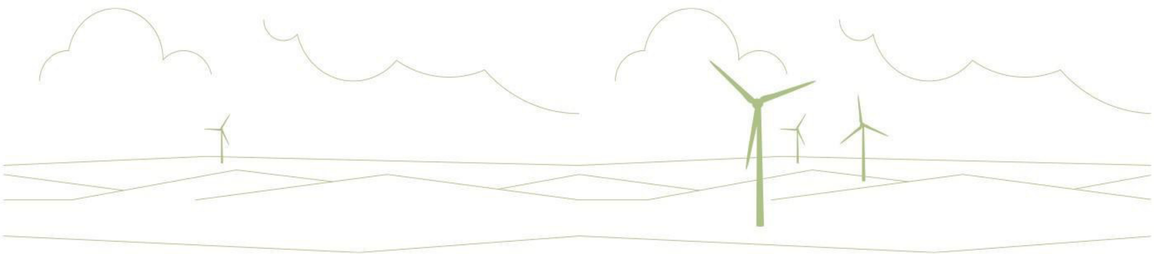
Technical Appendix 2.3: Outline Surface Water Management Plan

Table of contents



1 Introduction

1.1 Overview

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

- Ecologically Sensitive Processes
- Sustainable Drainage Systems (SuDS)

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

The SWMP aims to:

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

2 Baseline Environment

2.1 Site Description

Barnesmore Windfarm is located approximately 10 km northwest of Donegal Town. The existing turbines are sited on elevated moorland above Barnesmore Gap between the N15 and the Irish national border, the Site Boundary is wholly within the Republic of Ireland. The site elevation is between 300 m and 398 m AOD. The existing site infrastructure is bounded by the Barnesmore Bog Natural Heritage Area (NHA).

2.2 Topography

The topography at and in the immediate area surrounding the Site is highly variable with multiple peaks, ridges with variable elevations and inclines. At lower elevations the topography is relatively flat or comprising of low magnitude inclines, however at mid and high elevation relative to the Site, steep high magnitude inclines are common place, and in one particular location, south of the proposed location of T6, there is a near vertical rock face, however the infrastructure associated with the Operational Barnesmore Windfarm is positioned predominantly along ridges and on peaks, or within troughs, and where inclines are gentle, that is; steep inclines have been avoided. The Development utilises the existing infrastructure, however the proposed turbine and hardstand locations will be positioned further away from steep inclines where possible.

2.3 Hydrology and Geology

The majority of surface water runoff associated with the Site drains into Lough Golagh and directly connected streams which are central to the Site. Lough Golagh discharges into the Leaghany River, part of the Derg River sub basin, within Leghany River sub catchment, and Foyle River catchment. Surface water runoff associated with a small number of proposed turbine locations drain into Loughnaweelagh and Lough Innaghachola, which in turn discharge into Glendergen River, part of the Glendergan River sub basin, within Leghany River sub catchment, and Foyle River catchment. The surface water runoff associated with the remaining proposed turbine locations drains into Lough Namaddy and Lough Slug, which both discharge into the Lowerymore River sub basin/s, part of the Eske sub catchment, within Donegal Bay North catchment.

The surface water systems associated with Lowerymore sub basin and Eske sub catchment flow into Lough Eske, before discharging into the Eske River.

Blanket peat covers the vast majority of the Site, and significant rocky outcrops were observed across the Site. There are many minor rocky outcrops across the Site, particularly at higher elevations. Thin peat and exposed rock were observed at numerous existing cut and fill locations along the existing Site Access tracks and hardstands associated with the Operational Barnesmore Windfarm.

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
Ornithology	EIA Chapter 7
Soils and Geology	EIA Chapter 8
Hydrology and Geology	EIA Chapter 9

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 Project Hydrologist 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.
- An additional 10% 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.

- The stone used for the construction of the check dams will be washed graded stone with a size range between approximately 5mm and 40mm.
- Discharging directly back into the surrounding area will assist in maintaining the hydrological characteristics of the site.
- Vegetation will be reinstated on slopes as early as possible.
- Under track drainage will be provided with drainage pipes at existing surface water features. The under-track drainage will provide a means for flows to pass and maintain the natural flow throughout the site.
- A sump may be required for trench dewatering's. Water will subsequently be pumped into settlement ponds and allowed to settle. The general location of the small sump will ensure that they pose minimal health and safety risk to site personnel.
- The settlement ponds will be designed to cater for infilling and rehabilitation post construction phase of the project.
- The level of silt runoff during construction will be monitored and if found to be excessive in any area, will subsequently be managed by the provision of additional silt attenuation features such as silt fences or silt traps. If the suspended solids levels remain high, water can be pumped from settlement ponds into tankers and transferred off site to a suitable water treatment facility subject to agreement with the Local Authority. Note that works will be temporarily suspended in the area of the site contributing to elevated suspended solids levels.
- Field drains will be piped directly under the track through appropriately sized drainage pipes.
- Appropriate site management measures will be taken to ensure that runoff from the construction site is not contaminated by fuel or lubricant spillages.
- There will be no discharge of trade effluent, sewage effluent or contaminated drainage into any surface water feature.

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.

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.

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

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.

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

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

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

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

5.3 Buffered Outfalls

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

5.4 Trackside Drains (Dirty Water)

These are open gently sloping drainage channel 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.

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 require to be cleaned out on a regular basis, particularly after periods of heavy rainfall. Silt fences require to be inspected and maintained on a regular basis in order to ensure that silty water is not running under or round the silt fences. Silt fences can also be used to divert clean water away from the development area, minimising the volume of dirty water.

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.

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: 0.3m x (1 in 100 gradient) = 30m spacing;

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

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

See Table 5.1 for recommended 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 windfarm road surface will be attenuated to mimic natural runoff patterns. To capture runoff generated within the development footprint it is proposed to use constructed trackside drains. Accumulations of runoff will then be transferred to settlement ponds. See detail drawings (Drawing No. 5952-300-301 to 304) which displays a diagrammatic cross section through a settlement pond within the drainage regime. All ponds will be kept as shallow as possible so that they pose no health and safety risk to plant or personnel. Settlement ponds are to be securely fenced to prevent easy access.

The ponds are utilised to attenuate and to aid the removal of suspended solids from site runoff water. All the pond locations are displayed within the site drainage drawings. Settlement ponds will be emplaced at thirty two (32) locations along the drainage footprint. However, the exact positions and discharge points will be determined on site taking consideration of the local drainage conditions. Any changes to the SWMP will be agreed with the Project Hydrologist and Ecological Clerk of Works (ECoW) before drainage works commence.

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

- A 1 in 200 year rainfall return design (Source: Met Eireann - Please refer to Appendix 1).
- An initial outlet overflow rate is applied of 42.3 l/s/ha (litres per second) which approximates to Greenfield run-off rates for the site. (Source: HR Wallingford – Please refer to Appendix 2).
- 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 0.75 (10% for Climate Change, 65% for runoff) is conservatively applied to all footprint areas.

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 3.

Tables 5.2 Settlement Pond Sizing

Pond Ref.	Drawing Reference	Development Area (m^2)	Residual Volume (m^3)	Pond Dimensions			Overall Volume of Attenuation Pond (m^3)
				Dim. Length (m)	Dim. Width (m)	Dim. Height (m)	
SP1	5952-200-207	1,275	11	7.2	1.8	1	12.9
SP2	5952-200-207	1,275	11	7.2	1.8	1	9.7
SP3	5952-200-207	915	7.9	5.4	1.8	1	9.7
SP4	5952-200-207	675	5.8	5.4	1.8	1	9.7
SP5	5952-200-207	1,435	12.4	7.2	1.8	1	12.9
SP6	5952-200-207	462	4	5.4	1.8	1	9.7
SP7	5952-200-207	1,740	15	9.3	1.8	1	16.7
SP8	5952-200-205	1,595	13.8	9.3	1.8	1	16.7

Pond Ref.	Drawing Reference	Development Area (m^2)	Residual Volume (m^3)	Pond Dimensions			Overall Volume of Attenuation Pond (m^3)
				Dim. Length (m)	Dim. Width (m)	Dim. Height (m)	
SP9	5952-200-207	1,455	12.6	7.2	1.8	1	12.9
SP10	5952-200-207	970	8.4	5.4	1.8	1	9.7
SP11	5952-200-207	1,606	13.9	9.3	1.8	1	16.7
SP12	5952-200-207	580	5	5.4	1.8	1	9.7
SP13	5952-200-207	1,930	16.7	9.3	1.8	1	16.7
SP14	5952-200-207	350	3	5.4	1.8	1	9.7
SP15	5952-200-206	1,080	9.3	5.4	1.8	1	9.7
SP16	5952-200-206	1,080	9.3	5.4	1.8	1	9.7
SP17	5952-200-206	915	7.9	5.4	1.8	1	9.7
SP18	5952-200-206	1,240	10.7	7.2	1.8	1	12.9
SP19	5952-200-205	710	6.1	5.4	1.8	1	9.7
SP20	5952-200-205	1,495	12.9	7.2	1.8	1	12.9
SP21	5952-200-205	750	6.5	5.4	1.8	1	9.7
SP22	5952-200-205	1,470	12.7	7.2	1.8	1	12.9
SP23	5952-200-204	1,720	14.9	9.3	1.8	1	16.7
SP24	5952-200-204	1,125	9.7	5.4	1.8	1	9.7
SP25	5952-200-204	1,045	9	5.4	1.8	1	9.7
SP26	5952-200-204	1,145	9.9	7.2	1.8	1	12.9
SP27	5952-200-204	1,005	8.7	5.4	1.8	1	9.7
SP28	5952-200-204	1,215	10.5	7.2	1.8	1	12.9
SP29	5952-200-204	1,110	9.6	5.4	1.8	1	9.7
SP30	5952-200-204	1,110	9.6	5.4	1.8	1	9.7
SP31	5952-200-203	1,482	12.8	7.2	1.8	1	12.9
SP32	5952-200-203	1,270	11	7.2	1.8	1	12.9

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.

