MERCURY RENEWABLES (CARROWLEAGH) LIMITED

FIRLOUGH WIND FARM, CO. MAYO

AND

HYDROGEN PLANT, CO. SLIGO

CONSTRUCTION ENVIRONMENTAL MANAGEMENT PLAN (CEMP)

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DOCUMENT APPROVAL

PROJECT	Firlough Wind Farm and Hydrogen Plant	
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DOCUMENT TITLE	Construction Environmental Management Plan	

	Prepared by	**Reviewed /Approved by**
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Date June 2023	Signature Aileen Byrne Sarah Moore	Signature David Kiely

FIRLOUGH WIND FARM, CO. MAYO

CONSTRUCTION ENVIRONMENTAL MANAGEMENT PLAN

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1 INTRODUCTION

1.1 BACKGROUND TO REPORT

Jennings O'Donovan & Partners Limited, on behalf of Mercury Renewables (Carrowleagh) Limited, has prepared this Construction Environmental Management Plan (CEMP) for the construction of the proposed 13 no. turbine, Firlough Wind Farm, an on-site 110kV loop substation and all ancillary works and the construction of an underground grid connection via a looped connection between the Wind Farm Substation and the existing 110kV overhead powerline north of Bunnyconnellan village, Co. Mayo. The Proposed Development will also include a hydrogen production facility comprising 80MW of modular alkaline electrolysis production capacity and all associated infrastructure located at the Hydrogen Plant Site including; compressors, cooling equipment, refuelling points, water abstraction, storage and processing, the Hydrogen Plant Substation and the Interconnector. The Proposed 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 preliminary 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 Proposed 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 Firlough Wind Farm. It is a live document held 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.

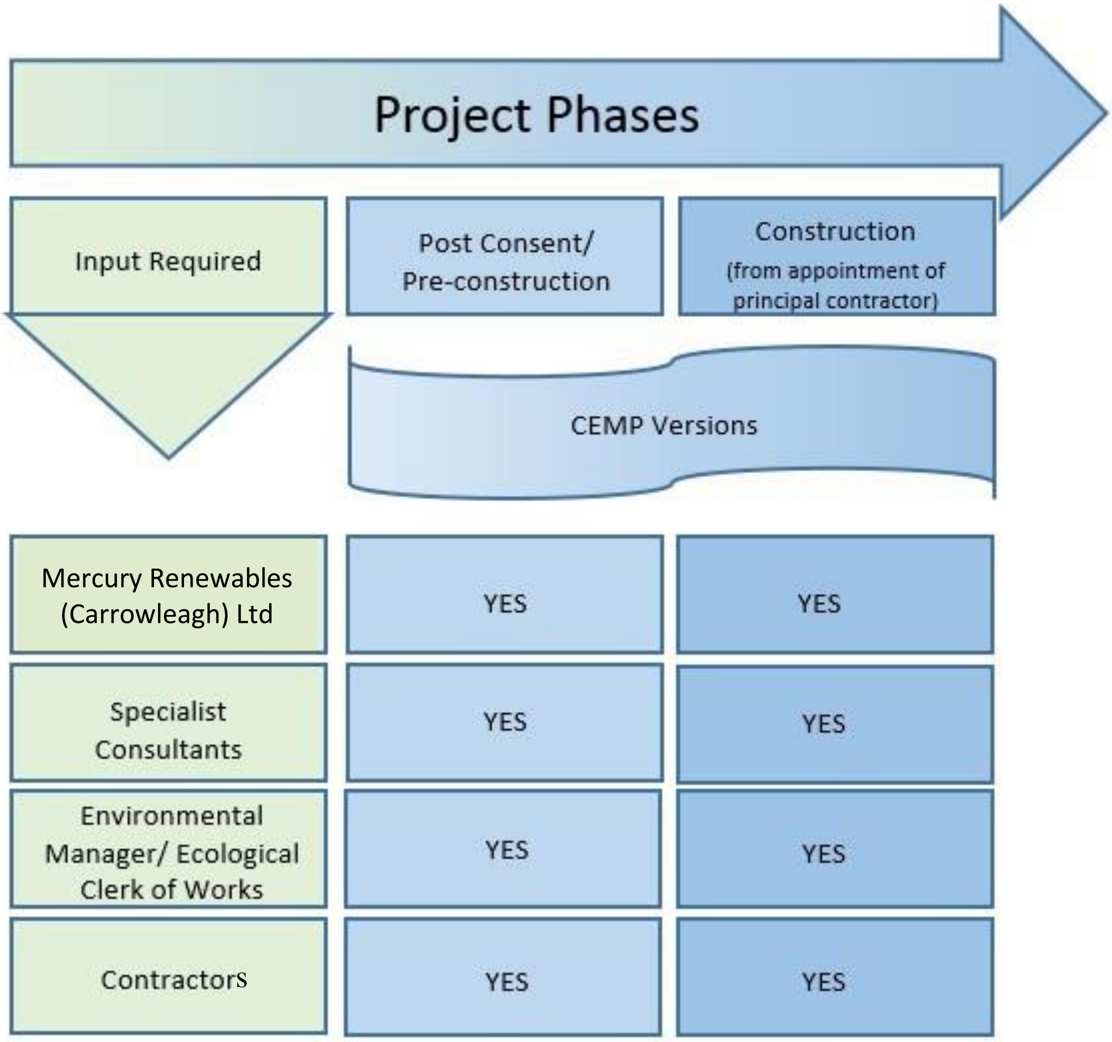


Figure 1.1 Summary of CEMP Development Process

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 Mercury Renewables (Carrowleagh) Limited 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 Mercury Renewables (Carrowleagh) Limited in response to Consent Conditions will be recorded in Table 3.9. Table 3.10 contains a record of all Scheme Amendments and Table 3.11 a Register of Variations.	**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 to the CEMP required during the works will be recorded by the Contractors in Tables 3.2 and 3.3.

Section	Title & Brief Description	Contractors Development Required
3	**Environmental Communications Plan** Contains details on specific requirements relating to: • Contact details for Mercury Renewables (Carrowleagh) 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.
6	**Management Plans & Available Information** Management Plans include the following:	**Yes** The Contractors is required to develop the Management Plans and/or include

Section	Title & Brief Description	Contractors Development Required
	• MP1 Environmental Response Plan (ERP) • MP2 Water Quality Management Plan (WQMP) • MP3 Surface Water Management Plan • MP4 Peat and Spoil Management Plan • MP5 Waste Management Plan • MP6 Decommissioning Plan • MP7 Traffic Management Plan	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 Development is primarily located on two distinct sites which, for the purposes of this CEMP have been called the Wind Farm Site and the Hydrogen Plant Site. Other elements of the Proposed Development are located on lands connecting these sites as well as other discrete locations which are required to facilitate the Project. This section describes the location and locational context of the Wind Farm Site, the Hydrogen Plant Site and the other lands associated with the Project.

2.1.1 Wind Farm Site

The Wind Farm Site as shown in **Figure 2.1 (EIAR Figure 2.12)**, has an area of approximately 445 hectares and is mainly cutover blanket bog with an extensive network of bog tracks. The Wind Farm Site is located within a broad area of peatland in the townland of Carrowleagh (Kilbride), Co. Mayo, within the lower north-western foothills of the Ox Mountains, adjacent to the county boundary between Mayo and Sligo. The Site elevations range from 120 m O.D. in the north-west up to circa 170 m O.D. in the south-east.

Notable towns and villages in the area include Bunnyconnellan (Co. Mayo) 4 km to the south-west, Corballa 6.5 km (Co. Sligo) to the north-west, Culleens 7.5 km (Co. Sligo) to the north, Enniscrone (Co. Sligo) 11 km to the north. The nearest large settlement is the town of Ballina (Co. Mayo.) 12 km to the west.

2.1.2 Hydrogen Plant Site

The Hydrogen Plant Site as shown in **Figure 2.2 (EIAR Figure 2.2)**, has an area of approximately 6.5 ha and is currently an agricultural field used for grazing horses. It is located in County Sligo in the townland of Carraun, adjacent to the Co. Mayo border, 6 km west of the Wind Farm Site and 0.6 km from the N59 national road. Site elevations range from 53 m OD at the north-west corner to 45 m OD along the southern boundary.

The Hydrogen Plant Site is pasture. There is an area of cutover, boggy peat adjacent to the south of the site boundary which has been avoided. It is 5.3 km north-west of the village of Bunnyconnellan (Co. Mayo) and 2.9 km south of the village of Corballa (Co. Sligo). The nearest large settlement is the town of Ballina (Co. Mayo.) 5.5 km to the south-west. It is accessed by the L-6611 local road and a newly designed roundabout and a site access road proposed to lead to the facility.

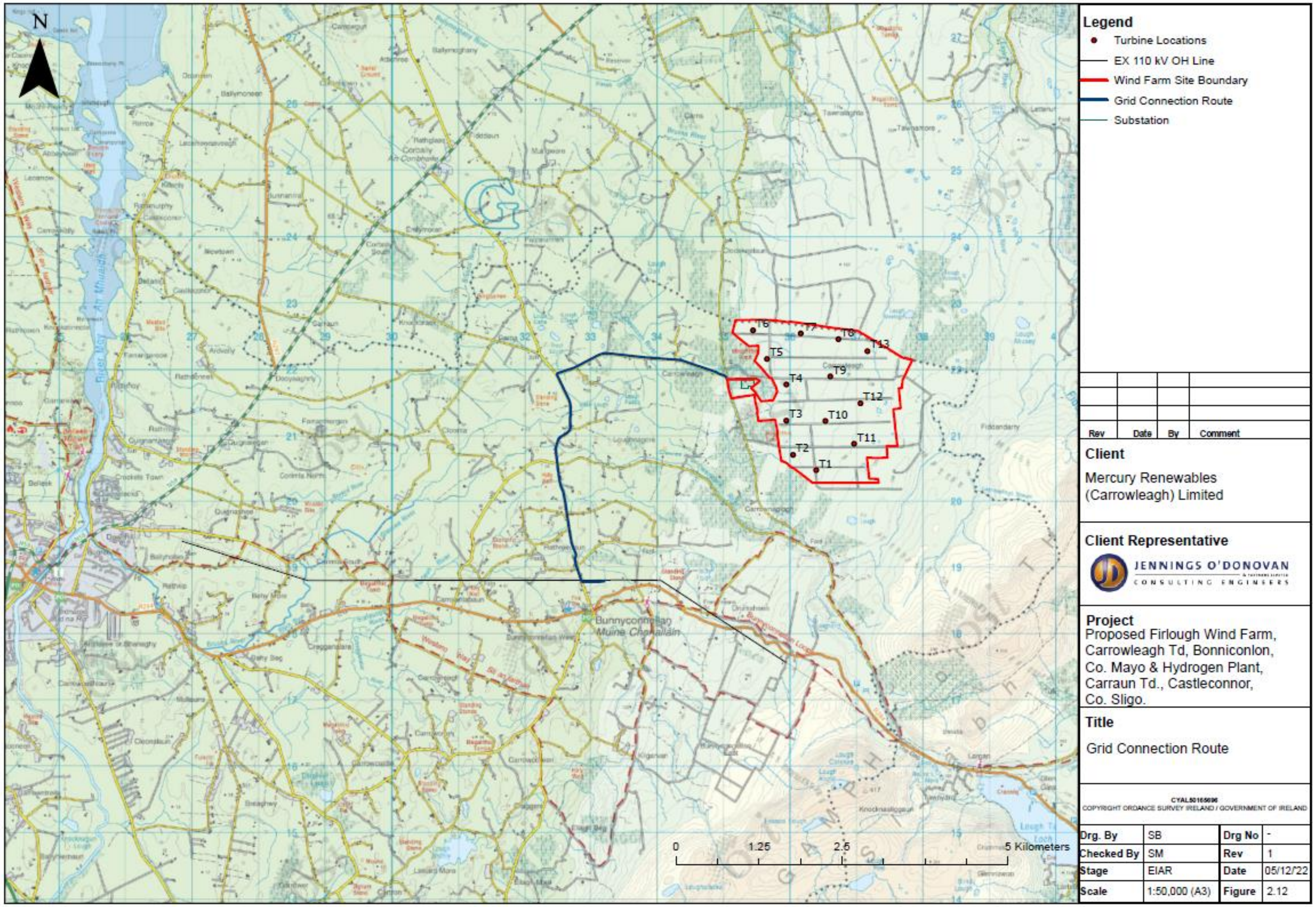


Figure 2.1: Map showing the location of Firlough Wind Farm and Grid Connection Route (EIAR Figure 2.12)

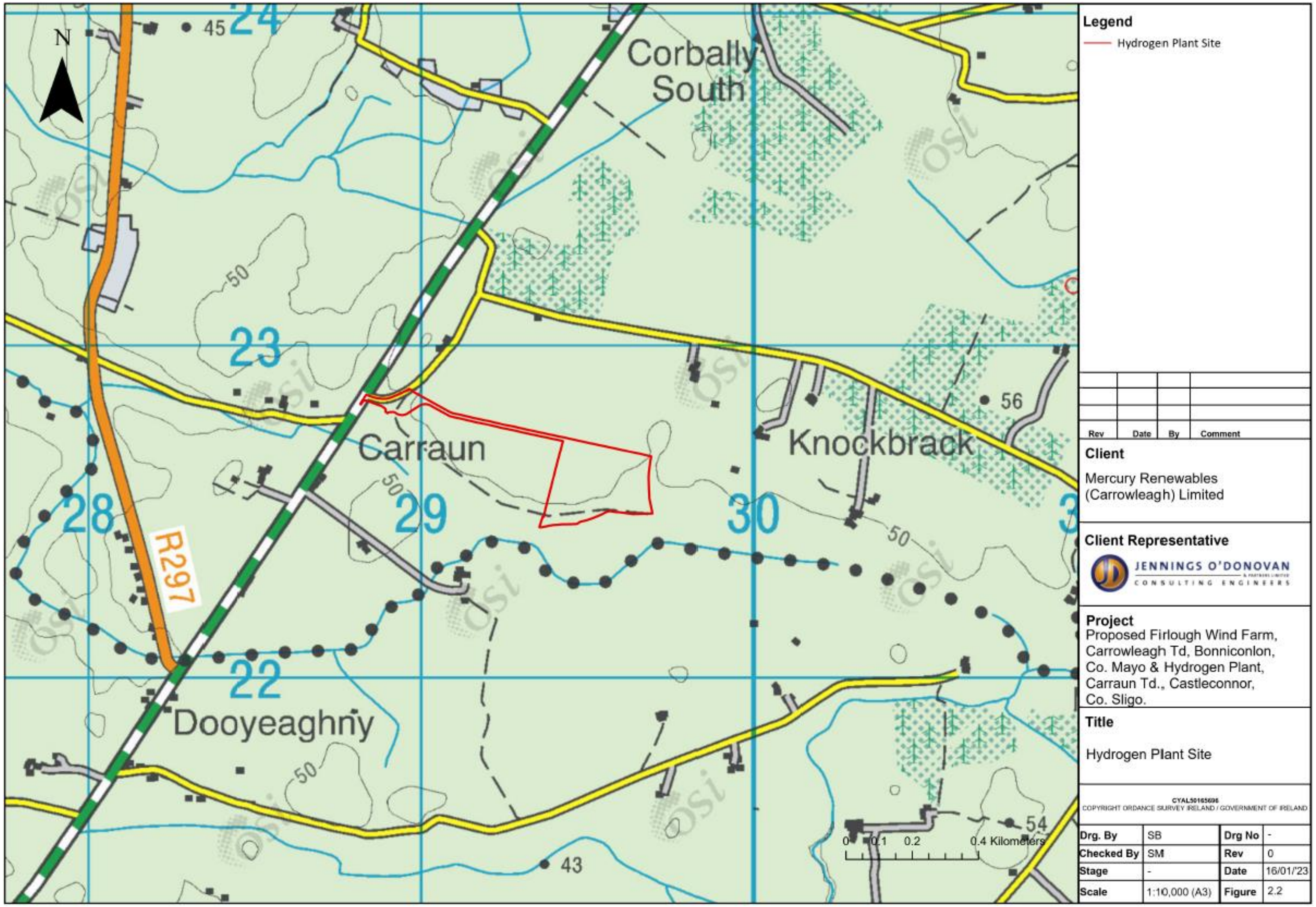


Figure 2.2: Map showing the location of Firlough Hydrogen Plant (EIAR Figure 2.2)

2.1.3 Proposed Development

The Proposed Development will comprise of the following main components:

- Construction of 13 no. wind turbines with an overall ground to blade tip height of between 177 m and 185 m inclusive. The wind turbines will have a rotor diameter of between 149 m and 155 m inclusive and a hub height of between 102.5 m and 110.5 m inclusive.
- Construction of permanent crane hardstand areas and temporary laydown/storage areas and turbine foundations.
- Construction of new permanent internal Wind Farm Site access roads and the upgrade of existing internal bog tracks to include passing bays and all associated drainage infrastructure.
- Development of a site drainage network for the Wind Farm Site including sediment control systems.
- All associated underground electrical and communications cabling connecting the wind turbines to the Wind Farm Substation.
- Construction of a permanent on-site 110 kV wind farm electrical substation including two no. control buildings with welfare facilities, all associated electrical plant and equipment, security fencing and gates, all associated underground cabling, wastewater holding tank, and all ancillary structures and works.
- All works associated with the permanent connection of the wind farm to the national electricity grid, which will be via a loop-in 110 kV underground cable, in permanent cable ducts from the proposed permanent wind farm substation in the townland of Carrowleagh, and through the townlands of Carha, Carrownaglogh, Rathreedaun, Drumsheen and Bunnyconnellan West County Mayo into the existing 110 kV overhead line in the townland of Rathreedaun County Mayo, with two new 16 m high steel lattice loop-in/out masts at the connection point.
- Construction of a Wind Farm Site Temporary Construction Compound with associated temporary site offices, parking areas, welfare facilities and security fencing.
- Construction of a temporary construction materials storage area for use during construction of the Wind Farm.
- Forestry felling to facilitate construction and operation of the Wind Farm Substation and any onsite forestry replanting.
- Upgrade works on the section of the turbine delivery route which is common to both the Killybegs Turbine Delivery Route and Galway Turbine Delivery Route to include

the following to facilitate the delivery of abnormal loads and turbine component deliveries:

- Improvement of the N59 and L-2604-0 junction in the townland of Ballymoghany, County Sligo to include for the temporary widening of it. The associated accommodation works will include the installation of new drainage pipes, the construction of a 1.2 m high concrete retaining wall and the erection of timber stock proof fencing and 2 no. agricultural gates.
- Localised widening of the L-2604-0 road in the townland of Cloonkeelaun, County Sligo. The associated accommodation works will include the construction of a 1.2 m high concrete retaining wall and the erection of concrete post and timber rail stock proof fencing and 2 no. agricultural gates.
- Localised widening of the L-2604-0, L-5137-0 and L-5137-9 local roads in the townlands of Ballymoghany, Muingwore and Cloonkeelaun County Sligo and Carrowleagh County Mayo to achieve a surfaced road width of 4.5 m.
- Localised widening of the L-5137-9, L-5136-0 and L-6612 roads in the townlands of Carraun and Knockbrack County Sligo, and Carha and Carrowleagh County Mayo to establish passing bays.

- Upgrade works on the Galway Turbine Delivery Route to include the following to facilitate the delivery of abnormal loads and turbine component deliveries:
  - Localised road widening at the N17/N5 roundabout in the townland of Ballyglass East County Mayo.
  - Localised road widening at the road junction with the N5 in the townland of Ballyglass East County Mayo.
  - Alterations to the embankments at the N5 junction with the L-5339 and L-1331 roads in the townland of Cloonmeen West County Mayo.
  - Localised road widening at the junction of the L-5339 and L-1331 in the townland of Lavy More County Mayo.
- Construction of a new Wind Farm Site entrance off the L-5137-9 in the townland of Carrowleagh County Mayo with the creation of a splayed entrance to facilitate the delivery of abnormal loads and turbine component deliveries.
- Construction of a Hydrogen Plant and an access road to it along with, upgrades to the L-6612-1 and the construction of a roundabout. The Hydrogen Plant includes the electrolyser building measuring 130 m by 110 m, and 16 m in height, and equipment, underground water storage tanks, drainage system, constructed wetlands, hydrogen dispensing station, tube trailer parking, water treatment building, fin fan coolers, fire water tanks, compressors, offices and welfare facilities and all ancillary equipment.

- Construction of a permanent on-site 110 kV Hydrogen Plant Substation in a compound of 3,520 m^2 including 2 no. control buildings with welfare facilities, all associated electrical plant and equipment, security fencing and gates, all associated underground cabling, wastewater holding tank, and all ancillary structures and works.
- Abstraction of groundwater from 2 no. boreholes in the townland of Carraun County Sligo and pumping to the proposed hydrogen plant site and all associated ancillary works.
- Construction of a Hydrogen Plant Site Temporary Construction Compound with associated temporary site offices, parking areas, materials storage and security fencing for use during construction of the Hydrogen Plant Site.
- All works associated with the permanent connection of the Wind Farm to the Hydrogen Plant comprising a 110 kV underground cable in permanent cable ducts from the proposed, permanent, on-site wind farm substation, in the townland of Carrowleagh Co. Mayo and onto the townlands of Carha, Co. Mayo, Knockbrack, Co. Sligo and terminating in the Hydrogen Plant Substation in the townland of Carraun, Co. Sligo.
- Demolition of agricultural shed C and partial demolition of agricultural shed B in the townland of Carraun to facilitate the construction of the upgraded L-6612-1 and roundabout.

A 10-year planning permission and 40-year operational life from the date of commissioning of the Firlough Wind Farm is being sought.

A permanent planning permission is being sought for the Grid Connection, Hydrogen Plant and Hydrogen Plant Substation as these are to remain in place upon decommissioning of the Wind Farm. The Wind Farm Substation will become an asset of the national grid under the management of EirGrid.

The Proposed Development includes activities which are subject to an Industrial Emissions License from the Environmental Protection Agency. In addition, the Proposed Development relates to an establishment which falls within the requirements of the Major Accidents Directive and which will be subject to regulation from the Health and Safety Authority.

While the Project is primarily comprised of the Proposed Development the Project for the purpose of the EIA also includes the following elements for which development consent is not being sought at this time:

Demolition of an existing dwelling and agricultural sheds D and E and the demolition of the remainder of shed B and construction of a new house and shed in the townland of Carraun.

In the North Mayo and Sligo region, the full renewable energy generation potential of the area cannot be realised due to physical shortcomings and restrictions in the electricity network. The Hydrogen Plant would provide a viable off-take and route to market for renewable energy that otherwise would have been lost due to these constraints. The Hydrogen Plant production capacity will be scaled up to a maximum 80 MW, to meet demand for green hydrogen in the Irish market. The physical infrastructure of the entire Hydrogen Plant, (i.e. buildings, roads, water treatment, cooling and fuelling, etc) will be built during a single construction phase with the modular electrolyser system installed in 5 MW batches. In terms of the split of electricity going to the grid and the Hydrogen Plant, the smallest initial batch of electrolyser capacity will be 10 MW (using 12-15% of electricity produced at the Wind Farm) and will produce a maximum of 4,000 kg of green hydrogen per day leaving 55 to 68 MW (84-87% and based on a turbine range of between 5 and 6 MW) of installed capacity of the Wind Farm dispatching to the electricity grid. This will be phased up to an 80 MW electrolyser producing a maximum of 31,200 kg of green hydrogen per day and consuming the whole output of the Wind Farm. The green hydrogen will be transported in tube trailers, at the lowest installed capacity the maximum number of tube trailers daily will be 11, at the maximum capacity this will be 26 (see Section 2.6.6.12 of the EIAR).

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 (2023) 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 4: Population & Human Health** has not identified any likely significant effects from the Proposed Development on population or human health.

The Proposed Development has been assessed as having the potential to result in effects of slight positive, long term impact overall. Cumulative effects are predicted to be not significant.

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 15: 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 TERRESTRIAL 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)
- CIRIA (2001). Control of water pollution from construction sites – Guidance for consultants and contractors (C532). Construction Industry Research and Information Association, London.
- CIRIA (2019). Culvert, screen and outfall manual (C786). Construction Industry Research and Information Association, London.
- DHPLG (2019). Draft Revised Wind Energy Development Guidelines. Department of Housing, Planning and Local Government. December 2019
- Enterprise Ireland (unknown). Best Practice Guide (BPGCS005) Oil storage guidelines.
- IFI (2016). Guidelines on Protection of Fisheries during Construction Works in and adjacent to waters. Inland Fisheries Ireland, Dublin.
- IWEA (2012). Best Practice Guidelines for the Irish Wind Energy Industry. Guidance prepared by Fehily Timoney & Company for the Irish Wind Energy Association.

- Kilfeather, P.K. (2007). Maintenance and protection of the Inland Fisheries resource during road construction and improvement works. Southern Regional Fisheries Board.
- Murphy, D.F. (2004). Requirements for the Protection of Fisheries Habitat during Construction and Development Works at River Sites. Eastern Regional Fisheries Board.
- NRA (2008). Guidelines for the Crossing of Watercourses during the Construction of National Road Schemes. National Roads Authority.
- SNH (2019). Good Practice during Wind Farm Construction (4th edition). Scottish Natural Heritage.

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

3.2.1 Ecology Mitigation Measures

This CEMP provides a contractual commitment to mitigation and monitoring, and reduces the risk of pollution whilst improving the sustainable management of resources. The environmental commitments of the Proposed Development will be managed through the CEMP and will be secured in contract documentation and arrangements for construction and later phases, such that there will be a robust mechanism in place for their implementation. The CEMP addresses the construction phase, and will be continued through to the commissioning, operation and final decommissioning phases.

It is noted that an Ecological Clerk of Works (ECoW) with experience in overseeing wind farm construction projects will be appointed by the Contractor for the duration of the construction phase to ensure that the CEMP is effectively implemented and that all planning conditions relating to biodiversity are complied with. An Environmental Manager will be appointed by the Developer to oversee the environmental management of the project, advise on the environmental issues and ensure compliance by the Contractor.

3.2.1.1 Habitat loss

As habitat loss cannot be mitigated, the loss of bog will be offset through a Biodiversity Enhancement and Management Plan (BEMP). The BEMP is outlined in section 6.8 and is presented in full in **Appendix 6.4**.

3.2.1.2 *Mitigation to minimise disturbance of bog and promote re-vegetation*

As described in section 6.4.4.3, the construction works will inevitably cause disturbance to bog habitats around the turbine and hardstand work areas, as an area will be needed by the Contractor to facilitate the works. To minimise disturbance to the bog and to ensure good recovery, as well as to minimise areas of bare peat which would be prone to erosion, the following programme will be adhered to during the construction phase.

3.2.1.3 *Restricted access to bog*

At the commencement of works, for each of the turbine locations the required work footprint on the bog will be identified and the area will be marked by a rope fence (using wooden poles) and with appropriate signage. No construction activities will be allowed outside of the agreed work area for the duration of the construction period. The ECoW will inspect the site regularly whilst works are on-going. Excavated peat and subsoil will be removed to the approved deposition area(s), with no storage of peat or any other materials on the adjoining bog areas. The rope fences will remain in place until the works are fully complete.

The above is of especial importance at the sites of turbines T3 and T9, which impact areas of high bog, as well as at T1, T10 and T13 which adjoin or are very close to areas of high bog.

3.2.1.4 *Protection of high bog*

The work areas at turbines T3 and T9 will impact areas of high bog. To minimise disturbance from plant machinery, bog mats will be used over the surface where tracking is likely to take place. The use of bog mats is a proven (yet simple) technique that is highly efficient in reducing the impact on the bog surface.

3.2.1.5 *Re-vegetation of bare surfaces at work areas*

An ecological objective is to minimise the area of exposed peat surface and to encourage rapid re-vegetation of disturbed bog surfaces. This will be achieved by the removal of the vegetated bog surface within the work footprint, the storage of this material, and subsequent re-use around the turbine and hardstand margins.

First, suitable areas within the site will be identified where the removed material can be stored for the duration of the works or until needed – it is noted that such areas will not be on other vegetated bog surfaces but rather areas of bare or sparsely vegetated peat.

Also, it is important that the selected storage areas will not be prone to disturbance for the duration of the required storage period.

Two approaches will then be used to 'save' the surface vegetated material. Where practical, the surface will be cut-out as sods or 'turves' to a depth of approximately 20-30 cm using a dumper/digger with a bucket. Care will be taken to keep the turves as intact as possible and the vegetated side upwards (though this is not always possible). The turves will be loaded to a trailer and transported to the pre-identified storage area. The turves will be off-loaded from the trailer and placed side by side and vegetation side upwards. They will be placed in single layers*, i.e*. not piled on top of each other.

Alternatively, where the cutting out of turves will not be practical due to shallow peat or an undulating surface from past turbary, the surface vegetated areas will be scrapped off and removed to storage areas where piles will be formed until ready to re-use when works are complete. Such material will contain root and rhizome material, as well as a seed bank.

Should storage of the above materials be for prolonged periods (months), the stored turves and peat piles will need to be watered during dry spells.

When ready for placement at the finished turbine/hardstand, the turves or peat piles will be lifted with a dumper and bucket and taken to the destination. Here they will be off-loaded and placed side by side on the disturbed bog surface with vegetation side up. The turves will be bedded in with the bucket of a dumper so that they form a continuous layer without gaps between them. This approach will provide almost immediate cover of the bare surfaces. Alternatively, the surface peat material from the stored peat piles will be spread over the bare surfaces.

All of the above processes will be monitored by the ECoW.

3.2.1.6 Mitigation to promote re-vegetation of spoil deposition areas

As described in section 6.4.4.2, there is a requirement to store excavated peat and subsoil on-site, with three spoil deposition areas identified on cutover bog amounting to 8.93 ha.

With the following mitigation, cutover bog vegetation similar to that originally at the proposed deposition areas will be re-established when the deposition works are complete.

The process of re-vegetation will essentially be the same as described in Section 6.5.2.2 above, with surface turves cut out, or surface vegetation scrapped off, and then stored until needed. It is noted that when filling the deposition areas to the allowed depth, the uppermost 50 cm (at the least) should be pure peat and not include subsoil. The saved material will then be spread across the surface using a wide track machine for access. Where used, turves will be bedded in using the bucket of the dumper.

3.2.1.7 Tree removal along Turbine Delivery Route

Any trees removed along the Turbine Delivery Route will be replaced by similar trees at the various impact locations. It is noted that ash trees removed will be replaced with another native species, preferably oak, due to the ongoing restriction on the planting of new ash.

3.2.1.8 Otter

While the watercourses within the site are not suitable for otter, downstream of the site the main rivers are likely to support otter populations. Such populations could be affected adversely by pollutants entering the watercourses, including the Dooyeaghny River which drains the site for the Hydrogen Plant, as a result of activities associated with the project.

The mitigation proposed to maintain water quality in the aquatic zones (as detailed in **Chapter 6: Aquatic Biodiversity** and **Chapter 9: Hydrology and Hydrogeology**, and summarised in the CEMP) will ensure that the food supplies for otters within local watercourses are not affected by contaminants generated by the Proposed Development.

3.2.1.9 Common frog and common lizard

The common frog is widespread on Site for the wind farm, occurring throughout the cutover bog. Areas where construction works are due to commence during the period February to August will be checked by the ECoW for the presence of frog spawn, tadpoles and adult frogs. If present, these will be removed under licence from NPWS and transferred to suitable ponds, drains or wetlands in the vicinity and away from the construction footprint.

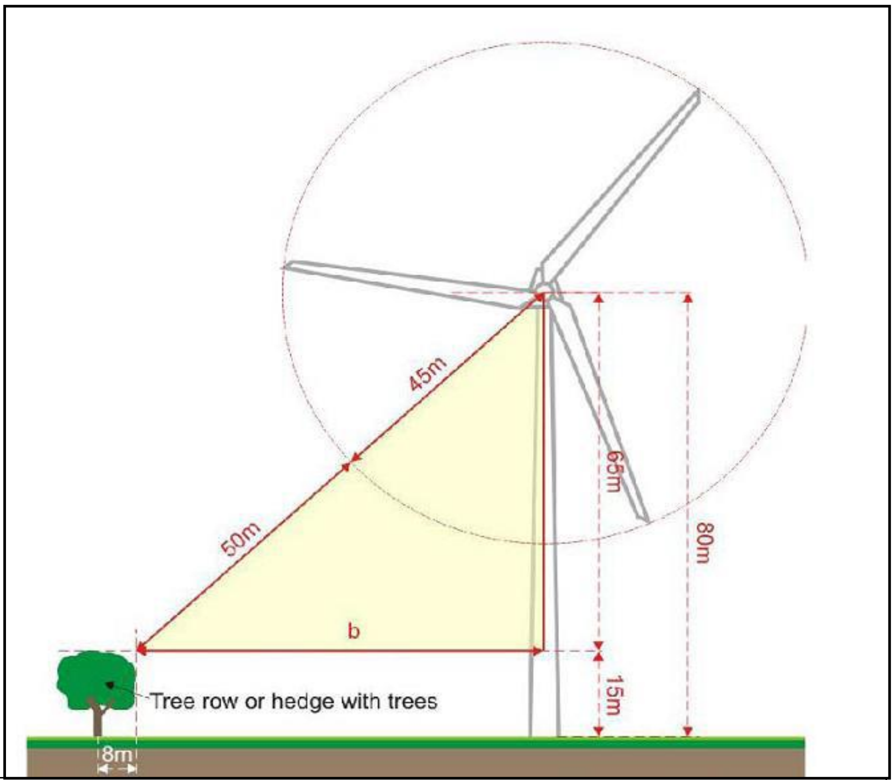
During the walk-over survey for presence of the common frog, any common lizards observed will be removed from the work area and placed on bog elsewhere within the site.

3.2.1.10 Bats

3.2.1.10.1 Buffer

Bats typically use woodland edge habitats for commuting and feeding purposes. Areas of conifer plantation surrounding the immediate vicinity of the proposed turbines should be felled in order to discourage bat species from flying close to turbines. Various publications provide guidelines on buffer zones surrounding turbines to reduce the favourability of the site for bat activity. Eurobats 'Guidelines for consideration of bats in wind farm projects' (Rodrigues *et al*. 2015) recommend buffer zones of 200 m from turbine base to high potential features whilst Natural England Bats (England 2014) recommend 50 m buffers from blade tip to tree. NIEA (2021) recommends a minimum buffer of 100 m between the turbines at the edge of commercial forestry where wind farms are proposed to be key-holed.

The following formula will be used to calculate the required felling buffer for turbines for each turbine (taking into account the height of surrounding woodland/plantations at each turbine location):



$$b = \sqrt{(50 + bl)^2 - (hh - fh)^2}$$

where: b = the distance on the ground between the edge of the canopy and the turbine (m)
bl = blade length (m)
hh = hub height (m)

fh = feature height (m)
$b = \sqrt{\{(50+77.5)^2 - (110.5-25)^2\}}$ b = 94.6 m

The proposed wind turbines have the following dimensions:

- Hub Height ranging from 110.5 to 102.5 m
- Rotor diameter ranging from 155 to 149 m
- Tip Height ranging from 185 to 179 m

All turbines are located a minimum of 140 m from conifer plantation edge. At this distance a buffer of 85 m from blade tip to forestry edge is achieved at all locations, adequately surpassing the typical 50 m buffer. The only other shrub plants found within this buffer zone surrounding the proposed turbine locations are small stands of gorse or willow. These will be removed prior to the powering up of the turbines.

3.2.1.10.2 Lighting restrictions

In general, artificial light creates a barrier to bats so lighting should be avoided where possible. Construction operations within the Site will take place during the hours of daylight where possible to minimise disturbances to faunal species at night. Some works along the Grid Connection cable route and wind farm Site may occur at night but the Environmental Manager/ECoW shall limit night-time works to sections of the route / site which avoid sensitive features (*e.g.* mature treelines). Where lighting is required, directional lighting*, i.e.* lighting which only shines on work areas and not nearby countryside, will be used to prevent overspill. This will be achieved by the design of the luminaire and by using accessories such as hoods, cowls, louvers and shields to direct the light to the intended area only.

3.2.1.10.3 Retention of trees

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.

3.3 AQUATIC ECOLOGY

- During the construction phase the appointed Contractor(s) will ensure that the following mitigation is adhered to in line with IFI (2016) *Guidelines on Protection of Fisheries during* Construction Works in and Adjacent to Waters:
- No works will take place within the 65 m buffer zone of watercourses except for the culvert extensions and road upgrade works.
- Site compounds and all storage areas will be located at a minimum distance of 65 m from any watercourse. All drainage from these facilities will be directed through a settlement pond with appropriate capacity and measures to provide spill containment.
- All site drainage will be directed through either sediment traps, settlement ponds and / or buffered drainage outfalls to ensure that total suspended solid levels in all waters discharging to any watercourse shall not exceed 25 mg/l (IFI, 2016). All construction site run-off will be channelled through a stilling process to allow suspended solids to settle out and through a spill-containment facility prior to discharge.
- Daily monitoring of all sediment traps and settlement ponds will be undertaken by the Environmental Manager or Ecological Clerk of Works to ensure satisfactory operation and/or maintenance requirements. A full specification for the water quality monitoring is presented in the WQMP.
- The storage of oils, hydraulic fluids, etc., will be undertaken in accordance with current best practice for oil storage (Enterprise Ireland, BPGCS005).
- The pouring of concrete, sealing of joints, application of water-proofing paint or protective systems, curing agents, etc., will be completed in the dry to avoid pollution of the freshwater environment.
- All machinery operating on water course crossings will be steam-cleaned at the site compound in advance of works and routinely checked to ensure no leakage of oils or lubricants occurs. All fuelling of machinery will be undertaken at a discrete "fuel station" designated for the purpose of safe fuel storage and fuel transfer to vehicles.
- Instream works will be undertaken during the period 1st July to 30th September as required by IFI Guidance (2016) to avoid accidental damage or siltation of spawning beds in downstream reaches.
- Method statements for the watercourse crossing culverts will be prepared and submitted to inland Fisheries Ireland for prior approval.
- Culvert extension or upgrade works will be undertaken in dry conditions and in low flow conditions.
- In the event that stream dewatering is required for the construction of culvert extensions, electrofishing will be undertaken during the instream working window from July to

September by suitably qualified and licenced personnel with any fish translocated downstream.

- During the culvert installation and associated construction work, double silt fences will be emplaced immediately down-gradient and downstream of the construction area for the duration of the construction phase.
- Any extensions to existing culverts or new culverts will be set at an embedded depth of 0.5 m.
- Where bank strengthening or scour protection is required, this will utilise sensitively placed rock armour with appropriate landscaping to tie the feature into the existing river bank profile. Gabion baskets and Reno mattresses will not be used.
- All bank sides and streambeds will be fully reinstated to avoid ongoing erosion. This will entail appropriately sloped banks to provide stability, and establishing vegetative cover as quickly as possible using only native species appropriate to the existing environment.
- There will be no batching or storage of cement allowed in the vicinity of the crossing construction area.
- Procedures (as detailed in this CEMP) will be put in place to ensure the full control of raw or uncured waste concrete to ensure that watercourses will not be impacted.
- Should there be any incidents of pollution to watercourses, immediate steps as specified in the Emergency Response Plan (CEMP-Management Plan 1) will be undertaken to resolve the cause of the pollution and where feasible, mitigate against the impact of pollution.

3.4 ORNITHOLOGY

3.4.1 Mitigation Measures

3.4.1.1 Measures for loss of habitat

While habitat loss cannot be mitigated, the loss of bog will be offset through a Biodiversity Enhancement and Management Plan (BEMP) attached as **Appendix 5.4**.

Briefly, the BEMP will preserve and enhance an area of 10.6 ha of blanket bog which has been partly cut. This will ensure that the bog is not planted with forestry (as have some adjoining areas) or cut further during the lifetime of the project.

Bird species associated with peatland habitats, including red grouse, merlin, snipe and meadow pipit will benefit. The regrowth of ling heather in the eroded blanket bog habitat would be of particular benefit to the local red grouse population.

This Plan will compensate for the loss of bog habitat for birds.

3.4.1.2 Measures to minimise potential disturbance to sensitive bird species

The present assessment has identified the potential for significant disturbance effects on three breeding species of conservation importance as a result of the construction works (see **Section 7.4.2.2**). These species are red grouse, merlin and snipe. Best available evidence has been reviewed and it is suggested that these species could be disturbed by works, including tree felling, at the following distances:

Red grouse	500 m
Merlin	500 m
Snipe	400 m

Should any of these species be recorded breeding within the given distances of the works area through confirmatory surveys before and/or during construction, a buffer zone (using above distances) shall be established around the expected location of the nest (location identified as far as is possible without causing disturbance to the bird) and all works will be restricted within the zone until it can be demonstrated by an ornithologist that the species has completed the breeding cycle in the identified area. Any restricted area that is required to be set up will be marked clearly using hazard tape fencing and all site staff will be alerted through toolbox talks.

The above mitigation, as needed, will apply from March to August (inclusive) and will ensure that the works will not have an adverse disturbance effect on the identified species of conservation importance recorded during the baseline surveys or in pre-construction surveys.

3.4.1.3 Measures to minimise potential disturbance to nesting passerine species

A range of passerine bird species breed within the Wind Farm Site, including the Red-listed meadow pipit and the Amber-listed skylark and willow warbler. In compliance with Section 40 of the Wildlife Acts 1976 as amended, all vegetation required to be cleared to facilitate the works will be done outside of the restricted period from 1st March to 30th August.

Should it be necessary to remove vegetation during the breeding season, for instance where bramble and ephemeral plant species have become established on ground cleared earlier, this will be surveyed by an ornithologist up to 10 days before any clearance. Should an active nest be located, the area will be restricted from works by a distance where it is considered that the works would not cause disturbance or abandonment of the nest. Such distances, which will vary according to species and local topography, will be determined by the ornithologist. The restriction will be maintained until it is established that any young birds present have fledged. Should an instance arise where the placement of a restriction would have significant implications for the time frame of the Project, and where no alternative mitigation is available, the ornithologist will prepare a report (to include species, stage of breeding etc.) on the implications of removal of the nest in the context of the Wildlife Acts and consultation will be undertaken with the NPWS.

With the above mitigation implemented, the effect of disturbance to nesting passerine species can be avoided or the reduced to Not Significant.

3.4.2 Monitoring

3.4.2.1 Pre-construction phase and construction phase

Confirmatory breeding bird surveys focused on red grouse, merlin and snipe, will take place in the spring/summer prior to construction to establish the breeding status and distribution within the Wind Farm site to a distance of approximately 500 m from any works area. From the results of monitoring, the likely need for restrictive zones to avoid or minimise the potential for adverse effects on breeding activities will be determined.

All monitoring surveys will be undertaken by a suitably qualified ornithologist, with the red grouse survey following the tape lure method (under licence).

As more than two or three years are expected to have passed between the baseline surveys in 2019-2021 and the commencement of construction, the surveys will include all target species as the distribution of some species may change in the intervening period.

Bird monitoring will take place as required to identify locations of nesting bird during the construction phase should vegetation need to be removed.

3.5 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 Peat and 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.

3.5.1 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 for the Wind Farm. This process was also conducted in the design phase of the Hydrogen plant. Arising from the results of these studies, constraints maps were produced that identifies areas where geotechnical constraints could make parts of the site less suitable for development. Constraints are mapped and presented in **Figure 3.1 (EIAR Figure 8.8b)**.

MEL/RSK, in consultation with the design team has reviewed the layout plans and has identified them as the best layout design available for protecting both site's existing geotechnical (and hydrological) regime, but while also incorporating and overlaying landownership, engineering and avoiding environmental constraints as detailed in this EIAR.

3.5.2 Nature Based Solutions

3.5.2.1 Wind Farm Site – Infrastructure Footprint

Due to baseline conditions and ongoing peat cutting activities at the site, implementing beneficial mitigations measures, beneficial impacts and promoting healthy peatland conditions e.g. rewetting and maintaining high bog water levels, is not conducive with how the adjacent lands are valued locally and in turn the current practices on site i.e. draining, cutting and harvesting.

To address conflicting systems and objectives[1], the Development will use an approach as presented conceptually in EIAR Chapter 9 Appendix 9.7 Conceptual Graphics WF Site – Conceptual Hardstand – Plan, Conceptual Graphics WF Site – Conceptual Hardstand – Section A, and Conceptual Graphics WF Site – Conceptual Hardstand – Section B, and as summarised follows:

- Isolate areas of land adjacent to the Development footprint by means of subsoil berms. The actual area will depend on land holding rights, proximity to receptors, and results of detailed materials balance assessment i.e. the area required will be dictated by the volume of material available with the intention of limiting the area in order to achieve original ground level with the deposited peat material.
  The dimensions and angle of repose for the berms will be specified by a suitably qualified geotechnical engineer during the detailed design phase.

[1] Joosten H, Clarke D (2022) Wise Use of Mires and Peatlands - Background and Principals including a Framework for Decision Making [Online] - Available at: ISBN 951-97744-8-3 [Accessed: n/a]

- Hardstand areas for both cranes and turbines will be constructed by means of infilling suitable material from competent ground up to the design elevation or Finished Ground Level (FGL).
- The areas now isolated between the berms and hardstand areas will be back filled with surplus excavated subsoils (minimal), catotelm peat (to GGL minus c. 0.3 m), and acrotelm peat (c. 0.3), ordered respectively. The deposition area will be managed in terms of ecological regeneration, including planting key species e.g. Sphagnum moss.
- Drainage i.e. interceptor drains surrounding the hardstand area will include check dams, or dams which will promote the diffuse discharge of runoff in to deposited peat / regeneration areas. Overflow will be directed to a stilling pond prior to buffered discharge (through coarse aggregate) into the receiving drainage network. This conceptual design is aimed at promoting and maintaining high bog water levels and healthy peatland conditions, refer to EIAR Chapter 9 – Hydrology & Hydrogeology for further information.
- Areas identified as suitable for soil berms will be isolated with silt screens prior to any construction / excavation works.

Implementing the above will ensure the reuse of all suitable (uncontaminated) soil material arising on site is achieved. The regeneration of the deposition areas will require monitoring and management, however assuming successfully implemented these areas will provide beneficial impacts in terms of improving environmental services on lands, including; reduced hydraulic response to rainfall, promoting active blanket bog and associated ecological and biodiversity attributes, and reduction in peat carbon emissions.

This approach will be implemented and refined in the detailed design phase and will be used at each turbine location, and other available land holdings on the site as detailed in **EIAR Figure 8.8a** and **EIAR Figure 8.8b**.

Further measures on the management of soils are detailed in the following sections.

3.5.2.2 Wind Farm Site – Improvement Areas

Areas of the site have been identified for enhancement works (**EIAR Figure 8.1a**). The areas and works involved are presented in Biosphere Environmental Services (2023) Biodiversity Enhancement and Management Plan. The plan describes measures including the blocking of existing drains in the enhancement areas, rewetting peat and monitoring.

3.5.2.3 Hydrogen Plant

Due to baseline conditions of agricultural practices of grazing and ongoing peat cutting activities at the site, implementing beneficial mitigations measures, beneficial impacts and promoting healthy peatland conditions e.g. rewetting and maintaining high bog water levels, is not conducive with how the adjacent lands are valued locally and in turn the current practices on site i.e. grazing, and the draining, cutting and harvesting of peat.

The Proposed Development will use approaches as presented conceptually in EIAR Chapter 9 Appendix 9.7 Conceptual Graphics – Soil Berms and Silt Screens.

- Isolate areas of land adjacent to the Proposed Development footprint by means of subsoil berms. The actual area will depend on land holding rights, proximity to receptors, and results of detailed materials balance assessment i.e. the area required will be dictated by the volume of material available with the intention of limiting the area in order to achieve original ground level with the deposited peat material.
  The dimensions and angle of repose for the berms will be specified by a suitably qualified geotechnical engineer during the detailed design phase.
- Areas identified as suitable for soil berms will be isolated with silt screens prior to any construction / excavation works.

Implementing the above will ensure the reuse of all suitable (uncontaminated) soil material arising on site is achieved. The regeneration of the deposition areas will require monitoring and management, however assuming successfully implemented these areas will provide beneficial impacts in terms of improving environmental services on lands, including; reduced hydraulic response to rainfall, promoting active blanket bog and associated ecological and biodiversity attributes, and reduction in peat carbon emissions.

3.5.3 Erosion and Degradation

Erosion and degradation of exposed soils will occur at a minimal, primarily during construction. Considering the variability of metrological conditions and the potential for significant events to occur at any stage of the year, the construction phase will be limited to favourable meteorological conditions to avoid erosion and runoff from the site. In order to mitigate for particular earth works tasks and suitable meteorological conditions, construction activities will not occur during periods of sustained significant rainfall events, or directly after such events (allowing time for work areas to drain excessive surface water loading and discharge rates reduce).

To avoid potentially loading of runoff with solids and other contaminants into the surface water network. Entrainment of solids in storm or construction water runoff are assessed under **Chapter 9: Hydrology & Hydrogeology.**

3.5.4 Soil Sealing

Soil sealing will be mitigated by the use of a geotextile membrane on top of in situ peat material will likely lead to a degree of subsidence with time. This will reduce the changes the geotechnical and hydrogeological attributes, for example; increased runoff. The use of impermeable material is an inevitable direct effect to some extent of most types of construction particularly in greenfield sites. However this will be mitigated by reducing the area of sealed soil to a minimal.

3.5.5 Subsoil and Bedrock Removal – Mitigation Measures

Mitigation by Avoidance

The removal of peat and mineral subsoil / bedrock is an unavoidable impact of the Proposed Development, but every effort will be made to ensure that the amount of earth materials excavated is kept to a minimum in order to limit the impact on the geotechnical and hydrological balance of the Site. This has been done initially through a process of "mitigation by avoidance" whereby the proposed turbines and infrastructure layout was dictated to a large degree by the existing infrastructure, peat depth and the topography, locating turbines in areas where the existing infrastructure is utilised, peat is shallow, and the topography is favourable. Similarly, engineered cut and fill extents which have been designed will minimise the volumes of subsoils to be removed either directly by excavation (turbine foundations) or as a function of cut and fill requirements (hardstands).

Riparian zones and / or 25 m surface water buffer zones will be maintained, in line with relevant forestry guidance. This includes minimising impacts during design and construction of surface water crossings and maintaining the 25 m riparian zone in afforested areas including commercial forestry, in line with relevant guidance.

Mitigation by Good Practices

- Excavation of peat in areas where there is >1.0 m in peat depth will follow appropriate engineering controls such as the drainage of the peat along the proposed Site tracks in advance of excavation activity (1 month in advance where possible) so as to reduce pore water content and thus instability of the peat substrate prior to excavation. Such drains will be positioned at an oblique angle to slope contours to ensure ground stability. Drains will not be positioned parallel to slope contours. This drainage will be attenuated prior to outfall (**Chapter 9: Hydrology and Hydrogeology**). It is noted that peat depth at the site is generally shallow and management of saturated peat will be required at relatively few locations.

- In those parts of the Site where excavation may intercept areas of peat that are >1.0 m depth, a geotechnical engineer/engineering geologist will be onsite to supervise and manage the excavation works and confirm the necessity for supporting newly excavated peat exposures or redirect initial construction phase drainage to maintain ground stability.

- For side walls in all excavations a safe angle of repose will be established. This will ensure the potential for side wall collapse will be minimised. For peat, the safe angle of repose is approximately 15°, which equates to a c. 10 m horizontal distance if excavating to 2.5 m depth, however given the quality of the peat, and the potential residual water content after pre-excavation drainage works, or increased water content following heavy rainfall events, there remains a risk of localised stability issues arising in areas of deeper peat. Therefore, for excavation in areas of deeper peat (>2.0 m) excavation supports will be used and this will be incorporated into the CEMP for the Development, for example; temporary sheet piling, or similar. This will minimise the effect of excavation to the minimum required. Areas of the site where deeper (>2.0 m) peat was detected during site surveys are presented in **EIAR Figure 8.7a.** Similarly, the safe angle of repose for subsoils at the Site (GRAVELS), or any other material (e.g. crushed rock) arising at the site must also be considered and similar consideration and mitigation applied respectively.

- Adopting good practices, planning ahead and real time monitoring in more sensitive (>1 m peat depth) areas will ensure that any excavations associated with the Development will have minimal impact, that is; the risk of the activity of excavation having an increasing or variable impact will be reduced. Similarly, application of the above mitigation measures will reduce the risk of stability issues arising at a localised scale.

Mitigation by Reuse

Subsoil and bedrock which are excavated as part of the initial decommissioning and construction phase will be reused onsite where possible. Bedrock material arising at the Site will reused as fill material, and access tracks. Excess bedrock will be reused as backfill in areas previously excavated, or as backfill in cut and fill operations. Using the local geology as fill will ensure that impacts to hydrochemistry are minimised.

Geotechnical testing on imported material from neighbouring quarry, will be carried out prior to its reuse onsite particularly for reuse as a running or load bearing surface and will only be reused for those purposes if the suitability of same is conforms to relevant standards. Useful guidance in this regard include:

- Good Practice during Wind Farm Construction (SNH, 2015)
- Notes for Guidance on the Specification for Road Works Series NG 600 – Earthworks (TII, 2013)
- Constructed tracks in the Scottish Uplands (SNH, 2015)

Peat material excavated will be reused as backfill in areas previously excavated as much as possible, and/or for reinstatement works elsewhere on the Site. To facilitate this the acrotelm (living layer) and the catotelm (lower layer) will be treated as two separate materials. Catotelm peat will be used to backfill, for example; around turbine foundation pads once established. Acrotelm peat will be used as a dressing on top of deposited catotelm peat in order to promote and re-establish flora and ensure the acrotelm layer becomes relatively cohesive in terms of localised peat stability (vegetated), see **EIAR Appendix 9.6 Conceptual Graphics.**

Temporary storage areas identified and outline in **Management Plan 4 Peat Spoil Management Plan,** will also acknowledge and avoid associated constraints presented in **Figure 3.1 (EIAR Figure 8.8b)** below**,** avoiding buffer zones of sensitive receptors, i.e. T4 and T13.

Similarly, all soil and subsoil types or horizons identified during actual construction will be treated as separate materials and arisings separated accordingly. This includes, for example; Acrotelm peat, catotelm peat, subsoils (/ TILL), weathered rock.

The management, movement, and temporary stockpiling of material on site will be detailed in the CEMP, this will include identification of suitable temporary set down areas which will be located within the development footprint and will consider and avoid geo-constraints identified in this report (**EIAR Figure 9.12a**). Temporary set down / stockpile areas will be considered similarly to active excavation areas in terms of applying precautionary measures and good practices, and mitigation measures, including those relating to control of runoff and entrainment of suspended solids (**Chapter 9: Hydrology & Hydrogeology**).

Mitigation by Remediation

The mitigation measures listed above, namely backfilling with peat in layers, are in effect remediation measures. These measures remediate the impacts of excavation and limits the impacts to the extent of the actual proposed infrastructure.

Excess subsoils and bedrock will be used for remediation and reinstatement purposes elsewhere on the Site, including areas already impacted by peat cutting and agricultural activities, eroded or degraded areas, for example, reinstating original ground level in areas of cut peat and/or damming drains in peat areas.

3.5.6 Storage and Stockpiles – Mitigation Measures

Mitigation by Avoidance and Good Practice

- No permanent stockpiles will remain on the Site. All excavated materials from the Site or introduced materials for construction will be used on site.
- No temporary stockpiles will be positioned or placed on areas of peat which have not been assessed or are indicated as being geo-hazards, particularly in areas of unacceptable factor of safety / stability.
- All temporary stockpiles will be positioned on established and existing hardstand areas or in designated areas which are appropriate for short term storage.

Mitigation by Reduction

The volume of material to be managed including temporary stockpiling is directly proportional to the volumes of material required to be excavated, however if managed appropriately the volume of material to be managed at any particular time can be dramatically reduced.

The **Peat and 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.

3.5.7 Vehicular Movements – Mitigation Measures

Mitigation by Avoidance and Good Practice

- Vehicular movements will be restricted to the footprint of the Proposed Development and advancing ahead of any constructed hardstand will be minimised in so far as practical.
- Ancillary machinery will be kept on established Hardstands, and no vehicles will be permitted outside of the footprint of the Proposed Development and will not move onto land that is not proposed for the Proposed Development if it can be avoided.
- Where vehicular movement are necessary outside of the Development footprint, ground conditions will be maintained as well as possible. This includes for example replacing sods, smoothing over with excavator bucket etc. Where ground conditions are poor, or prolonged works, temporary access measures will be deployed, for example floating platforms / floating access track.
- Floating tracks are applied directly to peatlands and remove the need to excavate any peat. The weight of the track structure will gradually lead to subsidence of the material, and compression of underlying peat, namely the acrotelm potentially resulting in reduced transmittance of runoff and impacting on baseline hydrological regime at the site. This can lead to excessive wetting upgradient and peatland drying and chronic degradation of water supply down gradient of tracks. Proposed drainage as part of the Proposed Development will be designed to maintain the baseline hydrological regime as far as practical (**Chapter 9: Hydrology and Hydrogeology)**

3.5.8 Ground Stability – Mitigation Measures

Mitigation by Avoidance and Good Practice

- Construction activities, including vehicular movements, will be limited to the footprint of the Proposed Development.
- Vehicular movements or construction activities outside of the footprint of the Proposed Development will be assessed by a competent geotechnical engineer before progressing.
- Temporary stockpiles will be limited to 1 m height in sensitive areas, and removed for reuse/remediation purposes or disposed offsite as soon as possible. It is envisaged that all material will be reused on site, unless obviously contaminated
- All Site excavations and construction will be supervised by a geotechnical engineer/engineering geologist.
- The contractor's * methodology statement and risk assessment will be in line with CEMP and will be reviewed and approved by a suitably qualified geotechnical

engineer/engineering geologist prior to Site operations. (*Contractor here refers to the chosen or contracted construction company at the commencement stage of the Proposed Development).

- Particular attention and pre-construction assessment (developer / sub-contractor site specific risk assessment and method statement (RAMS) and on-site toolbox talks etc.) and mitigation planning will be given to any new infrastructure, for example, the proposed Site Access Roads, watercourse crossings and hardstand associated with proximal geo-hazards including for example T2, T3 and T13 which are above particularly sensitive areas of the Site.
- Any excavations that have the potential to undermine the up-slope component of a peat and / or unstable subsoil slope will be sufficiently supported by buttress, frame or rampart to resist lateral slippage. To this end, all new turbine foundation excavation locations will incorporate a safe angle of repose, however with a view to minimising the impact of the Development Excavation in peat of >1 m depth will be supported by a restraining / support wall during the construction phase.
- In such excavations, the groundwater level (pore water pressure) will be kept low at all times (excavation dewatering) to avoid ground stability risks (subsidence) associated with peat and careful attention will be given to the existing drainage and how structures might affect it. Draining water from the construction area will be done through advanced dewatering techniques. In particular, ponding of water will not be allowed to occur in recent excavations, particularly in any areas encountered where peat is >1 m. All deliberate or incidental sumps will be drained to carry water away from the sump following rainfall.
- In areas of saturated peatlands, prior to excavation, drains will be established to effectively drain grounds prior to earthworks. Such drains will be positioned at an oblique angle to slope contours to ensure ground stability. Drains on areas of the Site with minimal risk of bog failure as identified by Site Investigations will be positioned at a more acute angle to the slope contour in order to reduce the velocity of surface water drainage. It is noted that deeper (>2.0 m) peat at the Site is generally confined to isolated pockets and the need for ‘heavy duty’ measures such as sheet piling is very low.
- All peat excavated will be immediately removed from sloping areas. Peat will be carefully managed particularly when in temporary storage. Temporary storage areas will be isolated from the receiving environment by means of temporary infrastructure such as boundary berms comprised of subsoils sourced at the Site, or similar material.

- There is potential for large volumes of bog water draining from new stockpiles which will also be managed. Mitigation will include removal of gross solids from runoff prior to bog water intercepting the wind farm drainage network.
- Temporary measures such as dewatering and pumping through silt bags will be employed to assist this process. Draining of stockpiled peat in a controlled manner is recommended. Similar measures will be applied to the management of subsoil arisings at the Site.
- Peat is required for reinstatement, therefore acrotelm peat (top living layer, c. 0.5 m) will be stripped off the surface of the bog and placed carefully at the margins of the Development along the Site Access Roads and hardstand margins that are characterised by near-horizontal slopes (<6°).
- Relatively high impact construction activities (e.g., excavations, movement of soils / subsoils / rock) will be limited to the spring to autumn period as this period is considered to be the optimal seasonal period in terms of likely rainfall conditions, low soil moisture deficit (SMD), and relatively stable pore water pressure conditions (not withstanding excessive human interference of pore waters). Construction activities will not occur during periods of sustained significant rainfall events, or directly after such events (allowing time for work areas to drain excessive surface water loading and discharge rates reduce).
- A minimum 24-hour advance meteorological forecasting (Met Éireann download) linked to a trigger-response system will be implemented. When a pre-determined rainfall trigger level is exceeded (e.g., one in a 100-year storm event or very heavy rainfall at >25 mm/hr), planned responses will be undertaken. These responses will include cessation of construction until the storm event including storm runoff has passed over. Following heavy rainfall events, and before construction works recommence, the Site will be inspected and corrective measures implemented to ensure safe working conditions, for example dewatering of standing water in open excavations, etc.
- Any impact to the hydrological and/or hydrogeological regime will be avoided as far as practical in relation to identified Geo-Hazards (**EIAR Figure 9.12a** and **Figure 9.12b**) where the presence of steep inclines, deep till deposits and iron pan give rise to elevated ground stability, particularly where the potential for impacts to hydrogeology in those area / subsoils exists.

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 Proposed 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 **Peat and 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 peat or slope stability issue does arise on the Site during the construction or operational phases of the Proposed 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 16: Major Accidents and Natural Disasters**) and established to form part of **Management Plan 1: Emergency Response Plan** before construction works initiate.

- In the event that soil stability issues arise during construction activities, all ongoing construction activities at the particular area of the Site will cease immediately, the assigned geotechnical supervisor will inspect and characterise the issue at hand, corrective measures will be prescribed.
- In the unlikely event that soil and slope stability issues arise during construction activities, all ongoing activities in the vicinity will cease immediately, all operators will evacuate the area by foot, the assigned geotechnical supervisor will inspect and characterise the issue at hand, corrective measures will be prescribed.
- On site training and toolbox talks will ensure any response to any potential incident is mobilised quickly and efficiently.

- Detailed emergency response protocols are specified in the **Management Plan 1: Emergency Response Plan**.

3.5.9 Soil Contamination – Mitigation Measures

Mitigation by Avoidance

Contaminants which pose the most significant risk to soils, namely hydrocarbons and construction materials such as cement / concrete, pose an even greater risk to surface waters and groundwaters. In the event an accidental discharge should occur, contaminates will likely leak or be spilled on soils initially, protecting soils from such will in turn mitigate against the potential for contaminates reaching the hydrological network associated with the Site, however given that such features are fundamental to the potentially far reaching effect of contaminates, mitigation measures for contaminants are presented in detail in **EIAR Chapter 9: Hydrology and Hydrogeology**.

As discussed in previous sections of this report, construction activities associated with the Proposed Development will be restricted to the footprint of the Proposed Development, therefore the potential for contaminants reaching soils is limited to the footprint of the Proposed Development or construction area.

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 **EIAR Chapter 9: Hydrology and Hydrogeology** 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 Proposed 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; installation of temporary sumps, drains or dykes to control the flow or migration of hydrocarbons; excavation and disposal of contaminated material. Any such measures will be reviewed by appropriate consultants, however considering that collector drainage (**Chapter 9: Hydrology and Hydrogeology**) will be established prior to construction activities, the need for drainage as an emergency response will be limited, however 'dig and dump' remediation processes will likely be required.
- 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 polluting incident e.g. discharge or accidental release of hydrocarbons / fuel to surface water systems, the relevant authorities, noted above and stakeholders will be informed.

3.6 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 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.

3.6.1 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**.

3.6.2 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 Proposed 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.

3.6.2.1 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 3.1** below (**EIAR Figure 8.8b**.)
- Minerex Environmental Ltd., 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

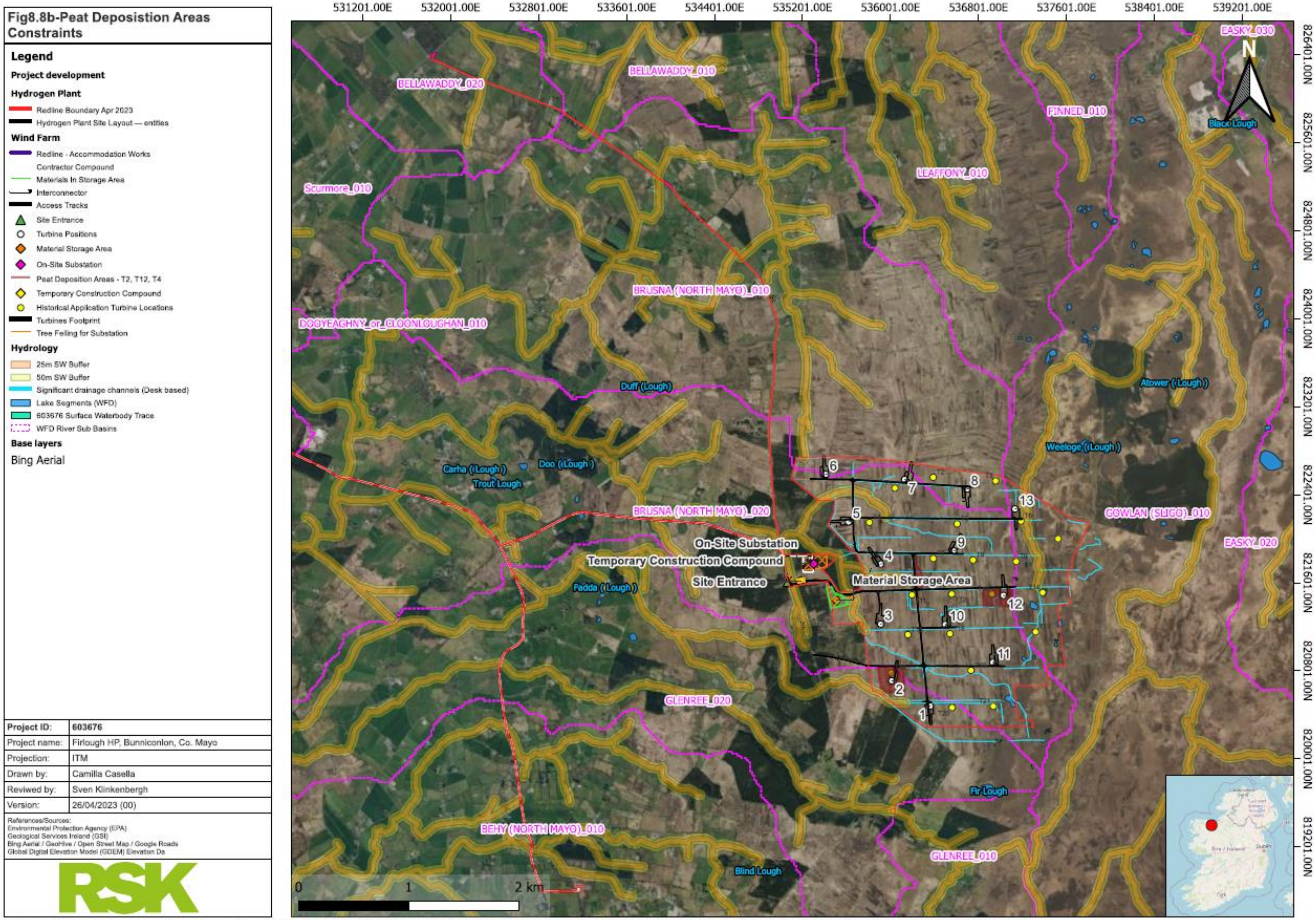
As part of mitigation by avoidance during the design phase of the Proposed Development, surface water, and drainage buffer zones were established where applicable.

- 50 m Surface Water Buffer Zone – Mapped surface water features i.e. mapped streams, rivers, lakes. Source for mapped surface water features; EPA.
- 15 m Drainage Buffer Zone – Non-mapped drainage features i.e. non-mapped streams, natural and artificial drainage features. Source for non-mapped surface water features; desk study and aerial photography assessment, Lidar topographic data and field observations. Note: Significant drainage features will be identified and mapped in so far as practical. Some drainage features will likely not be recorded due to issues relating to access and complexity e.g., within afforested areas, and extensive turbary areas. Such drainage features, while not mapped or prescribed buffer zones, will be treated with the same consideration as mapped drainage during the design and construction phase of the Proposed Development i.e., mitigating for the potential for drainage connection to receiving surface water network.

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., 15 m (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:

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

Some of the Proposed Development infrastructure footprint will fall within buffer zones due to the unique and limiting circumstances associated with the Site and the Proposed 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.



Note: Data points presented are georeferenced using open source data and/or a handheld GPS. This drawing / map is considered a conceptual model with reasonable accuracy for the purposes of environmental assessment. This drawing should not be relied upon for detailed design puporses.

Figure 3.1: Constraints Map (EIAR Figure 8.8b)

3.6.3 Excavation Works

- The Peat and Spoil Management Plan (**Management Plan 4**) incorporates provision on materials management with a view to establishing material balance (reuse of excavation arisings) during the proposed construction phase, thus minimising the potential for or the length of time excavated materials are exposed and vulnerable to entrainment by surface water runoff. Only temporary stockpiling of spoil will occur during the Construction phase.
- 24-hour advance meteorological forecasting (downloadable from Met Éireann) linked to a trigger-response system will be implemented. When a pre-determined rainfall trigger levels is exceeded (e.g., sustained rainfall (any foreseen rainfall event longer than 4-hour duration) and/or any yellow or greater rainfall warning (>25 mm/hour) issued by Met Éireann), planned responses will be undertaken. These responses will include; cessation of construction until the storm event including storm runoff has passed over, assessment of construction areas and infrastructure by Ecological Clerk of Works, and confirmation no additional escalation of response is required. All construction works will cease during storm events such as yellow warning (Met Éireann) rainfall events. Following heavy rainfall events, and before construction works recommence, the Site will be inspected and corrective measures implemented to ensure safe working conditions, for example, dewatering of standing water in open excavations, repair works to drainage features if necessary.
- Exposed soils/peat (exposed temporary stockpiles) will be covered with plastic sheeting during all relatively heavy rainfall events and during periods where works have temporarily ceased before completion at a particular area (e.g., weekends, overnight, etc).
- All drainage infrastructure (as per drainage design, **Sections 4 and 5 of Management Plan 3: Surface Water Management Plan**) required for the management of surface water runoff or draining peat ahead of excavation works will be established before excavation works commence.

Excavation Dewatering Mitigation Measures

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

- Conceptual and information graphics presented in **EIAR Chapter 9 – Appendix 9.7 – Tile no. 8 and 9** present indicative layout and specification for Active Management treatment trains (containment, management and treatment of construction water) and emergency response and intervention (recycling or diversion of poor quality runoff the

Active Management portion of the treatment train. Continuous real time monitoring is also detailed.

- Management of excavations, that is: areas of soil / subsoils to be excavated will be drained ahead of excavation works whenever possible, thus reducing the volumes of water encountered during excavation works.
- Engineered drainage and attenuation features (discussed in following sections) will be established ahead of excavation works.
- Dewatering flow rate or pumping rate will be controlled by an inline gate valve or similar infrastructure. This will facilitate reduction of loading on the receiving drainage and attenuation network, thus enhancing the attenuation and settlement of suspended solids. All pumped water will be discharged to constructed drainage and in line treatment train or to a vegetated surface through a silt bag outside of surface water buffer zones. Dewatering is a dynamic process and will require continuous monitoring and modification depending on conditions encountered.
- In some areas of the Proposed Development constraints related to incline and/or stability, or construction activities within the 25 m buffer zone, will likely limit the potential for installation of engineered attenuation features. In such instances it is recommended that water arising from dewatering activities is directed, or pumped to a settlement tank before being discharged to the receiving drainage network, OR pumped to an area of the site where the installation of attenuation features is suitable. Areas with such constraints are highlighted in **EIAR Figure 9.12a**.
- No extracted or pumped water will be discharged directly to the drainage or surface water network associated with the Site (This is in accordance with the Local Government (Water Pollution) Act, 1977 as amended).

