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# Surface Water Management Plan

## Kellystown Wind Farm

M02207-01\_DG03 | October 2024



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## 1 INTRODUCTION

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### 1.1 Terms of Reference

EDF via its lead consultant (Jennings O'Donovan) has appointed McCloy Consulting Ltd to prepare a Surface Water Management Plan (SWMP) to support a planning application for the proposed Kellystown Wind Farm (the Proposed Development).

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

This appendix is intended to supplement the Environmental Impact Assessment Report (EIAR) specifically **Chapter 11: Hydrology and Hydrogeology** and Technical **Appendix 11.3 Water Framework Directive Assessment** submitted in support of the planning application for the proposal.

### 1.2 Statement of Authority

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

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

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

### 1.3 Water Framework Directive

The European Water Framework Directive (2000/60/EC) was given legal effect in Ireland by the European Communities (Water Policy) Regulations 2003 (S.I. No. 722 of 2003). It applies to rivers, lakes, groundwater, and transitional coastal waters.

A requirement of the WFD is to attain good ecological water status and that deterioration in the status of water is prevented. The Environmental Impact Assessment Directive (85/337/EEC) requires likely significant environmental impacts to be identified, assessed, and mitigated. An impact that would compromise achievement of a WFD objectives or result in the deterioration in the status of waters would be considered a significant impact.

Any new development must ensure that this fundamental requirement of the Directive is not compromised. **Chapter 11: Hydrology and Hydrogeology** of the EIAR outlines mitigation measures specifically in relation to management of surface water (detailed further in this SWMP) to prevent deterioration of water quality and quantity. **Technical Appendix 11.3 Water Framework Directive Assessment** specially assess the effect of the Proposed Development on WFD objectives.

### 1.4 Hydrological / Drainage Setting

The hydrological setting is established at **EIAR Chapter 11**.

## 2 PERMANENT DRAINAGE

### 2.1 Approach

The permanent drainage plan will drain the permanent tracks, hardstanding, and compound areas to their finalised footprint after removal of areas of temporary widening during the construction phase.

The approach to drainage planning adopts a sustainable drainage approach and considers water quantity (rate of discharge affecting flood risk), water quality (to protect downstream receptors), amenity insofar as that is a limited consideration at the site, and biodiversity where water can be used to aide habitat management and improvement objectives.

### 2.2 Water Quantity Standards

Surface water drainage design is per the requirements of Louth County Council Development Plan and to the standards of Louth County Council Water Services Department, insofar as those standards apply to a development of this nature.

The County Development Plan includes objectives to promote the use of Sustainable Drainage Systems (SuDS). SuDS components are considered in relation to the nature and character of the site. The SuDS design demonstrates how water quantity and quality are dealt with as well as making provision for amenity and biodiversity where practicable.

Parts of the Proposed Development will cause an increase in the peak rate and volume of runoff from the site without mitigation. Permanent surface water drainage design, therefore, adopts SuDS principles and ensures that runoff from new impermeable and semi-impermeable surfaces (tracks, hard standings and ancillary infrastructure) shall be reduced to the pre-development greenfield rate. The principles adopted in the Drainage Plan are as follows:

The drainage system caters for protection for up to a 1% AEP rainfall event including allowance for climate change, common to the standard of protection for flooding from surface water drainage afforded by the Greater Dublin Strategic Drainage Study (GSDSDS) as best practice.

Proposed changes of surface are limited to proposed permeable or semi-impermeable (unbound gravel) tracks, hardstanding areas at turbine cranepads, and hardstanding areas at the proposed substation and Battery Energy Storage (BES). Flat lying track surfaces (gradients < 3%) will not require drainage where water will migrate vertically through the unbound gravel surface and subbase, and respond to rainfall in an identical way as existing greenfield runoff.

On all other steeper sections of tracks (conservatively adopted as >3%, where highly efficient permeable pavements are unsuitable at gradients >5%) where runoff is likely to flow laterally rather than infiltrate, runoff from access tracks shall be collected via open swales. Run-off shall be attenuated with the use of check dams in order to reduce the peak rate of run-off and to encourage infiltration of surface water. Outlets from swales will discharge to a control feature (basin) where water will be controlled and discharged. Disposal of water from positively drained areas will adopt a hierarchical approach to suit guidance in the SuDS manual and will either (in decreasing order of preference):

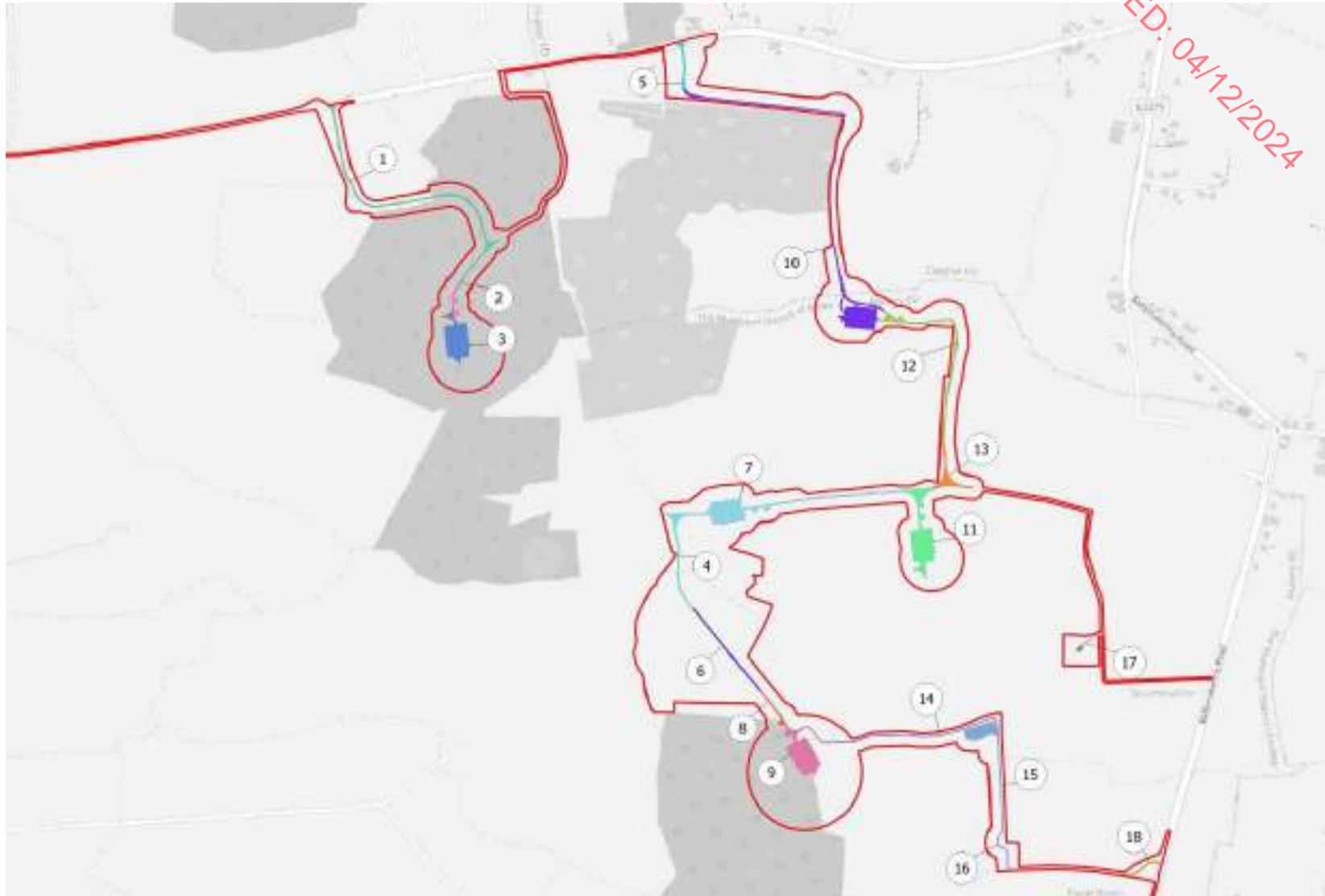
- be by infiltration at a designed feature (infiltration basin, infiltration other soakaway)
- be attenuated in an attenuation basin to a greenfield equivalent rate (Qbar) with the attenuated discharge being encouraged to disperse overland via a "level spreader"
- where a discharge to a watercourse is unavoidable, be attenuated in an attenuation basin to a greenfield equivalent rate (Qbar) and discharged to an outlet to a watercourse or drain.

Proposed permanent surface water drainage (SuDS) layout and typical detail drawings are included in **Annex A**.

#### 2.2.1 Sub catchments

Semi-impermeable areas have been split into sub-catchments and are shown on the following Figure 2.1 (overleaf).

Figure 2.1: Drainage Plan - Subcatchment Map



### 2.2.2 [Drainage Schedule](#)

A summary of the drainage approach per Subcatchment is scheduled as follows:

**Table 2-1: Drainage Subcatchment Schedule**

| Catchment ID | Area sq. m | Drainage Approach                               | Discharge Rate (lps) |
|--------------|------------|---|----------------------|
| 1            | 5659       | Attenuated Discharge to Watercourse (Drain)     | 2.2                  |
| 2            | 1075       | Attenuated Discharge overland by Level Spreader | 2                    |
| 3            | 6203       | Attenuated Discharge overland by Level Spreader | 2.4                  |
| 4            | 1803       | Attenuated Discharge overland by Level Spreader | 2                    |
| 5            | 964        | Infiltration Basin - Discharge to Ground        | NIL                  |
| 6            | 1589       | Infiltration through track subbase              | NIL                  |
| 7            | 9898       | Attenuated Discharge overland by Level Spreader | 3.8                  |
| 8            | 866        | Attenuated Discharge overland by Level Spreader | 2                    |
| 9            | 7420       | Attenuated Discharge to Watercourse (Drain)     | 2.8                  |
| 10           | 11862      | Attenuated Discharge overland by Level Spreader | 4.5                  |
| 11           | 9226       | Attenuated Discharge overland by Level Spreader | 3.5                  |
| 12           | 4004       | Attenuated Discharge overland by Level Spreader | 2                    |
| 13           | 2121       | Attenuated Discharge overland by Level Spreader | 2                    |
| 14           | 2045       | Attenuated Discharge to Watercourse (Drain)     | 2                    |
| 15           | 4770       | Infiltration Basin - Discharge to Ground        | NIL                  |
| 16           | 388        | Attenuated Discharge to Watercourse (Drain)     | 2                    |
| 17           | 297        | Infiltration through track subbase              | NIL                  |
| 18           | 757        | Infiltration Basin - Discharge to Ground        | NIL                  |

### 2.2.3 [Infiltration Design](#)

Ground conditions are suitable for infiltration on parts of the site. Geology and soils are described in **EIAR Chapter 10**. Site investigation data and Teagasc soil mapping indicates that parts of the site are underlain by sand, sandy clay, and some deep well drained soils.

Infiltration rates characteristic of the soil types encountered have been derived through comparison with relevant industry guidance. Selection of a mid-range infiltration coefficient of  $1 \times 10^{-5}$  m/s (0.018 m/hr), characteristic of clayey sand has been selected for purposes of planning design, and as such is conservative within the range permitted by all consulted industry guidance.

The planning design will be verified by in-situ infiltration testing per BRE 365, with testing to occur at the depth of formation of the planned infiltration basin.

Supporting calculations are included at **Annex E**.

### 2.2.4 [Attenuation Design](#)

The preliminary drainage plan intends surface water from the site to discharge either overland or directly to a minor watercourse/field drain via an attenuation basin at 13 no. locations. A flow control shall be

installed at the basin outflow point to ensure that flows are discharged at a greenfield limited rate up to the 1% AEP Climate Change event, which will ensure that there is no effect to flooding downstream

The storage calculation has not included the storage provided within the drainage conveyance system i.e. by check dams in swales. The attenuation sizes required are therefore considered conservative.

The pre-development greenfield runoff rate has been determined based on methods described in IH124. The specific runoff rate (Q<sub>Bar</sub>) at the site is 3.8 lps/Ha. Q<sub>Bar</sub> based on observations per the Wallingford method indicating a HOST class of 3 is adopted and is consistent with the Teagasc soil description and observed ground conditions.

The volume control approach for purposes of the design conservatively excludes long term storage and loss by infiltration, and therefore adopts a flow control rate of Q<sub>Bar</sub> or max 2 l/s/Ha but with a minimum practicable flow control rate of 2 lps, dictated by the need to manage potential maintenance / blockage issues.

Supporting calculations are included at **Annex E**. Proposed surface water drainage (SuDS) layout and detail drawings are included in **Annex A** and **Annex B** respectively.

## 2.3 Water Quality & Pollution Control

### 2.3.1 Wastewater Disposal

Wastewater from the staff welfare facilities in the control building will be collected in a sealed storage tank, fitted with a high-level alarm. This is a device installed in a fuel storage tank that is capable of sounding an alarm, during a filling operation, when the liquid level nears the top of the tank. All wastewater will be tankered off-site by a licensed waste collector to the nearest wastewater treatment plant, There will be no on-site treatment of wastewater.

### 2.3.2 Pollution Control (Oil)

Requirements vary dependent on drained surface type and specific measures are in place dependent on the proposed land use.

Operations on the site will involve infrequent visits by non-permanent staff. The site has been assessed as having sufficiently few traffic movements to be low risk, i.e. risk of infrequent light contamination and small spills only. The operational phase risk of minor spillages will be managed through the provision of SuDS which in sequence (swale > basin) provide a pollution control "Management Train".

Section 20 of the Greater Dublin Region Code of Practice for Drainage Works V6 states that where SuDS cannot be utilised or in areas where risk of pollution by petrol, oil, silt or other suspended materials appropriate interceptors must be installed. The substation / control compound includes transformers that use oil, however all oil storage is integrally bunded or external bunds are covered and so are not drained. The site will be drained via a comprehensive SuDS Management Train. No oil interceptor or separator is required.

Effectiveness of the proposed SuDS components in managing and remediating pollutants, using the CIRIA SuDS Manual 'simple index approach' is outlined in the following sections.

### 2.3.3 Emergency Response

The environmental assessment is precautionary and assesses the very unlikely potential for loss of control of a battery cell container. In that event fire suppression may include the fire service dousing adjacent units for cooling. Contaminated firefighting water migrating laterally to a surface water or vertically to groundwater may have potential to adversely affect the quality of surface or groundwater receptors. The approach is precautionary and presumes that the potential concentration of contaminants in water could reach a level that could cause potential environmental harm.

To mitigate the unlikely potential for contaminated water due to mixing of firefighting water with battery constituents, consideration has been given to potential for the need for firewater management at the battery storage site. NIEA / SEPA Pollution Prevention Guidelines (PPG) 18: Managing Firewater and Major Spillages

which is adopted as good practice in the absence of Irish-specific guidance sets out requirements for containment of runoff likely to carry firefighting contamination.

Measures adopted at the site prevent vertical and lateral pathways to waterbodies. Runoff in the event of a firefighting event will be stored within the permeable subbase and an adjacent open lagoon/basin, with infiltration to ground prevented by installation of an impermeable liner to the subbase and lagoon, and control of outflows by a pollution control valve. Storage in the BESS subbase (c. 1013 sq. m x 0.5m deep x typical 30% voids, c. 150 cu.m storage), contained to the site by an impermeable membrane, will eventually drain via perforated pipes to a lagoon with a capacity of a further min. 80 cu.m capacity. Total containment storage within the site will exceed the minimum recommended volume (228cu m) required to contain water used for boundary cooling per National Fire Chiefs Council (UK) - Grid Scale Battery Energy Storage System Planning - Guidance for Fire & Rescue Services, which is adopted as the best applicable guidance in the absence of an Irish equivalent.

Where loss of control is limited to a single BESS unit, fire suppression is by a mix of gas and internally supplied coolant by sprinkler which is self-contained. The drainage system is designed to give sufficient time to contain that water and allow for the arrangement of pumping facilities to remove the contaminated water from the network. Pumped firewater will be removed into suitable lorries which will transport this to a licensed facility for disposal.

The drainage layout including siting of the pollution control valve is shown on the Drainage Plan at Annex A.

#### 2.3.4 [Water Quality Indices](#)

Provision of water quality protection and treatment of runoff is per the indices guidance in the CIRIA SuDS Manual. The permanent access track, cranepads and substation area are taken as land use with low pollution risk, Table 26.2 of the SuDS Manual defines the pollution hazard as low, with pollution indices as follows.

|                        |     |
|------------------------|-----|
| Total Suspended Solids | 0.5 |
| Metals                 | 0.4 |
| Hydrocarbons           | 0.4 |

Provision of permeable surfaces, swale and infiltration basin in sequence will have a Pollution Mitigation Index per Table 26.3 and 26.15 of the SuDS Manual as shown in the following tables.

Table 2-2: Water Quality Indices – Infiltration from Subbase

| Pollutant    | Source Hazard Index | Permeable pavement / surface | Total Mitigation Index | Sufficient? |
|--------------|---------------------|------------------------------|------------------------|-------------|
| TSS          | 0.5                 | 0.7                          | 0.7                    | Yes         |
| Metals       | 0.4                 | 0.6                          | 0.6                    | Yes         |
| Hydrocarbons | 0.4                 | 0.7                          | 0.7                    | Yes         |

Table 2-3: Water Quality Indices – Trackside drainage to Infiltration Basin

| Pollutant    | Source Hazard Index | Swale | Infiltration Basin (0.5 mitigation index) | Total Mitigation Index | Sufficient? |
|--------------|---------------------|-------|---|------------------------|-------------|
| TSS          | 0.5                 | 0.7   | 0.025                                     | 0.725                  | Yes         |
| Metals       | 0.4                 | 0.4   | 0.025                                     | 0.425                  | Yes         |
| Hydrocarbons | 0.4                 | 0.6   | 0.025                                     | 0.625                  | Yes         |

Table 2-4: Water Quality Indices – Trackside drainage to Attenuation Basin

| Pollutant    | Source Hazard Index | Swale | Infiltration Basin (0.5 mitigation index) | Total Mitigation Index | Sufficient? |
|--------------|---------------------|-------|---|------------------------|-------------|
| TSS          | 0.5                 | 0.5   | 0.25                                      | 0.75                   | Yes         |
| Metals       | 0.4                 | 0.6   | 0.25                                      | 1.0                    | Yes         |
| Hydrocarbons | 0.4                 | 0.6   | 0.3                                       | 1.0                    | Yes         |

In relation to previous Table 2-1, discharges from attenuation basins that discharge overland via level spreader have an additional stage of treatment (percolation through drainage stone, percolation and filtration over intact vegetated ground) which further increases the water quality provision.

In summary there is certainty that the permanent drainage will ensure that runoff from the Proposed Development is treated to a standard that would not cause an adverse change to water quality elsewhere.

## 2.4 Maintenance Requirements

Permanent drainage assets shall be the responsibility of the site operator to maintain. The developer shall put in place drainage management procedures as part of the overall facility management. Maintenance plans for drainage features are shown in the following table.

**Table 2-5 Permanent Drainage – Operational Maintenance Schedule**

| Feature                          | Maintenance Requirements  | Time   |
|----------------------------------|---|--|
| Swales                           | Vegetation maintenance – replace / repair scour<br>Rebuild check dams   | Inspect annually.<br>Repair as required.               |
| Attenuation Basins               | Vegetation control – clear obstructions<br>Inlets & outlets – clear obstructions  | Annual and / or<br>After significant storm events      |
| Infiltration Basin               | Excessive depth or duration of standing water within basins following a rainfall event (48hrs +) may indicate failure of infiltration due to blinding of the base with fine sediment. Maintenance requirements would entail removal of silt by excavator and reinstatement of the basin in accordance with design drawings<br><br>Compacted or smeared soil layers in basins should be loosened by mechanical tilling (min. top 300mm) and re-planted | To suit observed conditions                            |
| Level Spreaders                  | Vegetation control – clear obstructions<br>Clearing / replacement of drainage stone<br>Checking for blockage of perforated outlet pipes and jetting as required.  | Inspect annually.<br>Repair as required.               |
| Flow control devices             | Checking of devices for siltation/blockages and clearing as required<br>Checking of device outlets for damage and undertaking remediation   | Annual and / or<br>After significant storm events      |
| Oil Interceptors                 | Clearing/ desludging  | Per manufacturers recommendations and after any spills |
| Inlets/Gullies/Drainage channels | Checking for siltation/blockage and jetting as required   | Annual and / or<br>After significant storm events      |

### 3 PERMANENT WATERCOURSE CROSSINGS

#### 3.1 Watercourse Crossing Design

To allow the built footprint of the Proposed Development the following is required:

- 3 no. crossings of minor watercourses.

No other temporary watercourse crossings are required.

Works to watercourse crossings will be subject to future authorisation by the Office of Public Works (OPW) under Section 50 of the Arterial Drainage Act 1945.

A sufficiently detailed design to allow assessment of environmental effects has been prepared as part of this assessment. Final design of watercourse crossings will be undertaken at detailed design stage, post planning consent.

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

- Hydrological assessments made using appropriate methods to determine the design flow. Culverts are designed to convey the 1% AEP flood, including climate change (MRFS scenario), with free inlet conditions. The design of WX01 allows for future changes to flows as a result of planned restoration work at the adjacent quarry;
- CIRIA Culvert design and operation guide (C689); and
- Fisheries considerations shall incorporate guidance stated in 'Guidelines on Protection of Fisheries During Construction Works in and Adjacent to Waters' as published by Inland Fisheries Ireland (2016).

Minimum dimensions are established in the watercourse crossing schedule at a **Watercourse Crossing Schedule** at **Annex F** to this report, including supporting calculations.

Watercourse crossings on the site shall comprise conventional closed culverts. Factors considered in the design and orientation of all watercourse crossings includes:

- Crossing direction to generally be perpendicular with access track direction, therefore minimising the length of stream affected;
- Consideration of the passage of out-of-bank flood flows; and
- Additional mitigation will be designed to prevent pollution of the watercourse during the construction of the watercourse crossing to reduce residual risk; comprising the temporary installation of silt fences in the stream channel downstream or similarly effective measures.

Design ensures that culverts are installed at a level lower than existing bed levels in order to create a "stilling" effect and reduce potential for increased local flow velocities in the culvert in addition to promoting the formation of a natural substrate within the culvert. A piped culvert detail is shown on drawing SWMP\_24 included in **Annex B**.

#### 3.2 Construction Phase Mitigation

Residual risk to watercourses specific to the construction stage will be fully addressed in the Contractor's construction method statement and will include the following:

- Works to install all crossings shall be programmed to coincide with a period of anticipated low drain flow and firm ground conditions in order to minimise potential for silt laden runoff draining toward the stream;
- For closed crossings (culverts) the channel will be dammed upstream of the proposed culvert location using sandbags or similar in order to provide a dry working environment at the culvert location. Dammed flows will be pumped out of channel and returning directly to the drain shortly downstream of the culvert location. Erosion protection shall be placed at the point of pump return. All pumping will be controlled on a contractor permit-to-pump scheme, such that pumping operations can be carefully planned, installed and monitored;
- Geotextile silt fences shall be installed adjacent to the drain bank upstream and downstream of the culvert location 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; Silt fence arrangements are shown on drawing SWMP\_41 included in Annex D.

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

### 3.3 Maintenance

Permanent drainage assets shall be the responsibility of the site operator to maintain. The developer shall put in place drainage management procedures as part of the overall facility management. Maintenance plans for drainage features are shown in the following table.

**Table 3-1 Permanent Culverts – Operational Maintenance Schedule**

| Feature                  | Maintenance Requirements   | Time   |
|--------------------------|--|--|
| Culvert Inlets / outlets | Vegetation maintenance – remove<br>Clear siltation and debris causing blockage             | Inspect twice annually and after significant storms.<br>Repair as required.              |
| Culvert barrel           | Inspect (visual / by camera) for cracking / fracturing and deflection. Repair as required. | Inspect prior to any heavy traffic movements for maintenance during the operation phase. |

## 4 CONSTRUCTION PHASE - TEMPORARY DRAINAGE & WATER MITIGATION

### 4.1 Preamble

The following key considerations have been identified in the planning-stage design of hydrology and drainage for the site to preserve water quality, downstream hydrology and preserve stream morphology sufficiently that there is certainty that the measures can be implemented effectively and to ensure that the assessment of residual effects can be predicted with certainty. The measures at planning stage will provide a framework within which any future design will match or better. Key concerns addressed by the planning-stage design are as follows:

- Definition of Buffer Zones;
- Separation of 'clean' and 'dirty' water; and
- Management and treatment of reduced quality runoff from the works ("dirty water").

A temporary works SuDS design has been prepared for purposes of the planning application. The design as presented in the planning application is conservative in its approach and is sufficiently detailed to allow a robust appraisal of the scheme in EIA terms, including consideration of the scheme earthworks footprint. Temporary drainage layouts prepared to inform the planning application are shown at Temporary Drainage Management Drawings at Annex C.

Specific requirements to be imposed on any Contractor involved in the construction of the scheme will be further outlined in a detailed Construction Environmental Management Plan (CEMP) which will include Construction Method Statements, which can be subject to approval by the relevant local authority prior to construction.

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

This section of the report outlines the steps which will be undertaken during the construction phase of the project to ensure compliance with relevant best practice guidance stated in **EIA Chapter 11**. Site visits by the SuDS Engineer will be agreed in advance and will be undertaken at various stages of the construction process to ensure that the proposed SuDS scheme is being constructed in line with the design.

Essential mitigation measures relevant to controlling erosion and runoff from construction of the SuDS are described in best practice guidance stated in **EIA Chapter 11**.

**The measures proposed for the Construction Phase shall be similarly implemented for the Decommissioning Phase.**

### 4.2 Pollution Prevention Buffer Zones

Buffer zones to water features have been established within the Site Boundary in **Chapter 11: Hydrology and Hydrogeology**. Proposed infrastructure is designed to lie out with stated hydrological buffer zones as described in the EIAR.

The same buffers and additional buffers to known potable water supplies will apply during the construction phase to limit the types of construction activities permissible in proximity to water, and to ensure additional precautions are applied in relation to pollution prevention (spills etc). Buffer areas will act as riparian zones allowing filtration and settlement, minimising sediment transport, attenuating flows and maximising infiltration.

Construction phase buffers are shown on the Temporary Drainage Management Drawings at Annex C.

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

- Due cognisance will be given to the prevailing ground conditions and season when programming the execution of the works, to seek to undertake the works in a period with low potential to cause introduction of silt laden runoff to on-site water features;

- Works will be planned so that trackside drains do not discharge directly into watercourses, but rather through a buffer area of adequate width or via a constructed settlement feature such as pond or sequence of silt fences;
- Cement and concrete will be kept out with buffer zone to avoid contamination of watercourses;
- Runoff from excavations will not be pumped directly to watercourses. Where dewatering of excavations is required, water shall be pumped to the head of a treatment train (swale, basin, or detention pond) to receive full treatment prior to re-entry to the natural drainage system; and
- SuDS treatment techniques will be utilised to remove silts from runoff prior to the discharge of flows over open vegetated areas.

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

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

### 4.3 Timing of Works

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

### 4.4 Temporary Drainage

#### 4.4.1 Main Principles

During the construction phase the following principles have been employed when planning temporary drainage requirement:

“clean” drainage / runoff from land upslope of the works footprint will be managed through or around the works in order to avoid mixing clean and “dirty” water.

- “Clean” drainage / runoff from land upslope of the works footprint will be managed through or around the works in order to avoid mixing clean and “dirty” water;
- Reduced quality runoff (“dirty water”) from the works will be managed and treated before it is discharged to any watercourse;
- Dirty water collected in temporary drainage will be dispersed frequently overland to allow filtration in vegetation, which is likely to be more effective in removing sediment than larger settlement basins; and
- Significant accumulations of dirty water at low points where water will be treated at temporary settlement ponds prior to any discharge to a watercourse.

The measures are more fully described in the following sections.

#### 4.4.2 Site-Wide Requirements

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

Temporary drainage measures in advance of earthworks will include:

- Temporary silt fences erected in areas where risk of pollution to watercourses has been identified e.g., watercourse crossing locations and areas where development (such as felling) unavoidably lie within watercourse buffer zones;
- Upslope cut-off drainage channels approximately parallel to the proposed track alignment installed in advance of any excavated cuttings for the track or turbine hardstanding areas. This will prevent washout by surface flows of exposed clays in excavations and fine sediments in track makeup, and increase efficiency of silt removal in future trackside drainage swales;

- Minor drains, other flow paths and cut-off drain outlet locations will be identified and charted, to ensure that piped crossings can be installed in advance of or adjacent to the track construction;
- Settlement ponds will be constructed in advance of commencing excavations for foundations and at any other locations identified as required at detailed design stage; and
- Trackside drainage swales will be installed in parallel with track construction. Note that this may require that drainage swales are reformed on an ongoing basis as temporary track alignments are modified to their eventual finished design level.

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

Suitable prevention measures will always be in place to prevent the conveyance of silts to receiving watercourses.

#### 4.4.3 Clean / Polluted Water Separation

Drainage management ensures that significant flows of clean water is not permitted to mix with contaminated water from sources such as excavation dewatering or track runoff, where “clean water” should be interpreted as natural surface runoff unaffected by construction / earthworks runoff.

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

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

Temporary silt / pollution prevention and scour protection measures (such as check dams) is provided in artificial clean water drainage installed to mitigate potential for scouring and transport of sediment from newly excavated channels.

Diversion drainage is to be dispersed over vegetated ground. Diversions are designed to avoid collection and interception of large catchments creating significant point flows, with associated risks due to scour and hydraulic capacity.

Temporary drainage is intended to be reinstated on completion of the temporary works.

Clean water drainage is shown on drawings included at Annex C Annex A and cutoff arrangements and culvert arrangements to pass clean water through / around works is shown at **SWMP\_43** in Annex D.

#### 4.4.4 Temporary Track Drainage

All track runoff (dirty water) will be directed to flow to ditches / swales installed to the track-edge, to be installed as tracks are constructed.

Dirty water will be discharged via frequent spillways created on the downhill sides of the access tracks.

Temporary drainage will be reinstated to the permanent drainage (refer to Section 2) to suit the permanent infrastructure footprint. Drainage track shoulders will be re-vegetated as soon as feasible after completion of the track and drainage across the site.

#### 4.4.5 Check Dams

Initial treatment is provided “at source” by check dams installed within trackside drainage at regular frequencies, to reduce flow velocities and improve conditions for the settlement of solids in transit.

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

Where stone is used, the aggregate used to form check dams will be a small ‘clean’ graded stone. On steeper slopes the check dams will be anchored using larger stone placed on the downhill side of the check dam to prevent washing away of the smaller graded stone.

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

#### 4.4.6 Settlement Basins

Washout pits to be located local to large excavations (i.e. turbine bases) are to accommodate the anticipated volume of contaminated water to be removed from the excavation, either through unavoidable surface water runoff or accumulation of shallow groundwater. Washout pits for concrete (washdown of concrete delivery plant) will be treated separately and shall be lined, with washwater removed for treatment offsite.

#### 4.4.7 Vegetative Filtration

Wherever possible, runoff from swales, ponds, or other pumped discharges will be dispersed over undisturbed intact vegetation, nominally over agreed riparian watercourse buffer zones, to allow vegetative filtration of runoff prior to water entering receiving watercourses.

### 4.5 Turbine Bases and Crane Pads

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

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

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

### 4.6 Cable Trenches

The following shall apply to the construction of all cable trenches at the site:

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

### 4.7 Dewatering

To control dewatering activities and to ensure that all dewatering allows for pollution prevention measures, a permit-to-work system will be implemented by the Contractor, particularly to ensure pumped dewatering

from excavations is controlled. A permit will be required to be issued to a competent person prior to allowing any specific dewatering to commence.

#### 4.8 Spoil Management

Design of permanent and temporary spoil management ensures the following:

- There will be no depositing of material within the watercourse buffer zones;
- Spoil shall be placed in such a manner to ensure no ponding of surface water on top of spoil heaps. Temporary spoil will be graded to ensure that all direct precipitation will run directly off the surface;
- Temporary spoil deposition areas ensure that natural flow paths (drainage channels) are not altered or blocked by deposited spoil; and

#### 4.9 Temporary Foul Drainage

The project will include an enclosed wastewater management system at the temporary compound capable of handling the demand during the construction phase with 52 to 65 on site at peak. A holding tank is proposed for wastewater management. Wastewater will be removed off-site weekly, by a licensed wastewater disposal company and disposed at an appropriate licenced facility, likely to be situated in the Drogheda area.

#### 4.10 Forestry Felling

Felling to facilitate construction works will take place prior to groundworks commencing. Water protection measures will reduce the risk of suspended solids and nutrient release in surface watercourses.

- Felling and extraction of timber, as far as possible, should be conducted during periods of dry weather. During a period of heavy rainfall, harvesting works should cease until the site has dried out to reduce the risk of siltation, rutting and soil compaction; and
- Any drains crossed during the extraction phase to be kept clear of any residues/debris to ensure no drainage issues arise for the remaining trees.

#### 4.11 Construction Phase Maintenance

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

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

##### 4.11.1 Drains / Check Dams

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

#### 4.11.2 Settlement Basins

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

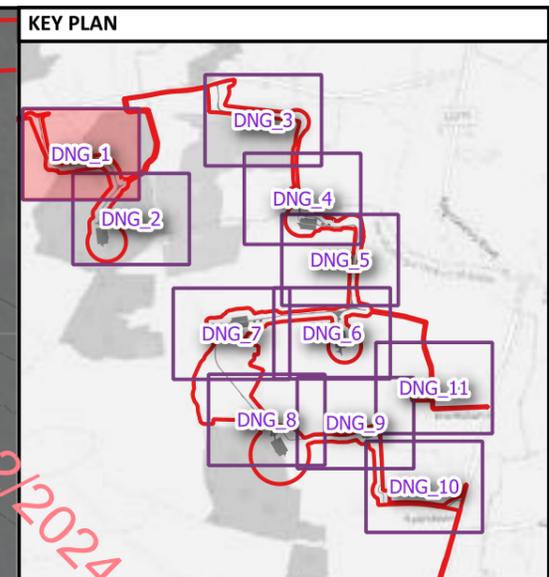
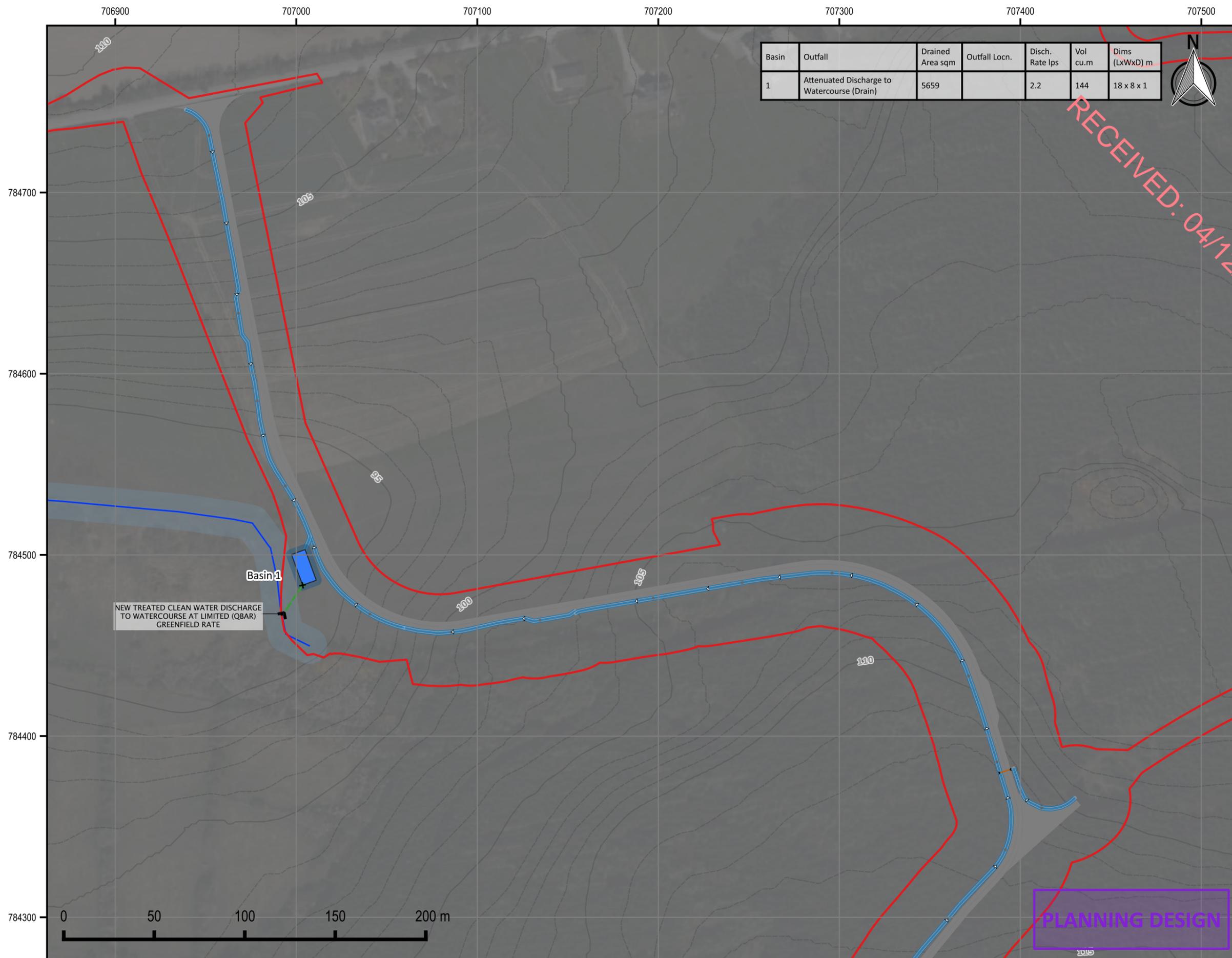
#### 4.11.3 Drainage Pipes

- Piped drainage (clean water / dirty water) to be monitored at inlets. Silt to be removed by hand or by excavator and disposed of; and
- Pipe deflection to be monitored. Ineffective gradients to be identified and pipes excavated and replaced to ensure drainage function.

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Annex A  
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# Permanent Drainage - Layouts



**LEGEND**

**Infrastructure**

- Application Boundary
- Permanent Infrastructure Footprint

**Hydrology Features & Constraints**

- "Major" Watercourse
- "Minor" Watercourse
- Other existing drainage
- Water Feature Setback / Buffer Zone (10m / 50m)
- Habitat Management Areas
- Wetland

**Permanent Drainage Features**

- Swale / Track Edge Drainage with Check Dams
- Track Drainage Pipe
- Attenuation Basin
- Infiltration Basin
- Flow Control + Outlet to Watercourse
- Flow Control + Outlet to Level Spreader (discharge overland)
- Proposed Watercourse Crossing (Culvert)

**BESS Pollution Control Features**

- Detention Basin
- Lined Impermeable Subbase
- BES Drainage & Pollution Control Valve

NEW TREATED CLEAN WATER DISCHARGE TO WATERCOURSE AT LIMITED (QBAR) GREENFIELD RATE

PLANNING DESIGN

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|--|--------------|-----------------|-------------|
| <b>DESCRIPTION</b>                                       |              |                 |             |
| KELLYSTOWN WIND FARM - PERMANENT DRAINAGE LAYOUT SHEET 1 |              |                 |             |
| <b>PROJECT / FIGURE NO.</b>                              |              |                 |             |
| M02207-01_DNG_1  |              |                 |             |
| <b>DRAWN BY</b>  | <b>SCALE</b> | <b>REVISION</b> | <b>DATE</b> |
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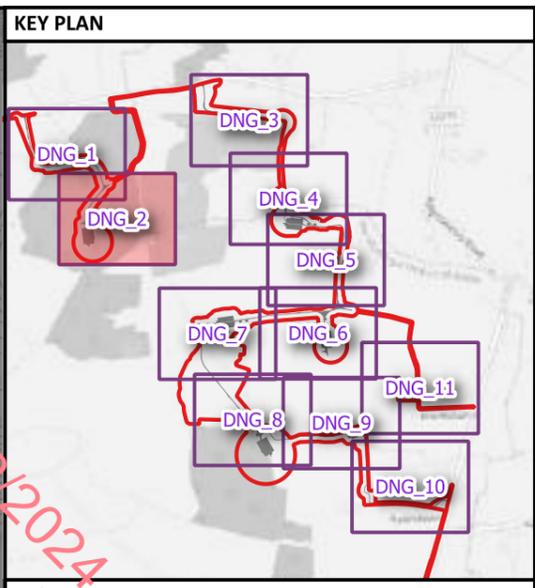
2. ADDITIONAL TEMPORARY DRAINAGE / MITIGATION WILL BE PROVIDED DURING THE CONSTRUCTION PHASE ON AN OBSERVATIONAL BASIS. REFER TO SEPERATE TEMPORARY DRAINAGE LAYOUTS.

