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# **DREENACREENIG WEST WIND FARM LIMITED**

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## **DERREENACRINNIG WEST WIND FARM CO. CORK**

### **MANAGEMENT PLAN 5 SURFACE WATER MANAGEMENT PLAN**

**JULY 2025**

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Wind Farm Limited**  
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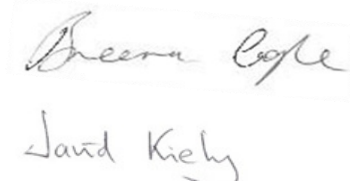


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**DOCUMENT APPROVAL**

<b>PROJECT</b>	Derreenacrinnig West Wind Farm	
<b>CLIENT / JOB NO</b>	Dreenacreenig West Wind Farm Limited	4636
<b>DOCUMENT TITLE</b>	Construction Environmental Management Plan (CEMP) Surface Water Quality Management Plan (SWQMP)	

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**DERREENCRINNIG WEST WIND FARM**  
**SURFACE WATER QUALITY MANAGEMENT PLAN**

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## **APPENDICES**

**Appendix 1: Water Monitoring Locations Map**

**Appendix 2: Water Sample Log Sheet**

**Appendix 3: Rainfall Data**

**Appendix 4: Greenfield Runoff Rate Estimation**

**Appendix 5: Derreenacrinnig West WF Suds Drainage Design**

# 1 SURFACE WATER QUALITY MANAGEMENT PLAN

## 1.1 Introduction

Field monitoring of water quality parameters and collection of samples will be undertaken by a suitably qualified Environmental Consultant. All samples will be analysed by an accredited laboratory.

Water samples will be taken from six locations in the vicinity of the wind farm, along with field measurements.

Please refer to **Figure 1** Water Sampling Points in **Appendix 1**. Details of the sample locations are outlined in **Table 1.1**.

**Table 1.1 Sample Location Details**

Sample ID	Location	Easting	Northing
DW1	West of site	111,950	51,798
DW2	South of site	111,648	51,509
DW3	Southeast of site	111,159	50,992
DW4	Northeast of site	110,325	52,549
DW5	East of Site	110,358	51,837
DW6	Downstream of Castledonovan Bridge	111,395	49,370

In addition to the sampling locations (DW1 to DW6) listed in **Table 1.1**, the water quality at the outfalls from on-site settlement ponds will be monitored.

Monitoring of water quality will also be carried out along the Grid Connection route. As these works will be constantly moving, there will be a reliance on field inspections and measurement of field parameters. The Ecological Clerk of Works will identify suitable sampling locations along the route as the works advance.

## 1.2 Sampling Methodology

Prior to collecting each water samples, the following information will be recorded;

- 1) site observations including weather conditions
- 2) sampling equipment used
- 3) quality control, decontamination procedures and order of sampling
- 4) water level changes (affect flow direction and gradients)

- 5) potential contaminants (to determine analytical parameters and type of sampling equipment)
- 6) Health & Safety
- 7) Access Issues
- 8) Visual observations of water quality (colour, clarity, turbidity, sheen, etc)

Surface water samples by nature are in contact with the atmosphere and should be taken by a sampling container located on an extendable pole that contains the sampling container. The benefit of using the actual laboratory supplied container on the extendable pole rather than filling from the same container is to prevent potential cross contamination and sorption of contaminants. The sample should be taken from mid-stream and mid-depth, if possible.

In-situ pH, temperature, conductivity, DO and turbidity measurements should be made using instruments calibrated before use. While laboratory measurements are generally more accurate, the values of some of these parameters could change during transport to the laboratory and stability may require to be verified. Samples should be kept cool and laboratory analysis commenced within 24 hours. Please see **Appendix 2: Water Sample Log Sheet** of this report which should be completed when collecting samples.

### 1.3 Laboratory Analysis

Laboratory analysis of water samples will be undertaken as part of the monitoring programme by an independent and appropriately certified laboratory.

All samples will be transported as quickly as practical to the laboratory (or contract laboratory) in a vehicle that, as a minimum, meets the following advice:

- (a) it is clean and has adequate storage facilities for empty sample containers and for containers filled with samples;
- (b) it has provision for keeping samples cool and for cooling samples, when necessary;
- (c) it is not used for any purpose that might cause contamination of samples; and its interior and cool boxes/refrigerators are regularly cleaned and maintained.

Analysis should take place within 24 hours, or as recommended in the ISO standard. However, if no significant changes are likely, samples can be analysed within 7 days.

Coordination of the laboratory sampling and analytical programme will be undertaken by site manager. The Environmental Consultant will be responsible for field collection of the

samples required for laboratory analysis. Samples will be dispatched for analysis under chain of custody procedures. Laboratory analytical results will be sent to the Environmental Consultant and Contractor.

Interpretation and reporting of both the field and laboratory data will be the responsibility of the Environmental Consultant.

#### **1.4 Aquatic Ecology Monitoring**

Aquatic ecological receptors can provide useful indicators of impacts on water quality. Therefore, along with hydrochemistry monitoring, the results of any surveys on these receptors will be incorporated into the interpretation and assessment of impacts on water quality whenever new survey data becomes available.

The aquatic ecology sampling will follow EPA guidance on undertaking aquatic ecology sampling and therefore sampling will only be undertaken within riffle sections of the watercourses.

The aquatic ecology water quality survey will be based on the Biotic Index or Q-value system as outlined by the EPA (McGarrigle, 2002). The EPA Q-Value system is a listed criteria for calculating surface water ecological status as outlined in Schedule 5 of the Surface Water Regulations 2009 (SI No. 272 of 2009). A five minute kick sample will be undertaken at each of the sample locations using a kick-net (mesh size: 1mm). The sample will then be transferred to a plastic sorting tray at the sampling site. Sample processing will be undertaken within 24 hours of sampling. The sample will then be sieved using a 500µm sieve to remove mud while stones and other organic detritus (such as leaves, wood fragments etc.). Invertebrates clinging to stones and leaves will be washed into a white sorting tray along with the sieved sample. Macroinvertebrates will be identified to the level required by the EPA Q-rating system using both low and high powered microscopes where necessary. Based on the relative abundance of indicator taxa a biotic index (Q-value) will be determined for each of the sample locations. This survey will be undertaken by an appropriately qualified specialist.

#### **1.5 Hydrochemistry Monitoring**

As a minimum, the monitoring programme will include:

- Weekly monitoring of temperature, pH, turbidity, DO, conductivity and total suspended solids at the outlet of each of the settlement ponds associated with the wind farm

footprint. Monitoring frequency will be increased during / following heavy rainfall events.

- Weekly monitoring of suspended solids, pH, turbidity and conductivity at the stream locations where construction is on-going in the catchment and monthly monitoring for all other parameters listed below.
- Additional monitoring will be undertaken when rainfall exceeds 25mm in one hour.
- The receiving waters along the Grid Connection route will be monitored. Monitoring locations will move as the works advance. The Ecological Clerk of Works will identify suitable sampling locations along the route as the works advance. Weekly monitoring will be conducted but increase during period of heavy rainfall.
- Post construction monitoring programme will include weekly monitoring of suspended solids, pH, turbidity and conductivity for a period of 1 month after completion of construction. Monthly monitoring of all parameters will be undertaken for a 6-month period after completion of construction.

Monitoring frequency will be specified and agreed with Inland Fisheries Ireland and Cork County Council prior to commencement of construction.

Analytical determinants (including limits of detection and frequency of analysis) will be specified and agreed with Inland Fisheries Ireland for each sample location. The expected suite of determinants will include:

1. Nitrate, mg/l, N
2. Nitrite, mg/l, N
3. Total Ammonia, mg/l, N
4. Unionised ammonia, mg/l, N
5. Ortho-phosphate, mg/l, P
6. Biochemical Oxygen Demand. Mg/l, O<sub>2</sub>
7. Total Suspended Solids (TSS), mg/l
8. Turbidity, NTU

Sampling locations, DW1 to DW6, as listed in **Table 1.1** and shown on **Figure 1**.

Temperature, pH, turbidity, DO and conductivity will also be recorded when sampling.

The settlement ponds will be monitored for temperature, pH, turbidity, DO, conductivity and total suspended solids. Monitoring will be conducted during and following rainfall events when treated water will be discharging from the ponds.

The receiving waters along the Grid Connection route will be monitored for temperature, pH, turbidity, DO, conductivity and total suspended solids.

## **2 REPORTING**

### **2.1 Water Quality Reporting**

Results of water quality monitoring shall assist in determining requirements for improvements in drainage and pollution prevention measures implemented on site.

It will be the responsibility of the Environmental Consultant to present the ongoing results of water quality and weather monitoring at regular site meetings. This shall be done monthly. Reports on water quality will consider all field monitoring and results of laboratory analysis completed that period. Reports will describe how the results compare with baseline data as well as previous reports on water quality. The reports will also describe whether any deterioration or improvement in water quality has been observed, whether any effects are attributable to construction activities and what remedial measures or corrective actions have been implemented. Reports will be sent to Inland Fisheries Ireland on a monthly basis.

### **2.2 Final Report on Water Quality**

Upon completion of all monitoring (including both hydrochemistry monitoring and aquatic ecology surveys etc), the Environmental Consultant will prepare a final report on water quality. This final report will cover the overall performance against baseline data, details on any impacts attributed to construction works and recommendations for remedial works if required.

This report will be issued to the Inland Fisheries Ireland and the environmental department of Cork County Council.

### 3 ENVIRONMENTAL CONSTRAINTS AND MITIGATION MEASURES

There are a number of construction phase mitigation measures that must be adhered to during the installation of the drainage system. The relevant EIA Chapters where mitigation measures can be found are shown in **Table 3.1**.