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

Contaminated water arising from construction works, namely, excavations, drilling and temporary stockpiling, will be contained and treated prior to release or discharge. The schematic presented here is a conceptual model of measures implemented to manage arisings and runoff.

A. Arisings. Arisings from the launch / reception pit, or any other significant excavation (e.g., cable joint bays), will be directed the treatment train.

B. Temporary Bund. Arising control area i.e., a temporary bund. Gross solids will be temporarily deposited here. Water arsing with the material will be allowed to drain to sump.

C. Sump / Pump. Sump will discharge by gravity / pumped to stilling pond.

D. Temporary Stilling Pond. This can be constructed using soils for bunding in combination with an impermeable liner.

E. Outfall. The outfall from the stilling pond will be buffered (coarse aggregate) to dissipate energy and diffuse discharging water.

F. Silt Screen. A silt screen will be in place down gradient of the Stilling Pond outfall. This is a precautionary measure to mitigate peak loads or surcharges in the system.

G. Monitoring Location/s. Discharge quality will be monitored in real time using telemetry systems.

H. Monitoring of discharge quality will be carried out at the outfall of the stilling pond i.e., before being actually discharged to surface vegetation or surface water (licenced).

I. Sump / Pump. Discharge By-Pass. If water discharging from the stilling pond exceeds quality reference limits water will be diverted (pumped) from the stilling pond to the settlement / treatment tank. Stilling Pond By-Pass. Similar to Discharge By-Pass, if conditions dictate water can be diverted directly to Settlement / Treatment Tank.

J. Settlement / Treatment Tank. A settlement tank will in line and ready to use if required i.e., water quality at stilling pond outfall fails to meet quality reference limits. The tank will be equipped with treatment systems which will be activated as the need arises, for example; very fine particles which are very slow to settle can be treated with a flocculant agent to promote settlement of particles.

K. GAC Vessel/s. As a precautionary measure, GAC (Granulated Activated Carbon) vessel/s will be in line and ready to use if required. GAC vessels are used to filter out low concentrations of hydrocarbons. Significant hydrocarbon contamination is only envisaged under accidental circumstances. If a hydrocarbon spill does occur, normal operations will pause and the treatment train will be utilised to remediate captured contaminated runoff.

L. GAC Vessel By-Pass. If the quality of the water is acceptable in terms of hydrocarbon contamination.

M. Treated water will be discharge by gravity / pump to the stilling pond for additional clarification, monitoring and buffered discharge to vegetated area.

N. Silt Bag. A silt bag can be used as alternative to stilling ponds. However, silt bags must only be used as primary method in lower risk areas i.e., outside of buffer zones, etc. Stilling ponds will be the primary method (D, N) is circumstances where risk is elevated, however a gate vale and silt bag can be included in the treatment train and used as an emergency discharge route in the event that the stilling pond needs remediation or maintenance.

In all instances, stilling ponds (D), Silt Bags (N) and outfalls I will be situated outside of surface water buffer zones. At many locations, particularly at HDD locations works will be within buffer zones. In these instances, waters can be pumped to the treatment train which can be positioned upgradient along the road (GCR) where discharge to vegetated areas / roadside drains can be managed.

Discharge of non-contaminated storm runoff to vegetated land within a site red line boundary is not a licenced activity however, particularly in relation to the grid connection this methodology is possible only under relatively low flow conditions (e.g., <2 litres per second (L/s) typical of runoff over a relatively small site area. Due to the constricted nature of the grid connection works within public roads, in the event that the expected incoming flow rate or dewatering rate is relatively high (>2 L/s, for example, HDD locations, culvert crossing locations) a discharge licence will be acquired and trade effluent will be discharge directly to the surface water network. The latter will include all works associated with HDD.

The discharge points will be identified during the licence application process. As discussed previously, the main components of the treatment will be positioned outside of the 50 m surface water buffer zone where possible. The developer will identify suitable locations for the establishment of temporary infrastructure taking into account other variable such as traffic and access management. Similarly, the preferred location of discharge points will be outside of buffer zones and into minor or non-mapped surface water / drainage features where possible. The subject drain will be inspected to ensure connection to the mapped network (not blocked).

The quality of the water being discharged will be monitored. If discharge water quality is poor (e.g. >25 mg/l) additional measures will be implemented, for example; pausing works as required and treating construction water by dosing with coagulant to enhance the settlement of finer solids – this can be done in a controlled manner by means of a suitably equipped settlement tank. Collected and treated construction water will be discharged by gravity / pump to a vegetated area of ground within the Site. Silt fences will be established at the discharge area to ensure potential residual suspended solids are attenuated and the potential for erosion is reduced. The discharge area will be outside of 50 m surface water buffer areas (similar to dewatering of excavations. The quality of water discharged will be in line with licence discharge limits assigned by the county council, and will be monitored in real time (telemetry with 15 min sampling rate), as well as laboratory samples taken, analysed and reported and the frequency indicated in the licence. Daily sampling is recommended given the short duration and temporary nature of the works.

Discharging of construction water (trade effluent) directly to surface waters or groundwater is a licenced activity. (This is in accordance with Local Government (Water Pollution) Act, 1977 as amended).

3.6.3.2 Release and Transport of Suspended Solids Proposed Mitigation Measures

- Collector drains and/or soil berms will be established to direct/divert surface water runoff from development areas, including temporary stockpiles, and direct same into established treatment trains including stilling ponds, buffered discharge points or other surface water runoff control infrastructure as appropriate. This is particularly important for effective surface water management associated with proposed infrastructure within the 50 m surface water buffer zones. The drainage system will be permanent (**EIAR Appendix 9.7**).
- Silt fences will be established along the perimeter of source areas e.g. stockpiles, within the drainage network, and in existing natural drains and degraded peat areas which are likely to receive surface water runoff. This will reduce the potential for surface water runoff loaded with suspended solids to rapidly infiltrate towards and be intercepted by drainage or significant surface water features, **EIAR Appendix 9.7 – Tile no. 14.** Multiple silt fences will be used drains / treatment trains discharging to the surface water network. Silt fences will be temporary features, but will remain in place for a period following the completion of the Construction Phase.

Waters arising as a product of excavation activities will be managed as follows:

- Waters arising from dewatering practices during excavation works are highly likely to be significantly loaded with suspended solids. As such, constructed stilling ponds or buffered outfalls may be insufficient in controlling the release of suspended solids to the surface water network, or have the potential to clog due to significant volumes of settled or attenuated solids. Therefore, any water pumped from excavations, or any waters clearly heavily laden with suspended solids will be contained and managed and pumped through the preestablished Active Management treatment train (**EIAR Chapter 9 – Appendix 9.7 – Tile no. 8, 9 and 11).**

Waters (likely loaded with suspended solids) intercepted by the established drainage network will be managed as follows;

- In line Stilling Ponds will buffer the run-off discharging from the drainage system during, by retaining water, thus reducing the hydraulic loading to watercourses. Stilling ponds are designed to reduce flow velocity to 0.3 m/s at which velocity silt settlement generally occurs. Note: this method of mitigation may not be feasible at some locations on the Site due to the complex and variable topography. If establishing stilling ponds is not feasible at any particular location (i.e. associated with managing runoff downstream of turbine locations in particular) the collector drain associated with the area will be constructed wider and marginally deeper in these areas i.e. establish a swale, thus facilitating the enhanced retention of runoff in the respective construction area. Stilling ponds established will be permanent (life of development at minimum). Flow control devices such as weirs and baffles will facilitate achieving better attenuation, particularly when considering fluctuating runoff rates.
- In line Check Dams will be constructed across drains **EIAR Chapter 9 – Appendix 9.7 – Tile no.–3 - 6**. Check dams will reduce the velocity of run-off in turn promoting settlement of solids upstream of the dam. Check dams will also reduce the potential for erosion of drains. Rock filter bunds may be used for check dams however, wood or straw/hay bales can also be used if properly anchored. It is recommended that multiple check dams are installed, particularly in areas immediately downgradient of construction areas. Check dams will only be constructed in drainage infrastructure and not in significant surface water features i.e. streams or rivers. Check dams (comprised of rock) established will be permanent. The following will be implemented in the design of check dams and their deployment (CIRA, 2004):

- Permanent rock filter bunds (coarse aggregate) will be used for check dams however, temporary wood or straw/hay bales can also be used if properly anchored and if the need arises. Permanent rock filter bunds are preferred as this will ensure that rapid surface water runoff is mitigated against for the life of the Proposed Development.
- Check dams will be installed at c. 20 m intervals within the length of drainage channels. This is dependent on the slope angle and height of check dams constructed, refer to **EIAR Appendix 9.7 – Tile no. 3**.
- Check dams will include a small orifice / pipe at the base to allow the flow of water during low flow conditions i.e. maintain hydrological regime during low flow conditions. Note: the use of coarse aggregate will facilitate some infiltration.
- Erosion protection will be established on the downstream side of the check dam i.e. cobbles or boulder (100-150 mm diameter) extending at least 1.2 m (**Appendix 9.7 - Tile no. 3 to 6**).
- Check dams will be constructed as part of the drain i.e. reduce the potential for bypassing between the drain wall and check dam.
- Further details and design considerations are presented in **Appendix 9.7 – Tile no. 3 to 6.**

* Surface water runoff will be discharged to land via buffered drainage outfalls, **Appendix 9.7 – Tile no. 12**. Buffered 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 acceptable levels any adjacent watercourses and avoiding direct discharge to the watercourse. A relatively high number of discharge points / buffered outfalls will be 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.
* Buffered drainage outfalls will be located outside of 50 m surface water buffer zones. wherever possible and any outfalls required within buffer zones will be part of and include stilling ponds and emergency intervention sumps for diversion of poor quality runoff to Active Management area of the treatment train (**Appendix 9.7**), Similarly, outfalls will not be positioned in areas with extensive existing erosion and exposed soils. Buffered outfalls will be fanned and be comprised of coarse aggregate (cobbles / boulders). These structures will be akin to rip raps (coastal erosion defences/ outfall erosion defences) **Appendix 9.7 – Tile no. 13**. Silt fences (discussed above) will be

established downstream of buffered outfalls with a view to ensuring the effectiveness of the attenuation train, particularly during elevated flow events. Buffered outfalls established will be permanent.

- Very fine solids, or colloidal particles, are very slow to settle out of waters and the finest of particles require near still water and relatively long periods of time to settle, therefore, such particles are unlikely to settle despite the aforementioned measures. To address this, as required flocculant will be used to promote the settlement of finer solids prior to redistributing to the treatment train and discharging to surface water networks. Flocculant 'gel blocks' are available and can be placed in drainage channels upstream of stilling ponds. Gel blocks are passive systems, self-dosing and self-limiting, however they still require management as per the manufacturer's instructions. Flocculants are made from ionic polymers. Cation polymers (positive charge) are effective flocculants, however their positive charge make them toxic to aquatic organisms. Anionic polymers (negative charge) are also effective flocculants, and are not toxic i.e. environmentally friendly [2]. Therefore, if flocculants are deployed the material used must be made from anionic polymer. Gel blocks will be a temporary measure during the construction phase **Appendix 9.7 – Tile no. 8 and 11**.
- Straw bales (similar to stone check dams) **Appendix 9.7 – Tile no. 13** and silt fences (discussed under diffuse runoff) **Appendix 9.7 – Tile no. 14** can also be used within drainage channels for the purposes of attenuating runoff and entrained suspended solids, however these measures should be considered temporary and will be used mainly in managing potential acute contamination incidents (e.g. additional features to control runoff during excavation works) or to facilitate temporary works (e.g. corrective actions, discussed in later sections). Note; the installation of straw bales or silt fences will require special attention to ensure bypassing is minimised. Coarse stone / boulders could be used in conjunction with these measures to address such issues.
- Attenuation lagoons are in principal akin to stilling ponds but larger in scale and potentially permanently hold water (a pond). Attenuation lagoons will collect all runoff at the site before being discharged outside of the site boundary, that is; the outfall of attenuation lagoons will likely be in relatively close proximity to mapped surface water features, but will be numbered sufficiently to ultimately aim to collect all runoff from the Development if practical – this implies detailed assessment of Development *micro catchments* with a view to collecting all runoff at the lowest point of each micro catchment (Micro catchments in line with Site areas used in water balance

[2] USEPA (2013) Stormwater Best Management Practice – Polymer Flocculation (Available at: http://www.siltstop.com/pictures/US_EPA_Polymer_Flocculant_Handout__3-14.pdf)

assessments in previous sections, however the drainage design accompanying the SWMP will require more detailed assessment of topography and Development drainage flow patterns which will identify suitable locations and quantities of lagoons). The scale of lagoons will be dependent on available space and site constraints, however the larger the lagoon the greater the potential for attenuation whereby flow rates are minimised and very fine solids settle out of solution. Presuming the upstream treatment train features are considered and installed adequately those features will remove gross solids from runoff, the role of the attenuation lagoon will be to ensure finer solids are given opportunity to settled out of suspension. Flow control devices will likely be required, particularly at restricted locations in terms of space available for constructed lagoons.

The above measures; constructed drainage, stilling ponds, check dams, attenuation lagoons etc. are referred to as The Treatment Train, whereby the runoff will continuously be treated from source (construction area) to receptor (site exit, outfall of attenuation lagoon).

These measures reduce the suspended sediment and associated nutrient loading to surface water courses and mitigates potential impacts to water quality and on plant and animal ecologies downstream of the site.

3.6.4 Release of Cement-Base Products

In order to mitigate the potential impact posed by the use of concrete and the associated effects on surface water in the receiving environment, the following precautions and mitigation measures are recommended:

- Precast concrete will be used wherever possible i.e. formed offsite. Elements of the Proposed Development where precast concrete will be used have been identified and are indicated in the CEMP. Elements of the Proposed 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 Proposed 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.
- Lean mix concrete will not be used.
- 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 of minimal precipitation. 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 (>3 mm/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.

3.6.5 Potential Release of Hydrocarbons during Construction and Storage

Release of Hydrocarbons Proposed Mitigation Measures

To control and contain any potential hydrocarbon and other harmful substances spillage by vehicles during construction, it is recommended where possible to refuel plant equipment off the development site, thus mitigating this potential impact by avoidance. However, given the remote nature of the Site, this is not likely to be a practical measure.

If fuelling must occur on site, then a discrete “fuel station” will be designated for the purpose of safe fuel storage and fuel transfer to vehicles. This fuel station will be bunded to 110% volume capacity of fuels stored at the site. The bunded area will be drained by an oil interceptor and drainage of same will be controlled by a pent stock valve that will be opened to discharge storm water from the bund. A suitably qualified management company will take responsibility for management and maintenance of the oil interceptor and associated drainage on a regular basis, including decommissioning following construction.

Despite the management of refuelling and fuel storage, there remains the risk of leakage from vehicles and plant equipment during construction activity. The plant equipment used on site will require regular mechanical checks and audits to prevent spillage of hydrocarbons on the exposed ground (during construction).

Oil (hydrocarbon) absorbent booms will be installed in all surface water features associated with the Proposed Development, downstream of each of the proposed construction areas, and at principal surface water features draining the Site. Two no. oil booms will be installed at each required location, this will facilitate changing out of booms if needed, without facilitating direct flow of floating product during such activities if present. Oil booms deployed will have sufficient absorbency relative to the hazard, for example; the volume of fuel in a particular construction vehicle.

In the event of an accidental spill during the construction or operational phase of the Proposed Development, contamination occurrences will be addressed immediately, this includes the cessation of works in the area of the spillage until the issue is resolved. In this regard, spill kits will be kept in each vehicle associated with the Proposed Development i.e. spill kits will be readily available to all operators. Spill kits will contain a minimum of; oil absorbent granules, oil absorbent pads, oil absorbent booms, and heavy-duty refuse bags (for collection and appropriate disposal of contaminated matter). No materials, contaminated or otherwise will be left on the Site. 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.

Once the above measures are implemented the risk of hydrocarbon contamination intercepting the surface water network will be significantly reduced, however there remains a level of risk, and therefore both precautionary measures and emergency response protocols will be established in **Management Plan 1: Emergency Response Plan** and **Management Plan 3: Surface Water Management Plan**.

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

3.7 AIR AND CLIMATE

Contractors Good practice site control measures include the following:

- Wind Farm Site access roads will be upgraded and built prior to the commencement of construction activities. These roads will be finished with graded aggregate which compacts, preventing dust.
- Approach roads and construction areas to and on the Wind Farm Site and Hydrogen Plant Site will be cleaned on a regular basis to prevent build-up of mud and prevent it from migrating around the sites and onto the public road network.
- Wheel wash facilities will be provided near the entrances to both sites to prevent mud/dirt being transferred from the site to the public road network.
- Public roads along the construction haul route will be inspected and cleaned daily. In the unlikely event that dirt/mud is identified on public roads, the road will be cleaned and the wheel wash facility will be investigated and the problem fixed to prevent this from happening again.
- During periods of dry and windy weather, there is potential for dust to become friable and cause nuisance to nearby residences and users of the local road network. This requires wetting material and ensuring water is supplied at the correct levels for the duration of the work activity. For example, weather will be monitored so that the need for damping down activities can be predicted. Water bowsers will be available to spray work areas (wind turbine area and grid connection route) and haul roads to suppress dust migration.
- Vehicles delivering materials will be covered appropriately when transporting materials that could result in dust, e.g., crushed rock or sand.
- Exhaust emissions from vehicles operating within the sites, including trucks, excavators, diesel generators or other plant equipment, will be controlled by the contractor by ensuring that emissions from vehicles are minimised through regular servicing of machinery.
- Ready-mix concrete will be delivered to the sites and no batching of concrete will take place on either site. Only washing out of chutes will take place on the sites and this will be undertaken at designated concrete washout facilities at show in **Figure 3.2** below.

- Speed restrictions on access roads will be implemented to reduce the likelihood of dust becoming airborne. Consideration should be given to how on-site speed limits are policed by the Site Foreman and toolbox talks should include this. Lower speed limits should be set for traffic on public roads also, to minimise nuisance to the general public.
- Stockpiling of materials will be carried out in such a way as to minimise their exposure to wind where possible. Stockpiles will be covered with geotextiles layering and damping down will be carried out when weather conditions require it.
- Earthworks and exposed areas/soil stockpiles will be re-vegetated to stabilise surfaces as soon as practicable.
- Methodology statements will be signed off by a suitably qualified Geotechnical Engineer. An independent, qualified Geotechnical Engineer will be contracted for the detailed design stage of the project and geotechnical services will be retained throughout the construction phase, including monitoring and supervision of construction activities on a regular basis.
- A complaints procedure will be implemented where complaints will be reported, logged and appropriate action taken.

3.8 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.

3.8.1 Mitigation

Construction Phase

- Ground works within the Redline boundary during the construction phase of the wind farm area will be subject to archaeological monitoring under licence by the National Monuments Service (DHLGH). An archaeological testing programme under licence by National Monuments Service shall be adopted at the greenfield areas within the Redline boundary for the proposed access road and hydrogen plant. This programme will be undertaken in advance of construction and will include targeted trenching of the former levelled vernacular settlement and lime-kilns within the design footprint. Should any material sub-surface remains be discovered, these shall be evaluated and recorded with written, drawn and photographic trench/section details.

- Given the ZoN and proximity to barrow SMR SL022-026---, licenced archaeological monitoring shall also extend to the domestic yard area at the proposed access road to the hydrogen plant. This shall be undertaken during groundworks associated the demolition and removal of existing outbuildings to site. A strict works exclusion zone shall also be adopted to ensure no access to the barrow monument is permitted during construction stage. A full written, drawn and photographic record of the vernacular outbuildings to the domestic yard area at the proposed access road will be undertaken prior to their removal.
- 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).
- A full written and photographic record of the court tomb RMP MA031-034--- located within the Site, to specifically include its monument setting, shall be undertaken for archival record purpose in advance of construction works. Furthermore, provision of a works exclusion zone via non-ground intrusive temporary fencing shall ensure that no construction related activities or tracking of machinery shall occur within the designated buffers assigned for court tomb RMP MA031-034--- which shall also account for a previously discovered area of potential archaeological sub-surface remains (burnt spread) (**EIAR Figure 14.12**).
- Licenced archaeological monitoring noted shall also extend to identified discreet sections of the UGC route at the location of a ringfort MA031-047--- and adjacent to a ringfort and children’s burial ground (MA031-023--- and MA031-023001-) as well as a short offline portion at the 110kV tie-in location at Rathreedaun/Bunnyconnellan West townland boundary.
- Works exclusion zones shall be applicable to the discreet areas outside the Redline boundary at the proposed hydrogen plant to ensure no inadvertent damage during construction stage to the undesignated cultural heritage features (turf stand and rock outcrop). In addition, due care and diligence will be exercised for all construction-related vehicular crossings for material haul routes at protected stone bridge RPS 428.

3.9 NOISE & VIBRATION

No significant construction noise effects have been identified. Therefore, no specific mitigation measures required. General guidance for controlling construction noise through the use of good practice given in BS 5228 will be followed. During construction, activity shall be limited to daytime, except where delivery of large transport loads such as turbines, where it may be necessary to transport outside of daytime hours. The Proposed Development has been designed to comply with the Wind Energy Development Guidelines 2006. 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.

All turbines have STE fitted as standard to reduce noise emission levels. No other mitigation is considered necessary. Any legislation, guidance or best practice relevant at the time of decommissioning should be complied with.

3.9.1 Hydrogen Plant

No significant construction effects have been identified. General guidance for controlling construction noise through the use of good practice given in BS 5228 will be followed. During construction of the development, activity generated noise shall be limited to daytime guidance given in the NRA guidelines, except where delivery of large transport loads such as the turbines, where it may be necessary to transport outside of daytime hours.

There are number of mitigation measures to be incorporated into the design of the site:

- The metal clad insulation within the Electrolyser Building will have a minimum Rw of 35dB
- The enclosure to the fin fans will reduce the noise level by 12dB, or alternatively low noise designs with low face velocities with an increase in surface area could also be considered
- The housing envelope enclosing the Compressor and Standby Compressor will have a minimum Rw of 25dB

The Hydrogen Plant has been designed to comply with a low background site according to the EPA's NG4 guidelines.

3.10 TRAFFIC

3.10.1 Construction Phase Mitigation

The potential effects of the construction of Proposed Development have been identified as being potentially high but temporary in nature. The following mitigation measures are recommended:

- A Traffic Management Plan (TMP) has been developed (see Management Plan 7 attached to the CEMP). Prior to construction and once the Contractors have confirmed their suppliers, the TMP will be updated in consultation with Sligo County Council and Mayo County Council and An Garda Síochána as necessary. HGV trips will be scheduled to avoid times when drop offs and pick-ups generally take place at schools, particularly at Stokane on the L2604. All drivers will be made aware of the location and presence of schools and other sensitive receptors at an induction session prior to construction activities taking place and will be made aware of the speed limits of the various roads on the route which are contained in the TMP. This is to ensure compliance with speed limits and school drop off and pick-up zones.
- All significant traffic likely to be generated by Firlough Wind Farm will be during the construction of the Proposed Development and will be temporary in nature. It is envisaged that the construction period for the wind farm will span a 21-month period with the underground cable being installed over a concurrent 12-month period. The construction-phase Traffic Management Plan will mitigate these impacts.
- Use special transporter vehicles with rear wheel steering in delivery of wind turbine components to ensure safe transportation and manoeuvrability on the roads. Extendable transporter vehicles will be retracted on return journeys.
- Prior to delivery of abnormal loads i.e. turbine components, the Applicant or their representatives, will consult with An Garda Síochána and Sligo County Council and Mayo County Council Roads Departments to discuss the requirement for a Garda escort.
- The Developer will confirm the intended timescale for deliveries and every effort will be made to avoid peak times such as school drop off times, church services, sporting events, peak traffic times where it is considered this may lead to unnecessary disruption.
- Abnormal loads are likely to travel at night and outside the normal construction times as may be required by An Garda Síochána. Due to the distance between Killybegs Port and the Site of c.148 km, the journey is achievable within a 4-5 hour timeframe and the distance between Galway Port and the Site of c 178, the journey is achievable within a 5-6 hour timeframe. Accordingly, locations for resting will not be required. Local

residents along the affected route will be notified of the timescale for abnormal load deliveries.

- The Developer will lodge a bond with Sligo County Council and Mayo County Council prior to commencement of construction in the amount to be agreed with the Council for the possible repair/upkeep of the roads. During the construction period, these roads will be inspected weekly by the Developer's Resident Engineer and the Contractor will be instructed to repair any defects within the following two weeks. At the end of the construction period, any further defects will be remedied to the satisfaction of Sligo County Council and Mayo County Council.
- Wheel cleaning equipment will be used at the exit to the wind farm site and hydrogen plant Site 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.
- The Site entry points will also be appropriately signed. Access to the wind farm and hydrogen plant construction Sites 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.
- 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 will be employed.
- To reduce dust emissions, vehicles transporting crushed stone will be covered during both entrance and egress to the Site.
- A survey of the turbine component haul route will be undertaken prior to commencement to identify if any new overhead lines or broadband lines will need to be lifted along the route to allow abnormal loads such as tower sections and nacelles to be delivered.
- During the construction phase, clear construction warning signs will be placed on the L2604, L1102, L66121, L6612 and L5136 as necessary, which will advise road users of the presence of a construction Site and of the likelihood of vehicles entering and exiting the Site or road construction areas. This will help improve road safety.
- Works on public roads on the turbine delivery road and grid connection will be strictly in accordance with "Guidance for the Control and Management of Traffic at Road Works

– 2nd Edition 2010" as well as "Traffic Signs Manual 2010-Chapter 8- Temporary Traffic Measures and Signs at Roadworks".

- Road Closures will be obtained for grid connection and interconnector works on narrow public roads with passing bays available. A number of options are available in some areas for diverting traffic that will allow flexibility during construction. When the interconnector is under construction on the L6612, then the L1102 may be utilized to divert traffic. For the grid connection works within the L1102 and L5136, passing bays can be utilized. While traffic diversions are in place, local access will be maintained at all times. All access points (domestic, business, farm) will be considered when finalising the proposed road closures and diversions. Additional measures such as local road widening, traffic shuttle systems and 'Stop-Go' systems will also be considered subject to agreement with Sligo County Council and Mayo County Council. Road closures will be scheduled in consultation with local residents and the Contractor shall endeavour to avoid times of high agricultural activity e.g. silage cutting.
- The widening/straightening of haul route L2604 is proposed to be completed in advance of road closures.
- The L1102 and the L66121 shall not be closed at the same time i.e. one should remain open while the other is closed.
- Road Opening Licences will be obtained for the grid connection trench and chambers within public roads as well as for the widening of public roads.
- 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 25 km/h shall apply to all vehicles within the wind farm site.
- Provide a footpath adjacent to the upgraded carriageway where works are being undertaken. This footpath should provide a safe method of permitting pedestrians to access the pre-exiting carriageway at the terminations of the works.
- Ensure all visibility envelopes are kept clear of high vegetation.
- Provide visibility splays set back a suitable distance from the yield line.
- Replace the RUS 001 sign with RUS 006.
- Provide signage opposite each entry arm.
- Provide a uniform radius from the roundabout entry to the exit.
- Reinstate any speed limit signs removed by the works.
- Replace the RRM017 with RRM001.
- Redesign this arm or roadside treatment to enable road users to differentiate this private access from the public ones.

3.11 WASTE

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

3.11.1 Mitigation

- The Contractors will avoid or minimise the volume of waste generated.
- Waste will be stored a minimum of 50 m from nearby watercourses or drains at the designated waste storage areas show in **Figure 3.2**.
- 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 disposal site. The nearest licenced waste facility is over 20 km to the west of the Wind Farm Site at Killala Road, Rathroeen, Ballina, Co. Mayo (Civic Amenity Services). Excavated material along the Grid Connection Route will be removed to a licenced waste facility. 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)[3]
    - Information on the quantity and nature of the waste and how it is contained
    - Names and addresses of the transferor at Firlough Wind Farm and Hydrogen Plant (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)

[3] https://www.epa.ie/publications/monitoring--assessment/waste/2019--FULL-template.pdf

    - 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)
- 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**.

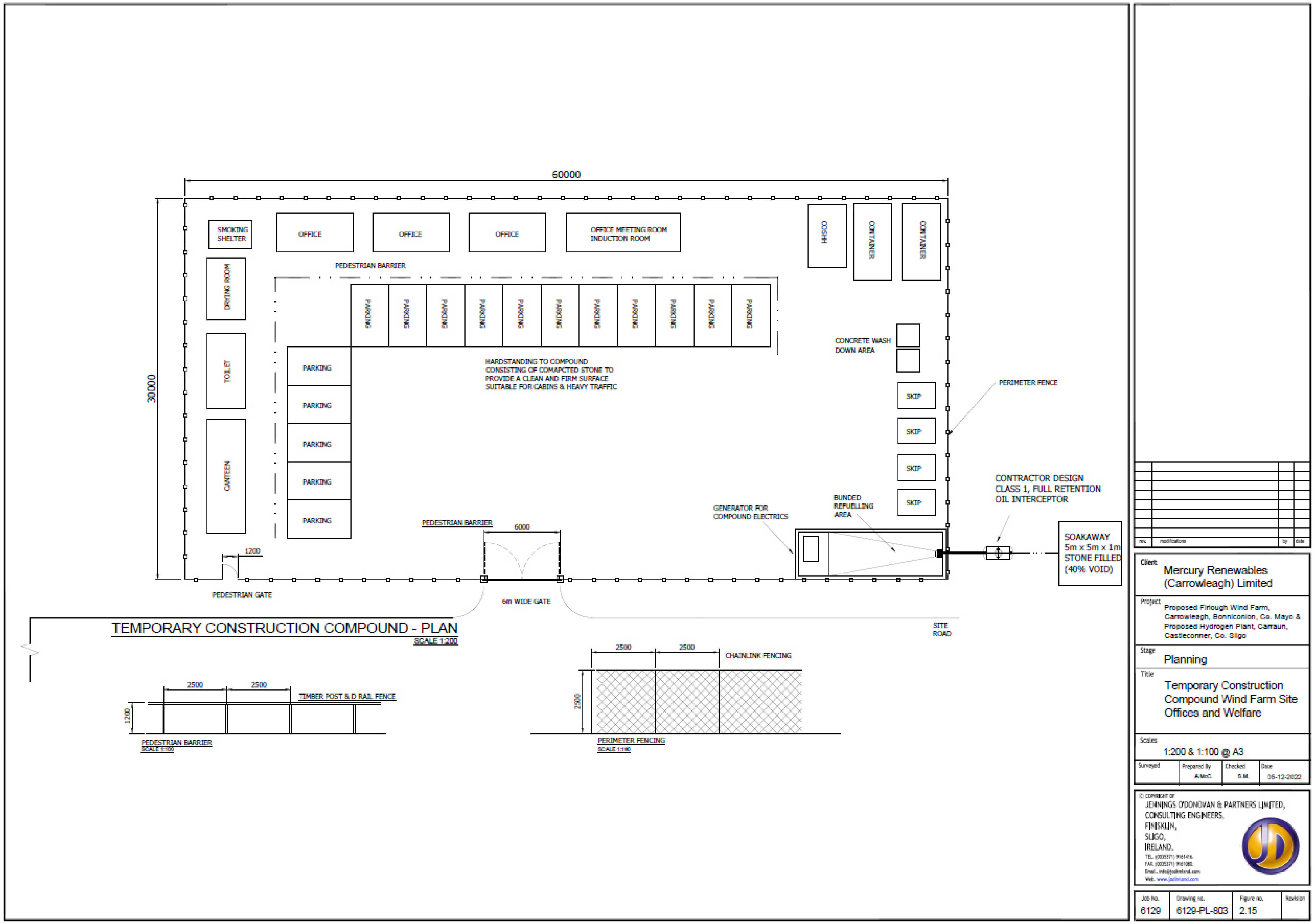


Figure 3.2: Contractors' Temporary Compound Plan (Excerpt from Drawing No. 6129-PL-803)

3.12 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.

3.12.1 Phasing of Works

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

3.12.2 Working Hours

The Proposed Development will have approximately 100-150 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 06:00 to facilitate turbine foundation construction and so that lifting operations are completed safely. Hours of working for turbine foundation construction will be agreed with Mayo 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 are in place with all suppliers coming to the Proposed Development.

3.12.3 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 (ECoW) and will be agreed with the appropriate parties, including Mayo County Council and Sligo 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.

3.12.3.1 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.

3.12.3.2 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 Proposed Development shall be set out by GPS (Real-Time Kinematicenabled[4]) 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

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

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

Within the wind farm Site, existing access tracks will require reinforcement. As the surrounding area is blanket bog, no borrow pits will be utilised during construction and all construction material will be imported to site.

3.12.3.3 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 65 m 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 Peat and 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.

3.12.3.4 Site Preparation

Entrance Formation

From Killybegs Port, County Donegal, turbine nacelles, tower hubs and rotor blades will be transported to the N56 some 4.0 km north-east of the harbour. The route primarily follows the national road network namely the N56, N15, N4 and N59 before turning left onto the local road L2604 towards the Site entrance.

Construction materials are proposed to be delivered via the N59 and the Development Sites.

Please refer to **Figure 3.3** illustrates the location of the Site entrances.

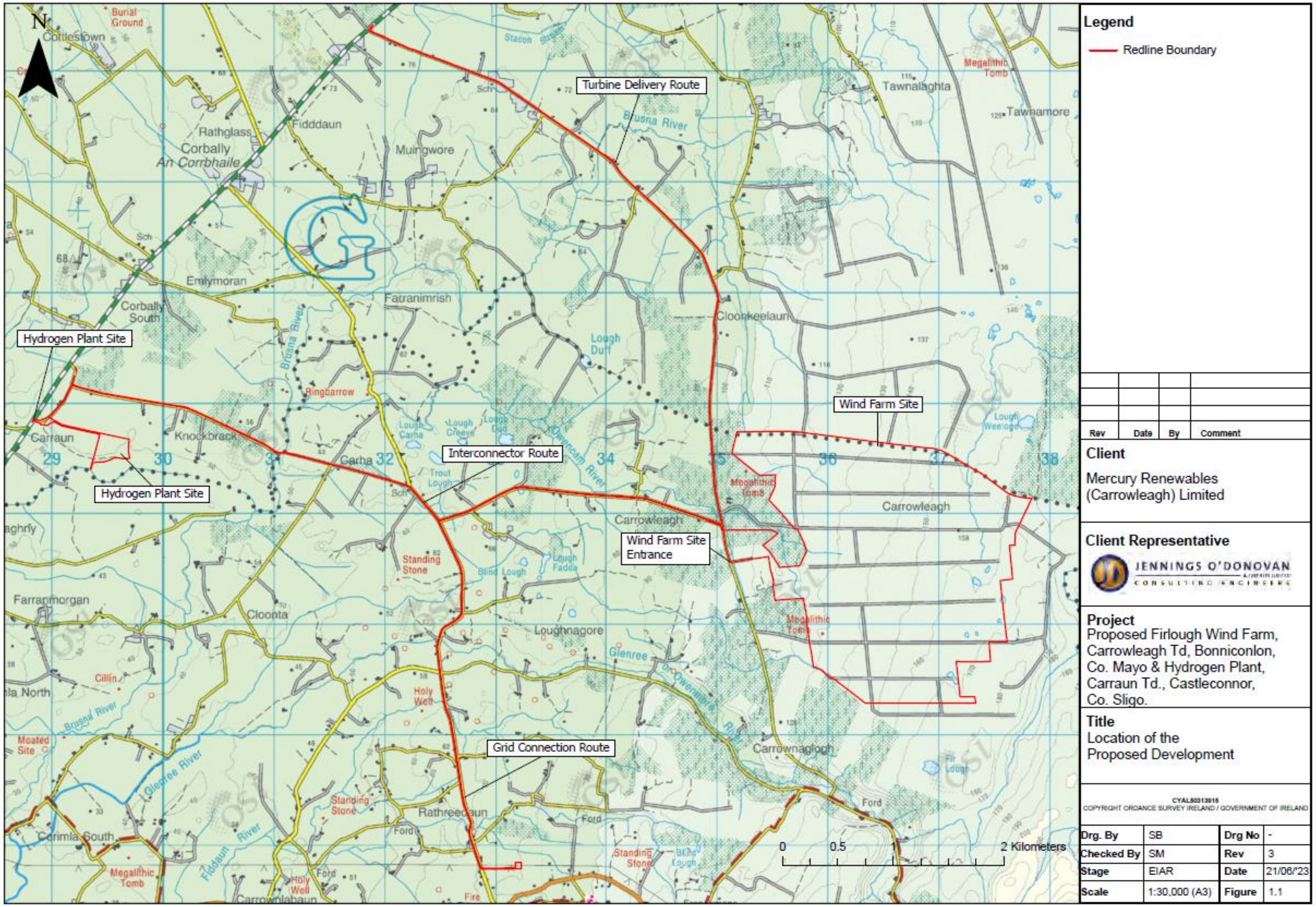


Figure 3.3: Map showing the proposed location of site entrances at Firlough Wind Farm.

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 into the site;
- 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 Sligo and Mayo County Councils and An Garda Síochána and implement.	The Contractors will agree an approved TMP with the Roads Section at Sligo and Mayo County Councils 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

Activity	Notes
accommodate the visibility splays.	visual impact.
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 peat and 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 Sligo and Mayo County Councils.
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 150 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.

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	Foul drainage from site welfare accommodation will discharge to a holding tank. The holding tank

Activity	Notes
accordance with the construction drawings. The site office will be located in the temporary storage area.	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.
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.

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 main site access point(s);
- Signage; and
- Signing in/out procedures.

3.13 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 Peat and Spoil Management Plan.
- Topsoil stockpiles shall be no more than 1 m 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.
- Monitor all rock breaking activities and survey areas for indicators of peat/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 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 1.0 m along access tracks.	Prevent movement of stored material and protect watercourses.
Excavated material will not be stored in areas which have been identified	Prevent movement of stored material and protect watercourses against harmful run offs.

Activity	Notes
as unsuitable for spoil storage.	
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; 2) Handle material; 3) Permanently store material	Return and re-vegetate the Site to its original state as soon as possible.
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.

3.13.1 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. However, where peat is encountered, it will be increased to 26.5 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.
    - 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 wind farm roads, the construction method will be Cut and Fill.

3.13.2 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 topsoil 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. 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.

3.13.3 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 **Management Plan 3: Surface Water Management Plan** and **Management Plan 2: Water Quality Management 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 150 mm diameter and increased to 300 mm 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 to see that there is sufficient flow connecting the upstream and downstream habitats. These will be inspected by the 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 and Ecological Clerk of Works prior to site clearance activities taking place on-site.

There are three proposed water crossings on site and the methodologies are discussed in **Management Plan 2: Water Quality Management Plan**.

3.13.3.1 Borrow Pits

No borrow pits are proposed for The Proposed Development.

3.13.3.2 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[5]. 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 900 m^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 +/- 1 m. The turbine foundation is estimated to be up to 3.3 m deep and therefore the formation level is up to 3.3 m below existing ground level.

[5] Draft Revised Wind Energy Development Guidelines, December 2019, [Accessed Online 17/02/2023 file:///C:/Users/abyrne/Desktop/Wind%20Energy%20Guidelines.pdf]

Plate 3.1: Turbine foundation under construction with adjoining crane pad[6]

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

- **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.

[6] Good Practice during Wind Farm Construction, 2019. Online: https://www.nature.scot/doc/guidance-good-practice-during-wind-farm-construction [Accessed 17/02/2023]

Plate 3.2: Wind turbine foundation[7]

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

[7] https://www.grousemountwindfarm.ie/documents/downloads/EIS%20Vol%201%20-%20Section%203%20-%20Text%20-%20Project%20Implementation.pdf [Accessed 17/02/2023]

Activity	Notes
	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 1 m 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.	
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	

Activity	Notes
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]

3.13.3.3 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 proposed Turbine Hardstand design is shown on **Figure 3.4**.

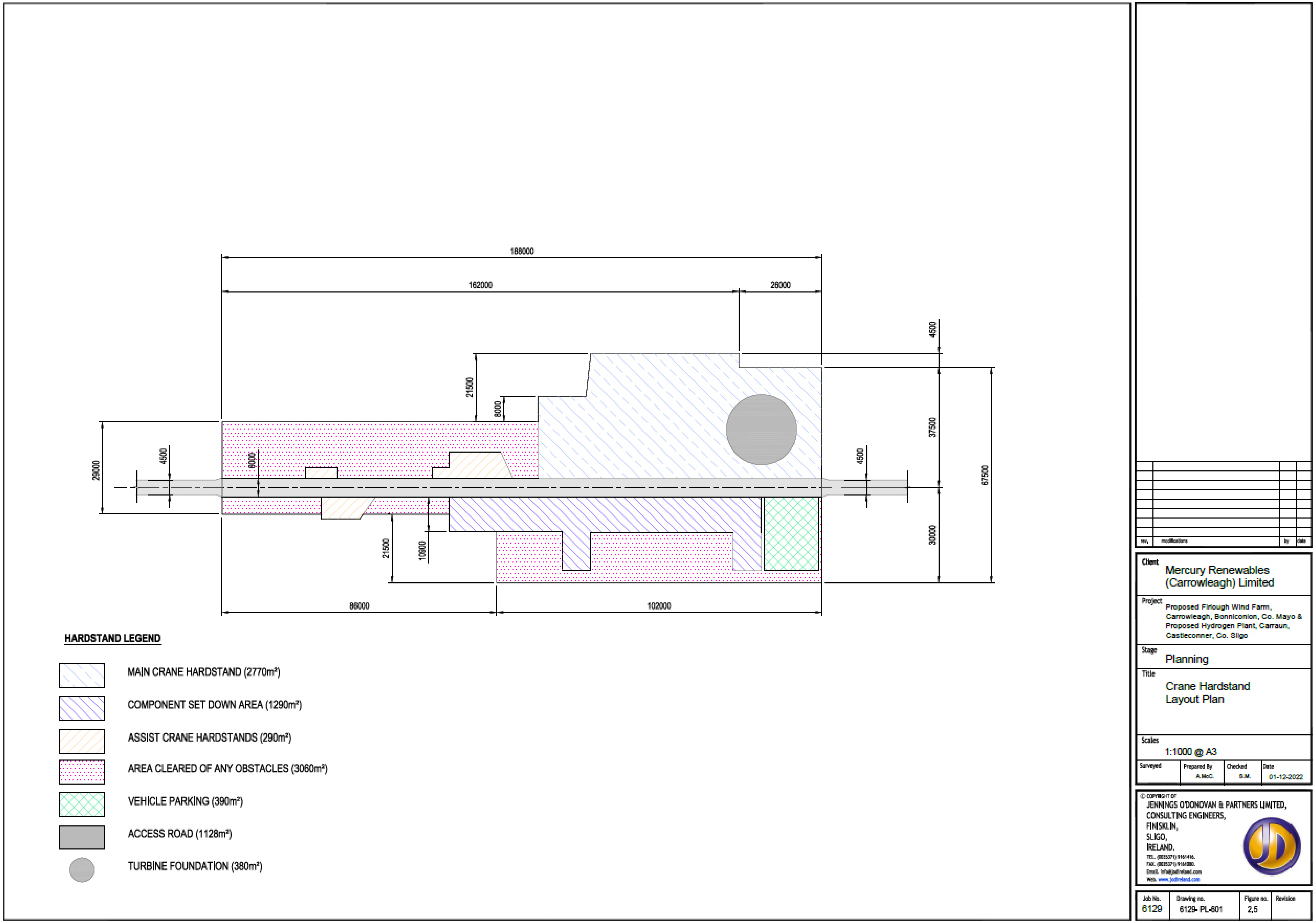


Figure 3.4: Crane Pad Hardstand Design (Excerpt from Drawing No. 6129-PL-601)

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 in accordance with the attached Peat and 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.	In areas of peat only 'bog master' low ground pressure excavators will be used to minimise the impact on the vegetation layer. 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 the amorphous peat and /or inorganic spoils that will have to be deposited at the nearest suitable location to the excavation.
Excavate remaining material to	Selected excavated organic material will be

Activity	Notes
1 m depth and segregate organic material from mineral material.	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. 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]

3.13.3.4 Handling/Disposal of Excavated Material

Details of spoil management methodology are outlined in the attached Peat and Spoil Management Plan. Excavated soil will be used for landscaping.

3.14 TRAFFIC MANAGEMENT

Traffic management mitigation measure for the construction phase are detailed in Section 3.10.1 and a Traffic Management Plan (CEMP Management Plan 7) has been prepared for the construction phase.

3.15 PLANNING CONDITIONS AND OUTLINE METHOD STATEMENTS

This CEMP and its future versions/revisions will form part of the Contract for Firlough Wind Farm. It will therefore be updated and revised during the different stages of the Proposed Development. Where the project is granted planning permission all the planning conditions associated with the Planning Application, applicant Mercury Renewables (Carrowleagh) Limited will be listed in **Table 3.6**.

Table 3.6: Relevant Planning Conditions and Related Documentation

Condition No.	Planning Condition	Reason
Planning Ref:		

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.

3.16 SCHEME AMENDMENTS

Scheme Amendments will be recorded in **Table 3.7**. 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 Mayo and Sligo County Council. For example, amendments to layouts or in accordance with the current grant of planning permission.

Table 3.7: Scheme Amendments

Reference	Date	Scheme Amendment Description	Environmental Sensitivities potentially

3.17 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 3.8**, 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 3.8**.

Table 3.8: 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 Mercury Renewables (Carrowleagh) 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
Mercury Renewables (Carrowleagh) Limited	Client Project Manager		
Contractors	Site Manager / EM		
Contractors	Contracts Manager		
Contractors	General Manager		
Contractors	Foreman		
Mercury Renewables (Carrowleagh) 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 Mayo County Council and Sligo 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
Final Environmental Report	Upon completion of construction	The final report will document the environmental and ecological effects of the construction period. The	The Final Report will be prepared by the Ecological Clerk of Works. The report will be made available to

Meeting/ Report	Schedule/ Frequency	Scope & Objective	Attendees/Responsibilities
	works	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 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 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	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
		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. • 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 Mercury Renewables (Carrowleagh) Limited at any time during the works. Audit procedures and forms are included within Section 4 and MP1. These will be followed /

Meeting/ Report	Schedule/ Frequency	Scope & Objective	Attendees/Responsibilities
			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 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 the relevant authorities, 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 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

Position	Roles and Responsibilities
	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. • 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.

Position	Roles and Responsibilities
Ecological Clerk of Works and/ or Water Quality Specialist	The Ecological Clerk of Works will work with Mercury Renewables (Carrowleagh) 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. • 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.

Position	Roles and Responsibilities
	• 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 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, 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

Position	Roles and Responsibilities
	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 active construction 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. • 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	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

Position	Roles and Responsibilities
Consultant	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]

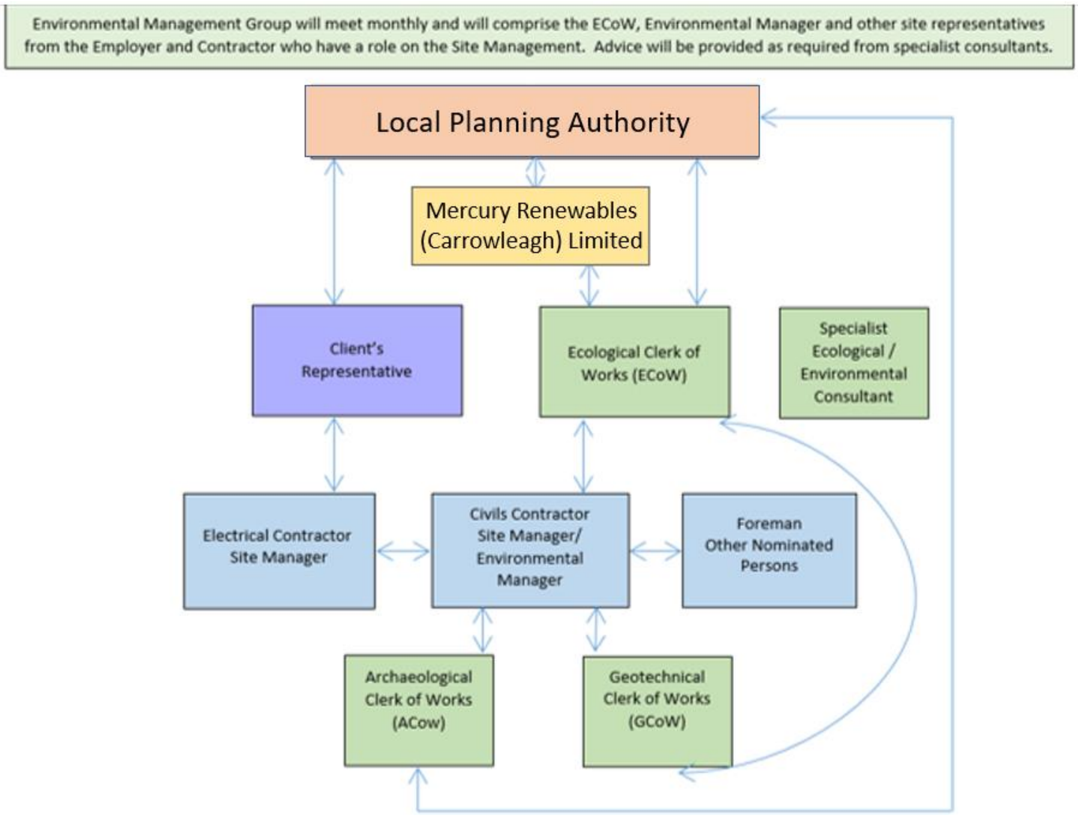


Figure 4.1 General Communication Plan

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, Sligo and Mayo

County Council will be informed immediately. In the case of water pollution, in addition to Sligo and Mayo 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 Mercury Renewables (Carrowleagh) Limited's 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	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	Peat and Spoil Management Plan	The Peat and Spoil Management Plan has estimated the volume of spoil that will be

No.	Name	Details
		generated during the construction phase and it outlines the locations where the material can be re-used on site. The Peat and 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 Plans

MERCURY RENEWABLES (CARROWLEAGH) LIMITED

FIRLOUGH WIND FARM, CO. MAYO

AND

HYDROGEN PLANT, CO. SLIGO

CONSTUCTION ENVIRONMENTAL MANAGEMENT PLAN (CEMP)

MANAGEMENT PLAN 1

EMERGENCY RESPONSE PLAN

JUNE 2023

Mercury Renewables (Carrowleagh) Ltd,
Coolcronan House,
Coolcronan,
Foxford,
Co. Mayo,
Ireland.

Jennings O'Donovan & Partners Limited,
Consulting Engineers,
Finisklin Business Park,
Sligo.
Tel.: 071 9161416
Fax: 071 9161080
email: info@jodireland.com

JENNINGS O'DONOVAN & PARTNERS LIMITED
Project, Civil and Structural Consulting Engineers,
FINISKLIN BUSINESS PARK,
SLIGO,
IRELAND.

Telephone (071) 91 61416
Fax (071) 91 61080

Email info@jodireland.com
Web Site www.jodireland.com

DOCUMENT APPROVAL

PROJECT	Firlough Wind Farm and Hydrogen Plant	
CLIENT / JOB NO	Mercury Renewables (Carrowleagh) Limited	6129
DOCUMENT TITLE	Construction Environmental Management Plan (CEMP) Emergency Response Plan	

	Prepared by	Reviewed/Approved by
Document Final	Name Sarah Moore Aileen Byrne	Name David Kiely
Date June 2023	Signature	Signature

MANAGEMENT PLAN 1: EMERGENCY RESPONSE PLAN

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 Firlough Wind Farm and Hydrogen Plant.

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 Firlough Wind Farm and Hydrogen Plant. 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
- Traffic Management Plan
- Decommissioning 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

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

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

Please see CEMP – Management Plan 4 – Peat Spoil Management Plan of storage locations for excavated materials. 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 Mayo County Council and Sligo County Council or Inland Fisheries Ireland (IFI).

6.1.4 Fire

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

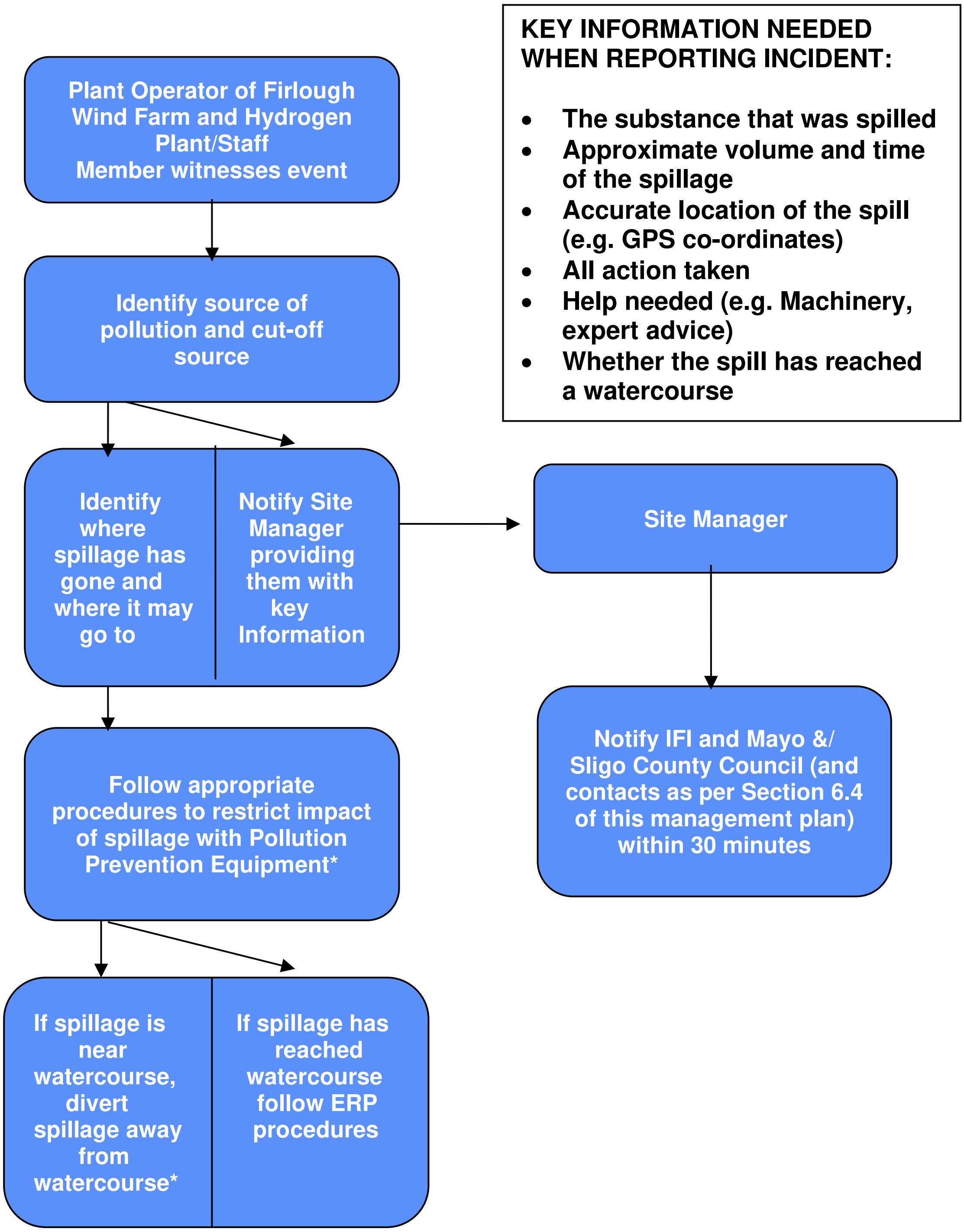
In the unlikely event of ice throw from blades, all activities in the area will cease and site personnel will stand clear of turbines where possible until they have been shut down completely.

6.1.6 Vandalism

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 Firlough Wind Farm and Hydrogen Plant

<table>
<tr><th colspan="2">INCIDENT RESPONSE PLAN FOR FIRLOUGH WIND FARM AND HYDROGEN PLANT
Based on template provided in GPP 21 – Pollution Prevention Guidelines.</th></tr>
<tr><td>Site Address:
Firlough Wind Farm, Carrowleagh, Co. Mayo
Firlough Hydrogen Plant, Carraun, Castleconnor, Co. Sligo.

Official Company Address:
Mercury Renewables Limited,
Coolcronan House,
Coolcronan,
Foxford,
Co. Mayo,
Ireland.
00 44 7836 556 964

KEY HOLDERS FOR SITE – NAME & CONTACT NUMBERS:</td><td>ITM: 536,530 E, 821,588 N

Map references: OSI Discovery Sheet 24

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 Bunnyconnellan Ballina	 096 45002 096 20560	
Local Hospital. Mayo University Hospital Sligo University Hospital	 094 9021733 071 9171111	
Environment Department, Sligo County Council, County Hall, Riverside, Co. Sligo. Environment, Climate Action & Agriculture Department, Second Floor, Mayo County Council, Áras an Chontae, The Mall, Castlebar, Co. Mayo.	071 9111457 094 9064000	
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:	
Firlough Wind Farm/ Hydrogen Plant 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:	
Firlough Wind Farm/Hydrogen Plant 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 50m 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 50m 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?				

Item	Questions	Yes	No	Corrective Action Required	
				Action	By
3.15	If wet wheel washing facilities are required, are these closed systems with no discharge to the water environment?				
3.16	Are there laboratory certificates (accredited by the Irish National Accreditation Board) to confirm that imported material stone aggregate brought onto site is free from any contamination?				
4. Noise, Dust 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)?				

Item	Questions	Yes	No	Corrective Action Required	
				Action	By
5.10	Is there any evidence of burning on site?				
5.11	Is there any evidence of unlicensed burial of waste?				
6. Water					
6.01	Do all discharges to land or watercourses have appropriate 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)?				

Item	Questions	Yes	No	Corrective Action Required	
				Action	By
6.14	Are there any sign of decaying straw bales in water courses? (this could lead to organic pollution of the water course)				
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				

Item	Questions	Yes	No	Corrective Action Required	
				Action	By
	responsibilities on site been delivered? Have attendance record been maintained for these?				
9. Documentation Check					
9.01	Start-up meeting record				
9.02	Full contacts list in Section 4, Table 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):				

MERCURY RENEWABLES (CARROWLEAGH) LIMITED

FIRLOUGH WIND FARM, CO. MAYO

AND

HYDROGEN PLANT, CO. SLIGO

CONSTUCTION ENVIRONMENTAL MANAGEMENT PLAN (CEMP)

MANAGEMENT PLAN 2

WATER QUALITY MANAGEMENT PLAN

JUNE 2023

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ENVIRONMENT ISO 14001:2015 NSAI Certified
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DOCUMENT APPROVAL

PROJECT	Firlough Wind Farm and Hydrogen Plant	
CLIENT / JOB NO	Mercury Renewables (Carrowleagh) Limited	6129
DOCUMENT TITLE	Construction Environmental Management Plan (CEMP) Water Quality Management Plan (WQMP)	

	Prepared by	Reviewed/Approved by
Document Final	Name Sarah Moore Aileen Byrne	Name David Kiely
Date June 2023	Signature Sal Moore Aileen Byrne	Signature David Kiely

MANAGEMENT PLAN 2: WATER QUALITY MANAGEMENT PLAN

CONTENTS

1 INTRODUCTION

1.1 Scope and Requirements

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.

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.

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

1.2 Reference Documentation

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 65m 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.

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

- Firlough Wind Farm, Co. Mayo and Hydrogen Plant, Co. Sligo, Environmental Impact Assessment Report (EIAR), June 2023
- Firlough Wind Farm and Hydrogen Plant, Natura Impact Statement (NIS), June 2023
- Firlough Wind Farm, Co. Mayo and Hydrogen Plant, Co. Sligo, CEMP, June 2023

2 RESPONSIBILITIES

2.1 General

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.

Prior to works commencing, the Ecological Clerk of Works will be retained by Mercury Renewables (Carrowleagh) 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.

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.

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.

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.

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.

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

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.

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

2.3.2 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.

The final report will be provided to Mayo and Sligo County Councils and Inland Fisheries Ireland.

2.4 Contingency Sampling & Emergency Response

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.

Where a pollution incident has occurred as a result of construction works, the Ecological Clerk of Works and Mayo and Sligo County Councils 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).

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

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.

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.

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.

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

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

Baseline monitoring undertaken at the Proposed Development as part of this study will be repeated periodically i.e., before, during and after construction phase, to measure any deviations from baseline hydrochemistry that occur at the Site, including discharge rates and along watercourses.

3.2 Hydrochemistry Monitoring

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

As a minimum, the monitoring programme will include:

- The baseline monitoring will include groundwater samples taken from 4 no. locations at the proposed Wind Farm.
- 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.
- Weekly visual inspections and monthly field hydrochemistry monitoring.
- One round of post construction monitoring, to be agreed with Mayo and Sligo County Councils. Post construction will be defined as when the reinstatement phase is completed.
- 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 are three (3) proposed watercourse crossings within the proposed redline boundary of the Site and an additional 10 no. watercourse crossings were identified over significant drainage features associated with peat harvesting activities, as shown in **Figure 4.1** and listed in **Table 4.1**. The water crossings for the Site are shown on Figure 4.1.

Table 4.1. Details of Watercourse Crossings associated with the Proposed Development.

Watercourse Crossing No.	Description	ITM East	ITM North
WCC1	Existing Culvert	535655.0	822422.7
WCC2	Existing Culvert	535962.07	822192.53
WCC3	New Clear Span Bridge	535618.8	821488.6
WCC4	Existing Culvert	536307.9	820831.0
WCC5	Existing Culvert	536333.6	820511.8
WCC6	New Culvert	536248.3	821365.5
WCC7	Existing Culvert	536219.8	821696.3
WCC8	Existing Culvert	535928.1	822525.1
WCC9	New Culvert	537144.7	822336.6
WCC10	Existing Culvert	537155.3	822183.6
WCC11	New Culvert	536636.0	822009.3
WCC12	Existing Culvert	536906.3	821550.5
WCC13	New Culvert	535387.5	822742.1

* Only during construction phase

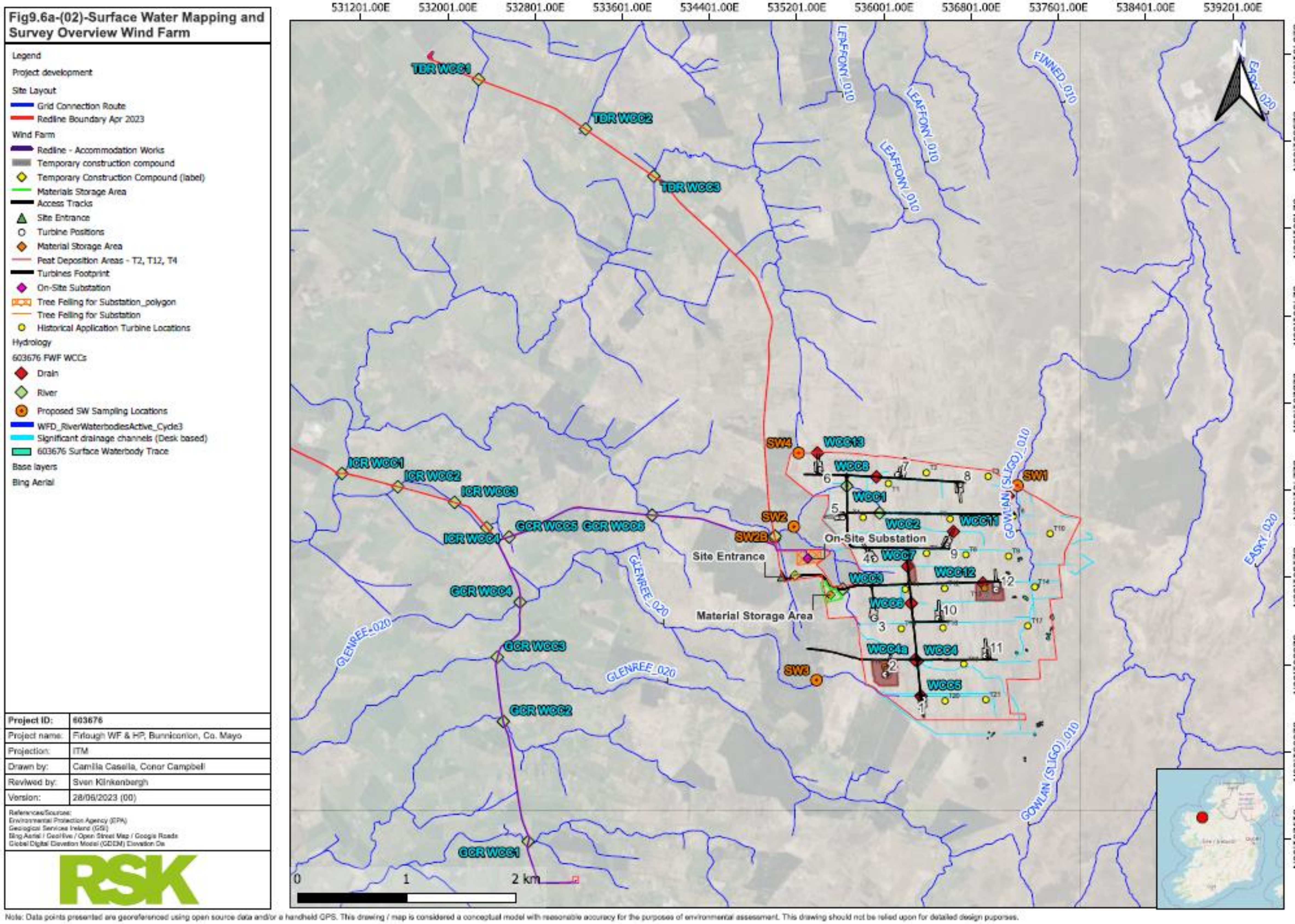
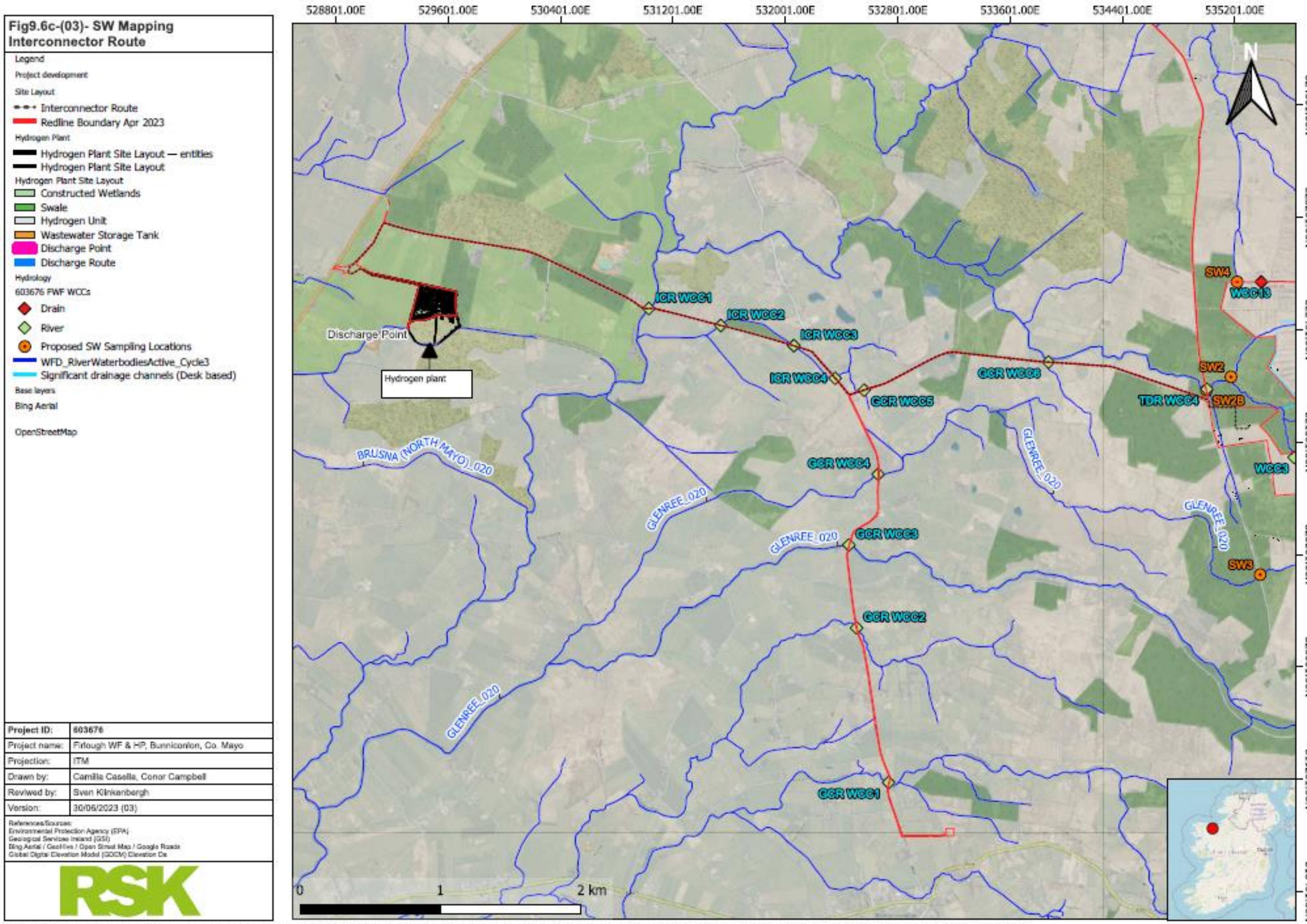


Figure 4.1: Watercourse crossings and Water Monitoring Locations



Note: Data points presented are georeferenced using open source data and/or a handheld GPS. This drawing / map is considered a conceptual model with reasonable accuracy for the purposes of environmental assessment. This drawing should not be relied upon for detailed design puporses.

Figure 4.2: Watercourse crossings and Water Monitoring Locations – Interconnector Route

Grid Connection

The Grid Connection Route will include up to 4 no. surface water crossings that were identified as part of the desk based study which will require Horizontal Directional Drilling methodology. The remaining water crossings will be crossed utilising either under or over culvert crossing methodology. Table 4.2 summarises the number of crossings and the location along the Grid Connection Route.

Table 4.2: Grid Connection Watercourse Crossings location

Grid Connection Watercourse Crossing No.	Description	ITM East	ITM North
GCR WCC1	HDD	532738.0	819171.9
GCR WCC2	HDD	532509.2	820278.8
GCR WCC3	HDD	532457.2	820870.0
GCR WCC4	HDD	532665.2	821361.9
GCR WCC5	Culvert	532571.2	821960.1
GCR WCC6	Culvert	533876.6	822171.4

The identified watercourse crossings along the proposed Interconnector Route as presented in Figure 4.2 include:

Interconnector Route

Interconnector Route Watercourse Crossing No.	Description	ITM East	ITM North
GCR WCC5	Culvert	532571.2	821960.1
GCR WCC6	Culvert	533876.6	822171.4
ICR WCC1	HDD	531027.8	822551.4
ICR WCC2	Culvert	531535.6	822437.5
ICR WCC3	Culvert	532067.2	822288.0
ICR WCC4	Culvert	532363.8	822055.4

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.

4.2.1 Clear Span Crossings

A clear span bridge will be installed at WCC3 as shown on Planning Drawing No. 6129-PL-305 (Appendix I). The clear span design is nominally segmented precast arch or similar and will avoid permanent disruption to the stream bed and banks, protecting fishery habitats.

- The crossing direction will be perpendicular to the stream direction, therefore minimising the length of stream affected.
- The crossing detailed design is to allow for the passage of out-of-bank flood flows within the clear span.
- The crossing location site has been informed by the hydrological analysis and identification of constraints to:
    - Be located in an area where bank slopes are shallow, thus reducing the potential for runoff to carry sediment into the watercourse.
    - Be located so as not to coincide with any incoming tributary streams.
- The structure will include ledges or areas of undisturbed riverbank to allow for the free passage of otters.

