LETTER WIND FARM LTD

LETTER WIND FARM

CO. LEITRIM

CONSTRUCTION ENVIRONMENTAL MANAGEMENT PLAN (CEMP)

MANAGEMENT PLAN 3
SURFACE WATER MANAGEMENT PLAN

DECEMBER 2023

Letter Wind Farm Ltd,
Ballysadare,
Co. Sligo,
Ireland.
F91 XK19.

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	Letter Wind Farm	
CLIENT / JOB NO	Letter Wind Farm Ltd	5969
DOCUMENT TITLE	Construction Environmental Management Plan (CEMP) Surface Water Management Plan	

	Prepared by	Reviewed/Approved by
Document Final	Name Shauna Conlon	Name David Kiely
Date December 2023	Signature Shauna Conlon	Signature David Kiely

LETTER WIND FARM, CO. LEITRIM

SURFACE WATER MANAGEMENT PLAN

CONTENTS

1 INTRODUCTION

This Surface Water Management Plan (SWMP) describes the management of surface water during construction of Letter Wind Farm, Co. Leitrim.

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 Site is shown in **Figure 2.1**.

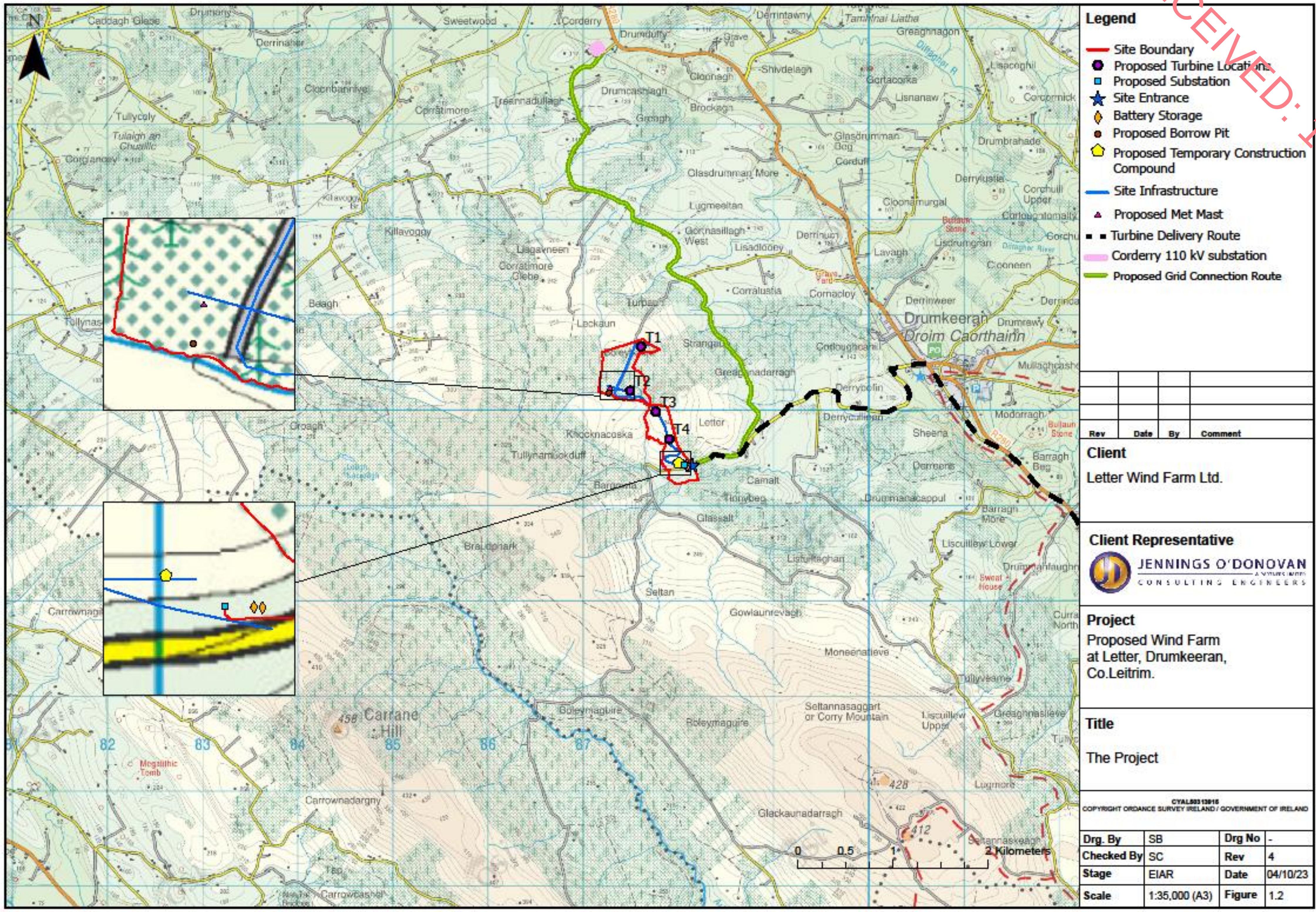

Figure 2.1: Site layout

2.2 Site Topography

The proposed development is located on elevated rolling transitional lands north of Corry Mountain (428m AOD) and northeast of Carrane Hill (458m AOD). The proposed development is situated along sloping lands situated at between c. 230-260m AOD and is intersected by a small stream that flows in a southerly direction through the site.

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 site are mapped and presented in **Figure 2.2**.

The Site and the southern part of the and Grid Connection Route are situated within the Upper Shannon Catchment (ID: 26; Area: 604.47km^2). The Northern part of the and Grid Connection Route is situated in the Sligo Bay Catchment (ID: 35, Area: 1605.94km^2). The Turbine Delivery Route passes through the Donegal Bay North Catchment (ID:37, Area: 807km^2), the Erne Catchment (ID:36, Area: 3440.55km^2) the Sligo Bay Catchment (ID: 35, Area: 1605.94km^2), the Upper Shannon Catchment (ID: 26B, Area: 674.13km^2), the Upper Shannon Catchment (ID: 26; Area: 604.47km^2) near the red line boundary of the Site.

