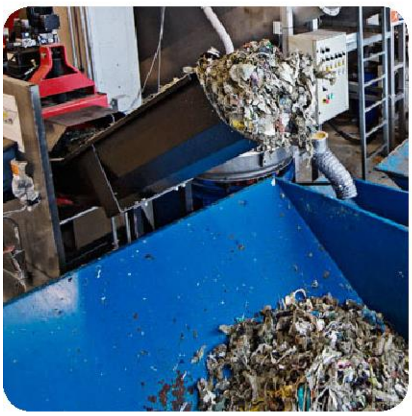
REnescience Northwich

Appendix G: Drainage Strategy







Appendix G - Addendum

The following paragraphs replace the text provided within paragraphs 4.19 and 4.20 of the Drainage Strategy Report (Appendix 8.A:Drainage Strategy).

4.19 The CLO material storage area will be covered by a formal canopy structure and will have walls on three sides. Roof drainage to this structure will be consistent with the strategy detailed above for other building roofs. Any liquid run-off from the CLO store will be drained to a central drainage channel, which will drain to a below ground holding sump and will be re-used within the process or if not suitable sent for off-site disposal.

4.20 RDF/SRF and recycled material will be stored on a concrete slab. Any rainwater or in the event of a leak liquid run-off from the storage area will be drained to a central drainage channel, which will drain to a below ground holding sump. The sump will include level monitoring and alarms to alert the operator before the sump becomes full. The contents of the sump will be monitored for contamination (e.g. pH and conductivity). Where the water is free from contamination the sump will be sent to the process water tank or manually discharged to Wade Brook. If contamination is identified the water will either be returned to the process water tank or off-site disposal arranged should the contents be unsuitable for process use.

Appendix 8.A: Drainage Strategy

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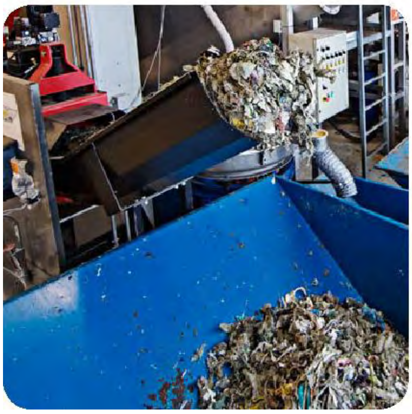
REnescience Northwich







Quality Management

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0	03/08/15	Draft	-	-
1	19/08/15	Draft	Initial internal review	TAD
2	29/09/15	Final	Foul drainage change	TAD

DISCLAIMER

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1 Introduction

General

1.1 This report has been produced to describe, in detail, the design principles and strategy required for the management of surface water runoff and foul water discharge from the proposed REnescience Northwich development.

1.2 The contents of this document are to be read in conjunction with all other supporting drawings or documents referenced herein or otherwise appended to this report, and/or submitted for the purposes of planning consent.

1.3 The project description in Chapter 2 of the ES gives full details of the proposed development, which comprises buildings for waste treatment, external bioreactors for enzyme treatment, tanks and associated pumps and pipework for anaerobic digestion, covered external storage areas for recyclable materials, refuse-derived fuel (RDF) and de-watered digestate (compost-like output, CLO), and associated hardstanding, vehicle movement, parking and landscape planting areas.

Site Description

1.4 The site is brownfield land that was previously used for chlorine manufacturing until 2001. At the time of previous re-development planning applications for the site in 2009 / 2010, buildings were still present, but they have since been demolished in 2013. At present, the site is cleared, with only residual foundation slabs, hardstandings, roadways and a disused security hut outside the site entrance gates remaining from the former industrial development. The site is fully enclosed by a palisade fence.

1.5 The site is generally flat with a large central plateau level of around 25.50m AOD. Site levels around the northern, western and southern boundaries are approximately 2m to 3m lower than the main plateau. This correlates with the levels of the existing railway line and associated sidings present to the north and south of the site. The wider site topography in terms of overland drainage flow paths generally trends in a southerly direction towards Wade Brook, which runs within a steeply sloping channel in an east-west direction just beyond the southern site boundary. The water level in Wade Brook is approximately 17.50m to 18.00m AOD (7.5m to 8.0m below existing general site levels).

1.6 The site area is sparsely vegetated, with only isolated trees and shrubs present around the site owing to the fact that the site is largely hard surfaced. The steep banks of Wade Brook to the south of the site are heavily wooded with trees and scrub to heights of approximately 10m.

1.7 Ground conditions identified by site investigation show a variable thickness of Made Ground is present from ground surface across the site. The thickness of Made Ground was generally greater in the northern half of the site. Made Ground is underlain by Glacial Till, which in turn overlies the Northwich Halite Formation.

1.8 More specifically, the geological strata encountered can be described as follows.

Made Ground

1.9 A variable thickness of Made Ground was encountered from the ground surface across the site. Made Ground was encountered to depths ranging from 0.10m, located in the southwest of the site, to 5.00m below ground level (bgl), located in the west of the site. The Made Ground was variable in nature, but generally comprised dark grey or brown, clayey, sand, gravel and cobbles, ranging to sandy, gravelly clay. Gravel and cobbles comprised brick, ash, clinker, sandstone, mudstone and wood.

Glacial Till

1.10 Glacial Till was encountered beneath the Made Ground at depths ranging from 0.10m to 5.00m bgl. The thickness of the stratum ranged from 2.20m to 13.20m (where proven) and was generally encountered to greatest depth in the south and west of the site. The base of the stratum was not encountered at depths of up to 15.50m bgl in the far west of the site. The stratum was variable in nature, but generally comprised red, occasionally grey, mottled, silty, sandy, occasionally gravelly clay. Gravel comprised fine to medium angular gravel of mudstone and sandstone. Rare clayey sand layers, up to 0.70m in thickness, were recorded in some locations.

Northwich Halite Formation

1.11 The surface of the Northwich Halite Formation was encountered at depths ranging from 5.70m to 13.30m bgl. The stratum was encountered as weak, red, brown, grey and green, sandy, highly to completely weathered mudstone.

1.12 Perched groundwater was encountered at depths ranging from 0.50m to 3.40m bgl, within the Made Ground, typically trapped within the depth or at the base of the Made Ground strata, which is in part granular in nature.

2 Existing Site Drainage

2.1 United Utilities sewer record plans indicate that there are no public sewers present within the vicinity of the proposed development site.

2.2 The site is currently served by privately owned and maintained surface water drains associated with the former chlorine production plant on the site. In addition, there are also a number of separate trade effluent drains present, which collected acid/ alkali and other miscellaneous effluents arising from the various former industrial processes undertaken on the site.

2.3 Surface water runoff from the site has historically been discharged to Wade Brook via a network of underground surface water drains. A small section of the site along the northern boundary, which is lower than the main plateau area and which is covered with stone ballast associated with the railway sidings serving the site, drains via infiltration and/or overland flows within the larger area of railway land beyond the northern boundary of the site.

2.4 Historic site plans dating back to the early to mid-1970s, when the site was most recently developed out as a chlorine production plant, indicate that surface water flows from the site at that time discharged via a 450mm diameter pipe outfall to Wade Brook, present just beyond the southern boundary of the site. No flow restrictions have been applied to the drainage outflow from this pipe.

2.5 The existing site impermeable area has been calculated as being approximately 2.19Ha, and which is identified on Figure 8.A. This drawing also identifies the extent of the existing main surface water drainage system layout present on site. The estimated maximum outflow to the surface water drainage outfall to Wade Brook has been assessed using MicroDrainage as Table 2.1, below. Design calculations for the existing network are included in Annex 8.A.1.

Table 2.1: Summary of existing surface water drainage system

Return Period	Critical Storm / Duration	Maximum Outflow	Drainage System Characteristics
1 in 1 year	15min, winter profile	238.1 L/s	No surcharging
1 in 30 year	15min, winter profile	428.7 L/s	Pipe surcharging, no flooding
1 in 100 year	15min, winter profile	502.9 L/s	Flooding, total 28.68m^3

2.6 In the course of a previous planning application for a waste treatment plant on this site by Viridor in 2009/2010, the Environment Agency was consulted as part of the planning process. This consultation concluded that all surface water discharge from any new site development should not exceed the existing outfall capacity for all discharges up to and including the 1 in 100 year flood event.

2.7 Based on the condition that the surface water discharge from the new development must not exceed the existing maximum 1 in 100 year storm event, it can be concluded that a maximum upper discharge limit of 502.9L/s will apply to the new development surface water drainage system.

3 Construction Stage Drainage

3.1 The site will initially be subject to a demolition operation to remove all remaining impermeable floor slabs, bases and hard paving surfaces. Recovered materials will be processed on site for re-use as engineered fill material. As part of this exercise, all redundant existing below ground drainage pipes (if not suitable for re-use) will either be grubbed up and removed, or filled and capped off using a cement based grout.

3.2 Existing surface water pipework connected to Wade Brook outfall will be retained upstream of the outfall for re-use as both a temporary and permanent means of surface water drainage disposal.

3.3 During construction, the site will be subject to a bulk earthworks cut and fill operation to re-profile the site to allow construction of new building structures, external plant and hardstanding areas. Measures will be put in place by the contractor to ensure temporary rainwater runoff from the site is collected and discharged in a controlled manner, including being treated by an appropriate means to remove silt and sedimentation from the runoff.

3.4 The project requires the construction of a large below ground waste storage bunker which will be 6m deep. The construction of this element is anticipated to be by means of an open cut excavation, and which will be formed as part of the overall bulk earthworks operation. The nature of this excavation, which will be within impermeable Glacial Till strata, will create a sump for rainwater runoff across the site during construction, either by direct overland flows or via infiltration flows through the overlying permeable horizons of made ground fill strata. As a result, a temporary land drainage system will be provided to the perimeter of the base of the bunker excavation to maintain a dry working environment at all times during construction. Disposal of collected rainwater will be via sump pumping to Wade Brook outfall via a silt interception / removal device.

3.5 Installation and ongoing management of surface water runoff for the duration of the construction works will be the responsibility of the contractor. All temporary drainage systems will be sized accordingly to ensure that adequate discharge flow capacity is available at all times. Temporary drainage systems will be regularly monitored and maintained by the contractor to ensure that all runoff is adequately contained within the site boundary at all times, and only discharged to Wade Brook at a rate less than the maximum existing surface water outfall capacity.

3.6 The contractor will develop a formal site management plan, which will address pollution management and control in relation to site vehicles, raw materials and waste generation, to ensure that all surface water runoff generated during the construction works is free of contamination.

3.7 These construction-stage requirements are set out in the Construction Environmental Management Plan at Appendix 2.C in Volume 3 of the Environmental Statement (ES).

4 Proposed Surface Water Drainage

4.1 The proposed site surface water drainage system will be a single gravity network, discharging via the existing 450 mm diameter outfall into Wade Brook. The surface water drainage run-off flow rate will be restricted to a maximum flow rate of 502.9L/s, in line with the calculated existing outfall capacity. The proposed new system is designed to positively drain all new building roofs and external hard-surfaced catchments.

4.2 The drainage system is designed to contain all surface water runoff in below-ground pipework and chambers during storms up to and including the 1 in 100 year return period (including climate change). Below-ground drainage pipework and chambers provide sufficient runoff attenuation to ensure that surface water during such flood events can be controlled and discharged from the existing Wade Brook outfall without surface flooding. The WinDes outputs for the proposed drainage design are provided in Annex 8.A.2 and summarised in Table 4.1, which confirm these criteria have been met.

4.3 Surface water within bunded areas (around AD tanks and bioreactors) will be retained within the respective bunds, to be discharged at a controlled rate to Wade Brook following inspection as required. This is detailed below.

4.4 The surface water drainage network has been designed to accommodate the long term effects of climate change. All rainfall intensities used in the design have been subject to increase allowing sufficient future proofing against climate change for the expected life of the development (25 years), and in accordance with current Environment Agency (EA) and planning guidelines. For the design life of the proposed development, a climate change effect factor of 20% will apply, and so design rainfall rates calculated for the new development have been increased accordingly.

4.5 The use of soakaways for disposal of surface water on site has been discounted on the grounds that the soil strata underlying the site, being Glacial Till and Northwich Halite Formation as described in section 1, have low permeability characteristics and so would not support direct infiltration of surface water runoff. In addition, Network Rail has indicated during consultation that soakaways to railway land should be avoided.

4.6 The proposed surface water drainage design is shown in Figure 8.C.

Building Roof Drainage

4.7 Large building roof areas will be drained by a specialist designed siphonic roof drainage system, with primary and secondary roof gutter outlets, designed in accordance with BS 8490 and BS EN 12056-3 to provide Category 3 protection for an envelope design life of 25 years. Small buildings and roof areas will be drained by traditional gravity means, designed in accordance with BS EN 12056-3.

4.8 Surface water runoff from all roof areas is classed as clean runoff, and as such requires no formal treatment prior to discharge to Wade Brook.

External Vehicular Hardstanding Drainage

4.9 External HGV circulation areas and vehicle parking areas will be drained via linear drainage channels, Beany-type linear kerb drains, and/or localised road gullies. All surface water drainage from vehicular parking or circulation areas will be trapped at point of source to remove silt or debris, then passed through a Class 1 bypass oil separator (with integral high level alarms) to ensure compliance with BS EN 858-1:2002, in accordance with Pollution Prevention Guideline document PPG3 ‘Use and design of Oil Separators in Surface Water Drainage Systems’.

4.10 The external vehicle fuelling station area will be isolated by way of a perimeter surface water drainage channel around the fuelling point to intercept potentially contaminated surface water runoff arising from re-fuelling activities. Runoff from this area will be passed through a Class 1 Forecourt oil separator (with integral high level alarms) to ensure compliance with BS EN 858-1:2002, in accordance with Pollution Prevention Guideline document PPG3 ‘Use and design of Oil Separators in Surface Water Drainage Systems’.