4.2.2 Culvert Crossings

- Works to install all crossings shall be programmed to coincide with a period of anticipated low drain flow and firm ground conditions in order to minimise potential for silt laden runoff draining toward the stream.
- For closed crossings (culverts) the channel will be dammed upstream of the proposed culvert location using sandbags or similar in order to provide a dry working environment at the culvert location. Dammed flows will be pumped out of channel and returning directly to the drain shortly downstream of the culvert location. Erosion protection shall be placed at the point of pump return. All

pumping will be controlled on a contractor permit-to–pump scheme, such that pumping operations can be carefully planned, installed and monitored.

- Geotextile silt fences shall be installed adjacent to the drain bank upstream and downstream of the culvert location in order to filter contaminated runoff that may be caused by plant movement associated with the culvert installation. A sequence (minimum 2 no.) in-channel geotextile check dams will be installed within the drain channel downstream of the culvert location and downstream of the pump-return.
- The culvert comprising pre-cast concrete or pre-formed plastic pipes shall be installed and backfilled with suitable aggregate. Headwalls and scour protection to the drain bed shall be formed at the culvert inlet and outlet using dry formed components (lean-mix concrete-filled sandbags or similar). Washed gravel or pebbles (including if feasible that material recovered from the natural substrate excavated to permit the culvert installation) shall be introduced to cover and protect the extent of the drain channel affected by excavations. No wet concrete or cementitious material shall be required to be used within the channel.
- Over pumping and upstream dams shall be removed and water permitted to pass through the culvert. Downstream in-channel filtration check dams shall be retained and renewed as necessary in order to trap sediment until any residual washout of sediment from the exposed excavation has stabilised to a normal (pre-construction) level.
- Geotextile or equivalent splash-guards shall be erected to the track embankment over the culvert or clear span crossing prior to trafficking.

4.2.3 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, Sligo and Mayo CCs will be frequently consulted during watercourse crossing construction, as agreed prior to the commencement of construction.

4.2.4 Mitigation Measures

Suspended solid pollution will be avoided by use of a clear span structures. Where a Clear Span Bridge is installed, its construction will follow IFI (2016) for works in or adjacent to watercourses.

Mitigation will include protection of the riparian bank structure, minimisation of sedimentation to the watercourse by use of silt fencing, sandbags or other sediment reducing measures, and minimisation of instream activity.

The following mitigation is proposed and is in line with IFI (2016) Guidelines on Protection of Fisheries during Construction Works in and Adjacent to Waters, in particular Section 6 – River and Stream Permanent Crossing Structures.

During the construction phase the appointed Contractor(s) shall ensure that:

- No works will take place within the 65m buffer zone of watercourses except for the clear span bridges, road development and drainage measures as detailed.
- Site compounds and temporary excavation areas will be located at a minimum distance of 65m from any watercourse. All drainage from these facilities will be directed through a settlement pond with appropriate capacity and measures to provide spill containment.
- All site drainage, as described in the **Management Plan 3: Surface Water Management Plan** and shown on associated drawings, will be directed through either sediment traps, settlement ponds and / or buffered drainage outfalls to ensure that total suspended solid levels in all waters discharging to any watercourse will not exceed 25mg/l (IFI, 2016). All construction site run-off will be channelled through a stilling process to allow suspended solids to settle out and through a spill-containment facility prior to discharge.
- Daily monitoring of all sediment traps and settlement ponds will be undertaken by the Ecological Clerk of Works to ensure satisfactory operation and/or maintenance requirements.
- The storage of oils, hydraulic fluids, etc., will be undertaken in accordance with current best practice for oil storage (Enterprise Ireland, BPGCS005).
- All machinery operating at the Site will be fully maintained and routinely checked to ensure no leakage of oils or lubricants occurs. All fuelling of machinery will be

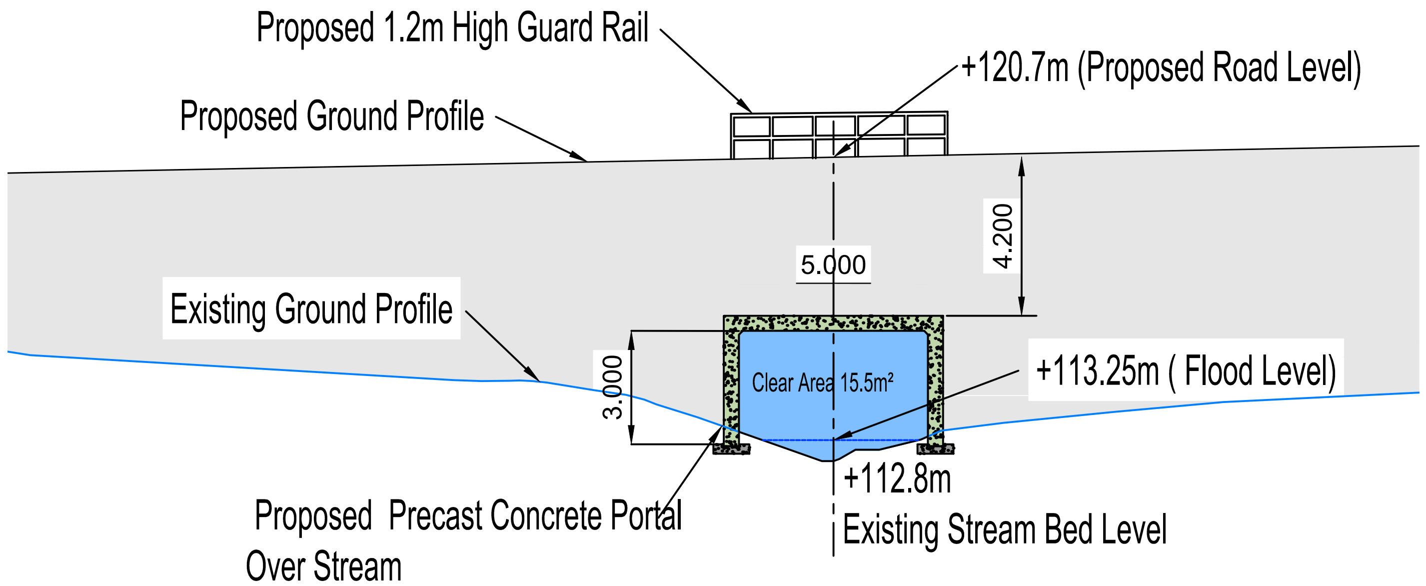
undertaken at a discrete "fuel station" designated for the purpose of safe fuel storage and fuel transfer to vehicles.

- Any extensions to existing drainage culverts on the site roads will be undertaken in dry conditions and in low flow conditions on drains that do not run dry.
- The pouring of concrete, sealing of joints, application of water-proofing paint or protective systems, curing agents, etc., will be completed in the dry to avoid pollution of the freshwater environment (see Chapter 9 for further details). There will be no batching or storage of cement allowed in the vicinity of any watercourse crossing construction area.
- Procedures (as detailed in **Chapter 9: Hydrology and Hydrogeology**) will be put in place to ensure the full control of raw or uncured waste concrete to ensure that watercourses will not be impacted.
- Should there be any incidents of pollution to watercourses, immediate steps as specified in the **Emergency Response Plan** (CEMP-Management Plan 1) will be undertaken to resolve the cause of the pollution and where feasible, mitigate against the impact of pollution.
- Re-seeding / re-vegetation of all areas of bare ground or the placement of Geo-jute (or similar) matting will take place prior to the start of the operational phase to prevent silt-laden run-off. The seed mix will contain only suitable native species of plant.
- Silt traps erected during the construction phase within roadside and artificial drainage will be replaced with stone check dams for the lifetime of the project. These stone check dams will only be placed within artificial drainage systems such as roadside drains and not in natural streams or drainage lines.
- A full review of construction stage temporary drainage will be undertaken by the Developer (in conjunction with the Project Hydrologist/Site Engineer and the Project Ecologist) following the completion of construction, and drainage removed or appropriately blocked where this will not interfere with infrastructure.

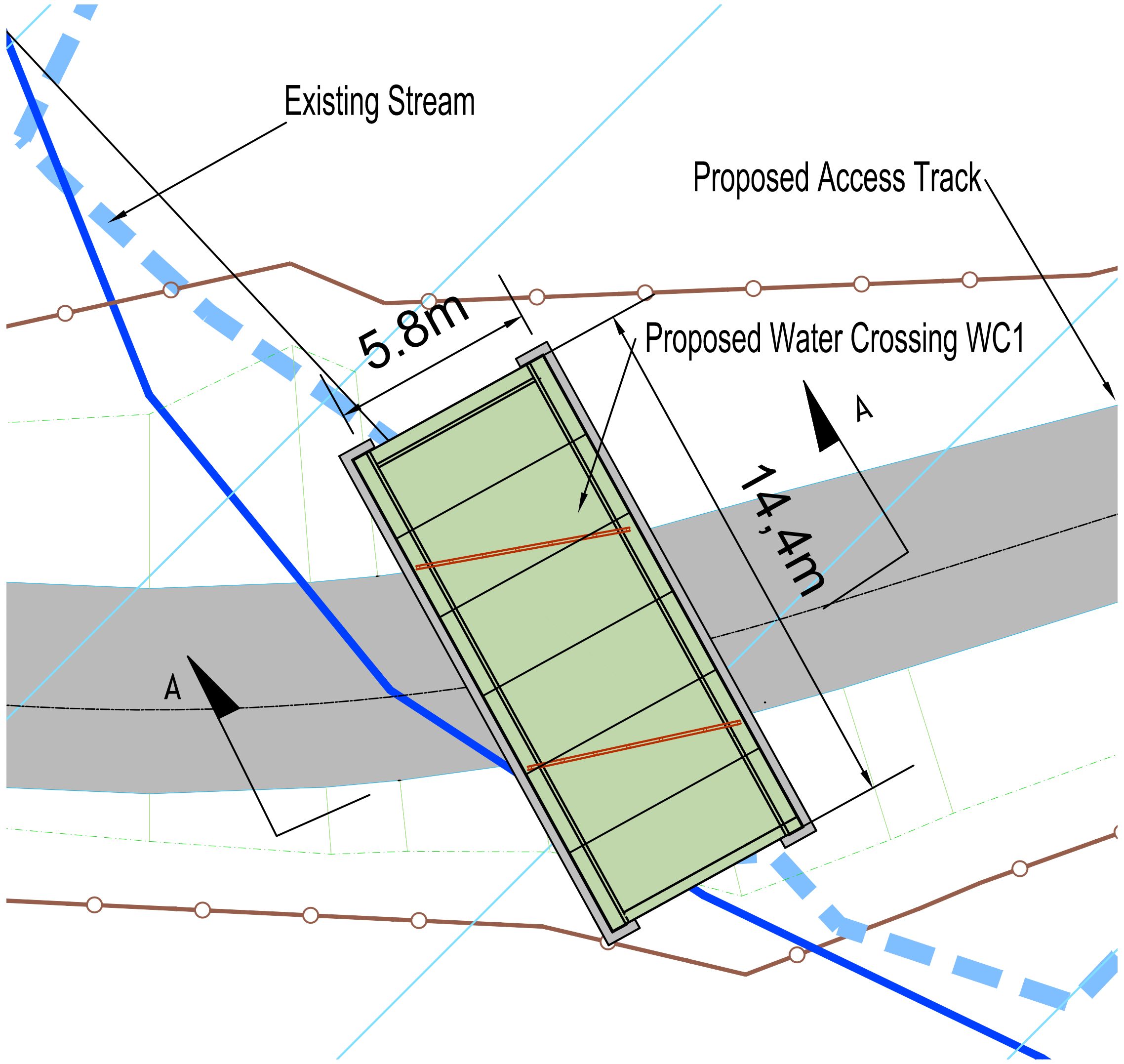
APPENDIX I

Design Drawings

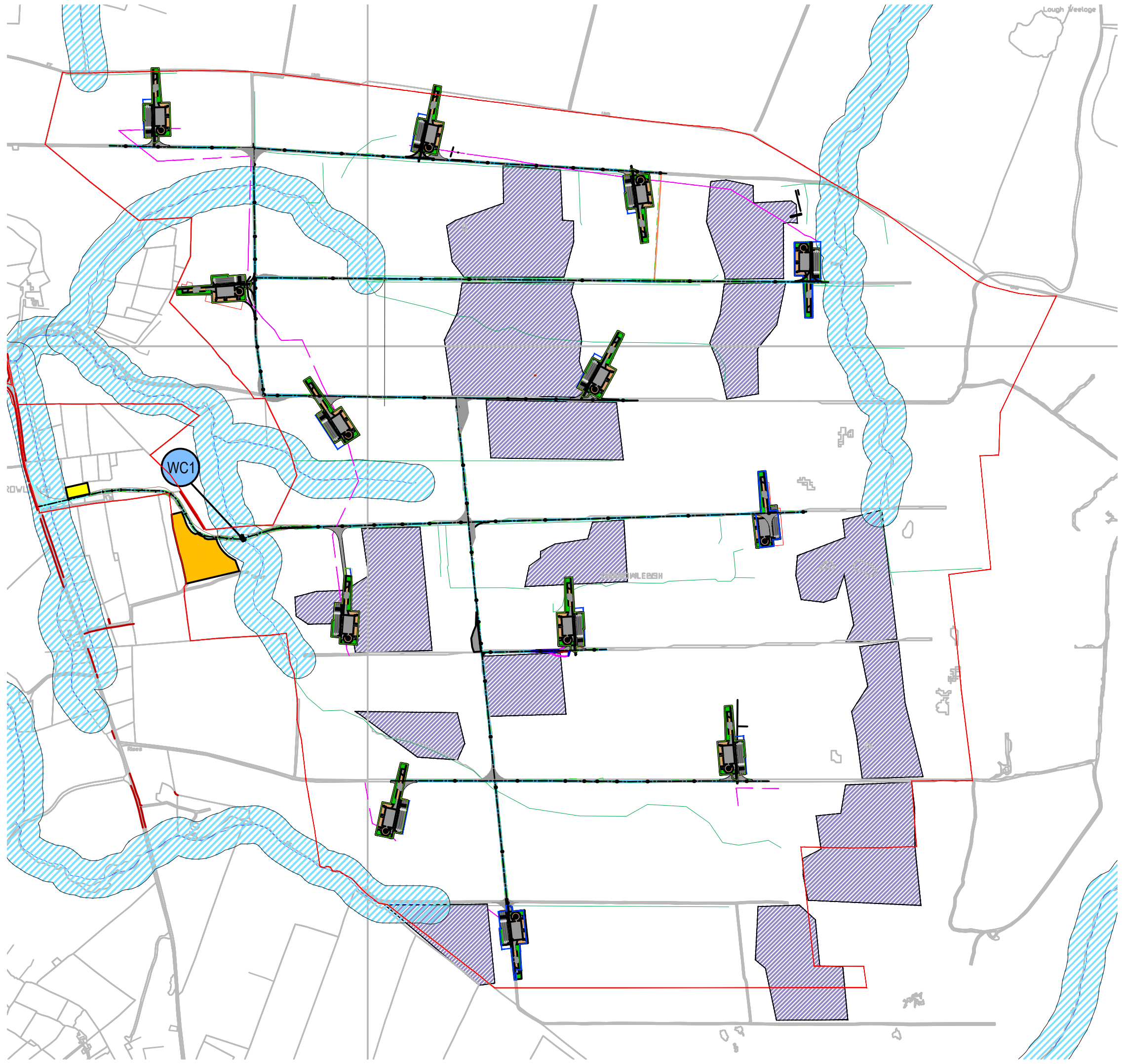
PHOTOGRAPH OF EXISTING WATERCOURSE



SECTION A - A THROUGH PROPOSED WATERCOURSE CROSSING WC 1 Scale 1:200



PLAN : WATERCOURSE CROSSING WC 1
Scale 1:200



LOCATION PLAN : WATERCOURSE CROSSING WC 1
Scale 1:20,000

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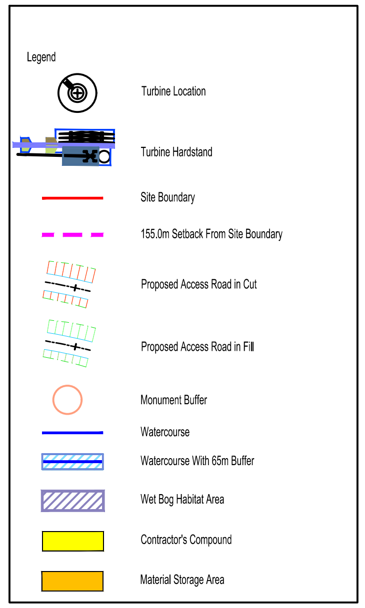
NOTES:

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



rev.	modifications	by	date

Client: Mercury Renewables (Carrowleagh) Limited

Project: Propsoed Firlough Wind Farm, Carrowleagh, Bunnyconnellan, Co. Mayo & Proposed Hydrogen Plant, Carraun, Castleconner, Co. Sligo

Stage: Planning

ELEMENT: Site Layout

Title: Proposed Watercourse Crossing WC1

Scales: 1:200 & 1:20,000 @ A3

Surveyed	Prepared By	Checked	Date
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Job No.	Drawing no.	Revision
6129	6129-PL-305	

MERCURY RENEWABLES (CARROWLEAGH) LIMITED

FIRLOUGH WIND FARM, CO. MAYO

AND

HYDROGEN PLANT, CO. SLIGO

CONSTUCTION ENVIRONMENTAL MANAGEMENT PLAN

(CEMP)

MANAGEMENT PLAN 3

SURFACE WATER MANAGEMENT PLAN

JUNE 2023

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DOCUMENT APPROVAL

PROJECT	Firlough Wind Farm and Hydrogen Plant	
CLIENT / JOB NO	Mercury Renewables (Carrowleagh) Limited	6129
DOCUMENT TITLE	Construction Environmental Management Plan (CEMP) Surface Water Management Plan	

	Prepared by	**Reviewed/Approved by**
Document Final	Name Sarah Moore Aileen Byrne	Name David Kiely
Date June 2023	Signature Sal Moore Aileen Byrne	Signature David Kiely

MANAGEMENT PLAN 3: SURFACE WATER MANAGEMENT PLAN

CONTENTS

1 INTRODUCTION

This Surface Water Management Plan (SWMP) describes the management of surface water during construction of Firlough Wind Farm & Hydrogen Plant, Co. Mayo.

The Surface Water Management Plan aims to:

- Describe the baseline environment of the site
- 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 BASELINE ENVIRONMENT

2.1 Site Description

The Wind Farm Site and the Hydrogen Plant Site are shown in **Figure 2.1.**

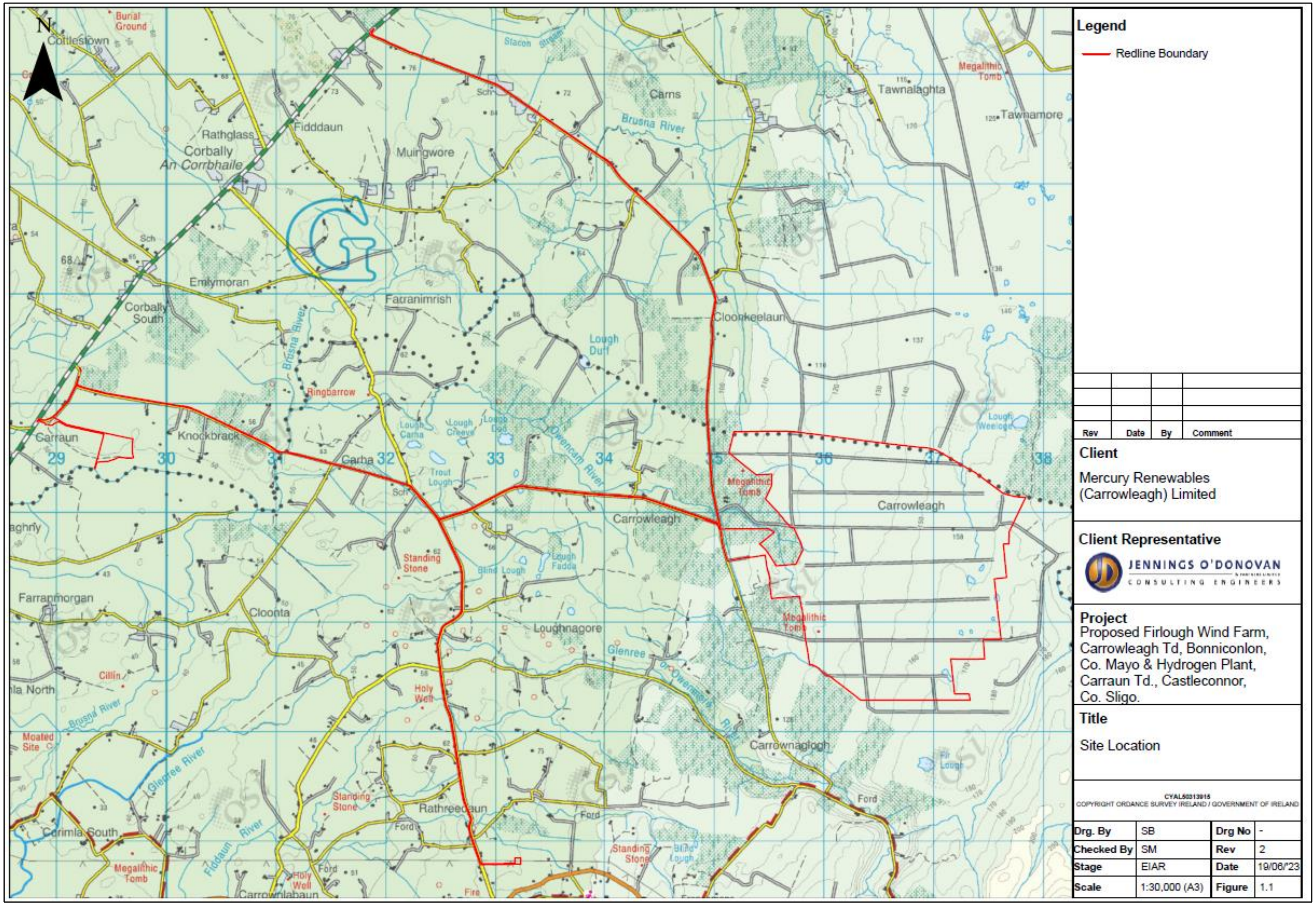

Figure 2.1: Location of Wind Farm Site and Hydrogen Plant Site

2.2 Site Topography

Topography at the Wind Farm Site, is generally flat, with minor undulating fields ranging from c. 110 maOD in the west to 160 maOD to the east of the Site. Topography elevations at the Hydrogen Plant Site range from 53 maOD at the north-west corner to 45 maOD along the southern boundary. A watercourse runs 70 m at the closest point along the south of the Hydrogen Plant Site which forms the Co. Sligo/Mayo County boundary and Carraun (Sligo)/Dooyeaghny (Mayo) townland boundary.

2.3 Hydrology and Geology

The geology and hydrology of the Site are detailed in **EIAR Chapter 8: Soils and Geology** and **EIAR Chapter 9: Hydrology and Hydrogeology**, respectively. Surface water networks draining the wind farm site and the hydrogen plant site are mapped and presented in **Figure 2.2a and b** respectively.

The proposed Wind Farm Site is situated within both the Moy Catchment, (Catchment ID: 34_01), which has an area of 2,110.72 km^2, and the Easky-Dunneil-Coastal Catchmane (Catchment ID: 35_03), with an area of 359.52 km^2.

Surface water runoff associated with the Site drain into two sub catchments and/or three river sub basins, or four no. rivers;

- Sub Catchment: Glenree_SC_010; River Sub Basins: Brusna (North Mayo) 020; Brusna (North Mayo)_010; and Glenree_020
- Sub Catchment: Easky_SC_010; River Sub Basin; Gowlan (Sligo)_010

Surface waters draining to the west of the Wind Farm Site eventually combine in Moy River, from which waters eventually flow to Killala Bay and into the North Atlantic Ocean. Surface waters draining the east of the Wind Farm Site join the Easky River which flows directly to the North Atlantic Ocean, **Figure 9.5.**

The proposed Hydrogen Plant Site is situated within the Moy Catchment.

Surface water runoff associated with this element of the Proposed Development drains into one sub catchments and/or one river sub-basins, or 1 no. rivers;

- Sub Catchment: Leaffony_SC_010;
- River Sub Basins: Dooyeaghny_010, Cloonloughan_010

Surface waters draining the proposed Hydrogen Plant Site eventually combine in Moy River, from which waters eventually flow to Killala Bay and into the North Atlantic Ocean.

Details of watercourse crossings can be found in **Management Plan 2: Water Quality Monitoring Plan and Watercourse Crossing Plan**.

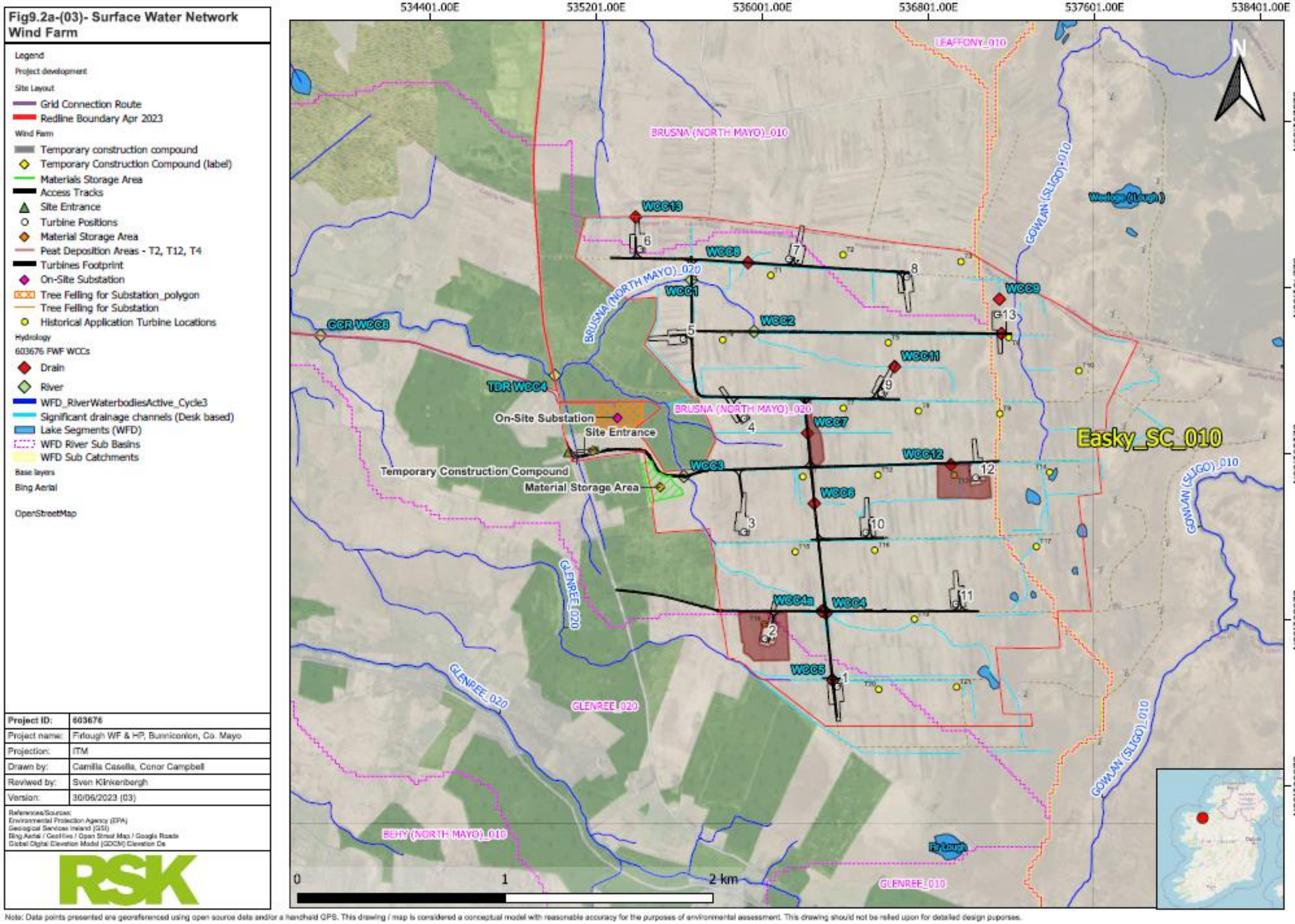

Figure 2.2a: Surface Water Networks at the Wind Farm Site (EIAR Figure 9.2a)

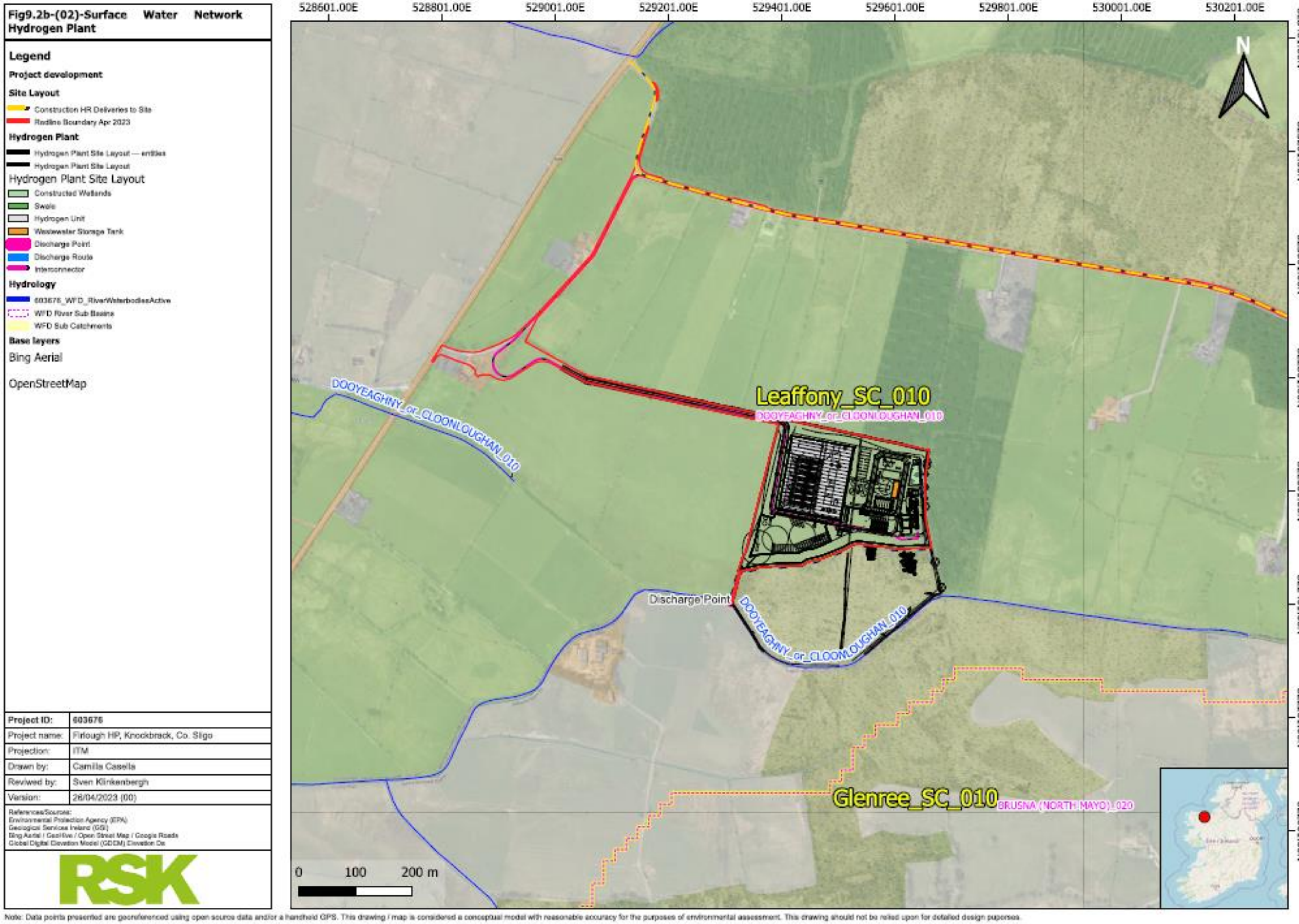

Figure 2.2b: Surface Water Networks at the Hydrogen Site (EIAR Figure 9.2b)

The Wind Farm Site is covered in extensive cutover blanket bog with some forestry to the west and southwest of the boundary. Due to its historical use, the Wind Farm Site is partially connected via a network of existing access tracks to turf cutting plots, which will require widening for turbine and machinery delivery. Consultation with published subsoil maps compiled by GSI (2022) specify that subsoil type of the Site is described as “Blanket Peat”.

The Hydrogen Plant Site is pastureland, currently an agricultural field used for grazing horse. There is an area of cutover, boggy peat adjacent to the south of the site boundary which has been avoided. Land underlying the Hydrogen Plant Site is mapped as being comprised of ‘Grey Brown Podzolics, Brown Earths’ and ‘Basin Blanket Peats’. Underlying subsoils have been classified as ‘(Carboniferous) Limestone tills’ along with ‘Cutover peat’.

3 ENVIRONMENTAL CONSTRAINTS AND MITIGATION MEASURES

This is a live document and where there is a requirement for variation to the proposed management of surface water during construction the SWMP will be updated to reflect any such changes. The SWMP will be updated by the Environmental Manager (EM) and, where it is relevant to ecology, with input from the Ecological Clerk of Works (ECoW) before any changes are made to the proposed management of surface water during construction of Firlough Wind Farm and Hydrogen Plant.

4 DRAINAGE SYSTEM OVERVIEW

The drainage system has been designed for this Proposed Development. It aims to ensure the Proposed Development does not change the baseline water quality within or downstream of the Site. The drainage system includes the following:

- A 50m buffer from watercourses except at water crossings. These will be marked out prior to works beginning on site.
- Drainage will be installed in parallel with road construction.
- Check dams will be mainly used for road drainage. All road sections will drain to settlement-attenuation ponds.
- Silt fencing will be utilised during water crossings and around stockpiles.
- Settlement-attenuation ponds will be used at every major excavation.

4.1 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 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 the existing hydrological environment of the site.
- To minimise sediment loads resulting from the Proposed 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.

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. This can be seen in **Drawing No. 6129-PL-100 to 6129-PL-117**.
- To provide appropriate retention times such that no flooding will occur.
- To provide settlement ponds to encourage sedimentation and storm water runoff settlement.

4.2 Design Philosophy

The SuDS design must be managed and monitored (see Section 6) and particularly after Met Éireann Status Yellow, Orange or Red weather warnings for wind, rain or snow and during construction phase. 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

4.2.1 Minimise

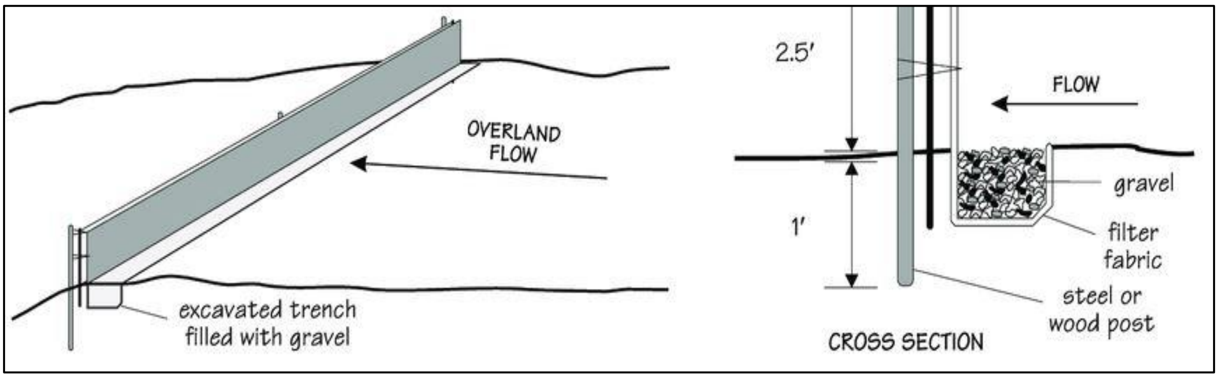

Figure 4.1: Diagram of silt fence[2]

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.

[2] Norman, David & Wampler, Peter & Throop, Allen & Schnitzer, E. & Roloff, Jaretta. (1997). Best management practices for reclaiming surface mines in Washington and Oregon.

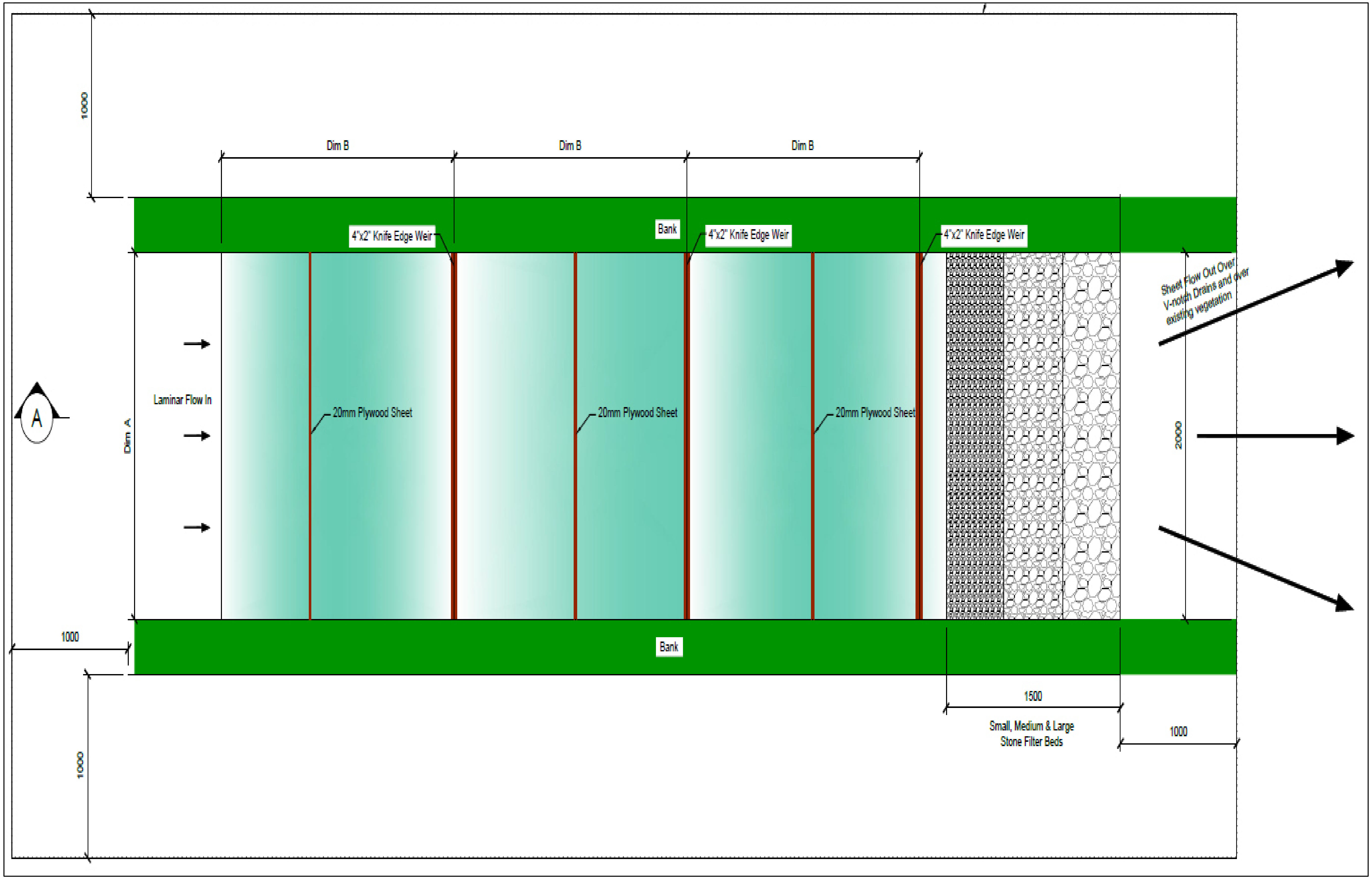

Figure 4.2: Diagram of settlement ponds outlet where outflow is dispersed across vegetated area

4.2.2 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.

Diagrammatic cross section of Interception Infiltration Drain is as shown in **Figure 4.3**.

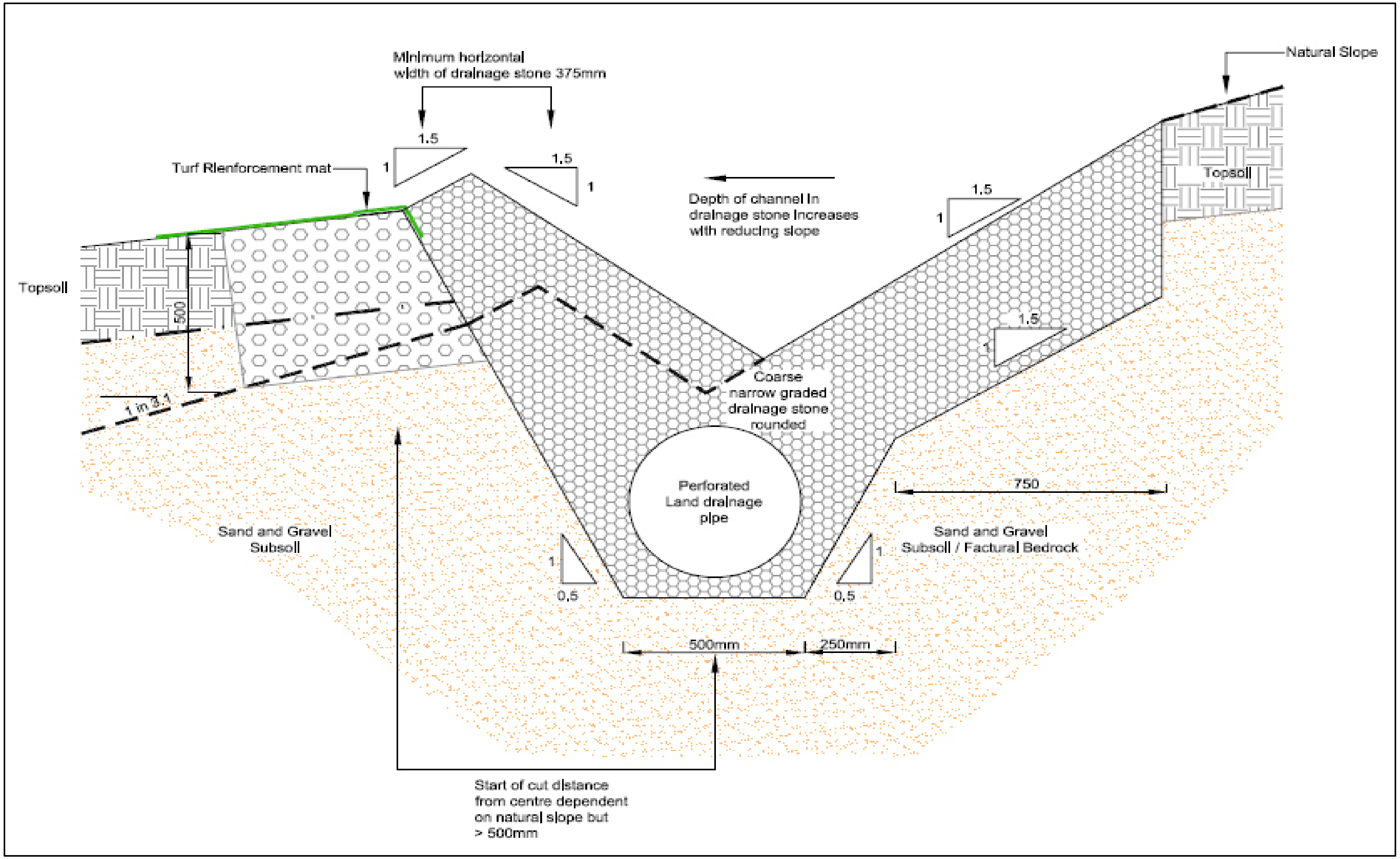

Figure 4.3: Diagrammatic cross section of Interception Infiltration Drains

4.2.3 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 into Settlement-Attenuation ponds. The treated effluent from the Settlement-Attenuation 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. Please see **Drawing No. 6129-PL-301** and **6129-PL-100 to 117**.

5 DETAILED DESIGN CONSIDERATIONS

5.1 Overview

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-Attenuation Ponds and Buffered Outfalls to control and store development runoff to achieve settlement and attenuation 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.

5.2 SuDS Design Principles

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

- The dimensions of drainage features will avoid intercepting large volumes of water because this could lead to an overloading of the system and a failure to treat and attenuate storm water. Any changes to the Surface Water Management Plan must be agreed with the Project Hydrologist and the Ecological Clerk of Works.
- Surface water runoff from the proposed Site Access Tracks will be managed with crossfall downslope to mimic the natural drainage patterns of the Site.
- Trackside drains (dirty water) 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 turf will be taken as a single piece and placed on the downslope side of the drain. Therefore, once construction works are complete the turves can be put back in place with minimal ecological damage.
- Drainage vegetation (vegetation including grasses established within a drainage channel can filter runoff water. Living and decomposing plants and roots and associated microorganisms trap sediments and take up excess nutrients) used will be similar in species to the local area and will be approved by the Ecological Clerk of Works.

- Temporary erosion protection together with silt fences may be required until the vegetation becomes established (coir matting or similar) as shown in **Plate 5.1**.
- 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 as significant levels of sediment are not expected because of the surface dressing of the roads. All trackside drainage will drain to settlement-attenuation ponds.

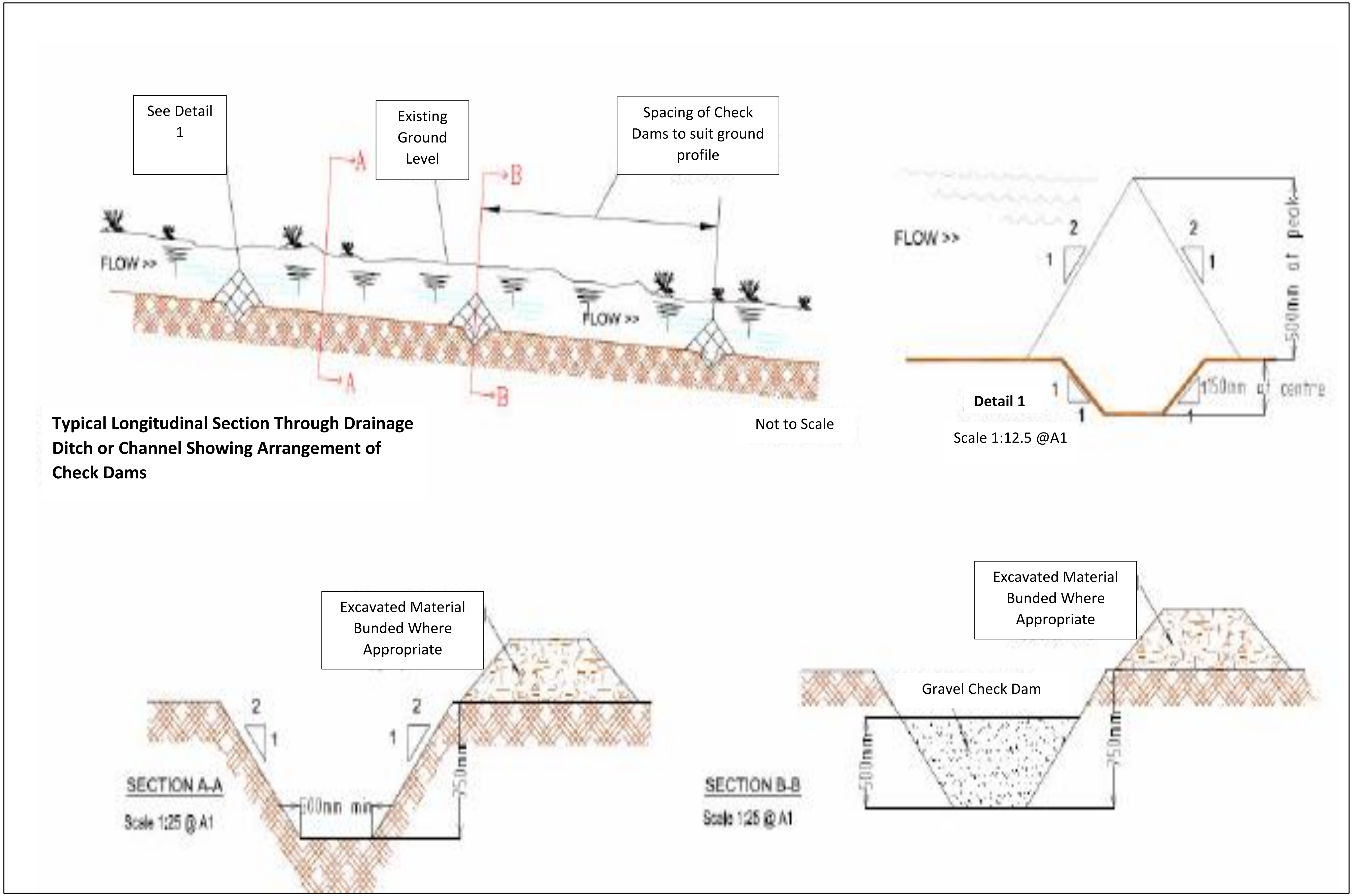

Figure 5.1: Typical check dam arrangement

- The stone used for the construction of the check dams will be washed graded stone with a size range between approximately 5mm and 40mm, see **Figure 5.5 and Plate 5.3**.
- Discharging directly back into the surrounding area will assist in maintaining the hydrological characteristics of the Site. It will prevent wetlands from drying out and without significantly impacting on ecosystems.
- Where vegetation is removed from sloped areas during construction, these areas will be reinstated as early as possible using the same vegetation or similar vegetation as advised by the ECoW.
- 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, see **Figure 5.2.**
- A sump may be required for trench dewatering. Water will subsequently be pumped into settlement-attenuation ponds or a siltbuster.

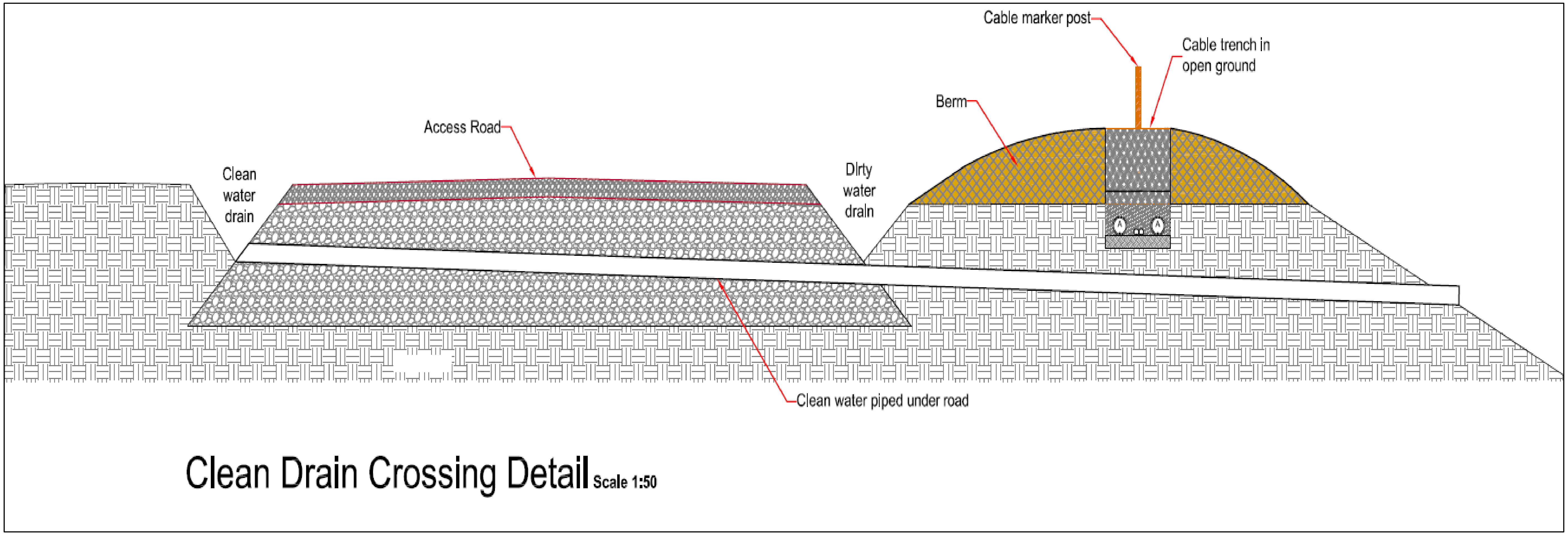

Figure 5.2: Proposed Road and Trench Sections and Drain Crossing Details.

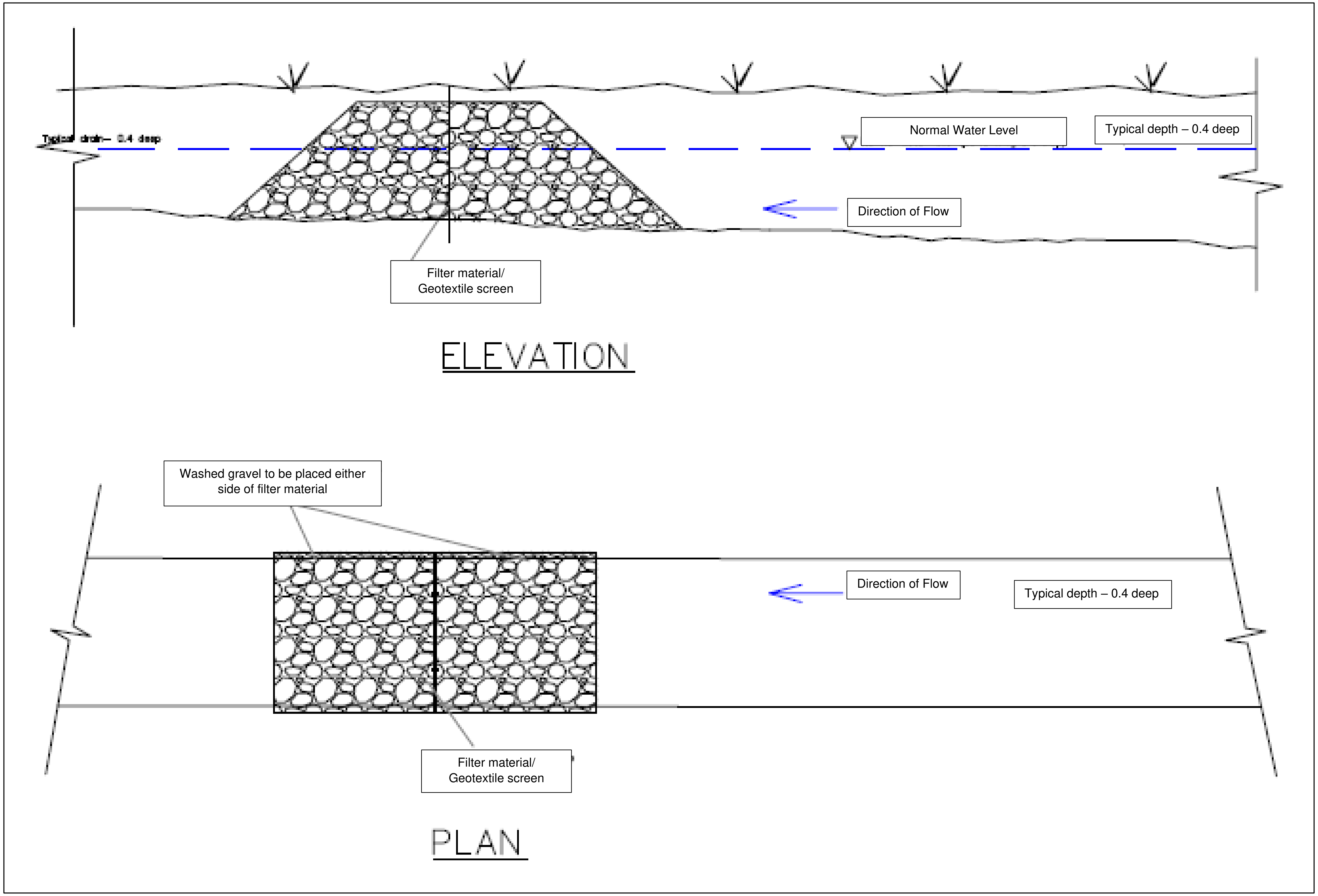

Figure 5.3: Typical silt trap

- Daily visual inspections will be carried out on the drainage network including all settlement-attenuations ponds and their discharge.
- Field drains will be piped directly under the track through appropriately sized drainage pipes.
- Appropriate site management measures (see CEMP, Section 3.6) 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 sewage effluent or contaminated drainage into any surface water feature.

Plate 5.1: Photograph of Coir Matting

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

These drains will be a maximum of 350mm – 500mm in depth and are outlined in **Figure 5.1**.

5.4 Trackside Drains (Dirty Water)

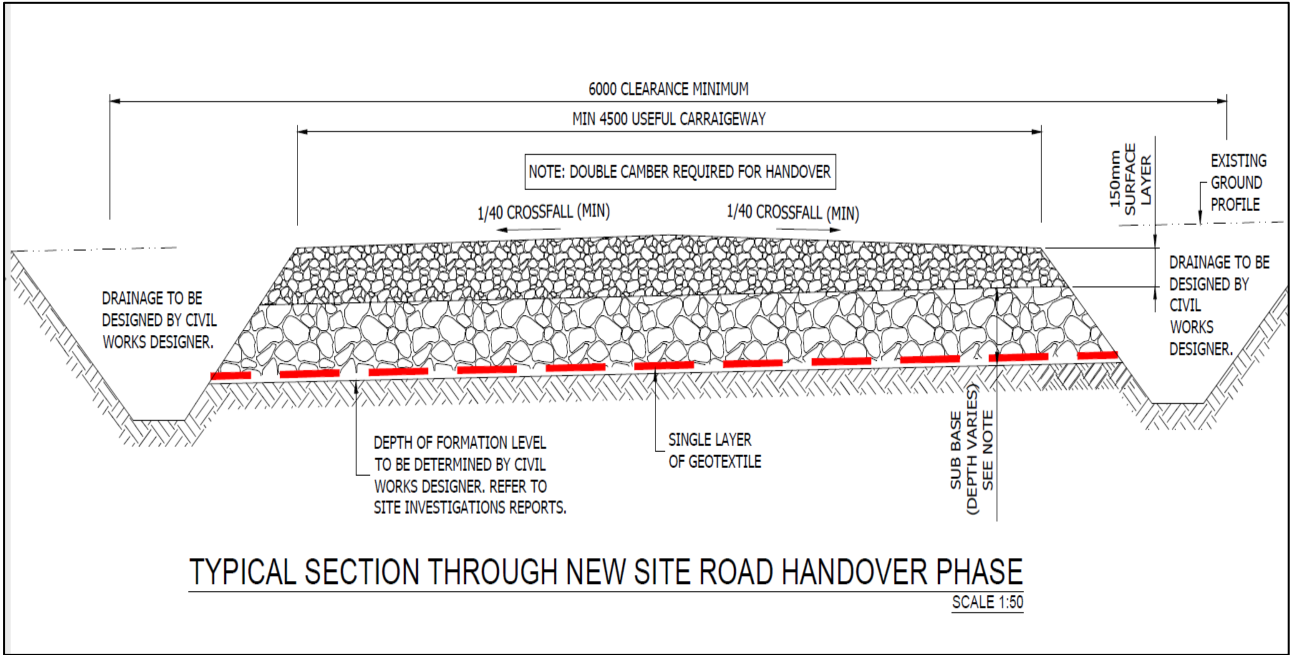

Figure 5.4: New Site Road Drainage

5.5 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 daily and maintained on a monthly 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.

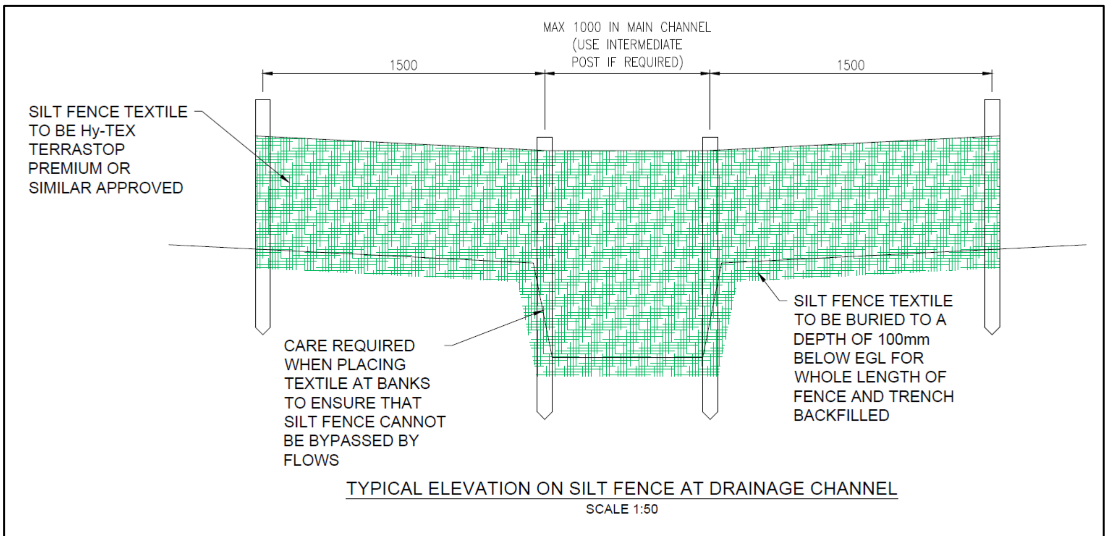

Figure 5.5: Illustration of silt fencing

Plate 5.2: Photograph of silt fencing

5.6 Filtration Check Dams

Check dams as set out in **Figure 5.6** (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.

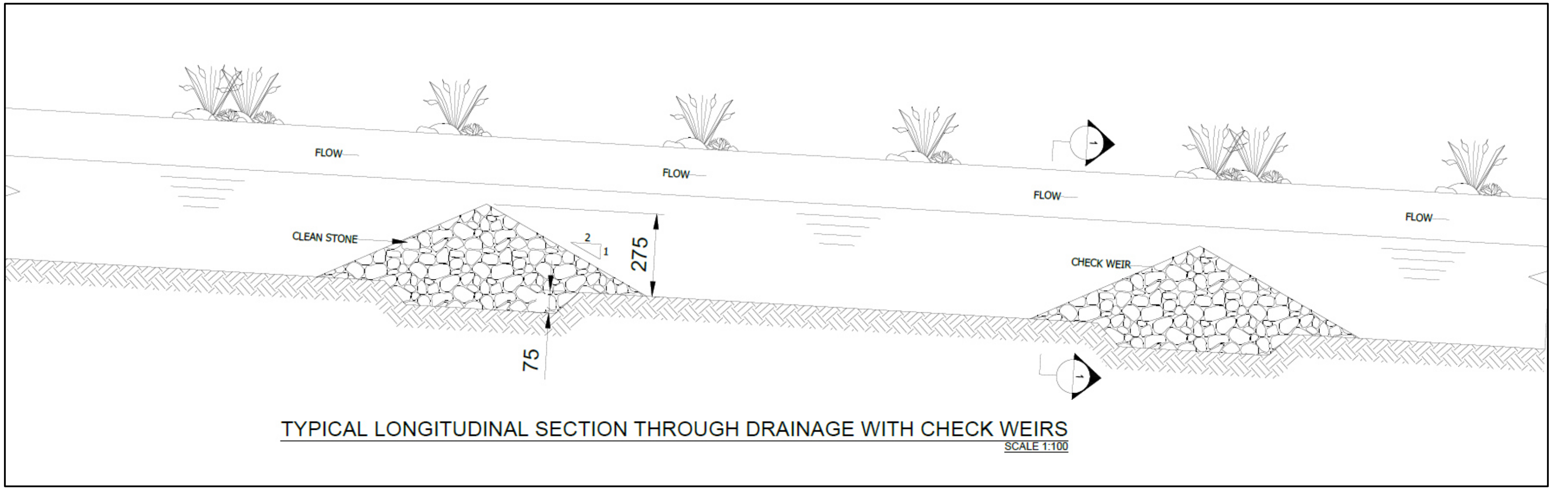

Figure 5.6: Diagram showing the function of check dams

Plate 5.3: Photograph of Check Dams

Settlement build up will be monitored daily 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 will be at least 0.2m lower than the outside edges;
- Side slopes will 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 will 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.

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

Table 5.1: 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)

5.7 Settlement-Attenuation Ponds

Runoff from the windfarm road surface will be attenuated to mimic natural runoff patterns. To capture runoff generated within the Proposed Development footprint it is proposed to use constructed trackside drains. Accumulations of runoff will then be transferred to Settlement-Attenuation ponds. See detail drawings (**Drawing No. 6129-PL-303**) which display a diagrammatic cross section through a settlement pond within the drainage regime. Settlement-Attenuation ponds are to be securely fenced to prevent easy access. Three consecutive ponds are to be situated together for further settlement of particles.

Plan view of settlement ponds as shown in **Figure 4.2**.

Plate 5.4a: Completed settlement pond system

Plate 5.4b: Completed settlement pond system showing levels of settlement

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 attached as **Appendix D**. Settlement ponds will be placed at (72) locations along the drainage footprint. The buffered outfalls from the settlement-attenuation ponds will be located in vegetated areas greater than 50m from any waterbody. The settlement-attenuation ponds are deigned to settle and attenuate to ensure the suspended solids concentration of the water discharged from the ponds in <25mg/l and will not impact any sensitive receptors (e.g. salmonid rivers) downstream of the construction works.

Where there is an exceedance of 25mg/l suspended solids, the discharge will be diverted to a siltbuster.

The settlement-attenuation ponds will buffer volumes of runoff discharging from the drainage system during periods of high rainfall (1 in 200yr rainfall event), by retaining water until the storm hydrograph has receded, thus reducing the hydraulic loading to watercourses.

Any changes to the Surface Water Management Plan will be agreed with the 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 Éireann - Please refer to **Appendix A**).
- An initial outlet overflow rate (the amount of water leaving the sediment pond per second per hectare) is applied of 17.93l/s/ha (litres per second) which approximates to Greenfield run-off rates for the site. (Source: HR Wallingford – Please refer to **Appendix B**).
- The Rational Method is subsequently applied to calculate the flow volumes into each settlement pond over these respective periods. The Rational Method is expressed by the formula $V = 2.78CAIt$, where V is the volume of water generated in the settlement pond, C is the run-off co-efficient, A is the area of the hardstanding / catchment, I is 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-attenuation ponds designed to treat and attenuate each development catchment area. The details in **Table 5.2** are based on the calculations included in **Appendix C**.

Table 5.2: Settlement-Attenuation 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)	
SP1	4,888	185.2	21	9	1	189
SP2	5,137	156.1	18	9	1	162
SP3	1,805	68.4	12	6	1	72
SP4	2,291	86.8	15	6	1	90
SP5	3,354	127.1	15	9	1	135
SP6	5,137	152.8	18	9	1	162
SP7	2,296	87.0	15	6	1	90
SP8	1,487	56.3	12	6	1	72
SP9-A	4,913	142.4	18	9	1	162
SP9-B	1,700	64.4	12	6	1	72
SP10	4,960	187.9	21	9	1	189
SP11	2,282	86.5	15	6	1	90
SP12	888	33.6	12	3	1	36
SP13-A	4,843	139.0	18	9	1	162
SP13-B	1,717	65.0	12	6	1	72
SP14	4,071	154.2	18	9	1	162
SP15	3,972	150.5	18	9	1	162
SP16	1,955	74.1	15	6	1	90
SP17	4,082	135.6	18	9	1	162
SP18	3,191	101.9	18	6	1	108

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)	
SP19	1,959	74.2	15	6	1	90
SP20	917	34.7	12	3	1	36
SP21	917	34.7	12	3	1	36
SP22	2,128	80.6	15	6	1	90
SP23	4,284	162.3	21	9	1	189
SP24-A	4,284	162.3	21	9	1	189
SP24-B	4,284	162.3	21	9	1	189
SP25	4,284	162.3	21	9	1	189
SP26	1,177	44.6	15	3	1	45
SP27	716	27.1	9	3	1	27
SP28	2,519	95.4	18	6	1	108
SP29	4,935	187.0	21	9	1	189
SP30	4,497	170.3	21	9	1	189
SP31	4,497	170.3	21	9	1	189
SP32	1,834	69.5	12	6	1	72
SP33-A	2,900	80.2	15	6	1	90
SP33-B	2,531	95.9	18	6	1	108
SP34	3,591	136.0	18	9	1	162
SP35	3,433	130.1	15	9	1	135
SP36-A	3,555	134.7	15	9	1	135
SP36-B	2,440	92.4	18	6	1	108
SP37	4,823	138.5	18	9	1	162
SP38	2,393	90.7	18	6	1	108
SP39-A	4,049	112.0	15	9	1	135
SP39-B	2,686	101.8	18	6	1	108
SP40	4,191	158.8	18	9	1	162
SP41	1,675	63.5	12	6	1	72
SP42	1,866	70.7	12	6	1	72
SP43-A	5,230	154.0	18	9	1	162
SP43-B	1,895	71.8	12	6	1	72
SP44	4,054	153.6	18	9	1	162
SP45	2,583	97.9	18	6	1	108
SP46	2,823	106.9	18	6	1	108
SP47	3,116	118.0	21	6	1	126
SP48	2,921	110.7	21	6	1	126
SP49-A	4,763	139.4	18	9	1	162
SP49-B	3,382	128.1	15	9	1	135

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)	
SP50	1,194	45.2	9	6	1	54
SP51	1,316	49.9	9	6	1	54
SP52	2,265	85.8	15	6	1	90
SP53	1,152	43.6	15	3	1	45
SP54	2,947	111.6	21	6	1	126
SP55-A	2,664	100.9	18	6	1	108
SP55-B	4,073	112.6	21	6	1	126
SP56	1,519	57.5	12	6	1	72
SP57	3,887	147.3	18	9	1	162
SP58-A	2,274	86.2	15	6	1	90
SP58-B	4,514	124.8	21	6	1	126
SP59	3,226	122.2	15	9	1	135
SP60	3,052	115.6	21	6	1	126
SP61	2,630	99.6	12	9	1	108
SP62	3,596	99.4	18	6	1	108

5.8 Cable Trench Drainage

Cable trenches are typically constructed in short sections c. 100m this minimises for drainage runoff to pick up large volumes of silt or suspended solids. Drainage runoff from cable trench works areas, is managed by storing excavated material on the upgradient side of the trench. Where rainfall causes runoff from the excavated material, the material is captured in the downgradient cable trench. Excess subsoil is removed from the cable trench works area immediately upon excavation. The excavated trench will be dewatered if required, from a sump installed within the low section of the opened trench. Where dewatering is required, silt laden water will be fully and appropriately attenuated, through silt bags, before being appropriately discharged to vegetation or surface water drainage feature.

On steeper slopes, silt fences will be installed temporarily downgradient of the cable trench works area, or on the downhill slope below where excavated material is being temporarily stored to control run-off.

5.9 High Rainfall Events

- An emergency response system has been developed for the construction phase of the project (see **Management Plan 1: Emergency Response Plan)**.
- There will be a 24-hour advance meteorological forecasting (Met Eireann download) linked to a trigger-response system. When a pre-determined rainfall trigger levels is exceeded (e.g., sustained rainfall (any foreseen rainfall event longer than 4 hour duration) and/or any yellow or greater rainfall warning (>25mm/hour) issued by Met Eireann), planned responses will be undertaken.
- These responses will include, inter alia; cessation of construction until the storm event including storm runoff has passed over. All construction works will cease during storm events such as yellow warning rainfall events. Following heavy rainfall events, and before construction works recommence, the Site will be inspected and corrective measures implemented to ensure safe working conditions e.g. dewatering of standing water in open excavations, etc.
- Exposed soils/peat (exposed temporary stockpiles) will be covered with plastic sheeting during all relatively heavy rainfall events and during periods where works have temporarily ceased before completion at a particular area (e.g., overnight and weekends).
- Mitigation measures related to surface water quality as outlined in the CEMP will be implemented before excavation works commence.