Surface water runoff associated with the Site drains into two sub catchments and/or three river sub basins, or three no. rivers, 1 no. lough:

- Sub Catchment: Owengar (Leitrim)_SC_10, River Sub Basins: Owengar (Leitrim)_SC_010 and Diffagher_10, Rivers: Owengar (Leirtim)_010, Owengar (Leitrim)_020, Diffagher_010
- Sub Catchment: Shannon Upper_SC_020; River Sub Basin: Shannon Upper_040, Lough: Lough Allen

All surface waters draining from the Site eventually combine into Lough Allen, from which waters eventually flow to the Upper Shannon, Lough Corry, Tap North and Lough Boderg, Lough Forbes, Lough Ree, the Lower Shannon, Lough Derg, and Shannon Estuary through to the mouth of the Shannon and into the south-western Atlantic Seaboard.

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

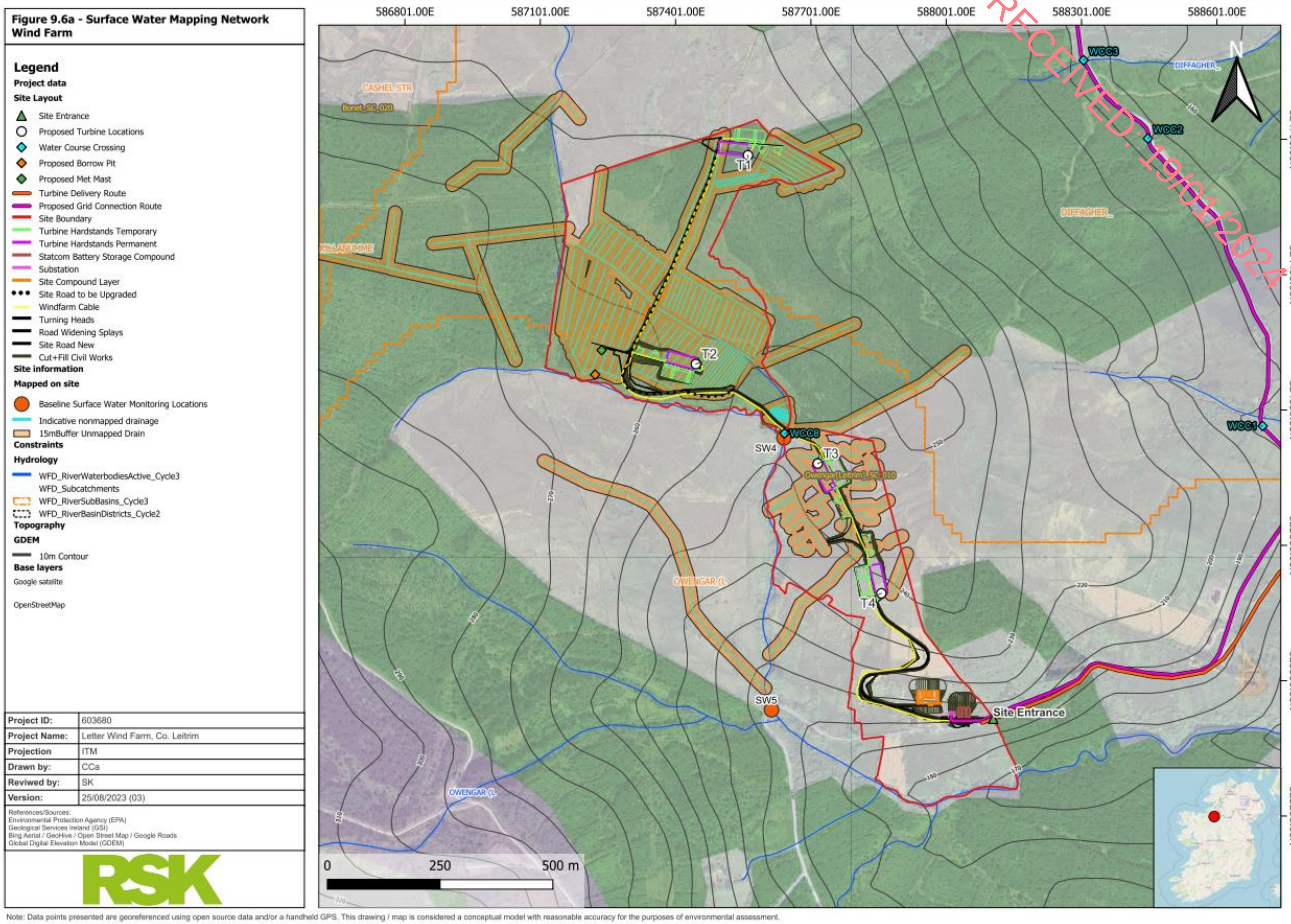

Figure 2.2: Surface Water Networks

Lands in the vicinity of the Site are predominantly underlain by Dergvone Shale Formation (Geological Survey Ireland[1]). The Dergvone Shale Formation contains four main shale facies, arranged in rhythmical order; primarily a dark pyritic, sometimes calcareous shale. Not the uppermost sequence, but underlying the Deryvone Formation, is the Carraun Shale Formation. This formation consists of grey black shale with minor limestone. The Brieklieve Limestone Formation, consisting of bioclastic cherty limestone is recorded in GSI online mapping to be the uppermost sequence approximately 3km west of the site. This formation is potentially present at significant depth below the Site. Superficial soils consisting of blanket peat are recorded to mantle the majority of the Site and have been confirmed during fieldwork to be the case at all significant infrastructure. Underlying mineral soils are consistent with tills derived from Namurian Shales recorded in the vicinity, where blanket peat is absent.

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 Letter Wind Farm.

