DRAINAGE IMPACT ASSESSMENT

FOR

PROPOSED ANAEROBIC DIGESTION PLANT

AT

HORSECLOSE

ON BEHALF OF

Project ref:	**GGP-29384-CD-DIA-Horseclose**
Date First Issued:	**14th February 2024**
Issue:	**08**
Revision Date:	**03rd February 2025**
Prepared by:	**J. Hattersley** Civil Project Engineer.
Checked by:	**J. Collins** BSc. (Hons), MCIWEM.

GGP Consult
2 Hallam Road
Priory Park East
Hull
HU4 7DY
United Kingdom

Tel: +44 (0) 1482 627963
Fax: +44 (0) 1482 641736
Email: willbrown@ggpconsult.co.uk
Website: www.ggpconsult.co.uk

APPENDICES

Document Revision Box			
Revision	Date	Description	Author
01	14th Feb 2024	First issued	JHC
02	16th Feb 2024	Planning Submission	JHC
03	13th May 2024	Updates following meeting with LLFA	JHC
04	21st August 2024	Updates following site plan changes	WOB
05	5th December 2024	Updates following site plan changes	WOB
06	19th December 2024	Updates following site plan changes	JSH
07	9th January 2025	Updates following site plan changes	JSH
08	3rd February 2025	Updates to Process Water Storage	JHC

1.0 Introduction

GGP Consult has been instructed by Acorn Bioenergy Ltd to prepare a drainage impact assessment to establish the storage requirements associated with the operation function of the proposed anaerobic digestion plant.

The calculations will detail how surface water from the site will be managed, in compliance with local policy and an environmental permit for the construction and operation of an Anaerobic Digestion facility, associated infrastructure and landscape planting at land south of East Lodge Farm.

Following consultation with the LLFA on the submitted document. The LLFA provided a response outline additional information required which was discussed in further detail with the LLFA via a teams calls on 1st May 2024.

1. The applicant is required to provide greenfield runoff rates and hydraulic model calculations of the preferred drainage option for each modelled storm event. As a minimum, the 1 in 1yr, 1 in 30yr, 1 in 100yr are required, inclusive of climate change. The hydraulic model should include all necessary assets including pipes, storage assets, manhole chambers and flow control devices if required.

   Micro drainage Source Control calculations have been provided for the 1:1, 1:30 & 1:100 yr events with an allowance for 40% climate changes. These can be found in appendix V – VIII covering the different scenarios designed for within the report.

2. The applicant should submit details (i.e., designs, diameters, invert and cover levels, gradients, dimensions, etc) of all elements of the proposed drainage system, to include pipes, inspection chambers, outfalls/inlets, pollution control measures and attenuation structures. Details of storage assets and calculations to show that all onsite storage assets can half empty within 24 hours of a storm event are also required. The detailed drainage design is required as the current design provided only includes a drainage layout and paving details.

   Following discussion with the LLFA it was outlined that a network model design could not be prepared due to the way the site harvest rainwater and the requirements to storage, hold back water while sampling is undertaken to determine it water quality before discharge. This is further complicated by the site 12hr day only site attendance. Adjustments to the hydrograph within Microdrainage software has been evaluated and discounted for the main reason, it has caused confusion why these standard graphs have been modified.
   We have updated the site drainage plan to show all cover, invert, pipes sizes, pipe gradients & lengths as requested with additional details prepared within appendix IV.
   Final the half drain down time was discussed and highlighted that as the site requires to storage and hold back as much runoff as possible for use over the week / month / year, the 24hr half drain time will be be achieved across the site. However, the water demand of the plant is of a significant volume which is discussed in detail within section 10.

3. Cross sections of the control chambers (including site specific levels mAOD) and manufacturers' hydraulic curves for all hydro-brakes and other flow control devices are required.

   The proposed hydro brake specification has been included within appendix XI.

4. The applicant is required to confirm why the asset between SWMH.54 and SWMH.55 (downstream of the treatment lagoon) has been selected as a pipe rather than a ditch which would also allow for some infiltration.

   We have looked into change the pipe network between the two-manhole denoted above and have concluded changing this to a open ditch will be difficult to achieve based on the available land width of 2.5m – 3.0m. Considering a side slope profile of 1:2 and a recommended depth of 1.0m. We would require an overall ditch with of 4.0m based on a 'V' Ditch arrangement.
   This would leave no space for maintenance access to the ditch or down to the watercourse outfall. Additional erosion of the ditch would be a concern of the design life, due to the steep fall the of the land over this area. This will lead to increase maintenance requirement of a heavily restricted width.
   We, therefore, feel the use of a below ground pipe network would provide better overall maintenance access for the design life.

5. Details are required of the organisation or body responsible for vesting and maintaining individual aspects of the drainage system. The maintenance and/or adoption proposal for every element of the surface water drainage system proposed on the site should be considered for the lifetime of the development. A maintenance schedule setting out which assets need to be maintained, at what intervals and what method is to be used, including details of expected design life of all assets with a schedule of when replacement assets may be required, should be submitted.

   The site shall be owner and operator by Acorn Bioenergy and shall have the full responsibility of the sites operations & maintenance upkeep through the design life of the plant. This shall be done in accordance with a Bespoke Environmental Permit. We have prepared a draft maintenance schedule based on previous projects. This maybe subject to change pending agreement with the EA, however it will be audited yearly to ensure the maintenance schedule has been followed. See Appendix XII

6. Section 2.4 of the drainage strategy refers to final discharge of surface water drainage from the development into an ordinary watercourse to the east of the site. From the current drainage strategy, it is not clear if the land between the development site and proposed watercourse falls within the development ownership. In this situation, details or permission to discharge / cross third-party land will be required. Agreement from the riparian owner of the watercourse will also need to be demonstrated to allow this connection.

   The land is within the planning & Ownership boundary of the applicant, and we have included a letter from the wider landowner confirm their acceptance of our surface water discharge into the riparian watercourse. See Appendix XIII

2.0 Description of Existing and Proposed Site

The site has an area of 6.31ha and is entirely greenfield.

A topographical survey has been undertaken within the site and shown the site falling from 126.000mAOD at the southeast corner to 115.000mAOD to the northwest corner.

Refer to Appendix I for the existing topographical survey.

It is proposed to develop an anaerobic digestion plant, consisting of 3nr digester tanks, silage clamps, a digestate lagoon, gas equipment, material storage buildings, rainwater lagoon, surface water lagoon, offices, substrate tanks, parking and additional miscellaneous equipment.

Refer to Appendix II for the general layout.

3.0 Catchment Areas

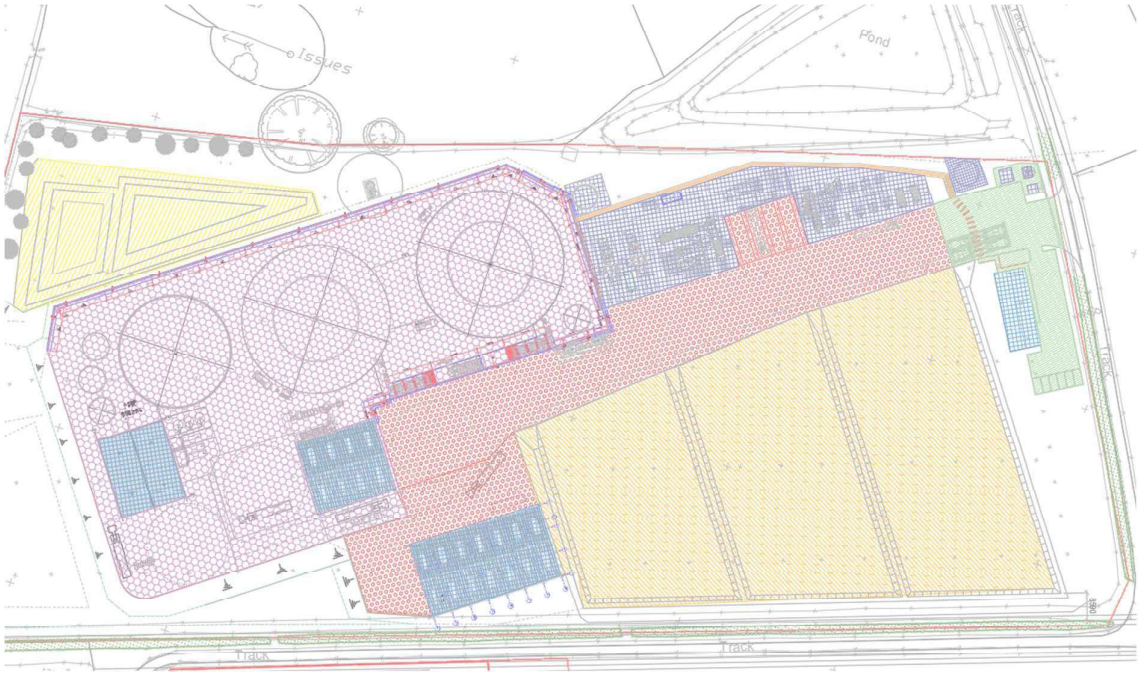
Various areas within the site will be subject to different operation functions, causing some areas being dirty and some clean, such that they require sealed drainage. Therefore, to improve water quality and optimise site efficiency, the site is split into catchments and subject to different drainage philosophies.

These catchments are classified in accordance with the environmental permit.

The site has been split into the following catchments in accordance with the best practice for environmental protection of land and water:

Catchment Area	**Area**
1 - Clean Surface Water Swale	2,548m²
2 - Clean Hardstanding with potential for petrochemical run-off	1,304m²
3 - Clean Equipment Runoff	2,450m²
4 – Clean Roof Runoff	2,258m²
5 - Clean/Contaminated Bund Runoff	11,664m²
6 - Dirty Silage Clamp Cover Runoff	11,741m²
7 – Contaminated Hardstanding Runoff	5,630m²
Total Catchment	**37,595m²**

Refer to Appendix III for the proposed catchment plan.



4.0 Design Philosophy

As stated within section 3.0, the site has been split into different catchments based on level of potential contamination. These catchments will be split into different drainage systems.

Two primary drainage systems will be adopted: clean and dirty.

In accordance with the approved SLR surface water drainage strategy, the site will be designed to contain all flows up to and including the 1:100-year event plus 40% climate change.

Dirty Water runoff, caused by silage residue, from the silage clamps and sections of hardstanding area will be collected through a series of drainage channels, pipes, and chambers and be brought into a below ground holding pumping chamber. From this pumping chamber, runoff will be pumped to 3nr 402m³ holding tanks within the bund where it will be reused within the process. Once the 1256m³ void within the holding tanks has been filled the spare lagoon will allow 510m³ of water to be stored.

This provides a total normal operating storage volume of 1,756m³. It must be noted that at the 1:100-year event there is a requirement that 2,131.5m³ is stored on site.

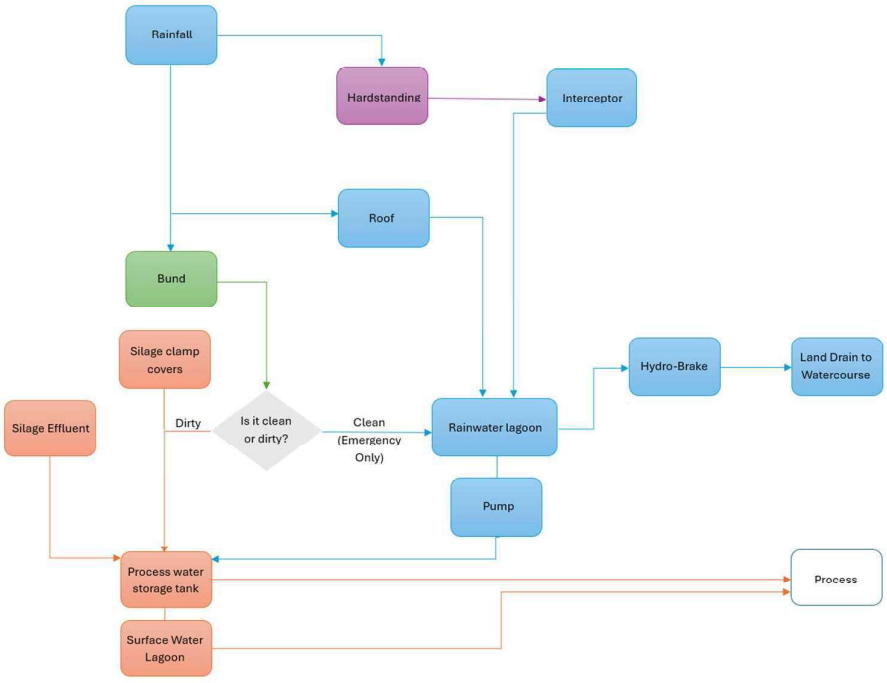
During a 1:100 year event the onsite digestate buffer tank (402m³) would be used to provide the additional volume.

The process has a yearly demand of 35,000m³ as per the mass balance document, equating to 1l/s continuous flow. This offers a sustainable drainage system, compliant with the hierarchy.

Clean runoff will be collected from buildings and sections of hardstanding and discharged into an open lagoon in the northwest corner before out falling into an existing watercourse to the northwest corner via a flow control. Petrochemicals may be present within the clean hardstanding runoff, which will be mitigated through a full retention petrol interceptor.

Bund runoff has the potential to become contaminated through process residue. This will be collected through a channel drain and discharged into a pump chamber where it will be sampled and pumped to the open lagoon (if clean) or reused in the process (if contaminated).

To illustrate the principals adopted, the below rainfall / process flow diagram has been provided.



Rainfall / Process Water flow diagram – See Appendix IX

4.1 Water Quality & Maintenance

Due to the likelihood of contamination from the hardstanding and other open areas of the Site, it is recommended that SuDS source control and conveyance features are not adopted on the Site. Consequently, a full retention interceptor & catchpit will be adopted to mitigate runoff contaminants. Additionally, the proposed AD plant will operate under an Environmental Permit, with a strict operational & maintenance procedure in place. These procedures are developed to ensure compliance and protection of the local receptors.

As part of the environmental permit a detailed maintenance schedule will be regulated against. This shall cover the drainage, external surfacing, buildings & concrete containment bund as a minimum.

The drainage maintenance document typically outlines daily, weekly, biweekly, monthly, quarterly & year inspection work to be carried out, along with the necessary actions required. A maintenance schedule shall be worked up with the Environment Agency based on the agree permit conditions. This shall be made available prior to the plant's been operationally.

Therefore, the proposed surface water drainage system shall conform and be regulated to a robust, audited & recorded operational & maintenance plan. This will ensure the performance of the drainage system is maintained throughout the life of the plant.

5.0 Proposed Discharge Rates

As mentioned within section 4.0, it is proposed to discharge clean surface water through a flow control device into the existing watercourse to the northwest corner of the development.

Calculations undertaken by SLR demonstrate a 7.8l/s per hectare rate with a proposed catchment area defined within section 3.0 as 4.21ha resulting in a peak site discharge rate of 32.88l/s.

The building roof, equipment and clean access roads shall be deemed to be clean and shall drain into a clean water storage lagoon before out falling at the restricted rate of 32.88l/s into the watercourse to the northwest boundary.

The silage clamp runoff, potential contaminated hardstanding area is deemed to be contaminated and shall be collected and pumped into above ground process storage tanks / spare lagoon for re-use within the process.

Refer to Appendix IV for the proposed drainage layout.

6.0 Clean/Contaminated Bund Runoff

Rainfall collected within the bund has the potential to be contaminated through process residue. Therefore, runoff is collected and contained within the bund until it is sampled to determine if contamination is present.

During an emergency water will be tested and if clean, runoff will be pumped to the rainwater lagoon. If dirty, runoff will be use within the process.