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

7 Post Construction Drainage Management

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

Appendix 1 – Barnesmore Rainfall Data

Met Eireann
Return Period Rainfall Depths for sliding Durations
Irish Grid: Easting: 205046, Northing: 383572,

	Interval		Years													
DURATION	6months,	1year,	2,	3,	4,	5,	10,	20,	30,	50,	75,	100,	150,	200,	250,	500,
5 mins	3.1,	3.9,	4.2,	4.8,	5.1,	5.4,	6.2,	7.1,	7.6,	8.4,	9.0,	9.5,	10.2,	10.7,	11.1,	N/A ,
10 mins	4.3,	5.4,	5.9,	6.7,	7.2,	7.5,	8.7,	9.9,	10.6,	11.7,	12.5,	13.2,	14.2,	14.9,	15.5,	N/A ,
15 mins	5.1,	6.3,	7.0,	7.9,	8.4,	8.9,	10.2,	11.6,	12.5,	13.7,	14.7,	15.5,	16.7,	17.5,	18.2,	N/A ,
30 mins	7.0,	8.8,	9.7,	10.9,	11.7,	12.3,	14.2,	16.1,	17.4,	19.0,	20.5,	21.5,	23.1,	24.3,	25.3,	N/A ,
1 hours	9.7,	12.2,	13.4,	15.1,	16.2,	17.1,	19.7,	22.4,	24.1,	26.4,	28.4,	29.9,	32.1,	33.7,	35.1,	N/A ,
2 hours	13.5,	16.9,	18.6,	21.0,	22.5,	23.7,	27.3,	31.1,	33.4,	36.7,	39.4,	41.4,	44.5,	46.8,	48.7,	N/A ,
3 hours	16.4,	20.5,	22.5,	25.4,	27.3,	28.7,	33.0,	37.6,	40.5,	44.4,	47.7,	50.2,	53.9,	56.7,	59.0,	N/A ,
4 hours	18.7,	23.5,	25.8,	29.1,	31.3,	32.9,	37.9,	43.1,	46.4,	50.9,	54.7,	57.5,	61.8,	65.0,	67.6,	N/A ,
6 hours	22.7,	28.4,	31.3,	35.3,	37.9,	39.8,	45.9,	52.3,	56.2,	61.6,	66.2,	69.7,	74.8,	78.7,	81.8,	N/A ,
9 hours	27.5,	34.4,	37.9,	42.7,	45.9,	48.2,	55.6,	63.3,	68.2,	74.7,	80.2,	84.4,	90.7,	95.4,	99.2,	N/A ,
12 hours	31.5,	39.5,	43.4,	49.0,	52.6,	55.3,	63.7,	72.5,	78.1,	85.6,	92.0,	96.7,	103.9,	109.3,	113.6,	N/A ,
18 hours	38.2,	47.8,	52.6,	59.4,	63.7,	67.0,	77.2,	87.9,	94.6,	103.7,	111.4,	117.2,	125.9,	132.4,	137.7,	N/A ,
24 hours	43.8,	54.8,	60.3,	68.0,	73.0,	76.8,	88.4,	100.7,	108.4,	118.8,	127.7,	134.3,	144.3,	151.7,	157.8,	178.1,
2 days	59.6,	72.3,	78.5,	87.1,	92.6,	96.7,	109.2,	122.1,	130.1,	140.8,	149.8,	156.5,	166.4,	173.8,	179.8,	199.5,
3 days	73.4,	87.4,	94.1,	103.4,	109.3,	113.7,	126.9,	140.5,	148.8,	159.8,	169.0,	175.9,	185.9,	193.4,	199.4,	219.1,
4 days	86.1,	101.2,	108.4,	118.3,	124.5,	129.1,	143.0,	157.1,	165.7,	177.0,	186.4,	193.4,	203.6,	211.2,	217.2,	237.1,
6 days	109.6,	126.6,	134.6,	145.4,	152.2,	157.1,	172.0,	187.0,	196.1,	207.9,	217.7,	224.9,	235.5,	243.2,	249.4,	269.5,
8 days	131.8,	150.2,	158.8,	170.4,	177.6,	182.9,	198.6,	214.3,	223.7,	236.0,	246.1,	253.5,	264.3,	272.1,	278.4,	298.8,
10 days	153.1,	172.8,	181.8,	194.1,	201.6,	207.1,	223.5,	239.8,	249.5,	262.1,	272.5,	280.0,	291.0,	299.0,	305.4,	326.0,
12 days	173.8,	194.5,	204.1,	216.8,	224.7,	230.4,	247.4,	264.1,	274.1,	286.9,	297.5,	305.2,	316.3,	324.4,	330.9,	351.6,
16 days	214.1,	236.6,	246.8,	260.4,	268.7,	274.8,	292.6,	310.1,	320.4,	333.7,	344.5,	352.4,	363.8,	372.0,	378.5,	399.5,
20 days	253.4,	277.2,	288.0,	302.3,	310.9,	317.2,	335.7,	353.6,	364.2,	377.8,	388.8,	396.8,	408.3,	416.6,	423.2,	444.2,
25 days	301.8,	326.9,	338.1,	353.0,	362.0,	368.5,	387.4,	405.8,	416.6,	430.3,	441.5,	449.5,	461.0,	469.4,	475.9,	496.9,

NOTES:
N/A Data not available
These values are derived from a Depth Duration Frequency (DDF) Model
For details refer to:
'Fitzgerald D. L. (2007), Estimates of Point Rainfall Frequencies, Technical Note No. 61, Met Eireann, Dublin',
Available for download at www.met.ie/climate/dataproducts/Estimation-of-Point-Rainfall-Frequencies_TN61.pdf

Appendix 2 – Greenfield Run-Off Rate

Greenfield runoff rate estimation for sites

www.uksuds.com | Greenfield runoff tool

Calculated by:	Andrew Ganley
Site name:	Barnesmore
Site location:	Keadew Upper

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

Site Details

Latitude:	54.69619° N
Longitude:	7.93391° W
Reference:	316199670
Date:	Dec 10 2019 14:58

Runoff estimation approach

IH124

Site characteristics

Total site area (ha):	14.4

Methodology

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

Soil characteristics

	Default	Edited
SOIL type:	5	5
HOST class:	N/A	N/A
SPR/SPRHOST:	0.53	0.53

Hydrological characteristics

	Default	Edited
SAAR (mm):	1901	1901
Hydrological region:	11	11
Growth curve factor 1 year:	0.88	0.88
Growth curve factor 30 years:	1.65	1.65
Growth curve factor 100 years:	1.96	1.96
Growth curve factor 200 years:	2.1	2.1

Notes

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

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

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

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

(3) Is SPR/SPRHOST ≤ 0.3?

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

Greenfield runoff rates

	Default	Edited
Q_{BAR} (l/s):	290.39	290.39
1 in 1 year (l/s):	255.55	255.55
1 in 30 years (l/s):	479.15	479.15
1 in 100 year (l/s):	569.17	569.17
1 in 200 years (l/s):	609.83	609.83

Appendix 3 – Settlement Pond Calculations

Barnesmore Suds Drainage Design

(C)Volumetric run-off coefficient 0.75

Catchment Area						
Ref	**A (m^2)**		**A (km^2)**	**Residual Volume (m3)**	**Dimensions Length (L X 1.8(w) X 1.0(d))m**	**Optimised length (m)**
SP1	1275		0.0013	11.0	6.12	7.2
SP2	1275		0.0013	11.0	6.12	7.2
SP3	915		0.0009	7.9	4.39	5.4
SP4	675		0.0007	5.8	3.24	5.4
SP5	1435		0.0014	12.4	6.89	7.2
SP6	462		0.0005	4.0	2.22	5.4
SP7	1740		0.0017	15.0	8.35	9.3
SP8	1595		0.0016	13.8	7.66	9.3
SP9	1455		0.0015	12.6	6.99	7.2
SP10	970		0.0010	8.4	4.66	5.4
SP11	1606		0.0016	13.9	7.71	9.3
SP12	580		0.0006	5.0	2.78	5.4
SP13	1930		0.0019	16.7	9.27	9.3
SP14	350		0.0004	3.0	1.68	5.4
SP15	1080		0.0011	9.3	5.19	5.4
SP16	1080		0.0011	9.3	5.19	5.4
SP17	915		0.0009	7.9	4.39	5.4
SP18	1240		0.0012	10.7	5.95	7.2
SP19	710		0.0007	6.1	3.41	5.4
SP20	1495		0.0015	12.9	7.18	7.2
SP21	750		0.0008	6.5	3.60	5.4
SP22	1470		0.0015	12.7	7.06	7.2
SP23	1720		0.0017	14.9	8.26	9.3
SP24	1125		0.0011	9.7	5.40	5.4
SP25	1045		0.0010	9.0	5.02	5.4
SP26	1145		0.0011	9.9	5.50	7.2
SP27	1005		0.0010	8.7	4.83	5.4
SP28	1215		0.0012	10.5	5.83	7.2
SP29	1110		0.0011	9.6	5.33	5.4
SP30	1110		0.0011	9.6	5.33	5.4
SP31	1482		0.0015	12.8	7.12	7.2
SP32	1270		0.0013	11.0	6.10	7.2