6 MAINTENANCE AND MONITORING

- Surface water runoff control infrastructure will be checked daily and maintained on a monthly basis or as required.
- Settlement-Attenuation ponds and check dams will be checked daily and maintained (desludged/settle solids removed) on a monthly basis or as required, particularly during the construction phase of the Proposed Development. The agitation of solids will be kept to a minimum during these works.
- The discharge from ponds located upstream of a freshwater pearl catchment and their discharge will be continuously monitored for turbidity. Turbidity can be measured in the field and will indicate if the suspended solids discharge limit of <25mg/l is being achieved. Where the discharge exceeds this limit, the discharge will be diverted to a silt buster prior to discharge to ensure the suspended solids concentration is <25mg/l.
- During the construction phase daily visual inspections will be carried out on all ponds and their discharge. Monthly grab samples will be taken from all ponds and sent to a laboratory to analyse the suspended solids content.
- The monitoring requirements for local surface water bodies upstream and downstream of the Site during the construction phase are outlined in **Management Plan 2: Water Quality Management Plan**.

7 POST CONSTRUCTION DRAINAGE MANAGEMENT

Following the completion of construction, all settlement-attenuation ponds will remain on site.

APPENDIX A

MET ÉIREANN RAINFALL DATA

Met Eireann
Return Period Rainfall Depths for sliding Durations
Irish Grid: Easting: 136402, Northing: 321536,

	Interval		Years													
DURATION	6months,	1year,	2,	3,	4,	5,	10,	20,	30,	50,	75,	100,	150,	200,	250,	500,
5 mins	2.7,	3.9,	4.6,	5.7,	6.5,	7.0,	9.0,	11.3,	12.8,	15.1,	17.1,	18.6,	21.1,	23.0,	24.6,	N/A ,
10 mins	3.7,	5.5,	6.4,	8.0,	9.0,	9.8,	12.5,	15.7,	17.9,	21.0,	23.8,	26.0,	29.4,	32.1,	34.3,	N/A ,
15 mins	4.4,	6.4,	7.6,	9.4,	10.6,	11.5,	14.8,	18.5,	21.0,	24.7,	28.0,	30.5,	34.6,	37.7,	40.4,	N/A ,
30 mins	5.8,	8.4,	9.8,	12.1,	13.6,	14.8,	18.7,	23.3,	26.4,	30.7,	34.7,	37.8,	42.6,	46.3,	49.5,	N/A ,
1 hours	7.6,	10.9,	12.8,	15.5,	17.4,	18.9,	23.7,	29.3,	33.0,	38.3,	43.0,	46.7,	52.4,	56.8,	60.6,	N/A ,
2 hours	10.1,	14.3,	16.5,	20.0,	22.3,	24.1,	30.1,	36.8,	41.3,	47.7,	53.3,	57.7,	64.5,	69.8,	74.2,	N/A ,
3 hours	11.8,	16.7,	19.3,	23.2,	25.8,	27.8,	34.5,	42.1,	47.1,	54.2,	60.5,	65.3,	72.8,	78.7,	83.5,	N/A ,
4 hours	13.3,	18.6,	21.5,	25.7,	28.6,	30.8,	38.1,	46.3,	51.8,	59.4,	66.1,	71.3,	79.4,	85.6,	90.8,	N/A ,
6 hours	15.6,	21.7,	25.0,	29.8,	33.1,	35.6,	43.8,	53.0,	59.0,	67.5,	75.0,	80.8,	89.7,	96.5,	102.2,	N/A ,
9 hours	18.4,	25.4,	29.1,	34.6,	38.2,	41.1,	50.3,	60.6,	67.3,	76.7,	85.0,	91.4,	101.3,	108.8,	115.1,	N/A ,
12 hours	20.7,	28.3,	32.4,	38.4,	42.4,	45.5,	55.5,	66.6,	73.9,	84.1,	93.0,	99.9,	110.4,	118.5,	125.2,	N/A ,
18 hours	24.3,	33.1,	37.7,	44.5,	49.0,	52.5,	63.8,	76.2,	84.3,	95.6,	105.5,	113.1,	124.7,	133.6,	140.9,	N/A ,
24 hours	27.3,	37.0,	42.0,	49.4,	54.4,	58.2,	70.3,	83.8,	92.6,	104.7,	115.3,	123.5,	135.9,	145.4,	153.3,	180.5,
2 days	35.1,	46.0,	51.7,	59.8,	65.1,	69.2,	82.2,	96.2,	105.2,	117.5,	128.2,	136.3,	148.6,	158.0,	165.6,	191.8,
3 days	42.0,	54.1,	60.2,	69.1,	74.8,	79.2,	93.0,	107.7,	117.1,	129.9,	140.9,	149.3,	161.8,	171.3,	179.1,	205.4,
4 days	48.3,	61.6,	68.2,	77.7,	83.8,	88.5,	103.0,	118.5,	128.3,	141.6,	153.0,	161.5,	174.4,	184.2,	192.1,	218.9,
6 days	60.3,	75.4,	82.9,	93.5,	100.4,	105.5,	121.5,	138.4,	148.9,	163.2,	175.3,	184.4,	198.0,	208.2,	216.5,	244.3,
8 days	71.5,	88.4,	96.6,	108.3,	115.7,	121.3,	138.6,	156.7,	168.0,	183.1,	195.9,	205.5,	219.8,	230.5,	239.2,	268.1,
10 days	82.4,	100.8,	109.7,	122.3,	130.4,	136.4,	154.9,	174.1,	186.0,	202.0,	215.4,	225.5,	240.4,	251.6,	260.6,	290.5,
12 days	92.9,	112.8,	122.4,	135.9,	144.5,	150.9,	170.5,	190.7,	203.3,	220.0,	234.1,	244.5,	260.1,	271.6,	281.0,	312.0,
16 days	113.6,	136.1,	147.0,	162.1,	171.6,	178.7,	200.3,	222.5,	236.2,	254.3,	269.5,	280.7,	297.4,	309.7,	319.7,	352.5,
20 days	133.8,	158.9,	170.8,	187.3,	197.7,	205.5,	228.9,	252.9,	267.5,	286.9,	303.1,	315.1,	332.7,	345.8,	356.3,	390.9,
25 days	158.8,	186.7,	200.0,	218.2,	229.6,	238.0,	263.6,	289.5,	305.3,	326.1,	343.5,	356.3,	375.1,	389.0,	400.1,	436.6,

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 rate estimation for sites

www.uksuds.com | Greenfield runoff tool

Calculated by:	Ken Dunne
Site name:	Firlough WF
Site location:	Firlough

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:	54.13823° N
Longitude:	8.97071° W
Reference:	2973604294
Date:	May 30 2023 15:27

Runoff estimation approach

IH124

Site characteristics

Total site area (ha):	446.2

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):	1372	1372
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):	3721.02	3721.02
1 in 1 year (l/s):	3162.87	3162.87
1 in 30 years (l/s):	6139.68	6139.68
1 in 100 year (l/s):	7255.98	7255.98
1 in 200 years (l/s):	8000.19	8000.19

Print | Close Report

HR Wallingford
Working with water

Greenfield runoff rate estimation for sites

www.uksuds.com | Greenfield runoff tool

Calculated by:	Sarah Moore
Site name:	Firlough
Site location:	Carrowleagh, Bunniconlon

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:	54.13715° N
Longitude:	8.96994° W
Reference:	3285869503
Date:	May 12 2023 13:30

Runoff estimation approach IH124

Site characteristics

Total site area (ha): 424

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):	1372	1372
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):	3555.79	3555.79
1 in 1 year (l/s):	3022.42	3022.42
1 in 30 years (l/s):	5867.05	5867.05
1 in 100 year (l/s):	6933.79	6933.79
1 in 200 years (l/s):	7644.95	7644.95

APPENDIX C

SETTLEMENT POND SIZING CALCULATIONS

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)	Required Length (m)	Optimised Length
SP1	4888	0	4888	0.0000	0.0049	185.2	9.00	1.0	20.6	21
SP2	5137	3764	1373	0.0038	0.0014	156.1	9.00	1.0	17.3	18
SP3	1805	0	1805	0.0000	0.0018	68.4	6.00	1.0	11.4	12
SP4	2291	0	2291	0.0000	0.0023	86.8	6.00	1.0	14.5	15
SP5	3354	0	3354	0.0000	0.0034	127.1	9.00	1.0	14.1	15
SP6	5137	4082	1055	0.0041	0.0011	152.8	9.00	1.0	17.0	18
SP7	2296	0	2296	0.0000	0.0023	87.0	6.00	1.0	14.5	15
SP8	1487	0	1487	0.0000	0.0015	56.3	6.00	1.0	9.4	12
SP9-A	4913	4275	638	0.0043	0.0006	142.4	9.00	1.0	15.8	18
SP9-B	1700	0	1700	0.0000	0.0017	64.4	6.00	1.0	10.7	12
SP10	4960	0	4960	0.0000	0.0050	187.9	9.00	1.0	20.9	21
SP11	2282	0	2282	0.0000	0.0023	86.5	6.00	1.0	14.4	15
SP12	888	0	888	0.0000	0.0009	33.6	3.00	1.0	11.2	12
SP13-A	4843	4345	498	0.0043	0.0005	139.0	9.00	1.0	15.4	18
SP13-B	1717	0	1717	0.0000	0.0017	65.0	6.00	1.0	10.8	12
SP14	4071	0	4071	0.0000	0.0041	154.2	9.00	1.0	17.1	18
SP15	3972	0	3972	0.0000	0.0040	150.5	9.00	1.0	16.7	18
SP16	1955	0	1955	0.0000	0.0020	74.1	6.00	1.0	12.3	15
SP17	4081.5	1855.5	2226	0.0019	0.0022	135.6	9.00	1.0	15.1	18
SP18	3190.5	1855.5	1335	0.0019	0.0013	101.9	6.00	1.0	17.0	18
SP19	1959	0	1959	0.0000	0.0020	74.2	6.00	1.0	12.4	15
SP20	917	0	917	0.0000	0.0009	34.7	3.00	1.0	11.6	12
SP21	917	0	917	0.0000	0.0009	34.7	3.00	1.0	11.6	12
SP22	2128	0	2128	0.0000	0.0021	80.6	6.00	1.0	13.4	15
SP23	4284	0	4283.925	0.0000	0.0043	162.3	9.00	1.0	18.0	21
SP24-A	4284	0	4283.925	0.0000	0.0043	162.3	9.00	1.0	18.0	21
SP24-B	4284	0	4283.925	0.0000	0.0043	162.3	9.00	1.0	18.0	21
SP25	4284	0	4283.925	0.0000	0.0043	162.3	9.00	1.0	18.0	21
SP26	1177	0	1177	0.0000	0.0012	44.6	3.00	1.0	14.9	15
SP27	716	0	716	0.0000	0.0007	27.1	3.00	1.0	9.0	9
SP28	2519	0	2519	0.0000	0.0025	95.4	6.00	1.0	15.9	18
SP29	4935	0	4935	0.0000	0.0049	187.0	9.00	1.0	20.8	21
SP30	4497	0	4496.5	0.0000	0.0045	170.3	9.00	1.0	18.9	21
SP31	4497	0	4496.5	0.0000	0.0045	170.3	9.00	1.0	18.9	21
SP32	1834	0	1834	0.0000	0.0018	69.5	6.00	1.0	11.6	12
SP33-A	2900	2900	0	0.0029	0.0000	80.2	6.00	1.0	13.4	15
SP33-B	2531	0	2531	0.0000	0.0025	95.9	6.00	1.0	16.0	18
SP34	3591	0	3591	0.0000	0.0036	136.0	9.00	1.0	15.1	18
SP35	3433	0	3433	0.0000	0.0034	130.1	9.00	1.0	14.5	15
SP36-A	3555	0	3555	0.0000	0.0036	134.7	9.00	1.0	15.0	15
SP36-B	2440	0	2440	0.0000	0.0024	92.4	6.00	1.0	15.4	18
SP37	4823	4324	499	0.0043	0.0005	138.5	9.00	1.0	15.4	18
SP38	2393	0	2393	0.0000	0.0024	90.7	6.00	1.0	15.1	18
SP39-A	4049	4049	0	0.0040	0.0000	112.0	9.00	1.0	12.4	15
SP39-B	2686	0	2686	0.0000	0.0027	101.8	6.00	1.0	17.0	18
SP40	4191	0	4191	0.0000	0.0042	158.8	9.00	1.0	17.6	18
SP41	1675	0	1675	0.0000	0.0017	63.5	6.00	1.0	10.6	12
SP42	1866	0	1866	0.0000	0.0019	70.7	6.00	1.0	11.8	12
SP43-A	5230	4314	916	0.0043	0.0009	154.0	9.00	1.0	17.1	18
SP43-B	1895	0	1895	0.0000	0.0019	71.8	6.00	1.0	12.0	12
SP44	4054	0	4054	0.0000	0.0041	153.6	9.00	1.0	17.1	18
SP45	2583	0	2583	0.0000	0.0026	97.9	6.00	1.0	16.3	18
SP46	2823	0	2823	0.0000	0.0028	106.9	6.00	1.0	17.8	18
SP47	3116	0	3116	0.0000	0.0031	118.0	6.00	1.0	19.7	21
SP48	2921	0	2921	0.0000	0.0029	110.7	6.00	1.0	18.4	21
SP49-A	4763	4012	751	0.0040	0.0008	139.4	9.00	1.0	15.5	18
SP49-B	3382	0	3382	0.0000	0.0034	128.1	9.00	1.0	14.2	15
SP50	1194	0	1194	0.0000	0.0012	45.2	6.00	1.0	7.5	9
SP51	1316	0	1316	0.0000	0.0013	49.9	6.00	1.0	8.3	9
SP52	2265	0	2265	0.0000	0.0023	85.8	6.00	1.0	14.3	15

SP53	1152	0	1152	0.0000	0.0012	43.6	3.00	1.0	14.5	15
SP54	2947	0	2947	0.0000	0.0029	111.6	6.00	1.0	18.6	21
SP55-A	2664	0	2664	0.0000	0.0027	100.9	6.00	1.0	16.8	18
SP55-B	4073	4073	0	0.0041	0.0000	112.6	6.00	1.0	18.8	21
SP56	1519	0	1519	0.0000	0.0015	57.5	6.00	1.0	9.6	12
SP57	3887	0	3887	0.0000	0.0039	147.3	9.00	1.0	16.4	18
SP58-A	2274	0	2274	0.0000	0.0023	86.2	6.00	1.0	14.4	15
SP58-B	4514	4514	0	0.0045	0.0000	124.8	6.00	1.0	20.8	21
SP59	3226	0	3226	0.0000	0.0032	122.2	9.00	1.0	13.6	15
SP60	3052	0	3052	0.0000	0.0031	115.6	6.00	1.0	19.3	21
SP61	2630	0	2630	0.0000	0.0026	99.6	6.00	1.0	16.6	18
SP62	3596	3596	0	0.0036	0.0000	99.4	6.00	1.0	16.6	18

	Catchment		**SP1**	Area Excl Hardstand					water discharge rate (l/s)		
Clean water natural flow									17.93		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	23.0	0.278	0.78	276	0.00489	0.293	87.8	5.4	2.6	85.1
M200 10min	10	32.1	0.278	0.78	192.6	0.00489	0.204	122.5	10.8	5.3	117.2
M200 15min	15	37.7	0.278	0.78	150.8	0.00489	0.160	143.9	16.1	7.9	136.0
M200 30min	30	46.3	0.278	0.78	92.6	0.00489	0.098	176.7	32.3	15.8	160.9
M200 60min	60	56.8	0.278	0.78	56.8	0.00489	0.060	216.7	64.5	31.6	185.2
M200 2hr	120	69.8	0.278	0.78	34.9	0.00489	0.037	266.3	129.1	63.1	203.2
M200 4hr	240	78.7	0.278	0.78	19.675	0.00489	0.021	300.3	258.2	126.2	174.1
M200 6hr	300	85.6	0.278	0.78	17.12	0.00489	0.018	391.9	387.3	189.3	202.6
M200 12hr	600	96.5	0.278	0.78	9.65	0.00489	0.010	441.9	774.6	378.6	63.3
M200 24hr	1200	108.8	0.278	0.78	5.44	0.00489	0.006	498.2	1549.1	757.2	-259.0
M200 48hr	2400	118.5	0.278	0.78	2.9625	0.00489	0.003	542.6	3098.2	1514.4	-971.8

	Catchment		**SP1**	Hardstand					water discharge rate (l/s)		
Clean water natural flow									17.93		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	23.0	0.278	0.6	276	0.00000	0.000	0.0	5.4	0.0	0.0
M200 10min	10	32.1	0.278	0.6	192.6	0.00000	0.000	0.0	10.8	0.0	0.0
M200 15min	15	37.7	0.278	0.6	150.8	0.00000	0.000	0.0	16.1	0.0	0.0
M200 30min	30	46.3	0.278	0.6	92.6	0.00000	0.000	0.0	32.3	0.0	0.0
M200 60min	60	56.8	0.278	0.6	56.8	0.00000	0.000	0.0	64.5	0.0	0.0
M200 2hr	120	69.8	0.278	0.6	34.9	0.00000	0.000	0.0	129.1	0.0	0.0
M200 4hr	240	78.7	0.278	0.6	19.675	0.00000	0.000	0.0	258.2	0.0	0.0
M200 6hr	300	85.6	0.278	0.6	17.12	0.00000	0.000	0.0	387.3	0.0	0.0
M200 12hr	600	96.5	0.278	0.6	9.65	0.00000	0.000	0.0	774.6	0.0	0.0
M200 24hr	1200	108.8	0.278	0.6	5.44	0.00000	0.000	0.0	1549.1	0.0	0.0
M200 48hr	2400	118.5	0.278	0.6	2.9625	0.00000	0.000	0.0	3098.2	0.0	0.0

	Catchment		**SP2**	Area Excl Hardstand					water discharge rate (l/s)		
Clean water natural flow									17.93		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	23.0	0.278	0.78	276	0.00137	0.082	24.7	5.4	0.7	23.9
M200 10min	10	32.1	0.278	0.78	192.6	0.00137	0.057	34.4	10.8	1.5	32.9
M200 15min	15	37.7	0.278	0.78	150.8	0.00137	0.045	40.4	16.1	2.2	38.2
M200 30min	30	46.3	0.278	0.78	92.6	0.00137	0.028	49.6	32.3	4.4	45.2
M200 60min	60	56.8	0.278	0.78	56.8	0.00137	0.017	60.9	64.5	8.9	52.0
M200 2hr	120	69.8	0.278	0.78	34.9	0.00137	0.010	74.8	129.1	17.7	57.1

M200 4hr	240	78.7	0.278	0.78	19.675	0.00137	0.006	84.4	258.2	35.4	48.9
M200 6hr	300	85.6	0.278	0.78	17.12	0.00137	0.005	110.1	387.3	53.2	56.9
M200 12hr	600	96.5	0.278	0.78	9.65	0.00137	0.003	124.1	774.6	106.3	17.8
M200 24hr	1200	108.8	0.278	0.78	5.44	0.00137	0.002	139.9	1549.1	212.7	-72.8
M200 48hr	2400	118.5	0.278	0.78	2.9625	0.00137	0.001	152.4	3098.2	425.4	-273.0

	Catchment		**SP2**	Hardstand					water discharge rate (l/s)		
Clean water natural flow									17.93		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	23.0	0.278	0.6	276	0.00376	0.173	52.0	5.4	2.0	50.0
M200 10min	10	32.1	0.278	0.6	192.6	0.00376	0.121	72.6	10.8	4.0	68.5
M200 15min	15	37.7	0.278	0.6	150.8	0.00376	0.095	85.2	16.1	6.1	79.1
M200 30min	30	46.3	0.278	0.6	92.6	0.00376	0.058	104.6	32.3	12.1	92.5
M200 60min	60	56.8	0.278	0.6	56.8	0.00376	0.036	128.4	64.5	24.3	104.1
M200 2hr	120	69.8	0.278	0.6	34.9	0.00376	0.022	157.8	129.1	48.6	109.2
M200 4hr	240	78.7	0.278	0.6	19.675	0.00376	0.012	177.9	258.2	97.2	80.7
M200 6hr	300	85.6	0.278	0.6	17.12	0.00376	0.011	232.2	387.3	145.8	86.4
M200 12hr	600	96.5	0.278	0.6	9.65	0.00376	0.006	261.7	774.6	291.5	-29.8
M200 24hr	1200	108.8	0.278	0.6	5.44	0.00376	0.003	295.1	1549.1	583.1	-288.0
M200 48hr	2400	118.5	0.278	0.6	2.9625	0.00376	0.002	321.4	3098.2	1166.2	-844.8

	Catchment		**SP3**	Area Excl Hardstand					water discharge rate (l/s)		
Clean water natural flow									17.93		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	23.0	0.278	0.78	276	0.00181	0.108	32.4	5.4	1.0	31.4
M200 10min	10	32.1	0.278	0.78	192.6	0.00181	0.075	45.2	10.8	1.9	43.3
M200 15min	15	37.7	0.278	0.78	150.8	0.00181	0.059	53.1	16.1	2.9	50.2
M200 30min	30	46.3	0.278	0.78	92.6	0.00181	0.036	65.2	32.3	5.8	59.4
M200 60min	60	56.8	0.278	0.78	56.8	0.00181	0.022	80.0	64.5	11.7	68.4
M200 2hr	120	69.8	0.278	0.78	34.9	0.00181	0.014	98.4	129.1	23.3	75.0
M200 4hr	240	78.7	0.278	0.78	19.675	0.00181	0.008	110.9	258.2	46.6	64.3
M200 6hr	300	85.6	0.278	0.78	17.12	0.00181	0.007	144.7	387.3	69.9	74.8
M200 12hr	600	96.5	0.278	0.78	9.65	0.00181	0.004	163.2	774.6	139.8	23.4
M200 24hr	1200	108.8	0.278	0.78	5.44	0.00181	0.002	184.0	1549.1	279.6	-95.7
M200 48hr	2400	118.5	0.278	0.78	2.9625	0.00181	0.001	200.4	3098.2	559.2	-358.9

	Catchment		**SP3**	Hardstand					water discharge rate (l/s)		
Clean water natural flow									17.93		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	23.0	0.278	0.6	276	0.00000	0.000	0.0	5.4	0.0	0.0
M200 10min	10	32.1	0.278	0.6	192.6	0.00000	0.000	0.0	10.8	0.0	0.0
M200 15min	15	37.7	0.278	0.6	150.8	0.00000	0.000	0.0	16.1	0.0	0.0
M200 30min	30	46.3	0.278	0.6	92.6	0.00000	0.000	0.0	32.3	0.0	0.0
M200 60min	60	56.8	0.278	0.6	56.8	0.00000	0.000	0.0	64.5	0.0	0.0
M200 2hr	120	69.8	0.278	0.6	34.9	0.00000	0.000	0.0	129.1	0.0	0.0
M200 4hr	240	78.7	0.278	0.6	19.675	0.00000	0.000	0.0	258.2	0.0	0.0
M200 6hr	300	85.6	0.278	0.6	17.12	0.00000	0.000	0.0	387.3	0.0	0.0
M200 12hr	600	96.5	0.278	0.6	9.65	0.00000	0.000	0.0	774.6	0.0	0.0
M200 24hr	1200	108.8	0.278	0.6	5.44	0.00000	0.000	0.0	1549.1	0.0	0.0
M200 48hr	2400	118.5	0.278	0.6	2.9625	0.00000	0.000	0.0	3098.2	0.0	0.0

	Catchment		**SP4**	Area Excl Hardstand					water discharge rate (l/s)		

Clean water natural flow 17.93 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	23.0	0.278	0.78	276	0.00229	0.137	41.1	5.4	1.2	39.9
M200 10min	10	32.1	0.278	0.78	192.6	0.00229	0.096	57.4	10.8	2.5	54.9
M200 15min	15	37.7	0.278	0.78	150.8	0.00229	0.075	67.4	16.1	3.7	63.7
M200 30min	30	46.3	0.278	0.78	92.6	0.00229	0.046	82.8	32.3	7.4	75.4
M200 60min	60	56.8	0.278	0.78	56.8	0.00229	0.028	101.6	64.5	14.8	86.8
M200 2hr	120	69.8	0.278	0.78	34.9	0.00229	0.017	124.8	129.1	29.6	95.3
M200 4hr	240	78.7	0.278	0.78	19.675	0.00229	0.010	140.7	258.2	59.2	81.6
M200 6hr	300	85.6	0.278	0.78	17.12	0.00229	0.009	183.7	387.3	88.7	95.0
M200 12hr	600	96.5	0.278	0.78	9.65	0.00229	0.005	207.1	774.6	177.5	29.6
M200 24hr	1200	108.8	0.278	0.78	5.44	0.00229	0.003	233.5	1549.1	354.9	-121.4
M200 48hr	2400	118.5	0.278	0.78	2.9625	0.00229	0.001	254.3	3098.2	709.8	-455.5

Catchment **SP4** Hardstand water discharge rate (l/s)

Clean water natural flow 17.93 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	23.0	0.278	0.6	276	0.00000	0.000	0.0	5.4	0.0	0.0
M200 10min	10	32.1	0.278	0.6	192.6	0.00000	0.000	0.0	10.8	0.0	0.0
M200 15min	15	37.7	0.278	0.6	150.8	0.00000	0.000	0.0	16.1	0.0	0.0
M200 30min	30	46.3	0.278	0.6	92.6	0.00000	0.000	0.0	32.3	0.0	0.0
M200 60min	60	56.8	0.278	0.6	56.8	0.00000	0.000	0.0	64.5	0.0	0.0
M200 2hr	120	69.8	0.278	0.6	34.9	0.00000	0.000	0.0	129.1	0.0	0.0
M200 4hr	240	78.7	0.278	0.6	19.675	0.00000	0.000	0.0	258.2	0.0	0.0
M200 6hr	300	85.6	0.278	0.6	17.12	0.00000	0.000	0.0	387.3	0.0	0.0
M200 12hr	600	96.5	0.278	0.6	9.65	0.00000	0.000	0.0	774.6	0.0	0.0
M200 24hr	1200	108.8	0.278	0.6	5.44	0.00000	0.000	0.0	1549.1	0.0	0.0
M200 48hr	2400	118.5	0.278	0.6	2.9625	0.00000	0.000	0.0	3098.2	0.0	0.0

Catchment **SP5** Area Excl Hardstand water discharge rate (l/s)

Clean water natural flow 17.93 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	23.0	0.278	0.78	276	0.00335	0.201	60.2	5.4	1.8	58.4
M200 10min	10	32.1	0.278	0.78	192.6	0.00335	0.140	84.0	10.8	3.6	80.4
M200 15min	15	37.7	0.278	0.78	150.8	0.00335	0.110	98.7	16.1	5.4	93.3
M200 30min	30	46.3	0.278	0.78	92.6	0.00335	0.067	121.2	32.3	10.8	110.4
M200 60min	60	56.8	0.278	0.78	56.8	0.00335	0.041	148.7	64.5	21.6	127.1
M200 2hr	120	69.8	0.278	0.78	34.9	0.00335	0.025	182.8	129.1	43.3	139.5
M200 4hr	240	78.7	0.278	0.78	19.675	0.00335	0.014	206.1	258.2	86.6	119.5
M200 6hr	300	85.6	0.278	0.78	17.12	0.00335	0.012	268.9	387.3	129.9	139.0
M200 12hr	600	96.5	0.278	0.78	9.65	0.00335	0.007	303.2	774.6	259.8	43.4
M200 24hr	1200	108.8	0.278	0.78	5.44	0.00335	0.004	341.8	1549.1	519.6	-177.7
M200 48hr	2400	118.5	0.278	0.78	2.9625	0.00335	0.002	372.3	3098.2	1039.1	-666.8

Catchment **SP5** Hardstand water discharge rate (l/s)

Clean water natural flow 17.93 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	23.0	0.278	0.6	276	0.00000	0.000	0.0	5.4	0.0	0.0
M200 10min	10	32.1	0.278	0.6	192.6	0.00000	0.000	0.0	10.8	0.0	0.0
M200 15min	15	37.7	0.278	0.6	150.8	0.00000	0.000	0.0	16.1	0.0	0.0
M200 30min	30	46.3	0.278	0.6	92.6	0.00000	0.000	0.0	32.3	0.0	0.0

M200 60min	60	56.8	0.278	0.6	56.8	0.00000	0.000	0.0	64.5	0.0	0.0
M200 2hr	120	69.8	0.278	0.6	34.9	0.00000	0.000	0.0	129.1	0.0	0.0
M200 4hr	240	78.7	0.278	0.6	19.675	0.00000	0.000	0.0	258.2	0.0	0.0
M200 6hr	300	85.6	0.278	0.6	17.12	0.00000	0.000	0.0	387.3	0.0	0.0
M200 12hr	600	96.5	0.278	0.6	9.65	0.00000	0.000	0.0	774.6	0.0	0.0
M200 24hr	1200	108.8	0.278	0.6	5.44	0.00000	0.000	0.0	1549.1	0.0	0.0
M200 48hr	2400	118.5	0.278	0.6	2.9625	0.00000	0.000	0.0	3098.2	0.0	0.0

	Catchment		**SP6**	Area Excl Hardstand					water discharge rate (l/s)		
Clean water natural flow									17.93		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	23.0	0.278	0.78	276	0.00106	0.063	18.9	5.4	0.6	18.4
M200 10min	10	32.1	0.278	0.78	192.6	0.00106	0.044	26.4	10.8	1.1	25.3
M200 15min	15	37.7	0.278	0.78	150.8	0.00106	0.034	31.0	16.1	1.7	29.3
M200 30min	30	46.3	0.278	0.78	92.6	0.00106	0.021	38.1	32.3	3.4	34.7
M200 60min	60	56.8	0.278	0.78	56.8	0.00106	0.013	46.8	64.5	6.8	40.0
M200 2hr	120	69.8	0.278	0.78	34.9	0.00106	0.008	57.5	129.1	13.6	43.9
M200 4hr	240	78.7	0.278	0.78	19.675	0.00106	0.005	64.8	258.2	27.2	37.6
M200 6hr	300	85.6	0.278	0.78	17.12	0.00106	0.004	84.6	387.3	40.9	43.7
M200 12hr	600	96.5	0.278	0.78	9.65	0.00106	0.002	95.4	774.6	81.7	13.7
M200 24hr	1200	108.8	0.278	0.78	5.44	0.00106	0.001	107.5	1549.1	163.4	-55.9
M200 48hr	2400	118.5	0.278	0.78	2.9625	0.00106	0.001	117.1	3098.2	326.9	-209.8

	Catchment		**SP6**	Hardstand					water discharge rate (l/s)		
Clean water natural flow									17.93		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	23.0	0.278	0.6	276	0.00408	0.188	56.4	5.4	2.2	54.2
M200 10min	10	32.1	0.278	0.6	192.6	0.00408	0.131	78.7	10.8	4.4	74.3
M200 15min	15	37.7	0.278	0.6	150.8	0.00408	0.103	92.4	16.1	6.6	85.8
M200 30min	30	46.3	0.278	0.6	92.6	0.00408	0.063	113.5	32.3	13.2	100.3
M200 60min	60	56.8	0.278	0.6	56.8	0.00408	0.039	139.2	64.5	26.3	112.9
M200 2hr	120	69.8	0.278	0.6	34.9	0.00408	0.024	171.1	129.1	52.7	118.4
M200 4hr	240	78.7	0.278	0.6	19.675	0.00408	0.013	192.9	258.2	105.4	87.5
M200 6hr	300	85.6	0.278	0.6	17.12	0.00408	0.012	251.8	387.3	158.1	93.7
M200 12hr	600	96.5	0.278	0.6	9.65	0.00408	0.007	283.8	774.6	316.2	-32.3
M200 24hr	1200	108.8	0.278	0.6	5.44	0.00408	0.004	320.0	1549.1	632.3	-312.3
M200 48hr	2400	118.5	0.278	0.6	2.9625	0.00408	0.002	348.6	3098.2	1264.7	-916.1

	Catchment		**SP7**	Area Excl Hardstand					water discharge rate (l/s)		
Clean water natural flow									17.93		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	23.0	0.278	0.78	276	0.00230	0.137	41.2	5.4	1.2	40.0
M200 10min	10	32.1	0.278	0.78	192.6	0.00230	0.096	57.5	10.8	2.5	55.1
M200 15min	15	37.7	0.278	0.78	150.8	0.00230	0.075	67.6	16.1	3.7	63.9
M200 30min	30	46.3	0.278	0.78	92.6	0.00230	0.046	83.0	32.3	7.4	75.6
M200 60min	60	56.8	0.278	0.78	56.8	0.00230	0.028	101.8	64.5	14.8	87.0
M200 2hr	120	69.8	0.278	0.78	34.9	0.00230	0.017	125.1	129.1	29.6	95.5
M200 4hr	240	78.7	0.278	0.78	19.675	0.00230	0.010	141.1	258.2	59.3	81.8
M200 6hr	300	85.6	0.278	0.78	17.12	0.00230	0.009	184.1	387.3	88.9	95.2
M200 12hr	600	96.5	0.278	0.78	9.65	0.00230	0.005	207.5	774.6	177.8	29.7
M200 24hr	1200	108.8	0.278	0.78	5.44	0.00230	0.003	234.0	1549.1	355.7	-121.7
M200 48hr	2400	118.5	0.278	0.78	2.9625	0.00230	0.001	254.9	3098.2	711.4	-456.5

Catchment **SP7** Hardstand water discharge rate (l/s)
Clean water natural flow 17.93 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	23.0	0.278	0.6	276	0.00000	0.000	0.0	5.4	0.0	0.0
M200 10min	10	32.1	0.278	0.6	192.6	0.00000	0.000	0.0	10.8	0.0	0.0
M200 15min	15	37.7	0.278	0.6	150.8	0.00000	0.000	0.0	16.1	0.0	0.0
M200 30min	30	46.3	0.278	0.6	92.6	0.00000	0.000	0.0	32.3	0.0	0.0
M200 60min	60	56.8	0.278	0.6	56.8	0.00000	0.000	0.0	64.5	0.0	0.0
M200 2hr	120	69.8	0.278	0.6	34.9	0.00000	0.000	0.0	129.1	0.0	0.0
M200 4hr	240	78.7	0.278	0.6	19.675	0.00000	0.000	0.0	258.2	0.0	0.0
M200 6hr	300	85.6	0.278	0.6	17.12	0.00000	0.000	0.0	387.3	0.0	0.0
M200 12hr	600	96.5	0.278	0.6	9.65	0.00000	0.000	0.0	774.6	0.0	0.0
M200 24hr	1200	108.8	0.278	0.6	5.44	0.00000	0.000	0.0	1549.1	0.0	0.0
M200 48hr	2400	118.5	0.278	0.6	2.9625	0.00000	0.000	0.0	3098.2	0.0	0.0

Catchment **SP8** Area Excl Hardstand water discharge rate (l/s)
Clean water natural flow 17.93 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	23.0	0.278	0.78	276	0.00149	0.089	26.7	5.4	0.8	25.9
M200 10min	10	32.1	0.278	0.78	192.6	0.00149	0.062	37.3	10.8	1.6	35.7
M200 15min	15	37.7	0.278	0.78	150.8	0.00149	0.049	43.8	16.1	2.4	41.4
M200 30min	30	46.3	0.278	0.78	92.6	0.00149	0.030	53.7	32.3	4.8	48.9
M200 60min	60	56.8	0.278	0.78	56.8	0.00149	0.018	65.9	64.5	9.6	56.3
M200 2hr	120	69.8	0.278	0.78	34.9	0.00149	0.011	81.0	129.1	19.2	61.8
M200 4hr	240	78.7	0.278	0.78	19.675	0.00149	0.006	91.4	258.2	38.4	53.0
M200 6hr	300	85.6	0.278	0.78	17.12	0.00149	0.006	119.2	387.3	57.6	61.6
M200 12hr	600	96.5	0.278	0.78	9.65	0.00149	0.003	134.4	774.6	115.2	19.2
M200 24hr	1200	108.8	0.278	0.78	5.44	0.00149	0.002	151.6	1549.1	230.4	-78.8
M200 48hr	2400	118.5	0.278	0.78	2.9625	0.00149	0.001	165.1	3098.2	460.7	-295.6

Catchment **SP8** Hardstand water discharge rate (l/s)
Clean water natural flow 17.93 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	23.0	0.278	0.6	276	0.00000	0.000	0.0	5.4	0.0	0.0
M200 10min	10	32.1	0.278	0.6	192.6	0.00000	0.000	0.0	10.8	0.0	0.0
M200 15min	15	37.7	0.278	0.6	150.8	0.00000	0.000	0.0	16.1	0.0	0.0
M200 30min	30	46.3	0.278	0.6	92.6	0.00000	0.000	0.0	32.3	0.0	0.0
M200 60min	60	56.8	0.278	0.6	56.8	0.00000	0.000	0.0	64.5	0.0	0.0
M200 2hr	120	69.8	0.278	0.6	34.9	0.00000	0.000	0.0	129.1	0.0	0.0
M200 4hr	240	78.7	0.278	0.6	19.675	0.00000	0.000	0.0	258.2	0.0	0.0
M200 6hr	300	85.6	0.278	0.6	17.12	0.00000	0.000	0.0	387.3	0.0	0.0
M200 12hr	600	96.5	0.278	0.6	9.65	0.00000	0.000	0.0	774.6	0.0	0.0
M200 24hr	1200	108.8	0.278	0.6	5.44	0.00000	0.000	0.0	1549.1	0.0	0.0
M200 48hr	2400	118.5	0.278	0.6	2.9625	0.00000	0.000	0.0	3098.2	0.0	0.0

Catchment **SP9-A** Area Excl Hardstand water discharge rate (l/s)
Clean water natural flow 17.93 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	23.0	0.278	0.78	276	0.00064	0.038	11.5	5.4	0.3	11.1
M200 10min	10	32.1	0.278	0.78	192.6	0.00064	0.027	16.0	10.8	0.7	15.3
M200 15min	15	37.7	0.278	0.78	150.8	0.00064	0.021	18.8	16.1	1.0	17.7

M200 30min	30	46.3	0.278	0.78	92.6	0.00064	0.013	23.1	32.3	2.1	21.0
M200 60min	60	56.8	0.278	0.78	56.8	0.00064	0.008	28.3	64.5	4.1	24.2
M200 2hr	120	69.8	0.278	0.78	34.9	0.00064	0.005	34.8	129.1	8.2	26.5
M200 4hr	240	78.7	0.278	0.78	19.675	0.00064	0.003	39.2	258.2	16.5	22.7
M200 6hr	300	85.6	0.278	0.78	17.12	0.00064	0.002	51.2	387.3	24.7	26.5
M200 12hr	600	96.5	0.278	0.78	9.65	0.00064	0.001	57.7	774.6	49.4	8.3
M200 24hr	1200	108.8	0.278	0.78	5.44	0.00064	0.001	65.0	1549.1	98.8	-33.8
M200 48hr	2400	118.5	0.278	0.78	2.9625	0.00064	0.000	70.8	3098.2	197.7	-126.8

Catchment				**SP9-A** Hardstand					water discharge rate (l/s)		
Clean water natural flow									17.93		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	23.0	0.278	0.6	276	0.00428	0.197	59.0	5.4	2.3	56.7
M200 10min	10	32.1	0.278	0.6	192.6	0.00428	0.137	82.4	10.8	4.6	77.8
M200 15min	15	37.7	0.278	0.6	150.8	0.00428	0.108	96.8	16.1	6.9	89.9
M200 30min	30	46.3	0.278	0.6	92.6	0.00428	0.066	118.9	32.3	13.8	105.1
M200 60min	60	56.8	0.278	0.6	56.8	0.00428	0.041	145.8	64.5	27.6	118.2
M200 2hr	120	69.8	0.278	0.6	34.9	0.00428	0.025	179.2	129.1	55.2	124.0
M200 4hr	240	78.7	0.278	0.6	19.675	0.00428	0.014	202.0	258.2	110.4	91.7
M200 6hr	300	85.6	0.278	0.6	17.12	0.00428	0.012	263.7	387.3	165.6	98.1
M200 12hr	600	96.5	0.278	0.6	9.65	0.00428	0.007	297.3	774.6	331.1	-33.9
M200 24hr	1200	108.8	0.278	0.6	5.44	0.00428	0.004	335.2	1549.1	662.2	-327.1
M200 48hr	2400	118.5	0.278	0.6	2.9625	0.00428	0.002	365.0	3098.2	1324.5	-959.5

Catchment				**SP9-B** Area Excl Hardstand					water discharge rate (l/s)		
Clean water natural flow									17.93		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	23.0	0.278	0.78	276	0.00170	0.102	30.5	5.4	0.9	29.6
M200 10min	10	32.1	0.278	0.78	192.6	0.00170	0.071	42.6	10.8	1.8	40.8
M200 15min	15	37.7	0.278	0.78	150.8	0.00170	0.056	50.0	16.1	2.7	47.3
M200 30min	30	46.3	0.278	0.78	92.6	0.00170	0.034	61.4	32.3	5.5	56.0
M200 60min	60	56.8	0.278	0.78	56.8	0.00170	0.021	75.4	64.5	11.0	64.4
M200 2hr	120	69.8	0.278	0.78	34.9	0.00170	0.013	92.6	129.1	21.9	70.7
M200 4hr	240	78.7	0.278	0.78	19.675	0.00170	0.007	104.4	258.2	43.9	60.5
M200 6hr	300	85.6	0.278	0.78	17.12	0.00170	0.006	136.3	387.3	65.8	70.5
M200 12hr	600	96.5	0.278	0.78	9.65	0.00170	0.004	153.7	774.6	131.7	22.0
M200 24hr	1200	108.8	0.278	0.78	5.44	0.00170	0.002	173.3	1549.1	263.4	-90.1
M200 48hr	2400	118.5	0.278	0.78	2.9625	0.00170	0.001	188.7	3098.2	526.7	-338.0

Catchment				**SP9-B** Hardstand					water discharge rate (l/s)		
Clean water natural flow									17.93		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	23.0	0.278	0.6	276	0.00000	0.000	0.0	5.4	0.0	0.0
M200 10min	10	32.1	0.278	0.6	192.6	0.00000	0.000	0.0	10.8	0.0	0.0
M200 15min	15	37.7	0.278	0.6	150.8	0.00000	0.000	0.0	16.1	0.0	0.0
M200 30min	30	46.3	0.278	0.6	92.6	0.00000	0.000	0.0	32.3	0.0	0.0
M200 60min	60	56.8	0.278	0.6	56.8	0.00000	0.000	0.0	64.5	0.0	0.0
M200 2hr	120	69.8	0.278	0.6	34.9	0.00000	0.000	0.0	129.1	0.0	0.0
M200 4hr	240	78.7	0.278	0.6	19.675	0.00000	0.000	0.0	258.2	0.0	0.0
M200 6hr	300	85.6	0.278	0.6	17.12	0.00000	0.000	0.0	387.3	0.0	0.0
M200 12hr	600	96.5	0.278	0.6	9.65	0.00000	0.000	0.0	774.6	0.0	0.0
M200 24hr	1200	108.8	0.278	0.6	5.44	0.00000	0.000	0.0	1549.1	0.0	0.0
M200 48hr	2400	118.5	0.278	0.6	2.9625	0.00000	0.000	0.0	3098.2	0.0	0.0

Catchment **SP10** Area Excl Hardstand water discharge rate (l/s)

Clean water natural flow 17.93 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	23.0	0.278	0.78	276	0.00496	0.297	89.1	5.4	2.7	86.4
M200 10min	10	32.1	0.278	0.78	192.6	0.00496	0.207	124.3	10.8	5.3	119.0
M200 15min	15	37.7	0.278	0.78	150.8	0.00496	0.162	146.0	16.1	8.0	138.0
M200 30min	30	46.3	0.278	0.78	92.6	0.00496	0.100	179.3	32.3	16.0	163.3
M200 60min	60	56.8	0.278	0.78	56.8	0.00496	0.061	219.9	64.5	32.0	187.9
M200 2hr	120	69.8	0.278	0.78	34.9	0.00496	0.038	270.3	129.1	64.0	206.2
M200 4hr	240	78.7	0.278	0.78	19.675	0.00496	0.021	304.7	258.2	128.1	176.7
M200 6hr	300	85.6	0.278	0.78	17.12	0.00496	0.018	397.7	387.3	192.1	205.6
M200 12hr	600	96.5	0.278	0.78	9.65	0.00496	0.010	448.4	774.6	384.2	64.2
M200 24hr	1200	108.8	0.278	0.78	5.44	0.00496	0.006	505.5	1549.1	768.4	-262.8
M200 48hr	2400	118.5	0.278	0.78	2.9625	0.00496	0.003	550.6	3098.2	1536.7	-986.1

Catchment **SP10** Hardstand water discharge rate (l/s)

Clean water natural flow 17.93 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	23.0	0.278	0.6	276	0.00000	0.000	0.0	5.4	0.0	0.0
M200 10min	10	32.1	0.278	0.6	192.6	0.00000	0.000	0.0	10.8	0.0	0.0
M200 15min	15	37.7	0.278	0.6	150.8	0.00000	0.000	0.0	16.1	0.0	0.0
M200 30min	30	46.3	0.278	0.6	92.6	0.00000	0.000	0.0	32.3	0.0	0.0
M200 60min	60	56.8	0.278	0.6	56.8	0.00000	0.000	0.0	64.5	0.0	0.0
M200 2hr	120	69.8	0.278	0.6	34.9	0.00000	0.000	0.0	129.1	0.0	0.0
M200 4hr	240	78.7	0.278	0.6	19.675	0.00000	0.000	0.0	258.2	0.0	0.0
M200 6hr	300	85.6	0.278	0.6	17.12	0.00000	0.000	0.0	387.3	0.0	0.0
M200 12hr	600	96.5	0.278	0.6	9.65	0.00000	0.000	0.0	774.6	0.0	0.0
M200 24hr	1200	108.8	0.278	0.6	5.44	0.00000	0.000	0.0	1549.1	0.0	0.0
M200 48hr	2400	118.5	0.278	0.6	2.9625	0.00000	0.000	0.0	3098.2	0.0	0.0

Catchment **SP11** Area Excl Hardstand water discharge rate (l/s)

Clean water natural flow 17.93 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	23.0	0.278	0.78	276	0.00228	0.137	41.0	5.4	1.2	39.7
M200 10min	10	32.1	0.278	0.78	192.6	0.00228	0.095	57.2	10.8	2.5	54.7
M200 15min	15	37.7	0.278	0.78	150.8	0.00228	0.075	67.2	16.1	3.7	63.5
M200 30min	30	46.3	0.278	0.78	92.6	0.00228	0.046	82.5	32.3	7.4	75.1
M200 60min	60	56.8	0.278	0.78	56.8	0.00228	0.028	101.2	64.5	14.7	86.5
M200 2hr	120	69.8	0.278	0.78	34.9	0.00228	0.017	124.3	129.1	29.5	94.9
M200 4hr	240	78.7	0.278	0.78	19.675	0.00228	0.010	140.2	258.2	58.9	81.3
M200 6hr	300	85.6	0.278	0.78	17.12	0.00228	0.008	183.0	387.3	88.4	94.6
M200 12hr	600	96.5	0.278	0.78	9.65	0.00228	0.005	206.3	774.6	176.8	29.5
M200 24hr	1200	108.8	0.278	0.78	5.44	0.00228	0.003	232.6	1549.1	353.5	-120.9
M200 48hr	2400	118.5	0.278	0.78	2.9625	0.00228	0.001	253.3	3098.2	707.0	-453.7

Catchment **SP11** Hardstand water discharge rate (l/s)

Clean water natural flow 17.93 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	23.0	0.278	0.6	276	0.00000	0.000	0.0	5.4	0.0	0.0

M200 10min	10	32.1	0.278	0.6	192.6	0.00000	0.000	0.0	10.8	0.0	0.0
M200 15min	15	37.7	0.278	0.6	150.8	0.00000	0.000	0.0	16.1	0.0	0.0
M200 30min	30	46.3	0.278	0.6	92.6	0.00000	0.000	0.0	32.3	0.0	0.0
M200 60min	60	56.8	0.278	0.6	56.8	0.00000	0.000	0.0	64.5	0.0	0.0
M200 2hr	120	69.8	0.278	0.6	34.9	0.00000	0.000	0.0	129.1	0.0	0.0
M200 4hr	240	78.7	0.278	0.6	19.675	0.00000	0.000	0.0	258.2	0.0	0.0
M200 6hr	300	85.6	0.278	0.6	17.12	0.00000	0.000	0.0	387.3	0.0	0.0
M200 12hr	600	96.5	0.278	0.6	9.65	0.00000	0.000	0.0	774.6	0.0	0.0
M200 24hr	1200	108.8	0.278	0.6	5.44	0.00000	0.000	0.0	1549.1	0.0	0.0
M200 48hr	2400	118.5	0.278	0.6	2.9625	0.00000	0.000	0.0	3098.2	0.0	0.0

	Catchment		**SP12**	Area Excl Hardstand					water discharge rate (l/s)		
Clean water natural flow									17.93		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	23.0	0.278	0.78	276	0.00089	0.053	15.9	5.4	0.5	15.5
M200 10min	10	32.1	0.278	0.78	192.6	0.00089	0.037	22.3	10.8	1.0	21.3
M200 15min	15	37.7	0.278	0.78	150.8	0.00089	0.029	26.1	16.1	1.4	24.7
M200 30min	30	46.3	0.278	0.78	92.6	0.00089	0.018	32.1	32.3	2.9	29.2
M200 60min	60	56.8	0.278	0.78	56.8	0.00089	0.011	39.4	64.5	5.7	33.6
M200 2hr	120	69.8	0.278	0.78	34.9	0.00089	0.007	48.4	129.1	11.5	36.9
M200 4hr	240	78.7	0.278	0.78	19.675	0.00089	0.004	54.6	258.2	22.9	31.6
M200 6hr	300	85.6	0.278	0.78	17.12	0.00089	0.003	71.2	387.3	34.4	36.8
M200 12hr	600	96.5	0.278	0.78	9.65	0.00089	0.002	80.3	774.6	68.8	11.5
M200 24hr	1200	108.8	0.278	0.78	5.44	0.00089	0.001	90.5	1549.1	137.6	-47.1
M200 48hr	2400	118.5	0.278	0.78	2.9625	0.00089	0.001	98.6	3098.2	275.1	-176.6

	Catchment		**SP12**	Hardstand					water discharge rate (l/s)		
Clean water natural flow									17.93		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	23.0	0.278	0.6	276	0.00000	0.000	0.0	5.4	0.0	0.0
M200 10min	10	32.1	0.278	0.6	192.6	0.00000	0.000	0.0	10.8	0.0	0.0
M200 15min	15	37.7	0.278	0.6	150.8	0.00000	0.000	0.0	16.1	0.0	0.0
M200 30min	30	46.3	0.278	0.6	92.6	0.00000	0.000	0.0	32.3	0.0	0.0
M200 60min	60	56.8	0.278	0.6	56.8	0.00000	0.000	0.0	64.5	0.0	0.0
M200 2hr	120	69.8	0.278	0.6	34.9	0.00000	0.000	0.0	129.1	0.0	0.0
M200 4hr	240	78.7	0.278	0.6	19.675	0.00000	0.000	0.0	258.2	0.0	0.0
M200 6hr	300	85.6	0.278	0.6	17.12	0.00000	0.000	0.0	387.3	0.0	0.0
M200 12hr	600	96.5	0.278	0.6	9.65	0.00000	0.000	0.0	774.6	0.0	0.0
M200 24hr	1200	108.8	0.278	0.6	5.44	0.00000	0.000	0.0	1549.1	0.0	0.0
M200 48hr	2400	118.5	0.278	0.6	2.9625	0.00000	0.000	0.0	3098.2	0.0	0.0

	Catchment		**SP13-A**	Area Excl Hardstand					water discharge rate (l/s)		
Clean water natural flow									17.93		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	23.0	0.278	0.78	276	0.00050	0.030	8.9	5.4	0.3	8.7
M200 10min	10	32.1	0.278	0.78	192.6	0.00050	0.021	12.5	10.8	0.5	11.9
M200 15min	15	37.7	0.278	0.78	150.8	0.00050	0.016	14.7	16.1	0.8	13.9
M200 30min	30	46.3	0.278	0.78	92.6	0.00050	0.010	18.0	32.3	1.6	16.4
M200 60min	60	56.8	0.278	0.78	56.8	0.00050	0.006	22.1	64.5	3.2	18.9
M200 2hr	120	69.8	0.278	0.78	34.9	0.00050	0.004	27.1	129.1	6.4	20.7
M200 4hr	240	78.7	0.278	0.78	19.675	0.00050	0.002	30.6	258.2	12.9	17.7
M200 6hr	300	85.6	0.278	0.78	17.12	0.00050	0.002	39.9	387.3	19.3	20.6
M200 12hr	600	96.5	0.278	0.78	9.65	0.00050	0.001	45.0	774.6	38.6	6.4
M200 24hr	1200	108.8	0.278	0.78	5.44	0.00050	0.001	50.8	1549.1	77.1	-26.4

M200 48hr	2400	118.5	0.278	0.78	2.9625	0.00050	0.000	55.3	3098.2	154.3	-99.0

Catchment				**SP13-A**	Hardstand				water discharge rate (l/s)		
Clean water natural flow									17.93		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	23.0	0.278	0.6	276	0.00435	0.200	60.0	5.4	2.3	57.7
M200 10min	10	32.1	0.278	0.6	192.6	0.00435	0.140	83.8	10.8	4.7	79.1
M200 15min	15	37.7	0.278	0.6	150.8	0.00435	0.109	98.4	16.1	7.0	91.4
M200 30min	30	46.3	0.278	0.6	92.6	0.00435	0.067	120.8	32.3	14.0	106.8
M200 60min	60	56.8	0.278	0.6	56.8	0.00435	0.041	148.2	64.5	28.0	120.2
M200 2hr	120	69.8	0.278	0.6	34.9	0.00435	0.025	182.1	129.1	56.1	126.0
M200 4hr	240	78.7	0.278	0.6	19.675	0.00435	0.014	205.3	258.2	112.2	93.2
M200 6hr	300	85.6	0.278	0.6	17.12	0.00435	0.012	268.0	387.3	168.3	99.7
M200 12hr	600	96.5	0.278	0.6	9.65	0.00435	0.007	302.1	774.6	336.5	-34.4
M200 24hr	1200	108.8	0.278	0.6	5.44	0.00435	0.004	340.6	1549.1	673.1	-332.4
M200 48hr	2400	118.5	0.278	0.6	2.9625	0.00435	0.002	371.0	3098.2	1346.2	-975.2

Catchment				**SP13-B**	Area Excl Hardstand				water discharge rate (l/s)		
Clean water natural flow									17.93		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	23.0	0.278	0.78	276	0.00172	0.103	30.8	5.4	0.9	29.9
M200 10min	10	32.1	0.278	0.78	192.6	0.00172	0.072	43.0	10.8	1.8	41.2
M200 15min	15	37.7	0.278	0.78	150.8	0.00172	0.056	50.5	16.1	2.8	47.8
M200 30min	30	46.3	0.278	0.78	92.6	0.00172	0.034	62.1	32.3	5.5	56.5
M200 60min	60	56.8	0.278	0.78	56.8	0.00172	0.021	76.1	64.5	11.1	65.0
M200 2hr	120	69.8	0.278	0.78	34.9	0.00172	0.013	93.6	129.1	22.2	71.4
M200 4hr	240	78.7	0.278	0.78	19.675	0.00172	0.007	105.5	258.2	44.3	61.2
M200 6hr	300	85.6	0.278	0.78	17.12	0.00172	0.006	137.7	387.3	66.5	71.2
M200 12hr	600	96.5	0.278	0.78	9.65	0.00172	0.004	155.2	774.6	133.0	22.2
M200 24hr	1200	108.8	0.278	0.78	5.44	0.00172	0.002	175.0	1549.1	266.0	-91.0
M200 48hr	2400	118.5	0.278	0.78	2.9625	0.00172	0.001	190.6	3098.2	532.0	-341.4

Catchment				**SP13-B**	Hardstand				water discharge rate (l/s)		
Clean water natural flow									17.93		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	23.0	0.278	0.6	276	0.00000	0.000	0.0	5.4	0.0	0.0
M200 10min	10	32.1	0.278	0.6	192.6	0.00000	0.000	0.0	10.8	0.0	0.0
M200 15min	15	37.7	0.278	0.6	150.8	0.00000	0.000	0.0	16.1	0.0	0.0
M200 30min	30	46.3	0.278	0.6	92.6	0.00000	0.000	0.0	32.3	0.0	0.0
M200 60min	60	56.8	0.278	0.6	56.8	0.00000	0.000	0.0	64.5	0.0	0.0
M200 2hr	120	69.8	0.278	0.6	34.9	0.00000	0.000	0.0	129.1	0.0	0.0
M200 4hr	240	78.7	0.278	0.6	19.675	0.00000	0.000	0.0	258.2	0.0	0.0
M200 6hr	300	85.6	0.278	0.6	17.12	0.00000	0.000	0.0	387.3	0.0	0.0
M200 12hr	600	96.5	0.278	0.6	9.65	0.00000	0.000	0.0	774.6	0.0	0.0
M200 24hr	1200	108.8	0.278	0.6	5.44	0.00000	0.000	0.0	1549.1	0.0	0.0
M200 48hr	2400	118.5	0.278	0.6	2.9625	0.00000	0.000	0.0	3098.2	0.0	0.0

Catchment				**SP14**	Area Excl Hardstand				water discharge rate (l/s)		
Clean water natural flow									17.93		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	23.0	0.278	0.78	276	0.00407	0.244	73.1	5.4	2.2	70.9
M200 10min	10	32.1	0.278	0.78	192.6	0.00407	0.170	102.0	10.8	4.4	97.6
M200 15min	15	37.7	0.278	0.78	150.8	0.00407	0.133	119.8	16.1	6.6	113.2
M200 30min	30	46.3	0.278	0.78	92.6	0.00407	0.082	147.1	32.3	13.1	134.0
M200 60min	60	56.8	0.278	0.78	56.8	0.00407	0.050	180.5	64.5	26.3	154.2
M200 2hr	120	69.8	0.278	0.78	34.9	0.00407	0.031	221.8	129.1	52.6	169.3
M200 4hr	240	78.7	0.278	0.78	19.675	0.00407	0.017	250.1	258.2	105.1	145.0
M200 6hr	300	85.6	0.278	0.78	17.12	0.00407	0.015	326.4	387.3	157.7	168.8
M200 12hr	600	96.5	0.278	0.78	9.65	0.00407	0.009	368.0	774.6	315.3	52.7
M200 24hr	1200	108.8	0.278	0.78	5.44	0.00407	0.005	414.9	1549.1	630.6	-215.7
M200 48hr	2400	118.5	0.278	0.78	2.9625	0.00407	0.003	451.9	3098.2	1261.3	-809.4

Catchment **SP14** Hardstand water discharge rate (l/s)

Clean water natural flow 17.93 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	23.0	0.278	0.6	276	0.00000	0.000	0.0	5.4	0.0	0.0
M200 10min	10	32.1	0.278	0.6	192.6	0.00000	0.000	0.0	10.8	0.0	0.0
M200 15min	15	37.7	0.278	0.6	150.8	0.00000	0.000	0.0	16.1	0.0	0.0
M200 30min	30	46.3	0.278	0.6	92.6	0.00000	0.000	0.0	32.3	0.0	0.0
M200 60min	60	56.8	0.278	0.6	56.8	0.00000	0.000	0.0	64.5	0.0	0.0
M200 2hr	120	69.8	0.278	0.6	34.9	0.00000	0.000	0.0	129.1	0.0	0.0
M200 4hr	240	78.7	0.278	0.6	19.675	0.00000	0.000	0.0	258.2	0.0	0.0
M200 6hr	300	85.6	0.278	0.6	17.12	0.00000	0.000	0.0	387.3	0.0	0.0
M200 12hr	600	96.5	0.278	0.6	9.65	0.00000	0.000	0.0	774.6	0.0	0.0
M200 24hr	1200	108.8	0.278	0.6	5.44	0.00000	0.000	0.0	1549.1	0.0	0.0
M200 48hr	2400	118.5	0.278	0.6	2.9625	0.00000	0.000	0.0	3098.2	0.0	0.0

Catchment **SP15** Area Excl Hardstand water discharge rate (l/s)

Clean water natural flow 17.93 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	23.0	0.278	0.78	276	0.00397	0.238	71.3	5.4	2.1	69.2
M200 10min	10	32.1	0.278	0.78	192.6	0.00397	0.166	99.5	10.8	4.3	95.3
M200 15min	15	37.7	0.278	0.78	150.8	0.00397	0.130	116.9	16.1	6.4	110.5
M200 30min	30	46.3	0.278	0.78	92.6	0.00397	0.080	143.6	32.3	12.8	130.7
M200 60min	60	56.8	0.278	0.78	56.8	0.00397	0.049	176.1	64.5	25.6	150.5
M200 2hr	120	69.8	0.278	0.78	34.9	0.00397	0.030	216.4	129.1	51.3	165.1
M200 4hr	240	78.7	0.278	0.78	19.675	0.00397	0.017	244.0	258.2	102.6	141.5
M200 6hr	300	85.6	0.278	0.78	17.12	0.00397	0.015	318.5	387.3	153.8	164.7
M200 12hr	600	96.5	0.278	0.78	9.65	0.00397	0.008	359.1	774.6	307.7	51.4
M200 24hr	1200	108.8	0.278	0.78	5.44	0.00397	0.005	404.8	1549.1	615.3	-210.5
M200 48hr	2400	118.5	0.278	0.78	2.9625	0.00397	0.003	440.9	3098.2	1230.6	-789.7

Catchment **SP15** Hardstand water discharge rate (l/s)

Clean water natural flow 17.93 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	23.0	0.278	0.6	276	0.00000	0.000	0.0	5.4	0.0	0.0
M200 10min	10	32.1	0.278	0.6	192.6	0.00000	0.000	0.0	10.8	0.0	0.0
M200 15min	15	37.7	0.278	0.6	150.8	0.00000	0.000	0.0	16.1	0.0	0.0
M200 30min	30	46.3	0.278	0.6	92.6	0.00000	0.000	0.0	32.3	0.0	0.0
M200 60min	60	56.8	0.278	0.6	56.8	0.00000	0.000	0.0	64.5	0.0	0.0
M200 2hr	120	69.8	0.278	0.6	34.9	0.00000	0.000	0.0	129.1	0.0	0.0
M200 4hr	240	78.7	0.278	0.6	19.675	0.00000	0.000	0.0	258.2	0.0	0.0
M200 6hr	300	85.6	0.278	0.6	17.12	0.00000	0.000	0.0	387.3	0.0	0.0

M200 12hr	600	96.5	0.278	0.6	9.65	0.00000	0.000	0.0	774.6	0.0	0.0
M200 24hr	1200	108.8	0.278	0.6	5.44	0.00000	0.000	0.0	1549.1	0.0	0.0
M200 48hr	2400	118.5	0.278	0.6	2.9625	0.00000	0.000	0.0	3098.2	0.0	0.0

Catchment **SP16** Area Excl Hardstand — water discharge rate (l/s)
Clean water natural flow — 17.93 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	23.0	0.278	0.78	276	0.00196	0.117	35.1	5.4	1.1	34.0
M200 10min	10	32.1	0.278	0.78	192.6	0.00196	0.082	49.0	10.8	2.1	46.9
M200 15min	15	37.7	0.278	0.78	150.8	0.00196	0.064	57.5	16.1	3.2	54.4
M200 30min	30	46.3	0.278	0.78	92.6	0.00196	0.039	70.7	32.3	6.3	64.3
M200 60min	60	56.8	0.278	0.78	56.8	0.00196	0.024	86.7	64.5	12.6	74.1
M200 2hr	120	69.8	0.278	0.78	34.9	0.00196	0.015	106.5	129.1	25.2	81.3
M200 4hr	240	78.7	0.278	0.78	19.675	0.00196	0.008	120.1	258.2	50.5	69.6
M200 6hr	300	85.6	0.278	0.78	17.12	0.00196	0.007	156.8	387.3	75.7	81.0
M200 12hr	600	96.5	0.278	0.78	9.65	0.00196	0.004	176.7	774.6	151.4	25.3
M200 24hr	1200	108.8	0.278	0.78	5.44	0.00196	0.002	199.3	1549.1	302.9	-103.6
M200 48hr	2400	118.5	0.278	0.78	2.9625	0.00196	0.001	217.0	3098.2	605.7	-388.7

Catchment **SP16** Hardstand — water discharge rate (l/s)
Clean water natural flow — 17.93 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	23.0	0.278	0.6	276	0.00000	0.000	0.0	5.4	0.0	0.0
M200 10min	10	32.1	0.278	0.6	192.6	0.00000	0.000	0.0	10.8	0.0	0.0
M200 15min	15	37.7	0.278	0.6	150.8	0.00000	0.000	0.0	16.1	0.0	0.0
M200 30min	30	46.3	0.278	0.6	92.6	0.00000	0.000	0.0	32.3	0.0	0.0
M200 60min	60	56.8	0.278	0.6	56.8	0.00000	0.000	0.0	64.5	0.0	0.0
M200 2hr	120	69.8	0.278	0.6	34.9	0.00000	0.000	0.0	129.1	0.0	0.0
M200 4hr	240	78.7	0.278	0.6	19.675	0.00000	0.000	0.0	258.2	0.0	0.0
M200 6hr	300	85.6	0.278	0.6	17.12	0.00000	0.000	0.0	387.3	0.0	0.0
M200 12hr	600	96.5	0.278	0.6	9.65	0.00000	0.000	0.0	774.6	0.0	0.0
M200 24hr	1200	108.8	0.278	0.6	5.44	0.00000	0.000	0.0	1549.1	0.0	0.0
M200 48hr	2400	118.5	0.278	0.6	2.9625	0.00000	0.000	0.0	3098.2	0.0	0.0

Catchment **SP17** Area Excl Hardstand — water discharge rate (l/s)
Clean water natural flow — 17.93 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	23.0	0.278	0.78	276	0.00223	0.133	40.0	5.4	1.2	38.8
M200 10min	10	32.1	0.278	0.78	192.6	0.00223	0.093	55.8	10.8	2.4	53.4
M200 15min	15	37.7	0.278	0.78	150.8	0.00223	0.073	65.5	16.1	3.6	61.9
M200 30min	30	46.3	0.278	0.78	92.6	0.00223	0.045	80.5	32.3	7.2	73.3
M200 60min	60	56.8	0.278	0.78	56.8	0.00223	0.027	98.7	64.5	14.4	84.3
M200 2hr	120	69.8	0.278	0.78	34.9	0.00223	0.017	121.3	129.1	28.7	92.6
M200 4hr	240	78.7	0.278	0.78	19.675	0.00223	0.009	136.8	258.2	57.5	79.3
M200 6hr	300	85.6	0.278	0.78	17.12	0.00223	0.008	178.5	387.3	86.2	92.3
M200 12hr	600	96.5	0.278	0.78	9.65	0.00223	0.005	201.2	774.6	172.4	28.8
M200 24hr	1200	108.8	0.278	0.78	5.44	0.00223	0.003	226.9	1549.1	344.8	-118.0
M200 48hr	2400	118.5	0.278	0.78	2.9625	0.00223	0.001	247.1	3098.2	689.7	-442.6

Catchment **SP17** Hardstand — water discharge rate (l/s)
Clean water natural flow — 17.93 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	23.0	0.278	0.6	276	0.00186	0.085	25.6	5.4	1.0	24.6
M200 10min	10	32.1	0.278	0.6	192.6	0.00186	0.060	35.8	10.8	2.0	33.8
M200 15min	15	37.7	0.278	0.6	150.8	0.00186	0.047	42.0	16.1	3.0	39.0
M200 30min	30	46.3	0.278	0.6	92.6	0.00186	0.029	51.6	32.3	6.0	45.6
M200 60min	60	56.8	0.278	0.6	56.8	0.00186	0.018	63.3	64.5	12.0	51.3
M200 2hr	120	69.8	0.278	0.6	34.9	0.00186	0.011	77.8	129.1	24.0	53.8
M200 4hr	240	78.7	0.278	0.6	19.675	0.00186	0.006	87.7	258.2	47.9	39.8
M200 6hr	300	85.6	0.278	0.6	17.12	0.00186	0.005	114.4	387.3	71.9	42.6
M200 12hr	600	96.5	0.278	0.6	9.65	0.00186	0.003	129.0	774.6	143.7	-14.7
M200 24hr	1200	108.8	0.278	0.6	5.44	0.00186	0.002	145.5	1549.1	287.4	-142.0
M200 48hr	2400	118.5	0.278	0.6	2.9625	0.00186	0.001	158.4	3098.2	574.9	-416.4

Catchment			**SP18**	Area Excl Hardstand					water discharge rate (l/s)		
Clean water natural flow									17.93		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	23.0	0.278	0.78	276	0.00134	0.080	24.0	5.4	0.7	23.3
M200 10min	10	32.1	0.278	0.78	192.6	0.00134	0.056	33.5	10.8	1.4	32.0
M200 15min	15	37.7	0.278	0.78	150.8	0.00134	0.044	39.3	16.1	2.2	37.1
M200 30min	30	46.3	0.278	0.78	92.6	0.00134	0.027	48.3	32.3	4.3	43.9
M200 60min	60	56.8	0.278	0.78	56.8	0.00134	0.016	59.2	64.5	8.6	50.6
M200 2hr	120	69.8	0.278	0.78	34.9	0.00134	0.010	72.7	129.1	17.2	55.5
M200 4hr	240	78.7	0.278	0.78	19.675	0.00134	0.006	82.0	258.2	34.5	47.5
M200 6hr	300	85.6	0.278	0.78	17.12	0.00134	0.005	107.0	387.3	51.7	55.3
M200 12hr	600	96.5	0.278	0.78	9.65	0.00134	0.003	120.7	774.6	103.4	17.3
M200 24hr	1200	108.8	0.278	0.78	5.44	0.00134	0.002	136.1	1549.1	206.8	-70.7
M200 48hr	2400	118.5	0.278	0.78	2.9625	0.00134	0.001	148.2	3098.2	413.6	-265.4

Catchment			**SP18**	Hardstand					water discharge rate (l/s)		
Clean water natural flow									17.93		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	23.0	0.278	0.6	276	0.00186	0.085	25.6	5.4	1.0	24.6
M200 10min	10	32.1	0.278	0.6	192.6	0.00186	0.060	35.8	10.8	2.0	33.8
M200 15min	15	37.7	0.278	0.6	150.8	0.00186	0.047	42.0	16.1	3.0	39.0
M200 30min	30	46.3	0.278	0.6	92.6	0.00186	0.029	51.6	32.3	6.0	45.6
M200 60min	60	56.8	0.278	0.6	56.8	0.00186	0.018	63.3	64.5	12.0	51.3
M200 2hr	120	69.8	0.278	0.6	34.9	0.00186	0.011	77.8	129.1	24.0	53.8
M200 4hr	240	78.7	0.278	0.6	19.675	0.00186	0.006	87.7	258.2	47.9	39.8
M200 6hr	300	85.6	0.278	0.6	17.12	0.00186	0.005	114.4	387.3	71.9	42.6
M200 12hr	600	96.5	0.278	0.6	9.65	0.00186	0.003	129.0	774.6	143.7	-14.7
M200 24hr	1200	108.8	0.278	0.6	5.44	0.00186	0.002	145.5	1549.1	287.4	-142.0
M200 48hr	2400	118.5	0.278	0.6	2.9625	0.00186	0.001	158.4	3098.2	574.9	-416.4

Catchment			**SP19**	Area Excl Hardstand					water discharge rate (l/s)		
Clean water natural flow									17.93		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	23.0	0.278	0.78	276	0.00196	0.117	35.2	5.4	1.1	34.1
M200 10min	10	32.1	0.278	0.78	192.6	0.00196	0.082	49.1	10.8	2.1	47.0
M200 15min	15	37.7	0.278	0.78	150.8	0.00196	0.064	57.7	16.1	3.2	54.5
M200 30min	30	46.3	0.278	0.78	92.6	0.00196	0.039	70.8	32.3	6.3	64.5
M200 60min	60	56.8	0.278	0.78	56.8	0.00196	0.024	86.9	64.5	12.6	74.2
M200 2hr	120	69.8	0.278	0.78	34.9	0.00196	0.015	106.7	129.1	25.3	81.5