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4. ALL DRAINAGE MANAGEMENT FEATURES SHOWN SHOULD BE READ IN CONJUNCTION WITH RELEVANT DETAIL DRAWINGS.



| Basin | Outfall   | Drained Area sqm | Outfall Locn. | Disch. Rate lps | Vol cu.m | Dims (LxWxD) m |
|-------|---|------------------|---------------|-----------------|----------|----------------|
| 2     | Attenuated Discharge overland by Level Spreader | 1075             |               | 2               | 16       | 5 x 4 x 0.8    |
| 3     | Attenuated Discharge overland by Level Spreader | 6203             |               | 2.4             | 160      | 16 x 10 x 1    |



**LEGEND**

**Infrastructure**

- Application Boundary
- Permanent Infrastructure Footprint

**Hydrology Features & Constraints**

- "Major" Watercourse
- "Minor" Watercourse
- Other existing drainage
- Water Feature Setback / Buffer Zone (10m / 50m)
- Habitat Management Areas
- Wetland

**Permanent Drainage Features**

- Swale / Track Edge Drainage with Check Dams
- Track Drainage Pipe
- Attenuation Basin
- Infiltration Basin
- Flow Control + Outlet to Watercourse
- Flow Control + Outlet to Level Spreader (discharge overland)
- Proposed Watercourse Crossing (Culvert)

**BESS Pollution Control Features**

- Detention Basin
- Lined Impermeable Subbase
- BES Drainage & Pollution Control Valve

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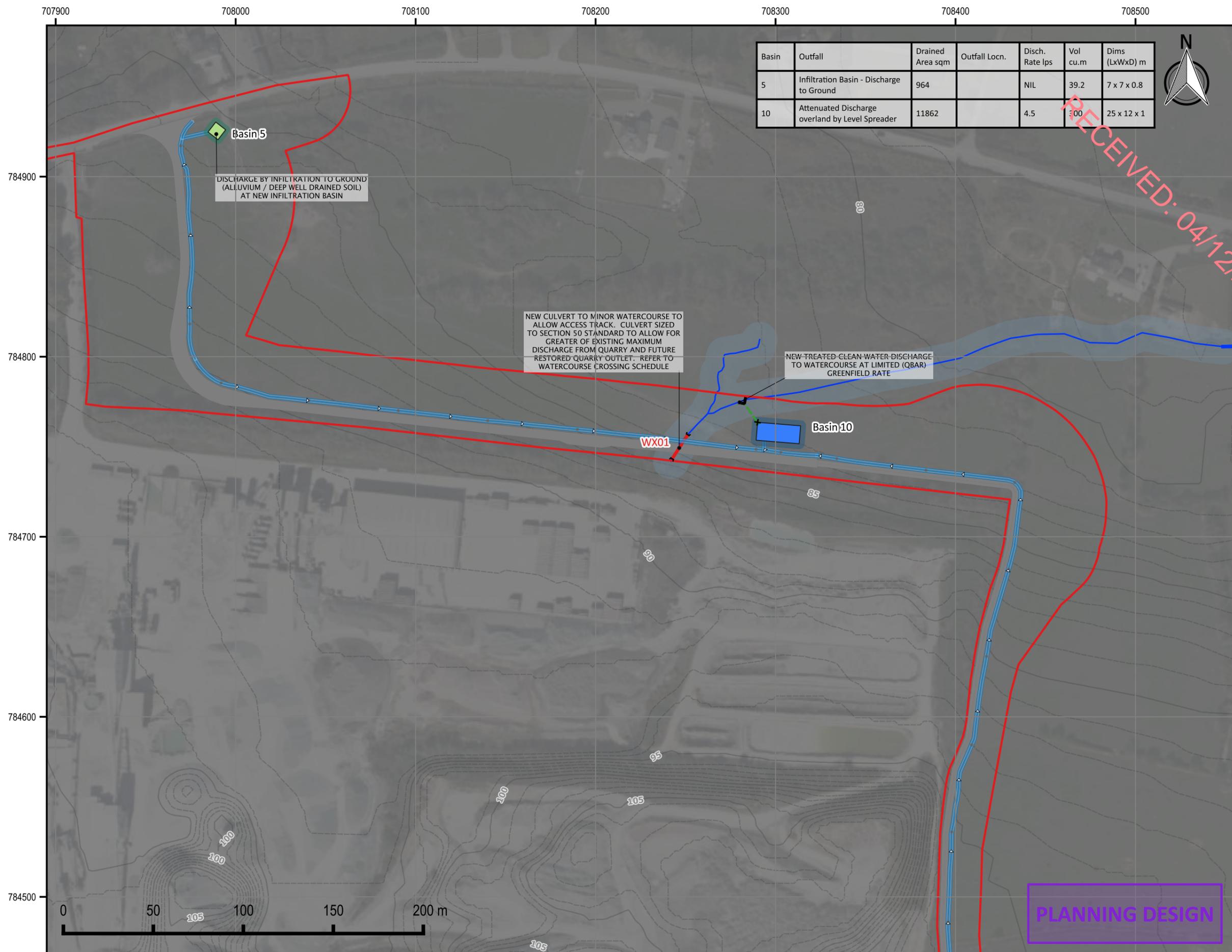
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|--|--------------|-----------------|-------------|
| <b>DESCRIPTION</b>                                       |              |                 |             |
| KELLYSTOWN WIND FARM - PERMANENT DRAINAGE LAYOUT SHEET 2 |              |                 |             |
| <b>PROJECT / FIGURE NO.</b>                              |              |                 |             |
| M02207-01_DNG_2  |              |                 |             |
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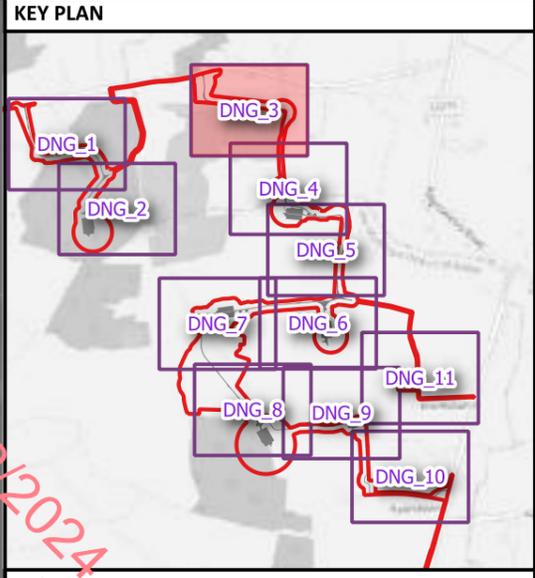


| Basin | Outfall   | Drained Area sqm | Outfall Locn. | Disch. Rate lps | Vol cu.m | Dims (LxWxD) m |
|-------|---|------------------|---------------|-----------------|----------|----------------|
| 5     | Infiltration Basin - Discharge to Ground        | 964              |               | NIL             | 39.2     | 7 x 7 x 0.8    |
| 10    | Attenuated Discharge overland by Level Spreader | 11862            |               | 4.5             | 300      | 25 x 12 x 1    |

Basin 5  
DISCHARGE BY INFILTRATION TO GROUND (ALLUVIUM / DEEP WELL DRAINED SOIL) AT NEW INFILTRATION BASIN

NEW CULVERT TO MINOR WATERCOURSE TO ALLOW ACCESS TRACK. CULVERT SIZED TO SECTION 50 STANDARD TO ALLOW FOR GREATER OF EXISTING MAXIMUM DISCHARGE FROM QUARRY AND FUTURE RESTORED QUARRY OUTLET. REFER TO WATERCOURSE CROSSING SCHEDULE

NEW TREATED CLEAN WATER DISCHARGE TO WATERCOURSE AT LIMITED (QBAR) GREENFIELD RATE



**LEGEND**

**Infrastructure**

- Application Boundary
- Permanent Infrastructure Footprint

**Hydrology Features & Constraints**

- "Major" Watercourse
- "Minor" Watercourse
- Other existing drainage
- Water Feature Setback / Buffer Zone (10m / 50m)
- Habitat Management Areas
- Wetland

**Permanent Drainage Features**

- Swale / Track Edge Drainage with Check Dams
- Track Drainage Pipe
- Attenuation Basin
- Infiltration Basin
- Flow Control + Outlet to Watercourse
- Flow Control + Outlet to Level Spreader (discharge overland)
- Proposed Watercourse Crossing (Culvert)

**BESS Pollution Control Features**

- Detention Basin
- Lined Impermeable Subbase
- BES Drainage & Pollution Control Valve

| Culvert ID | Dimension (m) | DESCRIPTION  |
|------------|---------------|--|
| WX01       | 0.9           | NEW 0.9M DIA PIPE CULVERT (CLASS 120 CONCRETE OR EQUIVALENT) |

PLANNING DESIGN

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| <b>DESCRIPTION</b>                                       |              |                 |             |
| KELLYSTOWN WIND FARM - PERMANENT DRAINAGE LAYOUT SHEET 3 |              |                 |             |
| <b>PROJECT / FIGURE NO.</b>                              |              |                 |             |
| M02207-01_DNG_3  |              |                 |             |
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**NOTES**

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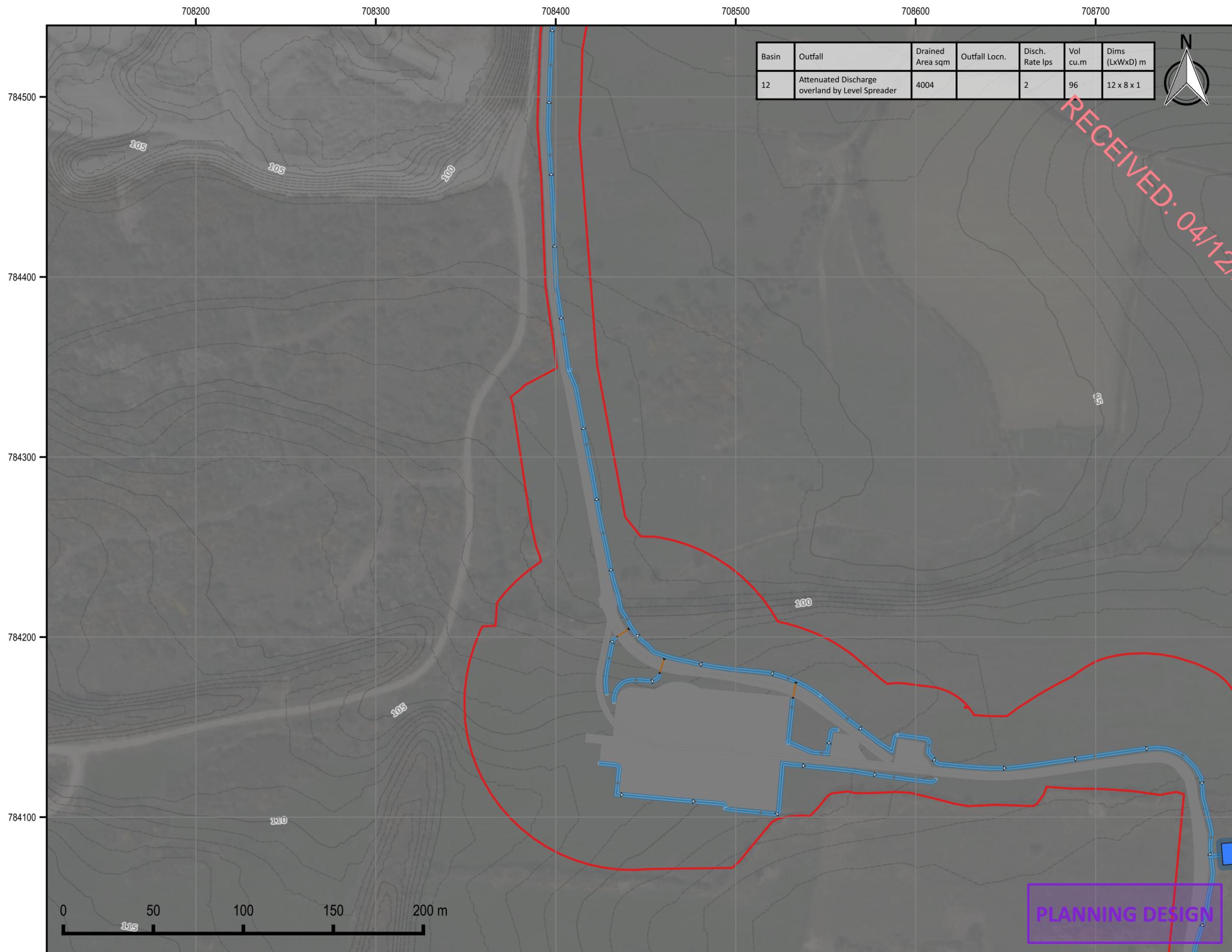
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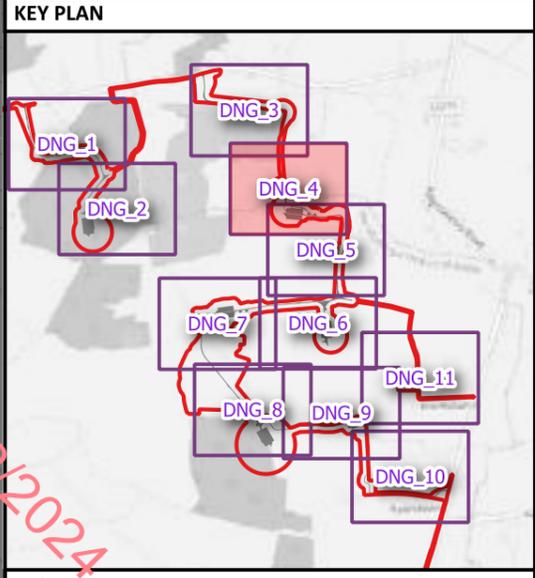
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| Basin | Outfall   | Drained Area sqm | Outfall Locn. | Disch. Rate lps | Vol cu.m | Dims (LxWxD) m |
|-------|---|------------------|---------------|-----------------|----------|----------------|
| 12    | Attenuated Discharge overland by Level Spreader | 4004             |               | 2               | 96       | 12 x 8 x 1     |



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**LEGEND**

**Infrastructure**

- Application Boundary
- Permanent Infrastructure Footprint

**Hydrology Features & Constraints**

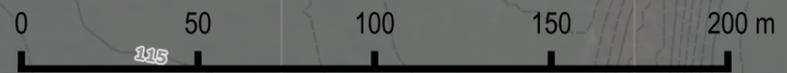
- "Major" Watercourse
- "Minor" Watercourse
- Other existing drainage
- Water Feature Setback / Buffer Zone (10m / 50m)
- Habitat Management Areas
- Wetland

**Permanent Drainage Features**

- Swale / Track Edge Drainage with Check Dams
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- Attenuation Basin
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- Flow Control + Outlet to Watercourse
- Flow Control + Outlet to Level Spreader (discharge overland)
- Proposed Watercourse Crossing (Culvert)

**BESS Pollution Control Features**

- Detention Basin
- Lined Impermeable Subbase
- BES Drainage & Pollution Control Valve



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| KELLYSTOWN WIND FARM - PERMANENT DRAINAGE LAYOUT SHEET 4 |              |                 |             |
| <b>PROJECT / FIGURE NO.</b>                              |              |                 |             |
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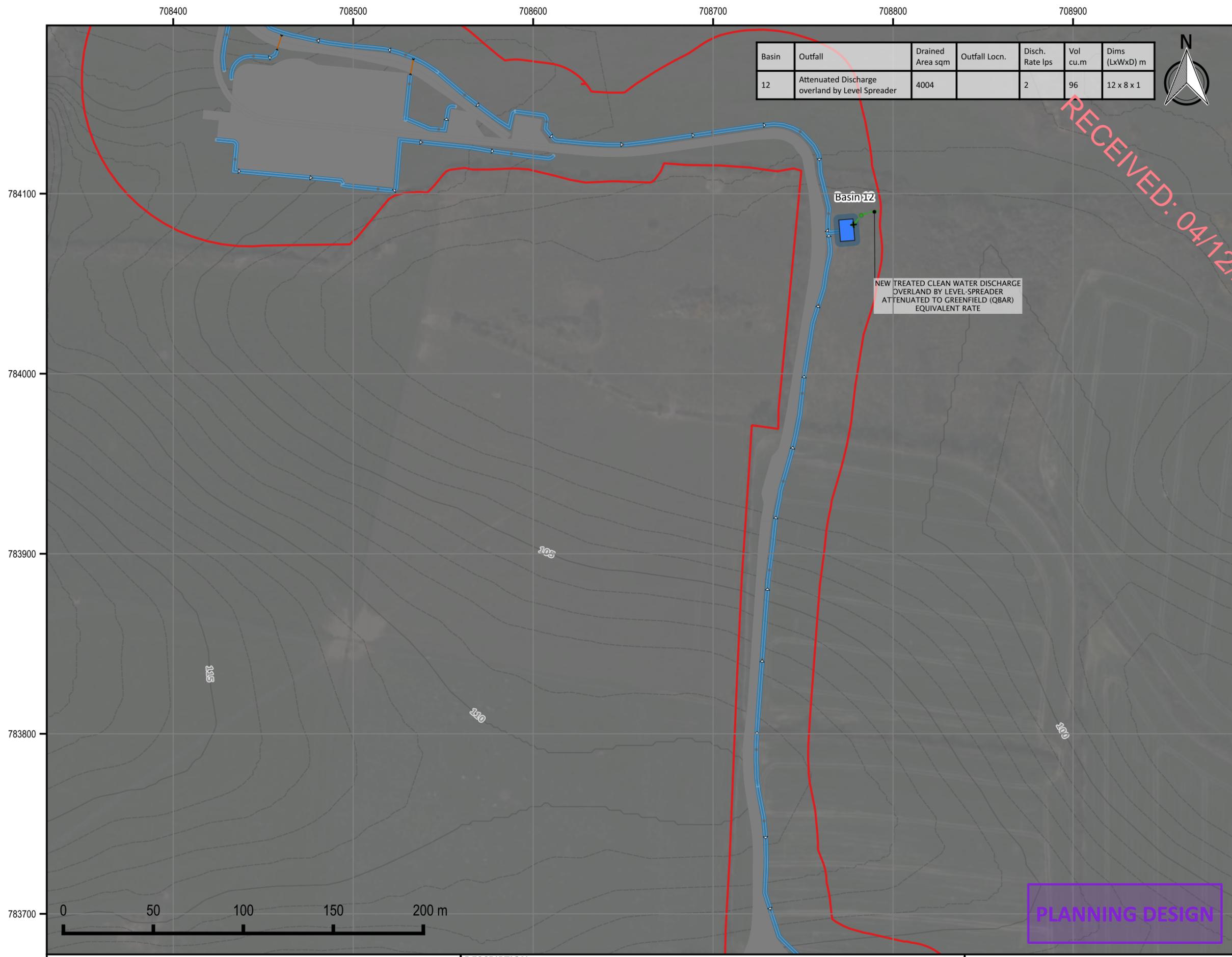
GENERAL

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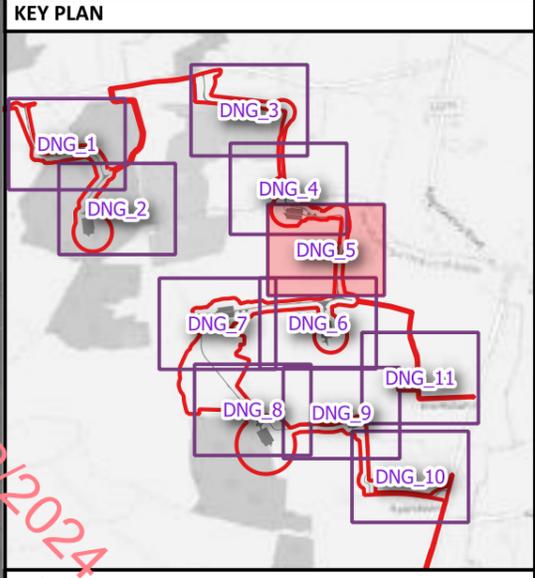
2. ADDITIONAL TEMPORARY DRAINAGE / MITIGATION WILL BE PROVIDED DURING THE CONSTRUCTION PHASE ON AN OBSERVATIONAL BASIS. REFER TO SEPARATE TEMPORARY DRAINAGE LAYOUTS.

3. BACKGROUND MAPPING REPRODUCED © OPENSTREETMAP CONTRIBUTORS

4. ALL DRAINAGE MANAGEMENT FEATURES SHOWN SHOULD BE READ IN CONJUNCTION WITH RELEVANT DETAIL DRAWINGS.



| Basin | Outfall   | Drained Area sqm | Outfall Locn. | Disch. Rate lps | Vol cu.m | Dims (LxWxD) m |
|-------|---|------------------|---------------|-----------------|----------|----------------|
| 12    | Attenuated Discharge overland by Level Spreader | 4004             |               | 2               | 96       | 12 x 8 x 1     |



**LEGEND**

**Infrastructure**

- Application Boundary
- Permanent Infrastructure Footprint

**Hydrology Features & Constraints**

- "Major" Watercourse
- "Minor" Watercourse
- Other existing drainage
- Water Feature Setback / Buffer Zone (10m / 50m)
- Habitat Management Areas
- Wetland

**Permanent Drainage Features**

- Swale / Track Edge Drainage with Check Dams
- Track Drainage Pipe
- Attenuation Basin
- Infiltration Basin
- Flow Control + Outlet to Watercourse
- Flow Control + Outlet to Level Spreader (discharge overland)
- Proposed Watercourse Crossing (Culvert)

**BESS Pollution Control Features**

- Detention Basin
- Lined Impermeable Subbase
- BES Drainage & Pollution Control Valve

**NOTES**

GENERAL

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2. ADDITIONAL TEMPORARY DRAINAGE / MITIGATION WILL BE PROVIDED DURING THE CONSTRUCTION PHASE ON AN OBSERVATIONAL BASIS. REFER TO SEPERATE TEMPORARY DRAINAGE LAYOUTS.

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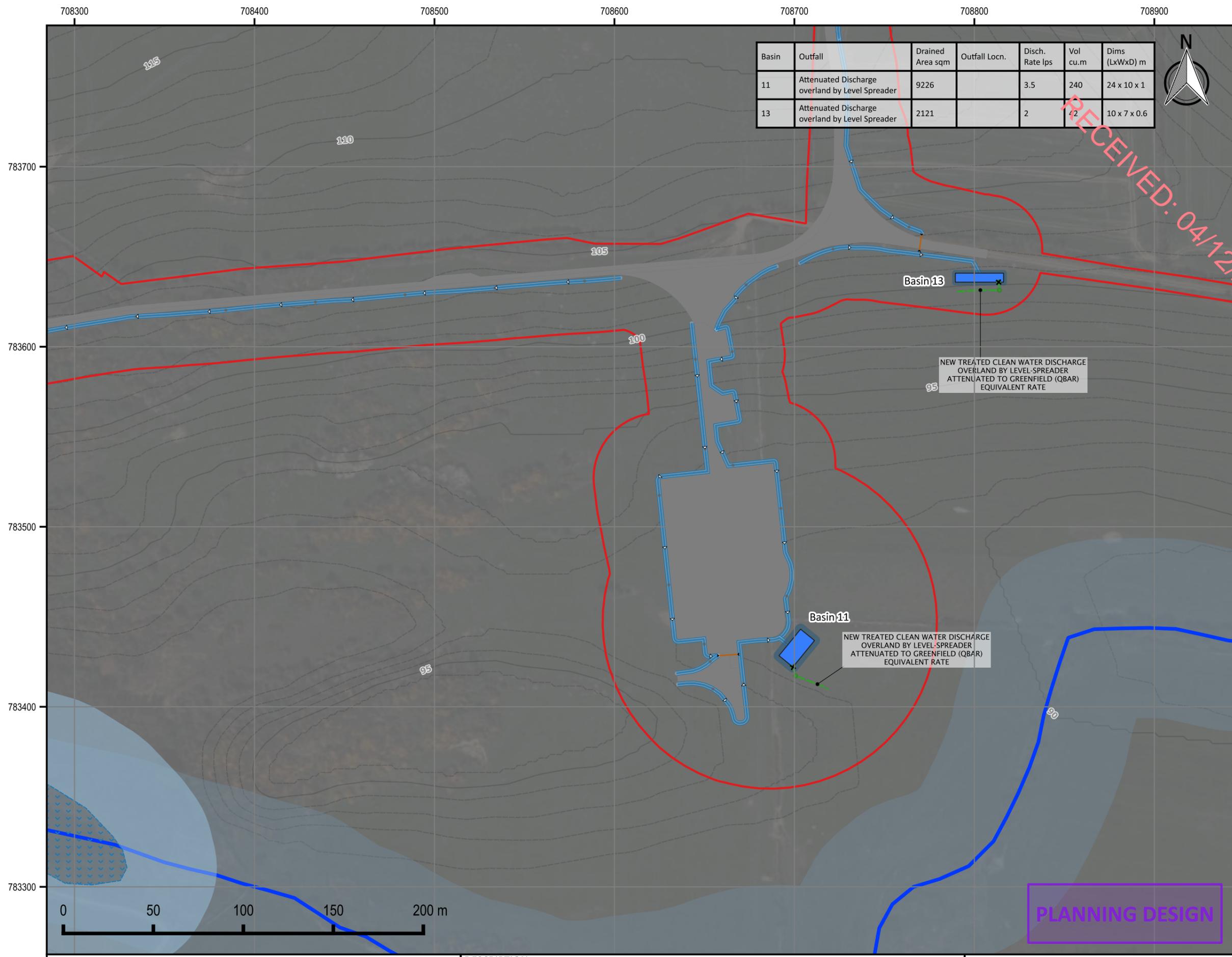
4. ALL DRAINAGE MANAGEMENT FEATURES SHOWN SHOULD BE READ IN CONJUNCTION WITH RELEVANT DETAIL DRAWINGS.

|  |              |                 |             |
|--|--------------|-----------------|-------------|
| <b>DESCRIPTION</b>                                       |              |                 |             |
| KELLYSTOWN WIND FARM - PERMANENT DRAINAGE LAYOUT SHEET 5 |              |                 |             |
| <b>PROJECT / FIGURE NO.</b>                              |              |                 |             |
| M02207-01_DNG_5  |              |                 |             |
| <b>DRAWN BY</b>  | <b>SCALE</b> | <b>REVISION</b> | <b>DATE</b> |
| DKS  | 1:2000       | 1               | 25/10/2024  |

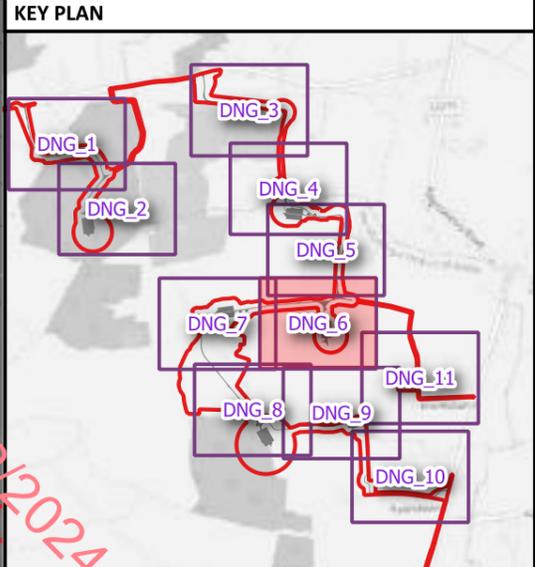
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| Basin | Outfall   | Drained Area sqm | Outfall Locn. | Disch. Rate lps | Vol cu.m | Dims (LxWxD) m |
|-------|---|------------------|---------------|-----------------|----------|----------------|
| 11    | Attenuated Discharge overland by Level Spreader | 9226             |               | 3.5             | 240      | 24 x 10 x 1    |
| 13    | Attenuated Discharge overland by Level Spreader | 2121             |               | 2               | 42       | 10 x 7 x 0.6   |



**LEGEND**

**Infrastructure**

- Application Boundary
- Permanent Infrastructure Footprint

**Hydrology Features & Constraints**

- "Major" Watercourse
- "Minor" Watercourse
- Other existing drainage
- Water Feature Setback / Buffer Zone (10m / 50m)
- Habitat Management Areas
- Wetland

**Permanent Drainage Features**

- Swale / Track Edge Drainage with Check Dams
- Track Drainage Pipe
- Attenuation Basin
- Infiltration Basin
- Flow Control + Outlet to Watercourse
- Flow Control + Outlet to Level Spreader (discharge overland)
- Proposed Watercourse Crossing (Culvert)

**BESS Pollution Control Features**

- Detention Basin
- Lined Impermeable Subbase
- BES Drainage & Pollution Control Valve

NEW TREATED CLEAN WATER DISCHARGE OVERLAND BY LEVEL-SPREADER ATTENUATED TO GREENFIELD (QBAR) EQUIVALENT RATE

NEW TREATED CLEAN WATER DISCHARGE OVERLAND BY LEVEL-SPREADER ATTENUATED TO GREENFIELD (QBAR) EQUIVALENT RATE

PLANNING DESIGN

**NOTES**

GENERAL

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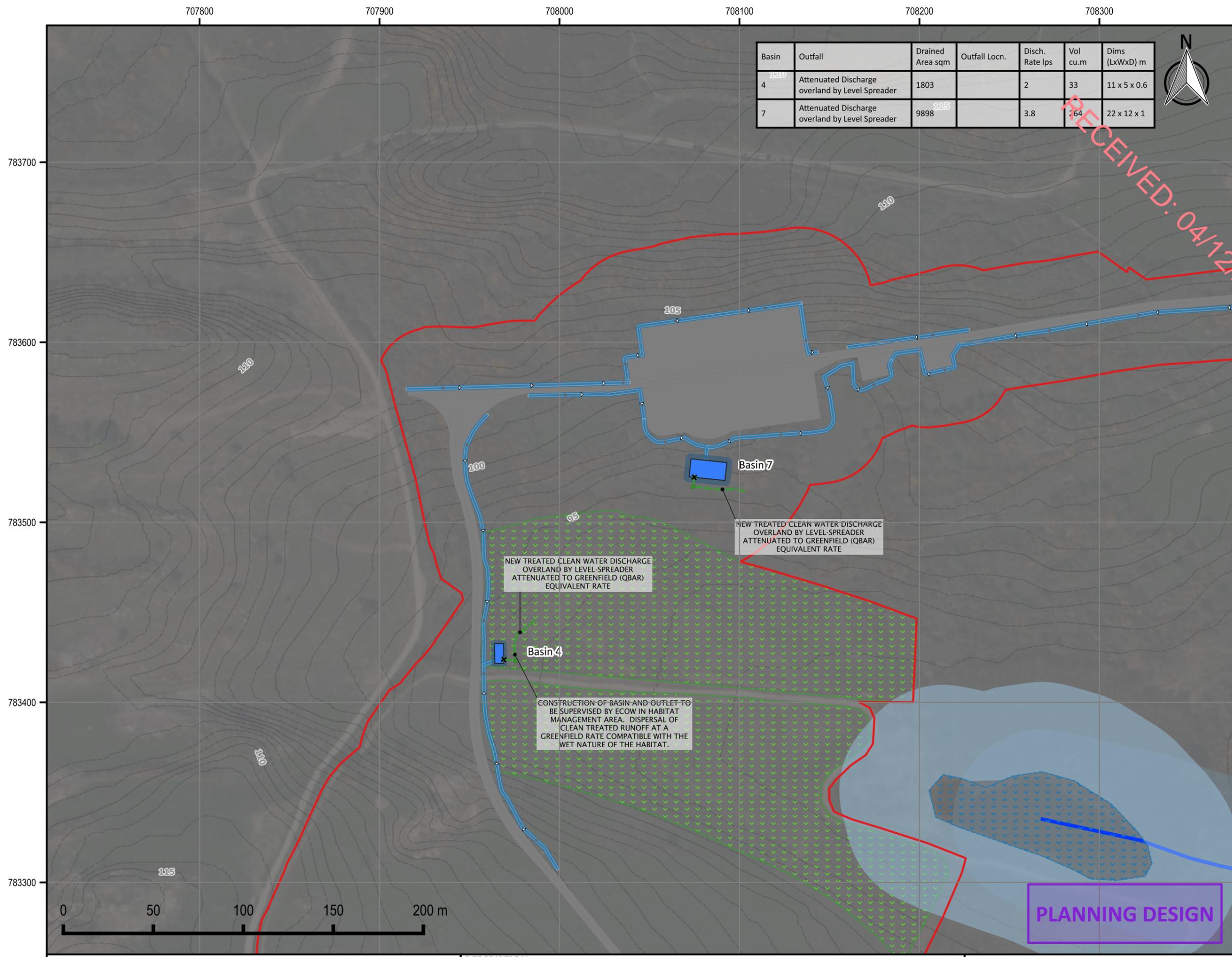
4. ALL DRAINAGE MANAGEMENT FEATURES SHOWN SHOULD BE READ IN CONJUNCTION WITH RELEVANT DETAIL DRAWINGS.

|  |              |                 |             |
|--|--------------|-----------------|-------------|
| <b>DESCRIPTION</b>                                       |              |                 |             |
| KELLYSTOWN WIND FARM - PERMANENT DRAINAGE LAYOUT SHEET 6 |              |                 |             |
| <b>PROJECT / FIGURE NO.</b>                              |              |                 |             |
| M02207-01_DNG_6  |              |                 |             |
| <b>DRAWN BY</b>  | <b>SCALE</b> | <b>REVISION</b> | <b>DATE</b> |
| DKS  | 1:2000       | 1               | 25/10/2024  |

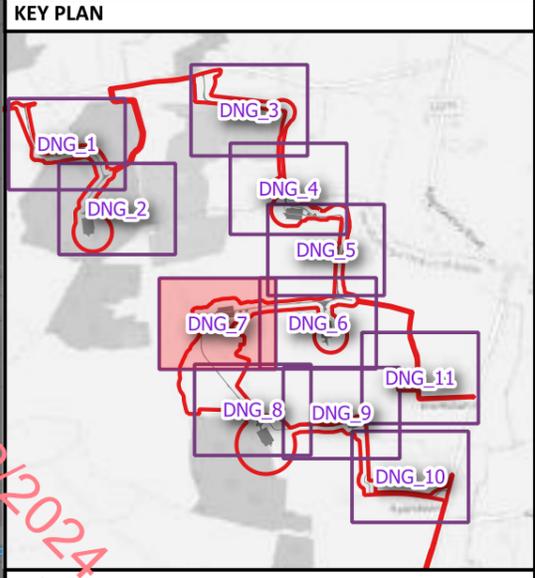
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| Basin | Outfall   | Drained Area sqm | Outfall Locn. | Disch. Rate lps | Vol cu.m | Dims (LxWxD) m |
|-------|---|------------------|---------------|-----------------|----------|----------------|
| 4     | Attenuated Discharge overland by Level Spreader | 1803             |               | 2               | 33       | 11 x 5 x 0.6   |
| 7     | Attenuated Discharge overland by Level Spreader | 9898             |               | 3.8             | 164      | 22 x 12 x 1    |



**LEGEND**

**Infrastructure**

- Application Boundary
- Permanent Infrastructure Footprint

**Hydrology Features & Constraints**

- "Major" Watercourse
- "Minor" Watercourse
- Other existing drainage
- Water Feature Setback / Buffer Zone (10m / 50m)
- Habitat Management Areas
- Wetland

**Permanent Drainage Features**

- Swale / Track Edge Drainage with Check Dams
- Track Drainage Pipe
- Attenuation Basin
- Infiltration Basin
- Flow Control + Outlet to Watercourse
- Flow Control + Outlet to Level Spreader (discharge overland)
- Proposed Watercourse Crossing (Culvert)

**BESS Pollution Control Features**

- Detention Basin
- Lined Impermeable Subbase
- BES Drainage & Pollution Control Valve



**PLANNING DESIGN**

**NOTES**

GENERAL

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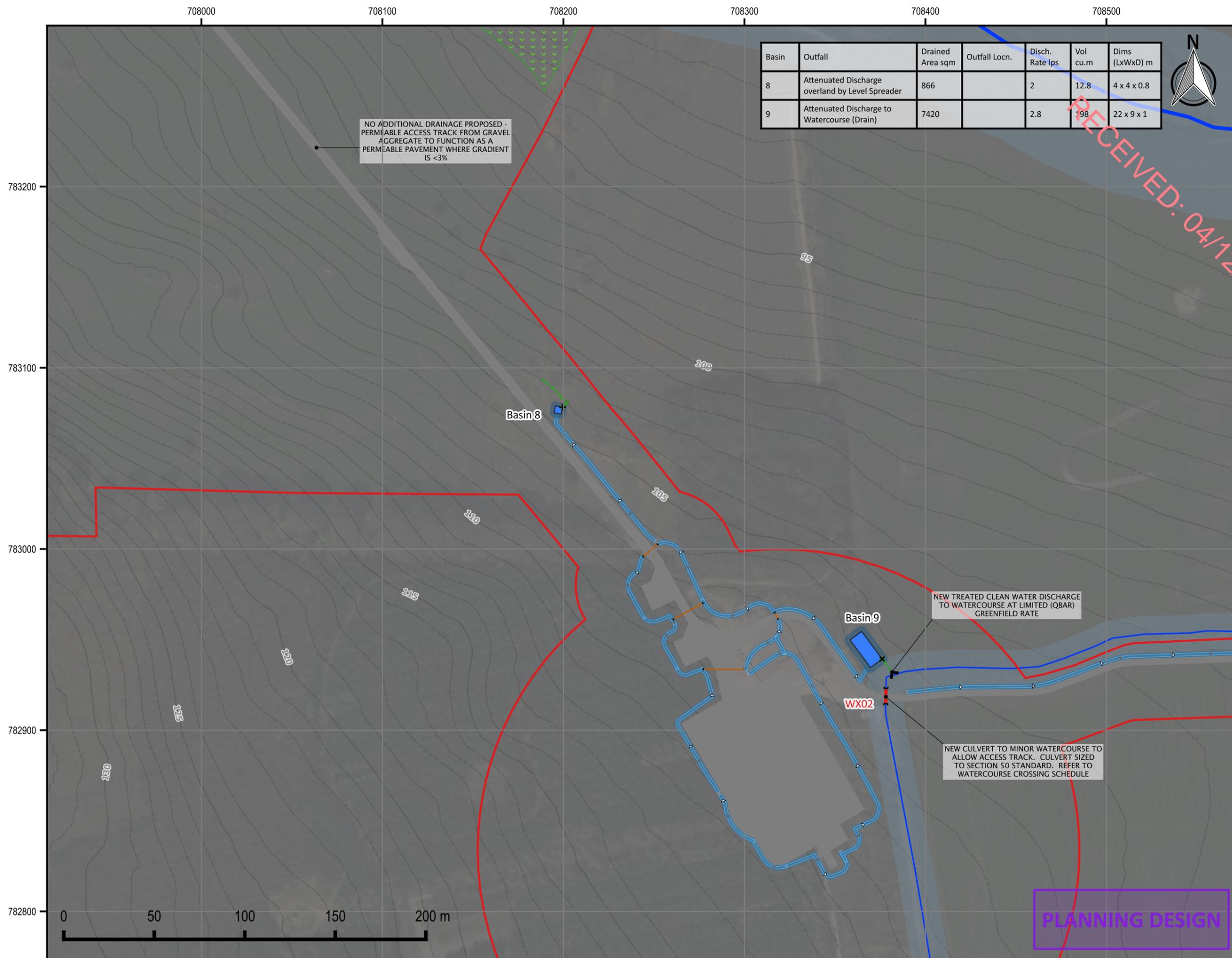
4. ALL DRAINAGE MANAGEMENT FEATURES SHOWN SHOULD BE READ IN CONJUNCTION WITH RELEVANT DETAIL DRAWINGS.

|  |              |                 |             |  |
|--|--------------|-----------------|-------------|--|
| <b>DESCRIPTION</b>                                       |              |                 |             |  |
| KELLYSTOWN WIND FARM - PERMANENT DRAINAGE LAYOUT SHEET 7 |              |                 |             |  |
| <b>PROJECT / FIGURE NO.</b>                              |              |                 |             |  |
| M02207-01_DNG_7  |              |                 |             |  |
| <b>DRAWN BY</b>  | <b>SCALE</b> | <b>REVISION</b> | <b>DATE</b> |  |
| DKS  | 1:2000       | 1               | 25/10/2024  |  |

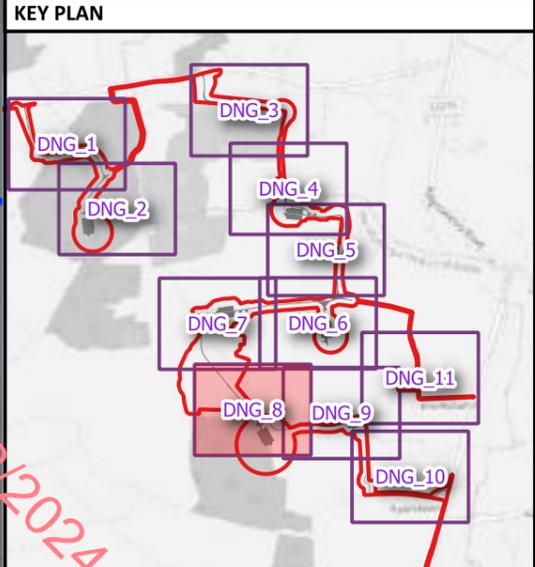
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| Basin | Outfall   | Drained Area sqm | Outfall Locn. | Disch. Rate lps | Vol cu.m | Dims (LxWxD) m |
|-------|---|------------------|---------------|-----------------|----------|----------------|
| 8     | Attenuated Discharge overland by Level Spreader | 866              |               | 2               | 12.8     | 4 x 4 x 0.8    |
| 9     | Attenuated Discharge to Watercourse (Drain)     | 7420             |               | 2.8             | 198      | 22 x 9 x 1     |



**LEGEND**

**Infrastructure**

- Application Boundary
- Permanent Infrastructure Footprint

**Hydrology Features & Constraints**

- "Major" Watercourse
- "Minor" Watercourse
- Other existing drainage
- Water Feature Setback / Buffer Zone (10m / 50m)
- Habitat Management Areas
- Wetland

**Permanent Drainage Features**

- Swale / Track Edge Drainage with Check Dams
- Track Drainage Pipe
- Attenuation Basin
- Infiltration Basin
- Flow Control + Outlet to Watercourse
- Flow Control + Outlet to Level Spreader (discharge overland)
- Proposed Watercourse Crossing (Culvert)

**BESS Pollution Control Features**

- Detention Basin
- Lined Impermeable Subbase
- BES Drainage & Pollution Control Valve

| Culvert ID | Dimension (m) | DESCRIPTION  |
|------------|---------------|--|
| WX02       | 0.9           | NEW 0.9M DIA CLOSED CULVERT (CLASS 120 CONCRETE OR EQUIVALENT) |

PLANNING DESIGN

|  |              |                 |             |
|--|--------------|-----------------|-------------|
| <b>DESCRIPTION</b>                                       |              |                 |             |
| KELLYSTOWN WIND FARM - PERMANENT DRAINAGE LAYOUT SHEET 8 |              |                 |             |
| <b>PROJECT / FIGURE NO.</b>                              |              |                 |             |
| M02207-01_DNG_8  |              |                 |             |
| <b>DRAWN BY</b>  | <b>SCALE</b> | <b>REVISION</b> | <b>DATE</b> |
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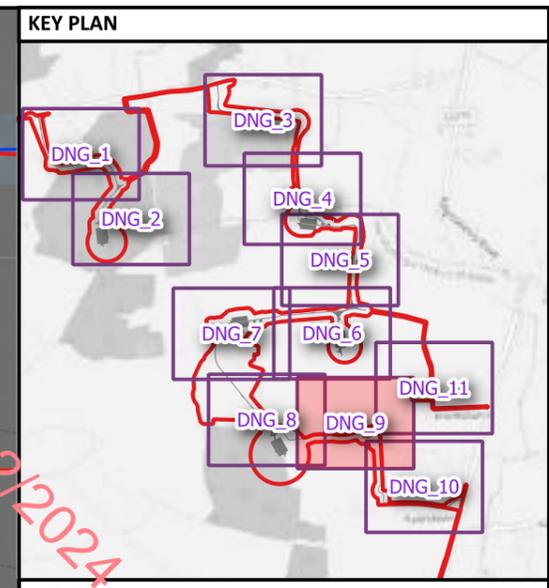
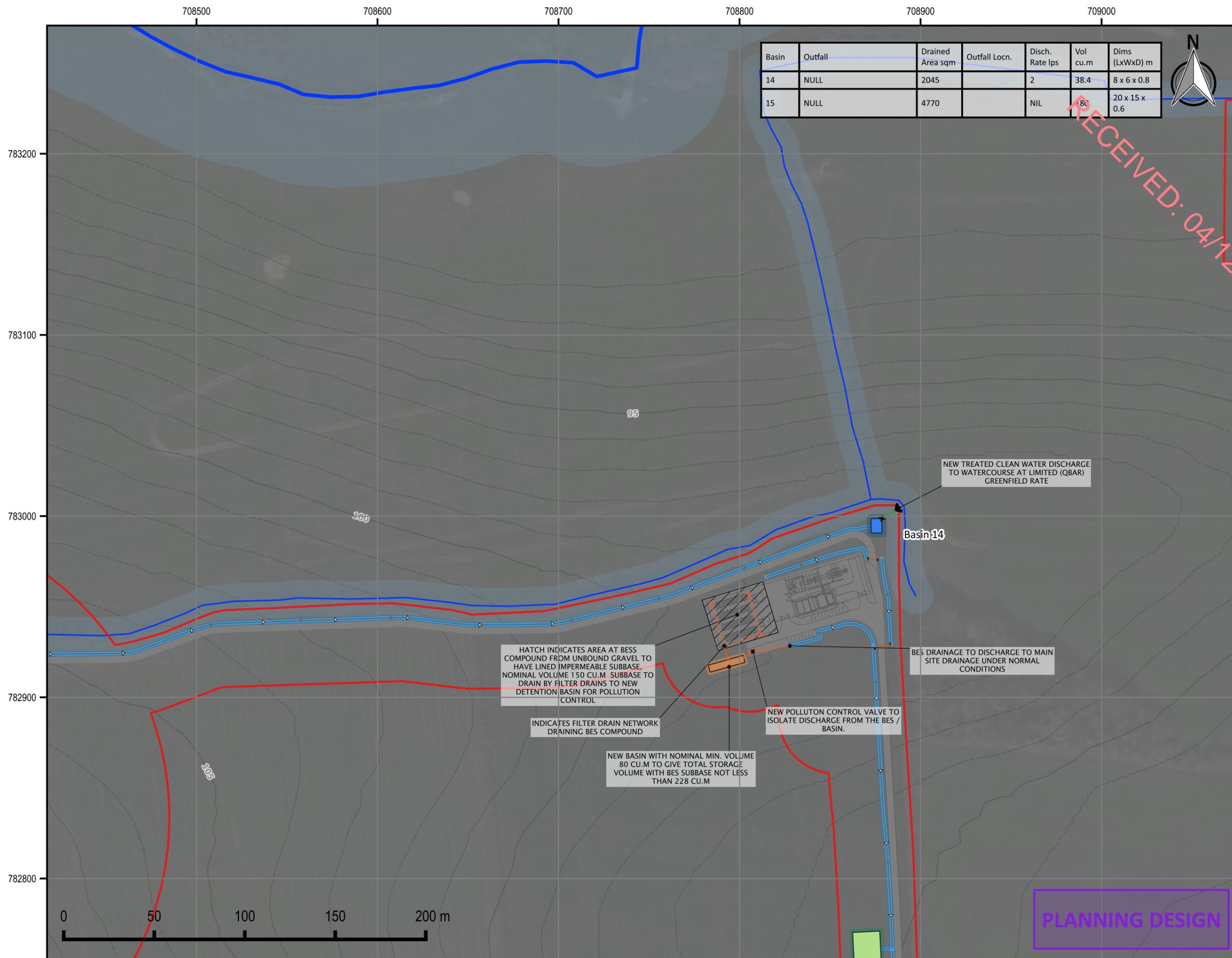
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**LEGEND**

**Infrastructure**

- Application Boundary
- Permanent Infrastructure Footprint

**Hydrology Features & Constraints**

- "Major" Watercourse
- "Minor" Watercourse
- Other existing drainage
- Water Feature Setback / Buffer Zone (10m / 50m)
- Habitat Management Areas
- Wetland

**Permanent Drainage Features**

- Swale / Track Edge Drainage with Check Dams
- Track Drainage Pipe
- Attenuation Basin
- Infiltration Basin
- Flow Control + Outlet to Watercourse
- Flow Control + Outlet to Level Spreader (discharge overland)
- Proposed Watercourse Crossing (Culvert)

**BESS Pollution Control Features**

- Detention Basin
- Lined Impermeable Subbase
- BES Drainage & Pollution Control Valve

HATCH INDICATES AREA AT BESS COMPOUND FROM UNBOUND GRAVEL TO HAVE LINED IMPERMEABLE SUBBASE, NOMINAL VOLUME 150 CU.M. SUBBASE TO DRAIN BY FILTER DRAINS TO NEW DETENTION BASIN FOR POLLUTION CONTROL

INDICATES FILTER DRAIN NETWORK DRAINING BESS COMPOUND

NEW BASIN WITH NOMINAL MIN. VOLUME 80 CU.M TO GIVE TOTAL STORAGE VOLUME WITH BESS SUBBASE NOT LESS THAN 228 CU.M

NEW POLLUTION CONTROL VALVE TO ISOLATE DISCHARGE FROM THE BESS / BASIN.

