control measures. Contingency measures outlining urgent protocols to repair or backup any breaches of designed mitigation measures are incorporated into the site-specific CEMP;
- In the event that mitigation measures are failing to reduce suspended solids to acceptable levels, construction works will cease until remediation works are completed;
- If fine solids or colloidal particles are very slow to settle out of waters, coagulant or flocculant will be used to promote the settlement of finer solids prior to discharging to surface water networks. Flocculant gel blocks can be placed in drainage channels, these are passive systems that are self-dosing, self-limiting and are environmentally friendly. Flocculant gel blocks bind elevated levels of silt and associated contaminants into masses that are easily separated, captured and then removed from the water; and,

- Surface water runoff controls will be checked and maintained on a regular basis and as soon as any signs of deterioration become visible. Surface water runoff controls, check dams and settlement ponds will be maintained and emptied on a regular basis and as soon as any signs of deterioration become visible.

The adoption of precautionary principles and the implementation of mitigation measures listed above will ensure that the risk of elevated suspended solids discharging to surface waters is low. This in turn will ensure that potential risks to sensitive receptors is also low. Nevertheless, should a significant discharge of suspended solids to surface waters occur, the absence of immediate proximity to designated sites and the assimilative capacity of the localised surface waters will act as a natural hydrological buffer in terms of suspended solids loading. Should such a discharge occur, the dilution and retention time of suspended solids in the localised surface water network will reduce potential impacts on highly sensitive downstream designated sites. It should be noted that this natural mitigation measure is not to be adopted as a first principle, and will not be relied upon to prevent adverse impacts on designated sites, it will be rather a last line of defence.

A detailed design of required drainage, collector drainage, stilling ponds and other listed mitigation infrastructure is contained in the **Surface Water Management Plan**. Unsuitable and particularly sensitive areas are identified and presented in various figures contained in **Volume III**.

3.4.4 Release of Cement-Base Products

The following mitigation measures to reduce potential impacts posed from the use of concrete and the associated effects on surface water in the receiving environment are proposed:

- The procurement, transport and use of any cement or concrete will be planned fully in advance and supervised by appropriately qualified personnel at all times;
- Vehicles transporting cement or concrete to the Site will be visually inspected for signs of excess cementitious material prior to being granted access to the Site. This will prevent the likelihood of cementitious material being accidentally deposited on the site access tracks or elsewhere at the Site;
- Drivers of such vehicles will be instructed to ensure that all vehicles are washed down in a controlled environment prior to the departure of the source site, such as at concrete batching plants;

- Precast concrete will be used wherever possible, although the use of pre-cast concrete is not a viable option for large structures such as turbine foundations and so concrete will be delivered to the Site;
- Concrete will not be poured during periods of rainfall or if any kind of precipitation is forecast. This policy will limit the potential for freshly poured concrete to adversely impact on surface water runoff;
- Raw or uncured waste concrete will be disposed of by removal from the Site;
- Washout of concrete trucks shall be strictly confined to the batching facility and shall not be located within the vicinity of watercourses or drainage channels. Only the chutes will be cleaned prior to departure from Site, and this will take place at a designated area at the temporary site compound;
- Spill kits will be readily available to Site personnel, and any spillages or deposits will be cleaned up immediately and disposed of appropriately;
- Pouring of concrete into standing water within excavations will be avoided;
- Excavations will be prepared before pouring of concrete by pumping standing water out of excavations to the buffered surface water discharge systems in place;
- Any surplus concrete will not be stored or deposited anywhere on Site and will be returned to the source location or disposed of appropriately at a suitably licensed facility; and,
- Any required shuttering installed to contain the concrete during pouring will be fully secured around its perimeter to minimise any potential for leaks.

3.4.5 Potential Release of Hydrocarbons during Construction and Storage

The following mitigation measures to reduce potential impacts from the environmental release of hydrocarbons and other harmful chemicals to the surface waters will be implemented:

- Refuelling of vehicles will be carried out off site to the greatest practical extent. This refuelling policy will mitigate the potential for impacts by avoidance. Due to the remote location and nature of the Site, it is unlikely that implementation of this refuelling policy will be practical in all circumstances. In instances where refuelling of vehicles on Site is unavoidable, a designated and controlled refuelling area will be established at the Site. The designated refuelling area will enable low risk refuelling and storage practices to be carried out during the works. The designated refuelling area will contain the following attributes and mitigation measures as a minimum requirement:
    - The designated refuelling area will be located a minimum distance of 50m from any surface waters or Site drainage features;

- The designated refuelling area will be bunded to 110% volume capacity of fuels stored at the Site;
- The bunded area will be drained by an oil interceptor that will be controlled by a pent stock valve that will be opened to discharge storm water from the bund;
- Management and maintenance of the oil interceptor and associated drainage will be carried out by a suitably licensed contractor on a regular basis;
- Any oil contaminated water will be disposed of at an appropriate oil recovery plant or licensed tip site;
- Any minor spillage during this process will be cleaned up immediately;
- Vehicles will not be left unattended whilst refuelling;
- All machinery will be checked regularly for any leaks or signs of wear and tear; and,
- Containers will be properly secured to prevent unauthorised access and misuse. An effective spillage procedure will be put in place with all staff properly briefed. Any waste oils or hydraulic fluids will be collected, stored in appropriate containers and disposed of offsite in an appropriate manner.

Notwithstanding the management of refuelling and fuel storage at the designated refuelling area, the potential risk of hydrocarbon spills from plant and equipment or other general chemical spills at other areas of the Site remains. To mitigate against potential spills at other areas of the Site, the following mitigation measures will be implemented:

- Oil absorbent booms and spill kits will be available adjacent to all surface water features associated with the Development. The controls will be positioned downstream of each construction area and at principal surface water drainage features. Oil booms deployed will have sufficient absorbency relative to the potential hazard;
- Spill kits will also be available at construction areas such as at turbine locations, the temporary site compound, on-site substation, spoils storage areas and met mast location etc.;
- Spill kits will contain a minimum of oil absorbent pads, oil absorbent booms, oil absorbent granules, and heavy-duty refuse bags for collection and appropriate disposal of contaminated matter;
- Should an accidental spill occur during the construction or operational phase of the Development, such incidents will be addressed immediately, this will include the cessation of works in the area of the spillage until the issue has been resolved;
- Spill kits will be kept in each vehicle at the Site and will be readily available to all operators;

- No materials, contaminated or otherwise will be left on the Site;
- Suitable receptacles for hydrocarbon contaminated materials will also be available at the Site; and,
- A detailed spill response plan forms part of the site-specific CEMP appended to **Appendix 2.1** of this EIAR.

Implementation of the above mitigation measures will significantly reduce the risk of hydrocarbon contamination being released to the surface water network. Nevertheless, the potential risk cannot be entirely eradicated. Therefore, precautionary measures and emergency response protocols will be established and are included in the site-specific CEMP appended to the EIAR in **Appendix 2.1**.

A full Schedule of Mitigation Measures relating to Site Drainage can be seen in **Appendix 17.1.**

3.4.6 Water Crossings

3.4.6.1 Wind Farm Site

At the wind farm site, one new watercourse crossing will be constructed. The required crossing will be a crossing of a small stream that are headwaters of the Finisk River: the location of the proposed crossing and proposed designs are mapped on **EIAR Figure 9.7** and outlined in the **Water Quality Management Plan and Watercourse Crossing Plan**.

The following measures provide for the planning and consideration of this watercourse as part of the overall approach to watercourse crossing to ensure potential impacts are adequately mitigated.

A confirmatory assessment in terms of bridge or culvert design will be carried out that will have cognisance to the crossing location including the characteristics of water flow at both locations. The proposed crossing location will be situated relatively near the headwaters of this small stream. As a result, bridge or culvert specification and construction are envisaged to be of relatively low significance in terms of expected flow and culvert diameter. As per details set out above the following design measures have been implemented for the watercourse crossing to ensure any potential impacts of the proposed watercourse crossing are minimised:

- The design of the proposed crossing and a method statement for the proposed construction will be agreed in advance with Inland Fisheries Ireland (IFI)

- Crossings have been designed to minimise, in so far as practical, the disturbance or alteration of water flow, erosion and sedimentation patterns and rates
- Vehicles and plant used in the construction of the proposed crossing will only be refuelled at the Site's bunded and designated refuelling area, no refuelling will be permitted within 50m of any watercourse at the Site
- To mitigate against the potential risk of accidental leaks or spillages from plant and equipment the following measures will be implemented: Multiple spill kits will be maintained on the Site at all times within the cabs of vehicles and placed strategically at environmentally sensitive locations across the Site. Spill kits will be routinely inspected to ensure that they are fully stocked with oil absorbent booms and pads at all times. Oil absorbent booms will be installed downstream of channel crossing work areas within 25m of the works location prior to the commencement of works.

3.4.6.2 Grid Connection Route

The proposed grid connection route includes the construction of 3 no. watercourse crossings. The crossings will be via horizontal directional drilling at two locations, and one via the existing bridge formation.

The following mitigation measures will be implemented during the installation of the grid connection route over existing the 1 no. existing bridge formation:

- Excavated road and soil will be stored in an area at least 10m from the crossing structure and watercourse, and preferably down gradient of the watercourse crossing but up-gradient of the excavated trench so that, after rainfall, material in run-off is contained in the trench.
- Silt fencing and silt capture structures such as straw bales will be deployed along either side of a watercourse crossing beyond the full width of the pipe, culvert or bridge structure. Silt fencing will be installed so that the wooden posts and attached fence is buried at least 300mm below the surface of road-side vegetation.
- Gullies that lead directly to a watercourse either side of a structure are key pathways for run-off conveyance and these will be blocked to ensure that the direction of potential run-off is conveyed to vegetated verges to allow for infiltration and trapping.
- A pre-emptive site drainage management plan will be applied to take account of predicted rainfall so that large excavations adjacent to watercourse crossing can be suspended or scaled back when heavy rain is forecast.

These measures will prevent the run-off of excess sediments via the key watercourses intersecting the cable route to key adjoining downstream watercourses that connect the crossing points to European Sites and sensitive aquatic receptors. The mitigation measures also will apply to any small drains that represent a pathway for conveyance of sediment to watercourses and qualifying habitats of the Blackwater River SAC and the Dungarvan Harbour SPA downstream of this watercourse crossing.

3.4.7 Horizontal Directional Drilling

The following mitigation measures to reduce potential impacts associated with horizontal directional drilling (HDD) will be implemented:

- Clearbore, which is not toxic to aquatic organisms and is biodegradable will be the drilling fluid used.
- Mud mixing will be monitored to suit the ground conditions encountered.
- The drilling fluids will be constantly monitored, any changes required to the mix will be performed on site by a specialised HDD Contractor upon consultation with the drilling fluid supplier and Environmental Clerk of Works.
- Mud testing equipment will be available at all times during drilling operations to monitor key mud parameters.
- All equipment will be carefully checked on a daily basis by the Site Supervisor prior to use to ensure plant and machinery is in good working order with no leaks or potential for spillages.
- Spill kits, including an appropriate hydrocarbon boom will be available on the site in the event of any unforeseen hydrocarbon spillages and all staff shall be trained in their use.
- All plant, materials and wastes will be removed from site following the HDD works.
- The launch pit will be reinstated to the original land surface condition and the normal duct trench will continue from this point.
- Should any dewatering be required, it will be carried out in accordance with the measures outlined in this CEMP.
- Test pits and boreholes will not be located directly on, or extend through, the proposed alignment, as these weak points may serve as conduits where inadvertent fluid returns or frac outs could occur. At least a 3m offset will be provided between the boreholes and pipe alignment.

3.5 AIR AND CLIMATE

Contractors Good practice site control measures include the following:

- Approach roads and construction areas will be cleaned on a regular basis to prevent build-up of mud and prevent it from migrating around the site and off-site onto the public road network;
- Wheel wash facilities will be provided near the site entrances to prevent mud/dirt being transferred from the site to the public road network;
- ‘Damping down’ will be used if dust becomes an issue on any part of the site. For example, weather will be monitored, to predict the need for damping down activities during periods of dry weather when dust is likely to become airborne;
- Vehicles delivering materials to the site will be covered appropriately when transporting materials that could result in dust, e.g. crushed rock or sand;
- Ready-mix concrete will be delivered to site and it is envisaged that no batching of concrete will take place on site. Only washing out of chutes will take place on site and this will be undertaken at a designated concrete washout facility at the site compounds;
- Speed restrictions on access tracks will be implemented to reduce the likelihood of dust becoming airborne;
- Public roads along the construction haul route will be inspected regularly and if dirt/mud is identified that could result in dust generation, then the road will be cleaned as necessary;
- Stockpiling of materials will be carried out in such a way as to minimise their exposure to wind where possible and damping down or covering of the stockpiles will be carried out where needed; and
- A complaints procedure will be implemented on site where complaints will be reported to the site manager, logged and appropriate action taken.

3.6 ARCHAEOLOGY AND CULTURAL HERITAGE

The following section details the environmental control measures which will be incorporated into the Contractors’ Construction Method Statement in respect of archaeology and cultural heritage. An assessment of the impacts from works on Archaeology and Cultural Heritage can be found in the EIAR, **Chapter 14: Cultural Heritage.** The control measures include pre-construction and construction phase archaeological site investigations as well as protection measures for known monuments. These measures are in accordance with the guidelines for archaeological planning conditions for wind energy developments located within close proximity to recorded archaeological monuments published in the 2006 Wind Energy Development Guidelines and the 2019 Draft Revised Wind Energy Development Guidelines.

3.6.1 Mitigation

Construction Phase

- The location of T9 and associated hardstand and access roads are within an area of improved green field land located 70m to the west of Wedge Tomb CO069-003 ----, and possibly within the general environs of any potential unrecorded sub-surface features associated with field boundary (CO069-070----). This grassland contains suitable ground conditions for undertaking a geophysical survey and this type of investigation will, therefore, be carried out in within the footprint of the T9 hardstand and access roads in the grassland area in advance of the construction phase. This will be followed by targeted archaeological test trenching of any identified features of archaeological potential which will also be carried out during the pre-construction phase. These investigations will be carried out under licences issued by the National Monuments Service.
- Ground works during the construction phase within other areas of the Site, as well as green field locations along the grid route and within turbine delivery work areas, will be subject to constant archaeological monitoring under licence by the National Monuments Service. A systematic advance programme of archaeological field-walking surveys will also be carried out within forestry plantations following pre-construction tree felling to assess whether they contain any visible surface traces of potential unrecorded archaeological or architectural heritage sites. Construction phase ground works within these felled areas will then be subject to archaeological monitoring. All grid connection road works within 50m of the location of lime kiln (CO057-002001-) will also be subject to constant archaeological monitoring and the location of this structure will be clearly marked by signage during the construction phase. An archaeological watching brief of grid connection trench excavations within other public and forest roads will be carried out to appraise whether any areas of these roads overlay undisturbed topsoil layers which may have the potential to contain archaeological remains. Constant monitoring of trench excavations will be carried out within any such identified areas as part of the programme of licensed archaeological monitoring of the Project.
- In the event that any sub-surface archaeological features are identified during these site investigations they will be recorded and then securely cordoned off while the National Monuments Service are consulted to determine further appropriate mitigation measures, which may include preservation in situ (by avoidance) or preservation by record (archaeological excavation). Any identified sub-surface archaeological features which will be preserved by avoidance will be securely cordoned off for the duration of the construction phase and clearly signed as a 'No Entry: Archaeological Area'.

- Buffer zones at the edge of proposed construction areas within the environs of the following extant recorded archaeological monuments will be securely cordoned off and clearly signed as 'No Entry: Archaeological Area' for the duration of the construction phase: Wedge Tomb CO069-003----, Wedge Tomb CO069-003---- and Enclosure CO069-002----.
- The Project is located within the Múscraí Gaeltacht area and any signage erected within the public realm during the construction phase will include Irish and English text.

3.7 NOISE & VIBRATION

No significant construction noise effects have been identified. However, where the grid route is within 20m to a receptor, then mitigation measures will be put in place. Mitigation could include the erection of a 2m high barrier between source and receptor. Maximum levels from grid connection will pertain for no more than one day at any location. General guidance for controlling construction noise through the use of good practice is given in BS 5228-1[2] will be followed (**EIAR Section 11.2.9.1.2**). During construction of the Development, activity shall be limited to working times incorporated in any planning permission, however there may be occasion where delivery of large transport loads such as turbines necessitates delivery outside of daytime hours. In such cases permission will be sought from the relevant authorities. The transport of large transport loads generates low levels of noise and vibration as trucks performing such tasks move at very low speeds. Construction activity is temporary and unlikely to generate noise issues at any receptor. Construction noise including ground vibration, and air overpressure impacts are predicted as insignificant.

3.8 TRAFFIC

The following mitigation measures are recommended:

- Prior to delivery of abnormal loads i.e., turbine components, the Applicant or their representatives, will consult with An Garda Síochána and Waterford City and County Council to discuss the requirement for a Garda escort. The Applicant will also outline the intended timescale for deliveries and efforts can be made to avoid peak times such as school drop off times, church services, peak traffic times where it is considered this may lead to unnecessary disruption, and abnormal loads may travel at night and outside the normal construction times as may be required by An Garda Síochána. Local residents at sensitive locations along the affected route will be notified of the timescale for abnormal load deliveries.

[2] British Standard 5228_:2009+A1:2014 Code of Practice for noise and vibration control on construction and open sites-Noise

- Wheel cleaning equipment will be used on the Site Access Track near the near the public road junction to prevent any mud and/or stones being transferred from Site to the public road network. All drivers will be required to see that their vehicle is free from dirt and stones prior to departure from the construction site.
- In addition, any dust generating activities will be minimised where practical during windy conditions, and drivers will adopt driving practices to minimise the creation of dust. Where conditions exist for dust to become friable, techniques such as damping down of the potentially affected areas may be employed.
- To reduce dust emissions, vehicle containers/loads will be covered during both entrance and egress to the Site where required.
- A survey of the Haul Route will be undertaken to identify if any overhead lines will need to be lifted along the route to allow abnormal loads such as tower sections and nacelles to be delivered.
- Turbine component deliveries will be timed to avoid peak times and in particular, times when pupils will be dropped off and picked up from the various schools on the turbine component Haul Route.
- During the wind farm construction and decommissioning phases, road works signs in accordance with the requirements of Chapter 8 of the Traffic Signs Manual will be erected at the wind farm site entrance on the N59 and at all locations on the haul route which are being modified to facilitate turbine delivery.
- Access to the construction site will be controlled by on Site personnel and all visitors will be asked to sign in and out of the Site by security/Site personnel on entering and exiting the site. All Site visitors will undergo a Site induction covering Health and Safety issues at the Contractor's temporary compound and will be required to wear appropriate Personal Protective Equipment (PPE) while onsite.

3.9 WASTE

The following section details the environmental control measures which will be incorporated into the Development in respect of Waste Management.

3.9.1 Mitigation

- The Contractors will avoid or minimise the volume of waste generated.
- Waste will be stored a minimum of 50m from nearby watercourses or drains at the proposed Dyrick Hill Wind Farm.
- Waste storage and disposal will be carried out in a way which prevents pollution in compliance with legislation.

- Rainwater, which has collected within bunded areas used for the storage of oils, chemicals and waste, will be collected and disposed offsite by suitably qualified waste Contractors.
- Waste derived from the port-a-cabins (office and canteen facility) onsite will be placed in an appropriately designed waste storage area prior to collection a licensed Contractors under the Waste Management Act, 1996.
- Port-a-loos will be regularly maintained by a suitably qualified waste Contractors engaged by the supplier.
- The wheel cleaning facility is proposed at the Site entrance; in addition, a track sweeper may be used.
- All waste to be transported off-site to a licensed facility will be documented in accordance with the European Union (Waste Directive) Regulations 2020. An adequate description of the waste and where it came from will be given and an appropriate European Waste Catalogue Code and Standard Industrial Classification Code will be provided. The quantity and nature of the waste will be described and how it is contained. Personal details of the waste transferor and transferee at Dyrick Hill Wind Farm will be documented. Waste will only be transferred by registered/licensed and competent person(s).
- Only trained operatives will handle hazardous substances. All stored hazardous waste will be clearly labelled.
- All oil storage facilities of over 200 litres need secondary containment facilities of 110% storage capacity (e.g., bund, enclosure, drip tray). All of these will be regularly inspected for visual signs of leaks or something that would impact on their capacity – e.g., a drip tray full of rainwater.
- Waste storage areas will be clearly located and signed. If space allows, key waste streams will be separated.
- All waste will be transported from the Site at appropriate frequency by a registered waste Contractors to prevent over-filling of waste containers.
- Frequency of Checks. The Contractors will ensure that all storage facilities are checked on a weekly basis. The checklist for completion is attached in **Management Plan 5: Waste Management Plan**.

3.10 CONSTRUCTION

The following sections detail an outline construction sequence to provide an overview of the construction process; The construction-stage details of the sequence and methodologies, to be undertaken within the framework of this CEMP, will be determined by the Contractors.

3.10.1 Phasing of Works

It is envisaged that the following will be the sequence of construction for the Development:

1. Site Preparation including felling and drainage
2. Site Access Roads
3. Contractors Compound and Welfare Facilities
4. Crane hardstandings
5. Turbine Foundations
6. Internal cable ducting
7. Installation of the Grid Connection
8. Erection of wind turbines
9. Commissioning and Energisation

3.10.2 Working Hours

The Development will have approximately 123 to 147 construction workers during the peak of the construction phase. Working hours for construction will be from 07:00 to 19:00 on weekdays, with reduced working hours at weekends, from 08:00 to 13:00 on a Saturday. It should be noted that during the turbine erection phase, operations will need to take place outside those hours with concrete pours commencing at 05:00 and continuing till 16:00, to facilitate turbine foundation construction and so that lifting operations are completed safely. Hours of working for turbine foundation construction will be agreed with Waterford City and County Council prior to the commencement of turbine foundation construction. **Chapter 15: Traffic and Transportation** refers to this in further detail. A detailed Traffic Management Plan will be implemented for the construction phase. This shall be agreed during the planning compliance stage with the Planning Authority so that strict controls described therein are in place with all suppliers coming to the Site.

3.10.3 Site Management Procedures and Construction Methodologies

Prior to commencement of construction, the appointed Contractors(s) will prepare detailed method statements and work programmes for the construction stage. These method statements will be prepared in the context of measures set out in this CEMP and will take account of mitigation measures as outlined in the planning application and accompanying environment reports, and site investigations to be carried out prior to construction. Any specific requirements will be fully incorporated into the appointed Contractors scopes of work and appropriate supervision and management will be carried out to ensure full compliance.

The method statements produced by the Contractors(s) will be reviewed by the Ecological Clerk of Works (EM) and will be agreed with the appropriate parties, including Waterford City and County Council. The developer will employ a project manager to monitor the construction phase of the project and ensure works are being carried out in accordance with the agreed method statements, safety procedures and pollution control measures.

3.10.3.1 Mobilisation of Contractors Plant

Prior to commencement of construction works, the selected Contractors shall submit to the Developer a full list of plant, equipment and accommodation (site offices etc.) proposed for use during the works.

Dates for mobilisation will be agreed with the developer and/or his representative/Owners Engineer.

3.10.3.2 Site Infrastructure

Site Access Roads / Turbines

Machinery and vehicles used in access track construction are operated from the track only as it is constructed.

The location of all infrastructure required for this Development shall be set out by GPS (Real-Time Kinematicenabled[3]) equipment to the permitted detail as noted on the approved drawings. The Site will be set out using wooden posts to mark the boundary and extent of construction activities, in accordance with the Site layout and environmental constraints drawings, and with contributions from the appointed ecologist. The boundaries of the buffer zones will be taped/fenced off to prevent construction plant from entering the buffer zones and impacting on water quality. Site personnel will be informed of the buffer zones through toolbox talks onsite, both before and during construction. New personnel will be informed of the construction buffer zones with induction training before commencing work.

Borrow Pits

Most of the crushed stone fill material for site track and hardstand areas will be sourced from the permitted borrow pits outlined above.

[3] Real-time kinematic (RTK) processing on a drone **records GPS information and geotags images as they're captured during flight**.

The rock will be extracted from the proposed borrow pits using two main methods, rock breaking and rock blasting. The primary method will be rock breaking. Rock sourced from the proposed borrow pits will be used for the roads and hardstanding areas. The borrow pits will operate for the duration of the construction period of the site infrastructure.

The effects of blasting vibration and air overpressure from the Development is at a distances greater than 870m and is therefore considered not significant and will be kept well within the recommended guidelines described in **Chapter 11: Noise**.

3.10.3.3 Establish Pre- Commencement Mitigation Measures

Prior to construction works advancing on site, the Contractors shall confirm to the Employer of their intention to advance the works in a sound practical manner with no undue impact on the receiving environment. The Contractors shall identify all sensitive environmental areas within the Employer's site and confirm their intended method of construction works regarding these areas in line with the methods outlined in this CEMP. All environmentally sensitive areas shall be identified prior to the detailed design/construction phase.

Where the estimated working area is reduced by any sensitive environmental areas i.e., buffer zones, post and tape marking shall be used to set out these locations and thus prevent the entry of Contractors plant within these areas during construction works.

To protect any known ecological features that occur close to the planned infrastructure, a delineated working corridor will be employed throughout the construction. Posts and tape will be used to establish these areas and thus prevent the entry of Contractors plant outside the working corridor during construction works. Locations of ecological significance or where invasive species are identified will also be fenced off.

A 50m buffer to natural watercourses will be employed during construction to protect water quality and to see that there is no significant direct effect on existing watercourses. The proposed locations for spoil storage are highlighted in the attached **Spoil Management Plan**. Where spoil storage areas are located in proximity to watercourse buffer zones, silt fencing will be installed along the area facing the buffer zone and maintained in line with the instructions of the manufacturer. Works within the buffer zone will be subject to specific method statements.

3.10.3.4 Site Preparation

Entrance Formation

There are two proposed Site entrances associated with the Development; Site Entrance 1 is a new site entrance that will be created and is located in the southeast of the Site located off R671 road and Site entrance 2 is an existing site entrance located in the southwest corner of the Site off the L1027 Local Road. The Turbine Delivery Route and the Construction Haul Routes will utilise Site Entrance 1.

Please refer to **Figures 3.2** for an illustration of the Site entrances location.

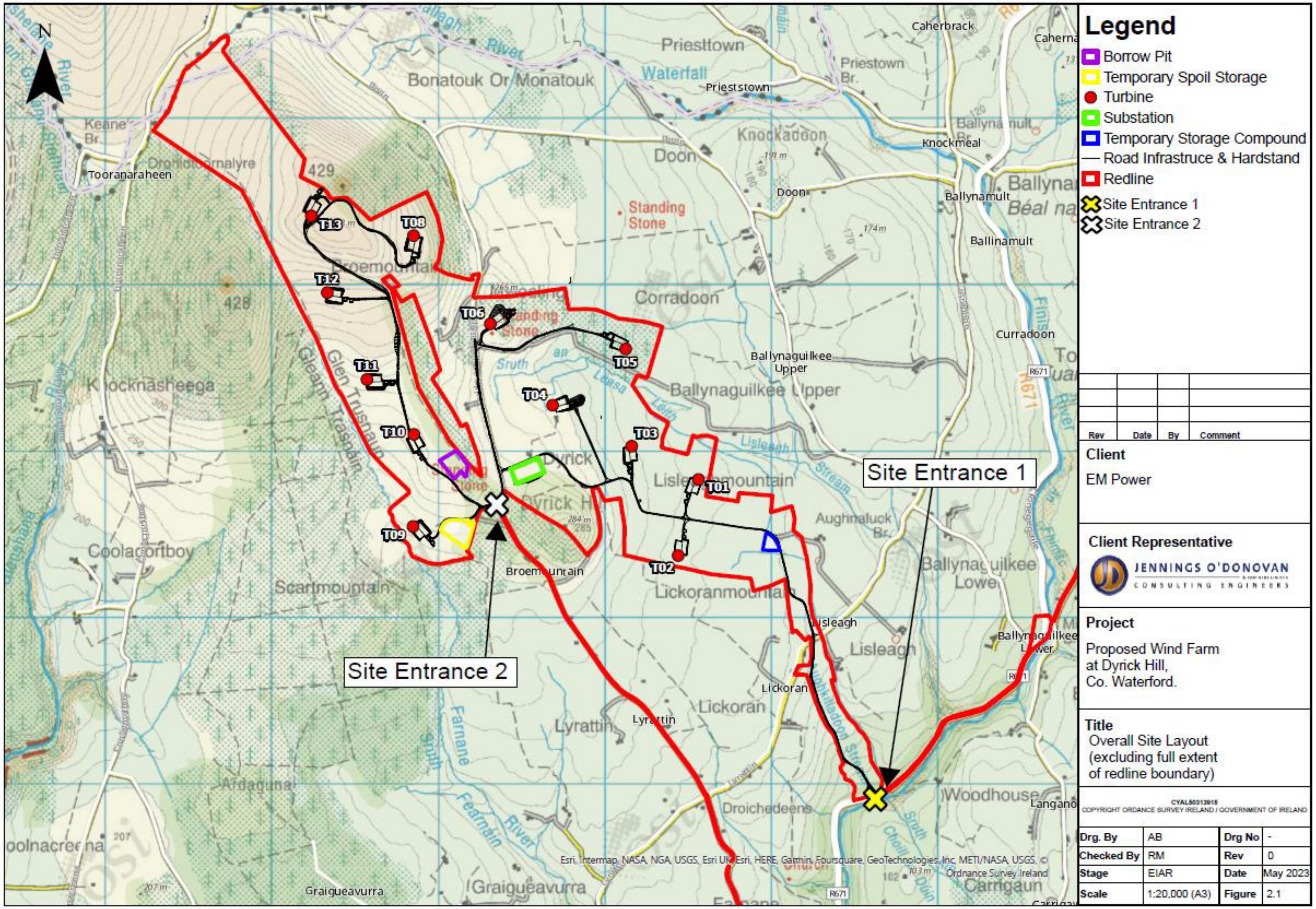

Figure 3.2: Map showing the proposed location of site entrances at Dyrick Wind Farm.

Works required at the site entrances will include the following:

- Clearing visibility splays of vegetation / soil to a level surface;
- Extending the entrance to allow HGVs turn right into the site from the N22;
- Excavating to solid formation level;
- Installing roadside drainage features;
- Placing entrance sub-base with rockfill material;
- Placing capping layer;
- Providing surface dressing where necessary to prevent rutting of existing road surface.

The detailed construction method statement for site entrance preparation is included in **Table 3.1**.

Table 3.1: Site Entrance Preparation CMS

Activity	Notes
Video Road Condition Survey.	The Contractors will arrange and provide a video survey to establish the condition of the road prior to mobilisation to site.
Prepare a Traffic Management Plan (TMP) in coordination with Waterford City and County Council and An Garda Síochána and implement.	The Contractors will agree an approved TMP with the Roads Section at Waterford City and County Council and An Garda Síochána and the developer.
Set out the alignment of the site entrance using GPS equipment.	Wooden pegs/posts or similar to be used in setting out, following a site walkover by the Ecological Clerk of Works.
Archaeology Requirements.	The Site will be accessible to the appointed archaeologist at all times during working hours. The nominated archaeologist will monitor all invasive works.
Install drainage treatment features as per the Surface Water Management Plan.	Required to minimise the transportation of suspended solids generated during the construction stage.
Excavate and/or clear the area which is required to	The top layer of vegetated material is set aside for re-use as a sealing layer to prevent sediment runoff and reduce visual impact.

Activity	Notes
accommodate the visibility splays.	
Re-align private fences as required by the visibility splays and detailed design.	Required for stock control, security, and sight line visibility requirements.
Excavate to track formation level along the extent of the site entrance and accommodate drainage.	The Contractors shall provide that soil is carefully distributed and banked adjacent to the entrance within the construction boundary. Soil will be managed as per the spoil management plan. Any storage of material will be located to see that no interference with visibility splays occurs.
Installation of stone foundation and surfacing of apron to be installed.	In the interests of road safety, appropriate construction measures will be implemented to see that site debris is not deposited on the carriageway. In the unlikely event of same occurring, the Contractors shall see that all material is removed immediately in accordance with the provisions of the TMP to be agreed with Waterford City and County Council.
Installation of security gates/hut (where required), tied into the re-aligned fence.	Required for site security.

Contractors Compound and Welfare Facilities

The temporary site compound will be in place for the duration of the construction works only. The compound will be used as a secure storage area for construction materials and to contain temporary site accommodation units for sealed type staff welfare facilities. The compound will contain cabins for offices space, meeting rooms, canteen area, a drying room, parking facilities, and similar personnel type facilities.

An area within the compound will be used for the storage of fuel and oils and this will be suitably bunded to 110% of the storage volume. The bund will be lined with an impermeable membrane in order to prevent any contamination of the surrounding soils, vegetation and water table. Double protection containers / equipment will be used along with drip trays and details

During the construction phase, water will be supplied by water bowser. The maximum wastewater production is estimated to be the same as the maximum water consumption (2,000 litres per day). The project will include an enclosed wastewater management system at the temporary compound capable of handling the demand during the construction phase with 50 construction workers on site at peak. A holding tank is proposed for wastewater management. Wastewater which will be removed off-site and disposed at an appropriate licenced facility.

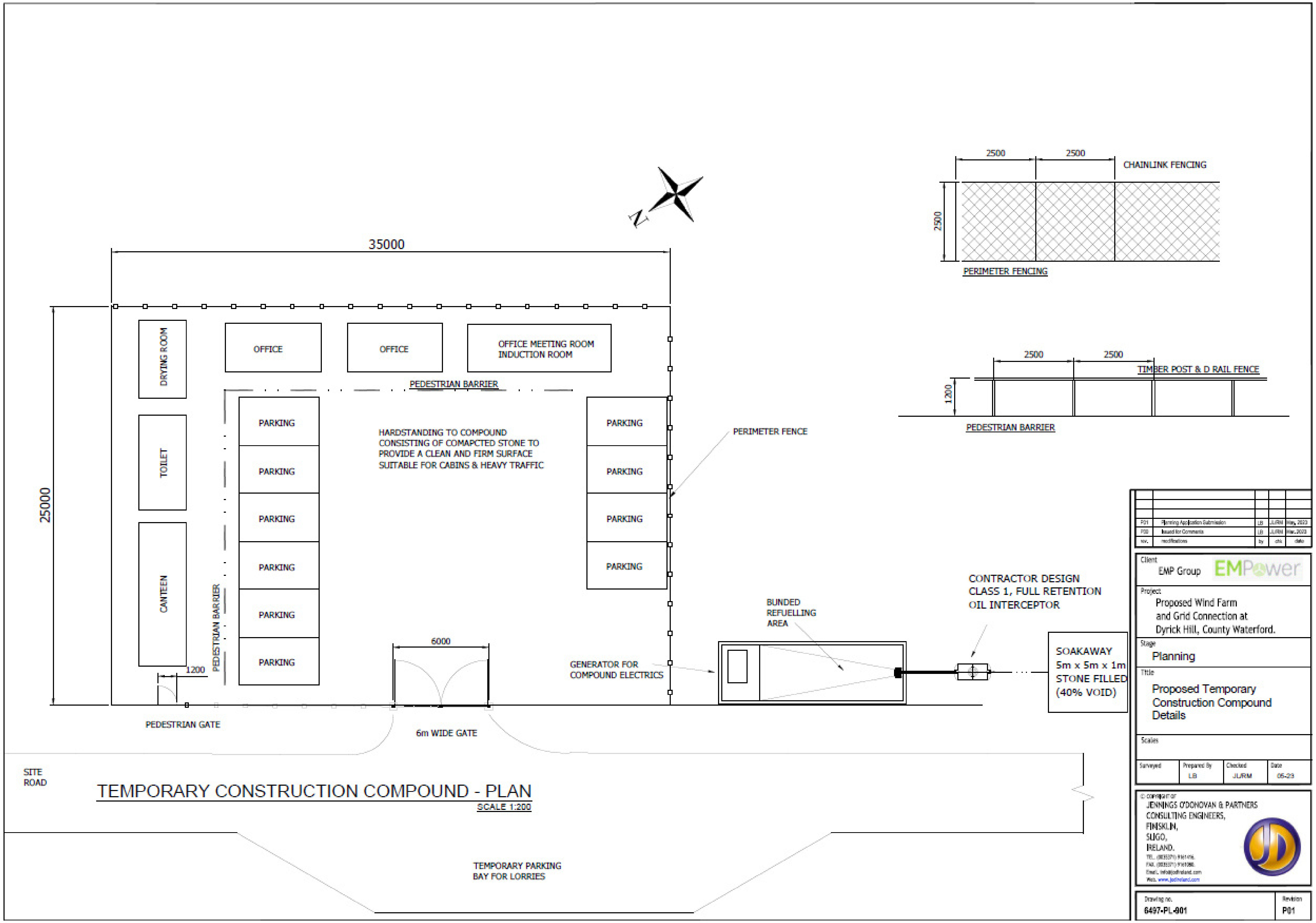

Figure 3.3: Contractors Temporary Compound Plan (Excerpt from Drawing No. 6497-PL-901)

The proposed construction method statement for the construction compound / storage area is detailed in **Table 3.2**.

Table 3.2: Contractors' Compound and Welfare Facilities CMS

Activity	Notes
Set out the perimeter of the site compound using GPS equipment following a site walkover by the Ecological Clerk of Works	Setting out must be undertaken to Irish Grid co-ordinates and to sub-centimetre accuracy in the X, Y and Z plane.
Archaeology	The Site will be accessible to the appointed archaeologist at all times during working hours. The nominated archaeologist will monitor all invasive works.
Install drainage treatment and flow attenuation features as per the detailed design	Required to minimise the transportation of suspended solids generated during the construction stage.
The top layer of vegetated material will be stripped and stored for re-use onsite.	The top layer of vegetated material is set aside for re-use as a sealing layer to prevent sediment runoff and reduce visual impact. The location for storage of these vegetated turves will be around the perimeter of the site compound away from any sensitive habitats.
Stone will be placed in layers to form the hardstanding area for the site compound.	Hardcore area with Clause 804 stone on geotextile layer (Netlon SS30 or similar) for temporary site offices and for vehicle movements / parking.
The accommodation, eating and sanitary cabins will be installed in accordance with the construction drawings. The site office will be located in the temporary storage area.	Foul drainage from site welfare accommodation will discharge to a holding tank. The holding tank will be fully enclosed with no discharge outlet. The toilets will be the 'portaloo' chemical toilet type. The holding tank will be emptied as required by a licenced waste disposal operator. Temporary power supply and telecommunications will be connected to the relevant cabins.
Construct covered bunded area for oil tanks Construct Plant refuelling Area	Bund to absorb 110% of potential spill volume. Non-permeable concrete refuelling area with petrol interceptor.

Activity	Notes
Storage units for hazardous products and covered waste skips will be installed as per best industry practice. Complete temporary service provisions – electrical, telecommunications, etc.	All storage units for hazardous products will be fully lockable and bunded proprietary steel containers.
Provide measures for waste management.	Waste segregation skips will be deployed for optimum recycling and re-use of materials. Skips will be covered with lid.
Construct an impervious bunded area for plant refuelling and plant maintenance and cleaning operations.	An oil interceptor will be installed on the drainage outlet from the bunded area to separate any oils from the surface run off. Generators and associated diesel tanks are to be installed on such an area.
Parking	Parking areas shall be identified by signage with a handrail system or barrier separating pedestrian areas and vehicle routes.
Reinstatement	Compound areas to be restored to pre-construction condition at completion and demobilisation stage.

Site Security

From an operational point of view, for control of site access and for proper site management, all access to the Site will require passage through a controlled safety barrier/gate or hut. The exact location(s) shall be decided by the Contractors with primary responsibility for safety on the Site. It is proposed that the barrier(s) be located at the entrance to the north of the Site, on a private road and to the east of the Site at the junction of R662 that no unauthorised traffic can enter the Site and to check that all personnel are permitted / inducted on the Site. The barrier will be set back sufficiently so that HGVs can enter the Site without stopping.

The Contractors shall be responsible for securing each area of work, so as to ensure the safety and health of all affected persons (Contractors personnel, site supervision staff, members of the general public, traffic, etc.). The Contractors will provide details to the Developer of security arrangements for the following:

- Fencing specification;
- Provision of personnel to man site access point(s);
- Signage; and
- Signing in/out procedures.

3.11 SITE CLEARANCE AND CONSTRUCTION METHODS

The management of earthworks will be of paramount importance throughout the construction of the project. The general principles that will apply to earthworks include:

- Excavations to only take place following implementation of setting out the working corridor, drainage treatment and flow attenuation provisions.
- Archaeological supervision works will be undertaken.
- Vegetation within the construction corridor shall be cleared as part of the excavation works.
- Suitable plant to be used, particularly when working off road i.e., use of geotextile mats.
- Machinery and vehicles used in access track construction are operated from the track only as it is constructed.
- Vegetated top-mat layer to be removed separately and set aside from other spoil and place around the excavations for use in reinstatement. Spoil storage areas will be around turbine bases and within borrow pits as per the attached Spoil Management Plan.
- Topsoil stockpiles shall be no more than 1m in height, smoothed to prevent erosion, and watered to prevent them drying out.
- Apply the vegetated capping layer to permanently exposed excavations or storage areas to mitigate against movement and to avoid sediment run-off. Input from the appointed ecologist will be used to apply the appropriate species of the immediate environment in the capping layer.
- No permanent stockpiles will remain on site after completion of the construction phase.
- Borrow pits will be utilised on site to reduce the requirement for imported fill.
- Monitor all rock breaking activities and survey areas for indicators of soil movement/slide. The appropriate remedial action will be taken.

The construction method statement for excavation and spoil management is shown in **Table 3.3**.

Table 3.3: Excavation and Spoil Management Method Statement

Activity	Notes
Archaeology	The Site will be accessible to the appointed archaeologist at all times during working hours. The nominated archaeologist will monitor all invasive works.
Install drainage treatment and flow attenuation features as per the detailed design, which includes recommendations of an expert ecologist	Required to minimise the transportation of suspended solids generated during the construction stage. Temporary and permanent ponds and outflow buffers will be constructed as per the attached Surface Water Management Plan.
Spoil locations to be identified to machine drivers	Spoil storage areas/borrow pits to be mapped and pegged out prior to excavation commencing.
A Risk Assessment shall be developed for each and every excavation location to be carried out on site.	Control measures to mitigate safety, stability and environmental risks specific to the local conditions.
The vegetated layer will always be removed and set aside separately from any spoil material.	Required to enhance revegetation.
Excavated material will only be stored to a maximum height of 1.0m along access tracks.	Prevent movement of stored material and protect watercourses.
Excavated material will not be stored in areas which have been identified as unsuitable for spoil storage.	Prevent movement of stored material and protect watercourses against harmful run offs.
Excavated material will be separated and stored so that it is not left exposed to the elements. This will be provided for through the immediate application of a vegetated capping layer.	No spoil is permitted to be stored on areas identified as sensitive or high value habitats. Other material will be used for landscaping or to rehabilitate the borrow pits.
Interim (temporary) material storage during the construction stage will be kept to a minimum by the implementation of a continuous construction cycle: 1) Excavate material;	Return and re-vegetate the Site to its original state as soon as possible.

Activity	Notes
2) Handle material; 3) Permanently store material	
Permanent excavated or spoil surfaces shall be re-vegetated without undue delay using seed collected pre-construction, final details of which will be approved by the ecologist. Reseeding will occur within the growing season.	To encourage growth of locally-common habitats
Material from excavations in rock, suitable sands and gravels will be carefully managed and re-used as structural fill in the locality of the excavation where possible.	To minimise the volume of imported material required and ensure no impact on the local pH level. No spoil will be permitted to be stored on areas identified as sensitive or high value habitats.

3.11.1 New Site Access Roads

Carrying capacity will be based on the weight restriction for the installation crane, which typically has a maximum 20 tonne axle weight with a minimum of 12 tonnes.

Prior to advancing any construction works, final road design shall take into account the following:

- Existing Ground Profile
- Existing Ground Soil Type
- Bearing Capacity
- Natural Drainage
- Proposed Turbine Delivery Specification
- Existing Environmental Buffers

As this project will most likely be advanced as Design & Build, the Contractors will be obliged to form the design and construction works with reference to the above and seek final approval from the Engineer for their design prior to advancing any work on site. In any event, it is proposed that the roads are built as follows:

- The alignment of the new site roads will be established and the centrelines will be marked out with ranging rods or timber posts.

- Any trees/hedgerow within the construction corridor shall be cleared prior to any construction works. All works will be undertaken outside of the breeding season.
- The first phase of drainage will then be installed in accordance with the detailed drainage design. Road construction will likely require the crossings of a number of cut drains and minor drainage paths.
- The angle of repose of the cut face of excavations shall be battered back approximately 45 degrees.
- Slopes will not be undercut or excavations left unsupported for periods in excess of 24 hours.
- Soil excavation shall be observed by a qualified archaeologist, in accordance with the approved scheme of archaeological monitoring in order to respond appropriately to identification of any potential archaeological remains.
- The access road will be excavated to a suitable formation level. Roadside berms will be developed as 0.6m in height and 1m in width.

Figure 3.4 Roadside Berm

  - Where necessary, stone will be delivered to site by tipper trucks from approved local quarries (please see **EIAR Figure 15.3**) and will be placed, spread and compacted in layers to form the running surface. The compaction will be carried out using a dead weight roller.
  - Imported stone will be used throughout for the final surfacing layer.
- Well-graded granular fill (quarry sourced clean stone) will be spread and compacted in layers to provide a homogeneous running surface. The thickness of layers and amount

of compaction required will be decided by the Site Manager based on the characteristics of the material and the compaction plant to be used.

As is typical with windfarm roads, the construction method will be Cut and Fill.

3.11.2 Cut and Fill (Excavated) Roads

This form of road construction is a traditional method whereby the final road construction is formed on a firm bearing strata. This is generally found following removal of the initial vegetation layer and more than likely the underlying layer of soft material found between the top soil layer and the firm strata. Typically, this form of road construction could be founded on relatively shallow excavations. However, if soft spots are encountered locally they will be excavated out and in-filled with selected excavated. Rock will be extracted from the borrow pits on site and turbine bases. Imported rock will be chemically compatible with the existing geology. It will be tested for compatibility prior to entering the Site. This involves using rock that is similar to the geology of the Site and locally sourced i.e., sandstone till. Construction of Cut and Fill road sections will be carried out in accordance with detailed design. This system will consist of either 1 or 2 layers of stone depending on the load bearing capacity of base layer and the design loading required with construction traffic. Where the underlying layer is clay, 2 layers of stone are used. In areas where the load bearing layer is rock, the capping layer is omitted, and the running layer is installed directly onto the rock surface.

. If the vertical alignment requires local infilling for the formation of the road, the above process of exposing a firm strata is followed and infill material is employed to raise the road profile in a local embankment.

3.11.3 Road Drainage

A vegetative filter strip and under-road drainage will allow discharge in a controlled manner downslope of the works.

Any crossing of field drains, man-made drains and vegetated drains will be piped directly under the road through appropriately sized drainage pipes. Where appropriate, a lateral drainage ditch (interceptor drain) will be cut along the uphill side of the road to intercept the natural runoff. This lateral drain will be drained under the road at regular intervals through correctly sized cross drains. In cases where the roads must run significantly downhill, transverse drains (‘grips’) will be constructed where appropriate in the surface of the roads to divert any runoff down the road into the drainage ditch. Where the crossing of ditches, field drains, man-made drains and vegetated drains cannot be avoided, the design of the crossing, (in this case culverts) shall be prepared in line with the drainage design philosophy. This is further detailed in the Surface Water Management Plan and Water Quality Management Plan and Watercourse Crossing Plan.

Under road drainage will be provided under the excavated roads at all locations where existing land drainage passes under the proposed roads. Conventional cross drains will be 150mm diameter and increased to 300mm diameter (minimum) at points for land drainage or natural drainage paths. The spacing of the cross drains will be dependent upon whether the roads run parallel or tangential with the general contours of the Site.

The detailed design of all under-road drains in areas near flushes will have the input from the Ecological Clerk of Works and Ecological Clerk of Works to see that there is sufficient flow connecting the upstream and downstream habitats. These will be inspected by the Ecological Clerk of Works and Ecological Clerk of Works during construction.

All existing site drainage channels and culverts shall be maintained and any additional drainage design required on-site shall be carried out as per the detailed design. Any such additional requirements will be reviewed by the Engineer, Ecological Clerk of Works and Ecological Clerk of Works prior to site clearance activities taking place on-site.

3.11.3.1 Borrow Pits

One borrow pit will be constructed as part of the Development. The borrow pit will be located on the commonage land and will provide excavated material to provide fill for the Site Access Tracks, Turbine Hardstands, Turbine Foundations and temporary compound area. The borrow pit will be excavated as required. Where rock and fill material is available from the excavation of Turbine Foundations, this material will be used first. The use of the on-site borrow pit will reduce the environmental effect of other aspects of the Development such as by reducing the need to transport material to the Site.

Further details on borrow pits can be found in **Management Plan 4: Spoil Management Plan**.

3.11.3.2 Turbine Bases/Foundations

Foundation requirements will be provided by the wind turbine supplier, and appropriate factors of safety will be applied to these in accordance with Draft Revised Wind Energy

Development Guidelines, 2019[4]. The turbine towers will be anchored to the concrete foundation using a bolt assembly which shall be cast into the concrete.

Each turbine will be constructed on a cast in-situ concrete foundation requiring approximately 590m^{3}of concrete which, for the most part, is buried in the ground. The turbine foundations will be constructed so that the top of the foundation is at the existing ground level, with an acceptable tolerance of +/- 1m. The turbine foundation is estimated to be between 2.8m and 3.2m deep and therefore the formation level is 2.8m to 3.2m below existing ground level.

Plate 3.1: Turbine foundation under construction with adjoining crane pad[5]

There are two options for design and construction of Turbine foundations as follows:

[4] Draft Revised Wind Energy Development Guidelines, December 2019, [Accessed Online 25/05/2022_ file:///C:/Users/sbradley/Downloads/109102_ae9107b8-6a27-4f26-9a12-6b00632ceaf0%20(1).pdf]

[5] Good Practice during Wind Farm Construction, 2019. Online: https://www.nature.scot/doc/guidance-good-practice-during-wind-farm-construction [Accessed 15/02/2022]

- **Option 1 – Turbine Foundation constructed directly on in-situ ground:**
  The Contractors shall demonstrate that the soil/rock properties at the formation level are in compliance with the turbine Foundation Design limiting criteria for a ground bearing base.

- **Option 2 –Turbine Foundation constructed on engineering fill:**
  If it cannot be demonstrated that Option 1 is achievable, the Contractors shall establish and demonstrate a suitable bearing stratum at a lower level, design and construct engineering fill to the formation level of the foundation and demonstrate that the fill properties at the formation level are in compliance with the Turbine Foundation Design limiting criteria for a ground bearing base.

Plate 3.2: Wind turbine foundation[6]

6 https://www.grousemountwindfarm.ie/documents/downloads/EIS%20Vol%201%20-%20Section%203%20-%20Text%20-%20Project%20Implementation.pdf [Accessed 15/02/2022]

The construction method statement for the turbine bases will generally follow the sequence as defined in **Table 3.4**.

Table 3.4: Turbine Base Construction Method Statement

Activity	Notes
Set out the turbine location with the use of GPS (RTK) equipment.	The Contractors shall tape off buffer zones with assistance from the Ecological Clerk of Works and Ecological Clerk of Works, and toolbox talks will be used to inform site staff of the importance of the buffer zones.
Archaeology	The Site will be accessible to the appointed archaeologist at all times during working hours. The nominated archaeologist will monitor all invasive works.
Set out and install drainage treatment and flow attenuation features.	Required to minimise the transportation of suspended solids generated during the construction stage..
Remove and locally store the top layer of vegetated material over the excavation area.	This material will be stored for re-use to cover and promote natural re-vegetation of the inorganic spoils that will be deposited at the nearest suitable location to the excavation, monitored by the Ecological Clerk of Works.
Excavate remaining material to 1m depth and segregate organic material from mineral material.	Selected excavated organic material will be considered for re-use as backfilling material.
Excavate to formation level. Complete plate bearing tests.	Any excavated inorganic material will be re-used as structural ballast to minimise the required volumes of spoil and imported stone.
A reinforcement steel cage for the foundation will be assembled after insertion of the turbine foundation insert arrangement (required for fixing steel tower) and formwork will be fixed to surround the cage.	

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Activity	Notes
Reinforcement steel for the top section of the foundation is fixed along with the required number of cable ducts.	Reinforcing steel shall be checked for design compliance and signed off upon acceptance.
Erect the formwork to contain the concrete pour.	Formwork will be re-used and removed offsite when foundation construction is complete.
The foundation anchorage system will be checked both for level and line prior to the concrete being installed in the base. These checks will be passed to the appointed Turbine Contractors for their approval.	
The foundation will be backfilled with a cohesive material.	Using the material arising during the excavation and landscaped using the vegetated soil set-aside during the excavation.

Plate 3.3: Wind Turbine Erection[2]

Plate 3.4: Assembly of wind turbine blades [2]

3.11.3.3 Turbine Hardstands/Crane Pads

A crane pad hardstand area will be required at each turbine. The hardstands must allow for two cranes (including outriggers) to operate in the vicinity of the turbine to allow for turbine erection. The hardstand must also provide storage and set down areas for turbine components. The hardstand requirements are specified by the turbine supplier and require strict compliance so that there are no stability issues during erection of the turbine sections.

All Turbine Hardstands will be designed to take account of the loadings which will be provided by the appointed turbine and installation Contractors and will consist of a compacted stone structure which is to be installed in accordance with the Transport Infrastructure Ireland (TII) Specification 800 2013.

Two types of hardstands are facilitated:

- Locations that will require a turning head.
- Standard Hardstand arrangement where delivery vehicles do not require a turning area.

Hardstand formation will consist of either 1 or 2 layers of stone depending on the properties of the underlying load bearing layer. Where the underlying layer is clay, 2 layers of stone formation are used, the stone capping layer and, the running layer. In areas where the load bearing layer is rock, the capping layer is omitted, and the running layer is installed directly onto the rock surface (in this case siltstone). The crane pad layout measures c.74m by 58m. The proposed Turbine Hardstand design is shown on **Figure 3.5**.

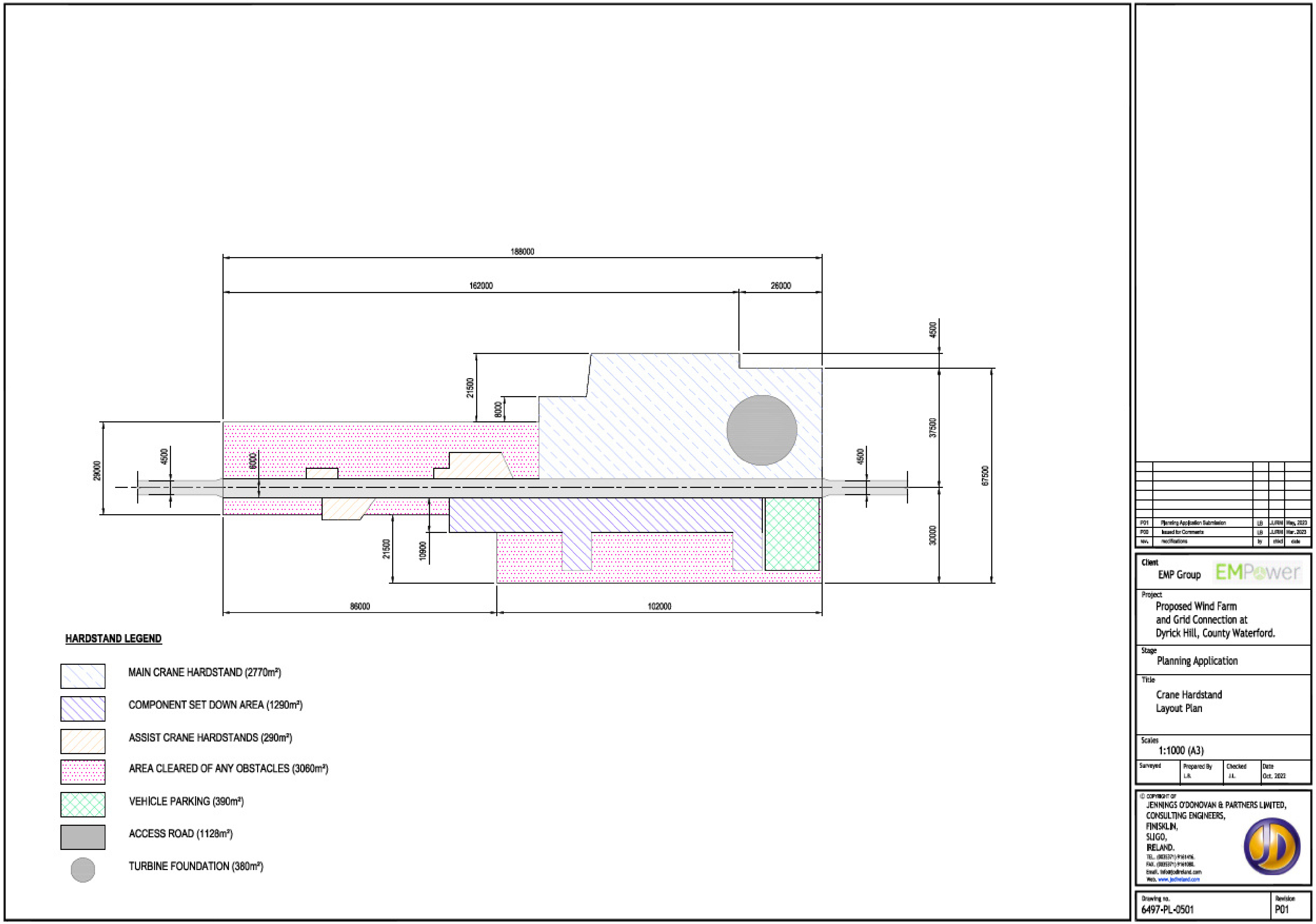

Figure 3.5: Crane Pad Hardstand Design (Excerpt from Drawing No. 6497-PL-501)

The hardstand area will be excavated to a formation level of weathered rock where possible or on stiff bearing strata on overlaying material.

Following completion of the hardstands, a series of plate load tests will be undertaken to demonstrate compliance with the turbine supplier requirements of 260kN/m^2.

Excavated material will be used for side slope formation local to the hardstands. Material from the excavation of the hardstands will be used to dress exposed areas around the hardstand with the remainder being used for landscaping around the turbine base or for the rehabilitation of the proposed borrow pits in accordance with the attached **Spoil Management Plan**. A Hardstand construction method statement is set out in **Table 3.5**.

Table 3.5: Typical Hardstands Construction Method Statement

Activity	Notes
Set out the crane hardstands with the use of GPS (RTK) equipment.	The Contractors shall see that buffer zones and areas of restricted working width are taped off with assistance from the ECoW and toolbox talks used to inform site staff of the importance of the buffer zones with identification of areas on drawings and maps.
Archaeology	The site will be accessible to the appointed archaeologist at all times during working hours.
Set out and install drainage treatment and flow attenuation features around the crane hardstand and turbine area.	Temporary and permanent ponds and outflow buffers will not be constructed in sensitive habitats or buffer zones. Liaison with the ECoW at the detailed design stage will assist in the identification of suitable locations.
Remove and locally store the top layer of vegetated material over the area of the crane hardstand excavation.	This material will be stored for re-use to cover and promote natural re-vegetation of inorganic spoils that will have to be deposited at the nearest suitable location to the excavation.
Excavate remaining material to 1m depth and segregate organic material from mineral material.	Selected excavated organic material will be considered for re-use as backfilling material.
Excavate material to the required formation level.	The formation level for the crane hardstands will be on weathered rock or stiff overlaying material.

Activity	Notes
	Where suitable, the excavated material will be re-used as structural backfill material to minimise the required volumes of spoil and stone.
Place rock fill in accordance with the design to form the crane hardstand structure. Where appropriate, geotextile and/or geogrid should be used to help reduce the volume of stone. Fence off steep edges.	Special consideration will be given towards the stone placement and compaction so that the structural integrity meets the loading requirements.
Plate bearing tests will be undertaken following completion of the hardstand structure.	The number and location of the plate bearing tests shall be specified by the Contractor's designer.

Plate 3.5: Crane for wind turbine erection [2]

3.11.3.4 Handling/Disposal of Excavated Material

Details of spoil management methodology are outlined in the attached **Spoil Management Plan**. Excavated soil will be used for landscaping and to reinstate the borrow pits.

3.12 TRAFFIC MANAGEMENT

All works on the public road network shall be carried out under a road opening licence and an approved traffic management plan. The location of works shall be signposted in accordance with the Traffic Signs Manual. Works shall be carried out within a dedicated work zone and fenced to prevent unauthorised access.

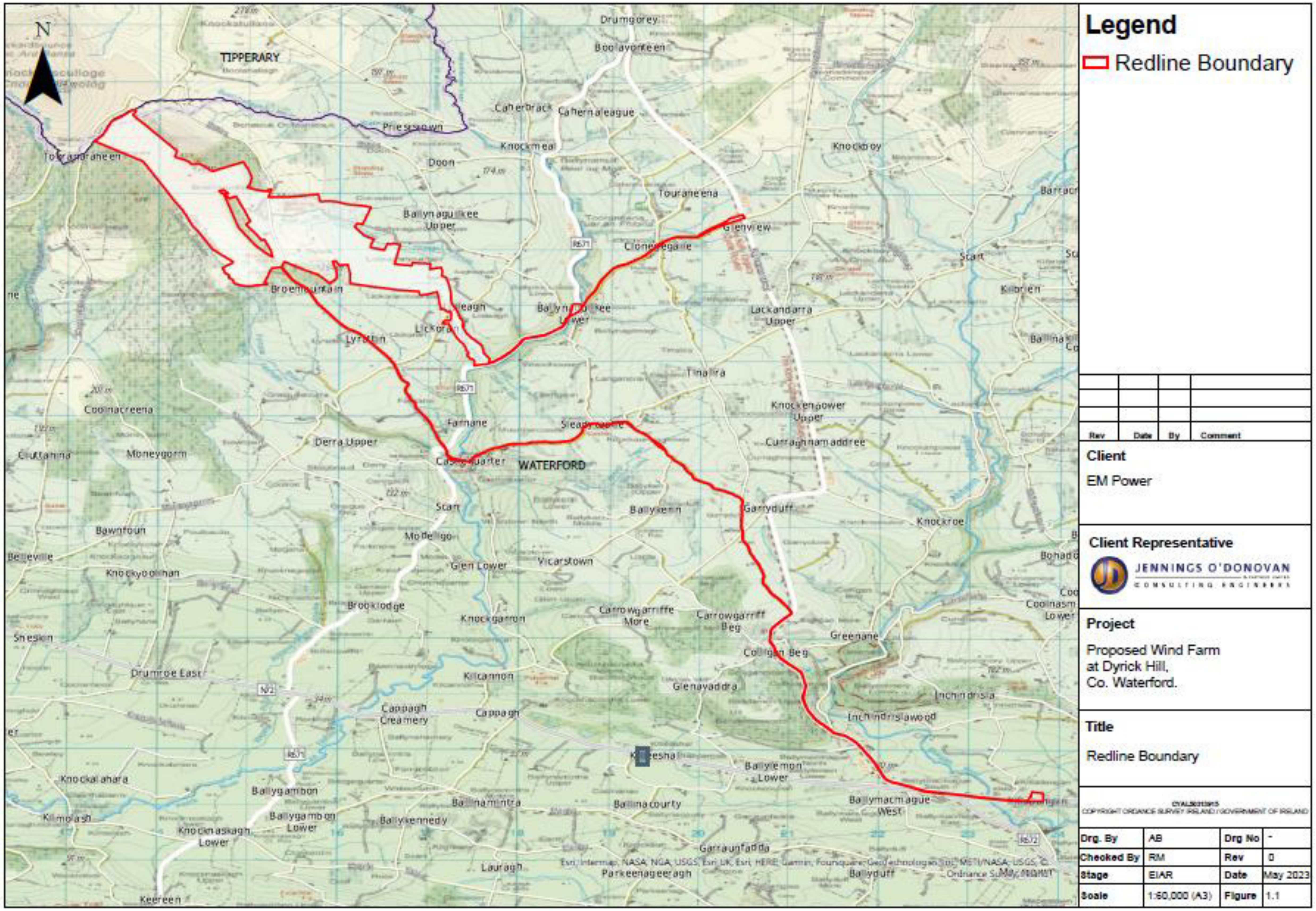

Figure 3.6: Map showing the site boundary which includes the Turbine Delivery Route third party lands and the Grid Connection Route.

Delivery Volume for Construction Materials

Table 3.6: Traffic Volumes for Wind Farm Site Infrastructure

Materials	Quantity	No. of Deliveries
Site Establishment and Removal	10	10
Concrete	13,200m^3	2,200
Reinforcing Steel	1,320t	66
Substation Building and electrical equipment	-	30
Other – Geotextile Mats, Tools, Fencing etc.	-	50
Internal Cabling Materials incl. bedding	-	220
Met Mast Materials	-	4
Imported Crushed Stone (engineering fill) as Upfill to Foundations	2,230m^3	186
Imported Crushed Stone for Substation, 200mm thick	2,100m^3	175
Imported Crushed Stone for Site Access Track and Turbine Hardstands (assumes 100mm thick wearing course)	13,362m^3	1,114
Forestry Removal	12,193m^3	300
Waste – 1 container/month		21
Total		**4,376**

Table 3.7: Traffic Volumes for Turbine Components

Materials	Quantity	No. of Deliveries
Site Establishment and Removal	24	24
Temporary Bridge Components	10	10
Delivery and Removal of Crush Stone for Access Tracks each side of Temporary Bridge	312m^3	52
Concrete for Abutments of Temporary Bridge (incl. Removal)	103m^3	40
Miscellaneous Deliveries for Temporary Bridge (fencing, silt fencing, siltbusters, drainage, sumps etc.) incl. Removal	30	30
Anchor Cages & Foundation Templates	15	15
Tower Sections	-	56
Nacelles	14	14
Rotor Blades	42	42
Transformers, Panels and Cabling	-	8
Tools etc.	-	1
Crane Deliveries to Site, including ballast, booms, etc. and removal of same	2 Cranes	50
Road Widening on Turbine Haul Route – Soil Disposal	2,200m^3	184
Crushed Stone for Widening and Strengthening of Turbine Haul Route	4,690m^3	391
Road Surfacing for Turbine Haul Route	1,420t	71
Ducting and Miscellaneous Deliveries to Turbine Haul Route	3	3
Total		**990**

3.12.1 Site Entrance

There are two proposed Site entrances associated with the Development; Site Entrance 1 is an existing site entrance located in the southeast of the Site located off R671 road and Site entrance 2 is an existing site entrance located in the southwest corner of the Site off the L1027 Local Road. The Turbine Delivery Route and the Construction Haul Routes will utilise Site Entrance 1.

A wheel wash facility will be provided near the Site entrance so that the wheels of vehicles exiting the Site can be cleaned prior to exiting onto the public road. This will be carried out under the supervision of the Site Health & Safety manager and in accordance with the agreed Traffic Management Plan to ensure that it is undertaken in a safe manner.

3.12.2 Construction Material Haul Route

The haul route of quarry materials i.e. readymix concrete will be established after the appointment of the Contractors, but it is envisaged that material will be sourced from quarries local to the Site to minimise disruption on the public road network as per **EIAR Figure 15.3**.

From Keim, trucks would follow the R582 in a south-easterly direction to the New Macroom By Pass (N22) and then follow the L-3402 to the Site.

For the quarries to the south, trucks would use the R587, then the R584 to the new Macroom By Pass (N22) and then follow the L-3402 to the Site.

The L-3402 between the existing N22 and the existing forestry entrance varies in width from c. 4-6m, generally with verges each side (see **Chapter 15: Traffic and Transportation**).

3.13 PLANNING CONDITIONS AND OUTLINE METHOD STATEMENTS

This CEMP and its future versions/revisions will form part of the Contract for Dyrick Hill Wind Farm. It will therefore be updated and revised during the different stages of the Development. Where the project is granted planning permission all the planning conditions associated with the Planning Application, applicant Dyrick Hill Wind Farm Limited will be listed in **Table 3.8**.

Table 3.9: Relevant Planning Conditions and Related Documentation

Condition No.	Planning Condition	Reason
Planning Ref: INSERT NUMBER		

The Contractors will address all of the mitigation measures and best practice construction methods detailed within the above consent in his design and in any detailed environmental plans as required by this CEMP or the Contract.

3.14 SCHEME AMENDMENTS

Scheme Amendments will be recorded in **Table 3.19**. These amendments do not include changes to the scheme design which are completed in accordance with the existing planning consent. Instead, this refers to changes in the design of the wind farm for which additional approvals and / or consents may be required from Waterford City and County Council. For example, amendments to layouts or in accordance with the current grant of planning permission.

Table 3.9: Scheme Amendments

Reference	Date	Scheme Amendment Description	Environmental Sensitivities potentially

3.15 REGISTER OF VARIATIONS

Where any variations to the Management Plans and CEMP are required (either as a result of Scheme Amendments or through corrective actions or improvements noted and undertaken on site) these will be recorded in **Table 3.10**, Register of Variations. Furthermore, all changes to construction methods, design, mitigation and the implications of these changes and authorising personnel will be recorded in **Table 3.10.**

Table 3.10: Register of Variations

No.	Variation Description	Authorising Personnel	Completion Date

4 COMMUNICATION PLAN

4.1 INTRODUCTION

Both the Contractors and the Client will appoint Project Managers to the project. These Project Managers will be the main points of contact between the two parties. This includes the Contractors Construction Project Manager and the Client.

It is envisaged that main project communications will take the form of structured reporting arrangements and meetings.

All issues in relation to environmental management/monitoring will be reported to the Ecological Clerk of Works. The Contractors Ecological Clerk of Works will report to the Contractors and Client on a regular basis.

4.2 CONTACT SHEETS

Table 4.1 provides a list of Dyrick Hill Wind Farm Limited., Contractors and relevant third party contact details. This table will be updated and maintained by the Contractors for the duration of the Contract.

Table 4.1: Contact Sheets

Company	Position	Name	Telephone
Dyrick Hill Wind Farm Limited	Client Project Manager		
Contractors	Site Manager / EM		
Contractors	Contracts Manager		
Contractors	General Manager		
Contractors	Foreman		
Dyrick Hill Wind Farm Limited	Construction Project Manager		

4.3 MEETINGS REPORTS AND CONSULTATIONS

Table 4.2 lists all meetings and consultations as required by the Contract. The table also provides details on the schedule/frequency, scope & objectives and attendees / responsibility for each meeting.

4.4 ROLES & RESPONSIBILITIES

Roles and responsibilities for environmental management, monitoring and reporting are detailed in **Table 4.3**. The Ecological Clerk of Works Contractors will be responsible for the delivery of all elements of the Environmental Management Plan. The Ecological Clerk of Works Contractors will retain all responsibility for issuing, changing and monitoring the Environmental Management Plan.

4.5 REPORTING PROCEDURES

Figure 4.1 provides a diagrammatic outline of the general tasks and communication lines, based on the roles described in **Tables 4.2** and **4.3** and tasks detailed in the Management Plans. The Contractors will update this information as part of the construction stage CEMP.

Management Plan (1) Emergency Response Plan includes the communications plan for reporting procedures for all potential environmental risks, hazards or incidents which may relate to ecology, water quality, dust, noise or archaeology. Environmental reporting to statutory bodies, such as Waterford City and County Council will be managed by the relevant Contractors in accordance with an agreed reporting schedule.

Table 4.2: Meetings, Reports and Consultations

Meeting/ Report	Schedule/ Frequency	Scope & Objective	Attendees/Responsibilities
A Record of all meetings, checks, permissions and licenses will be retained within Section 4 of this CEMP			
Site Inductions	All new site personnel and visitors		Contractors to organize and maintain records
Weekly environmental meetings	Weekly	To provide updates on environmental mitigation measures and performance and identify actions for improvement. The Ecological Clerk of Works Contractors is required to maintain a Pollution Prevention Measures Register in which mitigation measures put into place will be listed and checked weekly to assess the requirement for maintenance. The results of these checks will be discussed at the meeting and corrective actions agreed as required.	Attendance required: Ecological Clerk of Works Contractors Site Manager, and any other relevant personnel or statutory consultees where necessary.
Monthly Environmental Report & Monthly Environmental Management Group Meeting	Monthly	To provide a compiled record of weekly meeting minutes and environmental performance and monitoring results (e.g. air, noise or water quality monitoring as appropriate). To identify any areas / action for improvement.	To be prepared by Ecological Clerk of Works. Report to be issued to the Contractors and Construction Project Manager before the end of each calendar month. Report to be discussed at the monthly meeting with recommendations for improvement passed to the Contractors in written format

Meeting/ Report	Schedule/ Frequency	Scope & Objective	Attendees/Responsibilities
Final Environmental Report	Upon completion of construction works	The final report will document the environmental and ecological effects of the construction period. The evidence for effects will be based on findings included in the minutes of weekly meetings and monthly meetings, together with other recording information maintained by the Ecological Clerk of Works. The report will relate results to residual effects predicted in the EIS.	The Final Report will be prepared by the Ecological Clerk of Works. The report will be made available to the Contractors, Construction Project Manager and Planning Authority, if required.
Environmental Checks and Monitoring of Mitigation Works	As required in advance of construction works regular checks will also be made at least every 14 days.	Environmental Checks are to be carried out in advance of construction works. This will comprise an on-site meeting / inspection to confirm the appropriate use of identified mitigation measures and highlight any further issues / measures which may be relevant prior to commencement of works in any area. As a minimum, Environmental Checks will be completed at each main piece of site infrastructure (turbine	Environmental checks will be undertaken by the Contractors Ecological Clerk of Works. The Ecological Clerk of Works may also undertake regular checks, either independently or in conjunction with the Contractors checks as required. The Contractors and Ecological Clerk of Works will retain a record of all inspections / findings of Environmental Checks within Section 4 of this CEMP. All records will be made available for audit / review. All records will also be made available for discussion during regular meetings as scheduled herein.

Meeting/ Report	Schedule/ Frequency	Scope & Objective	Attendees/Responsibilities
		bases, construction compounds, sub-station, control room) prior to works commencing in that area. Environmental Checks will include: • Checks for visual evidence of contamination / sediment alongside watercourses, nearby working areas and in areas of surface water discharge. • Regular checks of all plant and equipment to identify any oil or fuel leaks to confirm the condition of the plant. • Inspection of drainage and erosion and sediment control measures. Additional checks will be made before, during (where safe to do so) and immediately following anticipated storm events or periods of continuous or heavy intermittent rainfall over one or more days.	

Meeting/ Report	Schedule/ Frequency	Scope & Objective	Attendees/Responsibilities
		• Environmental checks will also encompass a review of: - Waste management procedures - General site tidiness - Temporary materials storage (extracted materials stockpiles) and restoration works and - Soil stability - Signs of any mammal activity on site - Buffer zones (if any) are being maintained	
Environmental Audit	At least once every month.		Environmental Audits may be carried out by the Contractors, or Dyrick Hill Wind Farm Limited. at any time during the works. Audit procedures and forms are included within Section 4 and MP1. These will be followed / completed by the Employer when undertaking environmental audits and may also be adopted by the Contractors, unless alternative procedures and forms are submitted and approved

Meeting/ Report	Schedule/ Frequency	Scope & Objective	Attendees/Responsibilities
			as part of the Contractors' construction stage CEMP.
Liaison with regulator / statutory Consultees	As Required	Provide regular updates to relevant authority on environmental performance and maintain good working relationships with the regulatory bodies.	Contractors and Ecological Clerk of Works where required. Meetings will be initiated as required by Planning Conditions, Management Plans or as agreed throughout the duration of the construction phase. The Contractors is responsible for obtaining all relevant permissions, consents, licenses and permits. Some permits may require application and implementation by an appropriately qualified person. In these instances, the Contractors will consult with the other specialist Environmental Consultants where required.

Table 4.3: Roles and Responsibilities

Position	Roles and Responsibilities
Construction Project Manager	The Construction Project Manager will: Ensure that the Contractors has obtained the relevant approvals and licenses and consents from regulatory bodies and statutory consultees where required. Ensure that the Contractors has submitted all relevant documentation to t, liaise with the Site Manager and the Ecological Clerk of Works and ensure that corrective actions and variations to the CEMP have been instigated.
Project Site Manager/ Engineer	The Site Manager will provide liaison between the Ecological Clerk of Works and the Contractors where environmental sensitivities, instruction for environmental performance improvements or corrective actions are requested by the Ecological Clerk of Works or other appropriate person(s) as a result of environmental checks or audits conducted by these person(s). The Site Manager will ensure that all notifications of

Position	Roles and Responsibilities
	environmental sensitivities and incidents as well as other general observations on environmental performance are reported back to the Construction Project Manager. The Project Site Manager is responsible for review and further development of the CEMP.
Environmental Manager	The Ecological Clerk of Works will be a member of the Environmental Management group and will work with the Contractors to ensure compliance with best practice and with all environmental mitigation and monitoring requirements as detailed within the relevant planning conditions, compliance documents and CEMP during both the pre-construction and construction phases. The main roles of the Ecological Clerk of Works are as follows: • Organise start-up meeting / Toolbox talks with the Contractors to agree working methods, specifically including communications; schedules; monitoring of data storage; and preparation of plans indicating location of key features including mitigation measures, monitoring points and sensitive habitats (where not previously highlighted and approaches agreed). • Give tool box talks as agreed with the Contractors to address key areas, including water pollution prevention, protected species management, and on-site biodiversity. Highlight to staff the requirement for compliance with planning conditions. • Undertake a pre-construction walkover with the Site Engineer / Site Manager to confirm that access routes remain appropriate to the conditions present at the time of construction • Delineate any sensitive habitats or features with wooden stakes and high visibility tape • Undertake or delegate to an appropriately qualified person, a pre-construction Invasive Alien Species survey along the works route • Monitor the installation of poles and infrastructure • Inspect pollution control measures during the works • Maintain a presence on site during the pre-construction and construction works, including setting out of access routes. • Organise a minimum of weekly meetings with the Site Environmental Supervisor and / or Foreman, to allow briefing on the programme of works on site and to provide on-site guidance during construction. • Identify environmentally sensitive areas and ecological hazards for demarcation by the Contractors.

Position	Roles and Responsibilities
	• Develop written reports / audits and submit to the Contractors and present findings at meetings as required. Prepare updated reports and a final report on mitigation measures, procedures and monitoring. • Monitor potential environmental impacts and the successful implementation of all mitigation as detailed in the NIS and this CEMP. • Maintain a weekly presence on site during the main construction works • Prepare a pre-construction Invasive Alien Species survey along the works route • Identify environmentally sensitive areas and ecological hazards for demarcation by the Contractors. • Produce written reports to the Contractors following site visits and meetings. This includes monthly reports and a final report. The Contractors will provide comprehensive information on all proposed works and all scheduling to the Ecological Clerk of Works in advance, in order to anticipate and address any issues, especially access to new areas including areas where Invasive Alien Species may occur, vegetation clearance, setting out of buffer zones, excavation and silt mitigation measures, temporary compound works and vegetation reinstatement.
Ecological Clerk of Works and/ or Water Quality Specialist	The Ecological Clerk of Works will work with Dyrick Hill Wind Farm Limited., the Contractors to see that compliance is achieved with best practice and with all environmental mitigation and monitoring requirements as detailed within the NIS and CEMP, relevant planning conditions and CEMP. The Ecological Clerk of Works will delegate and oversee the work to ensure competency of tasks achieved. Where a particular ecological concern exists at the Site, or specific habitat management activities are to be undertaken in conjunction with the main civils construction works, a Specialist Ecologist / Environmental Consultant may also be required unless the Ecological Clerk of Works is suitably qualified to undertake the particular ecological responsibilities. The main roles of the Ecological Clerk of Works are as follows: • Organise start-up meeting / Tool box talks with the Contractor to agree working methods, specifically including communications; weekly schedules; monitoring of data storage; and preparation of plans indicating location of key features including mitigation measures, monitoring points and sensitive habitats. • Maintain a weekly presence on site during the main construction works.