Catchment			**SP1**					water discharge rate (l/s)			
Clean water natural flow									42.3		l/s/ha
1 in 200 year return	**minutes**	**Rainfall (mm)**		**C**	**i (mm/hr)**	**A (km^2)**	**(m^3/s)**	**Volume (m^3)**	**Discharge (m^3/ha)**	**Discharge (m^3)**	**Residual Volume (m^3)**
M200 5min	5	10.7	0.278	0.75	128.4	0.00128	0.034	10.2	12.7	1.6	8.6
M200 10min	10	14.9	0.278	0.75	89.4	0.00128	0.024	14.3	25.4	3.2	11.0
M200 15min	15	17.5	0.278	0.75	70	0.00128	0.019	16.7	38.1	4.9	11.9
M200 30min	30	24.3	0.278	0.75	48.6	0.00128	0.013	23.3	76.2	9.7	13.5
M200 60min	60	33.7	0.278	0.75	33.7	0.00128	0.009	32.3	152.5	19.4	12.8
M200 2hr	120	46.8	0.278	0.75	23.4	0.00128	0.006	44.8	304.9	38.9	5.9
M200 4hr	240	65	0.278	0.75	16.25	0.00128	0.004	62.2	609.8	77.8	-15.5
M200 6hr	300	78.7	0.278	0.75	15.74	0.00128	0.004	90.4	914.7	116.6	-26.2
M200 12hr	600	109.3	0.278	0.75	10.93	0.00128	0.003	125.5	1829.5	233.3	-107.7
M200 24hr	1200	151.7	0.278	0.75	7.585	0.00128	0.002	174.2	3659.0	466.5	-292.3
M200 48hr	2400	173.8	0.278	0.75	4.345	0.00128	0.001	199.6	7318.0	933.0	-733.4

Catchment			**SP2**					water discharge rate (l/s)			
Clean water natural flow									42.3		l/s/ha
1 in 200 year return	**minutes**	**Rainfall (mm)**		**C**	**i (mm/hr)**	**A (km^2)**	**(m^3/s)**	**Volume (m^3)**	**Discharge (m^3/ha)**	**Discharge (m^3)**	**Residual Volume (m^3)**
M200 5min	5	10.7	0.278	0.75	128.4	0.00128	0.034	10.2	12.7	1.6	8.6
M200 10min	10	14.9	0.278	0.75	89.4	0.001275	0.024	14.3	25.4	3.2	11.0
M200 15min	15	17.5	0.278	0.75	70	0.00128	0.019	16.7	38.1	4.9	11.9
M200 30min	30	24.3	0.278	0.75	48.6	0.00128	0.013	23.3	76.2	9.7	13.5
M200 60min	60	33.7	0.278	0.75	33.7	0.00128	0.009	32.3	152.5	19.4	12.8
M200 2hr	120	46.8	0.278	0.75	23.4	0.00128	0.006	44.8	304.9	38.9	5.9
M200 4hr	240	65	0.278	0.75	16.25	0.00128	0.004	62.2	609.8	77.8	-15.5
M200 6hr	300	78.7	0.278	0.75	15.74	0.00128	0.004	90.4	914.7	116.6	-26.2
M200 12hr	600	109.3	0.278	0.75	10.93	0.00128	0.003	125.5	1829.5	233.3	-107.7
M200 24hr	1200	151.7	0.278	0.75	7.585	0.00128	0.002	174.2	3659.0	466.5	-292.3
M200 48hr	2400	173.8	0.278	0.75	4.345	0.00128	0.001	199.6	7318.0	933.0	-733.4

Catchment			**SP3**					water discharge rate (l/s)			
Clean water natural flow									42.3		l/s/ha
1 in 200 year return	**minutes**	**Rainfall (mm)**		**C**	**i (mm/hr)**	**A (km^2)**	**(m^3/s)**	**Volume (m^3)**	**Discharge (m^3/ha)**	**Discharge (m^3)**	**Residual Volume (m^3)**
M200 5min	5	10.7	0.278	0.75	128.4	0.00092	0.024	7.3	12.7	1.2	6.2
M200 10min	10	14.9	0.278	0.75	89.4	0.00092	0.017	10.2	25.4	2.3	7.9
M200 15min	15	17.5	0.278	0.75	70	0.00092	0.013	12.0	38.1	3.5	8.5
M200 30min	30	24.3	0.278	0.75	48.6	0.00092	0.009	16.7	76.2	7.0	9.7
M200 60min	60	33.7	0.278	0.75	33.7	0.00092	0.006	23.1	152.5	13.9	9.2
M200 2hr	120	46.8	0.278	0.75	23.4	0.00092	0.004	32.1	304.9	27.9	4.2
M200 4hr	240	65	0.278	0.75	16.25	0.00092	0.003	44.6	609.8	55.8	-11.2
M200 6hr	300	78.7	0.278	0.75	15.74	0.00092	0.003	64.9	914.7	83.7	-18.8
M200 12hr	600	109.3	0.278	0.75	10.93	0.00092	0.002	90.1	1829.5	167.4	-77.3
M200 24hr	1200	151.7	0.278	0.75	7.585	0.00092	0.001	125.0	3659.0	334.8	-209.8
M200 48hr	2400	173.8	0.278	0.75	4.345	0.00092	0.001	143.2	7318.0	669.6	-526.4

Catchment			**SP4**					water discharge rate (l/s)			
Clean water natural flow									42.3		l/s/ha
1 in 200 year return	**minutes**	**Rainfall (mm)**		**C**	**i (mm/hr)**	**A (km^2)**	**(m^3/s)**	**Volume (m^3)**	**Discharge (m^3/ha)**	**Discharge (m^3)**	**Residual Volume (m^3)**
M200 5min	5	10.7	0.278	0.75	128.4	0.00068	0.018	5.4	12.7	0.9	4.6
M200 10min	10	14.9	0.278	0.75	89.4	0.00068	0.013	7.5	25.4	1.7	5.8
M200 15min	15	17.5	0.278	0.75	70	0.00068	0.010	8.9	38.1	2.6	6.3
M200 30min	30	24.3	0.278	0.75	48.6	0.00068	0.007	12.3	76.2	5.1	7.2
M200 60min	60	33.7	0.278	0.75	33.7	0.00068	0.005	17.1	152.5	10.3	6.8
M200 2hr	120	46.8	0.278	0.75	23.4	0.00068	0.003	23.7	304.9	20.6	3.1
M200 4hr	240	65	0.278	0.75	16.25	0.00068	0.002	32.9	609.8	41.2	-8.2
M200 6hr	300	78.7	0.278	0.75	15.74	0.00068	0.002	47.8	914.7	61.7	-13.9
M200 12hr	600	109.3	0.278	0.75	10.93	0.00068	0.002	66.5	1829.5	123.5	-57.0
M200 24hr	1200	151.7	0.278	0.75	7.585	0.00068	0.001	92.2	3659.0	247.0	-154.7
M200 48hr	2400	173.8	0.278	0.75	4.345	0.00068	0.001	105.7	7318.0	494.0	-388.3

Catchment			**SP9**					water discharge rate (l/s)			
Clean water natural flow									42.3		l/s/ha
1 in 200 year return	**minutes**	**Rainfall (mm)**		**C**	**i (mm/hr)**	**A (km^2)**	**(m^3/s)**	**Volume (m^3)**	**Discharge (m^3/ha)**	**Discharge (m^3)**	**Residual Volume (m^3)**
M200 5min	5	10.7	0.278	0.75	128.4	0.00146	0.039	11.7	12.7	1.8	9.8
M200 10min	10	14.9	0.278	0.75	89.4	0.00146	0.027	16.3	25.4	3.7	12.6
M200 15min	15	17.5	0.278	0.75	70	0.00146	0.021	19.1	38.1	5.5	13.6
M200 30min	30	24.3	0.278	0.75	48.6	0.00146	0.015	26.5	76.2	11.1	15.4
M200 60min	60	33.7	0.278	0.75	33.7	0.00146	0.010	36.8	152.5	22.2	14.6
M200 2hr	120	46.8	0.278	0.75	23.4	0.00146	0.007	51.1	304.9	44.4	6.7
M200 4hr	240	65	0.278	0.75	16.25	0.00146	0.005	71.0	609.8	88.7	-17.7
M200 6hr	300	78.7	0.278	0.75	15.74	0.00146	0.005	103.1	914.7	133.1	-30.0
M200 12hr	600	109.3	0.278	0.75	10.93	0.00146	0.003	143.2	1829.5	266.2	-122.9
M200 24hr	1200	151.7	0.278	0.75	7.585	0.00146	0.002	198.8	3659.0	532.4	-333.6
M200 48hr	2400	173.8	0.278	0.75	4.345	0.00146	0.001	227.8	7318.0	1064.8	-837.0