NEW TREATED CLEAN WATER DISCHARGE TO WATERCOURSE AT LIMITED (QBAR) GREENFIELD RATE

BESS DRAINAGE TO DISCHARGE TO MAIN SITE DRAINAGE UNDER NORMAL CONDITIONS

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|  |              |                 |             |
|--|--------------|-----------------|-------------|
| <b>DESCRIPTION</b>                                       |              |                 |             |
| KELLYSTOWN WIND FARM - PERMANENT DRAINAGE LAYOUT SHEET 9 |              |                 |             |
| <b>PROJECT / FIGURE NO.</b>                              |              |                 |             |
| M02207-01_DNG_9  |              |                 |             |
| <b>DRAWN BY</b>  | <b>SCALE</b> | <b>REVISION</b> | <b>DATE</b> |
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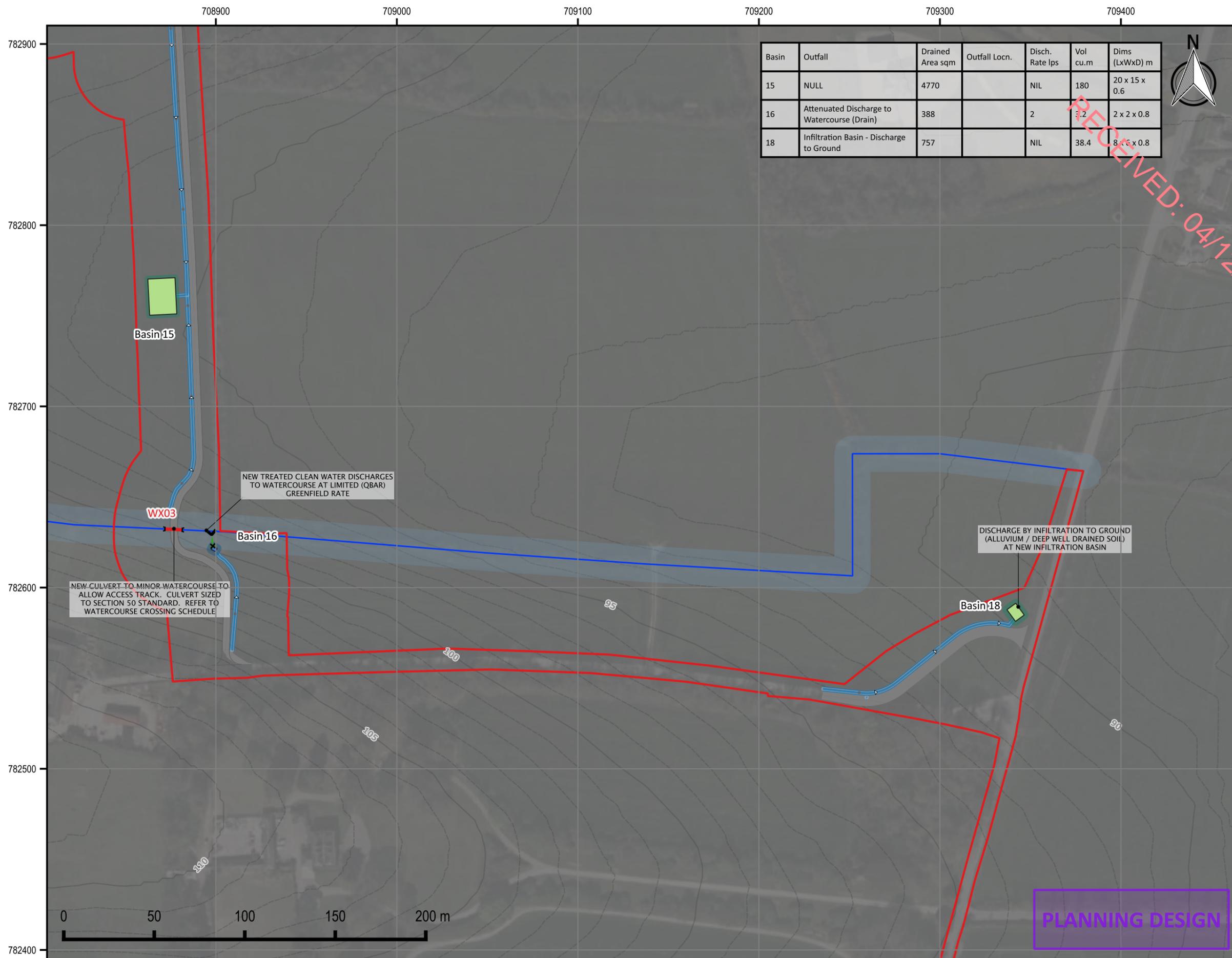
GENERAL

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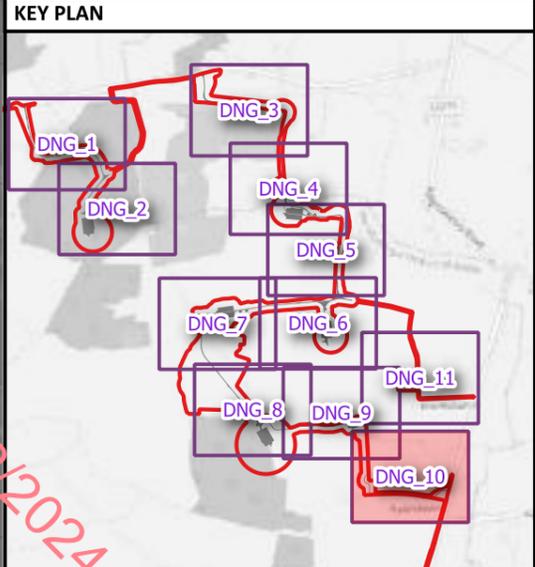
2. ADDITIONAL TEMPORARY DRAINAGE / MITIGATION WILL BE PROVIDED DURING THE CONSTRUCTION PHASE ON AN OBSERVATIONAL BASIS. REFER TO SEPARATE TEMPORARY DRAINAGE LAYOUTS.

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4. ALL DRAINAGE MANAGEMENT FEATURES SHOWN SHOULD BE READ IN CONJUNCTION WITH RELEVANT DETAIL DRAWINGS.



| Basin | Outfall                                     | Drained Area sqm | Outfall Locn. | Disch. Rate lps | Vol cu.m | Dims (LxWxD) m |
|-------|---|------------------|---------------|-----------------|----------|----------------|
| 15    | NULL  | 4770             |               | NIL             | 180      | 20 x 15 x 0.6  |
| 16    | Attenuated Discharge to Watercourse (Drain) | 388              |               | 2               | 3.2      | 2 x 2 x 0.8    |
| 18    | Infiltration Basin - Discharge to Ground    | 757              |               | NIL             | 38.4     | 8 x 6 x 0.8    |



### LEGEND

**Infrastructure**

- Application Boundary
- Permanent Infrastructure Footprint

**Hydrology Features & Constraints**

- "Major" Watercourse
- "Minor" Watercourse
- Other existing drainage
- Water Feature Setback / Buffer Zone (10m / 50m)
- Habitat Management Areas
- Wetland

**Permanent Drainage Features**

- Swale / Track Edge Drainage with Check Dams
- Track Drainage Pipe
- Attenuation Basin
- Infiltration Basin
- Flow Control + Outlet to Watercourse
- Flow Control + Outlet to Level Spreader (discharge overland)
- Proposed Watercourse Crossing (Culvert)

**BESS Pollution Control Features**

- Detention Basin
- Lined Impermeable Subbase
- BES Drainage & Pollution Control Valve

| Culvert ID | Dimension (m) | DESCRIPTION  |
|------------|---------------|--|
| WX03       | 0.9           | NEW 0.9M DIA CLOSED CULVERT (CLASS 120 CONCRETE OR EQUIVALENT) |

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|   |              |                 |             |
|---|--------------|-----------------|-------------|
| <b>DESCRIPTION</b>  |              |                 |             |
| KELLYSTOWN WIND FARM - PERMANENT DRAINAGE LAYOUT SHEET 10 |              |                 |             |
| <b>PROJECT / FIGURE NO.</b>                               |              |                 |             |
| M02207-01_DNG_10  |              |                 |             |
| <b>DRAWN BY</b>   | <b>SCALE</b> | <b>REVISION</b> | <b>DATE</b> |
| DKS   | 1:2000       | 1               | 25/10/2024  |

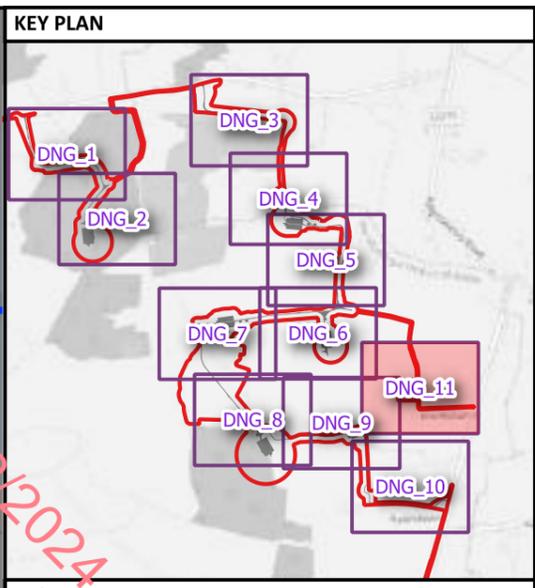
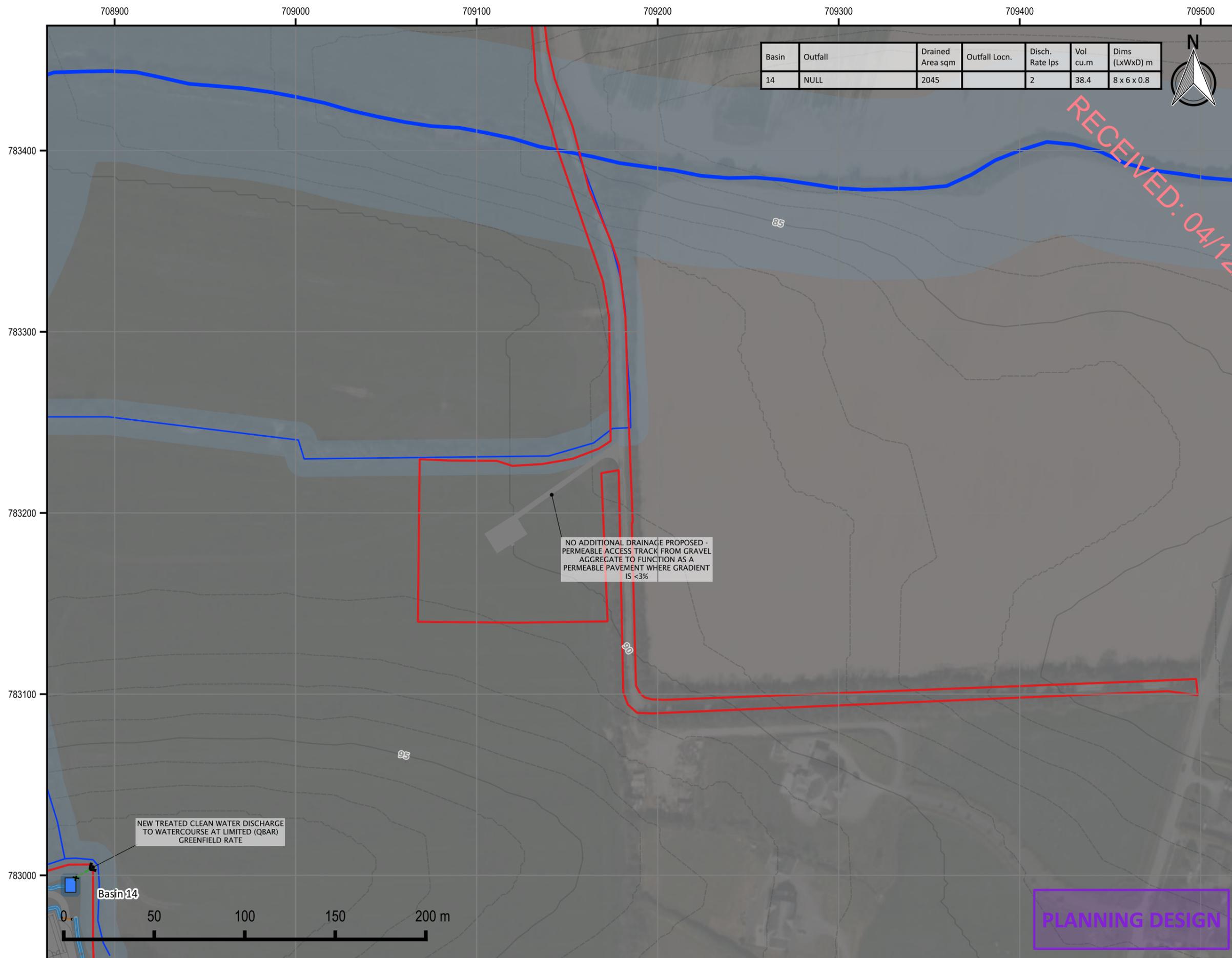
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**LEGEND**

**Infrastructure**

- Application Boundary
- Permanent Infrastructure Footprint

**Hydrology Features & Constraints**

- "Major" Watercourse
- "Minor" Watercourse
- Other existing drainage
- Water Feature Setback / Buffer Zone (10m / 50m)
- Habitat Management Areas
- Wetland

**Permanent Drainage Features**

- Swale / Track Edge Drainage with Check Dams
- Track Drainage Pipe
- Attenuation Basin
- Infiltration Basin
- Flow Control + Outlet to Watercourse
- Flow Control + Outlet to Level Spreader (discharge overland)
- Proposed Watercourse Crossing (Culvert)

**BESS Pollution Control Features**

- Detention Basin
- Lined Impermeable Subbase
- BES Drainage & Pollution Control Valve

**NOTES**

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|   |              |                 |             |
|---|--------------|-----------------|-------------|
| <b>DESCRIPTION</b>  |              |                 |             |
| KELLYSTOWN WIND FARM - PERMANENT DRAINAGE LAYOUT SHEET 11 |              |                 |             |
| <b>PROJECT / FIGURE NO.</b>                               |              |                 |             |
| M02207-01_DNG_11  |              |                 |             |
| <b>DRAWN BY</b>   | <b>SCALE</b> | <b>REVISION</b> | <b>DATE</b> |
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**Annex B**

**Permanent Drainage - Details**

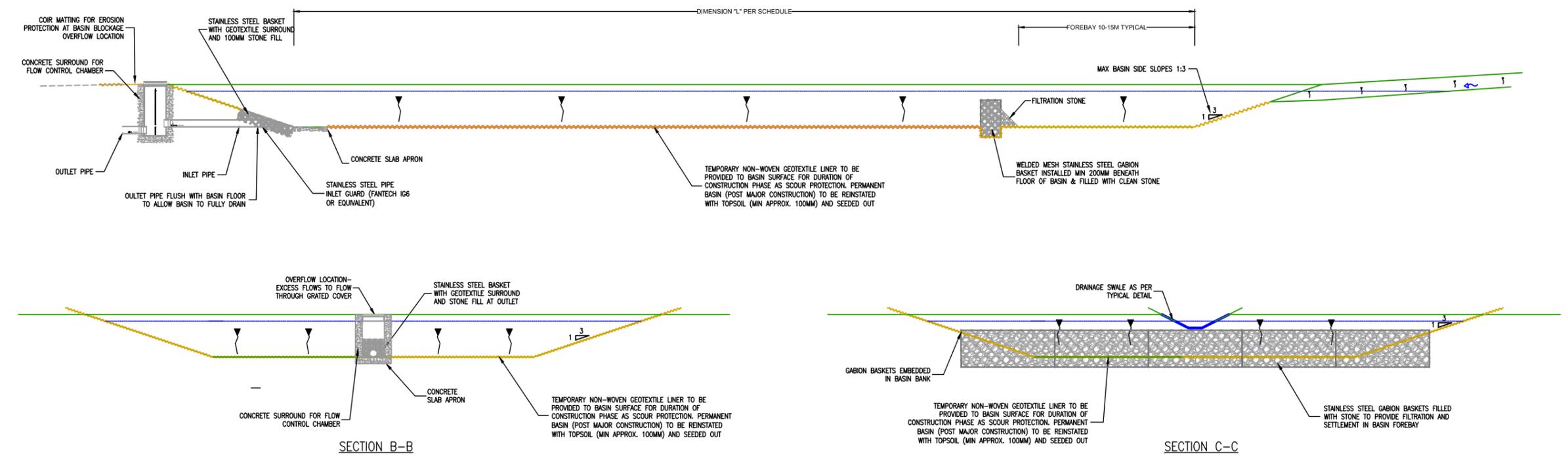
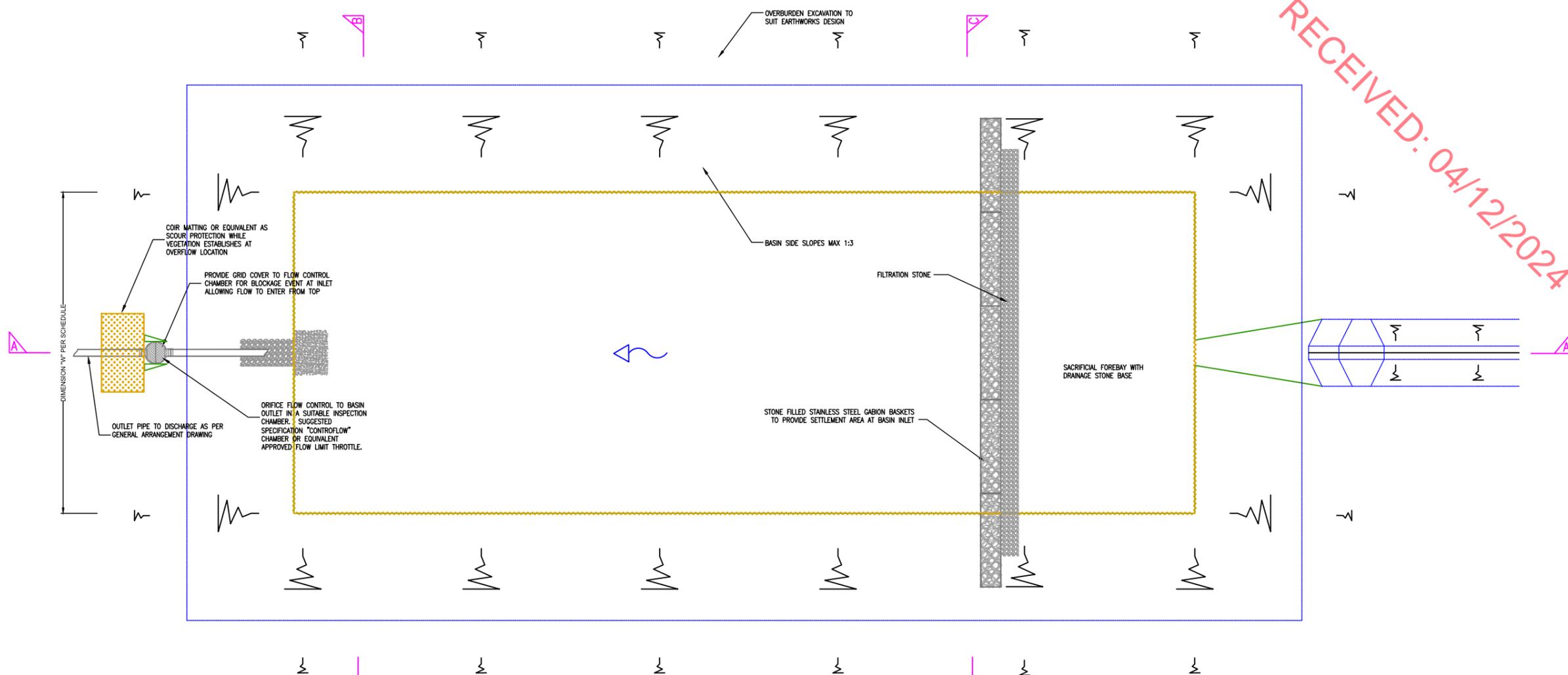
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- 21 - Level Spreader / Swale & Checkdam
- 22 - Attenuation Basin Arrangement
- 23 - Infiltration Basin Arrangement
- 24 - Piped Culvert



DETENTION BASIN PLAN  
SCALE 1:50

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- TRACK DRAINAGE NOTES
- ROAD CONSTRUCTION TO BE AS PER CIVIL WORKS DESIGN & SPECIFICATION. (BY OTHERS)
  - REFER TO LAYOUT PLAN DRAWINGS FOR DETAILS OF CHECK DAM / CROSS DRAIN / CUTOFF DRAIN / OUTFALL LOCATIONS ETC. MICRO-SITING OF DRAINAGE ELEMENTS TO BE DETERMINED ON SITE IN CONJUNCTION WITH DESIGNER TO SUIT SPECIFIC CONDITIONS ENCOUNTERED.
  - FEATURES SHOWN ARE TO SUIT PERMANENT INFRASTRUCTURE. TEMPORARY SITE DRAINAGE OVER AND ABOVE THAT SHOWN ON DRAWINGS MAY BE REQUIRED TO SUIT TEMPORARY ROAD ALIGNMENTS AND LEVELS.
  - ALL EXCAVATED SLOPES TO BE BATTERED BACK TO A SAFE ANGLE OF REPOSE.

| ISSUE | DRN | APP | DATE       | NOTES / DESCRIPTION |
|-------|-----|-----|------------|---------------------|
| 1     | DL  | KS  | 24/10/2024 | FOR PLANNING        |

STATUS: PLANNING

**McCloy Consulting**  
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 E: info@mcclayconsulting.com Newtownabbey  
 W: www.mcclayconsulting.com Co. Antrim, BT36 5QB

PROJECT: KELLYSTOWN WIND FARM

CLIENT: EDF RENEWABLES

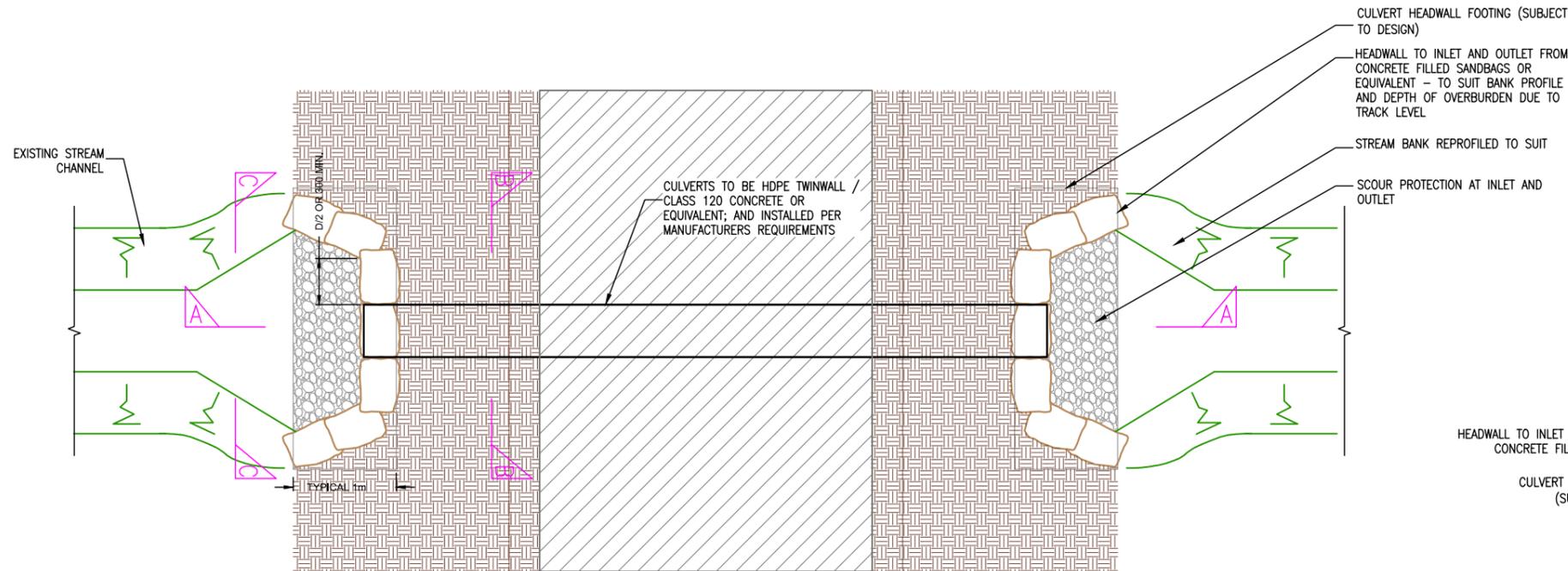
DRAWING TITLE: SURFACE WATER MANAGEMENT ATTENUATION BASIN DETAILS

| SCALE       | ORIGINAL SIZE |
|-------------|---------------|
| AS SHOWN@A1 | A1            |

| DRAWN | CHECKED | DATE       |
|-------|---------|------------|
| KS    | PDD     | 14/11/2023 |

| PROJECT NO. | DRAWING NO. | ISSUE NO. |
|-------------|-------------|-----------|
| M01944-02   | DWG_22      | 1         |

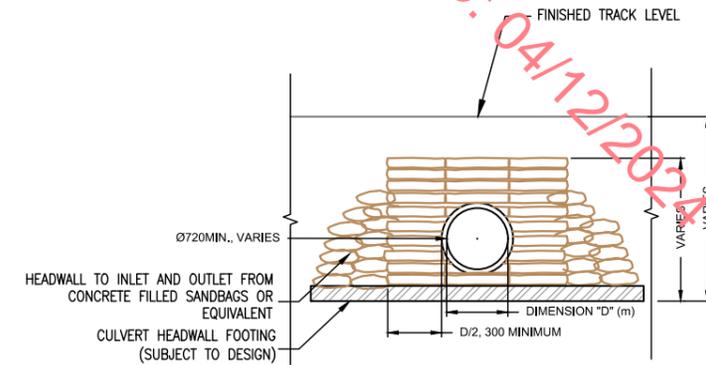




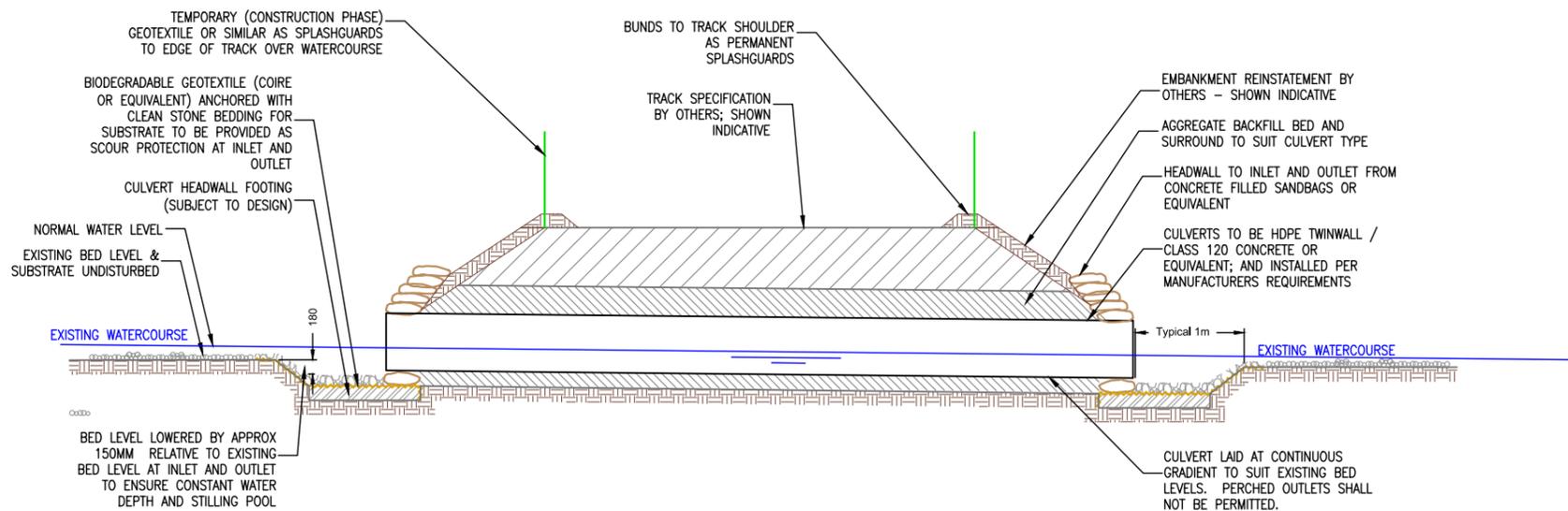
PLAN  
SCALE 1:40

CULVERT WATERCOURSE CROSSING  
SCALE AS SHOWN

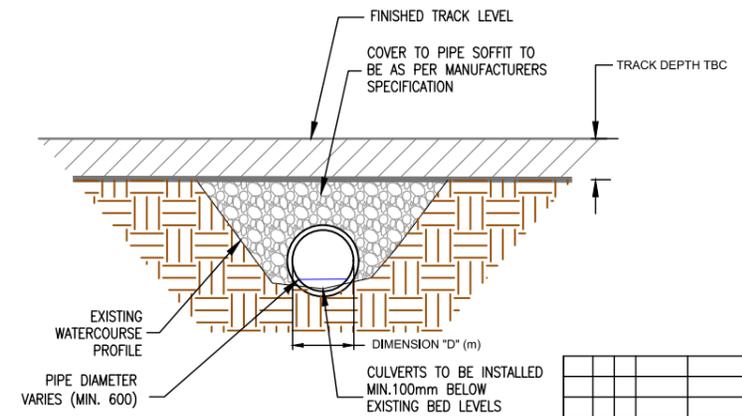
- NOTES FOR CONSTRUCTION METHODS & ENVIRONMENTAL PROTECTION**
- WORKS TO BE PROGRAMMED TO SUIT PERIODS OF LOW RIVER FLOW AND RAINFALL. DUE COGNISANCE GIVEN TO THE PREVAILING GROUND CONDITIONS AND SEASONAL WEATHER CONDITIONS.
  - CULVERT LOCATION TO BE DAMMED UPSTREAM BY USE OF SANDBAGS OR EQUIVALENT AND OVERPUMPED IN ORDER TO PROVIDE A DRY WORKING ENVIRONMENT.
  - IN CHANNEL SILT FENCING TO BE INSTALLED DOWNSTREAM OF THE WORKS AND DOWNSTREAM OF OVERPUMPING FOR THE DURATION OF THE CULVERT INSTALLATION WORKS.



ELEVATION C-C (WITH HEADWALL)  
1:40



SECTION A-A  
SCALE 1:40



SECTION B-B  
SCALE 1:40

| NO.      | DL  | KS  | 24/10/2024 | FOR PLANNING        |
|----------|-----|-----|------------|---------------------|
| 1        | DL  | KS  | 24/10/2024 | FOR PLANNING        |
| ISSUE    | DRN | APP | DATE       | NOTES / DESCRIPTION |
| STATUS   |     |     |            |                     |
| PLANNING |     |     |            |                     |

**McCloy Consulting**

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Newtownabbey  
Co. Antrim, BT36 5QB

KELLYSTOWN WIND FARM

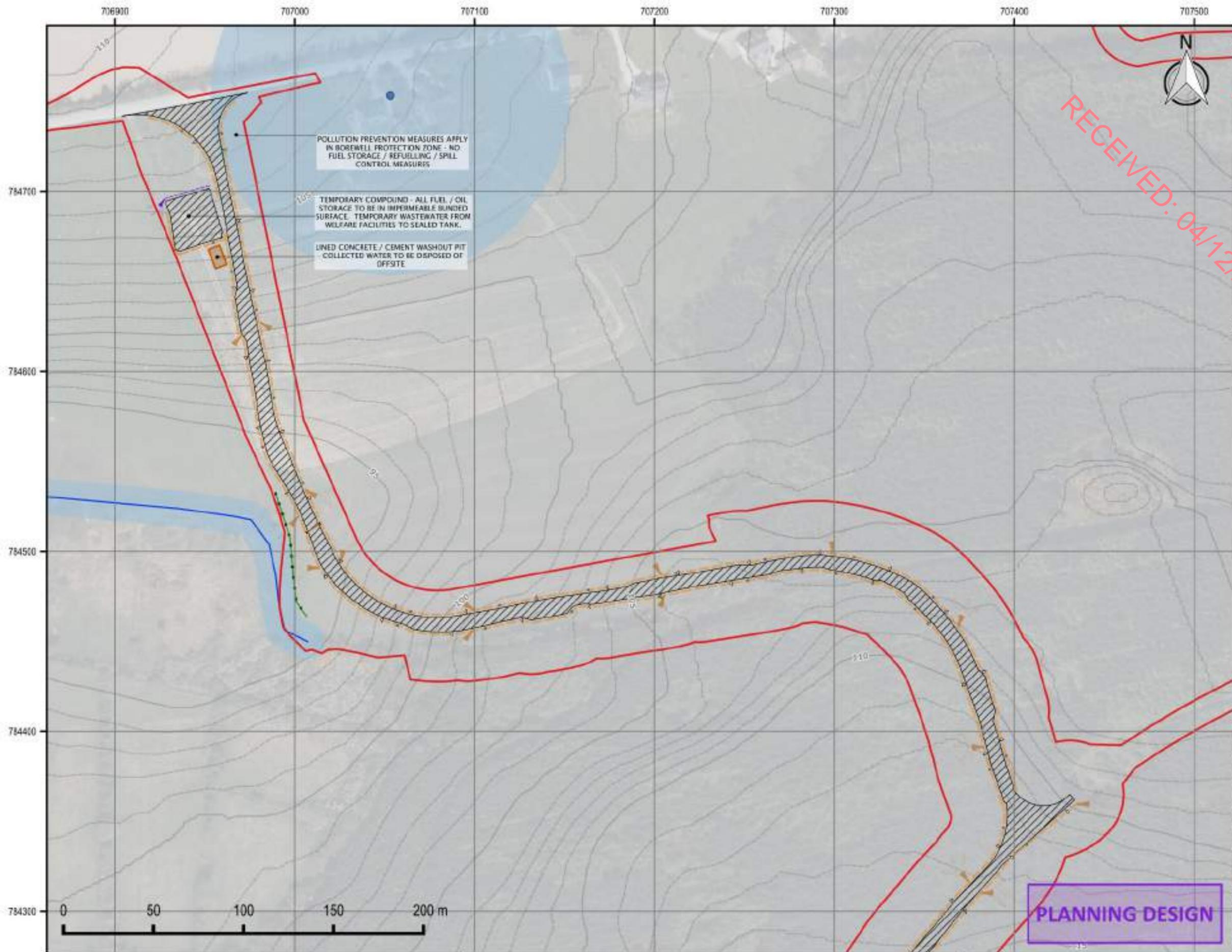
EDF RENEWABLES

PIPED CULVERT DETAIL

| SCALE       | ORIGINAL SIZE |            |
|-------------|---------------|------------|
| AS SHOWN@A1 | A1            |            |
| DRAWN       | CHECKED       | DATE       |
| KS          | PDD           | 14/11/2023 |
| PROJECT NO. | DRAWING NO.   | ISSUE NO.  |
| M01944-02   | DWG_24        | 1          |

Annex C  
RECEIVED: 04/12/2024

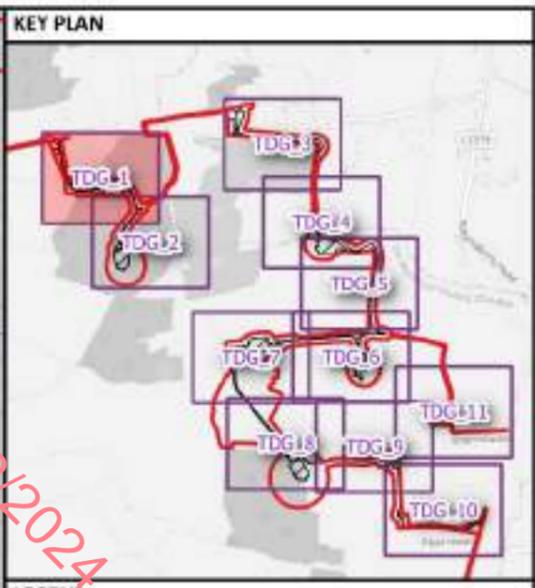
# Temporary Drainage - Layouts



POLLUTION PREVENTION MEASURES APPLY IN BOREWELL PROTECTION ZONE - NO FUEL STORAGE / REFUELLING / SPILL CONTROL MEASURES

TEMPORARY COMPOUND - ALL FUEL / OIL STORAGE TO BE IN IMPERMEABLE BUNDED SURFACE. TEMPORARY WASTEWATER FROM WELFARE FACILITIES TO SEALED TANK.

LINED CONCRETE / CEMENT WASHOUT PIT COLLECTED WATER TO BE DISPOSED OF OFFSITE



**LEGEND**

**Infrastructure**

- Application Boundary
- Temporary Infrastructure Footprint

**Hydrology Features & Constraints**

- "Major" Watercourse
- "Minor" Watercourse
- Other existing drainage
- Potable Borewell Location
- Water Feature Setback / Buffer Zone (10m / 50m)
- Habitat Management Areas
- Wetland
- Proposed Watercourse Crossing (Culvert)

**Temporary Drainage**

- CLEAN INTERCEPTOR
- DIRTY WATER DRAINAGE
- TEMPORARY PIPED DRAINAGE
- Silt Fence
- Settlement / Washout Basin

**NOTES**

GENERAL

- OVERLAYS ARE INTENDED TO INFORM THE PLANNING APPLICATION. DRAWINGS ARE NOT INTENDED FOR CONSTRUCTION AND SHOULD NOT BE USED AS SUCH. FOR AVOIDANCE OF DOUBT, SURFACE WATER MANAGEMENT DESIGN IS LIMITED TO BE FURTHER DEVELOPED POST-COMMITMENT OF THE PLANNING APPLICATION INCLUDING MICRODRAINAGE.
- DETAILED SITING OF LUGG FEATURES SHALL BE UNDERTAKEN ON AN OPERATIONAL BASIS DEPENDANT ON LOCAL TOPOGRAPHY AND CONSTRUCTION SEQUENCING.
- ALL DRAINAGE MANAGEMENT FEATURES SHOWN SHOULD BE READ IN CONJUNCTION WITH RELEVANT DESIGN DRAWINGS.

**POLLUTION PREVENTION**

- ALL WORK IN POLLUTION PREVENTION ZONES SHALL BE SUBJECT TO PLANNING IN CONJUNCTION WITH THE ENVIRONMENTAL COMMITMENT. WORKS TO BE PLANNED TO SUIT WEATHER FORECASTS.
- DRAINAGE MANAGEMENT FEATURES TO BE INSTALLED PRIOR TO OR IN PARALLEL WITH TRACK CONSTRUCTION.
- OIL FUEL SHOULD BE STORED WITHIN CONTAMINANT AREA IN THE SITE COMPOUND. CEMENT SHOULD BE STORED WITHIN COMPULSORY TENTS. TOOLS SHOULD BE WASHED IN THE SAME AREA AND WATER RECYCLED ON THE CEMENT WAG.

**TRACK / INFRASTRUCTURE DRAINAGE**

- THIS DRAWING INDICATES THE MINIMUM TEMPORARY DRAINAGE REQUIREMENTS. REFER TO SEPARATE PERMANENT DRAINAGE DRAWING SERIES. PERMANENT DRAINAGE FEATURES (SETTLEMENT PITS) MAY BE INSTALLED IN THE TEMPORARY PHASE FOR USE FOR SETTLEMENT. TEMPORARY DRAINAGE TO BE REMOVED OR AMENDED TO SUIT THE PERMANENT WORK FOOTPRINT AND DRAINAGE PLAN AS PART OF FINAL SITE RECONSTRUCTION.
- CLEAN STONE CHECK DAMS TO BE INSTALLED IN ALL DRAINAGE CHANNELS IN ORDER TO PROMOTE SETTLEMENT OF SUSPENDED SOLIDS AND CONTROL FLOW RATES. CHECK DAMS SHOULD BE TO BE LOCALITY WITH WELL GRADED STONE. APPROPRIATE SIZE FOR STONE CHECK DAMS TO BE THICKLY 1.4M HIGH STONE. ON STEEP SECTIONS SMALL STONE TO BE ANCHORED THROUGH THE PLACEMENT OF 300MM STONE ON THE DOWNHILL FACE OF THE CHECK DAM. SPACING AND FREQUENCY OF CHECK DAMS WILL BE DETERMINED UPON USUALLY GRADIENT OF SLOPE.

**WATERCOURSE & TRACK DRAINAGE CROSSINGS**

IS THE MINIMUM PIPE DIAMETER FOR ANY TRACK DRAINAGE CROSSING SHALL BE 150MM. ALL HOPE PIPES SHALL BE TANKWELL TYPE, BSA HAINS APPROVED.

**MAINTENANCE**

- THE LEVEL OF SILT BUILDUP DURING CONSTRUCTION TO BE MONITORED VISUALLY AND RECORD. SILT LEVELS IN RUNWAYS TO BE TEMPORARILY DRAINAGE THROUGH OR BY SILT FENCES / CONSTRUCTED SETTLEMENT FEATURES / CONTAINERS OR PROPRIETARY SOLUTIONS (SUBSTRIP / Silt SOCKS / SEDIMENT MATS).
- BUILD UP OF SILT LEVELS AT CHECK DAMS TO BE REMOVED AND DEPOSED OF. SILT LEVELS AT CHECK DAMS TO BE VISUALLY MONITORED AS PART OF AN ONGOING MAINTENANCE PROGRAMME THROUGH THE CONSTRUCTION PHASE. WHERE CHECK DAMS BECOME CLOGGED WITH SILT OR VEGETATION, STONE CHECK DAM TO BE REMOVED AND REPLACED SUBSEQUENT TO THE REMOVAL OF SILT.