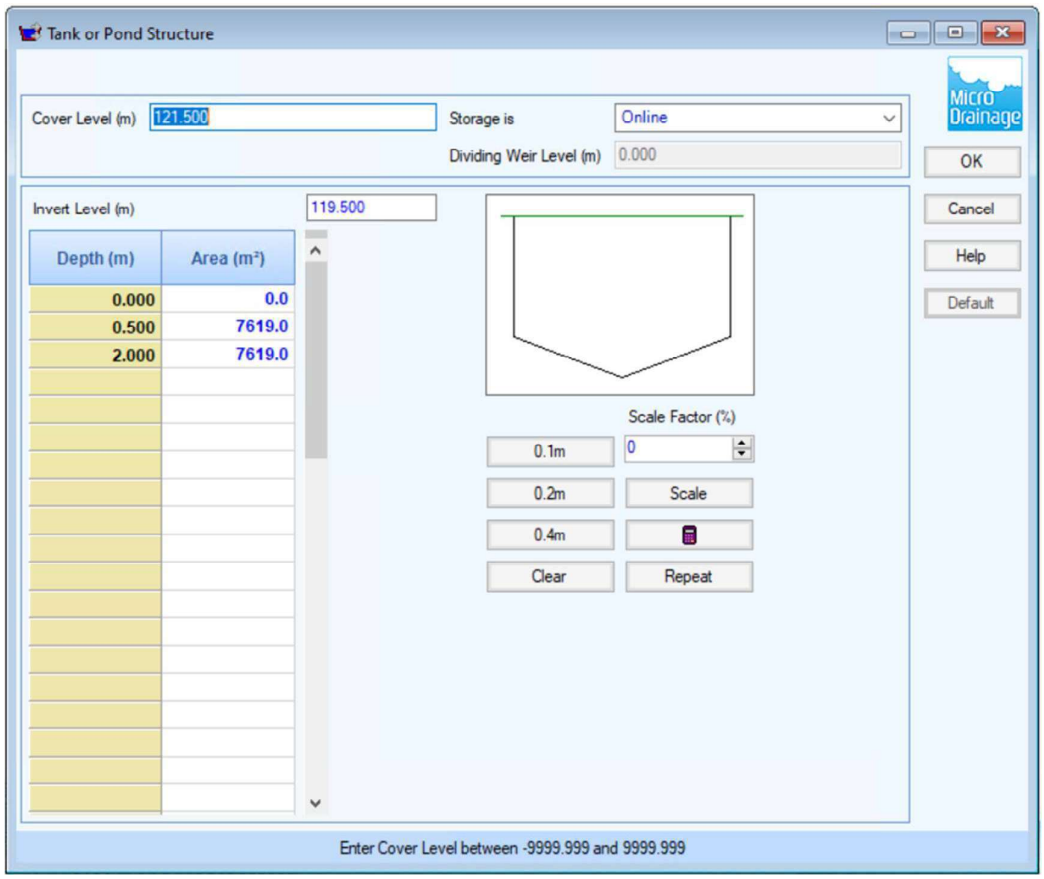
Runoff must be sampled prior to discharge, therefore, when the site is unmanned, the bund will store runoff until sampling can be undertaken. The longest period the site will be unmanned is over a 12hr night period.

Therefore, the bund will be modelled within no outfall with the 12hr storm events will be taken as the critical event.

The bund has a slab level of between 119.500m – 120.000m AOD with the lowest top wall level of 121.500mAOD.

The bund has an area of 12,189m², 4,570m² of which is taken by the tanks, resulting in an available bund area of 7,619m².

These parameters have been used to model the bund within MicroDrainage 'Source Control'. An extract of the structure can be seen below.



MicroDrainage 'Source Control' Tank/Pond Structure

The model has been run over a variety of storm events with the resultant volumes and depths detailed below.

Storm Event	Volume	Depth
1:1 Yr 12hr + 40%CC	361.5m³	329mm
1:2 Yr 12hr + 40%CC	436.4m³	350mm
1:10 Yr 12hr + 40%CC	617.3m³	393mm
1:30 Yr 12hr + 40%CC	777.1m³	425mm
1:100 Yr 12hr + 40%CC	1000.2m³	462mm

Refer to Appendix V for the full bund calculations.

7.0 Clean Northern Surface Water Runoff - Option 1

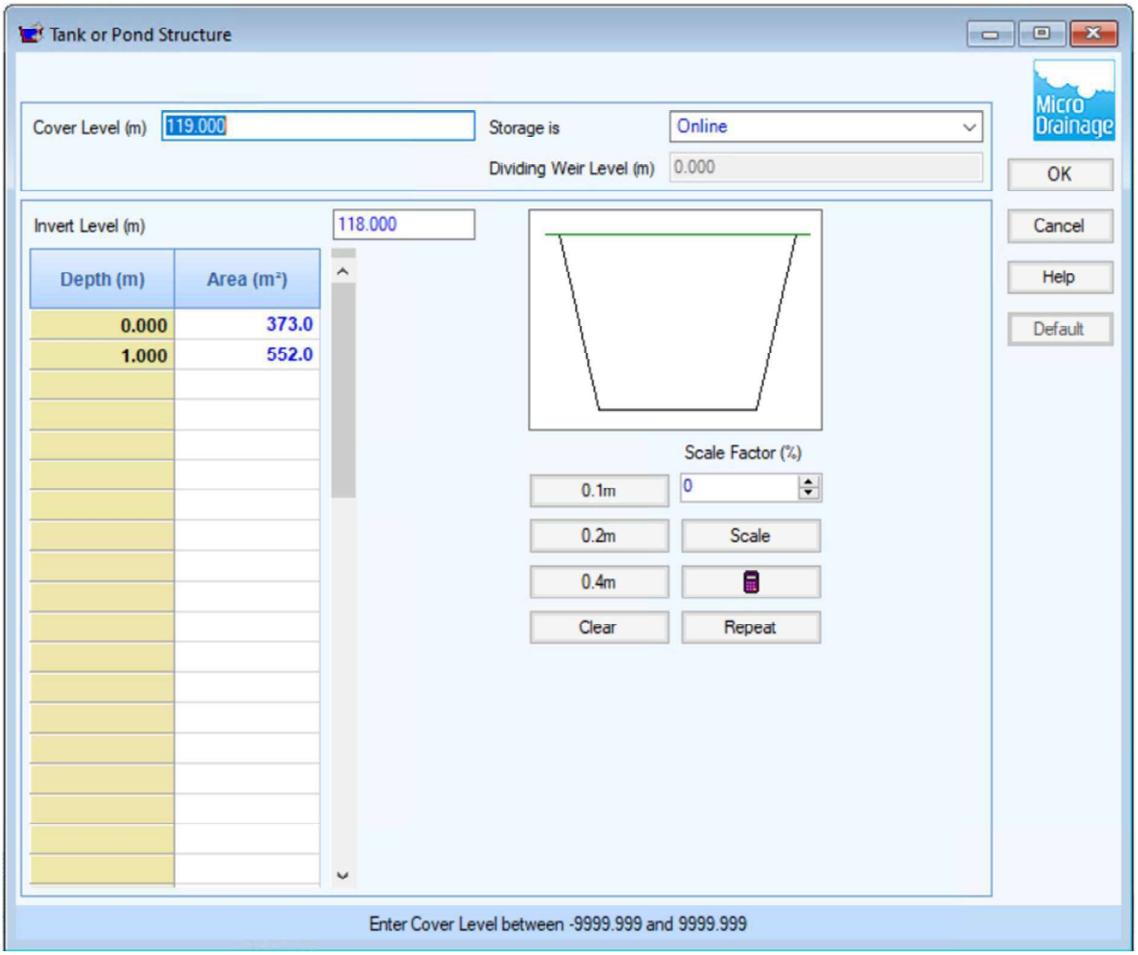
Surface water runoff from the buildings and clean hardstanding areas of the site will be collected through a series of rainwater pipes, pipes, chambers and gullies and be brought to the clean water lagoon to the northwest corner of the site. All runoff from external hardstanding areas shall pass through the full retention separator and be discharged into the lagoon.

Penstock isolation valves shall be provided on the up & down stream side of the interceptor along with all upstream connection to the lagoon.

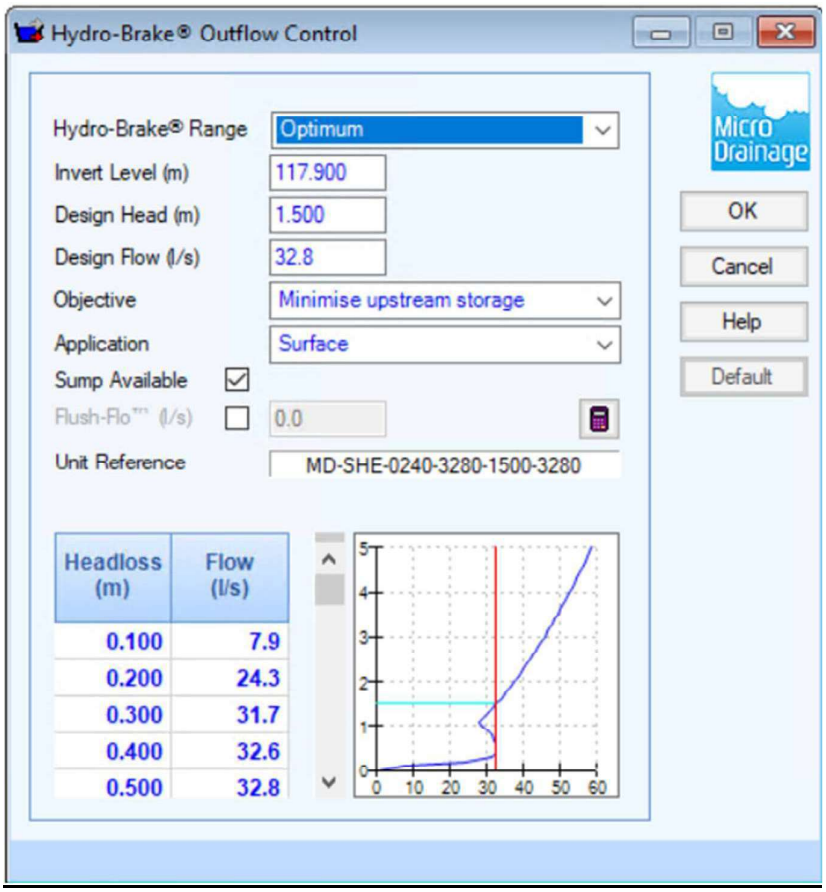
This will allow the site to fully isolated the clean water system during any emergency.

The lagoon has been designed to contain 511.57m³ of runoff, with a hydrobrake flow control.

An extract of the MicroDrainage 'Source Control' parameters can be seen below.



MicroDrainage 'Source Control' Pond Structure



MicroDrainage 'Source Control' Flow Control

The model has been run over a variety of storm events with the resultant volumes and depths detailed below.

Storm Event	Volume	Depth	Discharge Rate
1:1 Yr 30min + 40%CC	82.5m³	211mm	31.8l/s
1:2 Yr 30min+ 40%CC	113.8m³	287mm	32.6l/s
1:10 Yr 60min + 40%CC	193.2m³	469mm	32.8l/s
1:30 Yr 60min + 40%CC	268.8m³	631mm	32.8l/s
1:100 Yr 120min + 40%CC	383.8m³	859mm	32.8l/s

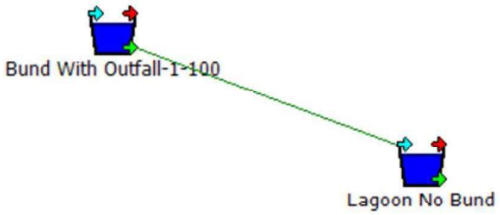
As shown above, all storm events are contained within the lagoon up to the 1:100 year event +40% CC.

Refer to Appendix VI for the full Clean Lagoon storage calculations.

8.0 Clean Northern Surface Water Runoff - Option 2

If the collected bund runoff is clean, it is proposed to pump the collected runoff at a rate of 5.0l/s into the clean water lagoon. The 'cascade' function within Source Control has been used to model the flow from the bund into the lagoon.

An extract of the cascade is shown below.



MicroDrainage 'Source Control' Cascade

The 1:100 Yr +40%CC has been used to calculate the highest occurring volumes and discharge rates within the lagoon.

Storm Event	Volume	Depth	Discharge Rate
1:1 Yr 60min + 40%CC	92.8m³	237mm	32.2l/s
1:30 Yr 60min + 40%CC	284.9m³	664mm	32.8l/s
1:100 Yr 120min + 40%CC	416.2m³	920mm	32.8l/s

As shown above, the lagoon contains all flows from the bund when pumped at a rate of 5.0l/s.

Refer to Appendix VII for full Lagoon/bund cascade calculations.

9.0 Contaminated Silage Clamp/Hardstanding Runoff

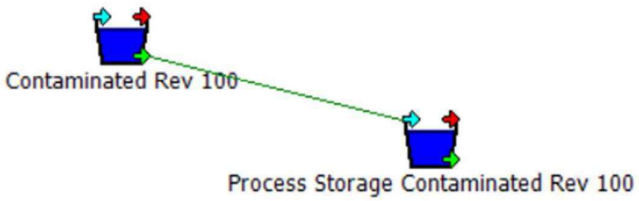
The runoff from the silage clamps and the surrounding hardstanding will be contaminated with leachate from the crop. As the contaminated runoff contains leachate, it has value to be reused within the process. Therefore, the site will use contaminated runoff as a main source of water.

Runoff will be collected through channel drains running along the front of the clamps where it will be discharged into an underground holding tank of 54m³. The area in front of the clamp may flood during storm event and been contained within the impermeable surface and kerbs / wall to the perimeter.

This will then be pumped into 4nr 402m³ holding tanks within the bund & a lagoon area holding 806m³ where it will be used within the process at an increase rate of 1.0l/s. This provides a total storage capacity of 2,406m³.

The 'cascade' function within Source Control has been used to model the flow from the Yard into the Process Water Tanks.

An extract of the cascade is shown below.



MicroDrainage 'Source Control' Cascade

The model has been run over a variety of storm events with the resultant volumes and depths detailed overleaf.

As the site for a maximum unsupervised period of 12hrs, the peak and 12hr event will be analysed.

12hr

Storm Event	Volume (Yard)	Volume (Process Tanks/Lagoon)
1:1 Yr 12hr + 40%CC	0.0m³	531.5m³
1:10 Yr 12hr + 40%CC	0.0m³	922.6m³
1:30 Yr 12hr + 40%CC	0.0m³	1163.8m³
1:100 Yr 12hr + 40%CC	0.0m³	1499.9m³

The below also shows the peak storm for the yard with the volume in the process tank. Which would allow additional water to be pumped into the process tanks if required.

The yard area will suffer from above ground flooding; however, this area is designed to contain water without it flowing off site or affecting over areas on site.

Peak Yard

Storm Event	Volume (Yard)	Volume (Process Tanks)
1:1 Yr 30min + 40%CC	0m³	191.6m³
1:10 Yr 30min + 40%CC	56m³	371.1m³
1:30 Yr 30min + 40%CC	133m³	474.4m³
1:100 Yr 30min + 40%CC	254.2m³	622.4m³

Peak Tanks

Storm Event	Volume (Yard)	Volume (Process Tanks)
1:1 Yr 5760min + 40%CC	8.1m³	768.1m³
1:10 Yr 8640min + 40%CC	0.0m³	1342.8m³
1:30 Yr 8640min + 40%CC	0.0m³	1682m³
1:100 Yr 10080min + 40%CC	0.0m³	2131.5m³

The above shows in the event of exceptional high intensity rainfall events, the volume the capacity of the pump resulting in above ground flooding as permitted and full contained within the designed area. The process tank will have spare capacity for the pump rates to be increased to aid the yard emptying quicker. Typically, the yard would be dry within 1hour after the storm event.

Refer to Appendix VIII for silage clamp 1.0l/s calculations.

10.0 Plant Water Demand Against Average Annual Rainfall

The site has been designed to contain all flows up to and including the 1:100 year +40% CC.

An assessment has been undertaken to compare the average annual rainfall (AAR) against the process' water demand to determine if the process demand is greater than the harvested water.

From reviewing the process, it is expected the process has a yearly operation demand of 35,000m³, equating to a continuous flow of 1l/s.

Dirty water runoff will be isolated, retained and reused within the process. The clean areas will not encounter any potential contamination, this catchment will be deducted through the analysis.

AAR = 0.662

Area (Potential Contamination) = 29,009m²

CC = 40%

Total annual rainfall (including climate change) = 22,423m³

As shown above, the plant has a significantly higher demand than the yearly rainfall within the potential dirty water system with the addition of climate change.

Therefore, the collected runoff is recycled within the process, satisfying sustainability and drainage hierarchy requirements. Where possible the shortfall in water demand based on the average annual rainfall shall be collected from any clean water system and used within the AD process.

The expected final discharge volume to the watercourse via the clean system shall be less than the calculated within the report, based on the shortfall in water from the process area.

Taking the full runoff area of 37,528m², Total annual rainfall (including climate change) = 33,866m³. This demonstrate the site yearly demand is greater than the runoff from the site.

11.0 Foul Water - Welfare

The proposed development will consist of site welfare office for up to 6 people per day.

The welfare shall contain, Toilets, Shower and Office Appliances.

Calculations will be based on the British Water – Flows and Loads tables.