Position	Roles and Responsibilities
	• Organise a minimum of weekly meetings with the Site Manager and / or Foreman, to allow briefing on the programme of works on site and to provide on-site guidance during construction. Note: It is essential that the Contractor supplies information on works and scheduling to the ECoW in advance in order to anticipate and address any issues, specifically including drainage, buffer /protection zones, silt mitigation measures, cabling, roads, turbine bases, met masts, compounds, landscaping, topsoil removal, storage and replacement, vegetation reinstatement and restoration works, planting, felling and habitat management. • Highlight the need for compliance with planning conditions. Contractors Note: If failures occur and actions are taken which contravene legislation then the Project Ecologist has the power to stop works in the affected area with immediate effect. These actions will only be taken where appropriate. Notification to stop works will be by verbal means, followed up with written confirmation recording the time and date of the instruction, personnel involved and reasons for the instruction. Upon recommencement of works, details of any corrective actions and / or remedial measures implemented will be recorded within Section 4. • Give tool box talks as agreed with the site contractor to address key areas, including water pollution prevention, protected species management, and on-site biodiversity. • Monitor potential environmental impacts, including: - Use of and storage of oils and toxic chemicals on site, e.g. cement - Dewatering of excavations (including turbine bases) - Silt control - Water management, including working in or close to watercourses - Protection of ecological interests, e.g. protected species and habitats • Identify environmentally-sensitive areas and ecological hazards for demarcation by the Contractor • Produce written reports to the Contractor following site visits and meetings. This includes monthly reports and a final report.
Specialist Ecologist/ Environmental Consultant	Where a Specialist Ecologist / Environmental Consultant is employed, this person(s) will: • Provide advice and maintain regular liaison with the Project Site Manager, Project Manager, Ecological Clerk of Works and Contractors

Position	Roles and Responsibilities
	and / or other specialist Environmental Consultant as and when required. • Undertake specific monitoring activities and reporting as defined in agreed documentation prepared as part of the planning process. • The Ecological Clerk of Works or a Water Quality Specialist will be appointed. They will have responsibility for fulfilling the requirements of the Water Quality Management Plan and Watercourse Crossing Plan, including: - Daily visual inspection of: access roads for signs of ground damage or solids escape to nearby watercourses in vicinity of construction works - The ground between the structure under construction and the nearest downslope watercourse for signs of solids escape or ground damage - Surface water features in vicinity of construction works - Any pollution control measures at structures and along access roads (e.g. silt fences, drain or stream crossings etc.) for evidence of contaminated run-off or mitigation failure - Attendance at the critical work phases including, access road construction, foundation excavation, watercourse crossings, concrete pouring and back-filling. - Collection and analysis of water samples at a number of monitoring locations (i.e. at a number of locations upstream & downstream of the work locations) before, during (if potential pollution visually identified) and after construction works at that location. - EPA Q Value Biological Monitoring at monitoring locations (i.e., upstream & downstream of instream construction work locations) before and after construction works.
Archaeological Clerk of Works	The main roles of the Archaeological Clerk of Works (licenced) are as follows: • Maintain regular liaison with the Project Site Manager, Project Manager, Ecologist and Ecological Clerk of Works as appropriate. • Maintain liaison with officers of the Planning Authority, specifically the Council Archaeologist and Planning Officers as appropriate. • Where applicable apply for licence application; the Minister for Dept of Culture Heritage and Gaeltacht can approve and issue a licence under Section 26 of the National Monuments Act 1930.

Position	Roles and Responsibilities
	• Facilitate compliance with planning conditions and agreed Archaeological Programme of Works. • Demarcate any archaeologically-sensitive areas and set up exclusion zones as required on site. • Immediately notify the relevant authorities in the event of the discovery of archaeological finds or remains and suspend works in the immediate area pending consultation. Allowance will also be made for full archaeological excavation if required. • Complete a full report for submission to the Planning Authority and the Department of Arts, Heritage and the Gaeltacht on completion of the works.
Geotechnical Clerk of Works or Appointed Geotechnical Consultant	The Geotechnical Clerk of Works will be responsible for preparation and monitoring of a geotechnical risk register as well as specific duties relating to geotechnical issues as they may arise during site construction works. Soil instability and the potential for slide even can have a significant impact on environmental receptors. In completing the geotechnical risk register, the Geotechnical Clerk of Works will work with the Contractors to identify suitable mitigation and monitoring methods. Where possible, construction works will avoid causing change to local hydrological and hydrogeological flow patterns and water levels.
Contractors Appointments	
Construction Manager	[The Contractors is required to specify roles and responsibilities for each individual below]
Site Agent	[To Be Confirmed]
Foreman	[To Be Confirmed]
Other Nominated Person(s)	[To Be Confirmed]

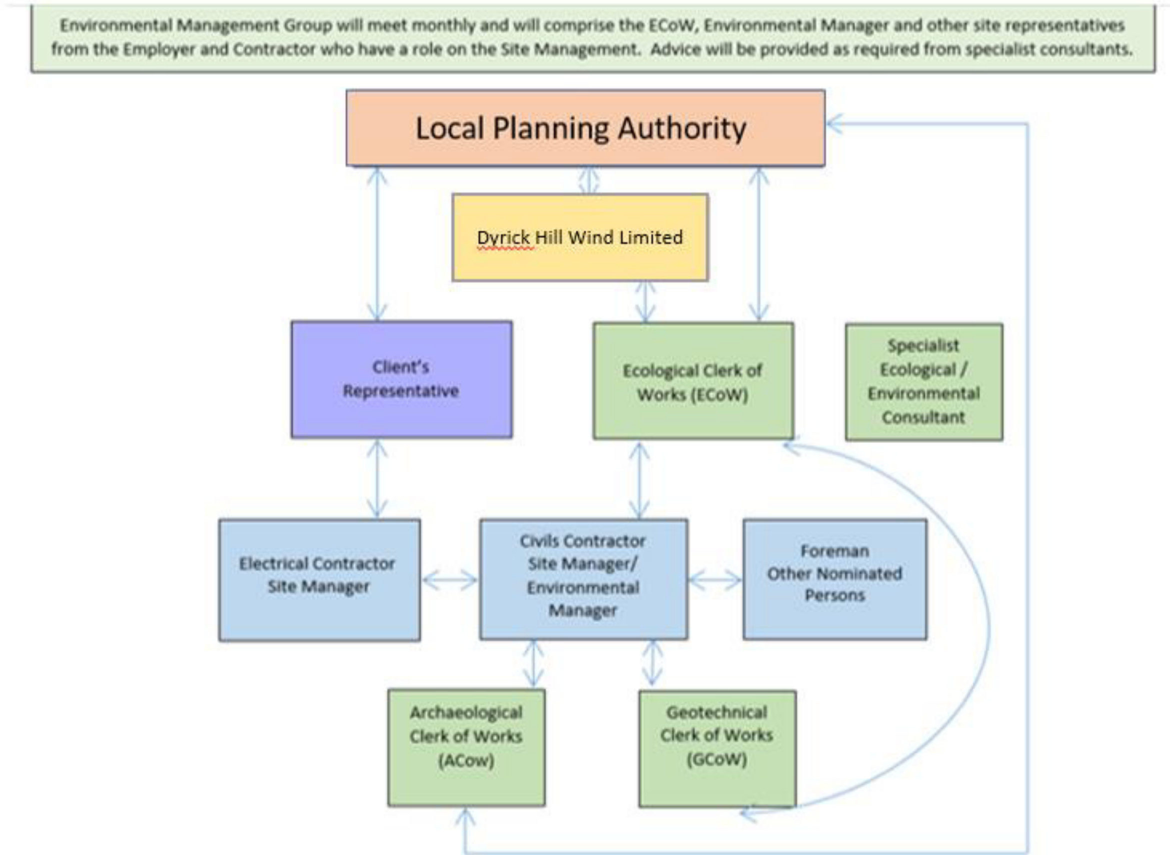

Figure 4.1 General Communication Plan

4.6 TRAINING, AWARENESS AND COMPETENCE

All site personnel will receive environmental awareness information as part of their initial site briefing. The detail of the information will be tailored to the scope of their work on site. This will ensure that personnel are familiar with the environmental aspects and impacts associated with their activities, the procedures in place to control these impacts and the consequences of departure from these procedures.

The CEMP will be posted on the main site notice board during the project. The environmental performance at the Site will be on the agenda of the monthly project management meetings for the project. Elements of the CEMP will be discussed at these meetings including objectives and targets, the effectiveness of environmental procedures etc. Two-way communication will be encouraged by inviting all personnel to offer their comments on environmental performance at the Site.

4.7 EMERGENCY PREPAREDNESS AND RESPONSE

An emergency preparedness and response procedure is required to prevent environmental pollution incidents. Suitable spill kits and absorbent material for dealing with oil spills will be maintained on site. In the event of pollution or potential risk of pollution, Waterford City and County Council will be informed immediately. In the case of water pollution, in addition to Waterford City and County Council, Inland Fisheries Ireland will also be informed immediately. Further details in relation to emergency responses are provided at **Management Plan 1: Emergency Response Plan.**

5 CORRESPONDENCE, RECORDS & REPORTS

5.1 REQUIREMENTS

The Contractors will insert / file all communication records and reports associated with Environmental Management and implementation of this CEMP under this Section 5. As a guide, the following sub-sections of filed information will be required (at a minimum):

5-A) Meeting minutes and attendance record

5-B) Weekly Environmental Reports

5-C) Monthly Environmental Reports

5-D) Environmental Checks

5-E) Audit Reports

5-F) Ecology documentation and monitoring records

5-G) Pollution Prevention, including a Pollution Prevention Measures Register

5-H) Water Quality documentation and monitoring records

5-I) Archaeology documentation and monitoring records

5-J) Ground Risk, including a Geotechnical Risk Register

5-K) Waste Management documentation

5-L) Licensing and Consents: copies of all permissions, consents, licenses and permits and related correspondence. A summary record of all such documents shall also be provided in accordance with **Table 5.1** of this CEMP.

5-M) General Correspondence: all other relevant internal and external communication records relating to environmental management issues and implementation of the CEMP.

5-N) Training Records

5-O) Toolbox Talk Records

5-P) Ecological Clerk of Works Reports

All of these documents and records will be made available for inspection in the site office. The documentation will be maintained and will be reviewed on a regular basis with revisions controlled in accordance with the site quality plan.

5.2 ENVIRONMENTAL AUDITS

The Contractors Ecological Clerk of Works will consult and assist with the Client in evaluating compliance with applicable legislation by means of a monthly Environmental Audit. A blank Environmental Audit Report form is included in **Management Plan 1: Emergency Response Plan**. All completed audit report forms and records of corrective actions (and close outs) must be filed within this section of the CEMP.

5.3 ENVIRONMENTAL CONSENTS, LICENSES & PERMITS

The Contractors Ecological Clerk of Works (or otherwise nominated responsible person(s)), will complete the summary record for all applicable permissions, consents, licenses and permits obtained for the Site. This record will follow the format provided in **Table 5.1**.

Table 5.1: Record of Environmental Consents, Licenses and Permits Issued

Consents, Licenses & Permits	Governing Legislation	Licensed Activity
Pollution Control & Hydrology		
Biodiversity		
Waste Management / Contaminated Land		
Noise / Vibration		
Archaeology		
Transport		
Other		

5.4 ENVIRONMENTAL MONITORING AND MEASURING

All of the mitigation measures outlined in Section 3.0 will be monitored, where applicable. The Contractors will put in place a program of monitoring for dust, noise, vibration and water sampling in accordance with the requirements of this CEMP.

Copies of all records will be maintained in the site office and will be reviewed by the Contractors.

5.5 NON-CONFORMANCE, CORRECTIVE AND PREVENTATIVE ACTION

Non-Conformance Notices will be issued where there is a situation where limits associated with activities on the project are exceeded, or there is an internal/external complaint associated with environmental performance.

Non-Conformance is the situation where essential components of the CEMP are not met, or where there is insufficient control of the activities and processes to the extent that the functionality of the CEMP, is compromised in terms of the policy, objectives and management programmes

Correction will be required in order to improve the identified non-conformance. The CEMP must conform to its objectives and targets and the requirements of the ISO 14001 management standard. In the event of non-conformance with any of the above, the following must be undertaken:

- Investigate the non-compliance;
- Develop a plan for correction of the non-compliance;
- Determine preventive measures and ensure they are effective;
- Verify the effectiveness of the correction of the non-compliance.
- Ensure that any procedures affected by the corrective action taken are revised accordingly.

Responsibility must be designated for the investigation, correction, mitigation and prevention of non-conformance.

6 MANAGEMENT PLANS & AVAILABLE INFORMATION

6.1 MANAGEMENT PLANS

Various Management Plans have been prepared. as listed in **Table 6.1**. These are intended to provide a benchmark for best practice and to define Dyrick Hill Wind Farm Limited minimum requirements for environmental management and mitigation.

6.2 CONTRACTORS REQUIREMENTS

The Contractors is required to further develop the Management Plans into detailed site and works specific environmental plans, method statements and procedural documents. Table 6.1 provides a summary of the content of the Management Plans and the Contractor's obligations for their further development.

Table 6.1: List of Management Plans

No.	Name	Details
MP1	Emergency Response Plan	The Contractors will further develop the Environmental (Incident and Emergency) Communication Response Plan. This will include procedures for dealing with containment of accidental chemical or fuel spills, potential overload of the drainage system by silt during unforeseen adverse weather conditions etc. The Contractors will prepare a Communication Plan for emergency response in the event of a spillage. Detailed procedures will be outlined in this document.
MP2	Water Quality Management Plan and Watercourse Crossing Plan	The Contractors is obliged to implement the water quality monitoring proposals set out therein. The Contractors is obliged to implement the water crossing proposals set out therein.
MP3	Surface Water Management Plan	The Contractors is obliged to implement the water quality monitoring proposals set out therein. Where changes to the plan are required the Contractors must consult with the Ecological Clerk of Works.
MP4	Spoil Management Plan	The Spoil Management Plan has estimated the volume of spoil that will be generated during the

No.	Name	Details
		construction phase and it outlines the locations where the material can be re-used on site. The Spoil Management Plan is a live document and can be amended by the Contractors where required.
MP5	Waste Management Plan	The Contractors will further develop the Waste Management Plan. The detailed plan will specify the licensed waste facilities that will be used for the duration of the Project.
MP6	Decommissioning Plan	The Contractors will further develop the Decommissioning Plan. Where changes to the plan are required, the Contractors must consult with the Ecological Clerk of Works.
MP7	Traffic Management Plan	The Contractors will further develop the Traffic Management Plan. Where changes to the plan are required, it can be amended by the Contractors.

MANAGEMENT PLAN 1

ENVIRONMENTAL INCIDENT AND EMERGENCY COMMUNICATION RESPONSE PLAN

DYRICK HILL WIND FARM LIMITED

DYRICK HILL WIND FARM

CO. WATERFORD

CONSTUCTION ENVIRONMENTAL MANAGEMENT PLAN (CEMP)

MANAGEMENT PLAN 1

EMERGENCY RESPONSE PLAN

MAY 2023

Dyrick Hill Wind Farm Limited
c/o EMPower,
2 Dublin Landings,
North Wall Quay,
North Dock,
Dublin,
D01 V4A3.

Jennings O'Donovan & Partners Limited,
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Sligo.
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DOCUMENT APPROVAL

PROJECT	Dyrick Hill Wind Farm	
CLIENT / JOB NO	Dyrick Hill Wind Farm Limited	6497
DOCUMENT TITLE	Construction Environmental Management Plan (CEMP) Emergency Response Plan	

	Prepared by	Reviewed/Approved by
Document Final	Name Ryan Mitchell	Name David Kiely
Date May 2023	Signature RMitchell	Signature David Kiely

CONTENTS

1. INTRODUCTION

1.1 Why have an Emergency Response Plan?

Many construction and industrial sites intrinsically have the potential to cause significant environmental harm which could threaten water supplies, public health and wildlife in the event of an environmental incident. The aim of this plan is to see that in the event of an emergency, quick action will limit any impacts on humans and the local environment.

This response plan forms part of the conditions of work for staff, and for every contractor or sub-contractor at the site.

1.2 Outline of this Environmental (Incident & Emergency) Response Plan

The information contained in this plan forms the Emergency Response Plan (ERP), part of the Construction Environmental Management Plan (CEMP) for Dyrick Hill Wind Farm.

It contains details of:

- Who should be contacted in an emergency?
- Procedures to be followed in an emergency
- Staff responsibilities in an emergency

1.3 What is an Environmental Incident?

This plan should be instigated once there has been an emergency or environmental incident on site or elsewhere, linked to the construction of Dyrick Hill Wind Farm. Such an incident is a discharge to air, land or water that could cause environmental damage. Causes of environmental incidents on this site include:

- Leaking plant or equipment
- Containment Failure
- Fire
- Land Slide
- Vandalism
- Overfilling of containment vessels
- Flooding on site
- Leaking Portaloo
- Discharge of raw or partially treated effluent

- Wind-blown waste, litter or dust
- Fuel drips or spills during refuelling
- Leak from fuel or chemical containers
- Contaminated water or sediment/silt entering a water course or drain
- Failure of pumps and pipelines
- Blade throw (results from wind turbine failure and may include the splintering of rotor blades and detachment of debris)

Any of these incidents could affect drainage systems, surface waters, aquatic ecosystems, groundwater and soil. These incidents could also affect air quality by producing toxic fumes and airborne pollutants which may damage human health, wild and domestic animals and ecosystems. The emergency procedures to be followed for each of the incidents listed above ae detailed in **Section 6.1**.

1.4 Reference Documents

Current legislation including the Safety, Health and Welfare at Work Act 2005 and the Safety Health and Welfare at Work (Construction) Regulations 2013, has been taken into account into the production of this Plan and will be accounted for in the further development of the Contractor's Construction Management Plan.

This plan has been developed alongside other Management Plans that form part of the Construction Environmental Management Plan (CEMP) including a:

- Water Quality Management Plan
- Surface Water Management Plan
- Peat and Spoil Management Plan
- Waste Management Plan
- Decommissioning Plan
- Traffic Management Plan

2. GENERAL REQUIREMENTS OF AN ERP

As mentioned, environmental incidents may include flooding, spillages (oil and chemicals), contaminated run-off, riverbed disturbance, damage to underground services, damage to habitats, poor waste disposal and storage.

This Emergency Response Plan:

- Identifies key staff and 24-hour contact details to be contacted in the event of an emergency (**Section 6.5**)
- Identifies key external bodies and emergency response numbers who should be contacted in the event of an emergency (**Section 6.4)**
- Details an Inventory of Chemical Products and Waste Inventory on Site (**Section 6.6**)*
- Details an Inventory of Pollution Prevention Equipment (**Section 6.7**)
- Provides details of staff trained in the use of spill kits and booms etc. (**Section 6.8**)
- Provides details of reporting requirements (**Sections 6.3 to 6.9**)
- Provides detailed procedures to be followed in the event of an emergency (Sections
- Provides a Communication Plan for operatives outlining key actions in the event of an emergency (**Section 6.2**). This will be available to all operatives on site.

*****_Because of the nature of wind farm construction operations and the nature of works on site, the potential pollutants will vary._

3. INCIDENT & HAZARD REPORTING

A blank Environmental Incident Report Form for reporting environmental incidents or hazards for the site is attached in **Section 6.9**. A blank Site Environmental Audit Form is attached in **Section 6.10** to record audit results. The details recorded in these forms will be regularly reviewed and will form part of the response plan procedural review.

4. WASTE DISPOSAL AFTER ENVIRONMENTAL INCIDENCES

If spill kits etc. are used in the event of a pollution incident, operatives need to carefully dispose of used equipment by carefully placing them in a sealed bag or container. They should then be removed from site by a licensed waste contractor as per the **Waste Management Plan**. Contaminated soil also needs to be disposed of as hazardous waste by a permit holder. This is also further detailed in the **Waste Management Plan** of this CEMP.

5. SITE INDUCTION AND TOOLBOX TALKS

It is imperative that all contractors, sub-contractors and staff on site are fully familiar with this emergency response plan and it will be detailed regularly in Toolbox Talks.

During these talks, they will also receive regular reminders of the importance of the local environment and of the necessary environmental controls that are in place on site.

6. PROCEDURE AND COMMUNICATION PLAN IN EVENT OF AN INCIDENT

6.1 Procedures to be followed in the event of an incident:

The following procedures are intended as a guide in dealing with incidents. Health & Safety guidance should be followed at all times applying common sense and ensuring the health & safety of yourself and others:

6.1.1 Spillages/Leaks/Containment Failure

1. Identify the source of the spillage and cut off source, if possible, e.g. by closing valve, righting container etc.
2. Work on site will cease and all operatives will assist in placing spill mats on the affected area. Site Manager/ Main Contact must be notified.
3. Identify where spillage may go. If spillage is near a watercourse (drainage/ditch/ river) divert spillage away from the watercourse through the use of absorbent materials from the spill kit.
4. Notify all parties in the order listed in **Sections 6.4 and 6.5**. Notification should be made by one member of staff whilst remainder of staff present deal with the spill/incident.
5. Dig up all contaminated ground as soon as possible/immediately. All contaminated materials should be placed in sealed polythene bags/containers and disposed of appropriately by an appropriate licensed waste contractor.
6. Complete required record of incident and response into reporting system

6.1.2 Contamination of Watercourse

Suspended Solids

7. If watercourse is at risk of contamination from suspended solids from a slope failure the Site Manager/ Main Contact must be notified and the following actions must be implemented:

   a) Place straw 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 stabilised.

b) Stone check dams faced with a layer of geotextile will be constructed at critical points along the watercourse.

c) Small sumps will be formed intermittently between the check dams to reduce the amount of suspended solids contained in the water.

Oil Spill in Watercourse

8. If spill has reached the watercourse the Site Manager/ Main Contact must be notified and the following actions must be implemented:

a) Place flexible absorbent booms across 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.

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.

6.1.3 Land Slide

9. Please see EIAR Figure 8.6 Mapped Landslide Susceptibility for further detail of flow routes and storage locations for excavated materials to be re-used for reinstatement works. Where the onset or actual detachment of peat (e.g., cracking, surface rippling) occurs:

a) All activities in the area will cease and all available resources will be diverted to assist in the required mitigation procedures.

b) The Site Manager/ Main Contact must be notified

c) All relevant authorities will be notified if a peat slide event occurs on site and this Emergency Response Plan (ERP) followed.

d) Where peat slides do not represent a risk to a watercourse and have stopped moving, they will be stabilised using rock infill, if required. The failed area and surrounding area will then be assessed by the engineering staff and a stabilisation procedure implemented. The area will be monitored, as appropriate, until movements have stopped.

e) Where possible, check barrages (comprises the placement of rock fill across a watercourse which allows the passage of water but will prevent peat debris from passing through) will be constructed on land using rock fill to prevent a peat slide reaching any watercourse.

f) If peat reaches a watercourse a check barrage will need to be constructed across the watercourse preventing the peat from moving downstream. The check barrage will allow water to flow through it, but the peat will be trapped.

g) The size of the check barrage will depend on the scale of the peat slide to be contained and the geometry of the watercourse at the location of the barrage.

h) All measures to contain the peat slide must be approved by the Waterford City & County Council or Inland Fisheries Ireland (IFI).

6.1.4 Fire

10. In the unlikely event of a fire at a turbine or at the substation, all personnel on site will meet at a designated fire point and emergency services will be contacted.

6.1.5 Blade Throw

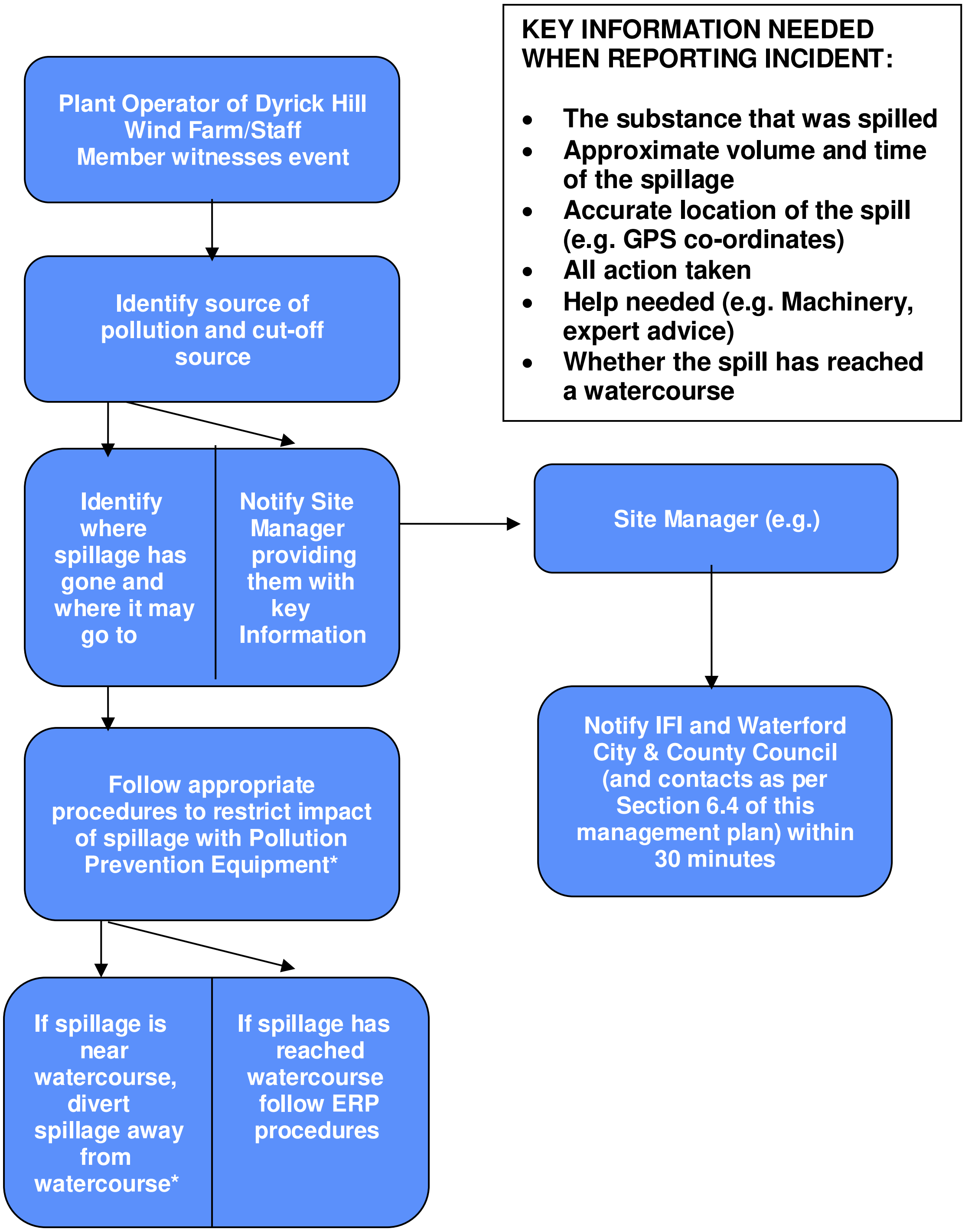
11. In the unlikely event of ice throw from blades, all activities in the area will cease and site personnel will stand clear of turbines where possible until they have been shut down completely.

6.1.6 Vandalism

12. In the event of a vandalism at the site, all personnel on site will be notified and An Garda Síochána will be contacted.

6.2 Communication Plan

A Communication Plan (to be followed in the event of an incident) will be provided by the Contactor, in liaison with relevant stakeholders and will be included in the updated ERP prior to commencement of site development works. An outline Communication Plan is proposed below:



6.3 Environmental Response Plan for Dyrick Hill Wind Farm

<table>
<tr><td colspan="2">INCIDENT RESPONSE PLAN FOR DYRICK HILL WIND FARM
Based on template provided in GPP 21 – Pollution Prevention Guidelines.</td></tr>
<tr><td>Site Address:
Dyrick Hill Wind Farm, Ballynamult, Co. Waterford

Official Company Address:
EMPower,
2 Dublin Landings,
North Wall Quay,
North Dock,
Dublin,
D01 V4A3.

KEY HOLDERS FOR SITE – NAME & CONTACT NUMBERS:</td><td>ITM: 615,487 E, 604,630N

Map references: OSI Discovery Sheet 79

Link to Map:</td></tr>
<tr><td colspan="2">Overview of the activities on site:
Include number of employees at different time of the day:

Daylight Hours:

Dusk to Dawn:

Weekend Dusk to Dawn:

Bank Holidays:</td></tr>
<tr><td>Date & 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:
To limit any potential harmful impact to the local environment through swift and appropriate actions in the event of an emergency.</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>

6.4 External Contacts

Contact	Office Hours	Out of Office
Emergency Services (Fire/Police/Ambulance)	999 or 112	999 or 112
Local Garda Station Ballymacarbry Garda Station	052 6136100	
Local Hospital. Dungarvan Community Hospital	058 20992	
Environment Department, Waterford City & County Council 4th Floor, Menapia Building, The Mall, Waterford, X91 PK15	0818 10 20 20	
EPA	053-916 0600	1850 365 121
Inland Fisheries Ireland	01 8842600	**1890 347 424 (24 hours a day)**
Roads Service (Blocked/Flooded Roads)	0300 2000 100	0300 2000 100
ESB- Electricity Company	01 8529534	
Telecommunications – Eircom	1800 475 475	

6.5 Internal Contacts

Names and position of staff authorised and trainers to activate and co-ordinate the plan.
Staff to be contacted if need to move or evacuate the site

Other Staff:		
Managing Director		
Site Manager		
Environmental Manager		
Health & Safety Manager		

6.6 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

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

For example:

- *Personal protective Equipment (PPE) available that should be worn*
- *absorbents*
- *drain mats/covers*
- *pipe blockers*
- *booms*
- *pumps*
- *sandbags*
- *silt fencing*
- *over drums*

IF ANY OF THIS EQUIPMENT REQUIRES SPECIALIST TRAINING – STATE WHO HAS BEEN TRAINED IN ITS USE AND DATE OF TRAINING (attach evidence where possible).

6.8 List of Staff Trained in the Use of Spill kits and Booms

Name	Date of Training

6.9 Site Environmental Incident Report Form

Site		Date	
Time		Weather:	
Report By:		Position:	
Dyrick Hill 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 By	
		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 REPORT COMPLETED____

6.10 Site Environmental Audit Form

Site:		Date:	
Time:		Weather conditions:	
Report by:		Position:	
Dyrick Hill Wind Farm personnel present:		Position:	
Contractor personnel present:		Position:	

Item	Questions	Yes	No	Corrective Action Required	
				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?				

Item	Questions	Yes	No	Corrective Action Required	
				Action	By
3. Material 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 mange bund rainwater levels? 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 trays more than 10m from any watercourse?				
3.10	Is all plant maintained in a good state of leaks? 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				

Item	Questions	Yes	No	Corrective Action Required	
				Action	By
	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 and 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 development, 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 licenced 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?				

Item	Questions	Yes	No	Corrective Action Required	
				Action	By
5.11	Is there any evidence of unlicensed burial of waste?				
6. Water					
6.01	Do all discharges to land or watercourses have appropriate authorisation from Local Authorities /IFI?				
6.02	Does all watercourse 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 Authority / IFI?				
6.04	Has confirmation for the SUDS design for access roads been gained from Local Authority / 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	Have field drain been diverted where necessary?				
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 minimised 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 there adequate flow attenuation measures within surface drain)?				
6.14	Are there any sign of decaying straw bales in water courses? (this could lead to organic pollution of the water course)				

Item	Questions	Yes	No	Corrective Action Required	
				Action	By
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 minimise 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	Is the ECoW a member of the institute of Ecology and /or Environmental management as required by planning conditions?				
8.03	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.)?				
8.04	Have toolbox talks on the subject of ecology and environmental responsibilities on site been delivered? Have attendance record been maintained for these?				

Item	Questions	Yes	No	Corrective Action Required	
				Action	By
9. Documentation Check					
9.01	Start-up meeting record				
9.02	Full contacts list in Section 3, Table 3.0 of 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				
9.10	Water Quality Monitoring Results				
9.11	Safety and Environmental Awareness Reports (SEARs). Filed and entered on database?				
9.12	Safety and Environmental Audit Reports for the site. (If yes, insert date of last audit___________________)				
9.13	Contractor's Environmental Plans (or Construction Method Statements):				

MANAGEMENT PLAN 2

WATER QUALITY INSPECTION AND MONITORING PLAN AND WATERCOURSE CROSSING PLAN

DYRICK HILL WIND FARM LIMITED

DYRICK HILL WIND FARM

CO. WATERFORD

CONSTUCTION ENVIRONMENTAL MANAGEMENT PLAN (CEMP)

MANAGEMENT PLAN 2

WATER QUALITY MANAGEMENT PLAN & WATERCOURSE CROSSING PLAN

MAY 2023

Dyrick Hill Wind Farm Limited
c/o EMPower,
2 Dublin Landings,
North Wall Quay,
North Dock,
Dublin,
D01 V4A3.

Jennings O'Donovan & Partners Limited,
Consulting Engineers,
Finisklin Business Park,
Sligo.
Tel.: 071 9161416
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Telephone (071) 91 61416
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DOCUMENT APPROVAL

PROJECT	Dyrick Hill Wind Farm	
CLIENT / JOB NO	Dyrick Hill Wind Farm Limited	6497
DOCUMENT TITLE	Construction Environmental Management Plan (CEMP) Water Quality Management Plan and Watercourse Crossing Plan (WQMP)	

	Prepared by	**Reviewed/Approved by**
Document Final	Name Ryan Mitchell	Name David Kiely
Date May 2023	Signature	Signature David Kiely

CONTENTS

1. INTRODUCTION

1.1 Scope and Requirements

1.1.1 The Contractor is responsible for pollution prevention for the duration of the contract and until such time as permanent measures, such as permanent drainage and silt mitigation controls, are deemed to be adequate and appropriately constructed.

1.1.2 In order to verify the efficacy of pollution prevention and mitigation works during construction, Water Quality Monitoring is required to be undertaken by a suitably qualified Environmental Consultant(s), 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, hydrochemistry and grab sample monitoring.

1.1.3 The approved plan will be coordinated and implemented on site by the Environmental Consultant appointed by the Contractor.

1.2 Reference Documentation

1.2.1 Construction works have the potential to cause pollution of the water environment. All construction works on site, and specifically construction works to be undertaken within and within 50m of any watercourses, will be completed in compliance with current legislation and best practice as detailed within the CEMP and in particular the Peat and Spoil Management Plan and the Surface Water Management Plan.

1.2.2 The following reports (along with any further surveys conducted) will be used to inform the scope of the construction phase Water Quality Management Plan.

- Dyrick Hill Wind Farm, Co. Waterford Environmental Impact Assessment Report (EIAR), May 2023
- Dyrick Hill Wind Farm, Co. Waterford Natura Impact Statement (NIS), May 2023
- Dyrick Hill Wind Farm, Co. Waterford CEMP, May 2023

2. RESPONSIBILITIES

2.1 General

2.1.1 Responsibility for the water quality monitoring programme, and coordination thereof, will lie with the independent Ecological Clerk of Works appointed at the start of the programme.

2.1.2 Prior to works commencing, the Ecological Clerk of Works will be retained by Dyrick Hill Wind Limited with a responsibility to implement this Water Quality Management Plan. Among other requirements, the Water Quality Management Plan requires a full baseline water quality survey to be undertaken prior to the commencement of construction and requires the contractor to provide a 'schedule of work' to Ecological Clerk of Works at the beginning of each week.

2.1.3 The Ecological Clerk of Works will prepare and deliver site induction and training to all construction personnel, in liaison with the Site Engineer.

- Field monitoring (as described in Section 3) of water quality parameters and collection of samples will be undertaken by the Ecological Clerk of Works or other suitably appointed person(s) (qualified to degree level with at least 5 years' experience in a similar role) based at the site. The Ecological Clerk of Works or nominated site person(s) will be appropriately trained on the required monitoring methods and the use, calibration and maintenance of all monitoring equipment used. Training will be provided by the Environmental Consultant appointed to undertake the Water Quality Monitoring programme. Undertake specific monitoring activities and reporting as defined in agreed documentation prepared as part of the planning process.
- Daily visual inspection of access roads for signs of ground damage or solids escape to nearby watercourses in vicinity of construction works
- The ground between the structure under construction and the nearest downslope watercourse for signs of solids escape or ground damage
- Surface water features in vicinity of construction works
- Any pollution control measures at structures and along access roads (e.g., silt fences, drain or stream crossings etc.) for evidence of contaminated run-off or mitigation failure
- Attendance at the critical work phases including: access road construction, foundation excavation, watercourse crossings, concrete pouring and back-filling.

- Collection and analysis of water samples at a number of monitoring locations (i.e., upstream & downstream of the seven onsite water crossing locations) before, during (if potential pollution visually identified) and after construction works at that location
- EPA Q Value Biological Monitoring at seven water crossing locations (i.e., upstream & downstream of instream construction work locations) before and after construction works.

2.1.4 Collection and analysis of water samples at a number of monitoring locations (i.e., upstream and downstream of construction work locations) before, during (if potential pollution visually identified) and after construction works.

2.2 Hydrochemistry Monitoring

2.2.1 Field Monitoring

Field monitoring of water quality parameters and collection of samples will be undertaken by the Ecological Clerk of Works. The Ecological Clerk of Works will be appropriately qualified to third level education and experienced in the field for no less than 5 years on the required monitoring methods and the use, calibration and maintenance of all monitoring equipment used. Sampling will be in accordance with International Standards of Operation. The chosen laboratory will be accredited.

2.2.2 Laboratory Analysis

Laboratory analysis of water samples will also be undertaken as part of the monitoring programme by an independent and appropriately certified laboratory to be appointed by the Ecological Clerk of Works. ISO 17025 Accreditation proves a laboratory has an acceptable quality management system in place, and it has the ability and competence to provide testing and calibration results.

2.2.3 Coordination of the laboratory sampling and analytical programme will be undertaken by the Ecological Clerk of Works/EM. Samples will be dispatched for analysis under chain of custody procedures. Laboratory analytical results will be sent directly to the Ecological Clerk of Works.

2.2.4 Interpretation and reporting of both the field and laboratory data will be the responsibility of the Ecological Clerk of Works.

2.3 Reporting

2.3.1 Monthly Water Quality Reporting

Results of water quality monitoring will assist in determining requirements for improvements in drainage and pollution prevention measures implemented on site. A monthly report on water quality will be prepared by the EM.

2.3.2 It will be the responsibility of the EM to present the ongoing results of water quality and weather monitoring at site meetings and with outside bodies. This will be done at weekly meetings and reported within the overall Monthly Environmental Report to be prepared by the Ecological Clerk of Works

2.3.3 The monthly reports on water quality will consider all visual, field monitoring and results of laboratory analysis received that month. Reports will describe how the results compare with baseline data as well as previous monthly reports on water quality. The reports will also 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 implemented.

2.3.4 Monthly reports on water quality will be provided to the Client Project Manager and will be made available to the Planning Authority.

2.3.5 Final Report on Water Quality

Upon completion of all post-construction monitoring, the Ecological Clerk of Works will prepare a final report on water quality. This final report will cover the overall performance against baseline data, details on any impacts attributed to construction works and recommendations for remedial works if required.

2.3.7 The final report will be provided to Waterford City & County Council and Inland Fisheries Ireland.

2.4 Contingency Sampling & Emergency Response

2.4.1 In the event that a pollution incident arises which threatens to enter or has entered a watercourse from the construction works, additional sampling and analysis of surface water samples will be undertaken. Examples of such incidents include a spill or accidental release of chemicals, oils and fuels or concrete. Additional sampling and analysis will determine the level of impact to the surface water receptor and remedial requirements, where necessary.

2.4.2 Where a pollution incident has occurred as a result of construction works, the Ecological Clerk of Works and Waterford City & County Council will be consulted to determine sampling requirements and any additional survey requirements where potentially significant impacts are identified. This will be done following the implementation of appropriate mitigation measures as per the **Emergency Response Plan** (Management Plan 1 of this CEMP).

2.4.3 The results of any monitoring or survey work undertaken by the Contractor will be made available to the Ecological Clerk of Works and the Local Authority. Copies of all correspondence and test certificates will be retained on site.

3. WATER QUALITY MONITORING: OUTLINE SCOPE

3.1 General

3.1.1 Construction-stage details of monitoring and precise monitoring locations will be agreed in writing with the Local Authority prior to commencement of construction works and following consultation with Inland Fisheries Ireland.

3.1.2 Water Quality Monitoring locations will be identified through grid reference, photographic record and indicated on a plan. For repeat sampling locations, each location will also be marked on the ground (stake/post) to ensure that the correct location is sampled each time.

3.1.3 Sample locations will be labelled consistently for the duration of the monitoring period. Where any additional locations are sampled during the works, the location (grid reference) of the sampling point will be recorded and a photograph will be taken at time of sampling.

3.1.4 ‘Control’ sample locations will also be included in the scope of any monitoring.

3.1.5 A water sampling location map will be developed and included in the detailed method statements for precise locations at water crossings within this development.

3.1.6 Water quality monitoring locations will include both upstream and downstream points relative to the works locations. The locations of the water quality monitoring points will be flexible and will be moved as the construction phase progresses so that monitoring points remain representative of the most likely construction impact receptor points;

3.1.7 The downstream monitoring locations will be positioned as close as possible downstream of the works location and another positioned further downstream. This approach will allow for an assessment of the dilution of potential contaminations (if present) as the distance from the point of diffuse source location increases;

3.1.8 Watercourses which do not have year-round flows such as artificial drains, ditches or ephemeral streams will be avoided as water quality monitoring locations;

3.2 Hydrochemistry Monitoring

3.2.1 Sample locations, monitoring frequency and precise hydrochemistry parameters will be agreed in writing with Waterford County Council, prior to commencement of construction, and following consultation with Inland Fisheries Ireland.

3.2.2 As a minimum, the monitoring programme will include:

- During the construction phase, daily visual inspections of excavations, dewatering procedure, settlement ponds, silt traps, buffered outfalls and drainage channels etc. will be carried out by a suitably qualified person. Any excess build-up of sediment at settlement ponds, drains or at any other drainage features that may decrease the effectiveness of the drainage feature will be promptly removed;
- During the construction phase of the Development, all development areas will be monitored on a daily basis for evidence of groundwater seepage, water ponding and wetting of previously dry spots;
- Following the completion of the construction phase, silt traps, buffered outfalls and drainage channels will be periodically inspected during maintenance visits to the Site when the operational phase water quality monitoring will also be carried out;
- Any proposed crossings of small unmapped drains will be monitored daily during construction and during each Site visit during the operational phase. These small culvert crossings will be monitored in terms of their impacts (if any) on the receiving watercourses and in terms of their structural integrity to identify any signs of erosion or potential for sediment release;

- It is proposed that a handheld turbidity meter is available at the Site to accurately measure the quality of water discharging from the Site. The meter will be maintained and calibrated before each use by a qualified Environmental Clerk of Works; and,
- Any discharges of sediment treated water should meet the requirements of the *Surface Water Regulations 2009*, as amended.

3.2.2.1 Daily visual observation in areas of high construction activity 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.

3.2.2.2 Weekly visual inspections and monthly field hydrochemistry monitoring.

3.2.2.3 One round of post construction monitoring, to be agreed with Waterford County Council. Post construction will be defined as when the reinstatement phase is completed.

3.2.3 Monthly analysis of water parameters will be carried out. Construction-stage analytical determinants (including limits of detection and frequency of analysis) will be specified and agreed with the Local Authority and third parties for each sample location. The agreed suite of grab sample determinants will include the following:

Parameters for hydrochemistry analysis

- pH
- Temperature
- Total Suspended Solids
- Dissolved Organic Carbon
- Conductivity
- Dissolved Oxygen
- Total Oxidized Nitrogen
- Ammoniacal Nitrogen
- Ammonia
- Potassium
- Phosphate
- Biological Oxygen Demand

- Chemical Oxygen Demand
- Total Petroleum Hydrocarbons*

4. WATER CROSSINGS

4.1 Locations

There is (1) proposed watercourse crossing on site as shown on **Figure 4.1**.

* Only during construction phase

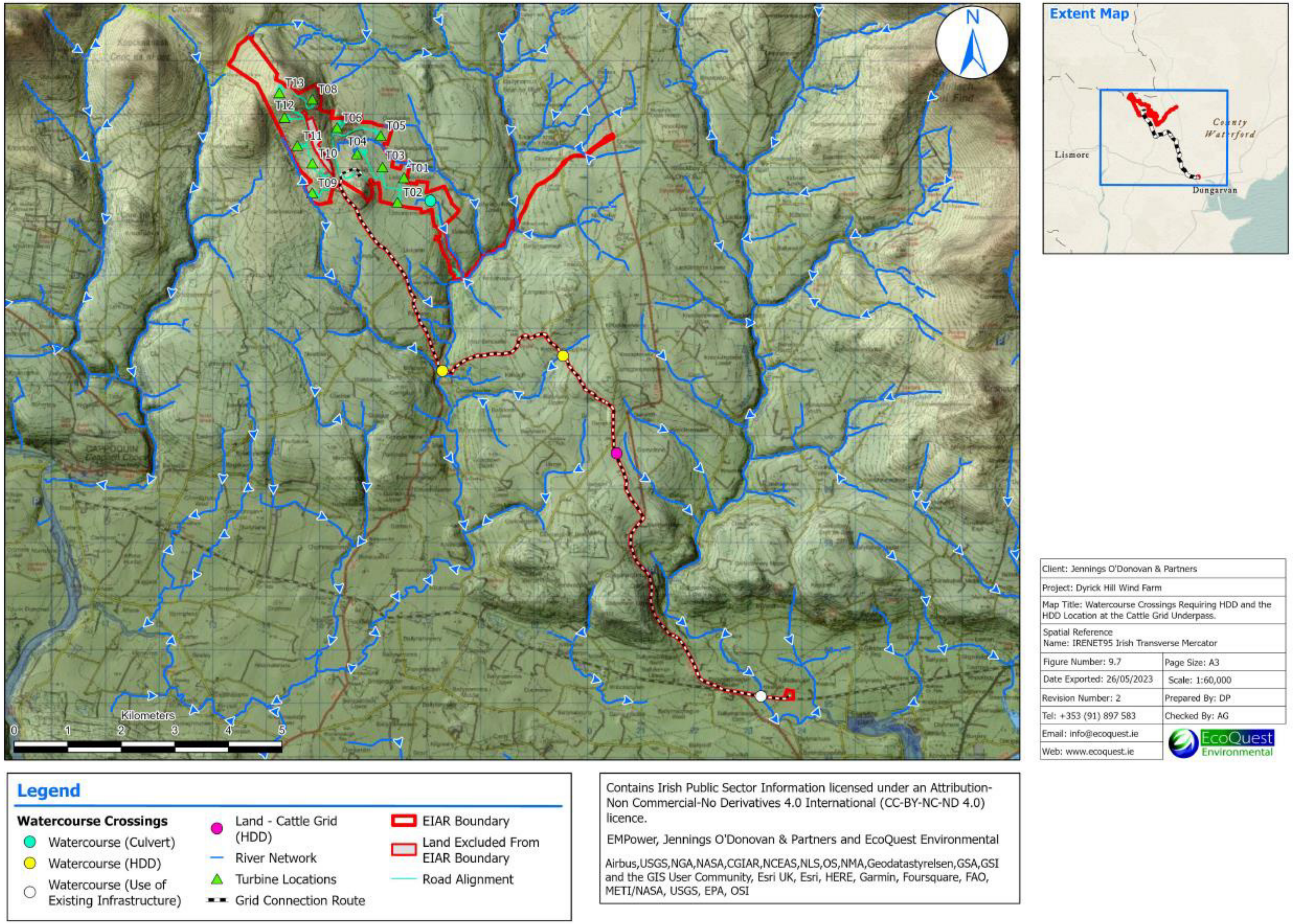


Figure 4.1 Watercourse crossings.

WC1

watercourse crossings / culverts of a the Aughkilladoon Stream will be constructed at the eastern extent of the Site as outlined in **Plate 4.1** . Details can be seen in **6497-PL-304** .

Plate 4.1: Where WC1 will be located.

Grid Connection

Appendix II details the Technical Notes for the Development as prepared by TLI Group. Table 4.1 summarises the number of crossings along the Grid Connection Route.

Table 4.1: Summary of crossings along the Grid Connection Route

Description	Service Crossings No.	Culvert Crossings No.	Watercourse/bridge Crossings No.
Underground Grid Connection	3	0	3
Total Crossings	3	0	3
Total	3		

4.2 Design

All watercourse crossings have been designed on a bespoke basis. The following guidance was used in the sizing of watercourse crossings:

- Hydrological assessments made using a number of methods including Flood Estimation Handbook (Statistical Analysis) and Flood Studies Report (FSR) where appropriate to determine the design flow.
- CIRIA Culvert design and operation guide (C689).
- Inland Fisheries Ireland (2016) Guidelines on Protection of Fisheries During Construction Works in and Adjacent to Waters.
- Where planning consent is received a Section 50 Application will be submitted to Office of Public Works (OPW) for approval prior to works commencing on site.
- As part of the drainage design, detailed mapping of drainage paths across the site has been undertaken; utilising topographical surveys, contour mapping and aerial photography.

4.3 Construction Requirements

The Ecological Clerk of Works (Ecological Clerk of Works) will be consulted with regard to all watercourse crossing works. Surveys by the Ecological Clerk of Works will be carried out immediately prior to construction so that adequate mitigation is built into the design in respect to fish passage and avoiding impact on downstream ecology.

Following consultation with the Contractors, Ecological Clerk of Works and third parties, CCC will be frequently consulted during watercourse crossing construction, as agreed prior to the commencement of construction.

4.4 Mitigation Measures

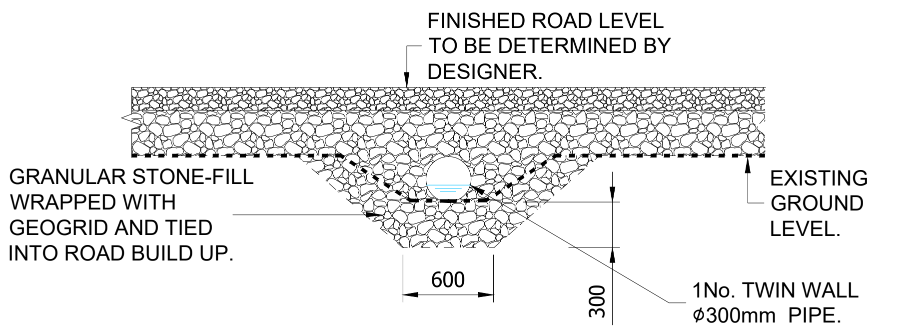
At the Site, one new watercourse crossings / culverts of a the Aughkilladoon Stream will be constructed at the eastern extent of the Site as outlined in **Figure 4.1**. It is possible that some small unmapped drainage channels could potentially require small culverts to be constructed to facilitate the construction of access roads. However, detailed planning and consideration as described below, to ensure potential impacts are assessed adequately and in turn mitigated against, will be implemented for these locations.

A detailed design stage assessment in terms of any small culvert design will be carried out that will have cognisance to locations including the characteristics of water flow at each drain location. The following mitigation measures will be implemented as minimum requirements to ensure any potential impacts of drainage feature crossings are minimised:

- The design of the proposed crossings and a method statement for the proposed construction will be prepared in advance of works taking place;
- This design of all crossings will adhere to relevant available guidance and will be reviewed through consultation with the OPW which will mitigate against any significant impact on surface water flow and in turn the risk of localised or downstream flooding.
- Crossings will be designed to minimise, in so far as practical and to the extent deemed acceptable by the competent authority, the disturbance or alteration of water flow, erosion and sedimentation patterns and rates;
- Watercourse crossings will include comprehensive details of the culvert design and construction methodology, including the environmental risk/s involved which have been identified and assessed in this EIAR. Contractors will be required to produced detailed site-specific mitigation measures and best practice techniques will be contained in the post planning construction management plan and Risk Assessment Method Statement (RAMS) for any proposed crossings of small unmapped drains.
- Vehicles used in the construction of small drain crossings will only be refuelled at the Site's bunded and designated refuelling area. No refuelling will be permitted within 50m of any watercourse at the Site.
- To mitigate against the potential risk of accidental leaks or spillages from plant and equipment, an emergency response plan for such incidents is contained in the CEMP appended to the EIAR in **Appendix 2.1**. Multiple spill kits will be maintained on the Site at all times within the cabs of vehicles and placed strategically at environmentally sensitive locations across the Site. Spill kits will be routinely inspected to ensure that they are fully stocked with oil absorbent booms and pads at all times. Oil absorbent booms will be installed downstream of channel crossing work areas within 25m of the works location, prior to the commencement of works.

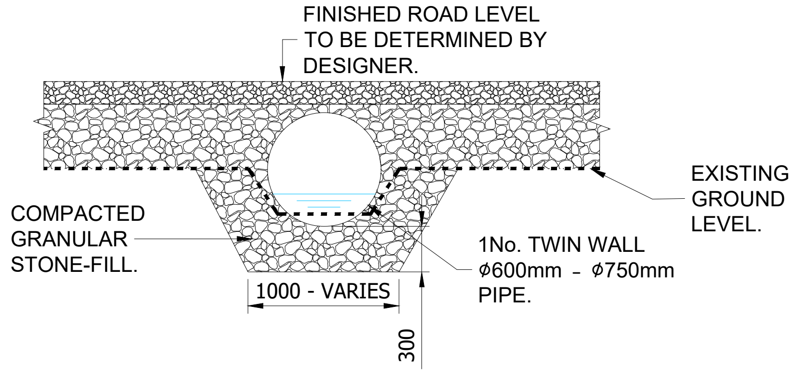
APPENDIX I

Design Drawings



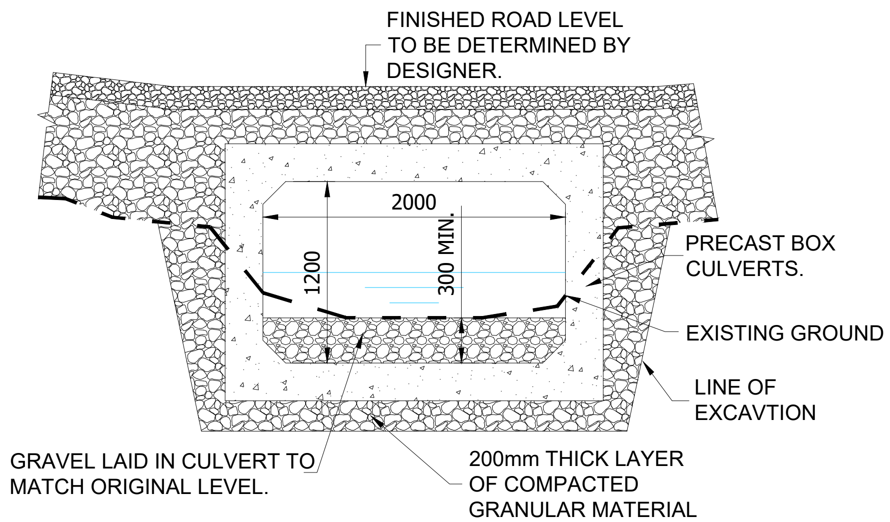
TYPE 1 CULVERT

SCALE 1:50



TYPE 2 CULVERT

SCALE 1:50



TYPE 3 CULVERT

SCALE 1:50

NOTE:

CULVERTS ARE TO BE OF ADEQUATE SIZE TO CARRY PEAK FLOWS CORRESPONDING TO A 1 IN 100 YEAR STORM EVENT, WITH A MINIMUM DIAMETER OF 900mm. THEY SHOULD BE INSTALLED TO CONFORM WHEREVER POSSIBLE TO THE NATURAL SLOPE AND ALIGNMENT OF THE STREAM OR DRAINAGE LINE. CULVERTS GREATER THAN 1m DIAMETER SHOULD BE BURIED TO A MINIMUM DEPTH OF 300mm BELOW THE STREAMBED AND THE ORIGINAL BED MATERIAL PLACED IN THE BOTTOM OF THE CULVERT.

1. FORMATION LEVEL TO BE DETERMINED BY THE CIVIL WORKS DESIGNER. REFER TO SITE INVESTIGATIONS REPORT.

2. SUB BASE MATERIAL TO CONFORM TO THE FOLLOWING:

IMPORTED MATERIAL
TO CONFORM TO TYPE 6F1 IN ACCORDANCE WITH TABLE 6/2 OF THE NRA SPECIFICATION FOR ROAD WORKS.

SITE WON MATERIAL
ROCK WON IN EXCAVATION OF TURBINES MUST BE CRUSHED AND GRADED ON SITE. THE MAXIMUM SIZE OF AGGREGATE TO BE 125mm. THE AGGREGATE GRADING TO BE AGREED WITH THE ENGINEER.

3. SURFACE LAYER TO BE CLAUSE 804. THIS LAYER MAY BE APPLIED IMMEDIATELY BEFORE TURBINE DELIVERY.

rev.	modifications	by	chkd	date
P00	Issued for Comments	LB	JL/RM	Mar. 2023

Client
EMP Group

Project
Proposed Wind Farm and Grid Connection at Dyrick Hill, County Waterford.

Stage
Planning Application

Title
Drainage Details
Sheet 3 of 4

Scales
1:50 (A3)

Surveyed	Prepared By	Checked	Date
	L.B.	J.L.	Oct. 2022

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Drawing no. 6497-PL-304

Revision P00

APPENDIX II

TLI Dyrick Hill Technical Notes

OUTLINE CONSTRUCTION METHODOLOGY

Dyrick Hill Wind Farm - 110kV Grid Connection

Document No: 05829-R02-00

Revision:	Author:	Checked:	Date:	Notes:
00	AF	DB	29.09.22	*Issued For Client Review*

Table of Contents

Table of Figures

1.0 Introduction

The purpose of this document is to outline and explain the construction techniques and methodologies which will be implemented during construction of the grid connection for the Dyrick Hill Wind Farm. It is proposed to connect the development via underground cable to the existing Dungarvan 110kV substation.

The 110kV grid connection will consist entirely of underground cabling (UGC) with the majority of the UGC to be installed within the public road network. There will also be short sections within the Dungarvan 110kV compound and within wind farm lands within to the Dyrick Hill Wind Farm. The UGC works will consist of the installation of 6 No. ducts in an excavated trench to accommodate 3 No. power cables, 1 No. fibre communications cable to allow communications between the Dyrick Hill Wind Farm and the existing Dungarvan 110kV substation, 1 No. spare communications duct and 1 No. earth continuity conductor duct.

This document is intended to be used as an aid to understand the methodologies to be employed during construction and should be read in conjunction with all other specialist reports which accompany the planning application. This document is in outline form only and will be revised and updated prior to the commencement of construction activities. Detailed method statements will be prepared in respect of each aspect of the development in advance of construction. The final construction methodology and method statements will be agreed with the Planning Authority in advance of commencement of construction.

2.0 Proposed 110kV Underground Cable Route

The proposed grid connection for the Dyrick Hill Wind Farm is approximately 16.01km in length and runs in a north-westerly direction from the existing Dungarvan 110kV Substation.

The proposed connection route utilizes sections of public road, existing access tracks, wind farm access tracks and some sections of private land.

The exact location of the UGC within the proposed site boundary is subject to minor modification following a further detailed assessment to be undertaken prior to construction and following consultation with Waterford County Council and all other relevant stakeholders, having regard to all environmental protection measures outlined in the planning application and accompanying technical reports.

Figure 1 below outlines the proposed UGC route in purple, with each section being formulated within Table 1.

This proposed grid connection route is shown as an Overall Site Location Plan in Drawing No. 05829-DR-100.

Figure 1 – Grid Connection Route Layout plan

Table 1 below summarises the route location features of the underground cable connection and route.

Table 1 – Approximate Route Location of Preliminary Design:		
Dungarvan Substation	**Public Roads**	**Private Land/Access Roads/WF**
115m	15,630m	268m

Table 1: Dungarvan 110kV Substation to the Dyrick Hill Wind Farm – UGC Route Location Summary

Table 2 below separates the UGC route into a number of sections and describes the specific construction requirements of each individual section.

Table 2 - Summary of 110kV Underground Cable Route
Description
Section 1 - UGC Route from Dungarvan 110kV Substation as far as the R672 Regional Road **For reference see Drawing No. 05829-DR-101.** The UGC will exit the Dungarvan Substation Compound to the south, passing a number of UGCs in the vicinity of the substation gate, and joins onto the national road (N72). Following the N72 in a west direction before meeting the Watercourse 1 (Colligan River) [Chainage – 500m] the first watercourse on this route. This watercourse is in the form of a precast concrete bridge with minimal cover, a Horizontal Direction Drill (HDD) will be utilised to cross this watercourse, within the road corridor. From here the UGC route follows the N72 west for approx. 1,110m as far as the R672. Section 1 Features: ▪ *Existing UGC Crossings* Third-party records show that the Dungarvan 110kV substation has a number of existing UGC routes exiting the substation within this section. The exact location, depth, and arrangement of the existing UGCs will need to be confirmed by detailed survey and site investigation works. A minimum separation distance between the cables will need to be adhered to in order to comply with EirGrid/ESB requirements. • *1 No. Joint Bays and associated chambers* The joint bays will be located below ground and finished/reinstated to the required Waterford County Council specification. All reinstatement works will be carried out in-line with the 'Guidelines for Managing Openings in Public Roads – 2017'. All Joint Bay infrastructure are to be installed within the corridor of the existing roadway. The link boxes and communication chambers will also be installed in the road corridor or verges where available. Road widening works may be required to facilitate the joint bays. The final position of the joint bay, link box and communication chamber will need to be agreed with ESB as part of the design approval process. • Joint Bay 01 (JB01) will be located at the entrance to the ESB Dungarvan 110kV Substation. • Joint Bay 02 (JB02) will be located West of JB01 within the N72. [Chainage – 800m] • *1 No. Bridge Crossings Colligan River*

Table 2 - Summary of 110kV Underground Cable Route
Description
There is one bridge crossings within this section, which requires Horizontal Directional Drilling (HDD) to cross it. 1. Bridge 1: WD-N72-007.00 This bridge is TII owned bridge, labelled 'WD-N72-007.00'. As this bridge is precast concrete, 500mm concrete slab, with the road surface sitting 100mm below the top of the concrete slab. There is a 500mm concrete base to support the bridge. This would indicate insufficient cover available to allow the ducts to be installed in the bridge deck, it is therefore recommended to utilise Horizontal Directional Drilling (HDD) to pass under the bridge and riverbed, within the road corridor. 1 No. HDD crossing will be carried out within the existing road corridor. The design and final location of the HDD launch/reception areas will need to be confirmed by a specialist drilling contractor following detailed site investigation works including bore holes. The total length of the proposed HDD will be approx. 75m – 100m. The HDD launch/reception pits will be reinstated with a transition coupler or transition chamber. All reinstatement works will be finished/reinstated to the required Waterford County Council specifications. All reinstatement works in the public road will be carried out in line with the 'Guidelines for Managing Openings in Public Roads – 2017'. The final position of each individual HDD and possible transition chambers will need prior agreement with ESB as part of the design approval process. • *Service Crossings* Initial studies show the UGC will cross at least 3 No. existing services within this section. These services will be crossed using an undercrossing or overcrossing method, which will be selected based on the cover available above the service. Service crossings have been designed in line with ESB specifications. All relevant stakeholders will be contacted to verify the existence of services prior to any construction works taking place.
Section 2 - UGC within the R672 Regional Road and the L5068 Local Road. **For reference see Drawing No. 05829-DR-101 through to 05829-DR-107** After exiting the N72 national road, the UGC continues north. This section begins in the R672 regional road. The UGC route follows the R672 for 3,600m. The R672 has several drainage crossings under the road, the majority of which are 350mm pipes. The UGC would run parallel to existing Irish Water infrastructure along this section of the route. The UGC carries predominantly north westerly converging onto local road (L5068). Along the L5068 the UGC encounters a cattle under cross which will require a HDD to pass under (Chainage – 8800m). The UGC follows the L5068 for approx. 568m, before turning west onto the L5068 for a further 1,409m before encountering the second watercourse crossing (Ballykerin Upper) [Chainage – 8800m] of the UGC route. This watercourse is in the form of a concrete slab bridge, situated on a bend on the road. It is proposed to cross this bridge utilising a HDD. The UGC continues in this local road for a further 2,777m before meeting the third watercourse (Finisk River) [Chainage – 11600m] crossing of the route. This bridge is in the form of a historically listed structure. An offroad HDD will have to be used to cross this watercourse. The UGC continues in this road for a further 235m to the village of Millstreet. The UGC crosses the R671 regional road through Millstreet, before carrying onto an un-named local road.

Table 2 - Summary of 110kV Underground Cable Route
Description

The UGC then follows an un-named local road, north of Millstreet, for 3,987m, until it reaches the wind farm boundary. This road is a single lane road with a number of culvert/drainage crossing.

Section 2 Features:

- *19 No. Joint Bays and associated chambers*

The joint bays will be located below ground and finished/reinstated to the required Waterford County Council specification. All reinstatement works will be carried out in-line with the 'Guidelines for Managing Openings in Public Roads – 2017'. All Joint Bay infrastructure are to be installed within the corridor of the existing roadway. The link boxes and communication chambers will also be installed in the road corridor or verges where available. Road widening works may be required to facilitate the joint bays. The final position of the joint bay, link box and communication chamber will need to be agreed with ESB as part of the design approval process.

- Joint Bay 03 (JB03) will be located West of the JB02 within the R672. [Chainage - 1600m]
- Joint Bay 04 (JB04) will be located Northwest of JB03 within the R672. [Chainage – 2400m]
- Joint Bay 05 (JB05) will be located Northwest of JB04 within the R672. [Chainage – 3150m]
- Joint Bay 06 (JB06) will be located North of JB05 within the R672. [Chainage – 3900m]
- Joint Bay 07 (JB07) will be located North of JB06 within the R672. [Chainage – 4700]
- Joint Bay 08 (JB08) will be located North of JB07 within the L5068 local road. [Chainage -5450m]
- Joint Bay 09 (JB09) will be located North of JB08 within the L5068 local road. [Chainage – 6200m]
- Joint Bay 10 (JB10) will be located North of JB09 within the L5068 local road. [Chainage – 6950m]
- Joint Bay 11 (JB11) will be located Northwest of JB010 within the L5068 local road. [Chainage – 7700m]
- Joint Bay 12 (JB12) will be located Northwest of JB11 within the L5068 local road. [Chainage – 8400m]
- Joint Bay 13 (JB13) will be located Northwest of JB12 within the L5068 local road. [Chainage – 9150m]
- Joint Bay 14 (JB14) will be located West of JB13 within the L5068 local road. [Chainage – 9900m]
- Joint Bay 15 (JB15) will be located West of JB14 within the L5068 local road. [Chainage – 10700m]
- Joint Bay 16 (JB16) will be located West of JB15 within the L5068 local road. [Chainage – 11450m]
- Joint Bay 17 (JB17) will be located North of JB16 within the unnamed local road. [Chainage – 12200m]
- Joint Bay 18 (JB18) will be located North of JB17 within the unnamed local road. [Chainage – 12950m]
- Joint Bay 19 (JB19) will be located North of JB18 within the unnamed local road. [Chainage – 13700m]
- Joint Bay 20 (JB20) will be located North of JB19 within the unnamed local road. [Chainage – 14400m]
- Joint Bay 21 (JB21) will be located North of JB19 within the unnamed local road. [Chainage – 15150m]

- *3 No. HDD Crossings*

There are 2 No. HDD crossings within this section.

1. Crossing 1: The first crossing in this section that will require a HDD to cross is an existing cattle concrete culvert under passing. There is approx. 500mm of cover between the road deck and the top of the concrete culvert. Due to the size and depth of the cattle underpass it is recommended to cross under the base of the culvert utilising a HDD.
2. Crossing 2: The second crossing that will require a HDD in this section is a river crossing. This river will be crossed entirely in private lands, this is due to a bridge with insufficient cover being located on a e

Table 2 - Summary of 110kV Underground Cable Route
Description
bend in the road. It may be achievable to complete a HDD bore within the road corridor, this will have to be confirmed by a drilling contractor. 3. Crossing 3: The third crossing that will require a HDD in this section is a historically listed structure in the form of a bridge. Mountain Castle Bridge – Reg. No. 22902211. It is proposed that this HDD crossing of the bridge will be within the road corridor. 1 No. HDD crossing will be carried out within private lands and 2 No. HDD crossing will be carried out I the road corridor. The design and final location of the HDD launch/reception areas will need to be confirmed by a specialist drilling contractor following detailed site investigation works including bore holes. The total length of the proposed HDD will be approx. 50m – 100m. The HDD launch/reception pits will be reinstated with a transition coupler or transition chamber. All reinstatement works will be finished/reinstated to the required Waterford County Council/Landowner specifications. All reinstatement works in the public road will be carried out in line with the 'Guidelines for Managing Openings in Public Roads – 2017'. The final position of each individual HDD and possible transition chambers will need prior agreement with ESB as part of the design approval process. • *Culvert Crossings/Drainage Crossings* The UGC will cross existing culverts within this section. The preferred crossing method is using a culvert undercrossing or overcrossing method which will be selected based on the cover available above the culvert. Culvert crossings have been designed in line with ESB specifications. Where it is not possible to cross under an existing culvert while maintaining the culvert in place, the culvert may be replaced. All reinstatement works will be carried out to the required Waterford County Council specification and in line with the 'Guidelines for Managing Openings in Public Roads – 2017'. • *Service Crossings* Initial studies show the UGC will cross at least 14 No. existing services within this section. These services will be crossed using an undercrossing or overcrossing method, which will be selected based on the cover available above the service. Service crossings have been designed in line with ESB specifications. All relevant stakeholders will be contacted to verify the existence of services prior to any construction works taking place.
Section 3 - UGC Route following Wind Farm Access tracks to the Proposed Wind Farm Substation. **For reference see Drawing No. 05829-DR-108 through to 05829-DR-109.** The UGC will exits the public road network and continues for the remainder of the route utilising private lands and the proposed wind farm access track.

Table 2 - Summary of 110kV Underground Cable Route
Description
Note: The precise location of the cable route may be subject to change as result of existing services/utility locations, ground conditions and any environmental constraints.

Table 2 - Summary of 110kV Underground Cable Route

3.0 Preliminary Site Investigations

It will be required to carry out preliminary site investigations along the cable route prior to construction to confirm design assumptions.

The following items may be carried out for the grid connection cable route:

- Slit trenches at locations of service crossings (full road/track width).
- Trial holes at all joint bay positions to ascertain ground conditions and thermal resistivity of the soil.
- Boreholes at HDD locations to ascertain ground conditions.

Traffic Management – Single Lane closure with Stop/Go system in place as required.

Equipment:

- 4x4 vehicle
- Concrete vibrator
- Wheeled dumper
- Soil compactor
- 360° tracked excavator (only rubber tracked machines will be allowed on public roads)

4.0 Access Routes to Work Area

The majority of the underground cable will be installed within the public road network and proposed access tracks and will therefore be accessed via the existing road network and the designated site access. Where the cable route is located on private lands, the contractor(s) will be required to utilise the local public road network in the vicinity of the work area.

A detailed Traffic Management Plan will be prepared and agreed with Waterford County Council prior to the commencement of construction. Some work areas will require a temporary road closure where it is not possible to safely implement a Stop/Go system. Where temporary road closures are necessary, a suitable diversion will be implemented using appropriate signage, following consultation and agreement with Waterford County Council.

Careful and considered local consultation will be carried out, to minimise the amount of disturbance caused during works. All plant and equipment employed during the works (e.g. diggers, tracked machines, footwear etc.) will be inspected prior to arrival and departure from site. Vehicles will be cleaned on access and egress to prevent the spread of invasive species.

5.0 Traffic Management

Traffic management and road signage will be in accordance with the Department of Transport: Traffic Signs Manual - Chapter 8: Temporary Traffic Measures and Signs for Road Works and in agreement with Waterford County Council. All work on public roads will be subject to the approval of a road opening license application. The contractor will prepare detailed traffic management plans for inclusion as part of the road opening applications. Where road widths allow, the UGC installation works will allow for one side of the road to be open to traffic at all times by means of a

‘Stop/Go’ type traffic management system, where a minimum 2.5m roadway will be maintained at all times. Where it is not possible to implement a ‘Stop/Go’ system a temporary road closure will be required. Temporary traffic signals will be implemented to allow road users safely pass through the works area by channelling them onto the open side of the road. The UGC will be usually installed in 100m sections, and no more than 100m will be excavated without the majority of the previous section being reinstated.

All construction vehicles will be parked within a designated works area so as not to cause additional obstruction or inconvenience to road users or residents. Temporary traffic signals will be in place prior to the works commencing and will remain in place until after the works are completed. The public road will be checked regularly and maintained free of mud and debris. Road sweeping will be carried out as appropriate to ensure construction traffic does not adversely affect the local road condition.

In the event of emergency, steel plates will be put in place across the excavation to allow traffic to flow on both sides of the road.

All traffic management measures will comply with those outlined in the accompanying Traffic Management Report (to be compiled prior to construction) and will be incorporated into a detailed Traffic Management Plan to be prepared in consultation with Waterford County Council prior to the commencement of UGC construction.

6.0 Road Opening Licence

The grid connection works will require a road opening licence under Section 254 of the Planning and Development Act 2000-2015 from Waterford County Council. A Traffic Management Plan (TMP) will be agreed with Waterford County Council prior to the commencement of the development. The TMP will outline the location of traffic management signage, together with the location of any necessary road closures and the routing of appropriate diversions. Where diversions are required, these will be agreed with Waterford County Council in advance of the preparation of the TMP.

7.0 Construction Hours

Standard working hours for construction will be 8.00am to 8.00pm Monday to Friday and 8.00am to 6.00pm on Saturday (if required), with no works on Sundays or Bank Holidays except in exceptional circumstances or in the event of an emergency. All site personnel will be required to wear project notification labelling on high visibility vests and head protection so that they can be easily identified by all workers on site.

8.0 UGC Construction Methodology

The UGC will consist of 3 No. 125mm diameter HDPE power cable ducts, 2 No. 125mm diameter HDPE communications ducts and 1 No. earth continuity conductor duct to be installed in an excavated trench. The trench will be typically 825mm wide by 1,315mm deep with variations on this design to adapt to bridge crossings, service crossings and watercourse crossings. The power cable ducts will accommodate 1 No. power cable per duct. One of the communications ducts will accommodate a fibre cable to allow communications between the Dyrick Hill Wind Farm and existing Dungarvan 110kV substation. The inclusion of 1 No. spare communications duct and 1 No. earth continuity conductor duct will also be required. The ducts will be installed, and the trench reinstated in accordance with landowner, EirGrid & Waterford County Council specifications. The electrical cabling/fibre cable will be pulled through the installed ducts in approximately 830 to 870m section lengths. Construction methodologies implemented and materials used will ensure that the UGC is installed in accordance with the requirements and specifications of EirGrid.

8.1 Trenching Methodology

The following section outlines the methodology to be followed during trenching works.

- The Contractor, and their appointed Site Manager, will prepare a targeted Method Statement concisely outlining the construction methodology and incorporating all mitigation and control measures as required by planning conditions where relevant;
- All existing underground services along the UGC route shall be confirmed prior to the commencement of construction works;
- At watercourse crossings, the contractor will be required to adhere to environmental control measures as described in the project Construction Environmental Management Plan (CEMP);
- Where the cable route intersects with culverts, the culvert will remain in place (where possible) and the ducting will be installed either above or below the culvert to provide minimum separation distances in accordance with EirGrid and Irish Water specifications;
- In the event that culverts require removal for ducting installation, a suitable method of damming the water source and pumping the water around the work area will be set out in a method statement and agreed with the relevant stakeholders. Once the ducts are installed the culvert will be reinstated to match existing levels and dimensions. If works of this nature are required, the contractor will liaise with Inland Fisheries Ireland in advance of works;
- A detailed Traffic Management Plan will be prepared and agreed with Waterford County Council;
- Excavated material will be temporarily stockpiled onsite for re-use during reinstatement. Stockpiles will be restricted to less than 2m in height. Stockpiles will be located a minimum of 50m from surface water features and all stockpiling locations will be subject to approval by the Site Manager and Project Ecological Clerk of Works (ECoW);
- Excavated material shall be employed to backfill the trench where appropriate and any surplus material will be transported off site and disposed of at a fully authorised soil recovery site;
- Any earthen (sod) banks to be excavated will be carefully opened with the surface sods being stored separately and maintained for use during reinstatement;
- The excavated trench will be dewatered if required, from a sump installed within the low section of the opened trench. Where dewatering is required, dirty water will be fully and appropriately attenuated, through silt bags, before being appropriately discharged to vegetation or surface water drainage feature;
- Where required, grass will be reinstated by either seeding or by replacing with grass turves;
- No more than a 50m section of trench will be opened at any one time. The second 50m will only be excavated once the majority of reinstatement has been completed on the first;
- The excavation, installation and reinstatement process will take approximately one day to complete a 100m section;
- Where the cable is being installed in a roadway, temporary reinstatement may be provided to allow larger sections of road to be permanently reinstated together;
- Following the installation of ducting, pulling the cable will take approximately one day between each joint bay, with the jointing of cables taking approximately 1 week per joint bay location.

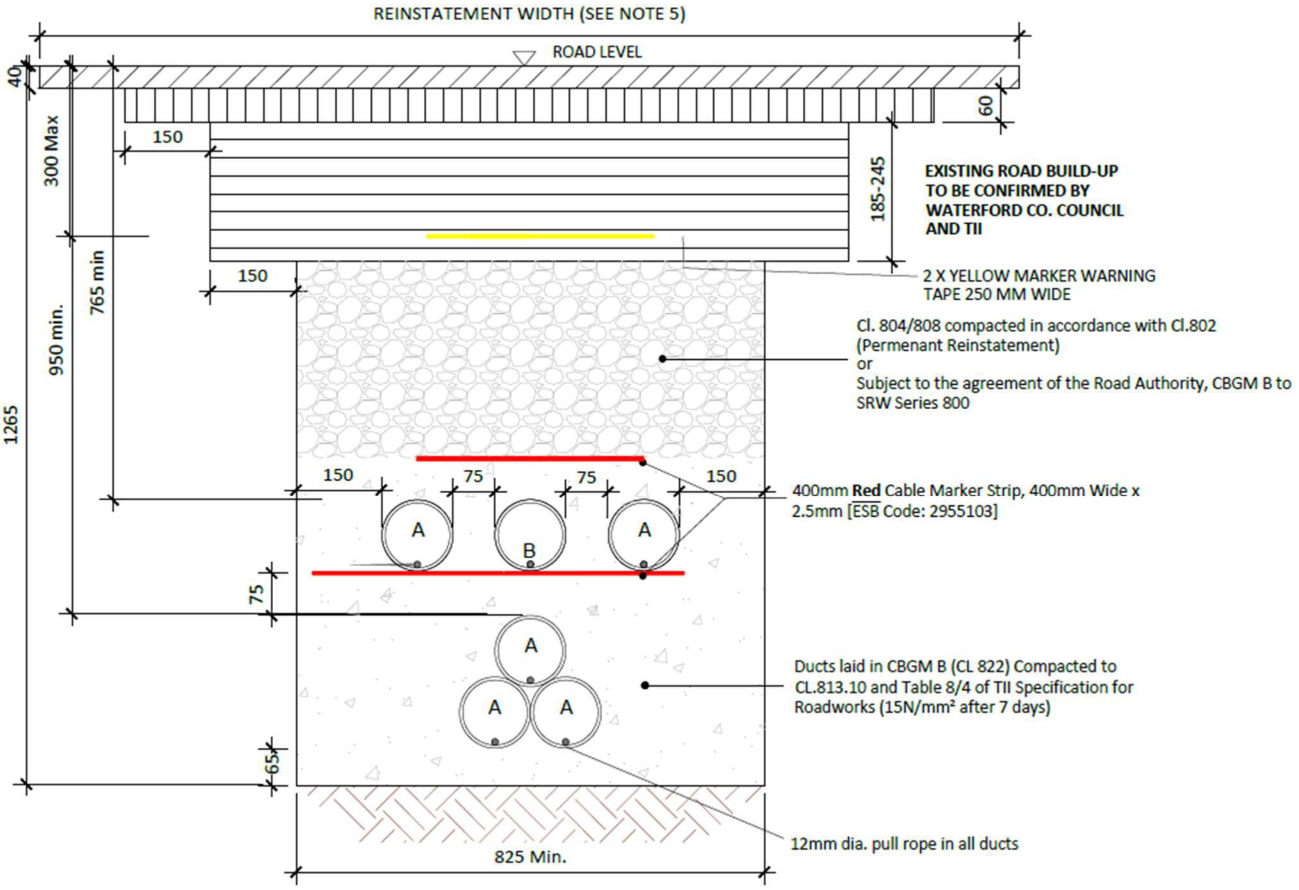
Figure 2 – Example of 110kV Underground Duct Installation

8.2 Ducting Installation Methodology

The trenching and ducting works will follow the step by step methodology below.