**Table 3.1 Location of relevant mitigation measures**

Element	Location of Mitigation Measures
Biodiversity	EIA Chapter 6
Land and Soils	EIA Chapter 7
Hydrology and Geology	EIA Chapter 8

### 4 DRAINAGE SYSTEM OVERVIEW

#### 4.1 SuDS Drainage Design

The design criteria for the SuDS design are as follows:

- To select and install ecologically sensitive drainage.
- To minimise alterations to the ambient Site hydrology and hydrogeology.
- To provide settlement and treatment controls as close to the Site footprint as possible and to replicate where possible the existing hydrological environment of the Site.
- To minimise sediment loads resulting from the development run-off during the construction phase.
- To preserve Greenfield runoff rates and volumes.
- To provide settlement ponds to encourage sedimentation and storm water runoff settlement.
- To reduce stormwater runoff velocities throughout the Site to prevent scouring and encourage settlement of sediment locally.
- To manage the problems of erosion and allow for the effective revegetation of bare surfaces.
- To control water within the Site and allow for the discharge of runoff from the Site within the limits prescribed in the Salmonid Regulations.

#### 4.2 SuDS Design Principles

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

- Additional drainage measures will only be added as necessary. The dimensions of these features will avoid intercepting large volumes of water. Any changes to the

SWMP must be agreed with the EM and the ECoW.

- Surface water runoff from the proposed Site access tracks will be managed with crossfall downslope to mimic the natural drainage patterns of the Site.
- Drainage vegetation used will be appropriate to the local area and will be approved by the ECoW.
- Temporary erosion protection together with silt fences may be required until the vegetation becomes established (coir matting or similar).
- Roads will be constructed from aggregate and will not be surfaced with bitumen materials, thus allowing for permeation and helping to reduce runoff volumes. Therefore, a reduced runoff coefficient of 65% is applicable. (for a completely impermeable surface, the coefficient will be 100%).
- An additional 20% will be included to take account for climate change.
- Stormwater runoff within the trackside drainage will be treated through the provision of check dams, within a range depending on local slope of the drain.
- Discharging directly back into the surrounding area will assist in maintaining the hydrological characteristics of the Site.
- Vegetation will be reinstated on slopes as early as possible.
- Under track drainage will be provided with drainage pipes at existing surface water features. The under-track drainage will provide a means for flows to pass and maintain the natural flow throughout the Site.
- A sump may be required for trench dewaterings. Water will subsequently be pumped into settlement ponds and allowed to settle. The general location of the small sump will ensure that they pose minimal health and safety risk to Site personnel.
- The settlement ponds will be designed to cater for infilling and rehabilitation post construction phase of the project.
- The level of silt runoff during construction will be monitored and if found to be excessive in any area, will subsequently be managed by the provision of additional silt attenuation features such as silt fences or silt traps. If the suspended solids levels remain high, water can be pumped from settlement ponds into tankers and transferred off Site to a suitable water treatment facility subject to agreement with the Local Authority. Note that works will be temporarily suspended in the area of the Site contributing to elevated suspended solids levels.
- Field drains will be piped directly under the track through appropriately sized drainage pipes.
- Appropriate Site management measures will be taken to ensure that runoff from the construction Site is not contaminated by fuel or lubricant spillages.

- There will be no discharge of trade effluent, sewage effluent or contaminated drainage into any surface water feature.

### 4.3 Purpose of a SuDs Drainage Design

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

The purpose of incorporating a SuDS design is:

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

### 4.4 Design Philosophy

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

Minimise → Intercept → Treat → Disperse → Dilute

#### 4.4.1 *Minimise*

The main principle of this SuDS design is to minimise the volume of ‘dirty’ water requiring treatment through means of informed, integrated and sustainable drainage design. It achieves this by keeping ‘clean’ water clean by interception and separation, and by collecting the ‘dirty’ water and treating it by removing the suspended sediments. The resultant outflow is dispersed across vegetation and will become diluted through contact with the clean water runoff in the buffer areas before entering Site/ roadside drains.

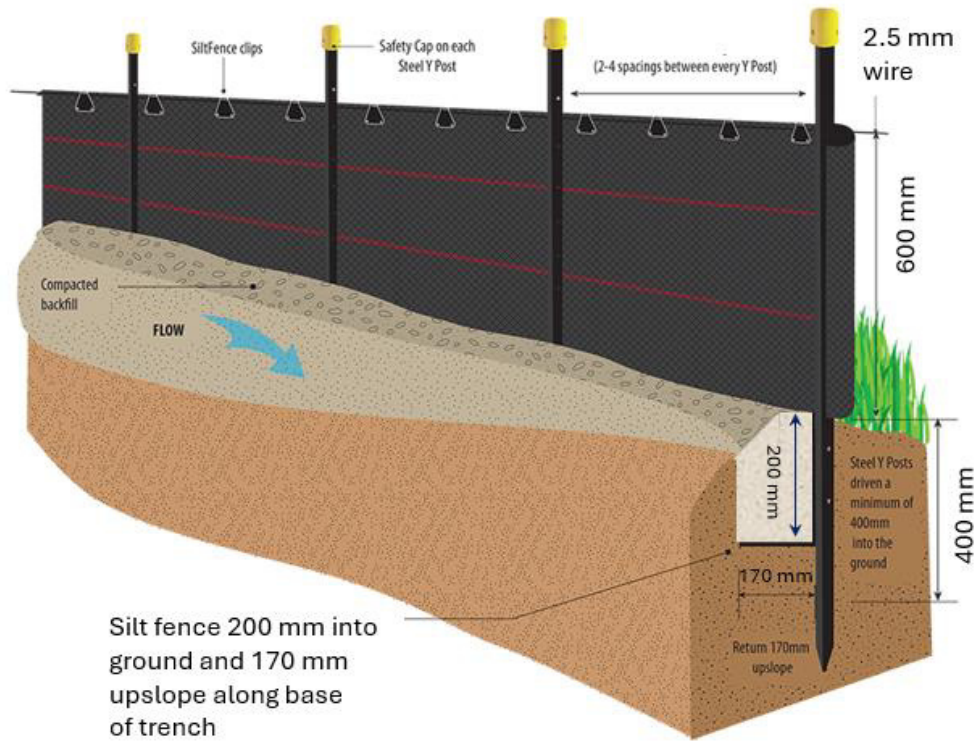


Figure 4.1: Diagram of silt fence <sup>2</sup>

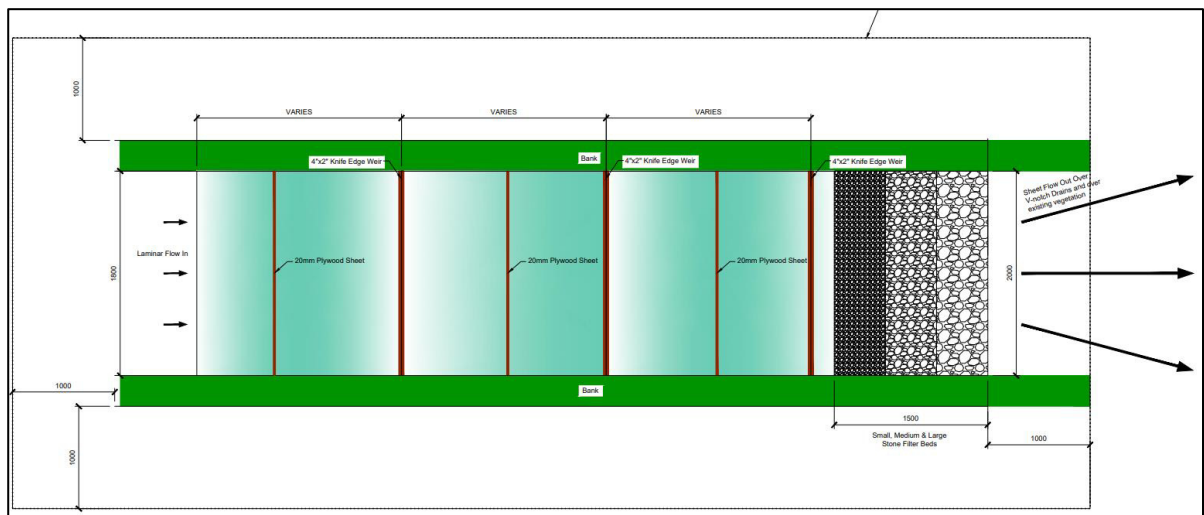


Figure 4.2: Diagram of settlement ponds outlet where outflow is dispersed across vegetated areas

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

### 4.4.2 Intercept

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

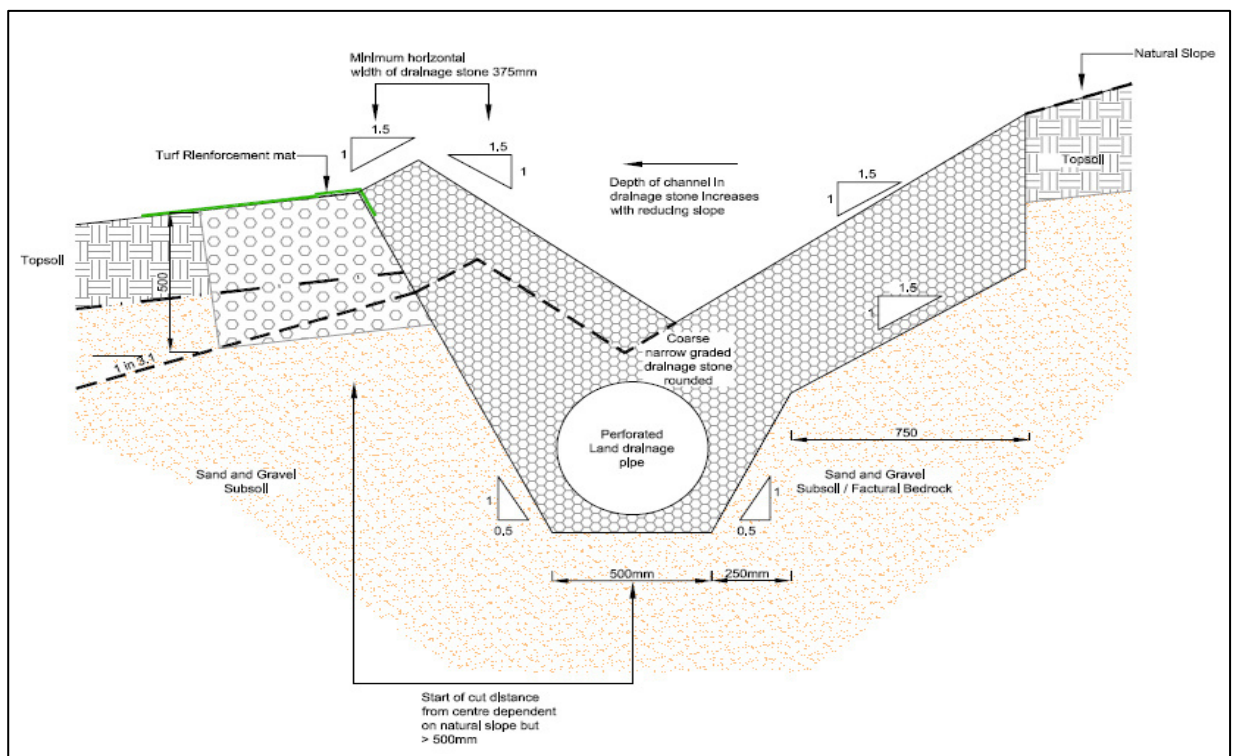


Figure 4.3: Diagrammatic cross section of Interception Infiltration

### 4.4.3 Treat, Disperse and Dilute

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

In the drawings, 'dirty water' drains, indicated in orange, collect all incident rainwater that falls on the Proposed Development infrastructure. These then drain to buffered outfalls or into settlement ponds. The treated effluent from the settlement ponds is then dispersed across vegetation (through buffered outfalls) to further filter the discharge. Dispersal in this manner has the effect of allowing the smaller particle sizes to be taken up by the vegetation.