M200 4hr	240	78.7	0.278	0.78	19.675	0.00196	0.008	120.4	258.2	50.6	69.8
M200 6hr	300	85.6	0.278	0.78	17.12	0.00196	0.007	157.1	387.3	75.9	81.2
M200 12hr	600	96.5	0.278	0.78	9.65	0.00196	0.004	177.1	774.6	151.7	25.4
M200 24hr	1200	108.8	0.278	0.78	5.44	0.00196	0.002	199.7	1549.1	303.5	-103.8
M200 48hr	2400	118.5	0.278	0.78	2.9625	0.00196	0.001	217.5	3098.2	606.9	-389.5

Catchment			**SP19**	Hardstand					water discharge rate (l/s)		
Clean water natural flow									17.93		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	23.0	0.278	0.6	276	0.00000	0.000	0.0	5.4	0.0	0.0
M200 10min	10	32.1	0.278	0.6	192.6	0.00000	0.000	0.0	10.8	0.0	0.0
M200 15min	15	37.7	0.278	0.6	150.8	0.00000	0.000	0.0	16.1	0.0	0.0
M200 30min	30	46.3	0.278	0.6	92.6	0.00000	0.000	0.0	32.3	0.0	0.0
M200 60min	60	56.8	0.278	0.6	56.8	0.00000	0.000	0.0	64.5	0.0	0.0
M200 2hr	120	69.8	0.278	0.6	34.9	0.00000	0.000	0.0	129.1	0.0	0.0
M200 4hr	240	78.7	0.278	0.6	19.675	0.00000	0.000	0.0	258.2	0.0	0.0
M200 6hr	300	85.6	0.278	0.6	17.12	0.00000	0.000	0.0	387.3	0.0	0.0
M200 12hr	600	96.5	0.278	0.6	9.65	0.00000	0.000	0.0	774.6	0.0	0.0
M200 24hr	1200	108.8	0.278	0.6	5.44	0.00000	0.000	0.0	1549.1	0.0	0.0
M200 48hr	2400	118.5	0.278	0.6	2.9625	0.00000	0.000	0.0	3098.2	0.0	0.0

Catchment			**SP20**	Area Excl Hardstand					water discharge rate (l/s)		
Clean water natural flow									17.93		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	23.0	0.278	0.78	276	0.00092	0.055	16.5	5.4	0.5	16.0
M200 10min	10	32.1	0.278	0.78	192.6	0.00092	0.038	23.0	10.8	1.0	22.0
M200 15min	15	37.7	0.278	0.78	150.8	0.00092	0.030	27.0	16.1	1.5	25.5
M200 30min	30	46.3	0.278	0.78	92.6	0.00092	0.018	33.1	32.3	3.0	30.2
M200 60min	60	56.8	0.278	0.78	56.8	0.00092	0.011	40.7	64.5	5.9	34.7
M200 2hr	120	69.8	0.278	0.78	34.9	0.00092	0.007	50.0	129.1	11.8	38.1
M200 4hr	240	78.7	0.278	0.78	19.675	0.00092	0.004	56.3	258.2	23.7	32.7
M200 6hr	300	85.6	0.278	0.78	17.12	0.00092	0.003	73.5	387.3	35.5	38.0
M200 12hr	600	96.5	0.278	0.78	9.65	0.00092	0.002	82.9	774.6	71.0	11.9
M200 24hr	1200	108.8	0.278	0.78	5.44	0.00092	0.001	93.5	1549.1	142.1	-48.6
M200 48hr	2400	118.5	0.278	0.78	2.9625	0.00092	0.001	101.8	3098.2	284.1	-182.3

Catchment			**SP20**	Hardstand					water discharge rate (l/s)		
Clean water natural flow									17.93		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	23.0	0.278	0.6	276	0.00000	0.000	0.0	5.4	0.0	0.0
M200 10min	10	32.1	0.278	0.6	192.6	0.00000	0.000	0.0	10.8	0.0	0.0
M200 15min	15	37.7	0.278	0.6	150.8	0.00000	0.000	0.0	16.1	0.0	0.0
M200 30min	30	46.3	0.278	0.6	92.6	0.00000	0.000	0.0	32.3	0.0	0.0
M200 60min	60	56.8	0.278	0.6	56.8	0.00000	0.000	0.0	64.5	0.0	0.0
M200 2hr	120	69.8	0.278	0.6	34.9	0.00000	0.000	0.0	129.1	0.0	0.0
M200 4hr	240	78.7	0.278	0.6	19.675	0.00000	0.000	0.0	258.2	0.0	0.0
M200 6hr	300	85.6	0.278	0.6	17.12	0.00000	0.000	0.0	387.3	0.0	0.0
M200 12hr	600	96.5	0.278	0.6	9.65	0.00000	0.000	0.0	774.6	0.0	0.0
M200 24hr	1200	108.8	0.278	0.6	5.44	0.00000	0.000	0.0	1549.1	0.0	0.0
M200 48hr	2400	118.5	0.278	0.6	2.9625	0.00000	0.000	0.0	3098.2	0.0	0.0

Catchment			**SP21**	Area Excl Hardstand					water discharge rate (l/s)		

Clean water natural flow									17.93		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	23.0	0.278	0.78	276	0.00092	0.055	16.5	5.4	0.5	16.0
M200 10min	10	32.1	0.278	0.78	192.6	0.00092	0.038	23.0	10.8	1.0	22.0
M200 15min	15	37.7	0.278	0.78	150.8	0.00092	0.030	27.0	16.1	1.5	25.5
M200 30min	30	46.3	0.278	0.78	92.6	0.00092	0.018	33.1	32.3	3.0	30.2
M200 60min	60	56.8	0.278	0.78	56.8	0.00092	0.011	40.7	64.5	5.9	34.7
M200 2hr	120	69.8	0.278	0.78	34.9	0.00092	0.007	50.0	129.1	11.8	38.1
M200 4hr	240	78.7	0.278	0.78	19.675	0.00092	0.004	56.3	258.2	23.7	32.7
M200 6hr	300	85.6	0.278	0.78	17.12	0.00092	0.003	73.5	387.3	35.5	38.0
M200 12hr	600	96.5	0.278	0.78	9.65	0.00092	0.002	82.9	774.6	71.0	11.9
M200 24hr	1200	108.8	0.278	0.78	5.44	0.00092	0.001	93.5	1549.1	142.1	-48.6
M200 48hr	2400	118.5	0.278	0.78	2.9625	0.00092	0.001	101.8	3098.2	284.1	-182.3

	Catchment		**SP21**	Hardstand					water discharge rate (l/s)		
Clean water natural flow									17.93		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	23.0	0.278	0.6	276	0.00000	0.000	0.0	5.4	0.0	0.0
M200 10min	10	32.1	0.278	0.6	192.6	0.00000	0.000	0.0	10.8	0.0	0.0
M200 15min	15	37.7	0.278	0.6	150.8	0.00000	0.000	0.0	16.1	0.0	0.0
M200 30min	30	46.3	0.278	0.6	92.6	0.00000	0.000	0.0	32.3	0.0	0.0
M200 60min	60	56.8	0.278	0.6	56.8	0.00000	0.000	0.0	64.5	0.0	0.0
M200 2hr	120	69.8	0.278	0.6	34.9	0.00000	0.000	0.0	129.1	0.0	0.0
M200 4hr	240	78.7	0.278	0.6	19.675	0.00000	0.000	0.0	258.2	0.0	0.0
M200 6hr	300	85.6	0.278	0.6	17.12	0.00000	0.000	0.0	387.3	0.0	0.0
M200 12hr	600	96.5	0.278	0.6	9.65	0.00000	0.000	0.0	774.6	0.0	0.0
M200 24hr	1200	108.8	0.278	0.6	5.44	0.00000	0.000	0.0	1549.1	0.0	0.0
M200 48hr	2400	118.5	0.278	0.6	2.9625	0.00000	0.000	0.0	3098.2	0.0	0.0

	Catchment		**SP22**	Area Excl Hardstand					water discharge rate (l/s)		
Clean water natural flow									17.93		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	23.0	0.278	0.78	276	0.00213	0.127	38.2	5.4	1.1	37.1
M200 10min	10	32.1	0.278	0.78	192.6	0.00213	0.089	53.3	10.8	2.3	51.0
M200 15min	15	37.7	0.278	0.78	150.8	0.00213	0.070	62.6	16.1	3.4	59.2
M200 30min	30	46.3	0.278	0.78	92.6	0.00213	0.043	76.9	32.3	6.9	70.0
M200 60min	60	56.8	0.278	0.78	56.8	0.00213	0.026	94.4	64.5	13.7	80.6
M200 2hr	120	69.8	0.278	0.78	34.9	0.00213	0.016	115.9	129.1	27.5	88.5
M200 4hr	240	78.7	0.278	0.78	19.675	0.00213	0.009	130.7	258.2	54.9	75.8
M200 6hr	300	85.6	0.278	0.78	17.12	0.00213	0.008	170.6	387.3	82.4	88.2
M200 12hr	600	96.5	0.278	0.78	9.65	0.00213	0.004	192.4	774.6	164.8	27.5
M200 24hr	1200	108.8	0.278	0.78	5.44	0.00213	0.003	216.9	1549.1	329.7	-112.8
M200 48hr	2400	118.5	0.278	0.78	2.9625	0.00213	0.001	236.2	3098.2	659.3	-423.1

	Catchment		**SP22**	Hardstand					water discharge rate (l/s)		
Clean water natural flow									17.93		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	23.0	0.278	0.6	276	0.00000	0.000	0.0	5.4	0.0	0.0
M200 10min	10	32.1	0.278	0.6	192.6	0.00000	0.000	0.0	10.8	0.0	0.0
M200 15min	15	37.7	0.278	0.6	150.8	0.00000	0.000	0.0	16.1	0.0	0.0
M200 30min	30	46.3	0.278	0.6	92.6	0.00000	0.000	0.0	32.3	0.0	0.0

M200 60min	60	56.8	0.278	0.6	56.8	0.00000	0.000	0.0	64.5	0.0	0.0
M200 2hr	120	69.8	0.278	0.6	34.9	0.00000	0.000	0.0	129.1	0.0	0.0
M200 4hr	240	78.7	0.278	0.6	19.675	0.00000	0.000	0.0	258.2	0.0	0.0
M200 6hr	300	85.6	0.278	0.6	17.12	0.00000	0.000	0.0	387.3	0.0	0.0
M200 12hr	600	96.5	0.278	0.6	9.65	0.00000	0.000	0.0	774.6	0.0	0.0
M200 24hr	1200	108.8	0.278	0.6	5.44	0.00000	0.000	0.0	1549.1	0.0	0.0
M200 48hr	2400	118.5	0.278	0.6	2.9625	0.00000	0.000	0.0	3098.2	0.0	0.0

Catchment			**SP23**	Area Excl Hardstand					water discharge rate (l/s)		
Clean water natural flow									17.93		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	23.0	0.278	0.78	276	0.00428	0.256	76.9	5.4	2.3	74.6
M200 10min	10	32.1	0.278	0.78	192.6	0.00428	0.179	107.3	10.8	4.6	102.7
M200 15min	15	37.7	0.278	0.78	150.8	0.00428	0.140	126.1	16.1	6.9	119.2
M200 30min	30	46.3	0.278	0.78	92.6	0.00428	0.086	154.8	32.3	13.8	141.0
M200 60min	60	56.8	0.278	0.78	56.8	0.00428	0.053	189.9	64.5	27.7	162.3
M200 2hr	120	69.8	0.278	0.78	34.9	0.00428	0.032	233.4	129.1	55.3	178.1
M200 4hr	240	78.7	0.278	0.78	19.675	0.00428	0.018	263.2	258.2	110.6	152.6
M200 6hr	300	85.6	0.278	0.78	17.12	0.00428	0.016	343.5	387.3	165.9	177.6
M200 12hr	600	96.5	0.278	0.78	9.65	0.00428	0.009	387.3	774.6	331.8	55.4
M200 24hr	1200	108.8	0.278	0.78	5.44	0.00428	0.005	436.6	1549.1	663.6	-227.0
M200 48hr	2400	118.5	0.278	0.78	2.9625	0.00428	0.003	475.5	3098.2	1327.3	-851.7

Catchment			**SP23**	Hardstand					water discharge rate (l/s)		
Clean water natural flow									17.93		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	23.0	0.278	0.6	276	0.00000	0.000	0.0	5.4	0.0	0.0
M200 10min	10	32.1	0.278	0.6	192.6	0.00000	0.000	0.0	10.8	0.0	0.0
M200 15min	15	37.7	0.278	0.6	150.8	0.00000	0.000	0.0	16.1	0.0	0.0
M200 30min	30	46.3	0.278	0.6	92.6	0.00000	0.000	0.0	32.3	0.0	0.0
M200 60min	60	56.8	0.278	0.6	56.8	0.00000	0.000	0.0	64.5	0.0	0.0
M200 2hr	120	69.8	0.278	0.6	34.9	0.00000	0.000	0.0	129.1	0.0	0.0
M200 4hr	240	78.7	0.278	0.6	19.675	0.00000	0.000	0.0	258.2	0.0	0.0
M200 6hr	300	85.6	0.278	0.6	17.12	0.00000	0.000	0.0	387.3	0.0	0.0
M200 12hr	600	96.5	0.278	0.6	9.65	0.00000	0.000	0.0	774.6	0.0	0.0
M200 24hr	1200	108.8	0.278	0.6	5.44	0.00000	0.000	0.0	1549.1	0.0	0.0
M200 48hr	2400	118.5	0.278	0.6	2.9625	0.00000	0.000	0.0	3098.2	0.0	0.0

Catchment			**SP24-A**	Area Excl Hardstand					water discharge rate (l/s)		
Clean water natural flow									17.93		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	23.0	0.278	0.78	276	0.00428	0.256	76.9	5.4	2.3	74.6
M200 10min	10	32.1	0.278	0.78	192.6	0.00428	0.179	107.3	10.8	4.6	102.7
M200 15min	15	37.7	0.278	0.78	150.8	0.00428	0.140	126.1	16.1	6.9	119.2
M200 30min	30	46.3	0.278	0.78	92.6	0.00428	0.086	154.8	32.3	13.8	141.0
M200 60min	60	56.8	0.278	0.78	56.8	0.00428	0.053	189.9	64.5	27.7	162.3
M200 2hr	120	69.8	0.278	0.78	34.9	0.00428	0.032	233.4	129.1	55.3	178.1
M200 4hr	240	78.7	0.278	0.78	19.675	0.00428	0.018	263.2	258.2	110.6	152.6
M200 6hr	300	85.6	0.278	0.78	17.12	0.00428	0.016	343.5	387.3	165.9	177.6
M200 12hr	600	96.5	0.278	0.78	9.65	0.00428	0.009	387.3	774.6	331.8	55.4
M200 24hr	1200	108.8	0.278	0.78	5.44	0.00428	0.005	436.6	1549.1	663.6	-227.0
M200 48hr	2400	118.5	0.278	0.78	2.9625	0.00428	0.003	475.5	3098.2	1327.3	-851.7

Catchment **SP24-A** Hardstand water discharge rate (l/s)

Clean water natural flow 17.93 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	23.0	0.278	0.6	276	0.00000	0.000	0.0	5.4	0.0	0.0
M200 10min	10	32.1	0.278	0.6	192.6	0.00000	0.000	0.0	10.8	0.0	0.0
M200 15min	15	37.7	0.278	0.6	150.8	0.00000	0.000	0.0	16.1	0.0	0.0
M200 30min	30	46.3	0.278	0.6	92.6	0.00000	0.000	0.0	32.3	0.0	0.0
M200 60min	60	56.8	0.278	0.6	56.8	0.00000	0.000	0.0	64.5	0.0	0.0
M200 2hr	120	69.8	0.278	0.6	34.9	0.00000	0.000	0.0	129.1	0.0	0.0
M200 4hr	240	78.7	0.278	0.6	19.675	0.00000	0.000	0.0	258.2	0.0	0.0
M200 6hr	300	85.6	0.278	0.6	17.12	0.00000	0.000	0.0	387.3	0.0	0.0
M200 12hr	600	96.5	0.278	0.6	9.65	0.00000	0.000	0.0	774.6	0.0	0.0
M200 24hr	1200	108.8	0.278	0.6	5.44	0.00000	0.000	0.0	1549.1	0.0	0.0
M200 48hr	2400	118.5	0.278	0.6	2.9625	0.00000	0.000	0.0	3098.2	0.0	0.0

Catchment **SP24-B** Area Excl Hardstand water discharge rate (l/s)

Clean water natural flow 17.93 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	23.0	0.278	0.78	276	0.00428	0.256	76.9	5.4	2.3	74.6
M200 10min	10	32.1	0.278	0.78	192.6	0.00428	0.179	107.3	10.8	4.6	102.7
M200 15min	15	37.7	0.278	0.78	150.8	0.00428	0.140	126.1	16.1	6.9	119.2
M200 30min	30	46.3	0.278	0.78	92.6	0.00428	0.086	154.8	32.3	13.8	141.0
M200 60min	60	56.8	0.278	0.78	56.8	0.00428	0.053	189.9	64.5	27.7	162.3
M200 2hr	120	69.8	0.278	0.78	34.9	0.00428	0.032	233.4	129.1	55.3	178.1
M200 4hr	240	78.7	0.278	0.78	19.675	0.00428	0.018	263.2	258.2	110.6	152.6
M200 6hr	300	85.6	0.278	0.78	17.12	0.00428	0.016	343.5	387.3	165.9	177.6
M200 12hr	600	96.5	0.278	0.78	9.65	0.00428	0.009	387.3	774.6	331.8	55.4
M200 24hr	1200	108.8	0.278	0.78	5.44	0.00428	0.005	436.6	1549.1	663.6	-227.0
M200 48hr	2400	118.5	0.278	0.78	2.9625	0.00428	0.003	475.5	3098.2	1327.3	-851.7

Catchment **SP24-B** Hardstand water discharge rate (l/s)

Clean water natural flow 17.93 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	23.0	0.278	0.6	276	0.00000	0.000	0.0	5.4	0.0	0.0
M200 10min	10	32.1	0.278	0.6	192.6	0.00000	0.000	0.0	10.8	0.0	0.0
M200 15min	15	37.7	0.278	0.6	150.8	0.00000	0.000	0.0	16.1	0.0	0.0
M200 30min	30	46.3	0.278	0.6	92.6	0.00000	0.000	0.0	32.3	0.0	0.0
M200 60min	60	56.8	0.278	0.6	56.8	0.00000	0.000	0.0	64.5	0.0	0.0
M200 2hr	120	69.8	0.278	0.6	34.9	0.00000	0.000	0.0	129.1	0.0	0.0
M200 4hr	240	78.7	0.278	0.6	19.675	0.00000	0.000	0.0	258.2	0.0	0.0
M200 6hr	300	85.6	0.278	0.6	17.12	0.00000	0.000	0.0	387.3	0.0	0.0
M200 12hr	600	96.5	0.278	0.6	9.65	0.00000	0.000	0.0	774.6	0.0	0.0
M200 24hr	1200	108.8	0.278	0.6	5.44	0.00000	0.000	0.0	1549.1	0.0	0.0
M200 48hr	2400	118.5	0.278	0.6	2.9625	0.00000	0.000	0.0	3098.2	0.0	0.0

Catchment **SP25** Area Excl Hardstand water discharge rate (l/s)

Clean water natural flow 17.93 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	23.0	0.278	0.78	276	0.00428	0.256	76.9	5.4	2.3	74.6
M200 10min	10	32.1	0.278	0.78	192.6	0.00428	0.179	107.3	10.8	4.6	102.7
M200 15min	15	37.7	0.278	0.78	150.8	0.00428	0.140	126.1	16.1	6.9	119.2

M200 30min	30	46.3	0.278	0.78	92.6	0.00428	0.086	154.8	32.3	13.8	141.0
M200 60min	60	56.8	0.278	0.78	56.8	0.00428	0.053	189.9	64.5	27.7	162.3
M200 2hr	120	69.8	0.278	0.78	34.9	0.00428	0.032	233.4	129.1	55.3	178.1
M200 4hr	240	78.7	0.278	0.78	19.675	0.00428	0.018	263.2	258.2	110.6	152.6
M200 6hr	300	85.6	0.278	0.78	17.12	0.00428	0.016	343.5	387.3	165.9	177.6
M200 12hr	600	96.5	0.278	0.78	9.65	0.00428	0.009	387.3	774.6	331.8	55.4
M200 24hr	1200	108.8	0.278	0.78	5.44	0.00428	0.005	436.6	1549.1	663.6	-227.0
M200 48hr	2400	118.5	0.278	0.78	2.9625	0.00428	0.003	475.5	3098.2	1327.3	-851.7

Catchment		**SP25**	Hardstand						water discharge rate (l/s)		
Clean water natural flow									17.93		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	23.0	0.278	0.6	276	0.00000	0.000	0.0	5.4	0.0	0.0
M200 10min	10	32.1	0.278	0.6	192.6	0.00000	0.000	0.0	10.8	0.0	0.0
M200 15min	15	37.7	0.278	0.6	150.8	0.00000	0.000	0.0	16.1	0.0	0.0
M200 30min	30	46.3	0.278	0.6	92.6	0.00000	0.000	0.0	32.3	0.0	0.0
M200 60min	60	56.8	0.278	0.6	56.8	0.00000	0.000	0.0	64.5	0.0	0.0
M200 2hr	120	69.8	0.278	0.6	34.9	0.00000	0.000	0.0	129.1	0.0	0.0
M200 4hr	240	78.7	0.278	0.6	19.675	0.00000	0.000	0.0	258.2	0.0	0.0
M200 6hr	300	85.6	0.278	0.6	17.12	0.00000	0.000	0.0	387.3	0.0	0.0
M200 12hr	600	96.5	0.278	0.6	9.65	0.00000	0.000	0.0	774.6	0.0	0.0
M200 24hr	1200	108.8	0.278	0.6	5.44	0.00000	0.000	0.0	1549.1	0.0	0.0
M200 48hr	2400	118.5	0.278	0.6	2.9625	0.00000	0.000	0.0	3098.2	0.0	0.0

Catchment		**SP26**	Area Excl Hardstand						water discharge rate (l/s)		
Clean water natural flow									17.93		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	23.0	0.278	0.78	276	0.00118	0.070	21.1	5.4	0.6	20.5
M200 10min	10	32.1	0.278	0.78	192.6	0.00118	0.049	29.5	10.8	1.3	28.2
M200 15min	15	37.7	0.278	0.78	150.8	0.00118	0.038	34.6	16.1	1.9	32.7
M200 30min	30	46.3	0.278	0.78	92.6	0.00118	0.024	42.5	32.3	3.8	38.7
M200 60min	60	56.8	0.278	0.78	56.8	0.00118	0.014	52.2	64.5	7.6	44.6
M200 2hr	120	69.8	0.278	0.78	34.9	0.00118	0.009	64.1	129.1	15.2	48.9
M200 4hr	240	78.7	0.278	0.78	19.675	0.00118	0.005	72.3	258.2	30.4	41.9
M200 6hr	300	85.6	0.278	0.78	17.12	0.00118	0.004	94.4	387.3	45.6	48.8
M200 12hr	600	96.5	0.278	0.78	9.65	0.00118	0.002	106.4	774.6	91.2	15.2
M200 24hr	1200	108.8	0.278	0.78	5.44	0.00118	0.001	120.0	1549.1	182.3	-62.4
M200 48hr	2400	118.5	0.278	0.78	2.9625	0.00118	0.001	130.7	3098.2	364.7	-234.0

Catchment		**SP26**	Hardstand						water discharge rate (l/s)		
Clean water natural flow									17.93		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	23.0	0.278	0.6	276	0.00000	0.000	0.0	5.4	0.0	0.0
M200 10min	10	32.1	0.278	0.6	192.6	0.00000	0.000	0.0	10.8	0.0	0.0
M200 15min	15	37.7	0.278	0.6	150.8	0.00000	0.000	0.0	16.1	0.0	0.0
M200 30min	30	46.3	0.278	0.6	92.6	0.00000	0.000	0.0	32.3	0.0	0.0
M200 60min	60	56.8	0.278	0.6	56.8	0.00000	0.000	0.0	64.5	0.0	0.0
M200 2hr	120	69.8	0.278	0.6	34.9	0.00000	0.000	0.0	129.1	0.0	0.0
M200 4hr	240	78.7	0.278	0.6	19.675	0.00000	0.000	0.0	258.2	0.0	0.0
M200 6hr	300	85.6	0.278	0.6	17.12	0.00000	0.000	0.0	387.3	0.0	0.0
M200 12hr	600	96.5	0.278	0.6	9.65	0.00000	0.000	0.0	774.6	0.0	0.0
M200 24hr	1200	108.8	0.278	0.6	5.44	0.00000	0.000	0.0	1549.1	0.0	0.0
M200 48hr	2400	118.5	0.278	0.6	2.9625	0.00000	0.000	0.0	3098.2	0.0	0.0

Catchment		SP27	Area Excl Hardstand					water discharge rate (l/s)			
Clean water natural flow									17.93		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	23.0	0.278	0.78	276	0.00072	0.043	12.9	5.4	0.4	12.5
M200 10min	10	32.1	0.278	0.78	192.6	0.00072	0.030	17.9	10.8	0.8	17.2
M200 15min	15	37.7	0.278	0.78	150.8	0.00072	0.023	21.1	16.1	1.2	19.9
M200 30min	30	46.3	0.278	0.78	92.6	0.00072	0.014	25.9	32.3	2.3	23.6
M200 60min	60	56.8	0.278	0.78	56.8	0.00072	0.009	31.7	64.5	4.6	27.1
M200 2hr	120	69.8	0.278	0.78	34.9	0.00072	0.005	39.0	129.1	9.2	29.8
M200 4hr	240	78.7	0.278	0.78	19.675	0.00072	0.003	44.0	258.2	18.5	25.5
M200 6hr	300	85.6	0.278	0.78	17.12	0.00072	0.003	57.4	387.3	27.7	29.7
M200 12hr	600	96.5	0.278	0.78	9.65	0.00072	0.001	64.7	774.6	55.5	9.3
M200 24hr	1200	108.8	0.278	0.78	5.44	0.00072	0.001	73.0	1549.1	110.9	-37.9
M200 48hr	2400	118.5	0.278	0.78	2.9625	0.00072	0.000	79.5	3098.2	221.8	-142.4

Catchment		SP27	Hardstand					water discharge rate (l/s)			
Clean water natural flow									17.93		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	23.0	0.278	0.6	276	0.00000	0.000	0.0	5.4	0.0	0.0
M200 10min	10	32.1	0.278	0.6	192.6	0.00000	0.000	0.0	10.8	0.0	0.0
M200 15min	15	37.7	0.278	0.6	150.8	0.00000	0.000	0.0	16.1	0.0	0.0
M200 30min	30	46.3	0.278	0.6	92.6	0.00000	0.000	0.0	32.3	0.0	0.0
M200 60min	60	56.8	0.278	0.6	56.8	0.00000	0.000	0.0	64.5	0.0	0.0
M200 2hr	120	69.8	0.278	0.6	34.9	0.00000	0.000	0.0	129.1	0.0	0.0
M200 4hr	240	78.7	0.278	0.6	19.675	0.00000	0.000	0.0	258.2	0.0	0.0
M200 6hr	300	85.6	0.278	0.6	17.12	0.00000	0.000	0.0	387.3	0.0	0.0
M200 12hr	600	96.5	0.278	0.6	9.65	0.00000	0.000	0.0	774.6	0.0	0.0
M200 24hr	1200	108.8	0.278	0.6	5.44	0.00000	0.000	0.0	1549.1	0.0	0.0
M200 48hr	2400	118.5	0.278	0.6	2.9625	0.00000	0.000	0.0	3098.2	0.0	0.0

Catchment		SP28	Area Excl Hardstand					water discharge rate (l/s)			
Clean water natural flow									17.93		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	23.0	0.278	0.78	276	0.00252	0.151	45.2	5.4	1.4	43.9
M200 10min	10	32.1	0.278	0.78	192.6	0.00252	0.105	63.1	10.8	2.7	60.4
M200 15min	15	37.7	0.278	0.78	150.8	0.00252	0.082	74.1	16.1	4.1	70.1
M200 30min	30	46.3	0.278	0.78	92.6	0.00252	0.051	91.0	32.3	8.1	82.9
M200 60min	60	56.8	0.278	0.78	56.8	0.00252	0.031	111.7	64.5	16.3	95.4
M200 2hr	120	69.8	0.278	0.78	34.9	0.00252	0.019	137.3	129.1	32.5	104.7
M200 4hr	240	78.7	0.278	0.78	19.675	0.00252	0.011	154.8	258.2	65.0	89.7
M200 6hr	300	85.6	0.278	0.78	17.12	0.00252	0.009	202.0	387.3	97.6	104.4
M200 12hr	600	96.5	0.278	0.78	9.65	0.00252	0.005	227.7	774.6	195.1	32.6
M200 24hr	1200	108.8	0.278	0.78	5.44	0.00252	0.003	256.7	1549.1	390.2	-133.5
M200 48hr	2400	118.5	0.278	0.78	2.9625	0.00252	0.002	279.6	3098.2	780.4	-500.8

Catchment		SP28	Hardstand					water discharge rate (l/s)			
Clean water natural flow									17.93		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	23.0	0.278	0.6	276	0.00000	0.000	0.0	5.4	0.0	0.0

M200 10min	10	32.1	0.278	0.6	192.6	0.00000	0.000	0.0	10.8	0.0	0.0
M200 15min	15	37.7	0.278	0.6	150.8	0.00000	0.000	0.0	16.1	0.0	0.0
M200 30min	30	46.3	0.278	0.6	92.6	0.00000	0.000	0.0	32.3	0.0	0.0
M200 60min	60	56.8	0.278	0.6	56.8	0.00000	0.000	0.0	64.5	0.0	0.0
M200 2hr	120	69.8	0.278	0.6	34.9	0.00000	0.000	0.0	129.1	0.0	0.0
M200 4hr	240	78.7	0.278	0.6	19.675	0.00000	0.000	0.0	258.2	0.0	0.0
M200 6hr	300	85.6	0.278	0.6	17.12	0.00000	0.000	0.0	387.3	0.0	0.0
M200 12hr	600	96.5	0.278	0.6	9.65	0.00000	0.000	0.0	774.6	0.0	0.0
M200 24hr	1200	108.8	0.278	0.6	5.44	0.00000	0.000	0.0	1549.1	0.0	0.0
M200 48hr	2400	118.5	0.278	0.6	2.9625	0.00000	0.000	0.0	3098.2	0.0	0.0

	Catchment			**SP29**	Area Excl Hardstand				water discharge rate (l/s)		
Clean water natural flow									17.93		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	23.0	0.278	0.78	276	0.00494	0.295	88.6	5.4	2.7	86.0
M200 10min	10	32.1	0.278	0.78	192.6	0.00494	0.206	123.7	10.8	5.3	118.4
M200 15min	15	37.7	0.278	0.78	150.8	0.00494	0.161	145.2	16.1	8.0	137.3
M200 30min	30	46.3	0.278	0.78	92.6	0.00494	0.099	178.4	32.3	15.9	162.4
M200 60min	60	56.8	0.278	0.78	56.8	0.00494	0.061	218.8	64.5	31.9	187.0
M200 2hr	120	69.8	0.278	0.78	34.9	0.00494	0.037	268.9	129.1	63.7	205.2
M200 4hr	240	78.7	0.278	0.78	19.675	0.00494	0.021	303.2	258.2	127.4	175.8
M200 6hr	300	85.6	0.278	0.78	17.12	0.00494	0.018	395.7	387.3	191.1	204.6
M200 12hr	600	96.5	0.278	0.78	9.65	0.00494	0.010	446.1	774.6	382.2	63.9
M200 24hr	1200	108.8	0.278	0.78	5.44	0.00494	0.006	503.0	1549.1	764.5	-261.5
M200 48hr	2400	118.5	0.278	0.78	2.9625	0.00494	0.003	547.8	3098.2	1529.0	-981.2

	Catchment			**SP29**	Hardstand				water discharge rate (l/s)		
Clean water natural flow									17.93		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	23.0	0.278	0.6	276	0.00000	0.000	0.0	5.4	0.0	0.0
M200 10min	10	32.1	0.278	0.6	192.6	0.00000	0.000	0.0	10.8	0.0	0.0
M200 15min	15	37.7	0.278	0.6	150.8	0.00000	0.000	0.0	16.1	0.0	0.0
M200 30min	30	46.3	0.278	0.6	92.6	0.00000	0.000	0.0	32.3	0.0	0.0
M200 60min	60	56.8	0.278	0.6	56.8	0.00000	0.000	0.0	64.5	0.0	0.0
M200 2hr	120	69.8	0.278	0.6	34.9	0.00000	0.000	0.0	129.1	0.0	0.0
M200 4hr	240	78.7	0.278	0.6	19.675	0.00000	0.000	0.0	258.2	0.0	0.0
M200 6hr	300	85.6	0.278	0.6	17.12	0.00000	0.000	0.0	387.3	0.0	0.0
M200 12hr	600	96.5	0.278	0.6	9.65	0.00000	0.000	0.0	774.6	0.0	0.0
M200 24hr	1200	108.8	0.278	0.6	5.44	0.00000	0.000	0.0	1549.1	0.0	0.0
M200 48hr	2400	118.5	0.278	0.6	2.9625	0.00000	0.000	0.0	3098.2	0.0	0.0

	Catchment			**SP30**	Area Excl Hardstand				water discharge rate (l/s)		
Clean water natural flow									17.93		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	23.0	0.278	0.78	276	0.00450	0.269	80.7	5.4	2.4	78.3
M200 10min	10	32.1	0.278	0.78	192.6	0.00450	0.188	112.7	10.8	4.8	107.8
M200 15min	15	37.7	0.278	0.78	150.8	0.00450	0.147	132.3	16.1	7.3	125.1
M200 30min	30	46.3	0.278	0.78	92.6	0.00450	0.090	162.5	32.3	14.5	148.0
M200 60min	60	56.8	0.278	0.78	56.8	0.00450	0.055	199.4	64.5	29.0	170.3
M200 2hr	120	69.8	0.278	0.78	34.9	0.00450	0.034	245.0	129.1	58.0	187.0
M200 4hr	240	78.7	0.278	0.78	19.675	0.00450	0.019	276.2	258.2	116.1	160.1
M200 6hr	300	85.6	0.278	0.78	17.12	0.00450	0.017	360.6	387.3	174.1	186.4
M200 12hr	600	96.5	0.278	0.78	9.65	0.00450	0.009	406.5	774.6	348.3	58.2
M200 24hr	1200	108.8	0.278	0.78	5.44	0.00450	0.005	458.3	1549.1	696.6	-238.3

M200 48hr	2400	118.5	0.278	0.78	2.9625	0.00450	0.003	499.1	3098.2	1393.1	-894.0

Catchment		**SP30**	Hardstand						water discharge rate (l/s)		
Clean water natural flow									17.93		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	23.0	0.278	0.6	276	0.00000	0.000	0.0	5.4	0.0	0.0
M200 10min	10	32.1	0.278	0.6	192.6	0.00000	0.000	0.0	10.8	0.0	0.0
M200 15min	15	37.7	0.278	0.6	150.8	0.00000	0.000	0.0	16.1	0.0	0.0
M200 30min	30	46.3	0.278	0.6	92.6	0.00000	0.000	0.0	32.3	0.0	0.0
M200 60min	60	56.8	0.278	0.6	56.8	0.00000	0.000	0.0	64.5	0.0	0.0
M200 2hr	120	69.8	0.278	0.6	34.9	0.00000	0.000	0.0	129.1	0.0	0.0
M200 4hr	240	78.7	0.278	0.6	19.675	0.00000	0.000	0.0	258.2	0.0	0.0
M200 6hr	300	85.6	0.278	0.6	17.12	0.00000	0.000	0.0	387.3	0.0	0.0
M200 12hr	600	96.5	0.278	0.6	9.65	0.00000	0.000	0.0	774.6	0.0	0.0
M200 24hr	1200	108.8	0.278	0.6	5.44	0.00000	0.000	0.0	1549.1	0.0	0.0
M200 48hr	2400	118.5	0.278	0.6	2.9625	0.00000	0.000	0.0	3098.2	0.0	0.0

Catchment		**SP31**	Area Excl Hardstand						water discharge rate (l/s)		
Clean water natural flow									17.93		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	23.0	0.278	0.78	276	0.00450	0.269	80.7	5.4	2.4	78.3
M200 10min	10	32.1	0.278	0.78	192.6	0.00450	0.188	112.7	10.8	4.8	107.8
M200 15min	15	37.7	0.278	0.78	150.8	0.00450	0.147	132.3	16.1	7.3	125.1
M200 30min	30	46.3	0.278	0.78	92.6	0.00450	0.090	162.5	32.3	14.5	148.0
M200 60min	60	56.8	0.278	0.78	56.8	0.00450	0.055	199.4	64.5	29.0	170.3
M200 2hr	120	69.8	0.278	0.78	34.9	0.00450	0.034	245.0	129.1	58.0	187.0
M200 4hr	240	78.7	0.278	0.78	19.675	0.00450	0.019	276.2	258.2	116.1	160.1
M200 6hr	300	85.6	0.278	0.78	17.12	0.00450	0.017	360.6	387.3	174.1	186.4
M200 12hr	600	96.5	0.278	0.78	9.65	0.00450	0.009	406.5	774.6	348.3	58.2
M200 24hr	1200	108.8	0.278	0.78	5.44	0.00450	0.005	458.3	1549.1	696.6	-238.3
M200 48hr	2400	118.5	0.278	0.78	2.9625	0.00450	0.003	499.1	3098.2	1393.1	-894.0

Catchment		**SP31**	Hardstand						water discharge rate (l/s)		
Clean water natural flow									17.93		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	23.0	0.278	0.6	276	0.00000	0.000	0.0	5.4	0.0	0.0
M200 10min	10	32.1	0.278	0.6	192.6	0.00000	0.000	0.0	10.8	0.0	0.0
M200 15min	15	37.7	0.278	0.6	150.8	0.00000	0.000	0.0	16.1	0.0	0.0
M200 30min	30	46.3	0.278	0.6	92.6	0.00000	0.000	0.0	32.3	0.0	0.0
M200 60min	60	56.8	0.278	0.6	56.8	0.00000	0.000	0.0	64.5	0.0	0.0
M200 2hr	120	69.8	0.278	0.6	34.9	0.00000	0.000	0.0	129.1	0.0	0.0
M200 4hr	240	78.7	0.278	0.6	19.675	0.00000	0.000	0.0	258.2	0.0	0.0
M200 6hr	300	85.6	0.278	0.6	17.12	0.00000	0.000	0.0	387.3	0.0	0.0
M200 12hr	600	96.5	0.278	0.6	9.65	0.00000	0.000	0.0	774.6	0.0	0.0
M200 24hr	1200	108.8	0.278	0.6	5.44	0.00000	0.000	0.0	1549.1	0.0	0.0
M200 48hr	2400	118.5	0.278	0.6	2.9625	0.00000	0.000	0.0	3098.2	0.0	0.0

Catchment		**SP32**	Area Excl Hardstand						water discharge rate (l/s)		
Clean water natural flow									17.93		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	23.0	0.278	0.78	276	0.00183	0.110	32.9	5.4	1.0	31.9
M200 10min	10	32.1	0.278	0.78	192.6	0.00183	0.077	46.0	10.8	2.0	44.0
M200 15min	15	37.7	0.278	0.78	150.8	0.00183	0.060	54.0	16.1	3.0	51.0
M200 30min	30	46.3	0.278	0.78	92.6	0.00183	0.037	66.3	32.3	5.9	60.4
M200 60min	60	56.8	0.278	0.78	56.8	0.00183	0.023	81.3	64.5	11.8	69.5
M200 2hr	120	69.8	0.278	0.78	34.9	0.00183	0.014	99.9	129.1	23.7	76.3
M200 4hr	240	78.7	0.278	0.78	19.675	0.00183	0.008	112.7	258.2	47.4	65.3
M200 6hr	300	85.6	0.278	0.78	17.12	0.00183	0.007	147.1	387.3	71.0	76.0
M200 12hr	600	96.5	0.278	0.78	9.65	0.00183	0.004	165.8	774.6	142.1	23.7
M200 24hr	1200	108.8	0.278	0.78	5.44	0.00183	0.002	186.9	1549.1	284.1	-97.2
M200 48hr	2400	118.5	0.278	0.78	2.9625	0.00183	0.001	203.6	3098.2	568.2	-364.6

Catchment **SP32** Hardstand water discharge rate (l/s)

Clean water natural flow 17.93 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	23.0	0.278	0.6	276	0.00000	0.000	0.0	5.4	0.0	0.0
M200 10min	10	32.1	0.278	0.6	192.6	0.00000	0.000	0.0	10.8	0.0	0.0
M200 15min	15	37.7	0.278	0.6	150.8	0.00000	0.000	0.0	16.1	0.0	0.0
M200 30min	30	46.3	0.278	0.6	92.6	0.00000	0.000	0.0	32.3	0.0	0.0
M200 60min	60	56.8	0.278	0.6	56.8	0.00000	0.000	0.0	64.5	0.0	0.0
M200 2hr	120	69.8	0.278	0.6	34.9	0.00000	0.000	0.0	129.1	0.0	0.0
M200 4hr	240	78.7	0.278	0.6	19.675	0.00000	0.000	0.0	258.2	0.0	0.0
M200 6hr	300	85.6	0.278	0.6	17.12	0.00000	0.000	0.0	387.3	0.0	0.0
M200 12hr	600	96.5	0.278	0.6	9.65	0.00000	0.000	0.0	774.6	0.0	0.0
M200 24hr	1200	108.8	0.278	0.6	5.44	0.00000	0.000	0.0	1549.1	0.0	0.0
M200 48hr	2400	118.5	0.278	0.6	2.9625	0.00000	0.000	0.0	3098.2	0.0	0.0

Catchment **SP33-A** Area Excl Hardstand water discharge rate (l/s)

Clean water natural flow 17.93 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	23.0	0.278	0.78	276	0.00000	0.000	0.0	5.4	0.0	0.0
M200 10min	10	32.1	0.278	0.78	192.6	0.00000	0.000	0.0	10.8	0.0	0.0
M200 15min	15	37.7	0.278	0.78	150.8	0.00000	0.000	0.0	16.1	0.0	0.0
M200 30min	30	46.3	0.278	0.78	92.6	0.00000	0.000	0.0	32.3	0.0	0.0
M200 60min	60	56.8	0.278	0.78	56.8	0.00000	0.000	0.0	64.5	0.0	0.0
M200 2hr	120	69.8	0.278	0.78	34.9	0.00000	0.000	0.0	129.1	0.0	0.0
M200 4hr	240	78.7	0.278	0.78	19.675	0.00000	0.000	0.0	258.2	0.0	0.0
M200 6hr	300	85.6	0.278	0.78	17.12	0.00000	0.000	0.0	387.3	0.0	0.0
M200 12hr	600	96.5	0.278	0.78	9.65	0.00000	0.000	0.0	774.6	0.0	0.0
M200 24hr	1200	108.8	0.278	0.78	5.44	0.00000	0.000	0.0	1549.1	0.0	0.0
M200 48hr	2400	118.5	0.278	0.78	2.9625	0.00000	0.000	0.0	3098.2	0.0	0.0

Catchment **SP33-A** Hardstand water discharge rate (l/s)

Clean water natural flow 17.93 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	23.0	0.278	0.6	276	0.00290	0.134	40.1	5.4	1.6	38.5
M200 10min	10	32.1	0.278	0.6	192.6	0.00290	0.093	55.9	10.8	3.1	52.8
M200 15min	15	37.7	0.278	0.6	150.8	0.00290	0.073	65.7	16.1	4.7	61.0
M200 30min	30	46.3	0.278	0.6	92.6	0.00290	0.045	80.6	32.3	9.4	71.3
M200 60min	60	56.8	0.278	0.6	56.8	0.00290	0.027	98.9	64.5	18.7	80.2
M200 2hr	120	69.8	0.278	0.6	34.9	0.00290	0.017	121.5	129.1	37.4	84.1
M200 4hr	240	78.7	0.278	0.6	19.675	0.00290	0.010	137.0	258.2	74.9	62.2
M200 6hr	300	85.6	0.278	0.6	17.12	0.00290	0.008	178.9	387.3	112.3	66.6

M200 12hr	600	96.5	0.278	0.6	9.65	0.00290	0.005	201.7	774.6	224.6	-23.0
M200 24hr	1200	108.8	0.278	0.6	5.44	0.00290	0.003	227.4	1549.1	449.2	-221.9
M200 48hr	2400	118.5	0.278	0.6	2.9625	0.00290	0.001	247.6	3098.2	898.5	-650.9

Catchment **SP33-B** Area Excl Hardstand water discharge rate (l/s)
Clean water natural flow 17.93 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	23.0	0.278	0.78	276	0.00253	0.151	45.4	5.4	1.4	44.1
M200 10min	10	32.1	0.278	0.78	192.6	0.00253	0.106	63.4	10.8	2.7	60.7
M200 15min	15	37.7	0.278	0.78	150.8	0.00253	0.083	74.5	16.1	4.1	70.4
M200 30min	30	46.3	0.278	0.78	92.6	0.00253	0.051	91.5	32.3	8.2	83.3
M200 60min	60	56.8	0.278	0.78	56.8	0.00253	0.031	112.2	64.5	16.3	95.9
M200 2hr	120	69.8	0.278	0.78	34.9	0.00253	0.019	137.9	129.1	32.7	105.2
M200 4hr	240	78.7	0.278	0.78	19.675	0.00253	0.011	155.5	258.2	65.3	90.1
M200 6hr	300	85.6	0.278	0.78	17.12	0.00253	0.009	202.9	387.3	98.0	104.9
M200 12hr	600	96.5	0.278	0.78	9.65	0.00253	0.005	228.8	774.6	196.0	32.8
M200 24hr	1200	108.8	0.278	0.78	5.44	0.00253	0.003	258.0	1549.1	392.1	-134.1
M200 48hr	2400	118.5	0.278	0.78	2.9625	0.00253	0.002	281.0	3098.2	784.2	-503.2

Catchment **SP33-B** Hardstand water discharge rate (l/s)
Clean water natural flow 17.93 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	23.0	0.278	0.6	276	0.00000	0.000	0.0	5.4	0.0	0.0
M200 10min	10	32.1	0.278	0.6	192.6	0.00000	0.000	0.0	10.8	0.0	0.0
M200 15min	15	37.7	0.278	0.6	150.8	0.00000	0.000	0.0	16.1	0.0	0.0
M200 30min	30	46.3	0.278	0.6	92.6	0.00000	0.000	0.0	32.3	0.0	0.0
M200 60min	60	56.8	0.278	0.6	56.8	0.00000	0.000	0.0	64.5	0.0	0.0
M200 2hr	120	69.8	0.278	0.6	34.9	0.00000	0.000	0.0	129.1	0.0	0.0
M200 4hr	240	78.7	0.278	0.6	19.675	0.00000	0.000	0.0	258.2	0.0	0.0
M200 6hr	300	85.6	0.278	0.6	17.12	0.00000	0.000	0.0	387.3	0.0	0.0
M200 12hr	600	96.5	0.278	0.6	9.65	0.00000	0.000	0.0	774.6	0.0	0.0
M200 24hr	1200	108.8	0.278	0.6	5.44	0.00000	0.000	0.0	1549.1	0.0	0.0
M200 48hr	2400	118.5	0.278	0.6	2.9625	0.00000	0.000	0.0	3098.2	0.0	0.0

Catchment **SP34** Area Excl Hardstand water discharge rate (l/s)
Clean water natural flow 17.93 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	23.0	0.278	0.78	276	0.00359	0.215	64.5	5.4	1.9	62.5
M200 10min	10	32.1	0.278	0.78	192.6	0.00359	0.150	90.0	10.8	3.9	86.1
M200 15min	15	37.7	0.278	0.78	150.8	0.00359	0.117	105.7	16.1	5.8	99.9
M200 30min	30	46.3	0.278	0.78	92.6	0.00359	0.072	129.8	32.3	11.6	118.2
M200 60min	60	56.8	0.278	0.78	56.8	0.00359	0.044	159.2	64.5	23.2	136.0
M200 2hr	120	69.8	0.278	0.78	34.9	0.00359	0.027	195.7	129.1	46.4	149.3
M200 4hr	240	78.7	0.278	0.78	19.675	0.00359	0.015	220.6	258.2	92.7	127.9
M200 6hr	300	85.6	0.278	0.78	17.12	0.00359	0.013	287.9	387.3	139.1	148.9
M200 12hr	600	96.5	0.278	0.78	9.65	0.00359	0.008	324.6	774.6	278.1	46.5
M200 24hr	1200	108.8	0.278	0.78	5.44	0.00359	0.004	366.0	1549.1	556.3	-190.3
M200 48hr	2400	118.5	0.278	0.78	2.9625	0.00359	0.002	398.6	3098.2	1112.6	-714.0

Catchment **SP34** Hardstand water discharge rate (l/s)
Clean water natural flow 17.93 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	23.0	0.278	0.6	276	0.00000	0.000	0.0	5.4	0.0	0.0
M200 10min	10	32.1	0.278	0.6	192.6	0.00000	0.000	0.0	10.8	0.0	0.0
M200 15min	15	37.7	0.278	0.6	150.8	0.00000	0.000	0.0	16.1	0.0	0.0
M200 30min	30	46.3	0.278	0.6	92.6	0.00000	0.000	0.0	32.3	0.0	0.0
M200 60min	60	56.8	0.278	0.6	56.8	0.00000	0.000	0.0	64.5	0.0	0.0
M200 2hr	120	69.8	0.278	0.6	34.9	0.00000	0.000	0.0	129.1	0.0	0.0
M200 4hr	240	78.7	0.278	0.6	19.675	0.00000	0.000	0.0	258.2	0.0	0.0
M200 6hr	300	85.6	0.278	0.6	17.12	0.00000	0.000	0.0	387.3	0.0	0.0
M200 12hr	600	96.5	0.278	0.6	9.65	0.00000	0.000	0.0	774.6	0.0	0.0
M200 24hr	1200	108.8	0.278	0.6	5.44	0.00000	0.000	0.0	1549.1	0.0	0.0
M200 48hr	2400	118.5	0.278	0.6	2.9625	0.00000	0.000	0.0	3098.2	0.0	0.0

Catchment		SP35	Area Excl Hardstand						water discharge rate (l/s)		
Clean water natural flow									17.93		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	23.0	0.278	0.78	276	0.00343	0.205	61.6	5.4	1.8	59.8
M200 10min	10	32.1	0.278	0.78	192.6	0.00343	0.143	86.0	10.8	3.7	82.3
M200 15min	15	37.7	0.278	0.78	150.8	0.00343	0.112	101.0	16.1	5.5	95.5
M200 30min	30	46.3	0.278	0.78	92.6	0.00343	0.069	124.1	32.3	11.1	113.0
M200 60min	60	56.8	0.278	0.78	56.8	0.00343	0.042	152.2	64.5	22.2	130.1
M200 2hr	120	69.8	0.278	0.78	34.9	0.00343	0.026	187.1	129.1	44.3	142.7
M200 4hr	240	78.7	0.278	0.78	19.675	0.00343	0.015	210.9	258.2	88.6	122.3
M200 6hr	300	85.6	0.278	0.78	17.12	0.00343	0.013	275.3	387.3	133.0	142.3
M200 12hr	600	96.5	0.278	0.78	9.65	0.00343	0.007	310.3	774.6	265.9	44.4
M200 24hr	1200	108.8	0.278	0.78	5.44	0.00343	0.004	349.9	1549.1	531.8	-181.9
M200 48hr	2400	118.5	0.278	0.78	2.9625	0.00343	0.002	381.1	3098.2	1063.6	-682.5

Catchment		SP35	Hardstand						water discharge rate (l/s)		
Clean water natural flow									17.93		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	23.0	0.278	0.6	276	0.00000	0.000	0.0	5.4	0.0	0.0
M200 10min	10	32.1	0.278	0.6	192.6	0.00000	0.000	0.0	10.8	0.0	0.0
M200 15min	15	37.7	0.278	0.6	150.8	0.00000	0.000	0.0	16.1	0.0	0.0
M200 30min	30	46.3	0.278	0.6	92.6	0.00000	0.000	0.0	32.3	0.0	0.0
M200 60min	60	56.8	0.278	0.6	56.8	0.00000	0.000	0.0	64.5	0.0	0.0
M200 2hr	120	69.8	0.278	0.6	34.9	0.00000	0.000	0.0	129.1	0.0	0.0
M200 4hr	240	78.7	0.278	0.6	19.675	0.00000	0.000	0.0	258.2	0.0	0.0
M200 6hr	300	85.6	0.278	0.6	17.12	0.00000	0.000	0.0	387.3	0.0	0.0
M200 12hr	600	96.5	0.278	0.6	9.65	0.00000	0.000	0.0	774.6	0.0	0.0
M200 24hr	1200	108.8	0.278	0.6	5.44	0.00000	0.000	0.0	1549.1	0.0	0.0
M200 48hr	2400	118.5	0.278	0.6	2.9625	0.00000	0.000	0.0	3098.2	0.0	0.0

Catchment		SP36-A	Area Excl Hardstand						water discharge rate (l/s)		
Clean water natural flow									17.93		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	23.0	0.278	0.78	276	0.00356	0.213	63.8	5.4	1.9	61.9
M200 10min	10	32.1	0.278	0.78	192.6	0.00356	0.148	89.1	10.8	3.8	85.3
M200 15min	15	37.7	0.278	0.78	150.8	0.00356	0.116	104.6	16.1	5.7	98.9
M200 30min	30	46.3	0.278	0.78	92.6	0.00356	0.071	128.5	32.3	11.5	117.0
M200 60min	60	56.8	0.278	0.78	56.8	0.00356	0.044	157.6	64.5	22.9	134.7
M200 2hr	120	69.8	0.278	0.78	34.9	0.00356	0.027	193.7	129.1	45.9	147.8

M200 4hr	240	78.7	0.278	0.78	19.675	0.00356	0.015	218.4	258.2	91.8	126.6
M200 6hr	300	85.6	0.278	0.78	17.12	0.00356	0.013	285.1	387.3	137.7	147.4
M200 12hr	600	96.5	0.278	0.78	9.65	0.00356	0.007	321.4	774.6	275.4	46.0
M200 24hr	1200	108.8	0.278	0.78	5.44	0.00356	0.004	362.3	1549.1	550.7	-188.4
M200 48hr	2400	118.5	0.278	0.78	2.9625	0.00356	0.002	394.6	3098.2	1101.4	-706.8

	Catchment			**SP36-A**	Hardstand				water discharge rate (l/s)		
Clean water natural flow									17.93		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	23.0	0.278	0.6	276	0.00000	0.000	0.0	5.4	0.0	0.0
M200 10min	10	32.1	0.278	0.6	192.6	0.00000	0.000	0.0	10.8	0.0	0.0
M200 15min	15	37.7	0.278	0.6	150.8	0.00000	0.000	0.0	16.1	0.0	0.0
M200 30min	30	46.3	0.278	0.6	92.6	0.00000	0.000	0.0	32.3	0.0	0.0
M200 60min	60	56.8	0.278	0.6	56.8	0.00000	0.000	0.0	64.5	0.0	0.0
M200 2hr	120	69.8	0.278	0.6	34.9	0.00000	0.000	0.0	129.1	0.0	0.0
M200 4hr	240	78.7	0.278	0.6	19.675	0.00000	0.000	0.0	258.2	0.0	0.0
M200 6hr	300	85.6	0.278	0.6	17.12	0.00000	0.000	0.0	387.3	0.0	0.0
M200 12hr	600	96.5	0.278	0.6	9.65	0.00000	0.000	0.0	774.6	0.0	0.0
M200 24hr	1200	108.8	0.278	0.6	5.44	0.00000	0.000	0.0	1549.1	0.0	0.0
M200 48hr	2400	118.5	0.278	0.6	2.9625	0.00000	0.000	0.0	3098.2	0.0	0.0

	Catchment			**SP36-B**	Area Excl Hardstand				water discharge rate (l/s)		
Clean water natural flow									17.93		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	23.0	0.278	0.78	276	0.00244	0.146	43.8	5.4	1.3	42.5
M200 10min	10	32.1	0.278	0.78	192.6	0.00244	0.102	61.1	10.8	2.6	58.5
M200 15min	15	37.7	0.278	0.78	150.8	0.00244	0.080	71.8	16.1	3.9	67.9
M200 30min	30	46.3	0.278	0.78	92.6	0.00244	0.049	88.2	32.3	7.9	80.3
M200 60min	60	56.8	0.278	0.78	56.8	0.00244	0.030	108.2	64.5	15.7	92.4
M200 2hr	120	69.8	0.278	0.78	34.9	0.00244	0.018	132.9	129.1	31.5	101.5
M200 4hr	240	78.7	0.278	0.78	19.675	0.00244	0.010	149.9	258.2	63.0	86.9
M200 6hr	300	85.6	0.278	0.78	17.12	0.00244	0.009	195.7	387.3	94.5	101.2
M200 12hr	600	96.5	0.278	0.78	9.65	0.00244	0.005	220.6	774.6	189.0	31.6
M200 24hr	1200	108.8	0.278	0.78	5.44	0.00244	0.003	248.7	1549.1	378.0	-129.3
M200 48hr	2400	118.5	0.278	0.78	2.9625	0.00244	0.002	270.9	3098.2	756.0	-485.1

	Catchment			**SP36-B**	Hardstand				water discharge rate (l/s)		
Clean water natural flow									17.93		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	23.0	0.278	0.6	276	0.00000	0.000	0.0	5.4	0.0	0.0
M200 10min	10	32.1	0.278	0.6	192.6	0.00000	0.000	0.0	10.8	0.0	0.0
M200 15min	15	37.7	0.278	0.6	150.8	0.00000	0.000	0.0	16.1	0.0	0.0
M200 30min	30	46.3	0.278	0.6	92.6	0.00000	0.000	0.0	32.3	0.0	0.0
M200 60min	60	56.8	0.278	0.6	56.8	0.00000	0.000	0.0	64.5	0.0	0.0
M200 2hr	120	69.8	0.278	0.6	34.9	0.00000	0.000	0.0	129.1	0.0	0.0
M200 4hr	240	78.7	0.278	0.6	19.675	0.00000	0.000	0.0	258.2	0.0	0.0
M200 6hr	300	85.6	0.278	0.6	17.12	0.00000	0.000	0.0	387.3	0.0	0.0
M200 12hr	600	96.5	0.278	0.6	9.65	0.00000	0.000	0.0	774.6	0.0	0.0
M200 24hr	1200	108.8	0.278	0.6	5.44	0.00000	0.000	0.0	1549.1	0.0	0.0
M200 48hr	2400	118.5	0.278	0.6	2.9625	0.00000	0.000	0.0	3098.2	0.0	0.0

	Catchment			**SP37**	Area Excl Hardstand				water discharge rate (l/s)		

Clean water natural flow 17.93 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	23.0	0.278	0.78	276	0.00050	0.030	9.0	5.4	0.3	8.7
M200 10min	10	32.1	0.278	0.78	192.6	0.00050	0.021	12.5	10.8	0.5	12.0
M200 15min	15	37.7	0.278	0.78	150.8	0.00050	0.016	14.7	16.1	0.8	13.9
M200 30min	30	46.3	0.278	0.78	92.6	0.00050	0.010	18.0	32.3	1.6	16.4
M200 60min	60	56.8	0.278	0.78	56.8	0.00050	0.006	22.1	64.5	3.2	18.9
M200 2hr	120	69.8	0.278	0.78	34.9	0.00050	0.004	27.2	129.1	6.4	20.7
M200 4hr	240	78.7	0.278	0.78	19.675	0.00050	0.002	30.7	258.2	12.9	17.8
M200 6hr	300	85.6	0.278	0.78	17.12	0.00050	0.002	40.0	387.3	19.3	20.7
M200 12hr	600	96.5	0.278	0.78	9.65	0.00050	0.001	45.1	774.6	38.7	6.5
M200 24hr	1200	108.8	0.278	0.78	5.44	0.00050	0.001	50.9	1549.1	77.3	-26.4
M200 48hr	2400	118.5	0.278	0.78	2.9625	0.00050	0.000	55.4	3098.2	154.6	-99.2

Catchment **SP37** Hardstand water discharge rate (l/s)

Clean water natural flow 17.93 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	23.0	0.278	0.6	276	0.00432	0.199	59.7	5.4	2.3	57.4
M200 10min	10	32.1	0.278	0.6	192.6	0.00432	0.139	83.3	10.8	4.7	78.7
M200 15min	15	37.7	0.278	0.6	150.8	0.00432	0.109	97.9	16.1	7.0	90.9
M200 30min	30	46.3	0.278	0.6	92.6	0.00432	0.067	120.2	32.3	14.0	106.3
M200 60min	60	56.8	0.278	0.6	56.8	0.00432	0.041	147.5	64.5	27.9	119.6
M200 2hr	120	69.8	0.278	0.6	34.9	0.00432	0.025	181.2	129.1	55.8	125.4
M200 4hr	240	78.7	0.278	0.6	19.675	0.00432	0.014	204.3	258.2	111.6	92.7
M200 6hr	300	85.6	0.278	0.6	17.12	0.00432	0.012	266.7	387.3	167.5	99.3
M200 12hr	600	96.5	0.278	0.6	9.65	0.00432	0.007	300.7	774.6	334.9	-34.2
M200 24hr	1200	108.8	0.278	0.6	5.44	0.00432	0.004	339.0	1549.1	669.8	-330.8
M200 48hr	2400	118.5	0.278	0.6	2.9625	0.00432	0.002	369.2	3098.2	1339.7	-970.5

Catchment **SP38** Area Excl Hardstand water discharge rate (l/s)

Clean water natural flow 17.93 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	23.0	0.278	0.78	276	0.00239	0.143	43.0	5.4	1.3	41.7
M200 10min	10	32.1	0.278	0.78	192.6	0.00239	0.100	60.0	10.8	2.6	57.4
M200 15min	15	37.7	0.278	0.78	150.8	0.00239	0.078	70.4	16.1	3.9	66.6
M200 30min	30	46.3	0.278	0.78	92.6	0.00239	0.048	86.5	32.3	7.7	78.8
M200 60min	60	56.8	0.278	0.78	56.8	0.00239	0.029	106.1	64.5	15.4	90.7
M200 2hr	120	69.8	0.278	0.78	34.9	0.00239	0.018	130.4	129.1	30.9	99.5
M200 4hr	240	78.7	0.278	0.78	19.675	0.00239	0.010	147.0	258.2	61.8	85.2
M200 6hr	300	85.6	0.278	0.78	17.12	0.00239	0.009	191.9	387.3	92.7	99.2
M200 12hr	600	96.5	0.278	0.78	9.65	0.00239	0.005	216.3	774.6	185.4	31.0
M200 24hr	1200	108.8	0.278	0.78	5.44	0.00239	0.003	243.9	1549.1	370.7	-126.8
M200 48hr	2400	118.5	0.278	0.78	2.9625	0.00239	0.002	265.6	3098.2	741.4	-475.8

Catchment **SP38** Hardstand water discharge rate (l/s)

Clean water natural flow 17.93 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	23.0	0.278	0.6	276	0.00000	0.000	0.0	5.4	0.0	0.0
M200 10min	10	32.1	0.278	0.6	192.6	0.00000	0.000	0.0	10.8	0.0	0.0
M200 15min	15	37.7	0.278	0.6	150.8	0.00000	0.000	0.0	16.1	0.0	0.0
M200 30min	30	46.3	0.278	0.6	92.6	0.00000	0.000	0.0	32.3	0.0	0.0

M200 60min	60	56.8	0.278	0.6	56.8	0.00000	0.000	0.0	64.5	0.0	0.0
M200 2hr	120	69.8	0.278	0.6	34.9	0.00000	0.000	0.0	129.1	0.0	0.0
M200 4hr	240	78.7	0.278	0.6	19.675	0.00000	0.000	0.0	258.2	0.0	0.0
M200 6hr	300	85.6	0.278	0.6	17.12	0.00000	0.000	0.0	387.3	0.0	0.0
M200 12hr	600	96.5	0.278	0.6	9.65	0.00000	0.000	0.0	774.6	0.0	0.0
M200 24hr	1200	108.8	0.278	0.6	5.44	0.00000	0.000	0.0	1549.1	0.0	0.0
M200 48hr	2400	118.5	0.278	0.6	2.9625	0.00000	0.000	0.0	3098.2	0.0	0.0

Catchment			**SP39-A**	Area Excl Hardstand					water discharge rate (l/s)		
Clean water natural flow									17.93		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	23.0	0.278	0.78	276	0.00000	0.000	0.0	5.4	0.0	0.0
M200 10min	10	32.1	0.278	0.78	192.6	0.00000	0.000	0.0	10.8	0.0	0.0
M200 15min	15	37.7	0.278	0.78	150.8	0.00000	0.000	0.0	16.1	0.0	0.0
M200 30min	30	46.3	0.278	0.78	92.6	0.00000	0.000	0.0	32.3	0.0	0.0
M200 60min	60	56.8	0.278	0.78	56.8	0.00000	0.000	0.0	64.5	0.0	0.0
M200 2hr	120	69.8	0.278	0.78	34.9	0.00000	0.000	0.0	129.1	0.0	0.0
M200 4hr	240	78.7	0.278	0.78	19.675	0.00000	0.000	0.0	258.2	0.0	0.0
M200 6hr	300	85.6	0.278	0.78	17.12	0.00000	0.000	0.0	387.3	0.0	0.0
M200 12hr	600	96.5	0.278	0.78	9.65	0.00000	0.000	0.0	774.6	0.0	0.0
M200 24hr	1200	108.8	0.278	0.78	5.44	0.00000	0.000	0.0	1549.1	0.0	0.0
M200 48hr	2400	118.5	0.278	0.78	2.9625	0.00000	0.000	0.0	3098.2	0.0	0.0

Catchment			**SP39-A**	Hardstand					water discharge rate (l/s)		
Clean water natural flow									17.93		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	23.0	0.278	0.6	276	0.00405	0.186	55.9	5.4	2.2	53.7
M200 10min	10	32.1	0.278	0.6	192.6	0.00405	0.130	78.0	10.8	4.4	73.7
M200 15min	15	37.7	0.278	0.6	150.8	0.00405	0.102	91.7	16.1	6.5	85.1
M200 30min	30	46.3	0.278	0.6	92.6	0.00405	0.063	112.6	32.3	13.1	99.5
M200 60min	60	56.8	0.278	0.6	56.8	0.00405	0.038	138.1	64.5	26.1	112.0
M200 2hr	120	69.8	0.278	0.6	34.9	0.00405	0.024	169.7	129.1	52.3	117.4
M200 4hr	240	78.7	0.278	0.6	19.675	0.00405	0.013	191.3	258.2	104.5	86.8
M200 6hr	300	85.6	0.278	0.6	17.12	0.00405	0.012	249.7	387.3	156.8	92.9
M200 12hr	600	96.5	0.278	0.6	9.65	0.00405	0.007	281.5	774.6	313.6	-32.1
M200 24hr	1200	108.8	0.278	0.6	5.44	0.00405	0.004	317.4	1549.1	627.2	-309.8
M200 48hr	2400	118.5	0.278	0.6	2.9625	0.00405	0.002	345.7	3098.2	1254.5	-908.7

Catchment			**SP39-B**	Area Excl Hardstand					water discharge rate (l/s)		
Clean water natural flow									17.93		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	23.0	0.278	0.78	276	0.00269	0.161	48.2	5.4	1.4	46.8
M200 10min	10	32.1	0.278	0.78	192.6	0.00269	0.112	67.3	10.8	2.9	64.4
M200 15min	15	37.7	0.278	0.78	150.8	0.00269	0.088	79.0	16.1	4.3	74.7
M200 30min	30	46.3	0.278	0.78	92.6	0.00269	0.054	97.1	32.3	8.7	88.4
M200 60min	60	56.8	0.278	0.78	56.8	0.00269	0.033	119.1	64.5	17.3	101.8
M200 2hr	120	69.8	0.278	0.78	34.9	0.00269	0.020	146.4	129.1	34.7	111.7
M200 4hr	240	78.7	0.278	0.78	19.675	0.00269	0.011	165.0	258.2	69.3	95.7
M200 6hr	300	85.6	0.278	0.78	17.12	0.00269	0.010	215.4	387.3	104.0	111.4
M200 12hr	600	96.5	0.278	0.78	9.65	0.00269	0.006	242.8	774.6	208.0	34.8
M200 24hr	1200	108.8	0.278	0.78	5.44	0.00269	0.003	273.8	1549.1	416.1	-142.3
M200 48hr	2400	118.5	0.278	0.78	2.9625	0.00269	0.002	298.2	3098.2	832.2	-534.0

Catchment		SP39-B	Hardstand						water discharge rate (l/s)		
Clean water natural flow									17.93		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	23.0	0.278	0.6	276	0.00000	0.000	0.0	5.4	0.0	0.0
M200 10min	10	32.1	0.278	0.6	192.6	0.00000	0.000	0.0	10.8	0.0	0.0
M200 15min	15	37.7	0.278	0.6	150.8	0.00000	0.000	0.0	16.1	0.0	0.0
M200 30min	30	46.3	0.278	0.6	92.6	0.00000	0.000	0.0	32.3	0.0	0.0
M200 60min	60	56.8	0.278	0.6	56.8	0.00000	0.000	0.0	64.5	0.0	0.0
M200 2hr	120	69.8	0.278	0.6	34.9	0.00000	0.000	0.0	129.1	0.0	0.0
M200 4hr	240	78.7	0.278	0.6	19.675	0.00000	0.000	0.0	258.2	0.0	0.0
M200 6hr	300	85.6	0.278	0.6	17.12	0.00000	0.000	0.0	387.3	0.0	0.0
M200 12hr	600	96.5	0.278	0.6	9.65	0.00000	0.000	0.0	774.6	0.0	0.0
M200 24hr	1200	108.8	0.278	0.6	5.44	0.00000	0.000	0.0	1549.1	0.0	0.0
M200 48hr	2400	118.5	0.278	0.6	2.9625	0.00000	0.000	0.0	3098.2	0.0	0.0

Catchment		SP40	Area Excl Hardstand						water discharge rate (l/s)		
Clean water natural flow									17.93		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	23.0	0.278	0.78	276	0.00419	0.251	75.2	5.4	2.3	73.0
M200 10min	10	32.1	0.278	0.78	192.6	0.00419	0.175	105.0	10.8	4.5	100.5
M200 15min	15	37.7	0.278	0.78	150.8	0.00419	0.137	123.3	16.1	6.8	116.6
M200 30min	30	46.3	0.278	0.78	92.6	0.00419	0.084	151.5	32.3	13.5	137.9
M200 60min	60	56.8	0.278	0.78	56.8	0.00419	0.052	185.8	64.5	27.1	158.8
M200 2hr	120	69.8	0.278	0.78	34.9	0.00419	0.032	228.4	129.1	54.1	174.3
M200 4hr	240	78.7	0.278	0.78	19.675	0.00419	0.018	257.5	258.2	108.2	149.3
M200 6hr	300	85.6	0.278	0.78	17.12	0.00419	0.016	336.1	387.3	162.3	173.7
M200 12hr	600	96.5	0.278	0.78	9.65	0.00419	0.009	378.9	774.6	324.6	54.2
M200 24hr	1200	108.8	0.278	0.78	5.44	0.00419	0.005	427.1	1549.1	649.2	-222.1
M200 48hr	2400	118.5	0.278	0.78	2.9625	0.00419	0.003	465.2	3098.2	1298.5	-833.2