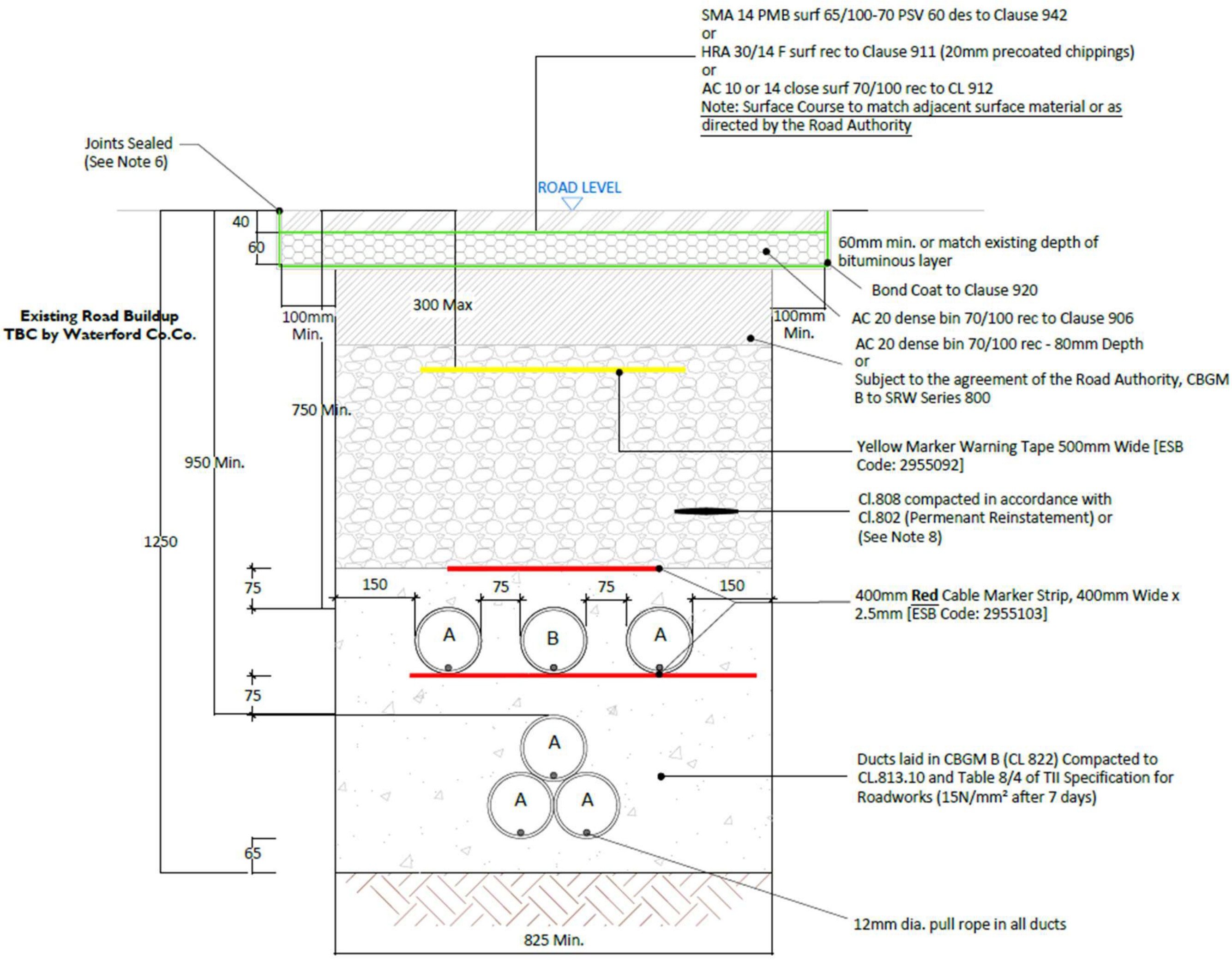
1. Grade, smooth and trim trench floor when the required 1,265mm depth and 825mm width have been obtained.
2. Place bedding layer of Cement Bound Granular Mixture B (CBGM B) material in accordance with its specification and compact it so that the compacted thickness is as per drawings.
3. Lay the bottom row of ducts in trefoil formation as detailed on design drawings. Use spacers as appropriate to establish horizontal duct spacing. Fit a secure cap / bung to the end of each duct run to prevent the ingress of dirt or water.
4. Carefully surround and cover ducts with CBGM B in accordance with the design drawings and specifications and thoroughly compact without damaging ducts.
5. Place cable protection strips on compacted CBGM B directly over the ducts.
6. Lay the top row of ducts onto the freshly compacted CBGM B including the cable protection strips above the bottom row of ducts. Place a secure cap at the end of each duct to prevent the ingress of dirt or water.
7. Carefully surround and cover ducts with CBGM B material in accordance with drawings and thoroughly compact without damaging ducts.
8. Place red cable protection strip on top of compacted CBGM B over each set of ducts as shown on the drawings.
9. Place and thoroughly compact CBGM B material or Clause 804 backfill, or soil backfill as specified and place warning tape at the depth shown on the drawings.
10. For concrete and asphalt/bitmac road sections, carry out immediate temporary/permanent reinstatement in accordance with the specification and to the approval of the local authority or landowner, unless otherwise agreed with local authorities *(Figure 3).*
11. For unsurfaced/grass sections, backfill with suitable excavated material to ground level leaving at least 100mm topsoil or match existing level at the top to allow for seeding or replace turves as per the specification of the local authority or landowner.

12. Clean and test the ducts in accordance with the specification by pulling through a brush and mandrel. Install 12mm polypropylene draw rope in each duct and seal all ducts using robust duct end seals fitted with rope attachment eyes in preparation for cable installation at a later date. All the works should be witnessed by an EirGrid Clerk of Works (CoW) as required.



A = 125mm: Outer Diameter HDPE Duct, SDR=17.6 (Power)
B = 125mm: Outer Diameter HDPE Duct, SDR=17.6 (Comms)

Figure 3 - 110kV Trefoil Trench in National Road



A = 125mm: Outer Diameter HDPE ESB Approved Duct, SDR=17.6 (Power) [ESB Code: 9317552]
B = 125mm: Outer Diameter HDPE ESB Approved Duct, SDR=17.6 (Comms) [ESB Code: 9317552]

Figure 4 – 110kV Trefoil Trench in Rural Roadway

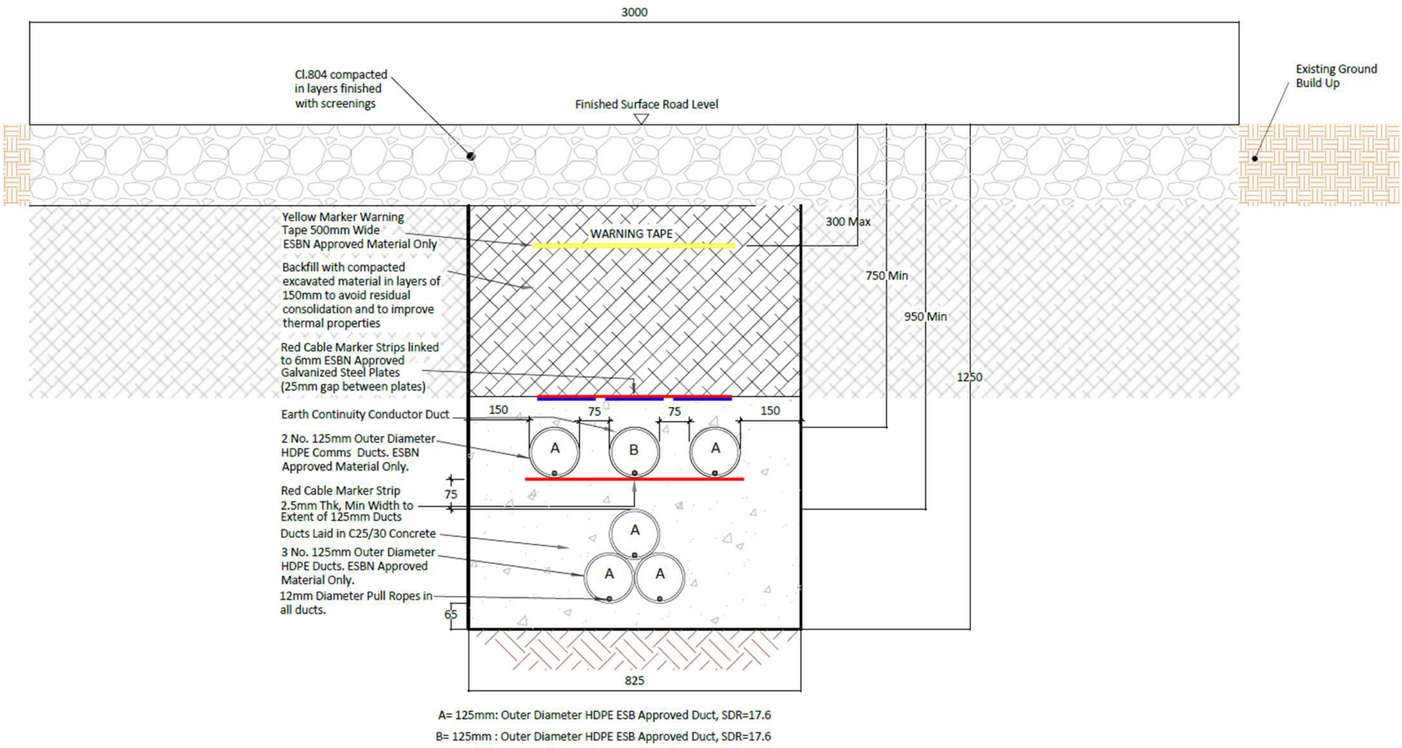


Figure 5 - Trench in Off Road Section

Equipment:

- 2-3 General Operatives;
- 1 Excavator Operator;
- 1 No. tracked excavator (only rubber tracked machines will be allowed on public roads);
- 1 No. dumper or tractor and trailer.

Materials:

- Sand for pipe bedding;
- Ready-mix Concrete where necessary (delivered to site);
- Trench backfilling material (excavated material and aggregates) to relevant specifications;
- 125mm diameter HDPE ducting;
- 125mm diameter HDPE ECC duct;
- Temporary Surface Reinstatement Materials;

8.2.1 UGC Installation within the public road

The majority of the 110kV route is located within public road and where applicable the trench will be installed in the non-trafficked strip between the typical vehicular wheel locations on the road. The cable will be micro-sited based on the presence of existing utilities and the nature of the road and the adjoining terrain. It is preferable to excavate a trench within the middle of the lane, or the middle of the roadway to reduce load on the cable.

8.3 Surface Cable Markers & Marker Posts

Surface cable markers will be placed along the route where the cable depth is unavoidably shallow due to constraints such as existing services. These cable markers will indicate the precise location of the UGC and will be metallic plates in accordance with ESBN and EirGrid standards.

Marker posts will be used on non-roadway routes to delineate the cable route and joint bay positions. Corrosion proof aluminium triangular danger sign, with a 700mm base, and with centred lightning symbol, on engineering grade fluorescent yellow background shall be installed in adequately sized concrete foundations. Marker post shall also be placed in the event that the cable burial depth is not standard. Siting of any marker posts will be agreed with EirGrid as part of the detailed design process *(Figure 5)*.

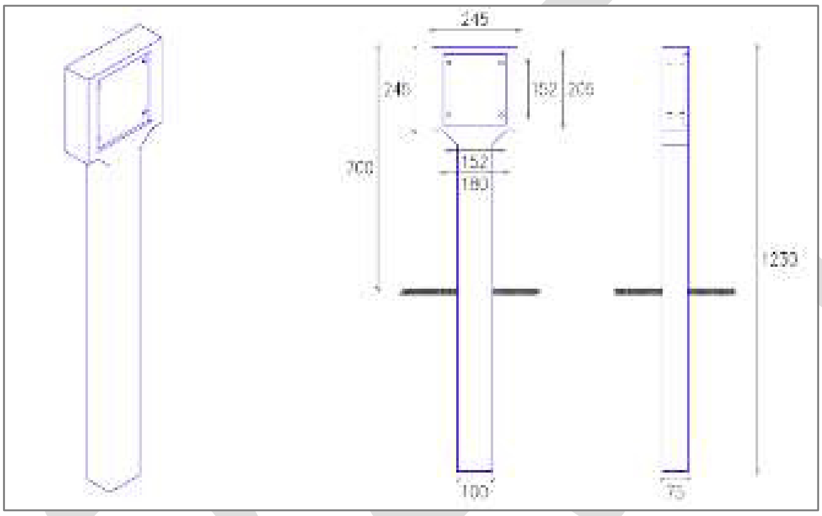


Figure 6 - EirGrid Marker Posts Example

8.4 Managing Excess Material from Trench

All excavated material will be temporarily stored adjacent to the trench prior to re-use in the trench reinstatement (where applicable). Stockpiles will be restricted to less than 2m in height. Excess material and excavated tar, etc. will be transported off site by an appropriately authorised waste collector and disposed of at an appropriately licenced waste facility.

8.5 Storage of Plant and Machinery

All plant, machinery and equipment will be stored on site within the UGC works area or within the temporary construction compound to be located at the proposed Dyrick Hill Wind Farm. Oils and fuels will be stored in an appropriately bunded area within the temporary construction compounds.

8.6 Joint Bays and Associated Chambers

Joints bays are to be installed approximately every 750m - 850m along the UGC route to facilitate the jointing of 3 No. lengths of UGC. Joint bays are approximately 2.5m x 6m x 1.75m pre-cast concrete structures installed below finished ground level. Joint bays will be located in the non-wheel bearing strip of roadways, however given the narrow profile of local roads this may not always be possible.

In association with joint bays, communication chambers are required at every joint bay location to facilitate communication links between the Dyrick Hill Wind Farm and the existing 110kV substation at Dungarvan. Earth sheath link chambers are only required at single point bonded sections along the cable route. Earth Sheath Links are used for earthing and bonding cable sheaths of underground power cables, so that the circulating currents and induced voltages are eliminated or reduced. Earth sheath link chambers and communication chambers are located in close proximity to joint bays. Earth sheath link chambers and communication chambers will be pre-cast concrete structures with an access cover at finished surface level.

The precise siting of all joint bays, earth sheath link chambers and communication chambers is subject to approval by EirGrid. Marker posts will be used on non-roadway routes to delineate the duct route and joint bay positions.

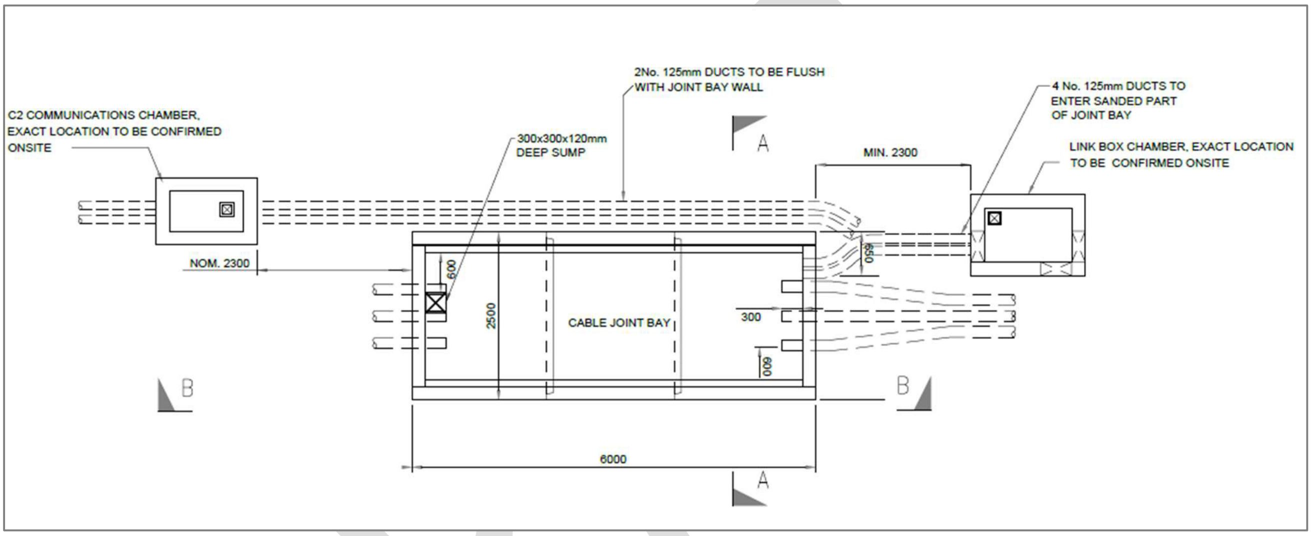


Figure 7 –110kV Joint Bay Plan Layout

8.7 Joint Bay Construction and Cable Installation

Before starting construction, the area around the edge of the joint bay which will be used by heavy vehicles will be surfaced with a terram cover (if required) and stone aggregate to minimise ground damage. Any roadside drains within the temporary works area will be culverted and check dams made from stone or sandbags covered with terram will be inserted upstream and downstream of these culverts to intercept any solids generated during the insertion or which wash out during the works. Silt fencing with straw bales will be interposed between the works area and any watercourses.

All excavated material will be stored near the excavations and reused for reinstatement works. Any soil required for reinstatement that will be temporarily stockpiled on site will be placed at least 15m back from the nearest watercourse on level ground and will be ringed at the base by silt fencing and be regularly monitored by a designated competent person for signs of solids escape. If necessary, an additional line of silt fencing with straw bales will be added in line with the relevant environmental control measures.

If the joint bay needs to be dewatered, this will be pumped to a percolation area if the soil is not saturated, otherwise a settlement tank will be used to remove any solids from the dewatering process to comply with the environmental control measures.

The following steps outline the methodology for joint bay construction and reinstatement:

1. The contractor will excavate a pit for joint bay construction, including for a sump in one corner.

2. Grade and smooth floor; then lay a 50mm depth of thick sand for pre-cast concrete construction on 200mm thick Clause 804 granular material.

3. Place pre-cast concrete sections on sand bedding. *(*Figure 8*)*

Figure 8 – Example of Joint Bay under construction (pre-cast)

4. Where joint bays are located under the road surface the joint bay will be backfilled with compacted layers of Clause 804 and the road surface temporarily reinstated as specified by the local authority.

5. For cable installation and jointing, the cable is supplied in pre-ordered lengths on large cable drums *(Figure 8).* Installing "one section" of cable normally involves pulling three individual conductors into three separate ducts. The cable pulling winch must be set at a predetermined cut off pulling tension as specified by the designer. The cable will be connected to the winch rope, using approved suitably sized and rated cable pulling stocking & swivel and a pulling head, fitted by the cable manufacturer**.** A sponge may also be secured to the winch rope to disperse lubricant through the duct. Lubrication is also applied to the cable in the joint bay before it enters the duct.


Figure 9 - HV cable pulling procedure (Drum set-up example)

6. Once the "two sections" of cable (total of 6 conductors) are pulled into the joint bay, a jointing container is positioned over the joint bay and the cable jointing procedure is carried out in this controlled environment. *(Figure 9)*


Figure 10 - HV cable jointing container

7. Following the completion of jointing and duct sealing works, place, and thoroughly compact cement-bound sand in the joint bay, in approximately 200mm layers to the level of the cable joint base to provide vertical support. Install additional layers of cement-bound sand and compact each layer until the cement-bound sand is level with the top of the joint. Install an additional 100mm cement-bound sand layer. Install cable protection strip. Backfill with cement-bound sand to a depth of 250mm below surface and carry out permanent reinstatement including placement of warning tape at 400mm depth below finished surface.

Equipment:

- 2-3 General Operatives
- 1 Excavator Operator
- 360˚ tracked excavator (13 ton normally, 22 ton for rock breaker)
- 1 No. tracked dumper or tractor and trailer

Materials:

- Sand for pipe bedding
- Clause 804 Material

- 160mm diameter HDPE ducting;
- 125mm diameter HDPE ducting;
- 63mm ECC Duct
- Precast Joint Bay Chamber Units
- Link Boxes & C2 Communication Chambers (precast)

9.0 Relocation of Existing Services

In order to facilitate the installation of the underground cable, it may be necessary to relocate existing underground services such as water mains or existing cables. In advance of any construction activity, the contractor will undertake detailed surveys and scans of the route to confirm the presence or otherwise of any services. If found to be present, the relevant service provider will be consulted in order to determine the requirement for specific excavation or relocation methods and to schedule a suitable time to carry out works.

9.1 HV Underground Cable (UGC) Crossings & Parallel Runs

As mentioned in Table 2 above there are a number of locations where the proposed UGC will have to cross other existing HV UGC routes. These crossing and parallel runs are most likely to occur in **Section 1** of the cable route surrounding the Dungarvan 110kV substation compound (see Table 2 for details)**.** Each individual crossing or parallel run will need to be individually assessed on a case-by-case basis. Site investigation works along with detailed surveying techniques and consultation with EirGrid/ESB will be required to determine the locations, depths, configurations, and ratings of any existing UGC routes.

A minimum separation distance between the cables will need to be adhered to in order to comply with EirGrid/ESB requirements. The EirGrid/ESB preferred undercrossing method will be used where possible. A crossing method can be seen in Figure 11 below. Where undercrossing of the existing UGC routes is not possible an overcrossing method will be used. All UGC crossings will need to be agreed with EirGrid/ESB as part of the design approval process. The UGC crossings have been designed in line with EirGrid/ESB specifications.

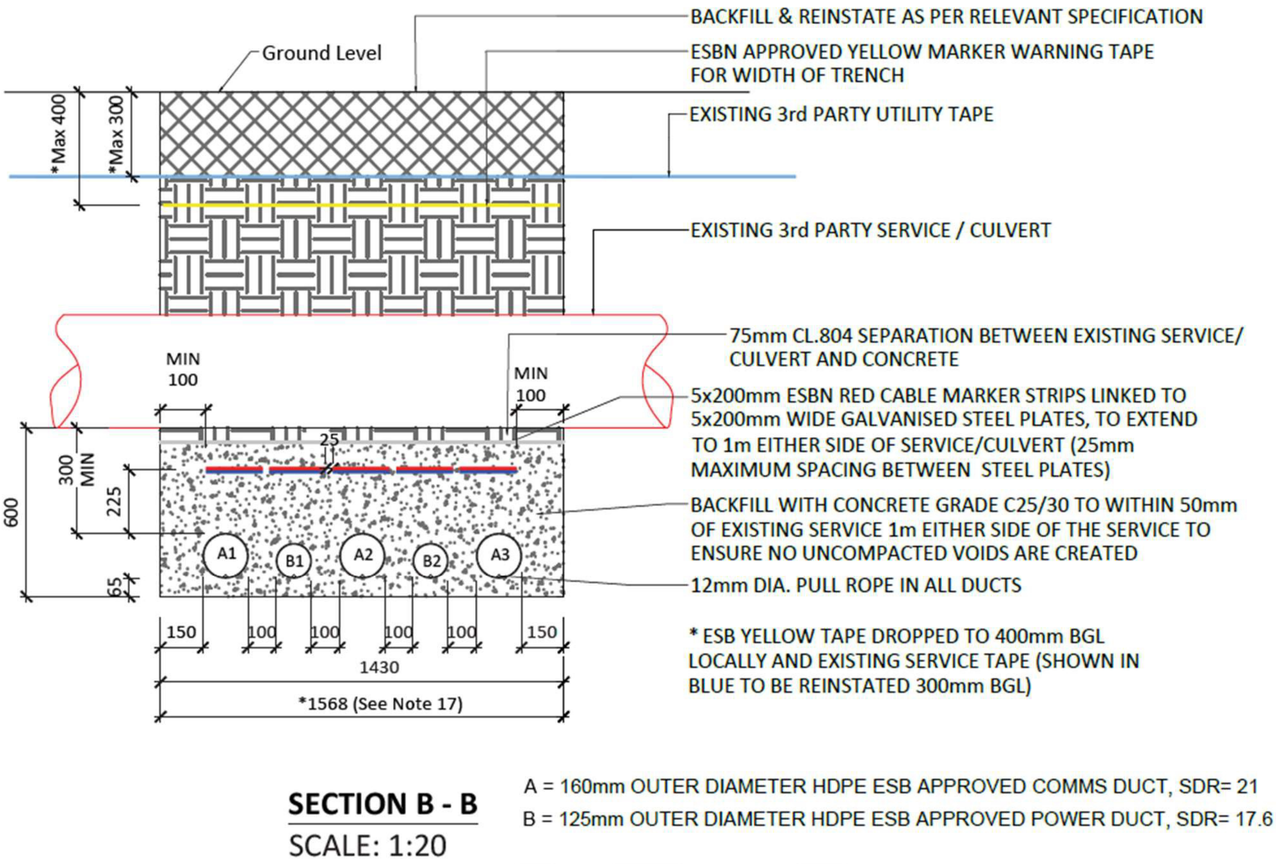


Figure 11 – Example of 110kV UGC Cable Undercrossing

9.2 Water Mains

Where conflict with existing watermains occurs, the water supply will be turned off by the utility so work can commence on diverting the service. The section of existing pipe will be removed and will be replaced with a new pipe along the new alignment of the service. The works will be carried out in accordance with the relevant utility standards.

10.0 Major Watercourse Crossings

The grid connection cable route includes 1 No. bridge crossings which will be completed using horizontal directional drilling (HDD) (refer to 11.0 below for further details). Where the cable route intersects with existing watercourses, a detailed construction method statement will need to be prepared by the Contractor prior to the commencement of construction and is to be approved by the Local Authority and relevant environmental agencies.

Minor watercourse crossing locations have been noted along the cable route in the form of culverts, pipe drains and minor field drains. Crossing of these existing culverts will be as per undercrossing or overcrossing methods, depending on the depth of the culvert or using open trenching. A detailed site survey of all culverts will need to be completed as part of the next phase of the project prior to construction. The culvert crossing methods are detailed in Figure 12 and Figure 13.

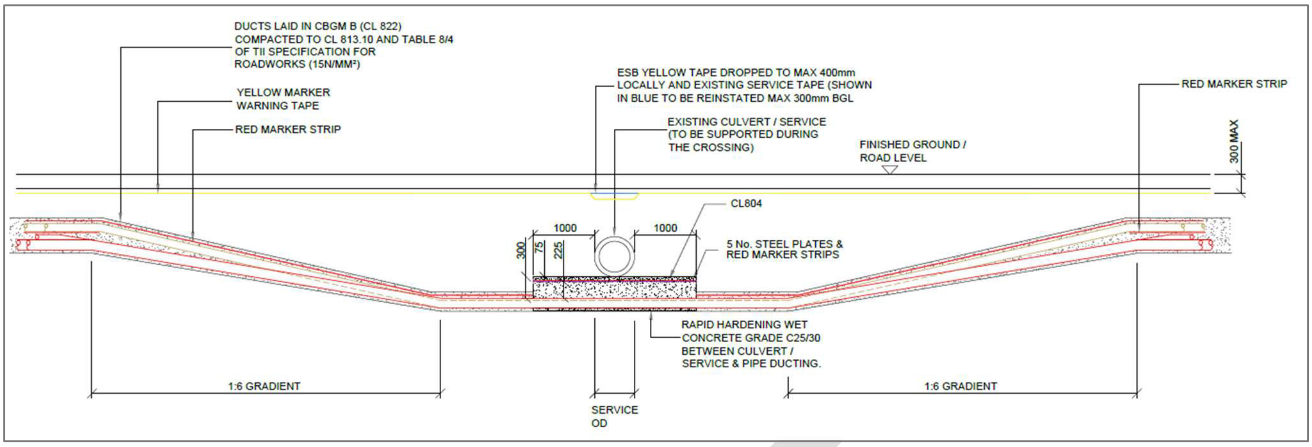


Figure 12 – 110kV UGC Culvert Undercrossing

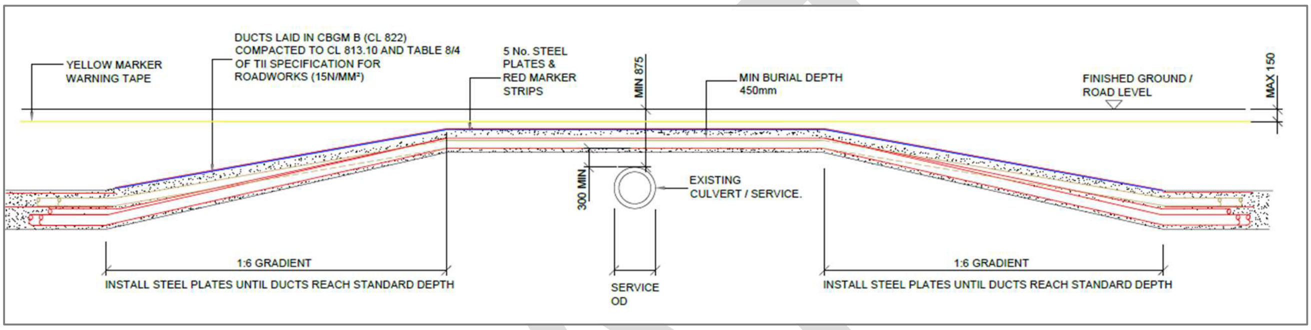


Figure 13 – 110kV UGC Culvert Overcrossing

Inland Fisheries Ireland have published guidelines relating to construction works along water bodies entitled ‘Requirements for the Protection of Fisheries Habitats during Construction and Development Works at River Sites”, and these guidelines will be adhered to during the construction of the development.

10.1 Watercourse 1 - Horizontal Directional Drilling (Colligan River)

ITM Coordinates: 623172.800, 595179.559

Bridge 1 has insufficient room to install the cable to ESB Networks and EirGrid specifications and the bridge is unsuitable to accommodate standard trenching. Horizontal directional drilling (HDD) will be implemented to bore approximately 1500mm beneath the waterway and bridge foundations. This depth is based on locating a suitable clay/silt formation for HDD and the required depth may increase subject to geotechnical investigations. Drilling will take place from the road carriageway**.** The methodology for HDD is outlined in Section 11.0 below. Transport Infrastructure Ireland engagements???

Figure 15 - Watercourse 1 Location within L7112

Figure 14 - Watercourse 1 superimposed on OSI

10.2 Watercourse 2 - Horizontal Directional Drilling (Ballykerin Stream)

ITM Coordinates: 619480.2853, 601537.8463

Watercourse 2 is a watercourse crossing located off road within private lands. Horizontal directional drilling (HDD) will be implemented to bore approximately 1500mm beneath the waterway. This depth is based on locating a suitable clay/silt formation for HDD and the required depth may increase subject to geotechnical investigations. Drilling will take place all within the privately owned lands**.** The methodology for HDD is outlined in Section 11.0 below.

Figure 16 - Watercourse 2 Crossing

Figure 17 - Watercourse 2 Crossing superimposed on OSI

10.3 Watercourse 3 - Horizontal Directional Drilling (Finisk River)

ITM Coordinates: 617224.7080, 601253.4596

Bridge 3 has insufficient room to install the cable to ESB Networks and EirGrid specifications and the bridge is unsuitable to accommodate standard trenching. Horizontal directional drilling (HDD) will be implemented to bore approximately 1500mm beneath the waterway to the north of the bridge structure. This depth is based on locating a suitable clay/silt formation for HDD and the required depth may increase subject to geotechnical investigations. Drilling will take place away from the road carriageway, utilising a corridor through private lands**.** The methodology for HDD is outlined in Section 11.0 below.

Figure 18 - Watercourse 3

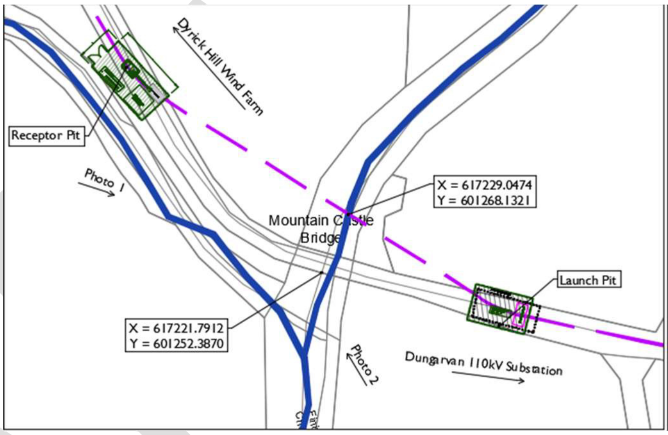


Figure 19 - Watercourse 3 superimposed on OSI

11.0 Horizontal Direction Drilling (HDD)

Horizontal Direction Drilling (HDD) is a method of drilling under obstacles such as bridges, railways, water courses, etc. in order to install cable ducts under the obstacle. This method is employed where installing the ducts using standard installation methods is not possible. There are two bridges on this UGC route which will require HDD due to insufficient cover and depth in the bridge to cross within the bridge deck.

The drilling methodology is as follows:

- A works area of circa. 150m^2 will be fenced on both sides of the river crossing, all within the road corridor.
- The drilling rig and fluid handling units will be located on one side of the bridge and will be stored on double bunded 0.5mm PVC bunds which will contain any fluid spills and storm water run-off.
- Entry and exit pits (1m x 1m x 2m) will be excavated using an excavator. The excavated material will be temporarily stored within the works area and used for reinstatement or disposed of to a licensed facility.
- A 1m x 1m x 2m steel box will be placed in each pit. This box will contain any drilling fluid returns from the borehole.
- The HDD pilot bore will be undertaken using a wireline guidance system. Assembly will be set up by the drilling team and steering engineer.
- The pilot bore will be drilled to the pre-determined profile and alignment under the watercourse crossings.
- The steering engineer and drill team will monitor the drilling works to ensure that modelled stresses and pressures are not exceeded.

- The drilled cuttings will be flushed back by drilling fluid to the entry and exist pits and re-cycled for re-use.
- Once the first pilot hole has been completed a hole-opener or back reamer will be fitted in the exit side which will then be pulled back to the entry side as part of the pre-reaming/hole opening process to enlarge the hole to the correct size.
- When the pre-reaming/hole opening/hole cleaning has been completed, a reamer of slightly smaller diameter than the final cut will be installed on the drill string to which the ducts will be attached for installation. The steel boxes will be removed, with the drilling fluid disposed of to a licensed facility.
- The ducts will be cleaned and proven, and their installed location surveyed.
- The entry and exit pits will be reinstated to the specification of ESB Networks, EirGrid and Waterford County Council.
- A joint bay/transition coupler/ transition chamber will be installed at either side of the bridge following the horizontal directional drilling as per EirGrid requirements, this will join the HDD ducts to the standard ducts.

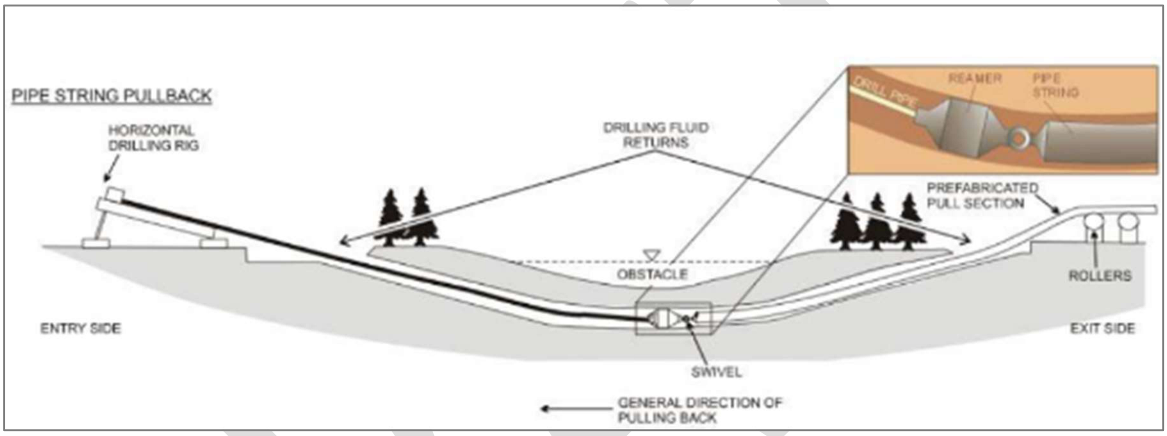


Figure 20 - Example of HDD Installation

12.0 Reinstatement of Private Land

Once all construction works are complete, the works areas on private lands will be reinstated with excavated soil and either seeded out with native species, allowed to vegetate naturally, or reinstated with excavated grass turves and will be restored to their original condition. This work will be carried out in consultation with the landowner and in line with any relevant measures outlined in the planning application, CEMP, and planning conditions.

13.0 Best Practice Design and Construction & Environmental Management Methodology

Prior to commencement of construction works the contractor will draw up detailed method statements which will be informed by this Outline Construction Methodology, environmental protection measures included within the planning application, measures within the CEMP, and the guidance documents and best practice measures listed below. This method statement will be adhered to by the contractors and will be overseen by the Project Manager, Environmental Manager and Ecological Clerk of Works (ECoW) where relevant.

The following documents will contribute to the preparation of the method statements in addition to those measures below: -

- Inland Fisheries Ireland (2016) *Guidelines on Protection of Fisheries during Construction Works in and Adjacent to Waters*. Inland Fisheries Ireland*, Dublin,*
- National Roads Authority (2008) *Guidelines for the Crossing of Watercourses during the Construction of National Road Schemes*. National Roads Authority, Dublin;
- E. Murnane, A. Heap and A. Swain. (2006) *Control of water pollution from linear construction projects.* Technical guidance (C648). CIRIA;
- E. Murnane et al., (2006) *Control of water pollution from linear construction projects*. Site guide (C649). CIRIA.
- Murphy, D. (2004) *Requirements for the Protection of Fisheries Habitat during Construction and Development Works at River Sites. Eastern Regional Fisheries Board, Dublin;*
- H. Masters-Williams et al (2001) *Control of water pollution from construction sites. Guidance for consultants and contractors* (C532);
- Enterprise Ireland (unknown). *Best Practice Guide (BPGCS005) Oil storage guidelines;*
- Law, C. and D'Aleo, S. (2016) *Environmental good practice on site pocket book*. (C762) 4th edition. CIRIA;
- CIRIA *Environmental Good Practice on Site (fourth edition) (C741) 2015*.

The works will be carried out by employing accepted best working practices during construction, including the environmental management measures listed below. Please note that the following measures will be supplemented by further specific environmental protection measures that will be included in method statements prepared for specific tasks during the works and will form part of the detailed CEMP.

- All materials shall be stored at the temporary compound within the Dyrick Hill Wind Farm site and transported to the works zone immediately prior to construction;
- Weather conditions will be considered when planning construction activities to minimise risk of run off from site;
- Provision of 50m exclusion zones and barriers (silt fences) between any excavated material and any surface water features to prevent sediment washing into the receiving water environment;
- If dewatering is required as part of the works e.g. in trenches for underground cabling or in wet areas, water must be treated prior to discharge;
- The contractor shall ensure that silt fences are regularly inspected and maintained during the construction phase;
- If very wet ground must be accessed during the construction process bog mats/aluminium panel tracks will be used to enable access to these areas by machinery. However, works will be scheduled to minimise access requirements during winter months;

- The contractor shall ensure that all personnel working on site are trained in pollution incident control response. A regular review of weather forecasts of heavy rainfall is required, with the Contractor required to prepare a contingency plan for before and after such events;
- The contractor will carry out visual examinations of local watercourses from the works during the construction phase to ensure that sediment is not above baseline conditions. In the unlikely event of water quality concerns, the Environmental Manager and ECoW will be consulted;
- Excavations will be left open for minimal periods to avoid acting as a conduit for surface water flows.
- Only emergency breakdown maintenance will be carried out on site. Emergency procedures and spillage kits will be available and construction staff will be familiar with emergency procedures.
- Appropriate containment facilities will be provided to ensure that any spills from vehicles are contained and removed off site. Adequate stocks of absorbent materials, such as sand or commercially available spill kits shall be available;
- Concrete or concrete contaminated water run-off will not be allowed to enter any watercourses. Any pouring of concrete (delivered to site ready mixed) will only be carried out in dry weather. Washout of concrete trucks shall be strictly confined to a designated and controlled wash-out area within the temporary construction compound at the substation site, remote from watercourses, drainage channels and other surface water features;
- A designated trained operator experienced in working with concrete will be employed during the concrete pouring phase;
- Concrete wastewater can be pumped into a skip to settle out; settled solids will need to be appropriately disposed of off-site;
- Wash-down water from exposed concrete surfaces will be trapped to allow sediment to settle out and reach neutral pH before clarified water is released to the drain system or allowed to percolate into the ground;
- Where dust suppression is considered to be required by the Contractor, such requirements and methodology shall be subject to the agreement with the Ecological Clerk of Works;
- Entry by plant equipment, machinery, vehicles and construction personnel into watercourses or wet drainage ditches shall not be permitted. All routes used for construction traffic shall be protected against migration of soil or waste water into watercourses;
- Cabins, containers, workshops, plant, materials storage, and storage tanks shall not be located near any surface water channels and will be located beyond the 50m hydrological buffer at all times.

The following mitigation measures will be undertaken specifically with regard to horizontal directional drilling:

- A geotechnical assessment shall be carried out prior to horizontal directional drilling and drilling shall only be carried out at locations where conditions are suitable for the control of drilling materials.
- All works will be supervised by a qualified environmental engineer.
- No works will be undertaken near the river corridor or river banks. Reception and launch pits for the directional drilling process shall be excavated a minimum of 20m from the stream banks.
- No construction activity will take place in riparian areas. Stockpiling of construction materials, refuelling of machinery and overnight parking will take place elsewhere in the temporary compound near the proposed substation. Concrete truck chute cleaning will take place in a separate appropriate location.
- The area around the bentonite batching, pumping, and recycling plants shall be bunded using terram and sandbags in order to contain any spillages.
- Silt fencing will be erected 5m from the reception and launch pits used for directional drilling.

- Horizontal directional drilling works shall not take place at periods of high rainfall and shall be scaled back or suspended if heavy rain is forecast.

14.0 Invasive Species Best Practice Measures

Invasive species can be introduced into a location by contaminated plant, machinery and equipment which were previously used in locations that contained invasive species. Good site organisation and hygiene management shall be maintained always on site, and best practice measures will be implemented, as follows:

- The contractor will prepare an Invasive Species Action Plan to be implemented during construction, and all personnel will be made aware of the requirements contained within;
- Plant and machinery will be inspected upon arrival and departure from site and cleaned/washed as necessary to prevent the spread of invasive aquatic / riparian species such as Japanese knotweed *Fallopia japonica* and Himalayan Balsam *Impatiens glandulifera*. A sign off sheet will be maintained by the contractor to confirm the implementation of measures;
- Site hygiene signage will be erected in relation to the management of non-native invasive material.

15.0 Waste Management

All waste arising during the construction phase will be managed and disposed of in a way that ensures the provisions of the Waste Management Act 1996 and associated amendments and regulations and the Waste Management Plan. Soil will be reinstated into trenches where possible. In the event there is excess material with no defined purpose, it will be transported to an authorised soil recovery site.

Instruction

Technical Lead: Andrew Foley - TLI Group

Date of Writing: 02.09.22

Scope of Note: 110kV Cable Rating Check

Documents & Data Issued for Review: n/a

Overview

TLI Group ("the Consultant") were engaged by EM Power ("the Client") on the development of Dyrick Hill Windfarm in Co. Waterford. The Consultant was engaged to assist the Client in selecting and preparing a planning application for the associated 110kV underground cable.

The grid connection will be a 110kV connection to the EirGrid 110kV Dungarvan Substation. The connected to the windfarm substation using a single circuit 110kV underground cable (UGC) circuit (approximate length 16.01km). The cable route and associated trench designs required for the cable route will be capable of achieving the required rating as required by the Dyrick Hill Wind Farm (74.4 MV Summer/Winter Rating). In order to meet the required maximum rating for this connection the developer may install 1000mm^2 Al XLPE cable or 1000mm^2 Cu XLPE cable for the cable circuit. The Client is currently working on the development of the windfarm and have indicated that the Maximum Export Capacity (MEC) of the windfarm will be 74.4MW.

This cable rating check was completed to assess the suitability of the cable size and cable trench designs for the 110kV UGC grid connection circuit.

The cable ratings check which have been completed as part of this study include:

- Standard Trefoil Trench Design
- Flat Formation Trench Design
- Horizontal Directional Drill Trench Design (3000mm depth)
- Flat Formation, Perpendicular (90°) Undercrossing Existing UGC Trench

Cable Study Parameters	
Cable Size:	1000mm^2 Al Cable /1000mm^2 Cu Cable
Nominal Voltage:	110kV *(Range 105kV to 120kV)*
Power:	68.8 *(As specified by Client)*
Power Factor:	0.95 assumed *(Range 0.85 lag to 0.93 lead)*
Avg. Cable Section Length:	750m *(trefoil), 50m (flat), 100m (HDD), 10m (flat, undercrossing)*
Cable Trench Design:	See Appendix A, B, C, & D
Ambient Temp (Soil)	20˚C /10 ˚C *(Summer/Winter rating)*
Soil Thermal Resistivity	1.2/1.0 Km/W *(Summer/Winter rating)*
Backfill Thermal Resistivity	1/0.85 Km/W *(Summer/Winter rating)*
Bentonite Thermal Resistivity	1.25 Km/W
Cable Screen Bonding:	Cross bonded
Power Duct Size:	125mm Standard

Table 1 - Cable Study General Parameters

Cable Rating Check Results

1000mm^2 Al Cable - 110kV Standard Trefoil Trench (Depth 950mm) Design:

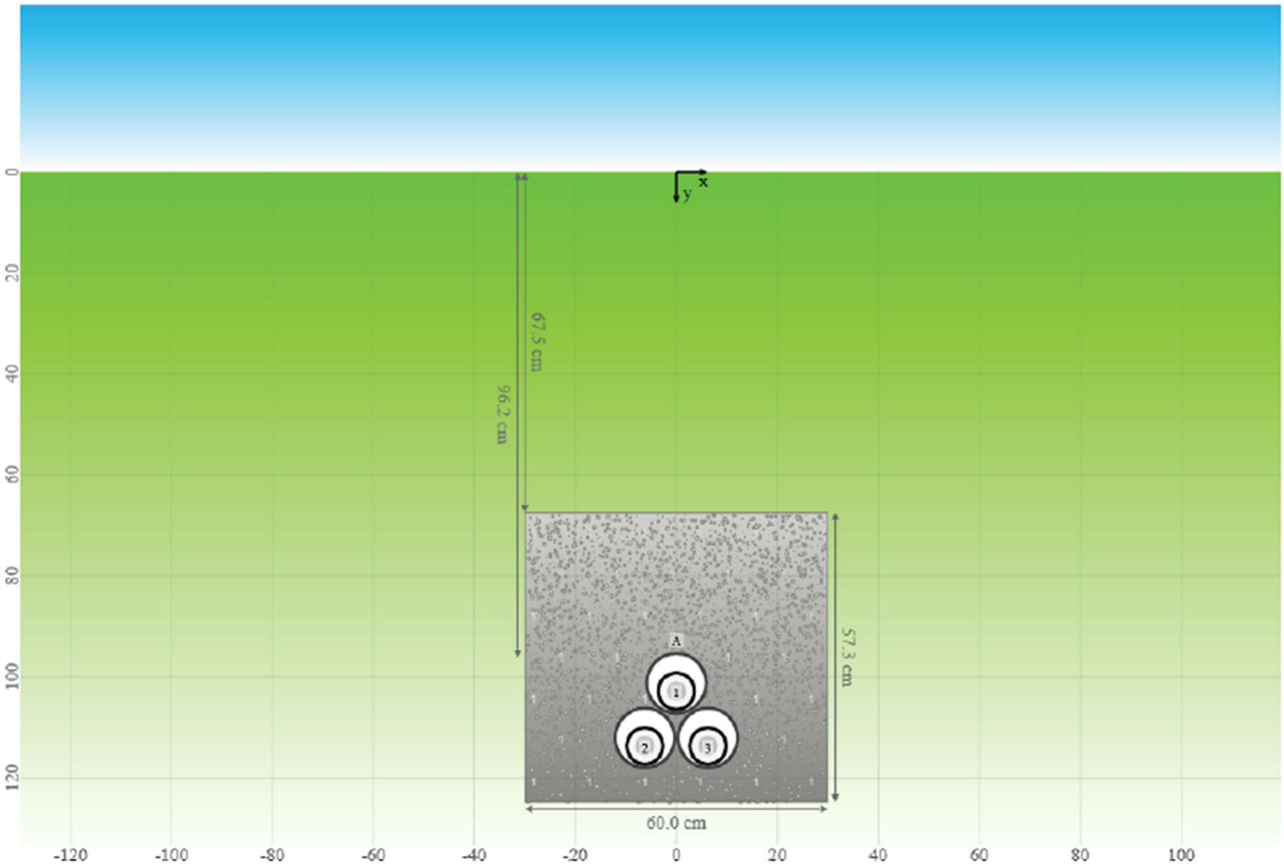
A cable rating study was completed for a **1000mm² Al XLPE (110kV) UGC** using the **standard trefoil trench design in 125mm ducts** as detailed in Appendix A. Using this arrangement, the cable circuit is capable of carrying a maximum full load current of **959A (153.20MW)**, see Table 2 below. Therefore, 1000mm² Al XLPE (110kV) UGC when installed using the standard trefoil trench design the circuit is capable of achieving the required summer maximum rating (74.4MW), see Table 2 below.

Rating Sheet Ref	Season	Ambient Temp (˚C)	Duct Spacing (mm)	Duct Depth (mm)	Rated MW	Rated Current	MW Loading	Loading Capacity
NKT 1000 Al - Standard Trefoil 125D-CB-Summer	Summer	20	-	950	153.20	847	68.8	45%
NKT 1000 Al - Standard Trefoil 125D-CB-Winter	Winter	10	-	950	173.50	959	74.4	43%

Table 2 - 1000mm^2 Al, Standard Trench Design

Statistics

Number of iterations of the solver	N_{calc}	5
Sum of currents from all systems	I_{sum}	846.6 A
Sum of average conductor temperatures from all systems	θ_{sum}	89.7 °C
Number of overheated electrical systems		0
Sum of losses from all systems	W_{sum}	86.96 W/m



Systems

Following systems are active in the arrangement:

System	Object	Current I_c [A]	max Temp. θ_c | θ_e (θ_{de}) [°C]	Losses W_{sys} [W/m]
System A	NKT 1000mm2 Al XLPE (110kV) - Copper Sheath -T1052	846.6	90.0 | 79.4 (67.8)	87.0

Figure 1 - Cable Rating Model, Standard Trench Design, 1000mm^2 Al

1000mm² Cu Cable - 110kV Standard Trefoil Trench (Depth 950mm) Design:

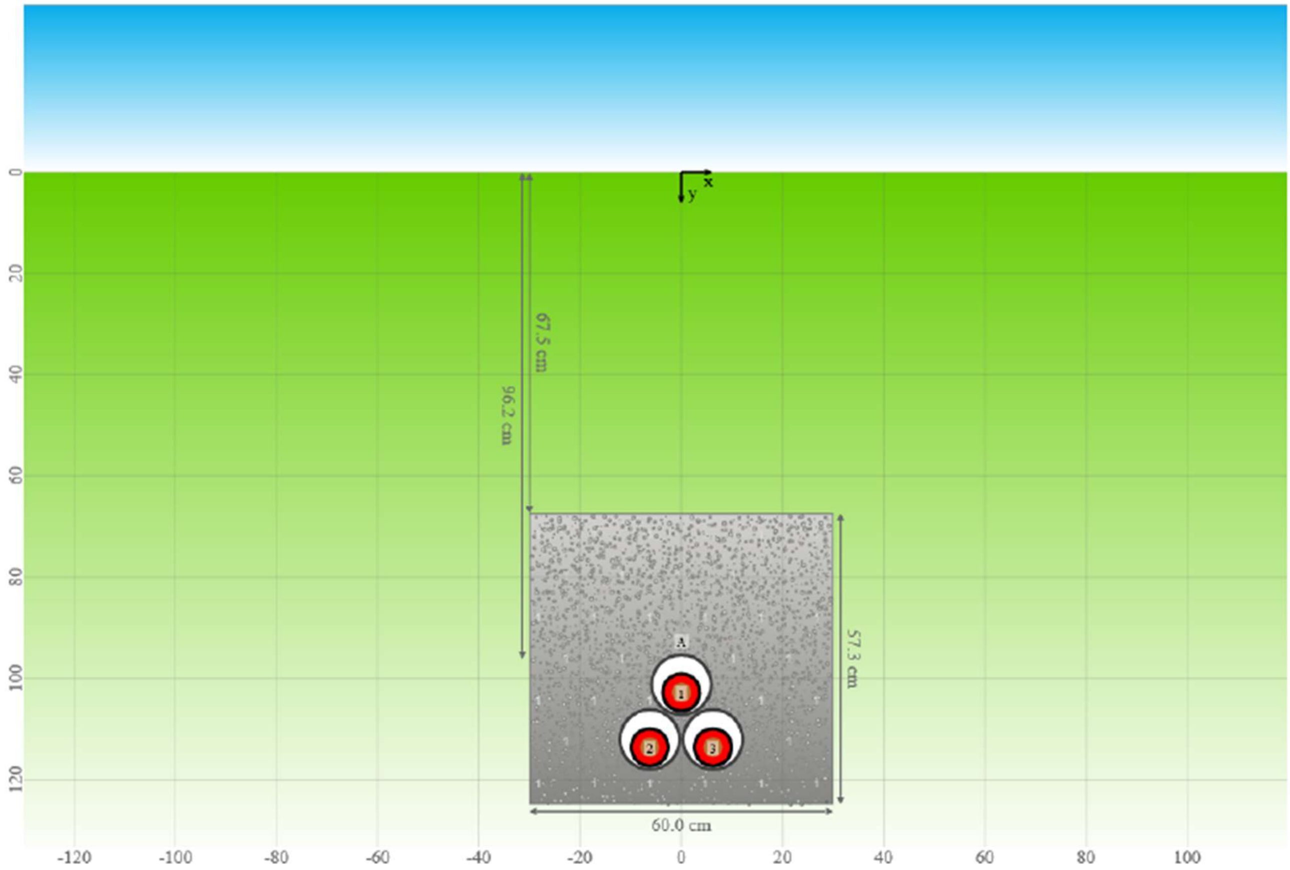
A cable rating study was completed for a **1000mm² Cu XLPE (110kV) UGC** using the **standard trefoil trench design in 125mm ducts** as detailed in Appendix A. Using this arrangement, the cable circuit is capable of carrying a maximum full load current of **1134A (205.20MW)**, see Table 2 below. Therefore, 1000mm² Cu XLPE (110kV) UGC when installed using the standard trefoil trench design the circuit is capable of achieving the required summer maximum rating (74.4MW), see Table 2 below.

Rating Sheet Ref	Season	Ambient Temp (°C)	Duct Spacing (mm)	Duct Depth (mm)	Rated MW	Rated Current	MW Loading	Loading Capacity
NKT 1000 Cu - Standard Trefoil 125D-CB-Summer	Summer	20	-	950	181.10	1001	74.4	41%
NKT 1000 Cu - Standard Trefoil 125D-CB-Winter	Winter	10	-	950	205.20	1134	74.4	36%

Table 3 - 1000mm² Al, Standard Trench Design

Statistics

Number of iterations of the solver	N_{calc}	5
Sum of currents from all systems	I_{sum}	1000.7 A
Sum of average conductor temperatures from all systems	θ_{sum}	89.7 °C
Number of overheated electrical systems		0
Sum of losses from all systems	W_{sum}	87.901 W/m



Systems

Following systems are active in the arrangement:

System	Object	Current I_c [A]	max Temp. θ_c | θ_e (θ_{de}) [°C]	Losses W_{sys} [W/m]
System A	NKT 1000mm2 Cu XLPE (110kV) - TDE2056a	1000.7	90.0 | 79.8 (68.3)	87.9

Figure 2 - Cable Rating Model, Standard Trench Design, 1000mm2 Cu

1000mm² Al Cable - 110kV Flat Formation (450mm) Design*:*

A cable rating study was completed for **1000mm² AL XLPE (110kV) UGC** over a distance of 50m using the **flat formation trench design with 125mm ducts** as detailed in Appendix B, this arrangement uses a spacing of 325mm between power ducts. Using this arrangement, the cable circuit is capable is capable of achieving the required summer maximum rating (74.4MV), see Table 3 below.

Rating Sheet Ref	Season	Ambient Temp (˚C)	Duct Spacing (mm)	Duct Depth (mm)	Rated MW	Rated Current	MW Loading	Loading Capacity
NKT 1000 Al - Flat125D-CB-Summer	Summer	20	325	450	194.60	1075	74.4	38%
NKT 1000 Al - Flat 125D-CB-Winter	Winter	10	325	450	215.20	1189	74.4	35%

Table 4 - 1600mm² Al, Flat Formation Trench, 450mm depth, 325mm spacing

1000mm² Cu Cable - 110kV Flat Formation (450mm) Design*:*

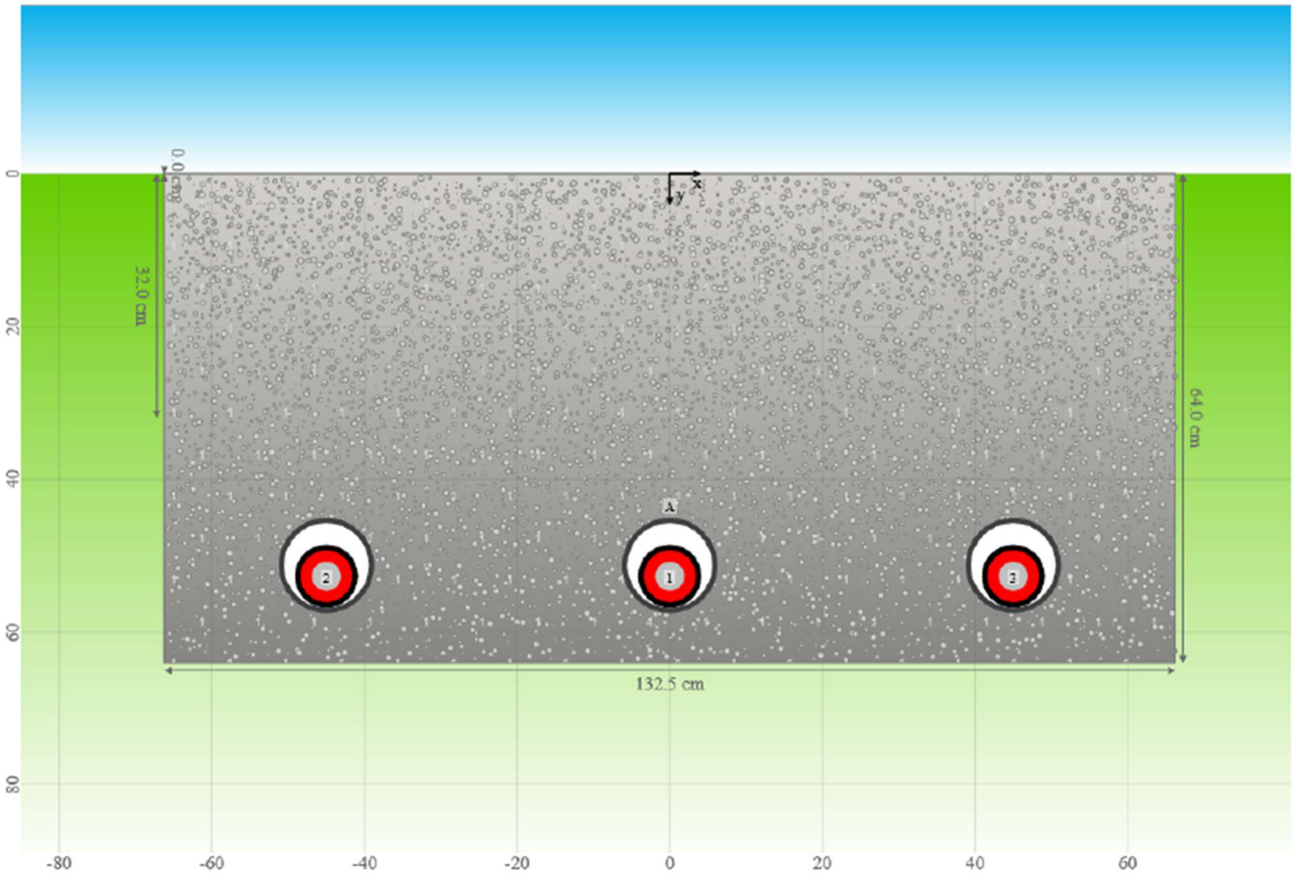
A cable rating study was completed for **1000mm² Cu XLPE (110kV) UGC** over a distance of 50m using the **flat formation trench design with 125mm ducts** as detailed in Appendix B, this arrangement uses a spacing of 325mm between power ducts. Using this arrangement, the cable circuit is capable is capable of achieving the required summer maximum rating (74.4MV), see Table 3 below.

Rating Sheet Ref	Season	Ambient Temp (˚C)	Duct Spacing (mm)	Duct Depth (mm)	Rated MW	Rated Current	MW Loading	Loading Capacity
NKT 1000 Cu - Flat 125D-CB-Summer	Summer	20	325	450	240.00	1326	74.4	31%
NKT 1000 Cu - Flat 125D-CB-Winter	Winter	10	325	450	265.50	1467	74.4	28%

Table 5 - 1000mm² Al, Flat Formation Trench, 450mm depth, 325mm spacing

Statistics

Number of iterations of the solver	N_{calc}	5
Sum of currents from all systems	I_{sum}	1075 A
Sum of average conductor temperatures from all systems	θ_{sum}	87.3 °C
Number of overheated electrical systems		0
Sum of losses from all systems	W_{sum}	136.836 W/m



Systems

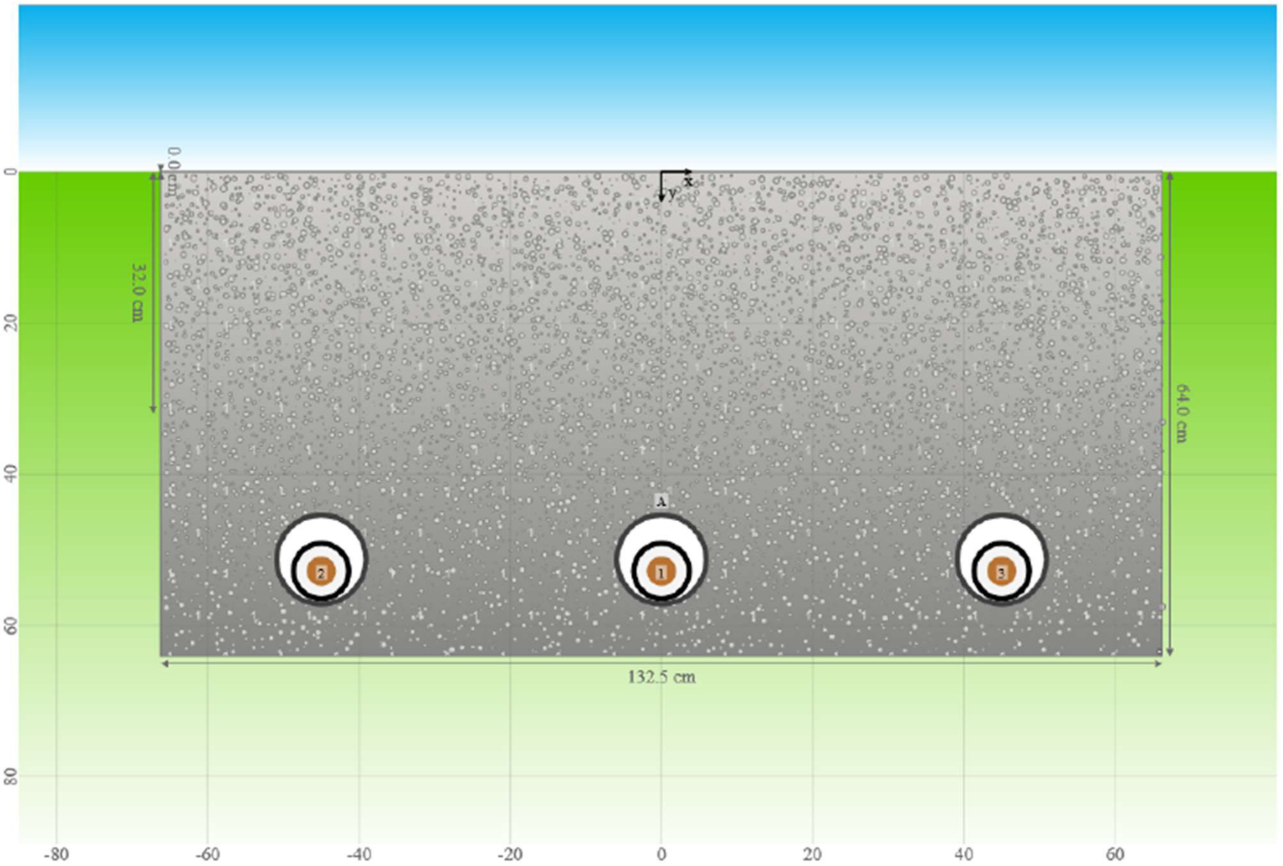
Following systems are active in the arrangement:

System	Object	Current I_c [A]	max Temp. θ_c | θ_e (θ_{de}) [°C]	Losses W_{sys} [W/m]
System A	NKT 1000mm2 Al XLPE (110kV) - Al Wire Scrn (2020)	1075.0	90.0 | 72.3 (53.8)	136.8

Figure 3 - Cable Rating Model, Flat Formation Trench, 1000mm^2 Al, 450mm depth, 325mm spacing, summer

Statistics

Number of iterations of the solver	N_{calc}	5
Sum of currents from all systems	I_{sum}	1325.9 A
Sum of average conductor temperatures from all systems	θ_{sum}	87 °C
Number of overheated electrical systems		0
Sum of losses from all systems	W_{sum}	136.945 W/m



Systems

Following systems are active in the arrangement:

System	Object	Current I_c [A]	max Temp. θ_c | θ_e (θ_{de}) [°C]	Losses W_{sys} [W/m]
System A	NKT 1000mm2 Cu XLPE (110kV) - TDE2056a	1325.9	90.0 | 73.0 (54.0)	136.9

Figure 4-Cable Rating Model, Flat Formation Trench, 1000mm2 Cu, 450mm depth, 325mm spacing, summer

Horizontal Directional Drill (HDD) - Trefoil Formation (Depth 3000mm):

A cable rating study was completed for a **1000mm² AL XLPE (110kV) UGC** over a distance of 100m utilising a HDD in a trefoil formation, at a **depth of 3000mm.** It should be noted that the HDD crossings a larger duct size of 140mm was used. This can be seen from Table 4 below.

Rating Sheet Ref	Season	Ambient Temp (°C)	Duct Spacing (mm)	Duct Depth (mm)	Rated MW	Rated Current	MW Loading	Loading Capacity
NKT 1000 Al - HDD Trefoil 3000mm 140D-CB-Summer	Summer	20	-	3000	135.10	747	74.4	55%

Table 6 – HDD Trefoil Options, Using 1000mm² Al Cable in 140mm Ducts

A cable rating study was completed for a **1000mm² Cu XLPE (110kV) UGC** over a distance of 100m utilising a HDD in a trefoil formation, at a **depth of 3000mm.** It should be noted that the HDD crossings a larger duct size of 140mm was used. This can be seen from Table 4 below.

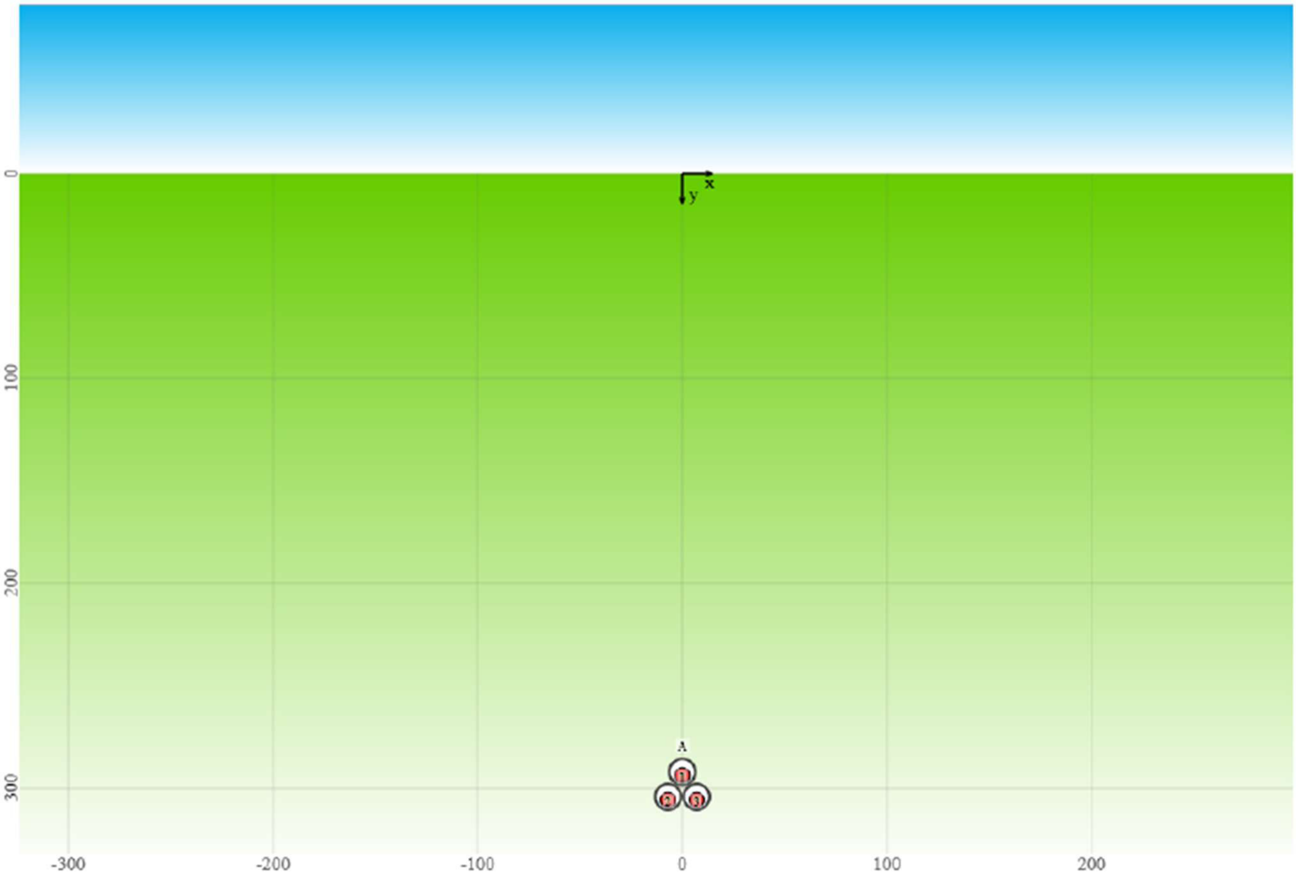
Rating Sheet Ref	Season	Ambient Temp (°C)	Duct Spacing (mm)	Duct Depth (mm)	Rated MW	Rated Current	MW Loading	Loading Capacity
NKT 1000 Cu - HDD Trefoil 3000mm 140D-CB-Summer	Summer	20	-	3000	161.10	890	74.4	46%

Table 7 – HDD Trefoil Options, Using 1000mm² Cu Cable in 140mm Ducts

It can be seen that both the 1000mm² Al and the 100mm² Cu cables can achieve the required rating.

Statistics

Number of iterations of the solver	N_{calc}	5
Sum of currents from all systems	I_{sum}	889.8 A
Sum of average conductor temperatures from all systems	θ_{sum}	89.9 °C
Number of overheated electrical systems		0
Sum of losses from all systems	W_{sum}	68.172 W/m



Systems

Following systems are active in the arrangement:

System	Object	Current I_c [A]	max Temp. θ_c | θ_e (θ_{de}) [°C]	Losses W_{sys} [W/m]
System A	NKT 1000mm2 Cu XLPE (110kV) - TDE2056a	889.8	90.0 | 82.0 (72.0)	68.2

Figure 5 - Cable Rating Model, HDD Trefoil, 1600mm^2 Cu, 3000mm depth, summer

Cable Study Results Summary

The results from the initial cable rating checks indicate that the use of either 1000mm^2 Al cable or 1000mm^2 Cu cable for the project is sufficient to carry the maximum 74.4MV maximum rating without exceeding the proposed recommended maximum conductor temperature of 90˚C.

Dyrick Hill WF - 110kV Grid Connection

Cable Rating Study Results
1000mm2 Al XLPE Cable - 1000mm2 Cu XLPE

Rev-00 (02.09.22)
Cable Rating Study Results

Rating Sheet Ref	Season	Ambient Temp (˚C)	Backfill Res. (K.m/W)	Soil Res. (K.m/W)	Duct Config.	Duct Spacing (mm)	Duct Depth (mm)	Rated MW	Rated Current (A)	Actual Current (A)	Loading MW (MEC)	Loading Capacity
NKT 1000 Al - Standard Trefoil 125D-CB-Summer	Summer	20	1	1.2	Trefoil 125mm	-	950	153.20	847	680	68.8	45%
NKT 1000 Al - Standard Trefoil 125D-CB-Winter	Winter	10	0.85	1	Trefoil 125mm	-	950	173.50	959	380	74.4	43%
NKT 1000 Cu - Standard Trefoil 125D-CB-Summer	Summer	20	1	1.2	Trefoil 125mm	-	950	181.10	1001	380	74.4	41%
NKT 1000 Cu - Standard Trefoil 125D-CB-Winter	Winter	10	0.85	1	Trefoil 125mm	-	950	205.20	1134	380	74.4	36%
NKT 1000 Al - Flat125D-CB-Summer	Summer	20	1	1.2	Flat 125mm	325	450	194.60	1075	380	74.4	38%
NKT 1000 Al - Flat 125D-CB-Winter	Winter	10	0.85	1	Flat 125mm	325	450	215.20	1189	380	74.4	35%
NKT 1000 Cu - Flat 125D-CB-Summer	Summer	20	1	1.2	Flat 125mm	325	450	240.00	1326	380	74.4	31%
NKT 1000 Cu - Flat 125D-CB-Winter	Winter	10	0.85	1	Flat 125mm	325	450	265.50	1467	380	74.4	28%
NKT 1000 Al-Flat_2500_325S-125D-Summer-CB	Summer	20	1	1.2	Flat 125mm	325	2500	151.20	835	380	74.4	49%
NKT 1000 Al-Flat_2500_325S-125D-Winter-CB	Winter	10	0.85	1	Flat 125mm	325	2500	160.70	888	380	74.4	46%
NKT 1000 Cu-Flat_2500_325S-125D-Summer-CB	Summer	20	1	1.2	Flat 125mm	325	2500	186.00	1028	380	74.4	40%
NKT 1000 Cu-Flat_2500_325S-125D-Winter-CB	Winter	10	0.85	1	Flat 125mm	325	2500	197.70	1093	380	74.4	38%
NKT 1000 Al - HDD Trefoil 3000mm 140D-CB-Summer	Summer	20	-	1.2	Trefoil 125mm	-	3000	135.10	747	380	74.4	55%
NKT 1000 Cu - HDD Trefoil 3000mm 140D-CB-Summer	Summer	20	-	1.2	Trefoil 125mm	-	3000	161.10	890	380	74.4	46%

Table 8 – Cable Rating Study Results Summary

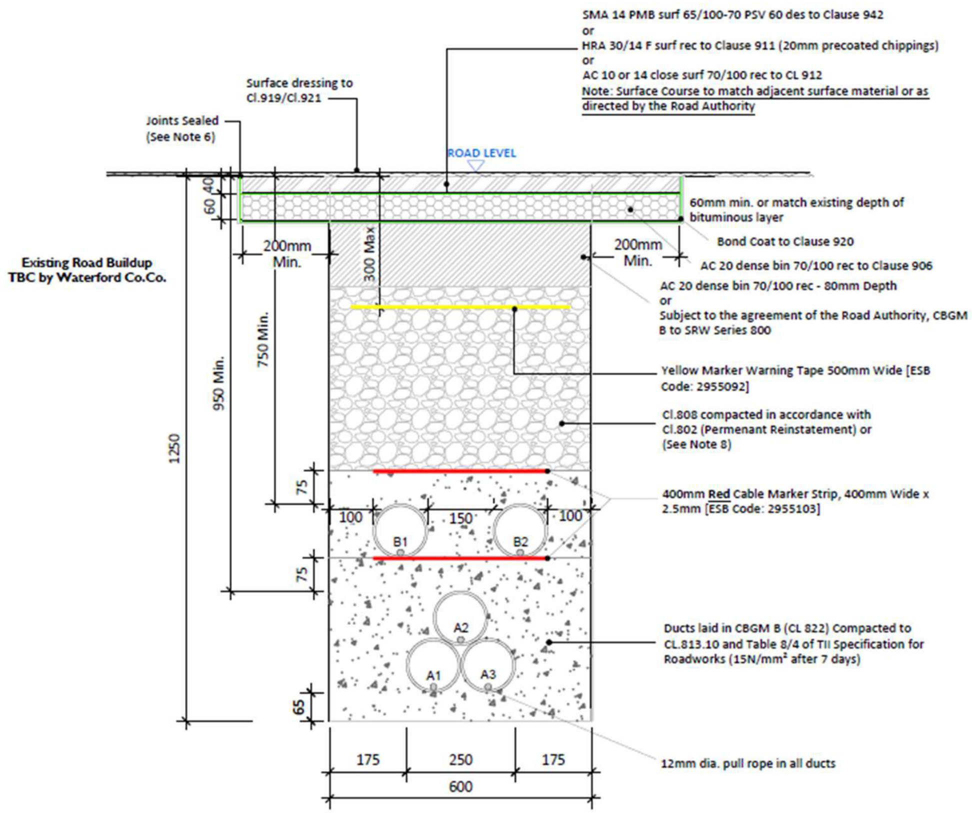
It can be seen from **Table *8*** above that both the 1000mm^2 Al XLPE cable and the 1000mm^2 Cu XLPE cable are capable of achieving the required maximum power capacity of **74.4MW** when installed in the standard trefoil trench design under summer conditions. All other trench designs are capable of achieving this 74.4MW rating.

As part of the planning process, a number of service crossings have been identified on the route. The exact number of service crossings will need to be confirmed following site investigation works and during construction as the service information provided by the utilities is indicative only. The size and depth of the services to be crossed is not known at this stage and will be confirmed during construction. The 110kV ducting will cross the existing services using either an undercrossing trench design or an overcrossing trench design as to be determined during construction. Other services may be encountered on the route during construction.

It should be noted that any crossings or parallel runs with other underground cable MV/HV circuits may result in a derating of the Dyrick Hill Windfarm 110kV UGC. This derating effect will decrease the available loading capacity of the cable, no major cable crossing points or parallel runs have been identified as part of the design stage.