Catchment			**SP10**					water discharge rate (l/s)			
Clean water natural flow									42.3		l/s/ha
1 in 200 year return	**minutes**	**Rainfall (mm)**		**C**	**i (mm/hr)**	**A (km^2)**	**(m^3/s)**	**Volume (m^3)**	**Discharge (m^3/ha)**	**Discharge (m^3)**	**Residual Volume (m^3)**
M200 5min	5	10.7	0.278	0.75	128.4	0.00097	0.026	7.8	12.7	1.2	6.6
M200 10min	10	14.9	0.278	0.75	89.4	0.00097	0.018	10.8	25.4	2.5	8.4
M200 15min	15	17.5	0.278	0.75	70	0.00097	0.014	12.7	38.1	3.7	9.0
M200 30min	30	24.3	0.278	0.75	48.6	0.00097	0.010	17.7	76.2	7.4	10.3
M200 60min	60	33.7	0.278	0.75	33.7	0.00097	0.007	24.5	152.5	14.8	9.7
M200 2hr	120	46.8	0.278	0.75	23.4	0.00097	0.005	34.1	304.9	29.6	4.5
M200 4hr	240	65	0.278	0.75	16.25	0.00097	0.003	47.3	609.8	59.2	-11.8
M200 6hr	300	78.7	0.278	0.75	15.74	0.00097	0.003	68.8	914.7	88.7	-20.0
M200 12hr	600	109.3	0.278	0.75	10.93	0.00097	0.002	95.5	1829.5	177.5	-82.0
M200 24hr	1200	151.7	0.278	0.75	7.585	0.00097	0.002	132.5	3659.0	354.9	-222.4
M200 48hr	2400	173.8	0.278	0.75	4.345	0.00097	0.001	151.8	7318.0	709.8	-558.0

Catchment			**SP11**					water discharge rate (l/s)			
Clean water natural flow									42.3		l/s/ha
1 in 200 year return	**minutes**	**Rainfall (mm)**		**C**	**i (mm/hr)**	**A (km^2)**	**(m^3/s)**	**Volume (m^3)**	**Discharge (m^3/ha)**	**Discharge (m^3)**	**Residual Volume (m^3)**
M200 5min	5	10.7	0.278	0.75	128.4	0.00161	0.043	12.9	12.7	2.0	10.9
M200 10min	10	14.9	0.278	0.75	89.4	0.00161	0.030	18.0	25.4	4.1	13.9
M200 15min	15	17.5	0.278	0.75	70	0.00161	0.023	21.1	38.1	6.1	15.0
M200 30min	30	24.3	0.278	0.75	48.6	0.00161	0.016	29.3	76.2	12.2	17.1
M200 60min	60	33.7	0.278	0.75	33.7	0.00161	0.011	40.6	152.5	24.5	16.1
M200 2hr	120	46.8	0.278	0.75	23.4	0.00161	0.008	56.4	304.9	49.0	7.4
M200 4hr	240	65	0.278	0.75	16.25	0.00161	0.005	78.4	609.8	97.9	-19.6
M200 6hr	300	78.7	0.278	0.75	15.74	0.00161	0.005	113.8	914.7	146.9	-33.1
M200 12hr	600	109.3	0.278	0.75	10.93	0.00161	0.004	158.1	1829.5	293.8	-135.7
M200 24hr	1200	151.7	0.278	0.75	7.585	0.00161	0.003	219.4	3659.0	587.6	-368.2
M200 48hr	2400	173.8	0.278	0.75	4.345	0.00161	0.001	251.4	7318.0	1175.3	-923.9

Catchment			**SP12**					water discharge rate (l/s)			
Clean water natural flow									42.3		l/s/ha
1 in 200 year return	**minutes**	**Rainfall (mm)**		**C**	**i (mm/hr)**	**A (km^2)**	**(m^3/s)**	**Volume (m^3)**	**Discharge (m^3/ha)**	**Discharge (m^3)**	**Residual Volume (m^3)**
M200 5min	5	10.7	0.278	0.75	128.4	0.00058	0.016	4.7	12.7	0.7	3.9
M200 10min	10	14.9	0.278	0.75	89.4	0.00058	0.011	6.5	25.4	1.5	5.0
M200 15min	15	17.5	0.278	0.75	70	0.00058	0.008	7.6	38.1	2.2	5.4
M200 30min	30	24.3	0.278	0.75	48.6	0.00058	0.006	10.6	76.2	4.4	6.2
M200 60min	60	33.7	0.278	0.75	33.7	0.00058	0.004	14.7	152.5	8.8	5.8
M200 2hr	120	46.8	0.278	0.75	23.4	0.00058	0.003	20.4	304.9	17.7	2.7
M200 4hr	240	65	0.278	0.75	16.25	0.00058	0.002	28.3	609.8	35.4	-7.1
M200 6hr	300	78.7	0.278	0.75	15.74	0.00058	0.002	41.1	914.7	53.1	-11.9
M200 12hr	600	109.3	0.278	0.75	10.93	0.00058	0.001	57.1	1829.5	106.1	-49.0
M200 24hr	1200	151.7	0.278	0.75	7.585	0.00058	0.001	79.3	3659.0	212.2	-133.0
M200 48hr	2400	173.8	0.278	0.75	4.345	0.00058	0.001	90.8	7318.0	424.4	-333.6

Catchment			**SP17**					water discharge rate (l/s)			
Clean water natural flow									42.3		l/s/ha
1 in 200 year return	**minutes**	**Rainfall (mm)**		**C**	**i (mm/hr)**	**A (km^2)**	**(m^3/s)**	**Volume (m^3)**	**Discharge (m^3/ha)**	**Discharge (m^3)**	**Residual Volume (m^3)**
M200 5min	5	10.7	0.278	0.75	128.4	0.00092	0.024	7.3	12.7	1.2	6.2
M200 10min	10	14.9	0.278	0.75	89.4	0.00092	0.017	10.2	25.4	2.3	7.9
M200 15min	15	17.5	0.278	0.75	70	0.00092	0.013	12.0	38.1	3.5	8.5
M200 30min	30	24.3	0.278	0.75	48.6	0.00092	0.009	16.7	76.2	7.0	9.7
M200 60min	60	33.7	0.278	0.75	33.7	0.00092	0.006	23.1	152.5	13.9	9.2
M200 2hr	120	46.8	0.278	0.75	23.4	0.00092	0.004	32.1	304.9	27.9	4.2
M200 4hr	240	65	0.278	0.75	16.25	0.00092	0.003	44.6	609.8	55.8	-11.2
M200 6hr	300	78.7	0.278	0.75	15.74	0.00092	0.003	64.9	914.7	83.7	-18.8
M200 12hr	600	109.3	0.278	0.75	10.93	0.00092	0.002	90.1	1829.5	167.4	-77.3
M200 24hr	1200	151.7	0.278	0.75	7.585	0.00092	0.001	125.0	3659.0	334.8	-209.8
M200 48hr	2400	173.8	0.278	0.75	4.345	0.00092	0.001	143.2	7318.0	669.6	-526.4

Catchment			**SP18**					water discharge rate (l/s)			
Clean water natural flow									42.3		l/s/ha
1 in 200 year return	**minutes**	**Rainfall (mm)**		**C**	**i (mm/hr)**	**A (km^2)**	**(m^3/s)**	**Volume (m^3)**	**Discharge (m^3/ha)**	**Discharge (m^3)**	**Residual Volume (m^3)**
M200 5min	5	10.7	0.278	0.75	128.4	0.00124	0.033	10.0	12.7	1.6	8.4
M200 10min	10	14.9	0.278	0.75	89.4	0.00124	0.023	13.9	25.4	3.2	10.7
M200 15min	15	17.5	0.278	0.75	70	0.00124	0.018	16.3	38.1	4.7	11.6
M200 30min	30	24.3	0.278	0.75	48.6	0.00124	0.013	22.6	76.2	9.5	13.2
M200 60min	60	33.7	0.278	0.75	33.7	0.00124	0.009	31.4	152.5	18.9	12.5
M200 2hr	120	46.8	0.278	0.75	23.4	0.00124	0.006	43.6	304.9	37.8	5.7
M200 4hr	240	65	0.278	0.75	16.25	0.00124	0.004	60.5	609.8	75.6	-15.1
M200 6hr	300	78.7	0.278	0.75	15.74	0.00124	0.004	87.9	914.7	113.4	-25.5
M200 12hr	600	109.3	0.278	0.75	10.93	0.00124	0.003	122.1	1829.5	226.9	-104.8
M200 24hr	1200	151.7	0.278	0.75	7.585	0.00124	0.002	169.4	3659.0	453.7	-284.3
M200 48hr	2400	173.8	0.278	0.75	4.345	0.00124	0.001	194.1	7318.0	907.4	-713.3