4.11 The proposed total site impermeable area has been calculated as being approximately 2.36 Ha, shown in Figure 8.B. This drawing also identifies the extent of the proposed main surface water drainage system on site, which is then shown in detail in Figure 8.C. Of this total area, 1.40 Ha is drained by free gravity discharge to Wade Brook, with the balance of 0.96 Ha retained within bunded storage areas for controlled discharge to Wade Brook. Discharge of rainwater from bunded areas of the site is discussed in the following sections of this report. The estimated maximum outflow to the surface water drainage outfall to Wade Brook has been assessed using MicroDrainage and results are summarised in Table 4.1, below. Design calculations for the proposed drainage network are included in Annex 8.A.2.

Table 4.1: Summary of proposed surface water drainage system

Return Period	Critical Storm / Duration	Maximum Outflow	Drainage System Characteristics
1 in 1 year	15min, winter profile	149.8 L/s	No surcharging
1 in 30 year	15min, winter profile	345.0 L/s	Pipe surcharging, storage in chambers
1 in 100 year	15min, winter profile	462.9 L/s	Pipe surcharging, storage in chambers

4.12 As can be seen from Table 4.1, the maximum free discharge from the proposed site surface water drainage system is 462.9L/s, under a 1 in 100 year storm event (with climate change effects). This is below the maximum existing site drainage system outfall flow rate of 502.9L/s for the same 1 in 100 year storm event and so it can therefore be demonstrated that the proposed site surface water drainage system from the new development has no detrimental effect to Wade Brook in an extreme rainfall event.

Anaerobic Digestion (AD) Tank Area Drainage

4.13 Surface water drainage to the proposed AD tank area will be contained within a fully watertight bunded area designed to BS EN 1992-3. General surface water runoff from this area will be collected within a perimeter drainage channel inside the perimeter bund wall. All general surface water runoff will be retained by default within the bunded tank area to avoid potentially contaminated surface water being discharged to Wade Brook. Release of runoff collected within the AD tank area will be controlled via a manually operated penstock valve. The penstock valve will default to the closed position, and only be opened to release collected runoff after formal inspection of the contents by a suitably qualified site operative.

4.14 A rainwater management regime will be implemented on site to ensure that standing water levels within the bunded area are controlled to acceptable levels, and to ensure that all runoff released to the surface water drainage system is fully inspected for cleanliness prior to discharge. The maximum permissible water volume will be equal to the 1 in 100 year storm event (plus climate change), which is 1,012 m^3. The maximum permissible rainwater level within the AD tank bund will be clearly identified by a maximum water level marker located adjacent to the penstock release valve.

4.15 The AD tank area will be afforded watertight bund protection to contain 25% of the combined working volume of all liquid containing AD tanks, which has been determined as 6,773 m^3. This volume is greater than 110% of the largest tank (a digester tank with a maximum capacity of 6,000 m^3). In addition, the bund will be sized to contain the volume of water attributable to the 1 in 100 year storm event, which is 1,012 m^3. A minimum freeboard of 100mm will be provided above the maximum predicted liquid level within the bunded area. The total containment volume within the AD tank bund will therefore be 7,785 m^3, with a bund wall height ranging from 0.83 m to 2.38 m (to account for the 1 in 80 longitudinal fall across the bund base level for drainage purposes) Calculations for the bund wall height are included in Annex 8.A.3.

Bio-reactor Tank Area Drainage

4.16 Surface water drainage within the proposed external bioreactor area will also be contained within a fully watertight bunded area designed to BS EN 1992-3. General surface water runoff from this area will be by collected within a perimeter drainage channel inside the perimeter bund wall. All general surface water runoff will be detained by default within the bunded area, to avoid potentially contaminated surface water being discharged to Wade Brook. Release of runoff collected within the bioreactor bunded area will be controlled via a manually operated penstock valve. The penstock valve will default to the closed position, and only be opened to release collected runoff after formal inspection of the contents by a suitably qualified site operative.

4.17 A rainwater management regime will be implemented on site to ensure that standing water levels within the bunded area are controlled to acceptable levels, and to ensure that all runoff released to the surface water drainage system is fully inspected for cleanliness prior to discharge. The maximum permissible water volume will be equal to the 1 in 100 year storm event (plus climate change), which is 81 m^3. The maximum permissible rainwater level within the bioreactor area bund will be clearly identified by a maximum water level marker located adjacent to the penstock release valve.

4.18 The bioreactor area will be afforded watertight bund protection to contain 110% volume of one of the two bioreactors, which has a maximum bio-liquid capacity of 270 m^3. This equates to a storage volume requirement of 297 m^3. In addition, the bund will be designed to contain the volume of water attributable to the 1 in 100 year storm event, which is 81 m^3. The total bioreactor bund containment is therefore 378m^3. A minimum freeboard of 100mm will be provided above the maximum predicted liquid level within the bunded area.

CLO / RDF Storage Areas Drainage

4.19 Both the CLO and RDF/recycled material storage areas will be covered by formal canopy structures such that rainwater will not be permitted to mix with any stored waste materials. Roof drainage to these canopy roof areas will be consistent with the strategy detailed above for other building roofs.

4.20 Any leakage or spillages of contaminated waste liquid within each of these storage areas will be drained to a centrally located drainage channel, which will drain to a below ground holding tank. Similarly any washdown of the floors in the CLO / RDF storage areas will be contained and drained to the holding tank for re-use in the waste process operation, or off-site disposal if and when required. The proposed drainage and tank arrangements are shown in Figure 8.C.

Fire Water Runoff Containment

4.21 Fire suppression systems shall be installed within the waste bunker and waste reception hall areas only. In the event of activation of the fire sprinkler systems provided within the building, fire water runoff will be directed by perimeter upstands / falls within the reception hall floor to the waste bunker, where it will be collected.

4.22 Fire water runoff from general firefighting water used by the Fire Service will be managed firstly with a manually operated penstock closure valve on the outfall of the surface water drainage system to Wade Brook. Proposed levels for the new development will be set such that all firefighting water runoff will be fully contained within the hard surfaced areas of the site, thus removing the risk of uncontrolled contaminated runoff leaving the site in the event of fire. This will in turn ensure compliance with Environment Agency Pollution Prevention Guideline document PPG18 ‘Managing Fire Water and Major Spillages’. Fire water run-off contained in such an event would be classed as contaminated run off and hence require off-site disposal by tanker.

5 Proposed Surface Water Design Parameters

5.1 The new surface water drainage system for the site has been designed using current Windes analysis software (by MicroDrainage), to prevent any flooding of the site and surrounding areas. The surface water drainage system has been designed in accordance with BS EN 752: 2008, *Drain and sewer systems outside buildings',* BS EN 12056-3 '*Gravity Drainage Inside Buildings – Roof Drainage, layout and calculation*' and Building Regulations Approved Document H *'Drainage and Waste Disposal'.*

Global Variables

- **Design return period:** 1, 30 and 100 years.
- **Climate change:** Rainfall intensity+20%
- **M5-60:** 19.2mm/hr
- **Ratio, 'r':** 0.408
- **Volumetric runoff coefficient:** 0.75 (summer) and 0.84 (winter)
- **Global time of entry:** 4 minutes
- **PIMP (%):** 100% impermeable area
- **Infiltration:** Ignore for peak flow design
- **Backdrops:** Permitted, maximum depth of 1.5m
- **Pipe velocity:** 0.75 m/s for self cleansing (private drainage system)
- **Surcharging:** No surcharging permitted during 1 in 2 year return period event.

5.2 The site surface water drainage system has been designed and checked against following storm intensities and durations:

- 2 year return period – 15 minute to 24 hour storm duration
- 30 year return period – 15 minute to 24 hour storm duration
- 100 year return period** – 15 minute to 24 hour storm duration

**plus climate change allowance

6 Proposed Foul Water Drainage

6.1 Foul water drainage from the new development will primarily be generated from staff welfare facilities within office areas, together with non-waste process related wash down areas, plant rooms etc.

6.2 Disposal of foul sewage arising from the new development site will be via an on-site cesspool, as there are no foul sewers or private foul drains available in the vicinity to facilitate an off-site connection.

6.3 In accordance with EA PPG4, the cesspool will be sited in a well ventilated area, away from any buildings, whilst also providing easy means of access for emptying. A high level warning alarm will also be provided to ensure the tank is emptied out at appropriate intervals.

6.4 The cesspool will be sized on a maximum site occupancy of 40 staff. Based on British Water Code of Practice – 'Flows and Loads', an industrial/factory development with no canteen would require an allowance of 50 Litres/ person/ day for foul effluent generation. This would equate to a maximum flow of 200Litres/ day for the site. In order to minimise frequency of tank emptying, allowance for up to 30 days' storage will be provided, therefore a 6,000L capacity effluent tank will be provided, shown in Figure 8.C.

Proposed Foul Water Design Parameters

6.5 The new foul water drainage system for the site has been designed using current Windes analysis software (by MicroDrainage), to prevent any flooding of the site and surrounding areas.

6.6 The foul water drainage system has been designed in accordance with BS EN 752: 2008, '*Drain and sewer systems outside buildings'*, BS EN 12056-2 '*Gravity Drainage Inside Buildings – Sanitary pipework, layout and calculation*' and Building Regulations Approved Document H *'Drainage and Waste Disposal'.*

Global Variables

- **Infiltration:** Ignore for peak flow design
- **Backdrops:** Permitted, maximum depth of 1.5m
- **Pipe velocity:** 0.75 m/s for self cleansing (private drainage system)

7 Maintenance

7.1 The following table indicates the anticipated drainage maintenance regime that will need to be followed.

Element	Access method including specific access equipment	Method/type of maintenance	Frequency required
Roof gutters / outlets	Scaffolding / Cherry pickers to be used where required	General cleaning and removal of debris from gutters /outlets. Jet cleaning where required	Bi-annual inspection. Periodic inspection of gutter coatings to prevent corrosion
Oil separators	In accordance with Health and Safety regulations. Confined spaces regulations apply	Refer to manufacturer's guidance. Removal of waste oils and sludge from units	Bi-annual inspection
Channel / kerb drains	In accordance with Health and Safety regulations	Regular performance monitoring to prevent blockages. Jet cleaning	Bi-annual inspection
Silt-traps / gullies	In accordance with Health and Safety regulations	Monitor to ensure no blockages develop. Sludge removal	Bi-annual inspection
Pump chambers	In accordance with Health and Safety regulations. Confined spaces regulations apply	Maintain in accordance with manufacturers recommendations.	Bi-annual inspection or as pump manufacturer's recommendations, whichever occurs first
Headwalls	In accordance with Health and Safety regulations	Monitor to ensure no blockages develop. Clearance of debris from trash screens	Bi-annual inspection
Penstock valves	In accordance with Health and Safety regulations. Confined spaces regulations apply	Refer to Manufacturer's guidance for details.	Bi-annual inspection
Hydrobrake units	In accordance with Health and Safety regulations. Confined spaces regulations apply	Monitor to ensure no blockages develop. in accordance with the manufacturers recommendations	Bi-annual inspection

Annex 8.A.1:Existing Network Analysis

STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for Storm

Pipe Sizes STANDARD Manhole Sizes STANDARD

FSR Rainfall Model - England and Wales

Return Period (years)	1	Add Flow / Climate Change (%)	0
M5-60 (mm)	19.200	Minimum Backdrop Height (m)	1.500
Ratio R	0.408	Maximum Backdrop Height (m)	2.500
Maximum Rainfall (mm/hr)	75	Min Design Depth for Optimisation (m)	1.200
Maximum Time of Concentration (mins)	30	Min Vel for Auto Design only (m/s)	1.00
Foul Sewage (l/s/ha)	0.000	Min Slope for Optimisation (1:X)	500
Volumetric Runoff Coeff.	0.750		

Designed with Level Inverts

Time Area Diagram for Storm

Time (mins)	Area (ha)	Time (mins)	Area (ha)
0-4	1.140	4-8	1.049

Total Area Contributing (ha) = 2.189

Total Pipe Volume (m³) = 52.268

Network Design Table for Storm

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Auto Design
1.000	24.000	0.200	120.0	0.068	4.00	0.0	0.600	o	150	
1.001	32.000	0.345	92.8	0.092	0.00	0.0	0.600	o	225	
2.000	34.000	0.283	120.1	0.091	4.00	0.0	0.600	o	150	
2.001	11.000	0.092	119.6	0.016	0.00	0.0	0.600	o	225	
1.002	38.000	0.317	119.9	0.060	0.00	0.0	0.600	o	225	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
1.000	55.88	4.44	23.720	0.068	0.0	0.0	0.0	0.92	16.2	10.3
1.001	53.91	4.83	23.520	0.160	0.0	0.0	0.0	1.36	54.0	23.4
2.000	54.95	4.62	23.550	0.091	0.0	0.0	0.0	0.92	16.2	13.5
2.001	54.18	4.77	23.267	0.107	0.0	0.0	0.0	1.19	47.5	15.7
1.002	51.48	5.36	23.175	0.327	0.0	0.0	0.0	1.19	47.4	45.6