4 DRAINAGE SYSTEM OVERVIEW

The drainage system has been designed for this Development. It aims to ensure the 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

[1] Geological Survey of Ireland (GSI) Spatial Resources. Online: https://dcenr.maps.arcgis.com/apps/MapSeries/index.html?appid=a30af518e87a4c0ab2fbde2aaac3c228. Accessed on 12/04/23

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 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. 5969-PL-101 to 5969-PL-WF-113**.
- 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 environmental auditing. The design rationale is that of an integrated approach where each element is assessed for its potential contribution to sediment suspension and the appropriate mitigation measures integrated into the layout design. The design principles are as follows:

Minimise → Intercept → Treat → Disperse → Dilute

4.2.1 Minimise

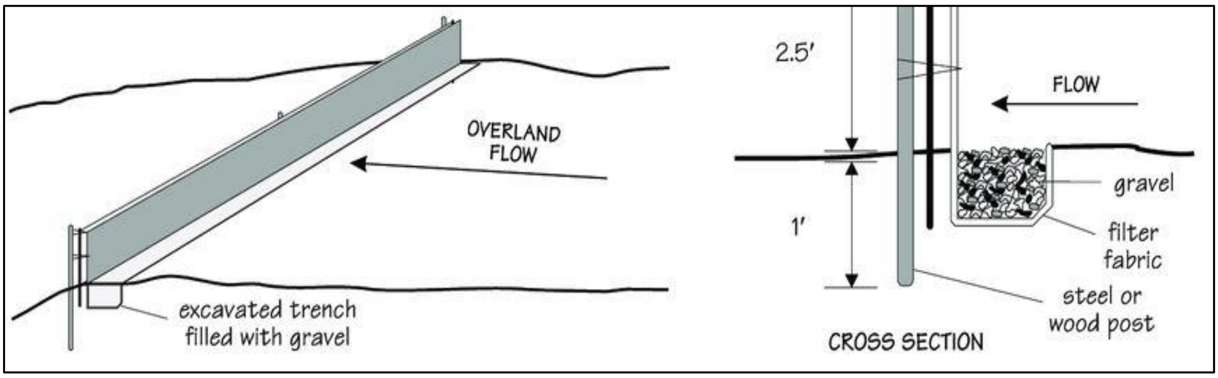

Figure 4.1: Diagram of silt fence[2]

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.

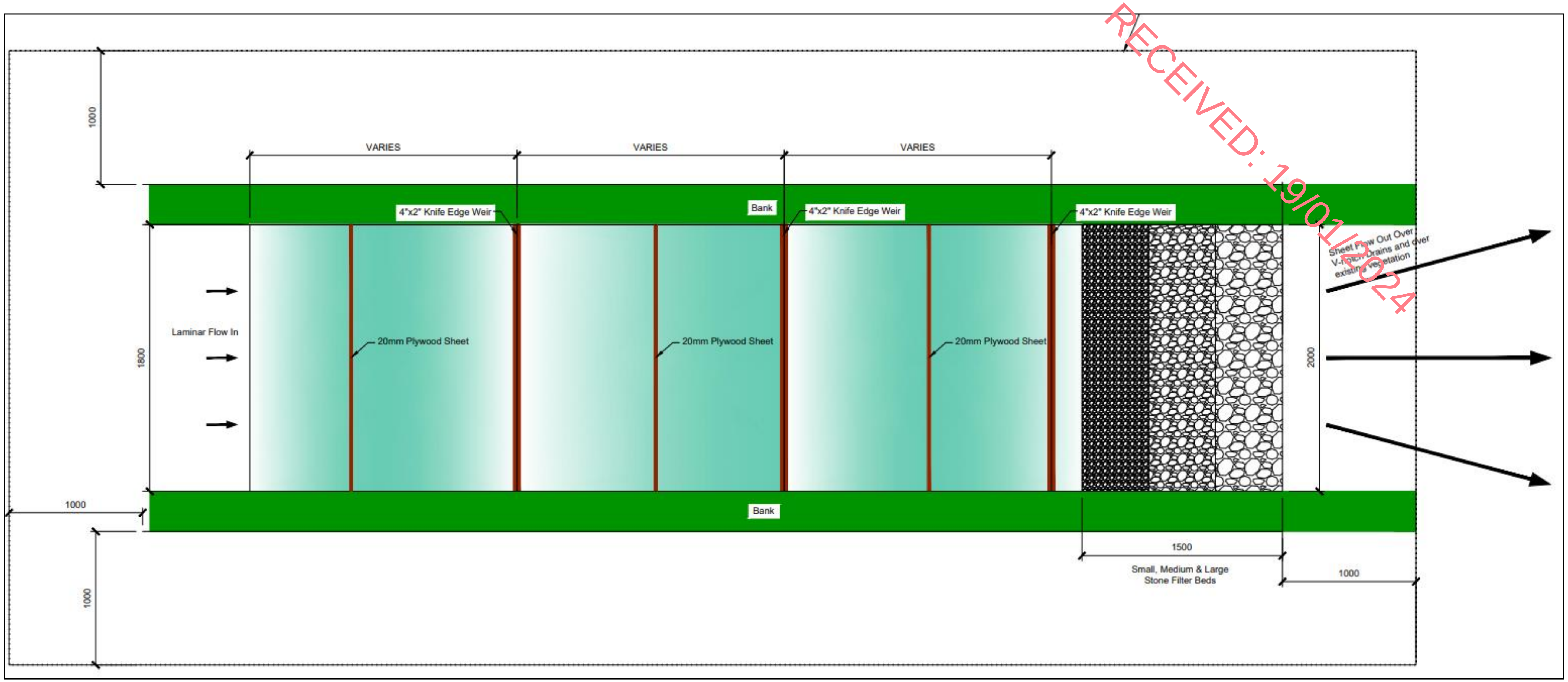

Figure 4.2: Diagram of settlement ponds outlet where outflow is dispersed across vegetated area

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**.