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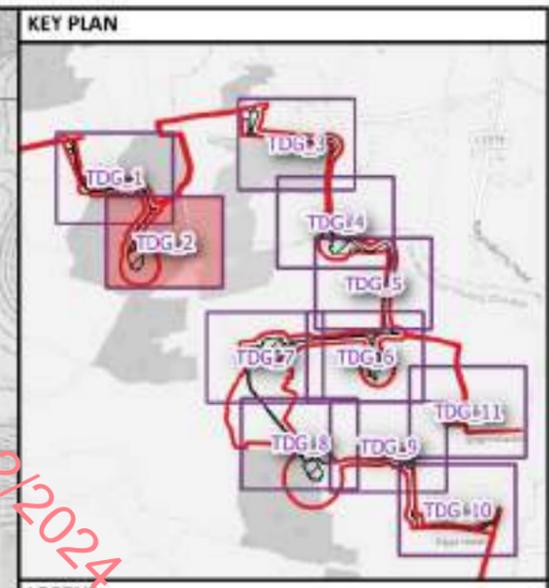
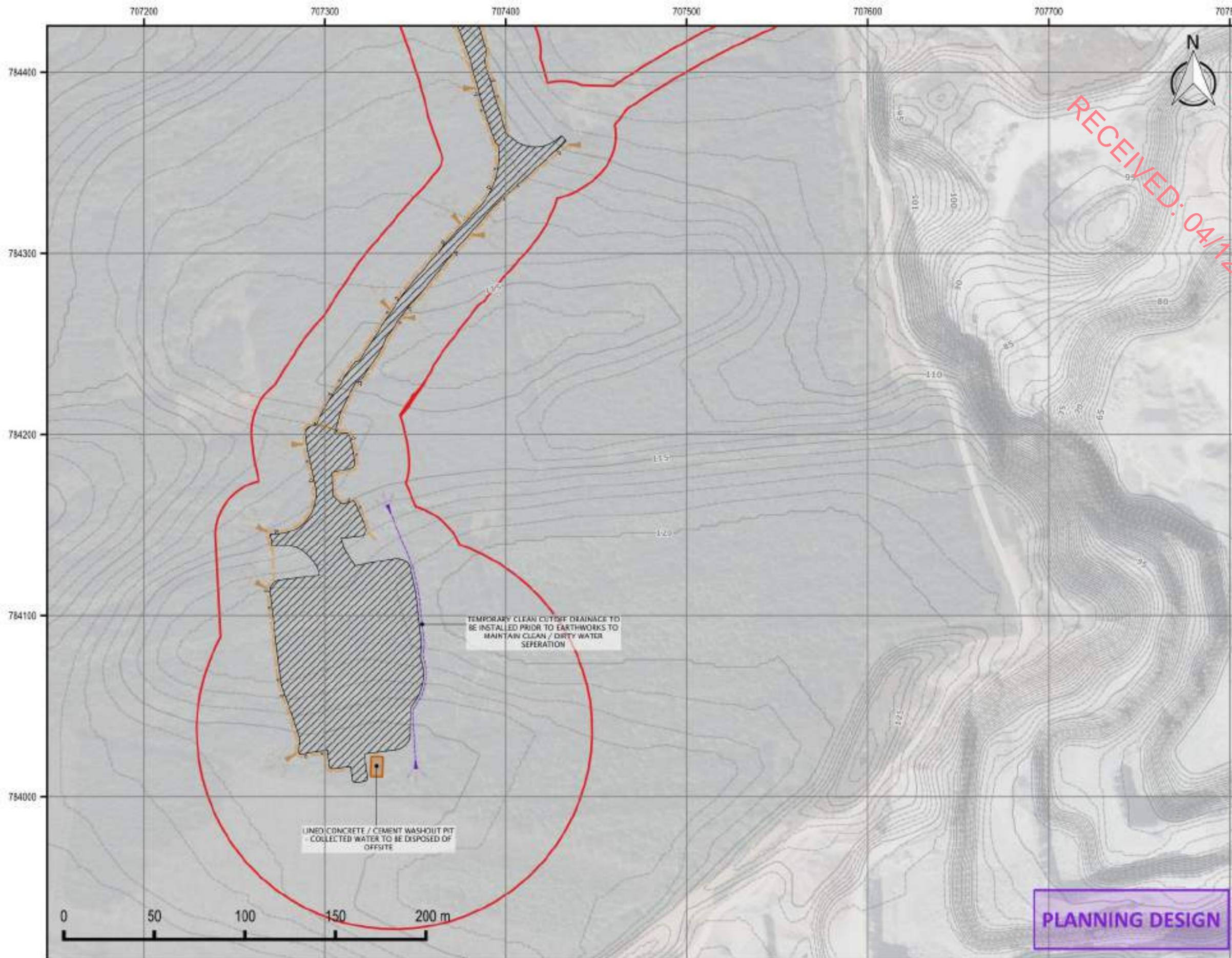
|  |              |                 |             |  |
|--|--------------|-----------------|-------------|--|
| <b>DESCRIPTION</b>                                       |              |                 |             |  |
| KELLYSTOWN WIND FARM - TEMPORARY DRAINAGE LAYOUT SHEET 1 |              |                 |             |  |
| <b>PROJECT / FIGURE NO.</b>                              |              |                 |             |  |
| M02207-01 TDG_1  |              |                 |             |  |
| <b>DRAWN BY</b>  | <b>SCALE</b> | <b>REVISION</b> | <b>DATE</b> |  |
| DKS  | 1:2000       | 1               | 29/10/2024  |  |

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PLANNING DESIGN



- LEGEND**
- Infrastructure**
- Application Boundary
  - Temporary Infrastructure Footprint
- Hydrology Features & Constraints**
- "Major" Watercourse
  - "Minor" Watercourse
  - Other existing drainage
  - Potable Borewell Location
  - Water Feature Siltback / Buffer Zone (10m / 50m)
  - Habitat Management Areas
  - Wetland
  - Proposed Watercourse Crossing (Culvert)
- Temporary Drainage**
- CLEAN INTERCEPTOR
  - DIRTY WATER DRAINAGE
  - TEMPORARY PIPED DRAINAGE
  - Silt Fence
  - Settlement / Washout Basin

**NOTES**

**GENERAL**

- DRAINAGE ARE INTENDED TO INFORM THE PLANNING APPLICATION. DRAWINGS ARE NOT INTENDED FOR CONSTRUCTION AND SHOULD NOT BE USED AS SUCH. FOR AVOIDANCE OF DOUBT, SURFACE WATER MANAGEMENT DESIGN IS LIMITED TO BE FURTHER DEVELOPED POST-COMPLETION OF THE PLANNING APPLICATION INCLUDING REVISIONS.
- DEFINITE SITING OF LOCAL TOPOGRAPHY AND CONSTRUCTION SEQUENCING.
- ALL DRAINAGE MANAGEMENT FEATURES SHOWN SHOULD BE READ IN CONJUNCTION WITH RELEVANT DESIGN DRAWINGS.

**POLLUTION PREVENTION**

- ALL WORK IN POLLUTION PREVENTION ZONES SHALL BE SUBJECT TO PLANNING IN CONJUNCTION WITH THE ENVIRONMENTAL COMPLYMENT. WORKS TO BE PLANNED TO SUIT WEATHER FORECASTS.
- DRAINAGE MANAGEMENT FEATURES TO BE INSTALLED PRIOR TO OR IN PARALLEL WITH TRACK CONSTRUCTION.
- SOIL FUEL SHOULD BE STORED WITHIN CONTAMINANT AREA IN THE SITE COMPOUND. CEMENT SHOULD BE STORED WITHIN COMPULSORY TOOLS SHOULD BE WASHED IN THE SAME AREA AND WATER RECYCLED OR RE-USED.

**TRACK / INFRASTRUCTURE DRAINAGE**

- THIS DRAWING INDICATES THE MINIMUM TEMPORARY DRAINAGE REQUIREMENTS. REFER TO SEPARATE PERMANENT DRAINAGE DRAWING SERIES. PERMANENT DRAINAGE FEATURES (SETTLIMENTATION POND) MAY BE INSTALLED IN THE TEMPORARY PHASE FOR USE FOR SETTLEMENT. TEMPORARY DRAINAGE TO BE REMOVED OR AVOIDED TO SUIT THE PERMANENT WORK FOOTPRINT AND DRAINAGE PLAN AS PART OF FINAL SITE RECONSTRUCTION.
- CLEAN STONE CHECK DAMS TO BE INSTALLED IN ALL DRAINAGE CHANNELS IN ORDER TO PROMOTE SETTLEMENT OF SUSPENDED SOLIDS AND CONTROL FLOW RATES. CHECK DAMS SHOULD BE TO BE LOCAL IF ACH WITH GRADUATED STONE. AGGREGATE SIZE FOR STONE CHECK DAMS TO BE TYPICALLY 1-4mm (MESH SIZE). ON STEEP SECTIONS SMALL STONE TO BE ANCHORED THROUGH THE PLACEMENT OF 200MM STONE ON THE DOWNHILL FACE OF THE CHECK DAM. SPACING AND FREQUENCY OF CHECK DAMS WILL BE DETERMINED UPON LOCAL TERRAIN GRADIENT OF SLOPE.

**WATERCOURSE & TRACK DRAINAGE CROSSINGS**

IS THE MINIMUM PIPE DIAMETER FOR ANY TRACK DRAINAGE CROSSING SHALL BE 100MM. ALL HOPE PIPES SHALL BE TANKWELL TYPE, BSA HAINS APPROVED.

**MAINTENANCE**

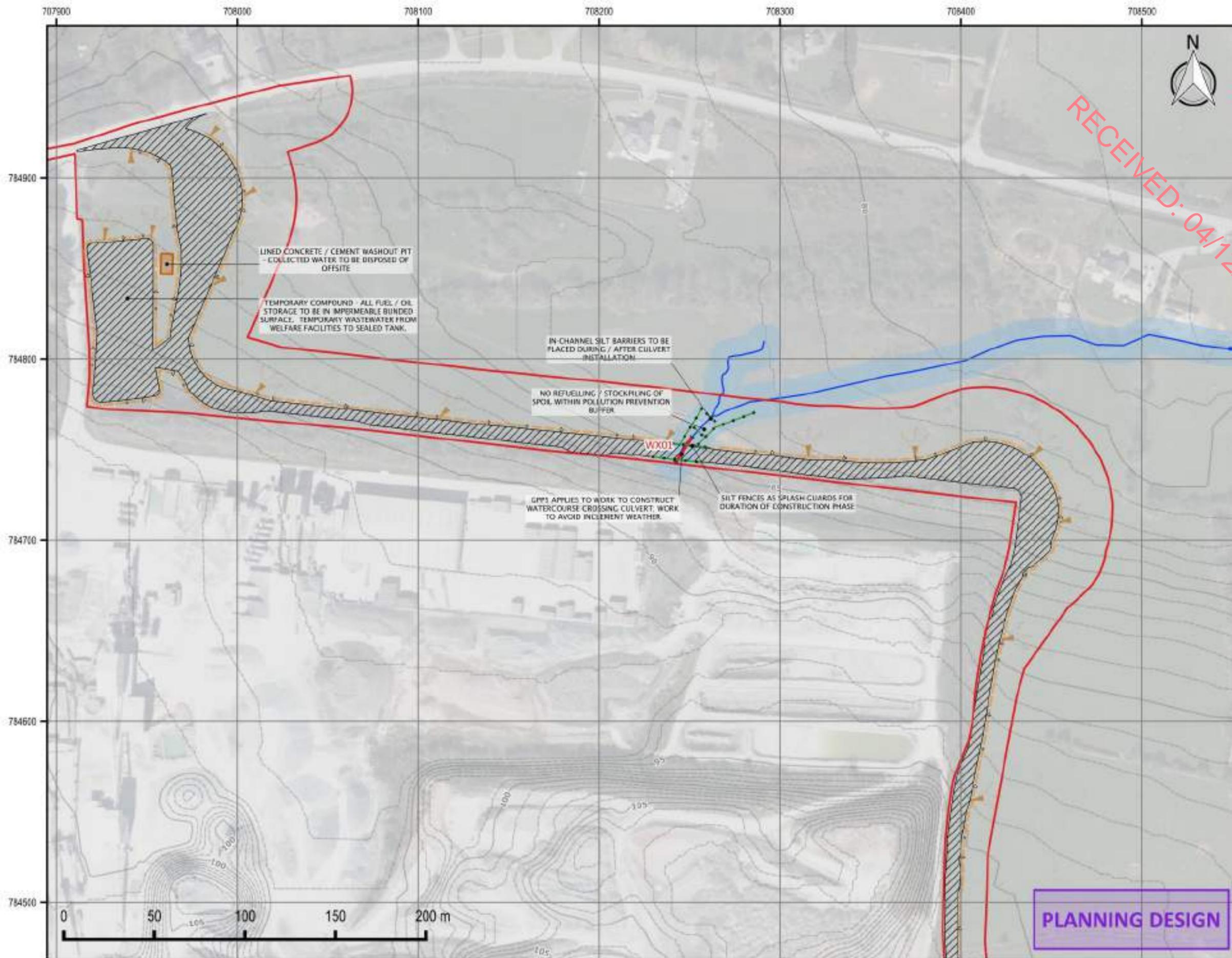
- THE LEVEL OF SILT BUILDUP DURING CONSTRUCTION TO BE MONITORED VISUALLY AND RECORD. SILT LEVELS IN RUN ARE TO BE TEMPORARILY DRAINAGE THROUGH OR BY SILT FENCE / CONSTRUCTED SETTLEMENT FEATURES) CONTAINERS OR PROPRIETARY SOLUTIONS (SILT TRAP / SILT SOCKS / SEDIMENT MATS).
- BUILD UP OF SILT LEVELS AT CHECK DAMS TO BE REMOVED AND DEPOSED OR SILT LEVELS AT CHECK DAMS TO BE VISUALLY MONITORED AS PART OF AN ONGOING MAINTENANCE PROGRAMME DURING THE CONSTRUCTION PHASE. WHERE CHECK DAMS BECOME CLOGGED WITH SILT OR VEGETATION, STONE CHECK DAM TO BE REMOVED AND REPLACED SUBSEQUENT TO THE REMOVAL OF SILT.

|  |              |                 |             |  |
|--|--------------|-----------------|-------------|--|
| <b>DESCRIPTION</b>                                       |              |                 |             |  |
| KELLYSTOWN WIND FARM - TEMPORARY DRAINAGE LAYOUT SHEET 2 |              |                 |             |  |
| <b>PROJECT / FIGURE NO.</b>                              |              |                 |             |  |
| M02207-01_TDG_2  |              |                 |             |  |
| <b>DRAWN BY</b>  | <b>SCALE</b> | <b>REVISION</b> | <b>DATE</b> |  |
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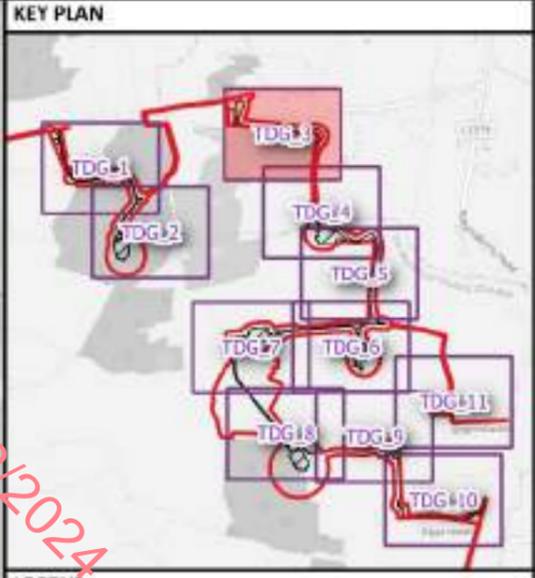
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**LEGEND**

|   |  |  |
|---|--|--|
| <b>Infrastructure</b>                       |  |  |
|   | Application Boundary                             |  |
|   | Temporary Infrastructure Footprint               |  |
| <b>Hydrology Features &amp; Constraints</b> |  |  |
|   | "Major" Watercourse                              |  |
|   | "Minor" Watercourse                              |  |
|   | Other existing drainage                          |  |
|   | Potable Borewell Location                        |  |
|   | Water Feature Siltback / Buffer Zone (10m / 50m) |  |
|   | Habitat Management Areas                         |  |
|   | Wetland  |  |
|   | Proposed Watercourse Crossing (Culvert)          |  |
| <b>Temporary Drainage</b>                   |  |  |
|   | CLEAN INTERCEPTOR                                |  |
|   | DIRTY WATER DRAINAGE                             |  |
|   | TEMPORARY PIPED DRAINAGE                         |  |
|   | Silt Fence                                       |  |
|   | Settlement / Washout Basin                       |  |

**NOTES**

**GENERAL**

1. DRAWINGS ARE INTENDED TO INFORM THE PLANNING APPLICATION. DRAWINGS ARE NOT INTENDED FOR CONSTRUCTION AND SHOULD NOT BE USED AS SUCH. FOR AVOIDANCE OF DOUBT, SURFACE WATER MANAGEMENT DESIGN IS LIMITED TO BE FURTHER DEVELOPED POST-COMMITMENT OF THE PLANNING APPLICATION INCLUDING MICRODRAINAGE.
2. DETAILED SITING OF LAND FEATURES SHALL BE UNDERTAKEN ON AN OBSERVATIONAL BASIS OR BASED ON LOCAL TOPOGRAPHY AND CONSTRUCTION SEQUENCE.
3. ALL DRAINAGE MANAGEMENT FEATURES SHOWN SHOULD BE READ IN CONJUNCTION WITH RELEVANT DESIGN DRAWINGS.

**POLLUTION PREVENTION**

4. ALL WORK IN POLLUTION PREVENTION ZONES SHALL BE SUBJECT TO PLANNING IN CONJUNCTION WITH THE ENVIRONMENTAL COMPLYMENT. WORKS TO BE PLANNED TO SUIT WEATHER FORECASTS.
5. DRAINAGE MANAGEMENT FEATURES TO BE INSTALLED PRIOR TO OR IN PARALLEL WITH TRACK CONSTRUCTION.
6. OIL FUEL SHOULD BE STORED WITHIN CONTAMINANT AREA IN THE SITE COMPOUND. CEMENT SHOULD BE STORED WITHIN COMPULSORY TOOLS SHOULD BE WASHED IN THE SAME AREA AND WATER RECYCLED ON THE CEMENT WAG.

**TRACK / INFRASTRUCTURE DRAINAGE**

7. THIS DRAWING INDICATES THE LOCATION OF TEMPORARY DRAINAGE REQUIREMENTS. REFER TO SEPARATE PERMANENT DRAINAGE DRAWING SERIES. PERMANENT DRAINAGE FEATURES (SETBACKS/SETBACKS) MAY BE INSTALLED IN THE TEMPORARY PHASE FOR USE FOR SETTLEMENT. TEMPORARY DRAINAGE TO BE REMOVED OR AMENDED TO SUIT THE PERMANENT WORK FOOTPRINT AND DRAINAGE PLAN AS PART OF FINAL SITE RECONFIGURATION.
8. CLEAN STONE CHECK DAMS TO BE INSTALLED IN ALL DRAINAGE CHANNELS IN ORDER TO PROMOTE SETTLEMENT OF SUSPENDED SOLIDS AND CONTROL FLOW RATES. CHECK DAMS SHOULD BE TO BE LOCAL IF WITH WELL GRADED STONE. AGGREGATE SIZE FOR STONE CHECK DAMS TO BE THICKNESS 1.4 TIMES STONE. ON STEEP SECTIONS SMALL STONE TO BE ANCHORED THROUGH THE PLACEMENT OF 300MM STONE ON THE DOWNHILL FACE OF THE CHECK DAM. SPACING AND FREQUENCY OF CHECK DAMS WILL BE DETERMINED UPON USUALLY GRADIENT OF SLOPE.

**WATERCOURSE & TRACK DRAINAGE CROSSINGS**

10. THE MINIMUM PIPE DIAMETER FOR ANY TRACK DRAINAGE CROSSING SHALL BE 150MM. ALL HOPE PIPES SHALL BE TANKWELL TYPE, BGA HAINS APPROVED.

**MAINTENANCE**

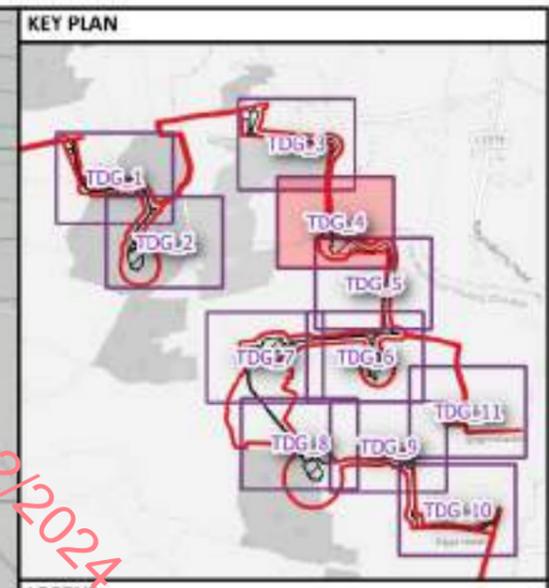
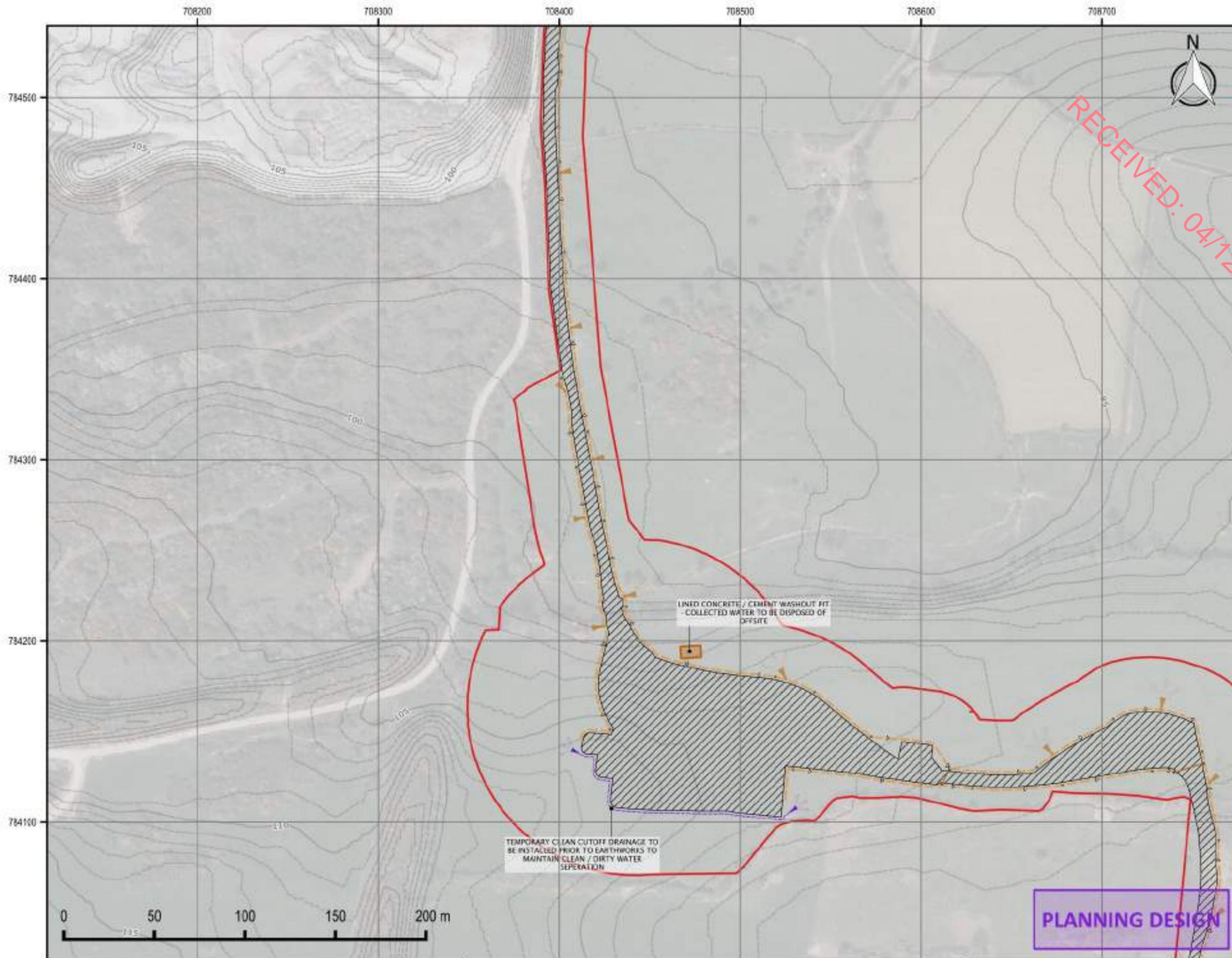
11. THE LEVEL OF SET BACKS DURING CONSTRUCTION TO BE MONITORED USUALLY AND RECORD SET LEVELS IN 500MM x 100MM TO BE TEMPORARY DRAINAGE THROUGH OR BY SILT FENCES / CONSTRUCTED SETTLEMENT FEATURES) CONTAINING OR PROPRIETARY SOLUTIONS (SILT TRAP / SET SOLO / SEDIMENT MATS).
12. BUILD UP OF SET LEVELS AT CHECK DAMS TO BE REMOVED AND DEPOSED OF. SET LEVELS AT CHECK DAMS TO BE USUALLY MONITORED AS PART OF AN ONGOING MAINTENANCE PROGRAMME DURING THE CONSTRUCTION PHASE. WHERE CHECK DAMS BECOME CLOGGED BY SET OR VEGETATION, STONE CHECK DAM TO BE REMOVED AND REPLACED SUBSEQUENT TO THE REMOVAL OF SET.

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|  |              |                 |             |  |
|--|--------------|-----------------|-------------|--|
| <b>DESCRIPTION</b>                                       |              |                 |             |  |
| KELLYSTOWN WIND FARM - TEMPORARY DRAINAGE LAYOUT SHEET 3 |              |                 |             |  |
| <b>PROJECT / FIGURE NO.</b>                              |              |                 |             |  |
| M02207-01_TDG_3  |              |                 |             |  |
| <b>DRAWN BY</b>  | <b>SCALE</b> | <b>REVISION</b> | <b>DATE</b> |  |
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**LEGEND**

**Infrastructure**

- Application Boundary
- Temporary Infrastructure Footprint

**Hydrology Features & Constraints**

- "Major" Watercourse
- "Minor" Watercourse
- Other existing drainage
- Potable Borewell Location
- Water Feature Setback / Buffer Zone (10m / 50m)
- Habitat Management Areas
- Wetland
- Proposed Watercourse Crossing (Culvert)

**Temporary Drainage**

- CLEAN INTERCEPTOR
- DIRTY WATER DRAINAGE
- TEMPORARY PIPED DRAINAGE
- Silt Fence
- Settlement / Washout Basin

**NOTES**

**GENERAL**

1. DRAWINGS ARE INTENDED TO INFORM THE PLANNING APPLICATION. DRAWINGS ARE NOT INTENDED FOR CONSTRUCTION AND SHOULD NOT BE USED AS SUCH. FOR AVOIDANCE OF DOUBT, SURFACE WATER MANAGEMENT DESIGN IS LIMITED TO BE FURTHER DEVELOPED POST-COMMITMENT OF THE PLANNING APPLICATION INCLUDING MICRODRAINAGE.
2. DETAILED SITING OF LOAD FEATURES SHALL BE UNDERTAKEN ON AN OPERATIONAL BASIS DEPENDANT ON LOCAL TOPOGRAPHY AND CONSTRUCTION SEQUENCING.
3. ALL DRAINAGE MANAGEMENT FEATURES SHOWN SHOULD BE READ IN CONJUNCTION WITH RELEVANT DESIGN DRAWINGS.

**POLLUTION PREVENTION**

4. ALL WORK IN POLLUTION PREVENTION ZONES SHALL BE SUBJECT TO PLANNING IN CONJUNCTION WITH THE ENVIRONMENTAL COMMITMENT. WORKS TO BE PLANNED TO SUIT WEATHER FORECASTS.
5. DRAINAGE MANAGEMENT FEATURES TO BE INSTALLED PRIOR TO OR IN PARALLEL WITH TRACK CONSTRUCTION.
6. OIL FUEL SHOULD BE STORED WITHIN CONTAMINANT AREA IN THE SITE COMPOUND. CEMENT SHOULD BE STORED WITHIN COMPULSORY TOOLS SHOULD BE WASHED IN THE SAME AREA AND WATER RECYCLED ON THE CEMENT WASH.

**TRACK / INFRASTRUCTURE DRAINAGE**

7. THIS DRAWING INDICATES THE MINIMUM TEMPORARY DRAINAGE REQUIREMENTS. REFER TO SEPARATE PERMANENT DRAINAGE DRAWING SERIES. PERMANENT DRAINAGE FEATURES (SETTLEMENT BASINS) MAY BE INSTALLED IN THE TEMPORARY PHASE FOR USE FOR SETTLEMENT. TEMPORARY DRAINAGE TO BE REMOVED OR HAVE NEED TO SUIT THE PERMANENT WORK FOOTPRINT AND DRAINAGE PLAN AS PART OF FINAL SITE RECONSTRUCTION.
8. CLEAN STONE CHECK DAMS TO BE INSTALLED IN ALL DRAINAGE CHANNELS IN ORDER TO PROMOTE SETTLEMENT OF SUSPENDED SOLIDS AND CONTROL FLOW RATES. CHECK DAMS CENTRAL TO BE LOCALITY WITH GRADUATED STONE. APPROPRIATE SIZE FOR STONE CHECK DAMS TO BE THOROUGHLY 1.4M DIA. STONE. ON STEEP SECTIONS SMALL STONE TO BE ANCHORED THROUGH THE PLACEMENT OF 200MM STONE ON THE DOWNHILL FACE OF THE CHECK DAM. FREQUENCY OF CHECK DAMS WILL BE DETERMINED UPON USUAL DRAINAGE GRADIENT OF SLOPE.

**WATERCOURSE & TRACK DRAINAGE CROSSINGS**

10. THE MINIMUM PIPE DIAMETER FOR ANY TRACK DRAINAGE CROSSINGS SHALL BE 150MM. ALL HOPE PIPES SHALL BE TANKWELL TYPE, BSA HAINS APPROVED.

**MAINTENANCE**

11. THE LEVEL OF SILT BUILDUP DURING CONSTRUCTION IS TO BE MONITORED VISUALLY AND RECORDS. SILT LEVELS IN RUNWAYS TO BE TEMPORARILY DRAINAGE THROUGHOUT OF SILT FENCES / CONSTRUCTED SETTLEMENT FEATURES) CONTAINERS OR PROPRIETARY SOLUTIONS (SUBSTRIP / Silt SOCKS / SEDIMENT MATS).
12. BUILD UP OF SILT LEVELS AT CHECK DAMS TO BE REMOVED AND DEPOSED OF. SILT LEVELS AT CHECK DAMS TO BE VISUALLY MONITORED AS PART OF AN ONGOING MAINTENANCE PROGRAMME DURING THE CONSTRUCTION PHASE. WHERE CHECK DAMS BECOME CLOGGED WITH SILT OR VEGETATION, STONE CHECK DAM TO BE REMOVED AND REPLACED SUBSEQUENT TO THE REMOVAL OF SILT.

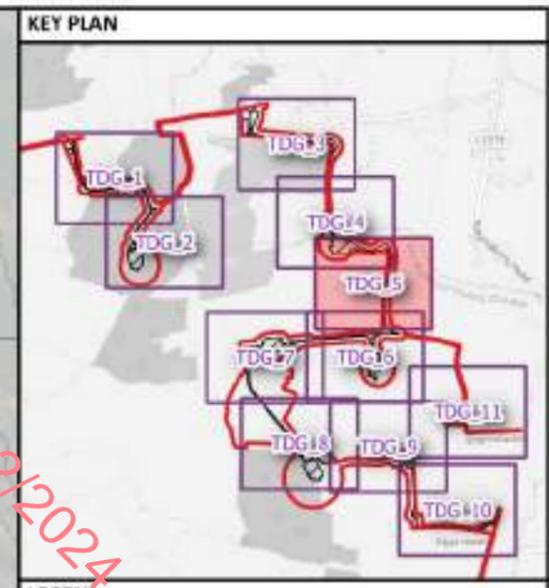
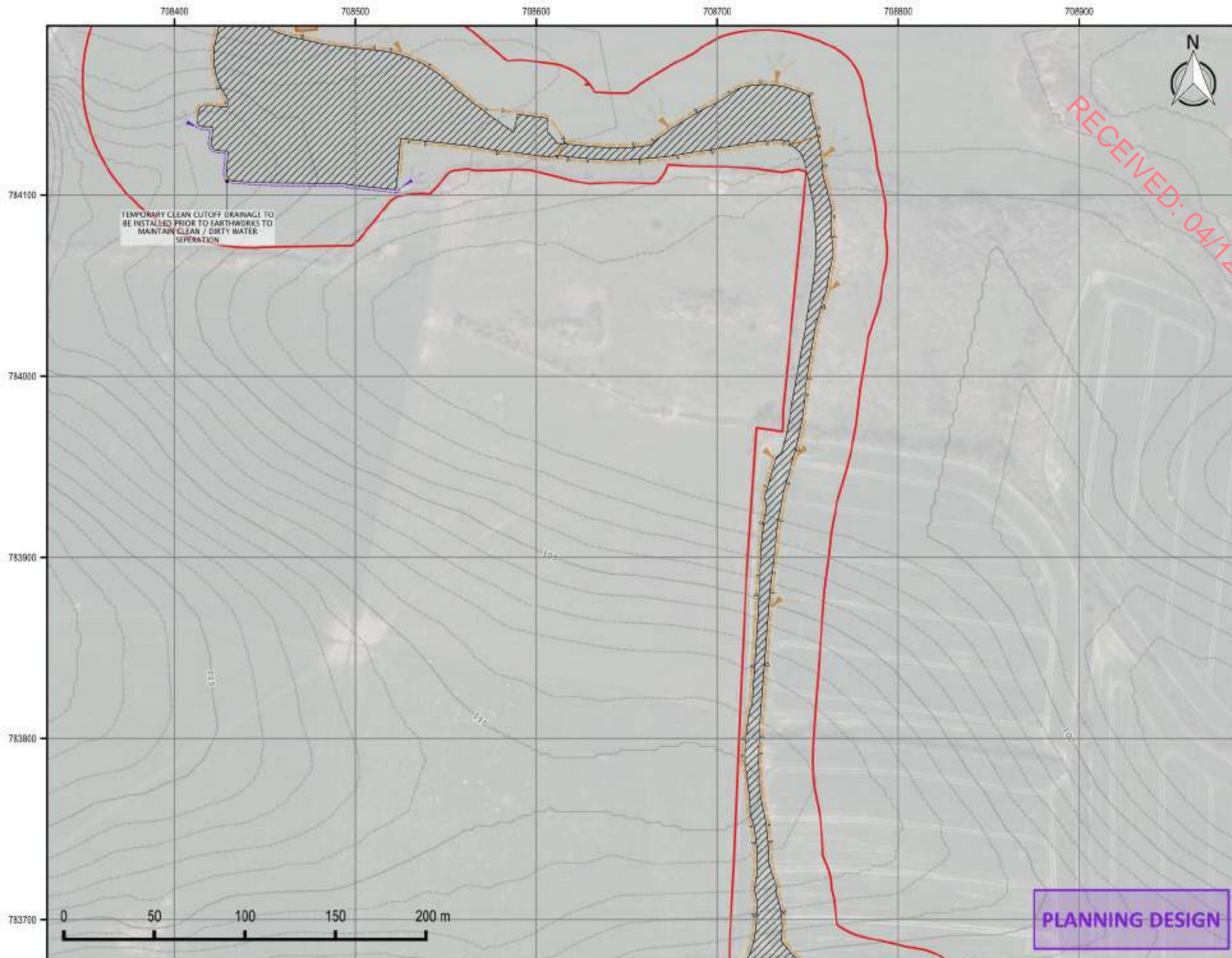
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|  |              |                 |             |  |
|--|--------------|-----------------|-------------|--|
| <b>DESCRIPTION</b>                                       |              |                 |             |  |
| KELLYSTOWN WIND FARM - TEMPORARY DRAINAGE LAYOUT SHEET 4 |              |                 |             |  |
| <b>PROJECT / FIGURE NO.</b>                              |              |                 |             |  |
| M02207-01 TDG_4  |              |                 |             |  |
| <b>DRAWN BY</b>  | <b>SCALE</b> | <b>REVISION</b> | <b>DATE</b> |  |
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**LEGEND**

| Infrastructure                   |  |
|----------------------------------|--|
| [Red outline]                    | Application Boundary                             |
| [Hatched area]                   | Temporary Infrastructure Footprint               |
| Hydrology Features & Constraints |  |
| [Thick blue line]                | "Major" Watercourse                              |
| [Thin blue line]                 | "Minor" Watercourse                              |
| [Dashed line]                    | Other existing drainage                          |
| [Blue square]                    | Potable Borewell Location                        |
| [Light blue area]                | Water Feature Siltback / Buffer Zone (10m / 50m) |
| [Green dashed area]              | Habitat Management Areas                         |
| [Blue wavy area]                 | Wetland  |
| [Red line with bridge symbol]    | Proposed Watercourse Crossing (Culvert)          |
| Temporary Drainage               |  |
| [Purple line with arrow]         | CLEAN INTERCEPTOR                                |
| [Yellow line with arrow]         | DIRTY WATER DRAINAGE                             |
| [Brown line with arrow]          | TEMPORARY PIPED DRAINAGE                         |
| [Green dashed line]              | Silt Fence                                       |
| [Orange rectangle]               | Settlement / Washout Basin                       |

**NOTES**

**GENERAL**

1. OVERLAYS ARE INTENDED TO INFORM THE PLANNING APPLICATION. DRAWINGS ARE NOT INTENDED FOR CONSTRUCTION AND SHOULD NOT BE USED AS SUCH. FOR AVOIDANCE OF DOUBT, SURFACE WATER MANAGEMENT DESIGN IS INTENDED TO BE FURTHER DEVELOPED POST-COMMITMENT OF THE PLANNING APPLICATION INCLUDING MICRODRAINAGE.
2. DETAILED SITING OF LAND FEATURES SHALL BE UNDERTAKEN ON AN OBSERVATIONAL BASIS OR PROVIDED ON LOCAL TOPOGRAPHY AND CONSTRUCTION SECTIONS.
3. ALL DRAINAGE MANAGEMENT FEATURES SHOWN SHOULD BE READ IN CONJUNCTION WITH RELEVANT DESIGN DRAWINGS.

**POLLUTION PREVENTION**

4. ALL WORK IN POLLUTION PREVENTION ZONES SHALL BE SUBJECT TO PLANNING IN CONJUNCTION WITH THE ENVIRONMENTAL COMMITMENT. WORKS TO BE PLANNED TO SUIT WEATHER FORECASTS.
5. DRAINAGE MANAGEMENT FEATURES TO BE INSTALLED PRIOR TO OR IN PARALLEL WITH TRACK CONSTRUCTION.
6. OIL FUEL SHOULD BE STORED WITHIN CONTAMINANT AREA IN THE SITE COMPOUND. CEMENT SHOULD BE STORED WITHIN COMPULSORY TILES. TOOLS SHOULD BE WASHED IN THE SAME AREA AND WATER RECYCLED OR THE CEMENT WASH.

**TRACK / INFRASTRUCTURE DRAINAGE**

7. THIS DRAWING INDICATES THE MINIMUM TEMPORARY DRAINAGE REQUIREMENTS. REFER TO SEPARATE PERMANENT DRAINAGE DRAWINGS SERIES. PERMANENT DRAINAGE FEATURES (SETTLIMENTATION POND) MAY BE INSTALLED IN THE TEMPORARY PHASE FOR USE FOR SETTLEMENT. TEMPORARY DRAINAGE TO BE REMOVED OR AS NEEDED TO SUIT THE PERMANENT WORK FOOTPRINT AND DRAINAGE PLAN AS PART OF FINAL SITE RECONSTRUCTION.
8. CLEAN STONE CHECK DAMS TO BE INSTALLED IN ALL DRAINAGE CHANNELS IN ORDER TO PROMOTE SETTLEMENT OF SUSPENDED SOLIDS AND CONTROL FLOW RATES. CHECK DAMS SHOULD BE TO BE LOCALITY WITH GRADUALLY GRADUALLY. AGGREGATE SIZE FOR STONE CHECK DAMS TO BE THICKLY 1.4M DIA. STONE. ON STEEP SECTIONS SMALL STONE TO BE ANCHORED THROUGH THE PLACEMENT OF 300MM STONE ON THE DOWNHILL FACE OF THE CHECK DAM. INSPECTION AND FREQUENCY OF CHECK DAMS WILL BE DETERMINED UPON USUAL/USUAL GRADIENT OF SLOPE.

**WATERCOURSE & TRACK DRAINAGE CROSSINGS**

10. THE MINIMUM PIPE DIAMETER FOR ANY TRACK DRAINAGE CROSSING SHALL BE 150MM. ALL HOPE PIPES SHALL BE TANKWELL TYPE, BSA HAINS APPROVED.

**MAINTENANCE**

11. THE LEVEL OF SILT BUILDUP DURING CONSTRUCTION IS TO BE MONITORED VISUALLY AND RECORDS TO BE KEPT. SILT LEVELS TO BE TO BE MONITORED THROUGHOUT OF SILT FENCES / CONSTRUCTED SETTLEMENT FEATURES / CONTAINERS OR PROPRIETARY SOLUTIONS (SILT TRAP / SILT SOCKS / SEDIMENT MATS).
12. BUILD UP OF SILT LEVELS AT CHECK DAMS TO BE REMOVED AND DEPOSITED. SILT LEVELS AT CHECK DAMS TO BE VISUALLY MONITORED AS PART OF AN ONGOING MAINTENANCE PROGRAMME DURING THE CONSTRUCTION PHASE. WHERE CHECK DAMS BECOME CLOGGED WITH SILT OR VEGETATION, STONE CHECK DAM TO BE REMOVED AND REPLACED SUBSEQUENT TO THE REMOVAL OF SILT.

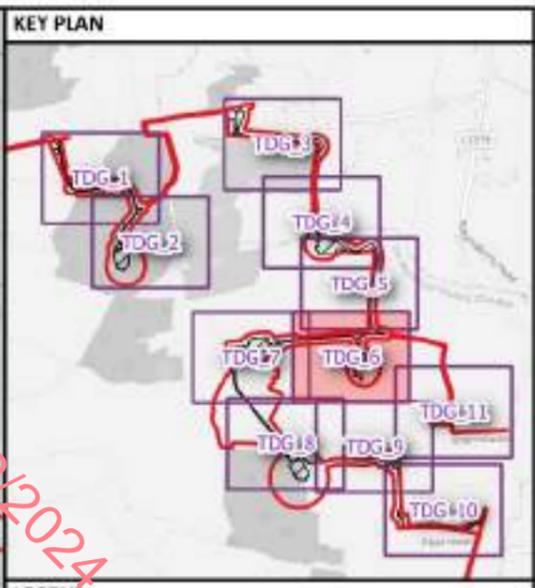
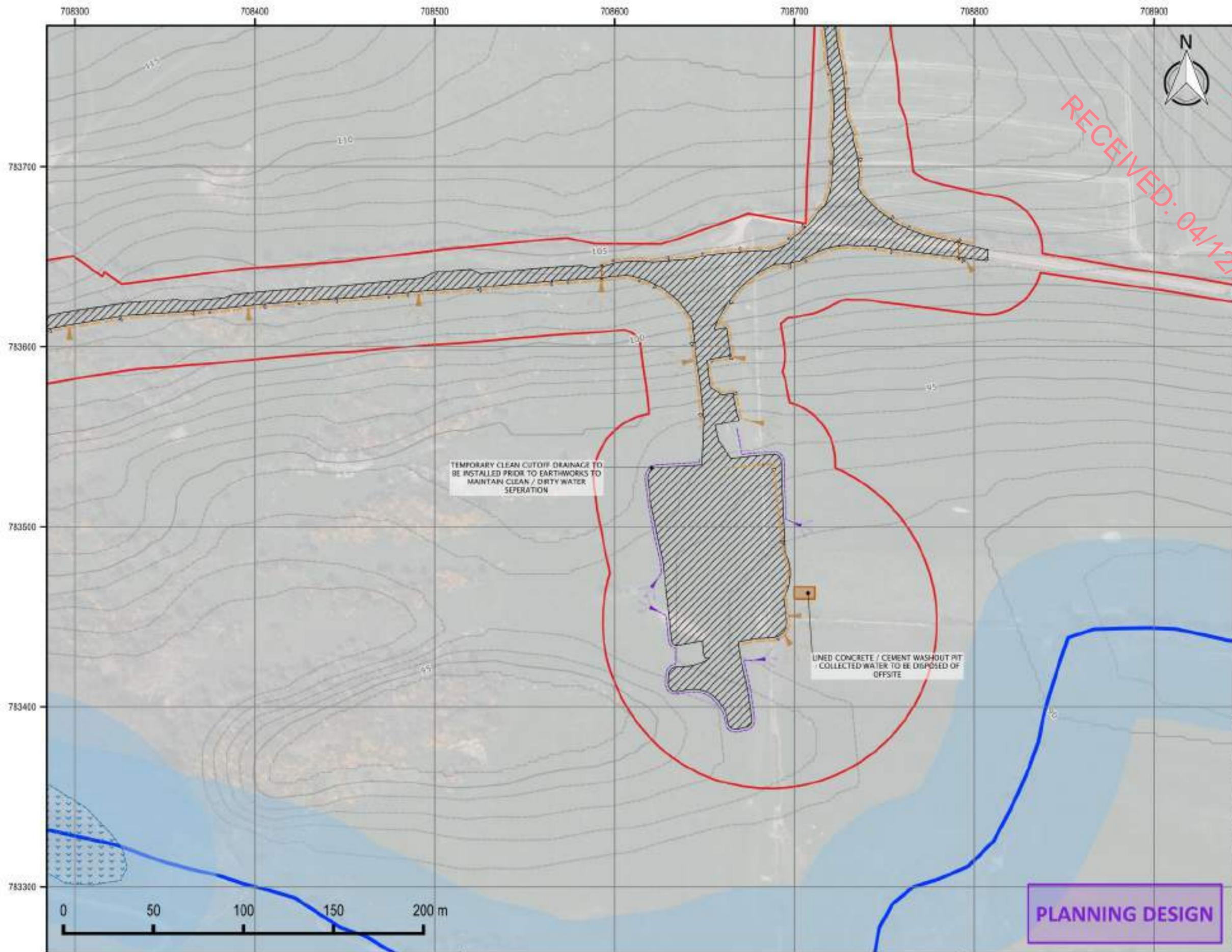
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|  |              |                 |             |  |
|--|--------------|-----------------|-------------|--|
| <b>DESCRIPTION</b>                                       |              |                 |             |  |
| KELLYSTOWN WIND FARM - TEMPORARY DRAINAGE LAYOUT SHEET 5 |              |                 |             |  |
| <b>PROJECT / FIGURE NO.</b>                              |              |                 |             |  |
| M02207-01_TDG_5  |              |                 |             |  |
| <b>DRAWN BY</b>  | <b>SCALE</b> | <b>REVISION</b> | <b>DATE</b> |  |
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**LEGEND**

**Infrastructure**

- Application Boundary
- Temporary Infrastructure Footprint

**Hydrology Features & Constraints**

- "Major" Watercourse
- "Minor" Watercourse
- Other existing drainage
- Potable Borewell Location
- Water Feature Siltback / Buffer Zone (10m / 50m)
- Habitat Management Area
- Wetland
- Proposed Watercourse Crossing (Culvert)

**Temporary Drainage**

- CLEAN INTERCEPTOR
- DIRTY WATER DRAINAGE
- TEMPORARY PIPED DRAINAGE
- Silt Fence
- Settlement / Washout Basin

TEMPORARY CLEAN CUTOFF DRAINAGE TO BE INSTALLED PRIOR TO EARTHWORKS TO MAINTAIN CLEAN / DIRTY WATER SEPERATION

LINED CONCRETE / CEMENT WASHOUT PIT / COLLECTED WATER TO BE DISPOSED OF OFFSITE

**PLANNING DESIGN**

**NOTES**

**GENERAL**

- DRAINAGE ARE INTENDED TO INFORM THE PLANNING APPLICATION. DRAWINGS ARE NOT INTENDED FOR CONSTRUCTION AND SHOULD NOT BE USED AS SUCH. FOR AVOIDANCE OF DOUBT, SURFACE WATER MANAGEMENT DESIGN IS INTENDED TO BE FURTHER DEVELOPED POST-COMMITMENT OF THE PLANNING APPLICATION INCLUDING MICRODRAINING.
- DEFINITE SITING OF LAND FEATURES SHALL BE UNDERTAKEN ON AN OBSERVATIONAL BASIS OR PRESENT ON LOCAL TOPOGRAPHY AND CONSTRUCTION SECTIONS.
- ALL DRAINAGE MANAGEMENT FEATURES SHOWN SHOULD BE READ IN CONJUNCTION WITH RELEVANT DESIGN DRAWINGS.