Catchment		SP40	Hardstand						water discharge rate (l/s)		
Clean water natural flow									17.93		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	23.0	0.278	0.6	276	0.00000	0.000	0.0	5.4	0.0	0.0
M200 10min	10	32.1	0.278	0.6	192.6	0.00000	0.000	0.0	10.8	0.0	0.0
M200 15min	15	37.7	0.278	0.6	150.8	0.00000	0.000	0.0	16.1	0.0	0.0
M200 30min	30	46.3	0.278	0.6	92.6	0.00000	0.000	0.0	32.3	0.0	0.0
M200 60min	60	56.8	0.278	0.6	56.8	0.00000	0.000	0.0	64.5	0.0	0.0
M200 2hr	120	69.8	0.278	0.6	34.9	0.00000	0.000	0.0	129.1	0.0	0.0
M200 4hr	240	78.7	0.278	0.6	19.675	0.00000	0.000	0.0	258.2	0.0	0.0
M200 6hr	300	85.6	0.278	0.6	17.12	0.00000	0.000	0.0	387.3	0.0	0.0
M200 12hr	600	96.5	0.278	0.6	9.65	0.00000	0.000	0.0	774.6	0.0	0.0
M200 24hr	1200	108.8	0.278	0.6	5.44	0.00000	0.000	0.0	1549.1	0.0	0.0
M200 48hr	2400	118.5	0.278	0.6	2.9625	0.00000	0.000	0.0	3098.2	0.0	0.0

Catchment		SP41	Area Excl Hardstand						water discharge rate (l/s)		
Clean water natural flow									17.93		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	23.0	0.278	0.78	276	0.00168	0.100	30.1	5.4	0.9	29.2
M200 10min	10	32.1	0.278	0.78	192.6	0.00168	0.070	42.0	10.8	1.8	40.2
M200 15min	15	37.7	0.278	0.78	150.8	0.00168	0.055	49.3	16.1	2.7	46.6

M200 30min	30	46.3	0.278	0.78	92.6	0.00168	0.034	60.5	32.3	5.4	55.1
M200 60min	60	56.8	0.278	0.78	56.8	0.00168	0.021	74.3	64.5	10.8	63.5
M200 2hr	120	69.8	0.278	0.78	34.9	0.00168	0.013	91.3	129.1	21.6	69.6
M200 4hr	240	78.7	0.278	0.78	19.675	0.00168	0.007	102.9	258.2	43.2	59.7
M200 6hr	300	85.6	0.278	0.78	17.12	0.00168	0.006	134.3	387.3	64.9	69.4
M200 12hr	600	96.5	0.278	0.78	9.65	0.00168	0.004	151.4	774.6	129.7	21.7
M200 24hr	1200	108.8	0.278	0.78	5.44	0.00168	0.002	170.7	1549.1	259.5	-88.8
M200 48hr	2400	118.5	0.278	0.78	2.9625	0.00168	0.001	185.9	3098.2	519.0	-333.0

	Catchment		**SP41**	Hardstand					water discharge rate (l/s)		
Clean water natural flow									17.93		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	23.0	0.278	0.6	276	0.00000	0.000	0.0	5.4	0.0	0.0
M200 10min	10	32.1	0.278	0.6	192.6	0.00000	0.000	0.0	10.8	0.0	0.0
M200 15min	15	37.7	0.278	0.6	150.8	0.00000	0.000	0.0	16.1	0.0	0.0
M200 30min	30	46.3	0.278	0.6	92.6	0.00000	0.000	0.0	32.3	0.0	0.0
M200 60min	60	56.8	0.278	0.6	56.8	0.00000	0.000	0.0	64.5	0.0	0.0
M200 2hr	120	69.8	0.278	0.6	34.9	0.00000	0.000	0.0	129.1	0.0	0.0
M200 4hr	240	78.7	0.278	0.6	19.675	0.00000	0.000	0.0	258.2	0.0	0.0
M200 6hr	300	85.6	0.278	0.6	17.12	0.00000	0.000	0.0	387.3	0.0	0.0
M200 12hr	600	96.5	0.278	0.6	9.65	0.00000	0.000	0.0	774.6	0.0	0.0
M200 24hr	1200	108.8	0.278	0.6	5.44	0.00000	0.000	0.0	1549.1	0.0	0.0
M200 48hr	2400	118.5	0.278	0.6	2.9625	0.00000	0.000	0.0	3098.2	0.0	0.0

	Catchment		**SP42**	Area Excl Hardstand					water discharge rate (l/s)		
Clean water natural flow									17.93		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	23.0	0.278	0.78	276	0.00187	0.112	33.5	5.4	1.0	32.5
M200 10min	10	32.1	0.278	0.78	192.6	0.00187	0.078	46.8	10.8	2.0	44.8
M200 15min	15	37.7	0.278	0.78	150.8	0.00187	0.061	54.9	16.1	3.0	51.9
M200 30min	30	46.3	0.278	0.78	92.6	0.00187	0.037	67.4	32.3	6.0	61.4
M200 60min	60	56.8	0.278	0.78	56.8	0.00187	0.023	82.7	64.5	12.0	70.7
M200 2hr	120	69.8	0.278	0.78	34.9	0.00187	0.014	101.7	129.1	24.1	77.6
M200 4hr	240	78.7	0.278	0.78	19.675	0.00187	0.008	114.6	258.2	48.2	66.5
M200 6hr	300	85.6	0.278	0.78	17.12	0.00187	0.007	149.6	387.3	72.3	77.4
M200 12hr	600	96.5	0.278	0.78	9.65	0.00187	0.004	168.7	774.6	144.5	24.1
M200 24hr	1200	108.8	0.278	0.78	5.44	0.00187	0.002	190.2	1549.1	289.1	-98.9
M200 48hr	2400	118.5	0.278	0.78	2.9625	0.00187	0.001	207.1	3098.2	578.1	-371.0

	Catchment		**SP42**	Hardstand					water discharge rate (l/s)		
Clean water natural flow									17.93		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	23.0	0.278	0.6	276	0.00000	0.000	0.0	5.4	0.0	0.0
M200 10min	10	32.1	0.278	0.6	192.6	0.00000	0.000	0.0	10.8	0.0	0.0
M200 15min	15	37.7	0.278	0.6	150.8	0.00000	0.000	0.0	16.1	0.0	0.0
M200 30min	30	46.3	0.278	0.6	92.6	0.00000	0.000	0.0	32.3	0.0	0.0
M200 60min	60	56.8	0.278	0.6	56.8	0.00000	0.000	0.0	64.5	0.0	0.0
M200 2hr	120	69.8	0.278	0.6	34.9	0.00000	0.000	0.0	129.1	0.0	0.0
M200 4hr	240	78.7	0.278	0.6	19.675	0.00000	0.000	0.0	258.2	0.0	0.0
M200 6hr	300	85.6	0.278	0.6	17.12	0.00000	0.000	0.0	387.3	0.0	0.0
M200 12hr	600	96.5	0.278	0.6	9.65	0.00000	0.000	0.0	774.6	0.0	0.0
M200 24hr	1200	108.8	0.278	0.6	5.44	0.00000	0.000	0.0	1549.1	0.0	0.0
M200 48hr	2400	118.5	0.278	0.6	2.9625	0.00000	0.000	0.0	3098.2	0.0	0.0

Catchment		SP43-A	Area Excl Hardstand					water discharge rate (l/s)			
Clean water natural flow									17.93		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	23.0	0.278	0.78	276	0.00092	0.055	16.4	5.4	0.5	16.0
M200 10min	10	32.1	0.278	0.78	192.6	0.00092	0.038	23.0	10.8	1.0	22.0
M200 15min	15	37.7	0.278	0.78	150.8	0.00092	0.030	27.0	16.1	1.5	25.5
M200 30min	30	46.3	0.278	0.78	92.6	0.00092	0.018	33.1	32.3	3.0	30.2
M200 60min	60	56.8	0.278	0.78	56.8	0.00092	0.011	40.6	64.5	5.9	34.7
M200 2hr	120	69.8	0.278	0.78	34.9	0.00092	0.007	49.9	129.1	11.8	38.1
M200 4hr	240	78.7	0.278	0.78	19.675	0.00092	0.004	56.3	258.2	23.6	32.6
M200 6hr	300	85.6	0.278	0.78	17.12	0.00092	0.003	73.5	387.3	35.5	38.0
M200 12hr	600	96.5	0.278	0.78	9.65	0.00092	0.002	82.8	774.6	70.9	11.9
M200 24hr	1200	108.8	0.278	0.78	5.44	0.00092	0.001	93.4	1549.1	141.9	-48.5
M200 48hr	2400	118.5	0.278	0.78	2.9625	0.00092	0.001	101.7	3098.2	283.8	-182.1

Catchment		SP43-A	Hardstand					water discharge rate (l/s)			
Clean water natural flow									17.93		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	23.0	0.278	0.6	276	0.00431	0.199	59.6	5.4	2.3	57.3
M200 10min	10	32.1	0.278	0.6	192.6	0.00431	0.139	83.2	10.8	4.6	78.5
M200 15min	15	37.7	0.278	0.6	150.8	0.00431	0.109	97.7	16.1	7.0	90.7
M200 30min	30	46.3	0.278	0.6	92.6	0.00431	0.067	119.9	32.3	13.9	106.0
M200 60min	60	56.8	0.278	0.6	56.8	0.00431	0.041	147.1	64.5	27.8	119.3
M200 2hr	120	69.8	0.278	0.6	34.9	0.00431	0.025	180.8	129.1	55.7	125.1
M200 4hr	240	78.7	0.278	0.6	19.675	0.00431	0.014	203.9	258.2	111.4	92.5
M200 6hr	300	85.6	0.278	0.6	17.12	0.00431	0.012	266.1	387.3	167.1	99.0
M200 12hr	600	96.5	0.278	0.6	9.65	0.00431	0.007	300.0	774.6	334.1	-34.2
M200 24hr	1200	108.8	0.278	0.6	5.44	0.00431	0.004	338.2	1549.1	668.3	-330.1
M200 48hr	2400	118.5	0.278	0.6	2.9625	0.00431	0.002	368.4	3098.2	1336.6	-968.2

Catchment		SP43-B	Area Excl Hardstand					water discharge rate (l/s)			
Clean water natural flow									17.93		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	23.0	0.278	0.78	276	0.00190	0.113	34.0	5.4	1.0	33.0
M200 10min	10	32.1	0.278	0.78	192.6	0.00190	0.079	47.5	10.8	2.0	45.4
M200 15min	15	37.7	0.278	0.78	150.8	0.00190	0.062	55.8	16.1	3.1	52.7
M200 30min	30	46.3	0.278	0.78	92.6	0.00190	0.038	68.5	32.3	6.1	62.4
M200 60min	60	56.8	0.278	0.78	56.8	0.00190	0.023	84.0	64.5	12.2	71.8
M200 2hr	120	69.8	0.278	0.78	34.9	0.00190	0.014	103.3	129.1	24.5	78.8
M200 4hr	240	78.7	0.278	0.78	19.675	0.00190	0.008	116.4	258.2	48.9	67.5
M200 6hr	300	85.6	0.278	0.78	17.12	0.00190	0.007	152.0	387.3	73.4	78.6
M200 12hr	600	96.5	0.278	0.78	9.65	0.00190	0.004	171.3	774.6	146.8	24.5
M200 24hr	1200	108.8	0.278	0.78	5.44	0.00190	0.002	193.1	1549.1	293.6	-100.4
M200 48hr	2400	118.5	0.278	0.78	2.9625	0.00190	0.001	210.4	3098.2	587.1	-376.8

Catchment		SP43-B	Hardstand					water discharge rate (l/s)			
Clean water natural flow									17.93		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	23.0	0.278	0.6	276	0.00000	0.000	0.0	5.4	0.0	0.0

M200 10min	10	32.1	0.278	0.6	192.6	0.00000	0.000	0.0	10.8	0.0	0.0
M200 15min	15	37.7	0.278	0.6	150.8	0.00000	0.000	0.0	16.1	0.0	0.0
M200 30min	30	46.3	0.278	0.6	92.6	0.00000	0.000	0.0	32.3	0.0	0.0
M200 60min	60	56.8	0.278	0.6	56.8	0.00000	0.000	0.0	64.5	0.0	0.0
M200 2hr	120	69.8	0.278	0.6	34.9	0.00000	0.000	0.0	129.1	0.0	0.0
M200 4hr	240	78.7	0.278	0.6	19.675	0.00000	0.000	0.0	258.2	0.0	0.0
M200 6hr	300	85.6	0.278	0.6	17.12	0.00000	0.000	0.0	387.3	0.0	0.0
M200 12hr	600	96.5	0.278	0.6	9.65	0.00000	0.000	0.0	774.6	0.0	0.0
M200 24hr	1200	108.8	0.278	0.6	5.44	0.00000	0.000	0.0	1549.1	0.0	0.0
M200 48hr	2400	118.5	0.278	0.6	2.9625	0.00000	0.000	0.0	3098.2	0.0	0.0

	Catchment		**SP44**	Area Excl Hardstand					water discharge rate (l/s)		
Clean water natural flow									17.93		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	23.0	0.278	0.78	276	0.00405	0.243	72.8	5.4	2.2	70.6
M200 10min	10	32.1	0.278	0.78	192.6	0.00405	0.169	101.6	10.8	4.4	97.2
M200 15min	15	37.7	0.278	0.78	150.8	0.00405	0.133	119.3	16.1	6.5	112.8
M200 30min	30	46.3	0.278	0.78	92.6	0.00405	0.081	146.5	32.3	13.1	133.4
M200 60min	60	56.8	0.278	0.78	56.8	0.00405	0.050	179.8	64.5	26.2	153.6
M200 2hr	120	69.8	0.278	0.78	34.9	0.00405	0.031	220.9	129.1	52.3	168.6
M200 4hr	240	78.7	0.278	0.78	19.675	0.00405	0.017	249.1	258.2	104.7	144.4
M200 6hr	300	85.6	0.278	0.78	17.12	0.00405	0.015	325.1	387.3	157.0	168.1
M200 12hr	600	96.5	0.278	0.78	9.65	0.00405	0.008	366.5	774.6	314.0	52.5
M200 24hr	1200	108.8	0.278	0.78	5.44	0.00405	0.005	413.2	1549.1	628.0	-214.8
M200 48hr	2400	118.5	0.278	0.78	2.9625	0.00405	0.003	450.0	3098.2	1256.0	-806.0

	Catchment		**SP44**	Hardstand					water discharge rate (l/s)		
Clean water natural flow									17.93		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	23.0	0.278	0.6	276	0.00000	0.000	0.0	5.4	0.0	0.0
M200 10min	10	32.1	0.278	0.6	192.6	0.00000	0.000	0.0	10.8	0.0	0.0
M200 15min	15	37.7	0.278	0.6	150.8	0.00000	0.000	0.0	16.1	0.0	0.0
M200 30min	30	46.3	0.278	0.6	92.6	0.00000	0.000	0.0	32.3	0.0	0.0
M200 60min	60	56.8	0.278	0.6	56.8	0.00000	0.000	0.0	64.5	0.0	0.0
M200 2hr	120	69.8	0.278	0.6	34.9	0.00000	0.000	0.0	129.1	0.0	0.0
M200 4hr	240	78.7	0.278	0.6	19.675	0.00000	0.000	0.0	258.2	0.0	0.0
M200 6hr	300	85.6	0.278	0.6	17.12	0.00000	0.000	0.0	387.3	0.0	0.0
M200 12hr	600	96.5	0.278	0.6	9.65	0.00000	0.000	0.0	774.6	0.0	0.0
M200 24hr	1200	108.8	0.278	0.6	5.44	0.00000	0.000	0.0	1549.1	0.0	0.0
M200 48hr	2400	118.5	0.278	0.6	2.9625	0.00000	0.000	0.0	3098.2	0.0	0.0

	Catchment		**SP45**	Area Excl Hardstand					water discharge rate (l/s)		
Clean water natural flow									17.93		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	23.0	0.278	0.78	276	0.00258	0.155	46.4	5.4	1.4	45.0
M200 10min	10	32.1	0.278	0.78	192.6	0.00258	0.108	64.7	10.8	2.8	61.9
M200 15min	15	37.7	0.278	0.78	150.8	0.00258	0.084	76.0	16.1	4.2	71.8
M200 30min	30	46.3	0.278	0.78	92.6	0.00258	0.052	93.4	32.3	8.3	85.0
M200 60min	60	56.8	0.278	0.78	56.8	0.00258	0.032	114.5	64.5	16.7	97.9
M200 2hr	120	69.8	0.278	0.78	34.9	0.00258	0.020	140.7	129.1	33.3	107.4
M200 4hr	240	78.7	0.278	0.78	19.675	0.00258	0.011	158.7	258.2	66.7	92.0
M200 6hr	300	85.6	0.278	0.78	17.12	0.00258	0.010	207.1	387.3	100.0	107.1
M200 12hr	600	96.5	0.278	0.78	9.65	0.00258	0.005	233.5	774.6	200.1	33.4
M200 24hr	1200	108.8	0.278	0.78	5.44	0.00258	0.003	263.3	1549.1	400.1	-136.9

M200 48hr	2400	118.5	0.278	0.78	2.9625	0.00258	0.002	286.7	3098.2	800.3	-513.5

Catchment		**SP45**	Hardstand						water discharge rate (l/s)		
Clean water natural flow									17.93		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	23.0	0.278	0.6	276	0.00000	0.000	0.0	5.4	0.0	0.0
M200 10min	10	32.1	0.278	0.6	192.6	0.00000	0.000	0.0	10.8	0.0	0.0
M200 15min	15	37.7	0.278	0.6	150.8	0.00000	0.000	0.0	16.1	0.0	0.0
M200 30min	30	46.3	0.278	0.6	92.6	0.00000	0.000	0.0	32.3	0.0	0.0
M200 60min	60	56.8	0.278	0.6	56.8	0.00000	0.000	0.0	64.5	0.0	0.0
M200 2hr	120	69.8	0.278	0.6	34.9	0.00000	0.000	0.0	129.1	0.0	0.0
M200 4hr	240	78.7	0.278	0.6	19.675	0.00000	0.000	0.0	258.2	0.0	0.0
M200 6hr	300	85.6	0.278	0.6	17.12	0.00000	0.000	0.0	387.3	0.0	0.0
M200 12hr	600	96.5	0.278	0.6	9.65	0.00000	0.000	0.0	774.6	0.0	0.0
M200 24hr	1200	108.8	0.278	0.6	5.44	0.00000	0.000	0.0	1549.1	0.0	0.0
M200 48hr	2400	118.5	0.278	0.6	2.9625	0.00000	0.000	0.0	3098.2	0.0	0.0

Catchment		**SP46**	Area Excl Hardstand						water discharge rate (l/s)		
Clean water natural flow									17.93		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	23.0	0.278	0.78	276	0.00282	0.169	50.7	5.4	1.5	49.2
M200 10min	10	32.1	0.278	0.78	192.6	0.00282	0.118	70.7	10.8	3.0	67.7
M200 15min	15	37.7	0.278	0.78	150.8	0.00282	0.092	83.1	16.1	4.6	78.5
M200 30min	30	46.3	0.278	0.78	92.6	0.00282	0.057	102.0	32.3	9.1	92.9
M200 60min	60	56.8	0.278	0.78	56.8	0.00282	0.035	125.2	64.5	18.2	106.9
M200 2hr	120	69.8	0.278	0.78	34.9	0.00282	0.021	153.8	129.1	36.4	117.4
M200 4hr	240	78.7	0.278	0.78	19.675	0.00282	0.012	173.4	258.2	72.9	100.5
M200 6hr	300	85.6	0.278	0.78	17.12	0.00282	0.010	226.4	387.3	109.3	117.0
M200 12hr	600	96.5	0.278	0.78	9.65	0.00282	0.006	255.2	774.6	218.7	36.5
M200 24hr	1200	108.8	0.278	0.78	5.44	0.00282	0.003	287.7	1549.1	437.3	-149.6
M200 48hr	2400	118.5	0.278	0.78	2.9625	0.00282	0.002	313.4	3098.2	874.6	-561.3

Catchment		**SP46**	Hardstand						water discharge rate (l/s)		
Clean water natural flow									17.93		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	23.0	0.278	0.6	276	0.00000	0.000	0.0	5.4	0.0	0.0
M200 10min	10	32.1	0.278	0.6	192.6	0.00000	0.000	0.0	10.8	0.0	0.0
M200 15min	15	37.7	0.278	0.6	150.8	0.00000	0.000	0.0	16.1	0.0	0.0
M200 30min	30	46.3	0.278	0.6	92.6	0.00000	0.000	0.0	32.3	0.0	0.0
M200 60min	60	56.8	0.278	0.6	56.8	0.00000	0.000	0.0	64.5	0.0	0.0
M200 2hr	120	69.8	0.278	0.6	34.9	0.00000	0.000	0.0	129.1	0.0	0.0
M200 4hr	240	78.7	0.278	0.6	19.675	0.00000	0.000	0.0	258.2	0.0	0.0
M200 6hr	300	85.6	0.278	0.6	17.12	0.00000	0.000	0.0	387.3	0.0	0.0
M200 12hr	600	96.5	0.278	0.6	9.65	0.00000	0.000	0.0	774.6	0.0	0.0
M200 24hr	1200	108.8	0.278	0.6	5.44	0.00000	0.000	0.0	1549.1	0.0	0.0
M200 48hr	2400	118.5	0.278	0.6	2.9625	0.00000	0.000	0.0	3098.2	0.0	0.0

Catchment		**SP47**	Area Excl Hardstand						water discharge rate (l/s)		
Clean water natural flow									17.93		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	23.0	0.278	0.78	276	0.00312	0.186	55.9	5.4	1.7	54.3
M200 10min	10	32.1	0.278	0.78	192.6	0.00312	0.130	78.1	10.8	3.4	74.7
M200 15min	15	37.7	0.278	0.78	150.8	0.00312	0.102	91.7	16.1	5.0	86.7
M200 30min	30	46.3	0.278	0.78	92.6	0.00312	0.063	112.6	32.3	10.1	102.6
M200 60min	60	56.8	0.278	0.78	56.8	0.00312	0.038	138.2	64.5	20.1	118.0
M200 2hr	120	69.8	0.278	0.78	34.9	0.00312	0.024	169.8	129.1	40.2	129.6
M200 4hr	240	78.7	0.278	0.78	19.675	0.00312	0.013	191.4	258.2	80.5	111.0
M200 6hr	300	85.6	0.278	0.78	17.12	0.00312	0.012	249.9	387.3	120.7	129.2
M200 12hr	600	96.5	0.278	0.78	9.65	0.00312	0.007	281.7	774.6	241.4	40.3
M200 24hr	1200	108.8	0.278	0.78	5.44	0.00312	0.004	317.6	1549.1	482.7	-165.1
M200 48hr	2400	118.5	0.278	0.78	2.9625	0.00312	0.002	345.9	3098.2	965.4	-619.5

Catchment **SP47** Hardstand water discharge rate (l/s)

Clean water natural flow 17.93 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	23.0	0.278	0.6	276	0.00000	0.000	0.0	5.4	0.0	0.0
M200 10min	10	32.1	0.278	0.6	192.6	0.00000	0.000	0.0	10.8	0.0	0.0
M200 15min	15	37.7	0.278	0.6	150.8	0.00000	0.000	0.0	16.1	0.0	0.0
M200 30min	30	46.3	0.278	0.6	92.6	0.00000	0.000	0.0	32.3	0.0	0.0
M200 60min	60	56.8	0.278	0.6	56.8	0.00000	0.000	0.0	64.5	0.0	0.0
M200 2hr	120	69.8	0.278	0.6	34.9	0.00000	0.000	0.0	129.1	0.0	0.0
M200 4hr	240	78.7	0.278	0.6	19.675	0.00000	0.000	0.0	258.2	0.0	0.0
M200 6hr	300	85.6	0.278	0.6	17.12	0.00000	0.000	0.0	387.3	0.0	0.0
M200 12hr	600	96.5	0.278	0.6	9.65	0.00000	0.000	0.0	774.6	0.0	0.0
M200 24hr	1200	108.8	0.278	0.6	5.44	0.00000	0.000	0.0	1549.1	0.0	0.0
M200 48hr	2400	118.5	0.278	0.6	2.9625	0.00000	0.000	0.0	3098.2	0.0	0.0

Catchment **SP48** Area Excl Hardstand water discharge rate (l/s)

Clean water natural flow 17.93 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	23.0	0.278	0.78	276	0.00292	0.175	52.4	5.4	1.6	50.9
M200 10min	10	32.1	0.278	0.78	192.6	0.00292	0.122	73.2	10.8	3.1	70.1
M200 15min	15	37.7	0.278	0.78	150.8	0.00292	0.096	86.0	16.1	4.7	81.3
M200 30min	30	46.3	0.278	0.78	92.6	0.00292	0.059	105.6	32.3	9.4	96.1
M200 60min	60	56.8	0.278	0.78	56.8	0.00292	0.036	129.5	64.5	18.9	110.7
M200 2hr	120	69.8	0.278	0.78	34.9	0.00292	0.022	159.2	129.1	37.7	121.5
M200 4hr	240	78.7	0.278	0.78	19.675	0.00292	0.012	179.5	258.2	75.4	104.0
M200 6hr	300	85.6	0.278	0.78	17.12	0.00292	0.011	234.2	387.3	113.1	121.1
M200 12hr	600	96.5	0.278	0.78	9.65	0.00292	0.006	264.0	774.6	226.2	37.8
M200 24hr	1200	108.8	0.278	0.78	5.44	0.00292	0.003	297.7	1549.1	452.5	-154.8
M200 48hr	2400	118.5	0.278	0.78	2.9625	0.00292	0.002	324.2	3098.2	905.0	-580.7

Catchment **SP48** Hardstand water discharge rate (l/s)

Clean water natural flow 17.93 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	23.0	0.278	0.6	276	0.00000	0.000	0.0	5.4	0.0	0.0
M200 10min	10	32.1	0.278	0.6	192.6	0.00000	0.000	0.0	10.8	0.0	0.0
M200 15min	15	37.7	0.278	0.6	150.8	0.00000	0.000	0.0	16.1	0.0	0.0
M200 30min	30	46.3	0.278	0.6	92.6	0.00000	0.000	0.0	32.3	0.0	0.0
M200 60min	60	56.8	0.278	0.6	56.8	0.00000	0.000	0.0	64.5	0.0	0.0
M200 2hr	120	69.8	0.278	0.6	34.9	0.00000	0.000	0.0	129.1	0.0	0.0
M200 4hr	240	78.7	0.278	0.6	19.675	0.00000	0.000	0.0	258.2	0.0	0.0
M200 6hr	300	85.6	0.278	0.6	17.12	0.00000	0.000	0.0	387.3	0.0	0.0

M200 12hr	600	96.5	0.278	0.6	9.65	0.00000	0.000	0.0	774.6	0.0	0.0
M200 24hr	1200	108.8	0.278	0.6	5.44	0.00000	0.000	0.0	1549.1	0.0	0.0
M200 48hr	2400	118.5	0.278	0.6	2.9625	0.00000	0.000	0.0	3098.2	0.0	0.0

Catchment **SP49-A** Area Excl Hardstand water discharge rate (l/s)
Clean water natural flow 17.93 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	23.0	0.278	0.78	276	0.00075	0.045	13.5	5.4	0.4	13.1
M200 10min	10	32.1	0.278	0.78	192.6	0.00075	0.031	18.8	10.8	0.8	18.0
M200 15min	15	37.7	0.278	0.78	150.8	0.00075	0.025	22.1	16.1	1.2	20.9
M200 30min	30	46.3	0.278	0.78	92.6	0.00075	0.015	27.1	32.3	2.4	24.7
M200 60min	60	56.8	0.278	0.78	56.8	0.00075	0.009	33.3	64.5	4.8	28.5
M200 2hr	120	69.8	0.278	0.78	34.9	0.00075	0.006	40.9	129.1	9.7	31.2
M200 4hr	240	78.7	0.278	0.78	19.675	0.00075	0.003	46.1	258.2	19.4	26.7
M200 6hr	300	85.6	0.278	0.78	17.12	0.00075	0.003	60.2	387.3	29.1	31.1
M200 12hr	600	96.5	0.278	0.78	9.65	0.00075	0.002	67.9	774.6	58.2	9.7
M200 24hr	1200	108.8	0.278	0.78	5.44	0.00075	0.001	76.5	1549.1	116.3	-39.8
M200 48hr	2400	118.5	0.278	0.78	2.9625	0.00075	0.000	83.4	3098.2	232.7	-149.3

Catchment **SP49-A** Hardstand water discharge rate (l/s)
Clean water natural flow 17.93 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	23.0	0.278	0.6	276	0.00401	0.185	55.4	5.4	2.2	53.3
M200 10min	10	32.1	0.278	0.6	192.6	0.00401	0.129	77.3	10.8	4.3	73.0
M200 15min	15	37.7	0.278	0.6	150.8	0.00401	0.101	90.8	16.1	6.5	84.4
M200 30min	30	46.3	0.278	0.6	92.6	0.00401	0.062	111.5	32.3	12.9	98.6
M200 60min	60	56.8	0.278	0.6	56.8	0.00401	0.038	136.8	64.5	25.9	110.9
M200 2hr	120	69.8	0.278	0.6	34.9	0.00401	0.023	168.2	129.1	51.8	116.4
M200 4hr	240	78.7	0.278	0.6	19.675	0.00401	0.013	189.6	258.2	103.6	86.0
M200 6hr	300	85.6	0.278	0.6	17.12	0.00401	0.011	247.5	387.3	155.4	92.1
M200 12hr	600	96.5	0.278	0.6	9.65	0.00401	0.006	279.0	774.6	310.8	-31.8
M200 24hr	1200	108.8	0.278	0.6	5.44	0.00401	0.004	314.5	1549.1	621.5	-307.0
M200 48hr	2400	118.5	0.278	0.6	2.9625	0.00401	0.002	342.6	3098.2	1243.0	-900.4

Catchment **SP49-B** Area Excl Hardstand water discharge rate (l/s)
Clean water natural flow 17.93 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	23.0	0.278	0.78	276	0.00338	0.202	60.7	5.4	1.8	58.9
M200 10min	10	32.1	0.278	0.78	192.6	0.00338	0.141	84.7	10.8	3.6	81.1
M200 15min	15	37.7	0.278	0.78	150.8	0.00338	0.111	99.5	16.1	5.5	94.1
M200 30min	30	46.3	0.278	0.78	92.6	0.00338	0.068	122.2	32.3	10.9	111.3
M200 60min	60	56.8	0.278	0.78	56.8	0.00338	0.042	150.0	64.5	21.8	128.1
M200 2hr	120	69.8	0.278	0.78	34.9	0.00338	0.026	184.3	129.1	43.7	140.6
M200 4hr	240	78.7	0.278	0.78	19.675	0.00338	0.014	207.8	258.2	87.3	120.5
M200 6hr	300	85.6	0.278	0.78	17.12	0.00338	0.013	271.2	387.3	131.0	140.2
M200 12hr	600	96.5	0.278	0.78	9.65	0.00338	0.007	305.7	774.6	262.0	43.8
M200 24hr	1200	108.8	0.278	0.78	5.44	0.00338	0.004	344.7	1549.1	523.9	-179.2
M200 48hr	2400	118.5	0.278	0.78	2.9625	0.00338	0.002	375.4	3098.2	1047.8	-672.4

Catchment **SP49-B** Hardstand water discharge rate (l/s)
Clean water natural flow 17.93 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	23.0	0.278	0.6	276	0.00000	0.000	0.0	5.4	0.0	0.0
M200 10min	10	32.1	0.278	0.6	192.6	0.00000	0.000	0.0	10.8	0.0	0.0
M200 15min	15	37.7	0.278	0.6	150.8	0.00000	0.000	0.0	16.1	0.0	0.0
M200 30min	30	46.3	0.278	0.6	92.6	0.00000	0.000	0.0	32.3	0.0	0.0
M200 60min	60	56.8	0.278	0.6	56.8	0.00000	0.000	0.0	64.5	0.0	0.0
M200 2hr	120	69.8	0.278	0.6	34.9	0.00000	0.000	0.0	129.1	0.0	0.0
M200 4hr	240	78.7	0.278	0.6	19.675	0.00000	0.000	0.0	258.2	0.0	0.0
M200 6hr	300	85.6	0.278	0.6	17.12	0.00000	0.000	0.0	387.3	0.0	0.0
M200 12hr	600	96.5	0.278	0.6	9.65	0.00000	0.000	0.0	774.6	0.0	0.0
M200 24hr	1200	108.8	0.278	0.6	5.44	0.00000	0.000	0.0	1549.1	0.0	0.0
M200 48hr	2400	118.5	0.278	0.6	2.9625	0.00000	0.000	0.0	3098.2	0.0	0.0

Catchment			SP50	Area Excl Hardstand					water discharge rate (l/s)		
Clean water natural flow									17.93		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	23.0	0.278	0.78	276	0.00119	0.071	21.4	5.4	0.6	20.8
M200 10min	10	32.1	0.278	0.78	192.6	0.00119	0.050	29.9	10.8	1.3	28.6
M200 15min	15	37.7	0.278	0.78	150.8	0.00119	0.039	35.1	16.1	1.9	33.2
M200 30min	30	46.3	0.278	0.78	92.6	0.00119	0.024	43.2	32.3	3.9	39.3
M200 60min	60	56.8	0.278	0.78	56.8	0.00119	0.015	52.9	64.5	7.7	45.2
M200 2hr	120	69.8	0.278	0.78	34.9	0.00119	0.009	65.1	129.1	15.4	49.6
M200 4hr	240	78.7	0.278	0.78	19.675	0.00119	0.005	73.4	258.2	30.8	42.5
M200 6hr	300	85.6	0.278	0.78	17.12	0.00119	0.004	95.7	387.3	46.2	49.5
M200 12hr	600	96.5	0.278	0.78	9.65	0.00119	0.002	107.9	774.6	92.5	15.5
M200 24hr	1200	108.8	0.278	0.78	5.44	0.00119	0.001	121.7	1549.1	185.0	-63.3
M200 48hr	2400	118.5	0.278	0.78	2.9625	0.00119	0.001	132.5	3098.2	369.9	-237.4

Catchment			SP50	Hardstand					water discharge rate (l/s)		
Clean water natural flow									17.93		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	23.0	0.278	0.6	276	0.00000	0.000	0.0	5.4	0.0	0.0
M200 10min	10	32.1	0.278	0.6	192.6	0.00000	0.000	0.0	10.8	0.0	0.0
M200 15min	15	37.7	0.278	0.6	150.8	0.00000	0.000	0.0	16.1	0.0	0.0
M200 30min	30	46.3	0.278	0.6	92.6	0.00000	0.000	0.0	32.3	0.0	0.0
M200 60min	60	56.8	0.278	0.6	56.8	0.00000	0.000	0.0	64.5	0.0	0.0
M200 2hr	120	69.8	0.278	0.6	34.9	0.00000	0.000	0.0	129.1	0.0	0.0
M200 4hr	240	78.7	0.278	0.6	19.675	0.00000	0.000	0.0	258.2	0.0	0.0
M200 6hr	300	85.6	0.278	0.6	17.12	0.00000	0.000	0.0	387.3	0.0	0.0
M200 12hr	600	96.5	0.278	0.6	9.65	0.00000	0.000	0.0	774.6	0.0	0.0
M200 24hr	1200	108.8	0.278	0.6	5.44	0.00000	0.000	0.0	1549.1	0.0	0.0
M200 48hr	2400	118.5	0.278	0.6	2.9625	0.00000	0.000	0.0	3098.2	0.0	0.0

Catchment			SP51	Area Excl Hardstand					water discharge rate (l/s)		
Clean water natural flow									17.93		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	23.0	0.278	0.78	276	0.00132	0.079	23.6	5.4	0.7	22.9
M200 10min	10	32.1	0.278	0.78	192.6	0.00132	0.055	33.0	10.8	1.4	31.6
M200 15min	15	37.7	0.278	0.78	150.8	0.00132	0.043	38.7	16.1	2.1	36.6
M200 30min	30	46.3	0.278	0.78	92.6	0.00132	0.026	47.6	32.3	4.2	43.3
M200 60min	60	56.8	0.278	0.78	56.8	0.00132	0.016	58.4	64.5	8.5	49.9
M200 2hr	120	69.8	0.278	0.78	34.9	0.00132	0.010	71.7	129.1	17.0	54.7

M200 4hr	240	78.7	0.278	0.78	19.675	0.00132	0.006	80.8	258.2	34.0	46.9
M200 6hr	300	85.6	0.278	0.78	17.12	0.00132	0.005	105.5	387.3	51.0	54.6
M200 12hr	600	96.5	0.278	0.78	9.65	0.00132	0.003	119.0	774.6	101.9	17.0
M200 24hr	1200	108.8	0.278	0.78	5.44	0.00132	0.002	134.1	1549.1	203.9	-69.7
M200 48hr	2400	118.5	0.278	0.78	2.9625	0.00132	0.001	146.1	3098.2	407.7	-261.6

Catchment		**SP51**	Hardstand						water discharge rate (l/s)		
Clean water natural flow									17.93		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	23.0	0.278	0.6	276	0.00000	0.000	0.0	5.4	0.0	0.0
M200 10min	10	32.1	0.278	0.6	192.6	0.00000	0.000	0.0	10.8	0.0	0.0
M200 15min	15	37.7	0.278	0.6	150.8	0.00000	0.000	0.0	16.1	0.0	0.0
M200 30min	30	46.3	0.278	0.6	92.6	0.00000	0.000	0.0	32.3	0.0	0.0
M200 60min	60	56.8	0.278	0.6	56.8	0.00000	0.000	0.0	64.5	0.0	0.0
M200 2hr	120	69.8	0.278	0.6	34.9	0.00000	0.000	0.0	129.1	0.0	0.0
M200 4hr	240	78.7	0.278	0.6	19.675	0.00000	0.000	0.0	258.2	0.0	0.0
M200 6hr	300	85.6	0.278	0.6	17.12	0.00000	0.000	0.0	387.3	0.0	0.0
M200 12hr	600	96.5	0.278	0.6	9.65	0.00000	0.000	0.0	774.6	0.0	0.0
M200 24hr	1200	108.8	0.278	0.6	5.44	0.00000	0.000	0.0	1549.1	0.0	0.0
M200 48hr	2400	118.5	0.278	0.6	2.9625	0.00000	0.000	0.0	3098.2	0.0	0.0

Catchment		**SP52**	Area Excl Hardstand						water discharge rate (l/s)		
Clean water natural flow									17.93		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	23.0	0.278	0.78	276	0.00227	0.136	40.7	5.4	1.2	39.4
M200 10min	10	32.1	0.278	0.78	192.6	0.00227	0.095	56.8	10.8	2.4	54.3
M200 15min	15	37.7	0.278	0.78	150.8	0.00227	0.074	66.7	16.1	3.7	63.0
M200 30min	30	46.3	0.278	0.78	92.6	0.00227	0.045	81.9	32.3	7.3	74.6
M200 60min	60	56.8	0.278	0.78	56.8	0.00227	0.028	100.4	64.5	14.6	85.8
M200 2hr	120	69.8	0.278	0.78	34.9	0.00227	0.017	123.4	129.1	29.2	94.2
M200 4hr	240	78.7	0.278	0.78	19.675	0.00227	0.010	139.2	258.2	58.5	80.7
M200 6hr	300	85.6	0.278	0.78	17.12	0.00227	0.008	181.6	387.3	87.7	93.9
M200 12hr	600	96.5	0.278	0.78	9.65	0.00227	0.005	204.7	774.6	175.4	29.3
M200 24hr	1200	108.8	0.278	0.78	5.44	0.00227	0.003	230.8	1549.1	350.9	-120.0
M200 48hr	2400	118.5	0.278	0.78	2.9625	0.00227	0.001	251.4	3098.2	701.8	-450.3

Catchment		**SP52**	Hardstand						water discharge rate (l/s)		
Clean water natural flow									17.93		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	23.0	0.278	0.6	276	0.00000	0.000	0.0	5.4	0.0	0.0
M200 10min	10	32.1	0.278	0.6	192.6	0.00000	0.000	0.0	10.8	0.0	0.0
M200 15min	15	37.7	0.278	0.6	150.8	0.00000	0.000	0.0	16.1	0.0	0.0
M200 30min	30	46.3	0.278	0.6	92.6	0.00000	0.000	0.0	32.3	0.0	0.0
M200 60min	60	56.8	0.278	0.6	56.8	0.00000	0.000	0.0	64.5	0.0	0.0
M200 2hr	120	69.8	0.278	0.6	34.9	0.00000	0.000	0.0	129.1	0.0	0.0
M200 4hr	240	78.7	0.278	0.6	19.675	0.00000	0.000	0.0	258.2	0.0	0.0
M200 6hr	300	85.6	0.278	0.6	17.12	0.00000	0.000	0.0	387.3	0.0	0.0
M200 12hr	600	96.5	0.278	0.6	9.65	0.00000	0.000	0.0	774.6	0.0	0.0
M200 24hr	1200	108.8	0.278	0.6	5.44	0.00000	0.000	0.0	1549.1	0.0	0.0
M200 48hr	2400	118.5	0.278	0.6	2.9625	0.00000	0.000	0.0	3098.2	0.0	0.0

Catchment		**SP53**	Area Excl Hardstand						water discharge rate (l/s)		

Clean water natural flow									17.93		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	23.0	0.278	0.78	276	0.00115	0.069	20.7	5.4	0.6	20.1
M200 10min	10	32.1	0.278	0.78	192.6	0.00115	0.048	28.9	10.8	1.2	27.6
M200 15min	15	37.7	0.278	0.78	150.8	0.00115	0.038	33.9	16.1	1.9	32.0
M200 30min	30	46.3	0.278	0.78	92.6	0.00115	0.023	41.6	32.3	3.7	37.9
M200 60min	60	56.8	0.278	0.78	56.8	0.00115	0.014	51.1	64.5	7.4	43.6
M200 2hr	120	69.8	0.278	0.78	34.9	0.00115	0.009	62.8	129.1	14.9	47.9
M200 4hr	240	78.7	0.278	0.78	19.675	0.00115	0.005	70.8	258.2	29.7	41.0
M200 6hr	300	85.6	0.278	0.78	17.12	0.00115	0.004	92.4	387.3	44.6	47.8
M200 12hr	600	96.5	0.278	0.78	9.65	0.00115	0.002	104.1	774.6	89.2	14.9
M200 24hr	1200	108.8	0.278	0.78	5.44	0.00115	0.001	117.4	1549.1	178.5	-61.0
M200 48hr	2400	118.5	0.278	0.78	2.9625	0.00115	0.001	127.9	3098.2	356.9	-229.0

	Catchment		**SP53**	Hardstand					water discharge rate (l/s)		
Clean water natural flow									17.93		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	23.0	0.278	0.6	276	0.00000	0.000	0.0	5.4	0.0	0.0
M200 10min	10	32.1	0.278	0.6	192.6	0.00000	0.000	0.0	10.8	0.0	0.0
M200 15min	15	37.7	0.278	0.6	150.8	0.00000	0.000	0.0	16.1	0.0	0.0
M200 30min	30	46.3	0.278	0.6	92.6	0.00000	0.000	0.0	32.3	0.0	0.0
M200 60min	60	56.8	0.278	0.6	56.8	0.00000	0.000	0.0	64.5	0.0	0.0
M200 2hr	120	69.8	0.278	0.6	34.9	0.00000	0.000	0.0	129.1	0.0	0.0
M200 4hr	240	78.7	0.278	0.6	19.675	0.00000	0.000	0.0	258.2	0.0	0.0
M200 6hr	300	85.6	0.278	0.6	17.12	0.00000	0.000	0.0	387.3	0.0	0.0
M200 12hr	600	96.5	0.278	0.6	9.65	0.00000	0.000	0.0	774.6	0.0	0.0
M200 24hr	1200	108.8	0.278	0.6	5.44	0.00000	0.000	0.0	1549.1	0.0	0.0
M200 48hr	2400	118.5	0.278	0.6	2.9625	0.00000	0.000	0.0	3098.2	0.0	0.0

	Catchment		**SP54**	Area Excl Hardstand					water discharge rate (l/s)		
Clean water natural flow									17.93		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	23.0	0.278	0.78	276	0.00295	0.176	52.9	5.4	1.6	51.3
M200 10min	10	32.1	0.278	0.78	192.6	0.00295	0.123	73.8	10.8	3.2	70.7
M200 15min	15	37.7	0.278	0.78	150.8	0.00295	0.096	86.7	16.1	4.8	82.0
M200 30min	30	46.3	0.278	0.78	92.6	0.00295	0.059	106.5	32.3	9.5	97.0
M200 60min	60	56.8	0.278	0.78	56.8	0.00295	0.036	130.7	64.5	19.0	111.6
M200 2hr	120	69.8	0.278	0.78	34.9	0.00295	0.022	160.6	129.1	38.0	122.5
M200 4hr	240	78.7	0.278	0.78	19.675	0.00295	0.013	181.0	258.2	76.1	105.0
M200 6hr	300	85.6	0.278	0.78	17.12	0.00295	0.011	236.3	387.3	114.1	122.2
M200 12hr	600	96.5	0.278	0.78	9.65	0.00295	0.006	266.4	774.6	228.3	38.1
M200 24hr	1200	108.8	0.278	0.78	5.44	0.00295	0.003	300.4	1549.1	456.5	-156.2
M200 48hr	2400	118.5	0.278	0.78	2.9625	0.00295	0.002	327.1	3098.2	913.1	-585.9

	Catchment		**SP54**	Hardstand					water discharge rate (l/s)		
Clean water natural flow									17.93		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	23.0	0.278	0.6	276	0.00000	0.000	0.0	5.4	0.0	0.0
M200 10min	10	32.1	0.278	0.6	192.6	0.00000	0.000	0.0	10.8	0.0	0.0
M200 15min	15	37.7	0.278	0.6	150.8	0.00000	0.000	0.0	16.1	0.0	0.0
M200 30min	30	46.3	0.278	0.6	92.6	0.00000	0.000	0.0	32.3	0.0	0.0

M200 60min	60	56.8	0.278	0.6	56.8	0.00000	0.000	0.0	64.5	0.0	0.0
M200 2hr	120	69.8	0.278	0.6	34.9	0.00000	0.000	0.0	129.1	0.0	0.0
M200 4hr	240	78.7	0.278	0.6	19.675	0.00000	0.000	0.0	258.2	0.0	0.0
M200 6hr	300	85.6	0.278	0.6	17.12	0.00000	0.000	0.0	387.3	0.0	0.0
M200 12hr	600	96.5	0.278	0.6	9.65	0.00000	0.000	0.0	774.6	0.0	0.0
M200 24hr	1200	108.8	0.278	0.6	5.44	0.00000	0.000	0.0	1549.1	0.0	0.0
M200 48hr	2400	118.5	0.278	0.6	2.9625	0.00000	0.000	0.0	3098.2	0.0	0.0

Catchment			**SP55-A**	Area Excl Hardstand					water discharge rate (l/s)		
Clean water natural flow									17.93		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	23.0	0.278	0.78	276	0.00266	0.159	47.8	5.4	1.4	46.4
M200 10min	10	32.1	0.278	0.78	192.6	0.00266	0.111	66.8	10.8	2.9	63.9
M200 15min	15	37.7	0.278	0.78	150.8	0.00266	0.087	78.4	16.1	4.3	74.1
M200 30min	30	46.3	0.278	0.78	92.6	0.00266	0.053	96.3	32.3	8.6	87.7
M200 60min	60	56.8	0.278	0.78	56.8	0.00266	0.033	118.1	64.5	17.2	100.9
M200 2hr	120	69.8	0.278	0.78	34.9	0.00266	0.020	145.2	129.1	34.4	110.8
M200 4hr	240	78.7	0.278	0.78	19.675	0.00266	0.011	163.7	258.2	68.8	94.9
M200 6hr	300	85.6	0.278	0.78	17.12	0.00266	0.010	213.6	387.3	103.2	110.4
M200 12hr	600	96.5	0.278	0.78	9.65	0.00266	0.006	240.8	774.6	206.3	34.5
M200 24hr	1200	108.8	0.278	0.78	5.44	0.00266	0.003	271.5	1549.1	412.7	-141.2
M200 48hr	2400	118.5	0.278	0.78	2.9625	0.00266	0.002	295.7	3098.2	825.4	-529.7

Catchment			**SP55-A**	Hardstand					water discharge rate (l/s)		
Clean water natural flow									17.93		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	23.0	0.278	0.6	276	0.00000	0.000	0.0	5.4	0.0	0.0
M200 10min	10	32.1	0.278	0.6	192.6	0.00000	0.000	0.0	10.8	0.0	0.0
M200 15min	15	37.7	0.278	0.6	150.8	0.00000	0.000	0.0	16.1	0.0	0.0
M200 30min	30	46.3	0.278	0.6	92.6	0.00000	0.000	0.0	32.3	0.0	0.0
M200 60min	60	56.8	0.278	0.6	56.8	0.00000	0.000	0.0	64.5	0.0	0.0
M200 2hr	120	69.8	0.278	0.6	34.9	0.00000	0.000	0.0	129.1	0.0	0.0
M200 4hr	240	78.7	0.278	0.6	19.675	0.00000	0.000	0.0	258.2	0.0	0.0
M200 6hr	300	85.6	0.278	0.6	17.12	0.00000	0.000	0.0	387.3	0.0	0.0
M200 12hr	600	96.5	0.278	0.6	9.65	0.00000	0.000	0.0	774.6	0.0	0.0
M200 24hr	1200	108.8	0.278	0.6	5.44	0.00000	0.000	0.0	1549.1	0.0	0.0
M200 48hr	2400	118.5	0.278	0.6	2.9625	0.00000	0.000	0.0	3098.2	0.0	0.0

Catchment			**SP55-B**	Area Excl Hardstand					water discharge rate (l/s)		
Clean water natural flow									17.93		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	23.0	0.278	0.78	276	0.00000	0.000	0.0	5.4	0.0	0.0
M200 10min	10	32.1	0.278	0.78	192.6	0.00000	0.000	0.0	10.8	0.0	0.0
M200 15min	15	37.7	0.278	0.78	150.8	0.00000	0.000	0.0	16.1	0.0	0.0
M200 30min	30	46.3	0.278	0.78	92.6	0.00000	0.000	0.0	32.3	0.0	0.0
M200 60min	60	56.8	0.278	0.78	56.8	0.00000	0.000	0.0	64.5	0.0	0.0
M200 2hr	120	69.8	0.278	0.78	34.9	0.00000	0.000	0.0	129.1	0.0	0.0
M200 4hr	240	78.7	0.278	0.78	19.675	0.00000	0.000	0.0	258.2	0.0	0.0
M200 6hr	300	85.6	0.278	0.78	17.12	0.00000	0.000	0.0	387.3	0.0	0.0
M200 12hr	600	96.5	0.278	0.78	9.65	0.00000	0.000	0.0	774.6	0.0	0.0
M200 24hr	1200	108.8	0.278	0.78	5.44	0.00000	0.000	0.0	1549.1	0.0	0.0
M200 48hr	2400	118.5	0.278	0.78	2.9625	0.00000	0.000	0.0	3098.2	0.0	0.0

Catchment			SP55-B	Hardstand					water discharge rate (l/s)	
Clean water natural flow									17.93	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	23.0	0.278	0.6	276	0.00407	0.188	56.3	5.4	2.2	54.1
M200 10min	10	32.1	0.278	0.6	192.6	0.00407	0.131	78.5	10.8	4.4	74.1
M200 15min	15	37.7	0.278	0.6	150.8	0.00407	0.102	92.2	16.1	6.6	85.6
M200 30min	30	46.3	0.278	0.6	92.6	0.00407	0.063	113.2	32.3	13.1	100.1
M200 60min	60	56.8	0.278	0.6	56.8	0.00407	0.039	138.9	64.5	26.3	112.6
M200 2hr	120	69.8	0.278	0.6	34.9	0.00407	0.024	170.7	129.1	52.6	118.1
M200 4hr	240	78.7	0.278	0.6	19.675	0.00407	0.013	192.5	258.2	105.2	87.3
M200 6hr	300	85.6	0.278	0.6	17.12	0.00407	0.012	251.2	387.3	157.7	93.5
M200 12hr	600	96.5	0.278	0.6	9.65	0.00407	0.007	283.2	774.6	315.5	-32.3
M200 24hr	1200	108.8	0.278	0.6	5.44	0.00407	0.004	319.3	1549.1	631.0	-311.6
M200 48hr	2400	118.5	0.278	0.6	2.9625	0.00407	0.002	347.8	3098.2	1261.9	-914.1

Catchment			SP56	Area Excl Hardstand					water discharge rate (l/s)	
Clean water natural flow									17.93	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	23.0	0.278	0.78	276	0.00152	0.091	27.3	5.4	0.8	26.5
M200 10min	10	32.1	0.278	0.78	192.6	0.00152	0.063	38.1	10.8	1.6	36.4
M200 15min	15	37.7	0.278	0.78	150.8	0.00152	0.050	44.7	16.1	2.5	42.3
M200 30min	30	46.3	0.278	0.78	92.6	0.00152	0.031	54.9	32.3	4.9	50.0
M200 60min	60	56.8	0.278	0.78	56.8	0.00152	0.019	67.4	64.5	9.8	57.5
M200 2hr	120	69.8	0.278	0.78	34.9	0.00152	0.011	82.8	129.1	19.6	63.2
M200 4hr	240	78.7	0.278	0.78	19.675	0.00152	0.006	93.3	258.2	39.2	54.1
M200 6hr	300	85.6	0.278	0.78	17.12	0.00152	0.006	121.8	387.3	58.8	63.0
M200 12hr	600	96.5	0.278	0.78	9.65	0.00152	0.003	137.3	774.6	117.7	19.7
M200 24hr	1200	108.8	0.278	0.78	5.44	0.00152	0.002	154.8	1549.1	235.3	-80.5
M200 48hr	2400	118.5	0.278	0.78	2.9625	0.00152	0.001	168.6	3098.2	470.6	-302.0

Catchment			SP56	Hardstand					water discharge rate (l/s)	
Clean water natural flow									17.93	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	23.0	0.278	0.6	276	0.00000	0.000	0.0	5.4	0.0	0.0
M200 10min	10	32.1	0.278	0.6	192.6	0.00000	0.000	0.0	10.8	0.0	0.0
M200 15min	15	37.7	0.278	0.6	150.8	0.00000	0.000	0.0	16.1	0.0	0.0
M200 30min	30	46.3	0.278	0.6	92.6	0.00000	0.000	0.0	32.3	0.0	0.0
M200 60min	60	56.8	0.278	0.6	56.8	0.00000	0.000	0.0	64.5	0.0	0.0
M200 2hr	120	69.8	0.278	0.6	34.9	0.00000	0.000	0.0	129.1	0.0	0.0
M200 4hr	240	78.7	0.278	0.6	19.675	0.00000	0.000	0.0	258.2	0.0	0.0
M200 6hr	300	85.6	0.278	0.6	17.12	0.00000	0.000	0.0	387.3	0.0	0.0
M200 12hr	600	96.5	0.278	0.6	9.65	0.00000	0.000	0.0	774.6	0.0	0.0
M200 24hr	1200	108.8	0.278	0.6	5.44	0.00000	0.000	0.0	1549.1	0.0	0.0
M200 48hr	2400	118.5	0.278	0.6	2.9625	0.00000	0.000	0.0	3098.2	0.0	0.0

Catchment			SP57	Area Excl Hardstand					water discharge rate (l/s)	
Clean water natural flow									17.93	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	23.0	0.278	0.78	276	0.00389	0.233	69.8	5.4	2.1	67.7
M200 10min	10	32.1	0.278	0.78	192.6	0.00389	0.162	97.4	10.8	4.2	93.2
M200 15min	15	37.7	0.278	0.78	150.8	0.00389	0.127	114.4	16.1	6.3	108.1

M200 30min	30	46.3	0.278	0.78	92.6	0.00389	0.078	140.5	32.3	12.5	127.9
M200 60min	60	56.8	0.278	0.78	56.8	0.00389	0.048	172.3	64.5	25.1	147.3
M200 2hr	120	69.8	0.278	0.78	34.9	0.00389	0.029	211.8	129.1	50.2	161.6
M200 4hr	240	78.7	0.278	0.78	19.675	0.00389	0.017	238.8	258.2	100.4	138.4
M200 6hr	300	85.6	0.278	0.78	17.12	0.00389	0.014	311.7	387.3	150.5	161.1
M200 12hr	600	96.5	0.278	0.78	9.65	0.00389	0.008	351.4	774.6	301.1	50.3
M200 24hr	1200	108.8	0.278	0.78	5.44	0.00389	0.005	396.2	1549.1	602.1	-206.0
M200 48hr	2400	118.5	0.278	0.78	2.9625	0.00389	0.002	431.5	3098.2	1204.3	-772.8

	Catchment		**SP57**	Hardstand					water discharge rate (l/s)		
Clean water natural flow									17.93		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	23.0	0.278	0.6	276	0.00000	0.000	0.0	5.4	0.0	0.0
M200 10min	10	32.1	0.278	0.6	192.6	0.00000	0.000	0.0	10.8	0.0	0.0
M200 15min	15	37.7	0.278	0.6	150.8	0.00000	0.000	0.0	16.1	0.0	0.0
M200 30min	30	46.3	0.278	0.6	92.6	0.00000	0.000	0.0	32.3	0.0	0.0
M200 60min	60	56.8	0.278	0.6	56.8	0.00000	0.000	0.0	64.5	0.0	0.0
M200 2hr	120	69.8	0.278	0.6	34.9	0.00000	0.000	0.0	129.1	0.0	0.0
M200 4hr	240	78.7	0.278	0.6	19.675	0.00000	0.000	0.0	258.2	0.0	0.0
M200 6hr	300	85.6	0.278	0.6	17.12	0.00000	0.000	0.0	387.3	0.0	0.0
M200 12hr	600	96.5	0.278	0.6	9.65	0.00000	0.000	0.0	774.6	0.0	0.0
M200 24hr	1200	108.8	0.278	0.6	5.44	0.00000	0.000	0.0	1549.1	0.0	0.0
M200 48hr	2400	118.5	0.278	0.6	2.9625	0.00000	0.000	0.0	3098.2	0.0	0.0

	Catchment		**SP58-A**	Area Excl Hardstand					water discharge rate (l/s)		
Clean water natural flow									17.93		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	23.0	0.278	0.78	276	0.00227	0.136	40.8	5.4	1.2	39.6
M200 10min	10	32.1	0.278	0.78	192.6	0.00227	0.095	57.0	10.8	2.4	54.5
M200 15min	15	37.7	0.278	0.78	150.8	0.00227	0.074	66.9	16.1	3.7	63.3
M200 30min	30	46.3	0.278	0.78	92.6	0.00227	0.046	82.2	32.3	7.3	74.8
M200 60min	60	56.8	0.278	0.78	56.8	0.00227	0.028	100.8	64.5	14.7	86.2
M200 2hr	120	69.8	0.278	0.78	34.9	0.00227	0.017	123.9	129.1	29.4	94.5
M200 4hr	240	78.7	0.278	0.78	19.675	0.00227	0.010	139.7	258.2	58.7	81.0
M200 6hr	300	85.6	0.278	0.78	17.12	0.00227	0.008	182.3	387.3	88.1	94.3
M200 12hr	600	96.5	0.278	0.78	9.65	0.00227	0.005	205.6	774.6	176.1	29.4
M200 24hr	1200	108.8	0.278	0.78	5.44	0.00227	0.003	231.8	1549.1	352.3	-120.5
M200 48hr	2400	118.5	0.278	0.78	2.9625	0.00227	0.001	252.4	3098.2	704.5	-452.1

	Catchment		**SP58-A**	Hardstand					water discharge rate (l/s)		
Clean water natural flow									17.93		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	23.0	0.278	0.6	276	0.00000	0.000	0.0	5.4	0.0	0.0
M200 10min	10	32.1	0.278	0.6	192.6	0.00000	0.000	0.0	10.8	0.0	0.0
M200 15min	15	37.7	0.278	0.6	150.8	0.00000	0.000	0.0	16.1	0.0	0.0
M200 30min	30	46.3	0.278	0.6	92.6	0.00000	0.000	0.0	32.3	0.0	0.0
M200 60min	60	56.8	0.278	0.6	56.8	0.00000	0.000	0.0	64.5	0.0	0.0
M200 2hr	120	69.8	0.278	0.6	34.9	0.00000	0.000	0.0	129.1	0.0	0.0
M200 4hr	240	78.7	0.278	0.6	19.675	0.00000	0.000	0.0	258.2	0.0	0.0
M200 6hr	300	85.6	0.278	0.6	17.12	0.00000	0.000	0.0	387.3	0.0	0.0
M200 12hr	600	96.5	0.278	0.6	9.65	0.00000	0.000	0.0	774.6	0.0	0.0
M200 24hr	1200	108.8	0.278	0.6	5.44	0.00000	0.000	0.0	1549.1	0.0	0.0
M200 48hr	2400	118.5	0.278	0.6	2.9625	0.00000	0.000	0.0	3098.2	0.0	0.0

Catchment		SP58-B	Area Excl Hardstand					water discharge rate (l/s)			
Clean water natural flow									17.93		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	23.0	0.278	0.78	276	0.00000	0.000	0.0	5.4	0.0	0.0
M200 10min	10	32.1	0.278	0.78	192.6	0.00000	0.000	0.0	10.8	0.0	0.0
M200 15min	15	37.7	0.278	0.78	150.8	0.00000	0.000	0.0	16.1	0.0	0.0
M200 30min	30	46.3	0.278	0.78	92.6	0.00000	0.000	0.0	32.3	0.0	0.0
M200 60min	60	56.8	0.278	0.78	56.8	0.00000	0.000	0.0	64.5	0.0	0.0
M200 2hr	120	69.8	0.278	0.78	34.9	0.00000	0.000	0.0	129.1	0.0	0.0
M200 4hr	240	78.7	0.278	0.78	19.675	0.00000	0.000	0.0	258.2	0.0	0.0
M200 6hr	300	85.6	0.278	0.78	17.12	0.00000	0.000	0.0	387.3	0.0	0.0
M200 12hr	600	96.5	0.278	0.78	9.65	0.00000	0.000	0.0	774.6	0.0	0.0
M200 24hr	1200	108.8	0.278	0.78	5.44	0.00000	0.000	0.0	1549.1	0.0	0.0
M200 48hr	2400	118.5	0.278	0.78	2.9625	0.00000	0.000	0.0	3098.2	0.0	0.0

Catchment		SP58-B	Hardstand					water discharge rate (l/s)			
Clean water natural flow									17.93		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	23.0	0.278	0.6	276	0.00451	0.208	62.3	5.4	2.4	59.9
M200 10min	10	32.1	0.278	0.6	192.6	0.00451	0.145	87.0	10.8	4.9	82.2
M200 15min	15	37.7	0.278	0.6	150.8	0.00451	0.114	102.2	16.1	7.3	94.9
M200 30min	30	46.3	0.278	0.6	92.6	0.00451	0.070	125.5	32.3	14.6	110.9
M200 60min	60	56.8	0.278	0.6	56.8	0.00451	0.043	154.0	64.5	29.1	124.8
M200 2hr	120	69.8	0.278	0.6	34.9	0.00451	0.026	189.2	129.1	58.3	130.9
M200 4hr	240	78.7	0.278	0.6	19.675	0.00451	0.015	213.3	258.2	116.5	96.8
M200 6hr	300	85.6	0.278	0.6	17.12	0.00451	0.013	278.4	387.3	174.8	103.6
M200 12hr	600	96.5	0.278	0.6	9.65	0.00451	0.007	313.9	774.6	349.6	-35.8
M200 24hr	1200	108.8	0.278	0.6	5.44	0.00451	0.004	353.9	1549.1	699.3	-345.4
M200 48hr	2400	118.5	0.278	0.6	2.9625	0.00451	0.002	385.4	3098.2	1398.5	-1013.1

Catchment		SP59	Area Excl Hardstand					water discharge rate (l/s)			
Clean water natural flow									17.93		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	23.0	0.278	0.78	276	0.00323	0.193	57.9	5.4	1.7	56.2
M200 10min	10	32.1	0.278	0.78	192.6	0.00323	0.135	80.8	10.8	3.5	77.4
M200 15min	15	37.7	0.278	0.78	150.8	0.00323	0.105	94.9	16.1	5.2	89.7
M200 30min	30	46.3	0.278	0.78	92.6	0.00323	0.065	116.6	32.3	10.4	106.2
M200 60min	60	56.8	0.278	0.78	56.8	0.00323	0.040	143.0	64.5	20.8	122.2
M200 2hr	120	69.8	0.278	0.78	34.9	0.00323	0.024	175.8	129.1	41.6	134.1
M200 4hr	240	78.7	0.278	0.78	19.675	0.00323	0.014	198.2	258.2	83.3	114.9
M200 6hr	300	85.6	0.278	0.78	17.12	0.00323	0.012	258.7	387.3	124.9	133.7
M200 12hr	600	96.5	0.278	0.78	9.65	0.00323	0.007	291.6	774.6	249.9	41.7
M200 24hr	1200	108.8	0.278	0.78	5.44	0.00323	0.004	328.8	1549.1	499.7	-171.0
M200 48hr	2400	118.5	0.278	0.78	2.9625	0.00323	0.002	358.1	3098.2	999.5	-641.4

Catchment		SP59	Hardstand					water discharge rate (l/s)			
Clean water natural flow									17.93		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	23.0	0.278	0.6	276	0.00000	0.000	0.0	5.4	0.0	0.0

M200 10min	10	32.1	0.278	0.6	192.6	0.00000	0.000	0.0	10.8	0.0	0.0
M200 15min	15	37.7	0.278	0.6	150.8	0.00000	0.000	0.0	16.1	0.0	0.0
M200 30min	30	46.3	0.278	0.6	92.6	0.00000	0.000	0.0	32.3	0.0	0.0
M200 60min	60	56.8	0.278	0.6	56.8	0.00000	0.000	0.0	64.5	0.0	0.0
M200 2hr	120	69.8	0.278	0.6	34.9	0.00000	0.000	0.0	129.1	0.0	0.0
M200 4hr	240	78.7	0.278	0.6	19.675	0.00000	0.000	0.0	258.2	0.0	0.0
M200 6hr	300	85.6	0.278	0.6	17.12	0.00000	0.000	0.0	387.3	0.0	0.0
M200 12hr	600	96.5	0.278	0.6	9.65	0.00000	0.000	0.0	774.6	0.0	0.0
M200 24hr	1200	108.8	0.278	0.6	5.44	0.00000	0.000	0.0	1549.1	0.0	0.0
M200 48hr	2400	118.5	0.278	0.6	2.9625	0.00000	0.000	0.0	3098.2	0.0	0.0

Catchment			**SP60**	Area Excl Hardstand					water discharge rate (l/s)		
Clean water natural flow									17.93		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	23.0	0.278	0.78	276	0.00305	0.183	54.8	5.4	1.6	53.2
M200 10min	10	32.1	0.278	0.78	192.6	0.00305	0.127	76.5	10.8	3.3	73.2
M200 15min	15	37.7	0.278	0.78	150.8	0.00305	0.100	89.8	16.1	4.9	84.9
M200 30min	30	46.3	0.278	0.78	92.6	0.00305	0.061	110.3	32.3	9.8	100.5
M200 60min	60	56.8	0.278	0.78	56.8	0.00305	0.038	135.3	64.5	19.7	115.6
M200 2hr	120	69.8	0.278	0.78	34.9	0.00305	0.023	166.3	129.1	39.4	126.9
M200 4hr	240	78.7	0.278	0.78	19.675	0.00305	0.013	187.5	258.2	78.8	108.7
M200 6hr	300	85.6	0.278	0.78	17.12	0.00305	0.011	244.7	387.3	118.2	126.5
M200 12hr	600	96.5	0.278	0.78	9.65	0.00305	0.006	275.9	774.6	236.4	39.5
M200 24hr	1200	108.8	0.278	0.78	5.44	0.00305	0.004	311.1	1549.1	472.8	-161.7
M200 48hr	2400	118.5	0.278	0.78	2.9625	0.00305	0.002	338.8	3098.2	945.6	-606.8

Catchment			**SP60**	Hardstand					water discharge rate (l/s)		
Clean water natural flow									17.93		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	23.0	0.278	0.6	276	0.00000	0.000	0.0	5.4	0.0	0.0
M200 10min	10	32.1	0.278	0.6	192.6	0.00000	0.000	0.0	10.8	0.0	0.0
M200 15min	15	37.7	0.278	0.6	150.8	0.00000	0.000	0.0	16.1	0.0	0.0
M200 30min	30	46.3	0.278	0.6	92.6	0.00000	0.000	0.0	32.3	0.0	0.0
M200 60min	60	56.8	0.278	0.6	56.8	0.00000	0.000	0.0	64.5	0.0	0.0
M200 2hr	120	69.8	0.278	0.6	34.9	0.00000	0.000	0.0	129.1	0.0	0.0
M200 4hr	240	78.7	0.278	0.6	19.675	0.00000	0.000	0.0	258.2	0.0	0.0
M200 6hr	300	85.6	0.278	0.6	17.12	0.00000	0.000	0.0	387.3	0.0	0.0
M200 12hr	600	96.5	0.278	0.6	9.65	0.00000	0.000	0.0	774.6	0.0	0.0
M200 24hr	1200	108.8	0.278	0.6	5.44	0.00000	0.000	0.0	1549.1	0.0	0.0
M200 48hr	2400	118.5	0.278	0.6	2.9625	0.00000	0.000	0.0	3098.2	0.0	0.0

Catchment			**SP61**	Area Excl Hardstand					water discharge rate (l/s)		
Clean water natural flow									17.93		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	23.0	0.278	0.78	276	0.00263	0.157	47.2	5.4	1.4	45.8
M200 10min	10	32.1	0.278	0.78	192.6	0.00263	0.110	65.9	10.8	2.8	63.1
M200 15min	15	37.7	0.278	0.78	150.8	0.00263	0.086	77.4	16.1	4.2	73.2
M200 30min	30	46.3	0.278	0.78	92.6	0.00263	0.053	95.1	32.3	8.5	86.6
M200 60min	60	56.8	0.278	0.78	56.8	0.00263	0.032	116.6	64.5	17.0	99.6
M200 2hr	120	69.8	0.278	0.78	34.9	0.00263	0.020	143.3	129.1	34.0	109.4
M200 4hr	240	78.7	0.278	0.78	19.675	0.00263	0.011	161.6	258.2	67.9	93.7
M200 6hr	300	85.6	0.278	0.78	17.12	0.00263	0.010	210.9	387.3	101.9	109.0
M200 12hr	600	96.5	0.278	0.78	9.65	0.00263	0.006	237.7	774.6	203.7	34.0
M200 24hr	1200	108.8	0.278	0.78	5.44	0.00263	0.003	268.0	1549.1	407.4	-139.4

M200 48hr	2400	118.5	0.278	0.78	2.9625	0.00263	0.002	291.9	3098.2	814.8	-522.9

Catchment		SP61	Hardstand						water discharge rate (l/s)		
Clean water natural flow									17.93		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	23.0	0.278	0.6	276	0.00000	0.000	0.0	5.4	0.0	0.0
M200 10min	10	32.1	0.278	0.6	192.6	0.00000	0.000	0.0	10.8	0.0	0.0
M200 15min	15	37.7	0.278	0.6	150.8	0.00000	0.000	0.0	16.1	0.0	0.0
M200 30min	30	46.3	0.278	0.6	92.6	0.00000	0.000	0.0	32.3	0.0	0.0
M200 60min	60	56.8	0.278	0.6	56.8	0.00000	0.000	0.0	64.5	0.0	0.0
M200 2hr	120	69.8	0.278	0.6	34.9	0.00000	0.000	0.0	129.1	0.0	0.0
M200 4hr	240	78.7	0.278	0.6	19.675	0.00000	0.000	0.0	258.2	0.0	0.0
M200 6hr	300	85.6	0.278	0.6	17.12	0.00000	0.000	0.0	387.3	0.0	0.0
M200 12hr	600	96.5	0.278	0.6	9.65	0.00000	0.000	0.0	774.6	0.0	0.0
M200 24hr	1200	108.8	0.278	0.6	5.44	0.00000	0.000	0.0	1549.1	0.0	0.0
M200 48hr	2400	118.5	0.278	0.6	2.9625	0.00000	0.000	0.0	3098.2	0.0	0.0