Network Design Table for Storm

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Auto Design
3.000	13.000	0.108	120.4	0.060	4.00	0.0	0.600	o	150	
3.001	28.000	0.694	40.3	0.057	0.00	0.0	0.600	o	150	
1.003	25.000	0.400	62.5	0.098	0.00	0.0	0.600	o	300	
1.004	20.000	0.242	82.6	0.053	0.00	0.0	0.600	o	300	
4.000	30.000	0.250	120.0	0.081	4.00	0.0	0.600	o	225	
4.001	35.000	0.292	119.9	0.110	0.00	0.0	0.600	o	225	
4.002	31.000	0.962	32.2	0.140	0.00	0.0	0.600	o	225	
1.005	33.000	0.275	120.0	0.085	0.00	0.0	0.600	o	375	
1.006	48.000	0.400	120.0	0.090	0.00	0.0	0.600	o	375	
1.007	22.000	0.220	100.0	0.081	0.00	0.0	0.600	o	375	
1.008	36.000	0.397	90.7	0.102	0.00	0.0	0.600	o	375	
5.000	38.000	0.317	119.9	0.108	4.00	0.0	0.600	o	150	
5.001	42.000	0.350	120.0	0.075	0.00	0.0	0.600	o	225	
5.002	20.000	0.167	119.8	0.039	0.00	0.0	0.600	o	225	
5.003	25.000	0.283	88.3	0.047	0.00	0.0	0.600	o	225	
6.000	40.000	0.333	120.1	0.129	4.00	0.0	0.600	o	225	
6.001	36.000	0.784	45.9	0.089	0.00	0.0	0.600	o	225	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
3.000	56.95	4.24	23.660	0.060	0.0	0.0	0.0	0.91	16.2	9.3
3.001	55.40	4.53	23.552	0.117	0.0	0.0	0.0	1.59	28.1	17.6
1.003	50.59	5.57	22.858	0.542	0.0	0.0	0.0	1.99	140.8	74.3
1.004	49.80	5.76	22.458	0.595	0.0	0.0	0.0	1.73	122.3	80.2
4.000	55.97	4.42	23.720	0.081	0.0	0.0	0.0	1.19	47.4	12.3
4.001	53.53	4.91	23.470	0.191	0.0	0.0	0.0	1.19	47.4	27.7
4.002	52.49	5.13	23.178	0.331	0.0	0.0	0.0	2.31	92.0	47.1
1.005	48.50	6.09	22.216	1.011	0.0	0.0	0.0	1.65	182.6	132.8
1.006	46.74	6.58	21.941	1.101	0.0	0.0	0.0	1.65	182.6	139.4
1.007	46.05	6.78	21.541	1.182	0.0	0.0	0.0	1.81	200.1	147.4
1.008	45.01	7.10	21.321	1.284	0.0	0.0	0.0	1.90	210.2	156.5
5.000	54.59	4.69	23.720	0.108	0.0	0.0	0.0	0.92	16.2	16.0
5.001	51.84	5.28	23.403	0.183	0.0	0.0	0.0	1.19	47.4	25.7
5.002	50.64	5.56	23.053	0.222	0.0	0.0	0.0	1.19	47.5	30.4
5.003	49.42	5.86	22.886	0.269	0.0	0.0	0.0	1.39	55.3	36.0
6.000	55.25	4.56	23.720	0.129	0.0	0.0	0.0	1.19	47.4	19.3
6.001	53.72	4.87	23.387	0.218	0.0	0.0	0.0	1.94	77.0	31.7

Network Design Table for Storm

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Auto Design
5.004	33.000	0.275	120.0	0.086	0.00	0.0	0.600	o	300	
5.005	68.000	1.404	48.4	0.104	0.00	0.0	0.600	o	300	
1.009	35.000	0.292	119.9	0.108	0.00	0.0	0.600	o	450	
1.010	32.000	2.777	11.5	0.120	0.00	0.0	0.600	o	450	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
5.004	47.95	6.24	22.603	0.573	0.0	0.0	0.0	1.43	101.4	74.4
5.005	46.18	6.74	22.328	0.677	0.0	0.0	0.0	2.26	160.1	84.7
1.009	44.03	7.41	20.924	2.069	0.0	0.0	0.0	1.86	295.2	246.7
1.010	43.76	7.50	20.632	2.189	0.0	0.0	0.0	6.01	956.6	259.4

Free Flowing Outfall Details for Storm

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
1.010	headwall	19.680	17.855	0.000	0	0

Simulation Criteria for Storm

Volumetric Runoff Coeff	0.750	Additional Flow - % of Total Flow	0.000
Areal Reduction Factor	1.000	MADD Factor * 10m³/ha Storage	2.000
Hot Start (mins)	0	Inlet Coeffiecient	0.800
Hot Start Level (mm)	0	Flow per Person per Day (l/per/day)	0.000
Manhole Headloss Coeff (Global)	0.500	Run Time (mins)	60
Foul Sewage per hectare (l/s)	0.000	Output Interval (mins)	1

Number of Input Hydrographs	0	Number of Offline Controls	0	Number of Time/Area Diagrams	0
Number of Online Controls	0	Number of Storage Structures	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FSR	Profile Type	Summer
Return Period (years)	1	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	19.200	Storm Duration (mins)	30
Ratio R	0.408		

Summary of Critical Results by Maximum Level (Rank 1) for Storm

Simulation Criteria

Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	0.000
Hot Start (mins)	0	MADD Factor * 10m³/ha Storage	2.000
Hot Start Level (mm)	0	Inlet Coeffiecient	0.800
Manhole Headloss Coeff (Global)	0.500	Flow per Person per Day (l/per/day)	0.000
Foul Sewage per hectare (l/s)	0.000		

Number of Input Hydrographs	0	Number of Offline Controls	0	Number of Time/Area Diagrams	0
Number of Online Controls	0	Number of Storage Structures	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FSR	Ratio R	0.408
Region	England and Wales	Cv (Summer)	0.750
M5-60 (mm)	19.200	Cv (Winter)	0.840

Margin for Flood Risk Warning (mm)	300.0	DVD Status	OFF
Analysis Timestep	Fine	Inertia Status	OFF
DTS Status	ON		

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440
Return Period(s) (years)	1, 30, 100
Climate Change (%)	0, 0, 0

PN	Storm	Return Period	Climate Change	First X Surcharge	First Y Flood	First Z Overflow	O/F Act.	Lvl Exc.
1.000	15 Winter	100	0%	30/15 Summer	100/15 Summer			4
1.001	15 Winter	100	0%	30/15 Summer	100/15 Summer			4
2.000	15 Winter	100	0%	30/15 Summer	100/15 Summer			4
2.001	15 Winter	100	0%	30/15 Summer	100/15 Summer			4
1.002	15 Winter	100	0%	30/15 Summer				
3.000	15 Winter	100	0%	30/15 Summer	100/15 Summer			4
3.001	15 Winter	100	0%	30/15 Summer	100/15 Summer			2
1.003	15 Winter	100	0%	30/15 Summer				
1.004	15 Winter	100	0%	30/15 Summer				
4.000	15 Winter	100	0%	30/15 Summer	100/15 Summer			2
4.001	15 Winter	100	0%	30/15 Summer	100/15 Summer			2
4.002	15 Winter	100	0%	30/15 Summer	100/15 Winter			1
1.005	15 Winter	100	0%	30/15 Summer				
1.006	15 Winter	100	0%	30/15 Summer				
1.007	15 Winter	100	0%	30/15 Summer				
1.008	15 Winter	100	0%	30/15 Summer				
5.000	15 Winter	100	0%	30/15 Summer	100/15 Summer			4
5.001	15 Winter	100	0%	30/15 Summer				
5.002	15 Winter	100	0%	30/15 Summer				
5.003	15 Winter	100	0%	30/15 Summer				
6.000	15 Winter	100	0%	30/15 Summer				
6.001	15 Winter	100	0%	30/15 Summer				
5.004	15 Winter	100	0%	30/15 Summer				
5.005	15 Winter	100	0%	30/15 Summer				
1.009	15 Winter	100	0%	30/15 Summer				
1.010	15 Winter	100	0%					

Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	Water Level (m)	Surch'ed Depth (m)	Flooded Volume (m³)	Flow / Cap.	O'flow (l/s)	Pipe Flow (l/s)	Status
1.000	1	25.134	1.264	4.108	1.71	0.0	26.3	FLOOD
1.001	2	25.131	1.386	1.286	0.71	0.0	36.1	FLOOD
2.000	3	25.076	1.376	5.605	1.72	0.0	26.8	FLOOD
2.001	4	25.052	1.560	1.688	0.76	0.0	30.4	FLOOD
1.002	5	25.084	1.684	0.000	1.45	0.0	64.9	FLOOD RISK
3.000	6	24.775	0.965	5.037	1.82	0.0	26.8	FLOOD
3.001	7	24.860	1.158	0.418	1.11	0.0	29.7	FLOOD
1.003	8	24.870	1.712	0.000	0.85	0.0	106.5	FLOOD RISK
1.004	9	24.705	1.947	0.000	1.11	0.0	118.0	SURCHARGED
4.000	10	25.174	1.229	4.278	0.94	0.0	41.8	FLOOD
4.001	11	25.181	1.486	1.542	1.26	0.0	56.3	FLOOD
4.002	12	25.170	1.767	0.022	0.87	0.0	74.4	FLOOD
1.005	13	24.491	1.900	0.000	1.21	0.0	197.8	SURCHARGED
1.006	14	24.073	1.757	0.000	1.33	0.0	224.2	SURCHARGED
1.007	15	23.350	1.434	0.000	1.45	0.0	247.1	SURCHARGED
1.008	16	22.886	1.190	0.000	1.46	0.0	275.8	SURCHARGED
5.000	17	25.135	1.265	4.692	1.92	0.0	30.1	FLOOD
5.001	18	25.032	1.404	0.000	0.87	0.0	39.4	FLOOD RISK
5.002	19	24.856	1.578	0.000	1.18	0.0	50.9	SURCHARGED
5.003	20	24.677	1.566	0.000	1.14	0.0	58.0	SURCHARGED
6.000	21	25.031	1.086	0.000	0.97	0.0	43.7	FLOOD RISK
6.001	22	24.830	1.218	0.000	0.81	0.0	59.0	SURCHARGED
5.004	23	24.318	1.415	0.000	1.50	0.0	138.9	SURCHARGED
5.005	24	23.706	1.078	0.000	1.08	0.0	165.4	SURCHARGED
1.009	25	22.035	0.661	0.000	1.81	0.0	468.6	SURCHARGED
1.010	26	20.887	-0.195	0.000	0.61	0.0	502.9	OK

Annex 8.A.2:Proposed Network Analysis

STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for Storm

Pipe Sizes STANDARD Manhole Sizes STANDARD

FSR Rainfall Model - England and Wales

Return Period (years)	1	Add Flow / Climate Change (%)	0
M5-60 (mm)	19.200	Minimum Backdrop Height (m)	0.200
Ratio R	0.408	Maximum Backdrop Height (m)	1.500
Maximum Rainfall (mm/hr)	75	Min Design Depth for Optimisation (m)	1.200
Maximum Time of Concentration (mins)	30	Min Vel for Auto Design only (m/s)	1.00
Foul Sewage (l/s/ha)	0.000	Min Slope for Optimisation (1:X)	500
Volumetric Runoff Coeff.	0.750		

Designed with Level Inverts

Time Area Diagram for Storm

Time (mins)	**Area (ha)**	**Time (mins)**	**Area (ha)**	**Time (mins)**	**Area (ha)**	**Time (mins)**	**Area (ha)**
0-4	0.656	4-8	0.650	8-12	0.059	12-16	0.007

Total Area Contributing (ha) = 1.371

Total Pipe Volume (m³) = 43.509

Network Design Table for Storm

PN	**Length (m)**	**Fall (m)**	**Slope (1:X)**	**I.Area (ha)**	**T.E. (mins)**	**Base Flow (l/s)**	**k (mm)**	**HYD SECT**	**DIA (mm)**	**Auto Design**
1.000	11.000	0.110	100.0	0.025	10.00	0.0	0.600	o	150	🔒
2.000	8.830	0.088	100.0	0.000	4.00	0.0	0.600	o	150	🔒
2.001	9.560	0.096	100.0	0.000	0.00	0.0	0.600	o	150	🔒
1.001	37.290	0.373	100.0	0.066	0.00	0.0	0.600	o	150	🔒

Network Results Table

PN	**Rain (mm/hr)**	**T.C. (mins)**	**US/IL (m)**	**Σ I.Area (ha)**	**Σ Base Flow (l/s)**	**Foul (l/s)**	**Add Flow (l/s)**	**Vel (m/s)**	**Cap (l/s)**	**Flow (l/s)**
1.000	37.18	10.18	23.825	0.025	0.0	0.0	0.0	1.00	17.8	2.5
2.000	57.45	4.15	23.825	0.000	0.0	0.0	0.0	1.00	17.8	0.0
2.001	56.58	4.31	23.737	0.000	0.0	0.0	0.0	1.00	17.8	0.0
1.001	36.02	10.80	23.641	0.091	0.0	0.0	0.0	1.00	17.8	8.9

Network Design Table for Storm

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Auto Design
3.000	21.740	0.217	100.2	0.015	4.00	0.0	0.600	o	150	
4.000	6.150	0.037	166.2	0.135	4.00	0.0	0.600	o	225	
1.002	39.450	0.240	164.4	0.000	0.00	0.0	0.600	o	225	
5.000	8.200	0.050	164.0	0.070	10.00	0.0	0.600	o	225	
5.001	42.880	0.260	164.9	0.030	0.00	0.0	0.600	o	225	
6.000	27.340	0.166	164.7	0.036	4.00	0.0	0.600	o	225	
7.000	7.500	0.045	166.7	0.135	4.00	0.0	0.600	o	225	
1.003	28.100	0.088	319.3	0.000	0.00	0.0	0.600	o	375	
8.000	3.000	0.030	100.0	0.030	4.00	0.0	0.600	o	150	
1.004	30.300	0.095	318.9	0.000	0.00	0.0	0.600	o	375	
9.000	15.320	0.093	164.7	0.052	10.00	0.0	0.600	o	225	
9.001	34.190	0.207	165.2	0.013	0.00	0.0	0.600	o	225	
9.002	23.040	0.140	164.6	0.040	0.00	0.0	0.600	o	225	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
3.000	56.28	4.36	24.025	0.015	0.0	0.0	0.0	1.00	17.7	2.3
4.000	57.70	4.10	23.305	0.135	0.0	0.0	0.0	1.01	40.2	21.1
1.002	34.89	11.45	23.193	0.241	0.0	0.0	0.0	1.02	40.4	22.8
5.000	37.27	10.13	23.700	0.070	0.0	0.0	0.0	1.02	40.5	7.1
5.001	35.95	10.84	23.650	0.100	0.0	0.0	0.0	1.02	40.4	9.7
6.000	55.82	4.45	23.950	0.036	0.0	0.0	0.0	1.02	40.4	5.4
7.000	57.58	4.12	23.790	0.135	0.0	0.0	0.0	1.01	40.2	21.1
1.003	34.13	11.91	22.803	0.512	0.0	0.0	0.0	1.01	111.4	47.3
8.000	58.00	4.05	23.900	0.030	0.0	0.0	0.0	1.00	17.8	4.7
1.004	33.35	12.41	22.715	0.542	0.0	0.0	0.0	1.01	111.4	48.9
9.000	37.05	10.25	23.650	0.052	0.0	0.0	0.0	1.02	40.4	5.2
9.001	35.99	10.81	23.557	0.065	0.0	0.0	0.0	1.01	40.3	6.3
9.002	35.33	11.19	22.850	0.105	0.0	0.0	0.0	1.02	40.4	10.0