**POLLUTION PREVENTION**

- ALL WORK IN POLLUTION PREVENTION ZONES SHALL BE SUBJECT TO PLANNING IN CONJUNCTION WITH THE ENVIRONMENTAL COMMITMENT. WORKS TO BE PLANNED TO SUIT WEATHER FORECASTS.
- DRAINAGE MANAGEMENT FEATURES TO BE INSTALLED PRIOR TO OR IN PARALLEL WITH TRACK CONSTRUCTION.
- SOIL FUEL SHOULD BE STORED WITHIN CONTAMINANT AREA IN THE SITE COMPOUND. CEMENT SHOULD BE STORED WITHIN COMPULSORY TOOLS SHOULD BE WASHED IN THE SAME AREA AND WATER RECYCLED OR THE CEMENT WASH.

**TRACK / INFRASTRUCTURE DRAINAGE**

- THIS DRAWING INDICATES THE MINIMUM TEMPORARY DRAINAGE REQUIREMENTS. REFER TO SEPARATE PERMANENT DRAINAGE DRAWING SERIES. PERMANENT DRAINAGE FEATURES (SETTLIMENTATION POND) MAY BE INSTALLED IN THE TEMPORARY PHASE FOR USE FOR SETTLEMENT. TEMPORARY DRAINAGE TO BE REMOVED OR ADDED TO SUIT THE PERMANENT WORK FOOTPRINT AND DRAINAGE PLAN AS PART OF FINAL SITE RECONFIGURATION.
- CLEAN STONE CHECK DAMS TO BE INSTALLED IN ALL DRAINAGE CHANNELS IN ORDER TO PROMOTE SETTLEMENT OF SUSPENDED SOLIDS AND CONTROL FLOW RATES. CHECK DAMS GENERAL TO BE LOCAL TO EACH WASH GRADUATED STONE. AGGREGATE SIZE FOR STONE CHECK DAMS TO BE THICKLY GRADUATED STONE. ON STEEP SECTIONS SMALL STONE TO BE ANCHORED THROUGH THE PLACEMENT OF 300MM STONE ON THE DOWNHILL FACE OF THE CHECK DAM. SPACING AND FREQUENCY OF CHECK DAMS WILL BE DETERMINED UPON USUAL/USUAL GRADIENT OF SLOPE.

**WATERCOURSE & TRACK DRAINAGE CROSSINGS**

IS THE MINIMUM PIPE DIAMETER FOR ANY TRACK DRAINAGE CROSSING SHALL BE 150MM. ALL HOPE PIPES SHALL BE TANKWELL TYPE, BSA HAINS APPROVED.

**MAINTENANCE**

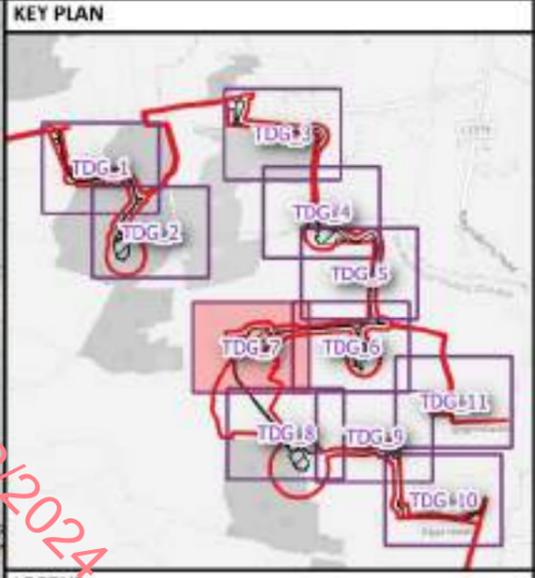
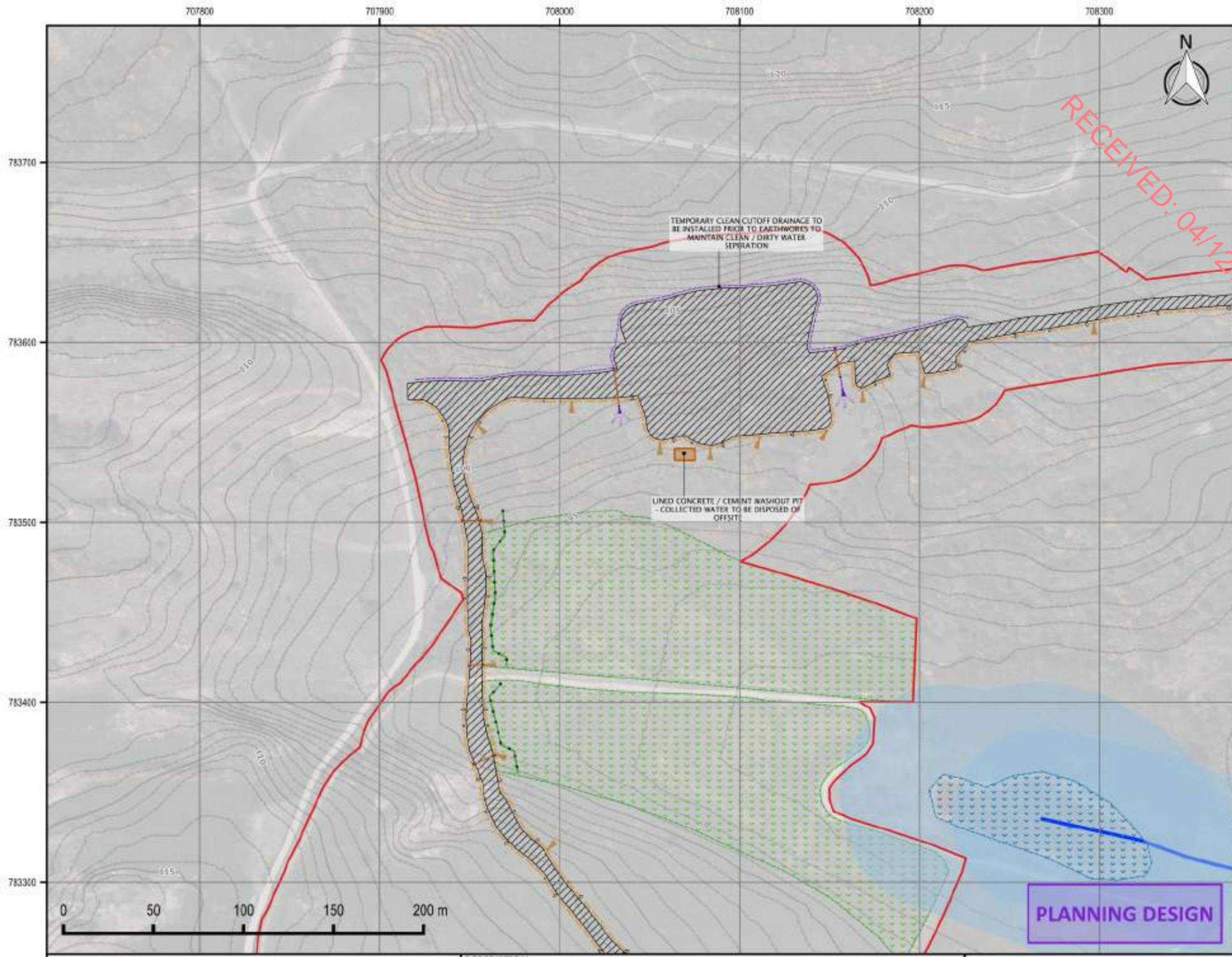
- THE LEVEL OF SILT BUILDUP DURING CONSTRUCTION TO BE MONITORED VISUALLY AND RECORD. SILT LEVELS IN RUNWAYS TO BE TEMPORARILY MAINTAINED THROUGHOUT OF SILT FENCE / CONSTRUCTED SETTLEMENT FEATURES) CONTAINERS OR PROPRIETARY SOLUTIONS (SILT TRAP / SILT SOCKS / SEDIMENT MATS).
- BUILD UP OF SILT LEVELS AT CHECK DAMS TO BE REMOVED AND DEPOSED OF. SILT LEVELS AT CHECK DAMS TO BE VISUALLY MONITORED AS PART OF AN ONGOING MAINTENANCE PROGRAMME DURING THE CONSTRUCTION PHASE. WHERE CHECK DAMS BECOME CLOGGED WITH SILT OR VEGETATION, STONE CHECK DAM TO BE REMOVED AND REPLACED SUBSEQUENT TO THE REMOVAL OF SILT.

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|--|--------------|-----------------|-------------|--|
| <b>DESCRIPTION</b>                                       |              |                 |             |  |
| KELLYSTOWN WIND FARM - TEMPORARY DRAINAGE LAYOUT SHEET 6 |              |                 |             |  |
| <b>PROJECT / FIGURE NO.</b>                              |              |                 |             |  |
| M02207-01_TDG_6  |              |                 |             |  |
| <b>DRAWN BY</b>  | <b>SCALE</b> | <b>REVISION</b> | <b>DATE</b> |  |
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**LEGEND**

|   |   |
|---|---|
| <b>Infrastructure</b>                       |   |
|   | Application Boundary                            |
|   | Temporary Infrastructure Footprint              |
| <b>Hydrology Features &amp; Constraints</b> |   |
|   | "Major" Watercourse                             |
|   | "Minor" Watercourse                             |
|   | Other existing drainage                         |
|   | Potable Borewell Location                       |
|   | Water Feature Setback / Buffer Zone (10m / 50m) |
|   | Habitat Management Areas                        |
|   | Wetland   |
|   | Proposed Watercourse Crossing (Culvert)         |
| <b>Temporary Drainage</b>                   |   |
|   | CLEAN INTERCEPTOR                               |
|   | DIRTY WATER DRAINAGE                            |
|   | TEMPORARY PIPED DRAINAGE                        |
|   | Silt Fence                                      |
|   | Settlement / Washout Basin                      |

**NOTES**

**GENERAL**

1. DRAWINGS ARE INTENDED TO INFORM THE PLANNING APPLICATION. DRAWINGS ARE NOT INTENDED FOR CONSTRUCTION AND SHOULD NOT BE USED AS SUCH. FOR AVOIDANCE OF DOUBT, SURFACE WATER MANAGEMENT DESIGN IS INTENDED TO BE FURTHER DEVELOPED POST-COMMITMENT OF THE PLANNING APPLICATION INCLUDING MICRODRAINAGE.

2. DETAILED SITING OF LAGOON FEATURES SHALL BE UNDERTAKEN ON AN OPERATIONAL BASIS OR PERMITTED BY LOCAL AUTHORITIES AND CONSTRUCTION SEQUENCE.

3. ALL DRAINAGE MANAGEMENT FEATURES SHOWN SHOULD BE READ IN CONJUNCTION WITH RELEVANT DESIGN DRAWINGS.

**POLLUTION PREVENTION**

4. ALL WORK IN POLLUTION PREVENTION ZONES SHALL BE SUBJECT TO PLANNING IN CONJUNCTION WITH THE ENVIRONMENTAL COMPLYMENT. WORKS TO BE PLANNED TO SUIT WEATHER FORECASTS.

5. DRAINAGE MANAGEMENT FEATURES TO BE INSTALLED PRIOR TO OR IN PARALLEL WITH TRACK CONSTRUCTION.

6. SOIL PILES SHOULD BE STORED WITHIN CONTAMINANT AREA IN THE SITE COMPOUND. CEMENT SHOULD BE STORED WITHIN COMPOLVED TOOLS SHOULD BE WASHED IN THE SAME AREA AND WATER RECYCLED OR THE CEMENT WASH.

**TRACK / INFRASTRUCTURE DRAINAGE**

7. THIS DRAWING INDICATES THE MINIMUM TEMPORARY DRAINAGE REQUIREMENTS. REFER TO SEPARATE PERMANENT DRAINAGE DRAWING SERIES. PERMANENT DRAINAGE FEATURES (SETBACKS/POLLUTION PREVENTION) MAY BE INSTALLED IN THE TEMPORARY PHASE FOR USE FOR SETTLEMENT. TEMPORARY DRAINAGE TO BE REMOVED OR HAVE NEED TO SUIT THE PERMANENT WORK FOOTPRINT AND DRAINAGE PLAN AS PART OF FINAL SITE RECONSTRUCTION.

8. CLEAN STONE CHECK DAMS TO BE INSTALLED IN ALL DRAINAGE CHANNELS IN ORDER TO PROMOTE SETTLEMENT OF SUSPENDED SOLIDS AND CONTROL FLOW RATES. CHECK DAMS CENTRAL TO BE LOCALITY WITH WELL GRADED STONE. AGGREGATE SIZE FOR STONE CHECK DAMS TO BE THIRDPART 14MM STONE. ON STEEP SECTIONS SMALL STONE TO BE ANCHORED THROUGH THE PLACEMENT OF 200MM STONE ON THE DOWNHILL FACE OF THE CHECK DAM. SPRINGS AND FREQUENCY OF CHECK DAMS WILL BE DETERMINED UPON USUAL/USUAL GRADIENT OF SLOPE.

**WATERCOURSE & TRACK DRAINAGE CROSSINGS**

10. THE MINIMUM PIPE DIAMETER FOR ANY TRACK DRAINAGE CROSSINGS SHALL BE 100MM. ALL HOPE PIPES SHALL BE TANKWELL TYPE, BSA HARDS APPROVED.

**MAINTENANCE**

11. THE LEVEL OF SILT IN/BELOW DRAINAGE CONSTRUCTION TO BE MAINTAINED VISUALLY AND RECORDS. SILT LEVELS IN/BELOW TO BE TEMPORARILY DRAINAGE THROUGH OR OF SILT FENCE / CONSTRUCTED SETTLEMENT FEATURES / CONTAINERS OR PROPRIETARY SOLUTIONS (SUBSTRATE / SILT SOCKS / SEDIMENT MATS).

12. BUILD UP OF SILT LEVELS AT CHECK DAMS TO BE REMOVED AND DEPOSED OF. SILT LEVELS AT CHECK DAMS TO BE VISUALLY MONITORED AS PART OF AN ONGOING MAINTENANCE PROGRAMME DURING THE CONSTRUCTION PHASE. WHERE CHECK DAMS BECOME CLOGGED WITH SILT OR VEGETATION, STONE CHECK DAM TO BE REMOVED AND REPLACED SUBSEQUENT TO THE REMOVAL OF SILT.

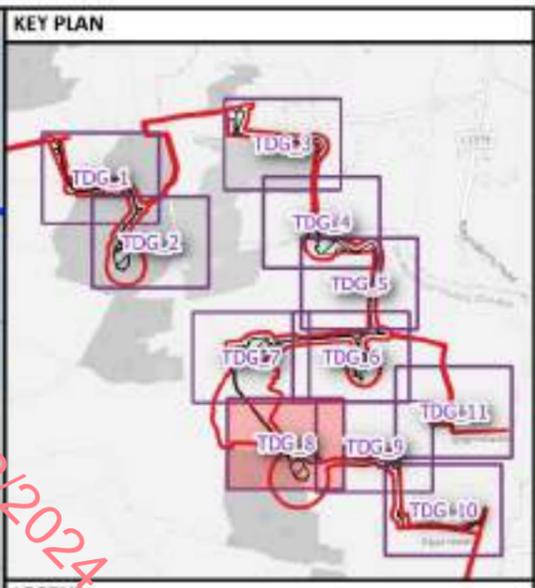
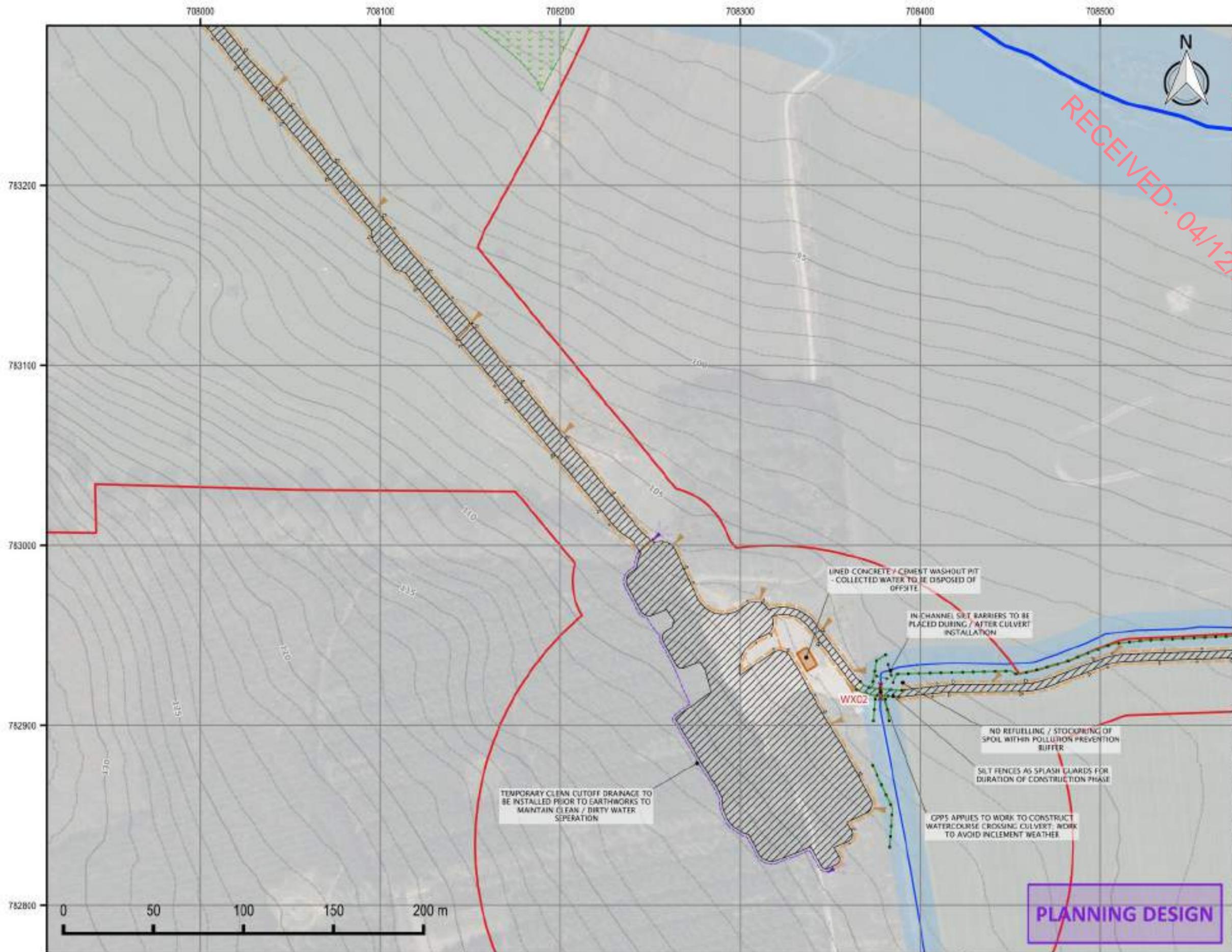
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|--|--------------|-----------------|-------------|--|
| <b>DESCRIPTION</b>                                       |              |                 |             |  |
| KELLYSTOWN WIND FARM - TEMPORARY DRAINAGE LAYOUT SHEET 7 |              |                 |             |  |
| <b>PROJECT / FIGURE NO.</b>                              |              |                 |             |  |
| M02207-01_TDG_7  |              |                 |             |  |
| <b>DRAWN BY</b>  | <b>SCALE</b> | <b>REVISION</b> | <b>DATE</b> |  |
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**LEGEND**

**Infrastructure**

- Application Boundary
- Temporary Infrastructure Footprint

**Hydrology Features & Constraints**

- "Major" Watercourse
- "Minor" Watercourse
- Other existing drainage
- Potable Borewell Location
- Water Feature Siltback / Buffer Zone (10m / 50m)
- Habitat Management Area
- Wetland
- Proposed Watercourse Crossing (Culvert)

**Temporary Drainage**

- CLEAN INTERCEPTOR
- DIRTY WATER DRAINAGE
- TEMPORARY PIPED DRAINAGE
- Silt Fence
- Settlement / Washout Basin

**NOTES**

**GENERAL**

1. DRAINAGES ARE INTENDED TO INFORM THE PLANNING APPLICATION. DRAWINGS ARE NOT INTENDED FOR CONSTRUCTION AND SHOULD NOT BE USED AS SUCH. FOR AVOIDANCE OF DOUBT, SURFACE WATER MANAGEMENT DESIGN IS LIMITED TO BE FURTHER DEVELOPED POST-COMPLETION OF THE PLANNING APPLICATION INCLUDING MICRODRAINING.
2. DETAILED SITING OF LIQUID FEATURES SHALL BE UNDERTAKEN ON AN OBSERVATIONAL BASIS OR FROM LOCAL TOPOGRAPHY AND CONSTRUCTION SECTIONS.
3. ALL DRAINAGE MANAGEMENT FEATURES SHOWN SHOULD BE READ IN CONJUNCTION WITH RELEVANT DESIGN DRAWINGS.

**POLLUTION PREVENTION**

4. ALL WORK IN POLLUTION PREVENTION ZONES SHALL BE SUBJECT TO PLANNING IN CONJUNCTION WITH THE ENVIRONMENTAL COMPLYMENT. WORKS TO BE PLANNED TO SUIT WEATHER FORECASTS.
5. DRAINAGE MANAGEMENT FEATURES TO BE INSTALLED PRIOR TO OR IN PARALLEL WITH TRACK CONSTRUCTION.
6. OIL FUEL SHOULD BE STORED WITHIN CONTAMINANT AREA IN THE SITE COMPOUND. CEMENT SHOULD BE STORED WITHIN COMPULSORY TOOLS SHOULD BE WASHED IN THE SAME AREA AND WATER RECYCLED ON THE CEMENT WAG.

**TRACK / INFRASTRUCTURE DRAINAGE**

7. THIS DRAWING INDICATES THE MINIMUM TEMPORARY DRAINAGE REQUIREMENTS. REFER TO SEPARATE PERMANENT DRAINAGE DRAWINGS SERIES. PERMANENT DRAINAGE FEATURES (SETTLEMENT BASINS) MAY BE INSTALLED IN THE TEMPORARY PHASE FOR USE FOR SETTLEMENT. TEMPORARY DRAINAGE TO BE REMOVED OR HAVE NEED TO SUIT THE PERMANENT WORK FOOTPRINT AND DRAINAGE PLAN AS PART OF FINAL SITE RECONFIGURATION.
8. CLEAN STONE CHECK DAMS TO BE INSTALLED IN ALL DRAINAGE CHANNELS IN ORDER TO PROMOTE SETTLEMENT OF SUSPENDED SOLIDS AND CONTROL FLOW RATES. CHECK DAMS GENERAL TO BE LOCAL TO EACH WELL GRADED STONE. AGGREGATE SIZE FOR STONE CHECK DAMS TO BE THICKLY 1.4M DIA CLEAN STONE. ON STEEP SECTIONS SMALL STONE TO BE ANCHORED THROUGH THE PLACEMENT OF 200MM STONE ON THE DOWNHILL FACE OF THE CHECK DAM. SPACING AND FREQUENCY OF CHECK DAMS WILL BE DETERMINED UPON USUAL/USUAL GRADIENT OF SLOPE.

**WATERCOURSE & TRACK DRAINAGE CROSSINGS**

10. THE MINIMUM PIPE DIAMETER FOR ANY TRACK DRAINAGE CROSSING SHALL BE 150MM. ALL HOPE PIPES SHALL BE TANKWELL TYPE, BGA HARS APPROVED.

**MAINTENANCE**

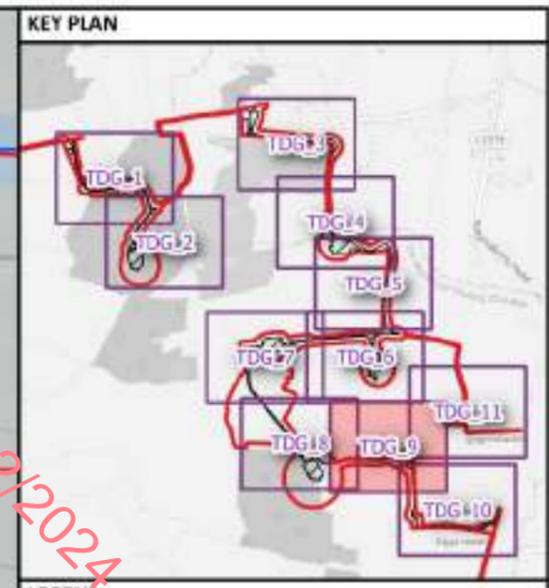
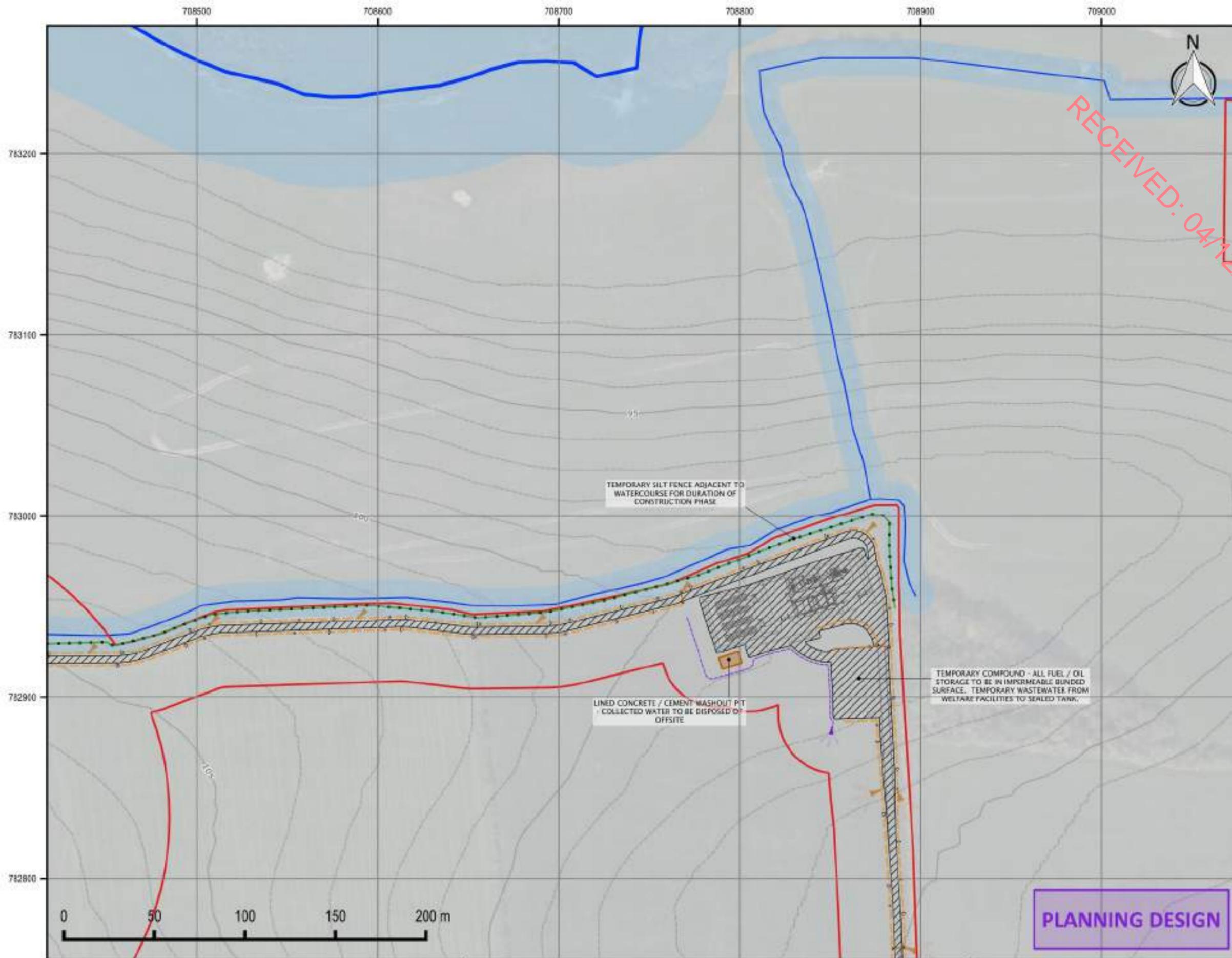
11. THE LEVEL OF SILT BUILDUP DURING CONSTRUCTION IS TO BE MONITORED VISUALLY AND RECORD. SILT LEVELS IN RUNWAYS TO BE TEMPORARILY DRAINAGE THROUGHOUT OF SILT FENCES / CONSTRUCTED SETTLEMENT FEATURES) CONTAINERS OR PROPRIETARY SOLUTIONS (SILTTRAP / SILT SOCKS / SEDIMENT MATS).
12. BUILD UP OF SILT LEVELS AT CHECK DAMS TO BE REMOVED AND DEPOSED OF. SILT LEVELS AT CHECK DAMS TO BE VISUALLY MONITORED AS PART OF AN ONGOING MAINTENANCE PROGRAMME DURING THE CONSTRUCTION PHASE. WHERE CHECK DAMS BECOME CLOGGED BY SILT OR VEGETATION, STONE CHECK DAM TO BE REMOVED AND REPLACED SUBSEQUENT TO THE REMOVAL OF SILT.

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|--|--------------|-----------------|-------------|--|
| <b>DESCRIPTION</b>                                       |              |                 |             |  |
| KELLYSTOWN WIND FARM - TEMPORARY DRAINAGE LAYOUT SHEET 8 |              |                 |             |  |
| <b>PROJECT / FIGURE NO.</b>                              |              |                 |             |  |
| M02207-01 TDG_8  |              |                 |             |  |
| <b>DRAWN BY</b>  | <b>SCALE</b> | <b>REVISION</b> | <b>DATE</b> |  |
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**LEGEND**

**Infrastructure**

- Application Boundary
- Temporary Infrastructure Footprint

**Hydrology Features & Constraints**

- "Major" Watercourse
- "Minor" Watercourse
- Other existing drainage
- Potable Borewell Location
- Water Feature Siltback / Buffer Zone (10m / 50m)
- Habitat Management Areas
- Wetland
- Proposed Watercourse Crossing (Culvert)

**Temporary Drainage**

- CLEAN INTERCEPTOR
- DIRTY WATER DRAINAGE
- TEMPORARY PIPED DRAINAGE
- Silt Fence
- Settlement / Washout Basin

**NOTES**

**GENERAL**

- OBSTACLES ARE INTENDED TO INFORM THE PLANNING APPLICATION. DRAWINGS ARE NOT INTENDED FOR CONSTRUCTION AND SHOULD NOT BE USED AS SUCH. FOR AVOIDANCE OF DOUBT, SURFACE WATER MANAGEMENT DESIGN IS INTENDED TO BE FURTHER DEVELOPED POST-COMMITMENT OF THE PLANNING APPLICATION INCLUDING MICRODRAINAGE.
- DETAILED SITING OF LAND FEATURES SHALL BE UNDERTAKEN ON AN OBSERVATIONAL BASIS OR FROM LOCAL TOPOGRAPHY AND CONSTRUCTION SECTIONS.
- ALL DRAINAGE MANAGEMENT FEATURES SHOWN SHOULD BE READ IN CONJUNCTION WITH RELEVANT DESIGN DRAWINGS.

**POLLUTION PREVENTION**

- ALL WORK IN POLLUTION PREVENTION ZONES SHALL BE SUBJECT TO PLANNING IN CONJUNCTION WITH THE ENVIRONMENTAL COMMITMENT. WORKS TO BE PLANNED TO SUIT WEATHER FORECASTS.
- DRAINAGE MANAGEMENT FEATURES TO BE INSTALLED PRIOR TO OR IN PARALLEL WITH TRACK CONSTRUCTION.
- OIL FUEL SHOULD BE STORED WITHIN CONTAMINANT AREA IN THE SITE COMPOUND. CEMENT SHOULD BE STORED WITHIN COMPULSORY TILES. TOOLS SHOULD BE WASHED IN THE SAME AREA AND WATER RECYCLED OR THE CEMENT WASH.

**TRACK / INFRASTRUCTURE DRAINAGE**

- THIS DRAWING INDICATES ONE OF SEVERAL TEMPORARY DRAINAGE REQUIREMENTS. REFER TO SEPARATE PERMANENT DRAINAGE DRAWING SERIES. PERMANENT DRAINAGE FEATURES (SETBACKS/PONDING) MAY BE INSTALLED IN THE TEMPORARY PHASE FOR USE FOR SETTLEMENT. TEMPORARY DRAINAGE TO BE REMOVED OR ADDED TO SUIT THE PERMANENT WORK FOOTPRINT AND DRAINAGE PLAN AS PART OF FINAL SITE RECONFIGURATION.
- CLEAN STONE CHECK DAMS TO BE INSTALLED IN ALL DRAINAGE CHANNELS IN ORDER TO PROMOTE SETTLEMENT OF SUSPENDED SOLIDS AND CONTROL FLOW RATES. CHECK DAMS GENERAL TO BE LOCAL TO EACH WELL GRADUATED. AGGREGATE SIZE FOR STONE CHECK DAMS TO BE THICKLY 1.4M DIA. STONE ON STEEP SECTIONS SMALL STONE TO BE ANCHORED THROUGH THE PLACEMENT OF 200MM STONE ON THE DOWNHILL FACE OF THE CHECK DAM. SPACING AND FREQUENCY OF CHECK DAMS WILL BE DETERMINED UPON USUALLY GRADIENT OF SLOPE.

**WATERCOURSE & TRACK DRAINAGE CROSSINGS**

IS THE MINIMUM PIPE DIAMETER FOR ANY TRACK DRAINAGE CROSSING SHALL BE 100MM. ALL HOPE PIPES SHALL BE TANKWELL TYPE, BSA HIPS APPROVED.

**MAINTENANCE**

- THE LEVEL OF SILT BUILDUP DURING CONSTRUCTION TO BE MONITORED VISUALLY AND RECORD. SILT LEVELS IN RUNWAYS TO BE TEMPORARILY DRAINAGE THROUGHOUT OF SILT FENCE / CONSTRUCTED SETTLEMENT FEATURES) CONTAINERS OR PROPRIETARY SOLUTIONS (SILTTRAP / SILT SOCKS / SEDIMENT MATS).
- BUILD UP OF SILT LEVELS AT CHECK DAMS TO BE REMOVED AND DEPOSED OR SILT LEVELS AT CHECK DAMS TO BE VISUALLY MONITORED AS PART OF AN ONGOING MAINTENANCE PROGRAMME DURING THE CONSTRUCTION PHASE. WHERE CHECK DAMS BECOME CLOGGED WITH SILT OR VEGETATION, STONE CHECK DAM TO BE REMOVED AND REPLACED SUBSEQUENT TO THE REMOVAL OF SILT.

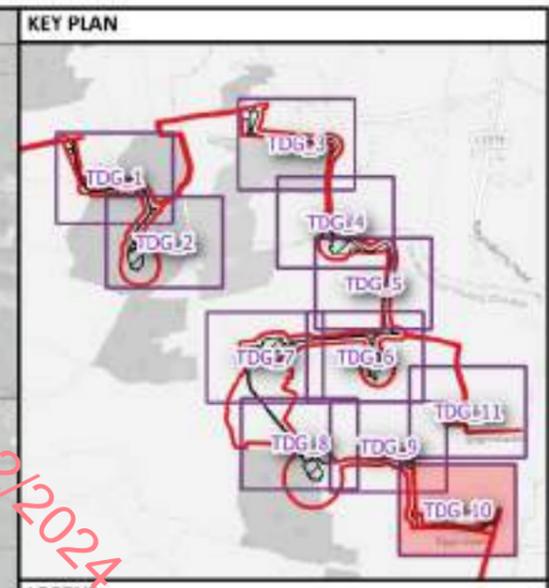
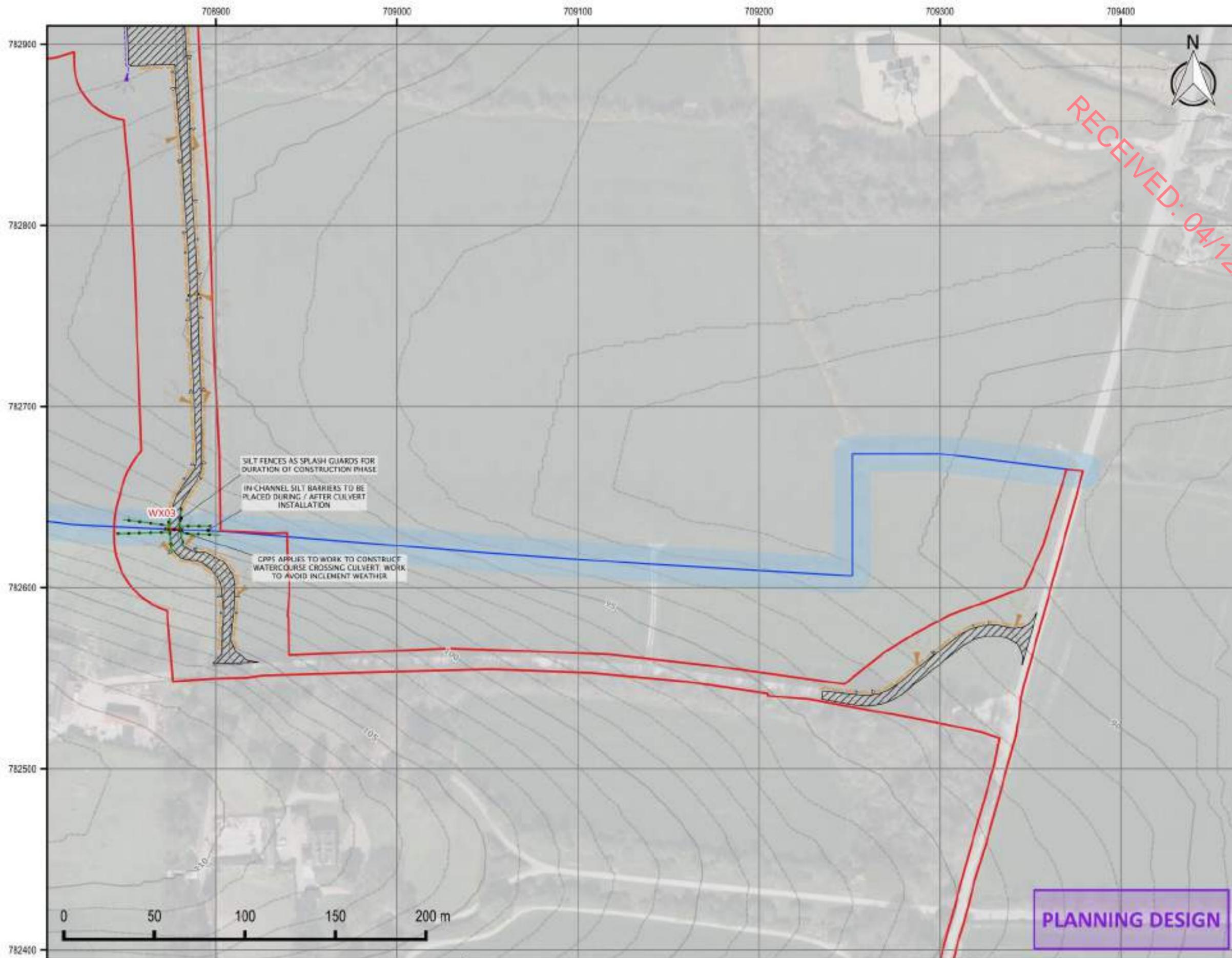
**PLANNING DESIGN**

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 UK +44 (0) 28 9084 8694  
 E: info@mcclloyconsulting.com  
 W: www.mcclloyconsulting.com

|  |              |                 |             |  |
|--|--------------|-----------------|-------------|--|
| <b>DESCRIPTION</b>                                       |              |                 |             |  |
| KELLYSTOWN WIND FARM - TEMPORARY DRAINAGE LAYOUT SHEET 9 |              |                 |             |  |
| <b>PROJECT / FIGURE NO.</b>                              |              |                 |             |  |
| M02207-01 TDG_9  |              |                 |             |  |
| <b>DRAWN BY</b>  | <b>SCALE</b> | <b>REVISION</b> | <b>DATE</b> |  |
| DKS  | 1:2000       | 1               | 29/10/2024  |  |

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**LEGEND**

| Infrastructure                   |  |
|----------------------------------|--|
| [Red outline]                    | Application Boundary                             |
| [Hatched area]                   | Temporary Infrastructure Footprint               |
| Hydrology Features & Constraints |  |
| [Thick blue line]                | "Major" Watercourse                              |
| [Thin blue line]                 | "Minor" Watercourse                              |
| [Dashed line]                    | Other existing drainage                          |
| [Blue square]                    | Potable Borewell Location                        |
| [Light blue area]                | Water Feature Siltback / Buffer Zone (10m / 50m) |
| [Green dashed area]              | Habitat Management Areas                         |
| [Green wavy area]                | Wetland  |
| [Red line with arrows]           | Proposed Watercourse Crossing (Culvert)          |
| Temporary Drainage               |  |
| [Blue line with arrow]           | CLEAN INTERCEPTOR                                |
| [Yellow line with arrow]         | DIRTY WATER DRAINAGE                             |
| [Black line with arrow]          | TEMPORARY PIPED DRAINAGE                         |
| [Green dashed line]              | Silt Fence                                       |
| [Orange rectangle]               | Settlement / Washout Basin                       |

**NOTES**

GENERAL

1. DRAWINGS ARE INTENDED TO INFORM THE PLANNING APPLICATION. DRAWINGS ARE NOT INTENDED FOR CONSTRUCTION AND SHOULD NOT BE USED AS SUCH. FOR AVOIDANCE OF DOUBT, SURFACE WATER MANAGEMENT DESIGN IS INTENDED TO BE FURTHER DEVELOPED POST-COMPLETION OF THE PLANNING APPLICATION INCLUDING MICRODRAINAGE.
2. DETAILED SITING OF LUDS FEATURES SHALL BE UNDERTAKEN ON AN OBSERVATIONAL BASIS OR PRESENTED ON LOCAL TOPOGRAPHY AND CONSTRUCTION SECTIONS.
3. ALL DRAINAGE MANAGEMENT FEATURES SHOWN SHOULD BE READ IN CONJUNCTION WITH RELEVANT DESIGN DRAWINGS.

**POLLUTION PREVENTION**

4. ALL WORK IN POLLUTION PREVENTION ZONES SHALL BE SUBJECT TO PLANNING IN CONJUNCTION WITH THE ENVIRONMENTAL COMPLYMENT. WORKS TO BE PLANNED TO SUIT WEATHER FORECASTS.
5. DRAINAGE MANAGEMENT FEATURES TO BE INSTALLED PRIOR TO OR IN PARALLEL WITH TRACK CONSTRUCTION.
6. OIL FUEL SHOULD BE STORED WITHIN CONTAMINANT AREA IN THE SITE COMPOUND. CEMENT SHOULD BE STORED WITHIN COMPULSORY TOOLS SHOULD BE WASHED IN THE SAME AREA AND WATER RECYCLED ON THE CEMENT WAG.