Appendix A – Standard 110kV Trench Trefoil Design (125mm Ducts)

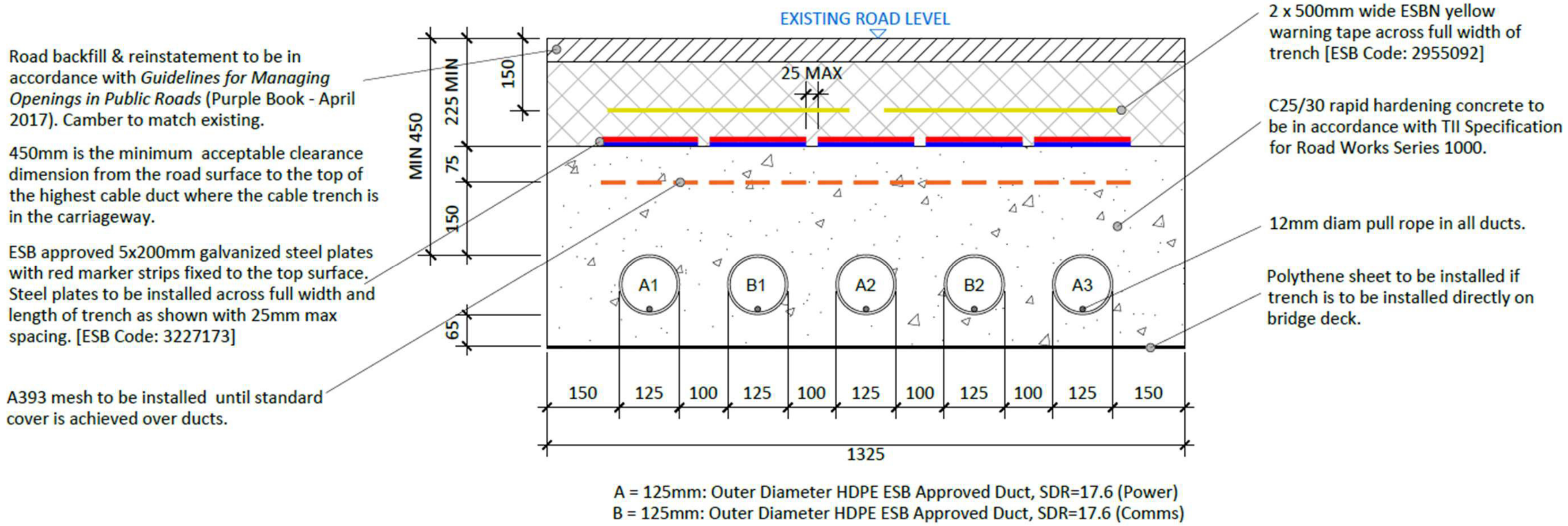
Reinstatement details based on Guidelines for Managing Openings in Public Roads - SD4



A = 125mm: Outer Diameter HDPE ESB Approved Duct, SDR=17.6 (Power) [ESB Code: 9317552]
B = 125mm: Outer Diameter HDPE ESB Approved Duct, SDR=17.6 (Comms) [ESB Code: 9317552]

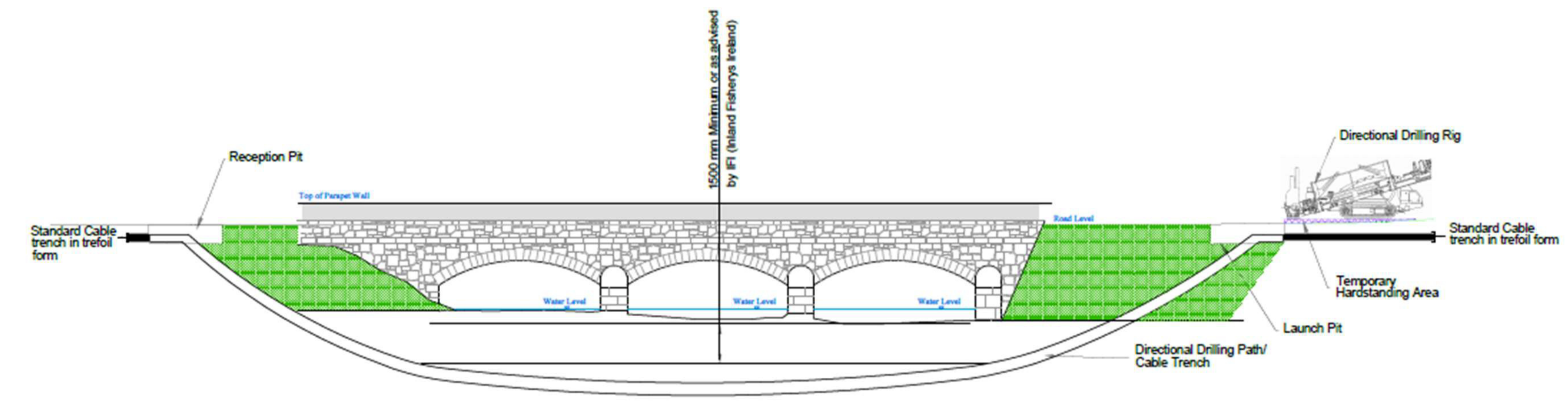
Typical Section Through Permanent Reinstatement of Longitudinal Opening in Roadway

Appendix B – Flat Formation 110kV Trench Design (125mm Ducts – 450mm Depth)

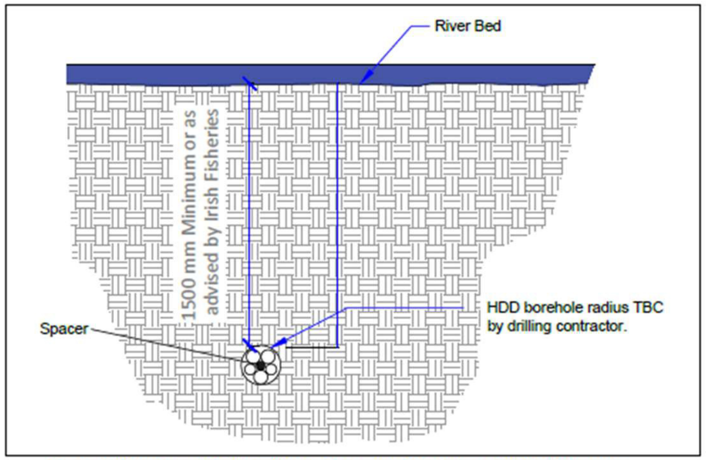


Typical Section Through Ducting in Flat Formation

Appendix C – HDD Trefoil Formation 110kV Trench Design (140mm Ducts – 3000mm Depth)



Typical Directional Drilling Bridge Crossing Detail - Cross Section



Typical Directional Drilling Water Crossing Detail-Longitudinal Section

Instruction:

Technical Lead: Ruairi Geary - TLI Group

Date of Writing: 02.09.2022

Scope of Note: Summary of cable pulling calculations check on pinch point sections within the UGC route.

Documents & Data Issued for Review: N/A

Details:

TLI Group (the Consultant) were engaged by EM Power (the Client) to identify and evaluate Cable Pulling Calculations from the proposed Dyrick Hill Windfarm Substation to the Dungarvan 110kV Substation for the proposed 110kV grid connection as part of the planning application process. The purpose of this Technical Note is to outline the calculations completed to ensure that the maximum pulling tension and side wall bearing pressure limits of the installed cable would not be exceeded during construction. These calculations were based on the current design, elevations and profile details for the UGC route recorded as part of the topographical survey.

The study area for these calculations were carried out between joint bays where potential pinch point sections could be encountered.

Coefficient of Friction considerations for Pulling of electroconductive cables have been incorporated in respect to cable manufactures parameters. These are as follows;

Material of Ducting:	*Greasing:*	*Outer Sheath PE*
HDPE	*Without*	*0.20*
	With	*0.15*

For the cable pulling calculations check it has been assumed that 110kV NKT 1000mm² Al XLPE Cable is to be installed for this project. The following pulling tension and side wall bearing pressure limits apply to this cable and have been used as part of the calculations:

Cable Type:	NKT 1000mm² AL XLPE (110kV)
Max Pulling Tension:	30 kN ≈ 30000 N ≈ 3059.15 kg (force)
Max Side Wall Bearing Pressure:	10 kN ≈ 10000 N ≈ 1001.97 kg (force) for Cables installed within ducts

These limits have been formulated, originating from cable manufacturers functional specifications **Appendix A, Mechanical Properties**. Max pulling tension and the max side wall bearing pressure can be derived from the unit conversion from kilo-newton meter (kN/m) to kilogram per meter units.

For calculation purposes applying the following: $\mathbf{1kN/m \approx 101.97\,kg/m}$

Section 1: *JB09 to JB10*

On review of the pinch point section highlighted between JB09 to JB10 section, the cable pulling study analysis found installing **NKT 1000mm² AL XLPE (110kV) UGC** from entry pit at JB09 and at JB10, the permissible pulling force exerted onto the cable for this prospective install resulted in approx. **5829.1N ≈ 5.8kN** which is within the manufactures specified limit of 30kN.

The cable pulling study finding for the maximum permissible sidewall force allowable was found to be satisfactory with approx. **55.3N/m ≈ 0.553kN** and therefore within the specified manufactures limit of 10kN when pulled predominantly on an upward trajectory from JB09 to JB10.

On review of the section from entry at JB10 and exiting at JB09, the permissible pulling force exerted onto the cable was more efficient. The pulling tension value for this prospective install resulted in approx. **3973.2N ≈ 3.97kN**

The cable pulling study finding for the maximum permissible sidewall force allowable was found to be satisfactory with approx. **3.4N/m ≈ 0.034kN** and therefore within the specified manufactures limit of 10kN when pulled from JB10 to JB09.

It is therefore recommended that this section of cable is pulled from Joint Bay 10 to JB09.

Section 2: *JB10 to JB11*

On review of the pinch point section highlighted within the JB10 to JB11, the cable pulling study analysis found installing **NKT 1000mm² AL XLPE (110kV) UGC** from entry pit at JB10 and exiting at JB11, the permissible pulling force exerted onto the cable for this prospective install resulted in approx. **3696N ≈ 3.7kN** which is within the manufactures specified limit of 30kN.

The cable pulling study finding for the maximum permissible sidewall force allowable was found to be satisfactory with approx. **35.6N/m ≈ 0.36kN** and therefore within the specified manufactures limit of 10kN when pulled from JB10 to JB11.

On review of the section from entry at JB11 and exiting at JB10, the permissible pulling force exerted onto the cable was more efficient. The pulling tension value for this prospective install resulted in approx. **4082N/m ≈ 4.08kN**

The cable pulling study finding for the maximum permissible sidewall force allowable was found to be satisfactory with approx. **73.4N/m ≈ 0.073kN** and therefore within the specified manufactures limit of 10kN when pulled from JB03 to JB02.

It is therefore recommended that this section of cable is pulled from Joint Bay 10 to Joint Bay 11.

<u>Section 3</u>: <u>*JB12 to JB13*</u>

On review of the pinch point section highlighted within JB12 to JB13 the cable pulling study analysis found installing **NKT 1000mm² AL XLPE (110kV) UGC** from entry pit at JB12 and exiting at JB13, the permissible pulling force exerted onto the cable for this prospective install resulted in approx. **5436.8N ≈ 5.4kN** which is within the manufactures specified limit of 30kN.

The cable pulling study finding for the maximum permissible sidewall force allowable was found to be satisfactory with approx. **162.6 N/m ≈ 0.163kN** and therefore within the specified manufactures limit of 10kN when pulled from JB15 to JB16.

On review of the section from entry at JB16 and exiting at JB15, the permissible pulling force exerted onto the cable was more effective. The pulling tension value for this prospective install resulted in approx. **5332.4N ≈ 5.33kN**

The cable pulling study finding for the maximum permissible sidewall force allowable was found to be satisfactory with approx. **69.2 N/m ≈ 0.07kN** and therefore within the specified manufactures limit of 10kN when pulled from JB16 to JB15.

<u>It is therefore recommended that this section of cable is pulled from Joint Bay 12 to Joint Bay 13.</u>

<u>Section 4</u>: <u>*JB14 to JB15*</u>

On review of the pinch point section highlighted within the JB14 to JB15 the cable pulling study analysis found installing **NKT 1000mm² AL XLPE (110kV) UGC** from entry pit at JB14 and exiting at JB15, the permissible pulling force exerted onto the cable for this prospective install resulted in approx. **2735.9N ≈ 2.74kN** which is within the manufactures specified limit of 30kN.

The cable pulling study finding for the maximum permissible sidewall force allowable was found to be satisfactory with approx. **90.7 N/m ≈ 0.091kN** and therefore within the specified manufactures limit of 10kN when pulled from JB20 to JB21.

On review of the section from entry at JB15 and exiting at JB14, the permissible pulling force exerted onto the cable was less effective. The pulling tension value for this prospective install resulted in approx. **4075.2N ≈ 4.1kN**

The cable pulling study finding for the maximum permissible sidewall force allowable was found to be satisfactory with approx. **22.1 N/m ≈ 0.02kN** and therefore within the specified manufactures limit of 10kN when pulled from JB21 to JB20.

<u>It is therefore recommended that this section of cable is pulled from Joint Bay 14 to Joint Bay 15.</u>

Appendix A – Functional Cable Specification

Item	Query	Unit	Reply
1	Conductor: (a) Material (b) Type e.g. round, etc. (c) Design e.g. stranded, segmental etc. (d) Nominal diameter (e) Cross-sectional area (f) Method of water blocking	 mm mm^2	 aluminium round stranded, compacted 38,9 1000 swelling yarns and/or swelling tapes
2	Inner Semi-conducting Layer: (a) Material Grade (b) Nominal Thickness (c) Minimum Thickness	 mm mm	 XLPE 1,1 0,7
3	Insulation: (a) Material Grade (b) Nominal thickness ;12-13 mm required (c) Minimum thickness (d) Ovality of insulation layer $\leq$ 10%	 mm mm	 XLPE 12,0 10,8 less 10%
4	Outer Semi-conducting Layer: (a) Material Grade (b) Thickness (c) Minimum thickness	 mm mm	 0,9 0,7
5	Nominal diameter over cable core	mm	67
	Roundness of cable core ; maximum ovality < 0.7 mm	mm	max. 0,7
6	Radial thickness of insulation and semi-conducting layers (a) Nominal (b) Minimum	 mm mm	 14,0 12,2
7	Bedding Layer/Water Barrier (a) Material (b) Thickness (c) OD of bedding layer (d) Method of electrical connection between 4 and 8 (e) Method of water blocking	 mm mm	 semiconducting and swellable tapes 2,0 72 semiconducting and swellable tapes semiconducting and swellable tapes
8	Metallic Sheath: (a) Material (b) Type, corrugated or smooth (c) Nominal thickness (d) Mean diameter (e) Cross-sectional area (f) Diameter over crest of corrugations (g) OD of sheath if not corrugated (h) Diameter and no. of extra copper wires required to ensure short circuit performance of cable meets Specification 18080 (if needed)	 mm mm mm^2 mm mm	 aluminium smooth 1,6 74 393 n. a. 76 n. a.
9	Outer MDPE/HDPE Sheath (a) Material (b) Nominal thickness (c) Minimum thickness	 mm mm	 HD PE 3,6 2,96
	(d) Shore D hardness		appr. 58
	(e) Shrinkage %		max. 3%
10	Nominal diameter of completed cable including thickness of any conductive outer layer	mm	84
11	Conductive Outer Sheath Layer (a) Material Type (b) Thickness (c) Extruded Layer Surface resistivity (d) Graphite Layer Surface Resistivity (e) Coefficient of friction of cable based on sidewall force equal (a) for graphite layer (b) extruded outer conductive layer	 mm KOhm/m KOhm/m	 graphite max. 16 kOhm/m - (b): n.a. here (a): in PE tube: 0,2 in PE tube, greased: 0,1... 0,2
	Coefficient of Friction based on 5000N/m sidewall force at bends (static and dynamic) (a) for graphite layer (b) for extruded outer conductive layer		 (b): n.a. here (a): in PE tube: 0,2 in PE tube, greased: 0,1... 0,2
12	(a) Normal length per drum (b) Maximum length per drum	 m	1000 m at drum diameter 3,4 m x width 2,2 m (p. ex.) tbd
13	(a) Normal gross weight of loaded drum (b) Maximum gross weight of loaded drum	kg kg	9300 tbd
14	Maximum drum dimensions width/height Minimum drum barrel dimension	 m	3,7 m width x 4,3 m height

Item	Query	Unit	Reply
15	Minimum radius of bend around which cable can be pulled		
	(a) Laid Direct	m	2,1
	(b) In ducts	m	2,1
	(c) Cable placed in position with former	m	1,25
	(d) Cable placed in position without former	m	2,1
16	Permissible pulling force allowed on conductors during installation	kN	30
17	Maximum permissible sidewall forces	kN	10

MANAGEMENT PLAN 3

SURFACE WATER MANAGEMENT PLAN

DYRICK HILL WIND FARM LIMITED

DYRICK HILL WIND FARM
CO. WATERFORD

CONSTUCTION ENVIRONMENTAL MANAGEMENT PLAN (CEMP)

MANAGEMENT PLAN 3
SURFACE WATER MANAGEMENT PLAN

MAY 2023

Dyrick Hill Wind Farm Limited
c/o EMPower,
2 Dublin Landings,
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North Dock,
Dublin,
D01 V4A3.

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DOCUMENT APPROVAL

PROJECT	Dyrick Hill Wind Farm	
CLIENT / JOB NO	Dyrick Hill Wind Farm Limited	6497
DOCUMENT TITLE	Construction Environmental Management Plan (CEMP) Surface Water Management Plan (SWMP)	

	Prepared by	**Reviewed/Approved by**
Document **Final**	Name Sarah Moore	Name David Kiley
Date May 2023	Signature	Signature

CONTENTS

APPENDICES

1 INTRODUCTION

This Surface Water Management Plan (SWMP) for the Development describes the site drainage that has been designed for the site using the following principles:

- Ecologically Sensitive Processes
- Sustainable Drainage Systems (SuDS)

This is a live document and where there is a requirement for variation on the ground to provide more ecologically sensitive drainage then the SWMP will be updated to reflect this. The SWMP will be updated by the appointed Contractor and changes to the document will be agreed with the Project Hydrologist and Ecological Clerk of Works (ECoW) before drainage works commence.

The SWMP aims to:

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

2 PROPOSED DEVELOPMENT

The Project will comprise of the following main components:

- Erection of 12 no. 6.0-7.2 MW wind turbines (Note* this is the current output available for turbines of this size. It is possible that with improvements in technology, the output may increase at the time of construction.) with an overall ground tip height of 185m. The candidate wind turbines will have a 162m rotor diameter and a hub height of 104m.
- Construction of Crane Hardstand areas and Turbine Foundations.
- Construction of new internal site Access Tracks and upgrade of existing site roads, to include passing bays and all associated drainage.
- Construction of a new wind farm site entrance with access onto the R671 regional road in the townlands of Lickoran.
- Improvement of existing site entrance with access onto local roads in the townlands of Broemountain.
- Improvements and temporary modifications to existing public road infrastructure to facilitate delivery of abnormal loads and turbine delivery.

- Construction of one Temporary Construction Compound with associated temporary site offices, parking area and security fencing.
- Development of on-site Borrow Pit.
- Installation of one Permanent Meteorological Mast with an overall height of 104m.
- Development of a site drainage network.
- Construction of one permanent 110 kV Substation.
- All associated Wind Farm Internal Cabling connecting the wind turbines to the wind farm substation.
- All works associated with the connection of the wind farm to the national electricity grid, which will be via 110 kV underground cable connection approximately 16km in length to the existing Dungarvan 110 kV Substation.
- Upgrade works on the Turbine Delivery Route from Waterford Port.
- Ancillary forestry felling to facilitate construction and operation of the Development.

3 SITE HYDROLOGY

The Site is located across land which is predominantly underlain by sandstone rock and brown podzolic or podzol soils of coarse loamy drift with siliceous stones of the Knockmealdown, Knockboy and Ballycondon series. According to the Soil Information System National Soils Map, pockets of peat may exist at the north-western extent of the site although no peat has been identified at the site during the geotechnical surveys of the site. The National Soils Hydrology Map classifies the majority of the site as being poorly drained, particularly in the western and northern areas. The remainder of the site is classified as being well drained with the majority of these areas being located in the eastern and southern areas of the Site.

The proposed Site is located beyond the south-eastern extent of the Knockmealdown Mountains mountain range. The western, northern and southern extents of the site are typically more elevated than the central and eastern extents of the Site. The site is broadly surrounded by the three main peaks of Knocknasheega (428m) west of the Site boundary, Broemountain (429m) in the northern extent of the site and Dyrick Hill (286m) within the southern central portion of the site. The eastern and central extents of the site are generally relatively flat with elevations typically ranging from between 130m to 190m. The proposed Site extends to 462 hectares (ha).

Forestry and agricultural land uses, including dairy and sheep farming are the predominant land uses within the study area. Forestry plantations border the western extent of the proposed Site on an area of commonage land. Additional areas of forestry exist within the central, north-eastern and southern extents of the proposed Site. The Site is intersected by Broemountain Road (L5058) which is a narrow local secondary road. The Farnane River, which is a tributary of the Finisk River, rises near the north-western extent of the Site and flows along the western extent of the Site. The Lisleagh Stream, which is also a tributary of the Finisk River, rises in the central portion of the Site and flows in a south-easterly direction until it merges with the Finisk River, north of the townland of Woodhouse. The Aughkilladoon Stream, another tributary of the Finisk River rises at the south-eastern extent of the Site and flows in a south-easterly direction until it merges with the Finisk River, east of the townland of Woodhouse.

The Farnane River, the Lisleagh Stream and the Aughkilladoon Stream are the main surface water bodies that drain the site. All of these surface waters are tributaries of the Finisk River which flows to the east and south-east of the proposed Site. The site is also drained by a network of artificial drainage ditches, many of which are located adjacent to field boundaries, particularly in the central and western extents of the Site. A number of small natural and artificial drains also exist at the western commonage area of the proposed Site. Two potential wetlands exist at the site, located east and west of the proposed T4 position. The Map of Irish Wetlands (2021) identifies these locations as “Other/Unsurveyed”, it was notable that highly saturated ground was evident at these locations during the site surveys.

The surface water bodies surrounding the proposed development are shown in Figure 3.1 and the watercrossings requiring HDD are shown in Figure 3.2.

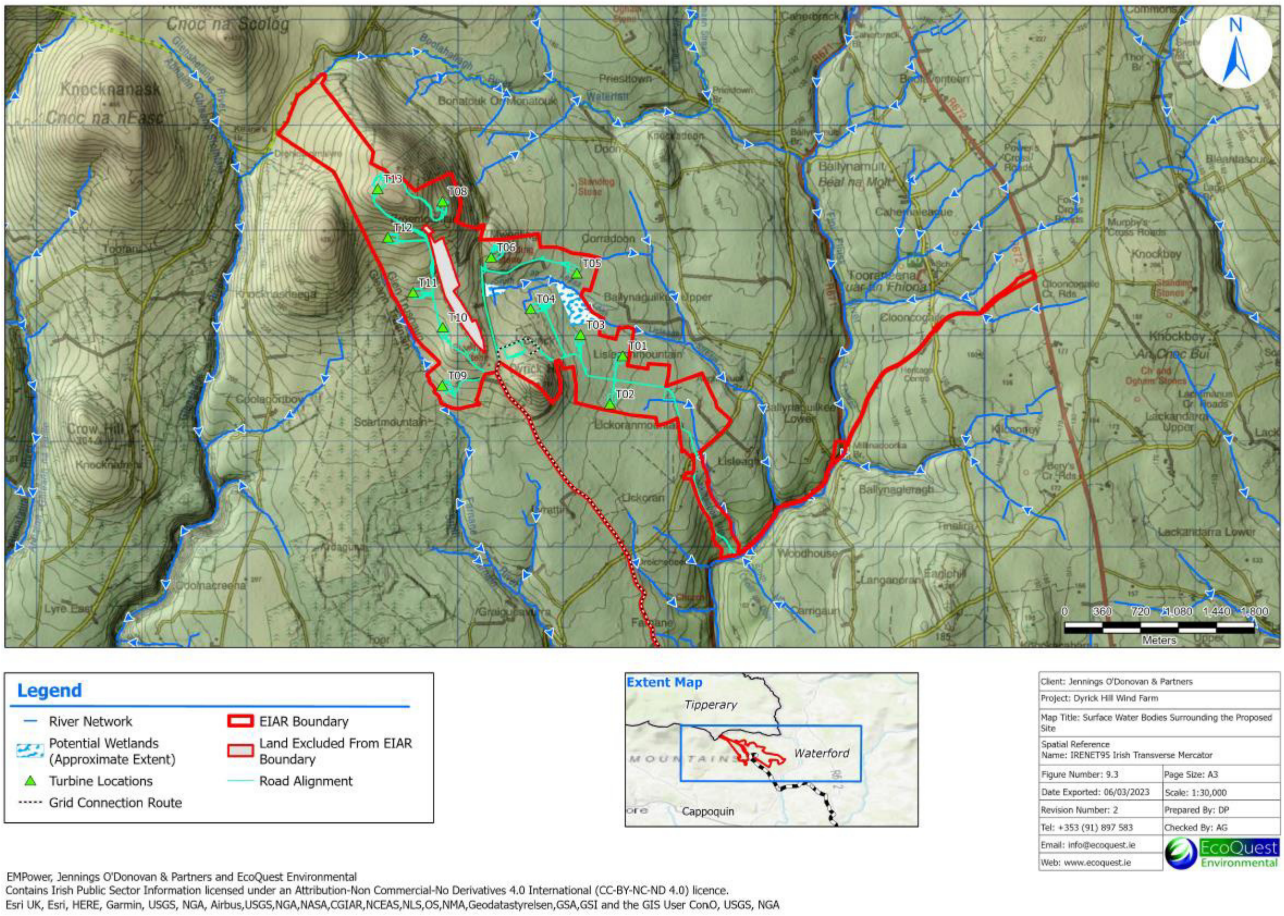


Figure 3.1: Surface Water Bodies Surrounding The Proposed Site (Reference EIAR Figure 9.3)

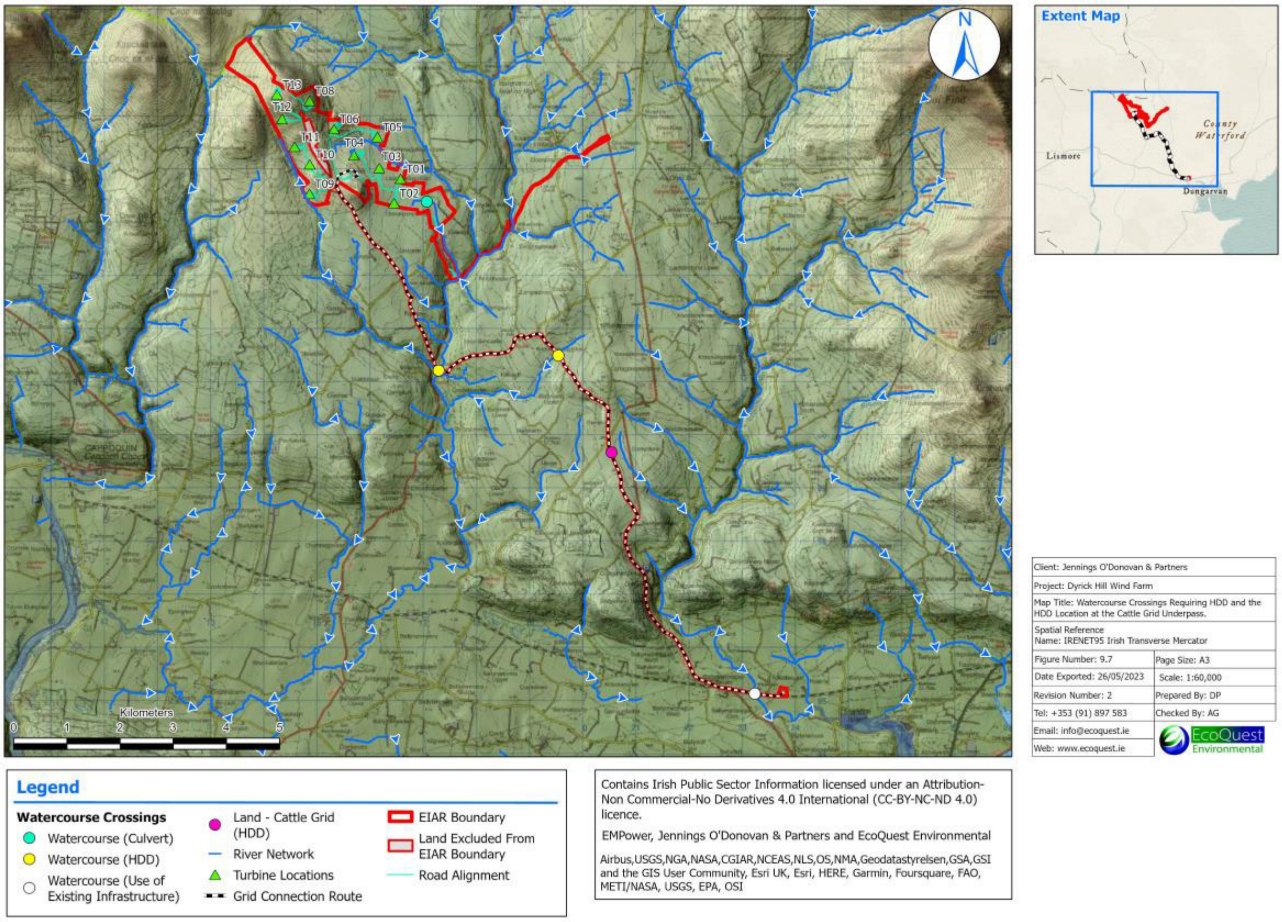


Figure 3.2: Watercrossings for the Proposed Development (EIAR Reference Figure 9.7)

4 ENVIRONMNETAL CONSTRAINTS AND MITITGATION MEASURES

4.1 Surface Water Buffer Zones

Prior to works commencing, a Water Quality Specialist will be retained by Dyrick Wind Limited with a responsibility to implement the Water Quality Management Plan and the Water Inspection and Monitoring Plan. Among other requirements, the latter requires a full baseline survey to be undertaken prior to the commencement of construction and requires the contractor to provide a 'schedule of work' to the water quality specialist at the beginning of each week.

The Environmental Manager (EM) or the Ecological Clerk of Works (ECoW) will ensure that a 50m watercourse buffer zone will be implemented to ensure the protection of watercourses. The only exceptions to this rule will be where the grid connection route traverses existing bridges, that are already located within the 50m buffer zone, where horizontal directional drilling is required and where one crossing will be constructed at the eastern extent of the site. In instances where implementation of a 50m buffer zone is unavoidable, such as at crossings or HDD locations, the use of sediment fences or straw bales will be implemented to reduce the potential for surface water run-off to sensitive watercourses.

4.2 Earthworks Proposed Mitigation Measures

Mitigation measures to reduce the potential for adverse impacts arising from earthworks and management of spoil include the following:

- Management of excavated material will adhere to the measures related to the management of temporary stockpiles outlined in the **EIAR Chapter 8: Soils and Geology** and the CEMP.
- No permanent or semi-permanent stockpiles will remain on the Site during the construction or operational phase of the Development. Excess spoil is to be taken to the designated borrow pit at the Site;
- Suitable locations for temporary stockpiles will be identified on an individual basis. The suitability of any particular location will consider Site specific characteristics, including;
    - The location of drainage networks in the vicinity;
    - The slope, incline and topography of the downgradient area; and,
    - Any other relevant characteristics which are likely to facilitate or increase the potential for entrainment by surface water runoff.
- Construction activities will not be carried out during periods of sustained significant rainfall events, or directly after such events. This will allow sufficient time for work areas to drain excessive surface water loading and discharge rates to be reduced;
- Following heavy rainfall events, and before construction works recommence, the Site will be inspected and any required corrective measures implemented;
- An emergency response plan will be developed for the construction phase of the project. The plan, at a minimum, will involve 24-hour advance meteorological forecasting linked to a trigger-response system. When a pre-determined rainfall trigger level is exceeded such as a very heavy rainfall at >25mm/hr, planned responses will be undertaken. These responses will include cessation of construction until the storm event, including storm runoff, has ceased;
- Sediment fencing will be erected along proximal and paralleling areas of watercourses, channels and drains spanned by the works to reduce the potential for sediment laden run-off to reach sensitive receptors;
- No direct flow paths between stockpiles and watercourses will be permitted at the Site;

- Excavated material will be backfilled to the excavation or transported to the spoil storage area as soon as is reasonably practicable to prevent long duration storage at the Site which increases the risk of adverse effects on aquatic environments; and,
- All mitigation measures related to surface water quality described throughout Section 4.0 of this Management Plan will be implemented before excavation works commence.

4.3 Excavation Dewatering Proposed Mitigation Measures

Mitigation measures to reduce the potential for adverse impacts arising from dewatering activities include the following:

- Management of excavations will adhere to the measures outlined in the **EIAR Chapter 8: Soils and Geology** and the **CEMP**. Areas of subsoils to be excavated will be drained ahead of excavation works. This will reduce the volumes of water encountered during excavation works and will therefore reduce the volume of water that is required to be dewatered whilst excavations are being carried out;
- Engineered drainage and attenuation features outlined in the **Surface Water Management Plan** will be established ahead of excavation works;
- Dewatering pumping rates will be controlled by an inline gate valve or similar infrastructure which will facilitate a reduction of loading on the receiving environment, thus enhancing the attenuation and settlement of suspended solids;
- The direct discharge of dewatered loads to surface waters will not be permitted under any circumstances;
- All dewatering will follow a strict procedure of pumping to a settlement tank and then to a dewatering bag, or settlement ponds prior to discharging to receiving environment for overland flow;
- Geofabric lined settlement ponds will buffer the run-off discharging from the drainage system which will reduce the hydraulic loading to watercourses. Settlement ponds will be designed to reduce flow velocity to 0.3 m/s at which velocity silt settlement generally occurs. In areas of the Site where the placement of settlement ponds is not feasible, other mitigation measures described below will be implemented;
- Check dams will be constructed across drains and will reduce the velocity of run-off which will in turn promote settlement of solids upstream of potential surface water receivers. An additional benefit of check dams is that they will reduce the potential for erosion of drains. Rock filter bunds may be used for check dams. Wood or hay bales can also be used if properly anchored. It is recommended that multiple check dams are installed, particularly in areas immediately down gradient of construction areas;

- Overland flow paths of the final dewatered discharge will be maximised to the greatest practical extent to avoid prematurely draining to drainage channels or surface waters. This approach will allow for enhanced settling out of suspended solids entrained in the run-off;
- All pumps, tanks, settlement ponds, dewatering bags and check dams used in the dewatering process will be regularly inspected and maintained as necessary to ensure surface water run-off is appropriately treated;
- Sediment fencing will be installed up gradient of water courses which may receive the final overland flow;
- The final treated dewatered discharge will be directed towards heavily vegetated areas to allow for further natural filtration of suspended solids;
- A programme of water quality monitoring will be implemented during the construction phase which is outlined in detail in the **Water Quality Management Plan and Watercrossing Management Plan**;
- No extracted or pumped water will be discharge directly to the surface water network associated with the Site (this in accordance with the *Local Government (Water Pollution) Act 1977* as amended); and,
- Any discharges of sediment treated water should meet the requirements of the *Surface Water Regulations 2009*, as amended.

4.4 Release and Transport of Suspended Solids Proposed Mitigation Measures

The following mitigation measures to reduce potential impacts from the release of suspended solids to the surface waters will be implemented:

- Collector drains and soil berms will be implemented to direct and divert surface water runoff from construction areas such as temporary stockpiles into established settlement ponds, buffered discharge points and other surface water runoff control infrastructure. This planning and placement of these control measures will be of fundamental importance, especially for the areas where works within the 50m buffer zone will be unavoidable;
- Sediment control fences will be implemented significantly upgradient of potential receiving waters and as part of the drainage network. Sediment control fences will also be established upgradient of the Site's pre-existing natural and artificial drains. This practice will reduce the potential for elevated suspended solids entrained in surface water runoff to discharge to surface waters;

- Multiple silt fences will be used in drains discharging to the surface water network. This will be especially important for the areas where works within the 50m buffer zone will be unavoidable;
- The drainage, attenuation and other surface water runoff management systems will be installed prior to the commencement of construction activities. Whenever possible, drainage and attenuation control measures will be installed during seasonally dry conditions to limit the potential for sediment laden run-off to discharge to surface waters during the installation of these measures;
- Surface water runoff will be discharged to land via buffered drainage outfalls that will contain hardcore material of similar composition to the geology of the bedrock at the Site. This mitigation measure will promote the capture and retention of suspended sediment;
- Buffered drainage outfalls also promote sediment percolation through vegetation in the buffer zone, reducing sediment loading to adjacent watercourses and avoiding direct discharge to the watercourse;
- Buffered drainage outfalls will be placed outside of the 50m buffer zone and will not be positioned in areas with extensive erosion and degradation;
- A relatively high number of discharge points will be established to decrease the loading on any one particular outfall;
- Discharging at regular intervals mimics the natural hydrology by encouraging percolation and by decreasing individual hydraulic loadings from discharge points;
- The site-specific CEMP has been developed which mandates regular inspections and maintenance of pollution control measures. Contingency measures outlining urgent protocols to repair or backup any breaches of designed mitigation measures are incorporated into the site-specific CEMP;
- In the event that mitigation measures are failing to reduce suspended solids to acceptable levels, construction works will cease until remediation works are completed;
- If fine solids or colloidal particles are very slow to settle out of waters, coagulant or flocculant will be used to promote the settlement of finer solids prior to discharging to surface water networks. Flocculant gel blocks can be placed in drainage channels, these are passive systems that are self-dosing, self-limiting and are environmentally friendly. Flocculant gel blocks bind elevated levels of silt and associated contaminants into masses that are easily separated, captured and then removed from the water; and,
- Surface water runoff controls will be checked and maintained on a regular basis and as soon as any signs of deterioration become visible. Surface water runoff controls, check

dams and settlement ponds will be maintained and emptied on a regular basis and as soon as any signs of deterioration become visible.

The adoption of precautionary principles and the implementation of mitigation measures listed above will ensure that the risk of elevated suspended solids discharging to surface waters is low. This in turn will ensure that potential risks to sensitive receptors is also low. Nevertheless, should a significant discharge of suspended solids to surface waters occur, the absence of immediate proximity to designated sites and the assimilative capacity of the localised surface waters will act as a natural hydrological buffer in terms of suspended solids loading. Should such a discharge occur, the dilution and retention time of suspended solids in the localised surface water network will reduce potential impacts on highly sensitive downstream designated sites. It should be noted that this natural mitigation measure is not to be adopted as a first principle, and will not be relied upon to prevent adverse impacts on designated sites, it will be rather a last line of defence.

A detailed design of required drainage, collector drainage, stilling ponds and other listed mitigation infrastructure is contained in the **Surface Water Management Plan**.

4.5 Horizontal Directional Drilling Mitigation Measures

The following mitigation measures to reduce potential impacts associated with horizontal directional drilling will be implemented:

- Clearbore, which is not toxic to aquatic organisms and is biodegradable will be the drilling fluid used;
- Mud mixing will be monitored to suit the ground conditions encountered and will initially be based on a mud programme developed by the specialised HDD Contractor, the drilling fluid supplier and an Environmental Clerk of Works;
- The drilling fluids will be constantly monitored, any changes required to the mix will be performed on site by a specialised HDD Contractor upon consultation with the drilling fluid supplier and Environmental Clerk of Works;
- Mud testing equipment will be available at all times during drilling operations to monitor key mud parameters;
- All equipment will be carefully checked on a daily basis by the Site Supervisor prior to use to ensure plant and machinery is in good working order with no leaks or potential for spillages;

- Spill kits, including an appropriate hydrocarbon boom, will be available on the site in the event of any unforeseen hydrocarbon spillages and all staff shall be trained in their use;
- All plant, materials and wastes will be removed from site following the HDD works;
- The launch pit will be reinstated to the original land surface condition and the normal duct trench will continue from this point;
- Should any dewatering be required, it will be carried out in accordance with the site-specific CEMP; and,
- Test pits and boreholes will not be located directly on, or extend through, the proposed alignment, as these weak points may serve as conduits where inadvertent fluid returns or frac outs occur. At least a 3m offset will be provided between the boreholes and pipe alignment.

4.6 Release of Hydrocarbons Proposed Mitigation Measures

The following mitigation measures to reduce potential impacts from the environmental release of hydrocarbons and other harmful chemicals to the surface waters will be implemented:

- Refuelling of vehicles will be carried out off site to the greatest practical extent. This refuelling policy will mitigate the potential for impacts by avoidance. Due to the remote location and nature of the Site, it is unlikely that implementation of this refuelling policy will be practical in all circumstances. In instances where refuelling of vehicles on Site is unavoidable, a designated and controlled refuelling area will be established at the Site. The designated refuelling area will enable low risk refuelling and storage practices to be carried out during the works. The designated refuelling area will contain the following attributes and mitigation measures as a minimum requirement:
    - The designated refuelling area will be located a minimum distance of 50m from any surface waters or Site drainage features;
    - The designated refuelling area will be bunded to 110% volume capacity of fuels stored at the Site;
    - The bunded area will be drained by an oil interceptor that will be controlled by a pent stock valve that will be opened to discharge storm water from the bund;
    - Management and maintenance of the oil interceptor and associated drainage will be carried out by a suitably licensed contractor on a regular basis;
    - Any oil contaminated water will be disposed of at an appropriate oil recovery plant or licensed tip site;

- Any minor spillage during this process will be cleaned up immediately;
- Vehicles will not be left unattended whilst refuelling;
- All machinery will be checked regularly for any leaks or signs of wear and tear; and,
- Containers will be properly secured to prevent unauthorised access and misuse. An effective spillage procedure will be put in place with all staff properly briefed. Any waste oils or hydraulic fluids will be collected, stored in appropriate containers and disposed of offsite in an appropriate manner.

Notwithstanding the management of refuelling and fuel storage at the designated refuelling area, the potential risk of hydrocarbon spills from plant and equipment or other general chemical spills at other areas of the Site remains. To mitigate against potential spills at other areas of the Site, the following mitigation measures will be implemented:

- Oil absorbent booms and spill kits will be available adjacent to all surface water features associated with the Development. The controls will be positioned downstream of each construction area and at principal surface water drainage features. Oil booms deployed will have sufficient absorbency relative to the potential hazard;
- Spill kits will also be available at construction areas such as at turbine locations, the temporary site compound, on-site substation, spoils storage areas and met mast location etc.;
- Spill kits will contain a minimum of oil absorbent pads, oil absorbent booms, oil absorbent granules, and heavy-duty refuse bags for collection and appropriate disposal of contaminated matter;
- Should an accidental spill occur during the construction or operational phase of the Development, such incidents will be addressed immediately, this will include the cessation of works in the area of the spillage until the issue has been resolved;
- Spill kits will be kept in each vehicle at the Site and will be readily available to all operators;
- No materials, contaminated or otherwise will be left on the Site;
- Suitable receptacles for hydrocarbon contaminated materials will also be available at the Site; and,
- A detailed spill response plan forms part of the site-specific CEMP appended to **Appendix 2.1** of this EIAR.

Implementation of the above mitigation measures will significantly reduce the risk of hydrocarbon contamination being released to the surface water network. Nevertheless, the potential risk cannot be entirely eradicated. Therefore, precautionary measures and emergency response protocols will be established and are included in the site-specific CEMP appended to the EIAR in **Appendix 2.1**.

4.7 Construction and Cementitious Materials Proposed Mitigation Measures

The following mitigation measures to reduce potential impacts posed from the use of concrete and the associated effects on surface water in the receiving environment are proposed:

- The procurement, transport and use of any cement or concrete will be planned fully in advance and supervised by appropriately qualified personnel at all times;
- Vehicles transporting cement or concrete to the Site will be visually inspected for signs of excess cementitious material prior to being granted access to the Site. This will prevent the likelihood of cementitious material being accidentally deposited on the site access tracks or elsewhere at the Site;
- Drivers of such vehicles will be instructed to ensure that all vehicles are washed down in a controlled environment prior to the departure of the source site, such as at concrete batching plants;
- Precast concrete will be used wherever possible, although the use of pre-cast concrete is not a viable option for large structures such as turbine foundations and so concrete will be delivered to the Site;
- Concrete will not be poured during periods of rainfall or if any kind of precipitation is forecast. This policy will limit the potential for freshly poured concrete to adversely impact on surface water runoff;
- Raw or uncured waste concrete will be disposed of by removal from the Site;
- Washout of concrete trucks shall be strictly confined to the batching facility and shall not be located within the vicinity of watercourses or drainage channels. Only the chutes will be cleaned prior to departure from Site, and this will take place at a designated area at the temporary site compound;
- Spill kits will be readily available to Site personnel, and any spillages or deposits will be cleaned up immediately and disposed of appropriately;
- Pouring of concrete into standing water within excavations will be avoided;
- Excavations will be prepared before pouring of concrete by pumping standing water out of excavations to the buffered surface water discharge systems in place;

- Any surplus concrete will not be stored or deposited anywhere on Site and will be returned to the source location or disposed of appropriately at a suitably licensed facility; and,
- Any required shuttering installed to contain the concrete during pouring will be fully secured around its perimeter to minimise any potential for leaks.

4.8 Watercourse Crossings Proposed Mitigation Measures

At the Site, one new watercourse crossings / culverts of a the Aughkilladoon Stream will be constructed at the eastern extent of the Site. It is possible that some small unmapped drainage channels could potentially require small culverts to be constructed to facilitate the construction of access roads. However, detailed planning and consideration as described below, to ensure potential impacts are assessed adequately and in turn mitigated against, will be implemented for these locations.

A detailed design stage assessment in terms of any small culvert design will be carried out that will have cognisance to locations including the characteristics of water flow at each drain location. The following mitigation measures will be implemented as minimum requirements to ensure any potential impacts of drainage feature crossings are minimised:

- The design of the proposed crossings and a method statement for the proposed construction will be prepared in advance of works taking place;
- This design of all crossings will adhere to relevant available guidance and will be reviewed through consultation with the OPW which will mitigate against any significant impact on surface water flow and in turn the risk of localised or downstream flooding;
- Crossings will be designed to minimise, in so far as practical and to the extent deemed acceptable by the competent authority, the disturbance or alteration of water flow, erosion and sedimentation patterns and rates;
- A Construction Environmental Management Plan has been prepared. Adherence to this plan, which will be mandatory throughout the construction of the watercourse crossings, will include comprehensive details of the culvert design and construction methodology, including the environmental risk/s involved which have been identified and assessed in this EIAR. Detailed site-specific mitigation measures and best practice techniques will be contained in the construction management plan and Risk Assessment Method Statement (RAMS) for any proposed crossings of small unmapped drains;

- Vehicles used in the construction of small drain crossings will only be refuelled at the Site's bunded and designated refuelling area. No refuelling will be permitted within 50m of any watercourse at the Site; and,
- To mitigate against the potential risk of accidental leaks or spillages from plant and equipment, an emergency response plan for such incidents is contained in the CEMP. Multiple spill kits will be maintained on the Site at all times within the cabs of vehicles and placed strategically at environmentally sensitive locations across the Site. Spill kits will be routinely inspected to ensure that they are fully stocked with oil absorbent booms and pads at all times. Oil absorbent booms will be installed downstream of channel crossing work areas within 25m of the works location, prior to the commencement of works.

4.9 Removal of Forestry and Afforestation Proposed Mitigation Measures

Similar to other aspects of the proposed Development, a primary mitigation measure to avoid potential impacts associated with removal of forestry will be mitigation by avoidance. The design layout of the proposed Development will ensure that the pre-existing forestry road network, such as that leading towards the T05 position for example, is incorporated into the proposed Development. Similarly, the pre-existing manmade forestry drainage network, and the pre-existing fire breaks, will be utilised during the construction and operational phases to the greatest practical extent. Utilisation of the existing forestry infrastructure such as roads, drainage network and fire breaks will remove the need to construct new features that would perform the same function. A reduced construction footprint would in turn reduce the potential for adverse impacts to occur such as increased eutrophication resulting from nutrient runoff and/or the potential for sediment laden runoff to occur.

To further reduce the likelihood of enhanced eutrophication or elevated sediment laden runoff to occur, the construction methodology in areas of forestry will adhere to the best practice specifications listed in the following Guidelines:

- The Forestry Service (2000), Forestry and Water Quality Guidelines;
- The Forestry Service (2000), Forest Harvesting and Environmental Guidelines (2000);
- Forestry and Water Quality Guidelines (2000);
- EPA (2008), Forestry Operations and Eutrophication – PEnrich, Sytheseis Report;
- Department of Agriculture, Food and the Marine (2015), Forestry Standards and Procedures Manual;

- Department of Agriculture, Food and the Marine (2016), Environmental Requirements for Afforestation; and,
- Department of Agriculture, Food and the Marine (2019), Standards for Felling and Reforestation.

Prior to the commencement of felling or afforestation activities, all personnel, particularly machine operators, will be made aware of the locations of watercourses. Machine combinations will be selected which are the most suitable for ground conditions at the time of felling in terms of minimising the potential for soil disturbance. Brash mats will be placed on top of the soil to minimise the potential for soil disturbance within areas of felling and afforestation.

Drainage ditches which drain from the felling area towards existing surface waters will have check dams and silt strips installed. Direct discharges of sediment laden runoff to any drainage ditches will not be permitted. All sediment controls such as silt traps and check dams are to be regularly inspected and maintained as required to ensure that they remain effective throughout felling and afforestation activities.

A felling license will be obtained from the Forest Service of the Department of Agriculture, Food & the Marine prior to any felling activities being carried out. The associated afforestation of alternative lands equivalent in area to those lands being permanently clear-felled is also subject to licensing (i.e. 'afforestation licensing'). Compliance with all provisions set out in CEMP will be mandatory for all personnel.

Buffer zone guidelines for the protection of water quality and aquatic ecosystems is provided for in Table 1 of the Forestry and Water Quality Guidelines (2000). These buffer zone distances will be adhered to at the Site. It should be noted that with the exception of the pre-existing manmade forestry drains at the Site, none of the tree felling activities will be carried out within the self-imposed 50m buffer zone at the Site. Areas to be selected for afforestation will not be located within the 50m buffer zone of surface waters.

4.10 Groundwater Contamination Proposed Mitigation Measures

A combination of the underlying bedrock geology, the associated likely presence of only local scale flow systems, moderate permeability subsoils beneath the Site and moderate recharge rates has resulted in the risk posed to groundwater quality by the Development being considered as low risk. Nevertheless, mitigation measures to reduce potential risks to groundwater will be implemented. A primary risk to the underlying groundwater quality would be through the accidental release of hydrocarbons from fuels or oils during the construction phase of the Development. In order to mitigate against potential groundwater contamination by hydrocarbons, implementation of the following mitigation measures is proposed:

- In the first instance, no fuel storage will occur at the Site whenever feasible and refuelling of plant and equipment will occur off site at a controlled fuelling station;
- In instances where on Site refuelling is unavoidable, then the bunded on-Site designated refuelling area must be used. The designated refuelling area must be bunded to 110% volume capacity of fuels stored at the Site;
- The bunded area will be drained by an oil interceptor that will be controlled by a pent stock valve that will be opened to discharge storm water from the bund;
- Management and maintenance of the oil interceptor and associated drainage will be carried out by a suitably licensed contractor on a regular basis;
- Any oil contaminated water will be disposed of at an appropriate oil recovery plant or licensed tip site
- Any minor spillage during this process will be cleaned up immediately;
- Vehicles will not be left unattended whilst refuelling;
- The site-specific CEMP will be enforced to ensure that equipment, materials and chemical storage areas are inspected and maintained as required on a regular basis; and,
- The mitigation measures outlined for the protection of surface waters as set out in **this section** will be also implemented which will inadvertently serve to protect groundwater from potential hydrocarbon contamination.

The following mitigation measures are proposed in relation to non-hydrocarbon potential contamination of groundwater:

- All other liquid-based chemicals such as paints, thinners, primers and cleaning products etc. will be stored in locked and labelled bunded chemical storage units;
- Temporary sanitation facilities such as portaloos used during the construction phase will be self-contained and supplied with water by tank trucks. Portaloos will contain water storage tanks and separate wastewater storage tanks which will be routinely emptied by vacuum removal for offsite disposal via a tank truck. All temporary sanitation facilities will be removed from the Site following the completion of the construction phase;

- The controlled attenuation of suspended solids in settlement ponds and check dams etc. will result in inorganic nutrients (if present in elevated concentrations) such as phosphorus and nitrogen being absorbed and retained by the solids in the water column. This will allow for a reduction of peak inorganic discharges in a controlled and stable run off rate.
- It is considered that there is a low risk of mobilising trace metals that may naturally be present in low concentrations in the baseline environment. The potential for mobilising trace metals is most likely to result from enhanced water percolation associated with excavated bedrock substrate. To mitigate against this potential impact, water quality will be monitored for trace metal concentrations prior to, during and after the construction phase;
- The potential for livestock such as cattle and sheep which have been observed grazing at the Site to cause bacteriological contamination of groundwater will be controlled through the implementation of strict grazing control zones, site perimeter fencing and exclusion zones around all open excavations; and,
- The mitigation measures outlined for the protection of surface waters as set out in this section will be also implemented which will inadvertently serve to protect groundwater from potential non-hydrocarbon contamination.

4.11 Groundwater Extraction Proposed Mitigation Measures

The extraction of groundwater from boreholes for the purpose of potable water supply will not be required for either the construction or operational phase of the project. As a result, no potential effects are anticipated from the extraction of groundwater as a potable water supply.

4.12 Pollution Contingency Plans

An Emergency Response Plan is attached as Management Plan 1 of the CEMP.

5 DRAINAGE SYSTEM OVERVIEW

5.1 SuDS Drainage Design

The design criteria for the SuDS design are as follows:

- To select and install ecologically sensitive drainage.
- 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 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 the problems of 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 Salmonid Regulations.

5.2 SuDS Design Principles

The approach to treatment and attenuation of storm water is as follows:

- Additional drainage measures will only be added as necessary. The dimensions of these features will avoid intercepting large volumes of water. Any changes to the SWMP must be agreed with the Environmental Manager and the ECoW.
- Surface water runoff from the proposed Site Access Tracks will be managed with crossfall downslope to mimic the natural drainage patterns of the site.
- Drainage vegetation used will be appropriate to the local area and will be approved by the ECoW.
- Temporary erosion protection together with silt fences may be required until the vegetation becomes established (coir matting or similar).
- Roads will be constructed from aggregate and will not be surfaced with bitumen materials, thus allowing for permeation and helping to reduce runoff volumes. Therefore, a reduced runoff coefficient of 65% is applicable. For hardstands, an open textured stone will be used as these will only be functional during construction of the specific turbine, a higher permeability is envisaged and the run-off co-efficient is reduced to 50%.
- An additional 20% rainfall will be included to allow for a possible increase in rainfall intensity due to climate change.
- Stormwater runoff within the trackside drainage will be treated through the provision of check dams, within a range depending on local slope of the drain.
- The stone used for the construction of the check dams will be washed graded stone with a size range between approximately 5mm and 40mm.

- 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 drainage pipes at existing surface water features. The under-track drainage will provide a means for flows to pass and maintain the natural flow throughout the site.
- A sump may be required for trench dewatering's. Water will subsequently be pumped into settlement ponds and allowed to settle. The general location of the small sump will ensure that they pose minimal health and safety risk to site personnel.
- The settlement ponds will be designed to cater for infilling and rehabilitation post construction phase of the project.
- The level of silt runoff during construction will be monitored and if found to be excessive in any area, will subsequently be managed by the provision of additional silt attenuation features such as silt fences or silt traps. If the suspended solids levels remain high, water can be pumped from settlement ponds into tankers and transferred off site to a suitable water treatment facility subject to agreement with the Local Authority. Note that works will be temporarily suspended in the area of the site contributing to elevated suspended solids levels.
- Field drains will be piped directly under the track through appropriately sized drainage pipes.
- Appropriate site management measures will be taken to ensure that runoff from the construction site is not contaminated by fuel or lubricant spillages.
- There will be no discharge of trade effluent, sewage effluent or contaminated drainage into any surface water feature.

5.3 Purpose of a SuDS Drainage Design

There is increased potential for water pollution, in particular sedimentation to local surface water features due to the excavation and generation of spoil and emplacement of stone materials during the construction stage of the project.

The purpose of incorporating a SuDS design is:

- To provide sufficient detail to ensure that water pollution will not occur as a result of construction activities at the site and to minimise the risk of any such occurrence.
- To regulate the rate of surface water run-off downslope to prevent scouring and to encourage settlement of sediment locally.

- To minimise the quantity of sediment laden stormwater and resulting settlement pond sizes by separating "clean" water from the "dirty" development runoff.

5.4 Design Philosophy

The SuDS design must be managed and monitored at all times, particularly after storm or heavy rainfall and during construction phase environmental auditing. The design rationale is that of an integrated approach where each element is assessed for its potential contribution to sediment suspension and the appropriate mitigation measures integrated into the layout design. The design principles are as follows:

Minimise → Intercept → Treat → Disperse → Dilute

5.4.1 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. It achieves this 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 in the buffer areas before entering site/ roadside drains.

5.4.2 Intercept

The key sediment control measure is the separation of construction runoff from the clean water runoff that arises in the undisturbed areas of the site and surrounding lands. This significantly reduces the volume and velocity of dirty water that the sediment and erosion control measures need to deal with. To achieve separation, clean water infiltration collector drains or silt fences are positioned on the upslope and dirty water v-drains positioned along the verge, with site surfaces sloped towards dirty water v-drains. The remainder of this clean water will be regularly piped under the site roads and dirty water v-drains to avoid contamination. Piping the clean water regularly under the site roads allows the clean water to follow the course it would have taken before construction thus mimicking the existing surface water sheet flow pattern of the site.

5.4.3 Treat, Disperse and Dilute

The clean water infiltration interceptor drains are positioned upslope of the development footprint, to prevent any mixing of the clean and 'dirty' water. The infiltration interceptor drains redirect the clean water away from the site infrastructure, as best suits the natural topography of each sector. The clean water outflow is then discharged into either, an existing drainage network or dispersed through an area of vegetation where it can percolate into the ground naturally.

In the drawings, 'dirty water' drains, collect all incident rainwater that falls on the development infrastructure. These then drain to buffered outfalls or into settlement ponds. The treated effluent from the settlement ponds is then 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.

6 DETAILED DESIGN CONSIDERATIONS

6.1 Overview

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

- Open Constructed drains for development run-off collection and treatment;
- Collection Drains for upslope "clean" water collection and dispersion;
- Filtration Check Dams to reduce velocities along sections of road which run perpendicular to contours;
- Settlement Ponds and Buffered Outfalls to control and store development runoff to encourage settlement prior to discharge at Greenfield runoff rates.

These measures provide a surface water management train that will mitigate any adverse impact on the hydrology of the site and surrounds during the construction phase of the project.

6.2 Cut-off Ditches / Collector Drains (Clean Water)

Drainage management will ensure that natural runoff is not permitted to mix with construction runoff from sources such as excavation dewatering or track runoff. Design will ensure that infiltration interceptor drains be installed upslope of development, to intercept and divert clean surface water runoff, prior to it coming in contact with areas of excavation. Design will ensure that natural runoff infiltration interceptor drains are installed ahead of main earthworks wherever practical.

This is intended to reduce the flow of natural runoff onto any exposed areas of peat/soil, thereby reducing the amount of potential silt laden runoff requiring treatment. Installed drainage will allow provision for natural runoff water, upslope of the development, to collect in infiltration interceptor drain and directed away from the development. In certain areas it will be required to pass through under track clean water culverts, separate to drainage provided for track runoff, and be discharged downstream of site development.

Temporary silt / pollution prevention and scour protection measures will be provided in artificial natural runoff drainage installed in order to mitigate potential for scouring and transport of sediment from newly excavated channels which will be formed as part of the construction runoff drainage provisions.

Frequency of outflow points are designed to avoid collection and interception of large catchments creating significant point flows, with associated risks due to scour and hydraulic capacity.

The drains will be a maximum of 350mm – 500mm in depth.

6.3 Buffered Outfalls

Dirty water will be discharged to land via buffered outfalls. These drainage outfalls will contain hard core material of similar or identical geology to the bedrock at the Site to entrap suspended sediment. In addition, these outfalls promote sediment percolation through vegetation in the buffer zone, reducing sediment loading to any adjacent watercourses and avoiding direct discharge to the watercourse. It is recommended that a relatively high number of discharge points are established, thus decreasing the loading on any particular outfall. Discharging at regular intervals mimics the natural hydrology by encouraging percolation and by decreasing individual hydraulic loadings from discharge points.

6.4 Trackside Drains (Dirty Water)

These are open gently sloping drainage channels to convey dirty water, trap sediment, enhance filtration and slow down the rate and magnitude of runoff that could enter the local watercourses. The drains will be a maximum of 350mm – 500mm in depth and the turve will be taken as a single piece and placed on the downslope side of the drain. Therefore, once construction works are complete the turve can be put back in place with minimal ecological damage.

6.5 Silt Fences

Silt Fences are designed in order to effectively filter the water, holding back the silt and allowing the water through, they need to be installed correctly with the lower part of the fence dug into the ground. Silt fences are also required to be cleaned out on a regular basis, particularly after periods of heavy rainfall. Silt fences need to be inspected and maintained on a regular basis in order to ensure that silty water is not running under or round the silt fences. Silt fences can also be used to divert clean water away from the development area, minimising the volume of dirty water.

6.6 Filtration Check Dams

Check dams (flow barriers or dams constructed across the drainage channel) will be installed at regular intervals within the dirty trackside drains in order to reduce erosion and allow for greater flow control. These check dams are required in order to reduce 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 scouring of the drainage channel itself. Rock filter bunds may be used for check dams however, stone can also be used if properly anchored. It is recommended that multiple check dams are installed, particularly in areas immediately downgradient of construction areas.

Settlement build up will be monitored and cleaned during the construction stage when necessary. 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;
- A Terram membrane barrier or similar non-woven geotextile membrane is to be placed around the check dam
- 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 will be removed before it reaches one half the original dam height.

Worked example for check dam spacings:

The depth of a check dam is 0.3m high: 0.3m x (1 in 100 gradient) = 30m spacing;

For a 0.3m high Check Dam: 0.3m x (1 in 50 gradient) = 15m spacing.

For a 0.5m high Check Dam: 0.5m x (1 in 50 gradient) = 25m spacing.

See Table 5.1 for recommended spacings, relative to the gradient of drain, for a 0.3m high check dam.

Table 6.1 Check Dam Spacing

Max Spacing (m)	Gradient
3m	10% (1 in 10)
4m	8% (1 in 12)
5m	6% (1 in 17)
6m	5% (1 in 20)
8m	4% (1 in 25)
10m	3% (1 In 33)
15m	2% (1 In 50)
20m	1.5% (1 in 67)
30m	(1 in 100)

6.7 Settlement Ponds

Runoff from the windfarm road surface will be attenuated to mimic natural runoff patterns. To capture runoff generated within the development footprint it is proposed to use constructed trackside drains. Accumulations of runoff will then be transferred to settlement ponds. See detail drawings (Drawing No. 6497-PL-101 to 107) which displays a diagrammatic cross section through a settlement pond within the drainage regime. All ponds will be kept as shallow as possible so that they pose no health and safety risk to plant or personnel. Settlement ponds are to be securely fenced to prevent easy access.

The ponds are utilised to attenuate and to aid the removal of suspended solids from site runoff water. All the pond locations are displayed within the site drainage drawings. Settlement ponds will be placed at (44) locations along the drainage footprint see drawings (Drawing No. 6497-PL-101 to 107). However, the exact positions and discharge points will be determined on site taking consideration of the local drainage conditions. Any changes to the SWMP will be agreed with the Project Hydrologist and Ecological Clerk of Works (ECoW) before drainage works commence.

Calculation parameters for the determination of storage requirements have been undertaken and are as follows:

- A 1 in 200 year rainfall return design (Source: Met Eireann - Please refer to Appendix A).
- An initial outlet overflow rate is applied of 16.45/s/ha (litres per second) which approximates to Greenfield run-off rates for the site. (Source: HR Wallingford – Please refer to Appendix A.
- The Rational Method is subsequently applied to calculate the flow volumes into each settlement pond over these respective periods.
- A is the area of the hardstanding / catchment, I is the rainfall depth and t is the duration of rainfall occurrence.
- A runoff coefficient of 0.60 (20% for Climate Change, 50% for runoff) is applied to all hardstand areas. These areas are only used using during the construction of turbine bases and delivery of turbine components. Therefore, their porosity will not be impacted during the construction or operation of the proposed development.
- A runoff coefficient of 0.78 (20% for Climate Change, 65% for runoff) is conservatively applied to the footprint areas excluding hardstands. As these areas will be used more frequently, they are more likely to become clogged with dirt and their porosity to reduce.

Table 6.2 identifies settlement ponds designed to treat and attenuate each development catchment area. The details in Table 6.2 are based on the calculations included in Appendix C.

Tables 6.2 Settlement Pond Sizing

Pond Ref.	Development Area (m^2)	Residual Volume (m^3)	Pond Dimensions			Overall Volume of Attenuation Pond (m^3)
			Dim. Length (m)	Dim. Width (m)	Dim. Height (m)	
SP 01	3938	63.0	12	6	1	72
SP 02	3938	63.0	12	6	1	72
SP 03	3600	79.8	15	6	1	90
SP 04	6015	108.9	21	6	1	126
SP 05	6015	108.9	21	6	1	126
SP 06	2585	57.3	15	4	1	60

Pond Ref.	Development Area (m^2)	Residual Volume (m^3)	Pond Dimensions			Overall Volume of Attenuation Pond (m^3)
			Dim. Length (m)	Dim. Width (m)	Dim. Height (m)	
SP 07	1280	28.4	12	3	1	36
SP 07A	3635	57.1	15	4	1	60
SP 07B	3635	57.1	15	4	1	60
SP 08	3275	72.6	15	6	1	90
SP 09	7595	119.2	21	6	1	126
SP 10	1610	35.7	12	3	1	36
SP 10A	3465	54.4	15	4	1	60
SP 10B	3465	45.3	15	4	1	60
SP 11	2550	56.6	15	4	1	60
SP 12	2235	49.6	15	4	1	60
SP 13	4700	73.8	15	6	1	90
SP 13A	4700	73.8	15	6	1	90
SP 14	3700	82.1	15	6	1	90
SP 14A	3700	82.1	15	6	1	90
SP 15	3650	81	15	6	1	90
SP 16	4215	66.2	12	6	1	72
SP 16A	4215	66.2	12	6	1	72
SP 17	1750	38.8	15	3	1	45
SP 18	2150	47.7	12	4	1	48
SP 19	4135	64.9	18	4	1	72
SP 19A	4135	64.9	18	4	1	72
SP 20	5552	87.1	15	6	1	90
SP 20A	5552	87.1	15	6	1	90
SP 20B	5552	87.1	15	6	1	90
SP 21	3700	82.1	15	6	1	90
SP 22	5100	113	21	6	1	126
SP 22A	5100	80	15	6	1	90
SP 23	5035	79	15	6	1	90
SP 23A	5035	79	15	6	1	90

Pond Ref.	Development Area (m^2)	Residual Volume (m^3)	Pond Dimensions			Overall Volume of Attenuation Pond (m^3)
			Dim. Length (m)	Dim. Width (m)	Dim. Height (m)	
SP 24	6965	109	21	6	1	126
SP 25	5330	83.7	15	6	1	90
SP 25A	5330	83.7	15	6	1	90
SP 26	3565	56	15	4	1	60
SP 27	3840	60.3	18	4	1	72
SP 27A	3840	60.3	18	4	1	72
SP28	2180	34.2	12	3	1	36
SP28A	3340	74.1	15	6	1	90
SP29	3450	76.5	15	6	1	90

7 MAINTENANCE AND MONITORING

- Surface water runoff control infrastructure will be checked daily and maintained on a regular basis and settlement ponds and check dams will be maintained (desludged/settle solids removed) on a regular basis, particularly during the construction phase of the Development. It is important to minimise the agitation of solids during these works, otherwise it will likely lead to an acute significant loading of suspended solids in the drainage network. Water quality monitoring shall be carried out in accordance with the Water Inspection and Monitoring Plan.

- Site water runoff quality will be monitored on a continuous basis at a reasonable frequency during both the construction, operational and decommissioning phases of the Development. A relatively high frequency of monitoring (e.g. daily) is required during the construction and decommissioning phases, similarly the early stages of the operational phase will require a relatively high frequency of monitoring, however the frequency of monitoring can gradually reduce thereafter – presuming there are no issues with the quality of discharging water at that point in time.

- It is recommended that continuous monitoring systems are put in place, particularly in principal surface water features draining the Site. For example; remote sensing, or telemetric monitoring sensors (turbidity) can be employed in this regard. It is recommended that a handheld turbidity meter is at available to accurately measure the quality of water discharging from the Site. The meter should be maintained and calibrated frequently and will also be used to check and calibrate remote sensors if they are employed. It is recommended that quality thresholds are established for the purposes of escalating water quality issues as/if they arise.

8 POST CONSTRUCTION DRAINAGE MANAGEMENT

Following the completion of construction, a full review of construction stage temporary drainage will be undertaken by the appointed Contractor (in conjunction with the Environmental Manager, Site Engineer and the Project ECoW), with a view to removing drainage infrastructure that is no longer required during the development's operation phase.

APPENDIX A

MET EIREANN RAINFALL DATA

Met Eireann
Return Period Rainfall Depths for sliding Durations
Irish Grid: Easting: 215818, Northing: 104956,

	Interval		Years													
DURATION	6months,	1year,	2,	3,	4,	5,	10,	20,	30,	50,	75,	100,	150,	200,	250,	500,
5 mins	3.2,	4.1,	4.5,	5.1,	5.5,	5.8,	6.8,	7.8,	8.4,	9.3,	10.1,	10.6,	11.5,	12.1,	12.6,	N/A ,
10 mins	4.4,	5.6,	6.3,	7.1,	7.7,	8.1,	9.4,	10.9,	11.8,	13.0,	14.0,	14.8,	16.0,	16.9,	17.6,	N/A ,
15 mins	5.2,	6.6,	7.4,	8.4,	9.0,	9.5,	11.1,	12.8,	13.8,	15.3,	16.5,	17.4,	18.8,	19.8,	20.7,	N/A ,
30 mins	7.0,	8.9,	9.9,	11.3,	12.2,	12.8,	15.0,	17.2,	18.6,	20.6,	22.2,	23.5,	25.3,	26.7,	27.9,	N/A ,
1 hours	9.5,	12.1,	13.3,	15.2,	16.4,	17.3,	20.2,	23.2,	25.1,	27.7,	29.9,	31.6,	34.1,	36.0,	37.6,	N/A ,
2 hours	12.8,	16.2,	18.0,	20.5,	22.1,	23.3,	27.2,	31.2,	33.8,	37.3,	40.3,	42.6,	46.0,	48.5,	50.6,	N/A ,
3 hours	15.2,	19.3,	21.4,	24.4,	26.3,	27.8,	32.3,	37.2,	40.3,	44.4,	48.0,	50.7,	54.7,	57.8,	60.2,	N/A ,
4 hours	17.2,	21.9,	24.2,	27.6,	29.8,	31.4,	36.6,	42.1,	45.6,	50.3,	54.3,	57.4,	61.9,	65.4,	68.2,	N/A ,
6 hours	20.5,	26.0,	28.8,	32.8,	35.4,	37.4,	43.5,	50.1,	54.2,	59.8,	64.6,	68.3,	73.7,	77.8,	81.2,	N/A ,
9 hours	24.3,	31.0,	34.3,	39.1,	42.2,	44.5,	51.8,	59.6,	64.6,	71.2,	77.0,	81.3,	87.8,	92.7,	96.6,	N/A ,
12 hours	27.6,	35.1,	38.9,	44.2,	47.7,	50.4,	58.7,	67.5,	73.1,	80.6,	87.1,	92.0,	99.3,	104.9,	109.4,	N/A ,
18 hours	32.8,	41.8,	46.3,	52.7,	56.8,	60.0,	69.8,	80.3,	87.0,	96.0,	103.7,	109.5,	118.2,	124.8,	130.2,	N/A ,
24 hours	37.1,	47.3,	52.3,	59.6,	64.3,	67.9,	79.0,	90.9,	98.4,	108.6,	117.3,	123.9,	133.8,	141.3,	147.3,	167.8,
2 days	46.8,	58.3,	64.1,	72.1,	77.3,	81.3,	93.4,	106.1,	114.1,	124.9,	134.0,	140.9,	151.1,	158.8,	165.0,	185.9,
3 days	54.9,	67.7,	73.9,	82.7,	88.3,	92.5,	105.5,	119.1,	127.6,	138.9,	148.5,	155.7,	166.3,	174.3,	180.8,	202.3,
4 days	62.2,	76.0,	82.8,	92.2,	98.2,	102.6,	116.4,	130.8,	139.6,	151.5,	161.5,	169.0,	180.1,	188.4,	195.0,	217.3,
6 days	75.4,	91.0,	98.6,	109.1,	115.7,	120.7,	135.8,	151.5,	161.1,	174.0,	184.7,	192.8,	204.6,	213.4,	220.5,	244.1,
8 days	87.4,	104.6,	112.8,	124.3,	131.5,	136.9,	153.2,	170.0,	180.4,	194.0,	205.5,	214.0,	226.6,	235.9,	243.4,	268.1,
10 days	98.6,	117.2,	126.1,	138.4,	146.1,	151.9,	169.3,	187.2,	198.1,	212.6,	224.6,	233.6,	246.8,	256.5,	264.3,	290.2,
12 days	109.3,	129.2,	138.7,	151.8,	160.0,	166.1,	184.5,	203.3,	214.8,	229.9,	242.6,	251.9,	265.7,	275.9,	284.0,	310.9,
16 days	129.5,	151.8,	162.4,	176.8,	185.9,	192.6,	212.9,	233.4,	245.9,	262.3,	276.0,	286.1,	300.8,	311.8,	320.5,	349.2,
20 days	148.7,	173.2,	184.7,	200.4,	210.2,	217.5,	239.4,	261.4,	274.8,	292.4,	307.0,	317.7,	333.4,	345.0,	354.2,	384.5,
25 days	171.7,	198.6,	211.2,	228.4,	239.1,	247.0,	270.7,	294.5,	308.9,	327.7,	343.3,	354.8,	371.6,	383.9,	393.7,	425.9,

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

APPENDIX B

HR WALLINGFORD GREENFIELD RUN-OFF RATES

Greenfield runoff r
estimation for s

www.uksuds.com | Greenfield runo

Calculated by:	Sarah Moore
Site name:	Dyrick Hill Wind Farm
Site location:	

This is an estimation of the greenfield runoff rates that are used to meet normal best practice criteria in line with Environment Agency guidance "Rainfall runoff management for developments", SC030219 (2013) , the SuDS Manual C753 (Ciria, 2015) and the non-statutory standards for SuDS (Defra, 2015). This information on greenfield runoff rates may be the basis for setting consents for the drainage of surface water runoff from sites.

Site Details

Latitude:	52.20750
Longitude:	7.79283°
Reference:	2157754
Date:	May 31 2023 12:

Runoff estimation approach

IH124

Site characteristics

Total site area (ha):	463

Methodology

Q_{BAR} estimation method:	Calculate from SPR and SAAR
SPR estimation method:	Calculate from SOIL type

Soil characteristics

	Default	Edited
SOIL type:	4	4
HOST class:	N/A	N/A
SPR/SPRHOST:	0.47	0.47

Hydrological characteristics

	Default	Edited
SAAR (mm):	1279	1279
Hydrological region:	13	13
Growth curve factor 1 year:	0.85	0.85
Growth curve factor 30 years:	1.65	1.65
Growth curve factor 100 years:	1.95	1.95
Growth curve factor 200 years:	2.15	2.15

Notes

(1) Is Q_{BAR} < 2.0 l/s/ha?

When Q_{BAR} is < 2.0 l/s/ha then limiting discharge rates are set at 2.0 l/s/ha.

(2) Are flow rates < 5.0 l/s?

Where flow rates are less than 5.0 l/s consent for discharge is usually set at 5.0 l/s if blockage from vegetation and other materials is possible. Lower consent flow rates may be set where the blockage risk is addressed by using appropriate drainage elements.

(3) Is SPR/SPRHOST ≤ 0.3?

Where groundwater levels are low enough the use of soakaways to avoid discharge offsite would normally be preferred for disposal of surface water runoff.