The following should be used;

Office = Office / Factory with canteen
Showers = Per Use

Table 1 – Total load

Use	Unit (No.)	People / Unit (No.)	Total People (No.)	Flows (L)	Total (L)
Office	1	6	6	50	300
Shower	1	3	3	40	120
Total					420

The above demonstrates a minimum flow of 420L per day or 0.420m^3.

Therefore, the Treatment Plant will take approximately 420L per day or 0.420m^3.

The volume shall now be considered for sizing the treatment plant.

Technical Specification

BioAir	Model	BioAir 2	BioAir 3	BioAir 4	BioAir 5	BioAir 6	BioAir 7	BioAir 8
Population Equivalent	Unit	6	9	12	15	20	25	35
Daily Flow	m3/d	0.9	1.35	1.8	2.25	3	3.75	5.25
Daily Load	kg BOD5/d	0.36	0.54	0.72	0.9	1.2	1.5	2.1
Measurements								
Inlet Invert	mm	455-755	575-875	500-2000	645-945	500-2000	500-2000	500-2000
Discharge Option		Gravity / IPS	Gravity / IPS	Gravity / IPS	Gravity / IPS	Gravity	Gravity	Gravity
Outlet Invert	mm	555-845 / 400-700	675-975 / 350-650	600-2100	745-1045 / 415-715	600-2100	600-2100	600-2100
Diameter	mm	1540	1690	1920	2010	1920	1920	1920
Length	mm	2500	2480	3238	3190	4400	5550	7400
Installation Depth	mm	1805-2105	2075-2375	2245-3745	2485-2785	2245-3745	2245-3745	2245-3745
Inlet Pipework	mm	Ø110	Ø110	Ø110	Ø110	Ø110	Ø110	Ø160
Outlet Pipework (Gravity / IPS)	mm	Ø110 / Ø50	Ø110 / Ø50	Ø110 / Ø50	Ø110 / Ø50	Ø110	Ø110	Ø160
Material Construction	MDPE / GRP	MDPE	MDPE	GRP	MDPE	GRP	GRP	GRP
Unit Weight	kg	170	200	500**	650	800**	1250**	1450**

***Tank weight based on 500mm invert*

From the above table a Klargester BioAir '2' will be of a sufficient sized to treat the expected daily flow into the treatment plant Maximum flow = 0.420m^3

In summary, it is proposed to use a treatment plant, the use of a treatment plant has been selected based on the requirement of the onsite welfare facilities. It will only have toilets and showers discharging into the treatment plant.

12.0 Summary

Following a site wide attenuation assessment, it has been clearly demonstrated that the proposed drainage system can provide more than sufficient attenuation capacity to avoid any exceedance of the permitted discharge rate.

The proposed clean runoff will be collected and attenuated within a clean water lagoon and discharge at peak rate of 32.8l/s. This will contain the 1:100 year +40%CC below ground.

The plant will harvest dirty water runoff to be reused within the process at a constant rate of 1l/s. This will be contained in an underground 54m³ holding tank and 3nr 402m³ holding tanks within the bund as well as an 510m³ lagoon.

All runoff within the bund will be collected and sampled prior to discharge. Clean runoff will discharge into the northern lagoon during an emergency, while dirty runoff will be used within the process.

Systems and pumps will be monitored, and data logged via a computer system with alarms to alert operators on or off site.

The site will operate under an environment permit with strict recording, sampling, and maintenance under full review.

The drainage system within the site will be under full ownership of the plant owners/operators operating under an Environmental Permit, with a robust, audited and recorded operation and maintenance plan. This will ensure the performance of the drainage system is maintained throughout the life of the plant.

From GGP CONSULT

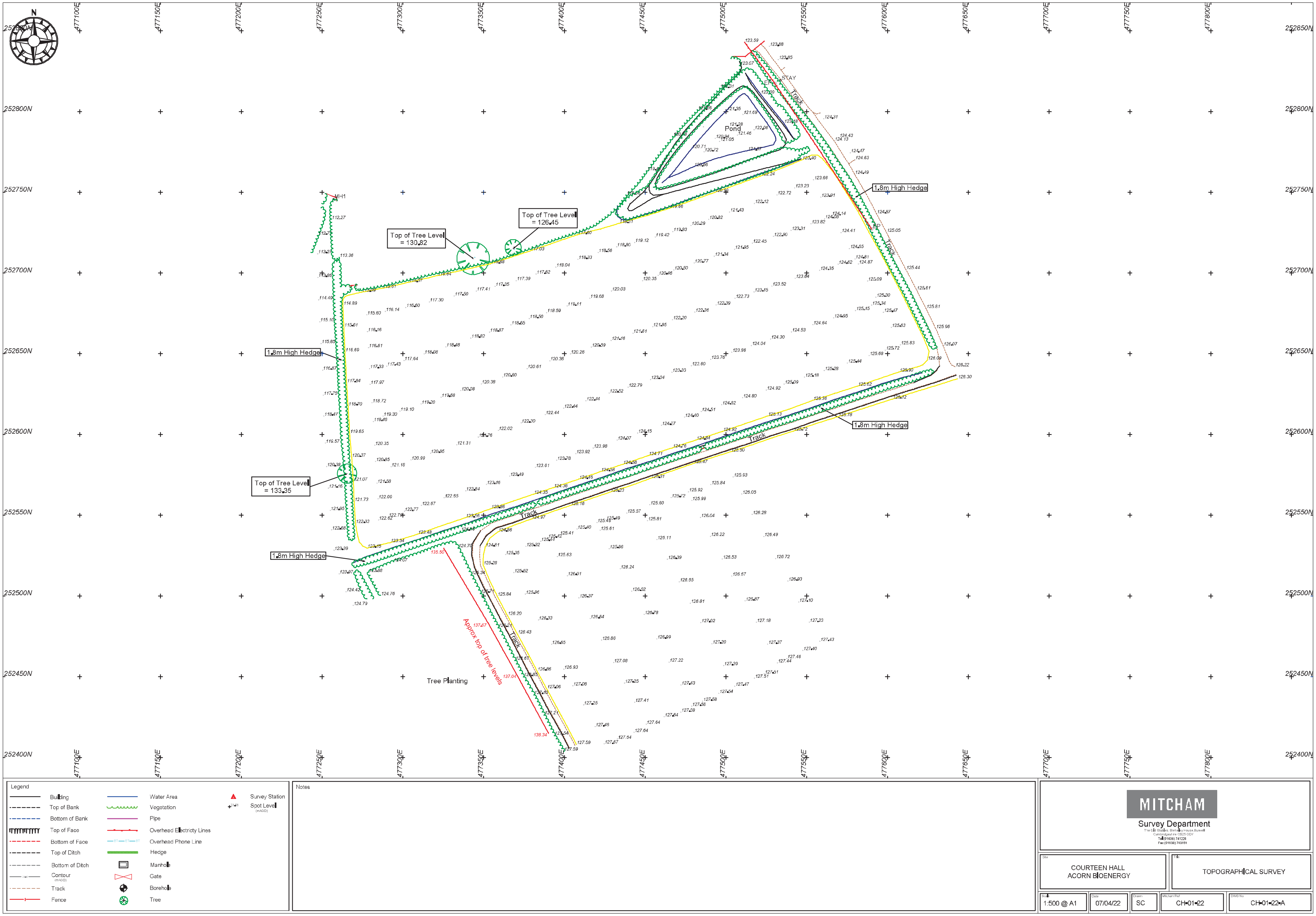
Report Checked by:-

J. H. Collins BSc. (Hons), MCIWEM

Associate Director - Drainage & Infrastructure

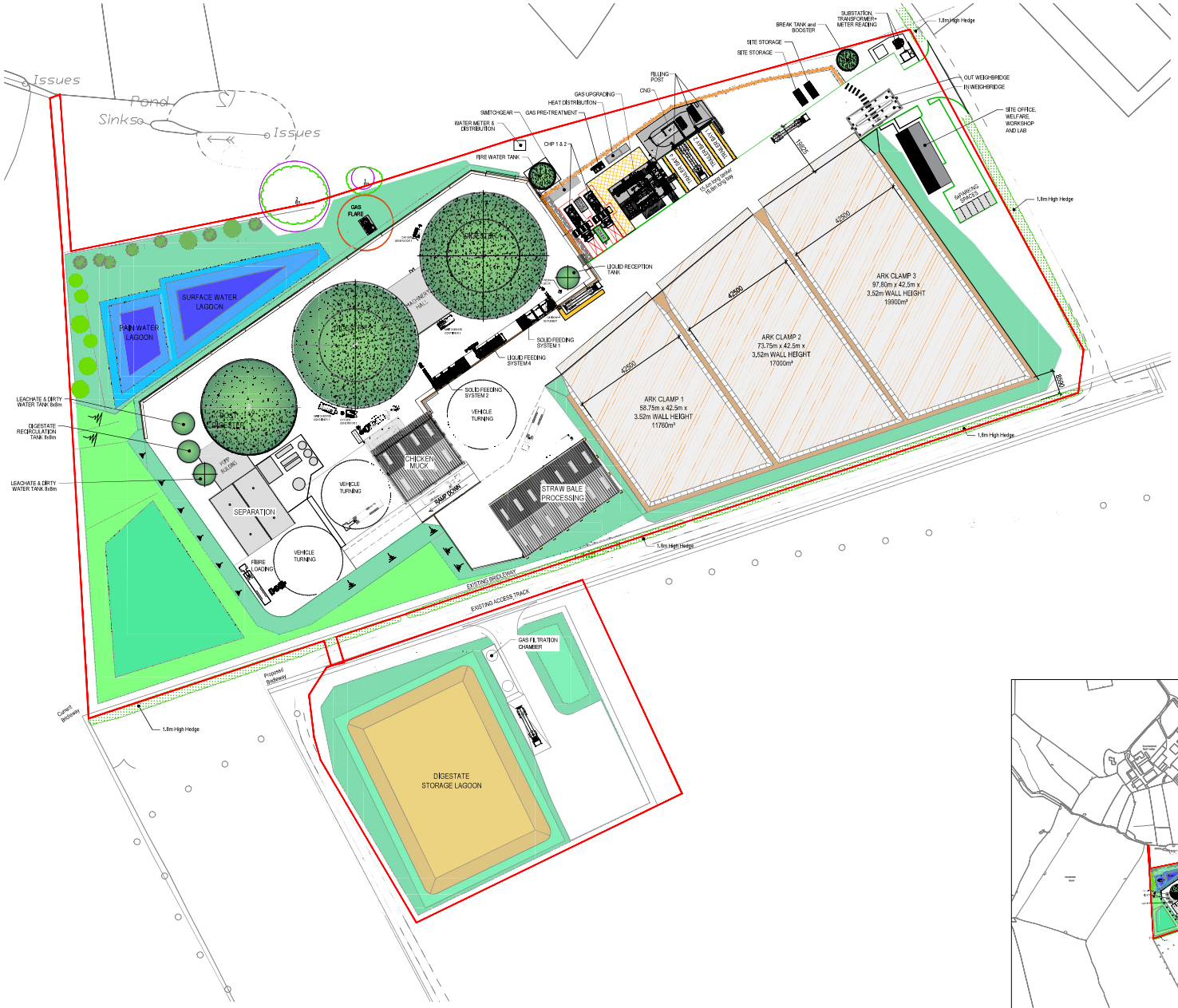
APPENDIX I

Existing Topographical Survey

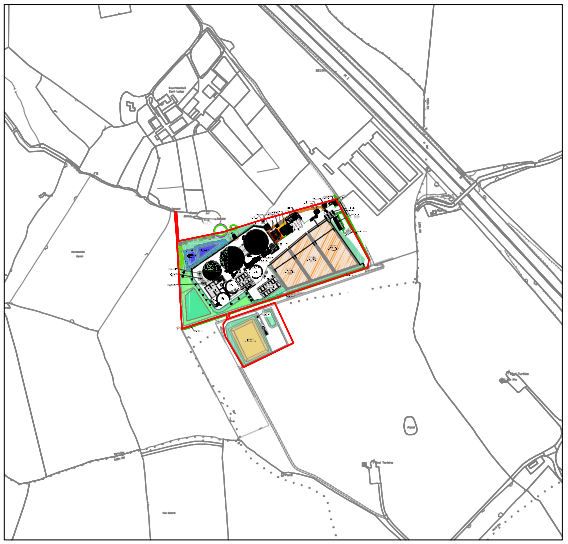

MITCHAM
Survey Department
COURTEEN HALL
ACORN BIOENERGY
TOPOGRAPHICAL SURVEY
1:500 @ A1
07/04/22
SC
CH-01-22
CH-01-22-A
Notes
Legend
Building
Top of Bank
Bottom of Bank
Top of Face
Bottom of Face
Top of Ditch
Bottom of Ditch
Contour
Track
Fence
Water Area
Vegetation
Pipe
Overhead Electricity Lines
Overhead Phone Line
Hedge
Manhole
Gate
Borehole
Tree
Survey Station
Spot Level
1.8m High Hedge
1.8m High Hedge
1.8m High Hedge
1.8m High Hedge
Top of Tree Level = 126.45
Top of Tree Level = 130.82
Top of Tree Level = 133.35
Pond
Track
Track
Track
Track
Tree Planting
Approx top of tree levels
252850N
252800N
252750N
252700N
252650N
252600N
252550N
252500N
252450N
252400N
477100E
477150E
477200E
477250E
477300E
477350E
477400E
477450E
477500E
477550E
477600E
477650E
477700E
477750E
477800E

APPENDIX II

General Layout



SITE LAYOUT PLAN
Scale: 1:600 @ A1



SITE LOCATION PLAN
Scale: 1:5000 @ A1

FOR CONSTRUCTION

NOTES:-

1. All dimensions must be checked on site and not scaled from this drawing.
2. The Contractor shall make a survey of the site and shall be responsible for obtaining all dimensions and levels necessary for the proper fabrication of the structure as indicated.
3. All levels shown on this drawing are relative to Agreed Topographic survey
4. This drawing is to be read in conjunction with 29384/100 Series Drawings.
5. All existing invert levels are to be confirmed by contractor prior to construction. Connection subject to approval.

Denotes Site Boundary

Rev	Date	Description	DR	CH
C06	03/02/25	Layout Updated	JH	JHC
C05	09/01/25	Layout Updated	JH	JHC
C04	18/12/24	Layout Updated	NK	JHC
C03	11/11/24	Issued For Construction	JH	JHC
C02	11/09/24	Issued For Construction	JH	JHC
C01	17/07/24	Issued For Construction	JH	JHC
C1	07/06/24	Issued For Contract	JH	JHC
T2	05/03/24	Issued For Tender	JH	JHC
T1	04/02/24	Issued For Tender	JH	JHC

GGP CONSULT
CONSULTING ENGINEERS
PROJECT MANAGEMENT
2 Hallam Road
Priory Park East
HULL HU4 7DY
United Kingdom
Telephone (+44 01482) 627963
Fax (+44 01482) 641756
Email info@ggpconsult.co.uk