Catchment			**SP19**					water discharge rate (l/s)			
Clean water natural flow									42.3		l/s/ha
1 in 200 year return	**minutes**	**Rainfall (mm)**		**C**	**i (mm/hr)**	**A (km^2)**	**(m^3/s)**	**Volume (m^3)**	**Discharge (m^3/ha)**	**Discharge (m^3)**	**Residual Volume (m^3)**
M200 5min	5	10.7	0.278	0.75	128.4	0.00071	0.019	5.7	12.7	0.9	4.8
M200 10min	10	14.9	0.278	0.75	89.4	0.00071	0.013	7.9	25.4	1.8	6.1
M200 15min	15	17.5	0.278	0.75	70	0.00071	0.010	9.3	38.1	2.7	6.6
M200 30min	30	24.3	0.278	0.75	48.6	0.00071	0.007	13.0	76.2	5.4	7.5
M200 60min	60	33.7	0.278	0.75	33.7	0.00071	0.005	18.0	152.5	10.8	7.1
M200 2hr	120	46.8	0.278	0.75	23.4	0.00071	0.003	24.9	304.9	21.6	3.3
M200 4hr	240	65	0.278	0.75	16.25	0.00071	0.002	34.6	609.8	43.3	-8.7
M200 6hr	300	78.7	0.278	0.75	15.74	0.00071	0.002	50.3	914.7	64.9	-14.6
M200 12hr	600	109.3	0.278	0.75	10.93	0.00071	0.002	69.9	1829.5	129.9	-60.0
M200 24hr	1200	151.7	0.278	0.75	7.585	0.00071	0.001	97.0	3659.0	259.8	-162.8
M200 48hr	2400	173.8	0.278	0.75	4.345	0.00071	0.001	111.1	7318.0	519.6	-408.4

Catchment			**SP20**					water discharge rate (l/s)			
Clean water natural flow									42.3		l/s/ha
1 in 200 year return	**minutes**	**Rainfall (mm)**		**C**	**i (mm/hr)**	**A (km^2)**	**(m^3/s)**	**Volume (m^3)**	**Discharge (m^3/ha)**	**Discharge (m^3)**	**Residual Volume (m^3)**
M200 5min	5	10.7	0.278	0.75	128.4	0.00150	0.040	12.0	12.7	1.9	10.1
M200 10min	10	14.9	0.278	0.75	89.4	0.00150	0.028	16.7	25.4	3.8	12.9
M200 15min	15	17.5	0.278	0.75	70	0.00150	0.022	19.6	38.1	5.7	13.9
M200 30min	30	24.3	0.278	0.75	48.6	0.00150	0.015	27.3	76.2	11.4	15.9
M200 60min	60	33.7	0.278	0.75	33.7	0.00150	0.011	37.8	152.5	22.8	15.0
M200 2hr	120	46.8	0.278	0.75	23.4	0.00150	0.007	52.5	304.9	45.6	6.9
M200 4hr	240	65	0.278	0.75	16.25	0.00150	0.005	72.9	609.8	91.2	-18.2
M200 6hr	300	78.7	0.278	0.75	15.74	0.00150	0.005	106.0	914.7	136.8	-30.8
M200 12hr	600	109.3	0.278	0.75	10.93	0.00150	0.003	147.2	1829.5	273.5	-126.3
M200 24hr	1200	151.7	0.278	0.75	7.585	0.00150	0.002	204.3	3659.0	547.0	-342.7
M200 48hr	2400	173.8	0.278	0.75	4.345	0.00150	0.001	234.0	0.0	0.0	234.0

Catchment			**SP25**					water discharge rate (l/s)			
Clean water natural flow									42.3		l/s/ha
1 in 200 year return	**minutes**	**Rainfall (mm)**		**C**	**i (mm/hr)**	**A (km^2)**	**(m^3/s)**	**Volume (m^3)**	**Discharge (m^3/ha)**	**Discharge (m^3)**	**Residual Volume (m^3)**
M200 5min	5	10.7	0.278	0.75	128.4	0.00105	0.028	8.4	12.7	1.3	7.1
M200 10min	10	14.9	0.278	0.75	89.4	0.00105	0.019	11.7	25.4	2.7	9.0
M200 15min	15	17.5	0.278	0.75	70	0.00105	0.015	13.7	38.1	4.0	9.7
M200 30min	30	24.3	0.278	0.75	48.6	0.00105	0.011	19.1	76.2	8.0	11.1
M200 60min	60	33.7	0.278	0.75	33.7	0.00105	0.007	26.4	152.5	15.9	10.5
M200 2hr	120	46.8	0.278	0.75	23.4	0.00105	0.005	36.7	304.9	31.9	4.8
M200 4hr	240	65	0.278	0.75	16.25	0.00105	0.004	51.0	609.8	63.7	-12.7
M200 6hr	300	78.7	0.278	0.75	15.74	0.00105	0.003	74.1	914.7	95.6	-21.5
M200 12hr	600	109.3	0.278	0.75	10.93	0.00105	0.002	102.9	1829.5	191.2	-88.3
M200 24hr	1200	151.7	0.278	0.75	7.585	0.00105	0.002	142.8	3659.0	382.4	-239.6
M200 48hr	2400	173.8	0.278	0.75	4.345	0.00105	0.001	163.6	7318.0	764.7	-601.1

Catchment			**SP26**					water discharge rate (l/s)			
Clean water natural flow									42.3		l/s/ha
1 in 200 year return	**minutes**	**Rainfall (mm)**		**C**	**i (mm/hr)**	**A (km^2)**	**(m^3/s)**	**Volume (m^3)**	**Discharge (m^3/ha)**	**Discharge (m^3)**	**Residual Volume (m^3)**
M200 5min	5	10.7	0.278	0.75	128.4	0.00115	0.031	9.2	12.7	1.5	7.7
M200 10min	10	14.9	0.278	0.75	89.4	0.00115	0.021	12.8	25.4	2.9	9.9
M200 15min	15	17.5	0.278	0.75	70	0.00115	0.017	15.0	38.1	4.4	10.7
M200 30min	30	24.3	0.278	0.75	48.6	0.00115	0.012	20.9	76.2	8.7	12.2
M200 60min	60	33.7	0.278	0.75	33.7	0.00115	0.008	29.0	152.5	17.5	11.5
M200 2hr	120	46.8	0.278	0.75	23.4	0.00115	0.006	40.2	304.9	34.9	5.3
M200 4hr	240	65	0.278	0.75	16.25	0.00115	0.004	55.9	609.8	69.8	-14.0
M200 6hr	300	78.7	0.278	0.75	15.74	0.00115	0.004	81.2	914.7	104.7	-23.6
M200 12hr	600	109.3	0.278	0.75	10.93	0.00115	0.003	112.7	1829.5	209.5	-96.8
M200 24hr	1200	151.7	0.278	0.75	7.585	0.00115	0.002	156.5	3659.0	419.0	-262.5
M200 48hr	2400	173.8	0.278	0.75	4.345	0.00115	0.001	179.2	0.0	0.0	179.2

Catchment			**SP27**					water discharge rate (l/s)			
Clean water natural flow									42.3		l/s/ha
1 in 200 year return	**minutes**	**Rainfall (mm)**		**C**	**i (mm/hr)**	**A (km^2)**	**(m^3/s)**	**Volume (m^3)**	**Discharge (m^3/ha)**	**Discharge (m^3)**	**Residual Volume (m^3)**
M200 5min	5	10.7	0.278	0.75	128.4	0.00101	0.027	8.1	12.7	1.3	6.8
M200 10min	10	14.9	0.278	0.75	89.4	0.00101	0.019	11.2	25.4	2.6	8.7
M200 15min	15	17.5	0.278	0.75	70	0.00101	0.015	13.2	38.1	3.8	9.4
M200 30min	30	24.3	0.278	0.75	48.6	0.00101	0.010	18.3	76.2	7.7	10.7
M200 60min	60	33.7	0.278	0.75	33.7	0.00101	0.007	25.4	152.5	15.3	10.1
M200 2hr	120	46.8	0.278	0.75	23.4	0.00101	0.005	35.3	304.9	30.6	4.7
M200 4hr	240	65	0.278	0.75	16.25	0.00101	0.003	49.0	609.8	61.3	-12.3
M200 6hr	300	78.7	0.278	0.75	15.74	0.00101	0.003	71.2	914.7	91.9	-20.7
M200 12hr	600	109.3	0.278	0.75	10.93	0.00101	0.002	98.9	1829.5	183.9	-84.9
M200 24hr	1200	151.7	0.278	0.75	7.585	0.00101	0.002	137.3	3659.0	367.7	-230.4
M200 48hr	2400	173.8	0.278	0.75	4.345	0.00101	0.001	157.3	7318.0	735.5	-578.1

Catchment			**SP28**					water discharge rate (l/s)			
Clean water natural flow									42.3		l/s/ha
1 in 200 year return	**minutes**	**Rainfall (mm)**		**C**	**i (mm/hr)**	**A (km^2)**	**(m^3/s)**	**Volume (m^3)**	**Discharge (m^3/ha)**	**Discharge (m^3)**	**Residual Volume (m^3)**
M200 5min	5	10.7	0.278	0.75	128.4	0.00122	0.033	9.8	12.7	1.5	8.2
M200 10min	10	14.9	0.278	0.75	89.4	0.00122	0.023	13.6	25.4	3.1	10.5
M200 15min	15	17.5	0.278	0.75	70	0.00122	0.018	16.0	38.1	4.6	11.3
M200 30min	30	24.3	0.278	0.75	48.6	0.00122	0.012	22.2	76.2	9.3	12.9
M200 60min	60	33.7	0.278	0.75	33.7	0.00122	0.009	30.7	152.5	18.5	12.2
M200 2hr	120	46.8	0.278	0.75	23.4	0.00122	0.006	42.7	304.9	37.0	5.6
M200 4hr	240	65	0.278	0.75	16.25	0.00122	0.004	59.3	609.8	74.1	-14.8
M200 6hr	300	78.7	0.278	0.75	15.74	0.00122	0.004	86.1	914.7	111.1	-25.0
M200 12hr	600	109.3	0.278	0.75	10.93	0.00122	0.003	119.6	1829.5	222.3	-102.7
M200 24hr	1200	151.7	0.278	0.75	7.585	0.00122	0.002	166.0	3659.0	444.6	-278.5
M200 48hr	2400	173.8	0.278	0.75	4.345	0.00122	0.001	190.2	7318.0	889.1	-698.9