Greenfield runoff rates

	Default	Edited
Q_{BAR} (l/s):	3542.27	3542.27
1 in 1 year (l/s):	3010.93	3010.93
1 in 30 years (l/s):	5844.75	5844.75
1 in 100 year (l/s):	6907.43	6907.43
1 in 200 years (l/s):	7615.88	7615.88

APPENDIX C

SETTLEMENT POND SIZING CALCULATIONS

Dyrick Hill SuDS Drainage Design

Rational Method Q = 0.278 CiA

		Catchment Area							
Ref	**Total Catchment A (m^2)**	**A Hardstand (m^2)**	**A excl Hardstand (m^2)**	**A Hardstand (km^2)**	**A excl Hardstand (km^2)**	**Residual Volume (m3)**	**Width (m)**	**Height (m)**	**Optimised Length**
SP 01	3937.5	3750	187.5	0.0038	0.0002	63.0	6.00	1.0	12
SP 02	3937.5	3750	187.5	0.0038	0.0002	63.0	6.00	1.0	12
SP 03	3600	0	3600	0.0000	0.0036	79.8	6.00	1.0	15
SP 04	6015	3780	2235	0.0038	0.0022	108.9	6.00	1.0	21
SP 05	6015	3780	2235	0.0038	0.0022	108.9	6.00	1.0	21
SP 06	2585	0	2585	0.0000	0.0026	57.3	4.00	1.0	15
SP 07	1280	0	1280	0.0000	0.0013	28.4	3.00	1.0	12
SP 07A	3635	3635	0	0.0036	0.0000	57.1	4.00	1.0	15
SP 07B	3635	3635	0	0.0036	0.0000	57.1	4.00	1.0	15
SP 08	3275	0	3275	0.0000	0.0033	72.6	6.00	1.0	15
SP 09	7595	7595	0	0.0076	0.0000	119.2	6.00	1.0	21
SP 10	1610	0	1610	0.0000	0.0016	35.7	3.00	1.0	12
SP 10A	3465	3465	0	0.0035	0.0000	54.4	4.00	1.0	15
SP 10B	3465	3465	0	0.0035	0.0000	45.3	4.00	1.0	15
SP 11	2550	0	2550	0.0000	0.0026	56.6	4.00	1.0	15
SP 12	2235	0	2235	0.0000	0.0022	49.6	4.00	1.0	15
SP 13	4700	4700	0	0.0047	0.0000	73.8	6.00	1.0	15
SP 13A	4700	4700	0	0.0047	0.0000	73.8	6.00	1.0	15
SP 14	3700	0	3700	0.0000	0.0037	82.1	6.00	1.0	15
SP 14A	3700	0	3700	0.0000	0.0037	82.1	6.00	1.0	15

Catchment			**SP 01**	Area Excl Hardstand					water discharge rate (l/s)	
Clean water natural flow									16.45	l/s/ha
1 in 200 year return	**minutes**	**Rainfall (mm)**		**C**	**i (mm/hr)**	**A (km^2)**	**(m^3/s)**	**Volume (m^3)**	**Discharge (m^3/ha)**	**Residual Volume (m^3)**
M200 5min	5	12.1	0.278	0.78	145.2	0.00019	0.006	1.8	4.9	1.7
M200 10min	10	16.9	0.278	0.78	101.4	0.00019	0.004	2.5	9.9	2.3
M200 15min	15	19.8	0.278	0.78	79.2	0.00019	0.003	2.9	14.8	2.6
M200 30min	30	26.7	0.278	0.78	53.4	0.00019	0.002	3.9	29.6	3.4
M200 60min	60	36	0.278	0.78	36	0.00019	0.001	5.3	59.2	4.2
M200 2hr	120	48.5	0.278	0.78	24.25	0.00019	0.001	7.1	118.4	4.9
M200 4hr	240	65.4	0.278	0.78	16.35	0.00019	0.001	9.6	236.9	5.1
M200 6hr	300	77.8	0.278	0.78	15.56	0.00019	0.001	13.7	355.3	7.0
M200 12hr	600	104.9	0.278	0.78	10.49	0.00019	0.000	18.4	710.6	5.1
M200 24hr	1200	141.3	0.278	0.78	7.065	0.00019	0.000	24.8	1421.3	-1.8
M200 48hr	2400	158.8	0.278	0.78	3.97	0.00019	0.000	27.9	2842.6	-25.4

Catchment			SP 01	Hardstand				water discharge rate (l/s)		
Clean water natural flow									16.45	l/s/ha
1 in 200 year return	**minutes**	**Rainfall (mm)**		**C**	**i (mm/hr)**	**A (km^2)**	**(m^3/s)**	**Volume (m^3)**	**Discharge (m^3/ha)**	**Residual Volume (m^3)**
M200 5min	5	12.1	0.278	0.6	145.2	0.00375	0.091	27.2	4.9	25.4
M200 10min	10	16.9	0.278	0.6	101.4	0.00375	0.063	38.1	9.9	34.4
M200 15min	15	19.8	0.278	0.6	79.2	0.00375	0.050	44.6	14.8	39.0
M200 30min	30	26.7	0.278	0.6	53.4	0.00375	0.033	60.1	29.6	49.0
M200 60min	60	36	0.278	0.6	36	0.00375	0.023	81.1	59.2	58.9
M200 2hr	120	48.5	0.278	0.6	24.25	0.00375	0.015	109.2	118.4	64.8
M200 4hr	240	65.4	0.278	0.6	16.35	0.00375	0.010	147.3	236.9	58.4
M200 6hr	300	77.8	0.278	0.6	15.56	0.00375	0.010	210.2	355.3	77.0
M200 12hr	600	104.9	0.278	0.6	10.49	0.00375	0.007	283.5	710.6	17.0
M200 24hr	1200	141.3	0.278	0.6	7.065	0.00375	0.004	381.8	1421.3	-151.2
M200 48hr	2400	158.8	0.278	0.6	3.97	0.00375	0.002	429.1	2842.6	-636.9

Catchment			SP 02	Area Excl Hardstand				water discharge rate (l/s)		
Clean water natural flow									16.45	l/s/ha
1 in 200 year return	**minutes**	**Rainfall (mm)**		**C**	**i (mm/hr)**	**A (km^2)**	**(m^3/s)**	**Volume (m^3)**	**Discharge (m^3/ha)**	**Residual Volume (m^3)**
M200 5min	5	12.1	0.278	0.78	145.2	0.00019	0.006	1.8	4.9	1.7
M200 10min	10	16.9	0.278	0.78	101.4	0.00019	0.004	2.5	9.9	2.3
M200 15min	15	19.8	0.278	0.78	79.2	0.00019	0.003	2.9	14.8	2.6
M200 30min	30	26.7	0.278	0.78	53.4	0.00019	0.002	3.9	29.6	3.4
M200 60min	60	36	0.278	0.78	36	0.00019	0.001	5.3	59.2	4.2
M200 2hr	120	48.5	0.278	0.78	24.25	0.00019	0.001	7.1	118.4	4.9
M200 4hr	240	65.4	0.278	0.78	16.35	0.00019	0.001	9.6	236.9	5.1
M200 6hr	300	77.8	0.278	0.78	15.56	0.00019	0.001	13.7	355.3	7.0
M200 12hr	600	104.9	0.278	0.78	10.49	0.00019	0.000	18.4	710.6	5.1
M200 24hr	1200	141.3	0.278	0.78	7.065	0.00019	0.000	24.8	1421.3	-1.8
M200 48hr	2400	158.8	0.278	0.78	3.97	0.00019	0.000	27.9	2842.6	-25.4

Catchment			SP 02	Hardstand				water discharge rate (l/s)		
Clean water natural flow									16.45	l/s/ha
1 in 200 year return	**minutes**	**Rainfall (mm)**		**C**	**i (mm/hr)**	**A (km^2)**	**(m^3/s)**	**Volume (m^3)**	**Discharge (m^3/ha)**	**Residual Volume (m^3)**
M200 5min	5	12.1	0.278	0.6	145.2	0.00375	0.091	27.2	4.9	25.4
M200 10min	10	16.9	0.278	0.6	101.4	0.00375	0.063	38.1	9.9	34.4
M200 15min	15	19.8	0.278	0.6	79.2	0.00375	0.050	44.6	14.8	39.0
M200 30min	30	26.7	0.278	0.6	53.4	0.00375	0.033	60.1	29.6	49.0
M200 60min	60	36	0.278	0.6	36	0.00375	0.023	81.1	59.2	58.9
M200 2hr	120	48.5	0.278	0.6	24.25	0.00375	0.015	109.2	118.4	64.8
M200 4hr	240	65.4	0.278	0.6	16.35	0.00375	0.010	147.3	236.9	58.4
M200 6hr	300	77.8	0.278	0.6	15.56	0.00375	0.010	210.2	355.3	77.0
M200 12hr	600	104.9	0.278	0.6	10.49	0.00375	0.007	283.5	710.6	17.0
M200 24hr	1200	141.3	0.278	0.6	7.065	0.00375	0.004	381.8	1421.3	-151.2
M200 48hr	2400	158.8	0.278	0.6	3.97	0.00375	0.002	429.1	2842.6	-636.9

Catchment		SP 03	Area Excl Hardstand					water discharge rate (l/s)		
Clean water natural flow									16.45	l/s/ha
1 in 200 year return	**minutes**	**Rainfall (mm)**		**C**	**i (mm/hr)**	**A (km^2)**	**(m^3/s)**	**Volume (m^3)**	**Discharge (m^3/ha)**	**Residual Volume (m^3)**
M200 5min	5	12.1	0.278	0.78	145.2	0.00360	0.113	34.0	4.9	32.2
M200 10min	10	16.9	0.278	0.78	101.4	0.00360	0.079	47.5	9.9	43.9
M200 15min	15	19.8	0.278	0.78	79.2	0.00360	0.062	55.6	14.8	50.3
M200 30min	30	26.7	0.278	0.78	53.4	0.00360	0.042	75.0	29.6	64.4
M200 60min	60	36	0.278	0.78	36	0.00360	0.028	101.2	59.2	79.8
M200 2hr	120	48.5	0.278	0.78	24.25	0.00360	0.019	136.3	118.4	93.7
M200 4hr	240	65.4	0.278	0.78	16.35	0.00360	0.013	183.8	236.9	98.5
M200 6hr	300	77.8	0.278	0.78	15.56	0.00360	0.012	262.4	355.3	134.4
M200 12hr	600	104.9	0.278	0.78	10.49	0.00360	0.008	353.8	710.6	97.9
M200 24hr	1200	141.3	0.278	0.78	7.065	0.00360	0.006	476.5	1421.3	-35.2
M200 48hr	2400	158.8	0.278	0.78	3.97	0.00360	0.003	535.5	2842.6	-487.8

Catchment		SP 03	Hardstand					water discharge rate (l/s)		
Clean water natural flow									16.45	l/s/ha
1 in 200 year return	**minutes**	**Rainfall (mm)**		**C**	**i (mm/hr)**	**A (km^2)**	**(m^3/s)**	**Volume (m^3)**	**Discharge (m^3/ha)**	**Residual Volume (m^3)**
M200 5min	5	12.1	0.278	0.6	145.2	0.00000	0.000	0.0	4.9	0.0
M200 10min	10	16.9	0.278	0.6	101.4	0.00000	0.000	0.0	9.9	0.0
M200 15min	15	19.8	0.278	0.6	79.2	0.00000	0.000	0.0	14.8	0.0
M200 30min	30	26.7	0.278	0.6	53.4	0.00000	0.000	0.0	29.6	0.0
M200 60min	60	36	0.278	0.6	36	0.00000	0.000	0.0	59.2	0.0
M200 2hr	120	48.5	0.278	0.6	24.25	0.00000	0.000	0.0	118.4	0.0
M200 4hr	240	65.4	0.278	0.6	16.35	0.00000	0.000	0.0	236.9	0.0
M200 6hr	300	77.8	0.278	0.6	15.56	0.00000	0.000	0.0	355.3	0.0
M200 12hr	600	104.9	0.278	0.6	10.49	0.00000	0.000	0.0	710.6	0.0
M200 24hr	1200	141.3	0.278	0.6	7.065	0.00000	0.000	0.0	1421.3	0.0
M200 48hr	2400	158.8	0.278	0.6	3.97	0.00000	0.000	0.0	2842.6	0.0

Catchment		SP 04	Area Excl Hardstand					water discharge rate (l/s)		
Clean water natural flow									16.45	l/s/ha
1 in 200 year return	**minutes**	**Rainfall (mm)**		**C**	**i (mm/hr)**	**A (km^2)**	**(m^3/s)**	**Volume (m^3)**	**Discharge (m^3/ha)**	**Residual Volume (m^3)**
M200 5min	5	12.1	0.278	0.78	145.2	0.00224	0.070	21.1	4.9	20.0
M200 10min	10	16.9	0.278	0.78	101.4	0.00224	0.049	29.5	9.9	27.3
M200 15min	15	19.8	0.278	0.78	79.2	0.00224	0.038	34.5	14.8	31.2
M200 30min	30	26.7	0.278	0.78	53.4	0.00224	0.026	46.6	29.6	40.0
M200 60min	60	36	0.278	0.78	36	0.00224	0.017	62.8	59.2	49.6
M200 2hr	120	48.5	0.278	0.78	24.25	0.00224	0.012	84.6	118.4	58.1
M200 4hr	240	65.4	0.278	0.78	16.35	0.00224	0.008	114.1	236.9	61.2
M200 6hr	300	77.8	0.278	0.78	15.56	0.00224	0.008	162.9	355.3	83.5
M200 12hr	600	104.9	0.278	0.78	10.49	0.00224	0.005	219.6	710.6	60.8
M200 24hr	1200	141.3	0.278	0.78	7.065	0.00224	0.003	295.8	1421.3	-21.8
M200 48hr	2400	158.8	0.278	0.78	3.97	0.00224	0.002	332.5	2842.6	-302.8

Catchment		SP 04	Hardstand				water discharge rate (l/s)			
Clean water natural flow									16.45	l/s/ha
1 in 200 year return	**minutes**	**Rainfall (mm)**		**C**	**i (mm/hr)**	**A (km^2)**	**(m^3/s)**	**Volume (m^3)**	**Discharge (m^3/ha)**	**Residual Volume (m^3)**
M200 5min	5	12.1	0.278	0.6	145.2	0.00378	0.092	27.5	4.9	25.6
M200 10min	10	16.9	0.278	0.6	101.4	0.00378	0.064	38.4	9.9	34.6
M200 15min	15	19.8	0.278	0.6	79.2	0.00378	0.050	44.9	14.8	39.3
M200 30min	30	26.7	0.278	0.6	53.4	0.00378	0.034	60.6	29.6	49.4
M200 60min	60	36	0.278	0.6	36	0.00378	0.023	81.7	59.2	59.3
M200 2hr	120	48.5	0.278	0.6	24.25	0.00378	0.015	110.1	118.4	65.3
M200 4hr	240	65.4	0.278	0.6	16.35	0.00378	0.010	148.4	236.9	58.9
M200 6hr	300	77.8	0.278	0.6	15.56	0.00378	0.010	211.9	355.3	77.6
M200 12hr	600	104.9	0.278	0.6	10.49	0.00378	0.007	285.7	710.6	17.1
M200 24hr	1200	141.3	0.278	0.6	7.065	0.00378	0.004	384.9	1421.3	-152.4
M200 48hr	2400	158.8	0.278	0.6	3.97	0.00378	0.003	432.5	2842.6	-642.0

Catchment		SP 05	Area Excl Hardstand				water discharge rate (l/s)			
Clean water natural flow									16.45	l/s/ha
1 in 200 year return	**minutes**	**Rainfall (mm)**		**C**	**i (mm/hr)**	**A (km^2)**	**(m^3/s)**	**Volume (m^3)**	**Discharge (m^3/ha)**	**Residual Volume (m^3)**
M200 5min	5	12.1	0.278	0.78	145.2	0.00224	0.070	21.1	4.9	20.0
M200 10min	10	16.9	0.278	0.78	101.4	0.00224	0.049	29.5	9.9	27.3
M200 15min	15	19.8	0.278	0.78	79.2	0.00224	0.038	34.5	14.8	31.2
M200 30min	30	26.7	0.278	0.78	53.4	0.00224	0.026	46.6	29.6	40.0
M200 60min	60	36	0.278	0.78	36	0.00224	0.017	62.8	59.2	49.6
M200 2hr	120	48.5	0.278	0.78	24.25	0.00224	0.012	84.6	118.4	58.1
M200 4hr	240	65.4	0.278	0.78	16.35	0.00224	0.008	114.1	236.9	61.2
M200 6hr	300	77.8	0.278	0.78	15.56	0.00224	0.008	162.9	355.3	83.5
M200 12hr	600	104.9	0.278	0.78	10.49	0.00224	0.005	219.6	710.6	60.8
M200 24hr	1200	141.3	0.278	0.78	7.065	0.00224	0.003	295.8	1421.3	-21.8
M200 48hr	2400	158.8	0.278	0.78	3.97	0.00224	0.002	332.5	2842.6	-302.8

Catchment		SP 05	Hardstand				water discharge rate (l/s)			
Clean water natural flow									16.45	l/s/ha
1 in 200 year return	**minutes**	**Rainfall (mm)**		**C**	**i (mm/hr)**	**A (km^2)**	**(m^3/s)**	**Volume (m^3)**	**Discharge (m^3/ha)**	**Residual Volume (m^3)**
M200 5min	5	12.1	0.278	0.6	145.2	0.00378	0.092	27.5	4.9	25.6
M200 10min	10	16.9	0.278	0.6	101.4	0.00378	0.064	38.4	9.9	34.6
M200 15min	15	19.8	0.278	0.6	79.2	0.00378	0.050	44.9	14.8	39.3
M200 30min	30	26.7	0.278	0.6	53.4	0.00378	0.034	60.6	29.6	49.4
M200 60min	60	36	0.278	0.6	36	0.00378	0.023	81.7	59.2	59.3
M200 2hr	120	48.5	0.278	0.6	24.25	0.00378	0.015	110.1	118.4	65.3
M200 4hr	240	65.4	0.278	0.6	16.35	0.00378	0.010	148.4	236.9	58.9
M200 6hr	300	77.8	0.278	0.6	15.56	0.00378	0.010	211.9	355.3	77.6
M200 12hr	600	104.9	0.278	0.6	10.49	0.00378	0.007	285.7	710.6	17.1
M200 24hr	1200	141.3	0.278	0.6	7.065	0.00378	0.004	384.9	1421.3	-152.4
M200 48hr	2400	158.8	0.278	0.6	3.97	0.00378	0.003	432.5	2842.6	-642.0

Catchment			SP 06	Area Excl Hardstand					water discharge rate (l/s)	
Clean water natural flow									16.45	l/s/ha
1 in 200 year return	**minutes**	**Rainfall (mm)**		**C**	**i (mm/hr)**	**A (km^2)**	**(m^3/s)**	**Volume (m^3)**	**Discharge (m^3/ha)**	**Residual Volume (m^3)**
M200 5min	5	12.1	0.278	0.78	145.2	0.00259	0.081	24.4	4.9	23.1
M200 10min	10	16.9	0.278	0.78	101.4	0.00259	0.057	34.1	9.9	31.6
M200 15min	15	19.8	0.278	0.78	79.2	0.00259	0.044	40.0	14.8	36.1
M200 30min	30	26.7	0.278	0.78	53.4	0.00259	0.030	53.9	29.6	46.2
M200 60min	60	36	0.278	0.78	36	0.00259	0.020	72.6	59.2	57.3
M200 2hr	120	48.5	0.278	0.78	24.25	0.00259	0.014	97.9	118.4	67.3
M200 4hr	240	65.4	0.278	0.78	16.35	0.00259	0.009	132.0	236.9	70.7
M200 6hr	300	77.8	0.278	0.78	15.56	0.00259	0.009	188.4	355.3	96.5
M200 12hr	600	104.9	0.278	0.78	10.49	0.00259	0.006	254.0	710.6	70.3
M200 24hr	1200	141.3	0.278	0.78	7.065	0.00259	0.004	342.2	1421.3	-25.2
M200 48hr	2400	158.8	0.278	0.78	3.97	0.00259	0.002	384.5	2842.6	-350.3

Catchment			SP 06	Hardstand					water discharge rate (l/s)	
Clean water natural flow									16.45	l/s/ha
1 in 200 year return	**minutes**	**Rainfall (mm)**		**C**	**i (mm/hr)**	**A (km^2)**	**(m^3/s)**	**Volume (m^3)**	**Discharge (m^3/ha)**	**Residual Volume (m^3)**
M200 5min	5	12.1	0.278	0.6	145.2	0.00000	0.000	0.0	4.9	0.0
M200 10min	10	16.9	0.278	0.6	101.4	0.00000	0.000	0.0	9.9	0.0
M200 15min	15	19.8	0.278	0.6	79.2	0.00000	0.000	0.0	14.8	0.0
M200 30min	30	26.7	0.278	0.6	53.4	0.00000	0.000	0.0	29.6	0.0
M200 60min	60	36	0.278	0.6	36	0.00000	0.000	0.0	59.2	0.0
M200 2hr	120	48.5	0.278	0.6	24.25	0.00000	0.000	0.0	118.4	0.0
M200 4hr	240	65.4	0.278	0.6	16.35	0.00000	0.000	0.0	236.9	0.0
M200 6hr	300	77.8	0.278	0.6	15.56	0.00000	0.000	0.0	355.3	0.0
M200 12hr	600	104.9	0.278	0.6	10.49	0.00000	0.000	0.0	710.6	0.0
M200 24hr	1200	141.3	0.278	0.6	7.065	0.00000	0.000	0.0	1421.3	0.0
M200 48hr	2400	158.8	0.278	0.6	3.97	0.00000	0.000	0.0	2842.6	0.0

Catchment			SP 07	Area Excl Hardstand					water discharge rate (l/s)	
Clean water natural flow									16.45	l/s/ha
1 in 200 year return	**minutes**	**Rainfall (mm)**		**C**	**i (mm/hr)**	**A (km^2)**	**(m^3/s)**	**Volume (m^3)**	**Discharge (m^3/ha)**	**Residual Volume (m^3)**
M200 5min	5	12.1	0.278	0.78	145.2	0.00128	0.040	12.1	4.9	11.5
M200 10min	10	16.9	0.278	0.78	101.4	0.00128	0.028	16.9	9.9	15.6
M200 15min	15	19.8	0.278	0.78	79.2	0.00128	0.022	19.8	14.8	17.9
M200 30min	30	26.7	0.278	0.78	53.4	0.00128	0.015	26.7	29.6	22.9
M200 60min	60	36	0.278	0.78	36	0.00128	0.010	36.0	59.2	28.4
M200 2hr	120	48.5	0.278	0.78	24.25	0.00128	0.007	48.5	118.4	33.3
M200 4hr	240	65.4	0.278	0.78	16.35	0.00128	0.005	65.3	236.9	35.0
M200 6hr	300	77.8	0.278	0.78	15.56	0.00128	0.004	93.3	355.3	47.8
M200 12hr	600	104.9	0.278	0.78	10.49	0.00128	0.003	125.8	710.6	34.8
M200 24hr	1200	141.3	0.278	0.78	7.065	0.00128	0.002	169.4	1421.3	-12.5
M200 48hr	2400	158.8	0.278	0.78	3.97	0.00128	0.001	190.4	2842.6	-173.4

Catchment			SP 07	Hardstand				water discharge rate (l/s)		
Clean water natural flow									16.45	l/s/ha
1 in 200 year return	**minutes**	**Rainfall (mm)**		**C**	**i (mm/hr)**	**A (km^2)**	**(m^3/s)**	**Volume (m^3)**	**Discharge (m^3/ha)**	**Residual Volume (m^3)**
M200 5min	5	12.1	0.278	0.6	145.2	0.00000	0.000	0.0	4.9	0.0
M200 10min	10	16.9	0.278	0.6	101.4	0.00000	0.000	0.0	9.9	0.0
M200 15min	15	19.8	0.278	0.6	79.2	0.00000	0.000	0.0	14.8	0.0
M200 30min	30	26.7	0.278	0.6	53.4	0.00000	0.000	0.0	29.6	0.0
M200 60min	60	36	0.278	0.6	36	0.00000	0.000	0.0	59.2	0.0
M200 2hr	120	48.5	0.278	0.6	24.25	0.00000	0.000	0.0	118.4	0.0
M200 4hr	240	65.4	0.278	0.6	16.35	0.00000	0.000	0.0	236.9	0.0
M200 6hr	300	77.8	0.278	0.6	15.56	0.00000	0.000	0.0	355.3	0.0
M200 12hr	600	104.9	0.278	0.6	10.49	0.00000	0.000	0.0	710.6	0.0
M200 24hr	1200	141.3	0.278	0.6	7.065	0.00000	0.000	0.0	1421.3	0.0
M200 48hr	2400	158.8	0.278	0.6	3.97	0.00000	0.000	0.0	2842.6	0.0

Catchment			SP 07A	Area Excl Hardstand				water discharge rate (l/s)		
Clean water natural flow									16.45	l/s/ha
1 in 200 year return	**minutes**	**Rainfall (mm)**		**C**	**i (mm/hr)**	**A (km^2)**	**(m^3/s)**	**Volume (m^3)**	**Discharge (m^3/ha)**	**Residual Volume (m^3)**
M200 5min	5	12.1	0.278	0.78	145.2	0.00000	0.000	0.0	4.9	0.0
M200 10min	10	16.9	0.278	0.78	101.4	0.00000	0.000	0.0	9.9	0.0
M200 15min	15	19.8	0.278	0.78	79.2	0.00000	0.000	0.0	14.8	0.0
M200 30min	30	26.7	0.278	0.78	53.4	0.00000	0.000	0.0	29.6	0.0
M200 60min	60	36	0.278	0.78	36	0.00000	0.000	0.0	59.2	0.0
M200 2hr	120	48.5	0.278	0.78	24.25	0.00000	0.000	0.0	118.4	0.0
M200 4hr	240	65.4	0.278	0.78	16.35	0.00000	0.000	0.0	236.9	0.0
M200 6hr	300	77.8	0.278	0.78	15.56	0.00000	0.000	0.0	355.3	0.0
M200 12hr	600	104.9	0.278	0.78	10.49	0.00000	0.000	0.0	710.6	0.0
M200 24hr	1200	141.3	0.278	0.78	7.065	0.00000	0.000	0.0	1421.3	0.0
M200 48hr	2400	158.8	0.278	0.78	3.97	0.00000	0.000	0.0	2842.6	0.0

Catchment			SP 07A	Hardstand				water discharge rate (l/s)		
Clean water natural flow									16.45	l/s/ha
1 in 200 year return	**minutes**	**Rainfall (mm)**		**C**	**i (mm/hr)**	**A (km^2)**	**(m^3/s)**	**Volume (m^3)**	**Discharge (m^3/ha)**	**Residual Volume (m^3)**
M200 5min	5	12.1	0.278	0.6	145.2	0.00364	0.088	26.4	4.9	24.6
M200 10min	10	16.9	0.278	0.6	101.4	0.00364	0.061	36.9	9.9	33.3
M200 15min	15	19.8	0.278	0.6	79.2	0.00364	0.048	43.2	14.8	37.8
M200 30min	30	26.7	0.278	0.6	53.4	0.00364	0.032	58.3	29.6	47.5
M200 60min	60	36	0.278	0.6	36	0.00364	0.022	78.6	59.2	57.1
M200 2hr	120	48.5	0.278	0.6	24.25	0.00364	0.015	105.9	118.4	62.8
M200 4hr	240	65.4	0.278	0.6	16.35	0.00364	0.010	142.8	236.9	56.6
M200 6hr	300	77.8	0.278	0.6	15.56	0.00364	0.009	203.8	355.3	74.6
M200 12hr	600	104.9	0.278	0.6	10.49	0.00364	0.006	274.8	710.6	16.4
M200 24hr	1200	141.3	0.278	0.6	7.065	0.00364	0.004	370.1	1421.3	-146.5
M200 48hr	2400	158.8	0.278	0.6	3.97	0.00364	0.002	415.9	2842.6	-617.3

Catchment			SP 07B	Area Excl Hardstand					water discharge rate (l/s)	
Clean water natural flow									16.45	l/s/ha
1 in 200 year return	minutes	Rainfall (mm)		C	i (mm/hr)	A (km^2)	(m^3/s)	Volume (m^3)	Discharge (m^3/ha)	Residual Volume (m^3)
M200 5min	5	12.1	0.278	0.78	145.2	0.00000	0.000	0.0	4.9	0.0
M200 10min	10	16.9	0.278	0.78	101.4	0.00000	0.000	0.0	9.9	0.0
M200 15min	15	19.8	0.278	0.78	79.2	0.00000	0.000	0.0	14.8	0.0
M200 30min	30	26.7	0.278	0.78	53.4	0.00000	0.000	0.0	29.6	0.0
M200 60min	60	36	0.278	0.78	36	0.00000	0.000	0.0	59.2	0.0
M200 2hr	120	48.5	0.278	0.78	24.25	0.00000	0.000	0.0	118.4	0.0
M200 4hr	240	65.4	0.278	0.78	16.35	0.00000	0.000	0.0	236.9	0.0
M200 6hr	300	77.8	0.278	0.78	15.56	0.00000	0.000	0.0	355.3	0.0
M200 12hr	600	104.9	0.278	0.78	10.49	0.00000	0.000	0.0	710.6	0.0
M200 24hr	1200	141.3	0.278	0.78	7.065	0.00000	0.000	0.0	1421.3	0.0
M200 48hr	2400	158.8	0.278	0.78	3.97	0.00000	0.000	0.0	2842.6	0.0

Catchment			SP 07B	Hardstand					water discharge rate (l/s)	
Clean water natural flow									16.45	l/s/ha
1 in 200 year return	minutes	Rainfall (mm)		C	i (mm/hr)	A (km^2)	(m^3/s)	Volume (m^3)	Discharge (m^3/ha)	Residual Volume (m^3)
M200 5min	5	12.1	0.278	0.6	145.2	0.00364	0.088	26.4	4.9	24.6
M200 10min	10	16.9	0.278	0.6	101.4	0.00364	0.061	36.9	9.9	33.3
M200 15min	15	19.8	0.278	0.6	79.2	0.00364	0.048	43.2	14.8	37.8
M200 30min	30	26.7	0.278	0.6	53.4	0.00364	0.032	58.3	29.6	47.5
M200 60min	60	36	0.278	0.6	36	0.00364	0.022	78.6	59.2	57.1
M200 2hr	120	48.5	0.278	0.6	24.25	0.00364	0.015	105.9	118.4	62.8
M200 4hr	240	65.4	0.278	0.6	16.35	0.00364	0.010	142.8	236.9	56.6
M200 6hr	300	77.8	0.278	0.6	15.56	0.00364	0.009	203.8	355.3	74.6
M200 12hr	600	104.9	0.278	0.6	10.49	0.00364	0.006	274.8	710.6	16.4
M200 24hr	1200	141.3	0.278	0.6	7.065	0.00364	0.004	370.1	1421.3	-146.5
M200 48hr	2400	158.8	0.278	0.6	3.97	0.00364	0.002	415.9	2842.6	-617.3

Catchment			SP 08	Area Excl Hardstand					water discharge rate (l/s)	
Clean water natural flow									16.45	l/s/ha
1 in 200 year return	minutes	Rainfall (mm)		C	i (mm/hr)	A (km^2)	(m^3/s)	Volume (m^3)	Discharge (m^3/ha)	Residual Volume (m^3)
M200 5min	5	12.1	0.278	0.78	145.2	0.00328	0.103	30.9	4.9	29.3
M200 10min	10	16.9	0.278	0.78	101.4	0.00328	0.072	43.2	9.9	40.0
M200 15min	15	19.8	0.278	0.78	79.2	0.00328	0.056	50.6	14.8	45.8
M200 30min	30	26.7	0.278	0.78	53.4	0.00328	0.038	68.3	29.6	58.6
M200 60min	60	36	0.278	0.78	36	0.00328	0.026	92.0	59.2	72.6
M200 2hr	120	48.5	0.278	0.78	24.25	0.00328	0.017	124.0	118.4	85.2
M200 4hr	240	65.4	0.278	0.78	16.35	0.00328	0.012	167.2	236.9	89.6
M200 6hr	300	77.8	0.278	0.78	15.56	0.00328	0.011	238.7	355.3	122.3
M200 12hr	600	104.9	0.278	0.78	10.49	0.00328	0.007	321.8	710.6	89.1
M200 24hr	1200	141.3	0.278	0.78	7.065	0.00328	0.005	433.5	1421.3	-32.0
M200 48hr	2400	158.8	0.278	0.78	3.97	0.00328	0.003	487.2	2842.6	-443.8

Catchment			SP 08	Hardstand				water discharge rate (l/s)		
Clean water natural flow									16.45	l/s/ha
1 in 200 year return	**minutes**	**Rainfall (mm)**		**C**	**i (mm/hr)**	**A (km^2)**	**(m^3/s)**	**Volume (m^3)**	**Discharge (m^3/ha)**	**Residual Volume (m^3)**
M200 5min	5	12.1	0.278	0.6	145.2	0.00000	0.000	0.0	4.9	0.0
M200 10min	10	16.9	0.278	0.6	101.4	0.00000	0.000	0.0	9.9	0.0
M200 15min	15	19.8	0.278	0.6	79.2	0.00000	0.000	0.0	14.8	0.0
M200 30min	30	26.7	0.278	0.6	53.4	0.00000	0.000	0.0	29.6	0.0
M200 60min	60	36	0.278	0.6	36	0.00000	0.000	0.0	59.2	0.0
M200 2hr	120	48.5	0.278	0.6	24.25	0.00000	0.000	0.0	118.4	0.0
M200 4hr	240	65.4	0.278	0.6	16.35	0.00000	0.000	0.0	236.9	0.0
M200 6hr	300	77.8	0.278	0.6	15.56	0.00000	0.000	0.0	355.3	0.0
M200 12hr	600	104.9	0.278	0.6	10.49	0.00000	0.000	0.0	710.6	0.0
M200 24hr	1200	141.3	0.278	0.6	7.065	0.00000	0.000	0.0	1421.3	0.0
M200 48hr	2400	158.8	0.278	0.6	3.97	0.00000	0.000	0.0	2842.6	0.0

Catchment			SP 09	Area Excl Hardstand				water discharge rate (l/s)		
Clean water natural flow									16.45	l/s/ha
1 in 200 year return	**minutes**	**Rainfall (mm)**		**C**	**i (mm/hr)**	**A (km^2)**	**(m^3/s)**	**Volume (m^3)**	**Discharge (m^3/ha)**	**Residual Volume (m^3)**
M200 5min	5	12.1	0.278	0.78	145.2	0.00000	0.000	0.0	4.9	0.0
M200 10min	10	16.9	0.278	0.78	101.4	0.00000	0.000	0.0	9.9	0.0
M200 15min	15	19.8	0.278	0.78	79.2	0.00000	0.000	0.0	14.8	0.0
M200 30min	30	26.7	0.278	0.78	53.4	0.00000	0.000	0.0	29.6	0.0
M200 60min	60	36	0.278	0.78	36	0.00000	0.000	0.0	59.2	0.0
M200 2hr	120	48.5	0.278	0.78	24.25	0.00000	0.000	0.0	118.4	0.0
M200 4hr	240	65.4	0.278	0.78	16.35	0.00000	0.000	0.0	236.9	0.0
M200 6hr	300	77.8	0.278	0.78	15.56	0.00000	0.000	0.0	355.3	0.0
M200 12hr	600	104.9	0.278	0.78	10.49	0.00000	0.000	0.0	710.6	0.0
M200 24hr	1200	141.3	0.278	0.78	7.065	0.00000	0.000	0.0	1421.3	0.0
M200 48hr	2400	158.8	0.278	0.78	3.97	0.00000	0.000	0.0	2842.6	0.0

Catchment			SP 09	Hardstand				water discharge rate (l/s)		
Clean water natural flow									16.45	l/s/ha
1 in 200 year return	**minutes**	**Rainfall (mm)**		**C**	**i (mm/hr)**	**A (km^2)**	**(m^3/s)**	**Volume (m^3)**	**Discharge (m^3/ha)**	**Residual Volume (m^3)**
M200 5min	5	12.1	0.278	0.6	145.2	0.00760	0.184	55.2	4.9	51.4
M200 10min	10	16.9	0.278	0.6	101.4	0.00760	0.128	77.1	9.9	69.6
M200 15min	15	19.8	0.278	0.6	79.2	0.00760	0.100	90.3	14.8	79.1
M200 30min	30	26.7	0.278	0.6	53.4	0.00760	0.068	121.8	29.6	99.3
M200 60min	60	36	0.278	0.6	36	0.00760	0.046	164.2	59.2	119.2
M200 2hr	120	48.5	0.278	0.6	24.25	0.00760	0.031	221.2	118.4	131.2
M200 4hr	240	65.4	0.278	0.6	16.35	0.00760	0.021	298.3	236.9	118.4
M200 6hr	300	77.8	0.278	0.6	15.56	0.00760	0.020	425.8	355.3	155.9
M200 12hr	600	104.9	0.278	0.6	10.49	0.00760	0.013	574.1	710.6	34.4
M200 24hr	1200	141.3	0.278	0.6	7.065	0.00760	0.009	773.3	1421.3	-306.2
M200 48hr	2400	158.8	0.278	0.6	3.97	0.00760	0.005	869.1	2842.6	-1289.8

Catchment			SP 10	Area Excl Hardstand					water discharge rate (l/s)	
Clean water natural flow									16.45	l/s/ha
1 in 200 year return	**minutes**	**Rainfall (mm)**		**C**	**i (mm/hr)**	**A (km^2)**	**(m^3/s)**	**Volume (m^3)**	**Discharge (m^3/ha)**	**Residual Volume (m^3)**
M200 5min	5	12.1	0.278	0.78	145.2	0.00161	0.051	15.2	4.9	14.4
M200 10min	10	16.9	0.278	0.78	101.4	0.00161	0.035	21.2	9.9	19.7
M200 15min	15	19.8	0.278	0.78	79.2	0.00161	0.028	24.9	14.8	22.5
M200 30min	30	26.7	0.278	0.78	53.4	0.00161	0.019	33.6	29.6	28.8
M200 60min	60	36	0.278	0.78	36	0.00161	0.013	45.2	59.2	35.7
M200 2hr	120	48.5	0.278	0.78	24.25	0.00161	0.008	61.0	118.4	41.9
M200 4hr	240	65.4	0.278	0.78	16.35	0.00161	0.006	82.2	236.9	44.1
M200 6hr	300	77.8	0.278	0.78	15.56	0.00161	0.005	117.3	355.3	60.1
M200 12hr	600	104.9	0.278	0.78	10.49	0.00161	0.004	158.2	710.6	43.8
M200 24hr	1200	141.3	0.278	0.78	7.065	0.00161	0.002	213.1	1421.3	-15.7
M200 48hr	2400	158.8	0.278	0.78	3.97	0.00161	0.001	239.5	2842.6	-218.2

Catchment			SP 10	Hardstand					water discharge rate (l/s)	
Clean water natural flow									16.45	l/s/ha
1 in 200 year return	**minutes**	**Rainfall (mm)**		**C**	**i (mm/hr)**	**A (km^2)**	**(m^3/s)**	**Volume (m^3)**	**Discharge (m^3/ha)**	**Residual Volume (m^3)**
M200 5min	5	12.1	0.278	0.6	145.2	0.00000	0.000	0.0	4.9	0.0
M200 10min	10	16.9	0.278	0.6	101.4	0.00000	0.000	0.0	9.9	0.0
M200 15min	15	19.8	0.278	0.6	79.2	0.00000	0.000	0.0	14.8	0.0
M200 30min	30	26.7	0.278	0.6	53.4	0.00000	0.000	0.0	29.6	0.0
M200 60min	60	36	0.278	0.6	36	0.00000	0.000	0.0	59.2	0.0
M200 2hr	120	48.5	0.278	0.6	24.25	0.00000	0.000	0.0	118.4	0.0
M200 4hr	240	65.4	0.278	0.6	16.35	0.00000	0.000	0.0	236.9	0.0
M200 6hr	300	77.8	0.278	0.6	15.56	0.00000	0.000	0.0	355.3	0.0
M200 12hr	600	104.9	0.278	0.6	10.49	0.00000	0.000	0.0	710.6	0.0
M200 24hr	1200	141.3	0.278	0.6	7.065	0.00000	0.000	0.0	1421.3	0.0
M200 48hr	2400	158.8	0.278	0.6	3.97	0.00000	0.000	0.0	2842.6	0.0

Catchment			SP 10A	Area Excl Hardstand					water discharge rate (l/s)	
Clean water natural flow									16.45	l/s/ha
1 in 200 year return	**minutes**	**Rainfall (mm)**		**C**	**i (mm/hr)**	**A (km^2)**	**(m^3/s)**	**Volume (m^3)**	**Discharge (m^3/ha)**	**Residual Volume (m^3)**
M200 5min	5	12.1	0.278	0.78	145.2	0.00000	0.000	0.0	4.9	0.0
M200 10min	10	16.9	0.278	0.78	101.4	0.00000	0.000	0.0	9.9	0.0
M200 15min	15	19.8	0.278	0.78	79.2	0.00000	0.000	0.0	14.8	0.0
M200 30min	30	26.7	0.278	0.78	53.4	0.00000	0.000	0.0	29.6	0.0
M200 60min	60	36	0.278	0.78	36	0.00000	0.000	0.0	59.2	0.0
M200 2hr	120	48.5	0.278	0.78	24.25	0.00000	0.000	0.0	118.4	0.0
M200 4hr	240	65.4	0.278	0.78	16.35	0.00000	0.000	0.0	236.9	0.0
M200 6hr	300	77.8	0.278	0.78	15.56	0.00000	0.000	0.0	355.3	0.0
M200 12hr	600	104.9	0.278	0.78	10.49	0.00000	0.000	0.0	710.6	0.0
M200 24hr	1200	141.3	0.278	0.78	7.065	0.00000	0.000	0.0	1421.3	0.0
M200 48hr	2400	158.8	0.278	0.78	3.97	0.00000	0.000	0.0	2842.6	0.0

Catchment			SP 10A	Hardstand				water discharge rate (l/s)		
Clean water natural flow									16.45	l/s/ha
1 in 200 year return	minutes	Rainfall (mm)		C	i (mm/hr)	A (km^2)	(m^3/s)	Volume (m^3)	Discharge (m^3/ha)	Residual Volume (m^3)
M200 5min	5	12.1	0.278	0.6	145.2	0.00347	0.084	25.2	4.9	23.5
M200 10min	10	16.9	0.278	0.6	101.4	0.00347	0.059	35.2	9.9	31.7
M200 15min	15	19.8	0.278	0.6	79.2	0.00347	0.046	41.2	14.8	36.1
M200 30min	30	26.7	0.278	0.6	53.4	0.00347	0.031	55.6	29.6	45.3
M200 60min	60	36	0.278	0.6	36	0.00347	0.021	74.9	59.2	54.4
M200 2hr	120	48.5	0.278	0.6	24.25	0.00347	0.014	100.9	118.4	59.9
M200 4hr	240	65.4	0.278	0.6	16.35	0.00347	0.009	136.1	236.9	54.0
M200 6hr	300	77.8	0.278	0.6	15.56	0.00347	0.009	194.3	355.3	71.1
M200 12hr	600	104.9	0.278	0.6	10.49	0.00347	0.006	261.9	710.6	15.7
M200 24hr	1200	141.3	0.278	0.6	7.065	0.00347	0.004	352.8	1421.3	-139.7
M200 48hr	2400	158.8	0.278	0.6	3.97	0.00347	0.002	396.5	2842.6	-588.5

Catchment			SP 10B	Area Excl Hardstand				water discharge rate (l/s)		
Clean water natural flow									16.45	l/s/ha
1 in 200 year return	minutes	Rainfall (mm)		C	i (mm/hr)	A (km^2)	(m^3/s)	Volume (m^3)	Discharge (m^3/ha)	Residual Volume (m^3)
M200 5min	5	12.1	0.278	0.78	145.2	0.00000	0.000	0.0	4.9	0.0
M200 10min	10	16.9	0.278	0.78	101.4	0.00000	0.000	0.0	9.9	0.0
M200 15min	15	19.8	0.278	0.78	79.2	0.00000	0.000	0.0	14.8	0.0
M200 30min	30	26.7	0.278	0.78	53.4	0.00000	0.000	0.0	29.6	0.0
M200 60min	60	36	0.278	0.78	36	0.00000	0.000	0.0	59.2	0.0
M200 2hr	120	48.5	0.278	0.78	24.25	0.00000	0.000	0.0	118.4	0.0
M200 4hr	240	65.4	0.278	0.78	16.35	0.00000	0.000	0.0	236.9	0.0
M200 6hr	300	77.8	0.278	0.78	15.56	0.00000	0.000	0.0	355.3	0.0
M200 12hr	600	104.9	0.278	0.78	10.49	0.00000	0.000	0.0	710.6	0.0
M200 24hr	1200	141.3	0.278	0.78	7.065	0.00000	0.000	0.0	1421.3	0.0
M200 48hr	2400	158.8	0.278	0.78	3.97	0.00000	0.000	0.0	2842.6	0.0

Catchment			SP 10B	Hardstand				water discharge rate (l/s)		
Clean water natural flow									16.45	l/s/ha
1 in 200 year return	minutes	Rainfall (mm)		C	i (mm/hr)	A (km^2)	(m^3/s)	Volume (m^3)	Discharge (m^3/ha)	Residual Volume (m^3)
M200 5min	5	12.1	0.278	0.6	145.2	0.00347	0.084	25.2	4.9	23.5
M200 10min	10	16.9	0.278	0.6	101.4	0.00347	0.059	35.2	9.9	31.7
M200 15min	15	19.8	0.278	0.6	79.2	0.00347	0.046	41.2	14.8	36.1
M200 30min	30	26.7	0.278	0.6	53.4	0.00347	0.031	55.6	29.6	45.3
M200 60min	60	36	0.278	0.6	36	0.00347	0.021	74.9	59.2	54.4
M200 2hr	120	48.5	0.278	0.6	24.25	0.00347	0.014	100.9	118.4	59.9
M200 4hr	240	65.4	0.278	0.6	16.35	0.00347	0.009	136.1	236.9	54.0
M200 6hr	300	77.8	0.278	0.6	15.56	0.00347	0.009	194.3	355.3	71.1
M200 12hr	600	104.9	0.278	0.6	10.49	0.00347	0.006	261.9	710.6	15.7
M200 24hr	1200	141.3	0.278	0.6	7.065	0.00347	0.004	352.8	1421.3	-139.7
M200 48hr	2400	158.8	0.278	0.6	3.97	0.00347	0.002	396.5	2842.6	-588.5

Catchment			SP 11	Area Excl Hardstand				water discharge rate (l/s)		
Clean water natural flow									16.45	l/s/ha
1 in 200 year return	minutes	Rainfall (mm)		C	i (mm/hr)	A (km^2)	(m^3/s)	Volume (m^3)	Discharge (m^3/ha)	Residual Volume (m^3)
M200 5min	5	12.1	0.278	0.78	145.2	0.00255	0.080	24.1	4.9	22.8
M200 10min	10	16.9	0.278	0.78	101.4	0.00255	0.056	33.6	9.9	31.1
M200 15min	15	19.8	0.278	0.78	79.2	0.00255	0.044	39.4	14.8	35.6
M200 30min	30	26.7	0.278	0.78	53.4	0.00255	0.030	53.1	29.6	45.6
M200 60min	60	36	0.278	0.78	36	0.00255	0.020	71.7	59.2	56.6
M200 2hr	120	48.5	0.278	0.78	24.25	0.00255	0.013	96.5	118.4	66.3
M200 4hr	240	65.4	0.278	0.78	16.35	0.00255	0.009	130.2	236.9	69.8
M200 6hr	300	77.8	0.278	0.78	15.56	0.00255	0.009	185.8	355.3	95.2
M200 12hr	600	104.9	0.278	0.78	10.49	0.00255	0.006	250.6	710.6	69.4
M200 24hr	1200	141.3	0.278	0.78	7.065	0.00255	0.004	337.5	1421.3	-24.9
M200 48hr	2400	158.8	0.278	0.78	3.97	0.00255	0.002	379.3	2842.6	-345.5

Catchment			SP 11	Hardstand				water discharge rate (l/s)		
Clean water natural flow									16.45	l/s/ha
1 in 200 year return	minutes	Rainfall (mm)		C	i (mm/hr)	A (km^2)	(m^3/s)	Volume (m^3)	Discharge (m^3/ha)	Residual Volume (m^3)
M200 5min	5	12.1	0.278	0.6	145.2	0.00000	0.000	0.0	4.9	0.0
M200 10min	10	16.9	0.278	0.6	101.4	0.00000	0.000	0.0	9.9	0.0
M200 15min	15	19.8	0.278	0.6	79.2	0.00000	0.000	0.0	14.8	0.0
M200 30min	30	26.7	0.278	0.6	53.4	0.00000	0.000	0.0	29.6	0.0
M200 60min	60	36	0.278	0.6	36	0.00000	0.000	0.0	59.2	0.0
M200 2hr	120	48.5	0.278	0.6	24.25	0.00000	0.000	0.0	118.4	0.0
M200 4hr	240	65.4	0.278	0.6	16.35	0.00000	0.000	0.0	236.9	0.0
M200 6hr	300	77.8	0.278	0.6	15.56	0.00000	0.000	0.0	355.3	0.0
M200 12hr	600	104.9	0.278	0.6	10.49	0.00000	0.000	0.0	710.6	0.0
M200 24hr	1200	141.3	0.278	0.6	7.065	0.00000	0.000	0.0	1421.3	0.0
M200 48hr	2400	158.8	0.278	0.6	3.97	0.00000	0.000	0.0	2842.6	0.0

Catchment			SP 12	Area Excl Hardstand				water discharge rate (l/s)		
Clean water natural flow									16.45	l/s/ha
1 in 200 year return	minutes	Rainfall (mm)		C	i (mm/hr)	A (km^2)	(m^3/s)	Volume (m^3)	Discharge (m^3/ha)	Residual Volume (m^3)
M200 5min	5	12.1	0.278	0.78	145.2	0.00224	0.070	21.1	4.9	20.0
M200 10min	10	16.9	0.278	0.78	101.4	0.00224	0.049	29.5	9.9	27.3
M200 15min	15	19.8	0.278	0.78	79.2	0.00224	0.038	34.5	14.8	31.2
M200 30min	30	26.7	0.278	0.78	53.4	0.00224	0.026	46.6	29.6	40.0
M200 60min	60	36	0.278	0.78	36	0.00224	0.017	62.8	59.2	49.6
M200 2hr	120	48.5	0.278	0.78	24.25	0.00224	0.012	84.6	118.4	58.1
M200 4hr	240	65.4	0.278	0.78	16.35	0.00224	0.008	114.1	236.9	61.2
M200 6hr	300	77.8	0.278	0.78	15.56	0.00224	0.008	162.9	355.3	83.5
M200 12hr	600	104.9	0.278	0.78	10.49	0.00224	0.005	219.6	710.6	60.8
M200 24hr	1200	141.3	0.278	0.78	7.065	0.00224	0.003	295.8	1421.3	-21.8
M200 48hr	2400	158.8	0.278	0.78	3.97	0.00224	0.002	332.5	2842.6	-302.8

Catchment			SP 12	Hardstand				water discharge rate (l/s)		
Clean water natural flow									16.45	l/s/ha
1 in 200 year return	**minutes**	**Rainfall (mm)**		**C**	**i (mm/hr)**	**A (km^2)**	**(m^3/s)**	**Volume (m^3)**	**Discharge (m^3/ha)**	**Residual Volume (m^3)**
M200 5min	5	12.1	0.278	0.6	145.2	0.00000	0.000	0.0	4.9	0.0
M200 10min	10	16.9	0.278	0.6	101.4	0.00000	0.000	0.0	9.9	0.0
M200 15min	15	19.8	0.278	0.6	79.2	0.00000	0.000	0.0	14.8	0.0
M200 30min	30	26.7	0.278	0.6	53.4	0.00000	0.000	0.0	29.6	0.0
M200 60min	60	36	0.278	0.6	36	0.00000	0.000	0.0	59.2	0.0
M200 2hr	120	48.5	0.278	0.6	24.25	0.00000	0.000	0.0	118.4	0.0
M200 4hr	240	65.4	0.278	0.6	16.35	0.00000	0.000	0.0	236.9	0.0
M200 6hr	300	77.8	0.278	0.6	15.56	0.00000	0.000	0.0	355.3	0.0
M200 12hr	600	104.9	0.278	0.6	10.49	0.00000	0.000	0.0	710.6	0.0
M200 24hr	1200	141.3	0.278	0.6	7.065	0.00000	0.000	0.0	1421.3	0.0
M200 48hr	2400	158.8	0.278	0.6	3.97	0.00000	0.000	0.0	2842.6	0.0

Catchment			SP 13	Area Excl Hardstand				water discharge rate (l/s)		
Clean water natural flow									16.45	l/s/ha
1 in 200 year return	**minutes**	**Rainfall (mm)**		**C**	**i (mm/hr)**	**A (km^2)**	**(m^3/s)**	**Volume (m^3)**	**Discharge (m^3/ha)**	**Residual Volume (m^3)**
M200 5min	5	12.1	0.278	0.78	145.2	0.00000	0.000	0.0	4.9	0.0
M200 10min	10	16.9	0.278	0.78	101.4	0.00000	0.000	0.0	9.9	0.0
M200 15min	15	19.8	0.278	0.78	79.2	0.00000	0.000	0.0	14.8	0.0
M200 30min	30	26.7	0.278	0.78	53.4	0.00000	0.000	0.0	29.6	0.0
M200 60min	60	36	0.278	0.78	36	0.00000	0.000	0.0	59.2	0.0
M200 2hr	120	48.5	0.278	0.78	24.25	0.00000	0.000	0.0	118.4	0.0
M200 4hr	240	65.4	0.278	0.78	16.35	0.00000	0.000	0.0	236.9	0.0
M200 6hr	300	77.8	0.278	0.78	15.56	0.00000	0.000	0.0	355.3	0.0
M200 12hr	600	104.9	0.278	0.78	10.49	0.00000	0.000	0.0	710.6	0.0
M200 24hr	1200	141.3	0.278	0.78	7.065	0.00000	0.000	0.0	1421.3	0.0
M200 48hr	2400	158.8	0.278	0.78	3.97	0.00000	0.000	0.0	2842.6	0.0

Catchment			SP 13	Hardstand				water discharge rate (l/s)		
Clean water natural flow									16.45	l/s/ha
1 in 200 year return	**minutes**	**Rainfall (mm)**		**C**	**i (mm/hr)**	**A (km^2)**	**(m^3/s)**	**Volume (m^3)**	**Discharge (m^3/ha)**	**Residual Volume (m^3)**
M200 5min	5	12.1	0.278	0.6	145.2	0.00470	0.114	34.1	4.9	31.8
M200 10min	10	16.9	0.278	0.6	101.4	0.00470	0.079	47.7	9.9	43.1
M200 15min	15	19.8	0.278	0.6	79.2	0.00470	0.062	55.9	14.8	48.9
M200 30min	30	26.7	0.278	0.6	53.4	0.00470	0.042	75.4	29.6	61.4
M200 60min	60	36	0.278	0.6	36	0.00470	0.028	101.6	59.2	73.8
M200 2hr	120	48.5	0.278	0.6	24.25	0.00470	0.019	136.9	118.4	81.2
M200 4hr	240	65.4	0.278	0.6	16.35	0.00470	0.013	184.6	236.9	73.2
M200 6hr	300	77.8	0.278	0.6	15.56	0.00470	0.012	263.5	355.3	96.5
M200 12hr	600	104.9	0.278	0.6	10.49	0.00470	0.008	355.3	710.6	21.3
M200 24hr	1200	141.3	0.278	0.6	7.065	0.00470	0.006	478.5	1421.3	-189.5
M200 48hr	2400	158.8	0.278	0.6	3.97	0.00470	0.003	537.8	2842.6	-798.2

Catchment		**SP 13A**	Area Excl Hardstand					water discharge rate (l/s)		
Clean water natural flow									16.45	l/s/ha
1 in 200 year return	**minutes**	**Rainfall (mm)**		**C**	**i (mm/hr)**	**A (km^2)**	**(m^3/s)**	**Volume (m^3)**	**Discharge (m^3/ha)**	**Residual Volume (m^3)**
M200 5min	5	12.1	0.278	0.78	145.2	0.00000	0.000	0.0	4.9	0.0
M200 10min	10	16.9	0.278	0.78	101.4	0.00000	0.000	0.0	9.9	0.0
M200 15min	15	19.8	0.278	0.78	79.2	0.00000	0.000	0.0	14.8	0.0
M200 30min	30	26.7	0.278	0.78	53.4	0.00000	0.000	0.0	29.6	0.0
M200 60min	60	36	0.278	0.78	36	0.00000	0.000	0.0	59.2	0.0
M200 2hr	120	48.5	0.278	0.78	24.25	0.00000	0.000	0.0	118.4	0.0
M200 4hr	240	65.4	0.278	0.78	16.35	0.00000	0.000	0.0	236.9	0.0
M200 6hr	300	77.8	0.278	0.78	15.56	0.00000	0.000	0.0	355.3	0.0
M200 12hr	600	104.9	0.278	0.78	10.49	0.00000	0.000	0.0	710.6	0.0
M200 24hr	1200	141.3	0.278	0.78	7.065	0.00000	0.000	0.0	1421.3	0.0
M200 48hr	2400	158.8	0.278	0.78	3.97	0.00000	0.000	0.0	2842.6	0.0

Catchment		**SP 13A**	Hardstand					water discharge rate (l/s)		
Clean water natural flow									16.45	l/s/ha
1 in 200 year return	**minutes**	**Rainfall (mm)**		**C**	**i (mm/hr)**	**A (km^2)**	**(m^3/s)**	**Volume (m^3)**	**Discharge (m^3/ha)**	**Residual Volume (m^3)**
M200 5min	5	12.1	0.278	0.6	145.2	0.00470	0.114	34.1	4.9	31.8
M200 10min	10	16.9	0.278	0.6	101.4	0.00470	0.079	47.7	9.9	43.1
M200 15min	15	19.8	0.278	0.6	79.2	0.00470	0.062	55.9	14.8	48.9
M200 30min	30	26.7	0.278	0.6	53.4	0.00470	0.042	75.4	29.6	61.4
M200 60min	60	36	0.278	0.6	36	0.00470	0.028	101.6	59.2	73.8
M200 2hr	120	48.5	0.278	0.6	24.25	0.00470	0.019	136.9	118.4	81.2
M200 4hr	240	65.4	0.278	0.6	16.35	0.00470	0.013	184.6	236.9	73.2
M200 6hr	300	77.8	0.278	0.6	15.56	0.00470	0.012	263.5	355.3	96.5
M200 12hr	600	104.9	0.278	0.6	10.49	0.00470	0.008	355.3	710.6	21.3
M200 24hr	1200	141.3	0.278	0.6	7.065	0.00470	0.006	478.5	1421.3	-189.5
M200 48hr	2400	158.8	0.278	0.6	3.97	0.00470	0.003	537.8	2842.6	-798.2

Catchment		**SP 14**	Area Excl Hardstand					water discharge rate (l/s)		
Clean water natural flow									16.45	l/s/ha
1 in 200 year return	**minutes**	**Rainfall (mm)**		**C**	**i (mm/hr)**	**A (km^2)**	**(m^3/s)**	**Volume (m^3)**	**Discharge (m^3/ha)**	**Residual Volume (m^3)**
M200 5min	5	12.1	0.278	0.78	145.2	0.00370	0.116	34.9	4.9	33.1
M200 10min	10	16.9	0.278	0.78	101.4	0.00370	0.081	48.8	9.9	45.2
M200 15min	15	19.8	0.278	0.78	79.2	0.00370	0.064	57.2	14.8	51.7
M200 30min	30	26.7	0.278	0.78	53.4	0.00370	0.043	77.1	29.6	66.2
M200 60min	60	36	0.278	0.78	36	0.00370	0.029	104.0	59.2	82.1
M200 2hr	120	48.5	0.278	0.78	24.25	0.00370	0.019	140.1	118.4	96.3
M200 4hr	240	65.4	0.278	0.78	16.35	0.00370	0.013	188.9	236.9	101.2
M200 6hr	300	77.8	0.278	0.78	15.56	0.00370	0.012	269.7	355.3	138.2
M200 12hr	600	104.9	0.278	0.78	10.49	0.00370	0.008	363.6	710.6	100.6
M200 24hr	1200	141.3	0.278	0.78	7.065	0.00370	0.006	489.7	1421.3	-36.1
M200 48hr	2400	158.8	0.278	0.78	3.97	0.00370	0.003	550.4	2842.6	-501.4

Catchment			**SP 14**	Hardstand				water discharge rate (l/s)		
Clean water natural flow									16.45	l/s/ha
1 in 200 year return	**minutes**	**Rainfall (mm)**		**C**	**i (mm/hr)**	**A (km^2)**	**(m^3/s)**	**Volume (m^3)**	**Discharge (m^3/ha)**	**Residual Volume (m^3)**
M200 5min	5	12.1	0.278	0.6	145.2	0.00000	0.000	0.0	4.9	0.0
M200 10min	10	16.9	0.278	0.6	101.4	0.00000	0.000	0.0	9.9	0.0
M200 15min	15	19.8	0.278	0.6	79.2	0.00000	0.000	0.0	14.8	0.0
M200 30min	30	26.7	0.278	0.6	53.4	0.00000	0.000	0.0	29.6	0.0
M200 60min	60	36	0.278	0.6	36	0.00000	0.000	0.0	59.2	0.0
M200 2hr	120	48.5	0.278	0.6	24.25	0.00000	0.000	0.0	118.4	0.0
M200 4hr	240	65.4	0.278	0.6	16.35	0.00000	0.000	0.0	236.9	0.0
M200 6hr	300	77.8	0.278	0.6	15.56	0.00000	0.000	0.0	355.3	0.0
M200 12hr	600	104.9	0.278	0.6	10.49	0.00000	0.000	0.0	710.6	0.0
M200 24hr	1200	141.3	0.278	0.6	7.065	0.00000	0.000	0.0	1421.3	0.0
M200 48hr	2400	158.8	0.278	0.6	3.97	0.00000	0.000	0.0	2842.6	0.0

Catchment			**SP 14A**	Area Excl Hardstand				water discharge rate (l/s)		
Clean water natural flow									16.45	l/s/ha
1 in 200 year return	**minutes**	**Rainfall (mm)**		**C**	**i (mm/hr)**	**A (km^2)**	**(m^3/s)**	**Volume (m^3)**	**Discharge (m^3/ha)**	**Residual Volume (m^3)**
M200 5min	5	12.1	0.278	0.78	145.2	0.00370	0.116	34.9	4.9	33.1
M200 10min	10	16.9	0.278	0.78	101.4	0.00370	0.081	48.8	9.9	45.2
M200 15min	15	19.8	0.278	0.78	79.2	0.00370	0.064	57.2	14.8	51.7
M200 30min	30	26.7	0.278	0.78	53.4	0.00370	0.043	77.1	29.6	66.2
M200 60min	60	36	0.278	0.78	36	0.00370	0.029	104.0	59.2	82.1
M200 2hr	120	48.5	0.278	0.78	24.25	0.00370	0.019	140.1	118.4	96.3
M200 4hr	240	65.4	0.278	0.78	16.35	0.00370	0.013	188.9	236.9	101.2
M200 6hr	300	77.8	0.278	0.78	15.56	0.00370	0.012	269.7	355.3	138.2
M200 12hr	600	104.9	0.278	0.78	10.49	0.00370	0.008	363.6	710.6	100.6
M200 24hr	1200	141.3	0.278	0.78	7.065	0.00370	0.006	489.7	1421.3	-36.1
M200 48hr	2400	158.8	0.278	0.78	3.97	0.00370	0.003	550.4	2842.6	-501.4

Catchment			**SP 14A**	Hardstand				water discharge rate (l/s)		
Clean water natural flow									16.45	l/s/ha
1 in 200 year return	**minutes**	**Rainfall (mm)**		**C**	**i (mm/hr)**	**A (km^2)**	**(m^3/s)**	**Volume (m^3)**	**Discharge (m^3/ha)**	**Residual Volume (m^3)**
M200 5min	5	12.1	0.278	0.6	145.2	0.00000	0.000	0.0	4.9	0.0
M200 10min	10	16.9	0.278	0.6	101.4	0.00000	0.000	0.0	9.9	0.0
M200 15min	15	19.8	0.278	0.6	79.2	0.00000	0.000	0.0	14.8	0.0
M200 30min	30	26.7	0.278	0.6	53.4	0.00000	0.000	0.0	29.6	0.0
M200 60min	60	36	0.278	0.6	36	0.00000	0.000	0.0	59.2	0.0
M200 2hr	120	48.5	0.278	0.6	24.25	0.00000	0.000	0.0	118.4	0.0
M200 4hr	240	65.4	0.278	0.6	16.35	0.00000	0.000	0.0	236.9	0.0
M200 6hr	300	77.8	0.278	0.6	15.56	0.00000	0.000	0.0	355.3	0.0
M200 12hr	600	104.9	0.278	0.6	10.49	0.00000	0.000	0.0	710.6	0.0
M200 24hr	1200	141.3	0.278	0.6	7.065	0.00000	0.000	0.0	1421.3	0.0
M200 48hr	2400	158.8	0.278	0.6	3.97	0.00000	0.000	0.0	2842.6	0.0

Dyrick Hill SuDS Drainage Design

Rational Method Q = 0.278 CiA

Ref	Total Catchment A (m^2)	Catchment Area: A Hardstand (m^2)	A excl Hardstand (m^2)	A Hardstand (km^2)	A excl Hardstand (km^2)	Residual Volume (m3)	Width (m)	Height (m)	Required Length (m)	Optimised Length
SP 15	3650	0	3650	0.0000	0.0037	81.0	6.00	1.0	13.5	15
SP 16	4215	4215	0	0.0042	0.0000	66.2	6.00	1.0	11.0	12
SP 16A	4215	4215	0	0.0042	0.0000	66.2	6.00	1.0	11.0	12
SP 17	1750	0	1750	0.0000	0.0018	38.8	3.00	1.0	12.9	15
SP 18	2150	0	2150	0.0000	0.0022	47.7	4.00	1.0	11.9	12
SP 19	4135	4135	0	0.0041	0.0000	64.9	4.00	1.0	16.2	18
SP 19A	4135	4135	0	0.0041	0.0000	64.9	4.00	1.0	16.2	18
SP 20	5552	5552	0	0.0056	0.0000	87.1	6.00	1.0	14.5	15
SP 20A	5552	5552	0	0.0056	0.0000	87.1	6.00	1.0	14.5	15
SP 20B	5552	5552	0	0.0056	0.0000	87.1	6.00	1.0	14.5	15
SP 21	3700	0	3700	0.0000	0.0037	82.1	6.00	1.0	13.7	15
SP 22	5100	0	5100	0.0000	0.0051	113.1	6.00	1.0	18.9	21
SP 22A	5100	5100	0	0.0051	0.0000	80.0	6.00	1.0	13.3	15
SP 23	5035	5035	0	0.0050	0.0000	79.0	6.00	1.0	13.2	15
SP 23A	5035	5035	0	0.0050	0.0000	79.0	6.00	1.0	13.2	15
SP 24	6965	6965	0	0.0070	0.0000	109.3	6.00	1.0	18.2	21
SP 25	5330	5330	0	0.0053	0.0000	83.7	6.00	1.0	13.9	15
SP 25A	5330	5330	0	0.0053	0.0000	83.7	6.00	1.0	13.9	15
SP 26	3565	3565	0	0.0036	0.0000	56.0	4.00	1.0	14.0	15
SP 27	3840	3840	0	0.0038	0.0000	60.3	4.00	1.0	15.1	18
SP 27A	3840	3840	0	0.0038	0.0000	60.3	4.00	1.0	15.1	18
SP28	2180	2180	0	0.0022	0.0000	34.2	3.00	1.0	11.4	12
SP28A	3340	0	3340	0.0000	0.0033	74.1	6.00	1.0	12.3	15
SP29	3450	0	3450	0.0000	0.0035	76.5	6.00	1.0	12.8	15

Catchment			**SP 15**	Area Excl Hardstand					water discharge rate (l/s)		
Clean water natural flow									16.45		l/s/ha
1 in 200 year return	**minutes**	**Rainfall (mm)**		**C**	**i (mm/hr)**	**A (km^2)**	**(m^3/s)**	**Volume (m^3)**	**Discharge (m^3/ha)**	**Discharge (m^3)**	**Residual Volume (m^3)**
M200 5min	5	12.1	0.278	0.78	145.2	0.00365	0.115	34.5	4.9	1.8	32.7
M200 10min	10	16.9	0.278	0.78	101.4	0.00365	0.080	48.2	9.9	3.6	44.6
M200 15min	15	19.8	0.278	0.78	79.2	0.00365	0.063	56.4	14.8	5.4	51.0
M200 30min	30	26.7	0.278	0.78	53.4	0.00365	0.042	76.1	29.6	10.8	65.3
M200 60min	60	36	0.278	0.78	36	0.00365	0.028	102.6	59.2	21.6	81.0
M200 2hr	120	48.5	0.278	0.78	24.25	0.00365	0.019	138.2	118.4	43.2	95.0
M200 4hr	240	65.4	0.278	0.78	16.35	0.00365	0.013	186.3	236.9	86.5	99.9
M200 6hr	300	77.8	0.278	0.78	15.56	0.00365	0.012	266.0	355.3	129.7	136.3
M200 12hr	600	104.9	0.278	0.78	10.49	0.00365	0.008	358.7	710.6	259.4	99.3
M200 24hr	1200	141.3	0.278	0.78	7.065	0.00365	0.006	483.1	1421.3	518.8	-35.6
M200 48hr	2400	158.8	0.278	0.78	3.97	0.00365	0.003	543.0	2842.6	1037.5	-494.6

Catchment		SP 15	Hardstand					water discharge rate (l/s)		
Clean water natural flow								16.45		l/s/ha
1 in 200 year return	**minutes**	**Rainfall (mm)**		**C**	**i (mm/hr)**	**A (km^2)**	**(m^3/s)**	**Volume (m^3)**	**Discharge (m^3/ha)**	**Discharge (m^3)**	**Residual Volume (m^3)**
M200 5min	5	12.1	0.278	0.6	145.2	0.00000	0.000	0.0	4.9	0.0	0.0
M200 10min	10	16.9	0.278	0.6	101.4	0.00000	0.000	0.0	9.9	0.0	0.0
M200 15min	15	19.8	0.278	0.6	79.2	0.00000	0.000	0.0	14.8	0.0	0.0
M200 30min	30	26.7	0.278	0.6	53.4	0.00000	0.000	0.0	29.6	0.0	0.0
M200 60min	60	36	0.278	0.6	36	0.00000	0.000	0.0	59.2	0.0	0.0
M200 2hr	120	48.5	0.278	0.6	24.25	0.00000	0.000	0.0	118.4	0.0	0.0
M200 4hr	240	65.4	0.278	0.6	16.35	0.00000	0.000	0.0	236.9	0.0	0.0
M200 6hr	300	77.8	0.278	0.6	15.56	0.00000	0.000	0.0	355.3	0.0	0.0
M200 12hr	600	104.9	0.278	0.6	10.49	0.00000	0.000	0.0	710.6	0.0	0.0
M200 24hr	1200	141.3	0.278	0.6	7.065	0.00000	0.000	0.0	1421.3	0.0	0.0
M200 48hr	2400	158.8	0.278	0.6	3.97	0.00000	0.000	0.0	2842.6	0.0	0.0

Catchment		SP 16	Area Excl Hardstand					water discharge rate (l/s)		
Clean water natural flow								16.45		l/s/ha
1 in 200 year return	**minutes**	**Rainfall (mm)**		**C**	**i (mm/hr)**	**A (km^2)**	**(m^3/s)**	**Volume (m^3)**	**Discharge (m^3/ha)**	**Discharge (m^3)**	**Residual Volume (m^3)**
M200 5min	5	12.1	0.278	0.78	145.2	0.00000	0.000	0.0	4.9	0.0	0.0
M200 10min	10	16.9	0.278	0.78	101.4	0.00000	0.000	0.0	9.9	0.0	0.0
M200 15min	15	19.8	0.278	0.78	79.2	0.00000	0.000	0.0	14.8	0.0	0.0
M200 30min	30	26.7	0.278	0.78	53.4	0.00000	0.000	0.0	29.6	0.0	0.0
M200 60min	60	36	0.278	0.78	36	0.00000	0.000	0.0	59.2	0.0	0.0
M200 2hr	120	48.5	0.278	0.78	24.25	0.00000	0.000	0.0	118.4	0.0	0.0
M200 4hr	240	65.4	0.278	0.78	16.35	0.00000	0.000	0.0	236.9	0.0	0.0
M200 6hr	300	77.8	0.278	0.78	15.56	0.00000	0.000	0.0	355.3	0.0	0.0
M200 12hr	600	104.9	0.278	0.78	10.49	0.00000	0.000	0.0	710.6	0.0	0.0
M200 24hr	1200	141.3	0.278	0.78	7.065	0.00000	0.000	0.0	1421.3	0.0	0.0
M200 48hr	2400	158.8	0.278	0.78	3.97	0.00000	0.000	0.0	2842.6	0.0	0.0

Catchment		SP 16	Hardstand					water discharge rate (l/s)		
Clean water natural flow								16.45		l/s/ha
1 in 200 year return	**minutes**	**Rainfall (mm)**		**C**	**i (mm/hr)**	**A (km^2)**	**(m^3/s)**	**Volume (m^3)**	**Discharge (m^3/ha)**	**Discharge (m^3)**	**Residual Volume (m^3)**
M200 5min	5	12.1	0.278	0.6	145.2	0.00422	0.102	30.6	4.9	2.1	28.5
M200 10min	10	16.9	0.278	0.6	101.4	0.00422	0.071	42.8	9.9	4.2	38.6
M200 15min	15	19.8	0.278	0.6	79.2	0.00422	0.056	50.1	14.8	6.2	43.9
M200 30min	30	26.7	0.278	0.6	53.4	0.00422	0.038	67.6	29.6	12.5	55.1
M200 60min	60	36	0.278	0.6	36	0.00422	0.025	91.1	59.2	25.0	66.2
M200 2hr	120	48.5	0.278	0.6	24.25	0.00422	0.017	122.8	118.4	49.9	72.8
M200 4hr	240	65.4	0.278	0.6	16.35	0.00422	0.011	165.5	236.9	99.8	65.7
M200 6hr	300	77.8	0.278	0.6	15.56	0.00422	0.011	236.3	355.3	149.8	86.5
M200 12hr	600	104.9	0.278	0.6	10.49	0.00422	0.007	318.6	710.6	299.5	19.1
M200 24hr	1200	141.3	0.278	0.6	7.065	0.00422	0.005	429.2	1421.3	599.1	-169.9
M200 48hr	2400	158.8	0.278	0.6	3.97	0.00422	0.003	482.3	2842.6	1198.1	-715.8

Catchment			SP 16A	Area Excl Hardstand					water discharge rate (l/s)		
Clean water natural flow									16.45		l/s/ha
1 in 200 year return	**minutes**	**Rainfall (mm)**		**C**	**i (mm/hr)**	**A (km^2)**	**(m^3/s)**	**Volume (m^3)**	**Discharge (m^3/ha)**	**Discharge (m^3)**	**Residual Volume (m^3)**
M200 5min	5	12.1	0.278	0.78	145.2	0.00000	0.000	0.0	4.9	0.0	0.0
M200 10min	10	16.9	0.278	0.78	101.4	0.00000	0.000	0.0	9.9	0.0	0.0
M200 15min	15	19.8	0.278	0.78	79.2	0.00000	0.000	0.0	14.8	0.0	0.0
M200 30min	30	26.7	0.278	0.78	53.4	0.00000	0.000	0.0	29.6	0.0	0.0
M200 60min	60	36	0.278	0.78	36	0.00000	0.000	0.0	59.2	0.0	0.0
M200 2hr	120	48.5	0.278	0.78	24.25	0.00000	0.000	0.0	118.4	0.0	0.0
M200 4hr	240	65.4	0.278	0.78	16.35	0.00000	0.000	0.0	236.9	0.0	0.0
M200 6hr	300	77.8	0.278	0.78	15.56	0.00000	0.000	0.0	355.3	0.0	0.0
M200 12hr	600	104.9	0.278	0.78	10.49	0.00000	0.000	0.0	710.6	0.0	0.0
M200 24hr	1200	141.3	0.278	0.78	7.065	0.00000	0.000	0.0	1421.3	0.0	0.0
M200 48hr	2400	158.8	0.278	0.78	3.97	0.00000	0.000	0.0	2842.6	0.0	0.0

Catchment			SP 16A	Hardstand					water discharge rate (l/s)		
Clean water natural flow									16.45		l/s/ha
1 in 200 year return	**minutes**	**Rainfall (mm)**		**C**	**i (mm/hr)**	**A (km^2)**	**(m^3/s)**	**Volume (m^3)**	**Discharge (m^3/ha)**	**Discharge (m^3)**	**Residual Volume (m^3)**
M200 5min	5	12.1	0.278	0.6	145.2	0.00422	0.102	30.6	4.9	2.1	28.5
M200 10min	10	16.9	0.278	0.6	101.4	0.00422	0.071	42.8	9.9	4.2	38.6
M200 15min	15	19.8	0.278	0.6	79.2	0.00422	0.056	50.1	14.8	6.2	43.9
M200 30min	30	26.7	0.278	0.6	53.4	0.00422	0.038	67.6	29.6	12.5	55.1
M200 60min	60	36	0.278	0.6	36	0.00422	0.025	91.1	59.2	25.0	66.2
M200 2hr	120	48.5	0.278	0.6	24.25	0.00422	0.017	122.8	118.4	49.9	72.8
M200 4hr	240	65.4	0.278	0.6	16.35	0.00422	0.011	165.5	236.9	99.8	65.7
M200 6hr	300	77.8	0.278	0.6	15.56	0.00422	0.011	236.3	355.3	149.8	86.5
M200 12hr	600	104.9	0.278	0.6	10.49	0.00422	0.007	318.6	710.6	299.5	19.1
M200 24hr	1200	141.3	0.278	0.6	7.065	0.00422	0.005	429.2	1421.3	599.1	-169.9
M200 48hr	2400	158.8	0.278	0.6	3.97	0.00422	0.003	482.3	2842.6	1198.1	-715.8

Catchment			SP 17	Area Excl Hardstand					water discharge rate (l/s)		
Clean water natural flow									16.45		l/s/ha
1 in 200 year return	**minutes**	**Rainfall (mm)**		**C**	**i (mm/hr)**	**A (km^2)**	**(m^3/s)**	**Volume (m^3)**	**Discharge (m^3/ha)**	**Discharge (m^3)**	**Residual Volume (m^3)**
M200 5min	5	12.1	0.278	0.78	145.2	0.00175	0.055	16.5	4.9	0.9	15.7
M200 10min	10	16.9	0.278	0.78	101.4	0.00175	0.038	23.1	9.9	1.7	21.4
M200 15min	15	19.8	0.278	0.78	79.2	0.00175	0.030	27.0	14.8	2.6	24.5
M200 30min	30	26.7	0.278	0.78	53.4	0.00175	0.020	36.5	29.6	5.2	31.3
M200 60min	60	36	0.278	0.78	36	0.00175	0.014	49.2	59.2	10.4	38.8
M200 2hr	120	48.5	0.278	0.78	24.25	0.00175	0.009	66.3	118.4	20.7	45.5
M200 4hr	240	65.4	0.278	0.78	16.35	0.00175	0.006	89.3	236.9	41.5	47.9
M200 6hr	300	77.8	0.278	0.78	15.56	0.00175	0.006	127.5	355.3	62.2	65.4
M200 12hr	600	104.9	0.278	0.78	10.49	0.00175	0.004	172.0	710.6	124.4	47.6
M200 24hr	1200	141.3	0.278	0.78	7.065	0.00175	0.003	231.6	1421.3	248.7	-17.1
M200 48hr	2400	158.8	0.278	0.78	3.97	0.00175	0.002	260.3	2842.6	497.4	-237.1

Catchment			SP 17	Hardstand					water discharge rate (l/s)		
Clean water natural flow									16.45		l/s/ha
1 in 200 year return	minutes	Rainfall (mm)		C	i (mm/hr)	A (km^2)	(m^3/s)	Volume (m^3)	Discharge (m^3/ha)	Discharge (m^3)	Residual Volume (m^3)
M200 5min	5	12.1	0.278	0.6	145.2	0.00000	0.000	0.0	4.9	0.0	0.0
M200 10min	10	16.9	0.278	0.6	101.4	0.00000	0.000	0.0	9.9	0.0	0.0
M200 15min	15	19.8	0.278	0.6	79.2	0.00000	0.000	0.0	14.8	0.0	0.0
M200 30min	30	26.7	0.278	0.6	53.4	0.00000	0.000	0.0	29.6	0.0	0.0
M200 60min	60	36	0.278	0.6	36	0.00000	0.000	0.0	59.2	0.0	0.0
M200 2hr	120	48.5	0.278	0.6	24.25	0.00000	0.000	0.0	118.4	0.0	0.0
M200 4hr	240	65.4	0.278	0.6	16.35	0.00000	0.000	0.0	236.9	0.0	0.0
M200 6hr	300	77.8	0.278	0.6	15.56	0.00000	0.000	0.0	355.3	0.0	0.0
M200 12hr	600	104.9	0.278	0.6	10.49	0.00000	0.000	0.0	710.6	0.0	0.0
M200 24hr	1200	141.3	0.278	0.6	7.065	0.00000	0.000	0.0	1421.3	0.0	0.0
M200 48hr	2400	158.8	0.278	0.6	3.97	0.00000	0.000	0.0	2842.6	0.0	0.0

Catchment			SP 18	Area Excl Hardstand					water discharge rate (l/s)		
Clean water natural flow									16.45		l/s/ha
1 in 200 year return	minutes	Rainfall (mm)		C	i (mm/hr)	A (km^2)	(m^3/s)	Volume (m^3)	Discharge (m^3/ha)	Discharge (m^3)	Residual Volume (m^3)
M200 5min	5	12.1	0.278	0.78	145.2	0.00215	0.068	20.3	4.9	1.1	19.2
M200 10min	10	16.9	0.278	0.78	101.4	0.00215	0.047	28.4	9.9	2.1	26.2
M200 15min	15	19.8	0.278	0.78	79.2	0.00215	0.037	33.2	14.8	3.2	30.0
M200 30min	30	26.7	0.278	0.78	53.4	0.00215	0.025	44.8	29.6	6.4	38.4
M200 60min	60	36	0.278	0.78	36	0.00215	0.017	60.4	59.2	12.7	47.7
M200 2hr	120	48.5	0.278	0.78	24.25	0.00215	0.011	81.4	118.4	25.5	55.9
M200 4hr	240	65.4	0.278	0.78	16.35	0.00215	0.008	109.8	236.9	50.9	58.8
M200 6hr	300	77.8	0.278	0.78	15.56	0.00215	0.007	156.7	355.3	76.4	80.3
M200 12hr	600	104.9	0.278	0.78	10.49	0.00215	0.005	211.3	710.6	152.8	58.5
M200 24hr	1200	141.3	0.278	0.78	7.065	0.00215	0.003	284.6	1421.3	305.6	-21.0
M200 48hr	2400	158.8	0.278	0.78	3.97	0.00215	0.002	319.8	2842.6	611.2	-291.3

Catchment			SP 18	Hardstand					water discharge rate (l/s)		
Clean water natural flow									16.45		l/s/ha
1 in 200 year return	minutes	Rainfall (mm)		C	i (mm/hr)	A (km^2)	(m^3/s)	Volume (m^3)	Discharge (m^3/ha)	Discharge (m^3)	Residual Volume (m^3)
M200 5min	5	12.1	0.278	0.6	145.2	0.00000	0.000	0.0	4.9	0.0	0.0
M200 10min	10	16.9	0.278	0.6	101.4	0.00000	0.000	0.0	9.9	0.0	0.0
M200 15min	15	19.8	0.278	0.6	79.2	0.00000	0.000	0.0	14.8	0.0	0.0
M200 30min	30	26.7	0.278	0.6	53.4	0.00000	0.000	0.0	29.6	0.0	0.0
M200 60min	60	36	0.278	0.6	36	0.00000	0.000	0.0	59.2	0.0	0.0
M200 2hr	120	48.5	0.278	0.6	24.25	0.00000	0.000	0.0	118.4	0.0	0.0
M200 4hr	240	65.4	0.278	0.6	16.35	0.00000	0.000	0.0	236.9	0.0	0.0
M200 6hr	300	77.8	0.278	0.6	15.56	0.00000	0.000	0.0	355.3	0.0	0.0
M200 12hr	600	104.9	0.278	0.6	10.49	0.00000	0.000	0.0	710.6	0.0	0.0
M200 24hr	1200	141.3	0.278	0.6	7.065	0.00000	0.000	0.0	1421.3	0.0	0.0
M200 48hr	2400	158.8	0.278	0.6	3.97	0.00000	0.000	0.0	2842.6	0.0	0.0

Catchment			**SP 19**	Area Excl Hardstand					water discharge rate (l/s)		
Clean water natural flow									16.45		l/s/ha
1 in 200 year return	**minutes**	**Rainfall (mm)**		**C**	**i (mm/hr)**	**A (km^2)**	**(m^3/s)**	**Volume (m^3)**	**Discharge (m^3/ha)**	**Discharge (m^3)**	**Residual Volume (m^3)**
M200 5min	5	12.1	0.278	0.78	145.2	0.00000	0.000	0.0	4.9	0.0	0.0
M200 10min	10	16.9	0.278	0.78	101.4	0.00000	0.000	0.0	9.9	0.0	0.0
M200 15min	15	19.8	0.278	0.78	79.2	0.00000	0.000	0.0	14.8	0.0	0.0
M200 30min	30	26.7	0.278	0.78	53.4	0.00000	0.000	0.0	29.6	0.0	0.0
M200 60min	60	36	0.278	0.78	36	0.00000	0.000	0.0	59.2	0.0	0.0
M200 2hr	120	48.5	0.278	0.78	24.25	0.00000	0.000	0.0	118.4	0.0	0.0
M200 4hr	240	65.4	0.278	0.78	16.35	0.00000	0.000	0.0	236.9	0.0	0.0
M200 6hr	300	77.8	0.278	0.78	15.56	0.00000	0.000	0.0	355.3	0.0	0.0
M200 12hr	600	104.9	0.278	0.78	10.49	0.00000	0.000	0.0	710.6	0.0	0.0
M200 24hr	1200	141.3	0.278	0.78	7.065	0.00000	0.000	0.0	1421.3	0.0	0.0
M200 48hr	2400	158.8	0.278	0.78	3.97	0.00000	0.000	0.0	2842.6	0.0	0.0

Catchment			**SP 19**	Hardstand					water discharge rate (l/s)		
Clean water natural flow									16.45		l/s/ha
1 in 200 year return	**minutes**	**Rainfall (mm)**		**C**	**i (mm/hr)**	**A (km^2)**	**(m^3/s)**	**Volume (m^3)**	**Discharge (m^3/ha)**	**Discharge (m^3)**	**Residual Volume (m^3)**
M200 5min	5	12.1	0.278	0.6	145.2	0.00414	0.100	30.0	4.9	2.0	28.0
M200 10min	10	16.9	0.278	0.6	101.4	0.00414	0.070	42.0	9.9	4.1	37.9
M200 15min	15	19.8	0.278	0.6	79.2	0.00414	0.055	49.2	14.8	6.1	43.0
M200 30min	30	26.7	0.278	0.6	53.4	0.00414	0.037	66.3	29.6	12.2	54.1
M200 60min	60	36	0.278	0.6	36	0.00414	0.025	89.4	59.2	24.5	64.9
M200 2hr	120	48.5	0.278	0.6	24.25	0.00414	0.017	120.4	118.4	49.0	71.4
M200 4hr	240	65.4	0.278	0.6	16.35	0.00414	0.011	162.4	236.9	97.9	64.4
M200 6hr	300	77.8	0.278	0.6	15.56	0.00414	0.011	231.8	355.3	146.9	84.9
M200 12hr	600	104.9	0.278	0.6	10.49	0.00414	0.007	312.6	710.6	293.8	18.7
M200 24hr	1200	141.3	0.278	0.6	7.065	0.00414	0.005	421.0	1421.3	587.7	-166.7
M200 48hr	2400	158.8	0.278	0.6	3.97	0.00414	0.003	473.2	2842.6	1175.4	-702.2