**TRACK / INFRASTRUCTURE DRAINAGE**

7. THIS DRAWING INDICATES THE MINIMUM TEMPORARY DRAINAGE REQUIREMENTS. REFER TO SEPARATE PERMANENT DRAINAGE DRAWING SERIES. PERMANENT DRAINAGE FEATURES (SETTLIMENTATION PONDS) MAY BE INSTALLED IN THE TEMPORARY PHASE FOR USE FOR SETTLEMENT. TEMPORARY DRAINAGE TO BE REMOVED OR AMENDED TO SUIT THE PERMANENT WORK FOOTPRINT AND DRAINAGE PLAN AS PART OF FINAL SITE RECONFIGURATION.
8. CLEAN STONE CHECK DAMS TO BE INSTALLED IN ALL DRAINAGE CHANNELS IN ORDER TO PROMOTE SETTLEMENT OF SUSPENDED SOLIDS AND CONTROL FLOW RATES. CHECK DAMS SHOULD BE TO BE LOCAL TO EACH WELL GRADED STONE. AGGREGATE SIZE FOR STONE CHECK DAMS TO BE THICKLY 1-4mm STONE. ON STEEP SECTIONS SMALL STONE TO BE ANCHORED THROUGH THE PLACEMENT OF 300MM STONE ON THE DOWNHILL FACE OF THE CHECK DAM. SPACING AND FREQUENCY OF CHECK DAMS WILL BE DETERMINED UPON LOCAL TOPOGRAPHY GRADIENT OF SLOPE.

**WATERCOURSE & TRACK DRAINAGE CROSSINGS**

10. THE MINIMUM PIPE DIAMETER FOR ANY TRACK DRAINAGE CROSSINGS SHALL BE 100MM. ALL HOPE PIPES SHALL BE TANKWELL TYPE, BSA HAINS APPROVED.

**MAINTENANCE**

11. THE LEVEL OF SET IN/BELOW DRAINAGE CONSTRUCTION TO BE MONITORED VISUALLY AND RECORD. SET LEVELS IN/BELOW TO BE TEMPORARILY DRAINAGE THROUGHOUT OF SET PINNACLES / CONSTRUCTED SETTLEMENT FEATURES / CONTAINERS OR PROPRIETARY SOLUTIONS (SILTTRAP / SET SOCKS / SEDIMENT MATS).
12. BUILD UP OF SET LEVELS AT CHECK DAMS TO BE REMOVED AND DEPOSED OF. SET LEVELS AT CHECK DAMS TO BE VISUALLY MONITORED AS PART OF AN ONGOING MAINTENANCE PROGRAMME DURING THE CONSTRUCTION PHASE. WHERE CHECK DAMS BECOME CLOGGED BY SET OR VEGETATION, STONE CHECK DAM TO BE REMOVED AND REPLACED SUBSEQUENT TO THE REMOVAL OF SET.

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|   |              |                 |             |  |
|---|--------------|-----------------|-------------|--|
| <b>DESCRIPTION</b>  |              |                 |             |  |
| KELLYSTOWN WIND FARM - TEMPORARY DRAINAGE LAYOUT SHEET 10 |              |                 |             |  |
| <b>PROJECT / FIGURE NO.</b>                               |              |                 |             |  |
| M02207-01_TDG_10  |              |                 |             |  |
| <b>DRAWN BY</b>   | <b>SCALE</b> | <b>REVISION</b> | <b>DATE</b> |  |
| DKS   | 1:2000       | 1               | 29/10/2024  |  |

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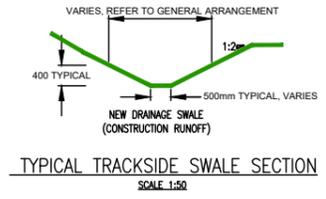
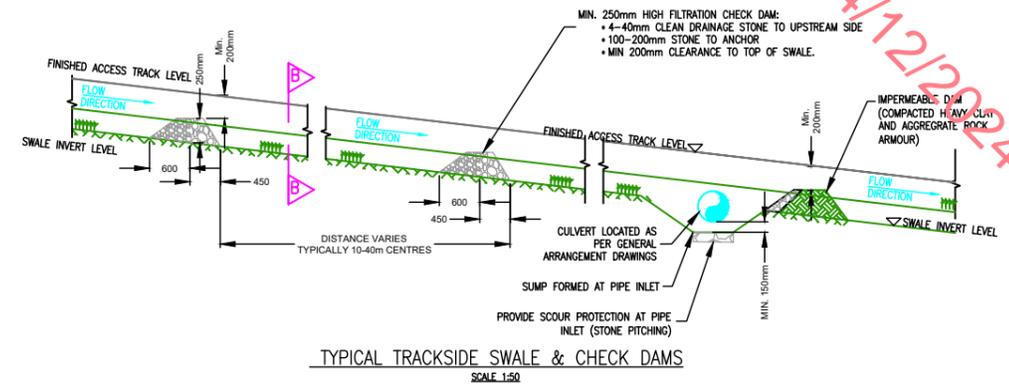
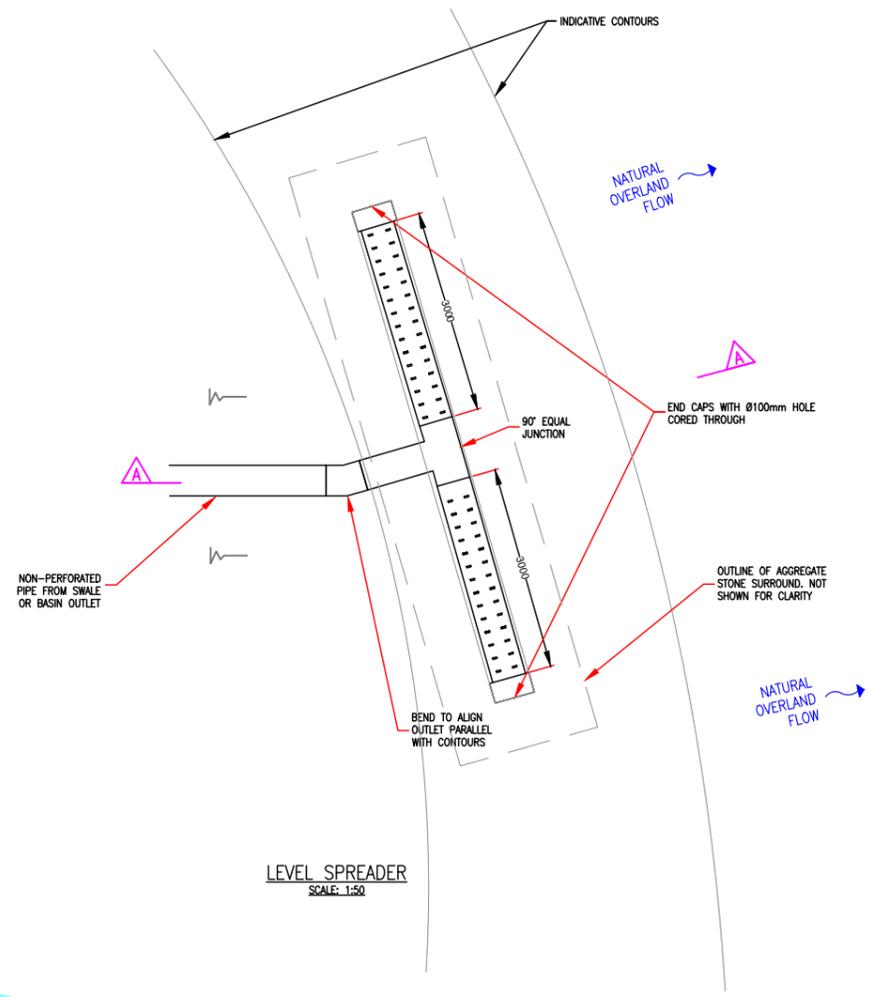


**Annex D**  
RECEIVED: 04/12/2024

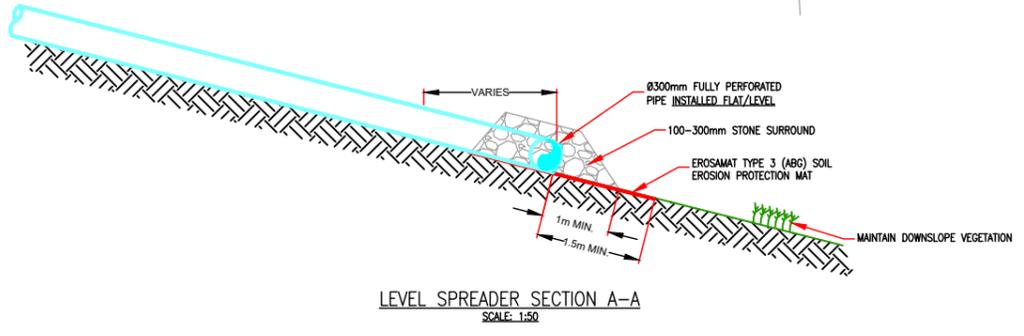
## Temporary Drainage - Details

- 41 Detail - Silt Fence
- 42 Settlement Basin Arrangement
- 43 Clean Cutoff Drainage / Breakout

RECEIVED: 04/12/2024



| CHECK-DAM SPACINGS (MAXIMUM) |             |
|------------------------------|-------------|
| CHANNEL GRADIENT             | SPACING (m) |
| <1%                          | 80          |
| 1-2.5%                       | 40          |
| 2.5-5%                       | 20          |
| >5%                          | 10          |



- TRACK DRAINAGE NOTES**
- ROAD CONSTRUCTION TO BE AS PER CIVIL WORKS DESIGN & SPECIFICATION. (BY OTHERS)
  - REFER TO LAYOUT PLAN DRAWINGS FOR DETAILS OF CHECK DAM / CROSS DRAIN / CUTOFF DRAIN / OUTFALL LOCATIONS ETC. MICRO-SITING OF DRAINAGE ELEMENTS TO BE DETERMINED ON SITE IN CONJUNCTION WITH DESIGNER TO SUIT SPECIFIC CONDITIONS ENCOUNTERED.
  - FEATURES SHOWN ARE TO SUIT PERMANENT INFRASTRUCTURE. TEMPORARY SITE DRAINAGE OVER AND ABOVE THAT SHOWN ON DRAWINGS MAY BE REQUIRED TO SUIT TEMPORARY ROAD ALIGNMENTS AND LEVELS.
  - ALL EXCAVATED SLOPES TO BE BATTERED BACK TO A SAFE ANGLE OF REPOSE.

| ISSUE | DRN | APP | DATE       | NOTES / DESCRIPTION |
|-------|-----|-----|------------|---------------------|
| 1     | DL  | KS  | 24/10/2024 | FOR PLANNING        |

STATUS: **PLANNING**

**McCloy Consulting**

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W: www.mcclayconsulting.com

Mossley Mill, Lower Ground (West)  
Cammerney Road North  
Newtownabbey  
Co. Antrim, BT36 5QB

PROJECT: KELLYSTOWN WIND FARM

CLIENT: EDF RENEWABLES

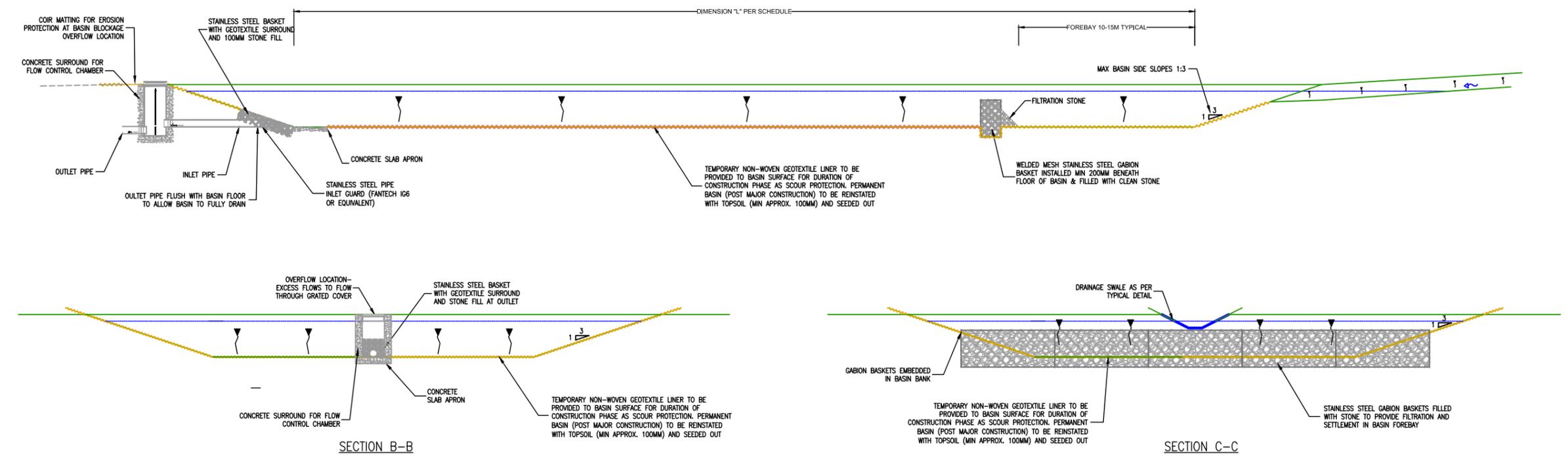
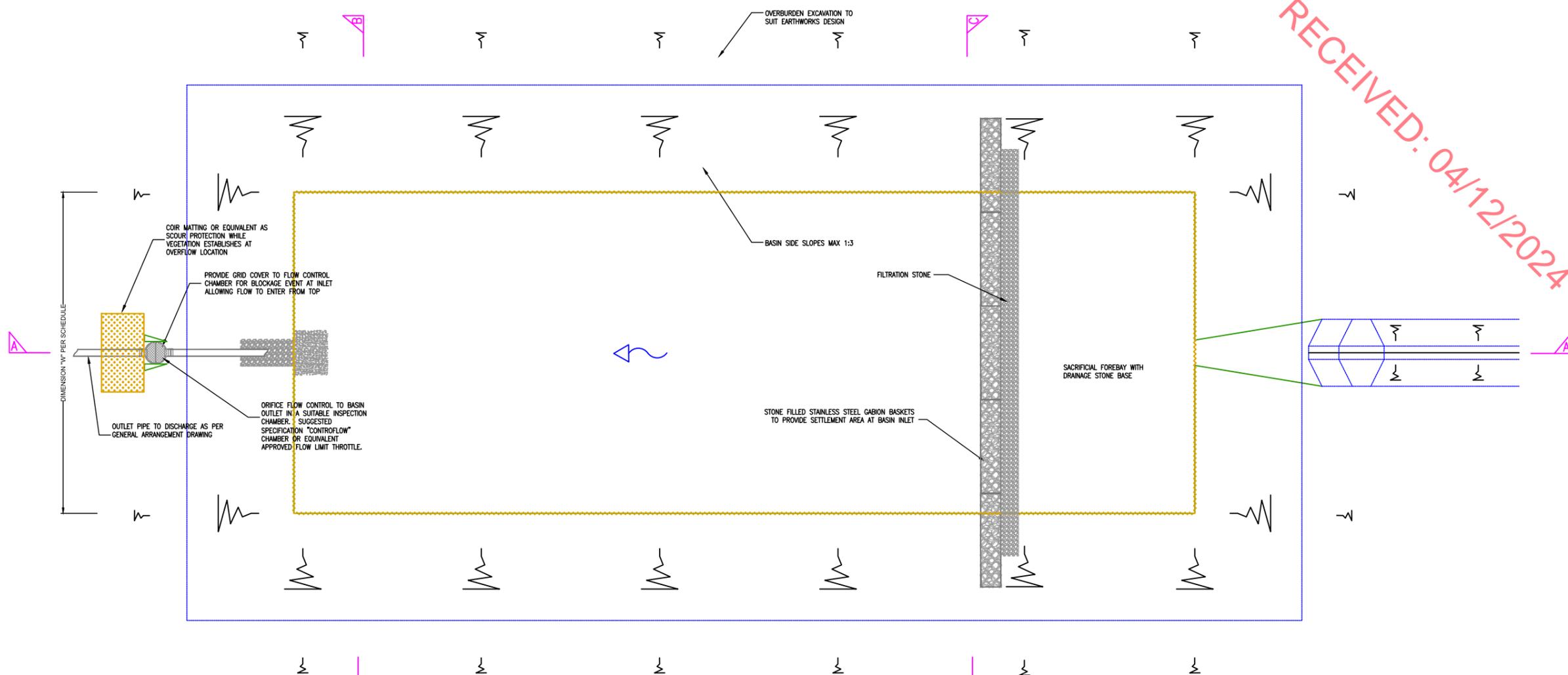
DRAWING TITLE: SURFACE WATER MANAGEMENT TYPICAL DRAINAGE DETAILS LEVEL SPREADER, CHECK DAMS

| SCALE                 | ORIGINAL SIZE      |
|-----------------------|--------------------|
| AS SHOWN@A1           | A1                 |
| DRAWN: KS             | CHECKED: PDD       |
| DATE: 14/11/2023      |                    |
| PROJECT NO: M01944-02 | DRAWING NO: DWG_21 |
| ISSUE NO: 1           |                    |

NOTE: DURING CONSTRUCTION PHASE THE LEVEL OF SUSPENDED SOLIDS IN TRACK RUN-OFF IS LIKELY TO NECESSITATE THE INCREASED FREQUENCY OF TEMPORARY CHECK DAMS FOR INCREASED SETTLEMENT POTENTIAL

DETENTION BASIN PLAN  
SCALE 1:50

RECEIVED: 04/12/2024



- TRACK DRAINAGE NOTES**
- ROAD CONSTRUCTION TO BE AS PER CIVIL WORKS DESIGN & SPECIFICATION. (BY OTHERS)
  - REFER TO LAYOUT PLAN DRAWINGS FOR DETAILS OF CHECK DAM / CROSS DRAIN / CUTOFF DRAIN / OUTFALL LOCATIONS ETC. MICRO-SITING OF DRAINAGE ELEMENTS TO BE DETERMINED ON SITE IN CONJUNCTION WITH DESIGNER TO SUIT SPECIFIC CONDITIONS ENCOUNTERED.
  - FEATURES SHOWN ARE TO SUIT PERMANENT INFRASTRUCTURE. TEMPORARY SITE DRAINAGE OVER AND ABOVE THAT SHOWN ON DRAWINGS MAY BE REQUIRED TO SUIT TEMPORARY ROAD ALIGNMENTS AND LEVELS.
  - ALL EXCAVATED SLOPES TO BE BATTERED BACK TO A SAFE ANGLE OF REPOSE.

| ISSUE | DRN | APP | DATE       | NOTES / DESCRIPTION |
|-------|-----|-----|------------|---------------------|
| 1     | DL  | KS  | 24/10/2024 | FOR PLANNING        |

STATUS: PLANNING

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 F: 028 9084 1525 Carronee Road North  
 E: info@mcclayconsulting.com Newtownabbey  
 W: www.mcclayconsulting.com Co. Antrim, BT36 5QB

PROJECT: KELLYSTOWN WIND FARM

CLIENT: EDF RENEWABLES

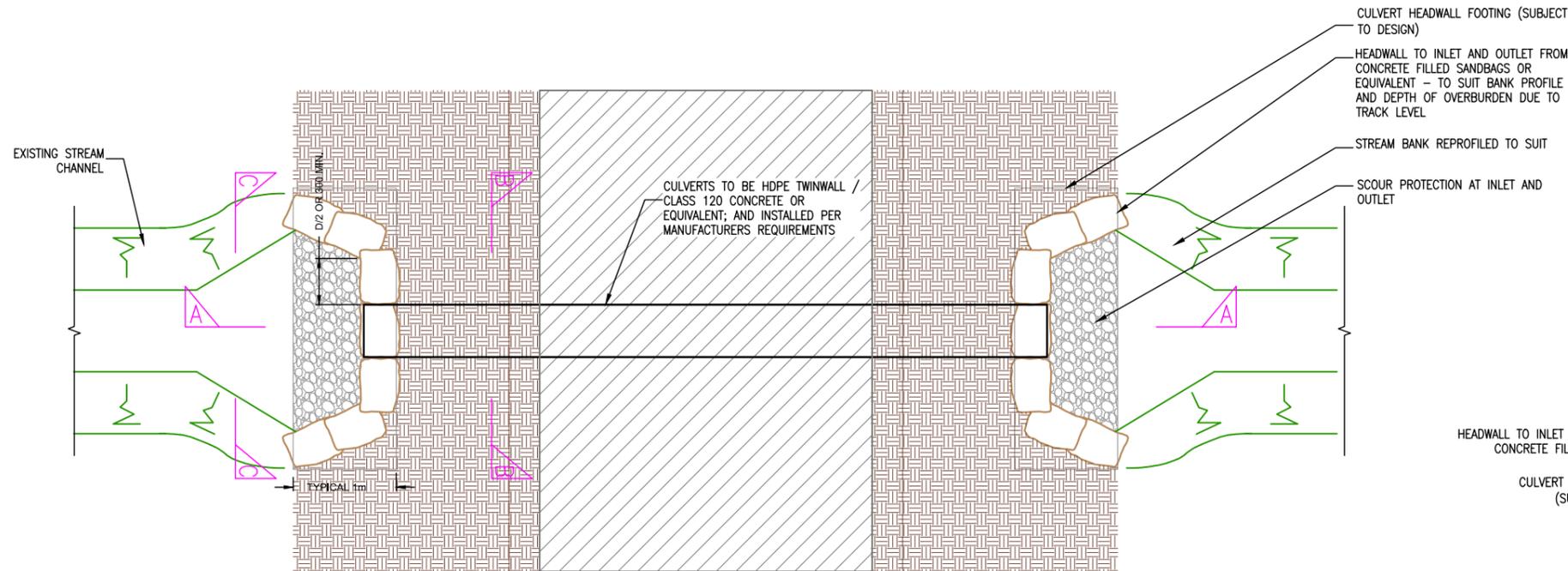
DRAWING TITLE: SURFACE WATER MANAGEMENT ATTENUATION BASIN DETAILS

| SCALE       | ORIGINAL SIZE |
|-------------|---------------|
| AS SHOWN@A1 | A1            |

| DRAWN | CHECKED | DATE       |
|-------|---------|------------|
| KS    | PDD     | 14/11/2023 |

| PROJECT NO. | DRAWING NO. | ISSUE NO. |
|-------------|-------------|-----------|
| M01944-02   | DWG_22      | 1         |

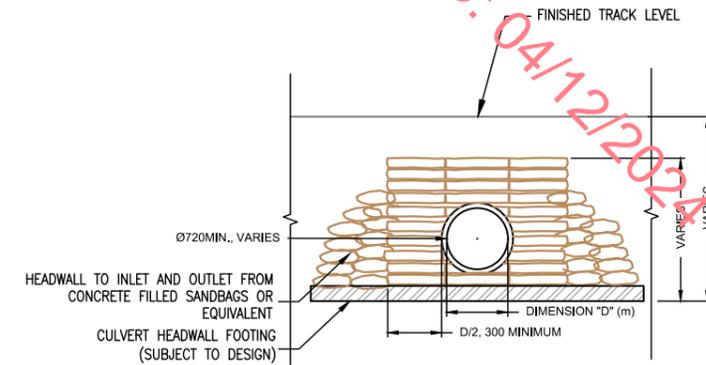




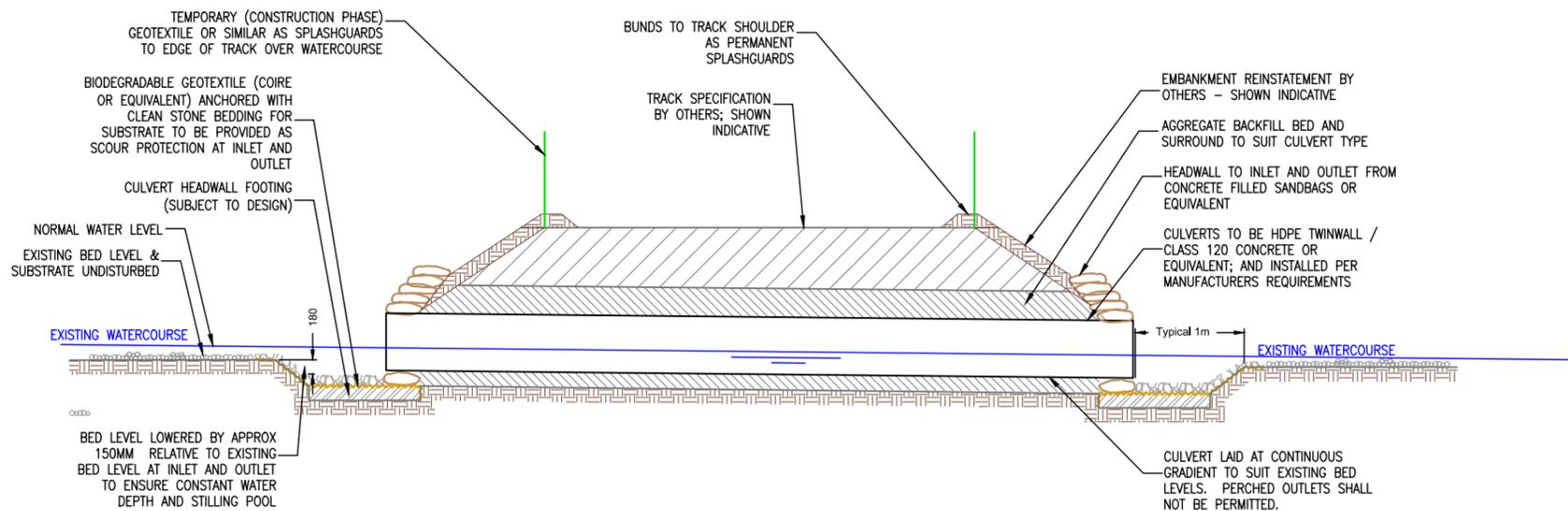
PLAN  
SCALE 1:40

CULVERT WATERCOURSE CROSSING  
SCALE AS SHOWN

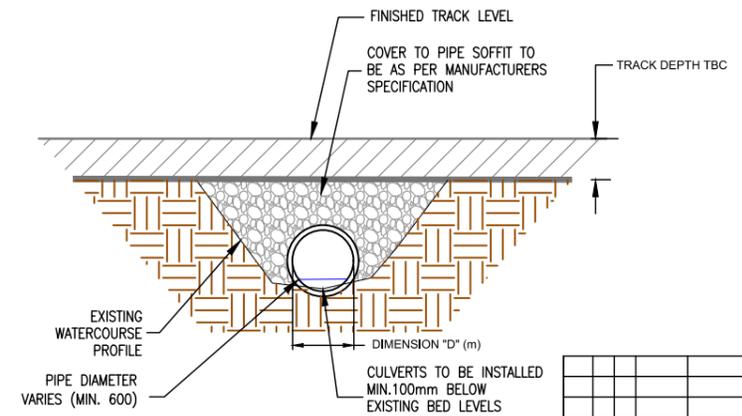
- NOTES FOR CONSTRUCTION METHODS & ENVIRONMENTAL PROTECTION**
- WORKS TO BE PROGRAMMED TO SUIT PERIODS OF LOW RIVER FLOW AND RAINFALL. DUE COGNISANCE GIVEN TO THE PREVAILING GROUND CONDITIONS AND SEASONAL WEATHER CONDITIONS.
  - CULVERT LOCATION TO BE DAMMED UPSTREAM BY USE OF SANDBAGS OR EQUIVALENT AND OVERPUMPED IN ORDER TO PROVIDE A DRY WORKING ENVIRONMENT.
  - IN CHANNEL SILT FENCING TO BE INSTALLED DOWNSTREAM OF THE WORKS AND DOWNSTREAM OF OVERPUMPING FOR THE DURATION OF THE CULVERT INSTALLATION WORKS.



ELEVATION C-C (WITH HEADWALL)  
1:40



SECTION A-A  
SCALE 1:40



SECTION B-B  
SCALE 1:40

| ISSUE  | DRN                | APP               | DATE       | NOTES / DESCRIPTION |
|--|--------------------|-------------------|------------|---------------------|
| 1  | DL                 | KS                | 24/10/2024 | FOR PLANNING        |
| STATUS: PLANNING   |                    |                   |            |                     |
| <p><b>McClay Consulting</b></p> <p>T: 028 9084 8694<br/>F: 028 9084 1525<br/>E: info@mcclayconsulting.com<br/>W: www.mcclayconsulting.com</p> <p>Mossley Mill, Lower Ground (West)<br/>Carronee Road North<br/>Newtownabbey<br/>Co. Antrim, BT36 5QB</p> |                    |                   |            |                     |
| PROJECT: KELLYSTOWN WIND FARM  |                    |                   |            |                     |
| CLIENT: EDF RENEWABLES   |                    |                   |            |                     |
| DRAWING TITLE: PIPED CULVERT DETAIL  |                    |                   |            |                     |
| SCALE: AS SHOWN@A1   |                    | ORIGINAL SIZE: A1 |            |                     |
| DRAWN: KS  | CHECKED: PDD       | DATE: 14/11/2023  |            |                     |
| PROJECT No: M01944-02  | DRAWING No: DWG_24 | ISSUE No: 1       |            |                     |

**Annex E**  
**Supporting Calculations**

RECEIVED: 04/12/24

C1  
Tracks & Hard standings –  
Qbar / Attenuation calculations

RECEIVED 04/12/2024

Calculated by: Kyle Somerville

Site name: Kellystown

Site location: Kellystown, Dunleer

## Site Details

Latitude: 53.79633° N

Longitude: 6.36553° W

Reference: 3596306499

Date: Oct 22 2024 15:46

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.

Runoff estimation approach: IH124

## Site characteristics

Total site area (ha): 7.1

## Methodology

Q<sub>BAR</sub> estimation method: Calculate from SPR and SAAR

SPR estimation method: Calculate from SOIL type

## 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.

## Soil characteristics

|              | Default | Edited |
|--------------|---------|--------|
| SOIL type:   | 2       | 3      |
| HOST class:  | N/A     | N/A    |
| SPR/SPRHOST: | 0.3     | 0.37   |

(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.

## Hydrological characteristics

|                                | Default | Edited |
|--------------------------------|---------|--------|
| SAAR (mm):                     | 894     | 894    |
| 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   |

(3) Is  $SPR/SPRHOST \leq 0.3$ ?

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 |
|-------------------------------|---------|--------|
| <b>Q<sub>BAR</sub> (l/s):</b> | 17.23   | 27.16  |
| <b>1 in 1 year (l/s):</b>     | 14.64   | 23.08  |
| <b>1 in 30 years (l/s):</b>   | 28.42   | 44.81  |
| <b>1 in 100 year (l/s):</b>   | 33.59   | 52.95  |
| <b>1 in 200 years (l/s):</b>  | 37.04   | 58.38  |

RECEIVED: 04/12/2024

This report was produced using the greenfield runoff tool developed by HR Wallingford and available at [www.uksuds.com](http://www.uksuds.com). The use of this tool is subject to the UK SuDS terms and conditions and licence agreement, which can both be found at [www.uksuds.com/terms-and-conditions.htm](http://www.uksuds.com/terms-and-conditions.htm). The outputs from this tool are estimates of greenfield runoff rates. The use of these results is the responsibility of the users of this tool. No liability will be accepted by HR Wallingford, the Environment Agency, CEH, Hydrosolutions or any other organisation for the use of this data in the design or operational characteristics of any drainage scheme.

# CRM Stormflow Stormwater Management Software

**Client:** EDF RENEWABLES - JOD  
**Project:** KELLYSTOWN WIND FARM  
**Location:** NR DUNLEER  
**Catchment:** Subcatchment 1

RECEIVED: 04/12/2024

### Catchment Details:

Buildings 0 m<sup>2</sup> x 95 %  
 Dense surfacing 5659 m<sup>2</sup> x 50 %  
 Effective Area 2829.5 m<sup>2</sup>

### Storage Details:

Length 18 m  
 Width 8 m  
 Depth 1 m  
 Porosity 100 %  
 Area Increase 0 %

### Rainfall Details - FSR Method:

Return Period 100 years  
 Climate Change Factor 20 %  
 r value 0.32  
 M5-60 17 mm

|          | mm   | mm/h  | storage (m <sup>3</sup> ) |
|----------|------|-------|---------------------------|
| 5 min    | 10.5 | 151.4 | 35.038                    |
| 10 min   | 15.9 | 114.8 | 52.815                    |
| 15 min   | 19.6 | 94.0  | 64.541                    |
| 30 min   | 26.4 | 63.3  | 85.593                    |
| 45 min   | 30.4 | 48.6  | 97.125                    |
| 60 min   | 33.3 | 40.0  | 105.246                   |
| 2 hours  | 41.1 | 24.7  | 123.681                   |
| 6 hours  | 55.6 | 11.1  | 141.325                   |
| 24 hours | 79.8 | 4.0   | 80.877                    |

### Outflow Details:

Infiltration rate 0 m/hr  
  
 Attenuation Control Fixed Outflow  
 Control Diameter - mm  
 Discharge rate 2.2 l/s

### Results:

Outcome: Pass  
 Critical Storm Duration 6.47 hrs  
 Hmax 0.982 m  
 Time to half empty 8.9 hrs

# CRM Stormflow Stormwater Management Software

|                   |                      |
|-------------------|----------------------|
| <b>Client:</b>    | EDF RENEWABLES - JOD |
| <b>Project:</b>   | KELLYSTOWN WIND FARM |
| <b>Location:</b>  | NR DUNLEER           |
| <b>Catchment:</b> | Subcatchment 1       |

RECEIVED: 04/12/2024

|                           |       |                |        |
|---------------------------|-------|----------------|--------|
| <b>Catchment Details:</b> |       |                |        |
| Buildings                 | 0     | m <sup>2</sup> | x 95 % |
| Dense surfacing           | 1075  | m <sup>2</sup> | x 50 % |
| Effective Area            | 537.5 | m <sup>2</sup> |        |

|                         |       |
|-------------------------|-------|
| <b>Storage Details:</b> |       |
| Length                  | 5 m   |
| Width                   | 4 m   |
| Depth                   | 0.8 m |
| Porosity                | 100 % |
| Area Increase           | 0 %   |

|                                       |      |       |                           |
|---------------------------------------|------|-------|---------------------------|
| <b>Rainfall Details - FSR Method:</b> |      |       |                           |
| Return Period                         | 100  | years |                           |
| Climate Change Factor                 | 20   | %     |                           |
| r value                               | 0.32 |       |                           |
| M5-60                                 | 17   | mm    |                           |
|                                       | mm   | mm/h  | storage (m <sup>3</sup> ) |
| 5 min                                 | 10.5 | 151.4 | 6.181                     |
| 10 min                                | 15.9 | 114.8 | 9.084                     |
| 15 min                                | 19.6 | 94.0  | 10.837                    |
| 30 min                                | 26.4 | 63.3  | 13.412                    |
| 45 min                                | 30.4 | 48.6  | 14.179                    |
| 60 min                                | 33.3 | 40.0  | 14.297                    |
| 2 hours                               | 41.1 | 24.7  | 12.104                    |
| 6 hours                               | 55.6 | 11.1  | 0.000                     |
| 24 hours                              | 79.8 | 4.0   | 0.000                     |

|                         |               |
|-------------------------|---------------|
| <b>Outflow Details:</b> |               |
| Infiltration rate       | 0 m/hr        |
| Attenuation Control     | Fixed Outflow |
| Control Diameter        | - mm          |
| Discharge rate          | 2 l/s         |

|                         |          |
|-------------------------|----------|
| <b>Results:</b>         |          |
| Outcome:                | Pass     |
| Critical Storm Duration | 57 min   |
| Hmax                    | 0.715 m  |
| Time to half empty      | 59.6 min |

# CRM Stormflow Stormwater Management Software

|                   |                      |
|-------------------|----------------------|
| <b>Client:</b>    | EDF RENEWABLES - JOD |
| <b>Project:</b>   | KELLYSTOWN WIND FARM |
| <b>Location:</b>  | NR DUNLEER           |
| <b>Catchment:</b> | Subcatchment 3       |

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|                           |        |                |        |
|---------------------------|--------|----------------|--------|
| <b>Catchment Details:</b> |        |                |        |
| Buildings                 | 0      | m <sup>2</sup> | x 95 % |
| Dense surfacing           | 6203   | m <sup>2</sup> | x 50 % |
| Effective Area            | 3101.5 | m <sup>2</sup> |        |

|                         |       |
|-------------------------|-------|
| <b>Storage Details:</b> |       |
| Length                  | 16 m  |
| Width                   | 10 m  |
| Depth                   | 1 m   |
| Porosity                | 100 % |
| Area Increase           | 0 %   |

|                                       |      |       |                           |
|---------------------------------------|------|-------|---------------------------|
| <b>Rainfall Details - FSR Method:</b> |      |       |                           |
| Return Period                         | 100  | years |                           |
| Climate Change Factor                 | 20   | %     |                           |
| r value                               | 0.32 |       |                           |
| M5-60                                 | 17   | mm    |                           |
|                                       | mm   | mm/h  | storage (m <sup>3</sup> ) |
| 5 min                                 | 10.5 | 151.4 | 38.409                    |
| 10 min                                | 15.9 | 114.8 | 57.899                    |
| 15 min                                | 19.6 | 94.0  | 70.756                    |
| 30 min                                | 26.4 | 63.3  | 93.842                    |
| 45 min                                | 30.4 | 48.6  | 106.493                   |
| 60 min                                | 33.3 | 40.0  | 115.405                   |
| 2 hours                               | 41.1 | 24.7  | 135.653                   |
| 6 hours                               | 55.6 | 11.1  | 155.159                   |
| 24 hours                              | 79.8 | 4.0   | 89.644                    |

|                         |               |
|-------------------------|---------------|
| <b>Outflow Details:</b> |               |
| Infiltration rate       | 0 m/hr        |
| Attenuation Control     | Fixed Outflow |
| Control Diameter        | - mm          |
| Discharge rate          | 2.4 l/s       |

|                         |         |
|-------------------------|---------|
| <b>Results:</b>         |         |
| Outcome:                | Pass    |
| Critical Storm Duration | 6.5 hrs |
| Hmax                    | 0.971 m |
| Time to half empty      | 9 hrs   |

# CRM Stormflow Stormwater Management Software

|                   |                      |
|-------------------|----------------------|
| <b>Client:</b>    | EDF RENEWABLES - JOD |
| <b>Project:</b>   | KELLYSTOWN WIND FARM |
| <b>Location:</b>  | NR DUNLEER           |
| <b>Catchment:</b> | Subcatchment 5       |

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|                           |     |                |        |
|---------------------------|-----|----------------|--------|
| <b>Catchment Details:</b> |     |                |        |
| Buildings                 | 0   | m <sup>2</sup> | x 95 % |
| Dense surfacing           | 964 | m <sup>2</sup> | x 50 % |
| Effective Area            | 482 | m <sup>2</sup> |        |

|                         |       |
|-------------------------|-------|
| <b>Storage Details:</b> |       |
| Length                  | 7 m   |
| Width                   | 7 m   |
| Depth                   | 0.8 m |
| Porosity                | 100 % |
| Area Increase           | 0 %   |

|                                       |      |       |                           |
|---------------------------------------|------|-------|---------------------------|
| <b>Rainfall Details - FSR Method:</b> |      |       |                           |
| Return Period                         | 100  | years |                           |
| Climate Change Factor                 | 20   | %     |                           |
| r value                               | 0.32 |       |                           |
| M5-60                                 | 17   | mm    |                           |
|                                       | mm   | mm/h  | storage (m <sup>3</sup> ) |
| 5 min                                 | 10.5 | 151.4 | 6.030                     |
| 10 min                                | 15.9 | 114.8 | 9.119                     |
| 15 min                                | 19.6 | 94.0  | 11.175                    |
| 30 min                                | 26.4 | 63.3  | 14.936                    |
| 45 min                                | 30.4 | 48.6  | 17.072                    |
| 60 min                                | 33.3 | 40.0  | 18.626                    |
| 2 hours                               | 41.1 | 24.7  | 22.437                    |
| 6 hours                               | 55.6 | 11.1  | 28.060                    |
| 24 hours                              | 79.8 | 4.0   | 29.547                    |

|                                 |            |
|---------------------------------|------------|
| <b>Outflow Details:</b>         |            |
| Infiltration rate               | 0.018 m/hr |
| Infiltration by CIRIA 3D method |            |
| Safety Factor against flooding  | 1.5        |
| Attenuation Control             | None       |
| Control Diameter                | - mm       |
| Discharge rate                  | 0 l/s      |

|                         |           |
|-------------------------|-----------|
| <b>Results:</b>         |           |
| Outcome:                | Pass      |
| Critical Storm Duration | 15.25 hrs |
| Hmax                    | 0.622 m   |
| Time to half empty      | 20.5 hrs  |

# CRM Stormflow Stormwater Management Software

|                   |                      |
|-------------------|----------------------|
| <b>Client:</b>    | EDF RENEWABLES - JOD |
| <b>Project:</b>   | KELLYSTOWN WIND FARM |
| <b>Location:</b>  | NR DUNLEER           |
| <b>Catchment:</b> | Subcatchment 7       |

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|                           |      |                |        |
|---------------------------|------|----------------|--------|
| <b>Catchment Details:</b> |      |                |        |
| Buildings                 | 0    | m <sup>2</sup> | x 95 % |
| Dense surfacing           | 9898 | m <sup>2</sup> | x 50 % |
| Effective Area            | 4949 | m <sup>2</sup> |        |

|                         |       |
|-------------------------|-------|
| <b>Storage Details:</b> |       |
| Length                  | 22 m  |
| Width                   | 12 m  |
| Depth                   | 1 m   |
| Porosity                | 100 % |
| Area Increase           | 0 %   |

|                                       |      |       |                           |
|---------------------------------------|------|-------|---------------------------|
| <b>Rainfall Details - FSR Method:</b> |      |       |                           |
| Return Period                         | 100  | years |                           |
| Climate Change Factor                 | 20   | %     |                           |
| r value                               | 0.32 |       |                           |
| M5-60                                 | 17   | mm    |                           |
|                                       | mm   | mm/h  | storage (m <sup>3</sup> ) |
| 5 min                                 | 10.5 | 151.4 | 61.298                    |
| 10 min                                | 15.9 | 114.8 | 92.405                    |
| 15 min                                | 19.6 | 94.0  | 112.931                   |
| 30 min                                | 26.4 | 63.3  | 149.795                   |
| 45 min                                | 30.4 | 48.6  | 170.009                   |
| 60 min                                | 33.3 | 40.0  | 184.256                   |
| 2 hours                               | 41.1 | 24.7  | 216.673                   |
| 6 hours                               | 55.6 | 11.1  | 248.224                   |
| 24 hours                              | 79.8 | 4.0   | 145.604                   |

|                         |               |
|-------------------------|---------------|
| <b>Outflow Details:</b> |               |
| Infiltration rate       | 0 m/hr        |
| Attenuation Control     | Fixed Outflow |
| Control Diameter        | - mm          |
| Discharge rate          | 3.8 l/s       |

|                         |          |
|-------------------------|----------|
| <b>Results:</b>         |          |
| Outcome:                | Pass     |
| Critical Storm Duration | 6.57 hrs |
| Hmax                    | 0.941 m  |
| Time to half empty      | 9.1 hrs  |

# CRM Stormflow Stormwater Management Software

|                   |                      |
|-------------------|----------------------|
| <b>Client:</b>    | EDF RENEWABLES - JOD |
| <b>Project:</b>   | KELLYSTOWN WIND FARM |
| <b>Location:</b>  | NR DUNLEER           |
| <b>Catchment:</b> | Subcatchment 9       |

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|                           |      |                |        |
|---------------------------|------|----------------|--------|
| <b>Catchment Details:</b> |      |                |        |
| Buildings                 | 0    | m <sup>2</sup> | x 95 % |
| Dense surfacing           | 7420 | m <sup>2</sup> | x 50 % |
| Effective Area            | 3710 | m <sup>2</sup> |        |

|                         |       |
|-------------------------|-------|
| <b>Storage Details:</b> |       |
| Length                  | 22 m  |
| Width                   | 9 m   |
| Depth                   | 1 m   |
| Porosity                | 100 % |
| Area Increase           | 0 %   |

|                                       |      |       |                           |
|---------------------------------------|------|-------|---------------------------|
| <b>Rainfall Details - FSR Method:</b> |      |       |                           |
| Return Period                         | 100  | years |                           |
| Climate Change Factor                 | 20   | %     |                           |
| r value                               | 0.32 |       |                           |
| M5-60                                 | 17   | mm    |                           |
|                                       | mm   | mm/h  | storage (m <sup>3</sup> ) |
| 5 min                                 | 10.5 | 151.4 | 45.966                    |
| 10 min                                | 15.9 | 114.8 | 69.301                    |
| 15 min                                | 19.6 | 94.0  | 84.702                    |
| 30 min                                | 26.4 | 63.3  | 112.381                   |
| 45 min                                | 30.4 | 48.6  | 127.578                   |
| 60 min                                | 33.3 | 40.0  | 138.302                   |
| 2 hours                               | 41.1 | 24.7  | 162.778                   |
| 6 hours                               | 55.6 | 11.1  | 187.131                   |
| 24 hours                              | 79.8 | 4.0   | 113.355                   |

|                         |               |
|-------------------------|---------------|
| <b>Outflow Details:</b> |               |
| Infiltration rate       | 0 m/hr        |
| Attenuation Control     | Fixed Outflow |
| Control Diameter        | - mm          |
| Discharge rate          | 2.8 l/s       |

|                         |          |
|-------------------------|----------|
| <b>Results:</b>         |          |
| Outcome:                | Pass     |
| Critical Storm Duration | 6.72 hrs |
| Hmax                    | 0.947 m  |
| Time to half empty      | 9.3 hrs  |