Catchment		SP5							water discharge rate (l/s)		
Clean water natural flow									42.3		l/s/ha
1 in 200 year return	minutes	Rainfall (mm)		C	i (mm/hr)	A (km^2)	(m^3/s)	Volume (m^3)	Discharge (m^3/ha)	Discharge (m^3)	Residual Volume (m^3)
M200 5min	5	10.7	0.278	0.75	128.4	0.00144	0.038	11.5	12.7	1.8	9.7
M200 10min	10	14.9	0.278	0.75	89.4	0.00144	0.027	16.0	25.4	3.6	12.4
M200 15min	15	17.5	0.278	0.75	70	0.00144	0.021	18.8	38.1	5.5	13.4
M200 30min	30	24.3	0.278	0.75	48.6	0.00144	0.015	26.2	76.2	10.9	15.2
M200 60min	60	33.7	0.278	0.75	33.7	0.00144	0.010	36.3	152.5	21.9	14.4
M200 2hr	120	46.8	0.278	0.75	23.4	0.00144	0.007	50.4	304.9	43.8	6.7
M200 4hr	240	65	0.278	0.75	16.25	0.00144	0.005	70.0	609.8	87.5	-17.5
M200 6hr	300	78.7	0.278	0.75	15.74	0.00144	0.005	101.7	914.7	131.3	-29.5
M200 12hr	600	109.3	0.278	0.75	10.93	0.00144	0.003	141.3	1829.5	262.5	-121.3
M200 24hr	1200	151.7	0.278	0.75	7.585	0.00144	0.002	196.1	3659.0	525.1	-329.0
M200 48hr	2400	173.8	0.278	0.75	4.345	0.00144	0.001	224.6	7318.0	1050.1	-825.5

Catchment		SP13							water discharge rate (l/s)		
Clean water natural flow									42.3		l/s/ha
1 in 200 year return	minutes	Rainfall (mm)		C	i (mm/hr)	A (km^2)	(m^3/s)	Volume (m^3)	Discharge (m^3/ha)	Discharge (m^3)	Residual Volume (m^3)
M200 5min	5	10.7	0.278	0.75	128.4	0.00193	0.052	15.5	12.7	2.5	13.0
M200 10min	10	14.9	0.278	0.75	89.4	0.00193	0.036	21.6	25.4	4.9	16.7
M200 15min	15	17.5	0.278	0.75	70	0.00193	0.028	25.4	38.1	7.4	18.0
M200 30min	30	24.3	0.278	0.75	48.6	0.00193	0.020	35.2	76.2	14.7	20.5
M200 60min	60	33.7	0.278	0.75	33.7	0.00193	0.014	48.8	152.5	29.4	19.4
M200 2hr	120	46.8	0.278	0.75	23.4	0.00193	0.009	67.8	304.9	58.8	8.9
M200 4hr	240	65	0.278	0.75	16.25	0.00193	0.007	94.2	609.8	117.7	-23.5
M200 6hr	300	78.7	0.278	0.75	15.74	0.00193	0.006	136.8	914.7	176.5	-39.7
M200 12hr	600	109.3	0.278	0.75	10.93	0.00193	0.004	190.0	1829.5	353.1	-163.1
M200 24hr	1200	151.7	0.278	0.75	7.585	0.00193	0.003	263.7	3659.0	706.2	-442.5
M200 48hr	2400	173.8	0.278	0.75	4.345	0.00193	0.002	302.1	7318.0	1412.4	-1110.2

Catchment		SP21							water discharge rate (l/s)		
Clean water natural flow									42.3		l/s/ha
1 in 200 year return	minutes	Rainfall (mm)		C	i (mm/hr)	A (km^2)	(m^3/s)	Volume (m^3)	Discharge (m^3/ha)	Discharge (m^3)	Residual Volume (m^3)
M200 5min	5	10.7	0.278	0.75	128.4	0.00075	0.020	6.0	12.7	1.0	5.1
M200 10min	10	14.9	0.278	0.75	89.4	0.00075	0.014	8.4	25.4	1.9	6.5
M200 15min	15	17.5	0.278	0.75	70	0.00075	0.011	9.9	38.1	2.9	7.0
M200 30min	30	24.3	0.278	0.75	48.6	0.00075	0.008	13.7	76.2	5.7	8.0
M200 60min	60	33.7	0.278	0.75	33.7	0.00075	0.005	19.0	152.5	11.4	7.5
M200 2hr	120	46.8	0.278	0.75	23.4	0.00075	0.004	26.3	304.9	22.9	3.5
M200 4hr	240	65	0.278	0.75	16.25	0.00075	0.003	36.6	609.8	45.7	-9.1
M200 6hr	300	78.7	0.278	0.75	15.74	0.00075	0.002	53.2	914.7	68.6	-15.4
M200 12hr	600	109.3	0.278	0.75	10.93	0.00075	0.002	73.8	1829.5	137.2	-63.4
M200 24hr	1200	151.7	0.278	0.75	7.585	0.00075	0.001	102.5	3659.0	274.4	-171.9
M200 48hr	2400	173.8	0.278	0.75	4.345	0.00075	0.001	117.4	7318.0	548.8	-431.4

Catchment		SP29							water discharge rate (l/s)		
Clean water natural flow									42.3		l/s/ha
1 in 200 year return	minutes	Rainfall (mm)		C	i (mm/hr)	A (km^2)	(m^3/s)	Volume (m^3)	Discharge (m^3/ha)	Discharge (m^3)	Residual Volume (m^3)
M200 5min	5	10.7	0.278	0.75	128.4	0.00111	0.030	8.9	12.7	1.4	7.5
M200 10min	10	14.9	0.278	0.75	89.4	0.00111	0.021	12.4	25.4	2.8	9.6
M200 15min	15	17.5	0.278	0.75	70	0.00111	0.016	14.6	38.1	4.2	10.3
M200 30min	30	24.3	0.278	0.75	48.6	0.00111	0.011	20.2	76.2	8.5	11.8
M200 60min	60	33.7	0.278	0.75	33.7	0.00111	0.008	28.1	152.5	16.9	11.2
M200 2hr	120	46.8	0.278	0.75	23.4	0.00111	0.005	39.0	304.9	33.8	5.1
M200 4hr	240	65	0.278	0.75	16.25	0.00111	0.004	54.2	609.8	67.7	-13.5
M200 6hr	300	78.7	0.278	0.75	15.74	0.00111	0.004	78.7	914.7	101.5	-22.9
M200 12hr	600	109.3	0.278	0.75	10.93	0.00111	0.003	109.3	1829.5	203.1	-93.8
M200 24hr	1200	151.7	0.278	0.75	7.585	0.00111	0.002	151.7	3659.0	406.1	-254.5
M200 48hr	2400	173.8	0.278	0.75	4.345	0.00111	0.001	173.8	7318.0	812.3	-638.5

Catchment		SP6							water discharge rate (l/s)		
Clean water natural flow									42.3		l/s/ha
1 in 200 year return	minutes	Rainfall (mm)		C	i (mm/hr)	A (km^2)	(m^3/s)	Volume (m^3)	Discharge (m^3/ha)	Discharge (m^3)	Residual Volume (m^3)
M200 5min	5	10.7	0.278	0.75	128.4	0.00046	0.012	3.7	12.7	0.6	3.1
M200 10min	10	14.9	0.278	0.75	89.4	0.00046	0.009	5.2	25.4	1.2	4.0
M200 15min	15	17.5	0.278	0.75	70	0.00046	0.007	6.1	38.1	1.8	4.3
M200 30min	30	24.3	0.278	0.75	48.6	0.00046	0.005	8.4	76.2	3.5	4.9
M200 60min	60	33.7	0.278	0.75	33.7	0.00046	0.003	11.7	152.5	7.0	4.6
M200 2hr	120	46.8	0.278	0.75	23.4	0.00046	0.002	16.2	304.9	14.1	2.1
M200 4hr	240	65	0.278	0.75	16.25	0.00046	0.002	22.5	609.8	28.2	-5.6
M200 6hr	300	78.7	0.278	0.75	15.74	0.00046	0.002	32.7	914.7	42.3	-9.5
M200 12hr	600	109.3	0.278	0.75	10.93	0.00046	0.001	45.5	1829.5	84.5	-39.0
M200 24hr	1200	151.7	0.278	0.75	7.585	0.00046	0.001	63.1	3659.0	169.0	-105.9
M200 48hr	2400	173.8	0.278	0.75	4.345	0.00046	0.000	72.3	7318.0	338.1	-265.8