## **5 DETAILED DESIGN CONSIDERATIONS**

### **5.1 Overview**

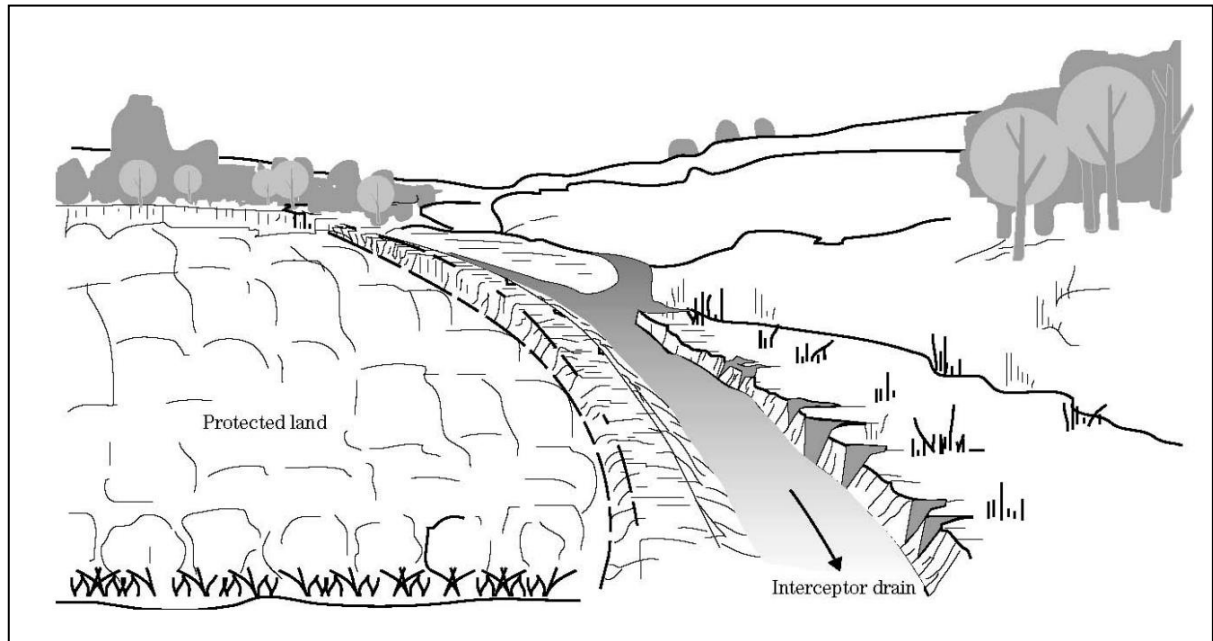
This SuDS adopts a design for the drainage of the Site. The following elements in series are proposed:

- Open constructed drains for Development run-off collection and treatment;
- Collection drains for upslope "clean" water collection and dispersion;
- Filtration check dams to reduce velocities along sections of road which run perpendicular to contours;
- Settlement ponds and buffered outfalls to control and store Development runoff to encourage settlement prior to discharge at Greenfield runoff rates.

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

### **5.2 Cut-off Ditches / Collector Drains (Clean Water)**

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



**Figure 5.1: Diagram showing interceptor drain (Source: NJWMG, 2007) <sup>1</sup>**

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

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

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

The drains will be max 350mm – 500mm in depth.

<sup>1</sup> New Jersey Water Management Guide, 2007. Online: [https://www.nrcs.usda.gov/Internet/FSE\\_DOCUMENTS/nrcs141p2\\_017651.pdf](https://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs141p2_017651.pdf) [Accessed 15/02/2022]

### 5.3 Buffered Outfalls

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

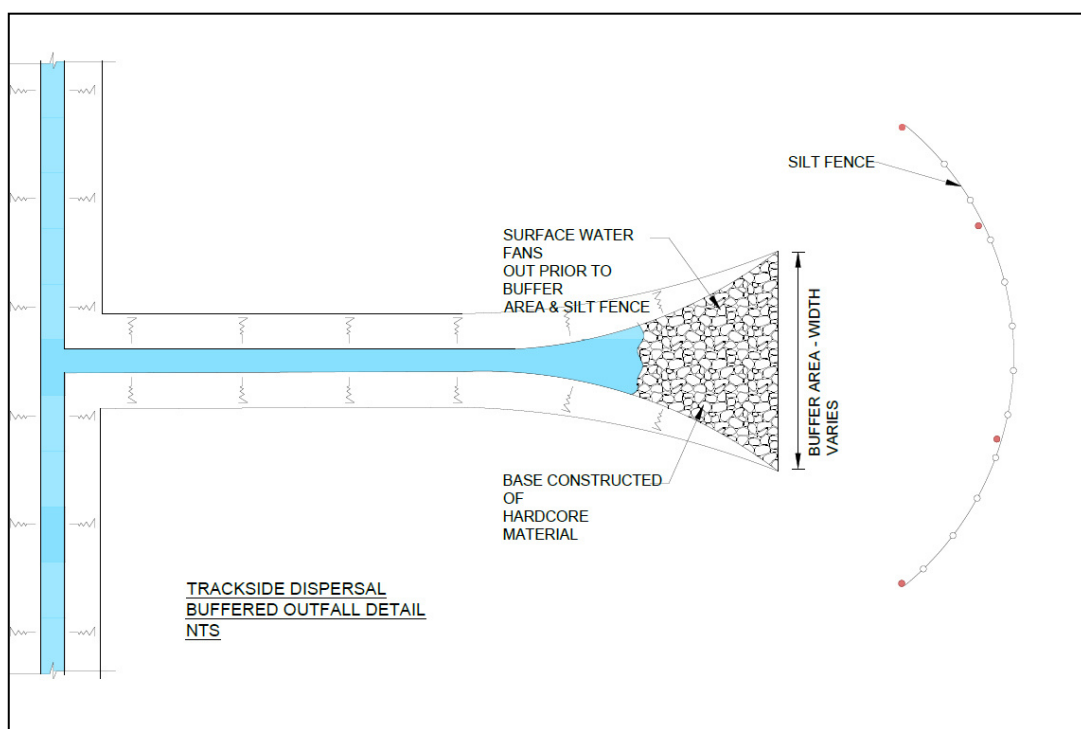
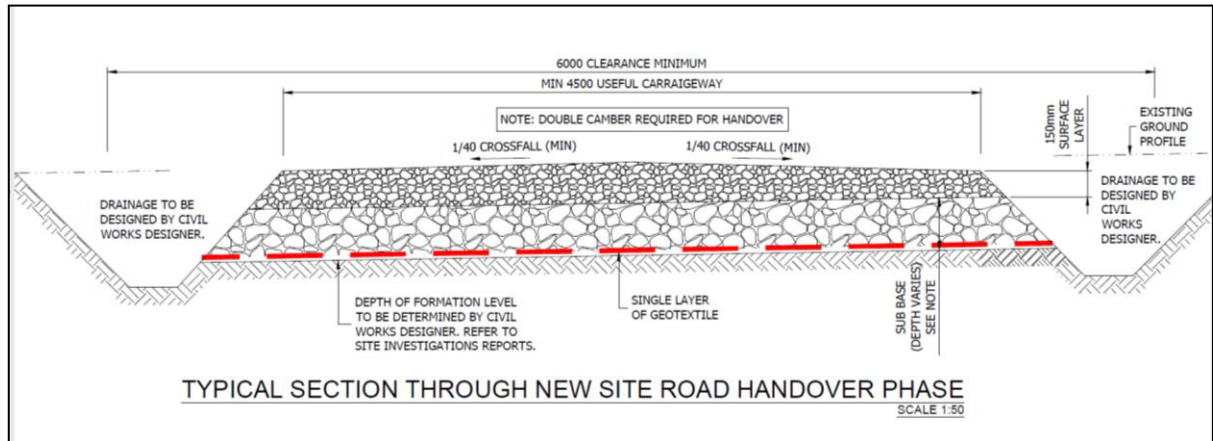