# CRM Stormflow Stormwater Management Software

|                   |                      |
|-------------------|----------------------|
| <b>Client:</b>    | EDF RENEWABLES - JOD |
| <b>Project:</b>   | KELLYSTOWN WIND FARM |
| <b>Location:</b>  | NR DUNLEER           |
| <b>Catchment:</b> | Subcatchment 10      |

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|                           |       |                |        |
|---------------------------|-------|----------------|--------|
| <b>Catchment Details:</b> |       |                |        |
| Buildings                 | 0     | m <sup>2</sup> | x 95 % |
| Dense surfacing           | 11862 | m <sup>2</sup> | x 50 % |
| Effective Area            | 5931  | m <sup>2</sup> |        |

|                         |       |
|-------------------------|-------|
| <b>Storage Details:</b> |       |
| Length                  | 25 m  |
| Width                   | 12 m  |
| Depth                   | 1 m   |
| Porosity                | 100 % |
| Area Increase           | 0 %   |

|                                       |      |       |                           |
|---------------------------------------|------|-------|---------------------------|
| <b>Rainfall Details - FSR Method:</b> |      |       |                           |
| Return Period                         | 100  | years |                           |
| Climate Change Factor                 | 20   | %     |                           |
| r value                               | 0.32 |       |                           |
| M5-60                                 | 17   | mm    |                           |
|                                       | mm   | mm/h  | storage (m <sup>3</sup> ) |
| 5 min                                 | 10.5 | 151.4 | 73.477                    |
| 10 min                                | 15.9 | 114.8 | 110.773                   |
| 15 min                                | 19.6 | 94.0  | 135.388                   |
| 30 min                                | 26.4 | 63.3  | 179.615                   |
| 45 min                                | 30.4 | 48.6  | 203.889                   |
| 60 min                                | 33.3 | 40.0  | 221.012                   |
| 2 hours                               | 41.1 | 24.7  | 260.054                   |
| 6 hours                               | 55.6 | 11.1  | 298.644                   |
| 24 hours                              | 79.8 | 4.0   | 179.161                   |

|                         |               |
|-------------------------|---------------|
| <b>Outflow Details:</b> |               |
| Infiltration rate       | 0 m/hr        |
| Attenuation Control     | Fixed Outflow |
| Control Diameter        | - mm          |
| Discharge rate          | 4.5 l/s       |

|                         |          |
|-------------------------|----------|
| <b>Results:</b>         |          |
| Outcome:                | Pass     |
| Critical Storm Duration | 6.67 hrs |
| Hmax                    | 0.997 m  |
| Time to half empty      | 9.2 hrs  |

# CRM Stormflow Stormwater Management Software

|                   |                      |
|-------------------|----------------------|
| <b>Client:</b>    | EDF RENEWABLES - JOD |
| <b>Project:</b>   | KELLYSTOWN WIND FARM |
| <b>Location:</b>  | NR DUNLEER           |
| <b>Catchment:</b> | Subcatchment 11      |

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|                           |      |                |        |
|---------------------------|------|----------------|--------|
| <b>Catchment Details:</b> |      |                |        |
| Buildings                 | 0    | m <sup>2</sup> | x 95 % |
| Dense surfacing           | 9226 | m <sup>2</sup> | x 50 % |
| Effective Area            | 4613 | m <sup>2</sup> |        |

|                         |       |
|-------------------------|-------|
| <b>Storage Details:</b> |       |
| Length                  | 24 m  |
| Width                   | 10 m  |
| Depth                   | 1 m   |
| Porosity                | 100 % |
| Area Increase           | 0 %   |

|                                       |      |       |                           |
|---------------------------------------|------|-------|---------------------------|
| <b>Rainfall Details - FSR Method:</b> |      |       |                           |
| Return Period                         | 100  | years |                           |
| Climate Change Factor                 | 20   | %     |                           |
| r value                               | 0.32 |       |                           |
| M5-60                                 | 17   | mm    |                           |
|                                       | mm   | mm/h  | storage (m <sup>3</sup> ) |
| 5 min                                 | 10.5 | 151.4 | 57.149                    |
| 10 min                                | 15.9 | 114.8 | 86.157                    |
| 15 min                                | 19.6 | 94.0  | 105.302                   |
| 30 min                                | 26.4 | 63.3  | 139.701                   |
| 45 min                                | 30.4 | 48.6  | 158.580                   |
| 60 min                                | 33.3 | 40.0  | 171.898                   |
| 2 hours                               | 41.1 | 24.7  | 202.265                   |
| 6 hours                               | 55.6 | 11.1  | 232.279                   |
| 24 hours                              | 79.8 | 4.0   | 139.348                   |

|                         |               |
|-------------------------|---------------|
| <b>Outflow Details:</b> |               |
| Infiltration rate       | 0 m/hr        |
| Attenuation Control     | Fixed Outflow |
| Control Diameter        | - mm          |
| Discharge rate          | 3.5 l/s       |

|                         |          |
|-------------------------|----------|
| <b>Results:</b>         |          |
| Outcome:                | Pass     |
| Critical Storm Duration | 6.67 hrs |
| Hmax                    | 0.969 m  |
| Time to half empty      | 9.2 hrs  |

# CRM Stormflow Stormwater Management Software

|                   |                      |
|-------------------|----------------------|
| <b>Client:</b>    | EDF RENEWABLES - JOD |
| <b>Project:</b>   | KELLYSTOWN WIND FARM |
| <b>Location:</b>  | NR DUNLEER           |
| <b>Catchment:</b> | Subcatchment 12      |

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|                           |      |                |        |
|---------------------------|------|----------------|--------|
| <b>Catchment Details:</b> |      |                |        |
| Buildings                 | 0    | m <sup>2</sup> | x 95 % |
| Dense surfacing           | 4004 | m <sup>2</sup> | x 50 % |
| Effective Area            | 2002 | m <sup>2</sup> |        |

|                         |       |
|-------------------------|-------|
| <b>Storage Details:</b> |       |
| Length                  | 12 m  |
| Width                   | 8 m   |
| Depth                   | 1 m   |
| Porosity                | 100 % |
| Area Increase           | 0 %   |

|                                       |      |       |                           |
|---------------------------------------|------|-------|---------------------------|
| <b>Rainfall Details - FSR Method:</b> |      |       |                           |
| Return Period                         | 100  | years |                           |
| Climate Change Factor                 | 20   | %     |                           |
| r value                               | 0.32 |       |                           |
| M5-60                                 | 17   | mm    |                           |
|                                       | mm   | mm/h  | storage (m <sup>3</sup> ) |
| 5 min                                 | 10.5 | 151.4 | 24.658                    |
| 10 min                                | 15.9 | 114.8 | 37.103                    |
| 15 min                                | 19.6 | 94.0  | 45.267                    |
| 30 min                                | 26.4 | 63.3  | 59.763                    |
| 45 min                                | 30.4 | 48.6  | 67.523                    |
| 60 min                                | 33.3 | 40.0  | 72.870                    |
| 2 hours                               | 41.1 | 24.7  | 84.318                    |
| 6 hours                               | 55.6 | 11.1  | 90.417                    |
| 24 hours                              | 79.8 | 4.0   | 18.915                    |

|                         |               |
|-------------------------|---------------|
| <b>Outflow Details:</b> |               |
| Infiltration rate       | 0 m/hr        |
| Attenuation Control     | Fixed Outflow |
| Control Diameter        | - mm          |
| Discharge rate          | 2 l/s         |

|                         |         |
|-------------------------|---------|
| <b>Results:</b>         |         |
| Outcome:                | Pass    |
| Critical Storm Duration | 4.7 hrs |
| Hmax                    | 0.951 m |
| Time to half empty      | 6.3 hrs |

# CRM Stormflow Stormwater Management Software

|                   |                      |
|-------------------|----------------------|
| <b>Client:</b>    | EDF RENEWABLES - JOD |
| <b>Project:</b>   | KELLYSTOWN WIND FARM |
| <b>Location:</b>  | NR DUNLEER           |
| <b>Catchment:</b> | Subcatchment 13      |

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|                           |        |                |        |
|---------------------------|--------|----------------|--------|
| <b>Catchment Details:</b> |        |                |        |
| Buildings                 | 0      | m <sup>2</sup> | x 95 % |
| Dense surfacing           | 2121   | m <sup>2</sup> | x 50 % |
| Effective Area            | 1060.5 | m <sup>2</sup> |        |

|                         |       |
|-------------------------|-------|
| <b>Storage Details:</b> |       |
| Length                  | 10 m  |
| Width                   | 7 m   |
| Depth                   | 0.6 m |
| Porosity                | 100 % |
| Area Increase           | 0 %   |

|                                       |      |       |                           |
|---------------------------------------|------|-------|---------------------------|
| <b>Rainfall Details - FSR Method:</b> |      |       |                           |
| Return Period                         | 100  | years |                           |
| Climate Change Factor                 | 20   | %     |                           |
| r value                               | 0.32 |       |                           |
| M5-60                                 | 17   | mm    |                           |
|                                       | mm   | mm/h  | storage (m <sup>3</sup> ) |
| 5 min                                 | 10.5 | 151.4 | 12.780                    |
| 10 min                                | 15.9 | 114.8 | 19.090                    |
| 15 min                                | 19.6 | 94.0  | 23.132                    |
| 30 min                                | 26.4 | 63.3  | 29.965                    |
| 45 min                                | 30.4 | 48.6  | 33.229                    |
| 60 min                                | 33.3 | 40.0  | 35.215                    |
| 2 hours                               | 41.1 | 24.7  | 37.893                    |
| 6 hours                               | 55.6 | 11.1  | 27.579                    |
| 24 hours                              | 79.8 | 4.0   | 0.000                     |

|                         |               |
|-------------------------|---------------|
| <b>Outflow Details:</b> |               |
| Infiltration rate       | 0 m/hr        |
| Attenuation Control     | Fixed Outflow |
| Control Diameter        | - mm          |
| Discharge rate          | 2 l/s         |

|                         |          |
|-------------------------|----------|
| <b>Results:</b>         |          |
| Outcome:                | Pass     |
| Critical Storm Duration | 2.13 hrs |
| Hmax                    | 0.542 m  |
| Time to half empty      | 2.6 hrs  |

# CRM Stormflow Stormwater Management Software

|                   |                      |
|-------------------|----------------------|
| <b>Client:</b>    | EDF RENEWABLES - JOD |
| <b>Project:</b>   | KELLYSTOWN WIND FARM |
| <b>Location:</b>  | NR DUNLEER           |
| <b>Catchment:</b> | Subcatchment 14      |

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|                           |        |                |        |
|---------------------------|--------|----------------|--------|
| <b>Catchment Details:</b> |        |                |        |
| Buildings                 | 0      | m <sup>2</sup> | x 95 % |
| Dense surfacing           | 2045   | m <sup>2</sup> | x 50 % |
| Effective Area            | 1022.5 | m <sup>2</sup> |        |

|                         |       |
|-------------------------|-------|
| <b>Storage Details:</b> |       |
| Length                  | 6 m   |
| Width                   | 8 m   |
| Depth                   | 0.8 m |
| Porosity                | 100 % |
| Area Increase           | 0 %   |

|                                       |      |       |                           |
|---------------------------------------|------|-------|---------------------------|
| <b>Rainfall Details - FSR Method:</b> |      |       |                           |
| Return Period                         | 100  | years |                           |
| Climate Change Factor                 | 20   | %     |                           |
| r value                               | 0.32 |       |                           |
| M5-60                                 | 17   | mm    |                           |
|                                       | mm   | mm/h  | storage (m <sup>3</sup> ) |
| 5 min                                 | 10.5 | 151.4 | 12.300                    |
| 10 min                                | 15.9 | 114.8 | 18.363                    |
| 15 min                                | 19.6 | 94.0  | 22.239                    |
| 30 min                                | 26.4 | 63.3  | 28.762                    |
| 45 min                                | 30.4 | 48.6  | 31.845                    |
| 60 min                                | 33.3 | 40.0  | 33.695                    |
| 2 hours                               | 41.1 | 24.7  | 36.019                    |
| 6 hours                               | 55.6 | 11.1  | 25.043                    |
| 24 hours                              | 79.8 | 4.0   | 0.000                     |

|                         |               |
|-------------------------|---------------|
| <b>Outflow Details:</b> |               |
| Infiltration rate       | 0 m/hr        |
| Attenuation Control     | Fixed Outflow |
| Control Diameter        | - mm          |
| Discharge rate          | 2 l/s         |

|                         |          |
|-------------------------|----------|
| <b>Results:</b>         |          |
| Outcome:                | Pass     |
| Critical Storm Duration | 2.03 hrs |
| Hmax                    | 0.75 m   |
| Time to half empty      | 2.5 hrs  |

# CRM Stormflow Stormwater Management Software

|                   |                      |
|-------------------|----------------------|
| <b>Client:</b>    | EDF RENEWABLES - JOD |
| <b>Project:</b>   | KELLYSTOWN WIND FARM |
| <b>Location:</b>  | NR DUNLEER           |
| <b>Catchment:</b> | Subcatchment 15      |

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|                           |      |                |        |
|---------------------------|------|----------------|--------|
| <b>Catchment Details:</b> |      |                |        |
| Buildings                 | 0    | m <sup>2</sup> | x 95 % |
| Dense surfacing           | 4770 | m <sup>2</sup> | x 50 % |
| Effective Area            | 2385 | m <sup>2</sup> |        |

|                         |       |
|-------------------------|-------|
| <b>Storage Details:</b> |       |
| Length                  | 15 m  |
| Width                   | 20 m  |
| Depth                   | 0.6 m |
| Porosity                | 100 % |
| Area Increase           | 0 %   |

|                                       |      |       |                           |
|---------------------------------------|------|-------|---------------------------|
| <b>Rainfall Details - FSR Method:</b> |      |       |                           |
| Return Period                         | 100  | years |                           |
| Climate Change Factor                 | 20   | %     |                           |
| r value                               | 0.32 |       |                           |
| M5-60                                 | 17   | mm    |                           |
|                                       | mm   | mm/h  | storage (m <sup>3</sup> ) |
| 5 min                                 | 10.5 | 151.4 | 29.786                    |
| 10 min                                | 15.9 | 114.8 | 45.020                    |
| 15 min                                | 19.6 | 94.0  | 55.152                    |
| 30 min                                | 26.4 | 63.3  | 73.633                    |
| 45 min                                | 30.4 | 48.6  | 84.086                    |
| 60 min                                | 33.3 | 40.0  | 91.660                    |
| 2 hours                               | 41.1 | 24.7  | 110.095                   |
| 6 hours                               | 55.6 | 11.1  | 136.429                   |
| 24 hours                              | 79.8 | 4.0   | 137.325                   |

|                                 |            |
|---------------------------------|------------|
| <b>Outflow Details:</b>         |            |
| Infiltration rate               | 0.018 m/hr |
| Infiltration by CIRIA 3D method |            |
| Safety Factor against flooding  | 1.5        |
| Attenuation Control             | None       |
| Control Diameter                | - mm       |
| Discharge rate                  | 0 l/s      |

|                         |           |
|-------------------------|-----------|
| <b>Results:</b>         |           |
| Outcome:                | Pass      |
| Critical Storm Duration | 13.38 hrs |
| Hmax                    | 0.485 m   |
| Time to half empty      | 18.6 hrs  |

# CRM Stormflow Stormwater Management Software

|                   |                      |
|-------------------|----------------------|
| <b>Client:</b>    | EDF RENEWABLES - JOD |
| <b>Project:</b>   | KELLYSTOWN WIND FARM |
| <b>Location:</b>  | NR DUNLEER           |
| <b>Catchment:</b> | Subcatchment 16      |

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|                           |     |                |        |
|---------------------------|-----|----------------|--------|
| <b>Catchment Details:</b> |     |                |        |
| Buildings                 | 0   | m <sup>2</sup> | x 95 % |
| Dense surfacing           | 388 | m <sup>2</sup> | x 50 % |
| Effective Area            | 194 | m <sup>2</sup> |        |

|                         |       |
|-------------------------|-------|
| <b>Storage Details:</b> |       |
| Length                  | 2 m   |
| Width                   | 2 m   |
| Depth                   | 0.8 m |
| Porosity                | 100 % |
| Area Increase           | 0 %   |

|                                       |      |       |                           |
|---------------------------------------|------|-------|---------------------------|
| <b>Rainfall Details - FSR Method:</b> |      |       |                           |
| Return Period                         | 100  | years |                           |
| Climate Change Factor                 | 20   | %     |                           |
| r value                               | 0.32 |       |                           |
| M5-60                                 | 17   | mm    |                           |
|                                       | mm   | mm/h  | storage (m <sup>3</sup> ) |
| 5 min                                 | 10.5 | 151.4 | 1.848                     |
| 10 min                                | 15.9 | 114.8 | 2.512                     |
| 15 min                                | 19.6 | 94.0  | 2.761                     |
| 30 min                                | 26.4 | 63.3  | 2.540                     |
| 45 min                                | 30.4 | 48.6  | 1.667                     |
| 60 min                                | 33.3 | 40.0  | 0.559                     |
| 2 hours                               | 41.1 | 24.7  | 0.000                     |
| 6 hours                               | 55.6 | 11.1  | 0.000                     |
| 24 hours                              | 79.8 | 4.0   | 0.000                     |

|                         |               |
|-------------------------|---------------|
| <b>Outflow Details:</b> |               |
| Infiltration rate       | 0 m/hr        |
| Attenuation Control     | Fixed Outflow |
| Control Diameter        | - mm          |
| Discharge rate          | 2 l/s         |

|                         |          |
|-------------------------|----------|
| <b>Results:</b>         |          |
| Outcome:                | Pass     |
| Critical Storm Duration | 20 min   |
| Hmax                    | 0.701 m  |
| Time to half empty      | 11.7 min |

# CRM Stormflow Stormwater Management Software

|                   |                      |
|-------------------|----------------------|
| <b>Client:</b>    | EDF RENEWABLES - JOD |
| <b>Project:</b>   | KELLYSTOWN WIND FARM |
| <b>Location:</b>  | NR DUNLEER           |
| <b>Catchment:</b> | Subcatchment 18      |

RECEIVED: 04/12/2024

|                           |       |                |        |
|---------------------------|-------|----------------|--------|
| <b>Catchment Details:</b> |       |                |        |
| Buildings                 | 0     | m <sup>2</sup> | x 95 % |
| Dense surfacing           | 757   | m <sup>2</sup> | x 50 % |
| Effective Area            | 378.5 | m <sup>2</sup> |        |

|                         |       |
|-------------------------|-------|
| <b>Storage Details:</b> |       |
| Length                  | 6 m   |
| Width                   | 8 m   |
| Depth                   | 0.8 m |
| Porosity                | 100 % |
| Area Increase           | 0 %   |

|                                       |      |       |                           |
|---------------------------------------|------|-------|---------------------------|
| <b>Rainfall Details - FSR Method:</b> |      |       |                           |
| Return Period                         | 100  | years |                           |
| Climate Change Factor                 | 20   | %     |                           |
| r value                               | 0.32 |       |                           |
| M5-60                                 | 17   | mm    |                           |
|                                       | mm   | mm/h  | storage (m <sup>3</sup> ) |
| 5 min                                 | 10.5 | 151.4 | 4.726                     |
| 10 min                                | 15.9 | 114.8 | 7.141                     |
| 15 min                                | 19.6 | 94.0  | 8.747                     |
| 30 min                                | 26.4 | 63.3  | 11.671                    |
| 45 min                                | 30.4 | 48.6  | 13.320                    |
| 60 min                                | 33.3 | 40.0  | 14.511                    |
| 2 hours                               | 41.1 | 24.7  | 17.390                    |
| 6 hours                               | 55.6 | 11.1  | 21.354                    |
| 24 hours                              | 79.8 | 4.0   | 20.639                    |

|                                 |            |
|---------------------------------|------------|
| <b>Outflow Details:</b>         |            |
| Infiltration rate               | 0.018 m/hr |
| Infiltration by CIRIA 3D method |            |
| Safety Factor against flooding  | 1.5        |
| Attenuation Control             | None       |
| Control Diameter                | - mm       |
| Discharge rate                  | 0 l/s      |

|                         |          |
|-------------------------|----------|
| <b>Results:</b>         |          |
| Outcome:                | Pass     |
| Critical Storm Duration | 12 hrs   |
| Hmax                    | 0.467 m  |
| Time to half empty      | 16.2 hrs |

# CRM Stormflow Stormwater Management Software

|                   |                      |
|-------------------|----------------------|
| <b>Client:</b>    | EDF RENEWABLES - JOD |
| <b>Project:</b>   | KELLYSTOWN WIND FARM |
| <b>Location:</b>  | NR DUNLEER           |
| <b>Catchment:</b> | Subcatchment 4       |

RECEIVED: 04/12/2024

|                           |       |                |        |
|---------------------------|-------|----------------|--------|
| <b>Catchment Details:</b> |       |                |        |
| Buildings                 | 0     | m <sup>2</sup> | x 95 % |
| Dense surfacing           | 1803  | m <sup>2</sup> | x 50 % |
| Effective Area            | 901.5 | m <sup>2</sup> |        |

|                         |       |
|-------------------------|-------|
| <b>Storage Details:</b> |       |
| Length                  | 11 m  |
| Width                   | 5 m   |
| Depth                   | 0.6 m |
| Porosity                | 100 % |
| Area Increase           | 0 %   |

|                                       |      |       |                           |
|---------------------------------------|------|-------|---------------------------|
| <b>Rainfall Details - FSR Method:</b> |      |       |                           |
| Return Period                         | 100  | years |                           |
| Climate Change Factor                 | 20   | %     |                           |
| r value                               | 0.32 |       |                           |
| M5-60                                 | 17   | mm    |                           |
|                                       | mm   | mm/h  | storage (m <sup>3</sup> ) |
| 5 min                                 | 10.5 | 151.4 | 10.774                    |
| 10 min                                | 15.9 | 114.8 | 16.048                    |
| 15 min                                | 19.6 | 94.0  | 19.394                    |
| 30 min                                | 26.4 | 63.3  | 24.932                    |
| 45 min                                | 30.4 | 48.6  | 27.437                    |
| 60 min                                | 33.3 | 40.0  | 28.856                    |
| 2 hours                               | 41.1 | 24.7  | 30.052                    |
| 6 hours                               | 55.6 | 11.1  | 16.967                    |
| 24 hours                              | 79.8 | 4.0   | 0.000                     |

|                         |               |
|-------------------------|---------------|
| <b>Outflow Details:</b> |               |
| Infiltration rate       | 0 m/hr        |
| Attenuation Control     | Fixed Outflow |
| Control Diameter        | - mm          |
| Discharge rate          | 2 l/s         |

|                         |          |
|-------------------------|----------|
| <b>Results:</b>         |          |
| Outcome:                | Pass     |
| Critical Storm Duration | 1.75 hrs |
| Hmax                    | 0.548 m  |
| Time to half empty      | 2.1 hrs  |

# CRM Stormflow Stormwater Management Software

|                   |                      |
|-------------------|----------------------|
| <b>Client:</b>    | EDF RENEWABLES - JOD |
| <b>Project:</b>   | KELLYSTOWN WIND FARM |
| <b>Location:</b>  | NR DUNLEER           |
| <b>Catchment:</b> | Subcatchment 8       |

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|                           |     |                |        |
|---------------------------|-----|----------------|--------|
| <b>Catchment Details:</b> |     |                |        |
| Buildings                 | 0   | m <sup>2</sup> | x 95 % |
| Dense surfacing           | 866 | m <sup>2</sup> | x 50 % |
| Effective Area            | 433 | m <sup>2</sup> |        |

|                         |       |
|-------------------------|-------|
| <b>Storage Details:</b> |       |
| Length                  | 4 m   |
| Width                   | 4 m   |
| Depth                   | 0.8 m |
| Porosity                | 100 % |
| Area Increase           | 0 %   |

|                                       |      |       |                           |
|---------------------------------------|------|-------|---------------------------|
| <b>Rainfall Details - FSR Method:</b> |      |       |                           |
| Return Period                         | 100  | years |                           |
| Climate Change Factor                 | 20   | %     |                           |
| r value                               | 0.32 |       |                           |
| M5-60                                 | 17   | mm    |                           |
|                                       | mm   | mm/h  | storage (m <sup>3</sup> ) |
| 5 min                                 | 10.5 | 151.4 | 4.863                     |
| 10 min                                | 15.9 | 114.8 | 7.084                     |
| 15 min                                | 19.6 | 94.0  | 8.380                     |
| 30 min                                | 26.4 | 63.3  | 10.104                    |
| 45 min                                | 30.4 | 48.6  | 10.372                    |
| 60 min                                | 33.3 | 40.0  | 10.118                    |
| 2 hours                               | 41.1 | 24.7  | 6.951                     |
| 6 hours                               | 55.6 | 11.1  | 0.000                     |
| 24 hours                              | 79.8 | 4.0   | 0.000                     |

|                         |               |
|-------------------------|---------------|
| <b>Outflow Details:</b> |               |
| Infiltration rate       | 0 m/hr        |
| Attenuation Control     | Fixed Outflow |
| Control Diameter        | - mm          |
| Discharge rate          | 2 l/s         |

|                         |          |
|-------------------------|----------|
| <b>Results:</b>         |          |
| Outcome:                | Pass     |
| Critical Storm Duration | 45 min   |
| Hmax                    | 0.648 m  |
| Time to half empty      | 43.2 min |

# C2 Temporary Settlement Calculations

RECEIVED: 04/12/2024

Project Kellystown Wind Farm  
 Ref M02207-01  
 Date 24/10/2024



**Purpose**

To determine settlement pond parameters (hydraulic retention time) to allow primary treatment of water quality for suspended solids in temporary construction phase runoff.

**Approach**

Design assumes:

- This calculation set considers the temporary construction phase. The calculation approach adopted assumes discharges at breakouts every c. 80m
- Settlement sizing for a drained area equivalent to the track surface.

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**Determination of Inflow Characteristics**

Water quality design event adopted as a 2-year rainfall event; assumes 1hr duration for peak intensity + 20% climate change

Inflow to Pond calculated using Rational method

$Q=CIA$

|                        |              |
|------------------------|--------------|
| Rainfall Intensity (i) | 15 mm/hr     |
| Runoff Coefficient (C) | 50 %         |
| Drained Works Area     | 0.048 Ha     |
| Design Inflow (Q)      | 100 lps      |
| or                     | 0.100 m3/sec |
| Design Outflow         | 33 lps       |
| or                     | 0.033 m3/sec |

Assuming 1hr event for peak inflow flow rate  
 Runoff from unbound surfaces  
 Based on 6m working strip x outflow interval

Outflow controlled by gravel checkdam

Characterisation of Influent

|                                    |                             |
|------------------------------------|-----------------------------|
| Median Concentration of TSS        | 2000 mg/l                   |
| Kinematic Viscosity of Water (n)   | 0.0000015 m <sup>2</sup> /s |
| Gravitational Constant (g)         | 9.81 m/s <sup>2</sup>       |
| Particle Density (p <sub>p</sub> ) | 2.76 kg/m <sup>3</sup>      |
| Water Density (p <sub>s</sub> )    | 1 kg/m <sup>3</sup>         |

per Construction Site Erosion and Sediment Controls - Planning Design & Performance, Pitt *et al*, 2007

Settlement Velocity for Silts  
 based on Stokes Law

$$V = \frac{d^2 g (\rho_p - \rho_s)}{18\eta}$$

Of Which (based on characteristic particle size distribution bearing in mind observed ground conditions)

| Particle Size     |          | % passing | %-age by mass | Median Concentration | Settling Velocity (based on Stokes Law) | Hydraulic Retention Time (HRT) (Time to Fully Settle) (based on 0.6m depth) |
|-------------------|----------|-----------|---------------|----------------------|---|---|
| mm                | m        | %         | %             | mg/l                 | m/s                                     | hrs   |
| 150um             | 0.00015  | 100       | 19            | 380                  | 0.014388                                | 0.0   |
| 63um              | 0.000063 | 86        | 74            | 1480                 | 0.002538043                             | 0.1   |
| 20um              | 0.00002  | 14        | 4             | 80                   | 0.000255787                             | 0.7   |
| 6um               | 0.000006 | 4         | 2             | 40                   | 2.30208E-05                             | 7.2   |
| Clay Range<br>2um | 0.000002 | 1         | 1             | 20                   | 2.55787E-06                             | 65.2  |

**Determination of Outflow Characteristics**

For purposes of the design, outflow from settlement feature dictated by flow control. Maximum permitted outflow Qbar per attenuation design requirements. Refer to separate Stormflow calculation for analysis of routing / maximum outflow rates across orifice. As a conservative measure, the effect of filtration via drainage stone media is excluded and the design assumes an unlimited overflow rate dictated by the inflow rate.

**Determination of Initial Settlement Pond Characteristics for Water Quality Treatment**

Surface Overflow Rate is dictated by the flow rate divided by the total surface area of the sedimentation feature, and is equivalent to the Terminal Settlement Velocity

Assuming a lagoon with base dimensions:

|                                 |                   |
|---------------------------------|-------------------|
| Length                          | 10 m              |
| Breadth                         | 3 m               |
| Total Depth                     | 1 m               |
| Of which flowing layer is say   | 0.6 m             |
| Volume                          | 64 m <sup>3</sup> |
| Side Slope (1 in)               | 2 n/a             |
| Area                            | 30 m <sup>2</sup> |
| Therefore Surface Overflow Rate | 0.0011 m/s        |

Average Flow velocity across lagoon 0.0185 m/s

Retention time in the lagoon is equivalent to the length of travel (lagoon length) relative to the outflow rate.

Retention time: 0.15 hrs

Initial settlement pond effluent is therefore characterised as follows:

| Particle Size            | HRT  | Residence sufficient for full settlement? | Residual Concentration |
|--------------------------|------|---|------------------------|
| um                       | hrs  |   | mg/l                   |
| 150                      | 0.01 | OK  | 0                      |
| 63                       | 0.07 | OK  | 0                      |
| 20                       | 0.65 | NO  | 62                     |
| Clay Range               | 6    | NO  | 39                     |
|                          | 2    | NO  | 20                     |
| Concentration in Outflow |      |   | 121 mg/l               |
| Equivalent to            |      |   | 94% removal            |

- Clay range not settle-able - all discharges overland over vegetation where vegetative filtration will offer a further stage of treatment that will reduce concentrations such that the discharge does not harm water receptors.78:78

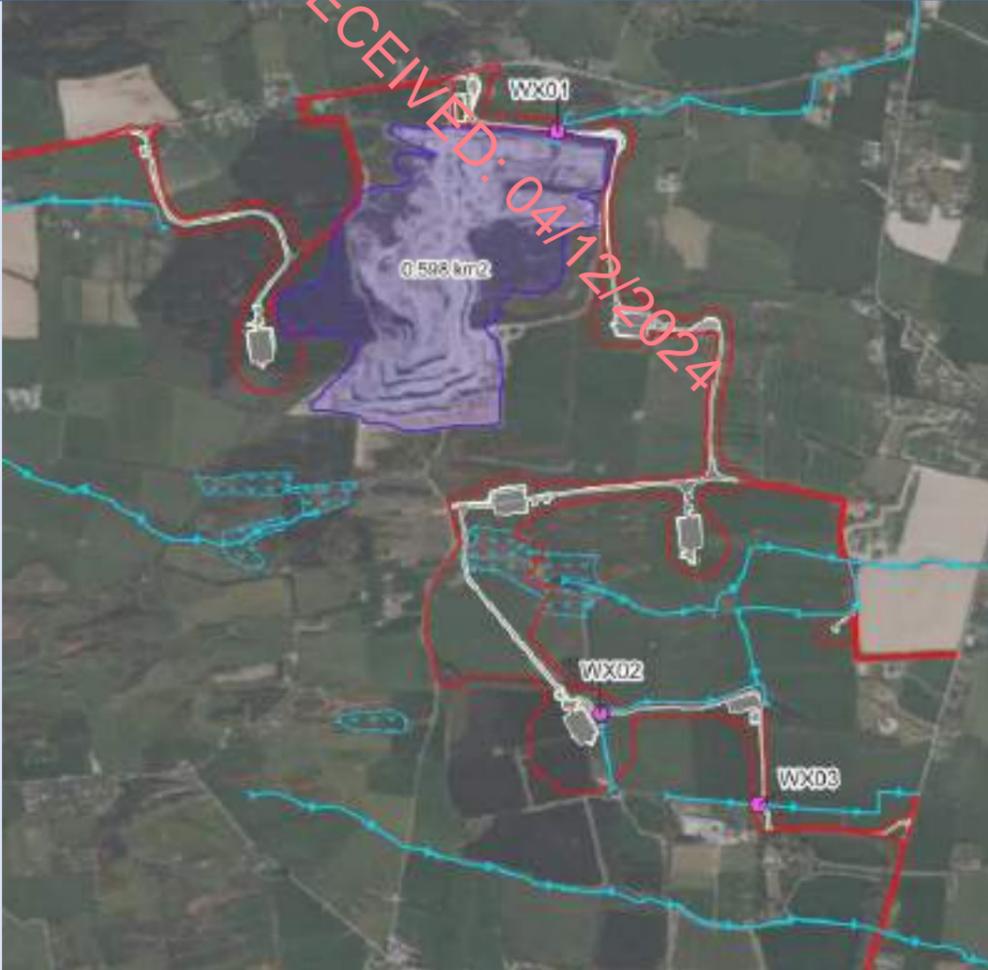
- Provide increased frequency of breakouts to reduce inflows at key locations (proximal to pollution prevention buffers)

| Calc | Checked | Date       | Revision | Notes |
|------|---------|------------|----------|-------|
| IB   | KS      | 29/10/2024 | Original | N/A   |
|      |         |            |          |       |

**Annex F**

**Watercourse Crossing Schedule**

RECEIVED: 04/12/2024

| WX REF | EASTING   | NORTHING  | DESCRIPTION   | PHOTO  | CATCHMENT MAP  |
|--------|-----------|-----------|---|--|--|
| WX01   | 708244.82 | 784749.53 | <p>PROPOSED TRACK CROSSES EPA WATERCOURSE (SLIEVEBOY 06).</p> <p>NEW MIN. 900 MM BOTTOMLESS CULVERT (PCC OR EQUIVALENT).</p> <p>DESIGNED FOR FREE INLET CONDITIONS FOR THE 1% AEP + CLIMATE CHANGE PEAK FLOW.</p> <p>POST QUARRY RESTORATION ESTIMATED FLOW IS CONSERVATIVE IN THAT IT DOES NOT ACCOUNT FOR FLOW ATTENUATION FROM RESERVOIRS AND LAKES (FARL). FARL FACTOR WOULD BE SIGNIFICANT AND LIKELY REDUCE PEAK FLOW VS. WHAT HAS BEEN ESTIMATED.</p> <p>HYDROLOGY &amp; HYDRAULIC ASSESSMENT IN ANNEX A &amp; B RESPECTIVELY.</p> |                        |  |
|        |           |           |   | <p>TAKEN DOWNSTREAM OF PROPOSED CROSSING LOCATION<br/>(FACING UPSTREAM TOWARDS QUARRY DISCHARGE POINT)</p> | <p>CATCHMENT AREA: 0.598 KM<sup>2</sup></p>  |

| WX REF | EASTING   | NORTHING  | DESCRIPTION   | PHOTO  | CATCHMENT MAP   |
|--------|-----------|-----------|---|--|---|
| WX02   | 708378.03 | 782918.56 | <p>PROPOSED TRACK CROSSES MINOR WATERCOURSE (UNNAMED).</p> <p>NEW MIN. 900 MM BOTTOMLESS CULVERT (PCC OR EQUIVALENT).</p> <p>DESIGNED FOR FREE INLET CONDITIONS FOR THE 1% AEP + CLIMATE CHANGE PEAK FLOW.</p> <p>HYDROLOGY &amp; HYDRAULIC ASSESSMENT IN ANNEX A &amp; B RESPECTIVELY.</p> |  <p>TAKEN DOWNSTREAM OF PROPOSED CROSSING LOCATION (FACING UPSTREAM)</p> |  <p>CATCHMENT AREA: 0.08 KM<sup>2</sup></p> |

| WX REF      | EASTING   | NORTHING  | DESCRIPTION   | PHOTO  | CATCHMENT MAP  |
|-------------|-----------|-----------|---|--|--|
| <b>WX03</b> | 708876.91 | 782631.93 | <p>PROPOSED TRACK CROSSES MINOR WATERCOURSE (UNNAMED).</p> <p>NEW MIN. 900 MM BOTTOMLESS CULVERT (PCC OR EQUIVALENT).</p> <p>DESIGNED FOR FREE INLET CONDITIONS FOR THE 1% AEP + CLIMATE CHANGE PEAK FLOW.</p> <p>HYDROLOGY &amp; HYDRAULIC ASSESSMENT IN ANNEX A &amp; B RESPECTIVELY.</p> |  |  |
|             |           |           |   | <p>TAKEN DOWNSTREAM OF PROPOSED CROSSING LOCATION (FACING UPSTREAM)</p>              | <p>CATCHMENT AREA: 0.169 KM<sup>2</sup></p>  |

ANNEX A – HYDROLOGY / FLOW ESTIMATION SUMMARY

RECEIVED: 04/12/2024

**Project** Kellystown Wind Farm, Co. Louth  
**Ref** M02207-01  
**Crossing Ref** WX01  
**Date** 22/10/2024



RECEIVED: 04/12/2024

Purpose: To estimate design flows for an Irish catchment by the FSSR No. 6 3-Variable Eqn method

This spreadsheet is suitable for estimating design flows on small catchments (less than 20 km<sup>2</sup>) using the FSSR no. 6 3-Variable equation for QBAR plus the FSR (FSSR14) regional growth curves.

|             |                              |       |                 |
|-------------|------------------------------|-------|-----------------|
| AREA        | Max from FSU / Height Data   | 0.598 | km <sup>2</sup> |
| SAAR4170    | From FSU                     | 837.4 | mm              |
| WRAP class: | From WRAP maps / FSU BFISOIL | 2     |                 |
| SOIL        |                              | 0.3   |                 |

|      |      |                   |
|------|------|-------------------|
| QBAR | 0.14 | m <sup>3</sup> /s |
|------|------|-------------------|

|            |                 |
|------------|-----------------|
| Map Region | Ireland (GDSDS) |
|------------|-----------------|

| Return period (years) | Growth Curve Factor | Design flow (m <sup>3</sup> /s) | Specific runoff (l/s/ha) |                                |
|-----------------------|---------------------|---------------------------------|--------------------------|--------------------------------|
| 2                     | 0.92                | 0.13                            | 2.10                     |                                |
| 30                    | 0.00                | 0.00                            | 0.00                     |                                |
| 50                    | 2.33                | 0.32                            | 5.31                     |                                |
| <b>100</b>            | 2.61                | 0.36                            | 5.95                     | <b>100-year + 20%<br/>0.43</b> |
| 500                   | 3.33                | 0.45                            | 7.58                     |                                |
| 1000                  | 3.62                | 0.49                            | 8.26                     |                                |

Outcomes are exclusive of the effect of climate change, estimated seperately

**Project** Kellystown Wind Farm, Co. Louth  
**Ref** M02207-01  
**Crossing Ref** WX01  
**Date** 22/10/2024



RECEIVED: 04/12/2024

Purpose: To estimate a design flow for a catchment in the Irish hydrological region by the Institute of Hydrology Report 124 (IoH 124) "Flood Estimation on Small Catchments" method.

This spreadsheet is suitable for estimating design flows on small rural catchments (less than 25 km<sup>2</sup>) using the IH Report 124 equation for QBAR plus the FSR regional growth curves. Rural can be taken as meaning URBAN less than 0.05, or equivalently URBEX. This sheet does not adopt the <5 sq km alternative method (for plot scale equations) in order to ensure a conservative approach to flood estimation.

|             |                                     |       |                 |
|-------------|-------------------------------------|-------|-----------------|
| AREA        | <i>Max from FSU / Height Data</i>   | 0.598 | km <sup>2</sup> |
| SAAR4170    | <i>From FSU</i>                     | 837.4 | mm              |
| WRAP class: | <i>From WRAP maps / FSU BFISOIL</i> | 2     |                 |
| SOIL        |                                     | 0.3   |                 |

|      |      |                   |
|------|------|-------------------|
| QBAR | 0.13 | m <sup>3</sup> /s |
|------|------|-------------------|

|            |                 |
|------------|-----------------|
| Map Region | Ireland (GDSDS) |
|------------|-----------------|

| Return period (years) | Growth Curve Factor (from FSSR 14 and FSU research) | Design flow (m <sup>3</sup> /s) | Specific runoff (l/s/ha) |                        |
|-----------------------|---|---------------------------------|--------------------------|------------------------|
| 2                     | 0.92  | 0.12                            | 2.03                     |                        |
| 30                    | 2.11  | 0.28                            | 4.66                     |                        |
| 50                    | 2.33  | 0.31                            | 5.13                     |                        |
| <b>100</b>            | 2.61  | 0.34                            | 5.75                     | 100-year + 20%<br>0.41 |
| <b>500</b>            | 3.33  | 0.44                            | 7.33                     |                        |
| <b>1000</b>           | 3.62  | 0.48                            | 7.99                     |                        |

Outcomes are exclusive of the effect of climate change, estimated separately

**Project** Kellystown Wind Farm, Co. Louth  
**Ref** M02207-01  
**Crossing Ref** WX02  
**Date** 22/10/2024



RECEIVED: 04/12/2024

Purpose: To estimate design flows for an Irish catchment by the FSSR No. 6 3-Variable Eqn method

This spreadsheet is suitable for estimating design flows on small catchments (less than 20 km<sup>2</sup>) using the FSSR no. 6 3-Variable equation for QBAR plus the FSR (FSSR14) regional growth curves.

|             |                              |       |                 |
|-------------|------------------------------|-------|-----------------|
| AREA        | Max from FSU / Height Data   | 0.08  | km <sup>2</sup> |
| SAAR4170    | From FSU                     | 837.4 | mm              |
| WRAP class: | From WRAP maps / FSU BFISOIL | 2     |                 |
| SOIL        |                              | 0.3   |                 |

|      |      |                   |
|------|------|-------------------|
| QBAR | 0.02 | m <sup>3</sup> /s |
|------|------|-------------------|

|            |                 |
|------------|-----------------|
| Map Region | Ireland (GDSDS) |
|------------|-----------------|

| Return period (years) | Growth Curve Factor | Design flow (m <sup>3</sup> /s) | Specific runoff (l/s/ha) |                        |
|-----------------------|---------------------|---------------------------------|--------------------------|------------------------|
| 2                     | 0.92                | 0.02                            | 2.46                     |                        |
| 30                    | 0.00                | 0.00                            | 0.00                     |                        |
| 50                    | 2.33                | 0.05                            | 6.24                     |                        |
| <b>100</b>            | 2.61                | 0.06                            | 6.98                     | 100-year + 20%<br>0.07 |
| 500                   | 3.33                | 0.07                            | 8.90                     |                        |
| 1000                  | 3.62                | 0.08                            | 9.70                     |                        |

Outcomes are exclusive of the effect of climate change, estimated separately

**Project** Kellystown Wind Farm, Co. Louth  
**Ref** M02207-01  
**Crossing Ref** WX02  
**Date** 22/10/2024



RECEIVED: 04/12/2024

Purpose: To estimate a design flow for a catchment in the Irish hydrological region by the Institute of Hydrology Report 124 (IoH 124) "Flood Estimation on Small Catchments" method.