Network Design Table for Storm

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Auto Design
1.005	27.410	0.137	200.1	0.035	0.00	0.0	0.600	o	375	🔒
10.000	10.900	0.066	165.2	0.106	4.00	0.0	0.600	o	225	🔒
1.006	12.730	0.064	198.9	0.000	0.00	0.0	0.600	o	375	🔒
11.000	4.610	0.028	164.6	0.040	4.00	0.0	0.600	o	225	🔒
11.001	18.000	0.110	163.6	0.000	0.00	0.0	0.600	o	225	🔒
1.007	8.000	0.040	200.0	0.000	0.00	0.0	0.600	o	375	🔒
1.008	9.500	0.048	197.9	0.000	0.00	0.0	0.600	o	375	🔒
12.000	24.950	0.151	165.2	0.036	4.00	0.0	0.600	o	225	🔒
13.000	19.013	0.115	165.3	0.110	4.00	0.0	0.600	o	225	🔒
12.001	10.700	0.045	237.8	0.050	0.00	0.0	0.600	o	300	🔒
12.002	9.500	0.040	237.5	0.015	0.00	0.0	0.600	o	300	🔒
12.003	22.800	0.095	240.0	0.015	0.00	0.0	0.600	o	300	🔒
12.004	30.650	0.128	239.5	0.045	0.00	0.0	0.600	o	300	🔒
12.005	28.000	0.117	239.3	0.050	0.00	0.0	0.600	o	300	🔒

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
1.005	32.82	12.77	21.489	0.682	0.0	0.0	0.0	1.28	141.1	60.6
10.000	57.27	4.18	21.418	0.106	0.0	0.0	0.0	1.01	40.3	16.4
1.006	32.58	12.94	21.352	0.788	0.0	0.0	0.0	1.28	141.5	69.5
11.000	57.85	4.08	24.050	0.040	0.0	0.0	0.0	1.02	40.4	6.3
11.001	56.23	4.37	22.398	0.040	0.0	0.0	0.0	1.02	40.5	6.3
1.007	32.43	13.04	21.288	0.828	0.0	0.0	0.0	1.28	141.1	72.7
1.008	32.25	13.16	21.148	0.828	0.0	0.0	0.0	1.28	141.8	72.7
12.000	56.02	4.41	23.935	0.036	0.0	0.0	0.0	1.01	40.3	5.5
13.000	56.54	4.31	23.899	0.110	0.0	0.0	0.0	1.01	40.3	16.8
12.001	55.11	4.59	23.709	0.196	0.0	0.0	0.0	1.02	71.8	29.3
12.002	54.34	4.74	23.664	0.211	0.0	0.0	0.0	1.02	71.8	31.0
12.003	52.56	5.12	23.624	0.226	0.0	0.0	0.0	1.01	71.4	32.2
12.004	50.37	5.62	23.529	0.271	0.0	0.0	0.0	1.01	71.5	37.0
12.005	48.54	6.08	23.401	0.321	0.0	0.0	0.0	1.01	71.5	42.2

Network Design Table for Storm

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Auto Design
14.000	21.000	0.127	165.4	0.027	4.00	0.0	0.600	o	225	🔒
14.001	34.400	0.143	240.6	0.076	0.00	0.0	0.600	o	225	🔒
14.002	25.960	0.157	165.4	0.018	0.00	0.0	0.600	o	225	🔒
14.003	10.100	0.061	165.6	0.000	0.00	0.0	0.600	o	225	🔒
12.006	42.100	0.211	199.5	0.050	0.00	0.0	0.600	o	300	🔒
15.000	12.633	0.077	164.1	0.051	4.00	0.0	0.600	o	225	🔒
12.007	21.100	0.106	199.1	0.000	0.00	0.0	0.600	o	300	🔒
1.009	13.150	1.100	12.0	0.000	0.00	0.0	0.600	o	450	🔒

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
14.000	56.37	4.35	23.925	0.027	0.0	0.0	0.0	1.01	40.3	4.1
14.001	52.96	5.03	23.798	0.103	0.0	0.0	0.0	0.84	33.3	14.8
14.002	51.07	5.46	23.655	0.121	0.0	0.0	0.0	1.01	40.3	16.7
14.003	50.37	5.62	23.498	0.121	0.0	0.0	0.0	1.01	40.3	16.7
12.006	46.27	6.72	22.417	0.492	0.0	0.0	0.0	1.11	78.4	61.6
15.000	57.12	4.21	22.283	0.051	0.0	0.0	0.0	1.02	40.5	7.9
12.007	45.22	7.03	21.206	0.543	0.0	0.0	0.0	1.11	78.5	66.5
1.009	32.20	13.20	19.100	1.371	0.0	0.0	0.0	5.90	939.1	119.6

Manhole Schedules for Storm

MH Name	MH CL (m)	MH Depth (m)	MH Connection	MH Diam.,L*W (mm)	PN	Pipe Out Invert Level (m)	Diameter (mm)	PN	Pipes In Invert Level (m)	Diameter (mm)	Backdrop (mm)
CP1	25.175	1.350	Open Manhole	1200	1.000	23.825	150				
CP2	25.175	1.350	Open Manhole	1200	2.000	23.825	150				
RET1	25.175	1.438	Open Manhole	1200	2.001	23.737	150	2.000	23.737	150	
S1	25.215	1.574	Open Manhole	1200	1.001	23.641	150	1.000	23.715	150	74
								2.001	23.641	150	
CP3	25.375	1.350	Open Manhole	1200	3.000	24.025	150				
CP4	25.090	1.785	Open Manhole	1200	4.000	23.305	225				
S2	25.250	2.057	Open Manhole	1200	1.002	23.193	225	1.001	23.268	150	
								3.000	23.808	150	540
								4.000	23.268	225	75
CP5	25.000	1.300	Open Manhole	1200	5.000	23.700	225				
S3	25.275	1.625	Open Manhole	1200	5.001	23.650	225	5.000	23.650	225	
CP6	25.250	1.300	Open Manhole	1200	6.000	23.950	225				
CP7	25.090	1.300	Open Manhole	1200	7.000	23.790	225				
S4	25.275	2.472	Open Manhole	1350	1.003	22.803	375	1.002	22.953	225	
								5.001	23.390	225	437
								6.000	23.784	225	831
								7.000	23.745	225	792
CP8	25.200	1.300	Open Manhole	1200	8.000	23.900	150				

Manhole Schedules for Storm

MH Name	MH CL (m)	MH Depth (m)	MH Connection	MH Diam.,L*W (mm)	PN	Pipe Out Invert Level (m)	Diameter (mm)	PN	Pipes In Invert Level (m)	Diameter (mm)	Backdrop (mm)
S5	25.240	2.525	Open Manhole	1350	1.004	22.715	375	1.003	22.715	375	
								8.000	23.870	150	930
CP11	25.250	1.600	Open Manhole	1200	9.000	23.650	225				
S6	25.375	1.818	Open Manhole	1200	9.001	23.557	225	9.000	23.557	225	
S7	25.390	2.540	Open Manhole	1200	9.002	22.850	225	9.001	23.350	225	500
S8	25.460	3.971	Open Manhole	1350	1.005	21.489	375	1.004	22.620	375	1131
								9.002	22.710	225	1071
CP12	25.025	3.607	Open Manhole	1200	10.000	21.418	225				
S9	25.180	3.828	Open Manhole	1350	1.006	21.352	375	1.005	21.352	375	
								10.000	21.352	225	
CP15	25.350	1.300	Open Manhole	1200	11.000	24.050	225				
S10	25.400	3.002	Open Manhole	1200	11.001	22.398	225	11.000	24.022	225	1624
S11	25.180	3.892	Open Manhole	1350	1.007	21.288	375	1.006	21.288	375	
								11.001	22.288	225	850
BYP1	25.180	4.032	Open Manhole	1350	1.008	21.148	375	1.007	21.248	375	100
S12	25.360	1.425	Open Manhole	1200	12.000	23.935	225				
S13	25.435	1.536	Open Manhole	1200	13.000	23.899	225				
S14	25.375	1.666	Open Manhole	1200	12.001	23.709	300	12.000	23.784	225	
								13.000	23.784	225	

Manhole Schedules for Storm

MH Name	MH CL (m)	MH Depth (m)	MH Connection	MH Diam.,L*W (mm)	PN	Pipe Out Invert Level (m)	Diameter (mm)	PN	Pipes In Invert Level (m)	Diameter (mm)	Backdrop (mm)
S15	25.350	1.686	Open Manhole	1200	12.002	23.664	300	12.001	23.664	300	
S16	25.350	1.726	Open Manhole	1200	12.003	23.624	300	12.002	23.624	300	
S17	25.375	1.846	Open Manhole	1200	12.004	23.529	300	12.003	23.529	300	
S18	25.325	1.924	Open Manhole	1200	12.005	23.401	300	12.004	23.401	300	
S20	25.350	1.425	Open Manhole	1200	14.000	23.925	225				
S21	25.350	1.552	Open Manhole	1200	14.001	23.798	225	14.000	23.798	225	
S22	25.260	1.605	Open Manhole	1200	14.002	23.655	225	14.001	23.655	225	
S23	25.100	1.602	Open Manhole	1200	14.003	23.498	225	14.002	23.498	225	
S19	25.325	2.908	Open Manhole	1200	12.006	22.417	300	12.005	23.284	300	867
								14.003	23.437	225	945
S24	25.120	2.837	Open Manhole	1200	15.000	22.283	225				
S25	25.300	4.094	Open Manhole	1200	12.007	21.206	300	12.006	22.206	300	1000
								15.000	22.206	225	925
S26	23.000	3.900	Open Manhole	1350	1.009	19.100	450	1.008	21.100	375	1925
								12.007	21.100	300	1850
Ex Headwall	19.680	1.680	Open Manhole	0		OUTFALL		1.009	18.000	450	

PIPELINE SCHEDULES for Storm

Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
1.000	o	150	CP1	25.175	23.825	1.200	Open Manhole	1200
2.000	o	150	CP2	25.175	23.825	1.200	Open Manhole	1200
2.001	o	150	RET1	25.175	23.737	1.288	Open Manhole	1200
1.001	o	150	S1	25.215	23.641	1.424	Open Manhole	1200
3.000	o	150	CP3	25.375	24.025	1.200	Open Manhole	1200
4.000	o	225	CP4	25.090	23.305	1.560	Open Manhole	1200
1.002	o	225	S2	25.250	23.193	1.832	Open Manhole	1200
5.000	o	225	CP5	25.000	23.700	1.075	Open Manhole	1200
5.001	o	225	S3	25.275	23.650	1.400	Open Manhole	1200
6.000	o	225	CP6	25.250	23.950	1.075	Open Manhole	1200
7.000	o	225	CP7	25.090	23.790	1.075	Open Manhole	1200
1.003	o	375	S4	25.275	22.803	2.097	Open Manhole	1350

Downstream Manhole

PN	Length (m)	Slope (1:X)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
1.000	11.000	100.0	S1	25.215	23.715	1.350	Open Manhole	1200
2.000	8.830	100.0	RET1	25.175	23.737	1.288	Open Manhole	1200
2.001	9.560	100.0	S1	25.215	23.641	1.424	Open Manhole	1200
1.001	37.290	100.0	S2	25.250	23.268	1.832	Open Manhole	1200
3.000	21.740	100.2	S2	25.250	23.808	1.292	Open Manhole	1200
4.000	6.150	166.2	S2	25.250	23.268	1.757	Open Manhole	1200
1.002	39.450	164.4	S4	25.275	22.953	2.097	Open Manhole	1350
5.000	8.200	164.0	S3	25.275	23.650	1.400	Open Manhole	1200
5.001	42.880	164.9	S4	25.275	23.390	1.660	Open Manhole	1350
6.000	27.340	164.7	S4	25.275	23.784	1.266	Open Manhole	1350
7.000	7.500	166.7	S4	25.275	23.745	1.305	Open Manhole	1350
1.003	28.100	319.3	S5	25.240	22.715	2.150	Open Manhole	1350

PIPELINE SCHEDULES for Storm

Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
8.000	o	150	CP8	25.200	23.900	1.150	Open Manhole	1200
1.004	o	375	S5	25.240	22.715	2.150	Open Manhole	1350
9.000	o	225	CP11	25.250	23.650	1.375	Open Manhole	1200
9.001	o	225	S6	25.375	23.557	1.593	Open Manhole	1200
9.002	o	225	S7	25.390	22.850	2.315	Open Manhole	1200
1.005	o	375	S8	25.460	21.489	3.596	Open Manhole	1350
10.000	o	225	CP12	25.025	21.418	3.382	Open Manhole	1200
1.006	o	375	S9	25.180	21.352	3.453	Open Manhole	1350
11.000	o	225	CP15	25.350	24.050	1.075	Open Manhole	1200
11.001	o	225	S10	25.400	22.398	2.777	Open Manhole	1200
1.007	o	375	S11	25.180	21.288	3.517	Open Manhole	1350
1.008	o	375	BYP1	25.180	21.148	3.657	Open Manhole	1350

Downstream Manhole

PN	Length (m)	Slope (1:X)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
8.000	3.000	100.0	S5	25.240	23.870	1.220	Open Manhole	1350
1.004	30.300	318.9	S8	25.460	22.620	2.465	Open Manhole	1350
9.000	15.320	164.7	S6	25.375	23.557	1.593	Open Manhole	1200
9.001	34.190	165.2	S7	25.390	23.350	1.815	Open Manhole	1200
9.002	23.040	164.6	S8	25.460	22.710	2.525	Open Manhole	1350
1.005	27.410	200.1	S9	25.180	21.352	3.453	Open Manhole	1350
10.000	10.900	165.2	S9	25.180	21.352	3.603	Open Manhole	1350
1.006	12.730	198.9	S11	25.180	21.288	3.517	Open Manhole	1350
11.000	4.610	164.6	S10	25.400	24.022	1.153	Open Manhole	1200
11.001	18.000	163.6	S11	25.180	22.288	2.667	Open Manhole	1350
1.007	8.000	200.0	BYP1	25.180	21.248	3.557	Open Manhole	1350
1.008	9.500	197.9	S26	23.000	21.100	1.525	Open Manhole	1350