Client: acorn

Job Title
AD Plant
Horse Close Green Power

Drawing Title
Site Layout Plan

Status: Construction

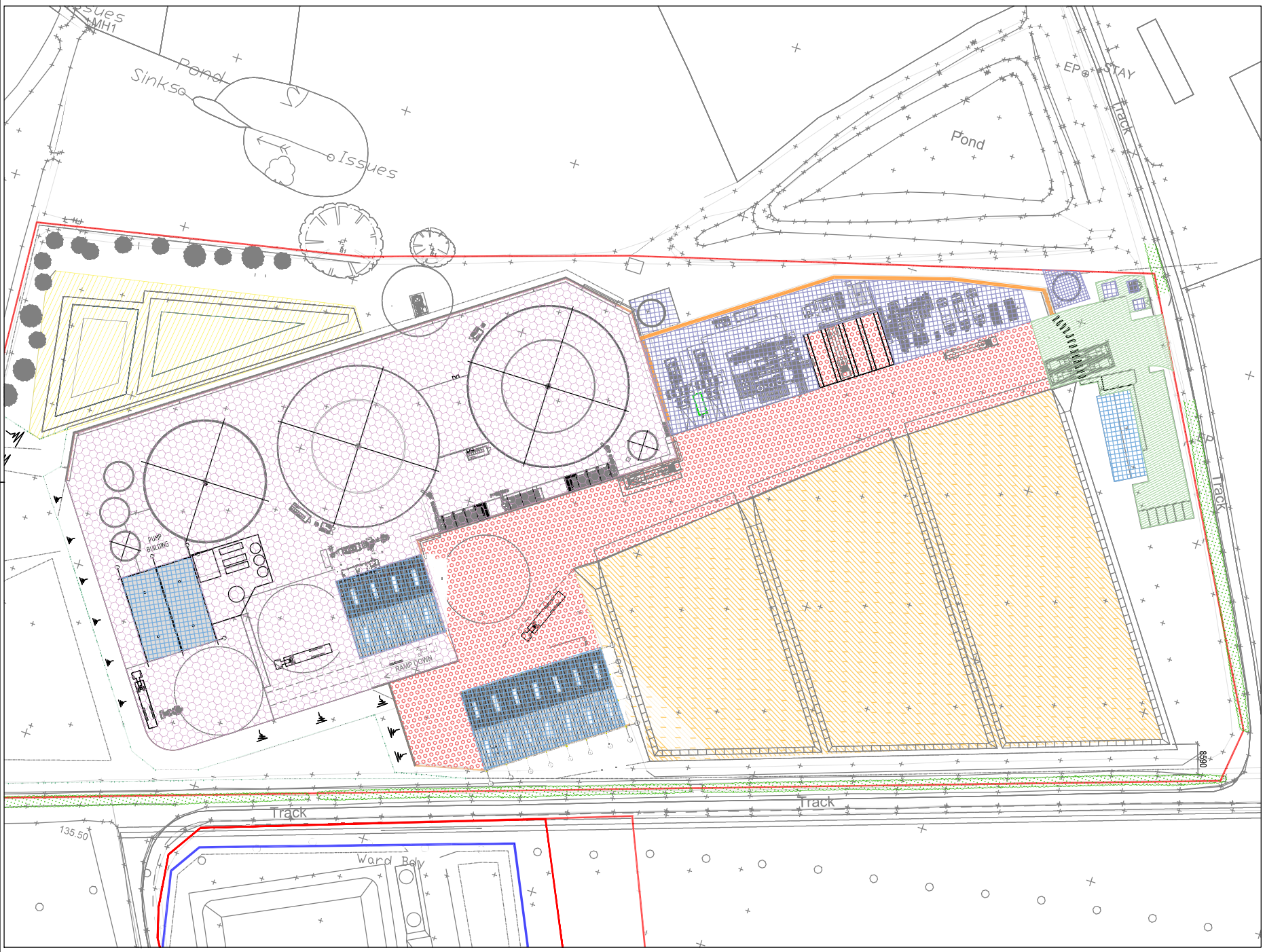
Scale	Date
As Noted @ A1	JULY' 2024

Drawn By	Checked	Approved
JH	JHC	JHC

Drg. No.	Rev
29384/C1/101	C06

APPENDIX III

Drainage Catchment Plan



SITE PLAN
Scale: 1:500 @ A1

FOR CONSTRUCTION

NOTES:

1. All dimensions must be checked on site and not scaled from this drawing.
2. The Contractor shall make a survey of the site and shall be responsible for obtaining all dimensions and levels necessary for the proper fabrication of the structure as indicated.
3. All levels shown on this drawing are relative to Agreed Topographic survey
4. This drawing is to be read in conjunction with 29384/100 Series Drawings.
5. All existing invert levels are to be confirmed by contractor prior to construction. Connection subject to approval.

- Denotes Site Boundary
- Denotes Clean Surface Water Swale Area – 2,548m²
- Denotes Clean w/Petrochemicals Hardstanding Runoff Area – 1,304m²
- Denotes Clean Equipment Runoff Area – 2,450m²
- Denotes Clean/Contaminated Bund Runoff Area – 11,664m²
- Denotes Dirty Silage Clamp Runoff Area – 11,714m²
- Denotes Contaminated Hardstanding Runoff Area – 5,630m²
- Denotes Clean Roof Runoff Area – 2,258m²

Rev	Date	Description	DR	CH
C06	09/01/24	Layout amended	JH	JHC
C05	18/12/24	Layout amended	NW	JHC
C04	12/11/24	Layout amended	MS	JHC
C03	10/09/24	Issued For Construction	WH	JHC
C02	21/08/24	Issued For Final Approval	WH	JHC
C01	16/08/24	Issued For Final Approval	WH	JHC
C1	07/06/24	Issued For Contract	MS	JHC
T2	05/03/24	Layout amended	MS	JHC
T1	03/02/24	Issued For Tender	MS	JHC

GGP CONSULT
CONSULTING ENGINEERS
PROJECT MANAGEMENT
2 Hallam Road
Priory Park East
HULL HU4 7DY
United Kingdom
Telephone (+44) 01482 627963
Fax (+44) 01482 641736
Email info@ggpconsult.co.uk

Client: acorn

Job Title:
AD Plant
Horse Close Green Power

Drawing Title:
Proposed Catchment Plan

Status: FINAL CONSTRUCTION

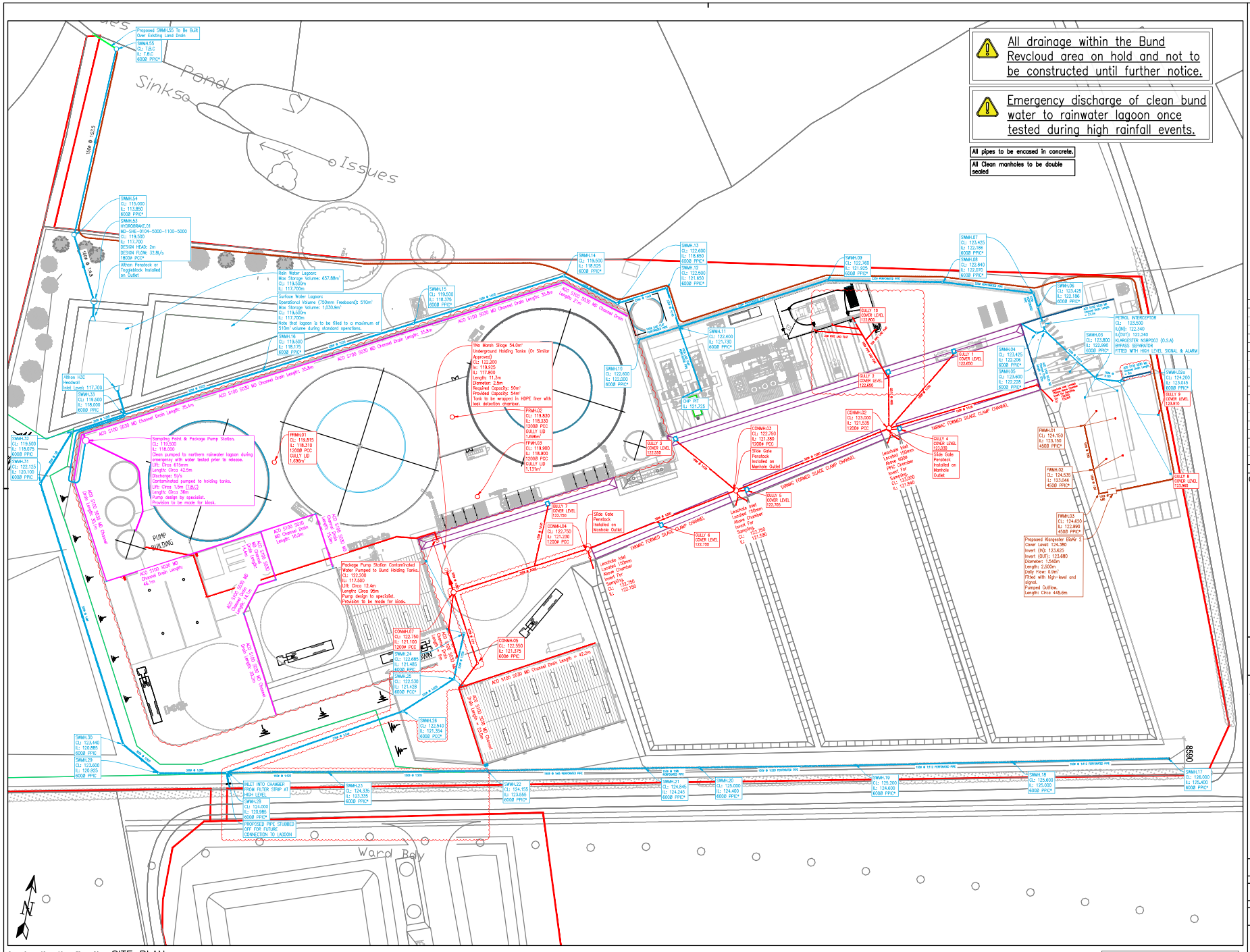
Scale	Date
As Noted @ A1	JUN' 2024

Drawn By	Checked	Approved
WB	JHC	JHC

Dwg. No.	Rev
29384/C1/103	C06

APPENDIX IV

Proposed Drainage Layout



NOTES -

1. All dimensions must be checked on site and not scaled from this drawing.
2. The Contractor shall make a survey of the site and shall be responsible for obtaining all dimensions and levels necessary for the proper fabrication of the structure as indicated.
3. All levels shown on this drawing are relative to Agreed Topographic survey
4. This drawing is to be read in conjunction with 29384/100 Series Drawings.
5. All existing invert levels are to be confirmed by contractor prior to construction. Connection subject to approval.

- Site Red Line Boundary
- Clean Surface Water Sewer
- Clean Surface Water Chamber
- Clean Surface Water Headwall
- Clean Surface Water Drainage Channel
- Clean Surface Water Rainwater Pipe
- Clean Surface Water Rising Main
- Contaminated Surface Water Sewer
- Contaminated Surface Water Chamber
- Contaminated Surface Water Drainage Channel
- Contaminated Surface Water Rising Main
- Bund Surface Water Sewer
- Bund Surface Water Chamber
- Bund Surface Water Channel Drain
- Foul Water Sewer
- Foul Water Chamber
- Foul Water Rising Main
- Soil Vent Pipe
- Leak Detection Chamber

Rev	Date	Description	DR	CH
C20	03/02/25	Issued For Construction	JH	JHC
C19	31/01/25	Issued For Construction	JH	JHC
C18	09/01/25	Issued For Construction	JH	JHC
C17	18/12/24	Issued For Construction	JH	JHC
C16	05/12/24	Issued For Construction	JH	JHC
C15	14/11/24	Issued For Construction	JH	JHC
C14	11/11/24	Issued For Construction	JH	JHC
C13	25/10/24	Issued For Construction	JH	JHC
C12	15/10/24	Issued For Construction	JH	JHC
C11	20/09/24	Issued For Construction	JH	JHC
C10	11/09/24	Issued For Construction	JH	JHC
C9	09/09/24	Issued For Construction	JH	JHC
C8	06/09/24	Issued For Final Approval	JH	JHC
C7	03/09/24	Issued For Final Approval	JH	JHC
C6	29/08/24	Issued For Final Approval	JH	JHC
C5	28/08/24	Issued For Final Approval	JH	JHC
C4	21/08/24	Issued For Final Approval	JH	JHC
C3	16/08/24	Issued For Final Approval	JH	JHC
C2	15/08/24	Issued For Final Approval	JH	JHC

GGP CONSULT
CONSULTING ENGINEERS
PROJECT MANAGEMENT
2 Hallam Road
Priory Park East
HULL HU4 7DY
United Kingdom
Telephone (+44) 01482 627963
Fax (+44) 01482 641736
Email info@ggpconsult.co.uk

Client: acorn

Job Title: AD Plant
Horse Close Green Power

Drawing Title: Proposed Drainage Layout

Status: CONSTRUCTION

Scale: As Noted @ A1 | Date: JUN' 2024

Drawn By: MK | Checked: JHC | Approved: JHC

Drg. No: 29384/C1/105 | Rev: C20

SITE PLAN
Scale: 1:500 @ A1

APPENDIX V

Bund Calculations

Summary of Results for 1 year Return Period (+40%)

Outflow is too low. Design is unsatisfactory.

Storm Event	Max Level (m)	Max Depth (m)	Max Volume (m³)	Status
15 min Summer	119.717	0.217	104.5	O K
30 min Summer	119.737	0.237	134.6	O K
60 min Summer	119.755	0.255	167.5	O K
120 min Summer	119.772	0.272	204.1	O K
180 min Summer	119.782	0.282	227.8	O K
240 min Summer	119.789	0.289	246.0	O K
360 min Summer	119.799	0.299	272.8	O K
480 min Summer	119.807	0.307	292.6	O K
600 min Summer	119.812	0.312	308.8	O K
720 min Summer	119.817	0.317	322.7	O K
960 min Summer	119.824	0.324	346.0	O K
1440 min Summer	119.835	0.335	381.6	O K
2160 min Summer	119.846	0.346	421.2	O K
2880 min Summer	119.854	0.354	451.8	O K
4320 min Summer	119.866	0.366	498.2	O K
5760 min Summer	119.875	0.375	534.0	O K
7200 min Summer	119.881	0.381	563.6	O K
8640 min Summer	119.887	0.387	589.2	O K
10080 min Summer	119.892	0.392	611.7	O K
15 min Winter	119.726	0.226	117.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)
15 min Summer	45.717	0.0	23
30 min Summer	29.437	0.0	38
60 min Summer	18.324	0.0	68
120 min Summer	11.160	0.0	128
180 min Summer	8.306	0.0	188
240 min Summer	6.727	0.0	248
360 min Summer	4.974	0.0	368
480 min Summer	4.000	0.0	488
600 min Summer	3.378	0.0	608
720 min Summer	2.942	0.0	728
960 min Summer	2.365	0.0	968
1440 min Summer	1.739	0.0	1448
2160 min Summer	1.280	0.0	2168
2880 min Summer	1.030	0.0	2888
4320 min Summer	0.757	0.0	4328
5760 min Summer	0.608	0.0	5768
7200 min Summer	0.514	0.0	7208
8640 min Summer	0.448	0.0	8648
10080 min Summer	0.398	0.0	10088
15 min Winter	45.717	0.0	23

Summary of Results for 1 year Return Period (+40%)

Storm Event	Max Level (m)	Max Depth (m)	Max Volume (m³)	Status
30 min Winter	119.746	0.246	150.7	O K
60 min Winter	119.764	0.264	187.6	O K
120 min Winter	119.782	0.282	228.6	O K
180 min Winter	119.793	0.293	255.1	O K
240 min Winter	119.800	0.300	275.5	O K
360 min Winter	119.811	0.311	305.6	O K
480 min Winter	119.818	0.318	327.7	O K
600 min Winter	119.824	0.324	345.9	O K
720 min Winter	119.829	0.329	361.5	O K
960 min Winter	119.837	0.337	387.5	O K
1440 min Winter	119.848	0.348	427.4	O K
2160 min Winter	119.859	0.359	471.7	O K
2880 min Winter	119.868	0.368	506.1	O K
4320 min Winter	119.880	0.380	558.0	O K
5760 min Winter	119.889	0.389	598.0	O K
7200 min Winter	119.896	0.396	631.2	O K
8640 min Winter	119.902	0.402	659.9	O K
10080 min Winter	119.907	0.407	685.1	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)
30 min Winter	29.437	0.0	38
60 min Winter	18.324	0.0	68
120 min Winter	11.160	0.0	128
180 min Winter	8.306	0.0	188
240 min Winter	6.727	0.0	248
360 min Winter	4.974	0.0	368
480 min Winter	4.000	0.0	488
600 min Winter	3.378	0.0	608
720 min Winter	2.942	0.0	728
960 min Winter	2.365	0.0	968
1440 min Winter	1.739	0.0	1448
2160 min Winter	1.280	0.0	2168
2880 min Winter	1.030	0.0	2888
4320 min Winter	0.757	0.0	4328
5760 min Winter	0.608	0.0	5768
7200 min Winter	0.514	0.0	7208
8640 min Winter	0.448	0.0	8648
10080 min Winter	0.398	0.0	10088

Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	1	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	20.400	Shortest Storm (mins)	15
Ratio R	0.440	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+40

Time Area Diagram

Total Area (ha) 1.219

Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)
0	4	0.610	4	8	0.609

Time Area Diagram

Total Area (ha) 0.000

Time From:	(mins) To:	Area (ha)
0	4	0.000

Model Details

Storage is Online Cover Level (m) 121.500

Tank or Pond Structure

Invert Level (m) 119.500

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	0.0	0.500	7619.0	2.000	7619.0

Summary of Results for 2 year Return Period (+40%)

Outflow is too low. Design is unsatisfactory.