Catchment		SP62	Area Excl Hardstand						water discharge rate (l/s)		
Clean water natural flow									17.93		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	23.0	0.278	0.78	276	0.00000	0.000	0.0	5.4	0.0	0.0
M200 10min	10	32.1	0.278	0.78	192.6	0.00000	0.000	0.0	10.8	0.0	0.0
M200 15min	15	37.7	0.278	0.78	150.8	0.00000	0.000	0.0	16.1	0.0	0.0
M200 30min	30	46.3	0.278	0.78	92.6	0.00000	0.000	0.0	32.3	0.0	0.0
M200 60min	60	56.8	0.278	0.78	56.8	0.00000	0.000	0.0	64.5	0.0	0.0
M200 2hr	120	69.8	0.278	0.78	34.9	0.00000	0.000	0.0	129.1	0.0	0.0
M200 4hr	240	78.7	0.278	0.78	19.675	0.00000	0.000	0.0	258.2	0.0	0.0
M200 6hr	300	85.6	0.278	0.78	17.12	0.00000	0.000	0.0	387.3	0.0	0.0
M200 12hr	600	96.5	0.278	0.78	9.65	0.00000	0.000	0.0	774.6	0.0	0.0
M200 24hr	1200	108.8	0.278	0.78	5.44	0.00000	0.000	0.0	1549.1	0.0	0.0
M200 48hr	2400	118.5	0.278	0.78	2.9625	0.00000	0.000	0.0	3098.2	0.0	0.0

Catchment		SP62	Hardstand						water discharge rate (l/s)		
Clean water natural flow									17.93		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	23.0	0.278	0.6	276	0.00360	0.166	49.7	5.4	1.9	47.7
M200 10min	10	32.1	0.278	0.6	192.6	0.00360	0.116	69.3	10.8	3.9	65.4
M200 15min	15	37.7	0.278	0.6	150.8	0.00360	0.090	81.4	16.1	5.8	75.6
M200 30min	30	46.3	0.278	0.6	92.6	0.00360	0.056	100.0	32.3	11.6	88.4
M200 60min	60	56.8	0.278	0.6	56.8	0.00360	0.034	122.6	64.5	23.2	99.4
M200 2hr	120	69.8	0.278	0.6	34.9	0.00360	0.021	150.7	129.1	46.4	104.3
M200 4hr	240	78.7	0.278	0.6	19.675	0.00360	0.012	169.9	258.2	92.8	77.1
M200 6hr	300	85.6	0.278	0.6	17.12	0.00360	0.010	221.8	387.3	139.3	82.5
M200 12hr	600	96.5	0.278	0.6	9.65	0.00360	0.006	250.0	774.6	278.5	-28.5
M200 24hr	1200	108.8	0.278	0.6	5.44	0.00360	0.003	281.9	1549.1	557.1	-275.1
M200 48hr	2400	118.5	0.278	0.6	2.9625	0.00360	0.002	307.1	3098.2	1114.1	-807.1

Catchment		0	Area Excl Hardstand						water discharge rate (l/s)		
Clean water natural flow									17.93		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	23.0	0.278	0.78	276	0.00000	0.000	0.0	5.4	0.0	0.0
M200 10min	10	32.1	0.278	0.78	192.6	0.00000	0.000	0.0	10.8	0.0	0.0
M200 15min	15	37.7	0.278	0.78	150.8	0.00000	0.000	0.0	16.1	0.0	0.0
M200 30min	30	46.3	0.278	0.78	92.6	0.00000	0.000	0.0	32.3	0.0	0.0
M200 60min	60	56.8	0.278	0.78	56.8	0.00000	0.000	0.0	64.5	0.0	0.0
M200 2hr	120	69.8	0.278	0.78	34.9	0.00000	0.000	0.0	129.1	0.0	0.0
M200 4hr	240	78.7	0.278	0.78	19.675	0.00000	0.000	0.0	258.2	0.0	0.0
M200 6hr	300	85.6	0.278	0.78	17.12	0.00000	0.000	0.0	387.3	0.0	0.0
M200 12hr	600	96.5	0.278	0.78	9.65	0.00000	0.000	0.0	774.6	0.0	0.0
M200 24hr	1200	108.8	0.278	0.78	5.44	0.00000	0.000	0.0	1549.1	0.0	0.0
M200 48hr	2400	118.5	0.278	0.78	2.9625	0.00000	0.000	0.0	3098.2	0.0	0.0

	Catchment		**0**	Hardstand					water discharge rate (l/s)		
Clean water natural flow									17.93		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	23.0	0.278	0.6	276	0.00000	0.000	0.0	5.4	0.0	0.0
M200 10min	10	32.1	0.278	0.6	192.6	0.00000	0.000	0.0	10.8	0.0	0.0
M200 15min	15	37.7	0.278	0.6	150.8	0.00000	0.000	0.0	16.1	0.0	0.0
M200 30min	30	46.3	0.278	0.6	92.6	0.00000	0.000	0.0	32.3	0.0	0.0
M200 60min	60	56.8	0.278	0.6	56.8	0.00000	0.000	0.0	64.5	0.0	0.0
M200 2hr	120	69.8	0.278	0.6	34.9	0.00000	0.000	0.0	129.1	0.0	0.0
M200 4hr	240	78.7	0.278	0.6	19.675	0.00000	0.000	0.0	258.2	0.0	0.0
M200 6hr	300	85.6	0.278	0.6	17.12	0.00000	0.000	0.0	387.3	0.0	0.0
M200 12hr	600	96.5	0.278	0.6	9.65	0.00000	0.000	0.0	774.6	0.0	0.0
M200 24hr	1200	108.8	0.278	0.6	5.44	0.00000	0.000	0.0	1549.1	0.0	0.0
M200 48hr	2400	118.5	0.278	0.6	2.9625	0.00000	0.000	0.0	3098.2	0.0	0.0

	Catchment		**0**	Area Excl Hardstand					water discharge rate (l/s)		
Clean water natural flow									17.93		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)**
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M200 48hr	2400	118.5	0.278	0.78	2.9625	0.00000	0.000	0.0	3098.2	0.0	0.0

	Catchment		**0**	Hardstand					water discharge rate (l/s)		
Clean water natural flow									17.93		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)**
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	Catchment		**0**	Area Excl Hardstand					water discharge rate (l/s)		
Clean water natural flow									17.93		l/s/ha
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	Catchment		**0**	Hardstand					water discharge rate (l/s)		
Clean water natural flow									17.93		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)**
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	Catchment		**0**	Area Excl Hardstand					water discharge rate (l/s)		
Clean water natural flow									17.93		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)**
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	Catchment		**0**	Hardstand					water discharge rate (l/s)		
Clean water natural flow									17.93		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)
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	Catchment			0	Area Excl Hardstand				water discharge rate (l/s)		
Clean water natural flow									17.93		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)**
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	Catchment			0	Hardstand				water discharge rate (l/s)		
Clean water natural flow									17.93		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)**
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	Catchment			0	Area Excl Hardstand				water discharge rate (l/s)		
Clean water natural flow									17.93		l/s/ha
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Catchment **0** Hardstand water discharge rate (l/s)

Clean water natural flow 17.93 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)**
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Catchment **0** Area Excl Hardstand water discharge rate (l/s)

Clean water natural flow 17.93 l/s/ha

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Catchment **0** Hardstand water discharge rate (l/s)

Clean water natural flow 17.93 l/s/ha

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M200 15min	15	37.7	0.278	0.6	150.8	0.00000	0.000	0.0	16.1	0.0	0.0
M200 30min	30	46.3	0.278	0.6	92.6	0.00000	0.000	0.0	32.3	0.0	0.0
M200 60min	60	56.8	0.278	0.6	56.8	0.00000	0.000	0.0	64.5	0.0	0.0
M200 2hr	120	69.8	0.278	0.6	34.9	0.00000	0.000	0.0	129.1	0.0	0.0
M200 4hr	240	78.7	0.278	0.6	19.675	0.00000	0.000	0.0	258.2	0.0	0.0
M200 6hr	300	85.6	0.278	0.6	17.12	0.00000	0.000	0.0	387.3	0.0	0.0
M200 12hr	600	96.5	0.278	0.6	9.65	0.00000	0.000	0.0	774.6	0.0	0.0
M200 24hr	1200	108.8	0.278	0.6	5.44	0.00000	0.000	0.0	1549.1	0.0	0.0
M200 48hr	2400	118.5	0.278	0.6	2.9625	0.00000	0.000	0.0	3098.2	0.0	0.0

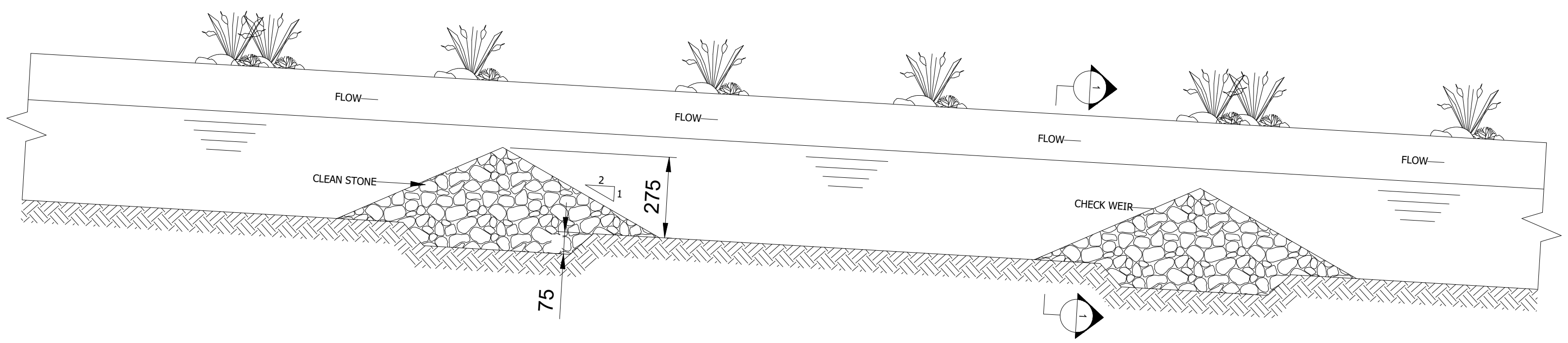
Catchment **0** Area Excl Hardstand water discharge rate (l/s)

Clean water natural flow									17.93		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	23.0	0.278	0.78	276	0.00000	0.000	0.0	5.4	0.0	0.0
M200 10min	10	32.1	0.278	0.78	192.6	0.00000	0.000	0.0	10.8	0.0	0.0
M200 15min	15	37.7	0.278	0.78	150.8	0.00000	0.000	0.0	16.1	0.0	0.0
M200 30min	30	46.3	0.278	0.78	92.6	0.00000	0.000	0.0	32.3	0.0	0.0
M200 60min	60	56.8	0.278	0.78	56.8	0.00000	0.000	0.0	64.5	0.0	0.0
M200 2hr	120	69.8	0.278	0.78	34.9	0.00000	0.000	0.0	129.1	0.0	0.0
M200 4hr	240	78.7	0.278	0.78	19.675	0.00000	0.000	0.0	258.2	0.0	0.0
M200 6hr	300	85.6	0.278	0.78	17.12	0.00000	0.000	0.0	387.3	0.0	0.0
M200 12hr	600	96.5	0.278	0.78	9.65	0.00000	0.000	0.0	774.6	0.0	0.0
M200 24hr	1200	108.8	0.278	0.78	5.44	0.00000	0.000	0.0	1549.1	0.0	0.0
M200 48hr	2400	118.5	0.278	0.78	2.9625	0.00000	0.000	0.0	3098.2	0.0	0.0

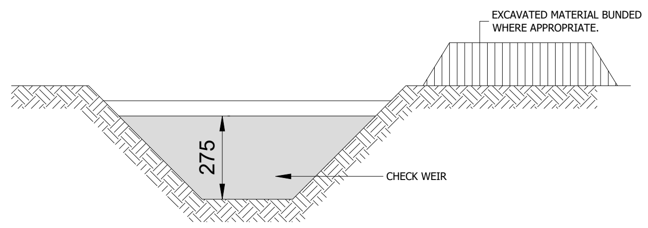
	Catchment		**0**	Hardstand					water discharge rate (l/s)		
Clean water natural flow									17.93		l/s/ha
1 in 200 year return	**minutes**	**Rainfall (mm)**		**C**	**i (mm/hr)**	**A (km^2)**	**(m^3/s)**	**Volume (m^3)**	**Discharge (m^3/ha)**	**Discharge (m^3)**	**Residual Volume (m^3)**
M200 5min	5	23.0	0.278	0.6	276	0.00000	0.000	0.0	5.4	0.0	0.0
M200 10min	10	32.1	0.278	0.6	192.6	0.00000	0.000	0.0	10.8	0.0	0.0
M200 15min	15	37.7	0.278	0.6	150.8	0.00000	0.000	0.0	16.1	0.0	0.0
M200 30min	30	46.3	0.278	0.6	92.6	0.00000	0.000	0.0	32.3	0.0	0.0
M200 60min	60	56.8	0.278	0.6	56.8	0.00000	0.000	0.0	64.5	0.0	0.0
M200 2hr	120	69.8	0.278	0.6	34.9	0.00000	0.000	0.0	129.1	0.0	0.0
M200 4hr	240	78.7	0.278	0.6	19.675	0.00000	0.000	0.0	258.2	0.0	0.0
M200 6hr	300	85.6	0.278	0.6	17.12	0.00000	0.000	0.0	387.3	0.0	0.0
M200 12hr	600	96.5	0.278	0.6	9.65	0.00000	0.000	0.0	774.6	0.0	0.0
M200 24hr	1200	108.8	0.278	0.6	5.44	0.00000	0.000	0.0	1549.1	0.0	0.0
M200 48hr	2400	118.5	0.278	0.6	2.9625	0.00000	0.000	0.0	3098.2	0.0	0.0

APPENDIX D

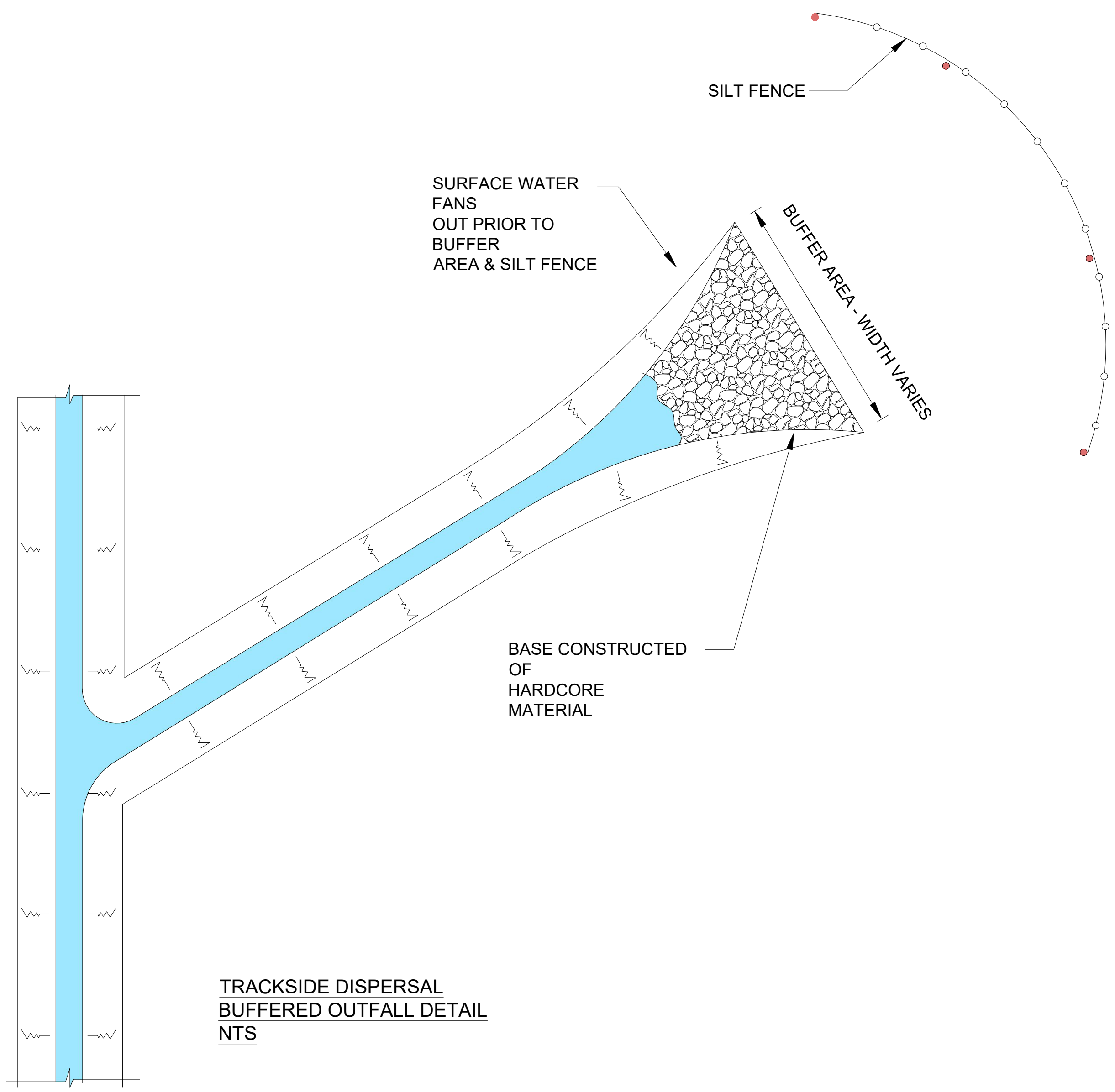
DRAINAGE DRAWINGS



TYPICAL 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.
   - PROPER MAINTENANCE PROVISIONS MUST BE PUT IN PLACE SO AS TO ENSURE THE PROPER FUNCTIONING OF THE DRAINAGE SYSTEM INCLUDING REGULAR INSPECTIONS, CLEANING AND REPAIRS WHERE NECESSARY.

3. DRAINS:
   - DRAINS SHALL BE DESIGNED AND CONSTRUCTED TO MITIGATE CHANNEL EROSION, E.G. BY INSTALLATION OF PERFORATED PIPE WITH DRAINAGE STONE SURROUND.
     DIVERTED RUNOFF FROM A DISTURBED AREA SHALL BE CONVEYED TO A SYSTEM OF STILLING PONDS AND BUFFERED OUTFALLS.
   - DIVERTED RUNOFF FROM AN UNDISTURBED AREA SHALL BE CONVEYED THROUGH A BUFFERED OUTFALL WITHIN AN UNDISTURBED STABILISED AREA AT NON-EROSIVE VELOCITIES.
   - 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.
   - STRAW BALES SHOULD, HOWEVER, ONLY BE USED TO INTERCEPT SEDIMENT-LADEN RUNOFF FROM ALL DRAINAGE AREAS OF DISTURBED SOIL.
   - BALES SHOULD BE ANCHORED IN PLACE BY THE USE OF TIMBER STAKES OR RE-BARS DRIVEN THROUGH THE BALE. WHERE BALES ARE TO BE PLACED IN POSITION ADJACENT TO OTHER BALES (EG WITHIN A STILLING POND), THE FIRST STAKE IN EACH BALE SHOULD BE DRIVEN TOWARDS THE PREVIOUSLY LAID BALE AT AN ANGLE. THIS HAS THE EFFECT OF FORCING THE TWO BALES TOGETHER.
   - BALES SHALL BE REPLACED AS REQUIRED
   - BALES SHALL BE REMOVED WHEN THEY HAVE SERVED THEIR USEFULNESS.

4. OUTFALLS:
   - ALL DRAINAGE CHANNELS SHALL FAN/TAPER OUT BEFORE ENTERING THE BUFFER ZONE. PRIOR TO ENTERING THE TAPERED ZONE, THE BASE OF THE DRAINAGE CHANNELS TO BE CONSTRUCTED OF A HARDCORE MATERIAL TO AID THE SETTLEMENT OF SUSPENDED SOLIDS.
   - NON-DEVELOPMENT RUN-OFF SHALL BE RETURNED TO A SURFACE FLOW CONDITION E.G. BY USE OF LEVEL SPREADERS.

5. STILLING PONDS:
   - ANY SEDIMENT TRAPS/STILLING PONDS SHALL BE LOCATED OUTSIDE OF BUFFER ZONES AND HAVE NO DIRECT OUTFLOW INTO WATERCOURSES.
   - STILLING PONDS SHOULD BE SIZED TO ACCOMMODATE PEAK FLOWS CORRESPONDING TO A 1 IN 100 YEAR STORM EVENT FOR THEIR RESPECTIVE CATCHMENT AREAS.
   - MAINTENANCE WORKS INCLUDING THE REMOVAL OF SETTLED MATERIALS SHOULD ONLY BE CARRIED OUT IN DRY CONDITIONS CARE SHOULD BE TAKEN WHEN REMOVING SETTLED MATERIALS SUCH THAT THE PONDS ARE NOT OVER DEEPENED.
   - IN THE DESIGN OF STILLING PONDS, CONSIDERATION SHOULD BE GIVEN TO IMPLEMENTING MEASURES SUCH THAT THERE IS NO POSSIBLILITY TO DIRECT FLOW THROUGH THE POND E.G. OFFSET INLETS AND OUTLETS FROM THE CENTRE AXIS ETC.

rev.	modifications	by	chkd	date

Client
Mercury Renewables (Carrowleagh) Limited

Project
Proposed Firlough Wind Farm, Carrowleagh, Bunnyconnellan, Co. Mayo & Proposed Hydrogen Plant, Carraun, Castleconner, Co. Sligo

Stage
Planning

Title
Drainage Details
Sheet 1 of 4

Scales
1:25 @ A3

Surveyed	Prepared By	Checked	Date
	A.McC.	S.M.	30-06-2023

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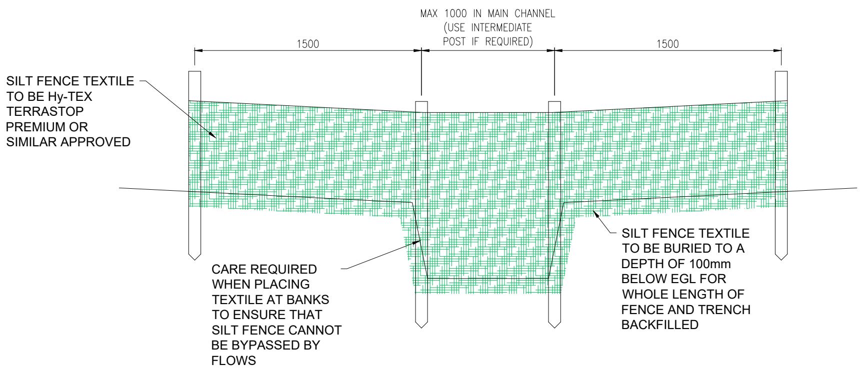
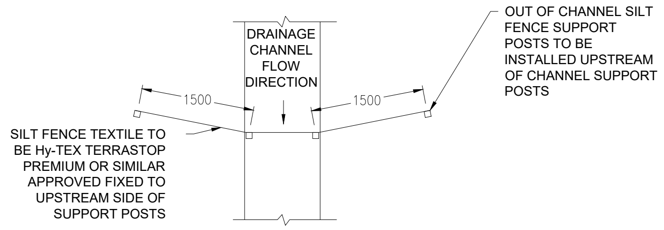
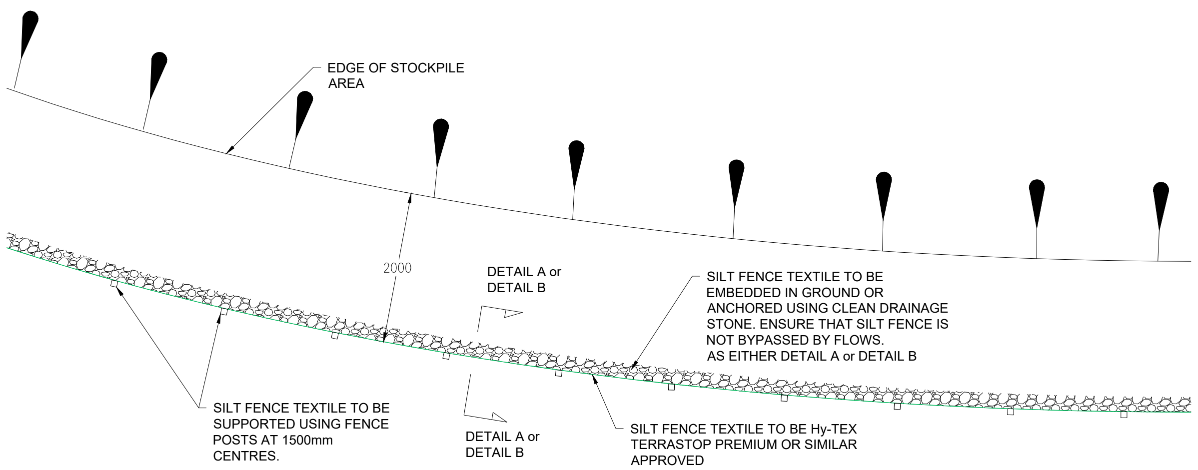
Job No.	Drawing no.	Figure no.	Revision
6129	6129-PL-301	2.11	



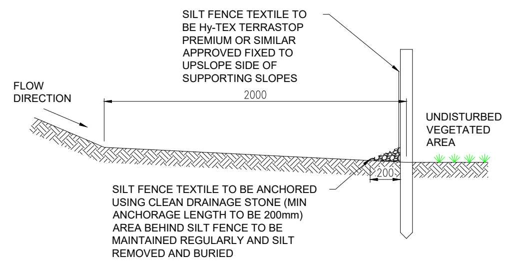
TYPICAL ELEVATION ON SILT FENCE AT DRAINAGE CHANNEL
SCALE 1:50



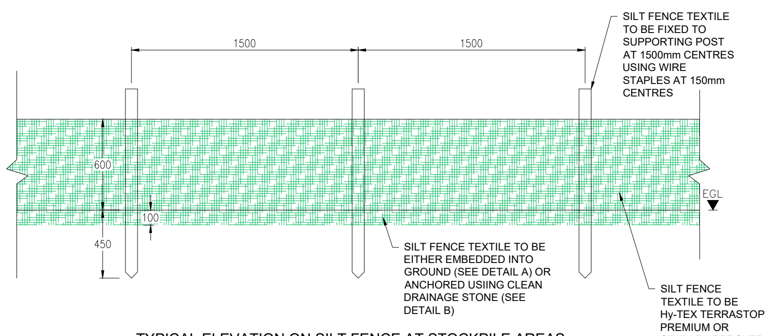
TYPICAL PLAN ON SILT FENCE AT DRAINAGE CHANNEL
SCALE 1:100



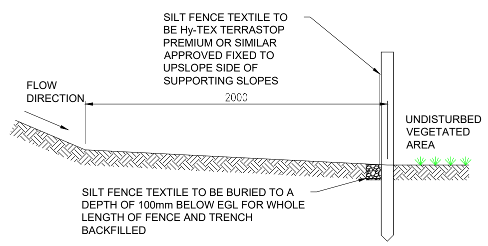
TYPICAL PLAN ON SILT FENCE AT STOCKPILE AREAS
SCALE 1:100



DETAIL A
SCALE 1:50



TYPICAL 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 50m.

2. CONSTRUCTION AND MAINTENANCE
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   - DRAINS ON THE UPPER SIDE OF THE ROAD MAY NEED CULVERTS TO THE LOWER SIDE.
   - PROPER MAINTENANCE PROVISIONS MUST BE PUT IN PLACE SO AS TO ENSURE THE PROPER FUNCTIONING OF THE DRAINAGE SYSTEM INCLUDING REGULAR INSPECTIONS, CLEANING AND REPAIRS WHERE NECESSARY.

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     DIVERTED RUNOFF FROM A DISTURBED AREA SHALL BE CONVEYED TO A SYSTEM OF STILLING PONDS AND BUFFERED OUTFALLS.
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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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   - STILLING PONDS SHOULD BE SIZED TO ACCOMMODATE PEAK FLOWS CORRESPONDING TO A 1 IN 100 YEAR STORM EVENT FOR THEIR RESPECTIVE CATCHMENT AREAS.
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rev.	modifications	by	chkd	date

Client
Mercury Renewables (Carrowleagh) Limited

Project
Proposed Firlough Wind Farm, Carrowleagh, Bunnyconnellan, Co. Mayo & Proposed Hydrogen Plant, Carraun, Castleconner, Co. Sligo

Stage
Planning

Title
Drainage Details Sheet 2 of 4

Scales
1:50 & 1:100 @ A3

Surveyed	Prepared By	Checked	Date
	A.McC.	S.M.	30-06-2023

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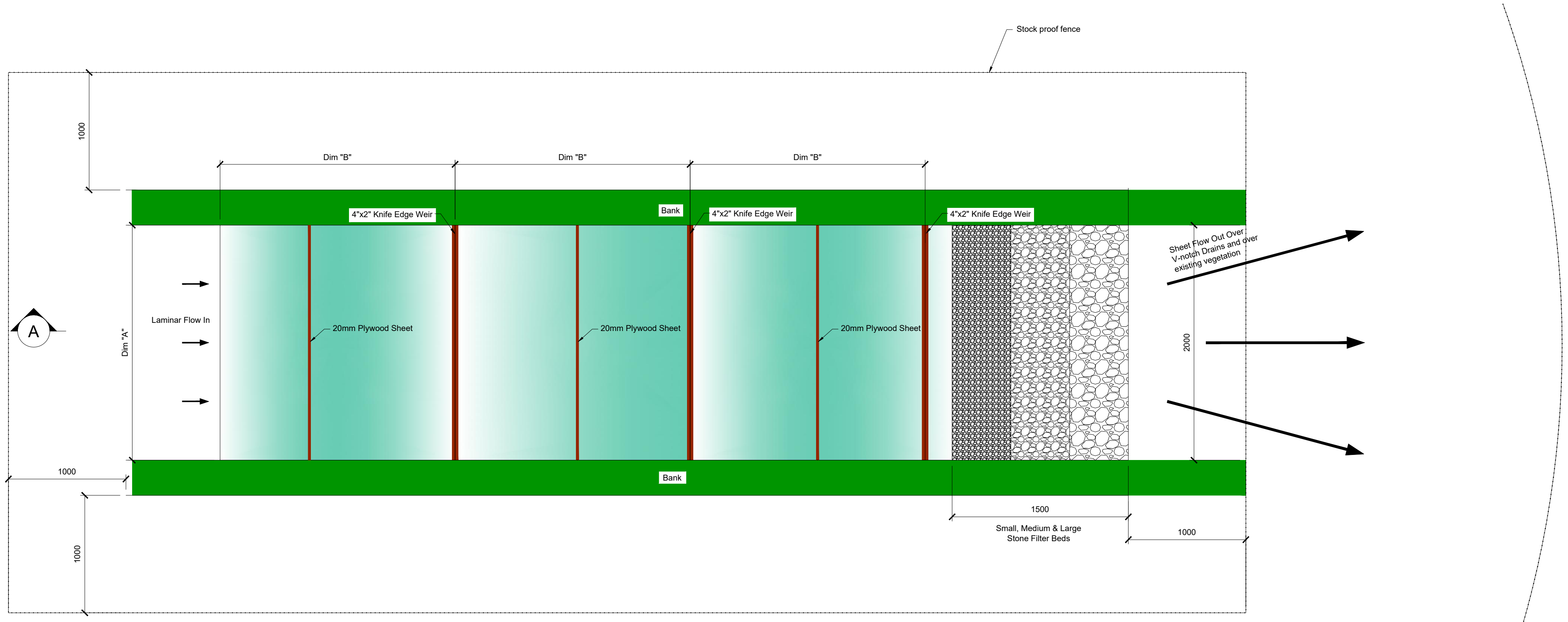
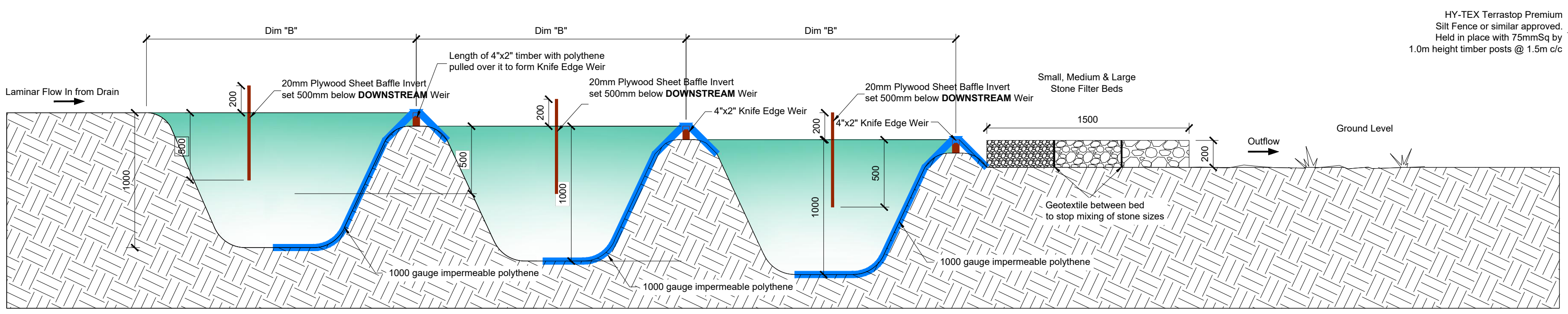
Job No.	Drawing no.	Figure no.	Revision
6129	6129-PL-302	2.12	

Note:
Please refer to EIAR Appendix 2.1, Management Plan 3: Surface Water Management Plan for the details of each proposed stilling pond.



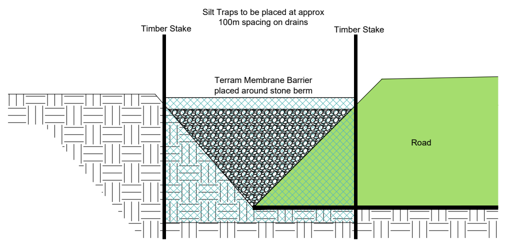
PLAN VIEW OF SETTLEMENT PONDS (WITH DISCHARGE TO DRAINS WHERE APPLICABLE)

SCALE: 1:50



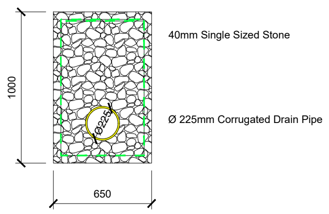
SECTION

SCALE: 1:50



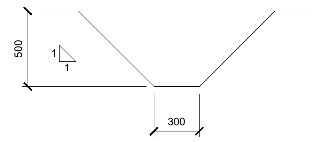
SEDIMENT FENCE DETAIL

SCALE: 1:50



PERMANENT PERIPHERAL LAND DRAIN

SCALE: 1:50



TEMPORARY "V" DITCH DRAIN PROFILE

SCALE: 1:50

COMPLETED SETTLEMENT POND SYSTEM

SCALE: NTS

rev.	modifications	by	chkd	date

Client: Mercury Renewables (Carrowleagh) Limited

Project: Proposed Firlough Wind Farm, Carrowleagh, Bunnyconnellan, Co. Mayo & Proposed Hydrogen Plant, Carraun, Castleconner, Co. Sligo

Stage: Planning

Title: Drainage Details Sheet 3 of 4

Scales: 1:50 @ A3

Surveyed	Prepared By	Checked	Date
	A.McC.	S.M.	30-06-2023

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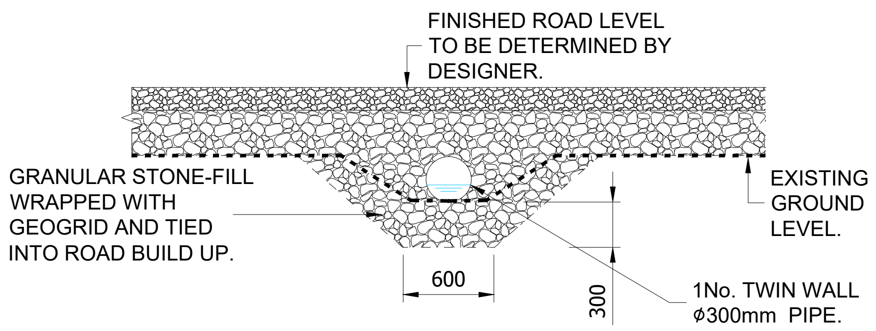
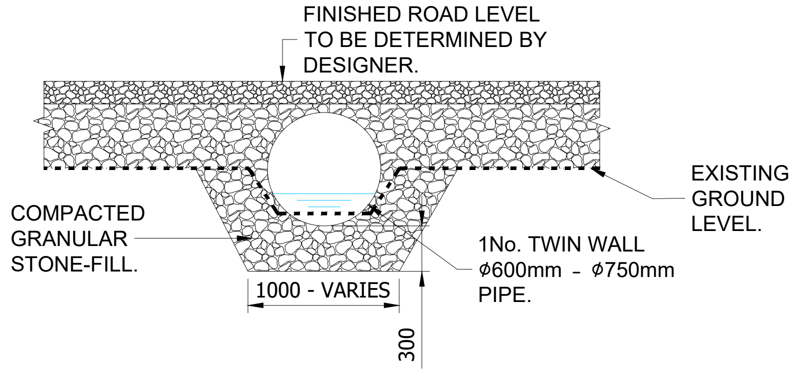
Job No.	Drawing no.	Figure no.	Revision
6129	6129-PL-303	2.13	



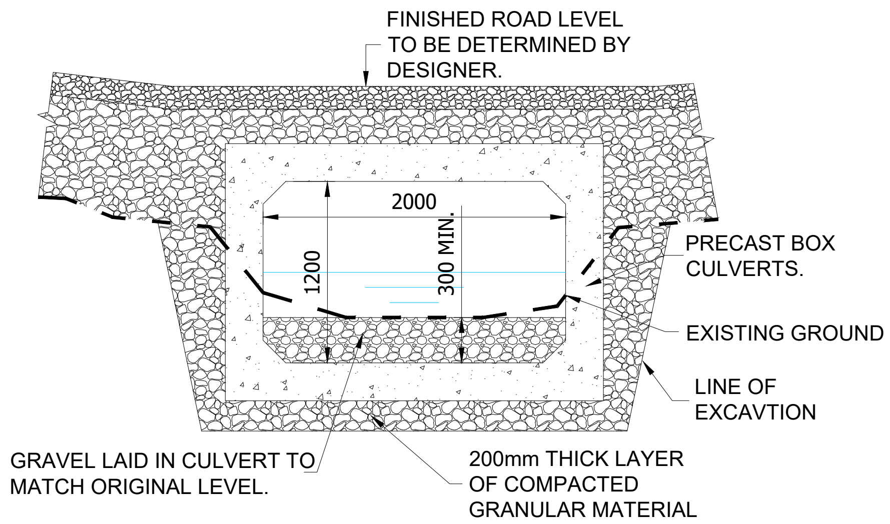
TYPE 1 CULVERT

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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Client
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Stage
Planning

Title
Drainage Details
Sheet 4 of 4

Scales
1:50 @ A3

Surveyed	Prepared By	Checked	Date
	A.McC.	S.M.	30-06-2023

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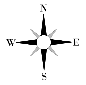
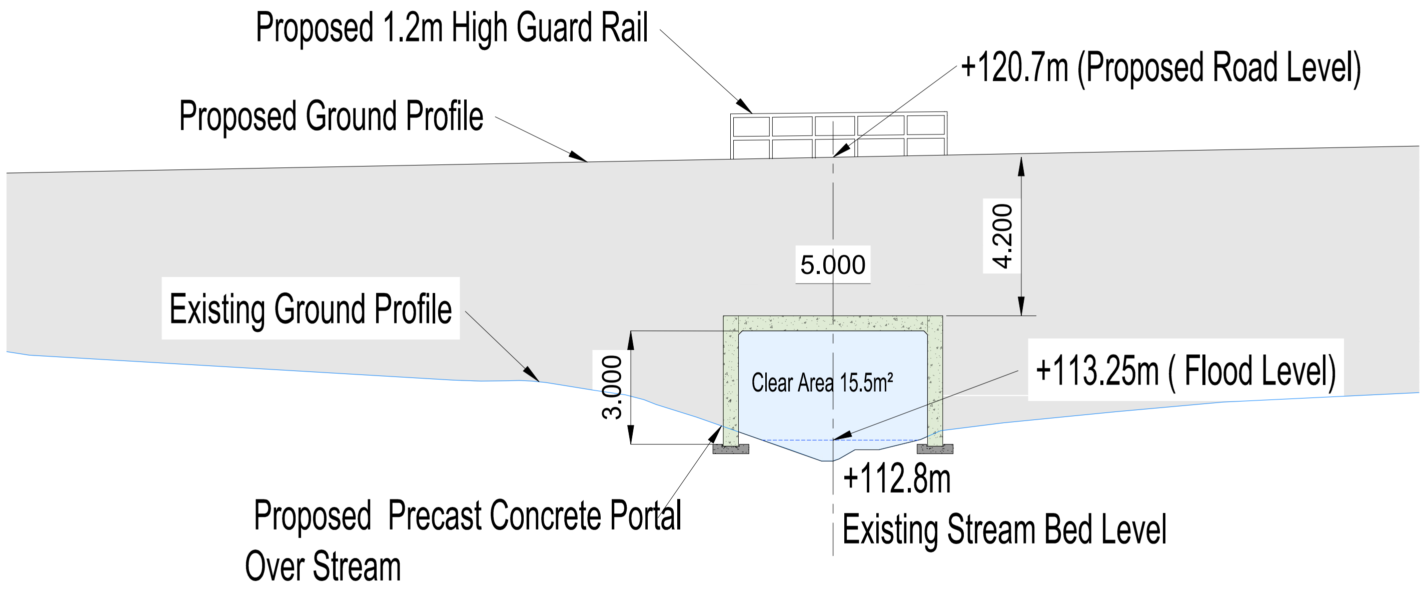
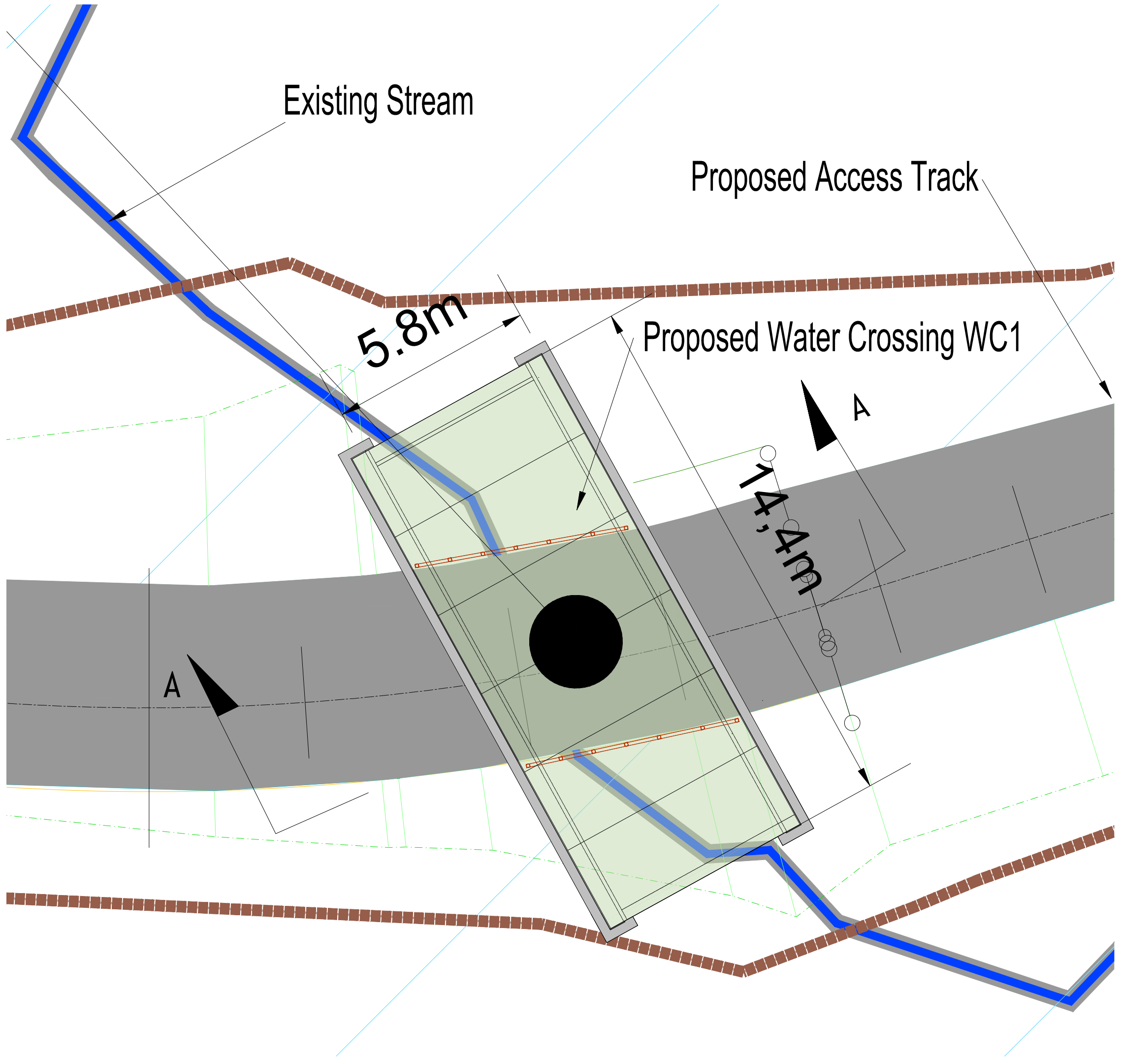
Job No.	Drawing no.	Figure no.	Revision
6129	6129-PL-304	2.14	



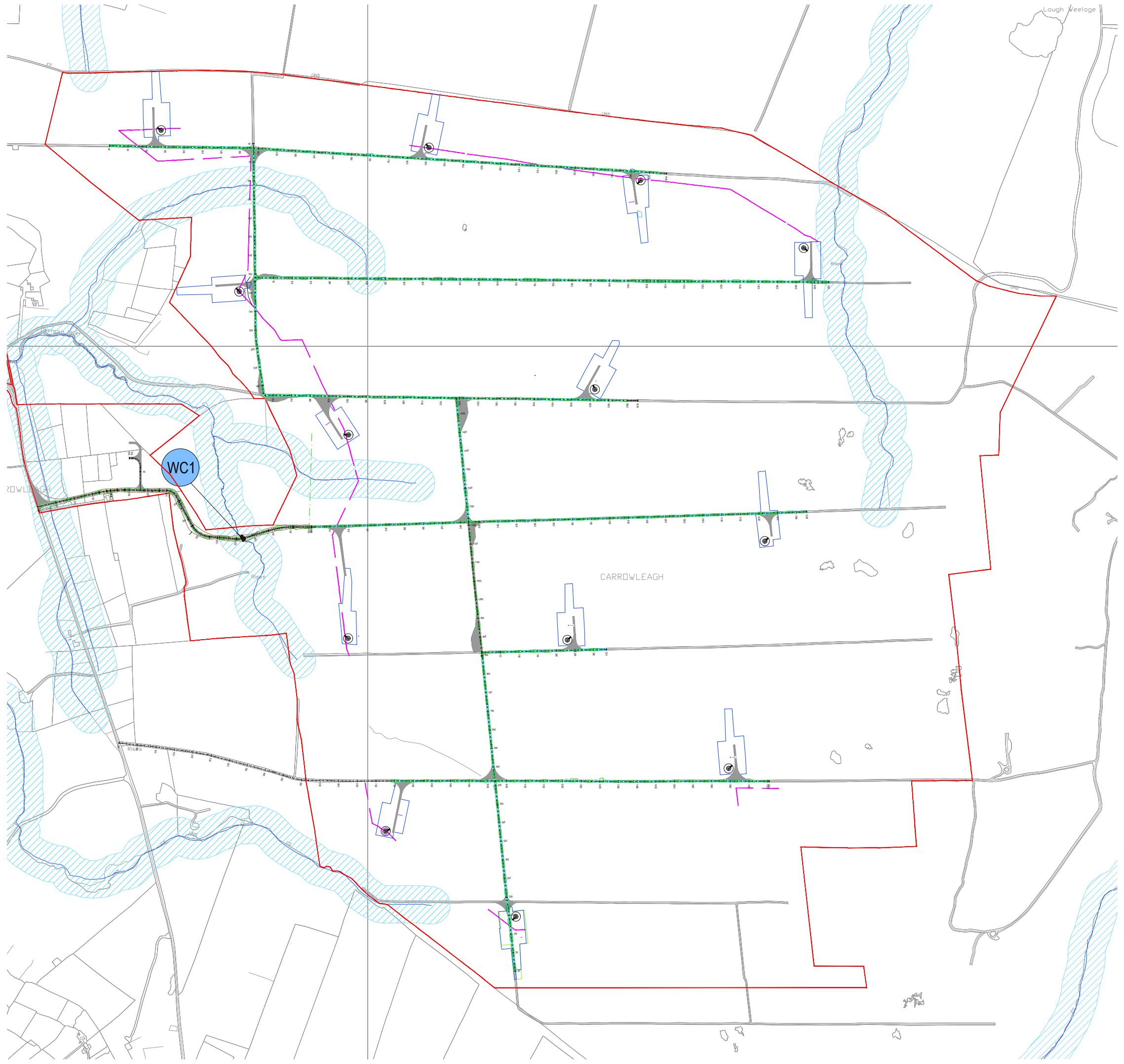
PHOTOGRAPH OF EXISTING WATERCOURSE



SECTION A - A THROUGH PROPOSED
WATERCOURSE CROSSING WC 1 Scale 1:200



PLAN : WATERCOURSE CROSSING WC 1
Scale 1:200

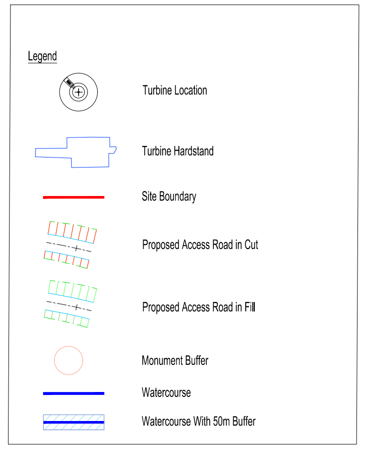


LOCATION PLAN : WATERCOURSE CROSSING WC 1
Scale 1:20,000

OSI License No. CYAL50313915

NOTES:

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



rev.	modifications	by	date

Client
Mercury Renewables (Carrowleagh) Limited

Project
Propsoed Firlough Wind Farm, Carrowleagh, Bunnyconnellan, Co. Mayo & Proposed Hydrogen Plant, Carraun, Castleconner, Co. Sligo

Stage
Planning

Title
Proposed Watercourse Crossing WC1

Scales
1:200 & 1:20,000 @ A3

Surveyed	Prepared By	Checked	Date
	J.D.	S.M.	01.07.2023

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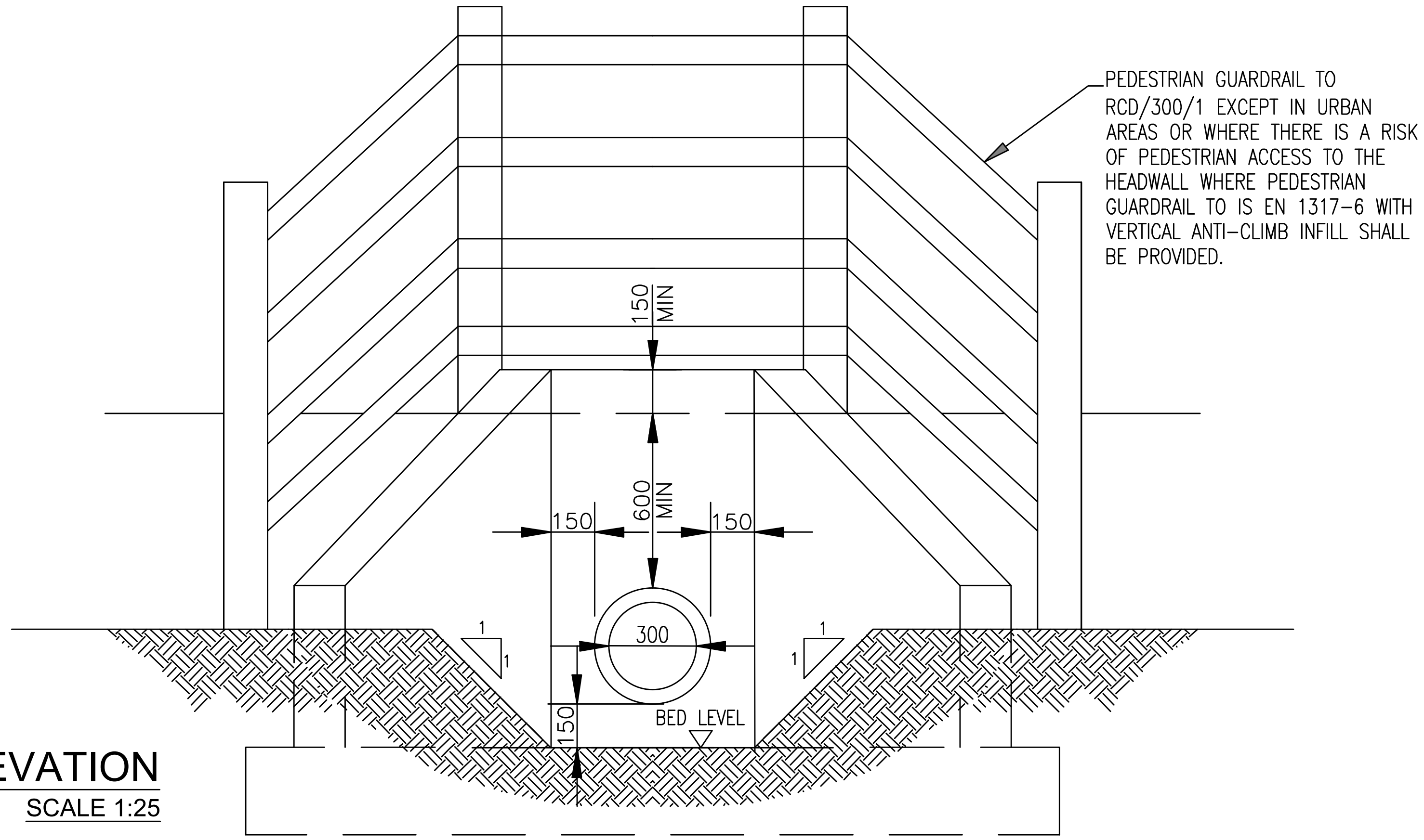
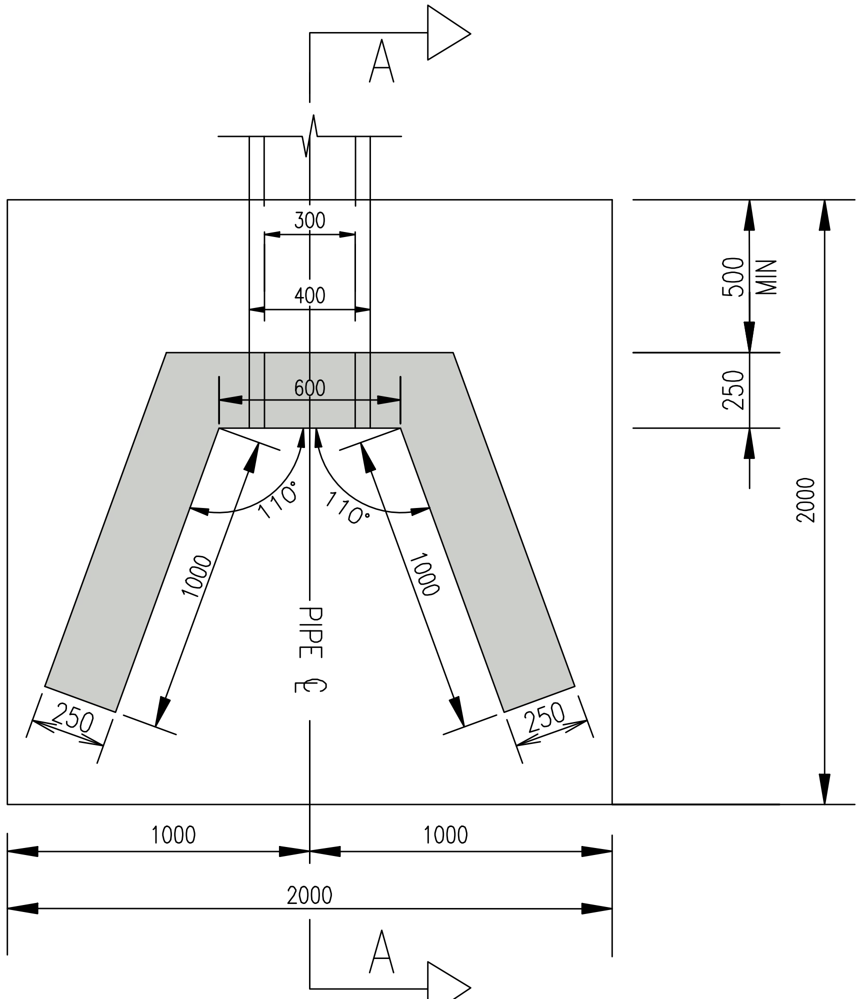
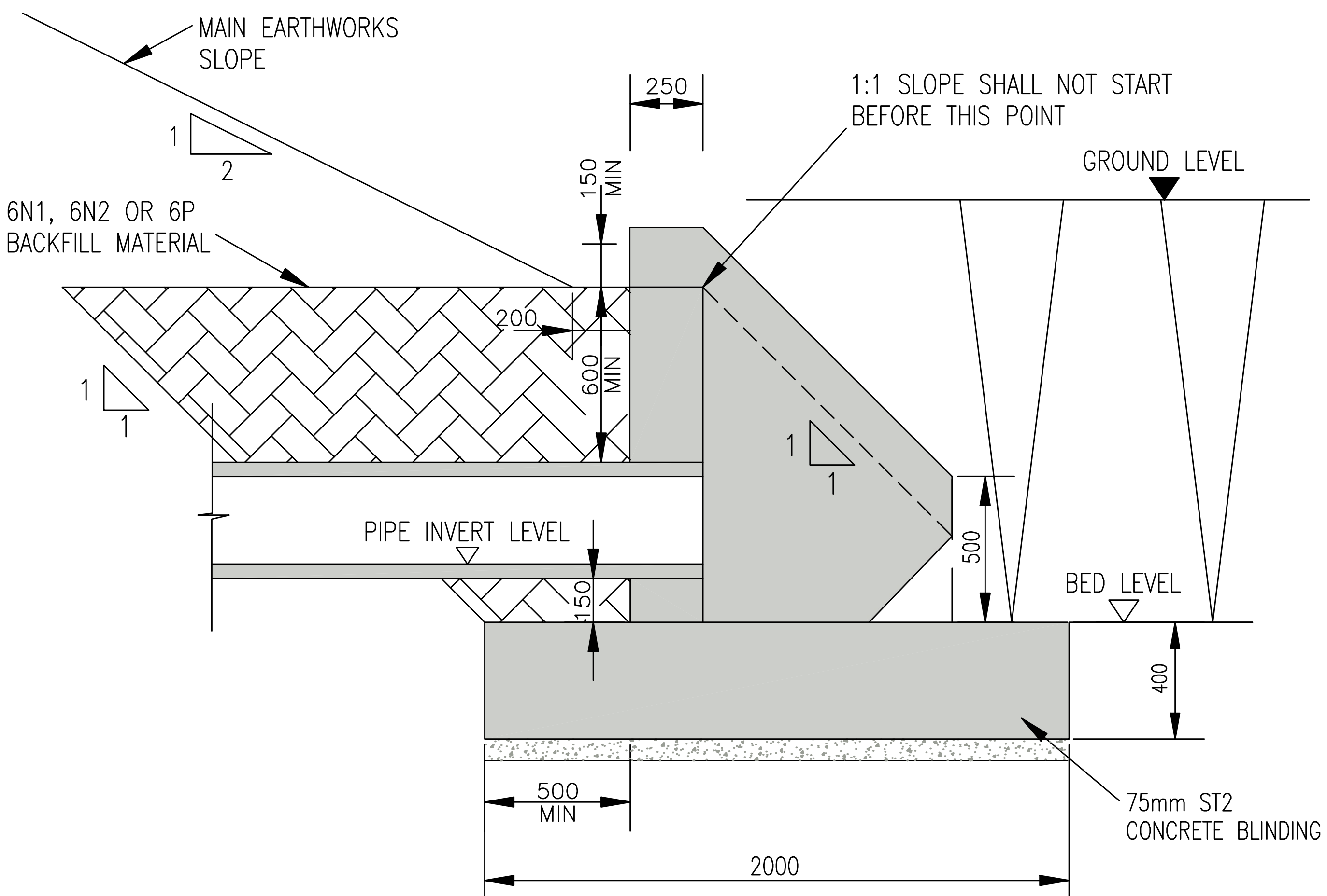
Job No.	Drawing no.	Revision
6129	6129-PL-305	



ELEVATION
SCALE 1:25



PLAN
SCALE 1:25



SECTION A-A
SCALE 1:25

NOTES :

1. ALL DIMENSIONS ARE MILLIMETRES.
2. THIS RCD IS ONLY TO BE USED IN ASSOCIATION WITH A UNIQUE STRUCTURAL DESIGN. THIS DESIGN IS TO CARRIED OUT IN ACCORDANCE WITH THE NRA REQUIREMENTS FOR THE USE OF EUROCODES FOR THE DESIGN OF ROAD STRUCTURES.
3. REINFORCED CONCRETE SHALL BE A MINIMUM GRADE OF C32/40. ALL STRUCTURAL CONCRETE SHALL BE SPECIFIED IN ACCORDANCE WITH SERIES 1700 OF THE NRA MCDRW.
4. ALL BLINDING CONCRETE SHALL BE ST2 IN ACCORDANCE WITH IS EN 206.
5. THE MINIMUM COVER TO REINFORCEMENT FOR DURABILITY SHALL BE IN ACCORDANCE WITH NRA BD 57. MINIMUM EXPOSURE CLASS TO BE XC4.
6. ANY RESULTING VOID BETWEEN THE OUTSIDE OF THE PIPE AND THE OPE IN THE HEADWALL SHALL BE FILLED WITH NON-COMPRESSIBLE HIGH STRENGTH GROUT.
7. ALL EXPOSED CONCRETE SURFACES FROM 100mm BELOW GROUND LEVEL TO BE CLASS U4/F4 FINISH. ALL OTHER CONCRETE SURFACES TO BE CLASS U1/F1 FINISH UNLESS OTHERWISE SPECIFIED.
8. HEADWALL WINGWALLS TO BE SLOPED AND SHALL MAINTAIN A MINIMUM HEIGHT OF 150mm ABOVE ADJACENT BACKFILL LEVEL.
9. RENDERED CONCRETE BLOCKWORK MAY BE USED AS AN ALTERNATIVE TO IN-SITU OR PRECAST CONCRETE FOR PIPES UP TO 300mm INNER DIAMETER.
10. ALL HEADWALLS SHALL BE BACKFILLED WITH CLASS 6N1, 6N2 OR 6P BACKFILL MATERIAL. HEADWALLS SHALL BE FOUNDED ON A MINIMUM 75mm LAYER OF ST2 BLINDING CONCRETE. DETAILS OF THE SUB-BASE LAYER TO BE CONFIRMED BASED ON SITE CONDITIONS.
11. ROCK ARMOUR AND/OR GABION HEADWALLS AND WINGWALLS ARE PROHIBITED.

- ANGLE BETWEEN HEADWALL AND WINGWALL IS 110°;
- BACKFILL MATERIAL IS FREE DRAINING;
- THERE ARE NO LIVE LOAD EFFECTS ON THE HEADWALL;
- CHARACTERISTIC VALUE OF INTERNAL FRICTION (ϕ) OF THE BACKFILL MATERIAL = 37.5°;
- 600mm COVER TO THE PIPE AT THE REAR OF THE HEADWALL, WITH A 200mm WIDE FLAT AREA BEFORE COMMENCEMENT OF THE MAIN EARTHWORKS SLOPE;
- SLOPE OF FILL MEASURED FROM THE REAR FACE OF THE WINGWALLS DOWNWARDS AND FROM BED LEVEL UPWARDS ARE BOTH TO BE 1:1

rev.	modifications	by	date

Client
Mercury Renewables (Carrowleagh) Limited

Project
Proposed Firlough Wind Farm, Carrowleagh, Bunnyconnellan, Co. Mayo & Proposed Hydrogen Plant, Carraun, Castleconner, Co. Sligo

Stage
Planning

Title
Formed Headwall Details
300mm Diameter Pipe

Scales
1:25 @ A3

Surveyed	Prepared By	Checked	Date
	R.M.	S.M.	30-06-2023

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Job No.	Drawing no.	Revision
6129	6129-PL-306	

MERCURY RENEWABLES (CARROWLEAGH) LIMITED

FIRLOUGH WIND FARM, CO. MAYO

AND

HYDROGEN PLANT, CO. SLIGO

CONSTUCTION ENVIRONMENTAL MANAGEMENT PLAN (CEMP)

MANAGEMENT PLAN 4

PEAT AND SPOIL MANAGEMENT PLAN

JUNE 2023

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DOCUMENT APPROVAL

PROJECT	Firlough Wind Farm and Hydrogen Plant	
CLIENT / JOB NO	Mercury Renewables (Carrowleagh) Limited	6129
DOCUMENT TITLE	Construction Environmental Management Plan (CEMP) Peat and Spoil Management Plan	

	Prepared by	**Reviewed/Approved by**
Document Final	Name Sarah Moore Aileen Byrne	Name David Kiely
Date June 2023	Signature Sarah Moore Aileen Byrne	Signature David Kiely

MANAGEMENT PLAN 4: PEAT AND SPOIL MANAGEMENT PLAN

CONTENTS

1 INTRODUCTION

1.1 General

The plan provides an assessment of the issue of handling surplus excavated material at the proposed Firlough Wind Farm and Hydrogen Plant 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

Minerex Environmental Ltd has been commissioned by Jennings O'Donovan & Partners on behalf of Mercury Renewables (Carrowleagh) Limited (the Developer) to assess the geological site characteristics in relation to the planning application for Firlough Wind Farm and Hydrogen Plant (the Proposed Development), Co. Mayo and Co. Sligo. The Site Investigations Report assesses ground conditions in terms of peat and slope stability risk, subsoil and geological characterisation and classification.

The Site Investigations works were completed between May and December 2021 as well as December 2022 of which the scope of works included:

- Bedrock and mineral subsoil outcrop logging and characterisation.
- Confirm if peat is present at or near any Proposed Development locations.
- Peat depth probing if peat is present (depth to bedrock and/or competent subsoil).
- Gouge coring if peat is present (peat and subsoil characterisation to BS 5930 and Von Post Humification scale.
- Trial holes in mineral soil to validate desk study findings.
- Boreholes in bedrock to validate to desk study findings.
- Slope measurements at proposed turbine locations to determine slope gradient.
- Recording of GPS co-ordinates for all investigation and monitoring points in the study.
- Digital photography of significant features.

1.3 General Aims and Principals of the Peat and Spoil Management Plan

The purpose of this Peat and Spoil Management Plan is:

- safety in relation to potential peat 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 Proposed 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 hydrogen plant infrastructure will be used to finish reinstated surfaces around the hydrogen plant. 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 sub-soil material will be used as fill material where suitable (e.g., back filling around and on top of Turbine Foundations) with any other sub-soil material to form berms around the turbine foundations.
- Excavated topsoil will be used to vegetate around the hydrogen plant infrastructure.
- All surplus peat material will be deposited in designated peat storage deposition areas.

1.4 Management of Excavated Material

The excavated peat material will be stored in designated spoil deposition areas as shown on drawing 6129-PL-100 There are 3 areas designated for peat storage. During excavation works peat will be deposited in the peat storage are closest to the works. Material excavated 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.

Temporary storage areas identified and outline in **Management Plan 4 Peat Spoil Management Plan,** will also acknowledge and avoid associated constraints presented in **Figure 3.1 (EIAR Figure 8.8b),** avoiding buffer zones of sensitive receptors, i.e. T4 and T13.

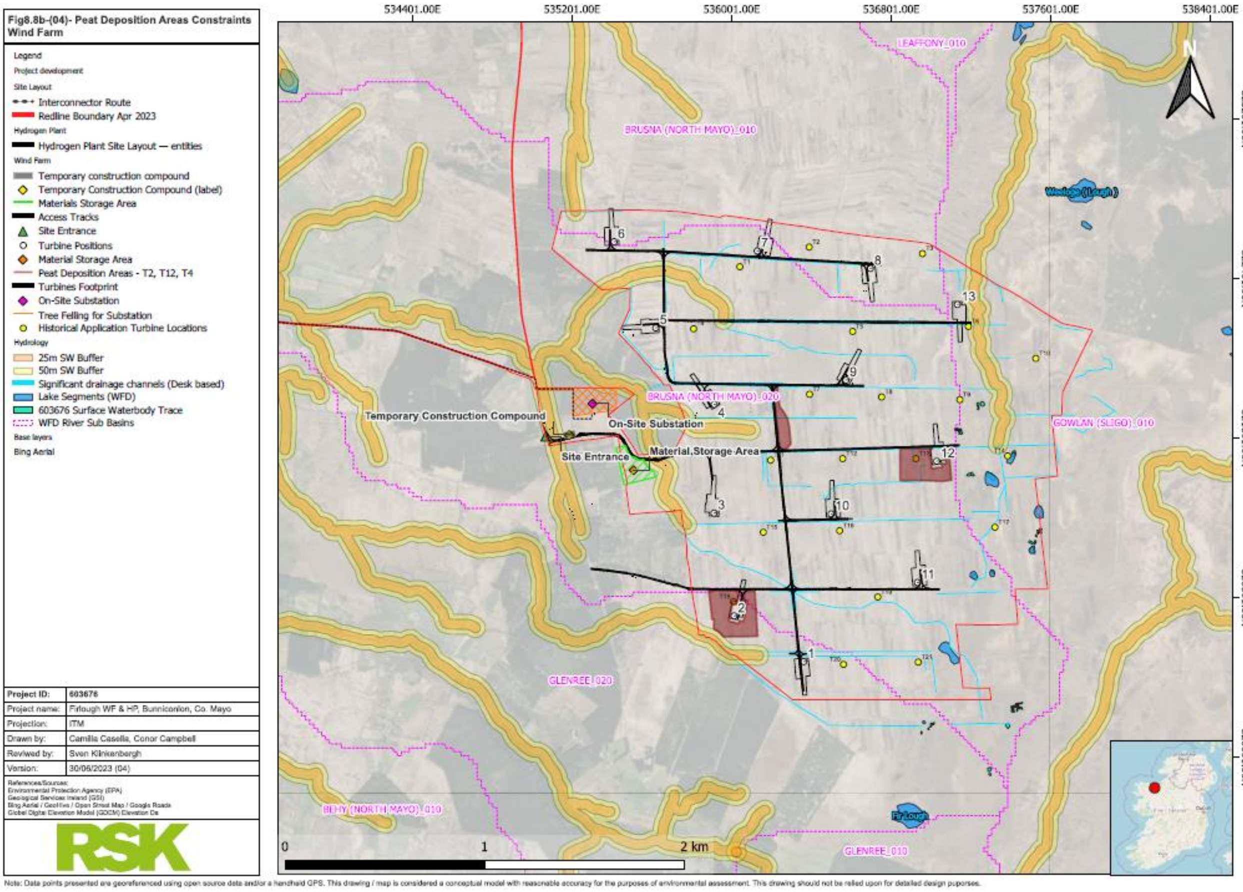

Figure 3.1 Spoil Deposition Areas and Site Constraints (EIAR Figure 8.8b)

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.