Catchment		SP14							water discharge rate (l/s)		
Clean water natural flow									42.3		l/s/ha
1 in 200 year return	minutes	Rainfall (mm)		C	i (mm/hr)	A (km^2)	(m^3/s)	Volume (m^3)	Discharge (m^3/ha)	Discharge (m^3)	Residual Volume (m^3)
M200 5min	5	10.7	0.278	0.75	128.4	0.00035	0.009	2.8	12.7	0.4	2.4
M200 10min	10	14.9	0.278	0.75	89.4	0.00035	0.007	3.9	25.4	0.9	3.0
M200 15min	15	17.5	0.278	0.75	70	0.00035	0.005	4.6	38.1	1.3	3.3
M200 30min	30	24.3	0.278	0.75	48.6	0.00035	0.004	6.4	76.2	2.7	3.7
M200 60min	60	33.7	0.278	0.75	33.7	0.00035	0.002	8.9	152.5	5.3	3.5
M200 2hr	120	46.8	0.278	0.75	23.4	0.00035	0.002	12.3	304.9	10.7	1.6
M200 4hr	240	65	0.278	0.75	16.25	0.00035	0.001	17.1	609.8	21.3	-4.3
M200 6hr	300	78.7	0.278	0.75	15.74	0.00035	0.001	24.8	914.7	32.0	-7.2
M200 12hr	600	109.3	0.278	0.75	10.93	0.00035	0.001	34.5	1829.5	64.0	-29.6
M200 24hr	1200	151.7	0.278	0.75	7.585	0.00035	0.001	47.8	3659.0	128.1	-80.2
M200 48hr	2400	173.8	0.278	0.75	4.345	0.00035	0.000	54.8	7318.0	256.1	-201.3

Catchment		SP22							water discharge rate (l/s)		
Clean water natural flow									42.3		l/s/ha
1 in 200 year return	minutes	Rainfall (mm)		C	i (mm/hr)	A (km^2)	(m^3/s)	Volume (m^3)	Discharge (m^3/ha)	Discharge (m^3)	Residual Volume (m^3)
M200 5min	5	10.7	0.278	0.75	128.4	0.00147	0.039	11.8	12.7	1.9	9.9
M200 10min	10	14.9	0.278	0.75	89.4	0.00147	0.027	16.4	25.4	3.7	12.7
M200 15min	15	17.5	0.278	0.75	70	0.00147	0.021	19.3	38.1	5.6	13.7
M200 30min	30	24.3	0.278	0.75	48.6	0.00147	0.015	26.8	76.2	11.2	15.6
M200 60min	60	33.7	0.278	0.75	33.7	0.00147	0.010	37.2	152.5	22.4	14.8
M200 2hr	120	46.8	0.278	0.75	23.4	0.00147	0.007	51.6	304.9	44.8	6.8
M200 4hr	240	65	0.278	0.75	16.25	0.00147	0.005	71.7	609.8	89.6	-17.9
M200 6hr	300	78.7	0.278	0.75	15.74	0.00147	0.005	104.2	914.7	134.5	-30.3
M200 12hr	600	109.3	0.278	0.75	10.93	0.00147	0.003	144.7	1829.5	268.9	-124.2
M200 24hr	1200	151.7	0.278	0.75	7.585	0.00147	0.002	200.9	3659.0	537.9	-337.0
M200 48hr	2400	173.8	0.278	0.75	4.345	0.00147	0.001	230.1	7318.0	1075.7	-845.6

Catchment		SP30							water discharge rate (l/s)		
Clean water natural flow									42.3		l/s/ha
1 in 200 year return	minutes	Rainfall (mm)		C	i (mm/hr)	A (km^2)	(m^3/s)	Volume (m^3)	Discharge (m^3/ha)	Discharge (m^3)	Residual Volume (m^3)
M200 5min	5	10.7	0.278	0.75	128.4	0.00111	0.030	8.9	12.7	1.4	7.5
M200 10min	10	14.9	0.278	0.75	89.4	0.00111	0.021	12.4	25.4	2.8	9.6
M200 15min	15	17.5	0.278	0.75	70	0.00111	0.016	14.6	38.1	4.2	10.3
M200 30min	30	24.3	0.278	0.75	48.6	0.00111	0.011	20.2	76.2	8.5	11.8
M200 60min	60	33.7	0.278	0.75	33.7	0.00111	0.008	28.1	152.5	16.9	11.2
M200 2hr	120	46.8	0.278	0.75	23.4	0.00111	0.005	39.0	304.9	33.8	5.1
M200 4hr	240	65	0.278	0.75	16.25	0.00111	0.004	54.2	609.8	67.7	-13.5
M200 6hr	300	78.7	0.278	0.75	15.74	0.00111	0.004	78.7	914.7	101.5	-22.9
M200 12hr	600	109.3	0.278	0.75	10.93	0.00111	0.003	109.3	1829.5	203.1	-93.8
M200 24hr	1200	151.7	0.278	0.75	7.585	0.00111	0.002	151.7	3659.0	406.1	-254.5
M200 48hr	2400	173.8	0.278	0.75	4.345	0.00111	0.001	173.8	7318.0	812.3	-638.5

Catchment		SP7							water discharge rate (l/s)		
Clean water natural flow									42.3		l/s/ha
1 in 200 year return	minutes	Rainfall (mm)		C	i (mm/hr)	A (km^2)	(m^3/s)	Volume (m^3)	Discharge (m^3/ha)	Discharge (m^3)	Residual Volume (m^3)
M200 5min	5	10.7	0.278	0.75	128.4	0.00174	0.047	14.0	12.7	2.2	11.8
M200 10min	10	14.9	0.278	0.75	89.4	0.00174	0.032	19.5	25.4	4.4	15.0
M200 15min	15	17.5	0.278	0.75	70	0.00174	0.025	22.9	38.1	6.6	16.2
M200 30min	30	24.3	0.278	0.75	48.6	0.00174	0.018	31.7	76.2	13.3	18.5
M200 60min	60	33.7	0.278	0.75	33.7	0.00174	0.012	44.0	152.5	26.5	17.5
M200 2hr	120	46.8	0.278	0.75	23.4	0.00174	0.008	61.1	304.9	53.1	8.1
M200 4hr	240	65	0.278	0.75	16.25	0.00174	0.006	84.9	609.8	106.1	-21.2
M200 6hr	300	78.7	0.278	0.75	15.74	0.00174	0.006	123.3	914.7	159.2	-35.8
M200 12hr	600	109.3	0.278	0.75	10.93	0.00174	0.004	171.3	1829.5	318.3	-147.0
M200 24hr	1200	151.7	0.278	0.75	7.585	0.00174	0.003	237.8	3659.0	636.7	-398.9
M200 48hr	2400	173.8	0.278	0.75	4.345	0.00174	0.002	272.4	7318.0	1273.3	-1000.9

Catchment		SP15							water discharge rate (l/s)		
Clean water natural flow									42.3		l/s/ha
1 in 200 year return	minutes	Rainfall (mm)		C	i (mm/hr)	A (km^2)	(m^3/s)	Volume (m^3)	Discharge (m^3/ha)	Discharge (m^3)	Residual Volume (m^3)
M200 5min	5	10.7	0.278	0.75	128.4	0.00108	0.029	8.7	12.7	1.4	7.3
M200 10min	10	14.9	0.278	0.75	89.4	0.00108	0.020	12.1	25.4	2.7	9.3
M200 15min	15	17.5	0.278	0.75	70	0.00108	0.016	14.2	38.1	4.1	10.1
M200 30min	30	24.3	0.278	0.75	48.6	0.00108	0.011	19.7	76.2	8.2	11.5
M200 60min	60	33.7	0.278	0.75	33.7	0.00108	0.008	27.3	152.5	16.5	10.9
M200 2hr	120	46.8	0.278	0.75	23.4	0.00108	0.005	37.9	304.9	32.9	5.0
M200 4hr	240	65	0.278	0.75	16.25	0.00108	0.004	52.7	609.8	65.9	-13.2
M200 6hr	300	78.7	0.278	0.75	15.74	0.00108	0.004	76.6	914.7	98.8	-22.2
M200 12hr	600	109.3	0.278	0.75	10.93	0.00108	0.002	106.3	1829.5	197.6	-91.3
M200 24hr	1200	151.7	0.278	0.75	7.585	0.00108	0.002	147.6	3659.0	395.2	-247.6
M200 48hr	2400	173.8	0.278	0.75	4.345	0.00108	0.001	169.1	7318.0	790.3	-621.3

Catchment		SP23							water discharge rate (l/s)		
Clean water natural flow									42.3		l/s/ha
1 in 200 year return	minutes	Rainfall (mm)		C	i (mm/hr)	A (km^2)	(m^3/s)	Volume (m^3)	Discharge (m^3/ha)	Discharge (m^3)	Residual Volume (m^3)
M200 5min	5	10.7	0.278	0.75	128.4	0.00172	0.046	13.8	12.7	2.2	11.6
M200 10min	10	14.9	0.278	0.75	89.4	0.00172	0.032	19.2	25.4	4.4	14.9
M200 15min	15	17.5	0.278	0.75	70	0.00172	0.025	22.6	38.1	6.6	16.0
M200 30min	30	24.3	0.278	0.75	48.6	0.00172	0.017	31.4	76.2	13.1	18.3
M200 60min	60	33.7	0.278	0.75	33.7	0.00172	0.012	43.5	152.5	26.2	17.3
M200 2hr	120	46.8	0.278	0.75	23.4	0.00172	0.008	60.4	304.9	52.4	8.0
M200 4hr	240	65	0.278	0.75	16.25	0.00172	0.006	83.9	609.8	104.9	-21.0
M200 6hr	300	78.7	0.278	0.75	15.74	0.00172	0.006	121.9	914.7	157.3	-35.4
M200 12hr	600	109.3	0.278	0.75	10.93	0.00172	0.004	169.3	1829.5	314.7	-145.3
M200 24hr	1200	151.7	0.278	0.75	7.585	0.00172	0.003	235.0	3659.0	629.3	-394.3
M200 48hr	2400	173.8	0.278	0.75	4.345	0.00172	0.002	269.3	7318.0	1258.7	-989.4