Storm Event	Max Level (m)	Max Depth (m)	Max Volume (m³)	Status
15 min Summer	119.737	0.237	135.0	O K
30 min Summer	119.757	0.257	172.4	O K
60 min Summer	119.775	0.275	211.7	O K
120 min Summer	119.792	0.292	254.2	O K
180 min Summer	119.803	0.303	281.3	O K
240 min Summer	119.810	0.310	301.8	O K
360 min Summer	119.820	0.320	332.3	O K
480 min Summer	119.827	0.327	355.1	O K
600 min Summer	119.833	0.333	373.7	O K
720 min Summer	119.837	0.337	389.6	O K
960 min Summer	119.845	0.345	416.0	O K
1440 min Summer	119.855	0.355	456.2	O K
2160 min Summer	119.867	0.367	500.3	O K
2880 min Summer	119.875	0.375	534.1	O K
4320 min Summer	119.886	0.386	585.4	O K
5760 min Summer	119.895	0.395	624.8	O K
7200 min Summer	119.901	0.401	657.2	O K
8640 min Summer	119.907	0.407	684.9	O K
10080 min Summer	119.912	0.412	709.3	O K
15 min Winter	119.746	0.246	151.2	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)
15 min Summer	59.065	0.0	23
30 min Summer	37.722	0.0	38
60 min Summer	23.156	0.0	68
120 min Summer	13.903	0.0	128
180 min Summer	10.257	0.0	188
240 min Summer	8.253	0.0	248
360 min Summer	6.058	0.0	368
480 min Summer	4.855	0.0	488
600 min Summer	4.088	0.0	608
720 min Summer	3.551	0.0	728
960 min Summer	2.844	0.0	968
1440 min Summer	2.079	0.0	1448
2160 min Summer	1.520	0.0	2168
2880 min Summer	1.217	0.0	2888
4320 min Summer	0.889	0.0	4328
5760 min Summer	0.712	0.0	5768
7200 min Summer	0.599	0.0	7208
8640 min Summer	0.520	0.0	8648
10080 min Summer	0.462	0.0	10088
15 min Winter	59.065	0.0	23

Summary of Results for 2 year Return Period (+40%)

Storm Event	Max Level (m)	Max Depth (m)	Max Volume (m³)	Status
30 min Winter	119.767	0.267	193.1	O K
60 min Winter	119.786	0.286	237.1	O K
120 min Winter	119.804	0.304	284.7	O K
180 min Winter	119.814	0.314	315.1	O K
240 min Winter	119.822	0.322	338.0	O K
360 min Winter	119.832	0.332	372.2	O K
480 min Winter	119.840	0.340	397.7	O K
600 min Winter	119.845	0.345	418.6	O K
720 min Winter	119.850	0.350	436.4	O K
960 min Winter	119.858	0.358	465.9	O K
1440 min Winter	119.869	0.369	511.0	O K
2160 min Winter	119.881	0.381	560.3	O K
2880 min Winter	119.889	0.389	598.2	O K
4320 min Winter	119.901	0.401	655.7	O K
5760 min Winter	119.910	0.410	699.7	O K
7200 min Winter	119.917	0.417	736.0	O K
8640 min Winter	119.923	0.423	767.1	O K
10080 min Winter	119.928	0.428	794.5	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)
30 min Winter	37.722	0.0	38
60 min Winter	23.156	0.0	68
120 min Winter	13.903	0.0	128
180 min Winter	10.257	0.0	188
240 min Winter	8.253	0.0	248
360 min Winter	6.058	0.0	368
480 min Winter	4.855	0.0	488
600 min Winter	4.088	0.0	608
720 min Winter	3.551	0.0	728
960 min Winter	2.844	0.0	968
1440 min Winter	2.079	0.0	1448
2160 min Winter	1.520	0.0	2168
2880 min Winter	1.217	0.0	2888
4320 min Winter	0.889	0.0	4328
5760 min Winter	0.712	0.0	5768
7200 min Winter	0.599	0.0	7208
8640 min Winter	0.520	0.0	8648
10080 min Winter	0.462	0.0	10088

Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	2	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	20.400	Shortest Storm (mins)	15
Ratio R	0.440	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+40

Time Area Diagram

Total Area (ha) 1.219

Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)
0	4	0.610	4	8	0.609

Time Area Diagram

Total Area (ha) 0.000

Time From:	(mins) To:	Area (ha)
0	4	0.000

Model Details

Storage is Online Cover Level (m) 121.500

Tank or Pond Structure

Invert Level (m) 119.500

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	0.0	0.500	7619.0	2.000	7619.0

Summary of Results for 10 year Return Period (+40%)

Outflow is too low. Design is unsatisfactory.

Storm Event	Max Level (m)	Max Depth (m)	Max Volume (m^3)	Status
15 min Summer	119.771	0.271	201.9	O K
30 min Summer	119.794	0.294	256.9	O K
60 min Summer	119.814	0.314	313.4	O K
120 min Summer	119.832	0.332	372.6	O K
180 min Summer	119.843	0.343	409.1	O K
240 min Summer	119.850	0.350	435.9	O K
360 min Summer	119.860	0.360	475.8	O K
480 min Summer	119.868	0.368	506.0	O K
600 min Summer	119.874	0.374	530.4	O K
720 min Summer	119.879	0.379	551.2	O K
960 min Summer	119.886	0.386	585.3	O K
1440 min Summer	119.897	0.397	636.7	O K
2160 min Summer	119.908	0.408	692.1	O K
2880 min Summer	119.917	0.417	734.0	O K
4320 min Summer	119.928	0.428	797.2	O K
5760 min Summer	119.937	0.437	845.1	O K
7200 min Summer	119.943	0.443	884.1	O K
8640 min Summer	119.949	0.449	917.3	O K
10080 min Summer	119.953	0.453	946.2	O K
15 min Winter	119.781	0.281	226.1	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m^3)	Time-Peak (mins)
15 min Summer	88.341	0.0	23
30 min Summer	56.209	0.0	38
60 min Summer	34.280	0.0	68
120 min Summer	20.377	0.0	128
180 min Summer	14.915	0.0	188
240 min Summer	11.921	0.0	248
360 min Summer	8.674	0.0	368
480 min Summer	6.918	0.0	488
600 min Summer	5.802	0.0	608
720 min Summer	5.024	0.0	728
960 min Summer	4.001	0.0	968
1440 min Summer	2.902	0.0	1448
2160 min Summer	2.103	0.0	2168
2880 min Summer	1.673	0.0	2888
4320 min Summer	1.211	0.0	4328
5760 min Summer	0.963	0.0	5768
7200 min Summer	0.806	0.0	7208
8640 min Summer	0.697	0.0	8648
10080 min Summer	0.616	0.0	10088
15 min Winter	88.341	0.0	23

Summary of Results for 10 year Return Period (+40%)

Storm Event	Max Level (m)	Max Depth (m)	Max Volume (m³)	Status
30 min Winter	119.805	0.305	287.8	O K
60 min Winter	119.826	0.326	351.0	O K
120 min Winter	119.845	0.345	417.3	O K
180 min Winter	119.856	0.356	458.2	O K
240 min Winter	119.864	0.364	488.3	O K
360 min Winter	119.874	0.374	532.9	O K
480 min Winter	119.882	0.382	566.7	O K
600 min Winter	119.888	0.388	594.1	O K
720 min Winter	119.893	0.393	617.3	O K
960 min Winter	119.901	0.401	655.6	O K
1440 min Winter	119.913	0.413	713.1	O K
2160 min Winter	119.924	0.424	775.1	O K
2880 min Winter	119.933	0.433	822.1	O K
4320 min Winter	119.945	0.445	892.9	O K
5760 min Winter	119.953	0.453	946.6	O K
7200 min Winter	119.960	0.460	990.2	O K
8640 min Winter	119.966	0.466	1027.3	O K
10080 min Winter	119.971	0.471	1059.7	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)
30 min Winter	56.209	0.0	38
60 min Winter	34.280	0.0	68
120 min Winter	20.377	0.0	128
180 min Winter	14.915	0.0	188
240 min Winter	11.921	0.0	248
360 min Winter	8.674	0.0	368
480 min Winter	6.918	0.0	488
600 min Winter	5.802	0.0	608
720 min Winter	5.024	0.0	728
960 min Winter	4.001	0.0	968
1440 min Winter	2.902	0.0	1448
2160 min Winter	2.103	0.0	2168
2880 min Winter	1.673	0.0	2888
4320 min Winter	1.211	0.0	4328
5760 min Winter	0.963	0.0	5768
7200 min Winter	0.806	0.0	7208
8640 min Winter	0.697	0.0	8648
10080 min Winter	0.616	0.0	10088

Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	10	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	20.400	Shortest Storm (mins)	15
Ratio R	0.440	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+40

Time Area Diagram

Total Area (ha) 1.219

Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)
0	4	0.610	4	8	0.609

Time Area Diagram

Total Area (ha) 0.000

Time From:	(mins) To:	Area (ha)
0	4	0.000

Model Details

Storage is Online Cover Level (m) 121.500

Tank or Pond Structure

Invert Level (m) 119.500

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	0.0	0.500	7619.0	2.000	7619.0

Summary of Results for 30 year Return Period (+40%)

Outflow is too low. Design is unsatisfactory.

Storm Event	Max Level (m)	Max Depth (m)	Max Volume (m³)	Status
15 min Summer	119.793	0.293	256.6	O K
30 min Summer	119.819	0.319	328.8	O K
60 min Summer	119.841	0.341	402.4	O K
120 min Summer	119.861	0.361	478.0	O K
180 min Summer	119.872	0.372	523.4	O K
240 min Summer	119.880	0.380	556.0	O K
360 min Summer	119.890	0.390	603.8	O K
480 min Summer	119.898	0.398	640.0	O K
600 min Summer	119.904	0.404	669.2	O K
720 min Summer	119.909	0.409	693.9	O K
960 min Summer	119.917	0.417	734.2	O K
1440 min Summer	119.928	0.428	794.4	O K
2160 min Summer	119.939	0.439	858.6	O K
2880 min Summer	119.947	0.447	906.8	O K
4320 min Summer	119.958	0.458	978.6	O K
5760 min Summer	119.967	0.467	1032.4	O K
7200 min Summer	119.973	0.473	1075.9	O K
8640 min Summer	119.978	0.478	1112.6	O K
10080 min Summer	119.983	0.483	1144.4	O K
15 min Winter	119.805	0.305	287.4	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)
15 min Summer	112.255	0.0	23
30 min Summer	71.925	0.0	38
60 min Summer	44.012	0.0	68
120 min Summer	26.143	0.0	128
180 min Summer	19.083	0.0	188
240 min Summer	15.205	0.0	248
360 min Summer	11.007	0.0	368
480 min Summer	8.750	0.0	488
600 min Summer	7.320	0.0	608
720 min Summer	6.325	0.0	728
960 min Summer	5.019	0.0	968
1440 min Summer	3.620	0.0	1448
2160 min Summer	2.609	0.0	2168
2880 min Summer	2.066	0.0	2888
4320 min Summer	1.487	0.0	4328
5760 min Summer	1.176	0.0	5768
7200 min Summer	0.981	0.0	7208
8640 min Summer	0.845	0.0	8648
10080 min Summer	0.745	0.0	10088
15 min Winter	112.255	0.0	23

Summary of Results for 30 year Return Period (+40%)

Storm Event	Max Level (m)	Max Depth (m)	Max Volume (m³)	Status
30 min Winter	119.831	0.331	368.2	O K
60 min Winter	119.854	0.354	450.7	O K
120 min Winter	119.875	0.375	535.4	O K
180 min Winter	119.886	0.386	586.2	O K
240 min Winter	119.894	0.394	622.8	O K
360 min Winter	119.905	0.405	676.2	O K
480 min Winter	119.913	0.413	716.8	O K
600 min Winter	119.919	0.419	749.5	O K
720 min Winter	119.925	0.425	777.1	O K
960 min Winter	119.933	0.433	822.3	O K
1440 min Winter	119.944	0.444	889.7	O K
2160 min Winter	119.956	0.456	961.6	O K
2880 min Winter	119.964	0.464	1015.6	O K
4320 min Winter	119.976	0.476	1096.0	O K
5760 min Winter	119.985	0.485	1156.3	O K
7200 min Winter	119.991	0.491	1205.0	O K
8640 min Winter	119.997	0.497	1246.1	O K
10080 min Winter	120.002	0.502	1281.7	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)
30 min Winter	71.925	0.0	38
60 min Winter	44.012	0.0	68
120 min Winter	26.143	0.0	128
180 min Winter	19.083	0.0	188
240 min Winter	15.205	0.0	248
360 min Winter	11.007	0.0	368
480 min Winter	8.750	0.0	488
600 min Winter	7.320	0.0	608
720 min Winter	6.325	0.0	728
960 min Winter	5.019	0.0	968
1440 min Winter	3.620	0.0	1448
2160 min Winter	2.609	0.0	2168
2880 min Winter	2.066	0.0	2888
4320 min Winter	1.487	0.0	4328
5760 min Winter	1.176	0.0	5768
7200 min Winter	0.981	0.0	7208
8640 min Winter	0.845	0.0	8648
10080 min Winter	0.745	0.0	10088

Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	30	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	20.400	Shortest Storm (mins)	15
Ratio R	0.440	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+40

Time Area Diagram

Total Area (ha) 1.219

Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)
0	4	0.610	4	8	0.609

Time Area Diagram

Total Area (ha) 0.000

Time From:	(mins) To:	Area (ha)
0	4	0.000

Model Details

Storage is Online Cover Level (m) 121.500

Tank or Pond Structure

Invert Level (m) 119.500

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	0.0	0.500	7619.0	2.000	7619.0

Summary of Results for 100 year Return Period (+40%)

Outflow is too low. Design is unsatisfactory.

Storm Event	Max Level (m)	Max Depth (m)	Max Volume (m³)	Status
15 min Summer	119.820	0.320	333.6	O K
30 min Summer	119.849	0.349	430.8	O K
60 min Summer	119.873	0.373	529.1	O K
120 min Summer	119.895	0.395	628.1	O K
180 min Summer	119.907	0.407	685.7	O K
240 min Summer	119.915	0.415	725.9	O K
360 min Summer	119.926	0.426	783.9	O K
480 min Summer	119.934	0.434	828.0	O K
600 min Summer	119.940	0.440	863.4	O K
720 min Summer	119.945	0.445	893.0	O K
960 min Summer	119.953	0.453	941.3	O K
1440 min Summer	119.964	0.464	1012.4	O K
2160 min Summer	119.975	0.475	1087.4	O K
2880 min Summer	119.983	0.483	1143.0	O K
4320 min Summer	119.994	0.494	1225.0	O K
5760 min Summer	120.002	0.502	1285.6	O K
7200 min Summer	120.008	0.508	1334.1	O K
8640 min Summer	120.014	0.514	1374.7	O K
10080 min Summer	120.018	0.518	1409.7	O K
15 min Winter	119.833	0.333	373.6	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)
15 min Summer	145.957	0.0	23
30 min Summer	94.237	0.0	38
60 min Summer	57.877	0.0	68
120 min Summer	34.352	0.0	128
180 min Summer	25.002	0.0	188
240 min Summer	19.851	0.0	248
360 min Summer	14.290	0.0	368
480 min Summer	11.321	0.0	488
600 min Summer	9.443	0.0	608
720 min Summer	8.140	0.0	728
960 min Summer	6.435	0.0	968
1440 min Summer	4.614	0.0	1448
2160 min Summer	3.304	0.0	2168
2880 min Summer	2.605	0.0	2888
4320 min Summer	1.861	0.0	4328
5760 min Summer	1.465	0.0	5768
7200 min Summer	1.216	0.0	7208
8640 min Summer	1.044	0.0	8648
10080 min Summer	0.918	0.0	10088
15 min Winter	145.957	0.0	23

Summary of Results for 100 year Return Period (+40%)

Storm Event	Max Level (m)	Max Depth (m)	Max Volume (m³)	Status
30 min Winter	119.862	0.362	482.5	O K
60 min Winter	119.888	0.388	592.6	O K
120 min Winter	119.911	0.411	703.5	O K
180 min Winter	119.923	0.423	768.0	O K
240 min Winter	119.931	0.431	813.1	O K
360 min Winter	119.942	0.442	878.0	O K
480 min Winter	119.950	0.450	927.4	O K
600 min Winter	119.957	0.457	967.0	O K
720 min Winter	119.962	0.462	1000.2	O K
960 min Winter	119.970	0.470	1054.2	O K
1440 min Winter	119.981	0.481	1133.9	O K
2160 min Winter	119.993	0.493	1217.9	O K
2880 min Winter	120.001	0.501	1280.2	O K
4320 min Winter	120.013	0.513	1371.9	O K
5760 min Winter	120.022	0.522	1439.9	O K
7200 min Winter	120.029	0.529	1494.2	O K
8640 min Winter	120.035	0.535	1539.7	O K
10080 min Winter	120.041	0.541	1578.9	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)
30 min Winter	94.237	0.0	38
60 min Winter	57.877	0.0	68
120 min Winter	34.352	0.0	128
180 min Winter	25.002	0.0	188
240 min Winter	19.851	0.0	248
360 min Winter	14.290	0.0	368
480 min Winter	11.321	0.0	488
600 min Winter	9.443	0.0	608
720 min Winter	8.140	0.0	728
960 min Winter	6.435	0.0	968
1440 min Winter	4.614	0.0	1448
2160 min Winter	3.304	0.0	2168
2880 min Winter	2.605	0.0	2888
4320 min Winter	1.861	0.0	4328
5760 min Winter	1.465	0.0	5768
7200 min Winter	1.216	0.0	7208
8640 min Winter	1.044	0.0	8648
10080 min Winter	0.918	0.0	10088

Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	20.400	Shortest Storm (mins)	15
Ratio R	0.440	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+40

Time Area Diagram

Total Area (ha) 1.219

Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)
0	4	0.610	4	8	0.609

Time Area Diagram

Total Area (ha) 0.000

Time From:	(mins) To:	Area (ha)
0	4	0.000

Model Details

Storage is Online Cover Level (m) 121.500

Tank or Pond Structure

Invert Level (m) 119.500

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	0.0	0.500	7619.0	2.000	7619.0

Summary of Results for 1 year Return Period (+40%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	118.161	0.161	30.9	62.2	O K
30 min Summer	118.183	0.183	31.4	71.0	O K
60 min Summer	118.187	0.187	31.5	72.8	O K
120 min Summer	118.170	0.170	31.1	65.8	O K
180 min Summer	118.150	0.150	30.7	57.8	O K
240 min Summer	118.134	0.134	29.1	51.6	O K
360 min Summer	118.110	0.110	25.8	42.0	O K
480 min Summer	118.092	0.092	23.0	34.9	O K
600 min Summer	118.078	0.078	20.7	29.6	O K
720 min Summer	118.067	0.067	18.8	25.5	O K
960 min Summer	118.051	0.051	16.1	19.3	O K
1440 min Summer	118.030	0.030	12.5	11.3	O K
2160 min Summer	118.012	0.012	9.7	4.5	O K
2880 min Summer	118.002	0.002	8.1	0.7	O K
4320 min Summer	118.000	0.000	6.1	0.0	O K
5760 min Summer	118.000	0.000	4.9	0.0	O K
7200 min Summer	118.000	0.000	4.1	0.0	O K
8640 min Summer	118.000	0.000	3.6	0.0	O K
10080 min Summer	118.000	0.000	3.2	0.0	O K
15 min Winter	118.183	0.183	31.4	71.0	O K
30 min Winter	118.210	0.210	31.8	81.8	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	45.717	0.0	84.1	18
30 min Summer	29.437	0.0	108.6	28
60 min Summer	18.324	0.0	135.1	44
120 min Summer	11.160	0.0	164.7	78
180 min Summer	8.306	0.0	183.2	110
240 min Summer	6.727	0.0	198.6	142
360 min Summer	4.974	0.0	219.9	204
480 min Summer	4.000	0.0	235.8	264
600 min Summer	3.378	0.0	249.1	326
720 min Summer	2.942	0.0	260.4	386
960 min Summer	2.365	0.0	279.1	506
1440 min Summer	1.739	0.0	307.9	750
2160 min Summer	1.280	0.0	339.6	1108
2880 min Summer	1.030	0.0	364.7	1468
4320 min Summer	0.757	0.0	402.1	0
5760 min Summer	0.608	0.0	431.0	0
7200 min Summer	0.514	0.0	455.0	0
8640 min Summer	0.448	0.0	475.6	0
10080 min Summer	0.398	0.0	493.8	0
15 min Winter	45.717	0.0	94.2	18
30 min Winter	29.437	0.0	121.6	29

Summary of Results for 1 year Return Period (+40%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
60 min Winter	118.211	0.211	31.8	82.5	O K
120 min Winter	118.182	0.182	31.4	70.4	O K
180 min Winter	118.150	0.150	30.7	57.9	O K
240 min Winter	118.128	0.128	28.3	49.2	O K
360 min Winter	118.097	0.097	23.8	36.9	O K
480 min Winter	118.076	0.076	20.4	28.9	O K
600 min Winter	118.061	0.061	17.8	23.1	O K
720 min Winter	118.050	0.050	15.8	18.7	O K
960 min Winter	118.033	0.033	13.0	12.5	O K
1440 min Winter	118.013	0.013	9.8	4.9	O K
2160 min Winter	118.000	0.000	7.4	0.0	O K
2880 min Winter	118.000	0.000	6.0	0.0	O K
4320 min Winter	118.000	0.000	4.4	0.0	O K
5760 min Winter	118.000	0.000	3.5	0.0	O K
7200 min Winter	118.000	0.000	3.0	0.0	O K
8640 min Winter	118.000	0.000	2.6	0.0	O K
10080 min Winter	118.000	0.000	2.3	0.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
60 min Winter	18.324	0.0	150.8	48
120 min Winter	11.160	0.0	184.5	84
180 min Winter	8.306	0.0	206.0	116
240 min Winter	6.727	0.0	222.2	148
360 min Winter	4.974	0.0	246.6	210
480 min Winter	4.000	0.0	264.2	272
600 min Winter	3.378	0.0	279.1	332
720 min Winter	2.942	0.0	291.7	394
960 min Winter	2.365	0.0	312.5	514
1440 min Winter	1.739	0.0	344.9	754
2160 min Winter	1.280	0.0	380.8	0
2880 min Winter	1.030	0.0	408.5	0
4320 min Winter	0.757	0.0	450.4	0
5760 min Winter	0.608	0.0	482.7	0
7200 min Winter	0.514	0.0	509.5	0
8640 min Winter	0.448	0.0	532.6	0
10080 min Winter	0.398	0.0	553.1	0

APPENDIX VI

Rainwater Lagoon Storage Calculations

Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	1	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	20.400	Shortest Storm (mins)	15
Ratio R	0.440	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+40

Time Area Diagram

Total Area (ha) 0.984

Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)
0	4	0.492	4	8	0.492

Time Area Diagram

Total Area (ha) 0.000

Time From:	(mins) To:	Area (ha)
0	4	0.000

Model Details

Storage is Online Cover Level (m) 119.000

Tank or Pond Structure

Invert Level (m) 118.000

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	373.0	1.000	552.0

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0240-3280-1500-3280
Design Head (m)	1.500
Design Flow (l/s)	32.8
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	240
Invert Level (m)	117.900
Minimum Outlet Pipe Diameter (mm)	300
Suggested Manhole Diameter (mm)	1800

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.500	32.8
Flush-Flo™	0.475	32.8
Kick-Flo®	1.033	27.4
Mean Flow over Head Range	-	28.1

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	7.9	1.200	29.5	3.000	45.7	7.000	69.0
0.200	24.3	1.400	31.7	3.500	49.3	7.500	71.3
0.300	31.7	1.600	33.8	4.000	52.6	8.000	73.6
0.400	32.6	1.800	35.8	4.500	55.7	8.500	75.8
0.500	32.8	2.000	37.6	5.000	58.6	9.000	77.9
0.600	32.5	2.200	39.4	5.500	61.3	9.500	80.0
0.800	31.4	2.400	41.1	6.000	64.0		
1.000	28.4	2.600	42.7	6.500	66.5		

Summary of Results for 2 year Return Period (+40%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	118.215	0.215	31.9	84.1	O K
30 min Summer	118.247	0.247	32.3	97.0	O K
60 min Summer	118.253	0.253	32.3	99.5	O K
120 min Summer	118.232	0.232	32.1	91.0	O K
180 min Summer	118.205	0.205	31.7	80.1	O K
240 min Summer	118.181	0.181	31.3	70.3	O K
360 min Summer	118.144	0.144	30.4	55.6	O K
480 min Summer	118.121	0.121	27.3	46.3	O K
600 min Summer	118.103	0.103	24.8	39.4	O K
720 min Summer	118.090	0.090	22.7	34.1	O K
960 min Summer	118.070	0.070	19.3	26.5	O K
1440 min Summer	118.045	0.045	15.0	16.9	O K
2160 min Summer	118.024	0.024	11.5	8.8	O K
2880 min Summer	118.011	0.011	9.5	3.9	O K
4320 min Summer	118.000	0.000	7.1	0.0	O K
5760 min Summer	118.000	0.000	5.7	0.0	O K
7200 min Summer	118.000	0.000	4.8	0.0	O K
8640 min Summer	118.000	0.000	4.2	0.0	O K
10080 min Summer	118.000	0.000	3.7	0.0	O K
15 min Winter	118.244	0.244	32.2	96.0	O K
30 min Winter	118.283	0.283	32.5	112.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	59.065	0.0	108.7	18
30 min Summer	37.722	0.0	138.9	30
60 min Summer	23.156	0.0	170.6	46
120 min Summer	13.903	0.0	204.8	80
180 min Summer	10.257	0.0	226.6	114
240 min Summer	8.253	0.0	243.8	144
360 min Summer	6.058	0.0	267.9	204
480 min Summer	4.855	0.0	286.4	266
600 min Summer	4.088	0.0	301.3	326
720 min Summer	3.551	0.0	314.1	386
960 min Summer	2.844	0.0	335.8	506
1440 min Summer	2.079	0.0	368.2	750
2160 min Summer	1.520	0.0	403.8	1108
2880 min Summer	1.217	0.0	431.1	1472
4320 min Summer	0.889	0.0	472.6	0
5760 min Summer	0.712	0.0	504.3	0
7200 min Summer	0.599	0.0	530.5	0
8640 min Summer	0.520	0.0	552.9	0
10080 min Summer	0.462	0.0	572.6	0
15 min Winter	59.065	0.0	121.9	19
30 min Winter	37.722	0.0	155.6	31

Summary of Results for 2 year Return Period (+40%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
60 min Winter	118.287	0.287	32.6	113.8	O K
120 min Winter	118.253	0.253	32.3	99.7	O K
180 min Winter	118.212	0.212	31.8	82.8	O K
240 min Winter	118.176	0.176	31.2	68.1	O K
360 min Winter	118.129	0.129	28.4	49.5	O K
480 min Winter	118.102	0.102	24.6	38.7	O K
600 min Winter	118.083	0.083	21.5	31.4	O K
720 min Winter	118.069	0.069	19.1	26.0	O K
960 min Winter	118.049	0.049	15.7	18.5	O K
1440 min Winter	118.025	0.025	11.7	9.5	O K
2160 min Winter	118.006	0.006	8.7	2.1	O K
2880 min Winter	118.000	0.000	7.1	0.0	O K
4320 min Winter	118.000	0.000	5.2	0.0	O K
5760 min Winter	118.000	0.000	4.1	0.0	O K
7200 min Winter	118.000	0.000	3.5	0.0	O K
8640 min Winter	118.000	0.000	3.0	0.0	O K
10080 min Winter	118.000	0.000	2.7	0.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
60 min Winter	23.156	0.0	191.7	50
120 min Winter	13.903	0.0	229.9	86
180 min Winter	10.257	0.0	254.6	120
240 min Winter	8.253	0.0	272.8	152
360 min Winter	6.058	0.0	300.3	212
480 min Winter	4.855	0.0	320.7	272
600 min Winter	4.088	0.0	337.8	332
720 min Winter	3.551	0.0	352.1	394
960 min Winter	2.844	0.0	376.0	516
1440 min Winter	2.079	0.0	412.3	754
2160 min Winter	1.520	0.0	452.1	1112
2880 min Winter	1.217	0.0	482.9	0
4320 min Winter	0.889	0.0	529.3	0
5760 min Winter	0.712	0.0	564.8	0
7200 min Winter	0.599	0.0	594.1	0
8640 min Winter	0.520	0.0	619.2	0
10080 min Winter	0.462	0.0	641.3	0

Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	2	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	20.400	Shortest Storm (mins)	15
Ratio R	0.440	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+40

Time Area Diagram

Total Area (ha) 0.984

Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)
0	4	0.492	4	8	0.492

Time Area Diagram

Total Area (ha) 0.000

Time From:	(mins) To:	Area (ha)
0	4	0.000

Model Details

Storage is Online Cover Level (m) 119.000

Tank or Pond Structure

Invert Level (m) 118.000

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	373.0	1.000	552.0

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0240-3280-1500-3280
Design Head (m)	1.500
Design Flow (l/s)	32.8
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	240
Invert Level (m)	117.900
Minimum Outlet Pipe Diameter (mm)	300
Suggested Manhole Diameter (mm)	1800

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.500	32.8
Flush-Flo™	0.475	32.8
Kick-Flo®	1.033	27.4
Mean Flow over Head Range	-	28.1

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	7.9	1.200	29.5	3.000	45.7	7.000	69.0
0.200	24.3	1.400	31.7	3.500	49.3	7.500	71.3
0.300	31.7	1.600	33.8	4.000	52.6	8.000	73.6
0.400	32.6	1.800	35.8	4.500	55.7	8.500	75.8
0.500	32.8	2.000	37.6	5.000	58.6	9.000	77.9
0.600	32.5	2.200	39.4	5.500	61.3	9.500	80.0
0.800	31.4	2.400	41.1	6.000	64.0		
1.000	28.4	2.600	42.7	6.500	66.5		

Summary of Results for 10 year Return Period (+40%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	118.335	0.335	32.8	134.3	O K
30 min Summer	118.392	0.392	32.8	159.2	O K
60 min Summer	118.410	0.410	32.8	166.8	O K
120 min Summer	118.389	0.389	32.8	157.9	O K
180 min Summer	118.357	0.357	32.8	143.6	O K
240 min Summer	118.323	0.323	32.7	129.2	O K
360 min Summer	118.263	0.263	32.4	103.7	O K
480 min Summer	118.214	0.214	31.9	83.6	O K
600 min Summer	118.176	0.176	31.3	68.3	O K
720 min Summer	118.149	0.149	30.6	57.2	O K
960 min Summer	118.117	0.117	26.7	44.6	O K
1440 min Summer	118.080	0.080	21.0	30.2	O K
2160 min Summer	118.050	0.050	15.9	18.9	O K
2880 min Summer	118.033	0.033	13.0	12.3	O K
4320 min Summer	118.011	0.011	9.5	4.3	O K
5760 min Summer	118.000	0.000	7.7	0.0	O K
7200 min Summer	118.000	0.000	6.5	0.0	O K
8640 min Summer	118.000	0.000	5.6	0.0	O K
10080 min Summer	118.000	0.000	5.0	0.0	O K
15 min Winter	118.379	0.379	32.8	153.1	O K
30 min Winter	118.446	0.446	32.8	182.9	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	88.341	0.0	162.9	19
30 min Summer	56.209	0.0	207.1	32
60 min Summer	34.280	0.0	252.6	52
120 min Summer	20.377	0.0	300.6	86
180 min Summer	14.915	0.0	329.8	120
240 min Summer	11.921	0.0	351.4	152
360 min Summer	8.674	0.0	384.1	216
480 min Summer	6.918	0.0	408.4	276
600 min Summer	5.802	0.0	427.8	334
720 min Summer	5.024	0.0	444.7	390
960 min Summer	4.001	0.0	472.4	508
1440 min Summer	2.902	0.0	513.8	750
2160 min Summer	2.103	0.0	558.3	1108
2880 min Summer	1.673	0.0	592.3	1472
4320 min Summer	1.211	0.0	643.4	2204
5760 min Summer	0.963	0.0	682.2	0
7200 min Summer	0.806	0.0	713.7	0
8640 min Summer	0.697	0.0	740.4	0
10080 min Summer	0.616	0.0	763.8	0
15 min Winter	88.341	0.0	182.2	20
30 min Winter	56.209	0.0	232.0	32