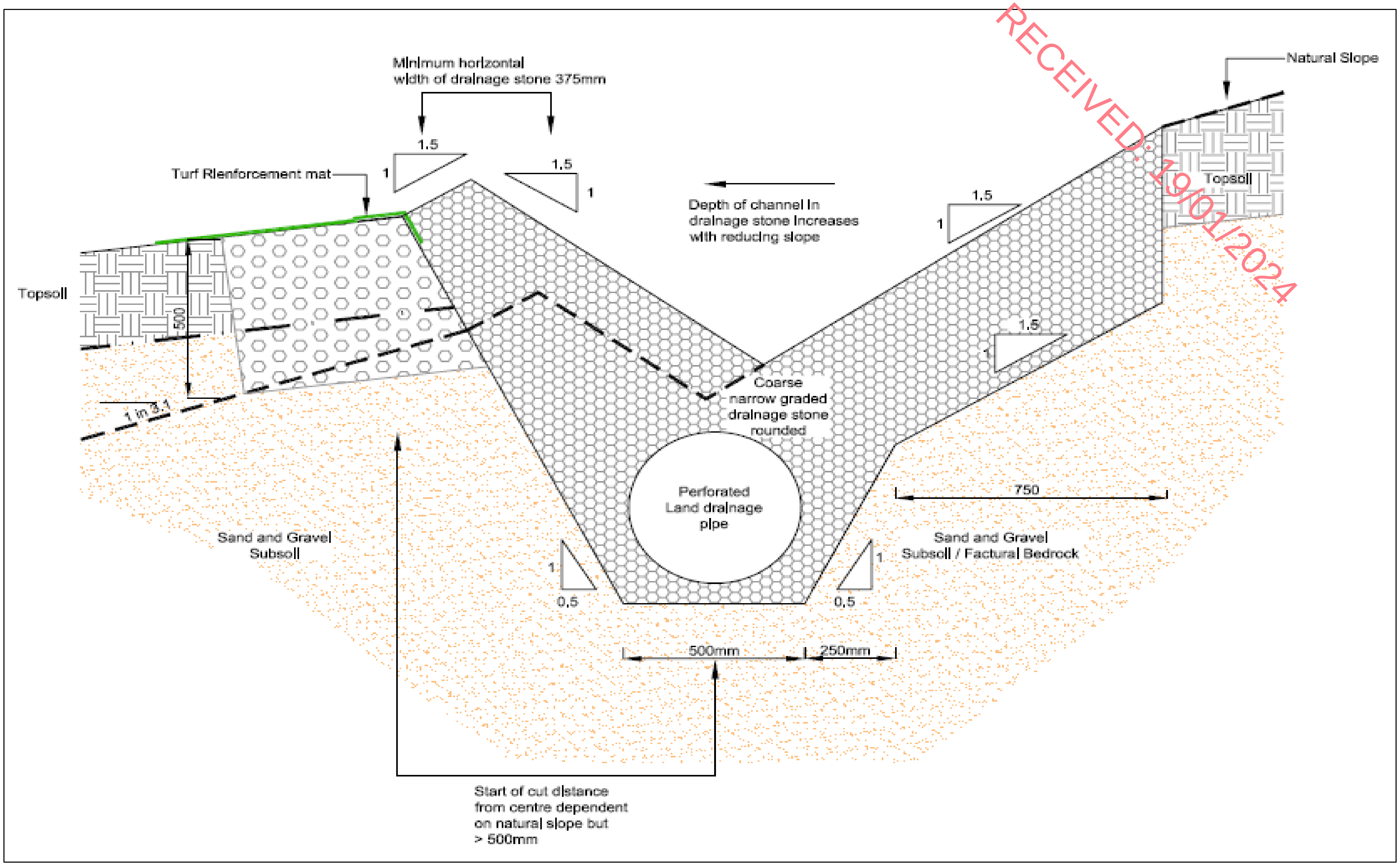

Figure 4.3: Diagrammatic cross section of Interception Infiltration Drains

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, indicated in orange, 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 **Planning Drawing No. 5969-PL-301 to 5969-PL-304**.

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:

- Additional drainage measures will only be added as necessary. The dimensions of these features will avoid intercepting large volumes of water. Any changes to the SWMP must be agreed with the Environmental Manager and the ECoW.
- Surface water runoff from the proposed Site Access Tracks will be managed with crossfall downslope to mimic the natural drainage patterns of the Site.
- Drainage vegetation (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.