Figure 5.2: Diagram of Buffered Outfall

### 5.4 Trackside Drains (Dirty Water)

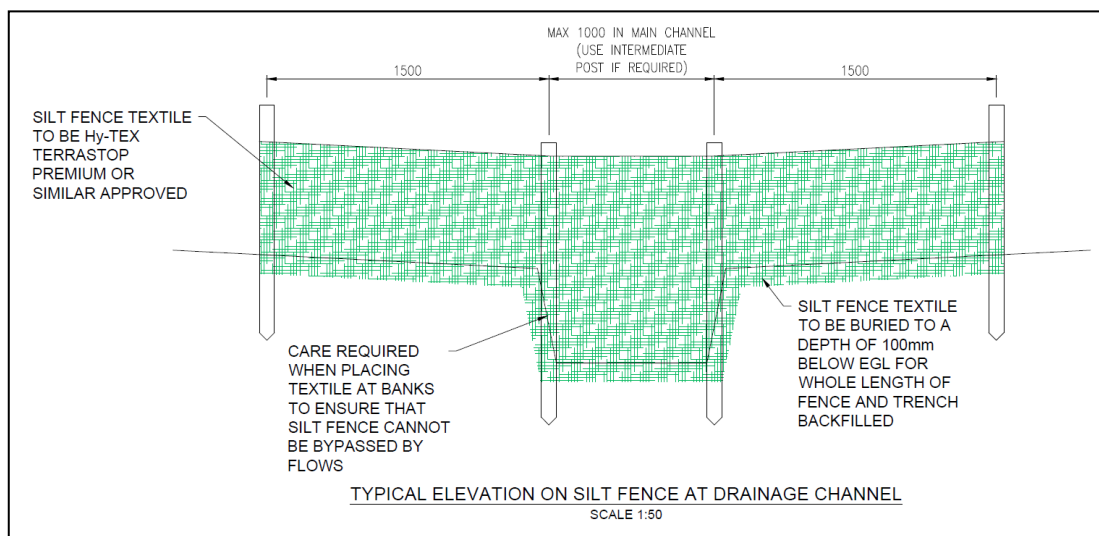
These are open gently sloping drainage channels to convey dirty water, trap sediment, enhance filtration and slow down the rate and magnitude of runoff that could enter the local watercourses. The drains will be max 350mm – 500mm in depth and the turve will be taken as a single piece and placed on the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



**Figure 5.3: Site Access Track Section**

**5.5 Silt Fences**

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



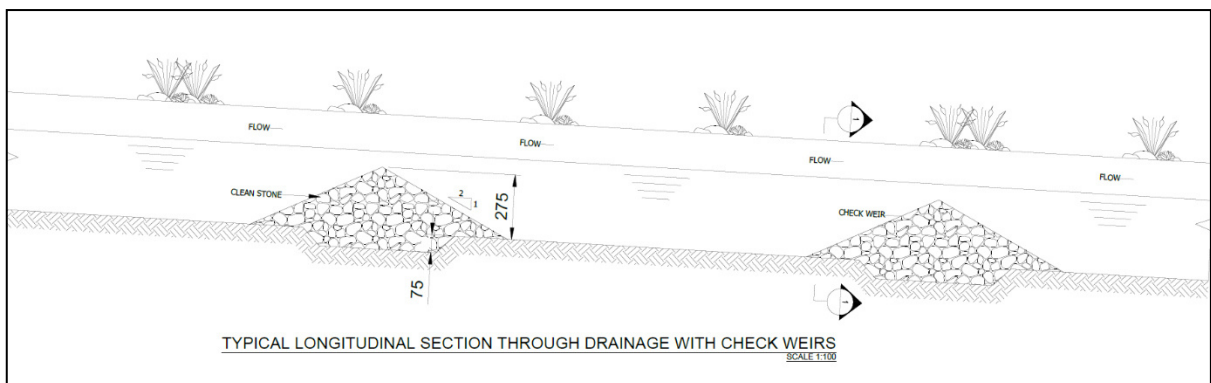
**Figure 5.4: Illustration of Silt Fencing**



**Plate 5.1: Photograph of Silt Fencing**

**5.6 Filtration Check Dams**

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



**Figure 5.5: Diagram Showing the Function of Check Dams**

Settlement build up will be monitored and cleaned during the construction stage when necessary. The number and location of check dams will be dependent on the slope, flow

and volume of water, although the following general rules will be applied:

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

#### Worked examples:

The depth of a check dam is 0.3m high:  $0.3\text{m} \times (1 \text{ in } 100 \text{ gradient}) = 30\text{m}$  spacing;

For a 0.3m high check dam:  $0.3\text{m} \times (1 \text{ in } 50 \text{ gradient}) = 15\text{m}$  spacing.

For a 0.5m high check dam:  $0.5\text{m} \times (1 \text{ in } 50 \text{ gradient}) = 25\text{m}$  spacing.

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

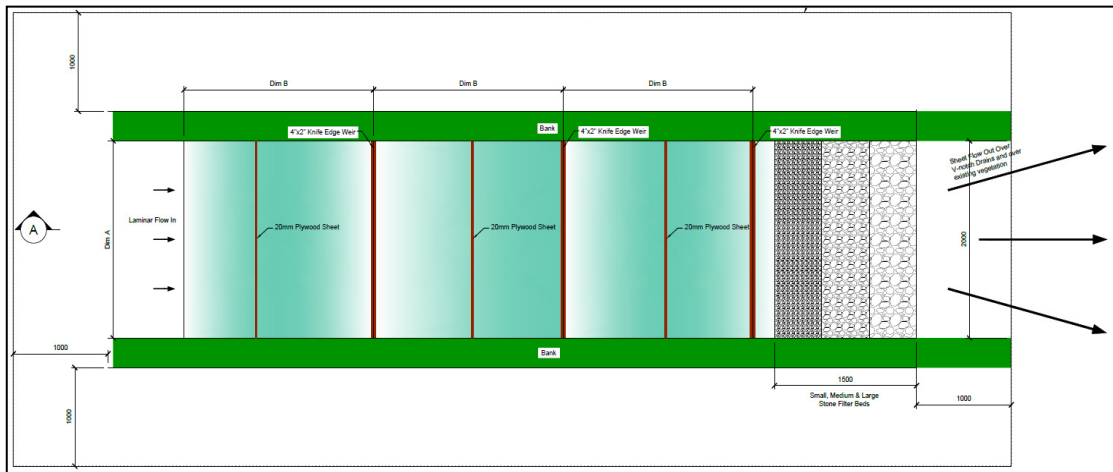
**Table 5.1 Check Dam Spacing**

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

## 5.7 Settlement Ponds

Runoff from the wind farm track surface will be attenuated to mimic natural runoff patterns. To capture runoff generated within the Development footprint, it is proposed to use constructed trackside drains. Accumulations of runoff will then be transferred to settlement ponds. See **Figure 5.6** below and detail drawings (Planning Drawing No. 4636-PL-200)

which displays a diagrammatic cross section through a settlement pond within the drainage regime. All ponds will be kept as shallow as possible so that they pose no health and safety risk to plant or personnel. Settlement ponds are to be securely fenced to prevent easy access.



**Figure 5.6: Plan View of Settlement Ponds (with Discharge to Drains where Applicable)**



**Plate 5.2: Completed Settlement Pond System**

The ponds are utilised to attenuate and to aid the removal of suspended solids from Site runoff water. All the pond locations are displayed within the site drainage drawings. Settlement ponds will be emplaced at eight (8) locations along the drainage footprint.

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

- A 1 in 200 year rainfall return over 15 minutes design has been used for the settlement ponds<sup>2</sup> (Source: Met Éireann - Please refer to **Appendix 3**).
- An initial outlet overflow rate is applied of 27.3 l/s/ha (litres per second) which approximates to greenfield run-off rates for the Site. (Source: HR Wallingford – Please refer to **Appendix 4**).
- The rational method is subsequently applied to calculate the flow volumes into each settlement pond over these respective periods.
- A, is the area of the hardstanding / catchment. I, is the rainfall depth and t, is the duration of rainfall occurrence.
- A runoff coefficient of 0.6 (20% for Climate Change, 50% for runoff) is conservatively applied to all footprint areas. These areas are only used during the construction of turbine bases and delivery of turbine components. Therefore, their porosity will not be impacted during the construction or operation of the Proposed Development.
- A runoff coefficient of 0.78 (20% for Climate Change, 65% for runoff) is conservatively applied to the footprint areas excluding hardstands. As these areas will be used more frequently, they are more likely to become more compacted and clogged with dirt and their porosity to reduce.

**Table 5.2** identifies settlement ponds designed to treat and attenuate each Development catchment area. The details in **Table 5.2** are based on calculations found in **Appendix 5**.

**Tables 5.2: Settlement Pond Sizing**

Pond Ref.	Total Catchment Area (m <sup>2</sup> )	Catchment Area				Residual Volume (m <sup>3</sup> )	Width (m)	Height (m)	Required Length (m)	Optimised Length
		A Hardstand (m <sup>2</sup> )	A excl Hardstand (m <sup>2</sup> )	A Hardstand (km <sup>2</sup> )	A excl Hardstand (km <sup>2</sup> )					
SP1	2,415	970	1,445	0.0010	0.0014	46.3	3.00	1.0	15.4	16
SP1A	1,200	0	1,200	0.0000	0.0012	26.3	3.00	1.0	8.8	9
SP2	365	0	365	0.0000	0.0004	8.0	3.00	1.0	8.0	9
SP3	2,935	0	2,935	0.0000	0.0029	64.4	3.00	1.0	21.5	21
SP4	3,125	970	2,155	0.0010	0.0022	61.9	3.00	1.0	20.6	21
SP5	1,800	0	1,800	0.0000	0.0018	39.5	3.00	1.0	13.2	15
SP6	1,350	0	1,350	0.0000	0.0014	29.6	3.00	1.0	9.9	12
SP7	2,720	970	1,750	0.0010	0.0018	53.0	3.00	1.0	17.7	18
SP8	1,760	0	1,760	0.0000	0.0018	24.9	3.00	1.0	8.3	9

<sup>2</sup> The drainage system will be designed for a 1 in 100 year 6 hour return period with the settlement ponds being designed for a 1 in 200 year 30 minute rainfall event.