PIPELINE SCHEDULES for Storm

Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
12.000	o	225	S12	25.360	23.935	1.200	Open Manhole	1200
13.000	o	225	S13	25.435	23.899	1.311	Open Manhole	1200
12.001	o	300	S14	25.375	23.709	1.366	Open Manhole	1200
12.002	o	300	S15	25.350	23.664	1.386	Open Manhole	1200
12.003	o	300	S16	25.350	23.624	1.426	Open Manhole	1200
12.004	o	300	S17	25.375	23.529	1.546	Open Manhole	1200
12.005	o	300	S18	25.325	23.401	1.624	Open Manhole	1200
14.000	o	225	S20	25.350	23.925	1.200	Open Manhole	1200
14.001	o	225	S21	25.350	23.798	1.327	Open Manhole	1200
14.002	o	225	S22	25.260	23.655	1.380	Open Manhole	1200
14.003	o	225	S23	25.100	23.498	1.377	Open Manhole	1200
12.006	o	300	S19	25.325	22.417	2.608	Open Manhole	1200
15.000	o	225	S24	25.120	22.283	2.612	Open Manhole	1200
12.007	o	300	S25	25.300	21.206	3.794	Open Manhole	1200

Downstream Manhole

PN	Length (m)	Slope (1:X)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
12.000	24.950	165.2	S14	25.375	23.784	1.366	Open Manhole	1200
13.000	19.013	165.3	S14	25.375	23.784	1.366	Open Manhole	1200
12.001	10.700	237.8	S15	25.350	23.664	1.386	Open Manhole	1200
12.002	9.500	237.5	S16	25.350	23.624	1.426	Open Manhole	1200
12.003	22.800	240.0	S17	25.375	23.529	1.546	Open Manhole	1200
12.004	30.650	239.5	S18	25.325	23.401	1.624	Open Manhole	1200
12.005	28.000	239.3	S19	25.325	23.284	1.741	Open Manhole	1200
14.000	21.000	165.4	S21	25.350	23.798	1.327	Open Manhole	1200
14.001	34.400	240.6	S22	25.260	23.655	1.380	Open Manhole	1200
14.002	25.960	165.4	S23	25.100	23.498	1.377	Open Manhole	1200
14.003	10.100	165.6	S19	25.325	23.437	1.663	Open Manhole	1200
12.006	42.100	199.5	S25	25.300	22.206	2.794	Open Manhole	1200
15.000	12.633	164.1	S25	25.300	22.206	2.869	Open Manhole	1200
12.007	21.100	199.1	S26	23.000	21.100	1.600	Open Manhole	1350

PIPELINE SCHEDULES for Storm

Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
1.009	o	450	S26	23.000	19.100	3.450	Open Manhole	1350

Downstream Manhole

PN	Length (m)	Slope (1:X)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
1.009	13.150	12.0	Ex Headwall	19.680	18.000	1.230	Open Manhole	0

Free Flowing Outfall Details for Storm

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
1.009	Ex Headwall	19.680	18.000	0.000	0	0

Simulation Criteria for Storm

Volumetric Runoff Coeff	0.750	Additional Flow - % of Total Flow	0.000
Areal Reduction Factor	1.000	MADD Factor * 10m³/ha Storage	2.000
Hot Start (mins)	0	Inlet Coeffiecient	0.800
Hot Start Level (mm)	0	Flow per Person per Day (l/per/day)	0.000
Manhole Headloss Coeff (Global)	0.500	Run Time (mins)	60
Foul Sewage per hectare (l/s)	0.000	Output Interval (mins)	1

Number of Input Hydrographs	0	Number of Storage Structures	0
Number of Online Controls	0	Number of Time/Area Diagrams	0
Number of Offline Controls	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FSR	Profile Type	Summer
Return Period (years)	1	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	19.200	Storm Duration (mins)	30
Ratio R	0.408		

Summary of Critical Results by Maximum Level (Rank 1) for Storm

Simulation Criteria

Areal Reduction Factor 1.000 Additional Flow - % of Total Flow 0.000
Hot Start (mins) 0 MADD Factor * 10m³/ha Storage 2.000
Hot Start Level (mm) 0 Inlet Coeffiecient 0.800
Manhole Headloss Coeff (Global) 0.500 Flow per Person per Day (l/per/day) 0.000
Foul Sewage per hectare (l/s) 0.000

Number of Input Hydrographs 0 Number of Storage Structures 0
Number of Online Controls 0 Number of Time/Area Diagrams 0
Number of Offline Controls 0 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model FSR Ratio R 0.408
Region England and Wales Cv (Summer) 0.750
M5-60 (mm) 19.200 Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 300.0 DVD Status ON
Analysis Timestep Fine Inertia Status ON
DTS Status ON

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 180, 360, 600, 720, 1440
Return Period(s) (years) 1
Climate Change (%) 0

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
1.000	CP1	15 Winter	1	+0%					23.863
2.000	CP2	60 Winter	1	+0%					23.825
2.001	RET1	60 Winter	1	+0%					23.737
1.001	S1	15 Winter	1	+0%					23.722
3.000	CP3	15 Winter	1	+0%					24.061
4.000	CP4	15 Summer	1	+0%					23.438
1.002	S2	15 Winter	1	+0%					23.346
5.000	CP5	15 Winter	1	+0%					23.769
5.001	S3	15 Winter	1	+0%					23.726
6.000	CP6	15 Winter	1	+0%					24.005
7.000	CP7	15 Summer	1	+0%					23.923
1.003	S4	15 Winter	1	+0%					23.022
8.000	CP8	15 Summer	1	+0%					23.966
1.004	S5	15 Winter	1	+0%					22.938
9.000	CP11	15 Winter	1	+0%					23.705
9.001	S6	15 Winter	1	+0%					23.617
9.002	S7	15 Winter	1	+0%					22.931
1.005	S8	15 Winter	1	+0%					21.706
10.000	CP12	15 Winter	1	+0%					21.629
1.006	S9	15 Winter	1	+0%					21.612
11.000	CP15	15 Summer	1	+0%					24.118
11.001	S10	15 Summer	1	+0%					22.458

Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	CP1	-0.112	0.000	0.14		2.3	OK	
2.000	CP2	-0.150	0.000	0.00		0.0	OK	
2.001	RET1	-0.150	0.000	0.00		0.0	OK	
1.001	S1	-0.069	0.000	0.55		9.5	OK	
3.000	CP3	-0.114	0.000	0.13		2.2	OK	
4.000	CP4	-0.092	0.000	0.65		19.5	OK	
1.002	S2	-0.072	0.000	0.78		29.9	OK	
5.000	CP5	-0.156	0.000	0.20		6.4	OK	
5.001	S3	-0.149	0.000	0.25		9.6	OK	
6.000	CP6	-0.170	0.000	0.14		5.2	OK	
7.000	CP7	-0.092	0.000	0.65		19.5	OK	
1.003	S4	-0.156	0.000	0.63		61.6	OK	
8.000	CP8	-0.084	0.000	0.40		4.3	OK	
1.004	S5	-0.152	0.000	0.66		65.0	OK	
9.000	CP11	-0.170	0.000	0.13		4.8	OK	
9.001	S6	-0.165	0.000	0.16		6.1	OK	
9.002	S7	-0.144	0.000	0.28		10.2	OK	
1.005	S8	-0.158	0.000	0.63		77.6	OK	
10.000	CP12	-0.014	0.000	0.42		14.2	OK	
1.006	S9	-0.115	0.000	0.80		86.2	OK	
11.000	CP15	-0.157	0.000	0.20		5.8	OK	
11.001	S10	-0.165	0.000	0.16		5.8	OK	

Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
1.007	S11	15 Winter	1	+0%					21.570
1.008	BYP1	15 Winter	1	+0%					21.420
12.000	S12	15 Winter	1	+0%					23.991
13.000	S13	15 Winter	1	+0%					24.003
12.001	S14	15 Winter	1	+0%					23.854
12.002	S15	15 Winter	1	+0%					23.816
12.003	S16	15 Winter	1	+0%					23.768
12.004	S17	15 Winter	1	+0%					23.684
12.005	S18	15 Winter	1	+0%					23.569
14.000	S20	15 Winter	1	+0%					23.974
14.001	S21	15 Winter	1	+0%					23.897
14.002	S22	15 Winter	1	+0%					23.751
14.003	S23	15 Winter	1	+0%					23.599
12.006	S19	15 Winter	1	+0%					22.618
15.000	S24	15 Summer	1	+0%					22.353
12.007	S25	15 Winter	1	+0%					21.423
1.009	S26	15 Winter	1	+0%					19.253

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
1.007	S11	-0.093	0.000	0.92		90.4	OK	
1.008	BYP1	-0.103	0.000	0.88		90.5	OK	
12.000	S12	-0.169	0.000	0.14		5.1	OK	
13.000	S13	-0.121	0.000	0.43		15.8	OK	
12.001	S14	-0.155	0.000	0.46		26.2	OK	
12.002	S15	-0.148	0.000	0.51		28.2	OK	
12.003	S16	-0.156	0.000	0.47		29.4	OK	
12.004	S17	-0.145	0.000	0.52		33.8	OK	
12.005	S18	-0.132	0.000	0.60		38.5	OK	
14.000	S20	-0.176	0.000	0.11		3.9	OK	
14.001	S21	-0.126	0.000	0.39		12.2	OK	
14.002	S22	-0.129	0.000	0.38		14.0	OK	
14.003	S23	-0.124	0.000	0.42		14.1	OK	
12.006	S19	-0.099	0.000	0.78		56.7	OK	
15.000	S24	-0.155	0.000	0.21		7.3	OK	
12.007	S25	-0.083	0.000	0.87		59.9	OK	
1.009	S26	-0.297	0.000	0.25		149.8	OK	

Summary of Critical Results by Maximum Level (Rank 1) for Storm

Simulation Criteria

Areal Reduction Factor 1.000 Additional Flow - % of Total Flow 0.000
Hot Start (mins) 0 MADD Factor * 10m³/ha Storage 2.000
Hot Start Level (mm) 0 Inlet Coeffiecient 0.800
Manhole Headloss Coeff (Global) 0.500 Flow per Person per Day (l/per/day) 0.000
Foul Sewage per hectare (l/s) 0.000

Number of Input Hydrographs 0 Number of Storage Structures 0
Number of Online Controls 0 Number of Time/Area Diagrams 0
Number of Offline Controls 0 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model FSR Ratio R 0.408
Region England and Wales Cv (Summer) 0.750
M5-60 (mm) 19.200 Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 300.0 DVD Status ON
Analysis Timestep Fine Inertia Status ON
DTS Status ON

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 180, 360, 600, 720, 1440
Return Period(s) (years) 30
Climate Change (%) 0

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
1.000	CP1	15 Winter	30	+0%	30/15 Summer				24.237
2.000	CP2	15 Winter	30	+0%	30/15 Summer				24.212
2.001	RET1	15 Winter	30	+0%	30/15 Summer				24.215
1.001	S1	15 Winter	30	+0%	30/15 Summer				24.219
3.000	CP3	15 Winter	30	+0%					24.083
4.000	CP4	15 Winter	30	+0%	30/15 Summer				23.979
1.002	S2	15 Winter	30	+0%	30/15 Summer				23.898
5.000	CP5	15 Winter	30	+0%					23.813
5.001	S3	15 Winter	30	+0%					23.783
6.000	CP6	15 Winter	30	+0%					24.040
7.000	CP7	15 Summer	30	+0%	30/15 Summer				24.078
1.003	S4	15 Winter	30	+0%	30/15 Summer				23.343
8.000	CP8	15 Summer	30	+0%					24.018
1.004	S5	15 Winter	30	+0%	30/15 Summer				23.180
9.000	CP11	15 Winter	30	+0%					23.739
9.001	S6	15 Winter	30	+0%					23.657
9.002	S7	15 Winter	30	+0%					22.999
1.005	S8	15 Winter	30	+0%	30/15 Summer				22.546
10.000	CP12	15 Winter	30	+0%	30/15 Summer				22.343
1.006	S9	15 Winter	30	+0%	30/15 Summer				22.272
11.000	CP15	15 Summer	30	+0%					24.161
11.001	S10	15 Summer	30	+0%					22.495

Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	CP1	0.262	0.000	0.51		8.1	SURCHARGED	
2.000	CP2	0.237	0.000	0.12		1.9	SURCHARGED	
2.001	RET1	0.328	0.000	0.30		4.7	SURCHARGED	
1.001	S1	0.428	0.000	1.19		20.4	SURCHARGED	
3.000	CP3	-0.092	0.000	0.32		5.3	OK	
4.000	CP4	0.449	0.000	1.33		39.8	SURCHARGED	
1.002	S2	0.480	0.000	1.50		57.4	SURCHARGED	
5.000	CP5	-0.112	0.000	0.50		15.8	OK	
5.001	S3	-0.092	0.000	0.65		24.8	OK	
6.000	CP6	-0.135	0.000	0.34		12.7	OK	
7.000	CP7	0.063	0.000	1.61		48.1	SURCHARGED	
1.003	S4	0.165	0.000	1.36		133.0	SURCHARGED	
8.000	CP8	-0.032	0.000	0.98		10.6	OK	
1.004	S5	0.090	0.000	1.46		143.6	SURCHARGED	
9.000	CP11	-0.136	0.000	0.33		11.7	OK	
9.001	S6	-0.125	0.000	0.40		15.2	OK	
9.002	S7	-0.076	0.000	0.75		27.8	OK	
1.005	S8	0.682	0.000	1.41		173.7	SURCHARGED	
10.000	CP12	0.700	0.000	0.93		31.8	SURCHARGED	
1.006	S9	0.545	0.000	1.82		194.6	SURCHARGED	
11.000	CP15	-0.114	0.000	0.49		14.1	OK	
11.001	S10	-0.128	0.000	0.39		14.1	OK	

Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
1.007	S11	15 Winter	30	+0%	30/15 Summer				22.015
1.008	BYP1	15 Winter	30	+0%	30/15 Summer				21.736
12.000	S12	15 Winter	30	+0%	30/15 Summer				24.186
13.000	S13	15 Winter	30	+0%	30/15 Summer				24.251
12.001	S14	15 Winter	30	+0%	30/15 Summer				24.164
12.002	S15	15 Winter	30	+0%	30/15 Summer				24.088
12.003	S16	15 Winter	30	+0%	30/15 Summer				24.013
12.004	S17	15 Winter	30	+0%	30/15 Summer				23.923
12.005	S18	15 Winter	30	+0%	30/15 Summer				23.766
14.000	S20	15 Winter	30	+0%					24.059
14.001	S21	15 Winter	30	+0%	30/15 Summer				24.040
14.002	S22	15 Winter	30	+0%					23.862
14.003	S23	15 Winter	30	+0%					23.723
12.006	S19	15 Winter	30	+0%	30/15 Summer				23.151
15.000	S24	15 Winter	30	+0%					22.398
12.007	S25	15 Winter	30	+0%	30/15 Summer				21.818
1.009	S26	15 Winter	30	+0%					19.348

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
1.007	S11	0.352	0.000	2.08		204.8	SURCHARGED	
1.008	BYP1	0.213	0.000	2.00		206.0	SURCHARGED	
12.000	S12	0.026	0.000	0.31		11.5	SURCHARGED	
13.000	S13	0.127	0.000	0.97		35.4	SURCHARGED	
12.001	S14	0.155	0.000	0.94		53.5	SURCHARGED	
12.002	S15	0.124	0.000	1.02		56.5	SURCHARGED	
12.003	S16	0.089	0.000	0.96		60.4	SURCHARGED	
12.004	S17	0.094	0.000	1.09		71.1	SURCHARGED	
12.005	S18	0.065	0.000	1.28		82.8	SURCHARGED	
14.000	S20	-0.091	0.000	0.24		8.8	OK	
14.001	S21	0.017	0.000	1.05		33.0	SURCHARGED	
14.002	S22	-0.018	0.000	0.97		36.0	OK	
14.003	S23	0.000	0.000	1.03		34.7	OK	
12.006	S19	0.434	0.000	1.75		128.0	SURCHARGED	
15.000	S24	-0.110	0.000	0.52		18.0	OK	
12.007	S25	0.312	0.000	2.01		138.3	SURCHARGED	
1.009	S26	-0.202	0.000	0.58		345.0	OK	

Summary of Critical Results by Maximum Level (Rank 1) for Storm

Simulation Criteria

Areal Reduction Factor 1.000 Additional Flow - % of Total Flow 0.000
Hot Start (mins) 0 MADD Factor * 10m³/ha Storage 2.000
Hot Start Level (mm) 0 Inlet Coeffiecient 0.800
Manhole Headloss Coeff (Global) 0.500 Flow per Person per Day (l/per/day) 0.000
Foul Sewage per hectare (l/s) 0.000

Number of Input Hydrographs 0 Number of Storage Structures 0
Number of Online Controls 0 Number of Time/Area Diagrams 0
Number of Offline Controls 0 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model FSR Ratio R 0.408
Region England and Wales Cv (Summer) 0.750
M5-60 (mm) 19.200 Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 300.0 DVD Status ON
Analysis Timestep Fine Inertia Status ON
DTS Status ON

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 180, 360, 600, 720, 1440
Return Period(s) (years) 100
Climate Change (%) 20

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
1.000	CP1	15 Winter	100	+20%	100/15 Summer				25.136
2.000	CP2	15 Winter	100	+20%	100/15 Summer				25.097
2.001	RET1	15 Winter	100	+20%	100/15 Summer				25.102
1.001	S1	15 Winter	100	+20%	100/15 Summer				25.109
3.000	CP3	15 Winter	100	+20%	100/15 Summer				24.690
4.000	CP4	15 Winter	100	+20%	100/15 Summer				24.816
1.002	S2	15 Winter	100	+20%	100/15 Summer				24.670
5.000	CP5	15 Winter	100	+20%	100/15 Summer				24.116
5.001	S3	15 Winter	100	+20%	100/15 Summer				24.049
6.000	CP6	15 Winter	100	+20%					24.066
7.000	CP7	15 Summer	100	+20%	100/15 Summer				24.239
1.003	S4	15 Winter	100	+20%	100/15 Summer				23.880
8.000	CP8	15 Summer	100	+20%	100/15 Summer				24.084
1.004	S5	15 Winter	100	+20%	100/15 Summer				23.644
9.000	CP11	15 Winter	100	+20%					23.764
9.001	S6	15 Winter	100	+20%					23.687
9.002	S7	15 Winter	100	+20%	100/15 Summer				23.460
1.005	S8	15 Winter	100	+20%	100/15 Summer				23.336
10.000	CP12	15 Winter	100	+20%	100/15 Summer				22.963
1.006	S9	15 Winter	100	+20%	100/15 Summer				22.877
11.000	CP15	15 Summer	100	+20%					24.198
11.001	S10	15 Summer	100	+20%					22.525

Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m^3)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	CP1	1.161	0.000	0.70		11.3	FLOOD RISK	
2.000	CP2	1.122	0.000	0.27		4.2	FLOOD RISK	
2.001	RET1	1.215	0.000	0.54		8.4	FLOOD RISK	
1.001	S1	1.318	0.000	1.61		27.6	FLOOD RISK	
3.000	CP3	0.515	0.000	0.45		7.6	SURCHARGED	
4.000	CP4	1.286	0.000	1.97		59.0	FLOOD RISK	
1.002	S2	1.252	0.000	1.84		70.5	SURCHARGED	
5.000	CP5	0.191	0.000	0.93		29.3	SURCHARGED	
5.001	S3	0.174	0.000	0.96		36.8	SURCHARGED	
6.000	CP6	-0.109	0.000	0.53		19.8	OK	
7.000	CP7	0.224	0.000	2.48		74.1	SURCHARGED	
1.003	S4	0.702	0.000	1.82		178.2	SURCHARGED	
8.000	CP8	0.034	0.000	1.53		16.6	SURCHARGED	
1.004	S5	0.554	0.000	1.90		187.0	SURCHARGED	
9.000	CP11	-0.111	0.000	0.51		18.3	OK	
9.001	S6	-0.095	0.000	0.62		23.6	OK	
9.002	S7	0.385	0.000	1.11		41.3	SURCHARGED	
1.005	S8	1.472	0.000	1.82		224.9	SURCHARGED	
10.000	CP12	1.320	0.000	1.44		48.9	SURCHARGED	
1.006	S9	1.150	0.000	2.41		258.0	SURCHARGED	
11.000	CP15	-0.077	0.000	0.76		22.0	OK	
11.001	S10	-0.098	0.000	0.61		22.0	OK	

Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
1.007	S11	15 Winter	100	+20%	100/15 Summer				22.435
1.008	BYP1	15 Winter	100	+20%	100/15 Summer				21.947
12.000	S12	15 Winter	100	+20%	100/15 Summer				24.831
13.000	S13	15 Winter	100	+20%	100/15 Summer				24.990
12.001	S14	15 Winter	100	+20%	100/15 Summer				24.800
12.002	S15	15 Winter	100	+20%	100/15 Summer				24.722
12.003	S16	15 Winter	100	+20%	100/15 Summer				24.634
12.004	S17	15 Winter	100	+20%	100/15 Summer				24.474
12.005	S18	15 Winter	100	+20%	100/15 Summer				24.172
14.000	S20	15 Winter	100	+20%	100/15 Summer				24.459
14.001	S21	15 Winter	100	+20%	100/15 Summer				24.434
14.002	S22	15 Winter	100	+20%	100/15 Summer				24.171
14.003	S23	15 Winter	100	+20%	100/15 Summer				23.915
12.006	S19	15 Winter	100	+20%	100/15 Summer				23.787
15.000	S24	15 Winter	100	+20%					22.436
12.007	S25	15 Winter	100	+20%	100/15 Summer				22.214
1.009	S26	15 Winter	100	+20%					19.401

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
1.007	S11	0.772	0.000	2.76		272.0	SURCHARGED	
1.008	BYP1	0.424	0.000	2.64		272.9	SURCHARGED	
12.000	S12	0.671	0.000	0.36		13.3	SURCHARGED	
13.000	S13	0.866	0.000	1.31		47.5	SURCHARGED	
12.001	S14	0.791	0.000	1.42		80.8	SURCHARGED	
12.002	S15	0.758	0.000	1.53		84.9	SURCHARGED	
12.003	S16	0.710	0.000	1.39		87.9	SURCHARGED	
12.004	S17	0.645	0.000	1.58		102.7	SURCHARGED	
12.005	S18	0.471	0.000	1.83		118.3	SURCHARGED	
14.000	S20	0.309	0.000	0.32		11.8	SURCHARGED	
14.001	S21	0.411	0.000	1.46		45.9	SURCHARGED	
14.002	S22	0.291	0.000	1.38		51.5	SURCHARGED	
14.003	S23	0.192	0.000	1.46		49.0	SURCHARGED	
12.006	S19	1.070	0.000	2.46		180.1	SURCHARGED	
15.000	S24	-0.072	0.000	0.80		28.0	OK	
12.007	S25	0.708	0.000	2.78		191.6	SURCHARGED	
1.009	S26	-0.149	0.000	0.78		462.9	OK	

Annex 8.A.3: AD Bund Wall Height Calculations

Calculation Sheet

Job No: MK018157	Project Ref: RENESCIENCE, NORTHWICH	Drawing Ref:
Subject: AD PLANT BUND CAPACITY		
By: GB	Date: SEPT 15	Checked by: DW	Date: 29/09/15

Ref	Calculations			Output
	TANK SCHEDULE :-		No. OFF	TOTAL VOLUME
•	DIGESTER TANK	$6,000m^3$	4	$24,000m^3$
	(LIQUID ONLY)	$5,100m^3$	4	$(20,400m^3)$
•	POST DIGESTER TANK	$2,500m^3$	2	$5,000m^3$
	MAX. 85% (LIQUID ONLY)	$2,125m^3$	2	$(4,225m^3)$
•	FEED TANK	$1,200m^3$	2	$2,400m^3$
	MAX 85% (LIQUID ONLY)	$1,020m^3$	2	$(2,040m^3)$
•	BIOLIQUID RESIDUAL TANK	$500m^3$	1	$500m^3$
	MAX 85% (LIQUID ONLY)	$425m^3$	1	$(425m^3)$
	TOTAL TANK VOLUME (MAXIMUM) =			$31,900m^3$
	TOTAL TANK VOLUME (LIQUID FRACTION ONLY) =			$(27,090m^3)$
	BUND CONTAINMENT :			
	110% OF LARGEST TANK @ $5,100m^3$ =			$5,610m^3$
OR	25% OF TOTAL GROUP @ $27,090m^3$ =			$6,773m^3$ ←

Job No: NK018157	Project Ref:	Drawing Ref:
Subject: AD PLANT BUND CAPACITY		
By: GB	Date: SEPT 15	Checked by:	Date:

Ref	Calculations	Output

OPTION 1 – 110% OF LARGEST TANK. (DIGESTER TANK)

MAX. CONTAINMENT = $5610\,m^3$ REQUIRED.

TOTAL PLAN AREA OF A.D TANKS IN BUND:–

D.T = $804\,m^2 \times 4 = 3216\,m^2$
A.D.T = $491\,m^2 \times 2 = 982\,m^2$
F.T = $133\,m^2 \times 2 = 266\,m^2$
C.T = $64\,m^2 \times 1 = 64\,m^2$
$4528\,m^2$

TOTAL PLAN AREA OF OTHER STRUCTURES IN AD BUND = $267\,m^2$

TOTAL PLAN AREA OF A.D BUND = $8,851\,m^2$

MAXIMUM AREA OF FREE STORAGE =
$8,851\,m^2$ LESS ALL AD TANKS, ($-4528\,m^2$), LESS OTHER STRUCTURES ($-267\,m^2$) AND AREA OF TANK SUBJECT TO FAILURE* ($+804\,m^2$) = $4,860\,m^2$.

* WATER/LIQUID STORAGE HEIGHT IS 6·34m IN TANK UNDER FAIL CONDITIONS, THEREFORE THIS AREA CONTRIBUTES TOWARDS TOTAL BUND AREA FOR STORAGE.

MIN BUND WALL HT = $\frac{5610}{4860} = 1{\cdot}15\,m$

ALLOW FOR 100 mm MIN FREEBOARD ∴ BUND WALL HEIGHT REQUIRED = **1·250m**

RPS Calculation Sheet

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Job No:	Project Ref:	Drawing Ref:
NK018157		

Subject: AD PLANT BUND CAPACITY

By:	Date:	Checked by:	Date:
GB	SEPT 15		

Ref	Calculations	Output
	<u>OPTION 2</u> - 25 % OF TOTAL TANK VOL.	
	MAX. CONTAINMENT = <u>6,773</u> m^3 REQUIRED	
	AS, OPTION 1 TOTAL PLAN AREA OF AD TANKS IN BUND = 4528 m^2	
	TOTAL PLAN AREA OF OTHER STRUCTURES = 267 m^2	
	TOTAL PLAN AREA OF AD BUND = 8851 m^2.	
	MAXIMUM AREA OF FREE STORAGE =	
	8851 m^2 - 4,528 m^2 - 267 m^2 + *TANK AREA SUBJECT TO FAILURE.	
	* AS ONLY COMPLETE TANKS CAN FAIL (UP TO 25 %)	
	CONSIDER 1 x DT = 804 m^2, 2 x FT = 266 m^2 PLUS 1 x CT = 64 m^2 = <u>1134</u> m^2 (25.0 %).	
	MAX. WATER LEVEL IN EACH ARE 6.34 m, 7.88 m, 6.68 m RESPECTIVELY ∴ CAN CONTRIBUTE USEABLE AREA.	
	∴ MAX. FREE STORAGE = 8851 - 4528 - 267 + 1134	
	= 5190 m^2	
	MIN BUND WALL HT = $\frac{6773}{5190}$ = 1.305 m	
	ALLOW FOR 100 mm MIN FREEBOARD ∴	
	BUND WALL HEIGHT REQUIRED = <u>1.450 m</u>	

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Job No: NK018157	Project Ref:	Drawing Ref:	
Subject: AD PLANT BUND CAPACITY			
By: GB	Date: SEPT 15	Checked by:	Date:

Ref	Calculations	Output

AD TANK BUND TO ALLOW FOR ADDITIONAL VOLUME OF RAINWATER RUNOFF CONTAINMENT IN ADDITION TO ACCIDENTAL SPILLAGE.