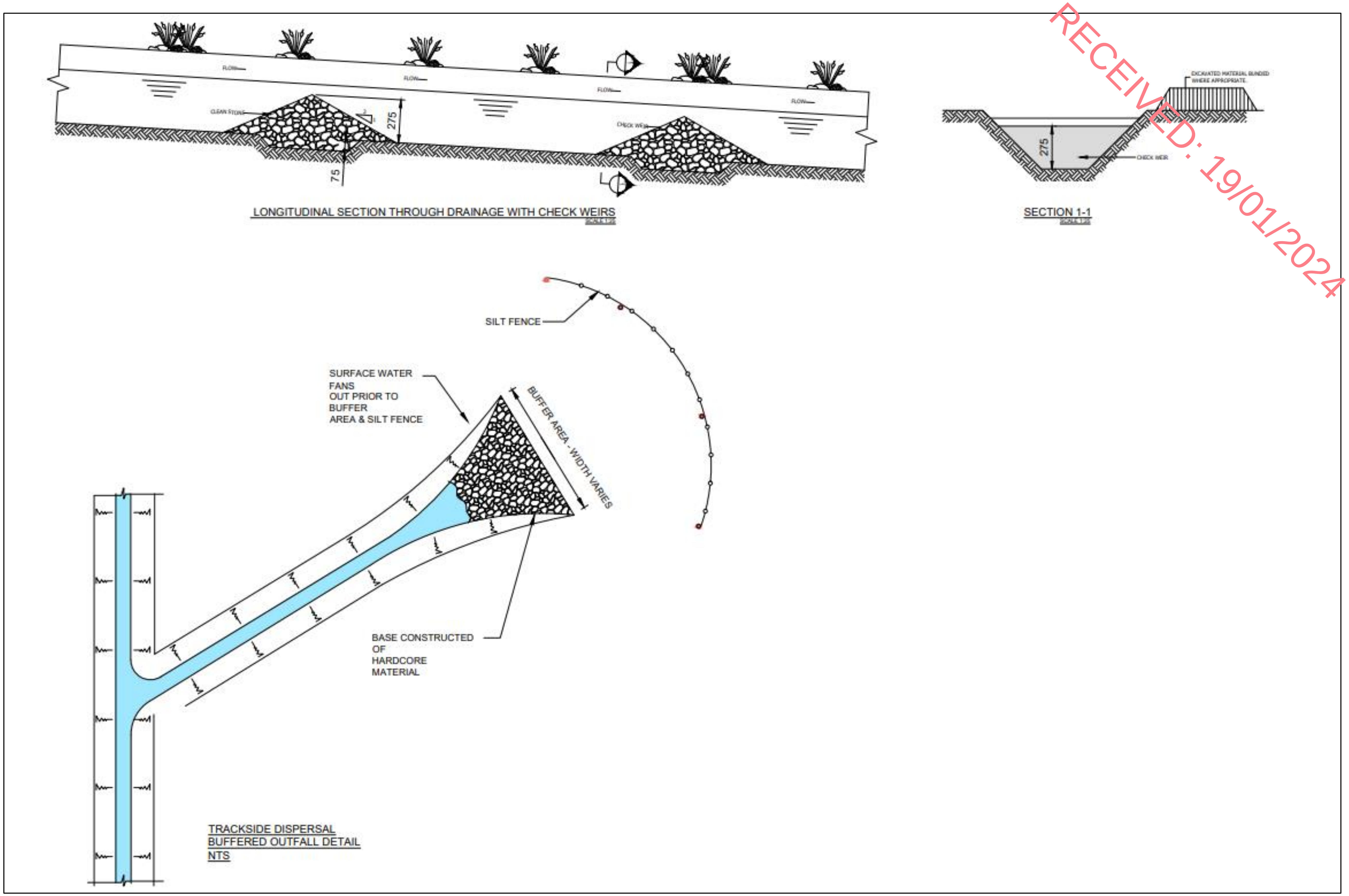

Figure 5.1: Typical check dam arrangement

- 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 5.6 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.
- The level of silt runoff during construction will be monitored which is detailed in (**Management Plan 2 Water Quality Management Plan** and **Chapter 9: Hydrology and Hydrogeology**) and if found to be excessive of 25 mg/L in any area, will subsequently be managed by the provision of additional silt attenuation features such as silt fences or silt traps.

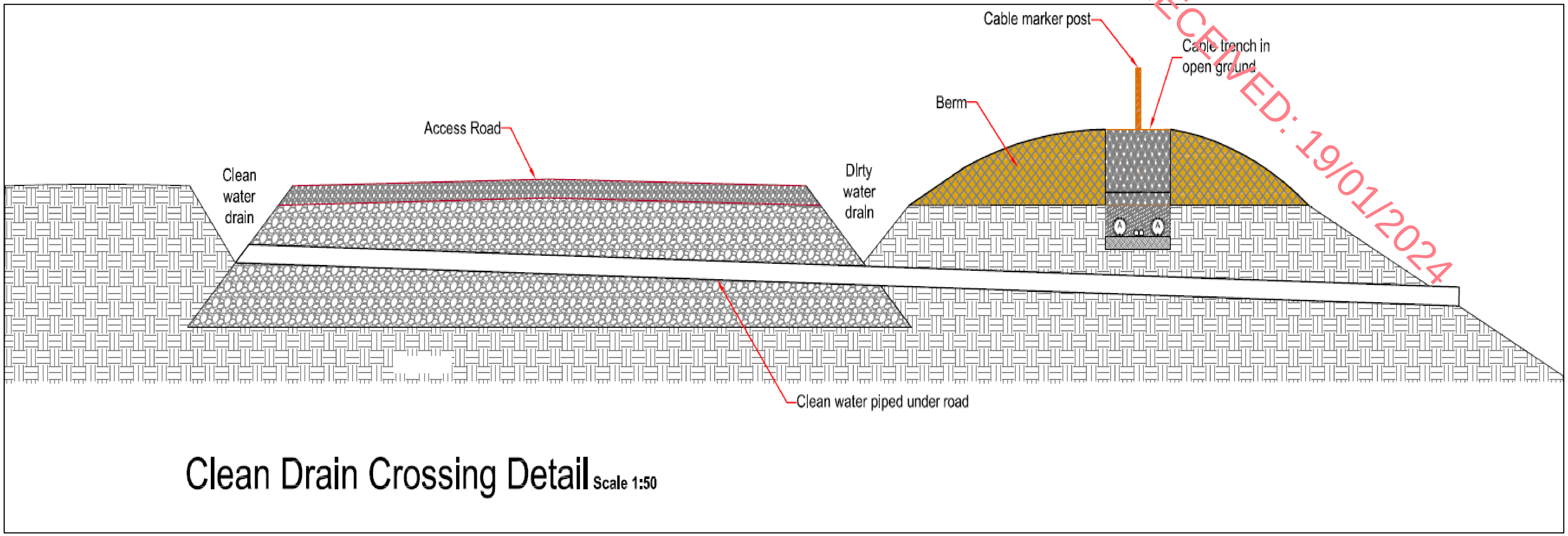

Figure 5.2: Proposed Road and Trench Sections and Drain Crossing Details.