## **6 MAINTENANCE AND MONITORING**

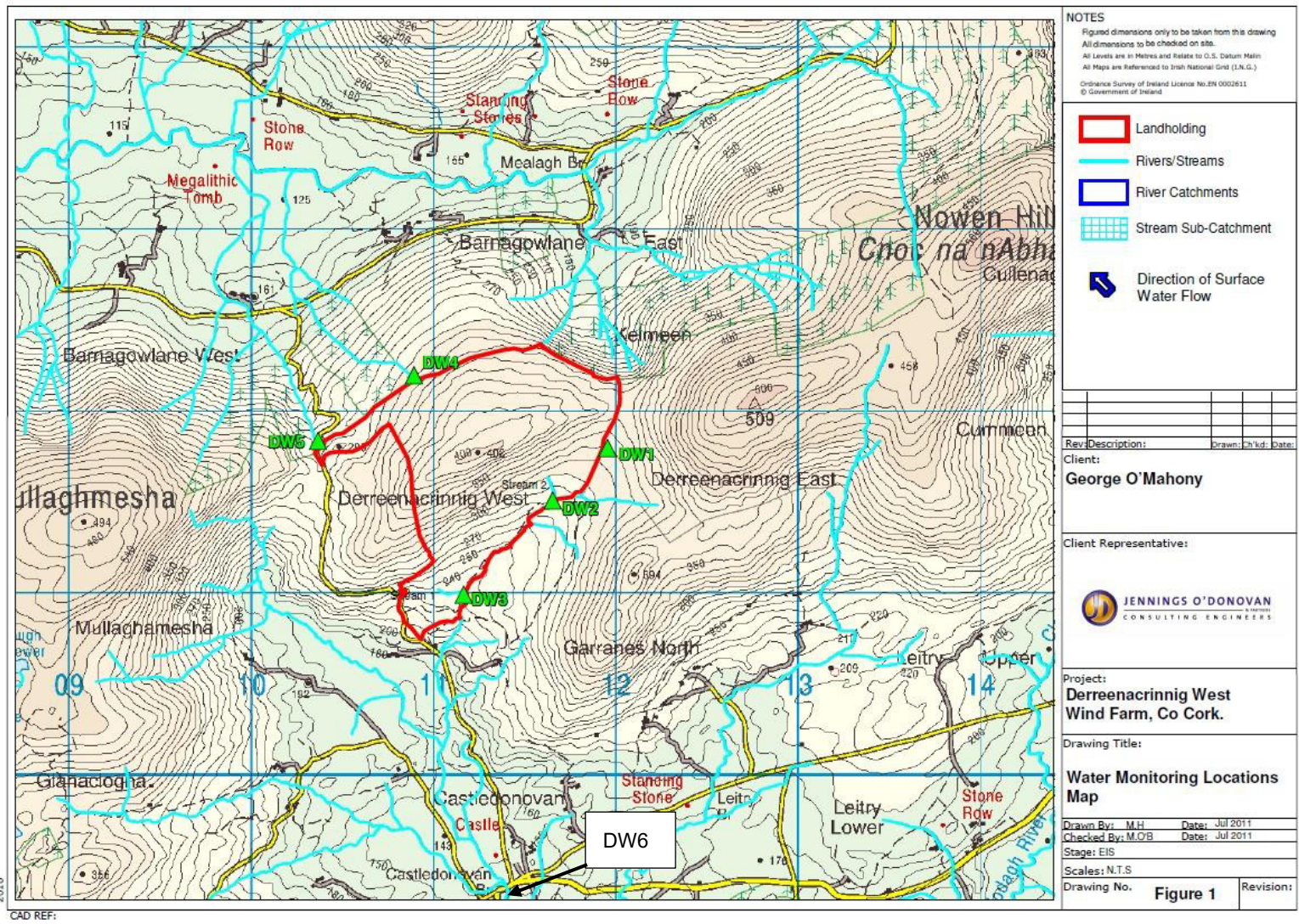
Surface water runoff control infrastructure will be checked and maintained on a regular basis and settlement ponds and check dams will be maintained (desludged/settle solids removed) on a regular basis, particularly during the construction phase of the Development. It is important to minimise the agitation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

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

## **7 POST CONSTRUCTION DRAINAGE MANAGEMENT**

Following the completion of construction, a full review of construction stage drainage will be undertaken by the appointed contractor (in conjunction with the EM and the ECoW) with a view to removing drainage infrastructure that is no longer required during the Development's operation phase.

# APPENDIX 1



## APPENDIX 2

### Water Sample Log Sheet – Sample ID

Date of sample:

Name of sampler:

Full details of sampling point and its location:

Sample identification:

Time of Sampling:

General observations:

#### Results of Field Measurements:

Location ID	Conductivity (µs/cm)	pH	Dissolved Oxygen mg/l	Temp °C	DO (mg/l or %)	Turbidity (NTU)

Photographic Record:

Conductivity: µ S/cm  
 pH value: pH units  
 Temperature: °C  
 DO: mg/l or %  
 Turbidity: NTU  
 Others:

#### Details of samples taken

Sample Number	Bottle Types	Bottle Volume	Preservation Details	Comments
DW1				

Observations:

Signature of sampler:

Sample received in the laboratory at (time and date):

By:

From:

## **APPENDIX 3: RAINFALL DATA**

Met Eireann  
Return Period Rainfall Depths for sliding Durations  
Irish Grid: Easting: 102956, Northing: 226655,

DURATION	Interval		Years													
	6months,	1year,	2,	3,	4,	5,	10,	20,	30,	50,	75,	100,	150,	200,	250,	500,
5 mins	3.2,	4.3,	4.8,	5.7,	6.2,	6.7,	8.0,	9.6,	10.5,	11.9,	13.1,	14.0,	15.4,	16.5,	17.4,	N/A ,
10 mins	4.4,	5.9,	6.7,	7.9,	8.7,	9.3,	11.2,	13.3,	14.7,	16.6,	18.3,	19.5,	21.5,	23.0,	24.2,	N/A ,
15 mins	5.2,	7.0,	7.9,	9.3,	10.2,	10.9,	13.2,	15.7,	17.3,	19.5,	21.5,	23.0,	25.3,	27.0,	28.5,	N/A ,
30 mins	6.9,	9.1,	10.3,	12.0,	13.1,	14.0,	16.7,	19.7,	21.7,	24.3,	26.6,	28.4,	31.1,	33.2,	34.8,	N/A ,
1 hours	9.1,	11.9,	13.3,	15.4,	16.8,	17.9,	21.2,	24.8,	27.1,	30.3,	33.0,	35.1,	38.3,	40.7,	42.7,	N/A ,
2 hours	12.0,	15.5,	17.3,	19.9,	21.5,	22.8,	26.9,	31.2,	34.0,	37.7,	41.0,	43.4,	47.1,	49.9,	52.2,	N/A ,
3 hours	14.1,	18.1,	20.1,	23.0,	24.9,	26.4,	30.9,	35.7,	38.7,	42.9,	46.5,	49.2,	53.2,	56.3,	58.8,	N/A ,
4 hours	15.8,	20.2,	22.4,	25.6,	27.6,	29.2,	34.0,	39.2,	42.5,	47.0,	50.8,	53.7,	58.0,	61.3,	64.0,	N/A ,
6 hours	18.6,	23.6,	26.1,	29.7,	31.9,	33.7,	39.1,	44.9,	48.5,	53.4,	57.6,	60.8,	65.5,	69.1,	72.0,	N/A ,
9 hours	21.9,	27.6,	30.4,	34.4,	36.9,	38.9,	44.9,	51.3,	55.3,	60.7,	65.3,	68.8,	74.0,	77.9,	81.1,	N/A ,
12 hours	24.6,	30.8,	33.9,	38.2,	41.0,	43.1,	49.6,	56.4,	60.7,	66.5,	71.4,	75.1,	80.7,	84.8,	88.2,	N/A ,
18 hours	29.0,	36.0,	39.4,	44.3,	47.4,	49.7,	56.9,	64.5,	69.3,	75.6,	81.0,	85.1,	91.1,	95.6,	99.3,	N/A ,
24 hours	32.6,	40.2,	43.9,	49.2,	52.5,	55.0,	62.8,	71.0,	76.0,	82.8,	88.6,	92.9,	99.3,	104.1,	108.0,	121.0,
2 days	41.5,	50.0,	54.1,	59.8,	63.4,	66.1,	74.4,	82.9,	88.1,	95.0,	100.9,	105.2,	111.6,	116.4,	120.3,	133.0,
3 days	49.4,	58.8,	63.2,	69.4,	73.2,	76.1,	84.8,	93.8,	99.2,	106.5,	112.5,	117.0,	123.6,	128.5,	132.4,	145.3,
4 days	56.8,	66.8,	71.6,	78.2,	82.3,	85.3,	94.5,	103.9,	109.6,	117.1,	123.4,	128.0,	134.8,	139.8,	143.8,	157.0,
6 days	70.5,	81.9,	87.2,	94.5,	99.0,	102.3,	112.4,	122.5,	128.7,	136.7,	143.4,	148.3,	155.5,	160.8,	165.0,	178.8,
8 days	83.5,	95.9,	101.7,	109.7,	114.6,	118.2,	129.0,	139.8,	146.4,	154.9,	161.9,	167.1,	174.7,	180.2,	184.6,	199.0,
10 days	95.9,	109.4,	115.7,	124.1,	129.4,	133.2,	144.7,	156.2,	163.1,	172.1,	179.5,	184.9,	192.8,	198.5,	203.1,	218.1,
12 days	108.1,	122.5,	129.1,	138.1,	143.7,	147.8,	159.9,	172.0,	179.2,	188.5,	196.3,	201.9,	210.1,	216.1,	220.8,	236.3,
16 days	131.7,	147.8,	155.2,	165.2,	171.3,	175.8,	189.0,	202.1,	209.9,	220.0,	228.3,	234.3,	243.0,	249.4,	254.5,	270.8,
20 days	154.9,	172.5,	180.5,	191.3,	197.9,	202.8,	217.0,	231.0,	239.3,	250.0,	258.8,	265.2,	274.4,	281.2,	286.5,	303.6,
25 days	183.5,	202.8,	211.6,	223.3,	230.4,	235.6,	251.0,	266.0,	274.9,	286.3,	295.6,	302.4,	312.2,	319.3,	324.9,	342.9,

NOTES:

N/A Data not available

These values are derived from a Depth Duration Frequency (DDF) Model

For details refer to:

'Fitzgerald D. L. (2007), Estimates of Point Rainfall Frequencies, Technical Note No. 61, Met Eireann, Dublin',

Available for download at [www.met.ie/climate/dataproducts/Estimation-of-Point-Rainfall-Frequencies\\_TN61.pdf](http://www.met.ie/climate/dataproducts/Estimation-of-Point-Rainfall-Frequencies_TN61.pdf)