Catchment			**SP 19A**	Area Excl Hardstand					water discharge rate (l/s)		
Clean water natural flow									16.45		l/s/ha
1 in 200 year return	**minutes**	**Rainfall (mm)**		**C**	**i (mm/hr)**	**A (km^2)**	**(m^3/s)**	**Volume (m^3)**	**Discharge (m^3/ha)**	**Discharge (m^3)**	**Residual Volume (m^3)**
M200 5min	5	12.1	0.278	0.78	145.2	0.00000	0.000	0.0	4.9	0.0	0.0
M200 10min	10	16.9	0.278	0.78	101.4	0.00000	0.000	0.0	9.9	0.0	0.0
M200 15min	15	19.8	0.278	0.78	79.2	0.00000	0.000	0.0	14.8	0.0	0.0
M200 30min	30	26.7	0.278	0.78	53.4	0.00000	0.000	0.0	29.6	0.0	0.0
M200 60min	60	36	0.278	0.78	36	0.00000	0.000	0.0	59.2	0.0	0.0
M200 2hr	120	48.5	0.278	0.78	24.25	0.00000	0.000	0.0	118.4	0.0	0.0
M200 4hr	240	65.4	0.278	0.78	16.35	0.00000	0.000	0.0	236.9	0.0	0.0
M200 6hr	300	77.8	0.278	0.78	15.56	0.00000	0.000	0.0	355.3	0.0	0.0
M200 12hr	600	104.9	0.278	0.78	10.49	0.00000	0.000	0.0	710.6	0.0	0.0
M200 24hr	1200	141.3	0.278	0.78	7.065	0.00000	0.000	0.0	1421.3	0.0	0.0
M200 48hr	2400	158.8	0.278	0.78	3.97	0.00000	0.000	0.0	2842.6	0.0	0.0

Catchment			SP 19A	Hardstand					water discharge rate (l/s)		
Clean water natural flow									16.45		l/s/ha
1 in 200 year return	minutes	Rainfall (mm)		C	i (mm/hr)	A (km^2)	(m^3/s)	Volume (m^3)	Discharge (m^3/ha)	Discharge (m^3)	Residual Volume (m^3)
M200 5min	5	12.1	0.278	0.6	145.2	0.00414	0.100	30.0	4.9	2.0	28.0
M200 10min	10	16.9	0.278	0.6	101.4	0.00414	0.070	42.0	9.9	4.1	37.9
M200 15min	15	19.8	0.278	0.6	79.2	0.00414	0.055	49.2	14.8	6.1	43.0
M200 30min	30	26.7	0.278	0.6	53.4	0.00414	0.037	66.3	29.6	12.2	54.1
M200 60min	60	36	0.278	0.6	36	0.00414	0.025	89.4	59.2	24.5	64.9
M200 2hr	120	48.5	0.278	0.6	24.25	0.00414	0.017	120.4	118.4	49.0	71.4
M200 4hr	240	65.4	0.278	0.6	16.35	0.00414	0.011	162.4	236.9	97.9	64.4
M200 6hr	300	77.8	0.278	0.6	15.56	0.00414	0.011	231.8	355.3	146.9	84.9
M200 12hr	600	104.9	0.278	0.6	10.49	0.00414	0.007	312.6	710.6	293.8	18.7
M200 24hr	1200	141.3	0.278	0.6	7.065	0.00414	0.005	421.0	1421.3	587.7	-166.7
M200 48hr	2400	158.8	0.278	0.6	3.97	0.00414	0.003	473.2	2842.6	1175.4	-702.2

Catchment			SP 20	Area Excl Hardstand					water discharge rate (l/s)		
Clean water natural flow									16.45		l/s/ha
1 in 200 year return	minutes	Rainfall (mm)		C	i (mm/hr)	A (km^2)	(m^3/s)	Volume (m^3)	Discharge (m^3/ha)	Discharge (m^3)	Residual Volume (m^3)
M200 5min	5	12.1	0.278	0.78	145.2	0.00000	0.000	0.0	4.9	0.0	0.0
M200 10min	10	16.9	0.278	0.78	101.4	0.00000	0.000	0.0	9.9	0.0	0.0
M200 15min	15	19.8	0.278	0.78	79.2	0.00000	0.000	0.0	14.8	0.0	0.0
M200 30min	30	26.7	0.278	0.78	53.4	0.00000	0.000	0.0	29.6	0.0	0.0
M200 60min	60	36	0.278	0.78	36	0.00000	0.000	0.0	59.2	0.0	0.0
M200 2hr	120	48.5	0.278	0.78	24.25	0.00000	0.000	0.0	118.4	0.0	0.0
M200 4hr	240	65.4	0.278	0.78	16.35	0.00000	0.000	0.0	236.9	0.0	0.0
M200 6hr	300	77.8	0.278	0.78	15.56	0.00000	0.000	0.0	355.3	0.0	0.0
M200 12hr	600	104.9	0.278	0.78	10.49	0.00000	0.000	0.0	710.6	0.0	0.0
M200 24hr	1200	141.3	0.278	0.78	7.065	0.00000	0.000	0.0	1421.3	0.0	0.0
M200 48hr	2400	158.8	0.278	0.78	3.97	0.00000	0.000	0.0	2842.6	0.0	0.0

Catchment			SP 20	Hardstand					water discharge rate (l/s)		
Clean water natural flow									16.45		l/s/ha
1 in 200 year return	minutes	Rainfall (mm)		C	i (mm/hr)	A (km^2)	(m^3/s)	Volume (m^3)	Discharge (m^3/ha)	Discharge (m^3)	Residual Volume (m^3)
M200 5min	5	12.1	0.278	0.6	145.2	0.00555	0.134	40.3	4.9	2.7	37.6
M200 10min	10	16.9	0.278	0.6	101.4	0.00555	0.094	56.3	9.9	5.5	50.9
M200 15min	15	19.8	0.278	0.6	79.2	0.00555	0.073	66.0	14.8	8.2	57.8
M200 30min	30	26.7	0.278	0.6	53.4	0.00555	0.049	89.0	29.6	16.4	72.6
M200 60min	60	36	0.278	0.6	36	0.00555	0.033	120.0	59.2	32.9	87.1
M200 2hr	120	48.5	0.278	0.6	24.25	0.00555	0.022	161.7	118.4	65.8	95.9
M200 4hr	240	65.4	0.278	0.6	16.35	0.00555	0.015	218.0	236.9	131.5	86.5
M200 6hr	300	77.8	0.278	0.6	15.56	0.00555	0.014	311.2	355.3	197.3	114.0
M200 12hr	600	104.9	0.278	0.6	10.49	0.00555	0.010	419.7	710.6	394.5	25.1
M200 24hr	1200	141.3	0.278	0.6	7.065	0.00555	0.007	565.3	1421.3	789.1	-223.8
M200 48hr	2400	158.8	0.278	0.6	3.97	0.00555	0.004	635.3	2842.6	1578.2	-942.9

Catchment			**SP 20A**	Area Excl Hardstand					water discharge rate (l/s)		
Clean water natural flow									16.45		l/s/ha
1 in 200 year return	**minutes**	**Rainfall (mm)**		**C**	**i (mm/hr)**	**A (km^2)**	**(m^3/s)**	**Volume (m^3)**	**Discharge (m^3/ha)**	**Discharge (m^3)**	**Residual Volume (m^3)**
M200 5min	5	12.1	0.278	0.78	145.2	0.00000	0.000	0.0	4.9	0.0	0.0
M200 10min	10	16.9	0.278	0.78	101.4	0.00000	0.000	0.0	9.9	0.0	0.0
M200 15min	15	19.8	0.278	0.78	79.2	0.00000	0.000	0.0	14.8	0.0	0.0
M200 30min	30	26.7	0.278	0.78	53.4	0.00000	0.000	0.0	29.6	0.0	0.0
M200 60min	60	36	0.278	0.78	36	0.00000	0.000	0.0	59.2	0.0	0.0
M200 2hr	120	48.5	0.278	0.78	24.25	0.00000	0.000	0.0	118.4	0.0	0.0
M200 4hr	240	65.4	0.278	0.78	16.35	0.00000	0.000	0.0	236.9	0.0	0.0
M200 6hr	300	77.8	0.278	0.78	15.56	0.00000	0.000	0.0	355.3	0.0	0.0
M200 12hr	600	104.9	0.278	0.78	10.49	0.00000	0.000	0.0	710.6	0.0	0.0
M200 24hr	1200	141.3	0.278	0.78	7.065	0.00000	0.000	0.0	1421.3	0.0	0.0
M200 48hr	2400	158.8	0.278	0.78	3.97	0.00000	0.000	0.0	2842.6	0.0	0.0

Catchment			**SP 20A**	Hardstand					water discharge rate (l/s)		
Clean water natural flow									16.45		l/s/ha
1 in 200 year return	**minutes**	**Rainfall (mm)**		**C**	**i (mm/hr)**	**A (km^2)**	**(m^3/s)**	**Volume (m^3)**	**Discharge (m^3/ha)**	**Discharge (m^3)**	**Residual Volume (m^3)**
M200 5min	5	12.1	0.278	0.6	145.2	0.00555	0.134	40.3	4.9	2.7	37.6
M200 10min	10	16.9	0.278	0.6	101.4	0.00555	0.094	56.3	9.9	5.5	50.9
M200 15min	15	19.8	0.278	0.6	79.2	0.00555	0.073	66.0	14.8	8.2	57.8
M200 30min	30	26.7	0.278	0.6	53.4	0.00555	0.049	89.0	29.6	16.4	72.6
M200 60min	60	36	0.278	0.6	36	0.00555	0.033	120.0	59.2	32.9	87.1
M200 2hr	120	48.5	0.278	0.6	24.25	0.00555	0.022	161.7	118.4	65.8	95.9
M200 4hr	240	65.4	0.278	0.6	16.35	0.00555	0.015	218.0	236.9	131.5	86.5
M200 6hr	300	77.8	0.278	0.6	15.56	0.00555	0.014	311.2	355.3	197.3	114.0
M200 12hr	600	104.9	0.278	0.6	10.49	0.00555	0.010	419.7	710.6	394.5	25.1
M200 24hr	1200	141.3	0.278	0.6	7.065	0.00555	0.007	565.3	1421.3	789.1	-223.8
M200 48hr	2400	158.8	0.278	0.6	3.97	0.00555	0.004	635.3	2842.6	1578.2	-942.9

Catchment			**SP 20B**	Area Excl Hardstand					water discharge rate (l/s)		
Clean water natural flow									16.45		l/s/ha
1 in 200 year return	**minutes**	**Rainfall (mm)**		**C**	**i (mm/hr)**	**A (km^2)**	**(m^3/s)**	**Volume (m^3)**	**Discharge (m^3/ha)**	**Discharge (m^3)**	**Residual Volume (m^3)**
M200 5min	5	12.1	0.278	0.78	145.2	0.00000	0.000	0.0	4.9	0.0	0.0
M200 10min	10	16.9	0.278	0.78	101.4	0.00000	0.000	0.0	9.9	0.0	0.0
M200 15min	15	19.8	0.278	0.78	79.2	0.00000	0.000	0.0	14.8	0.0	0.0
M200 30min	30	26.7	0.278	0.78	53.4	0.00000	0.000	0.0	29.6	0.0	0.0
M200 60min	60	36	0.278	0.78	36	0.00000	0.000	0.0	59.2	0.0	0.0
M200 2hr	120	48.5	0.278	0.78	24.25	0.00000	0.000	0.0	118.4	0.0	0.0
M200 4hr	240	65.4	0.278	0.78	16.35	0.00000	0.000	0.0	236.9	0.0	0.0
M200 6hr	300	77.8	0.278	0.78	15.56	0.00000	0.000	0.0	355.3	0.0	0.0
M200 12hr	600	104.9	0.278	0.78	10.49	0.00000	0.000	0.0	710.6	0.0	0.0
M200 24hr	1200	141.3	0.278	0.78	7.065	0.00000	0.000	0.0	1421.3	0.0	0.0
M200 48hr	2400	158.8	0.278	0.78	3.97	0.00000	0.000	0.0	2842.6	0.0	0.0

Catchment			SP 20B	Hardstand					water discharge rate (l/s)		
Clean water natural flow									16.45		l/s/ha
1 in 200 year return	**minutes**	**Rainfall (mm)**		**C**	**i (mm/hr)**	**A (km^2)**	**(m^3/s)**	**Volume (m^3)**	**Discharge (m^3/ha)**	**Discharge (m^3)**	**Residual Volume (m^3)**
M200 5min	5	12.1	0.278	0.6	145.2	0.00555	0.134	40.3	4.9	2.7	37.6
M200 10min	10	16.9	0.278	0.6	101.4	0.00555	0.094	56.3	9.9	5.5	50.9
M200 15min	15	19.8	0.278	0.6	79.2	0.00555	0.073	66.0	14.8	8.2	57.8
M200 30min	30	26.7	0.278	0.6	53.4	0.00555	0.049	89.0	29.6	16.4	72.6
M200 60min	60	36	0.278	0.6	36	0.00555	0.033	120.0	59.2	32.9	87.1
M200 2hr	120	48.5	0.278	0.6	24.25	0.00555	0.022	161.7	118.4	65.8	95.9
M200 4hr	240	65.4	0.278	0.6	16.35	0.00555	0.015	218.0	236.9	131.5	86.5
M200 6hr	300	77.8	0.278	0.6	15.56	0.00555	0.014	311.2	355.3	197.3	114.0
M200 12hr	600	104.9	0.278	0.6	10.49	0.00555	0.010	419.7	710.6	394.5	25.1
M200 24hr	1200	141.3	0.278	0.6	7.065	0.00555	0.007	565.3	1421.3	789.1	-223.8
M200 48hr	2400	158.8	0.278	0.6	3.97	0.00555	0.004	635.3	2842.6	1578.2	-942.9

Catchment			SP 21	Area Excl Hardstand					water discharge rate (l/s)		
Clean water natural flow									16.45		l/s/ha
1 in 200 year return	**minutes**	**Rainfall (mm)**		**C**	**i (mm/hr)**	**A (km^2)**	**(m^3/s)**	**Volume (m^3)**	**Discharge (m^3/ha)**	**Discharge (m^3)**	**Residual Volume (m^3)**
M200 5min	5	12.1	0.278	0.78	145.2	0.00370	0.116	34.9	4.9	1.8	33.1
M200 10min	10	16.9	0.278	0.78	101.4	0.00370	0.081	48.8	9.9	3.7	45.2
M200 15min	15	19.8	0.278	0.78	79.2	0.00370	0.064	57.2	14.8	5.5	51.7
M200 30min	30	26.7	0.278	0.78	53.4	0.00370	0.043	77.1	29.6	11.0	66.2
M200 60min	60	36	0.278	0.78	36	0.00370	0.029	104.0	59.2	21.9	82.1
M200 2hr	120	48.5	0.278	0.78	24.25	0.00370	0.019	140.1	118.4	43.8	96.3
M200 4hr	240	65.4	0.278	0.78	16.35	0.00370	0.013	188.9	236.9	87.6	101.2
M200 6hr	300	77.8	0.278	0.78	15.56	0.00370	0.012	269.7	355.3	131.5	138.2
M200 12hr	600	104.9	0.278	0.78	10.49	0.00370	0.008	363.6	710.6	262.9	100.6
M200 24hr	1200	141.3	0.278	0.78	7.065	0.00370	0.006	489.7	1421.3	525.9	-36.1
M200 48hr	2400	158.8	0.278	0.78	3.97	0.00370	0.003	550.4	2842.6	1051.7	-501.4

Catchment			SP 21	Hardstand					water discharge rate (l/s)		
Clean water natural flow									16.45		l/s/ha
1 in 200 year return	**minutes**	**Rainfall (mm)**		**C**	**i (mm/hr)**	**A (km^2)**	**(m^3/s)**	**Volume (m^3)**	**Discharge (m^3/ha)**	**Discharge (m^3)**	**Residual Volume (m^3)**
M200 5min	5	12.1	0.278	0.6	145.2	0.00000	0.000	0.0	4.9	0.0	0.0
M200 10min	10	16.9	0.278	0.6	101.4	0.00000	0.000	0.0	9.9	0.0	0.0
M200 15min	15	19.8	0.278	0.6	79.2	0.00000	0.000	0.0	14.8	0.0	0.0
M200 30min	30	26.7	0.278	0.6	53.4	0.00000	0.000	0.0	29.6	0.0	0.0
M200 60min	60	36	0.278	0.6	36	0.00000	0.000	0.0	59.2	0.0	0.0
M200 2hr	120	48.5	0.278	0.6	24.25	0.00000	0.000	0.0	118.4	0.0	0.0
M200 4hr	240	65.4	0.278	0.6	16.35	0.00000	0.000	0.0	236.9	0.0	0.0
M200 6hr	300	77.8	0.278	0.6	15.56	0.00000	0.000	0.0	355.3	0.0	0.0
M200 12hr	600	104.9	0.278	0.6	10.49	0.00000	0.000	0.0	710.6	0.0	0.0
M200 24hr	1200	141.3	0.278	0.6	7.065	0.00000	0.000	0.0	1421.3	0.0	0.0
M200 48hr	2400	158.8	0.278	0.6	3.97	0.00000	0.000	0.0	2842.6	0.0	0.0

Catchment			SP 22	Area Excl Hardstand					water discharge rate (l/s)		
Clean water natural flow									16.45		l/s/ha
1 in 200 year return	**minutes**	**Rainfall (mm)**		**C**	**i (mm/hr)**	**A (km^2)**	**(m^3/s)**	**Volume (m^3)**	**Discharge (m^3/ha)**	**Discharge (m^3)**	**Residual Volume (m^3)**
M200 5min	5	12.1	0.278	0.78	145.2	0.00510	0.161	48.2	4.9	2.5	45.7
M200 10min	10	16.9	0.278	0.78	101.4	0.00510	0.112	67.3	9.9	5.0	62.2
M200 15min	15	19.8	0.278	0.78	79.2	0.00510	0.088	78.8	14.8	7.6	71.3
M200 30min	30	26.7	0.278	0.78	53.4	0.00510	0.059	106.3	29.6	15.1	91.2
M200 60min	60	36	0.278	0.78	36	0.00510	0.040	143.3	59.2	30.2	113.1
M200 2hr	120	48.5	0.278	0.78	24.25	0.00510	0.027	193.1	118.4	60.4	132.7
M200 4hr	240	65.4	0.278	0.78	16.35	0.00510	0.018	260.4	236.9	120.8	139.6
M200 6hr	300	77.8	0.278	0.78	15.56	0.00510	0.017	371.7	355.3	181.2	190.5
M200 12hr	600	104.9	0.278	0.78	10.49	0.00510	0.012	501.2	710.6	362.4	138.7
M200 24hr	1200	141.3	0.278	0.78	7.065	0.00510	0.008	675.0	1421.3	724.9	-49.8
M200 48hr	2400	158.8	0.278	0.78	3.97	0.00510	0.004	758.7	2842.6	1449.7	-691.1

Catchment			SP 22	Hardstand					water discharge rate (l/s)		
Clean water natural flow									16.45		l/s/ha
1 in 200 year return	**minutes**	**Rainfall (mm)**		**C**	**i (mm/hr)**	**A (km^2)**	**(m^3/s)**	**Volume (m^3)**	**Discharge (m^3/ha)**	**Discharge (m^3)**	**Residual Volume (m^3)**
M200 5min	5	12.1	0.278	0.6	145.2	0.00000	0.000	0.0	4.9	0.0	0.0
M200 10min	10	16.9	0.278	0.6	101.4	0.00000	0.000	0.0	9.9	0.0	0.0
M200 15min	15	19.8	0.278	0.6	79.2	0.00000	0.000	0.0	14.8	0.0	0.0
M200 30min	30	26.7	0.278	0.6	53.4	0.00000	0.000	0.0	29.6	0.0	0.0
M200 60min	60	36	0.278	0.6	36	0.00000	0.000	0.0	59.2	0.0	0.0
M200 2hr	120	48.5	0.278	0.6	24.25	0.00000	0.000	0.0	118.4	0.0	0.0
M200 4hr	240	65.4	0.278	0.6	16.35	0.00000	0.000	0.0	236.9	0.0	0.0
M200 6hr	300	77.8	0.278	0.6	15.56	0.00000	0.000	0.0	355.3	0.0	0.0
M200 12hr	600	104.9	0.278	0.6	10.49	0.00000	0.000	0.0	710.6	0.0	0.0
M200 24hr	1200	141.3	0.278	0.6	7.065	0.00000	0.000	0.0	1421.3	0.0	0.0
M200 48hr	2400	158.8	0.278	0.6	3.97	0.00000	0.000	0.0	2842.6	0.0	0.0

Catchment			SP 22A	Area Excl Hardstand					water discharge rate (l/s)		
Clean water natural flow									16.45		l/s/ha
1 in 200 year return	**minutes**	**Rainfall (mm)**		**C**	**i (mm/hr)**	**A (km^2)**	**(m^3/s)**	**Volume (m^3)**	**Discharge (m^3/ha)**	**Discharge (m^3)**	**Residual Volume (m^3)**
M200 5min	5	12.1	0.278	0.78	145.2	0.00000	0.000	0.0	4.9	0.0	0.0
M200 10min	10	16.9	0.278	0.78	101.4	0.00000	0.000	0.0	9.9	0.0	0.0
M200 15min	15	19.8	0.278	0.78	79.2	0.00000	0.000	0.0	14.8	0.0	0.0
M200 30min	30	26.7	0.278	0.78	53.4	0.00000	0.000	0.0	29.6	0.0	0.0
M200 60min	60	36	0.278	0.78	36	0.00000	0.000	0.0	59.2	0.0	0.0
M200 2hr	120	48.5	0.278	0.78	24.25	0.00000	0.000	0.0	118.4	0.0	0.0
M200 4hr	240	65.4	0.278	0.78	16.35	0.00000	0.000	0.0	236.9	0.0	0.0
M200 6hr	300	77.8	0.278	0.78	15.56	0.00000	0.000	0.0	355.3	0.0	0.0
M200 12hr	600	104.9	0.278	0.78	10.49	0.00000	0.000	0.0	710.6	0.0	0.0
M200 24hr	1200	141.3	0.278	0.78	7.065	0.00000	0.000	0.0	1421.3	0.0	0.0
M200 48hr	2400	158.8	0.278	0.78	3.97	0.00000	0.000	0.0	2842.6	0.0	0.0

Catchment			SP 22A	Hardstand					water discharge rate (l/s)		
Clean water natural flow									16.45		l/s/ha
1 in 200 year return	minutes	Rainfall (mm)		C	i (mm/hr)	A (km^2)	(m^3/s)	Volume (m^3)	Discharge (m^3/ha)	Discharge (m^3)	Residual Volume (m^3)
M200 5min	5	12.1	0.278	0.6	145.2	0.00510	0.124	37.1	4.9	2.5	34.5
M200 10min	10	16.9	0.278	0.6	101.4	0.00510	0.086	51.8	9.9	5.0	46.7
M200 15min	15	19.8	0.278	0.6	79.2	0.00510	0.067	60.6	14.8	7.6	53.1
M200 30min	30	26.7	0.278	0.6	53.4	0.00510	0.045	81.8	29.6	15.1	66.7
M200 60min	60	36	0.278	0.6	36	0.00510	0.031	110.2	59.2	30.2	80.0
M200 2hr	120	48.5	0.278	0.6	24.25	0.00510	0.021	148.5	118.4	60.4	88.1
M200 4hr	240	65.4	0.278	0.6	16.35	0.00510	0.014	200.3	236.9	120.8	79.5
M200 6hr	300	77.8	0.278	0.6	15.56	0.00510	0.013	285.9	355.3	181.2	104.7
M200 12hr	600	104.9	0.278	0.6	10.49	0.00510	0.009	385.5	710.6	362.4	23.1
M200 24hr	1200	141.3	0.278	0.6	7.065	0.00510	0.006	519.3	1421.3	724.9	-205.6
M200 48hr	2400	158.8	0.278	0.6	3.97	0.00510	0.003	583.6	2842.6	1449.7	-866.1

Catchment			SP 23	Area Excl Hardstand					water discharge rate (l/s)		
Clean water natural flow									16.45		l/s/ha
1 in 200 year return	minutes	Rainfall (mm)		C	i (mm/hr)	A (km^2)	(m^3/s)	Volume (m^3)	Discharge (m^3/ha)	Discharge (m^3)	Residual Volume (m^3)
M200 5min	5	12.1	0.278	0.78	145.2	0.00000	0.000	0.0	4.9	0.0	0.0
M200 10min	10	16.9	0.278	0.78	101.4	0.00000	0.000	0.0	9.9	0.0	0.0
M200 15min	15	19.8	0.278	0.78	79.2	0.00000	0.000	0.0	14.8	0.0	0.0
M200 30min	30	26.7	0.278	0.78	53.4	0.00000	0.000	0.0	29.6	0.0	0.0
M200 60min	60	36	0.278	0.78	36	0.00000	0.000	0.0	59.2	0.0	0.0
M200 2hr	120	48.5	0.278	0.78	24.25	0.00000	0.000	0.0	118.4	0.0	0.0
M200 4hr	240	65.4	0.278	0.78	16.35	0.00000	0.000	0.0	236.9	0.0	0.0
M200 6hr	300	77.8	0.278	0.78	15.56	0.00000	0.000	0.0	355.3	0.0	0.0
M200 12hr	600	104.9	0.278	0.78	10.49	0.00000	0.000	0.0	710.6	0.0	0.0
M200 24hr	1200	141.3	0.278	0.78	7.065	0.00000	0.000	0.0	1421.3	0.0	0.0
M200 48hr	2400	158.8	0.278	0.78	3.97	0.00000	0.000	0.0	2842.6	0.0	0.0

Catchment			SP 23	Hardstand					water discharge rate (l/s)		
Clean water natural flow									16.45		l/s/ha
1 in 200 year return	minutes	Rainfall (mm)		C	i (mm/hr)	A (km^2)	(m^3/s)	Volume (m^3)	Discharge (m^3/ha)	Discharge (m^3)	Residual Volume (m^3)
M200 5min	5	12.1	0.278	0.6	145.2	0.00504	0.122	36.6	4.9	2.5	34.1
M200 10min	10	16.9	0.278	0.6	101.4	0.00504	0.085	51.1	9.9	5.0	46.1
M200 15min	15	19.8	0.278	0.6	79.2	0.00504	0.067	59.9	14.8	7.5	52.4
M200 30min	30	26.7	0.278	0.6	53.4	0.00504	0.045	80.7	29.6	14.9	65.8
M200 60min	60	36	0.278	0.6	36	0.00504	0.030	108.8	59.2	29.8	79.0
M200 2hr	120	48.5	0.278	0.6	24.25	0.00504	0.020	146.6	118.4	59.6	87.0
M200 4hr	240	65.4	0.278	0.6	16.35	0.00504	0.014	197.7	236.9	119.3	78.5
M200 6hr	300	77.8	0.278	0.6	15.56	0.00504	0.013	282.3	355.3	178.9	103.4
M200 12hr	600	104.9	0.278	0.6	10.49	0.00504	0.009	380.6	710.6	357.8	22.8
M200 24hr	1200	141.3	0.278	0.6	7.065	0.00504	0.006	512.7	1421.3	715.6	-203.0
M200 48hr	2400	158.8	0.278	0.6	3.97	0.00504	0.003	576.1	2842.6	1431.2	-855.1

Catchment			**SP 23A**	Area Excl Hardstand					water discharge rate (l/s)		
Clean water natural flow									16.45		l/s/ha
1 in 200 year return	**minutes**	**Rainfall (mm)**		**C**	**i (mm/hr)**	**A (km^2)**	**(m^3/s)**	**Volume (m^3)**	**Discharge (m^3/ha)**	**Discharge (m^3)**	**Residual Volume (m^3)**
M200 5min	5	12.1	0.278	0.78	145.2	0.00000	0.000	0.0	4.9	0.0	0.0
M200 10min	10	16.9	0.278	0.78	101.4	0.00000	0.000	0.0	9.9	0.0	0.0
M200 15min	15	19.8	0.278	0.78	79.2	0.00000	0.000	0.0	14.8	0.0	0.0
M200 30min	30	26.7	0.278	0.78	53.4	0.00000	0.000	0.0	29.6	0.0	0.0
M200 60min	60	36	0.278	0.78	36	0.00000	0.000	0.0	59.2	0.0	0.0
M200 2hr	120	48.5	0.278	0.78	24.25	0.00000	0.000	0.0	118.4	0.0	0.0
M200 4hr	240	65.4	0.278	0.78	16.35	0.00000	0.000	0.0	236.9	0.0	0.0
M200 6hr	300	77.8	0.278	0.78	15.56	0.00000	0.000	0.0	355.3	0.0	0.0
M200 12hr	600	104.9	0.278	0.78	10.49	0.00000	0.000	0.0	710.6	0.0	0.0
M200 24hr	1200	141.3	0.278	0.78	7.065	0.00000	0.000	0.0	1421.3	0.0	0.0
M200 48hr	2400	158.8	0.278	0.78	3.97	0.00000	0.000	0.0	2842.6	0.0	0.0

Catchment			**SP 23A**	Hardstand					water discharge rate (l/s)		
Clean water natural flow									16.45		l/s/ha
1 in 200 year return	**minutes**	**Rainfall (mm)**		**C**	**i (mm/hr)**	**A (km^2)**	**(m^3/s)**	**Volume (m^3)**	**Discharge (m^3/ha)**	**Discharge (m^3)**	**Residual Volume (m^3)**
M200 5min	5	12.1	0.278	0.6	145.2	0.00504	0.122	36.6	4.9	2.5	34.1
M200 10min	10	16.9	0.278	0.6	101.4	0.00504	0.085	51.1	9.9	5.0	46.1
M200 15min	15	19.8	0.278	0.6	79.2	0.00504	0.067	59.9	14.8	7.5	52.4
M200 30min	30	26.7	0.278	0.6	53.4	0.00504	0.045	80.7	29.6	14.9	65.8
M200 60min	60	36	0.278	0.6	36	0.00504	0.030	108.8	59.2	29.8	79.0
M200 2hr	120	48.5	0.278	0.6	24.25	0.00504	0.020	146.6	118.4	59.6	87.0
M200 4hr	240	65.4	0.278	0.6	16.35	0.00504	0.014	197.7	236.9	119.3	78.5
M200 6hr	300	77.8	0.278	0.6	15.56	0.00504	0.013	282.3	355.3	178.9	103.4
M200 12hr	600	104.9	0.278	0.6	10.49	0.00504	0.009	380.6	710.6	357.8	22.8
M200 24hr	1200	141.3	0.278	0.6	7.065	0.00504	0.006	512.7	1421.3	715.6	-203.0
M200 48hr	2400	158.8	0.278	0.6	3.97	0.00504	0.003	576.1	2842.6	1431.2	-855.1

Catchment			**SP 24**	Area Excl Hardstand					water discharge rate (l/s)		
Clean water natural flow									16.45		l/s/ha
1 in 200 year return	**minutes**	**Rainfall (mm)**		**C**	**i (mm/hr)**	**A (km^2)**	**(m^3/s)**	**Volume (m^3)**	**Discharge (m^3/ha)**	**Discharge (m^3)**	**Residual Volume (m^3)**
M200 5min	5	12.1	0.278	0.78	145.2	0.00000	0.000	0.0	4.9	0.0	0.0
M200 10min	10	16.9	0.278	0.78	101.4	0.00000	0.000	0.0	9.9	0.0	0.0
M200 15min	15	19.8	0.278	0.78	79.2	0.00000	0.000	0.0	14.8	0.0	0.0
M200 30min	30	26.7	0.278	0.78	53.4	0.00000	0.000	0.0	29.6	0.0	0.0
M200 60min	60	36	0.278	0.78	36	0.00000	0.000	0.0	59.2	0.0	0.0
M200 2hr	120	48.5	0.278	0.78	24.25	0.00000	0.000	0.0	118.4	0.0	0.0
M200 4hr	240	65.4	0.278	0.78	16.35	0.00000	0.000	0.0	236.9	0.0	0.0
M200 6hr	300	77.8	0.278	0.78	15.56	0.00000	0.000	0.0	355.3	0.0	0.0
M200 12hr	600	104.9	0.278	0.78	10.49	0.00000	0.000	0.0	710.6	0.0	0.0
M200 24hr	1200	141.3	0.278	0.78	7.065	0.00000	0.000	0.0	1421.3	0.0	0.0
M200 48hr	2400	158.8	0.278	0.78	3.97	0.00000	0.000	0.0	2842.6	0.0	0.0

Catchment			SP 24	Hardstand					water discharge rate (l/s)		
Clean water natural flow									16.45		l/s/ha
1 in 200 year return	minutes	Rainfall (mm)		C	i (mm/hr)	A (km^2)	(m^3/s)	Volume (m^3)	Discharge (m^3/ha)	Discharge (m^3)	Residual Volume (m^3)
M200 5min	5	12.1	0.278	0.6	145.2	0.00697	0.169	50.6	4.9	3.4	47.2
M200 10min	10	16.9	0.278	0.6	101.4	0.00697	0.118	70.7	9.9	6.9	63.8
M200 15min	15	19.8	0.278	0.6	79.2	0.00697	0.092	82.8	14.8	10.3	72.5
M200 30min	30	26.7	0.278	0.6	53.4	0.00697	0.062	111.7	29.6	20.6	91.0
M200 60min	60	36	0.278	0.6	36	0.00697	0.042	150.6	59.2	41.2	109.3
M200 2hr	120	48.5	0.278	0.6	24.25	0.00697	0.028	202.8	118.4	82.5	120.4
M200 4hr	240	65.4	0.278	0.6	16.35	0.00697	0.019	273.5	236.9	165.0	108.5
M200 6hr	300	77.8	0.278	0.6	15.56	0.00697	0.018	390.5	355.3	247.5	143.0
M200 12hr	600	104.9	0.278	0.6	10.49	0.00697	0.012	526.5	710.6	495.0	31.5
M200 24hr	1200	141.3	0.278	0.6	7.065	0.00697	0.008	709.2	1421.3	989.9	-280.8
M200 48hr	2400	158.8	0.278	0.6	3.97	0.00697	0.005	797.0	2842.6	1979.8	-1182.9

Catchment			SP 25	Area Excl Hardstand					water discharge rate (l/s)		
Clean water natural flow									16.45		l/s/ha
1 in 200 year return	minutes	Rainfall (mm)		C	i (mm/hr)	A (km^2)	(m^3/s)	Volume (m^3)	Discharge (m^3/ha)	Discharge (m^3)	Residual Volume (m^3)
M200 5min	5	12.1	0.278	0.78	145.2	0.00000	0.000	0.0	4.9	0.0	0.0
M200 10min	10	16.9	0.278	0.78	101.4	0.00000	0.000	0.0	9.9	0.0	0.0
M200 15min	15	19.8	0.278	0.78	79.2	0.00000	0.000	0.0	14.8	0.0	0.0
M200 30min	30	26.7	0.278	0.78	53.4	0.00000	0.000	0.0	29.6	0.0	0.0
M200 60min	60	36	0.278	0.78	36	0.00000	0.000	0.0	59.2	0.0	0.0
M200 2hr	120	48.5	0.278	0.78	24.25	0.00000	0.000	0.0	118.4	0.0	0.0
M200 4hr	240	65.4	0.278	0.78	16.35	0.00000	0.000	0.0	236.9	0.0	0.0
M200 6hr	300	77.8	0.278	0.78	15.56	0.00000	0.000	0.0	355.3	0.0	0.0
M200 12hr	600	104.9	0.278	0.78	10.49	0.00000	0.000	0.0	710.6	0.0	0.0
M200 24hr	1200	141.3	0.278	0.78	7.065	0.00000	0.000	0.0	1421.3	0.0	0.0
M200 48hr	2400	158.8	0.278	0.78	3.97	0.00000	0.000	0.0	2842.6	0.0	0.0

Catchment			SP 25	Hardstand					water discharge rate (l/s)		
Clean water natural flow									16.45		l/s/ha
1 in 200 year return	minutes	Rainfall (mm)		C	i (mm/hr)	A (km^2)	(m^3/s)	Volume (m^3)	Discharge (m^3/ha)	Discharge (m^3)	Residual Volume (m^3)
M200 5min	5	12.1	0.278	0.6	145.2	0.00533	0.129	38.7	4.9	2.6	36.1
M200 10min	10	16.9	0.278	0.6	101.4	0.00533	0.090	54.1	9.9	5.3	48.8
M200 15min	15	19.8	0.278	0.6	79.2	0.00533	0.070	63.4	14.8	7.9	55.5
M200 30min	30	26.7	0.278	0.6	53.4	0.00533	0.047	85.5	29.6	15.8	69.7
M200 60min	60	36	0.278	0.6	36	0.00533	0.032	115.2	59.2	31.6	83.7
M200 2hr	120	48.5	0.278	0.6	24.25	0.00533	0.022	155.2	118.4	63.1	92.1
M200 4hr	240	65.4	0.278	0.6	16.35	0.00533	0.015	209.3	236.9	126.3	83.1
M200 6hr	300	77.8	0.278	0.6	15.56	0.00533	0.014	298.8	355.3	189.4	109.4
M200 12hr	600	104.9	0.278	0.6	10.49	0.00533	0.009	402.9	710.6	378.8	24.1
M200 24hr	1200	141.3	0.278	0.6	7.065	0.00533	0.006	542.7	1421.3	757.5	-214.9
M200 48hr	2400	158.8	0.278	0.6	3.97	0.00533	0.004	609.9	2842.6	1515.1	-905.2

Catchment			SP 25A	Area Excl Hardstand					water discharge rate (l/s)		
Clean water natural flow									16.45		l/s/ha
1 in 200 year return	minutes	Rainfall (mm)		C	i (mm/hr)	A (km^2)	(m^3/s)	Volume (m^3)	Discharge (m^3/ha)	Discharge (m^3)	Residual Volume (m^3)
M200 5min	5	12.1	0.278	0.78	145.2	0.00000	0.000	0.0	4.9	0.0	0.0
M200 10min	10	16.9	0.278	0.78	101.4	0.00000	0.000	0.0	9.9	0.0	0.0
M200 15min	15	19.8	0.278	0.78	79.2	0.00000	0.000	0.0	14.8	0.0	0.0
M200 30min	30	26.7	0.278	0.78	53.4	0.00000	0.000	0.0	29.6	0.0	0.0
M200 60min	60	36	0.278	0.78	36	0.00000	0.000	0.0	59.2	0.0	0.0
M200 2hr	120	48.5	0.278	0.78	24.25	0.00000	0.000	0.0	118.4	0.0	0.0
M200 4hr	240	65.4	0.278	0.78	16.35	0.00000	0.000	0.0	236.9	0.0	0.0
M200 6hr	300	77.8	0.278	0.78	15.56	0.00000	0.000	0.0	355.3	0.0	0.0
M200 12hr	600	104.9	0.278	0.78	10.49	0.00000	0.000	0.0	710.6	0.0	0.0
M200 24hr	1200	141.3	0.278	0.78	7.065	0.00000	0.000	0.0	1421.3	0.0	0.0
M200 48hr	2400	158.8	0.278	0.78	3.97	0.00000	0.000	0.0	2842.6	0.0	0.0

Catchment			SP 25A	Hardstand					water discharge rate (l/s)		
Clean water natural flow									16.45		l/s/ha
1 in 200 year return	minutes	Rainfall (mm)		C	i (mm/hr)	A (km^2)	(m^3/s)	Volume (m^3)	Discharge (m^3/ha)	Discharge (m^3)	Residual Volume (m^3)
M200 5min	5	12.1	0.278	0.6	145.2	0.00533	0.129	38.7	4.9	2.6	36.1
M200 10min	10	16.9	0.278	0.6	101.4	0.00533	0.090	54.1	9.9	5.3	48.8
M200 15min	15	19.8	0.278	0.6	79.2	0.00533	0.070	63.4	14.8	7.9	55.5
M200 30min	30	26.7	0.278	0.6	53.4	0.00533	0.047	85.5	29.6	15.8	69.7
M200 60min	60	36	0.278	0.6	36	0.00533	0.032	115.2	59.2	31.6	83.7
M200 2hr	120	48.5	0.278	0.6	24.25	0.00533	0.022	155.2	118.4	63.1	92.1
M200 4hr	240	65.4	0.278	0.6	16.35	0.00533	0.015	209.3	236.9	126.3	83.1
M200 6hr	300	77.8	0.278	0.6	15.56	0.00533	0.014	298.8	355.3	189.4	109.4
M200 12hr	600	104.9	0.278	0.6	10.49	0.00533	0.009	402.9	710.6	378.8	24.1
M200 24hr	1200	141.3	0.278	0.6	7.065	0.00533	0.006	542.7	1421.3	757.5	-214.9
M200 48hr	2400	158.8	0.278	0.6	3.97	0.00533	0.004	609.9	2842.6	1515.1	-905.2

Catchment			SP 26	Area Excl Hardstand					water discharge rate (l/s)		
Clean water natural flow									16.45		l/s/ha
1 in 200 year return	minutes	Rainfall (mm)		C	i (mm/hr)	A (km^2)	(m^3/s)	Volume (m^3)	Discharge (m^3/ha)	Discharge (m^3)	Residual Volume (m^3)
M200 5min	5	12.1	0.278	0.78	145.2	0.00000	0.000	0.0	4.9	0.0	0.0
M200 10min	10	16.9	0.278	0.78	101.4	0.00000	0.000	0.0	9.9	0.0	0.0
M200 15min	15	19.8	0.278	0.78	79.2	0.00000	0.000	0.0	14.8	0.0	0.0
M200 30min	30	26.7	0.278	0.78	53.4	0.00000	0.000	0.0	29.6	0.0	0.0
M200 60min	60	36	0.278	0.78	36	0.00000	0.000	0.0	59.2	0.0	0.0
M200 2hr	120	48.5	0.278	0.78	24.25	0.00000	0.000	0.0	118.4	0.0	0.0
M200 4hr	240	65.4	0.278	0.78	16.35	0.00000	0.000	0.0	236.9	0.0	0.0
M200 6hr	300	77.8	0.278	0.78	15.56	0.00000	0.000	0.0	355.3	0.0	0.0
M200 12hr	600	104.9	0.278	0.78	10.49	0.00000	0.000	0.0	710.6	0.0	0.0
M200 24hr	1200	141.3	0.278	0.78	7.065	0.00000	0.000	0.0	1421.3	0.0	0.0
M200 48hr	2400	158.8	0.278	0.78	3.97	0.00000	0.000	0.0	2842.6	0.0	0.0

Catchment			SP 26	Hardstand					water discharge rate (l/s)		
Clean water natural flow									16.45		l/s/ha
1 in 200 year return	minutes	Rainfall (mm)		C	i (mm/hr)	A (km^2)	(m^3/s)	Volume (m^3)	Discharge (m^3/ha)	Discharge (m^3)	Residual Volume (m^3)
M200 5min	5	12.1	0.278	0.6	145.2	0.00357	0.086	25.9	4.9	1.8	24.1
M200 10min	10	16.9	0.278	0.6	101.4	0.00357	0.060	36.2	9.9	3.5	32.7
M200 15min	15	19.8	0.278	0.6	79.2	0.00357	0.047	42.4	14.8	5.3	37.1
M200 30min	30	26.7	0.278	0.6	53.4	0.00357	0.032	57.2	29.6	10.6	46.6
M200 60min	60	36	0.278	0.6	36	0.00357	0.021	77.1	59.2	21.1	56.0
M200 2hr	120	48.5	0.278	0.6	24.25	0.00357	0.014	103.8	118.4	42.2	61.6
M200 4hr	240	65.4	0.278	0.6	16.35	0.00357	0.010	140.0	236.9	84.4	55.6
M200 6hr	300	77.8	0.278	0.6	15.56	0.00357	0.009	199.9	355.3	126.7	73.2
M200 12hr	600	104.9	0.278	0.6	10.49	0.00357	0.006	269.5	710.6	253.3	16.1
M200 24hr	1200	141.3	0.278	0.6	7.065	0.00357	0.004	363.0	1421.3	506.7	-143.7
M200 48hr	2400	158.8	0.278	0.6	3.97	0.00357	0.002	407.9	2842.6	1013.4	-605.4

Catchment			SP 27	Area Excl Hardstand					water discharge rate (l/s)		
Clean water natural flow									16.45		l/s/ha
1 in 200 year return	minutes	Rainfall (mm)		C	i (mm/hr)	A (km^2)	(m^3/s)	Volume (m^3)	Discharge (m^3/ha)	Discharge (m^3)	Residual Volume (m^3)
M200 5min	5	12.1	0.278	0.78	145.2	0.00000	0.000	0.0	4.9	0.0	0.0
M200 10min	10	16.9	0.278	0.78	101.4	0.00000	0.000	0.0	9.9	0.0	0.0
M200 15min	15	19.8	0.278	0.78	79.2	0.00000	0.000	0.0	14.8	0.0	0.0
M200 30min	30	26.7	0.278	0.78	53.4	0.00000	0.000	0.0	29.6	0.0	0.0
M200 60min	60	36	0.278	0.78	36	0.00000	0.000	0.0	59.2	0.0	0.0
M200 2hr	120	48.5	0.278	0.78	24.25	0.00000	0.000	0.0	118.4	0.0	0.0
M200 4hr	240	65.4	0.278	0.78	16.35	0.00000	0.000	0.0	236.9	0.0	0.0
M200 6hr	300	77.8	0.278	0.78	15.56	0.00000	0.000	0.0	355.3	0.0	0.0
M200 12hr	600	104.9	0.278	0.78	10.49	0.00000	0.000	0.0	710.6	0.0	0.0
M200 24hr	1200	141.3	0.278	0.78	7.065	0.00000	0.000	0.0	1421.3	0.0	0.0
M200 48hr	2400	158.8	0.278	0.78	3.97	0.00000	0.000	0.0	2842.6	0.0	0.0

Catchment			SP 27	Hardstand					water discharge rate (l/s)		
Clean water natural flow									16.45		l/s/ha
1 in 200 year return	minutes	Rainfall (mm)		C	i (mm/hr)	A (km^2)	(m^3/s)	Volume (m^3)	Discharge (m^3/ha)	Discharge (m^3)	Residual Volume (m^3)
M200 5min	5	12.1	0.278	0.6	145.2	0.00384	0.093	27.9	4.9	1.9	26.0
M200 10min	10	16.9	0.278	0.6	101.4	0.00384	0.065	39.0	9.9	3.8	35.2
M200 15min	15	19.8	0.278	0.6	79.2	0.00384	0.051	45.7	14.8	5.7	40.0
M200 30min	30	26.7	0.278	0.6	53.4	0.00384	0.034	61.6	29.6	11.4	50.2
M200 60min	60	36	0.278	0.6	36	0.00384	0.023	83.0	59.2	22.7	60.3
M200 2hr	120	48.5	0.278	0.6	24.25	0.00384	0.016	111.8	118.4	45.5	66.4
M200 4hr	240	65.4	0.278	0.6	16.35	0.00384	0.010	150.8	236.9	91.0	59.8
M200 6hr	300	77.8	0.278	0.6	15.56	0.00384	0.010	215.3	355.3	136.4	78.8
M200 12hr	600	104.9	0.278	0.6	10.49	0.00384	0.007	290.3	710.6	272.9	17.4
M200 24hr	1200	141.3	0.278	0.6	7.065	0.00384	0.005	391.0	1421.3	545.8	-154.8
M200 48hr	2400	158.8	0.278	0.6	3.97	0.00384	0.003	439.4	2842.6	1091.5	-652.1

Catchment			SP 27A	Area Excl Hardstand					water discharge rate (l/s)		
Clean water natural flow									16.45		l/s/ha
1 in 200 year return	minutes	Rainfall (mm)		C	i (mm/hr)	A (km^2)	(m^3/s)	Volume (m^3)	Discharge (m^3/ha)	Discharge (m^3)	Residual Volume (m^3)
M200 5min	5	12.1	0.278	0.78	145.2	0.00000	0.000	0.0	4.9	0.0	0.0
M200 10min	10	16.9	0.278	0.78	101.4	0.00000	0.000	0.0	9.9	0.0	0.0
M200 15min	15	19.8	0.278	0.78	79.2	0.00000	0.000	0.0	14.8	0.0	0.0
M200 30min	30	26.7	0.278	0.78	53.4	0.00000	0.000	0.0	29.6	0.0	0.0
M200 60min	60	36	0.278	0.78	36	0.00000	0.000	0.0	59.2	0.0	0.0
M200 2hr	120	48.5	0.278	0.78	24.25	0.00000	0.000	0.0	118.4	0.0	0.0
M200 4hr	240	65.4	0.278	0.78	16.35	0.00000	0.000	0.0	236.9	0.0	0.0
M200 6hr	300	77.8	0.278	0.78	15.56	0.00000	0.000	0.0	355.3	0.0	0.0
M200 12hr	600	104.9	0.278	0.78	10.49	0.00000	0.000	0.0	710.6	0.0	0.0
M200 24hr	1200	141.3	0.278	0.78	7.065	0.00000	0.000	0.0	1421.3	0.0	0.0
M200 48hr	2400	158.8	0.278	0.78	3.97	0.00000	0.000	0.0	2842.6	0.0	0.0

Catchment			SP 27A	Hardstand					water discharge rate (l/s)		
Clean water natural flow									16.45		l/s/ha
1 in 200 year return	minutes	Rainfall (mm)		C	i (mm/hr)	A (km^2)	(m^3/s)	Volume (m^3)	Discharge (m^3/ha)	Discharge (m^3)	Residual Volume (m^3)
M200 5min	5	12.1	0.278	0.6	145.2	0.00384	0.093	27.9	4.9	1.9	26.0
M200 10min	10	16.9	0.278	0.6	101.4	0.00384	0.065	39.0	9.9	3.8	35.2
M200 15min	15	19.8	0.278	0.6	79.2	0.00384	0.051	45.7	14.8	5.7	40.0
M200 30min	30	26.7	0.278	0.6	53.4	0.00384	0.034	61.6	29.6	11.4	50.2
M200 60min	60	36	0.278	0.6	36	0.00384	0.023	83.0	59.2	22.7	60.3
M200 2hr	120	48.5	0.278	0.6	24.25	0.00384	0.016	111.8	118.4	45.5	66.4
M200 4hr	240	65.4	0.278	0.6	16.35	0.00384	0.010	150.8	236.9	91.0	59.8
M200 6hr	300	77.8	0.278	0.6	15.56	0.00384	0.010	215.3	355.3	136.4	78.8
M200 12hr	600	104.9	0.278	0.6	10.49	0.00384	0.007	290.3	710.6	272.9	17.4
M200 24hr	1200	141.3	0.278	0.6	7.065	0.00384	0.005	391.0	1421.3	545.8	-154.8
M200 48hr	2400	158.8	0.278	0.6	3.97	0.00384	0.003	439.4	2842.6	1091.5	-652.1

Catchment			SP28	Area Excl Hardstand					water discharge rate (l/s)		
Clean water natural flow									16.45		l/s/ha
1 in 200 year return	minutes	Rainfall (mm)		C	i (mm/hr)	A (km^2)	(m^3/s)	Volume (m^3)	Discharge (m^3/ha)	Discharge (m^3)	Residual Volume (m^3)
M200 5min	5	12.1	0.278	0.78	145.2	0.00000	0.000	0.0	4.9	0.0	0.0
M200 10min	10	16.9	0.278	0.78	101.4	0.00000	0.000	0.0	9.9	0.0	0.0
M200 15min	15	19.8	0.278	0.78	79.2	0.00000	0.000	0.0	14.8	0.0	0.0
M200 30min	30	26.7	0.278	0.78	53.4	0.00000	0.000	0.0	29.6	0.0	0.0
M200 60min	60	36	0.278	0.78	36	0.00000	0.000	0.0	59.2	0.0	0.0
M200 2hr	120	48.5	0.278	0.78	24.25	0.00000	0.000	0.0	118.4	0.0	0.0
M200 4hr	240	65.4	0.278	0.78	16.35	0.00000	0.000	0.0	236.9	0.0	0.0
M200 6hr	300	77.8	0.278	0.78	15.56	0.00000	0.000	0.0	355.3	0.0	0.0
M200 12hr	600	104.9	0.278	0.78	10.49	0.00000	0.000	0.0	710.6	0.0	0.0
M200 24hr	1200	141.3	0.278	0.78	7.065	0.00000	0.000	0.0	1421.3	0.0	0.0
M200 48hr	2400	158.8	0.278	0.78	3.97	0.00000	0.000	0.0	2842.6	0.0	0.0

Catchment			SP28	Hardstand					water discharge rate (l/s)		
Clean water natural flow									16.45		l/s/ha
1 in 200 year return	**minutes**	**Rainfall (mm)**		**C**	**i (mm/hr)**	**A (km^2)**	**(m^3/s)**	**Volume (m^3)**	**Discharge (m^3/ha)**	**Discharge (m^3)**	**Residual Volume (m^3)**
M200 5min	5	12.1	0.278	0.6	145.2	0.00218	0.053	15.8	4.9	1.1	14.8
M200 10min	10	16.9	0.278	0.6	101.4	0.00218	0.037	22.1	9.9	2.2	20.0
M200 15min	15	19.8	0.278	0.6	79.2	0.00218	0.029	25.9	14.8	3.2	22.7
M200 30min	30	26.7	0.278	0.6	53.4	0.00218	0.019	35.0	29.6	6.5	28.5
M200 60min	60	36	0.278	0.6	36	0.00218	0.013	47.1	59.2	12.9	34.2
M200 2hr	120	48.5	0.278	0.6	24.25	0.00218	0.009	63.5	118.4	25.8	37.7
M200 4hr	240	65.4	0.278	0.6	16.35	0.00218	0.006	85.6	236.9	51.6	34.0
M200 6hr	300	77.8	0.278	0.6	15.56	0.00218	0.006	122.2	355.3	77.5	44.8
M200 12hr	600	104.9	0.278	0.6	10.49	0.00218	0.004	164.8	710.6	154.9	9.9
M200 24hr	1200	141.3	0.278	0.6	7.065	0.00218	0.003	222.0	1421.3	309.8	-87.9
M200 48hr	2400	158.8	0.278	0.6	3.97	0.00218	0.001	249.5	2842.6	619.7	-370.2

Catchment			SP28A	Area Excl Hardstand					water discharge rate (l/s)		
Clean water natural flow									16.45		l/s/ha
1 in 200 year return	**minutes**	**Rainfall (mm)**		**C**	**i (mm/hr)**	**A (km^2)**	**(m^3/s)**	**Volume (m^3)**	**Discharge (m^3/ha)**	**Discharge (m^3)**	**Residual Volume (m^3)**
M200 5min	5	12.1	0.278	0.78	145.2	0.00334	0.105	31.5	4.9	1.6	29.9
M200 10min	10	16.9	0.278	0.78	101.4	0.00334	0.073	44.1	9.9	3.3	40.8
M200 15min	15	19.8	0.278	0.78	79.2	0.00334	0.057	51.6	14.8	4.9	46.7
M200 30min	30	26.7	0.278	0.78	53.4	0.00334	0.039	69.6	29.6	9.9	59.7
M200 60min	60	36	0.278	0.78	36	0.00334	0.026	93.9	59.2	19.8	74.1
M200 2hr	120	48.5	0.278	0.78	24.25	0.00334	0.018	126.5	118.4	39.6	86.9
M200 4hr	240	65.4	0.278	0.78	16.35	0.00334	0.012	170.5	236.9	79.1	91.4
M200 6hr	300	77.8	0.278	0.78	15.56	0.00334	0.011	243.4	355.3	118.7	124.7
M200 12hr	600	104.9	0.278	0.78	10.49	0.00334	0.008	328.2	710.6	237.4	90.9
M200 24hr	1200	141.3	0.278	0.78	7.065	0.00334	0.005	442.1	1421.3	474.7	-32.6
M200 48hr	2400	158.8	0.278	0.78	3.97	0.00334	0.003	496.8	2842.6	949.4	-452.6

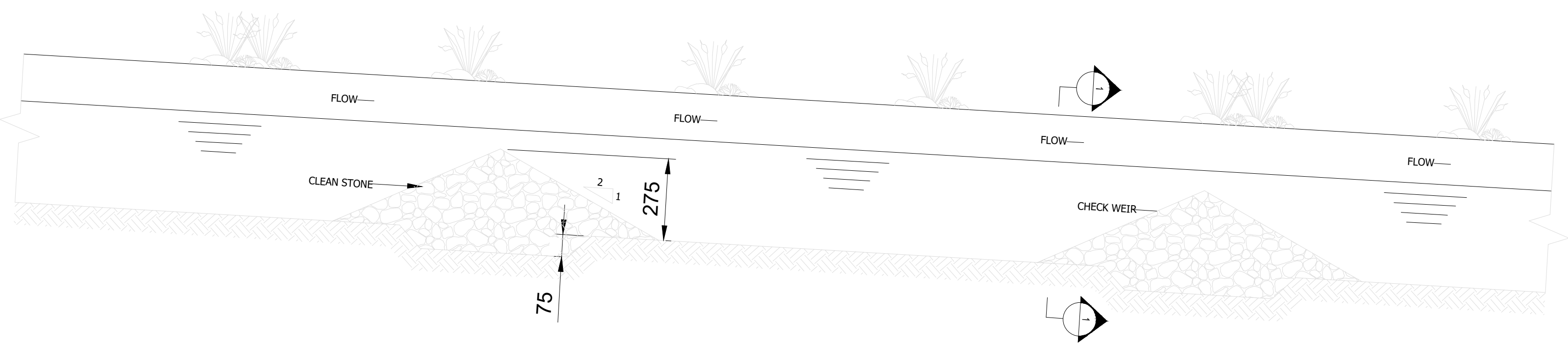
Catchment			SP28A	Hardstand					water discharge rate (l/s)		
Clean water natural flow									16.45		l/s/ha
1 in 200 year return	**minutes**	**Rainfall (mm)**		**C**	**i (mm/hr)**	**A (km^2)**	**(m^3/s)**	**Volume (m^3)**	**Discharge (m^3/ha)**	**Discharge (m^3)**	**Residual Volume (m^3)**
M200 5min	5	12.1	0.278	0.6	145.2	0.00000	0.000	0.0	4.9	0.0	0.0
M200 10min	10	16.9	0.278	0.6	101.4	0.00000	0.000	0.0	9.9	0.0	0.0
M200 15min	15	19.8	0.278	0.6	79.2	0.00000	0.000	0.0	14.8	0.0	0.0
M200 30min	30	26.7	0.278	0.6	53.4	0.00000	0.000	0.0	29.6	0.0	0.0
M200 60min	60	36	0.278	0.6	36	0.00000	0.000	0.0	59.2	0.0	0.0
M200 2hr	120	48.5	0.278	0.6	24.25	0.00000	0.000	0.0	118.4	0.0	0.0
M200 4hr	240	65.4	0.278	0.6	16.35	0.00000	0.000	0.0	236.9	0.0	0.0
M200 6hr	300	77.8	0.278	0.6	15.56	0.00000	0.000	0.0	355.3	0.0	0.0
M200 12hr	600	104.9	0.278	0.6	10.49	0.00000	0.000	0.0	710.6	0.0	0.0
M200 24hr	1200	141.3	0.278	0.6	7.065	0.00000	0.000	0.0	1421.3	0.0	0.0
M200 48hr	2400	158.8	0.278	0.6	3.97	0.00000	0.000	0.0	2842.6	0.0	0.0

Catchment		SP29	Area Excl Hardstand						water discharge rate (l/s)		
Clean water natural flow									16.45		l/s/ha
1 in 200 year return	minutes	Rainfall (mm)		C	i (mm/hr)	A (km^2)	(m^3/s)	Volume (m^3)	Discharge (m^3/ha)	Discharge (m^3)	Residual Volume (m^3)
M200 5min	5	12.1	0.278	0.78	145.2	0.00345	0.109	32.6	4.9	1.7	30.9
M200 10min	10	16.9	0.278	0.78	101.4	0.00345	0.076	45.5	9.9	3.4	42.1
M200 15min	15	19.8	0.278	0.78	79.2	0.00345	0.059	53.3	14.8	5.1	48.2
M200 30min	30	26.7	0.278	0.78	53.4	0.00345	0.040	71.9	29.6	10.2	61.7
M200 60min	60	36	0.278	0.78	36	0.00345	0.027	97.0	59.2	20.4	76.5
M200 2hr	120	48.5	0.278	0.78	24.25	0.00345	0.018	130.6	118.4	40.9	89.8
M200 4hr	240	65.4	0.278	0.78	16.35	0.00345	0.012	176.1	236.9	81.7	94.4
M200 6hr	300	77.8	0.278	0.78	15.56	0.00345	0.012	251.4	355.3	122.6	128.8
M200 12hr	600	104.9	0.278	0.78	10.49	0.00345	0.008	339.0	710.6	245.2	93.8
M200 24hr	1200	141.3	0.278	0.78	7.065	0.00345	0.005	456.7	1421.3	490.3	-33.7
M200 48hr	2400	158.8	0.278	0.78	3.97	0.00345	0.003	513.2	2842.6	980.7	-467.5

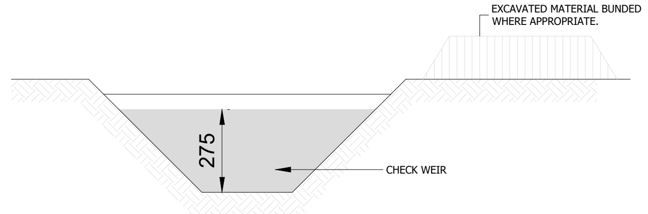
Catchment		SP29	Hardstand						water discharge rate (l/s)		
Clean water natural flow									16.45		l/s/ha
1 in 200 year return	minutes	Rainfall (mm)		C	i (mm/hr)	A (km^2)	(m^3/s)	Volume (m^3)	Discharge (m^3/ha)	Discharge (m^3)	Residual Volume (m^3)
M200 5min	5	12.1	0.278	0.6	145.2	0.00000	0.000	0.0	4.9	0.0	0.0
M200 10min	10	16.9	0.278	0.6	101.4	0.00000	0.000	0.0	9.9	0.0	0.0
M200 15min	15	19.8	0.278	0.6	79.2	0.00000	0.000	0.0	14.8	0.0	0.0
M200 30min	30	26.7	0.278	0.6	53.4	0.00000	0.000	0.0	29.6	0.0	0.0
M200 60min	60	36	0.278	0.6	36	0.00000	0.000	0.0	59.2	0.0	0.0
M200 2hr	120	48.5	0.278	0.6	24.25	0.00000	0.000	0.0	118.4	0.0	0.0
M200 4hr	240	65.4	0.278	0.6	16.35	0.00000	0.000	0.0	236.9	0.0	0.0
M200 6hr	300	77.8	0.278	0.6	15.56	0.00000	0.000	0.0	355.3	0.0	0.0
M200 12hr	600	104.9	0.278	0.6	10.49	0.00000	0.000	0.0	710.6	0.0	0.0
M200 24hr	1200	141.3	0.278	0.6	7.065	0.00000	0.000	0.0	1421.3	0.0	0.0
M200 48hr	2400	158.8	0.278	0.6	3.97	0.00000	0.000	0.0	2842.6	0.0	0.0

APPENDIX D

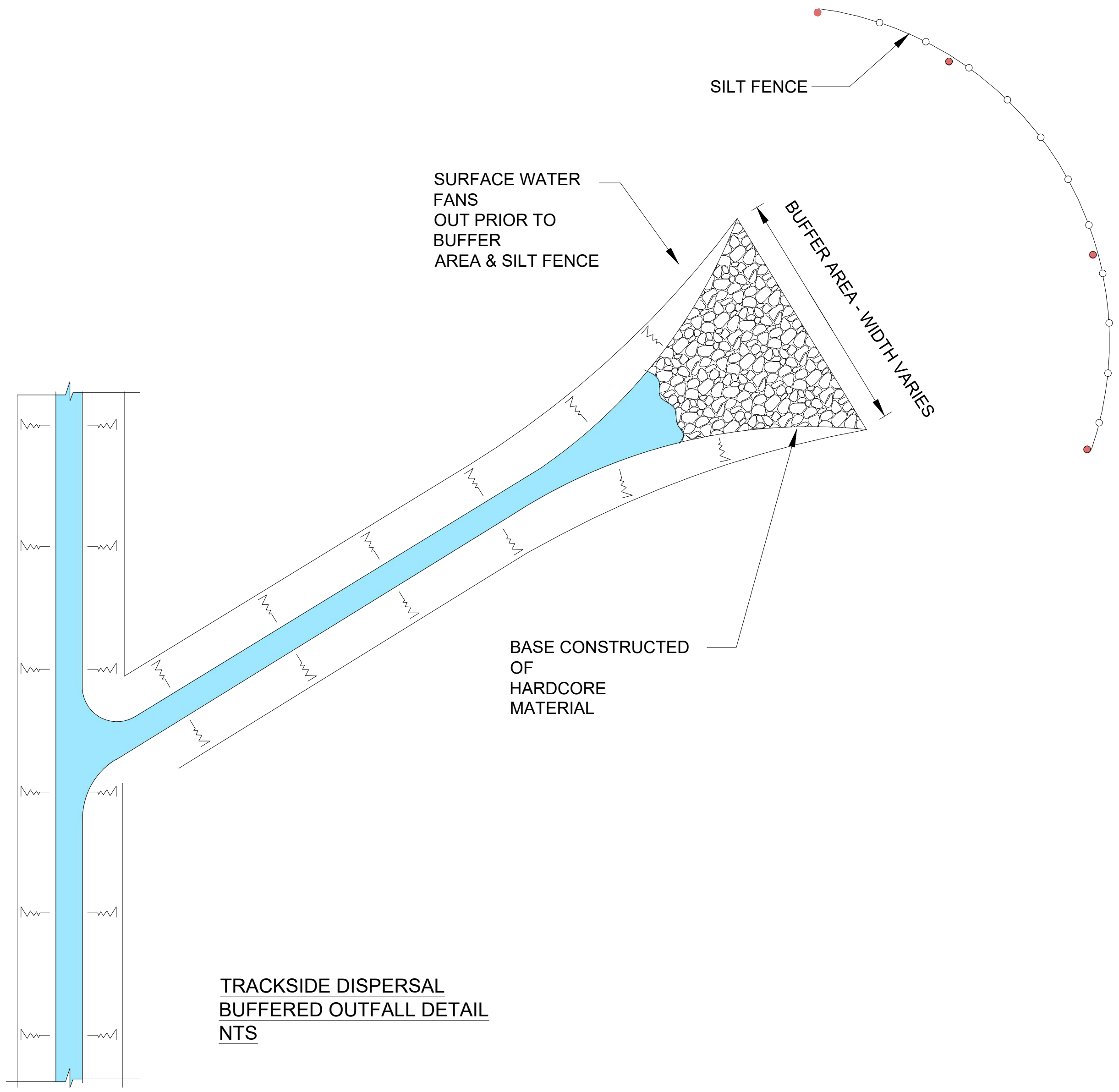
DRAINAGE DRAWINGS



LONGITUDINAL SECTION THROUGH DRAINAGE WITH CHECK WEIRS
SCALE 1:25



SECTION 1-1
SCALE 1:25



TRACKSIDE DISPERSAL
BUFFERED OUTFALL DETAIL
NTS

DRAINAGE NOTES

1. GENERAL:
   DRAINAGE BUFFER ZONE WIDTHS SHALL BE A MINIMUM OF 50m.

2. CONSTRUCTION AND MAINTENANCE
   - ROADSIDE DRAIN SHOULD NOT INTERCEPT LARGE VOLUMES OF WATER FROM THE GROUND ABOVE.
   - ROADSIDE DRAINS LIKELY TO CARRY HIGH SEDIMENT LOADS AND MUST DISCHARGE INTO A BUFFER OF ADEQUATE WIDTH.
   - DRAINS ON THE UPPER SIDE OF THE ROAD MAY NEED CULVERTS TO THE LOWER SIDE.
   - REGULAR INSPECTIONS, CLEANING AND REPAIRS WHERE NECESSARY.

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   - ALL OBSTRUCTIONS WITHIN A DRAINAGE CHANNEL SHALL BE REMOVED AND DISPOSED OF, SO AS NOT TO INTERFERE WITH THE PROPER FUNCTION OF THE DRAINAGE SYSTEM.
   - CHECK DAMS SHALL BE CONSTRUCTED USING WELL GRADED 150mm DOWN ANGULAR GRAVEL PLACED OVER A GEO-TEXTILE LAYER. SEE DETAIL 1.
   - THE SPACING OF CHECK DAMS SHALL BE SUCH THAT THE PEAK OF THE DOWNSTREAM DAM IS NO LOWER THAN THE FOOT OF THE UPSTREAM DAM.
   - THE USE OF STRAW BALES WITHIN THE DRAINAGE SYSTEM SHOULD BE CONSIDERED ON A TEMPORARY BASIS DURING CONSTRUCTION AND MAINTENANCE WORK.
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   - NON-DEVELOPMENT RUN-OFF SHALL BE RETURNED TO A SURFACE FLOW CONDITION E.G. BY USE OF LEVEL SPREADERS.

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Client
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Drainage Details
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Scales
1:25 (A3)

Surveyed	Prepared By	Checked	Date
	L.B.	J.L.	Jan. 2023

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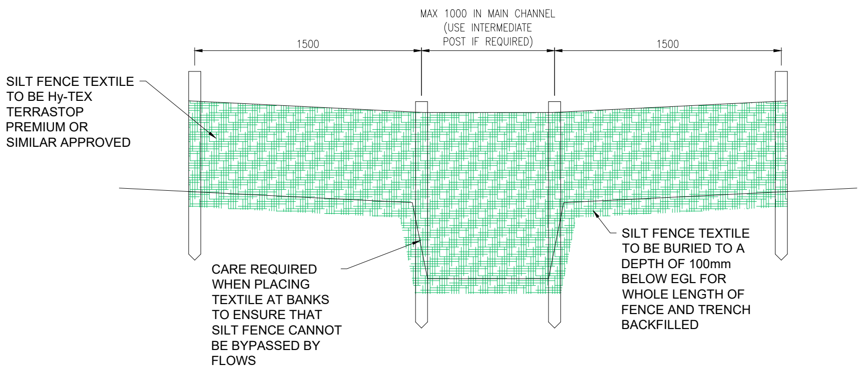
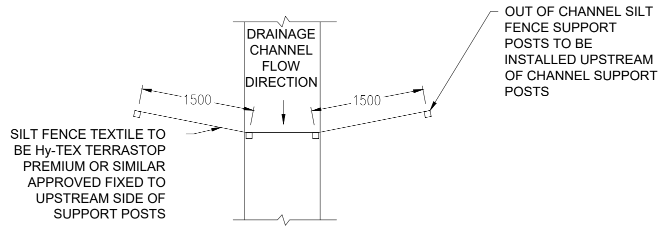
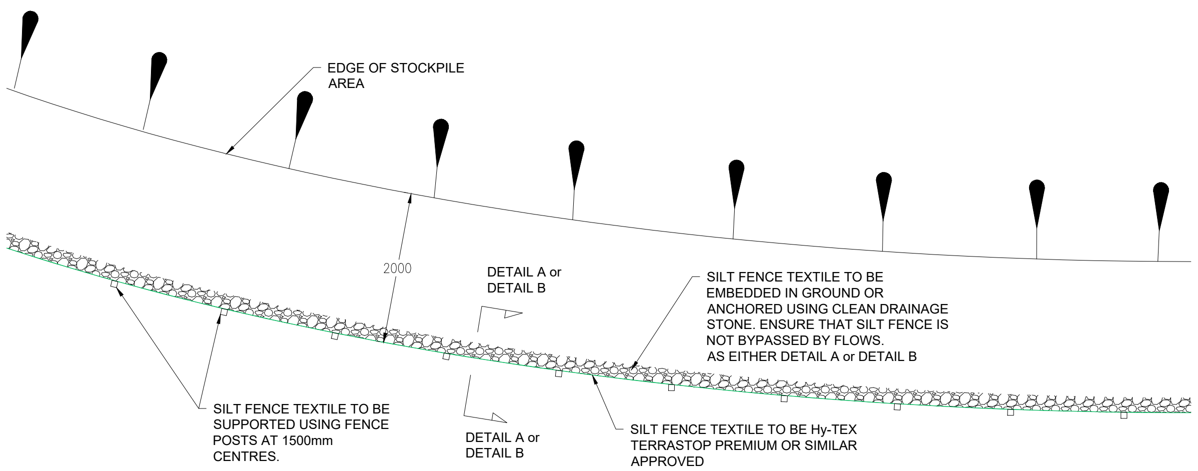
Drawing no. 6497-PL-301
Revision P01



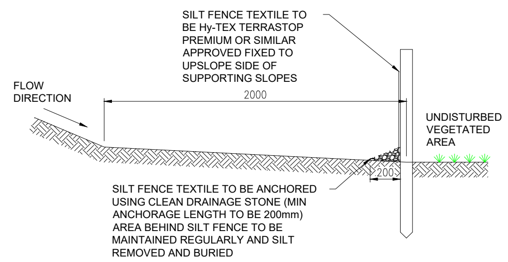
ELEVATION ON SILT FENCE AT DRAINAGE CHANNEL
SCALE 1:50



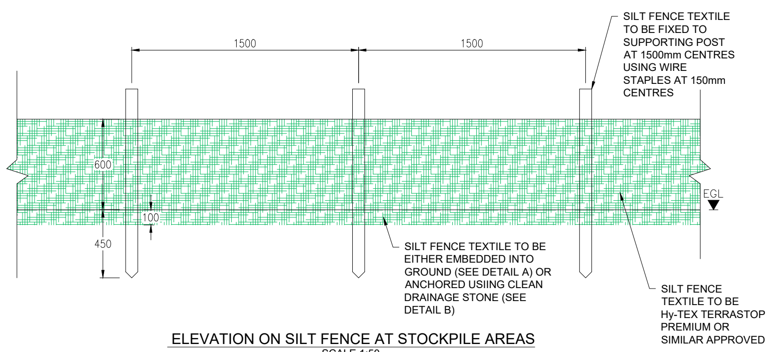
PLAN ON SILT FENCE AT DRAINAGE CHANNEL
SCALE 1:100



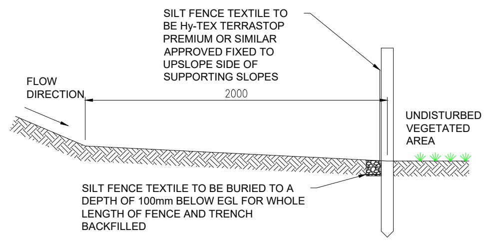
PLAN ON SILT FENCE AT STOCKPILE AREAS
SCALE 1:100



DETAIL A
SCALE 1:50



ELEVATION ON SILT FENCE AT STOCKPILE AREAS
SCALE 1:50



DETAIL B
SCALE 1:50

DRAINAGE NOTES

1. GENERAL:
   DRAINAGE BUFFER ZONE WIDTHS SHALL BE A MINIMUM OF 65m.

2. CONSTRUCTION AND MAINTENANCE
   - ROADSIDE DRAIN SHOULD NOT INTERCEPT LARGE VOLUMES OF WATER FROM THE GROUND ABOVE.
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Scales
1:50 & 1:100 (A3)

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	L.B.	J.L.	Oct. 2022

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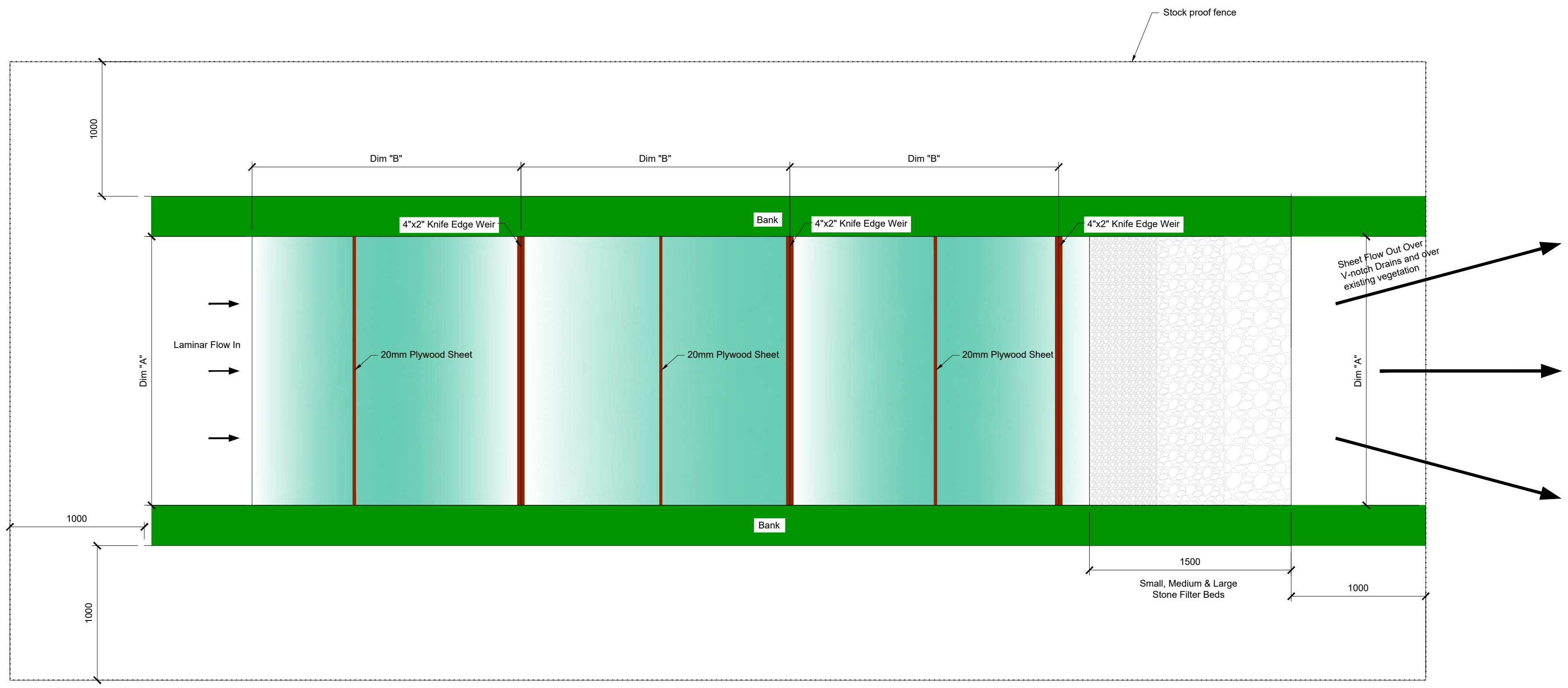
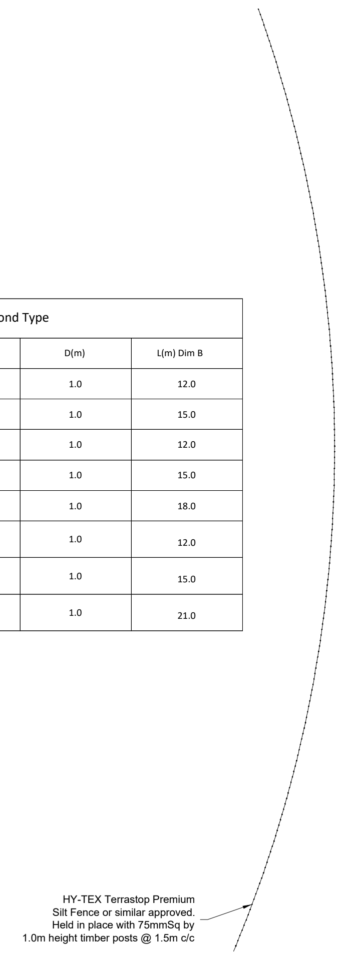
Drawing no.	Revision
6497-PL-302	P01

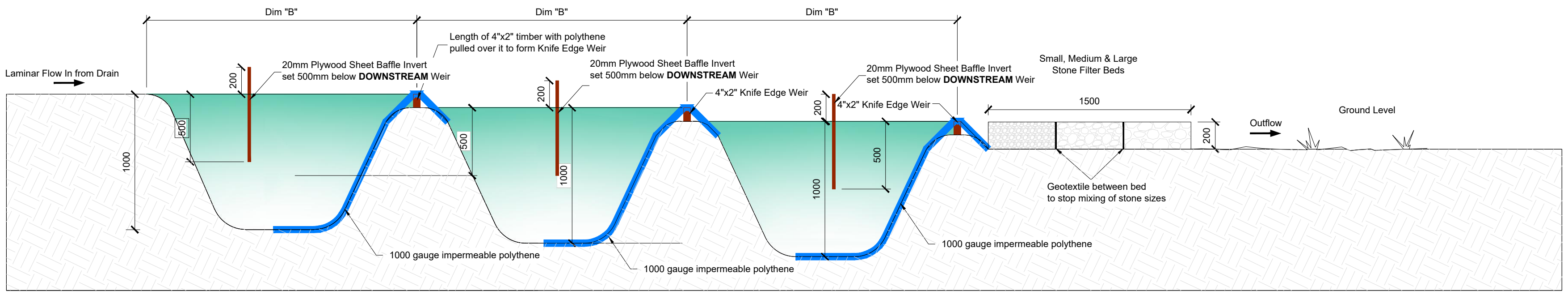


Pond Type			
Pond Type	W(m) Dim A	D(m)	L(m) Dim B
A	3.0	1.0	12.0
B	3.0	1.0	15.0
C	4.0	1.0	12.0
D	4.0	1.0	15.0
E	4.0	1.0	18.0
F	6.0	1.0	12.0
G	6.0	1.0	15.0
H	6.0	1.0	21.0



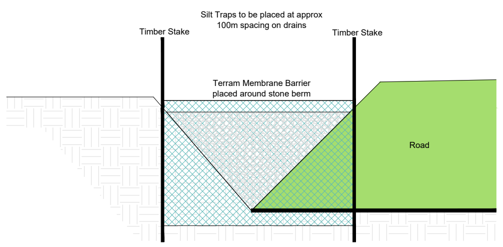
PLAN VIEW OF SETTLEMENT PONDS (WITH DISCHARGE TO DRAINS WHERE APPLICABLE)

SCALE: 1:50



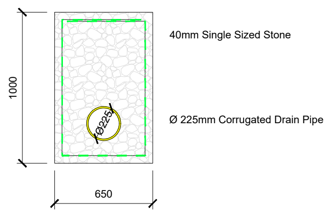
SECTION

SCALE: 1:50



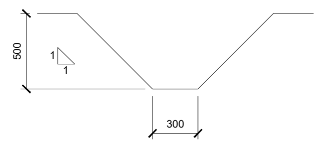
SEDIMENT FENCE DETAIL

SCALE: 1:25



PERMANENT PERIPHERAL LAND DRAIN

SCALE: 1:25



TEMPORARY "V" DITCH DRAIN PROFILE

SCALE: 1:25

COMPLETED SETTLEMENT POND SYSTEM

SCALE: NTS

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Stage

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Sheet 3 of 4

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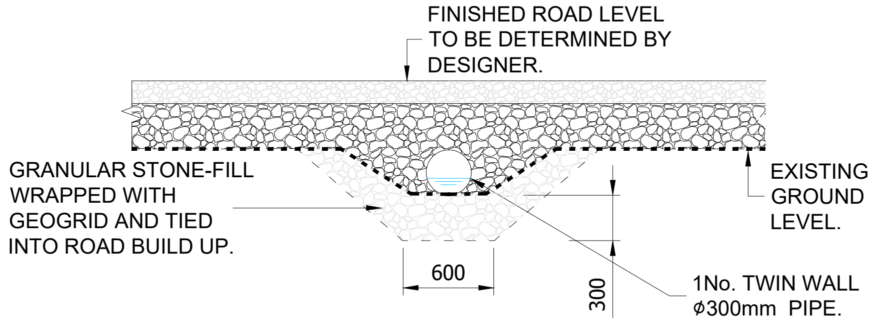
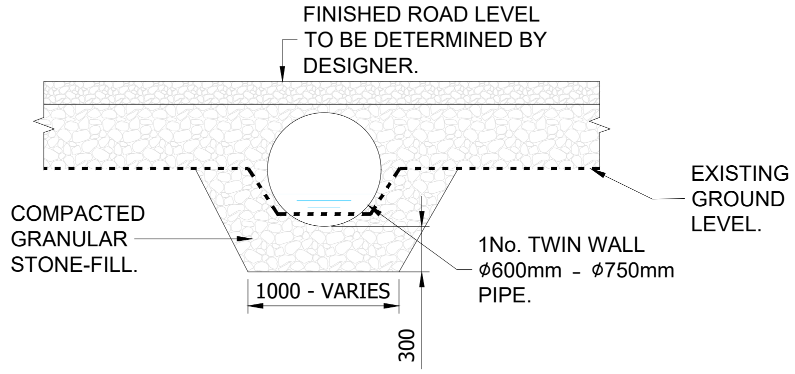
Drawing no. 6497-PL-303

Revision P01



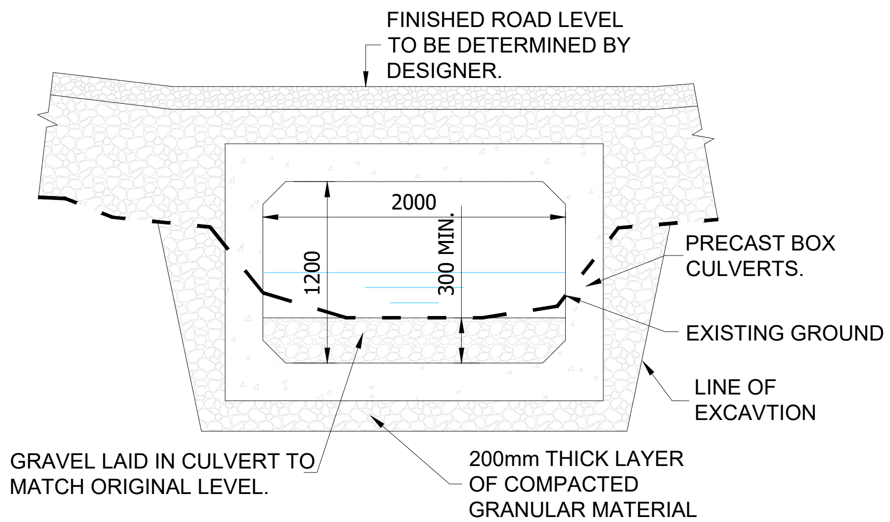
TYPE 1 CULVERT

SCALE 1:50



TYPE 2 CULVERT

SCALE 1:50



TYPE 3 CULVERT

SCALE 1:50

NOTE:

CULVERTS ARE TO BE OF ADEQUATE SIZE TO CARRY PEAK FLOWS CORRESPONDING TO A 1 IN 100 YEAR STORM EVENT, WITH A MINIMUM DIAMETER OF 900mm. THEY SHOULD BE INSTALLED TO CONFORM WHEREVER POSSIBLE TO THE NATURAL SLOPE AND ALIGNMENT OF THE STREAM OR DRAINAGE LINE. CULVERTS GREATER THAN 1m DIAMETER SHOULD BE BURIED TO A MINIMUM DEPTH OF 300mm BELOW THE STREAMBED AND THE ORIGINAL BED MATERIAL PLACED IN THE BOTTOM OF THE CULVERT.