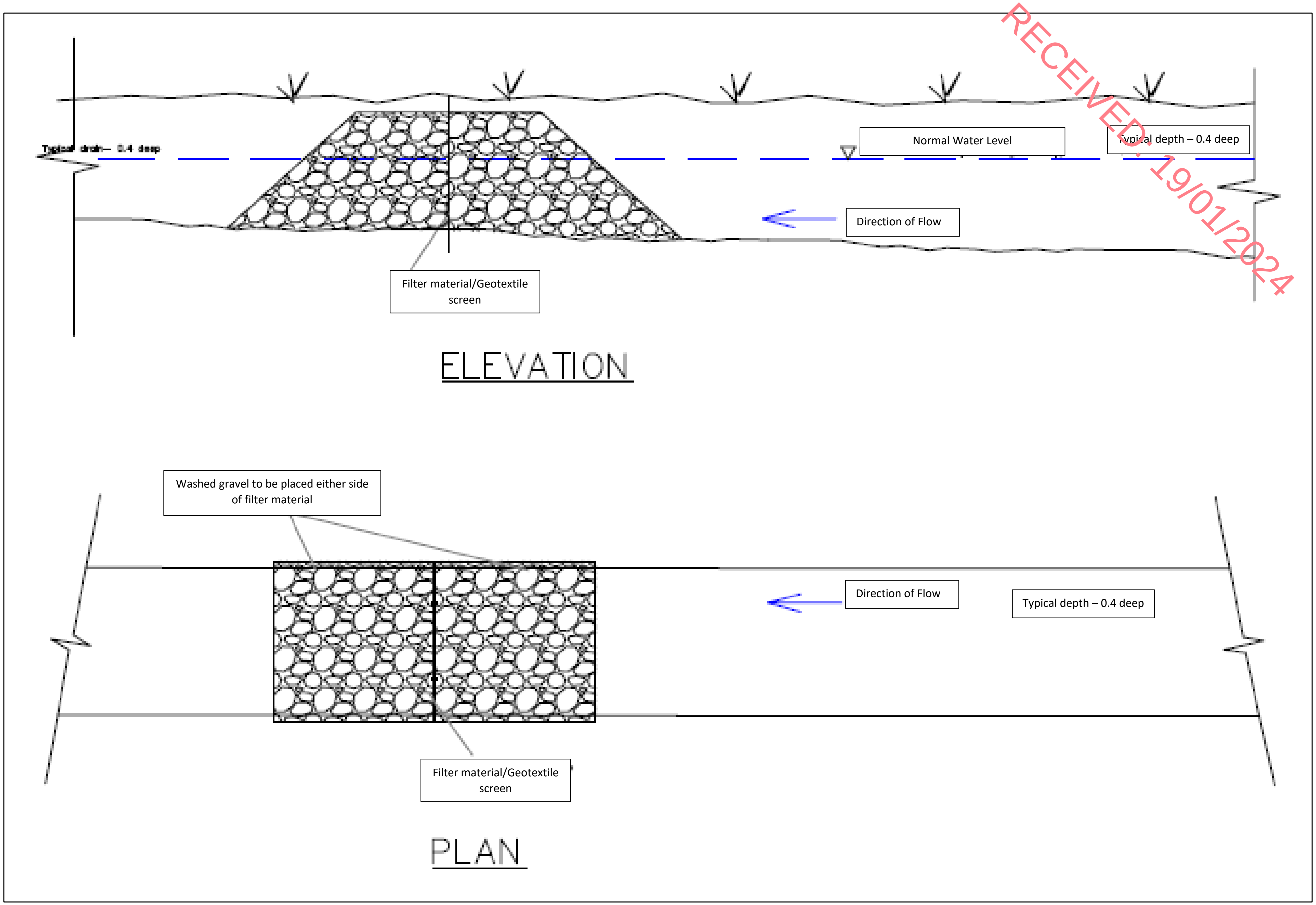

Figure 5.3: Typical silt trap

- 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 3.4) 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)