USING MICRODRAINAGE SOURCE CONTROL, MAXIMUM ATTENUATION VOLUME FOR RAINFALL IS $1012\,m^3$ DERIVED FROM 1 IN 100 YEAR STORM EVENT (10080 MINS DURATION) PLUS CLIMATE CHANGE @ 20%.

FROM PREVIOUS CALCULATIONS, OPTION 2 SCENARIO IS MOST SIGNIFICANT. THEREFORE OVERALL EMERGENCY AND FLOOD ATTENUATION STORAGE IN AD BUND IS :-

$$\frac{6773\,m^3 + 1012\,m^3}{5190\,m^2} = \underline{1.500m}$$

ALLOWING 100mm FREEBOARD, MAX. BUND WALL HEIGHT

$$= 1.500 + 0.100 = \underline{\underline{1.600m}}$$

Summary of Results for 100 year Return Period (+20%)

Outflow is too low. Design is unsatisfactory.

Storm Event	Max Level (m)	Max Depth (m)	Max Volume (m³)	Status
15 min Summer	23.521	0.021	189.2	O K
30 min Summer	23.528	0.028	247.8	O K
60 min Summer	23.535	0.035	309.3	O K
120 min Summer	23.542	0.042	373.4	O K
180 min Summer	23.547	0.047	411.7	O K
240 min Summer	23.550	0.050	438.8	O K
360 min Summer	23.554	0.054	476.9	O K
480 min Summer	23.557	0.057	506.3	O K
600 min Summer	23.560	0.060	530.0	O K
720 min Summer	23.562	0.062	549.9	O K
960 min Summer	23.566	0.066	582.4	O K
1440 min Summer	23.571	0.071	630.6	O K
2160 min Summer	23.577	0.077	681.7	O K
2880 min Summer	23.581	0.081	719.8	O K
4320 min Summer	23.588	0.088	776.1	O K
5760 min Summer	23.592	0.092	817.9	O K
7200 min Summer	23.596	0.096	851.5	O K
8640 min Summer	23.599	0.099	879.6	O K
10080 min Summer	23.602	0.102	903.9	O K
15 min Winter	23.524	0.024	211.9	O K
30 min Winter	23.531	0.031	277.5	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)
15 min Summer	114.021	0.0	27
30 min Summer	74.667	0.0	42
60 min Summer	46.601	0.0	72
120 min Summer	28.131	0.0	132
180 min Summer	20.676	0.0	192
240 min Summer	16.528	0.0	252
360 min Summer	11.975	0.0	372
480 min Summer	9.535	0.0	492
600 min Summer	7.984	0.0	612
720 min Summer	6.904	0.0	732
960 min Summer	5.484	0.0	972
1440 min Summer	3.959	0.0	1452
2160 min Summer	2.853	0.0	2172
2880 min Summer	2.259	0.0	2892
4320 min Summer	1.624	0.0	4332
5760 min Summer	1.284	0.0	5776
7200 min Summer	1.069	0.0	7216
8640 min Summer	0.920	0.0	8656
10080 min Summer	0.811	0.0	10096
15 min Winter	114.021	0.0	27
30 min Winter	74.667	0.0	42

Summary of Results for 100 year Return Period (+20%)

Storm Event	Max Level (m)	Max Depth (m)	Max Volume (m³)	Status
60 min Winter	23.539	0.039	346.4	O K
120 min Winter	23.547	0.047	418.2	O K
180 min Winter	23.552	0.052	461.1	O K
240 min Winter	23.556	0.056	491.5	O K
360 min Winter	23.560	0.060	534.2	O K
480 min Winter	23.564	0.064	567.1	O K
600 min Winter	23.567	0.067	593.6	O K
720 min Winter	23.570	0.070	615.9	O K
960 min Winter	23.574	0.074	652.3	O K
1440 min Winter	23.580	0.080	706.3	O K
2160 min Winter	23.586	0.086	763.5	O K
2880 min Winter	23.591	0.091	806.2	O K
4320 min Winter	23.598	0.098	869.2	O K
5760 min Winter	23.604	0.104	916.1	O K
7200 min Winter	23.608	0.108	953.7	O K
8640 min Winter	23.611	0.111	985.2	O K
10080 min Winter	23.614	0.114	1012.4	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)
60 min Winter	46.601	0.0	72
120 min Winter	28.131	0.0	132
180 min Winter	20.676	0.0	192
240 min Winter	16.528	0.0	252
360 min Winter	11.975	0.0	372
480 min Winter	9.535	0.0	492
600 min Winter	7.984	0.0	612
720 min Winter	6.904	0.0	732
960 min Winter	5.484	0.0	972
1440 min Winter	3.959	0.0	1452
2160 min Winter	2.853	0.0	2172
2880 min Winter	2.259	0.0	2892
4320 min Winter	1.624	0.0	4332
5760 min Winter	1.284	0.0	5776
7200 min Winter	1.069	0.0	7216
8640 min Winter	0.920	0.0	8656
10080 min Winter	0.811	0.0	10096

Annex 8.A.4: Bioreactor Bund Wall Height Calculations

RPS

Calculation Sheet

Job No: NK018157	Project Ref: RENESCIENCE, NORTHWICH	Drawing Ref:
Subject: BIOREACTOR BUND CAPACITY		
By: GB	Date: SEPT 15	Checked by: OW — Date: 29/09/15

Ref	Calculations	Output
	BIOREACTOR UNIT HAS SINGLE CAPACITY OF $270 m^3$ (LIQUID CAPACITY)	
	CONTAINMENT BUND HAS 2No. BIOREACTOR UNITS.	
	TANK VOLUME (MAXIMUM) = $270 m^3 \times 2$ =	$540 m^3$
	BUND CONTAINMENT:	
	110% OF LARGEST SINGLE TANK @ $270 m^3$ =	$297 m^3$ ←
OR	25% OF TOTAL GROUP @ $540 m^3$ =	$135 m^3$
	∴ CONSIDER FAILURE OF SINGLE BIOREACTOR TANK.	
	TOTAL PLAN AREA OF BUND = $17.5m \times 39m$ =	$683 m^2$
	PLAN AREA OF TANK SUPPORT PLINTHS = $5m \times 1.5m \times 16No.$ =	$120 m^2$
	MAXIMUM AREA OF FREE STORAGE = $683 - 120$ =	$563 m^2$
	BUND TO ALLOW FOR ADDITIONAL VOLUME OF RAINFALL CONTAINMENT IN ADDITION TO ACCIDENTAL SPILLAGES.	
	MICRODRAINAGE SOURCE CONTROL CALCULATION FOR	

RPS

Calculation Sheet

Job No: MC018757	Project Ref:	Drawing Ref:
Subject: BIOREACTOR BUND CAPACITY		
By: GB	Date: SEPT 15	Checked by: / Date:

Ref	Calculations	Output
	1 in 100 YEAR STORM EVENT (+ 20% CLIMATE EFFECTS) UNDER 10080 MINS DURATION (7 DAYS) = $81.2m^3$	
	TOTAL STORAGE VOLUME = 297 + $81.2 m^3$ =	$378.2m^3$
	∴ BUND WALL HEIGHT REQUIRED = $\frac{378.2}{563}$ = 0.672m.	
	ALLOWING 100mm FREEBOARD MINIMUM,	
	MAX BUND WALL HEIGHT = 0.672 + 0.100 ≈	0.800m

Summary of Results for 100 year Return Period (+20%)

Outflow is too low. Design is unsatisfactory.

Storm Event	Max Level (m)	Max Depth (m)	Max Volume (m³)	Status
15 min Summer	24.522	0.022	15.2	O K
30 min Summer	24.528	0.028	19.9	O K
60 min Summer	24.535	0.035	24.8	O K
120 min Summer	24.543	0.043	30.0	O K
180 min Summer	24.547	0.047	33.0	O K
240 min Summer	24.550	0.050	35.2	O K
360 min Summer	24.555	0.055	38.3	O K
480 min Summer	24.558	0.058	40.6	O K
600 min Summer	24.561	0.061	42.5	O K
720 min Summer	24.563	0.063	44.1	O K
960 min Summer	24.567	0.067	46.7	O K
1440 min Summer	24.572	0.072	50.6	O K
2160 min Summer	24.578	0.078	54.7	O K
2880 min Summer	24.582	0.082	57.7	O K
4320 min Summer	24.589	0.089	62.3	O K
5760 min Summer	24.594	0.094	65.6	O K
7200 min Summer	24.598	0.098	68.3	O K
8640 min Summer	24.601	0.101	70.6	O K
10080 min Summer	24.604	0.104	72.5	O K
15 min Winter	24.524	0.024	17.0	O K
30 min Winter	24.532	0.032	22.3	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)
15 min Summer	114.021	0.0	27
30 min Summer	74.667	0.0	42
60 min Summer	46.601	0.0	72
120 min Summer	28.131	0.0	132
180 min Summer	20.676	0.0	192
240 min Summer	16.528	0.0	252
360 min Summer	11.975	0.0	372
480 min Summer	9.535	0.0	492
600 min Summer	7.984	0.0	612
720 min Summer	6.904	0.0	732
960 min Summer	5.484	0.0	972
1440 min Summer	3.959	0.0	1452
2160 min Summer	2.853	0.0	2172
2880 min Summer	2.259	0.0	2892
4320 min Summer	1.624	0.0	4332
5760 min Summer	1.284	0.0	5776
7200 min Summer	1.069	0.0	7216
8640 min Summer	0.920	0.0	8656
10080 min Summer	0.811	0.0	10096
15 min Winter	114.021	0.0	27
30 min Winter	74.667	0.0	42

Summary of Results for 100 year Return Period (+20%)

Storm Event	Max Level (m)	Max Depth (m)	Max Volume (m³)	Status
60 min Winter	24.540	0.040	27.8	O K
120 min Winter	24.548	0.048	33.6	O K
180 min Winter	24.553	0.053	37.0	O K
240 min Winter	24.556	0.056	39.4	O K
360 min Winter	24.561	0.061	42.9	O K
480 min Winter	24.565	0.065	45.5	O K
600 min Winter	24.568	0.068	47.6	O K
720 min Winter	24.571	0.071	49.4	O K
960 min Winter	24.575	0.075	52.3	O K
1440 min Winter	24.581	0.081	56.7	O K
2160 min Winter	24.588	0.088	61.3	O K
2880 min Winter	24.592	0.092	64.7	O K
4320 min Winter	24.600	0.100	69.7	O K
5760 min Winter	24.605	0.105	73.5	O K
7200 min Winter	24.609	0.109	76.5	O K
8640 min Winter	24.613	0.113	79.0	O K
10080 min Winter	24.616	0.116	81.2	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)
60 min Winter	46.601	0.0	72
120 min Winter	28.131	0.0	132
180 min Winter	20.676	0.0	192
240 min Winter	16.528	0.0	252
360 min Winter	11.975	0.0	372
480 min Winter	9.535	0.0	492
600 min Winter	7.984	0.0	612
720 min Winter	6.904	0.0	732
960 min Winter	5.484	0.0	972
1440 min Winter	3.959	0.0	1452
2160 min Winter	2.853	0.0	2172
2880 min Winter	2.259	0.0	2892
4320 min Winter	1.624	0.0	4332
5760 min Winter	1.284	0.0	5776
7200 min Winter	1.069	0.0	7216
8640 min Winter	0.920	0.0	8656
10080 min Winter	0.811	0.0	10096

Existing Site Surface Water Drainage Assessment

Total Impermeable site area = 2.19 Hectares

Surface water drainage discharge rates to Wade Brook:-

1 in 1 year return period storm = 238.1L/s (15 min, winter)

1 in 30 year return period storm = 428.7L/s (15 min, winter)

1 in 100 year return period storm = 502.9L/s (15 min, winter)

Notes

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3. This drawing should be read in conjunction with all other relevant drawings and specifications.