This spreadsheet is suitable for estimating design flows on small rural catchments (less than 25 km<sup>2</sup>) using the IH Report 124 equation for QBAR plus the FSR regional growth curves. Rural can be taken as meaning URBAN less than 0.05, or equivalently URBEX. This sheet does not adopt the <5 sq km alternative method (for plot scale equations) in order to ensure a conservative approach to flood estimation.

|             |                                     |       |     |
|-------------|-------------------------------------|-------|-----|
| AREA        | <i>Max from FSU / Height Data</i>   | 0.08  | km2 |
| SAAR4170    | <i>From FSU</i>                     | 837.4 | mm  |
| WRAP class: | <i>From WRAP maps / FSU BFISOIL</i> | 2     |     |
| SOIL        |                                     | 0.3   |     |

|      |      |      |
|------|------|------|
| QBAR | 0.02 | m3/s |
|------|------|------|

|            |                 |
|------------|-----------------|
| Map Region | Ireland (GDSDS) |
|------------|-----------------|

| Return period (years) | Growth Curve Factor (from FSSR 14 and FSU research) | Design flow (m <sup>3</sup> /s) | Specific runoff (l/s/ha) |                        |
|-----------------------|---|---------------------------------|--------------------------|------------------------|
| 2                     | 0.92  | 0.02                            | 2.53                     |                        |
| 30                    | 2.11  | 0.05                            | 5.81                     |                        |
| 50                    | 2.33  | 0.05                            | 6.41                     |                        |
| <b>100</b>            | 2.61  | 0.06                            | 7.18                     | 100-year + 20%<br>0.07 |
| <b>500</b>            | 3.33  | 0.07                            | 9.14                     |                        |
| <b>1000</b>           | 3.62  | 0.08                            | 9.97                     |                        |

Outcomes are exclusive of the effect of climate change, estimated seperately

**Project** Kellystown Wind Farm, Co. Louth  
**Ref** M02207-01  
**Crossing Ref** WX03  
**Date** 22/10/2024



RECEIVED: 04/12/2024

Purpose: To estimate design flows for an Irish catchment by the FSSR No. 6 3-Variable Eqn method

This spreadsheet is suitable for estimating design flows on small catchments (less than 20 km<sup>2</sup>) using the FSSR no. 6 3-Variable equation for QBAR plus the FSR (FSSR14) regional growth curves.

|             |                              |       |                 |
|-------------|------------------------------|-------|-----------------|
| AREA        | Max from FSU / Height Data   | 0.169 | km <sup>2</sup> |
| SAAR4170    | From FSU                     | 837.4 | mm              |
| WRAP class: | From WRAP maps / FSU BFISOIL | 2     |                 |
| SOIL        |                              | 0.3   |                 |

|      |      |                   |
|------|------|-------------------|
| QBAR | 0.04 | m <sup>3</sup> /s |
|------|------|-------------------|

|            |                 |
|------------|-----------------|
| Map Region | Ireland (GDSDS) |
|------------|-----------------|

| Return period (years) | Growth Curve Factor | Design flow (m <sup>3</sup> /s) | Specific runoff (l/s/ha) |                        |
|-----------------------|---------------------|---------------------------------|--------------------------|------------------------|
| 2                     | 0.92                | 0.04                            | 2.32                     |                        |
| 30                    | 0.00                | 0.00                            | 0.00                     |                        |
| 50                    | 2.33                | 0.10                            | 5.87                     |                        |
| <b>100</b>            | 2.61                | 0.11                            | 6.58                     | 100-year + 20%<br>0.13 |
| 500                   | 3.33                | 0.14                            | 8.38                     |                        |
| 1000                  | 3.62                | 0.15                            | 9.14                     |                        |

Outcomes are exclusive of the effect of climate change, estimated seperately

**Project** Kellystown Wind Farm, Co. Louth  
**Ref** M02207-01  
**Crossing Ref** WX03  
**Date** 22/10/2024



RECEIVED: 04/12/2024

Purpose: To estimate a design flow for a catchment in the Irish hydrological region by the Institute of Hydrology Report 124 (IoH 124) "Flood Estimation on Small Catchments" method.

This spreadsheet is suitable for estimating design flows on small rural catchments (less than 25 km<sup>2</sup>) using the IH Report 124 equation for QBAR plus the FSR regional growth curves. Rural can be taken as meaning URBAN less than 0.05, or equivalently URBEX. This sheet does not adopt the <5 sq km alternative method (for plot scale equations) in order to ensure a conservative approach to flood estimation.

|             |                                     |       |                 |
|-------------|-------------------------------------|-------|-----------------|
| AREA        | <i>Max from FSU / Height Data</i>   | 0.169 | km <sup>2</sup> |
| SAAR4170    | <i>From FSU</i>                     | 837.4 | mm              |
| WRAP class: | <i>From WRAP maps / FSU BFISOIL</i> | 2     |                 |
| SOIL        |                                     | 0.3   |                 |

|      |      |                   |
|------|------|-------------------|
| QBAR | 0.04 | m <sup>3</sup> /s |
|------|------|-------------------|

|            |                 |
|------------|-----------------|
| Map Region | Ireland (GDSDS) |
|------------|-----------------|

| Return period (years) | Growth Curve Factor (from FSSR 14 and FSU research) | Design flow (m <sup>3</sup> /s) | Specific runoff (l/s/ha) |                        |
|-----------------------|---|---------------------------------|--------------------------|------------------------|
| 2                     | 0.92  | 0.04                            | 2.33                     |                        |
| 30                    | 2.11  | 0.09                            | 5.35                     |                        |
| 50                    | 2.33  | 0.10                            | 5.90                     |                        |
| <b>100</b>            | 2.61  | 0.11                            | 6.61                     | 100-year + 20%<br>0.13 |
| <b>500</b>            | 3.33  | 0.14                            | 8.42                     |                        |
| <b>1000</b>           | 3.62  | 0.16                            | 9.18                     |                        |

Outcomes are exclusive of the effect of climate change, estimated separately

ANNEX B - HYDRAULICS – CULVERT SIZING

RECEIVED: 04/12/2024

**Purpose**

To determine the adequacy of hydraulic capacity for culverts in accordance with the requirements of CIRIA C689

**1.0 Input Data:**

|   |        |         |                              |
|---|--------|---------|------------------------------|
| Culvert Ref:  | WX01   | Unnamed |                              |
| Watercourse Name  | 0.43   | m3/sec  | As per Hydrological Analysis |
| <b>Design Discharge Q</b>                                 | 100+CC | Yrs     | As per LA requirement        |
| <b>Design Return Period</b>                               | 85.5   | m AOD   | From Survey                  |
| Elevation of Stream Bed @ Culvert Inlet                   | 83.6   | m AOD   | From Survey                  |
| Elevation of Stream Bed @ Culvert Outlet                  | 15     | m       | From Survey                  |
| Culvert Length  | 85.7   | m AOD   | From Survey                  |
| Elevation of Stream bed upstream of Culvert               | 2.5    | m       | From Survey                  |
| Distance upstream of Culvert                              | 83.5   | m AOD   | From Survey                  |
| Elevation of Stream bed downstream of Culvert             | 3.1    | m       | From Survey                  |
| Distance downstream of Culvert                            | 87     | m AOD   | From Survey                  |
| Elevation of Proposed Embankment Crest                    | 0.9    | m       | From Survey                  |
| Average channel invert width                              | 1      | m       | From Survey                  |
| Average channel top of bank width                         | 0.2    | m       | From Survey                  |
| Average Channel Depth to Bank                             | 85.9   | m AOD   | From Survey                  |
| Left Over-Bank Ground Level (Floodplain) (Culvert Inlet)  | 1      | m       | From Survey                  |
| Distance from bank  | 85.8   | m AOD   | From Survey                  |
| Right Over-Bank Ground Level (Floodplain) (Culvert Inlet) | 2      | m       | From Survey                  |
| Distance from bank  | 0.045  |         | From C689 Table A1.1         |
| Mannings n - Channel                                      | 0.035  |         | From C689 Table A1.1         |
| Mannings n - Overbanks                                    | S1     | 12.50 - | Calculated                   |
| Bedslope upstream of Culvert 1 in S1                      | S2     | 31.00 - | Calculated                   |
| Bedslope downstream of Culvert 1 in S2                    | S3     | 7.89 -  | Calculated                   |
| Bedslope across Culvert 1 in S3                           | S4     | 9.36 -  | Calculated                   |
| Bedslope across whole reach considered 1 in S4            | X =    | 0.25 -  | Calculated                   |
| Channel Side Slopes 1 in X                                | Y =    | 5.00 -  | Calculated                   |
| Upstream Left Over- Bank Slope                            | Z =    | 20.00 - | Calculated                   |
| Upstream Right Over- Bank Slope                           |        |         |                              |

RECEIVED 04/12/2024

**2.0 Calculate Tailwater Depth and Level:**

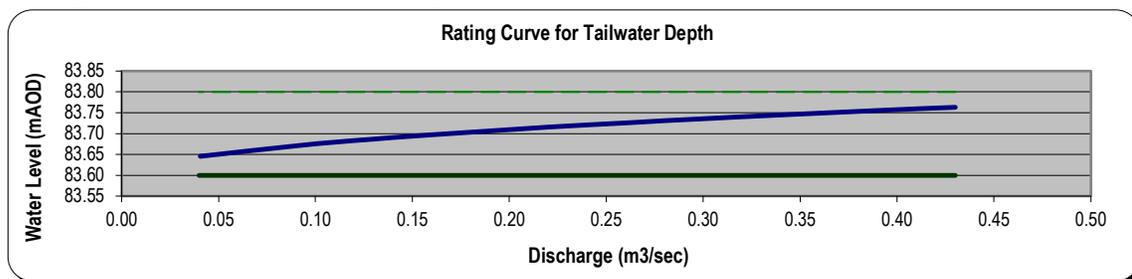
Mannings Equation:

$$Q = VA = \left(\frac{1.49}{n}\right) AR^{2/3} \sqrt{S} \quad [SI] \quad R_A = \frac{A}{P}$$

Discharge Contained in Channel, Depth of Normal Flow Considered

|  |          |            |            |
|--|----------|------------|------------|
| Depth of water in channel is                             | $Y_{dc}$ | 0.16 m     | Calculated |
| Therefore water level at downstream extent of culvert is | $WL_t$   | 83.76 mAOD | Calculated |
|  | $V_{dc}$ | 1.70 m/s   | Calculated |

**2.1 Rating Curve for Tailwater Channel Discharge**



**3.0 Calculate Tailwater Elevation (Total Head)  $H_t$ :**

$$H_t = Z_{bo} + y_{dc} + \frac{V_{dc}^2}{2g}$$

Where:  $Z_{bo}$  Elevation @ Culvert Outlet  
 $y_{dc}$  Water depth in downstream channel  
 $V_{dc}$  Velocity in downstream channel

|                      |       |            |            |
|----------------------|-------|------------|------------|
| Tailwater Elevation: | $H_t$ | 83.92 mAOD | Calculated |
|----------------------|-------|------------|------------|

4.0 Calculate Froude No.

|                                     |       |                           |
|-------------------------------------|-------|---------------------------|
| Cross Sectional Area (A)            |       | 0.25 m <sup>2</sup>       |
| Top Width (B)                       |       | 2.21 m                    |
| Hydraulic mean depth (A per unit B) | $d_m$ | 0.11 m                    |
| Froude Number                       | $Fr$  | 1.60 <b>Supercritical</b> |
| Critical depth in channel           | $h_c$ | 0.26 m                    |
| Critical Velocity                   | $v_c$ | 1.06 m/s                  |

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5.0 Initial Design

Initial Estimate of required culvert cross sectional area required. Analysis is based on new culvert, therefore design should allow for freeflow conditions. Applicable method is Flow Area Method

5.1 Flow Area Method - refer to C689 Section 6.7.1

|   |       |                     |            |
|---|-------|---------------------|------------|
| Depth; Min. Tailwater depth                                     | D     | 0.16 m              | Calculated |
| Assume 20% Initial loss of culvert height due to Freeboard / Si |       | 0.20 m              | Calculated |
| where freeboard depth is:                                       | F     | 0.02 m              | Calculated |
| Area required as per tailwater flow calculation:                | $A_t$ | 0.25 m <sup>2</sup> | Calculated |
| Nominal width (Area / Depth (not inc. freeboard):               |       | 1.55 m              | Calculated |
| Therefore prelim culvert dimensions (incl freeboard + sil       | $D_i$ | 0.20 m              | Calculated |
|   | $B_i$ | 1.55 m              | Calculated |

6.0 Detailed Design

6.1 Try Culvert dimensions...

Based on previous Initial Design

|   |    |          |
|---|----|----------|
| Height / Diameter                                 | D  | 0.90 m   |
| Breadth (BLANK IF CIRCULAR)                       | B  | m        |
| Number of Culverts                                | nr | 1 n/a    |
| Shape   |    | CIRCULAR |
| Freeboard   |    | 0.30 m   |
| Siltation / Depth lowered below ex. stream invert |    | 0.15 m   |

Therefore:

|  |       |            |
|--|-------|------------|
| Upstream Pipe Invert                     |       | 85.35 mAOD |
| Upstream Pipe Base (w/Silt) Elevation    | $Z_i$ | 85.50 mAOD |
| Upstream Soffit Elevation                |       | 86.25 mAOD |
| Downstream Pipe Invert Elevation         |       | 83.45 mAOD |
| Downstream Pipe Base (w/ Silt) Elevation | $Z_o$ | 83.60 mAOD |
| Downstream Soffit Elevation              |       | 84.35 mAOD |

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6.2 Calculation of Discharge Intensity

|                                    |  |    |                         |
|------------------------------------|--|----|-------------------------|
| $q_i = \frac{1.811Q}{A_b D^{0.5}}$ | Where  |    |                         |
|                                    | Discharge  | Q  | 0.43 m <sup>3</sup> /s  |
|                                    | Depth / Diameter of barrell                            | D  | 0.75 m                  |
|                                    | Culvert cross section area excl. freeboard + siltation | Ab | 0.38 m <sup>2</sup>     |
|                                    | Discharge Coefficient                                  | qi | 2.36 n/a                |
|                                    | Discharge intensity classification is:                 |    | Free Flow Inlet Control |

6.3 Calculation of headwater depth for free flow inlet control

Based on Table A1.3, Culvert type is **Nr 2** n/a  
 i.e., Circular pipe; headwall, socket end of pipe

$$\frac{E_{sh}}{D} = \frac{E_{sc}}{D} + k \left[ \frac{1.811Q}{A_b D^{0.5}} \right]^M - 0.5S_o \quad \text{Eqn 6.23}$$

$$\frac{E_{sh}}{D} = k \left[ \frac{1.811Q}{A_b D^{0.5}} \right]^M \quad \text{Eqn 6.25}$$

Therefore applicable CIRIA C689 equation reference: Equation 6.23

|       |  |                 |                        |            |
|-------|--|-----------------|------------------------|------------|
| Where | Discharge  | Q               | 0.43 m <sup>3</sup> /s |            |
|       | Depth / Diameter of barrell                            | D               | 0.75 m                 |            |
|       | Unsubmerged analysis constant                          | k               | 0.0078                 | Table A1.3 |
|       | Unsubmerged analysis constant                          | M               | 2                      | Table A1.3 |
|       | Culvert cross section area excl. freeboard + siltation | Ab              | 0.38 m <sup>2</sup>    |            |
|       | Culvert Slope  | So              | 0.13 m/m               | 1 in 7.89  |
|       | Critical depth calculated as:                          | yc              | 0.310 m                |            |
|       | Specific Energy at Critical Depth                      | E <sub>sc</sub> | 0.46 m                 |            |
|       | Therefore Specific Energy of Headwater                 | E <sub>sh</sub> | 0.45 m                 |            |

6.4 Calculation of headwater elevation for inlet control

Headwater Elevation H<sub>hic</sub> determined by:

$$H_{hic} = Z_i + E_{sh} + h_s \quad \text{Where}$$

|                              |                 |                          |
|------------------------------|-----------------|--------------------------|
| Headloss due to inlet screen | h <sub>s</sub>  | N/A (No Screen Proposed) |
| Stream Elevation at Inlet    | Z <sub>i</sub>  | 85.50 mAOD               |
| Specific Energy of Headwater | E <sub>sh</sub> | 0.45 m                   |

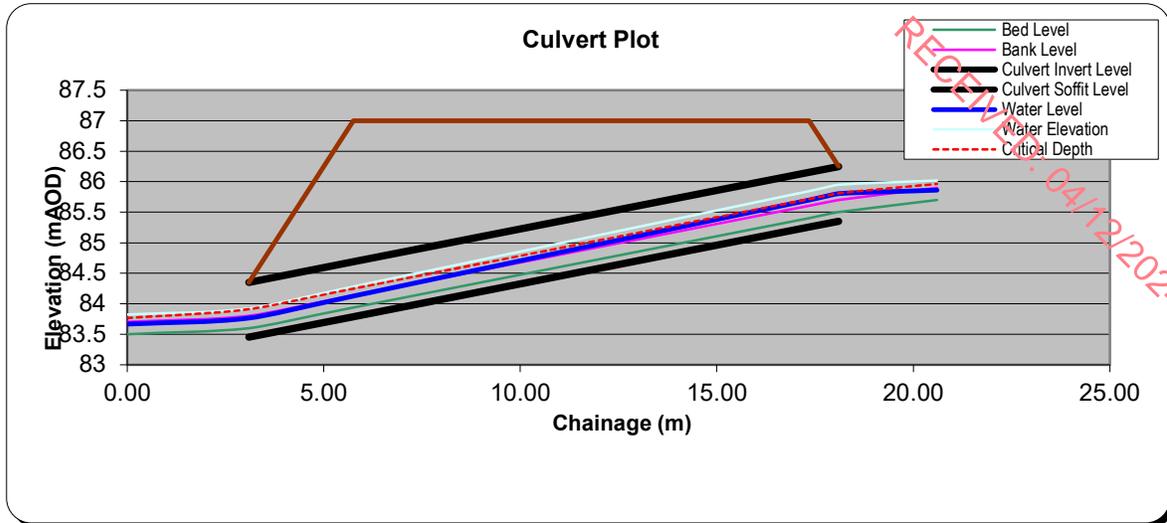
Therefore Headwater Elevation: H<sub>hic</sub> = 85.95 mAOD

Water Level at the headwater for inlet control WL<sub>hic</sub> determined by:

$$WL_{hic} = H_{hic} - \frac{V_{uc}^2}{2g} \quad \text{Where}$$

|                                 |                   |            |
|---------------------------------|-------------------|------------|
| Headwater Elevation:            | H <sub>hic</sub>  | 85.95 mAOD |
| Velocity in Upstream Channel    | V <sub>uc</sub>   | 1.70 m/s   |
| Therefore Water Level at Inlet: | WL <sub>hic</sub> | 85.80 mAOD |

6.5 Culvert Profile



7.0 Summary

|   | Complies | Fails | Comment |
|---|----------|-------|---------|
| Culvert Inlet Soffit Elevation > Headwater Elevation for Inlet Cd | X        |       |         |
| Adequate Freeboard provided to water level?                       | X        |       |         |

Therefore proposed culvert dimensions: 1 nr Diameter 0.90 m

| By | Checked | Revision | Date       |
|----|---------|----------|------------|
| DH | KS      | Original | 22/10/2024 |
|    |         |          |            |
|    |         |          |            |

**Purpose**

To determine the adequacy of hydraulic capacity for culverts in accordance with the requirements of CIRIA C689

1.0 Input Data:

|   |                               |                              |
|---|-------------------------------|------------------------------|
| Culvert Ref:  | WX02                          |                              |
| Watercourse Name  | Unnamed                       |                              |
| <b>Design Discharge Q</b>                                 | <b>0.07 m<sup>3</sup>/sec</b> | As per Hydrological Analysis |
| <b>Design Return Period</b>                               | <b>100+CC Yrs</b>             | As per LA requirement        |
| Elevation of Stream Bed @ Culvert Inlet                   | 105.9 m AOD                   | From Survey                  |
| Elevation of Stream Bed @ Culvert Outlet                  | 105.8 m AOD                   | From Survey                  |
| Culvert Length  | 9 m                           | From Survey                  |
| Elevation of Stream bed upstream of Culvert               | 106 m AOD                     | From Survey                  |
| Distance upstream of Culvert                              | 5.2 m                         | From Survey                  |
| Elevation of Stream bed downstream of Culvert             | 105.7 m AOD                   | From Survey                  |
| Distance downstream of Culvert                            | 5.1 m                         | From Survey                  |
| Elevation of Proposed Embankment Crest                    | 107 m AOD                     | From Survey                  |
| Average channel invert width                              | 0.8 m                         | From Survey                  |
| Average channel top of bank width                         | 0.9 m                         | From Survey                  |
| Average Channel Depth to Bank                             | 0.5 m                         | From Survey                  |
| Left Over-Bank Ground Level (Floodplain) (Culvert Inlet)  | 106.5 m AOD                   | From Survey                  |
| Distance from bank  | 1.5 m                         | From Survey                  |
| Right Over-Bank Ground Level (Floodplain) (Culvert Inlet) | 107 m AOD                     | From Survey                  |
| Distance from bank  | 0.5 m                         | From Survey                  |
| Mannings n - Channel                                      | 0.045                         | From C689 Table A1.1         |
| Mannings n - Overbanks                                    | 0.05                          | From C689 Table A1.1         |
| Bedslope upstream of Culvert 1 in S1                      | S1 52.00 -                    | Calculated                   |
| Bedslope downstream of Culvert 1 in S2                    | S2 51.00 -                    | Calculated                   |
| Bedslope across Culvert 1 in S3                           | S3 90.00 -                    | Calculated                   |
| Bedslope across whole reach considered 1 in S4            | S4 64.33 -                    | Calculated                   |
| Channel Side Slopes 1 in X                                | X = 0.10 -                    | Calculated                   |
| Upstream Left Over- Bank Slope                            | Y = 15.00 -                   | Calculated                   |
| Upstream Right Over- Bank Slope                           | Z = 0.83 -                    | Calculated                   |

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2.0 Calculate Tailwater Depth and Level:

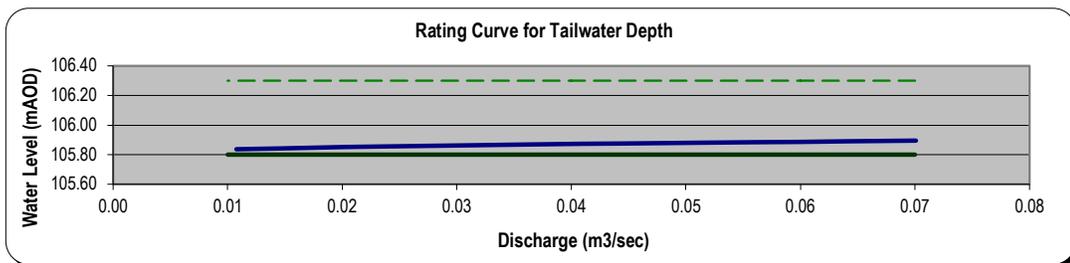
Mannings Equation:

$$Q = VA = \left(\frac{1.49}{n}\right) AR^2 \sqrt{S} \quad [SI] \quad R_h = \frac{A}{P}$$

Discharge Contained in Channel, Depth of Normal Flow Considered

|  |          |             |            |
|--|----------|-------------|------------|
| Depth of water in channel is                             | $Y_{dc}$ | 0.09 m      | Calculated |
| Therefore water level at downstream extent of culvert is | $WL_t$   | 105.89 mAOD | Calculated |
|  | $V_{dc}$ | 0.43 m/s    | Calculated |

2.1 Rating Curve for Tailwater Channel Discharge



3.0 Calculate Tailwater Elevation (Total Head)  $H_t$ :

$$H_t = Z_{bo} + y_{dc} + \frac{V_{dc}^2}{2g}$$

Where:  $Z_{bo}$  Elevation @ Culvert Outlet  
 $y_{dc}$  Water depth in downstream channel  
 $V_{dc}$  Velocity in downstream channel

|                      |       |             |            |
|----------------------|-------|-------------|------------|
| Tailwater Elevation: | $H_t$ | 105.90 mAOD | Calculated |
|----------------------|-------|-------------|------------|

4.0 Calculate Froude No.

|                                     |       |  |
|-------------------------------------|-------|--|
| Cross Sectional Area (A)            |       | 0.16 m <sup>2</sup>  |
| Top Width (B)                       |       | 2.68 m   |
| Hydraulic mean depth (A per unit B) | $d_m$ | 0.06 m   |
| Froude Number                       | Fr    | 0.55 <span style="background-color: #e0f2f1;">Subcritical</span> |
| Critical depth in channel           | $h_c$ | 0.06 m   |
| Critical Velocity                   | $v_c$ | 0.77 m/s   |

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5.0 Initial Design

Initial Estimate of required culvert cross sectional area required. Analysis is based on new culvert, therefore design should allow for freeflow conditions. Applicable method is Flow Area Method

5.1 Flow Area Method - refer to C689 Section 6.7.1

|  |       |                     |            |
|--|-------|---------------------|------------|
| Depth; Min. Tailwater depth                                    | D     | 0.09 m              | Calculated |
| Assume 20% Initial loss of culvert height due to Freeboard / S |       | 0.12 m              | Calculated |
| where freeboard depth is:                                      | F     | 0.01 m              | Calculated |
| Area required as per tailwater flow calculation:               | $A_t$ | 0.16 m <sup>2</sup> | Calculated |
| Nominal width (Area / Depth (not inc. freeboard):              |       | 1.74 m              | Calculated |
| Therefore prelim culvert dimensions (incl freeboard + s        | $D_i$ | 0.12 m              | Calculated |
|  | $B_i$ | 1.74 m              | Calculated |

6.0 Detailed Design

6.1 Try Culvert dimensions...

Based on previous Initial Design

|   |    |          |
|---|----|----------|
| Height / Diameter                                 | D  | 0.90 m   |
| Breadth (BLANK IF CIRCULAR)                       | B  | m        |
| Number of Culverts                                | nr | 1 n/a    |
| Shape   |    | CIRCULAR |
| Freeboard   |    | 0.30 m   |
| Siltation / Depth lowered below ex. stream invert |    | 0.15 m   |

Therefore:

|  |       |             |
|--|-------|-------------|
| Upstream Pipe Invert                     |       | 105.75 mAOD |
| Upstream Pipe Base (w/Silt)Elevation     | $Z_i$ | 105.90 mAOD |
| Upstream Soffit Elevation                |       | 106.65 mAOD |
| Downstream Pipe Invert Elevation         |       | 105.65 mAOD |
| Downstream Pipe Base (w/ Silt) Elevation | $Z_o$ | 105.80 mAOD |
| Downstream Soffit Elevation              |       | 106.55 mAOD |

6.2 Calculation of Discharge Intensity

|                                    |  |  |                |                         |
|------------------------------------|--|--|----------------|-------------------------|
| $q_i = \frac{1.811Q}{A_b D^{0.5}}$ | Where                                  | Discharge  | Q              | 0.07 m <sup>3</sup> /s  |
|                                    |  | Depth / Diameter of barrel                             | D              | 0.75 m                  |
|                                    |  | Culvert cross section area excl. freeboard + siltation | A <sub>b</sub> | 0.38 m <sup>2</sup>     |
|                                    |  | Discharge Coefficient                                  | q <sub>i</sub> | 0.38 n/a                |
|                                    | Discharge intensity classification is: |  |                | Free Flow Inlet Control |

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6.3 Calculation of headwater depth for free flow inlet control

Based on Table A1.3, Culvert type is Nr 2 n/a  
 i.e., Circular pipe; headwall, socket end of pipe

$$\frac{E_{sh}}{D} = k \left[ \frac{1.811Q}{A_b D^{0.5}} \right]^M \quad \text{Eqn 6.23}$$

$$\frac{E_{sh}}{D} = k \left[ \frac{1.811Q}{A_b D^{0.5}} \right]^M \quad \text{Eqn 6.25}$$

Therefore applicable CIRIA C689 equation reference: Equation 6.23

|                            |  |                 |                        |            |
|----------------------------|--|-----------------|------------------------|------------|
| Where                      | Discharge  | Q               | 0.07 m <sup>3</sup> /s |            |
|                            | Depth / Diameter of barrel                             | D               | 0.75 m                 |            |
|                            | Unsubmerged analysis constant                          | k               | 0.0078                 | Table A1.3 |
|                            | Unsubmerged analysis constant                          | M               | 2                      | Table A1.3 |
|                            | Culvert cross section area excl. freeboard + siltation | A <sub>b</sub>  | 0.38 m <sup>2</sup>    |            |
|                            | Culvert Slope  | So              | 0.01 m/m               | 1 in 100   |
| $\frac{Q^2 W}{g A^3} = 1$  | Critical depth calculated as:                          | Y <sub>c</sub>  | 0.099 m                |            |
| $E_{sc} = \frac{3}{2} y_c$ | Specific Energy at Critical Depth                      | E <sub>sc</sub> | 0.15 m                 |            |
|                            | Therefore Specific Energy of Headwater                 | E <sub>sh</sub> | 0.15 m                 |            |

6.4 Calculation of headwater elevation for inlet control

Headwater Elevation H<sub>hic</sub> determined by:

$$H_{hic} = Z_i + E_{sh} + h_s \quad \text{Where}$$

|                              |                 |                          |
|------------------------------|-----------------|--------------------------|
| Headloss due to inlet screen | h <sub>s</sub>  | N/A (No Screen Proposed) |
| Stream Elevation at Inlet    | Z <sub>i</sub>  | 105.90 mAOD              |
| Specific Energy of Headwater | E <sub>sh</sub> | 0.15 m                   |

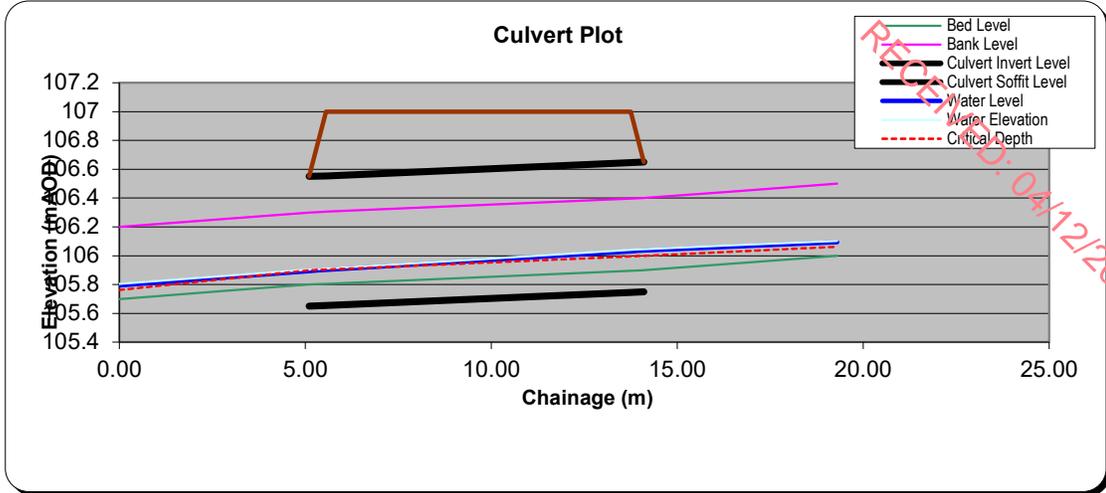
Therefore Headwater Elevation: H<sub>hic</sub> 106.05 mAOD

Water Level at the headwater for inlet control WL<sub>hic</sub> determined by:

$$WL_{hic} = H_{hic} - \frac{V_{uc}^2}{2g} \quad \text{Where}$$

|                                 |                   |             |
|---------------------------------|-------------------|-------------|
| Headwater Elevation:            | H <sub>hic</sub>  | 106.05 mAOD |
| Velocity in Upstream Channel    | V <sub>uc</sub>   | 0.43 m/s    |
| Therefore Water Level at Inlet: | WL <sub>hic</sub> | 106.04 mAOD |

6.5 Culvert Profile



7.0 Summary

|  | Complies | Fails | Comment |
|--|----------|-------|---------|
| Culvert Inlet Soffit Elevation > Headwater Elevation for Inlet C | X        |       |         |
| Adequate Freeboard provided to water level?                      | X        |       |         |

Therefore proposed culvert dimensions: 1 nr Diameter 0.90 m

| By | Checked | Revision | Date       |
|----|---------|----------|------------|
| DH | KS      | Original | 22/10/2024 |
|    |         |          |            |
|    |         |          |            |

**Purpose**

To determine the adequacy of hydraulic capacity for culverts in accordance with the requirements of CIRIA C689

1.0 Input Data:

|   |               |                          |                              |
|---|---------------|--------------------------|------------------------------|
| Culvert Ref:  | WX03          |                          |                              |
| Watercourse Name  | Unnamed       |                          |                              |
| <b>Design Discharge Q</b>                                 | <b>0.13</b>   | <b>m<sup>3</sup>/sec</b> | As per Hydrological Analysis |
| <b>Design Return Period</b>                               | <b>100+CC</b> | <b>Yrs</b>               | As per LA requirement        |
| Elevation of Stream Bed @ Culvert Inlet                   | 100           | m AOD                    | From Survey                  |
| Elevation of Stream Bed @ Culvert Outlet                  | 99.5          | m AOD                    | From Survey                  |
| Culvert Length  | 9             | m                        | From Survey                  |
| Elevation of Stream bed upstream of Culvert               | 100.3         | m AOD                    | From Survey                  |
| Distance upstream of Culvert                              | 12.9          | m                        | From Survey                  |
| Elevation of Stream bed downstream of Culvert             | 99.3          | m AOD                    | From Survey                  |
| Distance downstream of Culvert                            | 5.7           | m                        | From Survey                  |
| Elevation of Proposed Embankment Crest                    | 101.5         | m AOD                    | From Survey                  |
| Average channel invert width                              | 0.7           | m                        | From Survey                  |
| Average channel top of bank width                         | 0.9           | m                        | From Survey                  |
| Average Channel Depth to Bank                             | 0.5           | m                        | From Survey                  |
| Left Over-Bank Ground Level (Floodplain) (Culvert Inlet)  | 101           | m AOD                    | From Survey                  |
| Distance from bank  | 0.5           | m                        | From Survey                  |
| Right Over-Bank Ground Level (Floodplain) (Culvert Inlet) | 102           | m AOD                    | From Survey                  |
| Distance from bank  | 2             | m                        | From Survey                  |
| Mannings n - Channel                                      | 0.04          |                          | From C689 Table A1.1         |
| Mannings n - Overbanks                                    | 0.05          |                          | From C689 Table A1.1         |
| Bedslope upstream of Culvert 1 in S1                      | S1            | 43.00 -                  | Calculated                   |
| Bedslope downstream of Culvert 1 in S2                    | S2            | 28.50 -                  | Calculated                   |
| Bedslope across Culvert 1 in S3                           | S3            | 18.00 -                  | Calculated                   |
| Bedslope across whole reach considered 1 in S4            | S4            | 27.60 -                  | Calculated                   |
| Channel Side Slopes 1 in X                                | X =           | 0.20 -                   | Calculated                   |
| Upstream Left Over- Bank Slope                            | Y =           | 1.00 -                   | Calculated                   |
| Upstream Right Over- Bank Slope                           | Z =           | 1.33 -                   | Calculated                   |

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2.0 Calculate Tailwater Depth and Level:

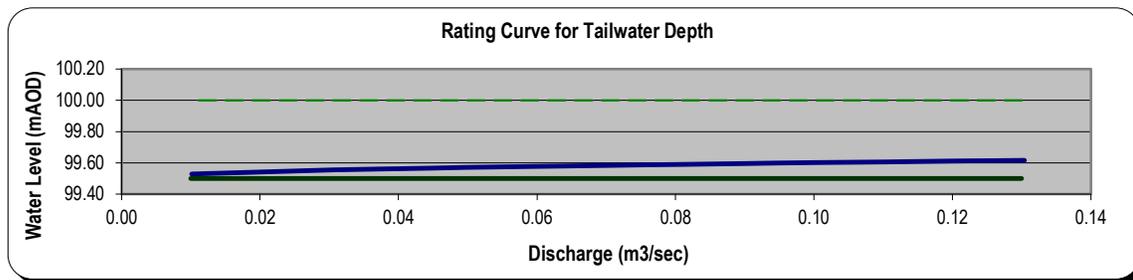
Mannings Equation:

$$Q = VA = \left( \frac{1.49}{n} \right) AR^2 \sqrt{S} \quad [SI] \quad R_h = \frac{A}{P}$$

Discharge Contained in Channel, Depth of Normal Flow Considered

|  |          |            |            |
|--|----------|------------|------------|
| Depth of water in channel is                             | $Y_{dc}$ | 0.12 m     | Calculated |
| Therefore water level at downstream extent of culvert is | $WL_t$   | 99.62 mAOD | Calculated |
|  | $V_{dc}$ | 0.88 m/s   | Calculated |

2.1 Rating Curve for Tailwater Channel Discharge



3.0 Calculate Tailwater Elevation (Total Head)  $H_t$ :

$$H_t = Z_{bo} + y_{dc} + \frac{V_{dc}^2}{2g}$$

Where:  $Z_{bo}$  Elevation @ Culvert Outlet  
 $y_{dc}$  Water depth in downstream channel  
 $V_{dc}$  Velocity in downstream channel

|                      |       |            |            |
|----------------------|-------|------------|------------|
| Tailwater Elevation: | $H_t$ | 99.66 mAOD | Calculated |
|----------------------|-------|------------|------------|

4.0 Calculate Froude No.

|                                     |       |                         |
|-------------------------------------|-------|-------------------------|
| Cross Sectional Area (A)            |       | 0.15 m <sup>2</sup>     |
| Top Width (B)                       |       | 1.86 m                  |
| Hydraulic mean depth (A per unit B) | $d_m$ | 0.08 m                  |
| Froude Number                       | $Fr$  | 0.99 <b>Subcritical</b> |
| Critical depth in channel           | $h_c$ | 0.09 m                  |
| Critical Velocity                   | $v_c$ | 0.89 m/s                |

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5.0 Initial Design

Initial Estimate of required culvert cross sectional area required. Analysis is based on new culvert, therefore design should allow for freeflow conditions. Applicable method is Flow Area Method

5.1 Flow Area Method - refer to C689 Section 6.7.1

|   |       |                     |            |
|---|-------|---------------------|------------|
| Depth; Min. Tailwater depth                                     | D     | 0.12 m              | Calculated |
| Assume 20% Initial loss of culvert height due to Freeboard / Si |       | 0.15 m              | Calculated |
| where freeboard depth is:                                       | F     | 0.01 m              | Calculated |
| Area required as per tailwater flow calculation:                | $A_t$ | 0.15 m <sup>2</sup> | Calculated |
| Nominal width (Area / Depth (not inc. freeboard):               |       | 1.28 m              | Calculated |
| Therefore prelim culvert dimensions (incl freeboard + sil       | $D_i$ | 0.15 m              | Calculated |
|   | $B_i$ | 1.28 m              | Calculated |

6.0 Detailed Design

6.1 Try Culvert dimensions...

Based on previous Initial Design

|   |    |          |
|---|----|----------|
| Height / Diameter                                 | D  | 0.90 m   |
| Breadth (BLANK IF CIRCULAR)                       | B  | m        |
| Number of Culverts                                | nr | 1 n/a    |
| Shape   |    | CIRCULAR |
| Freeboard   |    | 0.30 m   |
| Siltation / Depth lowered below ex. stream invert |    | 0.15 m   |

Therefore:

|  |       |             |
|--|-------|-------------|
| Upstream Pipe Invert                     |       | 99.85 mAOD  |
| Upstream Pipe Base (w/Silt) Elevation    | $Z_i$ | 100.00 mAOD |
| Upstream Soffit Elevation                |       | 100.75 mAOD |
| Downstream Pipe Invert Elevation         |       | 99.35 mAOD  |
| Downstream Pipe Base (w/ Silt) Elevation | $Z_o$ | 99.50 mAOD  |
| Downstream Soffit Elevation              |       | 100.25 mAOD |

6.2 Calculation of Discharge Intensity

|                                    |  |    |                         |
|------------------------------------|--|----|-------------------------|
| $q_i = \frac{1.811Q}{A_b D^{0.5}}$ | Where  |    |                         |
|                                    | Discharge  | Q  | 0.13 m <sup>3</sup> /s  |
|                                    | Depth / Diameter of barrell                            | D  | 0.75 m                  |
|                                    | Culvert cross section area excl. freeboard + siltation | Ab | 0.38 m <sup>2</sup>     |
|                                    | Discharge Coefficient                                  | qi | 0.71 n/a                |
|                                    | Discharge intensity classification is:                 |    | Free Flow Inlet Control |

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6.3 Calculation of headwater depth for free flow inlet control

Based on Table A1.3, Culvert type is **Nr** 2 n/a  
 i.e., Circular pipe; headwall, socket end of pipe

$$\frac{E_{sh}}{D} = \frac{E_{sc}}{D} + k \left[ \frac{1.811Q}{A_b D^{0.5}} \right]^M - 0.5S_o \quad \text{Eqn 6.23}$$

$$\frac{E_{sh}}{D} = k \left[ \frac{1.811Q}{A_b D^{0.5}} \right]^M \quad \text{Eqn 6.25}$$

Therefore applicable CIRIA C689 equation reference: Equation 6.23

|       |  |                 |                        |            |
|-------|--|-----------------|------------------------|------------|
| Where | Discharge  | Q               | 0.13 m <sup>3</sup> /s |            |
|       | Depth / Diameter of barrell                            | D               | 0.75 m                 |            |
|       | Unsubmerged analysis constant                          | k               | 0.0078                 | Table A1.3 |
|       | Unsubmerged analysis constant                          | M               | 2                      | Table A1.3 |
|       | Culvert cross section area excl. freeboard + siltation | Ab              | 0.38 m <sup>2</sup>    |            |
|       | Culvert Slope  | So              | 0.06 m/m               | 1 in 18    |
|       | Critical depth calculated as:                          | yc              | 0.147 m                |            |
|       | Specific Energy at Critical Depth                      | E <sub>sc</sub> | 0.22 m                 |            |
|       | Therefore Specific Energy of Headwater                 | E <sub>sh</sub> | 0.20 m                 |            |

6.4 Calculation of headwater elevation for inlet control

Headwater Elevation H<sub>hic</sub> determined by:

$$H_{hic} = Z_i + E_{sh} + h_s \quad \text{Where}$$

|                              |                 |                          |
|------------------------------|-----------------|--------------------------|
| Headloss due to inlet screen | h <sub>s</sub>  | N/A (No Screen Proposed) |
| Stream Elevation at Inlet    | Z <sub>i</sub>  | 100.00 mAOD              |
| Specific Energy of Headwater | E <sub>sh</sub> | 0.20 m                   |

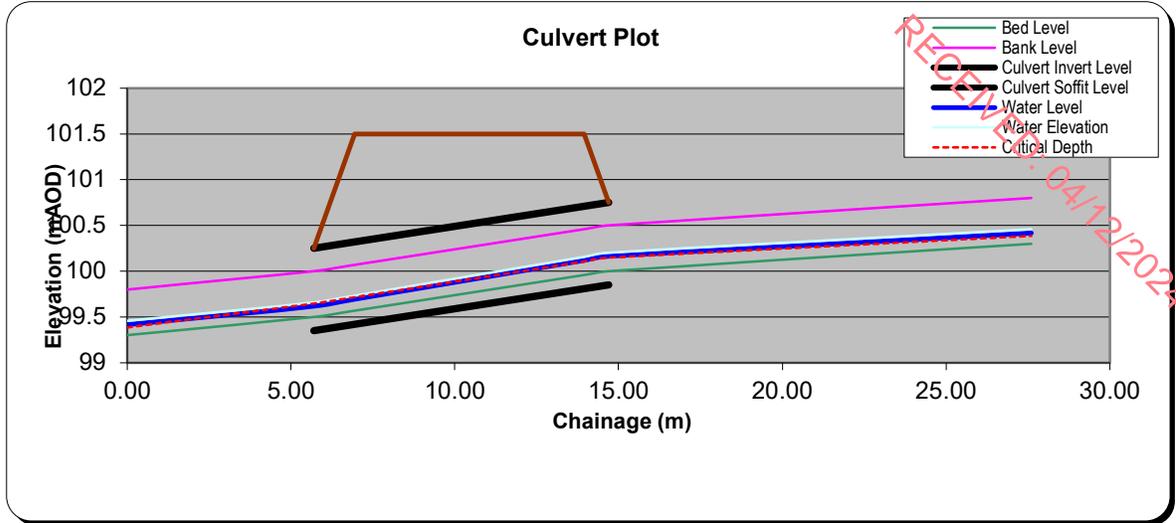
Therefore Headwater Elevation: H<sub>hic</sub> 100.20 mAOD

Water Level at the headwater for inlet control WL<sub>hic</sub> determined by:

$$WL_{hic} = H_{hic} - \frac{V_{uc}^2}{2g} \quad \text{Where}$$

|                                 |                   |             |
|---------------------------------|-------------------|-------------|
| Headwater Elevation:            | H <sub>hic</sub>  | 100.20 mAOD |
| Velocity in Upstream Channel    | V <sub>uc</sub>   | 0.88 m/s    |
| Therefore Water Level at Inlet: | WL <sub>hic</sub> | 100.16 mAOD |

6.5 Culvert Profile



7.0 Summary

|   | Complies | Fails | Comment |
|---|----------|-------|---------|
| Culvert Inlet Soffit Elevation > Headwater Elevation for Inlet Cd | X        |       |         |
| Adequate Freeboard provided to water level?                       | X        |       |         |

Therefore proposed culvert dimensions: 1 nr Diameter 0.90 m

| By | Checked | Revision | Date       |
|----|---------|----------|------------|
| DH | KS      | Original | 22/10/2024 |
|    |         |          |            |
|    |         |          |            |