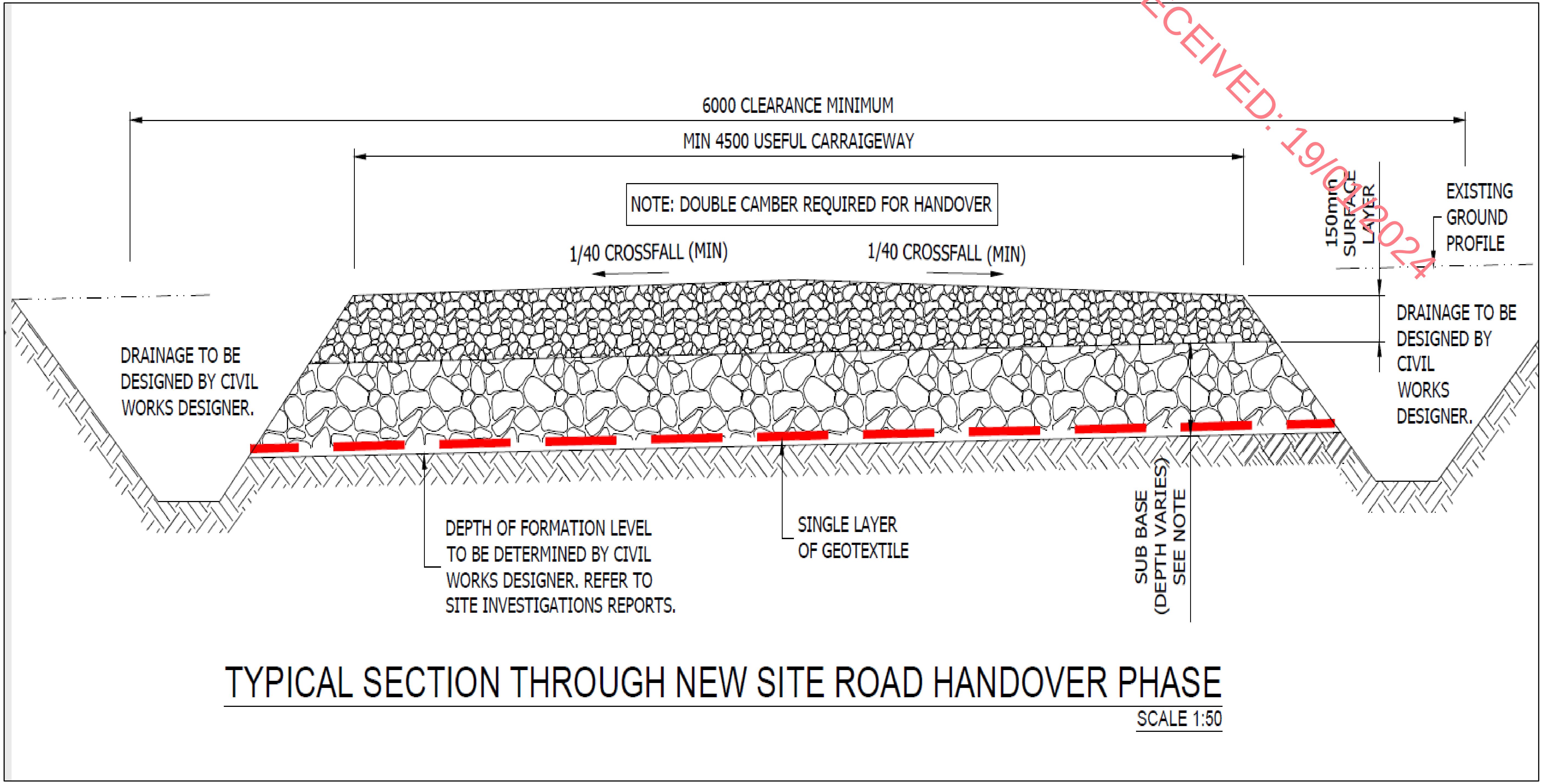

Figure 5.4: New Site Road Drainage

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.

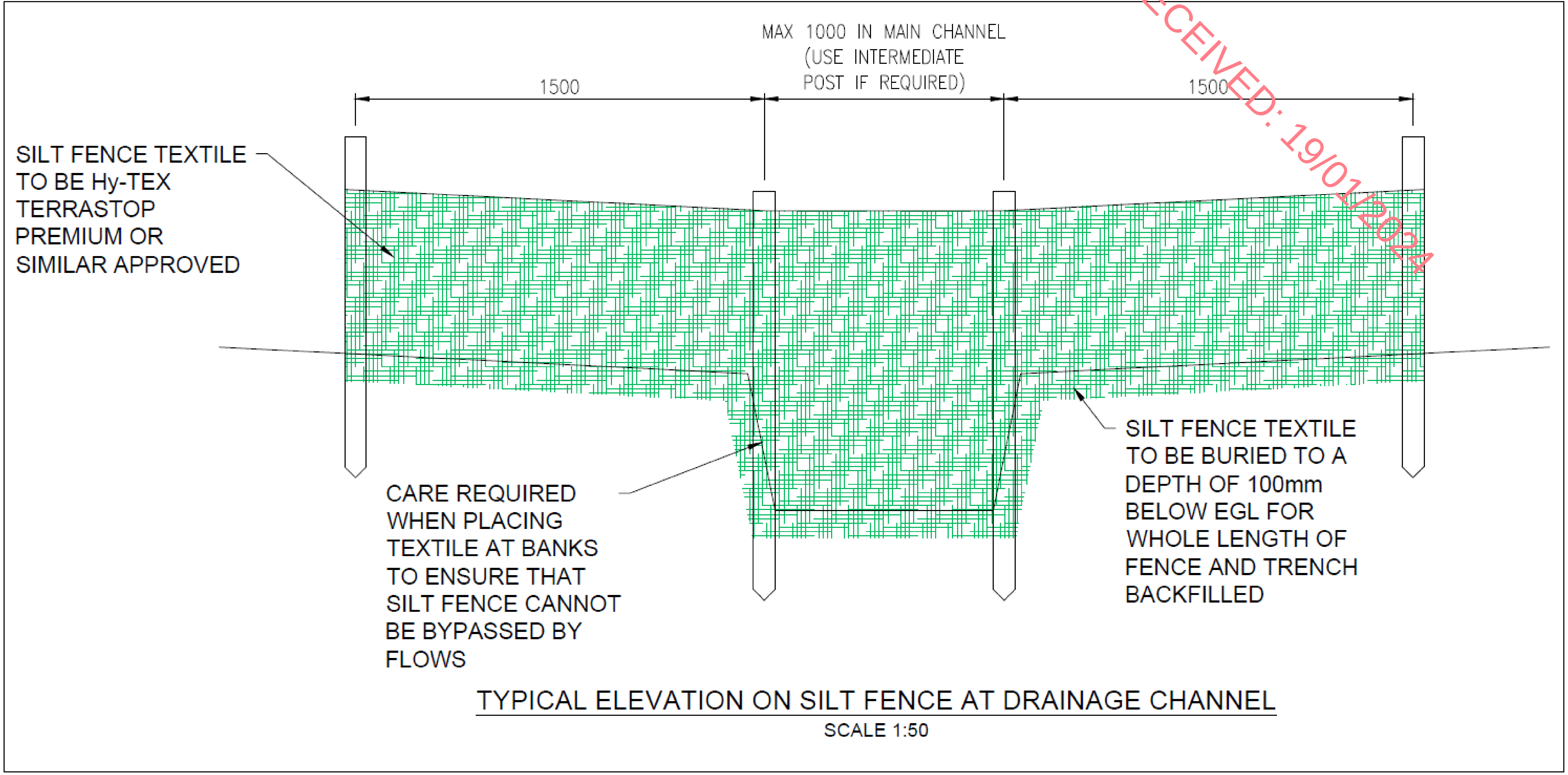

Figure 5.5: Illustration of silt fencing

Plate 5.2: Photograph of silt fencing

5.6 Filtration Check Dams

Check weirs 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.