1. FORMATION LEVEL TO BE DETERMINED BY THE CIVIL WORKS DESIGNER. REFER TO SITE INVESTIGATIONS REPORT.

2. SUB BASE MATERIAL TO CONFORM TO THE FOLLOWING:

IMPORTED MATERIAL
TO CONFORM TO TYPE 6F1 IN ACCORDANCE WITH TABLE 6/2 OF THE NRA SPECIFICATION FOR ROAD WORKS.

SITE WON MATERIAL
ROCK WON IN EXCAVATION OF TURBINES MUST BE CRUSHED AND GRADED ON SITE. THE MAXIMUM SIZE OF AGGREGATE TO BE 125mm. THE AGGREGATE GRADING TO BE AGREED WITH THE ENGINEER.

3. SURFACE LAYER TO BE CLAUSE 804. THIS LAYER MAY BE APPLIED IMMEDIATELY BEFORE TURBINE DELIVERY.

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Scales
1:50 (A3)

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Drawing no.
6497-PL-304

Revision
P01

MANAGEMENT PLAN 4

SPOIL MANAGEMENT PLAN

DYRICK HILL WIND FARM LIMITED

DYRICK HILL WIND FARM

CO. WATERFORD

CONSTUCTION ENVIRONMENTAL MANAGEMENT PLAN (CEMP)

MANAGEMENT PLAN 4

SPOIL MANAGEMENT PLAN

MAY 2023

Dyrick Hill Wind Farm Limited
c/o EMPower,
2 Dublin Landings,
North Wall Quay,
North Dock,
Dublin,
D01 V4A3.

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ENGINEERS IRELAND
cpd ACCREDITED EMPLOYER

QUALITY ISO 9001:2015 NSAI Certified	ENVIRONMENT ISO 14001:2015 NSAI Certified	HEALTH & SAFETY ISO 45001:2018 NSAI Certified

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DOCUMENT APPROVAL

PROJECT	Dyrick Hill Wind Farm	
CLIENT / JOB NO	Dyrick Hill Wind Farm Limited	6497
DOCUMENT TITLE	Construction Environmental Management Plan (CEMP) Peat and Spoil Management Plan	

	Prepared by	**Reviewed/Approved by**
Document Final	Name Ryan Mitchell	Name David Kiely
Date May 2023	Signature RMitchell	Signature David Kiely

CONTENTS

1 INTRODUCTION

1.1 General

The plan provides an assessment of the issue of handling surplus excavated material at the proposed Dyrick Hill Wind Farm Site. The measures outlined in the plan will be monitored on Site by the appointed Ecological Clerk of Works and will be discussed with the Contractor before works commence on Site. This plan should be read in conjunction with the Construction Environmental Management Plan (CEMP) and Management Plans.

1.2 Site Investigations

Ecoquest Ltd has been commissioned by Jennings O'Donovan & Partners on behalf of EMPower Ltd to assess the geological site characteristics in relation to the planning application for Dyrick Hill Wind Farm (the Development), Co. Waterford. The Site Investigations Report (**Appendix I**) assesses ground conditions in terms of peat and slope stability risk, subsoil and geological characterisation and classification.

The Site Investigations works were completed in September 2021 of which the scope of works included:

- Peat depth probing, 347 No. sampling locations.
- Trial pits, 15 No.

1.3 General Aims and Principals of the Peat and Spoil Management Plan

The purpose of this Spoil Management Plan is:

- safety in relation to potential spoil slippage risk;
- reduction in bare soil exposure and release of sediment;
- to make sure that the landscape is not adversely impacted as a result of the Development; and
- to make sure that good site management practices are carried out.

Any reinstatement and reprofiling proposals will consider and mitigate against all identified significant risks to environmental receptors.

Topsoil and surface vegetation excavated during the construction of the wind farm infrastructure will be used to finish reinstated surfaces around Turbine Foundations and Turbine Hardstands. Reinstatement and reprofiling of, and around, infrastructure will be carried out during the construction phase.

Landscaping will allow for sympathetic restoration of the ground surface and ground profile to reduce the visual impact of new infrastructure, facilitate vegetation regrowth and reduce scour and erosion of bare surfaces prior to vegetation establishment. Reinstatement will be undertaken as work progresses. This work will be completed only by experienced personnel under guidance from the appointed Ecological Clerk of Works, and they will conduct regular inspections of the work to ensure it is completed in an appropriate manner.

All areas subjected to reinstatement will be fenced with stock-proof fencing to prevent livestock disturbance until vegetation has become established.

Excavated material is used in several ways:

- Excavated Subsoil/Rock is used for Site Access Roads and Turbine Hardstands.
- Excavated soil material will be used as fill material where suitable (e.g., back filling around and on top of Turbine Foundations) with any other soil material to be placed in shallow deposition areas around the WTG foundations (always avoiding sensitive habitats).
- Excavated topsoil will be used to vegetate edges of Turbine Hardstands and Turbine Foundations.
- All surplus material will be used to reinstate the proposed borrow pits.

1.4 Management of Excavated Material

The excavated material will be stored in the borrow pits. Excavated materials during the construction phase required for reinstatement, shall in the first instance be stored on site, in an environmentally safe manner that will not result in the pollution of waters, until it is required for re-use.

A buffer of 50m from watercourses will be implemented for storage areas of excavated materials to be re-used for reinstatement works.

Excavated material will not be stored adjacent to slopes (>15 degrees gradient). This will be subject to evaluation and approval by the Civil Contractors' geotechnical engineer and will accommodate the Site stockpiling requirements based on earthwork calculations.

The locations chosen for temporary storage are based on gradient, geotechnical data and ground stability assessment, habitat type, and the adequacy of the ground to support the surcharge material. The Civil Contractor will be responsible for ensuring that the removal and storage of excavated material is done in accordance with the requirements of this management plan. The temporary storage area and the vegetative material will be inspected regularly from an ecological perspective.

1.5 Reinstatement

Reinstatement works will commence at an early stage of the construction works. Such reinstatement will occur following the completion of individual sections of work such as the completion of, say, a Turbine Foundation or Turbine Hardstand. Reinstatement will include grading of any slopes left by the construction works, followed by the careful placement of topsoil which had been previously excavated from this area and temporarily stored on site.

Natural revegetation is the preferred method of recovery. However, if required, bare material and/or reinstated soil can be secured using vegetation blankets such as Greenfix Embankment Mat2, Geojute2 or similar approved product. An appropriately pre-seeded Coir-Mesh2 would also be suitable. This may be required in patches where excavation works have excessively impacted on the ability of vegetation to recover.

2 ESTIMATED EXCAVATION QUANTITIES

The topography of the site slopes gently downwards from a high point on Broemountain at the northwest corner of the site (maximum elevation 429mOD) down to a low point of approximately 150mOD in the southeast corner of the site. Dyrick Hill forms an elevated area close to the centre of the site which rises rapidly to an elevation of 286mOD. Geotechnical drawings prepared by Minerex Environmental Limited were used in conjunction with the peat depth probes and geotechnical trial pit logs as seen in **Appendix I – Site Investigations Report** to calculate the spoil volumes generated by the Development, as can be seen in **Tables 2.1** to **2.6**.

2.1 Road Construction

The minimum useful road width required for delivery of turbine components is 5m. **Table 2.1** tabulates the volumes of topsoil and sub-soil to be excavated for the Site access roads.

Table 2.1: Estimated Excavation for Road Construction

Road Section	Length (m)	Width (m)	Area (m^2)	Average Peat Depth (m)	Depth to firm Sub-soil/Subsoil/Rock (m)	Depth of Sub soil to be excavated (m)	Total Volume to be excavated (m^3)	Vol of peat to be excavated (m^3)	Vol of soil to be excavated (m^3)	Vol of Subsoil/Rock to be excavated (m^3)
Upgraded Site Access Road	1,780	5	8,900	0	0.1	0.1	3,029.4	N/a	1,009.8	2,019.6
New Site Access Road	10,760	5	53,800	0	0.1	0.1	16,140	N/a	5380	10760
Totals	***12,540***		***67,896***				***19,169***	**N/a**	***6,389.8***	***12,779.6***

Table 2.2: Estimated Excavation for Cut and Fill & Junction Areas

Road Section	Average Peat Depth (m)	Depth to firm Sub-soil/Subsoil/Rock (m)	Depth of Sub soil to be excavated (m)	Total Volume to be excavated (m^3)	Vol of peat to be excavated (m^3)	Vol of soil to be excavated (m^3)	Vol of Subsoil/Rock to be excavated (m^3)
Cut and Fill Junctions	0	0.1	0.1	337,075	N/a	33,707.5	303,367.50

Trial Pit data is available in the Site Investigation Report (**Appendix I**). Average peat depth from this data was calculated to be 0.1m. Excavation for roads is required to 0.3m only. From this, the volume of peat, soil and Subsoil/Rock to be extracted was extrapolated and can be seen in **Table 2.1**.

2.2 Wind Turbine Foundations

The depth of excavation required for each wind turbine foundation will vary depending on peat depths. The diameter of the gravity Turbine Foundations will be 25.5m. Each Turbine Foundation excavation will be 2.5m deep. **Table 2.3** provide a breakdown of the estimated total excavation volume for the Turbine Foundations.

Table 2.3: Estimated Excavation for WTG Foundations (25.5m Diameter)

Turbine No.	Area of Foundation Excavation (m^2)	Foundation Depth (m)	Max Peat Depth (m)	Mineral Soil (m)	Depth to suitable formation (m)	Subsoil/Subsoil/Rock depth (m)	Total Excavation (m^3)	Total Peat (m^3)	Total Soil (m^3)	Total Subsoil/Rock (m^3)
1	510.7	2.5	N/a	0.1	2.5	5	1,276.75	N/a	51.07	1225.68
2	510.7	2.5	N/a	0.1	2.5	5	1,276.75	N/a	51.07	1225.68
3	510.7	2.5	N/a	0.1	2.5	5	1,276.75	N/a	51.07	1225.68
4	510.7	2.5	N/a	0.1	2.5	5	1,276.75	N/a	51.07	1225.68
5	510.7	2.5	N/a	0.1	2.5	5	1,276.75	N/a	51.07	1225.68
6	510.7	2.5	N/a	0.1	2.5	5	1,276.75	N/a	51.07	1225.68
7	510.7	2.5	N/a	0.1	2.5	5	1,276.75	N/a	51.07	1225.68
8	510.7	2.5	N/a	0.1	2.5	5	1,276.75	N/a	51.07	1225.68
9	510.7	2.5	N/a	0.1	2.5	5	1,276.75	N/a	51.07	1225.68
10	510.7	2.5	N/a	0.1	2.5	5	1,276.75	N/a	51.07	1225.68
11	510.7	2.5	N/a	0.1	2.5	5	1,276.75	N/a	51.07	1225.68
12	510.7	2.5	N/a	0.1	2.5	5	1,276.75	N/a	51.07	1225.68
Totals							***15,321***	***N/a***	***613***	***14,708***

2.3 Turbine Hardstands

The depth of excavation required for each crane hardstand will vary and has been calculated below. The total Turbine Hardstands area will be 3,395m^2 and includes the main crane hardstand, the component set down area, the assist crane hardstands and the vehicle parking. **Table 2.4** provides a breakdown of the estimated total excavation volume for the Turbine Hardstands.

Table 2.4: Estimated Excavation from Turbine Hardstands

Hardstand No	Area (m^2)	Depth to suitable formation (m)	Max Peat Depth (m)	Mineral Soil (m)	Total Excavation (m^3)	Total Peat (m^3)	Total Soil (m^3)	Total Subsoil/Rock (m^3)
1	3,395	0.3	N/a	0.1	1,018.5	N/a	339.5	679
2	3,395	0.3	N/a	0.1	1,018.5	N/a	339.5	679
3	3,395	0.3	N/a	0.1	1,018.5	N/a	339.5	679
4	3,395	0.3	N/a	0.1	1,018.5	N/a	339.5	679
5	3,395	0.3	N/a	0.1	1,018.5	N/a	339.5	679
6	3,395	0.3	N/a	0.1	1,018.5	N/a	339.5	679
7	3,395	0.3	N/a	0.1	1,018.5	N/a	339.5	679
8	3,395	0.3	N/a	0.1	1,018.5	N/a	339.5	679
9	3,395	0.3	N/a	0.1	1,018.5	N/a	339.5	679
10	3,395	0.3	N/a	0.1	1,018.5	N/a	339.5	679
11	3,395	0.3	N/a	0.1	1,018.5	N/a	339.5	679
12	3,395	0.3	N/a	0.1	1,018.5	N/a	339.5	679
Total					***12,222***	***N/a***	***4,074***	***8,148***

2.4 Electrical Sub-Station and Site Compound

Table 2.5a Dimensions of Sub-Station and Site Compound

Description	Length	Width	Depth	No.	Area (m^2)	Volume of Excavation (m^3)
Electrical Substation	123	63	2	1	7,749	15,498
Site Compound	25	35	2	1	875	1,750
Total					***8,624***	***17,248***

Table 2.5b Estimated Excavation from Sub-Stations and Site Compounds

Infrastructure	Area (m^2)	Depth to Formation (m)	Average Peat Depth (m)	Mineral Soil (m)	Total Excavation (m^3)	Total Peat (m^3)	Total Soil (m^3)	Total Subsoil/Rock (m^3)
Electrical Substation	7,749	2	N/a	0.1	15,498	N/a	774.9	14,723.1
Site Compound	875	2	N/a	0.1	1,750	N/a	87.5	1662.5
Total					***17,248***	***N/a***	***862.4***	***16,385.6***

2.5 Grid Connection

The proposed Grid Connection is located in the townlands of The proposed Grid Connection passes through the townlands of Broemountain, Lyrattin, Farnane Lower, Farnane Upper, Castlequarter, Mountaincastle South, Carrigaun (Mansfield), Langanoran, Sleadycastle, Knockaunnaglokee, Garryduff, Colligan More, Garryclone, Colliganwood, Ballymacmague North, Ballymacmague South and Killadangan. and will be c. 16.01km in length as shown in **Figure 2.1.**

The proposed grid connection would be connected to the Dungarvan 110kV substation situated 12.6km southwest (16.01km Southwest by Road) of the development. The route from the 110Kv Substation follows directly to the south, passing a number of existing Underground Grid Connections (UGC) in the vicinity, and continues onto the N72 heading in a westerly direction towards Cappoquin. Continue on this route until the junctions between the N72 and R672 meet turning north onto the R672. This route is followed for approximately 4km before diverting northwest onto a local road. The UGC will continue through Sleady and crossing underneath the River Finisk near the Mountain Castle bridge and crossing the R671 continuing north to the Wind Farm site. This section of local road is approximately 8km in Length.

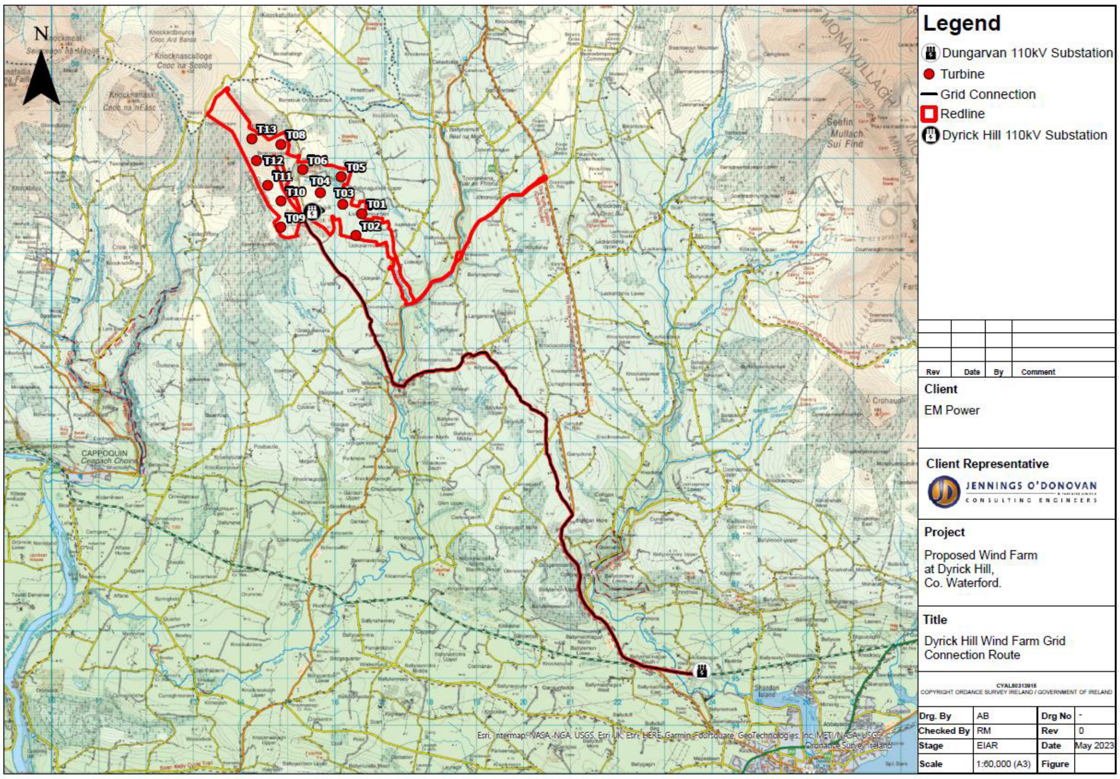

Figure 2.1 Dyrick Hill Wind Farm Grid Connection Route

The cable network will be installed in trenches approximately 0.6m wide by 1.3m in depth. There will be 21 No. pre-cast concrete jointing bays measuring 6m by 2.5m buried approximately 2m deep along the grid connection route and at varying intervals from c. 500-820m intervals (See **EIAR Appendix 2.4**). All extracted material along the Grid Connection Route will be disposed of at a licensed facility as per the Waste Management Plan (**CEMP**, **Management Plan 5**). In addition, Table 2.6 provides a breakdown of the estimated total excavation volume for the Turbine Hardstands.

Table 2.6: Estimated Excavation from Grid Connection

Description	Length (m)	Width (m)	Depth (m)	No.	Area (m^2)	Depth to BedSubsoil/Rock (m)	Depth to Subsoil /Rock (m)	Peat Depth (m)	Depth (m)	Mineral Soil Depth	Volume of Excavation (m^3)	Volume of Peat Eatraction (m^3)	Volume of Soil Extraction (m^3)	Volume of Subsoil/Rock Extraction (m^3)
Internal Cabling	10,997	0.6	1.0	4	4,583	1.6	0	0	1	0.1	4,583	N/a	4,583	0
110kV Cable Trench	16,013	0.825	1.265	1	13,211	1.6	0	0	1	0.1	16,712	N/a	16,712	0
Joint Pits	6	2.5	2.3	21	315	1.6	0	0	2	0.1	725	N/a	504	221
Totals											**22,020**	N/a	**21,799**	**221**

2.6 Drainage

Please see **CEMP Management Plan 3: Surface Water Management Plan** for further details.

2.7 Total Estimated Excavation Volume Summary

As detailed in Sections 2.1 to 2.5, the total estimated excavation volume is 454,949m³, of which 69,339.70m³ is soil and 385,609.7m³ is Subsoil/Rock. These quantities are detailed in **Table 2.7**.

Table 2.7: Summary of Estimated Excavation Quantities (m³)

Description	Total Volume to be excavated (m³)	Vol of peat to be excavated (m³)	Vol of soil to be excavated (m³)	Vol of Subsoil/Rock to be excavated (m³)
Access Tracks	19,169	N/a	6389.8	12,779.6
Cut & Fill Areas & Junctions	337,075	N/a	33,707.50	303,367.50
Turbine Foundation	15,321	N/a	613	14,708
Turbine Hardstands	12,222	N/a	4,074	8,148
Electrical Substation/Site Compound	17,248	N/a	862.4	16,385.6
Grid Connection*	17,437	N/a	17,216	221
Internal Cabling (power & communications)	4583	N/a	4583	0
Borrow Pit	31,894	N/a	1894	30,000
Totals	**454,949**	**N/a**	**69,339.7**	**385,609.7**

*All material will be disposed of at a licensed facility

As the excavated materials arising from the construction of the Grid Connection Route will be disposed of at a licensed facility 17,437m³. Any Subsoil/Rock won onsite will be used before storing surplus in the on-site borrow pits, the remaining 69,339m³ of soil will need to be re-used within the Site.

3 RE-USE OF EXCAVATED MATERIAL

3.1 Road Construction

The total length of new Site Access Roads is 10,760m, however there are also 1,780m of existing tracks being utilised as part of the Development. The reuse of material along the Site Access Roads will be in the form of roadside berms (18,500m) measuring 1 m in height and 1m in width with tapers. This gives a road-side berm volume of 18,500m^3, consisting of Subsoil/Rock.

All additional excavated material will be used to reinstate the onsite borrow pits.

3.2 Turbine Foundation Excavations

The concrete foundation of each turbine will be 25.5m in diameter. The 1532.1m^3 of excavated subsoil material will be used as backfill to the perimeter of the turbine foundations, the remaining 13,788.90 m^3 will be temporarily stored in the dedicated temporary storage area and/or utilised onsite.

All excavated material in the temporary storage area will used to reinstate the Borrow pit. The Borrow pit will be used as a permanent storage area. The spoil can be stored up to a height of 2m above ground level.

3.3 Grid Connection

The total volumes of soil and Subsoil/Rock to be excavated for the Grid Connection Route excluding internal cabling is estimated at 17,437m^3. All material associated with the grid connection will be disposed of at a licensed facility according to **Management Plan 5: Waste Management Plan** due to the presence of bituminous material and hydrocarbons.

3.4 BedSubsoil/Rock

Subsoil/Rock encountered in the excavations such as cobbles or boulders will be crushed and used for hardcore in the Site Access Roads and Turbine Hardstands. When this resource has been used up, the onsite borrow pits will be used to provide Subsoil/Rock. The onsite borrow pits will provide 30,000m^3 good quality excavated material to provide for the Site Access Roads, Turbine Hardstands, upfill to foundations and temporary compounds.

Subsoil/Rock

Table 3.1a: Volume of Subsoil/Rock to be Extracted from Borrow Pits

Borrow Pits	Length (m)	Width (m)	Area (m^2)	Depth (m)	Volume to be extracted from Borrow Pits (m^3)
A	127	127	13,211	2	31,894
Total Volume of Usable Subsoil/Rock to be Extracted from Borrow Pits					***30,000***

The borrow pits will provide 30,000m^3 of material to be used on-site. They also have the capacity to be filled to 31,894m^3 and to be topped by up to 2m (63,788m^3).

Excavated Material to be Re-used On-Site.

A total estimated volume of 337,075m^3 of soil and Subsoil/Rock material will be excavated on site for cut and fill junction work. Below in table 3.1c outlines the overall volume of excavated material from these works to be re-used on-site.

Table 3.1b: Overall Volume of Excavated Material to be Re-used On-Site.

Excavated material Reinstatement	Total Volume of reinstated material m^3
Cut and fill required to achieve formation level for roads and hardstands	186,180
Berm construction	18,500
Material used for road and hardstand structural layers	55,745
Material used road and hardstand surfacing layers	21,450
Material used for landscaping	34,100
Soil requirement for Landscaping*	40,900
Total	**356,875**
Volume of excavated Remaining	**19,800**

*Soil is only a small proportion of the excavated material and has been treated separately.

3.5 Summary of Re-Use of Excavated Material

All of the excavated material can be re-used on Site. **Table 3.2a and b** provides a summary of the re-use methods.

Table 3.2a: Summary of Estimated Excavation Quantities (m^3)

Excavated Material Type	Excavated Material Volume (m^3)	Proposed Re-Use Volume		Comments
Roads	19,169	6,389.8	m^3 soil	To be used in roadside berms and to reinstate the onsite borrow pits.
		12,779.6	m^3 Subsoil/Rock	Where possible Subsoil/Rock will be crushed and used as hardcore in Site Access Tracks and Crane Hardstands. Any surplus Subsoil/Rock will be stored in the temporary storage compound.
Turbine Foundations	15,321	613	soil m^3	To be used as backfill to foundations. Any surplus will be used to reinstate the borrow pit after extraction.
		14,708	m^3 Subsoil/Rock	Where possible Subsoil/Rock will be crushed and used as hardcore in Site Access Tracks and Crane Hardstands. Any surplus Subsoil/Rock will be stored in the temporary storage compound. Subsoil/ Rock

Excavated Material Type	Excavated Material Volume (m^3)	Proposed Re-Use Volume		Comments
Turbine Hardstands	12,222	4,074 8,148	m^3 soil m^3 Subsoil/Rock	Soil is to be deposited locally at hardstand edges and will be used as berms around turbine hardstands. Where possible Subsoil/Rock will be crushed and used as hardcore in Site Access Tracks and Crane Hardstands. Any surplus Subsoil/Rock will be stored in the temporary storage compound.
Electrical Sub-Stations & temporary Compounds.	17,248	862.4m^3 soil 16,385.6m^3 Subsoil/Rock		Re-used to reinstate the Temporary Compound Areas. Where possible Subsoil/Rock will be crushed and used as hardcore in Site Access Tracks and Crane Hardstands. Any surplus Subsoil/Rock will be stored in the temporary storage compound.
Internal Cabling	4583	4583m^3	Soil	To be used as backfill in cable trenches. Any surplus will be used to reinstate the borrow pit after extraction.
Grid Connection (Excluding internal cabling)	22,020	17,216 m^3 221 m^3	Soil m^3 Subsoil/Rock	To back fill the trench and any excess material will be disposed of at a licensed facility (LoW

Excavated Material Type	Excavated Material Volume (m^3)	Proposed Re-Use Volume	Comments
			17 05 03*, 17 05 04) Please see Waste Management Plan for more details

4 PERMENANT STORAGE OF SPOIL

The remaining surplus material which comprises of 1,980m^3 of soil and 17,820m^3 of Subsoil/Rock will be temporarily stored in the temporary spoil storage area. Once the borrow pit can be reinstated the surplus material will be stored in the borrow pit to ground level and the remaining surplus material will be stored on top up to a height 1.4m above ground level.

5 RECOMMENDATION

Based on the available information, Jennings O'Donovan make the following recommendations:

- The estimated potential total volume of excavated material is 454,949m^3. However, this volume is dependent on the results of further ground investigation tests during the construction phase.
- Excavated material along the Grid Connection Route will need to be moved to a licensed facility.
- All other excavated material can be re-used on the Site.
  Subsoil/Rock

APPENDIX I

Site Investigations Report

Ecoquest Environmental dparkinson@ecoquest.ie	Dyrick Hill Windfarm Trial Pit Log	Trial Pit No: Substation
Eastings 615613 ITM Northings 604847	Date: 02/07/2022 Weather: Occasional showers	Logged by: AG Plant: JCB 3CX Pit Size: 3 x 1m

Strata Description	Depth (m)	Water	Notes
TOPSOIL: Firm dark brown sandy gravelly silt.	0.2		
Medium dense reddish brown silty sandy GRAVEL with medium cobble content and occasional boulders of siltstone below 1.5m. Gravel is angular to subangular, fine to coarse, siltstone. Cobbles are angular to subangular, siltstone.	1.7		
Possible Bedrock at 1.7m			

Remarks: Unable to excavate past 2.2m due to possible bedrock and collapsing.	Stability: Unstable	Groundwater: Dry

Jennings O'Donovan, Consulting Engineers, Finisklin Business Park, Sligo, Ireland,	**Proposed Windfarm at Dyrick Hill, Co. Waterford**	Trial Pit No: **Substation**

Ecoquest Environmental dparkinson@ecoquest.ie	Dyrick Hill Windfarm Trial Pit Log	Trial Pit No: T01
Eastings 616513 ITM Northings 604876	Date: 02/07/2022 Weather: Occasional Showers	Logged by: AG Plant: JCB 3CX Pit Size: 3 x 1m

Strata Description	Depth (m)	Water	Notes
TOPSOIL: Soft brown sandy gravelly silt.	0.3		
Medium dense orange brown silty slightly sandy GRAVEL with medium cobble content and occasional angular boulders of siltstone. Gravel is subangular to angular, fine to coarse. Cobbles are angular to subangular, siltstone.	1.1		
Possible bedrock at 1.1m			

Remarks:	Stability:	Groundwater:
Unable to excavate past 1.1m due to possible bedrock.	Good	Dry

Jennings O'Donovan, Consulting Engineers, Finisklin Business Park, Sligo, Ireland,	**Proposed Windfarm at Dyrick Hill, Co. Waterford**	Trial Pit No: **T01**

Ecoquest Environmental dparkinson@ecoquest.ie	Dyrick Hill Windfarm Trial Pit Log	Trial Pit No: T02
Eastings 616427 ITM Northings 604388	Date: 02/07/2022 Weather: Occasional Showers	Logged by: AG Plant: JCB 3CX Pit Size: 3 x 1m

Strata Description	Depth (m)	Water	Notes
TOPSOIL: Soft brown sandy gravelly silt.	0.2		
Stiff brown mottled orange brown slightly sandy gravelly SILT with medium cobble content and occasional subangular boulders of siltstone. Gravel is subangular to subrounded, fine to coarse. Cobbles are angular to subangular, siltstone.	1.6		
Strong purple weathered dark grey fine SILTSTONE.	1.7		

Remarks: Unable to excavate past 1.7m due to bedrock.	Stability: Good	Groundwater: Dry

Jennings O'Donovan, Consulting Engineers, Finisklin Business Park, Sligo, Ireland,	**Proposed Windfarm at Dyrick Hill, Co. Waterford**	Trial Pit No: **T02**

Ecoquest Environmental dparkinson@ecoquest.ie	**Dyrick Hill Windfarm Trial Pit Log**	**Trial Pit No: T03**
Eastings 616112 ITM Northings 605076	Date: 02/07/2022 Weather: Occasional Showers	Logged by: AG Plant: JCB 3CX Pit Size: 3 x 1m

Strata Description	Depth (m)	Water	Notes
TOPSOIL: Soft dark grey peaty silt.	0.2		
Medium dense reddish brown very silty SAND and GRAVEL with medium cobble content and occasional angular boulders of siltstone. Gravel is subangular to angular, fine to coarse. Cobbles are angular to subangular, siltstone.	3.0		
Possible boulders or bedrock at 3.0m			

Remarks: Unable to excavate past 3.0m due to possible boulders or bedrock.	Stability: Good	Groundwater: Dry

Jennings O'Donovan, Consulting Engineers, Finisklin Business Park, Sligo, Ireland,	**Proposed Windfarm at Dyrick Hill, Co. Waterford**	Trial Pit No: **T03**

Ecoquest Environmental dparkinson@ecoquest.ie	**Dyrick Hill Windfarm** **Trial Pit Log**	**Trial Pit No:** **T04**
Eastings 615602 ITM Northings 605311	Date: 01/07/2022 Weather: Moderate Rain	Logged by: AG Plant: JCB 3CX Pit Size: 3 x 1m

Strata Description	Depth (m)	Water	Notes
TOPSOIL: Soft dark brown silty gravelly clay with cobbles.	0.3		
Dense reddish brown silty sandy GRAVEL with high cobble content and occasional boulders of siltstone (<0.5m diameter). Gravel is angular to subangular, fine to coarse, siltstone. Cobbles are angular to subangular, siltstone.	2.2		
Possible Bedrock at 2.2m			

Remarks: Unable to excavate past 2.2m due to possible bedrock and collapsing.	Stability: Unstable	Groundwater: Dry

Jennings O'Donovan, Consulting Engineers, Finisklin Business Park, Sligo, Ireland,	**Proposed Windfarm at Dyrick Hill, Co. Waterford**	Trial Pit No: **T04**

Ecoquest Environmental dparkinson@ecoquest.ie	**Dyrick Hill Windfarm Trial Pit Log**	**Trial Pit No: T05**
Eastings 615985 ITM Northings 605692	Date: 01/07/2022 Weather: Light Rain	Logged by: AG Plant: JCB 3CX Pit Size: 3 x 1m

Strata Description	Depth (m)	Water	Notes
TOPSOIL: Firm dark brown peaty gravelly silt.	0.3		
Stiff orange brown slightly sandy gravelly SILT with low cobble content and occasional angular boulders of siltstone (<0.4m diam.) Gravel is angular to subangular, fine to coarse, siltstone. Cobbles are angular to subangular, siltstone.	2.5		
Possible Bedrock at 2.5m			

Remarks: Hard digging below 2m.Unable to excavate past 2.5m due to possible bedrock. Undertaken 98m NW of T05 due to trees.	Stability: Good	Groundwater: Dry

Jennings O'Donovan, Consulting Engineers, Finisklin Business Park, Sligo, Ireland,	**Proposed Windfarm at Dyrick Hill, Co. Waterford**	Trial Pit No: **T05**

Ecoquest Environmental dparkinson@ecoquest.ie	**Dyrick Hill Windfarm Trial Pit Log**	**Trial Pit No: T06**
Eastings 615263 ITM Northings 605810	Date: 01/07/2022 Weather: Moderate Rain	Logged by: AG Plant: JCB 3CX Pit Size: 3 x 1m

Strata Description	Depth (m)	Water	Notes
TOPSOIL: Soft dark brown silty gravelly clay.	0.3		
Medium dense orange brown silty sandy GRAVEL with medium cobble content. Gravel is angular to subangular, fine to coarse, shaley siltstone. Cobbles are angular to subangular, shaly siltstone.	2.5		
Possible Bedrock at 2.5m			

Remarks: Unable to excavate past 2.5m due to possible bedrock.	Stability: Unstable	Groundwater: Dry

Jennings O'Donovan, Consulting Engineers, Finisklin Business Park, Sligo, Ireland,	**Proposed Windfarm at Dyrick Hill, Co. Waterford**	Trial Pit No: **T06**

Ecoquest Environmental dparkinson@ecoquest.ie	**Dyrick Hill Windfarm** **Trial Pit Log**	**Trial Pit No:** **T06B**
Eastings 614954 ITM Northings 605931	Date: 01/07/2022 Weather: Light Rain	Logged by: AG Plant: JCB 3CX Pit Size: 3 x 1m

Strata Description	Depth (m)	Water	Notes
TOPSOIL: Soft dark brown silty gravelly clay.	0.3		
Dense reddish brown silty sandy GRAVEL with high cobble content and occasional boulders of siltstone (<0.4m diameter). Gravel is angular to subangular, fine to coarse, siltstone. Cobbles are angular to subangular, siltstone.	2.1		
Possible Bedrock at 2.1m			

Remarks: Unable to excavate past 2.1m due to possible bedrock.	Stability: Good	Groundwater: Dry

Jennings O'Donovan, Consulting Engineers, Finisklin Business Park, Sligo, Ireland,	**Proposed Windfarm at Dyrick Hill, Co. Waterford**	Trial Pit No: **T06B**

Ecoquest Environmental dparkinson@ecoquest.ie	**Dyrick Hill Windfarm Trial Pit Log**	**Trial Pit No: T07**
Eastings 615828 ITM Northings 606010	Date: 02/07/2022 Weather: Occasional Showers	Logged by: AG Plant: JCB 3CX Pit Size: 3 x 1m

Strata Description	Depth (m)	Water	Notes
TOPSOIL: Firm brown sandy gravelly silt	0.2		
Firm pinkish brown mottled orange brown slightly sandy gravelly SILT with medium cobble content and occasional angular boulders of fine sandstone. Gravel is subangular to angular, fine to coarse. Cobbles are angular to subangular, fine sandstone.	1.3		
Dense pinkish brown silty sandy GRAVEL with high cobble content and occasional subangular bouldersof siltstone. Gravel is angular to subangular, fine to coarse, siltstone. Cobbles are angular to subangular, siltstone.	2.1		
Possible bedrock or boulders at 2.1m			

Remarks: Unable to excavate past 2.1m due to possible boulders or bedrock.	Stability: Good	Groundwater: Dry

Jennings O'Donovan, Consulting Engineers, Finisklin Business Park, Sligo, Ireland,	**Proposed Windfarm at Dyrick Hill, Co. Waterford**	Trial Pit No: **T07**

Ecoquest Environmental dparkinson@ecoquest.ie	Dyrick Hill Windfarm Trial Pit Log	Trial Pit No: T08
Eastings 614816 ITM Northings 606193	Date: 01/07/2022 Weather: Moderate Rain	Logged by: AG Plant: JCB 3CX Pit Size: 3 x 1m

Strata Description	Depth (m)	Water	Notes
TOPSOIL: Soft dark brown silty gravelly clay.	0.3		
Dense reddish brown silty sandy GRAVEL with high cobble content and occasional boulders of siltstone (<0.4m diameter). Gravel is angular to subangular, fine to coarse, siltstone. Cobbles are angular to subangular, siltstone.	1.7		
Possible Bedrock at 1.7m			

Remarks:	Stability:	Groundwater:
Unable to excavate past 1.7m due to possible bedrock. Undertaken 148m west of T08 due to gradients and wet ground.	Moderate - minor spalling	Dry

Jennings O'Donovan, Consulting Engineers, Finisklin Business Park, Sligo, Ireland,	**Proposed Windfarm at Dyrick Hill, Co. Waterford**	Trial Pit No: **T08**

Ecoquest Environmental dparkinson@ecoquest.ie	Dyrick Hill Windfarm Trial Pit Log	Trial Pit No: T09
Eastings 614800 ITM Northings 604594	Date: 01/07/2022 Weather: Overcast	Logged by: AG Plant: JCB 3CX Pit Size: 3 x 1m

Strata Description	Depth (m)	Water	Notes
TOPSOIL: Loose brown silty sand with rootlets	0.3		
Dense orange brown silty sandy GRAVEL with low cobble content. Gravel is angular to subangular, fine to coarse, siltstone and sandstone. Cobbles are angular to subangular, siltstone and sandstone.	0.8		
Dense pinkish brown silty sandy GRAVEL with high cobble content. Gravel is angular to subangular, fine to coarse, siltstone and sandstone. Cobbles are angular to subangular, siltstone and sandstone.	2.0		
Possible Bedrock at 2.0m			

Remarks: Unable to excavate past 2.0m due to possible bedrock.	Stability: Good	Groundwater: Dry

Jennings O'Donovan, Consulting Engineers, Finisklin Business Park, Sligo, Ireland,	**Proposed Windfarm at Dyrick Hill, Co. Waterford**	Trial Pit No: **T09**

Ecoquest Environmental dparkinson@ecoquest.ie	**Dyrick Hill Windfarm Trial Pit Log**	**Trial Pit No: T10**
Eastings 614805 ITM Northings 605146	Date: 01/07/2022 Weather: Fine	Logged by: AG Plant: JCB 3CX Pit Size: 3 x 1m

Strata Description	Depth (m)	Water	Notes
TOPSOIL: Soft dark brown peaty silt with cobbles and boulders.	0.3		
Firm to stiff reddish brown sandy gravelly SILT with high cobble content. Gravel is angular to subangular, fine to coarse, sandstone and siltstone. Cobbles are angular to subangular, sandstone and silstone.	1.3		
Possible Bedrock at 1.3m			

Remarks: Unable to excavate past 1.3m due to possible bedrock.	Stability: Good	Groundwater: Dry

Jennings O'Donovan, Consulting Engineers, Finisklin Business Park, Sligo, Ireland,	**Proposed Windfarm at Dyrick Hill, Co. Waterford**	Trial Pit No: **T10**

Ecoquest Environmental dparkinson@ecoquest.ie	**Dyrick Hill Windfarm** **Trial Pit Log**	**Trial Pit No:** **T11**
Eastings 614522 ITM Northings 605476	Date: 01/07/2022 Weather: Overcast	Logged by: AG Plant: JCB 3CX Pit Size: 3 x 1m

Strata Description	Depth (m)	Water	Notes
TOPSOIL: Soft dark brown gravelly peat with cobbles and boulders.	0.3		
Dense brown silty sandy GRAVEL with medium cobble content. Gravel is subangular to subrounded, fine to coarse, siltstone and sandstone. Cobbles are aubangular, siltstone and sandstone. Cobbles are aubangular to subrounded, siltstone.	1.8	Seepage	1-1.5m
Possible Bedrock at 1.8m			

Remarks: Unable to excavate past 1.8m due to possible bedrock.	Stability: Moderate - minor spalling	Groundwater: Seepage 1 - 1.5m

Jennings O'Donovan, Consulting Engineers, Finisklin Business Park, Sligo, Ireland,	**Proposed Windfarm at Dyrick Hill, Co. Waterford**	Trial Pit No: **T11**

Ecoquest Environmental dparkinson@ecoquest.ie	Dyrick Hill Windfarm Trial Pit Log	Trial Pit No: T12
Eastings 614256 ITM Northings 605995	Date: 01/07/2022 Weather: Overcast	Logged by: AG Plant: JCB 3CX Pit Size: 3 x 1m

Strata Description	Depth (m)	Water	Notes
TOPSOIL: Soft dark brown peaty gravelly silt with cobbles.	0.3		
Stiff orange brown slightly sandy gravelly SILT with medium cobble content. Gravel is subangular to subrounded, fine to coarse, siltstone and sandstone. Cobbles subangular to subrounded, siltstone and sandstone.	3.1	Seepage	0.5m
Possible Bedrock at 3.1m			

Remarks:	Stability:	Groundwater:
Unable to excavate past 3.1m due to possible bedrock. Undertaken 28m west of T12 due to gradients.	Good	Slight seepage @0.5

Jennings O'Donovan, Consulting Engineers, Finisklin Business Park, Sligo, Ireland,	**Proposed Windfarm at Dyrick Hill, Co. Waterford**	Trial Pit No: **T12**

Ecoquest Environmental dparkinson@ecoquest.ie	**Dyrick Hill Windfarm Trial Pit Log**	**Trial Pit No: T13**
Eastings 614019 ITM Northings 606303	Date: 01/07/2022 Weather: Moderate Drizzle	Logged by: AG Plant: JCB 3CX Pit Size: 3 x 1m

Strata Description	Depth (m)	Water	Notes
TOPSOIL: Soft dark brown silty cobbly peat.	0.4		
Stiff orange brown slightly sandy gravelly SILT with high cobble content and boulders of fine sandstone (<0.4m). Gravel is subangular to subrounded, fine to coarse, fine sandstone. Cobbles and boulders are angular to subangular, fine sandstone.	2.0		
Possible Bedrock at 2.0m			

Remarks:	Stability:	Groundwater:
Unable to excavate past 2.0m due to possible bedrock. Undertaken 200m west of T13 due to fence/gradients/wet ground.	Good	Slight seepage from topsoil

Jennings O'Donovan, Consulting Engineers, Finisklin Business Park, Sligo, Ireland,	**Proposed Windfarm at Dyrick Hill, Co. Waterford**	Trial Pit No: **T13**

MANAGEMENT PLAN 5

WASTE MANAGEMENT PLAN

DYRICK HILL WIND FARM LIMITED

DYRICK HILL WIND FARM

CO. WATERFORD

CONSTUCTION ENVIRONMENTAL MANAGEMENT PLAN (CEMP)

MANAGEMENT PLAN 5

WASTE MANGEMENT PLAN

MAY 2023

Dyrick Hill Wind Farm Limited
c/o EMPower,
2 Dublin Landings,
North Wall Quay,
North Dock,
Dublin,
D01 V4A3.

Jennings O'Donovan & Partners Limited,
Consulting Engineers,
Finisklin Business Park,
Sligo.
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email: info@jodireland.com

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Web Site www.jodireland.com

DOCUMENT APPROVAL

PROJECT	Dyrick Hill Wind Farm	
CLIENT / JOB NO	Dyrick Hill Wind Farm Limited	6497
DOCUMENT TITLE	Construction Environmental Management Plan (CEMP) Waste Management Plan	

	Prepared by	**Reviewed/Approved by**
Document Final	Name Ryan Mitchell	Name David Kiely
Date May 2023	Signature	Signature

CONTENTS

1 INTRODUCTION

1.1 Scope and Requirements

This Management Plan is a 'live' document that can be reviewed and updated at regular intervals throughout the project life cycle. The Contractor is required to develop and adapt this document in line with the activities of the project being undertaken for the Development. The contractor will approve this Plan (and any future amendments of the document) with the Ecological Clerk of Works prior to any work commencing.

The information in this document forms part of the Construction Environmental Management Plan (CEMP) and is the Site Waste Management Plan for the Project.

The CEMP and the measures detailed in this Waste Management Plan are part of the main requirements for consents for planning permissions. As such, the contractor (and all sub-contractors) on site are obligated to incorporate these waste requirements (contained herein) in all operations.

The general methods and principles detailed within this document will be adhered to by the contractor as they are committed to reduce the resources it uses in the construction work of the Development.

1.2 Waste Prevention & Waste Regulations:

In 2012, the Department of the Environment, Community and Local Government published the Waste Management Policy in Ireland (DoECLG, 2012). One of its guiding principles is to minimise waste.

The Waste Hierarchy which contractors are obligated to apply: (Source: EC[1]):

The waste management hierarchy applies to all waste, including hazardous waste. The top of the hierarchy indicates that the priority should be in preventing waste being produced in the first place.

The Contractor will:

- Ensure that the disposal and recovery of waste does not present a risk to water, air, soil, plants and animals
- Not allow waste disposal to constitute 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
- Prepare Waste Management Plans
- Ensure that waste treatment operations are licensed
- Require waste collectors to have special authorization and to keep records
- Ensure that the waste which cannot be prevented or recovered is disposed of without causing environmental pollution.

[1] European Commission [Accessed Online 03/05/2022]
https://ec.europa.eu/environment/topics/waste-and-recycling/waste-framework-directive_en

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

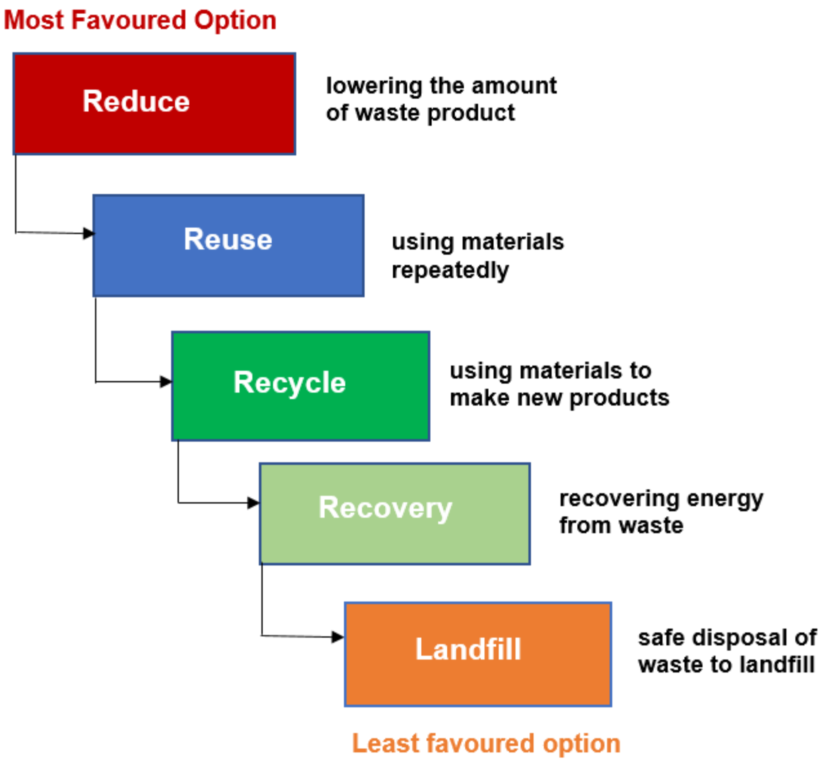
- Be in possession of a waste permit for waste disposal and
- Be prepared at all times for inspection regarding monitoring of waste activities.

1.3 Benefits of Waste Prevention

The contractor will prevent waste through implementing reduction and effectively managing resources from the design stage of construction to the completion of the construction of the project. This will ensure that:

- Legal obligations are met
- Waste production is minimised
- Build costs are minimised
- A framework for continuous assessment and best practice is implemented
- Carbon emissions and negative environmental impacts of and from waste materials are reduced

The following image explains this in more detail. The least favoured option is to dispose of waste to landfill where embodied energy is not recovered. The Waste Hierarchy (EU Waste Framework Directive, 2008) is outlined below:



1.4 Reference Documentation

As well as the Waste Management Act 1996-2008 other guidance documents have been used to develop this plan. These include:

Pollution Prevention Guidelines:

Best Practice Guidelines on the Preparation of Waste Management Plans for Construction and Demolition Projects, Department of Environment, Heritage & Local Government, July 2006.

EU Directive:

Article 4 of Waste Framework Directive (Directive 2008/98/EC)

This sets out the five steps for dealing with waste.

2 WASTE MANAGEMENT PLAN MINIMUM REQUIREMENTS

A Site Waste Management Plan involves the following stages:

- Planning
- Implementation
- Monitor
- Review

2.1 Planning

The planning stage of the Development has taken into account the nature of the site, design of the wind farm, environmental considerations and construction methods to minimise the quantity of waste produced on site during its construction.

2.2 Implementation

This Waste Management Plan will include:

1. An inventory of waste type expected to be produced in the course of the project.
2. Estimates of each type of waste that will be produced in the construction of this wind farm.
3. A statement showing how the contractor will minimise each type of waste to be produced prior to any activity generating this waste.
4. Procedures for identification of the waste management actions proposed for each different waste type, including re-using, recycling, recovery and disposal (in accordance with the waste hierarchy priorities).

2.3 Monitoring

2.3.1 Checks and Records

All stores on site of oil, fuel, chemicals etc will be regularly checked (in particular in extreme weather conditions) for evidence of leaks or spills. The timing of each of these checks is detailed in Section 3. These checks will be visual inspections to look for evidence of contamination.

Records of all visual checks will be maintained and be available for inspection on request. Waste Management will be a regular item on team meetings as required by the CEMP. Waste Management Practices will be revised at these meetings. A waste audit will be carried out every six months (Section 2.3.3).

2.3.2 Waste Inventory

A waste inventory will be maintained and kept up to date. It will include an inventory of all waste materials leaving the site for disposal and the name of the licensed operator and intended disposal facility. A Waste Inventory Spreadsheet will be added to this plan by the Contractor.

2.3.3 Monitoring of Site Waste Management Plan

The contractor will appoint a person to implement and monitor the Waste Management Plan. This will be the Ecological Clerk of Works .

As stated, the Waste Management Plan will include an inventory of the types and estimates of the waste to be produced on site. The appointed person will ensure that a Site Waste Audit is carried out every six months.

2.4 Completion, Audit and Review

Upon completion of construction works but before the end of the defects correction period, a Waste Management Review will be undertaken. The aim of this is to identify project progress, measure compliance with licenses and to consider lessons learnt.
A Waste Management Review will be carried out at the end of construction.

2.5 Site Waste Management as Part of Site Induction process

All workers on-site at the Development will be fully briefed with the Waste Management Plan. All site visitors will be briefed on appropriate waste storage and disposal units. Littering on site will not be tolerated. All personnel have a Duty of Care to challenge others noted littering on site.

3 GENERAL WASTE MANAGEMENT PRINCIPLES

3.1 The Contractor will avoid or minimise the volume of waste generated.

3.2 Waste will be stored a minimum of 50m from nearby watercourses or drains at the Site.

3.3 Waste storage and disposal will be carried out in a way which prevents pollution in compliance with legislation.

3.4 All waste to be transported off-site to a licensed disposal site. The nearest licenced waste facility is 13.8km southeast of the Development in the townland of Ballynamuck Middle, Dungarvan, Co. Waterford (Dungarvan Civic Amenity Site). Excavated material along the Grid Connection Route will be removed to a licenced waste facility. A list of waste facilities within the vicinity of the Development has been included in **Appendix I**. Duty of Care Waste Control dockets must be produced and filed on site with each load. These **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 European Waste Codes)[2]
- Information on the quantity and nature of the waste and how it is contained
- Names and addresses of the transferor at Dyrick Hill Wind Farm (the person currently in control of the waste) and the transferee (usually either a registered waste carrier or a waste management licence holder (waste manager)
- The Standard Industry Classification 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)

3.5 Only trained operatives will handle hazardous substances. All stored hazardous waste will be clearly labelled.

[2] https://www.epa.ie/publications/monitoring--assessment/waste/2019--FULL-template.pdf

3.6 All oil storage facilities will have secondary containment facilities of 110% storage capacity (e.g., bund, enclosure, drip tray). All of these will be regularly inspected for visual signs of leaks or something that would impact on their capacity – e.g., a drip tray full of rainwater.

3.7 Waste storage areas will be clearly located and signed. Key waste streams will be separated.

3.8 All waste will be transported from site at appropriate frequency by a registered waste contractor to prevent over-filling of waste containers.

3.9 Frequency of Checks. The contractor will ensure that all storage facilities are checked on a weekly basis. The checklist for completion is attached below.

VISUAL WASTE STORAGE CHECKLIST		
Waste Area Checked	**Date Checked**	**Initials of Checker**
GENERAL OFFICE WASTE		
BOWSER		
PORTALOO		
EXCAVATED SOIL		
WASHINGS		
CONCRETE		
OIL		
HAZARDOUS WASTE e.g., 17 05 03* soil and stones containing hazardous substances 3		

[3] https://www.epa.ie/publications/monitoring--assessment/waste/2019--FULL-template.pdf

4 ANTICIPATED CONSTRUCTION WASTE STREAMS

As stated previously, the Contractors will outline prior to commencement of construction all anticipated waste streams to be produced at the construction site at the Development.

4.1 Waste from Staff Facilities

4.1.1 General Waste Generate at Staff facilities

There will be the typical waste generated in an office such as left-over food and sandwich wrappers. This is a non-hazardous waste. All such waste will be stored appropriately and safely from wind, rain and wild animals that often tear apart rubbish bags. Provision for separation of waste streams will be provided so that e.g., paper and cardboard waste and bottles may be recycled.

4.1.1 Sewage

The self-contained port-a-loo units which will be managed and serviced regularly (by removal of the contents by tanker to a designated sewage treatment plant such as (Dungarvan Wastewater Treatment Plant) and removed off site on completion of construction. Toilet waste is a non-hazardous waste.

4.2 Concrete

4.2.1 Concrete Waste and wash-out water

- Precast concrete will be used wherever possible i.e., formed offsite. Elements of the Development where precast concrete will be used have been identified and are indicated in the CEMP. Elements of the Development where the use of precast concrete will be used include structural elements of watercourse crossings (single span / closed culverts) as well as Cable Joint Bays. Elements of the development where the use of precast concrete is not possible includes turbine foundations and joint bay pit excavations. Where the use of precast concrete is not possible the following mitigation measures will apply.
- The acquisition, transport and use of any cement or concrete on site will be planned fully in advance and supervised at all times.
- Vehicles transporting such material will be relatively clean upon arrival on site, that is; vehicles will be washed/rinsed removing cementitious material leaving the source location of the material. There will be no excess cementitious material on the vehicle which could be deposited on trackways or anywhere else on site. To this end, vehicles will undergo a visual inspection prior to being permitted to

drive onto the proposed site or progress beyond the contractor's yard. Vehicles will also be in good working order.

- Any shuttering installed to contain the concrete during pouring will be installed to a high standard with minimal potential for leaks. Additional measures will be taken to ensure this, for example the use of plastic sheeting or other sealing products at joints.
- Concrete will be poured during metrological dry periods/seasons~~.~~ This will reduce the potential for surface water run off being significantly affected by freshly poured concrete. This will require limiting these works to dry meteorological conditions i.e. avoid foreseen sustained rainfall (any foreseen rainfall event longer than 4 hour duration) and/or any foreseen intense rainfall event (>3mm/hour, yellow on Met Eireann rain forecast maps), and do not proceed during any yellow (or worse) rainfall warning issued by Met Eireann. This also will avoid such conditions while concrete is curing, in so far as practical.
- Ground crew will have a spill kit readily available, and any spillages or deposits will be cleaned/removed as soon as possible and disposed of appropriately.
- Pouring of concrete into standing water within excavations will be avoided. Excavations will be prepared before pouring of concrete by pumping standing water out of excavations to the buffered surface water discharge systems in place.
- Temporary storage of cement bound sand (if required) will be on hardstand areas only where there is no direct drainage to surface waters and where the area has been bunded e.g., using sand-bags and geotextile sheeting or silt fencing to contain any solids in run-off.
- No surplus concrete will be stored or deposited anywhere on site. Such material will be returned to the source location or disposed of off-site appropriately. A concrete washings area can be seen on Drawing 6225-PL-803.

4.3 Chemicals, Fuel and Oils

All storage containers of over 200 litres will have a secondary containment of 110% capacity to ensure that any leaking oil is contained and does not enter the aquatic environment. Oil waste is classified as hazardous.

A **Chemical and Waste Inventory will be kept**. This inventory will include:

- List of all substances stored on-site (volume and description);

- Procedures and location details for storage of all materials listed; and
- Waste disposal records, including copies of all Waste Transfer Notes detailing disposal routes and waste carriers used.
- Any tap or valve permanently fixed to the mobile unit through which oil can be discharged to the open or when delivered through a flexible pipe which is fitted permanently to the mobile unit, will be fitted with a lock and locked shut when not in use.
- Sight gauges will be fitted with a valve or tap, which will be shut when not in use. Sight gauge tubes, if used will be well supported and fitted with a valve.
- Mobile units must have secondary containment when in use/out on site.

Where mobile bowers are used on site guidelines will be followed so that:

- Any flexible pipe, tap or valve will be fitted with a lock where it leaves the container and be locked shut when not in use;
- Flexible delivery pipes will be fitted with manually operated pumps or a valve at the delivery end that closes automatically when not in use. Where possible, a nozzle designed to dispense oil is used;
- The pump or valve will have a lock and be locked shut when not in use.

4.3.1 Transport of Diesel/Oils to the site

Diesel is classified as a dangerous substance. Under the EU Directive 95/55/EC all such dangerous substances will be conveyed in a container that compiles with the ADR. As such the manufacturer of each bowser will provide certification to contractors that the following:

- A leak-proof test certificate
- A copy of the IBC approval certificate
- An identification plate attached to the container

For loads in excess of 1000 litres (220 gallons), the bowser vehicle driver will have undergone training and hold a special license.

4.3.2 Refuelling on Site

Where possible all refuelling on site will be within the temporary compound within the re-fuelling area (see Drawing 6225-PL-803). Only essential refuelling (e.g., cranes) will be carried out, outside of this area, but not within 65m of any watercourse. In such cases a non-permeable High-density Polyethylene (HDPE) membrane will be provided beneath connection points to catch any residual oil during filling and disconnection. This membrane will be inspected and if there is any sign of oil contamination, it will be removed from site by a specialist licensed waste contractor.

All vehicles will be well maintained and free from oil or hydraulic fuel leaks.

4.4 Packaging

Packaging will be brought on site and can include cardboard, wood and plastics used to package turbine components. In accordance with the waste hierarchy, packaging will be returned to the originator ahead of re-use or recycling. Where this is not possible, waste will be separated as appropriate and safely stored on site appropriately site in anticipation of recycling. This waste is non-hazardous.

4.5 Waste Metals

Waste metals from concrete reinforcing etc will have commercial value and will be re-used or recycled with the appropriate licensed waste contractor. This waste is non-hazardous.

5 EXCAVATED MATERIALS

Excavated materials will be required for habitat and ecological restoration, reprofiling and backfilling in accordance with the **Spoil Management Plan**. As such, excavated materials will not be classified as waste except along the Grid Connection Route.

5.1 Anticipated materials to be excavated on site.

No excavated material will be removed from within the Site Boundary. Road surfacing will be stored in slabs for reuse/recycling. Please see Chapter 15: Traffic and Transportation for nearest soil and store sites.

It is anticipated that c. 75,951m^3 of sub-soil and 56,193m^3 of peat will be excavated during construction.

5.1.1 Classification and Plan for Excavated Materials on site

The contractor will liaise with the Local Authority on all aspects of waste management relating to excavated soil to ensure compliance during construction. The Ecological Clerk of Works will ensure all mitigation measures outlined are adhered to. All excavated materials are to be reused on site except that which is excavated along the Grid Connection Route. A list of potential Local Authority licenced facilities in the vicinity of the Development is included in **Appendix I**.

5.2 Estimated Volumes of Soil

Volumes are outlined in a **Spoil Management Plan** and provided in Management Plan 4 of the CEMP. Whilst there will be significant volumes of soil to be excavated on site during the construction of the Development, excavated material will be used for reinstatement and restoration works. Where this is not possible, e.g., along the Grid Connection Route and Turbine Delivery Route where some soils contain hydrocarbons (hazardous material), the waste materials will be taken to a licenced facility by an authorised permit holder.

The **Spoil Management Plan** outlines the re-use proposals for excavated materials.

5.3 Waste or Not Waste

Any excavated materials which are not intended to be disposed of, or discarded, will NOT be considered as waste. It will not be regulated under waste management controls where the following six criteria are ALL met:

i) Use is a necessary part of the planned works

ii) Material is suitable for that use

iii) Material does not require any processing or treatment before it is reused

iv) No more than the quantity necessary is used

v) Use of the material is not a mere possibility but a certainty and

vi) Use of the soil will not result in pollution of the environment or harm to human health

Where excavated soil on site does not meet all of the six criteria listed above, for the purposes of waste description, it would fall under chapter 17 of the European Waste Catalogue (EWC) Construction and Demolition wastes. The EWC code '17 05 04 soil and stones (non-hazardous) waste or 17 05 03* soil and stones containing hazardous substances would apply. This will occur on along the Grid Connection Route and parts of the Turbine Delivery Route.

The principles of the waste hierarchy will be strictly adhered to avoid and minimise production of excavated soil, and to ensure that all materials are recovered and reused on site.

6 PEST CONTROL

Responsible rodenticide use will be practiced on site. Incorrect use and management of rodenticide can indirectly have a negative impact on wildlife. Best practice use include:

- Pest control on site will be undertaken by a trained professional.
- Rodenticide baits will only be used for as long as is necessary to achieve satisfactory control.
- Good house-keeping and proper waste management practices will ensure there are no flood sources available to vermin.
- A record of all bait points and the amount of bait laid will be maintained during the treatment. Activity will be noted at each bait point, including any missing or disturbed baits, as the treatment progresses.
- By carefully recording the sites of all bait points, responsible users of rodenticides will return to these sites at the end of the treatment and remove uneaten bait so that it does not become available to wildlife.
- The bodies of dead rodents may carry residues of rodenticides and, if eaten by predators or scavengers, may be a source of wildlife exposure to rodenticides.
- Regular searches for rodent bodies will be carried out, both during and after the treatment period. Bodies may be found for several days after rats have eaten the bait and rats may die up to 100 metres or more away from the baited site.
- Any rodent bodies will be removed from the Site and disposed of safely using the methods recommended on the label.
- Bait will be sufficiently protected to avoid accidentally poisoning other mammals and birds. Natural materials will be used where possible.
- Bait stations will be appropriate to the prevailing circumstances. They will provide access to the bait by rodents, while reducing the risks of non-target access and interference by unauthorised persons. They will protect the bait from contamination by dust or rain. Their design, construction and placement will be such that interference is minimised.
- On completion of the treatment, records will be updated to signify that the infestation is controlled and that, as far as reasonably practical, all steps have been taken to ensure that the site is now free of rodenticide bait.

WASTE INVENTORY

THE CONTRACTOR WILL PREPARE AND UPDATE REGULARLY A WASTE INVENTORY FOR INCLUSION IN THE WASTE MANAGEMENT PLAN

APPENDIX I

LICENCED FACILITIES

Local Authority Waste Facility Register: Waterford;			
Authorisation Reference	**Name**	**Trading As**	**Address**
COR-WCCC-18-0004-01	Kollect on Demand Ltd		Roy & Andrew McCarthy Ltd Killure Road St John's Park Waterford X91 KXK5
WFP-WCCC-18-0004-01	Kereen Quarries Ltd		Kereen Lower Cappoquin Co Waterford P51 E652
WFP-WCCC-18-0006-01	Friends of the Earth (Skip & Fuels) Ltd		Carriganard Six Cross Roads Waterford Co Waterford X91 A388
COR-WCCC-18-0007-01	Enva Ireland Ltd		Crossary Lackaroe Youghal Co Waterford
WFP-WCCC-19-0001-01	Michael Shanahan		Coolfinn Farm Coolfinn Portlaw Co Waterford X91 TW72
WFP-WCCC-19-0003-01	James Cahill		Ballylin Lower Lismore Co. Waterford
WFP-WCCC-19-0004-01	Thomas Phelan		Halfway House Woodstown Co Waterford X91 E725
COR-WCCC-19-0005-01	Roy & Andrew McCarthy Ltd	McCarthy Services	Killure Road St Johns Park Waterford X91 KXK5
COR-WCCC-20-0001-01	Noel Frisby Construction Ltd		Phase 1 Housing Estate Williamstown Waterford
WFP-WCCC-20-0001-01	Horsom Contracting Ltd		Kiladangan Dungarvan Co. Waterford
COR-WCCC-20-0004-01	Kollect on Demand Ltd.		Circle K Manor Service Station Cork Road Waterford, X91 ADP9
WFP-WCCC-16-0002-03	Michael Murphy and Gavin Rees	Green Marine	Coolnagoppoge Tramore Co. Waterford X91 V086
COR-WCCC-21-0001-01	Richard Barron		Ballyhoo Waterford
WFP-WCCC-21-0002-01	Tony Kirwan Civil Engineering Contractors Ltd.		Ballycraddock Kilmeaden Co. Waterford
WFP-WCCC-18-0002-02	Richard Barron		Knockeen Butlerstown Co Waterford X91 HX2D
WFP-WCCC-21-0001-02	James Cahill		Rockfield Cappagh Dungarvan Co. Waterford
WFP-WCCC-21-0004-01	S.E. Construction (Kent) Ltd.		Ballindud, Tramore Road Co. Waterford
WFP-WCCC-15-0002-02	Richard Nugent	Nugent Car Dismantlers	Ballymartin North Glencairn Lismore Co. Waterford P51 K032
COR-WCCC-20-0005-01A	Richard Barron		Knockeen Butlerstown Co. Waterford X91 K129

Local Authority Waste Facility Register: Waterford;			
Authorisation Reference	**Name**	**Trading As**	**Address**
WFP-WCCC-21-0003-01	Thomas Kiely		Gortnadiha Ring Dungarvan Co. Waterford
COR-WCCC-22-0002-01	BIGbin Waste Tech Ltd.		Circle K garage Kilrush Dungarvan Co. Waterford X35 VX06
WFP-WCCC-22-0001-01	Tom Bolster Ltd.		Ballymorris Fenor Co. Waterford
WFP-WCCC-16-0003-03	John O'Brien	Clonmel Car Dismantler's	Kilgainey Clonmel Co Waterford E91 DY29
WFP-WCCC-18-0005-02	John Morrison		Ballinaspick North Lismore Co Waterford
WFP-WCCC-16-0004-03	Jim & Sean Moroney		Ballycullane Beg Dungarvan Co. Waterford X35 V406
COR-WCCC-22-0003-01	Eddie Power (JCB Hire) Ltd.,	Eddie Power (JCB Hire) Ltd.,	Carriglong Tramore, Co. Waterford
WFP-WCCC-22-0002-01	Kilbarry Developments Ltd		Lacken Road Kilbarry Co Waterford
COR-WCCC-23-0001-01	Middlethird Estates Ltd.,	The Brook	Mountfield Ring Road Tramore Co. Waterford
COR-WCCC-23-0002-01	Cleary and Doyle Construction Ltd		Ballynaneashagh Waterford

MANAGEMENT PLAN 6

DECOMMISSIONING PLAN

DYRICK HILL WIND FARM LIMITED

DYRICK HILL WIND FARM

CO. WATERFORD

CONSTUCTION ENVIRONMENTAL MANAGEMENT PLAN (CEMP)

MANAGEMENT PLAN 6

DECOMMISSIONING PLAN

MAY 2022

Dyrick Hill Wind Farm Limited
c/o EMPower,
2 Dublin Landings,
North Wall Quay,
North Dock,
Dublin,
D01 V4A3.

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DOCUMENT APPROVAL

PROJECT	Dyrick Hill Wind Farm	
CLIENT / JOB NO	Dyrick Hill Wind Farm Limited	6497
DOCUMENT TITLE	Construction Environmental Management Plan (CEMP) Decommissioning Plan	

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DYRICK HILL WIND FARM, CO. WATERFORD

DECOMMISSIONING PLAN

CONTENTS

1 INTRODUCTION

This Decommissioning Plan has been prepared by Jennings O'Donovan & Partners Limited on behalf of Dyrick Hill Wind Farm Limited for the decommissioning of the proposed Dyrick Hill Wind Farm development and relevant infrastructure which is hereafter referred to as the Development. This document is being prepared, alongside an Environmental Impact Assessment Report (EIAR), as part of an application for planning permission for the Development to An Bord Pleanála.

Decommissioning of the Development will be scheduled to take place after the proposed 40-year lifespan of the Project.

This report provides the environmental management framework to be adhered to during the decommissioning phase of the Development and it incorporates the mitigating principles to ensure that the work is carried out in a way that minimises the potential for any environmental impacts to occur.

As noted in the Scottish Natural Heritage report Research and Guidance on Restoration and Decommissioning of Onshore Wind Farms (SNH, 2013) reinstatement proposals for a wind farm are made approximately 30 years in advance, so within the lifespan of the wind farm. Due to the efficiency of modern day turbines, it is estimated that their lifespan will be 35 years. The technological advances and preferred approaches to reinstatement are likely to change in the intervening decades.

In this regard, this Decommissioning Plan will be reviewed and updated for the written agreement of the Planning Authority prior to commencement of a decommissioning works. It will take account of the relevant conditions of the planning permission and current health and safety standards in accordance with the approach set out and the principles established in this document.

1.1 SCOPE OF THE DECOMMISSIONING PLAN

This plan for the decommissioning of the Development includes its connection to the national grid. Where the term 'site' is used in the Decommissioning Plan it refers to the site of the Development and all works associated with the Development including enabling works. The Decommissioning Plan clearly outlines the mitigation measures and monitoring proposals that are required to be adhered to in order to complete the works in an appropriate manner.

The report is divided into eight sections, as outlined below:

Section 1 provides a brief introduction as to the scope of the report.

Section 2 outlines the Site and Project details, detailing the targets and objectives of this plan along with providing an overview of works methodologies that will be adopted throughout decommissioning.

Section 3 sets out details of the environmental controls to be implemented on site including the mechanisms for implementation. A waste management plan is also included in this section.

Section 4 outlines the Emergency Response Procedure to be adopted in the event of an emergency in terms of site health and safety and environmental protection.

Section 5 sets out a programme for the timing of the works.

Section 6 consists of a summary table of all mitigation measures to be adhered to during the decommissioning-phase.

Section 7 outlines the proposals for reviewing compliance with the provisions of this report.

2 SITE AND PROJECT DETAILS

2.1 SITE LOCATION AND DESCRIPTION

The Site, as shown in **Figure 2.1**, is located within an area of farmland, forestry and upland heath, and is located within the townlands of Ballynaguilkee Upper, Broemountain, Corradoon, Dyrick, Lickoran, Lickoranmountain, Lisleagh, Lisleaghmountain, Lyrattin and Scartmountain. The Site is located 43km west of Waterford City, 55km northeast of Cork City, and 12.9km northwest of Dungarvan.

The site extends to 463ha, and comprises a mixture of farmland, forestry and upland heath. Much of the lands are in private, third-party ownership, while a portion of the site is shared land (commonage).

2.2 DESCRIPTION OF THE DECOMISSIONING

- Removal of 12 No. wind turbines and concrete plinths.
- Removal of permanent meteorological mast.
- Removal of all associated underground electrical and communications cabling connecting the wind turbines to the wind farm substation. Ducting is to remain *in-situ*

All other elements of the proposed development will remain in-situ. The Site Access Roads and associated drainage systems will serve ongoing forestry and agriculture activity in the area. All other hard surfaced areas will be allowed to revegetate naturally. Based on the experience of the project team monitoring operational wind farm sites throughout the country, the approach of allowing these areas to revegetate naturally has proven to be very successful.

Cranes of similar size to those used for construction will disassemble each turbine using the same crane hardstands. The towers, blades and all above ground components will be removed from site and reused, recycled, or disposed of in a suitably licenced facility. (The financial costs of decommissioning, at current material values, will be more than met by the recycling value of the turbine components.)

Turbines will be cut on site so as to fit on articulated trucks, therefore allowing the use of the civil construction delivery route to the south for removal.

The following elements are included in the decommissioning phase:

- Decommissioning works will be limited to action necessary to remove the wind farm structures, i.e., removal of turbines, cabling, and the monitoring mast.
- Existing Hardstands will be utilised to act as a temporary compound for the appointed Contractor.
- Roads and associated drainage systems will remain in place to serve ongoing forestry and agriculture activity[1].Hardstanding areas will be allowed to revegetate naturally.
- Turbine plinths will be removed, and the hardcore covering turbine foundations will be allowed to revegetate naturally[2].
- Soil disturbance will be avoided.

2.3 TARGETS AND OBJECTIVES

This decommissioning plan has considered environmental issues as listed in Section 3.

The key targets are as follows:

- Ensure decommissioning works and activities are completed in accordance with mitigation and best practice approach presented in the accompanying Environmental Impact Assessment Report (EIAR) and associated planning documentation. A Schedule of Mitigation Measures has been included in **Appendix 17.1** of the EIAR.
- Ensure decommissioning works and activities have minimal impact/disturbance to local landowners and the local community. This will relate to transport, particularly of material off site with noise and dust also impacting on receptors at time of decommissioning to a lesser extent.
- Ensure decommissioning works and activities have minimal impact on the natural environment. Disturbance to habitats will be avoided and the use of existing infrastructure and drainage will ensure silt does not enter waterways.
- Adopt a sustainable approach to decommissioning. This means comparing alternative methods for turbine disassembly and taking the approach with the least impact on the natural environment; and,
- Provide toolbox talks, environmental training and awareness of sensitive receptors and waste management within the Site for all project personnel.

[1] For a wind farm where the roads are not to be retained, natural revegetation is preferred to reprofiling, or the importation of soil.

[2] The covering of turbine foundations with soil material was discussed, and discounted. Instead, the possibility was discussed of roughening the surface of the concrete foundation, to assist in the initiation and subsequent growth and coalescence of flora. However, the foundations will in fact be covered with hardcore, so this step is unnecessary.

The key site objectives are as follows:

- Avoidance of any pollution incident or near miss as a result of working around or close to existing watercourses and have emergency measures in place, in accordance with the Water Quality Management Plan. Similar mitigation measures to the construction phase will be implemented. Please Section 3 for more details.
- Avoidance of vandalism.
- Keeping all watercourses free from obstruction and debris.
- Sustainable drainage system /drainage design principles will be maintained and monitored to ensure efficiency.
- Keep impact of decommissioning works to a minimum on the local environment, namely watercourses, and wildlife through the use of defences such as buffers and silt fences.
- Correct fuel storage and refuelling procedures to be followed.
- Good waste management and housekeeping to be implemented.
- Air and noise pollution prevention to be implemented.
- Monitoring of the works and any adverse effects that it may have on the environment.

Section 3 discusses the above in more detail.

2.4 DECOMMISSIONING METHODOLOGIES OVERVIEW

2.4.1 Introduction

An experienced main contractor will be appointed to undertake the decommissioning of the Development. The main contractors will comply with the mitigation measures of the Construction and Environmental Management Plan (CEMP) prepared for the construction phase. An overview of the decommissioning methodologies is provided below.