## **APPENDIX 4: GREENFIELD RUNOFF RATE ESTIMATION**

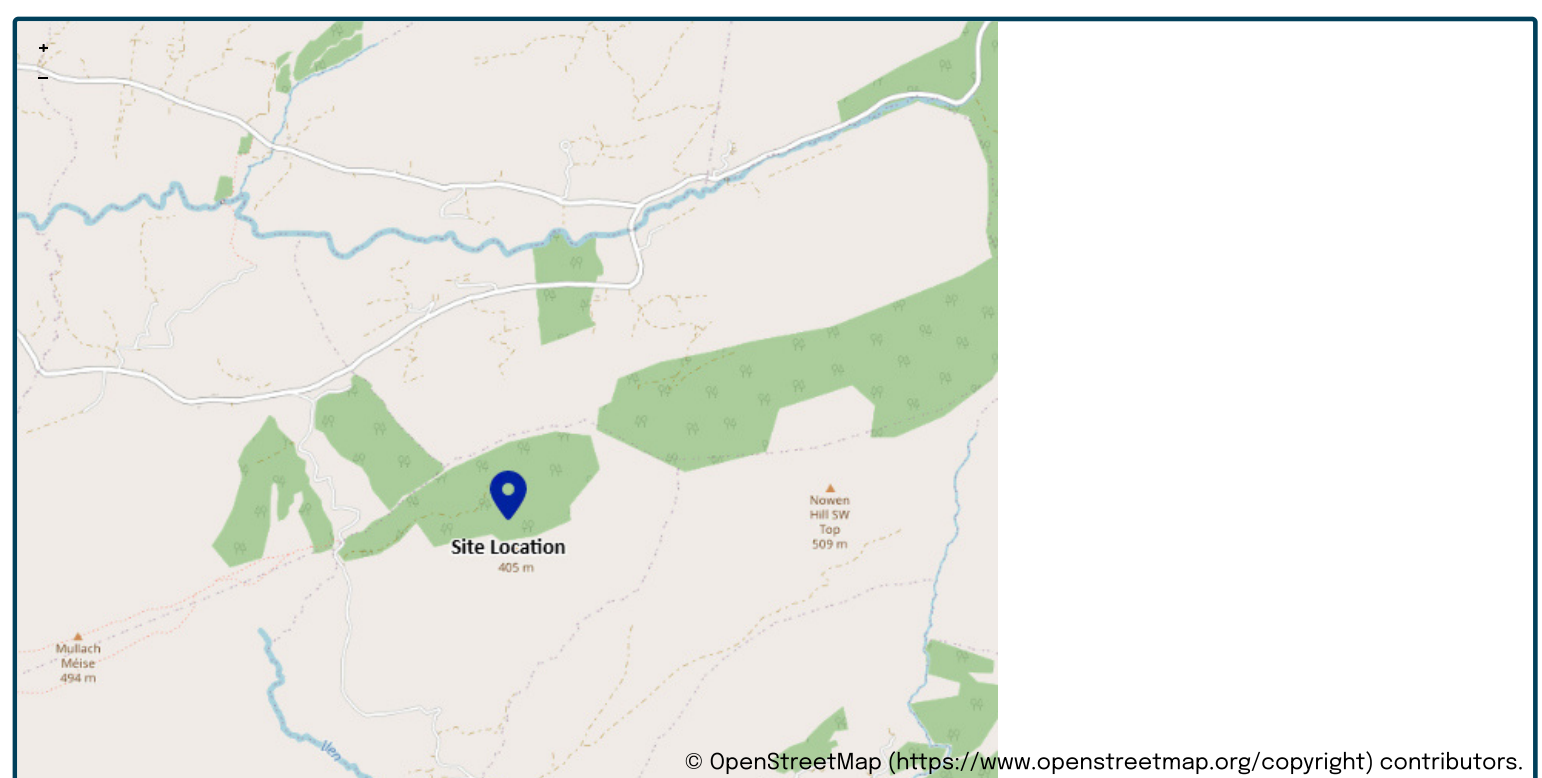
This is an estimation of the greenfield runoff rates that are used to meet normal best practice criteria in line with Environment Agency guidance “Rainfall runoff management for developments”, SC030219 (2013), the SuDS Manual C753 (CIRIA, 2015) and the non-statutory standards for SuDS (Defra, 2015).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

## Project details

Date	<input type="text" value="04/07/2025"/>
Calculated by	<input type="text" value="Liam Boyle"/>
Reference	<input type="text" value="4636 Dreenacreenig WF"/>
Model version	<input type="text" value="2.0.1"/>

## Location

Site name	<input type="text" value="4636 Dreenacreenig WF"/>
Site location	<input type="text" value="County Cork"/>



Site easting	<input type="text" value="-102961"/>
Site northing	<input type="text" value="226675"/>

## Site details

Total site area (ha)	<input type="text" value="1"/>	ha
----------------------	--------------------------------	----

# Greenfield runoff

## Method

Method

## IH124

SAAR (mm)	<input type="text" value="1601"/> mm	<input type="radio"/>	<input type="text" value="1601"/>
How should SPR be derived?	<input type="text" value="WRAP soil type"/>		
WRAP soil type	<input type="text" value="4"/>	<input type="radio"/>	<input type="text" value="5"/>
SPR	<input type="text" value="0.47"/>		
QBar (IH124) (l/s)	<input type="text" value="12.7"/> l/s		

## Growth curve factors

Hydrological region	<input type="text" value="13"/>	<input type="radio"/>	<input type="text" value="13"/>
1 year growth factor	<input type="text" value="0.85"/>		
2 year growth factor	<input type="text" value="0.95"/>		
10 year growth factor	<input type="text" value="1.4"/>		
30 year growth factor	<input type="text" value="1.65"/>		
100 year growth factor	<input type="text" value="1.95"/>		
200 year growth factor	<input type="text" value="2.15"/>		

## Results

Method	<input type="text" value="IH124"/>	
Flow rate 1 year (l/s)	<input type="text" value="10.8"/> l/s	
Flow rate 2 year (l/s)	<input type="text" value="12.1"/> l/s	
Flow rate 10 years (l/s)	<input type="text" value="17.8"/> l/s	
Flow rate 30 years (l/s)	<input type="text" value="21"/> l/s	
Flow rate 100 years (l/s)	<input type="text" value="24.8"/> l/s	
Flow rate 200 years (l/s)	<input type="text" value="27.3"/> l/s	

### Disclaimer

This report was produced using the Greenfield runoff rate estimation tool (2.0.1) developed by HR Wallingford and available at [uksuds.com](https://www.uksuds.com/) (<https://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 [uksuds.com/terms-conditions](https://www.uksuds.com/terms-conditions) (<https://www.uksuds.com/terms-conditions>). The outputs from this tool have been used to estimate 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, Centre for Ecology and Hydrology, Wallingford Hydrosolutions or any other organisation for the use of these data in the design or operational characteristics of any drainage scheme.

**APPENDIX 5:**  
**DERREENACRINNIG WEST WF SUDS DRAINAGE DESIGN**

## Draft Wind Farm Derreenacrinnig SuDS Drainage Design

	Catchment Area						Residual Volume (m3)	Width (m)	Height (m)	Required Length (m)	Optimised Length
	Ref	Total Catchment A (m <sup>2</sup> )	A Hardstand (m <sup>2</sup> )	A excl Hardstand (m <sup>2</sup> )	A Hardstand (km <sup>2</sup> )	A excl Hardstand (km <sup>2</sup> )					
AT01 and Access Track	SP1	2415	970	1445	0.0010	0.0014	46.3	3.00	1.0	15.4	16
Access Track	SP1A	1200	0	1200	0.0000	0.0012	26.3	3.00	1.0	8.8	9
Turning Head	SP2	365	0	365	0.0000	0.0004	8.0	1.00	1.0	8.0	9
Acc Rd	SP3	2935	0	2935	0.0000	0.0029	64.4	3.00	1.0	21.5	21
AT02 and Access Track	SP4	3125	970	2155	0.0010	0.0022	61.9	3.00	1.0	20.6	21
Acc Rd	SP5	1800	0	1800	0.0000	0.0018	39.5	3.00	1.0	13.2	15
Acc Rd	SP6	1350	0	1350	0.0000	0.0014	29.6	3.00	1.0	9.9	12
AT03 and Access Track	SP7	2720	970	1750	0.0010	0.0018	53.0	3.00	1.0	17.7	18
Access Track	SP8	1760	0	1760	0.0000	0.0018	24.9	3.00	1.0	8.3	9

Catchment												
Catchment			SP1	Area Excl Hardstand				water discharge rate (l/s/ha)				
Clean water natural flow									27.30	l/s/ha		
1 in 200 year return	minutes	Rainfall (mm)	Q	C	i (mm/hr)	A (km <sup>2</sup> )	(m <sup>3</sup> /s)	Volume (m <sup>3</sup> )	Discharge (m <sup>3</sup> /ha)	Discharge (m <sup>3</sup> )	Residual Volume (m <sup>3</sup> )	
5min	5	16.5	0.278	0.78	198	0.00145	0.062	18.6	8.2	1.2	17.4	
10min	10	23	0.278	0.78	138	0.00145	0.043	25.9	16.4	2.4	23.6	
15min	15	27	0.278	0.78	108	0.00145	0.034	30.5	24.6	3.6	26.9	
30min	30	33.2	0.278	0.78	66.4	0.00145	0.021	37.4	49.1	7.1	30.3	
M200 60min	60	40.7	0.278	0.78	40.7	0.00145	0.013	45.9	98.3	14.2	31.7	
M200 2hr	120	49.9	0.278	0.78	24.95	0.00145	0.008	56.3	196.6	28.4	27.9	
M200 4hr	240	61.3	0.278	0.78	15.325	0.00145	0.005	69.1	393.1	56.8	12.3	

M200 6hr	300	69.1	0.278	0.78	13.82	0.00145	0.004	93.5	589.7	85.2	8.3
M200 12hr	600	84.8	0.278	0.78	8.48	0.00145	0.003	114.8	1179.4	170.4	-55.6
M200 24hr	1200	104.1	0.278	0.78	5.205	0.00145	0.002	140.9	2358.7	340.8	-199.9
M200 48hr	2400	116.4	0.278	0.78	2.91	0.00145	0.001	157.6	4717.4	681.7	-524.1