Summary of Results for 10 year Return Period (+40%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
60 min Winter	118.469	0.469	32.8	193.2	O K
120 min Winter	118.438	0.438	32.8	179.5	O K
180 min Winter	118.389	0.389	32.8	157.8	O K
240 min Winter	118.338	0.338	32.8	135.7	O K
360 min Winter	118.248	0.248	32.3	97.6	O K
480 min Winter	118.181	0.181	31.3	70.1	O K
600 min Winter	118.140	0.140	29.8	53.7	O K
720 min Winter	118.116	0.116	26.7	44.6	O K
960 min Winter	118.086	0.086	22.1	32.7	O K
1440 min Winter	118.053	0.053	16.4	20.0	O K
2160 min Winter	118.027	0.027	12.1	10.1	O K
2880 min Winter	118.012	0.012	9.6	4.4	O K
4320 min Winter	118.000	0.000	7.0	0.0	O K
5760 min Winter	118.000	0.000	5.6	0.0	O K
7200 min Winter	118.000	0.000	4.7	0.0	O K
8640 min Winter	118.000	0.000	4.0	0.0	O K
10080 min Winter	118.000	0.000	3.6	0.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
60 min Winter	34.280	0.0	282.8	58
120 min Winter	20.377	0.0	336.3	92
180 min Winter	14.915	0.0	369.3	130
240 min Winter	11.921	0.0	393.7	164
360 min Winter	8.674	0.0	430.3	228
480 min Winter	6.918	0.0	457.2	284
600 min Winter	5.802	0.0	479.3	338
720 min Winter	5.024	0.0	498.1	398
960 min Winter	4.001	0.0	529.0	514
1440 min Winter	2.902	0.0	575.3	754
2160 min Winter	2.103	0.0	625.5	1112
2880 min Winter	1.673	0.0	663.5	1476
4320 min Winter	1.211	0.0	720.8	0
5760 min Winter	0.963	0.0	764.1	0
7200 min Winter	0.806	0.0	799.3	0
8640 min Winter	0.697	0.0	829.3	0
10080 min Winter	0.616	0.0	855.4	0

Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	10	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	20.400	Shortest Storm (mins)	15
Ratio R	0.440	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+40

Time Area Diagram

Total Area (ha) 0.984

Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)
0	4	0.492	4	8	0.492

Time Area Diagram

Total Area (ha) 0.000

Time From:	(mins) To:	Area (ha)
0	4	0.000

Model Details

Storage is Online Cover Level (m) 119.000

Tank or Pond Structure

Invert Level (m) 118.000

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	373.0	1.000	552.0

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0240-3280-1500-3280
Design Head (m)	1.500
Design Flow (l/s)	32.8
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	240
Invert Level (m)	117.900
Minimum Outlet Pipe Diameter (mm)	300
Suggested Manhole Diameter (mm)	1800

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.500	32.8
Flush-Flo™	0.475	32.8
Kick-Flo®	1.033	27.4
Mean Flow over Head Range	-	28.1

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	7.9	1.200	29.5	3.000	45.7	7.000	69.0
0.200	24.3	1.400	31.7	3.500	49.3	7.500	71.3
0.300	31.7	1.600	33.8	4.000	52.6	8.000	73.6
0.400	32.6	1.800	35.8	4.500	55.7	8.500	75.8
0.500	32.8	2.000	37.6	5.000	58.6	9.000	77.9
0.600	32.5	2.200	39.4	5.500	61.3	9.500	80.0
0.800	31.4	2.400	41.1	6.000	64.0		
1.000	28.4	2.600	42.7	6.500	66.5		

Summary of Results for 30 year Return Period (+40%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	118.432	0.432	32.8	176.7	O K
30 min Summer	118.515	0.515	32.8	214.2	O K
60 min Summer	118.551	0.551	32.8	231.2	O K
120 min Summer	118.535	0.535	32.8	223.7	O K
180 min Summer	118.502	0.502	32.8	208.1	O K
240 min Summer	118.464	0.464	32.8	191.0	O K
360 min Summer	118.392	0.392	32.8	158.8	O K
480 min Summer	118.329	0.329	32.7	131.6	O K
600 min Summer	118.275	0.275	32.5	108.9	O K
720 min Summer	118.231	0.231	32.1	90.6	O K
960 min Summer	118.167	0.167	31.1	64.5	O K
1440 min Summer	118.111	0.111	25.9	42.3	O K
2160 min Summer	118.073	0.073	19.8	27.5	O K
2880 min Summer	118.051	0.051	16.0	19.2	O K
4320 min Summer	118.025	0.025	11.7	9.5	O K
5760 min Summer	118.010	0.010	9.4	3.8	O K
7200 min Summer	118.000	0.000	7.9	0.0	O K
8640 min Summer	118.000	0.000	6.8	0.0	O K
10080 min Summer	118.000	0.000	6.0	0.0	O K
15 min Winter	118.486	0.486	32.8	201.0	O K
30 min Winter	118.581	0.581	32.8	245.3	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	112.255	0.0	207.0	20
30 min Summer	71.925	0.0	265.3	33
60 min Summer	44.012	0.0	324.9	60
120 min Summer	26.143	0.0	385.9	90
180 min Summer	19.083	0.0	422.8	124
240 min Summer	15.205	0.0	448.9	158
360 min Summer	11.007	0.0	487.4	224
480 min Summer	8.750	0.0	516.5	286
600 min Summer	7.320	0.0	540.0	346
720 min Summer	6.325	0.0	559.8	404
960 min Summer	5.019	0.0	592.4	516
1440 min Summer	3.620	0.0	641.0	752
2160 min Summer	2.609	0.0	693.0	1108
2880 min Summer	2.066	0.0	731.8	1472
4320 min Summer	1.487	0.0	789.7	2204
5760 min Summer	1.176	0.0	833.2	2936
7200 min Summer	0.981	0.0	868.5	0
8640 min Summer	0.845	0.0	898.1	0
10080 min Summer	0.745	0.0	923.8	0
15 min Winter	112.255	0.0	231.7	20
30 min Winter	71.925	0.0	297.1	34

Summary of Results for 30 year Return Period (+40%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
60 min Winter	118.631	0.631	32.8	268.8	O K
120 min Winter	118.609	0.609	32.8	258.3	O K
180 min Winter	118.562	0.562	32.8	236.0	O K
240 min Winter	118.506	0.506	32.8	210.3	O K
360 min Winter	118.398	0.398	32.8	161.5	O K
480 min Winter	118.304	0.304	32.7	121.2	O K
600 min Winter	118.230	0.230	32.1	90.0	O K
720 min Winter	118.174	0.174	31.2	67.4	O K
960 min Winter	118.122	0.122	27.4	46.5	O K
1440 min Winter	118.077	0.077	20.5	29.1	O K
2160 min Winter	118.045	0.045	15.0	16.8	O K
2880 min Winter	118.026	0.026	11.9	9.9	O K
4320 min Winter	118.005	0.005	8.6	1.9	O K
5760 min Winter	118.000	0.000	6.8	0.0	O K
7200 min Winter	118.000	0.000	5.7	0.0	O K
8640 min Winter	118.000	0.000	4.9	0.0	O K
10080 min Winter	118.000	0.000	4.3	0.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
60 min Winter	44.012	0.0	363.0	60
120 min Winter	26.143	0.0	431.7	98
180 min Winter	19.083	0.0	473.1	136
240 min Winter	15.205	0.0	502.0	172
360 min Winter	11.007	0.0	545.9	240
480 min Winter	8.750	0.0	578.5	302
600 min Winter	7.320	0.0	604.8	360
720 min Winter	6.325	0.0	627.1	412
960 min Winter	5.019	0.0	663.7	520
1440 min Winter	3.620	0.0	718.0	754
2160 min Winter	2.609	0.0	776.0	1116
2880 min Winter	2.066	0.0	819.5	1472
4320 min Winter	1.487	0.0	884.5	2204
5760 min Winter	1.176	0.0	933.4	0
7200 min Winter	0.981	0.0	972.7	0
8640 min Winter	0.845	0.0	1005.9	0
10080 min Winter	0.745	0.0	1034.7	0

Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	30	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	20.400	Shortest Storm (mins)	15
Ratio R	0.440	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+40

Time Area Diagram

Total Area (ha) 0.984

Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)
0	4	0.492	4	8	0.492

Time Area Diagram

Total Area (ha) 0.000

Time From:	(mins) To:	Area (ha)
0	4	0.000

Model Details

Storage is Online Cover Level (m) 119.000

Tank or Pond Structure

Invert Level (m) 118.000

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	373.0	1.000	552.0

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0240-3280-1500-3280
Design Head (m)	1.500
Design Flow (l/s)	32.8
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	240
Invert Level (m)	117.900
Minimum Outlet Pipe Diameter (mm)	300
Suggested Manhole Diameter (mm)	1800

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.500	32.8
Flush-Flo™	0.475	32.8
Kick-Flo®	1.033	27.4
Mean Flow over Head Range	-	28.1

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	7.9	1.200	29.5	3.000	45.7	7.000	69.0
0.200	24.3	1.400	31.7	3.500	49.3	7.500	71.3
0.300	31.7	1.600	33.8	4.000	52.6	8.000	73.6
0.400	32.6	1.800	35.8	4.500	55.7	8.500	75.8
0.500	32.8	2.000	37.6	5.000	58.6	9.000	77.9
0.600	32.5	2.200	39.4	5.500	61.3	9.500	80.0
0.800	31.4	2.400	41.1	6.000	64.0		
1.000	28.4	2.600	42.7	6.500	66.5		

Summary of Results for 100 year Return Period (+40%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	118.564	0.564	32.8	237.2	O K
30 min Summer	118.682	0.682	32.8	294.0	O K
60 min Summer	118.753	0.753	32.8	329.0	O K
120 min Summer	118.747	0.747	32.8	325.9	O K
180 min Summer	118.711	0.711	32.8	308.3	O K
240 min Summer	118.671	0.671	32.8	288.2	O K
360 min Summer	118.589	0.589	32.8	249.0	O K
480 min Summer	118.515	0.515	32.8	214.3	O K
600 min Summer	118.447	0.447	32.8	183.3	O K
720 min Summer	118.385	0.385	32.8	156.0	O K
960 min Summer	118.285	0.285	32.6	112.9	O K
1440 min Summer	118.163	0.163	31.0	63.0	O K
2160 min Summer	118.104	0.104	24.9	39.5	O K
2880 min Summer	118.075	0.075	20.2	28.5	O K
4320 min Summer	118.043	0.043	14.7	16.4	O K
5760 min Summer	118.025	0.025	11.7	9.4	O K
7200 min Summer	118.013	0.013	9.8	4.7	O K
8640 min Summer	118.004	0.004	8.4	1.3	O K
10080 min Summer	118.000	0.000	7.4	0.0	O K
15 min Winter	118.632	0.632	32.8	269.3	O K
30 min Winter	118.766	0.766	32.8	335.7	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	145.957	0.0	268.9	21
30 min Summer	94.237	0.0	347.5	34
60 min Summer	57.877	0.0	426.8	62
120 min Summer	34.352	0.0	506.9	102
180 min Summer	25.002	0.0	553.4	132
240 min Summer	19.851	0.0	585.6	166
360 min Summer	14.290	0.0	632.9	232
480 min Summer	11.321	0.0	667.9	298
600 min Summer	9.443	0.0	696.6	362
720 min Summer	8.140	0.0	720.7	422
960 min Summer	6.435	0.0	759.7	538
1440 min Summer	4.614	0.0	817.1	762
2160 min Summer	3.304	0.0	877.7	1108
2880 min Summer	2.605	0.0	922.6	1472
4320 min Summer	1.861	0.0	988.7	2204
5760 min Summer	1.465	0.0	1037.6	2936
7200 min Summer	1.216	0.0	1076.8	3672
8640 min Summer	1.044	0.0	1109.7	4400
10080 min Summer	0.918	0.0	1137.9	0
15 min Winter	145.957	0.0	301.5	21
30 min Winter	94.237	0.0	389.2	34

Summary of Results for 100 year Return Period (+40%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
60 min Winter	118.854	0.854	32.8	381.0	Flood Risk
120 min Winter	118.859	0.859	32.8	383.8	Flood Risk
180 min Winter	118.810	0.810	32.8	358.2	O K
240 min Winter	118.754	0.754	32.8	329.9	O K
360 min Winter	118.636	0.636	32.8	271.5	O K
480 min Winter	118.524	0.524	32.8	218.5	O K
600 min Winter	118.421	0.421	32.8	172.0	O K
720 min Winter	118.333	0.333	32.8	133.2	O K
960 min Winter	118.203	0.203	31.7	79.0	O K
1440 min Winter	118.111	0.111	26.0	42.4	O K
2160 min Winter	118.068	0.068	18.9	25.6	O K
2880 min Winter	118.045	0.045	15.0	16.9	O K
4320 min Winter	118.019	0.019	10.8	7.2	O K
5760 min Winter	118.004	0.004	8.5	1.5	O K
7200 min Winter	118.000	0.000	7.1	0.0	O K
8640 min Winter	118.000	0.000	6.1	0.0	O K
10080 min Winter	118.000	0.000	5.3	0.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
60 min Winter	57.877	0.0	478.2	62
120 min Winter	34.352	0.0	567.4	116
180 min Winter	25.002	0.0	619.6	144
240 min Winter	19.851	0.0	656.4	182
360 min Winter	14.290	0.0	708.5	254
480 min Winter	11.321	0.0	748.2	320
600 min Winter	9.443	0.0	780.1	384
720 min Winter	8.140	0.0	807.5	442
960 min Winter	6.435	0.0	850.8	548
1440 min Winter	4.614	0.0	915.1	756
2160 min Winter	3.304	0.0	982.9	1112
2880 min Winter	2.605	0.0	1033.2	1476
4320 min Winter	1.861	0.0	1107.3	2204
5760 min Winter	1.465	0.0	1162.1	2936
7200 min Winter	1.216	0.0	1206.1	0
8640 min Winter	1.044	0.0	1242.8	0
10080 min Winter	0.918	0.0	1274.5	0

Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	20.400	Shortest Storm (mins)	15
Ratio R	0.440	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+40

Time Area Diagram

Total Area (ha) 0.984

Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)
0	4	0.492	4	8	0.492

Time Area Diagram

Total Area (ha) 0.000

Time From:	(mins) To:	Area (ha)
0	4	0.000

Model Details

Storage is Online Cover Level (m) 119.000

Tank or Pond Structure

Invert Level (m) 118.000

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	373.0	1.000	552.0

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0240-3280-1500-3280
Design Head (m)	1.500
Design Flow (l/s)	32.8
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	240
Invert Level (m)	117.900
Minimum Outlet Pipe Diameter (mm)	300
Suggested Manhole Diameter (mm)	1800

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.500	32.8
Flush-Flo™	0.475	32.8
Kick-Flo®	1.033	27.4
Mean Flow over Head Range	-	28.1

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	7.9	1.200	29.5	3.000	45.7	7.000	69.0
0.200	24.3	1.400	31.7	3.500	49.3	7.500	71.3
0.300	31.7	1.600	33.8	4.000	52.6	8.000	73.6
0.400	32.6	1.800	35.8	4.500	55.7	8.500	75.8
0.500	32.8	2.000	37.6	5.000	58.6	9.000	77.9
0.600	32.5	2.200	39.4	5.500	61.3	9.500	80.0
0.800	31.4	2.400	41.1	6.000	64.0		
1.000	28.4	2.600	42.7	6.500	66.5		

APPENDIX VII

Rainwater Lagoon/Bunds Cascade Calculations

Cascade Summary of Results for Lagoon No Bund-1-1.SRCX

Upstream Structures	Outflow To	Overflow To
Bund With Outfall-1-1.SRCX	(None)	(None)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	118.172	0.172	31.2	66.6	O K
30 min Summer	118.199	0.199	31.7	77.6	O K
60 min Summer	118.211	0.211	31.8	82.2	O K
120 min Summer	118.202	0.202	31.7	78.5	O K
180 min Summer	118.184	0.184	31.4	71.5	O K
240 min Summer	118.167	0.167	31.1	64.6	O K
360 min Summer	118.140	0.140	29.8	53.7	O K
480 min Summer	118.121	0.121	27.4	46.4	O K
600 min Summer	118.107	0.107	25.3	40.8	O K
720 min Summer	118.096	0.096	23.6	36.5	O K
960 min Summer	118.080	0.080	21.0	30.3	O K
1440 min Summer	118.060	0.060	17.6	22.6	O K
2160 min Summer	118.043	0.043	14.6	16.2	O K
2880 min Summer	118.033	0.033	13.0	12.3	O K
4320 min Summer	118.021	0.021	11.0	7.7	O K
5760 min Summer	118.013	0.013	9.8	5.0	O K
7200 min Summer	118.008	0.008	9.1	3.1	O K
8640 min Summer	118.001	0.001	8.1	0.4	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	45.717	0.0	188.6	18
30 min Summer	29.437	0.0	243.0	29
60 min Summer	18.324	0.0	302.3	46
120 min Summer	11.160	0.0	368.6	80
180 min Summer	8.306	0.0	411.5	112
240 min Summer	6.727	0.0	444.2	144
360 min Summer	4.974	0.0	493.1	204
480 min Summer	4.000	0.0	528.9	266
600 min Summer	3.378	0.0	557.8	326
720 min Summer	2.942	0.0	583.1	386
960 min Summer	2.365	0.0	624.7	508
1440 min Summer	1.739	0.0	689.8	750
2160 min Summer	1.280	0.0	761.3	1108
2880 min Summer	1.030	0.0	816.3	1472
4320 min Summer	0.757	0.0	899.9	2204
5760 min Summer	0.608	0.0	964.5	2936
7200 min Summer	0.514	0.0	1018.4	3672
8640 min Summer	0.448	0.0	1064.7	4360