Peat material excavated will be reused as backfill in areas previously excavated and/or for reinstatement works elsewhere on the Site. To facilitate this the acrotelm (living layer) and the catotelm (lower layer) will be treated as two separate materials. Catotelm peat will be used to backfill, for example, around Turbine Foundation pads once established. Acrotelm peat will be used as a dressing on top of deposited catotelm peat in order to promote and re-establish flora and ensure the acrotelm layer becomes relatively cohesive in terms of localised peat stability (vegetated) and also reduces sediment release.

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 Wind Farm Site has an area of approximately 445 hectares and is mainly cutover blanket bog with an extensive network of bog tracks, which were laid out in the 1930's to provide access to turf cutting plots. Almost the entire Wind Farm Site is subdivided into turbary plots lying primarily on a north-south axis between the east-west alignments of the road network. There are over 620 individual plots each measuring 50m x 180m. There is a network of bog roads on the Site, laid out in the 1930's, to provide access for turf cutting plots. There are a number of small gravel borrow pits on and in the immediate vicinity of the Wind Farm Site, these were used to source material for the construction of the bog roads. Continual turf extraction on the Wind Farm Site has meant that deep drains and heavily truncated areas of peat are common.

The Hydrogen Plant Site has an area of approximately 6.5 ha and is currently an agricultural field used for grazing horses. It is located in County Sligo in the townland of Carraun, adjacent to the Co. Mayo border, 6km west of the Wind Farm Site and 0.6km from the N59 national road. Site elevations range from 53m OD at the north-west corner to 45m OD along the southern boundary.

Geotechnical drawings prepared by Minerex Environmental Limited were used in conjunction with the peat depth probes and geotechnical trial pit logs to calculate the spoil volumes generated by the Proposed Development. The excavation volumes associated with the Wind Farm Site are outlined in **Tables 2.1** to **2.6** and the excavation volumes for the Hydrogen Plant Site are detailed in **Table 2.7**.

2.1 Road Construction

There are 8,772m of existing roads on Site that will be upgraded and extended from 3m to 4.5m. There will be 1,323m of new road within the Wind Farm Site and 785m of new road within the Hydrogen Plant Site constructed to a width of 4.5m as the minimum useful road width required for delivery of turbine components is 4.5m. **Table 2.1a** to **2.1d** and **Table 2.7** tabulates the volumes of topsoil and sub-soil to be excavated for the Wind Farm Site and Hydrogen Plant Site access roads respectively.

Table 2.1a Estimated Excavation Volumes for New Site Access Road Construction

Road Section	Road Length (m)	Road Width (m)	Road Area (m^2)	Nominal Road Depth (m)	Worst Case Peat Depth (m)	Road Volume of Subsoil to be Extracted (m^3)	Road Volume of Peat to be Extracted (m^3)	Total Volume to be Extracted (m^3)
Road length from Kilbride Road (Substation)(Hydrogen Plant) to T3	800	4.5	3,600.00	0.6	0.83	0	2,970	2,970
Road linking road south of T3.T10 to north of T3/T10	345	4.5	1552.50	0.6	3.00	0	4,658	4,658
Road to Substation	178	5.5	979	0.6	0.83	0	813	813
Totals	**1,323**					**0**	**8,292**	**8,292**

Table 2.1b Estimated Excavation Volumes for Existing Site Access Road Construction

Road Section	Road Length (m)	Road Width (m)	Road Area (m^2)	Nominal Road Depth (m)	Worst Case Peat Depth (m)	Road Volume of Subsoil to be Extracted (m^3)	Road Volume of Peat to be Extracted (m^3)	Total Volume to be Extracted (m^3)
T6, T7, T8 East to West	1,482	1.5	2,223	0.6	2.50	0	5,558	5,558
T5, T13 East to West	1,537	1.5	2,306	0.6	1.00	0	2,306	2,306
T4, T9 East to West	975	1.5	1,463	0.6	2.50	0	3,656	3,656
T3, T12 East to West	1,328	1.5	1,992	0.6	2.00	0	3,984	3,984
T10 East to West	334	1.5	501	0.6	2.00	0	1,002	1,002
T2, T11 East to West	1,075	1.5	1,613	0.6	1.90	0	3,064	3,064
T1 to T10 South to North	694	1.5	1,041	0.6	1.10	0	1,145	1,145
North to South, East of T3 to T4	684	1.5	1,026	0.6	2.90	0	2,975	2,975
T4 to T6, passing T5. North to South	663	1.5	995	0.6	1.60	0	1,591	1,591
Totals	**8,772**					**0**	**25,281**	**25,281**

Table 2.1c Estimated Excavation Volumes for Road Junctions

Road Section	Road Length (m)	Road Width (m)	Road Area (m^2)	Nominal Road Depth (m)	Worst Case Peat Depth (m)	Road Volume of Subsoil to be Extracted (m^3)	Road Volume of Peat to be Extracted (m^3)	Total Volume to be Extracted (m^3)
Crossroad T1 / T2 / T13	-	-	891	0.6	0.6	0	535	535
Crossroad T10	-	-	1,337	0.6	0.6	0	802	802
Crossroad T3 / T12	-	-	1,293	0.6	0.6	0	776	776
Crossroad T4 / T9	-	-	1,681	0.6	0.6	0	1,009	1,009
Site Entrance	-	-	820	0.6	0.6	0	492	492
T4 Corner	-	-	1,451	0.6	0.6	0	871	871
T5	-	-	820	0.6	0.6	0	492	492
Crossroad T6 / T7	**-**	**-**	912	0.6	0.6	0	547	547
SS	-	-	312	0.6	0.6	0	187	187
Totals						**0**	**5,711**	**5,711**

Table 2.1d Estimated Excavation Volumes for Road Junctions – Hardstand Splays

Road Section	Road Length (m)	Road Width (m)	Road Area (m^2)	Nominal Road Depth (m)	Worst Case Peat Depth (m)	Road Volume of Subsoil to be Extracted (m^3)	Road Volume of Peat to be Extracted (m^3)	Total Volume to be Extracted (m^3)
T1	-	-	614	0.6	0.60	0	368	368
T2	-	-	531	0.6	0.60	0	318	318
T3	-	-	1,166	0.6	0.60	0	700	700
T4	-	-	834	0.6	0.60	0	501	501
T5	-	-	311	0.6	0.60	0	186	186
T6	-	-	460	0.6	0.60	0	276	276
T7	-	-	237	0.6	0.60	0	142	142

Road Section	Road Length (m)	Road Width (m)	Road Area (m^2)	Nominal Road Depth (m)	Worst Case Peat Depth (m)	Road Volume of Subsoil to be Extracted (m^3)	Road Volume of Peat to be Extracted (m^3)	Total Volume to be Extracted (m^3)
T8	-	-	193	0.6	0.60	0	116	116
T9	-	-	330	0.6	0.60	0	198	198
T10	-	-	250	0.6	0.60	0	150	150
T11	-	-	424	0.6	0.60	0	254	254
T13	-	-	107	0.6	0.60	0	64	64
Totals						**0**	**3,273**	**3,273**

Peat Probe data is available from site the investigation work carried out on site. Worst-case peat depth from this data was calculated for each section of road. Excavation for roads is required to 0.6m only. From this, the volume of peat, soil and rock to be extracted was extrapolated and can be seen in **Table 2.1 and Table 2.2**.

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 Turbine Foundations will be 25.5m. Each Turbine Foundation excavation will be 3.30m deep. **Table 2.2** provides a breakdown of the estimated total excavation volume for the Turbine Foundations.

Table 2.2 Estimated Excavation Volumes for WTG Foundations (25.5m Diameter)

Turbine No.	Turbine Foundations (25.5m Diameter) Area (m^2)	Turbine Foundations Depth (m)	Turbine Foundations Volume (m3)	Worst-Case Peat Depth (m)	Turbine Foundations Volume of Subsoil to be Extracted (m^3)	Turbine Foundations Volume of Peat to be Extracted (m^3)	Total Volume to be Extracted (m^3)
T1	511	3.30	1,686	1.20	1,073	613	1,686
T2	511	3.30	1,686	0.50	1,431	256	1,686
T3	511	3.30	1,686	3.00	153	1,533	1,686
T4	511	3.30	1,686	2.50	409	1,278	1,686
T5	511	3.30	1,686	0.60	1,380	307	1,686
T6	511	3.30	1,686	1.60	869	818	1,686
T7	511	3.30	1,686	2.50	409	1,278	1,686
T8	511	3.30	1,686	0.40	1,482	204	1,686
T9	511	3.30	1,686	3.00	153	1,533	1,686
T10	511	3.30	1,686	0.60	1,380	307	1,686
T11	511	3.30	1,686	1.90	715	971	1,686
T12	511	3.30	1,686	1.50	920	767	1,686
T13	511	3.30	1,686	1.50	920	767	1,686
Totals					**11,293**	**10,629**	**21,922**

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 3,600m². **Table 2.3** provides a breakdown of the estimated total excavation volume for the Turbine Hardstands.

Table 2.3 Estimated Excavation Volumes from Turbine Hardstands

Hardstand No	Hardstand Area (m^2)	Worst-Case Peat Depth (m)	Nominal Hardstand Depth (m)	Hardstand Volume of Subsoil to be Extracted (m^3)	Hardstand Volume of Peat to be Extracted (m^3)	Total Volume to be Extracted (m^3)
T1	3,600	1.20	0.6	0	4,320	4,320
T2	3,600	0.50	0.6	360	1,800	2,160
T3	3,600	3.00	0.6	0	10,800	10,800
T4	3,600	2.50	0.6	0	9,000	9,000
T5	3,600	0.60	0.6	0	2,160	2,160
T6	3,600	1.60	0.6	0	5,760	5,760
T7	3,600	2.50	0.6	0	9,000	9,000
T8	3,600	0.40	0.6	720	1,440	2,160
T9	3,600	3.00	0.6	0	10,800	10,800
T10	3,600	0.60	0.6	0	2,160	2,160
T11	3,600	1.90	0.6	0	6,840	6,840
T12	3,600	1.50	0.6	0	5,400	5,400
T13	3,600	1.50	0.6	0	5,400	5,400
Total				**1,080**	**74,880**	**75,960**

2.4 Electrical Sub-Station and Site Compound

Table 2.4 Estimated Excavation Volumes for Sub-Station, Site Compound and Material Storage Area

Infrastructure	Area (m^2)	Depth to Formation (m)	Average Peat Depth (m)	Total Excavation (m^3)	Total Peat (m^3)	Total Soil (m^3)	Total Rock (m^3)
Electrical Substation	13,892	0.6	0.2	8,335	2,778	5,557	0
Site Compound	1,800	0.6	0.2	1,080	360	720	0
Material Storage Area	16,665	0.6	0.2	9,999	3,333	6,666	0
Total					**6,471**	**12,943**	**0**

2.5 Internal Cabling and Grid Connection

The overall Length of the Grid Connection between the Firlough Wind Farm Site substation and the existing Glenree – Moy 110kV overhead line (OHL) is 6.65km, of which 0.25km is within the Wind Farm Site, 5.95km is located along the public road corridor and the remaining 0.45km is located off road in third party lands.

The cable network will be installed in trenches approximately 0.6m wide by 1.315m in depth. There will be 16 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. 700m intervals. 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 2.5** provides a breakdown of the estimated total excavation volume for the Grid Connection.

Table 2.5 Estimated Excavation Volume from Grid Connection

Description	Length (m)	Width (m)	Depth (m)	No.	Area (m^2)	Peat Depth (m)	Volume of Peat Extraction (m^3)	Volume of Soil Extraction (m^3)	Volume of Rock Extraction (m^3)
Internal Cabling	13,000	0.45	1.0	1.0	5,850	1.50	5,850	0	0
110kV Cable Trench	6,650	0.6	1.315	2	7,980	0	0	10,494	0
Joint Bays	6	2.5	2	16	240	0	0	480	0
Interconnector	8,000	0.6	1.315	1.0	4,800	0	0	6,312	0
Link Box	1.5	1.2	1.2	8	14	0	0	18	0
Comms Box	1.5	1.23	1.37	16	30	0	0	40	0
Totals							**5,850**	**17,344**	**0**

2.6 Drainage

There are 72 No. stilling ponds on site with a combined area of 8,514m^2 and a combined volume of 8,514m^3. Please see **CEMP 3: Surface Water Management Plan** of the CEMP for further details.

2.7 Hydrogen Plant Site

The volume of spoil from the Hydrogen Plant Site are outlined in **Table 2.6**.

Table 2.6 Estimated Excavation Volume from Hydrogen Plant Site

Description	Length (m)	Width (m)	Depth (m)	No.	Area (m^2)	Peat Depth (m)	Volume of Peat Extraction (m^3)	Volume of Soil Extraction (m^3)	Volume of Rock Extraction (m^3)
Hydrogen Plant Electrolyser Building Pad Foundations	1.2	1.2	1	420	605	0	0	605	0
Tube Trailer Parking Area	16	106	0.5	1	1,700	0	0	848	0
Water Storage tanks	45.65 (diameter)		5	2		0	0	16,374	0
Constructed Wetlands	10	8	0.5	1	80	0	0	40	0
	35	17	0.5	1	580	0	0	290	0
Process Swale	131	4	0.5	1	524	0	0	262	0
Wastewater Storage	30	10	5		300	0	0	1,500	0
Hydrogen Plant Temporary Construction Compound	60	30	0.6	1	1,800	0	0	1,080	0
Hydrogen Plant site access track incl. Roundabout & Splays	785	7	0.6	1	5,882	0	0	3,529	0
Hydrogen Plant Substation			0.6	1	2,587	0	0	1,552	0
Totals							**0**	**26,080**	**0**

2.8 Total Estimated Excavation Volume Summary

As detailed in Sections 2.1 to 2.6, the total estimated excavation volume from the Wind Farm Site and Grid Connection is 193,246m³, of which 140,137m³ is peat soil and 53,109m³ is mineral subsoil. These quantities are detailed in **Table 2.7a**.

Table 2.7a Summary of the Wind Farm Site 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 rock to be excavated (m³)
Turbine Foundations	21,922	10,629	11,293	0
Turbine Hardstands	75,960	74,880	1,080	0
Blade Fingers	1,685	491	1,194	0
Roads	42,557	42,557	0	0
Electrical Substation/Site Compound/Material Storage Area	19,414	3,333	6,666	0
Internal Cabling	5,850	0	5,850	0
Grid Connection*	17,344	10,812	6,532	0
Drainage	8,514	5,108	3,406	0
Totals	**193,246**	**140,137**	**53,109**	**0**

*All excavated materials arising from the construction of the Grid Connection Route will be disposed of at a licensed facility

As detailed in Section 2.7, the total estimated excavation volume from the Hydrogen Plant Site is 26,080m³, all of which is mineral subsoil. These quantities are detailed in **Table 2.7b**.

Table 2.7b Summary of the Hydrogen Plant Site 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 rock to be excavated (m³)
Hydrogen Plant Electrolyser Building Pad Foundations	605	0	605	0
Tube Trailer Parking Area	848	0	848	0
Water Storage tanks	16,374	0	16,374	0
Constructed Wetlands	330	0	330	0
Process Swale	262	0	262	0
Wastewater Storage	1,500	0	1,500	0
Hydrogen Plant Temporary Construction Compound	1,080	0	1,080	0
Hydrogen Plant site access track incl. Roundabout & Splays	3,529	0	3,529	0

Description	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 rock to be excavated (m^3)
Hydrogen Plant Substation	1,552	0	1,552	0
Total	**26,080**	**0**	**26,080**	**0**

3 RE-USE OF EXCAVATED MATERIAL

3.1 Turbine Foundation Excavations

The concrete foundation of each turbine will be 25.5m in diameter. The 21,922m^3 of excavated subsoil material will be used as backfill to the perimeter of the turbine foundations and will be backfilled to the top of turbine foundations as ballast. The remaining soils will be used to form landscaping berms around the base of each turbine.

All additional excavated peat will put in the designated Spoil Deposition Areas.

3.2 Storage Areas to the perimeter of Hardstands

Peat and subsoil will be used in landscaping and remediation around turbines and hardstands. The balance of soil excavated for the hardstands will be placed along the hardstand edges. The total calculated volume of excavated material at these locations is 75,960m^3, of which 74,880m^3 is peat soil and 1,080m^3 is mineral subsoil. The landscaping berms around the perimeter of the Turbine Hardstands will measure 0.5m in height and the base will be 1.5m in width. It is estimated that 2,113m^3 of excavated peat will be used in landscaping. However, it must be noted that the while all peat soils will be entirely removed from the Turbine Hardstand areas, the final volumes of subsoils will depend on the results of plate bearing tests. The total volume of excavated material for deposition may be reduced substantially following these Site Investigations. Surplus material will be put in the designated Spoil Deposition Areas.

3.3 Grid Connection

The total volumes to be excavated for the Grid Connection Route is estimated at 8,850m^3. This material will be used to backfill the trenches once the cable has been laid. Any surplus material 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 Hydrogen Plant Site

The total volume to be excavated from the Hydrogen Plant Site is 26,080m^3. This material will remain on the Hydrogen Plant Site and will be reused for fill and landscaping.

3.5 Summary of Re-Use of Excavated Material

All of the excavated material from the Wind Far Site can be reused on the Site or deposited in the designated Spoil Deposition Areas. All material associated with the Grid Connection will be disposed of off-site. All material excavated for the Hydrogen Plant will be reused on the Hydrogen Plant Site. **Tables 3.1a** and **3.1b** provide a summary of the re-use methods.

Table 3.1a Summary of Wind Farm Site Estimated Excavation Quantities (m^3)

Excavated Material Type	Excavated Material Volume (m^3)	Proposed Re-Use Volume		Comments
Roads	42,557	42,557 0	m^3 peat m^3 subsoil	All material will be deposited in the designated spoil storage areas.
Turbine Foundations	21,922	10,629	m^3 peat	To be used as backfill to foundations. Any surplus will be deposited in the designated spoil storage areas.
		11,293	m^3 subsoil	Deposited locally adjacent to Turbine Bases. Any surplus will be deposited in the designated spoil storage areas.
Turbine Hardstands	75,960	74,880 1,080	m^3 peat m^3 subsoil	Peat and subsoil is to be deposited locally at hardstand edges as berms. 2,113m^3 will be used as berms around Turbine Hardstands. Any surplus will be deposited in the designated spoil storage areas.
Blade Fingers	1,685	491 1,194	m^3 peat m^3 subsoil	Some material will be reused locally for landscaping. Any surplus material will be deposited in the designated spoil storage areas.
Electrical Sub-Station, temporary Compound and Material Storage Area.	19,414	6,471 12,943	m^3 peat m^3 subsoil	Some material will be reused for landscaping. Any surplus material will be deposited in the designated spoil storage areas.
Internal Cabling	5,850	5,850 0	m^3 peat m^3 subsoil	All material will be deposited in the designated spoil storage areas.
Grid Connection	17,344	0 17,344	m^3 peat m^3 subsoil	To be disposed of at a licensed facility (LoW 17 05 03*, 17 05 04).
Drainage	8,514	8,514	m^3 peat	All material will be deposited in the designated spoil storage areas.

Table 3.1b Summary of Hydrogen Plant Site Estimated Excavation Quantities (m^3)

Excavated Material Type	Excavated Material Volume (m^3)	Proposed Re-Use Volume		Comments
Hydrogen Plant Electrolyser Building Pad Foundations	605	605	m^3 subsoil	All material will be reused as backfill or for landscaping.
Tube Trailer Parking Area	848	848	m^3 subsoil	All material will be reused as backfill or for landscaping.
Water Storage tanks	16,374	16,374	m^3 subsoil	All material will be reused as backfill or for landscaping.
Constructed Wetlands	330	330	m^3 subsoil	All material will be reused as backfill or for landscaping.
Process Swale	262	262	m^3 subsoil	All material will be reused as backfill or for landscaping.
Wastewater Storage	1,500	1,500	m^3 subsoil	All material will be reused as backfill or for landscaping.
Hydrogen Plant Temporary Construction Compound	1,080	1,080	m^3 subsoil	All material will be reused as backfill or for landscaping.
Hydrogen Plant site access track incl. Roundabout & Splays	3,529	3,529	m^3 subsoil	All material will be reused as backfill or for landscaping.
Hydrogen Plant Substation	1,552	1,552	m^3 subsoil	All material will be reused as backfill or for landscaping.

4 CONCLUSION

Based on the available information, Jennings O'Donovan make the following recommendations:

- The estimated potential total volume of excavated material is 193,246m³ for the Wind Farm Site and Grid Connection of which 175,902m³ will be reused where possible or placed in the designated Spoil Deposition Areas and 17,344m³ will be moved off site for disposal. However, this volume is dependent on the results of plate-bearing tests during the construction phase.
- Excavated material along the Grid Connection (17,344m³) will be removed off site to a licensed waste facility.
- The estimated potential total volume of excavated material is 26,080m³. All this material will be reused on the Hydrogen Plant Site.
- The designated spoil storage areas have a capacity of 178,614m³. This means there is capacity to accommodate al the excavated material from the Wind Farm Site and this would be a surplus capacity of 2,712m³.

MERCURY RENEWABLES (CARROWLEAGH) LIMITED

FIRLOUGH WIND FARM, CO. MAYO

AND

HYDROGEN PLANT, CO. SLIGO

CONSTUCTION ENVIRONMENTAL MANAGEMENT PLAN (CEMP)

MANAGEMENT PLAN 6

DECOMMISSIONING PLAN

JUNE 2023

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DOCUMENT APPROVAL

PROJECT	Firlough Wind Farm and Hydrogen Plant	
CLIENT / JOB NO	Mercury Renewables (Carrowleagh) Limited	6129
DOCUMENT TITLE	Construction Environmental Management Plan (CEMP) Decommissioning Plan	

	Prepared by	Reviewed /Approved by
Document Final	Name Sarah Moore Aileen Byrne	Name David Kiely
Date June 2023	Signature Sarah Moore Aileen Byrne	Signature David Kiely

MANAGEMENT PLAN 6: DECOMMISSIONING PLAN

CONTENTS

1 INTRODUCTION

This Decommissioning Plan has been prepared by Jennings O'Donovan & Partners Limited on behalf of Mercury Renewables (Carrowleagh) Limited for the decommissioning of the Proposed Development and relevant infrastructure which is hereafter referred to as the Proposed Development. This document is being prepared, alongside an Environmental Impact Assessment Report (EIAR), as part of an application for planning permission for the Proposed Development to An Bord Pleanála.

Decommissioning of the Proposed 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 Proposed 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 40 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 Proposed 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 Proposed Development and all works associated with the Proposed 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 Proposed Development associated with the Project is primarily located on two distinct sites which, for the purposes of this EIAR we have called the Wind Farm Site and the Hydrogen Plant Site.

2.1.1 Wind Farm Site

The Wind Farm Site is located within a broad area of peatland in the townland of Carrowleagh (Kilbride), Co. Mayo, within the lower north-western foothills of the Ox Mountains, adjacent to the county boundary between Mayo and Sligo. The Wind Farm Site has an area of approximately 445 hectares and is mainly cutover blanket bog with an extensive network of bog tracks, which were laid out in the 1930's to provide access to turf cutting plots.

2.1.2 Hydrogen Plant Site

The Hydrogen Plant Site is pasture. There is an area of cutover, boggy peat adjacent to the south of the site boundary which has been avoided. It is 5.3 km north-west of the village of Bunnyconnellan (Co. Mayo) and 2.9 km south of the village of Corbally (Co. Sligo). The nearest large settlement is the town of Ballina (Co. Mayo.) 5.5 km to the south-west. It is accessed by the L-6611 local road and a newly designed roundabout and a site access road proposed to lead to the facility. The Hydrogen Plant Site has an area of approximately 6.5 ha and is currently an agricultural field used for grazing horses. It is located in County Sligo in the townland of Carraun, adjacent to the Co. Mayo border, 6 km west of the Wind Farm Site and 0.6 km from the N59 national road.

2.2 DESCRIPTION OF THE DECOMISSIONING

- Removal of 13 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 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 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.

[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.

- 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.

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 Proposed 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 15: 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 7 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.

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 CEMP- **Management Plan 3: 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 Proposed 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

This waste management plan which outlines the best practice procedures during the decommissioning of the Proposed 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 Proposed 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 Proposed 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 Proposed 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 Sligo and Mayo Country Councils 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 Proposed 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.

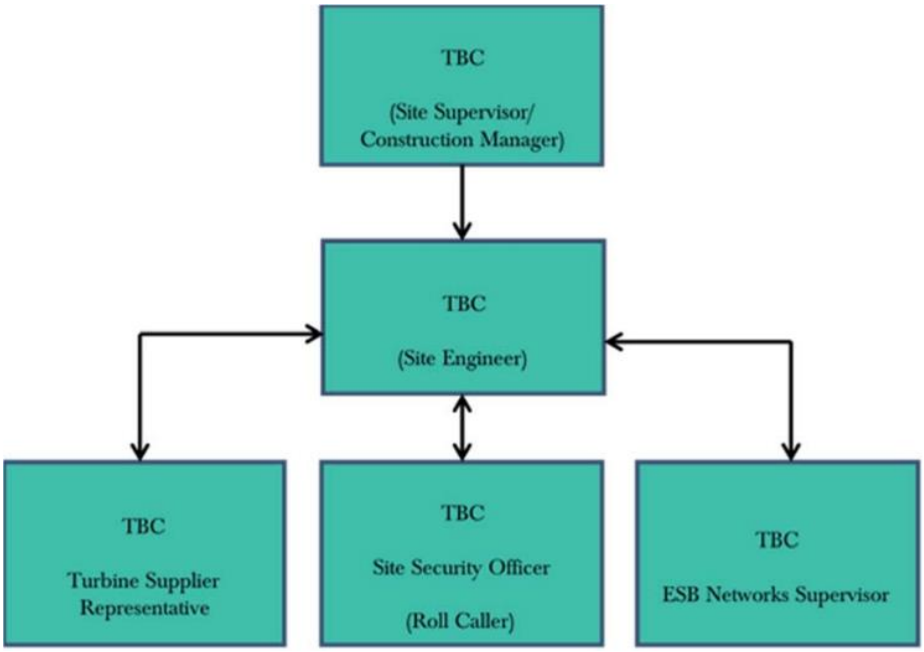

Figure 4.1: Emergency Response Procedure Chain of Command

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 Excessive Peat Movement

The wind farm infrastructure has been designed such that peat will be stable (see **EIAR Chapter 8: Soils and Geology**). No excessive excavation works are proposed for the decommissioning phase. In the unlikely event of excessive peat movement or continuing peat movement recorded at a monitoring location, or identified at any location within the Site, but no apparent signs of distress to the peat (e.g., cracking, surface rippling) (not as a result of the decommissioning of the Wind Farm) then the following shall be carried out:

1. All decommissioning activities shall cease within the affected area.
2. Increased monitoring at the location shall be carried out. The area will be monitored, as appropriate, until such time as movements have ceased.
3. Re-commencement of limited construction activity will only start following a cessation of movement and the completion of a geotechnical risk assessment by a geotechnical engineer.
4. Such detailed monitoring and awareness will further ensure that the potential for a peat slide is absolutely minimised as actions arising from monitoring will reduce the significance of the possible negative effects.

4.1.5 Onset of Peat Slide

Neither the site activities nor the site characteristics are conducive to a peat slide arising as a result of decommissioning. In the highly unlikely event of an onset or actual detachment of peat then the following shall be carried out:

1. On alert of a peat slide incident, all activities will cease and all available resources will be diverted to assist in the required mitigation procedures.
2. For localised peat slides that do not represent a risk to a watercourse and have essentially come to rest the area will be stabilised initially by rock infill, if required. The failed area and surrounding area will then be assessed by the geotechnical engineer and stabilisation procedures implemented. The area will be monitored, as appropriate, until such time as movements have ceased.

4.1.6 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 Mayo and Sligo County Council, and the Environmental Protection Agency, if deemed necessary.

4.1.7 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 Mayo and Sligo 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: Mercury Renewables (Carrowleagh) Limited	00 44 7836 556 964
Doctor – Ballina Health Centre	091 21511
Emergency Services – Ambulance, Fire, Gardaí	999/112
ESB Emergency Services	1850 372 999
Hospital – Sligo University Hospital Mayo University Hospital	071 917 1111 094 902 1733
Gas Networks Ireland Emergency	1850 20 50 50
Gardaí – Ballina Garda Station Enniscrone Garda station	096 20560 096 36103
Health and Safety Co-ordinator - Health & Safety Services	TBC
Health and Safety Authority	1890 289 389
Inland Fisheries Ireland (IFI)	1890 347 424

Contact	Telephone no.
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 Proposed 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 Heading	EIAR Chapter	Section	Mitigation Measure	Audit Result	Action Required
	Decommissioning Phase					
MM1	Decommissioning	Chapter 6: Aquatic Ecology	6.5.4 Decommissioning Phase Mitigation	Decommissioning of the Development will be scheduled to take place after the proposed 40 year lifespan of the project. Decommissioning phase impacts for the proposed development are likely to be broadly similar to construction phase impacts, in terms of potential surface water quality impacts from ground disturbance, refuelling and the storage of potentially hazardous materials onsite. The implementation of all mitigation measures detailed for the construction phase will be adopted in full during the decommissioning phase to ensure all such impacts are avoided. 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, as required. However, it should be noted that by the time decommissioning is undertaken after the planned 30-year lifespan of the Development, the areas within the site will have revegetated resulting in a resumption of the natural drainage management that will have existed prior to any construction. It is not anticipated that the decommissioning phase will interrupt this restored drainage regime in any way with the works proposed. As a minimum measure, areas where freshly placed soil material as part of turbine foundation reinstatement work will be surrounded by silt fencing if deemed necessary until the area has naturally revegetated. Restoration of the Site following decommissioning of infrastructure will require the prior establishment of the new baseline conditions at the site which will have developed over the		

Ref. No.	Reference Heading	EIAR Chapter	Section	Mitigation Measure	Audit Result	Action Required
				intervening 40 years life of the project. These studies will inform any modification or additional sensitivities that may need to be factored in restoration and site-specific measures.		
MM2	Decommissioning	Chapter 4: Soils and Geology	8.5.4 Decommissioning Phase	It is the intention that the Hydrogen Plant will continue operations indefinitely. The source of electricity for the Hydrogen Plant would change upon the decommissioning of the Wind Farm and be changed to one of the following options: • Subject to planning consents, the repowering of Firlough Wind Farm. • Reinforced electricity network with a corporate Power Purchase Agreement with a green electricity producer. • Connection to an offshore wind power generator off the west coast. No new impacts are anticipated during the decommissioning phase of the Wind Farm project (removal of turbines and similar infrastructure on the geological, geomorphological and geotechnical environment) therefore no new mitigation measures are required, however the decommissioning of major infrastructure including proposed turbines poses similar hazards and risks to the environment compared to that of the construction phase. Further details can be found in **Chapter 2 Section 2.9**. Restoration of the Wind Farm Site and its substation, following decommissioning of the proposed infrastructure is in its own right a phase of the Development. Restoration activities have the potential to be disruptive and hazardous to the environment, to the point that a 'benefit analysis' will likely be required to evaluate any such activity before it is permitted (Schumann, M., and Joosten, H., 2008).		

Ref. No.	Reference Heading	EIAR Chapter	Section	Mitigation Measure	Audit Result	Action Required
				Likely difficulties impeding restoration highlighted by means of 'benefit analysis' in terms of soil and geology include the following: • Removal of Turbine Foundations – Significant disturbance due to the difficulties associated with excavating, breaking concrete, cutting steel, loading and transferring foundation materials offsite, and subsequent disturbance associated with the excavation of suitable material to be used as fill to replace the turbine foundation. Vibration caused, particularly in relation to the breaking of concrete, may impact on peat and slope stability locally. Turbine foundations will likely be left in situ. • Removal of Hardstand / Substation / Site tracks – Significant disturbance due to operations associated with excavation and removal of hardstand materials. Removal of such materials will likely impact on blanket bog directly adjacent to the hardstand area in question, and change the hydrological characteristics of the area in question (**Chapter 9: Hydrology and Hydrogeology**). For this reason all proposed Wind Farm site access roads, hardstanding areas and drainage will be left in situ for future use. • The material required to reinstate any areas where infrastructure is removed will need to be sourced from elsewhere on the Wind Farm Site. Considering the elapsed time (reasonable to presume >20 years) the acquisition of natural material itself will likely do more harm (to established blanket bog) than that of the benefit of removing and restoring infrastructure associated with the Development. Ultimately, any such restoration activities will need to be assessed under the scope of multiple environmental disciplines, similar to this EIAR, and the potential synergistic effects. Given that the condition of the environment will likely change over the course of		

Ref. No.	Reference Heading	EIAR Chapter	Section	Mitigation Measure	Audit Result	Action Required
				the operational phase of the Development, particularly in terms of the health and degree of establishment of blanket bog and associated ecology, and ornithology, it is recommended that the potential for restoration following the decommissioning phase of the Development is evaluated closer to the time (c. 35-40 years). It should be noted that restoration activities do not currently conform to baseline conditions. Excavation of all material including concrete turbine foundations will likely not be proposed due to the high impact nature of such works e.g. breaking of reinforced concrete. Extensive vehicular movement on peat is not anticipated to any significant extent considering adequate hardstand will have been established, however the risk of fuel or other contaminant spillages, or management of waste are valid hazards during the decommissioning phase of the Development. The mitigation measures described in this EIAR chapter will be adopted and implemented by means of a Decommissioning Phase Management Plan (DPMP). On the basis that a Decommissioning Phase Management Plan will be established, and implemented during the decommissioning works associated with the Development, potential issues arising giving cause to residual impacts are likely to be infrequent, imperceptible to slight, localised and reversible. Residual impacts after the decommissioning phase is complete include all impacts classified as being long-term to permanent effects of the Development, that is; there will remain a change in ground conditions at the Site with the replacement of natural materials such as peat, subsoil and bedrock by concrete, subgrade and surfacing materials. This is a localised, negative,		

Ref. No.	Reference Heading	EIAR Chapter	Section	Mitigation Measure	Audit Result	Action Required
				moderate adverse significance, Significant / Moderate weighted significance, direct permanent change to the materials composition at the Site. However, the carefully managed reintroduction and/or reuse of soils and peat at the Site in place of hardstand areas, and successful habitat management, revegetating and rewilding of those areas will have beneficial impacts, or revert to baseline conditions preconstruction phase.		
MM3	Decommissioning	Chapter 9: Hydrology and Hydrogeology	9.5.4 Development Decommissioning & Restoration Phase	No new impacts are anticipated during the decommissioning phase of the Project on the hydrological and hydrogeological environment therefore no additional mitigation measures are required, however the decommissioning of major infrastructure including proposed turbines, poses similar hazards and risks to the environment compared to that of the construction phase. Mitigation measures similar to the construction phase will be implemented. In regard to Wind Farm Site, excavation of material is not anticipated, similarly vehicular movement on soil is not anticipated considering adequate hardstand will have been established, therefore the risk of release of suspended solids is **slight**, however the risk of fuel or other contaminant spillages, or management of waste are valid hazards during the decommissioning phase of the proposed development. Deconstruction works during the decommissioning phase of the Proposed Development pose similar hazards and risks associated with the construction phase but to a far lesser extent, for example; the potential for fuel spills from vehicles is valid but there will likely be less vehicles required, for example, no excavators. The principles mitigation measures described in this EIAR chapter will be implemented by means of a Decommissioning Phase Management Plan.		

Ref. No.	Reference Heading	EIAR Chapter	Section	Mitigation Measure	Audit Result	Action Required
				Restoration of the Wind Farm Site following decommissioning of infrastructure is in its own right a phase of the Proposed Development. Restoration activities have the potential to be disruptive and hazardous to the environment (similar impacts to construction), to the point that a 'benefit analysis' will likely be required to evaluate any such activity before it is permitted (Schumann, M., and Joosten, H., 2008). Baseline conditions will likely change over the life of the project, therefore repeat assessments will be carried out prior to decommissioning and restoration with a view to tailoring and implementing site specific measures which will be reviewed and agreed with the planning authority prior to the commencement of decommissioning. Examples of difficulties impeding restoration highlighted by means 'benefit analysis' in terms of hydrology and hydrogeology include the following: • Removal of Hardstand / Access Tracks – Significant disturbance due to operations associated with excavation and removal of hardstand materials. Removal of such materials will leave an exposed area of ground in situ, which will lead to erosion and entrainment of suspended solids in surface water runoff traversing these exposed areas. The drainage network established for the purposes of the construction phase of the Proposed Development will likely not be sufficiently suitable to manage such contamination instances, and Active Management will be required similar to the construction phase. • Removal of Turbine Foundations – The removal of concrete foundations is a challenge in itself, however it also increases the potential for surface water contamination via concrete dust and other debris. If water accumulates within open foundation removal excavations, and concrete dust is entrained, the		

Ref. No.	Reference Heading	EIAR Chapter	Section	Mitigation Measure	Audit Result	Action Required
				water arising from dewatering activities will likely have an elevated pH. Discharging such water to the receiving surface water network could potentially have significant adverse effects. The water would likely require treatment before discharging. For this reason, and the disproportionate effort required to remove buried foundations, they will likely be left in situ. • The material required to reinstate any areas where infrastructure is removed will need to be sourced from elsewhere on the site. This will lead to similar issues as described in the points above. It is the intention that the Hydrogen Plant will continue operations indefinitely. The source of electricity for the Hydrogen Plant would change upon the decommissioning of the Wind Farm and be changed to one of the following options: • Subject to planning consents, the repowering of Firlough Wind Farm. • Reinforced electricity network with a corporate Power Purchase Agreement with a green electricity producer. • Connection to an offshore wind power generator off the west coast. If these alternatives are not viable then the process equipment would be decommissioned; all plant, machinery and equipment will be emptied and dismantled to be sold or recycled or, where these are not possible, disposed of through a licenced waste contractor. If required, all machinery will be cleaned prior to removal and all necessary measures implemented to prevent the release of contaminants. All waste will be removed from the facility and recycled wherever possible, disposal operations will be controlled by licenced waste contractors.		

Ref. No.	Reference Heading	EIAR Chapter	Section	Mitigation Measure	Audit Result	Action Required
				Ultimately, any such restoration activities will need to be assessed under the scope of multiple environmental disciplines, similar to this EIAR, and the potential synergistic effects at the end of life of the project (c. 40 years). Given that the condition of the environment will likely change over the course of the operational phase of the Proposed Development, particularly in terms of the health and degree of establishment of environmental attributes including land use, ecology and ornithology etc., it is recommended that the potential for restoration following the decommissioning phase of the Proposed Development is evaluated closer to the time.		
MM4	Decommissioning	Chapter 15: Traffic and Transport	15.6.3 Decommissioning Phase	As the turbine blades can be cut into manageable lengths on decommissioning, there is no requirements to re-use the turbine supply haul route for decommissioning. Thus, all decommissioning related traffic will use the L2604. The Developer is applying for a consent for an operational period of 40 years for the Wind Farm. Cranes of similar size to those used for construction will disassemble each wind turbine using the same crane hardstands. The towers, blades and all components will then be removed from the Wind Farm Site and 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. Underground cables will be removed while the ducting will be left in-situ. The foundations and upstand sections will remain in-situ. All Wind Farm site access roads, hardstanding areas and drainage will be left in situ for future use.		

Ref. No.	Reference Heading	EIAR Chapter	Section	Mitigation Measure	Audit Result	Action Required
				It is intended that all above ground components and underground cabling (ducting left in-situ) will be removed from the Wind Farm Site as part of the decommissioning of the Wind Farm. The following elements are included in the decommissioning phase: • Wind turbines dismantling and removal off the Wind Farm Site • Underground cabling removal (ducting left in-situ) • Turbine Foundation backfilling following dismantling and removal of wind turbines (any excavated material, will be re-instated / foundations that protrude above ground level will be backfilled with soil -underground reinforced concrete remaining in-situ) • Transport Route Accommodation Works Any structural materials suitable for recycling will be disposed of and sent to a licenced facility. The financial costs of decommissioning, at current material values, will be more than met by the recycling value of the wind turbine components. Prior to wind turbine removal, due consideration will be given to any potential impacts arising from these operations. Potential impacts are likely to be similar to that of the construction phase, to an equal or lesser extent. Some of the potential issues could include: • Potential disturbance by the presence of cranes, HGVs, and personnel on-site • Time of year and timescale (to be outside sensitive periods). Prior to the decommissioning work, a comprehensive plan will be drawn up and submitted to the relevant planning authority for written agreement. The plan will take account of the findings of this EIAR and the contemporary best practice at that time, to		

Ref. No.	Reference Heading	EIAR Chapter	Section	Mitigation Measure	Audit Result	Action Required
				manage and control the component removal and ground reinstatement. It is the intention that the Hydrogen Plant will continue operations indefinitely. The source of electricity for the Hydrogen Plant would change upon the decommissioning of the Wind Farm and be changed to one of the following options: • Subject to planning consents, the repowering of the Wind Farm. • Reinforced electricity network with a corporate Power Purchase Agreement with a green electricity producer. • Connection to an offshore wind power generator off the west coast. If these alternatives are not viable then the process equipment would be decommissioned; all plant, machinery and equipment will be emptied and dismantled to be sold or recycled or, where these are not possible, disposed of through a licenced waste contractor. If required, all machinery will be cleaned prior to removal and all necessary measures implemented to prevent the release of contaminants. All waste will be removed from the facility and recycled wherever possible, disposal operations will be controlled by licenced waste contractors. The buildings and infrastructure would be retained and repurposed.		

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 Proposed 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 Proposed 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 Sligo and Mayo 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 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.

MERCURY RENEWABLES (CARROWLEAGH) LIMITED

FIRLOUGH WIND FARM, CO. MAYO

AND

HYDROGEN PLANT, CO. SLIGO

CONSTRUCTION ENVIRONMENTAL MANAGEMENT PLAN (CEMP)

MANAGEMENT PLAN 7

TRAFFIC MANAGEMENT PLAN

JUNE 2023

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DOCUMENT APPROVAL

PROJECT	Firlough Wind Farm and Hydrogen Plant	
CLIENT / JOB NO	Mercury Renewables (Carrowleagh) Limited	6129
DOCUMENT TITLE	Construction Environmental Management Plan (CEMP) Traffic Management Plan	

	Prepared by	Reviewed/Approved by
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MANAGEMENT PLAN 7: TRAFFIC MANAGEMENT PLAN

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 "living 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 Wind Farm Site is located within a broad area of peatland in the townland of Carrowleagh (Kilbride), Co. Mayo, within the lower north-western foothills of the Ox Mountains, adjacent to the county boundary between Mayo and Sligo. The Site elevations range from 120 m O.D. in the north-west up to circa 170 m O.D. in the south-east. Notable towns and villages in the area include Bunnyconnellan (Co. Mayo) 4 km to the south-west, Corballa 6.5 km (Co. Sligo) to the north-west, Culleens 7.5 km (Co. Sligo) to the north, Enniscrone (Co. Sligo) 11 km to the north. The nearest large settlement is the town of Ballina (Co. Mayo.) 12 km to the west.

The Hydrogen Plant Site is pasture. There is an area of cutover, boggy peat adjacent to the south of the site boundary which has been avoided. It is 5.3 km north-west of the village of Bunnyconnellan (Co. Mayo) and 2.9 km south of the village of Corballa (Co. Sligo). The nearest large settlement is the town of Ballina (Co. Mayo.) 5.5 km to the south-west. It is accessed by the L-6611 local road and a newly designed roundabout and a site access road proposed to lead to the facility.

The Grid Connection will be over a length of 6.65 km between the Wind Farm Site and the Glenree – Moy 110 kV over-head line (OHL) is in the townlands of Carrowleagh, Carha, Carrownaglogh, Rathreedaun, Drumsheen and Bunnyconnellan West.

The Interconnector underground cable route connects the Wind Farm Substation to the Hydrogen Plant Substation and extends for 8.2 km in the townlands of Carrowleagh, Carha, Knockbrack and Carraun.

Turbine components will be delivered via Killybegs Port, Co. Donegal and Galway Port, Co. Galway.

2.2 Project Description

The Proposed Development will comprise of the following main components:

- Construction of 13 no. wind turbines with an overall ground to blade tip height of between 177 m and 185 m inclusive. The wind turbines will have a rotor diameter of between 149 m and 155 m inclusive and a hub height of between 102.5 m and 110.5 m inclusive.
- Construction of permanent crane hardstand areas and temporary laydown/storage areas and turbine foundations.
- Construction of new permanent internal Wind Farm Site access roads and the upgrade of existing internal bog tracks to include passing bays and all associated drainage infrastructure.
- Development of a site drainage network for the Wind Farm Site including sediment control systems.
- All associated underground electrical and communications cabling connecting the wind turbines to the Wind Farm Substation.
- Construction of a permanent on-site 110 kV wind farm electrical substation including two no. control buildings with welfare facilities, all associated electrical

plant and equipment, security fencing and gates, all associated underground cabling, wastewater holding tank, and all ancillary structures and works.

- All works associated with the permanent connection of the wind farm to the national electricity grid, which will be via a loop-in 110 kV underground cable, in permanent cable ducts from the proposed permanent wind farm substation in the townland of Carrowleagh, and through the townlands of Carha, Carrownaglogh, Rathreedaun, Drumsheen and Bunnyconnellan West County Mayo into the existing 110 kV overhead line in the townland of Rathreedaun County Mayo, with two new 16 m high steel lattice loop-in/out masts at the connection point.
- Construction of a Wind Farm Site Temporary Construction Compound with associated temporary site offices, parking areas, welfare facilities and security fencing.
- Construction of a temporary construction materials storage area for use during construction of the Wind Farm.
- Forestry felling to facilitate construction and operation of the Wind Farm Substation and any onsite forestry replanting.
- Upgrade works on the section of the turbine delivery route which is common to both the Killybegs Turbine Delivery Route and Galway Turbine Delivery Route to include the following to facilitate the delivery of abnormal loads and turbine component deliveries:
    - Improvement of the N59 and L-2604-0 junction in the townland of Ballymoghany, County Sligo to include for the temporary widening of it. The associated accommodation works will include the installation of new drainage pipes, the construction of a 1.2 m high concrete retaining wall and the erection of timber stock proof fencing and 2 no. agricultural gates.
    - Localised widening of the L-2604-0 road in the townland of Cloonkeelaun, County Sligo. The associated accommodation works will include the construction of a 1.2 m high concrete retaining wall and the erection of concrete post and timber rail stock proof fencing and 2 no. agricultural gates.
    - Localised widening of the L-2604-0, L-5137-0 and L-5137-9 local roads in the townlands of Ballymoghany, Muingwore and Cloonkeelaun County Sligo and Carrowleagh County Mayo to achieve a surfaced road width of 4.5 m.
    - Localised widening of the L-5137-9, L-5136-0 and L-6612 roads in the townlands of Carraun and Knockbrack County Sligo, and Carha and Carrowleagh County Mayo to establish passing bays.

- Upgrade works on the Galway Turbine Delivery Route to include the following to facilitate the delivery of abnormal loads and turbine component deliveries:
  - Localised road widening at the N17/N5 roundabout in the townland of Ballyglass East County Mayo.
  - Localised road widening at the road junction with the N5 in the townland of Ballyglass East County Mayo.
  - Alterations to the embankments at the N5 junction with the L-5339 and L-1331 roads in the townland of Cloonmeen West County Mayo.
  - Localised road widening at the junction of the L-5339 and L-1331 in the townland of Lavy More County Mayo.
- Construction of a new Wind Farm Site entrance off the L-5137-9 in the townland of Carrowleagh County Mayo with the creation of a splayed entrance to facilitate the delivery of abnormal loads and turbine component deliveries.
- Construction of a Hydrogen Plant and an access road to it along with, upgrades to the L-6612-1 and the construction of a roundabout. The Hydrogen Plant includes the electrolyser building measuring 130 m by 110 m, and 16 m in height, and equipment, underground water storage tanks, drainage system, constructed wetlands, hydrogen dispensing station, tube trailer parking, water treatment building, fin fan coolers, fire water tanks, compressors, offices and welfare facilities and all ancillary equipment.
- Construction of a permanent on-site 110 kV Hydrogen Plant Substation in a compound of 3,520 m2 including 2 no. control buildings with welfare facilities, all associated electrical plant and equipment, security fencing and gates, all associated underground cabling, wastewater holding tank, and all ancillary structures and works.
- Abstraction of groundwater from 2 no. boreholes in the townland of Carraun County Sligo and pumping to the proposed hydrogen plant site and all associated ancillary works.
- Construction of a Hydrogen Plant Site Temporary Construction Compound with associated temporary site offices, parking areas, materials storage and security fencing for use during construction of the Hydrogen Plant Site.
- All works associated with the permanent connection of the Wind Farm to the Hydrogen Plant comprising a 110 kV underground cable in permanent cable ducts from the proposed, permanent, on-site wind farm substation, in the townland of Carrowleagh Co. Mayo and onto the townlands of Carha Co. Mayo,

Knockbrack Co. Sligo and terminating in the Hydrogen Plant Substation in the townland of Carraun, Co. Sligo.

- Demolition of agricultural shed C and partial demolition of agricultural shed B in the townland of Carraun to facilitate the construction of the upgraded L-6612-1 and roundabout.

A 10-year planning permission and 40-year operational life from the date of commissioning of the Firlough Wind Farm is being sought.

A permanent planning permission is being sought for the Grid Connection, Interconnector, Hydrogen Plant and Hydrogen Plant Substation as these are to remain in place upon decommissioning of the Wind Farm. The Wind Farm Substation will become an asset of the national grid under the management of EirGrid.

The Proposed Development includes activities which are subject to an Industrial Emissions License from the Environmental Protection Agency. In addition, the Proposed Development relates to an establishment which falls within the requirements of the Major Accidents Directive and which will be subject to regulation from the Health and Safety Authority.

While the Project is primarily comprised of the Proposed Development the Project for the purpose of the EIA also includes the following elements for which development consent is not being sought at this time:

- Demolition of an existing dwelling and agricultural sheds D and E and the demolition of the remainder of shed B and construction of a new house and shed in the townland of Carraun.

In the North Mayo and Sligo region, the full renewable energy generation potential of the area cannot be realised due to physical shortcomings and restrictions in the electricity network. The Hydrogen Plant would provide a viable off-take and route to market for renewable energy that otherwise would have been lost due to these constraints. The Hydrogen Plant production capacity will be scaled up to a maximum 80 MW, to meet demand for green hydrogen in the Irish market. The physical infrastructure of the entire Hydrogen Plant, (i.e. buildings, roads, water treatment, cooling and fuelling, etc) will be built during a single construction phase with the modular electrolyser system installed in 5 MW batches. In terms of the split of electricity going to the grid and the Hydrogen Plant, the smallest initial batch of electrolyser capacity will be 10 MW (using 12-15% of electricity produced at the Wind Farm) and will produce a maximum of 4,000 kg of green hydrogen per day leaving 55 to 68 MW (84-87% and based on a turbine range of between 5 and 6 MW) of installed capacity of the Wind Farm dispatching to the electricity grid. This will be phased up to an 80 MW electrolyser producing a maximum of 31,200 kg of green hydrogen per day and consuming the whole output of the Wind Farm. The green hydrogen will be transported in tube trailers, at the lowest installed capacity the maximum number of tube trailers daily will be 11, at the maximum capacity this will be 26 (see Section 2.6.6.12 of the EIAR).

2.3 Site Access and Egress

2.3.1 There are four separate elements of the works which will have their own separate access routes viz:

- Haul route for delivery of turbine components.
- Haul route for crushed stone, concrete, substation components and other materials for the Wind Farm Site.
- Haul route for crushed stone, concrete, substation components and other materials for the Hydrogen Plant Site.
- Haul route for delivery vehicles leaving the site.

2.3.2 It is proposed that the turbine and electrical components will be delivered via Killybegs Port, Co. Donegal or via Galway Port, Co. Galway as follows:

Killybegs to Wind Farm Site haul route:

- Exit Killybegs Port taking the 2nd exit at the roundabout to the Shore Road.
- Continue on Shore Road and turn right onto the R263
- Continue on R263 until road joins to the N56
- At the 1st roundabout near Donegal town, continue on the N56
- At the 2nd roundabout near Donegal town, take the 2nd exit onto the N15
- At the roundabout outside Laghey, continue on the N15
- At the roundabout outside Ballyshannon, continue on the N15
- At the 1st roundabout outside Bundoran, continue on the N15
- At the 2nd roundabout outside Bundoran, continue on the N15

- Continue on N15, then join onto the N4.
- At the roundabout near Sligo town, take 2nd exit continuing on the N4
- Take slip road off N4 and turn right to join the N59
- At the 1st roundabout in Ballysadare, take the 3rd exit and continue on the N59
- At the 2nd roundabout in Ballysadare, take the 2nd exit and continue on the N59
- Continue on N59, then turn left at Stokane onto the L-2604-0.
- Continue on L-2604-0 until left turn to Site entrance.

Galway Port to Wind Farm Site haul route:

- Continue on L-2604-0 until left turn to Site entrance
- Exit the Port of Galway onto Lough Atalia Road
- At the junction with R339, Turn right onto College Rd
- At Connolly Avenue junction, turn left towards Taum Road
- At the junction with R336, turn right onto Tuam Road
- At the junction with the N83, continue straight onto the N83
- At the roundabout prior to Tuam, take the 1st exit onto the N17
- At the roundabout north of Tuam, take the 1st exit onto the N17
- At the roundabout south of Charlestown, take the 2nd exit onto the road towards N5
- Continue on N5 for 1.4km to the junction towards the L-1331
- At the junction, turn left onto the L-1331 towards Charlestown
- At the junction in Charlestown, turn right onto the N17
- At the junction in Tobercurry, continue straight on the R294
- At the junction, rejoint the N17
- At the roundabout south of Collooney, take the 1st exit and go contraflow onto the N4
- At the second roundabout, take the 2nd exit to continue to go contraflow on the N4
- At the contraflow slipway at the N4/N59, take the slipway and joint the N59
- At the 1st roundabout in Ballysadare, take the 3rd exit and continue on the N59
- At the 2nd roundabout in Ballysadare, take the 2nd exit and continue on the N59
- Continue on N59, then turn left at Stokane onto the L-2604-0
- Continue on L-2604-0 until left turn to Site entrance.

All sub-base, base course and final running layer materials for the Access Track and Turbine Hardstand construction will require importation. Specific grades of rock fill may be required as fill under Turbine Foundations. The crushed stone as well as rock fill and concrete for Turbine Foundations, concrete blocks for the construction of substation buildings and precast chambers for site cabling will be sourced from one of the local quarries in the area. Concrete, crushed stone and concrete blocks for construction of the Proposed Development will come from licenced quarries in the locality such as:

- Killala Rock Quarry, Killala
- Coolturk Quarries Ltd., Crossmolina
- Maloney Quarries, Swinford
- Harrington Concrete & Quarry, Kilkelly
- Frank Harrington Limited, Abbeytown
- Liam Scott Developments, Easky
- Molloy Concrete Limited, Ballina

These quarries will also be the source of crushed stone and concrete for widening works to the turbine haul routes (N59 junctions, L-5137-0, L-5137-9 and L-2604-0), Construction Haul Routes (L-6612, L-6612-1, L-1102, L-5136-0, L-5137-9 and L-2604-0) Grid Connection Route (L-2604-0, L-5136-0, L-5137-9 and L-1102) and the Interconnector Route between the Wind Farm and Hydrogen Plant (L-5137-9, L-5136-0, L-1102, L-6612 and L-6612-1).

The delivery route proposed primarily uses the national road network from Co. Donegal to Co. Mayo bypassing densely populated areas such as Donegal town, Ballyshannon and Bundoran and the national road network from Co. Galway to Co. Mayo bypassing densely populated areas such as Galway, Milltown and Charlestown.

For all quarries, trucks will approach the study area using the N59 before turning on to the L-6612, followed by the L-5136-0, and then the L-5137-9 on approach to the Wind Farm Site entrance.

The Hydrogen Plant Construction Haul Route will make use of a haul route separate to the Wind Farm Construction Haul Routes detailed previously. Importing and exporting materials and components for the Hydrogen Plant will use the N59 and will turn on to the L-6612-1 for a short distance before joining an access road to be constructed as part of the Proposed Development.

Existing felled wood from forestry felling will be removed from site once all the civil works are complete, which will accommodate for the construction of the Wind Farm substation. Wests Timber located on the outskirts of Ballina along the N59 is a possible suitable location to deposit any forestry felling. The proposed route for transporting wood would be utilising the Construction Haul Away Route and following the N59 approx. 8km south-west before turning left into West Timbers.

The proposed Grid Connection Route runs parallel to a section of the Construction Haul Route Leaving the Wind Farm Site, the Grid Connection Route will follow a short section of the L-5137-9, followed by the L-5136-0 and then joining the L-1102, continuing southwards for a distance of 3.3km towards Bunnyconnellan. The underground Grid Connection (UGC) is proposed to leave the L-1102 and enter private lands a short distance before breaking ground and looping-in to the existing Moy to Glenree 110kV overhead line.

For the Grid Connection, general in-situ material excavated from trenches in public roads will be disposed of to a licenced facility while in-situ excavated road surfacing material will be recycled. General soil waste will be transported to one or more of the following licensed facilities:

- Harrington Concrete (Sligo) ULC, Abbeytown, Ballysadare, Co. Sligo
- Mangan Concrete & Haulage Ltd., Ballynalynagh Crossmolina Co Mayo
- Coolturk Quarries Ltd., Coolturk, Crossmolina, Co. Mayo
- Harrington Concrete & Quarries, Gortnafolla Turlough Co. Mayo

Soil and stone spoil from road widening on the Turbine Haul Route will be disposed of to the same facilities.

Excavated road surfacing materials will be recycled and used for temporary reinstatement of trenches. Bitumen and supplementary road surfacing for trench reinstatement can be sourced from Mayo Driveways, Ballina, Co. Mayo or GS Contracts (Gordon Sherlock), Ballysadare, Co. Sligo or Moran Tarmacadam Brendan, Tristia, Co. Mayo.

Grid Connection Route construction traffic will be serviced via the N59 at Corballa along the Construction Haul Routes to and away from the Wind Farm Site and Hydrogen Plant Site.

The Interconnector Route construction traffic will also be serviced via the N59 at Corballa along the Construction Haul Routes to site and away from the Wind Farm Site and Hydrogen Plant Site**.** Traffic will be allowed to use the constructed passing bays along the L-6612-1, L-6612, L-1102 and L-5136-0.

The Wind Farm Site is historically a cutover blanket bog with an extensive network of bog tracks which were laid to provide access to turf cutting plots. Turf harvesting activities still occur to date and coordination with local communities will take place to enable continued access to harvest turf.

3 EXISTING ROAD NETWORK

The EIAR Traffic and Transport Chapter (Chapter 15) describes the existing surrounding road network to be impacted by the Proposed Development including Grid Connection. The main routes to the various elements of the works are via the N59, Regional Roads and Local Roads.

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
N59	To be used for delivery of wind turbine components, electrical equipment, concrete, reinforcing steel, precast concrete components, crushed stone, building materials, electrical ducts, road surfacing materials for the Wind Farm, haul route works and Grid Connection. To be used for removal of forestry logs from the site. May be used for spoil disposal for haul route works and grid works. Will also be used for construction workers travelling to/from the site.
L-2604-0, L-5137-0, L-5137-9	To be used for delivery of wind turbine components

Road Number	Activity Likely to Generate Impact
L-6612,	Delivery of crushed stone, precast concrete components, electrical cables and equipment, ducts, road surfacing, building materials and ducting to the Wind Farm Site and possibly for the removal of spoil arising from the construction of the Grid Connection and Interconnector.
L-1102	To be used for haul way route for delivery vehicles The Grid Connection trenches, joint bays and link boxes will be installed in Local Road The single circuit Interconnector trenches will be 0.6m wide and will include joint bays
L-6612-1	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. The single circuit Interconnector trenches will be 0.6m wide and will include joint bays
L-5136-0, L-5137-9	To be used for delivery in and delivery away route. The Grid Connection trenches, joint bays and link boxes will be installed in Local Road The single circuit Interconnector trenches will be 0.6m wide and will include joint bays

4 CONSTRUCTION STAGE

4.1 Programme

The project will have a construction period of 21 months. The Wind Farm construction period is as follows:

• Site Establishment/ Fencing	Months 1 – 3
• Internal Access Road Upgrade & Construction	Months 2 – 6
• Substation & Compound Construction	Months 2 – 8
• Substation Electrical Works	Months 9 – 17
• Substation Commissioning	Months 16 – 17
• Excavation & Construction of Turbine Foundations & Turbine Hardstands	Month 2 - 11
• Internal Cabling Installation	Months 10 – 16
• Turbine Deliver and Erection	Months 12 – 16
• Grid Connection	Months 13 – 17
• Energisation	Month 18
• Turbine Commissioning	Months 19 – 21
• Site Restoration	Months 18 – 21

The Hydrogen Plant construction period is as follows:

• Site Establishment/ Fencing	Month 1
• Contactor Compound and Welfare Facilities	Month 1
• Hydrogen Plant Site Preparation including drainage	Months 2 – 4
• Site Access Road	Months 2 – 4
• Excavation and Installation of Underground Storage Tank	Months 5 – 8
• Electrolyser Building Construction	Months 5 – 18
• Ancillary buildings and Hydrogen Plant Substation construction	Month 7 - 16
• Installation of outdoor plant and equipment	Months 15 – 18
• Installation of the Wind Farm Interconnector	Month 7 - 16
• Delivery of equipment and installation	Months 15 – 18
• Testing and Commissioning	Months 18 – 21
• Site Restoration	Months 19 – 21

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 24 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 100 - 150 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 150 workers could be employed at peak times.

4.3.2 Staff Traffic Generations

The 150 workers will generally travel to the site via light vehicle (LV) (i.e. car or small van) assuming 2 persons per vehicle, or 75 trips to and 75 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.

- 20 trips each way to/from grid construction works.
- 25 trips each way to/from Hydrogen Plant Site.

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 Proposed 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 110/33kV transformer for the Wind Farm Substation and Hydrogen Plant Substation and the Wind Farm turbine components will be abnormal loads. An assessment of these loads have been made based on the details in the EIAR Chapter 15, Section 15.5.1 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 15.5.1 of the EIAR presents an analysis of the HGV and abnormal loads associated with each of the construction elements.

Referring to Table 15.24 of the EIAR (within Section 15.5.1), the peak times for HGV deliveries will be in months 2 to 12 when the Turbine Foundations will be constructed, Turbine 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 914 trips each month with an average of 42 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 634 loads or 29 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 15.5.3 of the EIAR.

Table 4.1 below (Table 15.26 from the EIAR) presents a summary of the peak traffic movements per day on each of the road elements. The various nodes are shown on **Figure 40.1**.

Table 4.1: Summary of Peak Additional Construction Traffic Movements on Roads

Node	Road	Total No. of Deliveries	Peak Deliveries/ Month	Peak Deliveries/ Day	Staff	Peak Traffic Movements/ Day
Killybegs/Galway to N59/L-2604-0 Junction	N59	2207	356	20	90	50
L-2604-0 to Windfarm access road	L-2604-0	856	356	15	90	40
N59/L-1102 Junction	L-1102	8624	939	150	150	390
N59/L-6612-1 Junction	L-6612-1	2972	290	150	150	300
L-6612-1/L-6612 Junction	L-6612	5736	677	150	150	390
L-6612/L-1102 Junction	L-1102	10616	1062	150	150	390
L-1102/L-5136 Junction	L-5136	10616	1062	150	150	390

The numbers of HGVs generated by the Proposed Development (390 movements per day at peak) could be considered as a significant increase on the numbers of HGVs which are predicted to use the existing N59 in 2026, which is predicted to be 157 movements per day (See **Section 15.3.6**). However, the construction stage traffic movements between Killybegs Port or Galway Port and the L-2604-0 Junction (N56, N83, N15, N17, N5, N4 and N59) will be at 50 movements (20 deliveries) per day, resulting in 207 AADT of HGV. Assuming that the majority of the route between Killybegs Port or Galway Port and the L-2604-0 junction has a carriageway width of 7.3 m and is classified as a type 1 road, the capacity of 11,600 AADT is used as per Table 6.1 of the TII publication DN-GEO-03031 – Rural link design, the change of HGV would be 4.1%. The magnitude of change is considered as being "Very Low" (see **Section 15.2.9**).

For the turbine delivery routes between the L-2604-0, L-5137-0, L-5137-9 and the Wind Farm Site entrance, an additional 40 traffic movements per day will arise during this activity. The L-2604-0, L-5137-0 and L-5137-9 carriageway maintains an average width of 3.5 m – 4 m and is classified as a type 3 road, the capacity of 5000 AADT is used as per Table 6.1 of the TII publication DN-GEO-03031 – Rural link design. Adding a further 40 traffic movements to the predicted 2026 traffic movements of 81 AADT (See **Table 15.17**), resulting to 121 AADT. The flows would increase by 2.4% which, in terms of magnitude, are considered as being "Very Low" (see **Section 15.2.9**).

For the construction haul route between the N59/L-1102 Junction, an additional 390 traffic movements per day will arise during this activity. Assuming that the majority of the route has a carriageway width of 7.3 m and is classified as a type 1 road, the capacity of 11,600 AADT is used as per Table 6.1 of the TII publication DN-GEO-03031 – Rural link. Adding a further 390 traffic movements to the 2026 traffic movements of 4322 AADT, resulting to 4712 AADT, the flows would increase by 40.6% which, in terms of magnitude, are considered as being "Low" (see **Section 15.2.9**).

For the construction haul route between the N59/L-6612-1 junction, an additional 300 traffic movements per day will arise during this. The predicted flows for the N59/L-6612-1 junction for 2026 is 6,100 AADT (See **Section 15.3.6**). This is 52.5% of the guidance capacity of 11,600 AADT. Adding a further 300 traffic movements, the flows would increase to 6,400 AADT which is well within the guidance capacity of 11,600 AADT, in terms of magnitude, are considered as being "Low" (see **Section 15.2.9**).

For the construction haul route between the L-6612/L-1102 Junction, an additional 390 traffic movements per day will arise during this activity. The L-1102 and L-6612 carriageway maintains an average width of 5.3 m and 4.3 m respectively, and is classified as a type 3 road, the capacity of 5000 AADT is used as per Table 6.1 of the TII publication DN-GEO-03031 – Rural link design. Adding a further 390 traffic movements to the 2026 traffic movements of 413 (See **Table 15.17**), resulting to 803 AADT, the flows would increase by 16.1% which, in terms of magnitude, are considered as being “Very Low” (see **Section 15.2.9**).

For the construction haul route between the N59/L-6612-1 junction, an additional 390 traffic movements per day will arise during this activity. The L-6612-1 carriageway maintains an average width of 3.1 m and is classified as a type 3 road, the capacity of 5000 AADT is used as per Table 6.1 of the TII publication DN-GEO-03031 – Rural link design. Adding a further 390 traffic movements to the 2026 traffic movements of 87 AADT (See **Table 15.17**), resulting to 477 AADT, the flows would increase by 9.5% which, in terms of magnitude, are considered as being “Very Low” (see **Section 15.2.9**).

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 Mayo 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 Sligo and Mayo 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 Sligo and Mayo 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 Proposed 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 Sligo and Mayo 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 Sligo and Mayo County Council.
- Liaison with Local Authorities – liaison with Sligo and Mayo 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 (TSC) 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

At the proposed access points to the Proposed Development, visibility splays shall be provided and maintained in accordance with the TII guidelines of a 2.4 m setback over a length of 160 m in both directions. To ensure a safe working access for all construction vehicles on the Wind Farm Site and Hydrogen Plant Site, 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 L-2604-0 and L-6612, with the most prevalent use of the national road network to be the existing N59. 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. There is a school at Stokane on the L-2604-0 haul route to the Wind Farm Site and deliveries/construction traffic should be scheduled so as to avoid school drop-off and collection times.

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. Such material deliveries are envisaged to utilise one of the haul routes identified in **Figure 20.3**. 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 L-2604-0 as well as Grid Connection and Interconnector Connection works within the L-5136-0, L-5137-9, L-1102, L-6612, L-6612-1 (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 L-2604-0, L-5137-0, L-5137-9, L-6612, L-6612-1, L-1102 and L-5136-0. It is not envisaged that TMOs would be required at the L-5137-9 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 L-6612/L-1102 and N59/L-2604-0 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 L-5136-0, L-5137-9, L-1102, L-6612 and L-6612-1, 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 Proposed 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 L-2604-0.
- 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 25 km/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 Proposed 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 Sligo and Mayo 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 177 no. abnormal loads for turbine components are anticipated to be transported to the site along the abnormal loads haul route identified in **Figure 20.2** 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 6 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 Moy to Glenree 110Kv OHL is required, see **Figure 20.5**. This requires a transverse trenched road crossing of the L-5136-0, L-5137-9 and L-6612.

Road closures are likely to be required for construction of the grid within narrow public roads such as the L-2604-0, L-5136-0, L-5137-9, L-5137-0, L-6612, L-6612-1 and L-1102.

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 150 m sections, and no more than 100 m 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 L-2604-0, L-6612, L-5136-0, L-5137-9, L-5137-0, L-6612-1 and L-1102.

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 L-2604-0 is closed, local access will be provided. No requirement for diversions are envisaged.

For the Grid Connection Route and Interconnector Route works within the L-5136-0, L-5137-9, L-1102, L-6612 and L-6612-1, traffic from residents along 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 Sligo and Mayo 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 and Hydrogen Plant 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 L-2604-0 (Wind Farm access) and L-6612-1 (Hydrogen Plant access).

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.

There will be a maximum of 26 tube trailers filled with gaseous hydrogen and then transported away from the plant everyday. Typically, regular staff will be using the facility on an on-going basis and staff parking has been incorporated in to the design. Approximately 10 cars can be allowed for as working traffic to the Hydrogen Plant. This means that the N59 at the L-6612-1 Junction is predicted to be running at 618 AADT at this junction, which is approximately 5.3% of its capacity and therefore has the capacity to accommodate the Hydrogen Plant operational traffic. The effect of traffic associated with the operation of the Hydrogen Plant on the existing public road network will be imperceptible due to the type of traffic and the low volume of traffic generated during operation.

Although the effects during operation have been assessed as being imperceptible, it is still important that any effect is minimised as for as possible. Therefore, the following measures are recommended:

- All vehicles using the Wind Farm Site shall either have roof mounted flashing beacons or will use their hazard lights.
- A speed limit of 25 km/h shall apply to all vehicles within the Wind Farm Site.
- Signage shall be maintained throughout the operational period.
- Road surfaces shall be inspected on a quarterly basis and any remedial works identified will be carried out within one month of the inspection.
- While production of green hydrogen is expected to be a 24 hour a day process, the Developer intends to restrict tube trailers from entering and leaving the premises between the hours of 7:00 and 19:00 as part of a wider traffic management plan. The movement of transportation of hydrogen will comply with The European Communities (Carriage of Dangerous Goods by Road and Use of Transportable Pressure Equipment) Regulations 2011 to 2021, as amended, Directive 2008/68/EC, Directive 2010/35/EU and the "Agreement Concerning the International Carriage of Dangerous Goods by Road" (ADR).
- Appropriate safety signage will be placed on all tube trailers.
- Vehicles will regularly be inspected for damage, leaks or equipment malfunction and maintained in good working order.
- Tube trailers cylinders will have fitted temperature and pressure sensors that can be monitored remotely.
- Vehicle operators will be suitable qualified.
- Detailed telematics monitor vehicle and driver performance to ensure road safety.
- Cylinders will undergo extensive testing, including, cycling tests in which they are pressurized and depressurized many more times than they would be during their lifetime to make sure that they meet these performance requirements. Hydraulic stress testing to test the strength of the cylinders is performed.

- A detailed Emergency Response Plan (ERP) for the operational phase of the Hydrogen Plant, to cover health and safety emergencies as well as environmental emergencies, as part of the H&S Plan will be developed. This ERP shall be activated in the event of an emergency such as an accident, fire, spillage etc. and will provide details on who is required to be notified, first aid facilities and closest hospitals.
- Prior to the commencement of the construction phase of the Proposed Development, a detailed Traffic Management Plan will be prepared by the Contractor for agreement with the relevant local authorities and An Garda Síochána.

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 L-2604-0, L-5137-9, L-6612, L-6612-1 and L-1102 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.