Catchment			SP1	Hardstand				water discharge rate (l/s)						
Clean water natural flow												27.30	l/s/ha	
1 in 200 year return	minutes	Rainfall (mm)		C	i (mm/hr)	A (km <sup>2</sup> )	(m <sup>3</sup> /s)	Volume (m <sup>3</sup> )	Discharge (m <sup>3</sup> /ha)	Discharge (m <sup>3</sup> )	Residual Volume (m <sup>3</sup> )			
M200 5min	5	16.5	0.278	0.6	198	0.00097	0.032	9.6	8.2	0.8	8.8			
M200 10min	10	23	0.278	0.6	138	0.00097	0.022	13.4	16.4	1.6	11.8			
M200 15min	15	27	0.278	0.6	108	0.00097	0.017	15.7	24.6	2.4	13.3			
M200 30min	30	33.2	0.278	0.6	66.4	0.00097	0.011	19.3	49.1	4.8	14.6			
M200 60min	60	40.7	0.278	0.6	40.7	0.00097	0.007	23.7	98.3	9.5	14.2			
M200 2hr	120	49.9	0.278	0.6	24.95	0.00097	0.004	29.1	196.6	19.1	10.0			
M200 4hr	240	61.3	0.278	0.6	15.325	0.00097	0.002	35.7	393.1	38.1	-2.4			
M200 6hr	300	69.1	0.278	0.6	13.82	0.00097	0.002	48.3	589.7	57.2	-8.9			
M200 12hr	600	84.8	0.278	0.6	8.48	0.00097	0.001	59.3	1179.4	114.4	-55.1			
M200 24hr	1200	104.1	0.278	0.6	5.205	0.00097	0.001	72.8	2358.7	228.8	-156.0			
M200 48hr	2400	116.4	0.278	0.6	2.91	0.00097	0.000	81.4	4717.4	457.6	-376.2			

Catchment			SP2	Area Excl Hardstand				water discharge rate (l/s/ha)						
Clean water natural flow												27.30	l/s/ha	
1 in 200 year return	minutes	Rainfall (mm)	Q	C	i (mm/hr)	A (km <sup>2</sup> )	(m <sup>3</sup> /s)	Volume (m <sup>3</sup> )	Discharge (m <sup>3</sup> /ha)	Discharge (m <sup>3</sup> )	Residual Volume (m <sup>3</sup> )			
5min	5	16.5	0.278	0.78	198	0.00037	0.016	4.7	8.2	0.3	4.4			
10min	10	23	0.278	0.78	138	0.00037	0.011	6.6	16.4	0.6	6.0			
15min	15	27	0.278	0.78	108	0.00037	0.009	7.7	24.6	0.9	6.8			

30min	30	33.2	0.278	0.78	66.4	0.00037	0.005	9.5	49.1	1.8	7.7
M200 60min	60	40.7	0.278	0.78	40.7	0.00037	0.003	11.6	98.3	3.6	8.0
M200 2hr	120	49.9	0.278	0.78	24.95	0.00037	0.002	14.2	196.6	7.2	7.0
M200 4hr	240	61.3	0.278	0.78	15.325	0.00037	0.001	17.5	393.1	14.3	3.1
M200 6hr	300	69.1	0.278	0.78	13.82	0.00037	0.001	23.6	589.7	21.5	2.1
M200 12hr	600	84.8	0.278	0.78	8.48	0.00037	0.001	29.0	1179.4	43.0	-14.1
M200 24hr	1200	104.1	0.278	0.78	5.205	0.00037	0.000	35.6	2358.7	86.1	-50.5
M200 48hr	2400	116.4	0.278	0.78	2.91	0.00037	0.000	39.8	4717.4	172.2	-132.4

Catchment		SP3		Area Excl Hardstand		water discharge rate (l/s/ha)					
Clean water natural flow									27.30	l/s/ha	
1 in 200 year return	minutes	Rainfall (mm)	Q	C	i (mm/hr)	A (km <sup>2</sup> )	(m <sup>3</sup> /s)	Volume (m <sup>3</sup> )	Discharge (m <sup>3</sup> /ha)	Discharge (m <sup>3</sup> )	Residual Volume (m <sup>3</sup> )
5min	5	16.5	0.278	0.78	198	0.00294	0.126	37.8	8.2	2.4	35.4
10min	10	23	0.278	0.78	138	0.00294	0.088	52.7	16.4	4.8	47.9
15min	15	27	0.278	0.78	108	0.00294	0.069	61.9	24.6	7.2	54.6
30min	30	33.2	0.278	0.78	66.4	0.00294	0.042	76.1	49.1	14.4	61.6
M200 60min	60	40.7	0.278	0.78	40.7	0.00294	0.026	93.2	98.3	28.8	64.4
M200 2hr	120	49.9	0.278	0.78	24.95	0.00294	0.016	114.3	196.6	57.7	56.6
M200 4hr	240	61.3	0.278	0.78	15.325	0.00294	0.010	140.4	393.1	115.4	25.1
M200 6hr	300	69.1	0.278	0.78	13.82	0.00294	0.009	190.0	589.7	173.1	16.9
M200 12hr	600	84.8	0.278	0.78	8.48	0.00294	0.005	233.1	1179.4	346.1	-113.0
M200 24hr	1200	104.1	0.278	0.78	5.205	0.00294	0.003	286.2	2358.7	692.3	-406.1
M200 48hr	2400	116.4	0.278	0.78	2.91	0.00294	0.002	320.0	4717.4	1384.6	-1064.5

Catchment		SP4		Area Excl Hardstand		water discharge rate (l/s/ha)					
Clean water natural flow									27.30	l/s/ha	
1 in 200 year return	minutes	Rainfall (mm)	Q	C	i (mm/hr)	A (km <sup>2</sup> )	(m <sup>3</sup> /s)	Volume (m <sup>3</sup> )	Discharge (m <sup>3</sup> /ha)	Discharge (m <sup>3</sup> )	Residual Volume (m <sup>3</sup> )

5min	5	16.5	0.278	0.78	198	0.00216	0.093	27.8	8.2	1.8	26.0
10min	10	23	0.278	0.78	138	0.00216	0.064	38.7	16.4	3.5	35.2
15min	15	27	0.278	0.78	108	0.00216	0.050	45.4	24.6	5.3	40.1
30min	30	33.2	0.278	0.78	66.4	0.00216	0.031	55.9	49.1	10.6	45.3
M200 60min	60	40.7	0.278	0.78	40.7	0.00216	0.019	68.5	98.3	21.2	47.3
M200 2hr	120	49.9	0.278	0.78	24.95	0.00216	0.012	83.9	196.6	42.4	41.6
M200 4hr	240	61.3	0.278	0.78	15.325	0.00216	0.007	103.1	393.1	84.7	18.4
M200 6hr	300	69.1	0.278	0.78	13.82	0.00216	0.006	139.5	589.7	127.1	12.4
M200 12hr	600	84.8	0.278	0.78	8.48	0.00216	0.004	171.2	1179.4	254.2	-83.0
M200 24hr	1200	104.1	0.278	0.78	5.205	0.00216	0.002	210.1	2358.7	508.3	-298.2
M200 48hr	2400	116.4	0.278	0.78	2.91	0.00216	0.001	235.0	4717.4	1016.6	-781.6

Catchment			SP4 Hardstand				water discharge rate (l/s)					
Clean water natural flow							27.30	l/s/ha				
1 in 200 year return	minutes	Rainfall (mm)		C	i (mm/hr)	A (km <sup>2</sup> )	(m <sup>3</sup> /s)	Volume (m <sup>3</sup> )	Discharge (m <sup>3</sup> /ha)	Discharge (m <sup>3</sup> )	Residual Volume (m <sup>3</sup> )	
M200 5min	5	16.5	0.278	0.6	198	0.00097	0.032	9.6	8.2	0.8	8.8	
M200 10min	10	23	0.278	0.6	138	0.00097	0.022	13.4	16.4	1.6	11.8	
M200 15min	15	27	0.278	0.6	108	0.00097	0.017	15.7	24.6	2.4	13.3	
M200 30min	30	33.2	0.278	0.6	66.4	0.00097	0.011	19.3	49.1	4.8	14.6	
M200 60min	60	40.7	0.278	0.6	40.7	0.00097	0.007	23.7	98.3	9.5	14.2	
M200 2hr	120	49.9	0.278	0.6	24.95	0.00097	0.004	29.1	196.6	19.1	10.0	
M200 4hr	240	61.3	0.278	0.6	15.325	0.00097	0.002	35.7	393.1	38.1	-2.4	
M200 6hr	300	69.1	0.278	0.6	13.82	0.00097	0.002	48.3	589.7	57.2	-8.9	
M200 12hr	600	84.8	0.278	0.6	8.48	0.00097	0.001	59.3	1179.4	114.4	-55.1	
M200 24hr	1200	104.1	0.278	0.6	5.205	0.00097	0.001	72.8	2358.7	228.8	-156.0	
M200 48hr	2400	116.4	0.278	0.6	2.91	0.00097	0.000	81.4	4717.4	457.6	-376.2	