2.4.2 Decommissioning Methodology

The proposed decommissioning methodology is summarised under the following main headings:

- Wind turbines
- Turbine Foundations.
- Underground Cabling.

2.4.2.1 Wind Turbines

Prior to any works being undertaken on wind turbines, they will be disconnected from the grid by the site operator in conjunction with ESB Networks and EirGrid. The dismantling and removal of wind turbines of this scale is a specialist operation which will be undertaken by the turbine supplier or competent subcontractor. Turbine dismantling will be undertaken in reverse order to methodology employed during their construction. Cranes will be brought back to site utilising the hard stand areas. The dismantling of turbines will be bound by the same safety considerations as will be the case during construction in terms of weather conditions. Works will not be undertaken during adverse weather conditions and in particular not during high winds.

The turbine blades will be cut on site and removed in articulated trucks, the details of which are assessed in **Chapter 14: Traffic & Transportation** of the EIAR which accompany this application.

The transport of disassembled turbines from the Site will be undertaken in accordance with a Transport Management Plan (Management Plan 6 of the CEMP). The Transport Management Plan will provide for all necessary safety measures, including a convoy and Garda escort as required, off-peak turning/reversing movements and any necessary safety controls.

The Met Mast will also be removed as its purpose will cease once the turbines have been dismantle and removed. In addition, the Met Mast is solely a requirement of the operational phase to satisfy EirGrid's requirements.

2.4.2.2 Turbine Foundations

On the dismantling of turbines, it is not intended to remove the concrete foundations from the ground. It is considered that their removal will be the least preferred options in terms of potential effects on the environment. Turbine plinths will be removed and hardcore from the hardstands will be used to cover the plinth area. The hardcore covering turbine foundations will be allowed to revegetate naturally.

2.4.2.3 Underground Cabling

The cabling on site will be pulled from the cable duct using a mechanical winch which will extract the cable and re-roll it on to a cable drum. This will be undertaken at each of the joint bays/pull pits along the cable. The ground above original pulling pits/joint bays will be excavated to access the cable ducts using a mechanical excavator and will be fully re-instated once the cables are removed. Excavated material will be temporarily stored adjacent to the site of excavation at a height of less than 1m and at 25m distance from any watercourse.

The cable ducting will be left in-situ as it is considered the most environmentally prudent option, avoiding unnecessary excavation and soil disturbance for an underground element that is not visible with no environmental impact.

The onsite substation and associated grid connection will remain in place as it will be under the ownership of the ESB and will form a permanent part of the national electricity grid.

2.4.2.4 Transport Route Accommodation Works

Turbines will be cut at the hardstand locations on site so as to fit on articulated trucks, therefore allowing the use of the civil construction delivery route for removal.

3 ENVIRONMENTAL CONTROLS

The following sections give an overview of the drainage design, dust and noise control measures, a waste management plan for the site and the implementation of the environmental management procedures for the site. Based on the nature and extent of the decommissioning works these are the key on-site controls that are applicable at decommissioning. (Associated mitigation measures are described in Section 6).

3.1 SITE DRAINAGE

The site drainage features for this site during its construction and operation are outlined in the EIAR and Surface Water Management Plan which accompany this application. This document has been prepared on a preliminary (outline) basis and will be further developed and expanded following the appointment of the Contractors for the main construction/decommissioning works. Some items of this CEMP can only be finalised with appropriate input from the Contractors who will actually carry out the main construction/ decommissioning works. This CEMP identifies, for the incoming Contractors, the key planning, environmental and contract document constraints that must be adhered to in order to deliver optimum environmental reassurance for the site. As stated in Section 2.2, the drainage system will serve ongoing activity on the area.

When the final Decommissioning Plan is prepared prior to decommissioning and presented as a standalone document, all drainage management measures, which will include maintenance of the operational drainage measures, will be included in that document. However, it should be noted that by the time decommissioning is undertaken after the planned 40-year lifespan of the Development, the areas within the Site will have revegetated substantially resulting in a drainage pattern that is similar to what existed prior to any construction. It is not anticipated that the decommissioning phase will interrupt this drainage regime in any way with the works proposed. As an additional measure, areas where freshly placed soil material as part of excavation works will be surrounded by silt fencing if deemed necessary until the area has naturally revegetated e.g., near joint bays.

3.2 REFUELLING; FUEL AND HAZARDOUS MATERIALS STORAGE

The plant and equipment used during decommissioning will require refuelling during the works. Appropriate management of fuels will be required to ensure that incidents relating to refuelling are avoided. The following mitigation measures, which are the same as those proposed for the construction phase, are proposed to avoid release of hydrocarbons at the Site:

- Road-going vehicles will be refuelled off site wherever possible.
- On-site refuelling will be carried out at designated refuelling area at the temporary decommissioning compound at the Site. Existing Hardstands will be utilised to act as a temporary compound for the appointed Contractor. Machinery such as cranes will be refuelled directly by a mobile fuel truck that will come to site as required. Drip trays will be used in such circumstances.
- 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.
- Fuel volumes stored on site will be minimised. The fuel storage areas will be bunded to 110% of the storage volume.
- The plant used will be regularly inspected for leaks and fitness for purpose.
- An emergency plan for the decommissioning phase to deal with accidental spillages will be developed. Spill kits will be available to deal with an accidental spillage in and outside the refuelling area.
- A programme for the regular inspection of plant and equipment for leaks and fitness for purpose will be developed at the outset of the decommissioning phase.

3.3 DUST CONTROL

Dust is unlikely to be generated in significant amounts from on-site activities during decommissioning. The extent of dust generation will depend on the type of activity undertaken, the proximity of activities to receptors and the nature of the dust, i.e., soil, and the weather. In addition, dust dispersion is influenced by external factors such as wind speed and direction and/or, periods of dry weather. Site traffic movements also have the potential to generate dust as they travel along the haul route.

Proposed measures, which are the same as those proposed for the construction phase, to control dust include:

- Any site roads with the potential to give rise to dust will be regularly watered, as appropriate, during dry and/or windy conditions.
- The designated public roads outside the site and along the main transport routes to the site will be inspected daily by the Site Manager for cleanliness and cleaned if deposits are found.
- Material handling systems and material storage areas influenced by convenience and ease of handling, and peat slippage safety.

- Water misting or sprays will be used in dry and windy if particularly dusty activities are necessary during dry or windy periods.
- The transport of soils or other material, which has significant potential to generate dust, will be undertaken in tarpaulin-covered vehicles.
- Daily inspection of the site to examine dust measures and their effectiveness.
- When in dry and/or windy weather and dirt is visible on the roads, sections of the haul route will be swept using a truck mounted vacuum sweeper.

3.4 NOISE CONTROL

The operation of plant and machinery, including site vehicles, is a source of potential impact that will require mitigation at all locations within the site. Proposed measures, which are the same as those proposed for the construction phase, to control noise include:

- Diesel generators will be enclosed in sound proofed containers to minimise the potential for noise impacts.
- Plant and machinery with low inherent potential for generation of noise and/or vibration will be selected. All plant and equipment to be used on-site will be modern equipment and will comply with the S.I. No. 359/1996 - European Communities (Construction Plant and Equipment) (Permissible Noise Levels) (Amendment) Regulations.
- Regular maintenance of plant will be carried out in order to minimise noise emissions. Particular attention will be paid to the lubrication of bearings and the integrity of silencers.
- All vehicles and mechanical plant will be fitted with effective exhaust silencers and maintained in good working order for the duration of the works.
- Compressors will be of the “sound reduced” 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.
- Machines, which are used intermittently, will be shut down during those periods when they are not in use.
- Training will be provided by the Site Manager to drivers to ensure smooth machinery operation/driving, and to minimise unnecessary noise generation.
- Local areas of the haul route will be condition monitored and maintained, if necessary.

3.5 INVASIVE SPECIES MANAGEMENT

Prior to decommissioning, a suitably qualified ecologist will complete an invasive species survey of the Site to identify invasive species where any excavation will be required. An Invasive Species Management Plan will be implemented if invasive species are identified.

3.6 TRAFFIC MANAGEMENT

A Traffic Management Plan will be prepared in advance of any decommissioning works. The traffic management arrangements for the removal of turbines although similar to those that will be implemented for construction materials delivery (to a lesser extent) as outlined in the EIAR, will be agreed in advance of decommissioning with the competent authority.

The Traffic Management Plan for the decommissioning phase will also include provision for the removal of underground cables from the underground ducts within the Site. Cables in public roads will be left in-situ as they will be the responsibility of the ESB.

3.7 WASTE MANAGEMENT PLAN

A Waste Management Plan will be prepared in advance of any decommissioning works. This Waste Management Plan will include the best practice procedures during the decommissioning of the Development. The Waste Management Plan will outline the methods of waste prevention and minimisation by recycling, recovery and reuse at each stage of decommissioning. Disposal of waste will be a last resort.

3.7.1 Legislation

The Waste Management Act 1996 as amended requires that any waste related activity has to have all necessary licenses and authorisations. It will be the duty of the Waste Manager on the site of the Dyrick Hill Wind Farm development to ensure that all contractors hired to remove waste from the site have valid Waste Collection Permits. It will then be necessary to ensure that the waste is delivered to a licensed or permitted waste facility. The hired waste contractors and subsequent receiving facilities must adhere to the conditions set out in their respective permits and authorisations. Waste removal-related traffic volumes during the decommissioning phase, will be similar or less than those anticipated and assessed for the construction phase.

The Department of the Environment provides a document entitled, 'Best Practice Guidelines on the Preparation of Waste Management Plans for Construction and Demolition Projects' (2006). No demolition will take place at this site.

3.7.2 Waste Management Hierarchy

The waste management hierarchy sets out the most efficient way of managing waste in the following order:

1. **Prevention and Minimisation:**

The primary aim of the Waste Management Plan will be to prevent and thereby reduce the amount of waste generated.

2. **Reuse of Waste:**

No material is likely to be reused on site during the Decommissioning phase. Materials such as cabling will be reused off-site.

3. **Recycling of Waste:**

There are several established markets available for the beneficial use of Construction and Demolition waste such as using waste concrete as fill for new roads.

4. **Disposal of Waste to Landfill**

At all times during the implementation of the Waste Management Plan, disposal of waste to landfill will be considered only as a last resort.

3.7.3 Waste Arising from Decommissioning

The relevant components will be removed from site for re-use, recycling or waste disposal. Any structural elements that are not suitable for recycling will be disposed of in an appropriate manner. All lubrication fluids will be drained down and put aside for appropriate collection, storage, transport and disposal. Any materials which cannot be re-used or recycled will be disposed of by an appropriately licenced contractor.

The waste types arising from the decommissioning of the Development are outlined in **Table 3.1** below.

Table 3.1 Waste Types Arising during the Decommissioning Phase

Material Type	Example	EWC Code
Cables	Electrical wiring	17 04 11
Metals	Copper, aluminium, lead and iron	17 04 07
Fibreglass	Turbine blade component	10 11 03
Hydrocarbons	Oils and lubricants drained from the turbines	13 01 01,13 02 04

3.7.3.1 Reuse

Many construction materials can be reused several times before they have to be disposed of:

- Electrical wiring can be reused on similar wind energy projects
- Elements of the turbine components can be reused but this will be determined by the condition that they are in.

3.7.3.2 Recycling

If a certain type of material cannot be reused, then recycling is the most suitable option. The opportunity for recycling during decommissioning will be limited and restricted to components of the wind turbines and met mast.

All wastes will be sorted and segregated on-site during the time of decommissioning. The anticipated volume of all waste material to be generated at the Dyrick Hill Wind Farm development is low which provides the justification for adopting small containers as a method of waste storage.

3.7.3.3 Implementation

3.7.3.3.1 Roles and Responsibilities

The Ecological Clerk of Works will have responsibility for overseeing and the implementation of the objectives of the Decommissioning plan, ensuring that all hired waste contractors have the necessary authorisations and that the waste management hierarchy is adhered to. The person nominated will have sufficient authority so that they can ensure everyone working on the decommissioning adheres to the management plan.

3.7.3.3.2 Training

It is important for the Decommissioning Waste Manager to communicate effectively with colleagues in relation to the aims and objectives of the waste management plan. All employees working on site during the decommissioning phase of the project will be trained in materials management and thereby, will be able to:

- Distinguish reusable materials from those suitable for recycling.
- Ensure maximum segregation at source.
- Co-operate with site manager on the best locations for stockpiling reusable materials.
- Separate materials for recovery.
- Identify and liaise with waste contractors and waste facility operators.

3.7.3.3.3 Record Keeping

The Waste Management Plan will provide systems that will enable all arisings and movements of construction waste to be recorded. This system will enable the contractor to measure and record the quantity of waste being generated. The Waste Management Plan can then be adapted with changes that are seen through record keeping.

3.7.3.4 Waste Management Plan Conclusion

The Waste Management Plan will be properly adhered to by all staff involved in the project and will be outlined within the induction process for all site personnel. Reuse of certain types of decommissioning wastes will cut down on the cost and requirement of raw materials at other sites therefore further minimising waste levels going to landfill. This Waste Management Plan outlines the main objectives that are to be adhered to.

3.8 ENVIRONMENTAL MANAGEMENT IMPLEMENTATION

3.8.1 Roles and Responsibilities

The Site Manager and/or Environmental Clerk of Works will be key members of the Contractors team.

In general, the Ecological Clerk of Works will maintain responsibility for monitoring the decommissioning works and Contractors/Sub-contractors from an environmental perspective. The Ecological Clerk of Works will act as the regulatory interface on environmental matters. The Site Manager will be responsible for reporting to and liaising with Waterford & City Country Council and other statutory bodies as required.

A suitably qualified and experienced ecologist and any other suitably qualified and experienced professionals such as engineers and geotechnical experts will further advise the Ecological Clerk of Works and Site Manager. This will ensure there is no negative impact on the environment as a result of the decommissioning of the Development.

4 EMERGENCY RESPONSE PLAN

An Emergency Response Plan provides details of procedures to be adopted in the event of an emergency in terms of site health and safety and environmental protection.

4.1 EMERGENCY RESPONSE PROCEDURE

The site Emergency Response Plan includes details the response required and the responsibilities of all personnel in the event of an emergency. The Emergency Response Plan will require updating and submissions from the Contractor/Project Supervisor Decommissioning Stage (appointed to manage and co-ordinate health and safety matters during the construction stage) and sub-contractors as decommissioning progresses. Where sub-contractors are governed by their own emergency response procedure a bridging arrangement will be adopted to allow for inclusion of the sub-contractor’s Emergency Response Plan within this document.

4.1.1 Roles and Responsibilities

The chain of command during an emergency response sets out who is responsible for coordinating the response. The Site Supervisor/Construction Manager will lead the emergency response which makes him responsible for activating and coordinating the emergency response procedure. The other site personnel who can be identified at this time who will be delegated responsibilities during the emergency response are presented in Figure 4.1. In a situation where the Site Supervisor/ Construction Manager is to coordinate the emergency response, the responsibility will be transferred to the next person in the chain of command outlined in Figure 4.1. This will be updated throughout the various stages of the project.

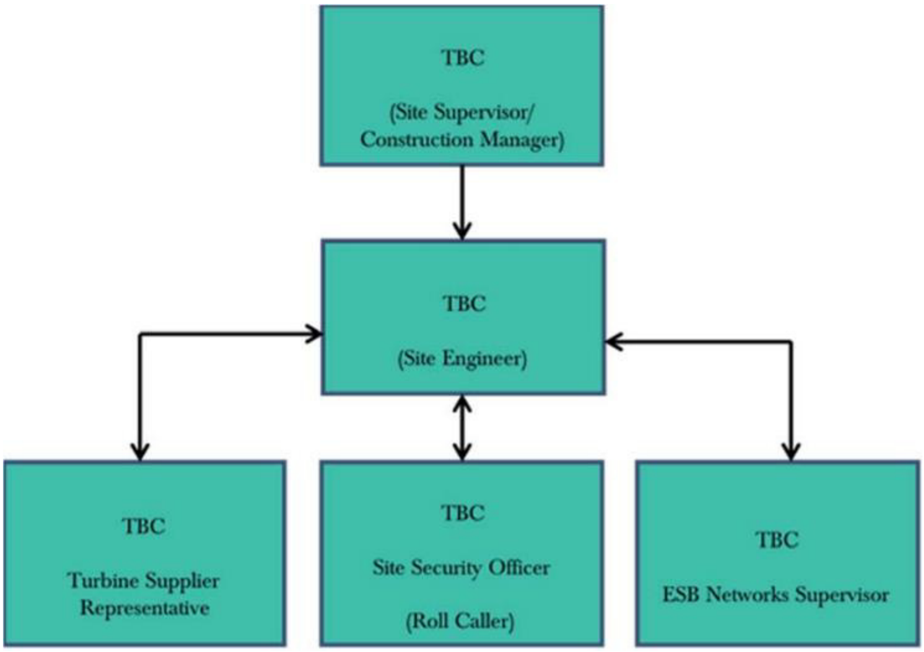

Figure 4.1 Emergency Response Procedure Chain of Command

4.1.2 Initial Steps

The following hazards have been identified as being potential situations that may require an emergency response in the event of an occurrence.

Table 4.1 Hazards associated with potential emergency situations

Hazard	Emergency Situation
Construction Vehicles: Dump trucks, tractors, excavators, cranes etc.	Collision or overturn which has resulted in operator or third-party injury.
Peat Instability	Excessive movement of peat on site; onset of peat slide.
Abrasive wheels/Portable Tools	Entanglement, amputation or electrical shock associated with portable tools
Contact with services	Electrical shock or gas leak associated with an accidental breach of underground services
Fire	Injury to operative through exposure to fire
Falls from heights including falls from scaffold towers, scissor lifts, ladders, roofs and turbines	Injury to operative after a fall from a height
Sickness	Illness unrelated to site activities of an operative e.g. heart attack, loss of consciousness, seizure
Turbine Specific Incident	This will be included the turbine manufacturers' emergency response plan.

In the event of an emergency situation such as the hazards outlined in Table 4.2 the Site Supervisor/Construction Manager will carry out the following:

- Establish the scale of the emergency situation and identify the number of personnel, if any, who have been injured or are at risk of injury.
- Where necessary, sound the emergency siren/foghorn that activates an emergency evacuation on the site. The Site Supervisor/Construction Manager must proceed to the assembly point if the emergency poses any significant threat to their welfare and if there are no injured personnel at the scene that require assistance. The Site Supervisor/ Construction Manager will be required to use their own discretion at that point. In the case of fire, the emergency evacuation of the turbines and substation should proceed, without exception. The site evacuation procedure is outlined in Section 4.1.3.
- Make safe the area if possible and ensure that no identifiable risk exists with regard to dealing with the situation e.g., if a machine has turned over, ensure that it is in a safe position so as not to endanger others before assisting the injured.
- Contact the required emergency services or delegate the task to someone. If delegating the task, ensure that the procedures for contacting the emergency services as set out in Section 4.2 is followed.
- Take any further steps that are deemed necessary to make safe or contain the emergency incident e.g., cordon off an area where an incident associated with electrical issues has occurred.
- Contact any regulatory body or service provider as required e.g., ESB Networks the numbers for which are provided in Section 4.3.
- Contact the next of kin of any injured personnel where appropriate.

4.1.3 Site evacuation/Fire Drill

A site evacuation/fire drill procedure will provide basis for carrying out the immediate evacuation of all site personnel in the event of an emergency. The following steps will be taken:

- Notification of the emergency situation. Provision of a siren or foghorn to notify all personnel of an emergency situation.
- An assembly point will be designated in the construction compound area and will be marked with a sign. All site personnel will assemble at this point.
- A roll call will be carried out by the Site Security Officer to account for all personnel on site.

- The Site Security Officer will inform the Site Supervisor/Construction Manager when all personnel have been accounted for. The Site Supervisor/Construction Manager will decide the next course of action, which be determined by the situation that exists at that time and will advise all personnel accordingly.

All personnel will be made aware of the evacuation procedure during site induction. The Fire Services Acts of 1981 and 2003 require the holding of fire safety evacuation drills at specified intervals and the keeping of records of such drills.

4.1.4 Spill Control Measures

Every effort will be made to prevent an environmental incident during the decommissioning phase of the project. Oil/fuel spillages if arising, are likely to be small and localised. The importance of a swift and effective response in the event of a spill is important. The following steps provide the procedure to be followed in the event of such an incident:

- Stop the source of the spill and raise the alarm to alert people working in the vicinity of any potential dangers.
- If applicable, eliminate any sources of ignition in the immediate vicinity of the incident.
- Contain the spill using the spill control materials, track mats or other material as required. Do not spread or flush away the spill.
- If necessary, cover or bund off any vulnerable areas where appropriate such as drains, watercourses or sensitive habitats.
- Clean up as much as possible using the spill control materials.
- Contain any used spill control material. Dispose of used materials appropriately using a fully licensed waste contractor with the appropriate permits so that further contamination is limited.
- Notify the Ecological Clerk of Works immediately giving information on the location, type and extent of the spill so that they can take appropriate action.
- The Ecological Clerk of Works will inspect the site and ensure the necessary measures are in place to contain and clean up the spill and prevent further spillage from occurring.
- The Ecological Clerk of Works will notify the appropriate regulatory body such as Waterford City & County Council, and the Environmental Protection Agency, if deemed necessary.

4.1.5 Environmental Investigation

Any environmental incident must be investigated in accordance with the following steps.

- The Ecological Clerk of Works will be immediately notified.
- If necessary, the Ecological Clerk of Works will inform the appropriate regulatory authority. The regulatory authority will depend on the nature of the incident.
- The details of the incident will be recorded on an Environmental Incident Form which will provide information such as the cause, extent, actions and remedial measures used following the incident. The form will also include any recommendations made to avoid reoccurrence of the incident.
- If the incident has impacted on a sensitive receptor such as an archaeological feature the Ecological Clerk of Works will halt work and will liaise with the Project Archaeologist.
- A record of all environmental incidents will be kept on file by the Ecological Clerk of Works and the Main Contractor. These records will be made available to the relevant authorities such as Waterford City & County Council, Environmental Protection Agency if required.

The Ecological Clerk of Works will be responsible for any corrective actions required as a result of the incident e.g., an investigative report, formulation of alternative works methodologies or environmental sampling, and will advise the Main Contractor as appropriate.

4.2 CONTACT THE EMERGENCY SERVICES

In the event of requiring the assistance of the emergency services the following steps will be taken:

Ring 999 **or** 112.

Clearly state the situation and the location.

Await further instructions from Emergency Services.

Table 4.2 Emergency Contacts

Contact	Telephone no.
Client: FuturEnergy Ireland	01 6698565
Doctor – Ballyvourney Health Centre	026 45 341

Contact	Telephone no.
Emergency Services – Ambulance, Fire, Gardaí	999/112
ESB Emergency Services	1850 372 999
Hospital – Dungarvan Community Hospital	058 20992
Gas Networks Ireland Emergency	1850 20 50 50
Gardaí –Ballymacarbry Garda Station	052 6136100
Health and Safety Co-ordinator - Health & Safety Services	TBC
Health and Safety Authority	1890 289 389
Inland Fisheries Ireland (IFI)	1890 347 424
Project Supervisor Construction Stage (PSCS): TBC	TBC
Project Supervisor Design Stage (PSDS)*: Jennings O'Donovan & Partners Limited	071 9161416

* Oversees the coordination of the design with the design team, architects' engineers etc.

5 PROGRAMME OF WORKS

5.1 DECOMMISSIONING SCHEDULE

The decommissioning phase will take approximately 3 – 6 months to complete from commencing the removal of turbines to the final reinstatement of the site.

The decommissioning of the Development will take place after the 40-year operational period of the planning permission period has elapsed.

The phasing and scheduling of the main decommissioning task items are outlined in **Figure 5.1** below, where the 1st January has been shown as an indicative start date for decommissioning to commence.

ID	Task Name	Task Description	Q1			Q2			Q3			
			Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct
1	Site Health and Safety											
2	Turbine Decommissioning	Disconnect Power Output										
3	Turbine and Met Mast Dismantling	Disassemble turbine components and met mast										
4	Turbine Removal	Transport of all turbine components off site										
5	Cable Removal	Remove underground cables form ducting										
6	Turbine Foundations Backfill	Reinstate foundation areas by covering with soil material										

Figure 5.1 Indicative Decommissioning Schedule

6 MITIGATION PROPOSALS

The decommissioning Mitigation Measures are presented in the following pages.

By presenting the mitigation proposals in the below format, it is intended to provide an easy to audit list that can be reviewed and reported on during the decommissioning phase of the project.

Table 6.1 Mitigation Measures

Ref. No.	Reference Location	Mitigation Measure	Audit Result	Action Required
		Decommissioning Phase		
MM1	EIAR Chapter 2 Project Description	This plan will be updated and agreed in writing with Waterford & City County Council.		
MM2	Decommissioning Plan Section 3	A suitably qualified and experienced ecologist and any other suitably qualified and experienced professionals such as engineers and geotechnical experts will further advise the Ecological Clerk of Works and Site Manager on works and mitigation measures associated with the Decommissioning phase. This will ensure there is no negative impact on the environment as a result of the decommissioning of the Development.		
MM3	Decommissioning Plan Section 3	Prior to decommissioning, a suitably qualified (CIEEM accredited) ecologist will complete an invasive species survey of the material proposed for turbine foundation backfilling. The invasive species survey will also be undertaken along the cable route to identify invasive species at joint bay locations where excavation to expose the cabling for removal will be required.		
MM4	EIAR Chapter 2 Project Description Decommissioning Plan Section 2	The approach proposed for decommissioning is one of minimal intervention. • Decommissioning works will be limited to action necessary to remove the wind farm structures, i.e., removal of turbines, cabling and the monitoring mast. • Roads and associated drainage systems will remain in place to serve ongoing forestry and agriculture activity. • Hardstanding areas will be allowed to revegetate naturally.		

Ref. No.	Reference Location	Mitigation Measure	Audit Result	Action Required
Decommissioning Phase				
		• Turbine plinths will be removed, and the hardcore covering turbine foundations will be allowed to revegetate naturally. • Soil disturbance will be avoided. • A permanent permission is being sought for the substation. It is outside the scope of the decommissioning process.		
MM5	EIAR Chapter 2 Project Description Decommissioning Plan Section 3	The following mitigation measures are proposed to avoid release of hydrocarbons at the Site: • Road-going vehicles will be refuelled off site wherever possible. • On-site refuelling will be carried out at designated refuelling area (Planning Drawing No. 803) at the Site. Machinery such as cranes will be refuelled directly by a fuel truck that will come to site as required. • 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. • Fuel volumes stored on site will be minimised. The fuel storage areas will be bunded to 110% of the storage volume. • The plant used will be regularly inspected for leaks and fitness for purpose. • An emergency plan for the decommissioning phase to deal with accidental spillages will be developed. Spill kits will be available to deal with an accidental spillage in and outside the refuelling area.		

Ref. No.	Reference Location	Mitigation Measure	Audit Result	Action Required
		Decommissioning Phase		
		A programme for the regular inspection of plant and equipment for leaks and fitness for purpose will be developed at the outset of the decommissioning phase. • Vehicles will undergo a visual inspection prior to being permitted to drive onto the proposed site or progress beyond the Contractors' yard. Vehicles will also be in good working order. • The Contractors and Ecological Clerk of Works will retain a record of all inspections/findings of Environmental Clerks within Section 4 of the main CEMP document. All records will be made available for discussion during meetings.		
MM6	EIAR Chapter 16 Air and Climate DP Section 3	Proposed measures to control dust, the same as those proposed for the construction phase, include: • Any site roads with the potential to give rise to dust will be regularly watered, as appropriate, during dry and/or windy conditions. • Although highly unlikely to occur, the designated public roads outside the site and along the main transport routes to the site will be inspected daily by the Site Manager for cleanliness and cleaned if deposits are found. • Material handling systems and material storage areas will be designed and laid out to minimise exposure to wind. • Water misting or sprays will be used in dry and windy if particularly dusty activities are necessary during dry or windy periods.		

Ref. No.	Reference Location	Mitigation Measure	Audit Result	Action Required
Decommissioning Phase				
		• The transport of soils or other material, which has significant potential to generate dust, will be undertaken in tarpaulin-covered vehicles. • Daily inspection of the site to examine dust measures and their effectiveness. • When in dry and/or windy weather and dirt is visible on the roads, sections of the haul route will be swept using a truck mounted vacuum sweeper.		
MM7	EIAR Chapter 10 Noise Decommissioning Plan Section 3	Proposed measures to control noise, the same as those proposed for the construction phase, include: • Diesel generators will be enclosed in sound proofed containers to minimise the potential for noise impacts. • Plant and machinery with low inherent potential for generation of noise and/or vibration will be selected. All plant and equipment to be used on-site will be modern equipment and will comply with the European Communities (Construction Plant and Equipment) (Permissible Noise Levels) Regulations SI No. 320/1988 and SI No 359/1996. • Regular maintenance of plant will be carried out in order to minimise noise emissions. Particular attention will be paid to the lubrication of bearings and the integrity of silencers. • All vehicles and mechanical plant will be fitted with effective exhaust silencers and maintained in good working order for the duration of the works.		

Ref. No.	Reference Location	Mitigation Measure	Audit Result	Action Required
		Decommissioning Phase		
		• Compressors will be of the "sound reduced" 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. • Machines, which are used intermittently, will be shut down during those periods when they are not in use. • Training will be provided by the Site Manager to drivers to ensure smooth machinery operation/driving, and to minimise unnecessary noise generation. • Local areas of the haul route will be condition monitored and maintained, if necessary. • Contractors working on the site and along the site haul routes will be required to have 'white noise' reversing beepers on all dump trucks to minimise the potential for tonal noise.		
MM8	EIAR Chapter 15 Traffic and Transportation Decommissioning Plan Section 3	The Traffic Management Plan (Management Plan 6) has been prepared to consider the decommissioning as a standalone project. The traffic management arrangements for the removal of turbines although similar to those that will be implemented for construction materials (to a lesser extent) delivery as outlined in the EIAR, will be agreed in advance of decommissioning with the competent authority.		

Ref. No.	Reference Location	Mitigation Measure	Audit Result	Action Required
		Decommissioning Phase		
		The Traffic Management Plan for the decommissioning phase will also include provision for the removal of underground cables from the underground ducts. This will be done by opening the joint bays in the public road. A Traffic Management Plan will not be required within the Site Boundary.		
MM9	Decommissioning Plan Section 3	Waste Management is detailed in Section 3.7 of the Decommissioning Plan. A Waste Management Plan detailing the best practice procedures during the decommissioning of the Development will be prepared. The Waste Management Plan will outline the methods of waste prevention and minimisation by recycling, recovery and reuse at each stage of decommissioning. Disposal of waste will be a last resort.		
MM10	Decommissioning Plan Section 3	Ecological Clerk of Works will maintain responsibility for monitoring the decommissioning works and Contractors/Sub-contractors from an environmental perspective. The Ecological Clerk of Works will act as the regulatory interface on environmental matters. The Site Manager will be responsible for reporting to and liaising with Waterford City & County Council and other statutory bodies as required.		

7 COMPLIANCE AND REVIEW

7.1 SITE INSPECTIONS AND ENVIRONMENTAL AUDITS

Routine inspections of decommissioning activities will be carried out on a daily and weekly basis by the Ecological Clerk of Works and the Site Supervisor/Construction Manager to ensure all controls are in place to prevent environmental impacts, relevant to the decommissioning activities taking place at the time.

Environmental inspections will ensure that the works are undertaken in compliance with this Decommissioning Plan and all other planning application documents. Only suitably trained staff will undertake environmental site inspections. These staff will have undergone third level educational training and will have experience in a similar role.

7.2 AUDITING

An Environmental audit will first be carried out prior to the decommissioning phase of the development to ensure the implementation of mitigation measures. Further environmental audits will be carried on a monthly basis during the construction phase of the project and again after the decommissioning of the wind turbines.

Environmental audits will be carried out by the Ecological Clerk of Works. An impartial and objective approach will be taken. Environmental audits will be conducted at monthly to determine to determine whether the Decommissioning Plan is being properly implemented and maintained. The results of environmental audits will be provided to the contractor.

An audit of compliance with the decommissioning mitigation measures will be completed by the Ecological Clerk of Works during the decommissioning phase of the development. The findings of each audit will be documented by the Ecological Clerk of Works in an audit report within the Decommissioning Plan for the site. The audit report will be made available to Waterford City & County Council on request.

7.3 ENVIRONMENTAL COMPLIANCE

The following definitions will apply in relation to the classification of Environmental Occurrences during decommissioning of the proposed wind farm development:

- **Environmental Near Miss:** An occurrence which if not controlled or due to its nature could lead to an Environmental Incident.

- **Environmental Incident:** Any occurrence which has potential, due to its scale and nature, to migrate from source and have an environmental impact beyond the immediate area of the incident.
- **Environmental Exceedance Event:** An environmental exceedance event occurs when monitoring results indicate that limits for a particular environmental parameter (as indicated in the Environmental Monitoring Programme) has been exceeded.

Any of these events will immediately trigger an investigation into the reason for the incident and the application of suitable mitigation where necessary.

Exceedance events can be closed out on achieving a monitoring result below the assigned limit for a particular environmental parameter e.g. 25mg/L total suspended solids in waters (Inland Fisheries Ireland, 2016).

7.4 CORRECTIVE ACTION PROCEDURE

A corrective action is implemented to rectify an environmental problem on-site. Corrective actions will be implemented by the Site Supervisor/Construction Manager, as advised by the Site Environmental Clerk of Works. Corrective actions may be required as a result of the following:

- Environmental Audits
- Environmental Inspections and Reviews
- Environmental Monitoring
- Environmental Incidents
- Environmental Complaints

A Corrective Action Notice will be used to communicate the details of the action required to the main contractor. A Corrective Action Notice is a form that describes the cause and effect of an environmental problem on site and the recommended corrective action that is required. The Corrective Action Notice, when completed, will include details of close out and follow up actions.

If an environmental problem occurs on site that requires immediate attention direct communications between the Site supervisor/Construction Manager and the Ecological Clerk of Works will be conducted. This in turn will be passed down to the site staff involved. A Corrective Action Notice will be completed at a later date.

7.5 DECOMMISSIONING PLAN REVIEW

This Decommissioning Plan will be reviewed and confirmed prior to commencement of decommissioning works. Further details will be added to the plan during decommissioning works to adapt to specific situations or site conditions that are encountered that need to be considered by the Plan.

MANAGEMENT PLAN 7

TRAFFIC MANAGEMENT PLAN

DYRICK HILL WIND FARM LIMITED

DYRICK HILL WIND FARM

CO. WATERFORD

CONSTUCTION ENVIRONMENTAL MANAGEMENT PLAN (CEMP)

MANAGEMENT PLAN 7

TRAFFIC MANAGEMENT PLAN

MAY 2023

Dyrick Hill Wind Farm Limited
c/o EMPower,
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North Wall Quay,
North Dock,
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D01 V4A3.

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ENGINEERS IRELAND
cpd ACCREDITED EMPLOYER

QUALITY	ENVIRONMENT	HEALTH & SAFETY
ISO 9001:2015	ISO 14001:2015	ISO 45001:2018
NSAI Certified	NSAI Certified	NSAI Certified

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DOCUMENT APPROVAL

PROJECT	Dyrick Hill Wind Farm	
CLIENT / JOB NO	Dyrick Hill Wind Farm Limited	6497
DOCUMENT TITLE	Construction Environmental Management Plan (CEMP) Traffic Management Plan	

	Prepared by	**Reviewed/Approved by**
Document Final	Name Cavelle Hendry	Name David Kiely
Date May 2023	Signature	Signature David Kiely

CONTENTS

1 INTRODUCTION

1.1 General

This document is a Traffic Management Plan (TMP), prepared as an Appendix to the Construction Environmental Management Plan (CEMP).

The TMP is a "live document". Therefore, any changes which may occur in the planning process and in the detailed construction programme can be incorporated, as can inputs by the Contractor(s), the detailed design team and the Developer. The commitments included within the Environmental Impact Assessment Report (EIAR) and in the CEMP are the minimum commitments that the Contractor shall follow, and others will be developed during the Construction Phase in consultation with the various stakeholders, including the Local Authorities.

1.2 Objectives

This TMP has been prepared prior to the appointment of a Contractor, material suppliers and final Construction Phase programme. It will be updated following grant of planning permission and prior to commencement of any construction works as outlined in Section 3.15 of the CEMP.

The primary objectives of this TMP are to:

- Outline minimum road safety measures to be undertaken at site access/egress locations during the Construction Phase, including approaches to such access/ egress locations.
- Demonstrate to the Developer, Contractor and suppliers the need to adhere to the relevant guidance documentation for such works.

The TMP addresses the following issues which are explained in detail in this report:

- Consent, Licenses, Notifications and Permissions
- General Provisions
- Site Access and Egress
- Routing of Construction Traffic
- Site Specific Temporary Traffic Measures
- Enforcement of Traffic Management Plan
- Emergency Procedures During the Construction

1.3 Implementation and Monitoring

The works are likely to be constructed under three separate contracts:

- Turbine Supply Contract
- Civil Works Balance of Plant Contract
- Electrical Works Balance of Plant Contract including Grid Connection and Interconnector

In addition, forestry will be clear felled and removed from site by a specialist forestry felling Contractor.

All contracts have the potential to impact on traffic and roads.

The Contractors shall agree and implement measures to monitor the effectiveness of the TMP, in conjunction with the Local Authority and Developer. On finalisation of the TMP, the Contractors shall adopt the plan and associated monitoring measures.

In order to ensure that environmental awareness and compliance is communicated effectively at the start and throughout the construction works, this TMP in conjunction with the CEMP and its contents, will be communicated to all site personnel, including management staff, operative and sub-contractors. The key elements of this CEMP will form part of the site induction which will be mandatory for all employees, Contractors and visitors attending the site. Refer to Environmental Training and Awareness in Section 4.6 of the CEMP.

2 THE PROJECT

2.1 Project Location

The Site is located within an area of farmland, forestry and upland heath, and is located within the townlands of Ballynaguilkee Upper, Broemountain, Corradoon, Dyrick, Lickoran, Lickoranmountain, Lisleagh, Lisleaghmountain, Lyrattin and Scartmountain. The Site is located 43km west of Waterford City, 55km northeast of Cork City, and 12.9km northwest of Dungarvan.

The proposed Grid Connection passes through the townlands of Broemountain, Lyrattin, Farnane Lower, Farnane Upper, Castlequarter, Mountaincastle South, Carrigaun (Mansfield), Langanoran, Sleadycastle, Knockaunnaglokee, Garryduff, Colligan More, Garryclone, Colliganwood, Ballymacmague North, Ballymacmague South and Killadangan.

Temporary works will be required to accommodate the delivery of the turbine components. These temporary works within the redline boundary on third party lands are included as part of this application and are assessed as part of this EIAR. These are located in the townlands of Lickoran, Lisleagh, Ballynaguilkee Lower, Kilcooney and Clooncogaile,

2.2 Project Description

Planning permission is being sought by the Developer for the construction of 12 wind turbines, a Permanent Met Mast, 110kV on-site substation and all ancillary works and the construction of an underground Grid Connection to Dungarvan 110kV Substation, Co. Waterford.

The Project will comprise of the following main components:

- Erection of 12 no. 6.0-7.2 MW wind turbines (Note* this is the current output available for turbines of this size. It is possible that with improvements in technology, the output may increase at the time of construction.) with an overall ground tip height of 185m. The candidate wind turbines will have a 162m rotor diameter and a hub height of 104m.
- Construction of Crane Hardstand areas and Turbine Foundations.
- Construction of new internal site Access Tracks and upgrade of existing site roads, to include passing bays and all associated drainage.
- Construction of a new wind farm site entrance with access onto the R671 regional road in the townlands of Lickoran.
- Improvement of existing site entrance with access onto local roads in the townlands of Broemountain.
- Improvements and temporary modifications to existing public road infrastructure to facilitate delivery of abnormal loads and turbine delivery.
- Construction of one Temporary Construction Compound with associated temporary site offices, parking area and security fencing.
- Development of on-site Borrow Pit.
- Installation of one Permanent Meteorological Mast with an overall height of 104m.
- Development of a site drainage network.
- Construction of one permanent 110 kV Substation.
- All associated Wind Farm Internal Cabling connecting the wind turbines to the wind farm substation.

- All works associated with the connection of the wind farm to the national electricity grid, which will be via 110 kV underground cable connection approximately 16km in length to the existing Dungarvan 110 kV Substation.
- Upgrade works on the Turbine Delivery Route from Waterford Port.
- Ancillary forestry felling to facilitate construction and operation of the Development.

A 15-year planning permission and 40-year operational life from the date of commissioning of the entire wind farm is being sought.

2.3 Site Access and Egress

2.3.1 There are two proposed Site entrances associated with the Development; Site Entrance 1 is an existing site entrance located in the southeast of the Site located off R671 road and Site entrance 2 is an existing site entrance located in the southwest corner of the Site off the L1027 Local Road. The Turbine Delivery Route and the Construction Haul Routes will utilise Site Entrance 1.

2.3.2 The Site Access Tracks are necessary to allow access for cranes and delivery trucks during construction of the Development and also during servicing/repairs to the wind turbines. The existing Site Access Tracks will be used as far as possible to minimise additional land take. These tracks will be upgraded as necessary so that the minimum width will be 5m. Site Access Tracks will be wider at bends and at passing bay locations where a width of 5.5m is provided. Gradients will, be limited to 1 in 7 (approximately 12%) and a stone layer provided, so as to provide a good grip during wet weather. Gradients of site Access Tracks will not exceed this value.

All Access tracks shall be free from overhead and side obstructions to provide a clear corridor. The larger components require 9.5m overhead minimum clearance for turbine delivery.

2.3.3 It is proposed that the turbine components including rotor blades, towers, nacelles, hubs and drivetrains will be landed by ship and stored for transportation at Belview Port (Waterford Port). From there, they will be transported to the Site using specialised abnormal load vehicles. Turbine delivery vehicles will travel to site using the N29 national primary road travelling northwest, will join the N25 national primary road and then the N72 national secondary road. Delivery vehicles will join the R672 regional road at the N72 / R672 junction and the L5071 local road at its junction with the R672. Turbine delivery vehicles will join the R671 at its junction with the L5071 and continue to the wind farm site entrance on the R671. The proposed haul route for turbine delivery traffic is shown on Figure 14.4, the turbine delivery haul route in the vicinity of the site is shown on Figure 14.5. Detailed analysis of the proposed turbine haul route between Belview port and the R761 have been carried out by Pell Frishmann Ltd and are included in the Abnormal Indivisible Load Route. Detailed analysis of the proposed turbine haul route between the R761 and the site entrance have been carried out by Jennings O'Donovan.

The haul route for wind farm construction traffic will use the national and regional road network to access the site. The use of local roads for construction traffic will be prohibited unless the local road is part of an agreed haul route or provides access to a licenced suppliers facility. Haul roads for general construction traffic. Earthworks calculations carried out for the wind farm site have shown that the majority of granular materials for Site Access Track and Turbine Hardstand construction will be sourced from excavations and from the borrow pit within the Site. It is also envisaged that ready-mix concrete for Turbine Foundation construction and Substation foundations will be sourced from a local authorised quarry located along the N72 road corridor. The location of aggregate suppliers, concrete suppliers and waste disposal facilities in the vicinity of the proposed wind farm are listed below with distances to concrete and aggregate suppliers from the wind farm site.

- Roadstone Cappagh – 10.5k
- Kereen Quarry – 11.6km
- Gleeson Quarries – 56.6km
- Corbett Concrete – 31.0km
- Lagan Products – 58.7km

Construction workers will use the Site entrance on the R671 to access the site but will need to have flexibility in the roads they use to reach the Site.

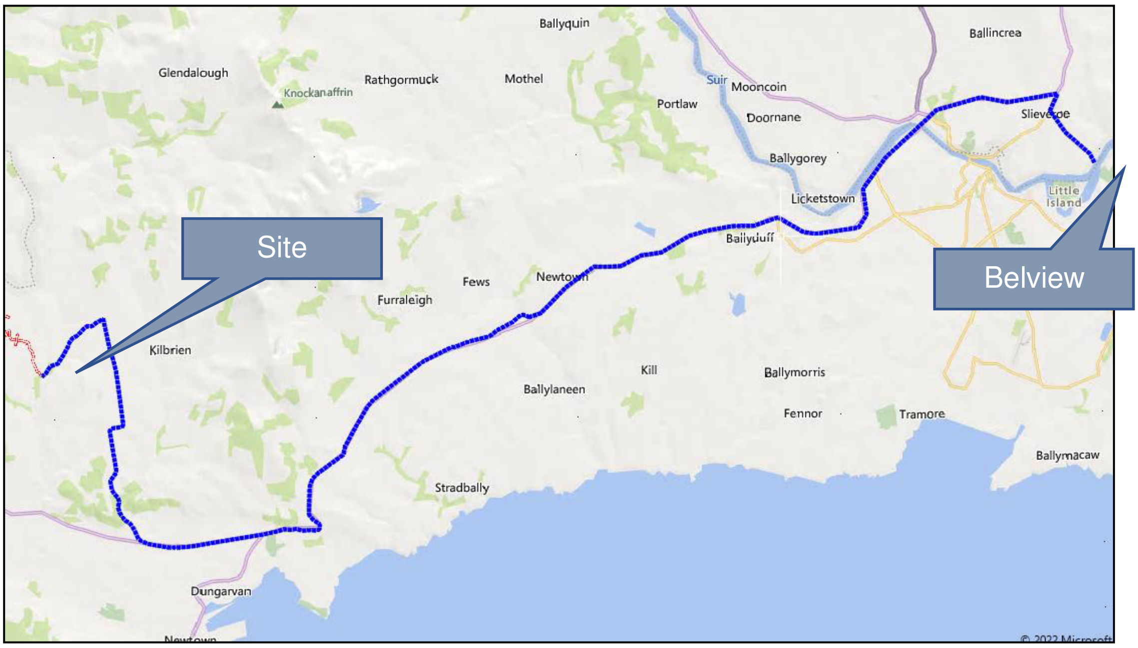

Figure 14.4: Turbine Delivery Haul Route

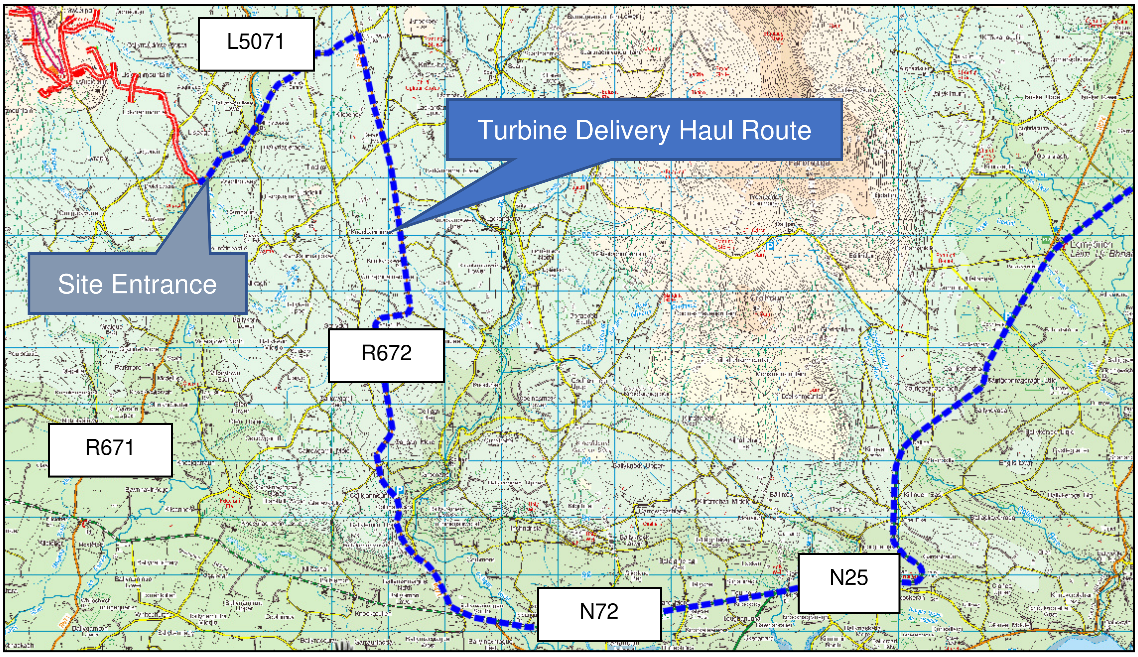

Figure 14.5: Turbine Delivery Haul Route from N25 to Site

3 EXISTING ROAD NETWORK

The EIAR Traffic and Transport Chapter (Chapter 14) describes the existing surrounding road network to be impacted by the proposed wind farm Development including grid connection. The main routes to the various elements of the works are via the N72 , Regional Roads and Local Roads.

JENNINGS O'DONOVAN & PARTNERS LIMITED CONSULTING ENGINEERS

Table 3.1 summarises the roads to be impacted by the proposed Development.

Table 3.1: Roads to be Impacted by the Proposed Development

Road Number	Activity Likely to Generate Impact
N25	To be used for delivery of wind turbine components. To be used for delivery of crushed stone, reinforcing steel, concrete, precast concrete components, electrical cables and equipment, building materials and ducting to the hydrogen plant site.
N29	To be used for delivery of wind turbine components
N72	To be used for delivery of wind turbine components. To be used for delivery of ready-mix concrete. To be used for delivery of crushed stone, reinforcing steel, concrete, precast concrete components, electrical cables and equipment, building materials. To be used as the grid connection route
R672	To be used for haul way route for delivery vehicles. To be used as the grid connection route To be used for delivery of crushed stone, reinforcing steel, concrete, precast concrete components, electrical cables and equipment, building materials and ducting to the hydrogen plant site.
R671	To be used for haul way route for delivery vehicles. Construction workers will use this road to gain access to site. To be used as the grid connection route To be used for delivery of crushed stone, reinforcing steel, concrete, precast concrete components, electrical cables and equipment, building materials.

4 CONSTRUCTION STAGE

4.1 Programme

The project will have a construction period of 20 months. The wind farm construction period is as follows:

- Site Establishment/ Fencing — Months 1 – 3
- Internal Access Road Upgrade & Construction — Months 2 – 7
- Substation & Compound Construction — Months 2 – 8
- Substation Electrical Works — Months 9 – 17
- Substation Commissioning — Months 16 – 17

• Excavation & Construction of Turbine Foundations & Hardstands	Month 2 - 11
• Internal Cabling Installation	Months 10 – 16
• Turbine Deliver and Erection	Months 12 – 16
• Grid Connection	Months 6 – 17
• Energisation	Month 18
• Turbine Commissioning	Months 19 – 20
• Site Restoration	Months 18 – 20

However, the programme will be dependent on lead times for turbines, transformers and electrical cable as well as weather conditions and the programme could stretch to 23 months.

4.2 Hours of Construction

The hours of construction activity will be limited to avoid unsociable hours, where possible. Construction operations shall generally be restricted to between 07:00hrs and 19:00hrs on weekdays and between 07:00hrs and 13:00hrs on Saturdays.

However, to ensure that optimal use is made of good weather periods or at critical periods within the programme (i.e. concrete pours or to accommodate delivery of large turbine components along public routes), it may be necessary on occasion to work outside of these hours. Any such out of hours working will be agreed in advance with the Local Authority.

4.3 Construction Phase Traffic

4.3.1 *Staff Levels*

For the wind farm construction, a peak workforce of 50 persons are anticipated on the main site. There will be peaks and troughs in the numbers, with a larger workforce during the general site works.

In addition to the onsite construction workforce, additional construction staff will be required for the cable laying works and the turbine haul route works. One gang is envisaged for the haul route works while two-three will be required for the grid connection. At each location off site, a maximum of 10 construction staff are anticipated including traffic management operatives. Thus, up to 90 workers could be employed at peak times.

4.3.2 Staff Traffic Generations

The 90 workers will generally travel to the site via light vehicle (LV) (i.e. car or small van) assuming 2 persons per vehicle, or 45 trips to and 45 trips per day.

This is made up of:

- 25 trips each way to/from wind farm site.
- 5 trips each way to/from haul route improvement works.
- 15 trips each way to/from grid construction works.

4.3.3 Construction Vehicles

The construction phase for the proposed Development will result in additional traffic on the roads in the vicinity of the Development. The proposed HGVs will typically be rigid vehicles (i.e. concrete trucks, dump trucks, delivery vehicles) or maximum legal articulated vehicles within normal vehicle loading.

This additional construction traffic will include the following:

- Construction worker vehicles, e.g. cars or vans (light vehicles).
- HGVs carrying conventional earthworks equipment such as an excavator, a roller, stone crusher, forklifts, etc.
- Forestry felling machinery and timber transportation trucks.
- Mobile Cranes.
- Delivery vehicles carrying:
    - Conventional construction materials for the site, e.g. aggregate, concrete, rebar, etc.
    - Conventional construction materials for the substation, e.g. electrical components, bricks, concrete, rebar, fencing, etc.
    - Drainage infrastructure i.e. culverts, clear span bridge, tanks, etc.
    - Met mast, electric cabling, transformers and electrical equipment for the on-site substation.

The 110kV transformer for the substation and the wind turbine components will be abnormal loads. An assessment of these loads have been made based on the details in the EIAR Chapter 14, Section 14.5.1 pending confirmation of the specification during procurement at Construction Stage. The contactor will be responsible for obtaining all associated licenses from the Local Authority or Gardaí during construction for the abnormal loads.

4.3.4 Summary of Peak Additional Traffic Movements on Roads during Construction Phase and Likely Impacts

Section 14.5.1 of the EIAR presents an analysis of the HGV and abnormal loads associated with each of the construction elements.

Referring to Table 14.11 of the EIAR (within Section 14.5.1), the peak times for HGV deliveries will be in months 3 to 14 when the turbine foundations will be constructed, hardstands and Site tracks will be finished in imported stone and the grid connection works will be ongoing. This is estimated to result in a maximum of 858 trips each month with an average of 39 HGV trips per day in this period. Peak deliveries are expected to be during the period of concrete pours for turbine foundations when there will be approximately 140 loads per turbine foundation. If two foundations are poured per month, then the balance of the loads in the busiest month would be 578 loads or 26 loads per day over the remaining days of the month.

The predicted impacts of the additional traffic on roads during the construction phase is discussed in Section 14.5.3 of the EIAR.

Table 4.1 below (Table 14.11 from the EIAR) presents a summary of the peak traffic movements per day on each of the road elements.

Table 4.1: Summary of Peak Additional Construction Traffic Movements on Roads

Materials	Quantity	No. Of Deliveries	Timeframe (Week)	Maximum Loads / Day	Vehicle Type
Mobilise on Site		15	1	5	OGV1
Construction of Site Compound	200m^3	20	1-2	10	OGV2
Rock for Site Access Tracks and Turbine Hardstands	20,000m^3	2,000	2-56	10	OGV2
Site Drainage and Fencing		40	4-56	2	OGV2
Ready Mix Concrete for turbine Foundations	9,768m^3	1,221	8-56	102	OGV2
Steel Reinforcement for Turbine Foundations	1,080T	54	8-56	5	OGV2

Materials	Quantity	No. Of Deliveries	Timeframe (Week)	Maximum Loads / Day	Vehicle Type
Foundation Bolts	12 Turbines	12	8-56	1	OGV2
Substation Building Materials		15	8-28	1	OGV2
Electrical Switchgear		2	26-36	1	OGV2
Electrical Cables		10	6-56	1	OGV2
Grid Connection Works	18.6km	2400	10-60	12	OGV2
Wind Turbine Components	12 Turbines	120	50-64	3	OGV2
Crane		10	50	5	OGV2
Reinstatement and Demobilisation		25	70-80	5	OGV2
Total		**5,944**			

It is estimated that, during the wind farm construction, an approximate total of 5,944 loads of material and building supplies will be delivered and removed from the Site. The majority of granular materials for access road and turbine hardstand construction will be sourced from the onsite borrow pit, site excavations and processed on site. The majority of HGV movements to and from site will occur during the first fourteen months of the construction period and will be associated with the construction of site roads, turbine hardstands and turbine foundations.

Weeks 1 to 8 will involve deliveries of materials for site access works, site access tracks, site compound, site offices, site security, and drainage. This period will include deliveries of fencing materials for site boundaries and compounds, temporary fencing to protect trees, hedges and ecological buffer zones where necessary, road construction materials for access tracks and site entrance, and delivery of temporary site office units. It is anticipated that a maximum of 25 HGV vehicles (50 HGV movements) will visit the site on a daily basis during the period of weeks 1 to 8.

Weeks 8 to 56 will involve deliveries of materials for site access works, turbine hardstand, turbine foundations, site access tracks, substation building and cable / ducting works, turbine component delivery and 110kV grid connection works. This period will include deliveries of fencing materials for site boundaries, road construction materials for access tracks, site entrances and turbine hardstands, ready mix concrete and steel reinforcement for turbine foundations. It is anticipated that a maximum of 39 HGV vehicles (78 HGV movements) will visit the site on a daily basis during the period of weeks 8 to 56 with an additional 102 HGV vehicles (204 HGV movements) delivering concrete for turbine foundations on twelve separate days during the forty eight week period between weeks 8 to 56.

Weeks 56 to 80 will involve HGV movements for works associated with turbine delivery, turbine erection, turbine commissioning, electrical works, site landscaping and the removal of temporary works materials such as offices and fencing from site. It is anticipated that a maximum of 15 HGV vehicles (30 HGV movements) will visit the site on a daily basis during the period of weeks 56 to 80.

The expected HGV volumes are based on earthworks calculations and traffic profiles generated by similar sized wind farms and will be subject to amendment based on local conditions and contractor working practices.

Based on the indicative timetable outlined above the peak times for HGV deliveries per day will be months 3 to 14 when site access roads, Turbine Hardstands and Turbine Foundations will be constructed.

Increased volumes of traffic will be generated by the proposed development during the construction period. Peak traffic generated by the development will correspond to the construction of turbine foundations and will occur during twelve days within the 20 month construction period when the development will generate a maximum of 141 HGV trips (282 HGV movements) and 60 LGV (120 traffic movements) at the R671 site entrance. Outside these times, construction traffic will typically consist of 39 HGV trips (78 HGV movements) and 60 LGV (120 traffic movements) at the R671 site entrance. Development traffic will be distributed throughout the day with morning, afternoon and evening peaks.

5 CONSTRUCTION PHASE TRAFFIC MANAGEMENT PLAN

The Contractors shall develop and take account of the commitments imposed within this TMP. The following are the commitments made at the planning stage of the project which shall be further developed by the Contractor and agreed with the Roads Authorities, prior to works commencing on site:

- General Provisions
- Site Access & Egress
- Routing of Construction Phase Traffic
- Site Specific Temporary Traffic Measures
  - Traffic Management Logistics
  - Traffic Management Speed Limits
  - Traffic Management Signage
  - Road Closures
  - Timings of Material Deliveries to Site
  - Abnormal Load
  - Road Cleaning
- Enforcement of Traffic Management Plan and
- Emergency Procedures During the Construction.

5.1 Consents, Licences, Notifications and Permissions

The key consents, licences, notifications and permissions likely to be required for the project with regards to traffic and roads are summarised as:

- Planning permission and associated planning compliance.
- Abnormal loads – it is envisaged that permits will be required for the abnormal loads that will be required for the delivery of the transformer and turbine components to the site.
- Road opening licences for underground cable works, junction upgrade works, foundations in the public roadway etc.
- Approval of temporary traffic management plans.
- Road closures and diversions.
- Permission for works outside of standard construction operation hours agreed with the Waterford City and County Council County Council.
- Permission from the Motorway Maintenance and Renewal Contractor (MMaRC) / Public Private Partnership Contractor (PPP) on the relevant national roads.

The above list is non-exhaustive but identifies the key consents, licenses, notifications and permissions required for the project. This list will be further populated as required through planning compliance and stakeholder engagement to ensure that any further consents are identified as early as possible and do not impact on the construction programme.

5.2 General Provisions

The construction traffic impacts of the proposed Development have been identified as being temporary in nature. It is important that any impact caused by the proposed Development is minimised as far as possible and, considering this the following mitigation measures shall be included in future developments of this TMP:

- Traffic movements will be limited to 07:00 - 19:00 Monday to Friday and 07:00 – 13:00 Saturday, unless otherwise agreed in writing with Waterford City and County Council County Council.
- HGV movements will be restricted during peak road network hours (including morning school hours) from 08.30 – 09.30 and 17.00 - 18.00 Monday to Friday, unless otherwise agreed in writing with Waterford City and County Council County Council.
- No parking shall be permitted along the access route for unloading or activities that result in blockages of access routes. Such vehicles will be immediately requested to move to avoid impeding the works and traffic on the road network.
- Measures to remove queuing of construction traffic on the adjoining road network including turning space and queuing of convoy HGVs will be provided within the site (i.e. one-way internal access track loop system and passing bays).
- Wheel wash equipment will be used on site to prevent mud and stones being transferred from site to the public road network.
- Activities generating dust will be minimised where practical during windy conditions. Loads will be covered on arrival and departure from site, where required. Other measures are outlined in the CEMP.
- Clear construction warning signs will be placed on the public road network to provide advance warning to road users to the presence of the construction site and slower moving vehicles making turning manoeuvres.
- Access to the construction site will be controlled by on site personnel and all visitors will be asked to sign in and out of the site by security / site personnel and site visitors will all receive a suitable Health and Safety site induction.
- Security gates will be sufficiently set back from the public road, so that vehicles entering the site will stop well clear of the public road.
- Passing bays located within the main Wind Farm site will have dimensions of 5.0m x 50m long.
- Compound locations have been identified for storage, site offices and welfare facilities.

The final TMP will also include provision by the appointed Contractor, for details of intended construction practice for the development, including:

- Traffic Management Co-ordinator – a competent traffic management co-ordinator will be appointed for the duration of the project and this person will be the main point of contact for all matters relating to traffic management.
- Delivery Programme – a programme of deliveries will be submitted to Waterford City and County Council County Council in advance of the delivery of the turbine components to site.
- Information to locals – local residents in the area will be informed of any upcoming traffic related matters, e.g. temporary lane/road closures (if required) or any night deliveries of turbine components, via letter drops and posters in public places. Information will include the contact details of the Developer's representative (Community Liaison Officer), who will be the main point of contact for all queries from the public or local authority during normal working hours. An "out of hours" emergency number will also be provided.
- Pre and Post Construction Condition Survey:
    - A pre-condition survey of roads on approach to the site will be carried out prior to construction commencement to record the condition of the road.
    - A post construction survey will be carried out after works are completed.
    - Impacts on the road condition as a result of the proposed Development will be rectified and the road condition returned at least to its original condition.
    - The timing of these surveys will be agreed with Waterford City and County Council County Council.
- Liaison with Local Authorities – liaison with Waterford City and County Council County Council and other Local Authorities, including the roads and transport section, through which the delivery route traverses and An Garda Siochána, during the delivery phase of the abnormal loads, wherein an escort for all convoys may be required.
- Temporary Alterations – implementation of temporary alterations to road network at critical junctions.
- Travel plan for construction workers – a travel plan for construction staff and sub-contractor construction staff.
- Temporary traffic signs – As part of the traffic management measures, temporary traffic signs will be put in place.

- Traffic Management Operatives (TMOs) will be present at all site access points during peak delivery times.
- Delivery Times of Large Turbine Components – The Turbine Supply Contractor will include the option to deliver the larger wind turbine plant components at night in order to minimise disruption to general traffic during the construction stage.
- All vehicles using or while operating within the wind farm site shall either have roof mounted flashing beacons or will use their hazard lights.

The Traffic Management Plan (TMP) will be updated by the Contractors (on appointment) and agreed with the Planning Authorities prior to commencement of development in the event of a grant of permission.

5.3 Site Access and Egress Safety Measures

At the proposed access points to the proposed Development, visibility splays shall be provided and maintained in accordance with the TII guidelines of a 2.4m setback over a length of 160m in both directions. To ensure a safe working access for all construction vehicles on the Wind Farm, these works will be required to be undertaken in advance of all other activities on the site utilising this access.

The Contractors shall be required to utilise a safe system of traffic management, including the use of Traffic Management Operatives (TMOs) for the control of traffic during access / egress operations at the wind farm site access location during the peak construction activities (e.g. during the 14 days of delivery for the turbine foundation concrete pours).

5.4 Routing of Construction Phase Traffic

The proposed haul roads were identified based on review of existing quarry sources, principal road networks (i.e. national and regional) and consultation with the local authorities. The haul routes utilise the national and regional road network as much as feasible. All construction traffic to the wind farm site will arrive via the R671, with the most prevalent use of the national road network to be the existing N72. As detailed in Section 4.3.4, the majority of materials delivered to site will be delivered using maximum legal articulated lorries or smaller vehicles.

Project construction HGV traffic will be directed away from communities and sensitive receptors (i.e. schools, dense residential areas, urban centres) where possible to minimise the effect on these communities.

Other Construction Materials such as stone fill required for internal access tracks, concrete, fencing materials and landscaping elements will be sourced by the relevant Contractors. The Contractors shall be required, in the further development of the TMP, to confirm the specific sources and proposed haul routes for all material supplies.

5.5 Site Specific Temporary Traffic Measures

The specific details of each temporary traffic measure shall be developed by the Contractor(s) for each site access in consultation with the Roads Authority, An Garda Síochána and other Emergency services, before being submitted to the Roads Authority for formal approval prior to any works taking place.

The maximum length of the active traffic management area for widening works to R671 as well as grid connection and interconnector works within the R671, R672 and N72 (i.e., including taper lengths) shall be no more than 500m in length for any proposed shuttle system i.e., the length of road affected by the works.
In order to minimise traffic delays, it may be necessary to limit the works site to shorter lengths if queuing delays are encountered.

Any requirement for a traffic lane closure will be controlled by an active traffic management system (i.e. temporary traffic signals or Stop & Go / Téigh discs). An Garda Síochána shall be consulted prior to the implementation of the active traffic management system. The operation of a manual 'Stop & Go / Téigh' system will be undertaken by trained personnel, wearing suitable high visibility garments. The operators of this type of system will be in verbal contact (i.e. walkie talkie) and preferably inter-visible. At these locations queue lengths will be estimated initially with onsite measurements to determine the necessary warning distance for approaching drivers. The signage shall be adjusted as necessary when the actual impact on traffic flows is established.

The optimum traffic lane width shall be 3.3m, with a minimum width of 3.0m. Reduction of the temporary traffic lane width below these parameters may result in the requirement for marshalling of larger vehicles (i.e. HGV and buses) or alternatively implementing a diversion route for traffic, which shall be approved by the Road Authority following consultation with the Road Authority, An Garda Síochána and other emergency services.

Where roadworks impede dwelling access onto the road network, the residents shall be instructed on how to egress the property at times when a shuttle system is in operation. The Contractor shall provide a TMO at accesses where the motorist is having difficulty following the instructions.

Where reasonably practicable, consideration will be given to the possibility of removing the traffic management measures in order to deal with:

- Particularly high traffic volumes due to sporting or other events
- Adverse weather conditions
- Emergency access
- Times when work is not in progress

If the night-time or weekend Temporary Traffic Management (TTM) measures varies from daytime plan, a separate TTM will be prepared to be approved by the Roads Authority.

On completion of the works, the traffic management measures are to be removed when the road is safe and free from obstructions, all reinstatement of road surfacing is completed and all permanent signs, road markings and other items are in place.

5.5.1 Traffic Management Systems / Logistics

The Contractor as a minimum shall employ the following traffic management systems and logistics to facilitate the safe transport of materials to and from the proposed Development.

5.5.1.1 Traffic Management Operatives (TMOs)

No pinch points are present on the public road during the delivery of materials from the sources on the haul routes to the site access on the N72, N671 and R672. It is not envisaged that TMOs would be required at the R671 access during average construction traffic volumes. The road has adequate width for vehicles to turn into the site and advanced warning signage is proposed. During peak construction activities, the appointed Contractor may require TTM (i.e. stop / go system) at the site access to facilitate movement of construction vehicles off site if in convoy.

At the R671/R672 and R671/N72 junctions, TMOs implementing a Stop / Go System are recommended during delivery/removal of materials for road widening and for the delivery of turbine components.

TMOs will be required within the wind farm site to manage the movement of HGVs within the internal layout, in particular during peak construction activities.

The requirement for TMOs in conjunction with pilot vehicles for the wind turbine component delivery will be confirmed by the appointed Contractor in consultation with the specialised haulage provider, An Garda Síochána and the Local Authority.

For grid connection and interconnector works within the R671 and N72, half the roadway will be kept open during the construction period for the grid and interconnector within this section of road and traffic will be controlled by TMO's using Stop/Go system.

5.5.1.2 Convoy System

A convoy system shall be employed by the Contractor, applied to HGVs departing the site, involving:

- Traffic management operatives at the proposed Development access / egress points. The TMOs shall restrict HGVs exiting the site, to facilitate the development of a convoy system (maximum 4 no. HGVs).
- Suitable spaces shall be made available within the site for queuing of HGVs (i.e. passing bays and at widened crossing points / site accesses).
- Traffic management operatives shall be stationed at the wind farm site entrance with suitable intercommunication system (i.e. radio) to control the release of the convoy system between the main site and the forestry access to the R671.
- The convoy shall have separation between convoys to facilitate use of the public road network in the absence of construction HGV movements.

5.5.2 Traffic Management Speed Limits

It shall be noted that where a temporary speed limit is deemed appropriate by the contractor(s) to facilitate the Construction Phase activities along the public roads serving the proposed Development, it shall be a requirement for the appointed Contractor to liaise with the relevant Roads Authority for the purpose of obtaining a temporary speed limit.

Adherence to posted / legal speed limits will be emphasised to all staff / suppliers and Contractors during induction training. In speed zones greater than 60km/h, drivers of construction vehicles / HGVs will be instructed that vehicular movements in sensitive locations, such as schools and local community areas, shall be restricted to 60 km/h. Such advisory speed limits will only apply to Construction Phase haulage traffic and shall not apply to general traffic. It is not proposed to signpost such speed limits in the interest of clarity for local road users.

Within the wind farm site, the speed limit shall be 25km/h.

5.5.3 Traffic Management Signage

Signage for temporary traffic measures shall be provided in accordance with the Department of Transports Traffic Signs Manual, August 2019 - Chapter 8 – Temporary Traffic Measures and Signs for Roadworks (or any subsequent update of the standards that will be in place at the time of construction).

Advanced warning signs will be used to alert drivers to the unexpected road layout. Clear construction warning signs shall be placed at adjacent roads and the entrances, to advise the general public of the presence of construction sites and activities. All permanent road signs contrary to the proposed roadworks will be covered for the duration of the works and uncovered on removal of the temporary traffic management measures.

5.5.4 Timing of Material Deliveries

In order to reduce impacts on local communities and residents adjacent to the proposed sites, it is proposed that:

- Construction activities will be undertaken based on a six-day working week, with deliveries between 07:00-19:00 on weekdays and 07:00-13:00 on Saturdays.
- HGV deliveries shall avoid passing schools at opening and closing times where it is reasonably practical. Deliveries are restricted between the hours of 08:00 and 09:00hrs, the school morning peak and peak traffic on the road network.
- Construction activities and deliveries outside these hours shall be agreed with the Local Authority in advance.
- The Contractors shall liaise with the management of other construction projects and the local authority to co-ordinate deliveries.

- The Contractors shall schedule deliveries in such a way that construction activities and delivery activities do not occur during peak traffic flows or run concurrently, such as:
  - avoiding pouring of concrete on the same day as other large material deliveries to site in order to avoid conflicts between vehicles.
  - staggering the pouring of concrete on different days.
- HGV deliveries to the Development site will be suspended on the days of any major events (i.e. sporting, agricultural etc), that have the potential to cause larger than normal traffic volumes on the existing road network, in the vicinity of the works.
- The Contractor will be required to interact with members of the local community to ensure that deliveries will not conflict with sensitive events such as funerals.
- It is likely that some deliveries will be required to be undertaken outside these hours. For example, during large concrete pours or other essential continuous operation whereby the continuous delivery of material will be required. Such deliveries will be agreed in advance with Waterford City and County Council County Council.

The scheduling of material deliveries is required in order to facilitate the implementation of traffic management activities at the site and the works zones within the site. It will also impact on the offsite works locations for the abnormal loads advanced works. A convoy system shall be employed for HGVs departing the proposed Development to reduce the frequency of isolated HGV movements on the public road network as much as practicable.

5.5.5 Abnormal Loads for Turbine Components

A total of 120 no. abnormal loads for turbine components are anticipated to be transported to the site along the abnormal loads haul route associated with the delivery of anchor cages, tower sections, nacelles, blades, transformers, panels and cabling crane establishment and removal. It is envisaged that these loads will be moved outside of normal hours as night-time works in convoys. A maximum of 3 turbines (i.e. all tower, nacelle and blades) will be delivered to site per month. The convoys are anticipated to have 3 or 5 no. abnormal loads per convoy with deliveries over a maximum of 9 days or a minimum of 5 days.

The Contractor shall ensure that the haulage of these abnormal loads is done in conjunction with an Gardaí Síochána and the Roads Authorities. The appointed Contractor and their haulage provider will be responsible for obtaining all necessary permissions and licences from the local authorities and Gardaí.

5.5.6 Road Closures

In order to facilitate the grid connection of the proposed wind farm to the national grid, a connection between the proposed site and Dungarvan 100kV GIS Sub Station is required. This requires a transverse trenched road crossing of the R672 and N72.

Road closures are likely to be required for construction of the grid within narrow public roads such as the R671, R672 and N72.

Where road widths allow, the installation works will allow for one side of the road to be open to traffic at all times by means of a 'Stop/Go' type traffic management system, where a minimum 2.5m roadway will be maintained at all times.

Where it is not possible to implement a 'Stop/Go' system a full road closure will be required. Temporary traffic signals will be implemented to allow road users safely pass through the works area by channelling them onto the open side of the road. Typically, the grid trench will be installed in 150m sections, and no more than 100m will be excavated without the majority of the previous section being reinstated. Where the construction requires the crossing of a road, works on one carriageway will be completed before the second carriageway is opened, to maintain traffic flows.

All construction vehicles will be parked within the works area so as not to cause additional obstruction or inconvenience to road users or residents. The traffic signals will be in place prior to the works commencing and will remain in place until after the works are completed. The public road will be checked regularly and maintained free of mud and debris. Road sweeping will be carried out as appropriate to ensure construction traffic does not adversely affect the local road condition.

In the event of emergency, steel plates, which will be available on site, can be put in place across the excavation to allow traffic to flow on both sides of the road.

Road closures will also be required for widening works on the R671 and R672.

The timing/duration of road closures will be agreed with local residents by the Developer's Community Liaison Officer. Periods of key agricultural activity (e.g. silage cutting) will be avoided.

At the time of construction work and in advance of the required Road Closure, the appointed Contractor shall consult and comply with the Roads Authority, An Garda Síochána and other Emergency services to agree a suitable diversion route prior to implementing a Road Closure.

Local access will be provided during all road closures.

When the R671 and R672 is closed, local access will be provided. No requirement for diversions is envisaged.

For the grid connection and interconnector works within the R671, R672 and N72, traffic from residents along the these routes will have access to passing bays throughout the sections of roads been worked on.

Road closures shall only be undertaken following consultation with the local authority and following any requests for notifications by the local authority. A road opening licence shall also be applied for, by the Contractor to the local authority via the RMO system. The Contractor will also be required to provide the requisite bond to ensure reinstatement is completed to the satisfaction of the road's authority. Full pavement reinstatement is required in accordance with the "Purple Book" or former Department of Transport, Tourism and Sport 'Guidelines for Managing Openings in Public Roads', Second Edition Rev 1 April 2017.

5.5.7 Road Cleaning

Regular visual surveys of the road network in the vicinity of the sites will be carried out. Where identified / required, the Contractor shall carry out road sweeping operations, employing a suction sweeper to remove any project related dirt and material deposited on the road network by construction / delivery vehicles. It shall be a requirement of the works contract that the Contractor(s) will be required to provide wheel cleaning facilities, and any other necessary measures to remove mud and organic material from vehicles. In addition, the cleaning of delivery lorries such as concrete delivery lorries shall be carried out at the material storage yard as outlined in the CEMP.

5.6 Enforcement of Traffic Management Plan

The appointed Contractor will further develop this TMP in consultation with the Road's Authority Waterford City and County Council County Council. The Contractor will, during the development and adoption of the TMP, agree and implement an appropriate way of monitoring the effectiveness of the plan.

All project staff and material suppliers will be required to adhere to the Traffic Management Plan. Inspections / spot checks will also be carried out by the Contractor(s) to ensure that all project staff and material supplies follow the agreed measures adopted in the Traffic Management Plan.

5.7 Emergency Procedures during the Construction

In the case of an emergency, the following procedure shall be followed:

- Emergency Services will be contacted immediately by dialling 112.
- Exact details of the emergency/ incident will be given by the caller to the emergency line operator to allow them to assess the situation and respond in an adequate manner.
- Follow the instructions of the Local Authorities and An Garda Síochána.
- The emergency will then be reported to the Site Team Supervisors and the Safety Officer.
- Where required, appointed site first aiders will attend the emergency immediately.
- The Safety Officer will ensure that the emergency services are enroute.

It is important that during the Construction Phase, emergency services can gain ready access to any property along the Haul Road or in the vicinity of any of the infrastructure sites, or indeed can gain priority usage of any Haul Road. Emergency procedures will be agreed, and contact numbers provided to the local Emergency Services. On being notified of a priority condition, all construction vehicles will be directed to give right of way to the emergency vehicles until the need for priority access has passed.

With respect to an emergency condition arising on any of the sites, priority access to and from these sites will be given to ambulance or fire tenders.

6 OPERATIONAL AND DECOMMISSIONING PHASES

6.1 Operational Phase

On completion of the construction works, and when the wind farm is operational, the majority of the traffic generated for the operation of the site will be for routine maintenance by a small van or four by four.

The site will be regularly accessed for forestry proposes similar to the existing background traffic generated.. This will generate a small amount of additional traffic to the R671 and R672.

All vehicles using the wind farm site shall either have roof mounted flashing beacons or will use their hazard lights.

A speed limit of 25km/h shall apply to all vehicles within the wind farm site.

Internal wind farm signage shall be maintained throughout the operational period.

Road surfaces shall be inspected on a quarterly basis and any maintenance work identified shall be completed within one month of the inspection.

Overall, due to the relatively low operational and recreational traffic, it is envisaged that the operational impacts of the proposed Development will be slight when compared to the existing background traffic.

As the site accesses for construction have been designed as new or upgraded in accordance with the TII DN-GEO-03060, adequate visibility splays are available from the accesses in both directions. Minor maintenance of hedgerows and vegetation to maintain the required visibility shall be required.

6.2 Decommission Phase

The wind turbines proposed as part of the proposed Development are expected to have a lifespan of up to 40 years. Following the end of their useful life, the wind turbines may be replaced with a new set of machines, subject to planning permission being obtained, or the site may be decommissioned fully, and the components may be reused, recycled, or disposed of in a suitably licenced facility. The wind turbine transformers will also be removed from the Wind Farm Site. There is potential to reuse wind turbine components, while others can be recycled.

Upon decommissioning of the proposed wind farm, the wind turbines will be disassembled in reverse order to how they were erected. All above ground turbine components will be separated and removed off-site for recycling. Turbine foundations will remain in place underground and will be covered with earth and allowed to revegetate or reseeded as appropriate. Leaving the turbine foundations in-situ is considered a more environmentally prudent option, as to remove that volume of reinforced concrete from the ground could result in potentially significant environment nuisances such as noise, dust and/or vibration. The site roadways will be in use for additional purposes to the operation of the wind farm (e.g. for forestry and recreational use) by the time the decommissioning of the project is to be considered, and therefore the site roads will remain in situ for future use. If it were to be confirmed that the roads were not required in the future for any other useful purpose, they could be removed.

As the turbine blades can be cut into manageable lengths on decommissioning, there is no requirement to re-use the turbine supply haul route for decommissioning.

The traffic management of the decommissioning phase will be advised by the road conditions at the time of decommissioning. It is not possible to predict the changes to the public road infrastructure and policies in the next 30-40 years. It is envisaged that a Traffic Management Plan will be developed for the decommissioning phase.

Nevertheless, the following traffic management measures are likely to be required:

- Signage will be erected at the site entrance and on the R671, R672 and N72 approaching the site.
- Construction traffic associated with decommissioning will be scheduled so as to avoid school drop off and collection times.
- All vehicles using or while in operation at the wind farm site shall either have roof mounted flashing beacons or will use their hazard lights.
- A speed limit of 25km/h shall apply to all vehicles within the wind farm site.

7 CONCLUSION

The TMP is a living document and shall be developed through the Detailed Design and Construction phases with ongoing consultation with the Local Authority, An Garda Síochána, Emergency Services and other stakeholders.

This TMP has thus far been developed to the Planning Stage, so that the necessary steps are taken throughout the planning proposals to support an efficient, safe transportation operation, with the least possible impact upon vulnerable road users and traffic along the haul roads or in close proximity to the proposed Development.