Key:

Existing Impermeable Area
Total Area = 2.19 Hectares

Rev	Description	By	Ckd	Date

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Client RENescience — value from waste

Project RENescience Northwich

Title Existing Site Plan Showing Impermeable Areas

Status	Scale	Date Created
Final	1:500 @A1	11.09.2015
Project Leader	**Drawn By**	**Checked by**
AMS	CW	GB

Document Number	Revision	Suitability
Figure 8.A	-	S2

Project Number — Originator - Zone - Level - Type - Role - Drawing Number

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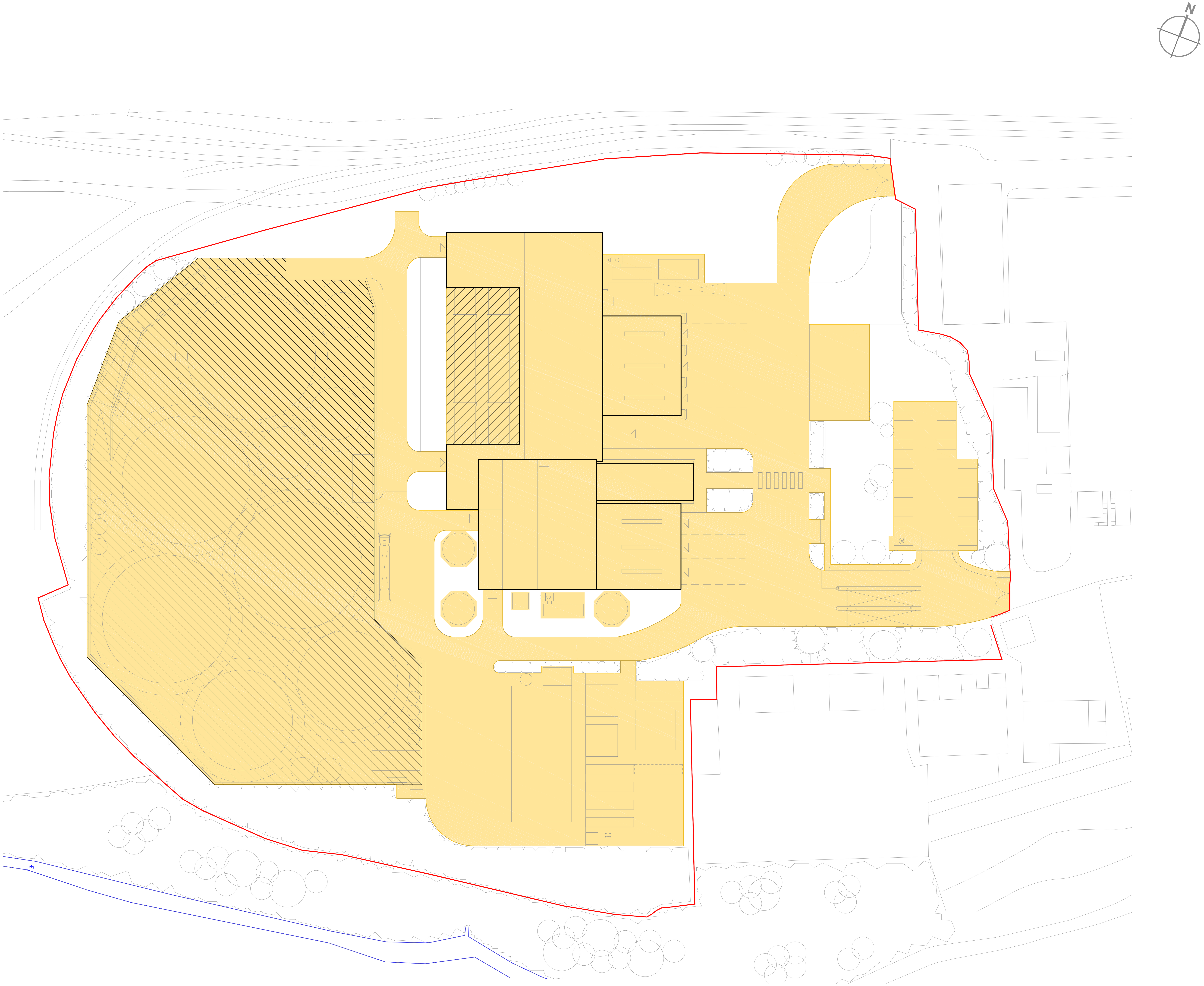

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Key:

Total Proposed Development Impermeable Area
Area = 23,642m²

Proposed Anaerobic Digester Plant Bund Containment Area (Controlled Discharge)
Area = 8,851m²

Proposed Bioreactor Bund Containment Area (Controlled Discharge)
Total Area = 713m²

Net Impermeable Area (Free Discharge)
Area = 23,642 - 8,851 - 713 = **14,078m²**

Rev	Description	By	Ckd	Date
C	Site plan updated.	DW	GB	29.09.15
B	Key notation updated.	DW	GB	25.09.15
A	Minor amendments.	CW	DW	23.09.15

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Client REnescience value from waste

Project REnescience Northwich

Title Proposed Site Plan Showing Impermeable Areas

Status Final | Scale 1:500 @A1 | Date Created 18.09.2015

Project Leader AS | Drawn By CW | Checked by DW

Document Number: Figure 8.B | Revision: C | Suitability: S2

Project Number | Originator - Zone - Level - Type - Role - Drawing Number

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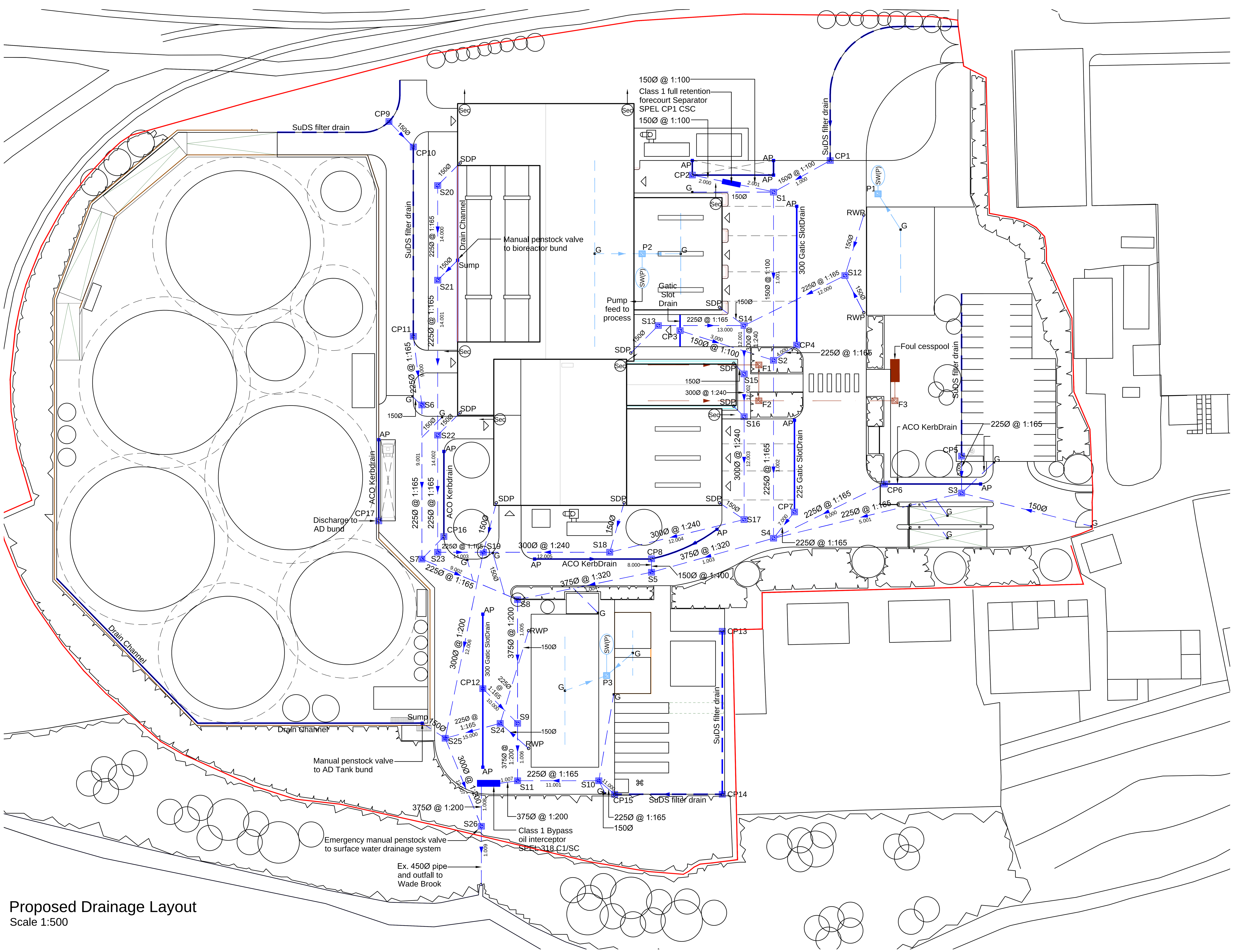
Note:
All primary siphonic rainwater system downpipes to extend to first external manhole (within 10m of building)



Proposed Drainage Layout
Scale 1:500

Key:

150Ø 1/135	FW Sewer (I/D & Gradient)
***mmØ 1/300	SW Sewer (I/D & Gradient)
F1	FW Manhole
S2	SW Manhole
P1	SW (Process Drainage)
Fi4	Internal FW Manhole (≤150ø)
Fi4	Internal FW Manhole (>150ø)
(10.00) F1(11.60)	Backdrop Manhole (FW Illustrated)
	Slot Drain (with subsoil drain below)
	SuDS Filter Drain
(11.60)	SW Pumping Station with Inlet Invert
(11.60)	FW Pumping Station with Inlet Invert
***mm O/D	SW HDPE Rising Main (O/D & Gradient)
***mm O/D	FW HDPE Rising Main (O/D & Gradient)
	Trade Effluent (discharge to tank for offsite disposal)
G	Trapped Gully
FG	Trapped Floor Gully
SVP	Soil Vent Pipe
AAV	Air Admittance Valve
DS	Discharge Stack
RWP	Rainwater Pipe (c/w RE)
SDP	Syphonic Primary Downpipe
Sec	Syphonic Secondary Discharge
RE	Rodding Eye
CL	Cover Level
CRL	Crown Level
SL	Soffit Level
IL	Invert Level
BD	Back Drop
I/D	Internal Diamater
CP	Catch pit
AP	Access point
	Water retaining bund walls Designed to BS EN 1992-3
SW(P)	SW (Process) Water Containment Tank

10m SCALE 1:500

Rev	Description	By	Ckd	Date
D	Site plan updated.	DW	GB	29.09.15
C	Minor drawing amendments.	CW	DW	25.09.15
B	Drawing size amended to A1.	CW	DW	23.09.15
A	Minor drawing amendments.	DW	GB	21.09.15

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Client RENescience value from waste

Project REnescience Northwich

Title Proposed Drainage Layout

Status	Scale	Date Created
Final	1:500 @A1	18.09.2015
Project Leader	Drawn By	Checked by
AS	CW	DW

Document Number	Revision	Suitability
Figure 8.C	D	S2

Project Number · Originator - Zone - Level - Type - Role - Drawing Number

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Surface Water Manhole Schedule

Manhole Ref	Cover Level (m)	Manhole Depth (mm)	Manhole Ø (mm)	Pipe Out Invert Level (m)	Pipe Out Ø (mm)	Pipe In Invert Level (m)	Pipe In Ø (mm)	Comments
CP1	25.175	1350	1200	23.825	150	-	-	
CP2	25.175	1350	1200	23.825	150	-	-	
S1	25.215	1574	1200	23.641	150	23.715	150	
-	-	-	-	-	-	23.641	150	
-	-	-	-	-	-	-	150	
CP3	25.375	1350	1200	24.025	150	-	-	
CP4	25.090	1785	1200	23.305	225	-	-	
S2	25.250	2057	1200	23.193	225	23.268	225	
-	-	-	-	-	-	23.268	150	
-	-	-	-	-	-	23.808	150	
CP5	25.000	1300	1200	23.700	225	-	-	
CP6	25.250	1300	1200	23.950	225	-	-	
CP7	25.090	1300	1200	23.790	225	-	-	
S3	25.275	1625	1200	23.650	225	23.650	225	
-	-	-	-	-	-	-	150	
-	-	-	-	-	-	-	150	
S4	25.275	2472	1350	22.803	375	22.953	225	
-	-	-	-	-	-	23.784	225	
-	-	-	-	-	-	23.745	225	
-	-	-	-	-	-	23.390	225	
CP8	25.200	1300	1200	23.900	150	-	-	
S5	25.240	2525	1350	22.715	375	22.715	375	
-	-	-	-	-	-	23.870	150	
CP9	25.325	1350	1200	23.975	150	-	-	
CP10	25.250	1350	1200	-	-	23.900	150	
CP11	25.250	1600	1200	23.650	225	-	-	
S6	25.375	1818	1200	23.557	225	23.557	225	
-	-	-	-	-	-	-	150	
S7	25.390	2540	1200	22.850	225	23.350	225	
S8	25.460	3971	1350	21.489	375	22.620	375	
-	-	-	-	-	-	22.710	225	
CP12	25.025	3607	1200	21.418	225	-	-	
-	-	-	-	-	-	-	-	
S9	25.180	3828	1350	21.352	375	21.352	375	
-	-	-	-	-	-	21.352	225	
CP13	25.350	1350	1200	24.000	-	-	-	
CP14	25.000	1350	1200	23.650	-	-	-	
CP15	25.500	1350	1200	23.650	225	-	-	
CP16	25.225	1350	1200	23.875	-	-	-	
S10	25.400	3002	1200	22.398	225	-	225	
-	-	-	-	-	-	-	150	
-	-	-	-	-	-	-	150	
S11	25.180	3.892	1350	21.288	375	21.288	375	
-	-	-	-	-	-	21.288	225	
S13	25.435	1536	1200	23.899	225	-	150	Vented cover - siphonic discharge manhole
S14	25.375	1666	1200	23.709	300	23.784	225	Vented cover - siphonic discharge manhole
-	-	-	-	-	-	23.784	225	
-	-	-	-	-	-	-	150	
S15	25.350	1686	1200	23.664	300	23.664	300	Vented cover - siphonic discharge manhole
-	-	-	-	-	-	-	150	
S16	25.350	1726	1200	23.624	300	23.624	300	Vented cover - siphonic discharge manhole
-	-	-	-	-	-	-	150	
S17	25.375	1846	1200	23.529	300	23.529	300	Vented cover - siphonic discharge manhole
-	-	-	-	-	-	-	150	
S18	25.325	1924	1200	23.401	300	23.401	300	Vented cover - siphonic discharge manhole
-	-	-	-	-	-	-	150	
S19	25.325	2908	1200	22.417	300	23.284	300	Vented cover - siphonic discharge manhole
-	-	-	-	-	-	23.437	225	
-	-	-	-	-	-	-	150	
S20	25.350	1425	1200	23.925	225	-	150	Vented cover - siphonic discharge manhole
S21	25.350	1552	1200	23.798	225	23.798	150	
-	-	-	-	-	-	-	150	
S22	25.260	1605	1200	23.655	225	23.655	225	Vented cover - siphonic discharge manhole
-	-	-	-	-	-	-	150	
S23	25.100	1602	1200	23.498	225	23.498	225	
S25	25.300	4094	1200	21.206	300	22.206	300	
-	-	-	-	-	-	22.206	225	
-	-	-	-	-	-	-	150	
S26	23.000(Ex)	3900	1350	19.100	450	21.100	375	
-	-	-	-	-	-	21.100	300	

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Rev	Description	Date	Initial	Checked

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Client DONG Energy Limited

Project REnescience Northwich

Title Surface Water Manhole Schedule

Date Created September 2015 | Drawn By DW | PM/Checked By GB

Job Ref. NK018157

Figure Number 8.D | Rev 0

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