Catchment			SP5 Area Excl Hardstand				water discharge rate (l/s/ha)				
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Clean water natural flow									27.30	l/s/ha		
1 in 200 year return	minutes	Rainfall (mm)	Q	C	i (mm/hr)	A (km <sup>2</sup> )	(m <sup>3</sup> /s)	Volume (m <sup>3</sup> )	Discharge (m <sup>3</sup> /ha)	Discharge (m <sup>3</sup> )	Residual Volume (m <sup>3</sup> )	
5min	5	16.5	0.278	0.78	198	0.00180	0.077	23.2	8.2	1.5	21.7	
10min	10	23	0.278	0.78	138	0.00180	0.054	32.3	16.4	2.9	29.4	
15min	15	27	0.278	0.78	108	0.00180	0.042	37.9	24.6	4.4	33.5	
30min	30	33.2	0.278	0.78	66.4	0.00180	0.026	46.7	49.1	8.8	37.8	
M200 60min	60	40.7	0.278	0.78	40.7	0.00180	0.016	57.2	98.3	17.7	39.5	
M200 2hr	120	49.9	0.278	0.78	24.95	0.00180	0.010	70.1	196.6	35.4	34.7	
M200 4hr	240	61.3	0.278	0.78	15.325	0.00180	0.006	86.1	393.1	70.8	15.4	
M200 6hr	300	69.1	0.278	0.78	13.82	0.00180	0.005	116.5	589.7	106.1	10.4	
M200 12hr	600	84.8	0.278	0.78	8.48	0.00180	0.003	143.0	1179.4	212.3	-69.3	
M200 24hr	1200	104.1	0.278	0.78	5.205	0.00180	0.002	175.5	2358.7	424.6	-249.0	
M200 48hr	2400	116.4	0.278	0.78	2.91	0.00180	0.001	196.3	4717.4	849.1	-652.9	



<b>Catchment</b>	<b>SP6</b>	Area Excl Hardstand	water discharge rate (l/s/ha)
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Clean water natural flow									27.30	l/s/ha		
1 in 200 year return	minutes	Rainfall (mm)	Q	C	i (mm/hr)	A (km <sup>2</sup> )	(m <sup>3</sup> /s)	Volume (m <sup>3</sup> )	Discharge (m <sup>3</sup> /ha)	Discharge (m <sup>3</sup> )	Residual Volume (m <sup>3</sup> )	
5min	5	16.5	0.278	0.78	198	0.00135	0.058	17.4	8.2	1.1	16.3	
10min	10	23	0.278	0.78	138	0.00135	0.040	24.2	16.4	2.2	22.0	
15min	15	27	0.278	0.78	108	0.00135	0.032	28.5	24.6	3.3	25.1	
30min	30	33.2	0.278	0.78	66.4	0.00135	0.019	35.0	49.1	6.6	28.4	
M200 60min	60	40.7	0.278	0.78	40.7	0.00135	0.012	42.9	98.3	13.3	29.6	
M200 2hr	120	49.9	0.278	0.78	24.95	0.00135	0.007	52.6	196.6	26.5	26.1	
M200 4hr	240	61.3	0.278	0.78	15.325	0.00135	0.004	64.6	393.1	53.1	11.5	
M200 6hr	300	69.1	0.278	0.78	13.82	0.00135	0.004	87.4	589.7	79.6	7.8	
M200 12hr	600	84.8	0.278	0.78	8.48	0.00135	0.002	107.2	1179.4	159.2	-52.0	
M200 24hr	1200	104.1	0.278	0.78	5.205	0.00135	0.002	131.6	2358.7	318.4	-186.8	

M200 48hr	2400	116.4	0.278	0.78	2.91	0.00135	0.001	147.2	4717.4	636.9	-489.7
<b>Catchment</b>			<b>SP7</b> Area Excl Hardstand				water discharge rate (l/s/ha)				
Clean water natural flow									27.30	l/s/ha	
1 in 200 year return	minutes	Rainfall (mm)	Q	C	i (mm/hr)	A (km <sup>2</sup> )	(m <sup>3</sup> /s)	Volume (m <sup>3</sup> )	Discharge (m <sup>3</sup> /ha)	Discharge (m <sup>3</sup> )	Residual Volume (m <sup>3</sup> )
5min	5	16.5	0.278	0.78	198	0.00175	0.075	22.5	8.2	1.4	21.1
10min	10	23	0.278	0.78	138	0.00175	0.052	31.4	16.4	2.9	28.6
15min	15	27	0.278	0.78	108	0.00175	0.041	36.9	24.6	4.3	32.6
30min	30	33.2	0.278	0.78	66.4	0.00175	0.025	45.4	49.1	8.6	36.8
M200 60min	60	40.7	0.278	0.78	40.7	0.00175	0.015	55.6	98.3	17.2	38.4
M200 2hr	120	49.9	0.278	0.78	24.95	0.00175	0.009	68.2	196.6	34.4	33.8
M200 4hr	240	61.3	0.278	0.78	15.325	0.00175	0.006	83.7	393.1	68.8	14.9
M200 6hr	300	69.1	0.278	0.78	13.82	0.00175	0.005	113.3	589.7	103.2	10.1
M200 12hr	600	84.8	0.278	0.78	8.48	0.00175	0.003	139.0	1179.4	206.4	-67.4
M200 24hr	1200	104.1	0.278	0.78	5.205	0.00175	0.002	170.7	2358.7	412.8	-242.1
M200 48hr	2400	116.4	0.278	0.78	2.91	0.00175	0.001	190.8	4717.4	825.6	-634.7

<b>Catchment</b>			<b>SP7</b> Hardstand				water discharge rate (l/s)				
Clean water natural flow									27.30	l/s/ha	
1 in 200 year return	minutes	Rainfall (mm)		C	i (mm/hr)	A (km <sup>2</sup> )	(m <sup>3</sup> /s)	Volume (m <sup>3</sup> )	Discharge (m <sup>3</sup> /ha)	Discharge (m <sup>3</sup> )	Residual Volume (m <sup>3</sup> )
M200 5min	5	16.5	0.278	0.6	198	0.00097	0.032	9.6	8.2	0.8	8.8
M200 10min	10	23	0.278	0.6	138	0.00097	0.022	13.4	16.4	1.6	11.8
M200 15min	15	27	0.278	0.6	108	0.00097	0.017	15.7	24.6	2.4	13.3
M200 30min	30	33.2	0.278	0.6	66.4	0.00097	0.011	19.3	49.1	4.8	14.6
M200 60min	60	40.7	0.278	0.6	40.7	0.00097	0.007	23.7	98.3	9.5	14.2
M200 2hr	120	49.9	0.278	0.6	24.95	0.00097	0.004	29.1	196.6	19.1	10.0

M200 4hr	240	61.3	0.278	0.6	15.325	0.00097	0.002	35.7	393.1	38.1	-2.4
M200 6hr	300	69.1	0.278	0.6	13.82	0.00097	0.002	48.3	589.7	57.2	-8.9
M200 12hr	600	84.8	0.278	0.6	8.48	0.00097	0.001	59.3	1179.4	114.4	-55.1
M200 24hr	1200	104.1	0.278	0.6	5.205	0.00097	0.001	72.8	2358.7	228.8	-156.0
M200 48hr	2400	116.4	0.278	0.6	2.91	0.00097	0.000	81.4	4717.4	457.6	-376.2

Catchment			SP8	Area Excl Hardstand		water discharge rate (l/s)						
Clean water natural flow						27.30						l/s/ha
1 in 200 year return	minutes	Rainfall (mm)		C	i (mm/hr)	A (km <sup>2</sup> )	(m <sup>3</sup> /s)	Volume (m <sup>3</sup> )	Discharge (m <sup>3</sup> /ha)	Discharge (m <sup>3</sup> )	Residual Volume (m <sup>3</sup> )	
M200 5min	5	16.5	0.278	0.78	198	0.00097	0.042	12.5	8.2	0.8	11.7	
M200 10min	10	23	0.278	0.78	138	0.00097	0.029	17.4	16.4	1.6	15.8	
M200 15min	15	27	0.278	0.78	108	0.00097	0.023	20.4	24.6	2.4	18.1	
M200 30min	30	33.2	0.278	0.78	66.4	0.00097	0.014	25.1	49.1	4.8	20.4	
M200 60min	60	40.7	0.278	0.78	40.7	0.00097	0.009	30.8	98.3	9.5	21.3	
M200 2hr	120	49.9	0.278	0.78	24.95	0.00097	0.005	37.8	196.6	19.1	18.7	
M200 4hr	240	61.3	0.278	0.78	15.325	0.00097	0.003	46.4	393.1	38.1	8.3	
M200 6hr	300	69.1	0.278	0.78	13.82	0.00097	0.003	62.8	589.7	57.2	5.6	
M200 12hr	600	84.8	0.278	0.78	8.48	0.00097	0.002	77.1	1179.4	114.4	-37.3	
M200 24hr	1200	104.1	0.278	0.78	5.205	0.00097	0.001	94.6	2358.7	228.8	-134.2	
M200 48hr	2400	116.4	0.278	0.78	2.91	0.00097	0.001	105.8	4717.4	457.6	-351.8	

Catchment			SP1A	Area Excl Hardstand		water discharge rate (l/s)						
Clean water natural flow						27.30						l/s/ha
1 in 200 year return	minutes	Rainfall (mm)		C	i (mm/hr)	A (km <sup>2</sup> )	(m <sup>3</sup> /s)	Volume (m <sup>3</sup> )	Discharge (m <sup>3</sup> /ha)	Discharge (m <sup>3</sup> )	Residual Volume (m <sup>3</sup> )	
M200 5min	5	16.5	0.278	0.78	198	0.00120	0.052	15.5	8.2	1.0	14.5	

M200 10min	10	23	0.278	0.78	138	0.00120	0.036	21.5	16.4	2.0	19.6
M200 15min	15	27	0.278	0.78	108	0.00120	0.028	25.3	24.6	2.9	22.3
M200 30min	30	33.2	0.278	0.78	66.4	0.00120	0.017	31.1	49.1	5.9	25.2
M200 60min	60	40.7	0.278	0.78	40.7	0.00120	0.011	38.1	98.3	11.8	26.3
M200 2hr	120	49.9	0.278	0.78	24.95	0.00120	0.006	46.7	196.6	23.6	23.2
M200 4hr	240	61.3	0.278	0.78	15.325	0.00120	0.004	57.4	393.1	47.2	10.2
M200 6hr	300	69.1	0.278	0.78	13.82	0.00120	0.004	77.7	589.7	70.8	6.9
M200 12hr	600	84.8	0.278	0.78	8.48	0.00120	0.002	95.3	1179.4	141.5	-46.2
M200 24hr	1200	104.1	0.278	0.78	5.205	0.00120	0.001	117.0	2358.7	283.0	-166.0
M200 48hr	2400	116.4	0.278	0.78	2.91	0.00120	0.001	130.8	4717.4	566.1	-435.2