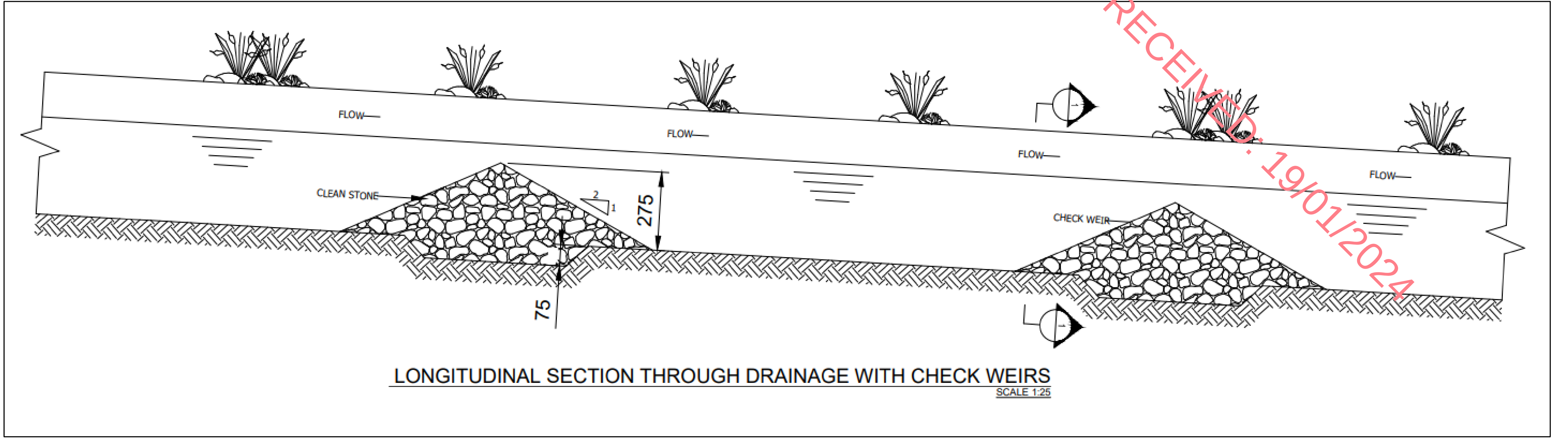

Figure 5.6 Diagram showing the function of check dams

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 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. 5969-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 (12) 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. freshwater pearl mussel catchments or 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 100yr 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 100 year rainfall return design (Source: Met Éireann - Please refer to **Appendix B**).
- An initial outlet overflow rate (the amount of water leaving the sediment pond per second per hectare) is applied of 30.06/s/ha (litres per second) which approximates to Greenfield run-off rates for the site. (Source: HR Wallingford – Please refer to **Appendix A**).
- The Rational Method is subsequently applied to calculate the flow volumes into each settlement pond over these respective periods. 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 5.2 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	5,910	71	18	4	1	72
SP2	6,850	91	12	3	1	36
SP3	1,650	31	12	3	1	36
SP4	5,925	71	18	4	1	72
SP5	1,525	29	12	3	1	36
SP6	4,985	60	15	4	1	72
SP7	2,515	48	12	4	1	48
SP8	4,520	54	15	4	1	72
SP9	1,245	24	9	3	1	36
SP10	1,245	24	9	3	1	36
SP11	2,100	40	12	4	1	48
SP12	1,940	37	12	3	1	36

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 Forestry Felling Drainage Management

Best practise methods related to water incorporated into the forestry management and water quality protection measures are as follows:

- Forest Service (2000): Forestry and Water Quality Guidelines. Forest Service, DAF, Johnstown Castle Estate, Co. Wexford
- Forest Service, (2000): Code of Best Forest Practice – Ireland. Forest Service, DAF, Johnstown Castle Estate, Co. Wexford
- COFORD (2004): Forest Road Manual – Guidelines for the design, construction and management of forest roads

Control Measures

- Forestry felling works must be overseen by the ECoW. Prior to the forestry works commencing the ECoW will carry out a pre-felling inspection to identify the main drainage ditches.
- Works will be carried out during periods of no, or low rainfall, in order to minimise entrainment of exposed sediment in surface water runoff.
- Machinery will be chosen which will minimise soils disturbance. Consideration will be given to the use of cable-crane extraction, to reduce soil disturbance.
- Checking and maintenance of roads and culverts will be undertaken by the ECoW through the felling operation.
- No tracking of vehicles through watercourses will occur, as vehicles will use road infrastructure and watercourse crossing points.
- Drains which flow from the areas to be felled will be blocked, and temporary sediment settlement ponds and silt fences will be used.
- Brash mats will be used to support vehicles on soft ground, reducing peat and mineral soils erosion and avoiding the formation of rutted areas, in which surface water ponding will occur.

- Timber will be stacked in dry areas away from surface water buffer zones. Straw bales to be emplaced on the down-gradient side of timber processing areas.
- Surface water samples will be taken downstream during the felling works at locations (**EIAR Figure 9.6a**). Daily sampling is recommended given the short duration and temporary nature of the works.

5.10 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 Development. The agitation of solids will be kept to a minimum during these works.
- 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**. Monitoring includes:

  <u>General</u>

  - 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 development.

  <u>Hydrochemistry Monitoring</u>

  - Sample locations, monitoring frequency and precise hydrochemistry parameters will be agreed in writing with Leitrim County Council, prior to commencement of construction, and following consultation with Inland Fisheries Ireland.
  - As a minimum, the monitoring programme will include:

- At least one baseline monitoring visit.

- 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 Leitrim County Council. 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 (TSS)
- Dissolved Organic Carbon (DOC)
- Conductivity
- Dissolved Oxygen (DO)
- Total Oxidized Nitrogen (TON)
- Ammoniacal Nitrogen
- Ammonia
- Potassium
- Phosphate
- Biological Oxygen Demand (BOD)
- Chemical Oxygen Demand (COD)
- Total Petroleum Hydrocarbons (TPH)*

* *Only during construction phase*

7 POST CONSTRUCTION DRAINAGE MANAGEMENT

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

APPENDIX A

MET ÉIREANN RAINFALL DATA

APPENDIX B

HR WALLINGFORD GREENFIELD RUN-OFF RATES

APPENDIX C

SETTLEMENT POND SIZING CALCULATIONS

APPENDIX D

DRAINAGE DRAWINGS