Catchment		SP31							water discharge rate (l/s)		
Clean water natural flow									42.3		l/s/ha
1 in 200 year return	minutes	Rainfall (mm)		C	i (mm/hr)	A (km^2)	(m^3/s)	Volume (m^3)	Discharge (m^3/ha)	Discharge (m^3)	Residual Volume (m^3)
M200 5min	5	10.7	0.278	0.75	128.4	0.00148	0.040	11.9	12.7	1.9	10.0
M200 10min	10	14.9	0.278	0.75	89.4	0.00148	0.028	16.6	25.4	3.8	12.8
M200 15min	15	17.5	0.278	0.75	70	0.00148	0.022	19.5	38.1	5.6	13.8
M200 30min	30	24.3	0.278	0.75	48.6	0.00148	0.015	27.0	76.2	11.3	15.7
M200 60min	60	33.7	0.278	0.75	33.7	0.00148	0.010	37.5	152.5	22.6	14.9
M200 2hr	120	46.8	0.278	0.75	23.4	0.00148	0.007	52.1	304.9	45.2	6.9
M200 4hr	240	65	0.278	0.75	16.25	0.00148	0.005	72.3	609.8	90.4	-18.1
M200 6hr	300	78.7	0.278	0.75	15.74	0.00148	0.005	105.1	914.7	135.6	-30.5
M200 12hr	600	109.3	0.278	0.75	10.93	0.00148	0.003	145.9	1829.5	271.1	-125.2
M200 24hr	1200	151.7	0.278	0.75	7.585	0.00148	0.002	202.5	3659.0	542.3	-339.8
M200 48hr	2400	173.8	0.278	0.75	4.345	0.00148	0.001	232.0	7318.0	1084.5	-852.5

Catchment		SP8							water discharge rate (l/s)		
Clean water natural flow									42.3		l/s/ha
1 in 200 year return	minutes	Rainfall (mm)		C	i (mm/hr)	A (km^2)	(m^3/s)	Volume (m^3)	Discharge (m^3/ha)	Discharge (m^3)	Residual Volume (m^3)
M200 5min	5	10.7	0.278	0.75	128.4	0.00160	0.043	12.8	12.7	2.0	10.8
M200 10min	10	14.9	0.278	0.75	89.4	0.00160	0.030	17.8	25.4	4.1	13.8
M200 15min	15	17.5	0.278	0.75	70	0.00160	0.023	21.0	38.1	6.1	14.9
M200 30min	30	24.3	0.278	0.75	48.6	0.00160	0.016	29.1	76.2	12.2	16.9
M200 60min	60	33.7	0.278	0.75	33.7	0.00160	0.011	40.3	152.5	24.3	16.0
M200 2hr	120	46.8	0.278	0.75	23.4	0.00160	0.008	56.0	304.9	48.6	7.4
M200 4hr	240	65	0.278	0.75	16.25	0.00160	0.005	77.8	609.8	97.3	-19.4
M200 6hr	300	78.7	0.278	0.75	15.74	0.00160	0.005	113.1	914.7	145.9	-32.8
M200 12hr	600	109.3	0.278	0.75	10.93	0.00160	0.004	157.0	1829.5	291.8	-134.8
M200 24hr	1200	151.7	0.278	0.75	7.585	0.00160	0.003	217.9	3659.0	583.6	-365.7
M200 48hr	2400	173.8	0.278	0.75	4.345	0.00160	0.001	249.7	7318.0	1167.2	-917.5

Catchment		SP16							water discharge rate (l/s)		
Clean water natural flow									42.3		l/s/ha
1 in 200 year return	minutes	Rainfall (mm)		C	i (mm/hr)	A (km^2)	(m^3/s)	Volume (m^3)	Discharge (m^3/ha)	Discharge (m^3)	Residual Volume (m^3)
M200 5min	5	10.7	0.278	0.75	128.4	0.00108	0.029	8.7	12.7	1.4	7.3
M200 10min	10	14.9	0.278	0.75	89.4	0.00108	0.020	12.1	25.4	2.7	9.3
M200 15min	15	17.5	0.278	0.75	70	0.00108	0.016	14.2	38.1	4.1	10.1
M200 30min	30	24.3	0.278	0.75	48.6	0.00108	0.011	19.7	76.2	8.2	11.5
M200 60min	60	33.7	0.278	0.75	33.7	0.00108	0.008	27.3	152.5	16.5	10.9
M200 2hr	120	46.8	0.278	0.75	23.4	0.00108	0.005	37.9	304.9	32.9	5.0
M200 4hr	240	65	0.278	0.75	16.25	0.00108	0.004	52.7	609.8	65.9	-13.2
M200 6hr	300	78.7	0.278	0.75	15.74	0.00108	0.004	76.6	914.7	98.8	-22.2
M200 12hr	600	109.3	0.278	0.75	10.93	0.00108	0.002	106.3	1829.5	197.6	-91.3
M200 24hr	1200	151.7	0.278	0.75	7.585	0.00108	0.002	147.6	3659.0	395.2	-247.6
M200 48hr	2400	173.8	0.278	0.75	4.345	0.00108	0.001	169.1	7318.0	790.3	-621.3

Catchment		SP24							water discharge rate (l/s)		
Clean water natural flow									42.3		l/s/ha
1 in 200 year return	minutes	Rainfall (mm)		C	i (mm/hr)	A (km^2)	(m^3/s)	Volume (m^3)	Discharge (m^3/ha)	Discharge (m^3)	Residual Volume (m^3)
M200 5min	5	10.7	0.278	0.75	128.4	0.00113	0.030	9.0	12.7	1.4	7.6
M200 10min	10	14.9	0.278	0.75	89.4	0.00113	0.021	12.6	25.4	2.9	9.7
M200 15min	15	17.5	0.278	0.75	70	0.00113	0.016	14.8	38.1	4.3	10.5
M200 30min	30	24.3	0.278	0.75	48.6	0.00113	0.011	20.5	76.2	8.6	11.9
M200 60min	60	33.7	0.278	0.75	33.7	0.00113	0.008	28.5	152.5	17.2	11.3
M200 2hr	120	46.8	0.278	0.75	23.4	0.00113	0.005	39.5	304.9	34.3	5.2
M200 4hr	240	65	0.278	0.75	16.25	0.00113	0.004	54.9	609.8	68.6	-13.7
M200 6hr	300	78.7	0.278	0.75	15.74	0.00113	0.004	79.7	914.7	102.9	-23.2
M200 12hr	600	109.3	0.278	0.75	10.93	0.00113	0.003	110.8	1829.5	205.8	-95.1
M200 24hr	1200	151.7	0.278	0.75	7.585	0.00113	0.002	153.7	3659.0	411.6	-257.9
M200 48hr	2400	173.8	0.278	0.75	4.345	0.00113	0.001	176.1	7318.0	823.3	-647.2

Catchment		SP32							water discharge rate (l/s)		
Clean water natural flow									42.3		l/s/ha
1 in 200 year return	minutes	Rainfall (mm)		C	i (mm/hr)	A (km^2)	(m^3/s)	Volume (m^3)	Discharge (m^3/ha)	Discharge (m^3)	Residual Volume (m^3)
M200 5min	5	10.7	0.278	0.75	128.4	0.00127	0.034	10.2	12.7	1.6	8.6
M200 10min	10	14.9	0.278	0.75	89.4	0.00127	0.024	14.2	25.4	3.2	11.0
M200 15min	15	17.5	0.278	0.75	70	0.00127	0.019	16.7	38.1	4.8	11.8
M200 30min	30	24.3	0.278	0.75	48.6	0.00127	0.013	23.2	76.2	9.7	13.5
M200 60min	60	33.7	0.278	0.75	33.7	0.00127	0.009	32.1	152.5	19.4	12.8
M200 2hr	120	46.8	0.278	0.75	23.4	0.00127	0.006	44.6	304.9	38.7	5.9
M200 4hr	240	65	0.278	0.75	16.25	0.00127	0.004	62.0	609.8	77.4	-15.5
M200 6hr	300	78.7	0.278	0.75	15.74	0.00127	0.004	90.0	914.7	116.2	-26.1
M200 12hr	600	109.3	0.278	0.75	10.93	0.00127	0.003	125.0	1829.5	232.3	-107.3
M200 24hr	1200	151.7	0.278	0.75	7.585	0.00127	0.002	173.5	3659.0	464.7	-291.2
M200 48hr	2400	173.8	0.278	0.75	4.345	0.00127	0.001	198.8	7318.0	929.4	-730.6