Cascade Summary of Results for Lagoon No Bund-1-1.SRCX

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
10080 min Summer	118.000	0.000	7.2	0.0	O K
15 min Winter	118.194	0.194	31.6	75.6	O K
30 min Winter	118.227	0.227	32.0	89.0	O K
60 min Winter	118.237	0.237	32.2	92.8	O K
120 min Winter	118.217	0.217	31.9	84.9	O K
180 min Winter	118.189	0.189	31.5	73.3	O K
240 min Winter	118.162	0.162	31.0	62.7	O K
360 min Winter	118.128	0.128	28.2	49.0	O K
480 min Winter	118.105	0.105	25.1	40.3	O K
600 min Winter	118.090	0.090	22.7	34.2	O K
720 min Winter	118.079	0.079	20.8	29.9	O K
960 min Winter	118.063	0.063	18.1	23.7	O K
1440 min Winter	118.044	0.044	14.8	16.5	O K
2160 min Winter	118.029	0.029	12.3	10.8	O K
2880 min Winter	118.020	0.020	10.9	7.5	O K
4320 min Winter	118.010	0.010	9.4	3.8	O K
5760 min Winter	118.000	0.000	7.9	0.0	O K
7200 min Winter	118.000	0.000	6.7	0.0	O K
8640 min Winter	118.000	0.000	5.8	0.0	O K
10080 min Winter	118.000	0.000	5.2	0.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
10080 min Summer	0.398	0.0	1105.5	0
15 min Winter	45.717	0.0	211.3	19
30 min Winter	29.437	0.0	272.1	30
60 min Winter	18.324	0.0	338.5	50
120 min Winter	11.160	0.0	412.4	86
180 min Winter	8.306	0.0	461.0	120
240 min Winter	6.727	0.0	497.3	152
360 min Winter	4.974	0.0	552.1	212
480 min Winter	4.000	0.0	592.0	274
600 min Winter	3.378	0.0	624.8	334
720 min Winter	2.942	0.0	652.7	394
960 min Winter	2.365	0.0	699.9	514
1440 min Winter	1.739	0.0	772.5	756
2160 min Winter	1.280	0.0	852.1	1124
2880 min Winter	1.030	0.0	914.2	1472
4320 min Winter	0.757	0.0	1008.3	2204
5760 min Winter	0.608	0.0	1080.7	2912
7200 min Winter	0.514	0.0	1140.8	0
8640 min Winter	0.448	0.0	1192.5	0
10080 min Winter	0.398	0.0	1238.2	0

Cascade Rainfall Details for Lagoon No Bund-1-1.SRCX

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	1	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	20.400	Shortest Storm (mins)	15
Ratio R	0.440	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+40

Time Area Diagram

Total Area (ha) 0.984

Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)
0	4	0.492	4	8	0.492

Time Area Diagram

Total Area (ha) 0.000

Time From:	(mins) To:	Area (ha)
0	4	0.000

Cascade Model Details for Lagoon No Bund-1-1.SRCX

Storage is Online Cover Level (m) 119.000

Tank or Pond Structure

Invert Level (m) 118.000

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	373.0	1.000	552.0

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0240-3280-1500-3280
Design Head (m)	1.500
Design Flow (l/s)	32.8
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	240
Invert Level (m)	117.900
Minimum Outlet Pipe Diameter (mm)	300
Suggested Manhole Diameter (mm)	1800

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.500	32.8
Flush-Flo™	0.475	32.8
Kick-Flo®	1.033	27.4
Mean Flow over Head Range	-	28.1

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	7.9	1.200	29.5	3.000	45.7	7.000	69.0
0.200	24.3	1.400	31.7	3.500	49.3	7.500	71.3
0.300	31.7	1.600	33.8	4.000	52.6	8.000	73.6
0.400	32.6	1.800	35.8	4.500	55.7	8.500	75.8
0.500	32.8	2.000	37.6	5.000	58.6	9.000	77.9
0.600	32.5	2.200	39.4	5.500	61.3	9.500	80.0
0.800	31.4	2.400	41.1	6.000	64.0		
1.000	28.4	2.600	42.7	6.500	66.5		

Cascade Summary of Results for Lagoon No Bund-1-30.SRCX

Upstream Structures	Outflow To	Overflow To
Bund With Outfall-1-30.SRCX	(None)	(None)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	118.444	0.444	32.8	182.1	O K
30 min Summer	118.534	0.534	32.8	223.2	O K
60 min Summer	118.585	0.585	32.8	246.8	O K
120 min Summer	118.579	0.579	32.8	244.3	O K
180 min Summer	118.553	0.553	32.8	232.1	O K
240 min Summer	118.522	0.522	32.8	217.6	O K
360 min Summer	118.458	0.458	32.8	188.4	O K
480 min Summer	118.399	0.399	32.8	162.3	O K
600 min Summer	118.347	0.347	32.8	139.3	O K
720 min Summer	118.300	0.300	32.6	119.4	O K
960 min Summer	118.227	0.227	32.0	88.9	O K
1440 min Summer	118.144	0.144	30.4	55.6	O K
2160 min Summer	118.102	0.102	24.6	38.9	O K
2880 min Summer	118.080	0.080	21.1	30.4	O K
4320 min Summer	118.055	0.055	16.8	20.9	O K
5760 min Summer	118.041	0.041	14.4	15.5	O K
7200 min Summer	118.032	0.032	12.9	12.0	O K
8640 min Summer	118.026	0.026	11.8	9.6	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	112.255	0.0	463.2	20
30 min Summer	71.925	0.0	593.8	34
60 min Summer	44.012	0.0	726.5	62
120 min Summer	26.143	0.0	863.7	96
180 min Summer	19.083	0.0	945.8	128
240 min Summer	15.205	0.0	1004.4	162
360 min Summer	11.007	0.0	1091.0	230
480 min Summer	8.750	0.0	1156.6	294
600 min Summer	7.320	0.0	1209.7	356
720 min Summer	6.325	0.0	1253.8	416
960 min Summer	5.019	0.0	1326.8	532
1440 min Summer	3.620	0.0	1435.2	752
2160 min Summer	2.609	0.0	1551.0	1108
2880 min Summer	2.066	0.0	1638.7	1472
4320 min Summer	1.487	0.0	1768.4	2204
5760 min Summer	1.176	0.0	1866.3	2936
7200 min Summer	0.981	0.0	1943.5	3672
8640 min Summer	0.845	0.0	2010.5	4376

Cascade Summary of Results for Lagoon No Bund-1-30.SRCX

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
10080 min Summer	118.021	0.021	11.0	7.7	O K
15 min Winter	118.498	0.498	32.8	206.5	O K
30 min Winter	118.601	0.601	32.8	254.5	O K
60 min Winter	118.664	0.664	32.8	284.9	O K
120 min Winter	118.659	0.659	32.8	282.4	O K
180 min Winter	118.624	0.624	32.8	265.6	O K
240 min Winter	118.579	0.579	32.8	244.3	O K
360 min Winter	118.484	0.484	32.8	200.1	O K
480 min Winter	118.395	0.395	32.8	160.3	O K
600 min Winter	118.317	0.317	32.7	126.6	O K
720 min Winter	118.252	0.252	32.3	99.4	O K
960 min Winter	118.163	0.163	31.0	63.2	O K
1440 min Winter	118.107	0.107	25.4	40.9	O K
2160 min Winter	118.074	0.074	20.0	27.9	O K
2880 min Winter	118.056	0.056	16.9	21.2	O K
4320 min Winter	118.037	0.037	13.6	13.7	O K
5760 min Winter	118.026	0.026	11.8	9.6	O K
7200 min Winter	118.019	0.019	10.7	6.9	O K
8640 min Winter	118.014	0.014	9.9	5.1	O K
10080 min Winter	118.010	0.010	9.3	3.7	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
10080 min Summer	0.745	0.0	2068.0	5136
15 min Winter	112.255	0.0	518.7	21
30 min Winter	71.925	0.0	665.3	34
60 min Winter	44.012	0.0	814.1	62
120 min Winter	26.143	0.0	967.2	108
180 min Winter	19.083	0.0	1059.1	140
240 min Winter	15.205	0.0	1125.4	178
360 min Winter	11.007	0.0	1222.0	248
480 min Winter	8.750	0.0	1295.2	314
600 min Winter	7.320	0.0	1354.4	374
720 min Winter	6.325	0.0	1404.2	432
960 min Winter	5.019	0.0	1486.0	534
1440 min Winter	3.620	0.0	1561.5	756
2160 min Winter	2.609	0.0	1737.4	1112
2880 min Winter	2.066	0.0	1835.7	1472
4320 min Winter	1.487	0.0	1980.5	2200
5760 min Winter	1.176	0.0	2089.7	2936
7200 min Winter	0.981	0.0	2178.2	3584
8640 min Winter	0.845	0.0	2251.6	4296
10080 min Winter	0.745	0.0	2316.1	5144

Cascade Rainfall Details for Lagoon No Bund-1-30.SRCX

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	30	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	20.400	Shortest Storm (mins)	15
Ratio R	0.440	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+40

Time Area Diagram

Total Area (ha) 0.984

Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)
0	4	0.492	4	8	0.492

Time Area Diagram

Total Area (ha) 0.000

Time From:	(mins) To:	Area (ha)
0	4	0.000

Cascade Model Details for Lagoon No Bund-1-30.SRCX

Storage is Online Cover Level (m) 119.000

Tank or Pond Structure

Invert Level (m) 118.000

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	373.0	1.000	552.0

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0240-3280-1500-3280
Design Head (m)	1.500
Design Flow (l/s)	32.8
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	240
Invert Level (m)	117.900
Minimum Outlet Pipe Diameter (mm)	300
Suggested Manhole Diameter (mm)	1800

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.500	32.8
Flush-Flo™	0.475	32.8
Kick-Flo®	1.033	27.4
Mean Flow over Head Range	-	28.1

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	7.9	1.200	29.5	3.000	45.7	7.000	69.0
0.200	24.3	1.400	31.7	3.500	49.3	7.500	71.3
0.300	31.7	1.600	33.8	4.000	52.6	8.000	73.6
0.400	32.6	1.800	35.8	4.500	55.7	8.500	75.8
0.500	32.8	2.000	37.6	5.000	58.6	9.000	77.9
0.600	32.5	2.200	39.4	5.500	61.3	9.500	80.0
0.800	31.4	2.400	41.1	6.000	64.0		
1.000	28.4	2.600	42.7	6.500	66.5		

Cascade Summary of Results for Lagoon No Bund.SRCX

Upstream Structures	Outflow To	Overflow To
Bund With Outfall-1-100.SRCX	(None)	(None)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	118.577	0.577	32.8	243.3	O K
30 min Summer	118.702	0.702	32.8	303.6	O K
60 min Summer	118.786	0.786	32.8	345.7	O K
120 min Summer	118.799	0.799	32.8	352.7	O K
180 min Summer	118.771	0.771	32.8	338.0	O K
240 min Summer	118.736	0.736	32.8	320.5	O K
360 min Summer	118.665	0.665	32.8	285.5	O K
480 min Summer	118.599	0.599	32.8	253.6	O K
600 min Summer	118.536	0.536	32.8	224.1	O K
720 min Summer	118.477	0.477	32.8	197.1	O K
960 min Summer	118.375	0.375	32.8	151.3	O K
1440 min Summer	118.231	0.231	32.1	90.7	O K
2160 min Summer	118.137	0.137	29.4	52.6	O K
2880 min Summer	118.105	0.105	25.1	40.1	O K
4320 min Summer	118.073	0.073	19.8	27.5	O K
5760 min Summer	118.055	0.055	16.7	20.7	O K
7200 min Summer	118.043	0.043	14.7	16.4	O K
8640 min Summer	118.035	0.035	13.4	13.2	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	145.957	0.0	602.7	21
30 min Summer	94.237	0.0	778.0	35
60 min Summer	57.877	0.0	955.7	62
120 min Summer	34.352	0.0	1134.7	114
180 min Summer	25.002	0.0	1239.0	142
240 min Summer	19.851	0.0	1311.6	174
360 min Summer	14.290	0.0	1416.4	240
480 min Summer	11.321	0.0	1496.4	306
600 min Summer	9.443	0.0	1560.3	372
720 min Summer	8.140	0.0	1584.1	434
960 min Summer	6.435	0.0	1622.9	554
1440 min Summer	4.614	0.0	1669.5	782
2160 min Summer	3.304	0.0	1964.8	1112
2880 min Summer	2.605	0.0	2065.4	1472
4320 min Summer	1.861	0.0	2213.5	2204
5760 min Summer	1.465	0.0	2322.8	2936
7200 min Summer	1.216	0.0	2411.6	3672
8640 min Summer	1.044	0.0	2483.5	4400

Cascade Summary of Results for Lagoon No Bund.SRCX

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
10080 min Summer	118.029	0.029	12.4	10.9	O K
15 min Winter	118.644	0.644	32.8	275.1	O K
30 min Winter	118.785	0.785	32.8	345.4	O K
60 min Winter	118.886	0.886	32.8	398.1	Flood Risk
120 min Winter	118.920	0.920	32.8	416.2	Flood Risk
180 min Winter	118.884	0.884	32.8	396.8	Flood Risk
240 min Winter	118.836	0.836	32.8	371.5	O K
360 min Winter	118.736	0.736	32.8	320.4	O K
480 min Winter	118.636	0.636	32.8	271.6	O K
600 min Winter	118.541	0.541	32.8	226.5	O K
720 min Winter	118.453	0.453	32.8	186.1	O K
960 min Winter	118.307	0.307	32.7	122.1	O K
1440 min Winter	118.147	0.147	30.6	56.6	O K
2160 min Winter	118.097	0.097	23.9	37.1	O K
2880 min Winter	118.074	0.074	20.0	28.1	O K
4320 min Winter	118.050	0.050	15.8	18.7	O K
5760 min Winter	118.036	0.036	13.5	13.5	O K
7200 min Winter	118.027	0.027	12.1	10.1	O K
8640 min Winter	118.021	0.021	11.1	7.9	O K
10080 min Winter	118.017	0.017	10.4	6.2	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
10080 min Summer	0.918	0.0	2547.6	5112
15 min Winter	145.957	0.0	674.6	21
30 min Winter	94.237	0.0	821.2	35
60 min Winter	57.877	0.0	1070.7	62
120 min Winter	34.352	0.0	1271.1	118
180 min Winter	25.002	0.0	1387.7	170
240 min Winter	19.851	0.0	1469.3	190
360 min Winter	14.290	0.0	1570.9	262
480 min Winter	11.321	0.0	1610.3	332
600 min Winter	9.443	0.0	1641.7	398
720 min Winter	8.140	0.0	1667.5	462
960 min Winter	6.435	0.0	1709.3	576
1440 min Winter	4.614	0.0	1767.3	768
2160 min Winter	3.304	0.0	2200.8	1124
2880 min Winter	2.605	0.0	2313.8	1472
4320 min Winter	1.861	0.0	2479.6	2204
5760 min Winter	1.465	0.0	2602.1	2936
7200 min Winter	1.216	0.0	2700.7	3672
8640 min Winter	1.044	0.0	2783.0	4368
10080 min Winter	0.918	0.0	2853.0	5088

Cascade Rainfall Details for Lagoon No Bund.SRCX

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	20.400	Shortest Storm (mins)	15
Ratio R	0.440	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+40

Time Area Diagram

Total Area (ha) 0.984

Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)
0	4	0.492	4	8	0.492

Time Area Diagram

Total Area (ha) 0.000

Time (mins) From:	To:	Area (ha)
0	4	0.000

Cascade Model Details for Lagoon No Bund.SRCX

Storage is Online Cover Level (m) 119.000

Tank or Pond Structure

Invert Level (m) 118.000

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	373.0	1.000	552.0

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0240-3280-1500-3280
Design Head (m)	1.500
Design Flow (l/s)	32.8
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	240
Invert Level (m)	117.900
Minimum Outlet Pipe Diameter (mm)	300
Suggested Manhole Diameter (mm)	1800

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.500	32.8
Flush-Flo™	0.475	32.8
Kick-Flo®	1.033	27.4
Mean Flow over Head Range	-	28.1

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	7.9	1.200	29.5	3.000	45.7	7.000	69.0
0.200	24.3	1.400	31.7	3.500	49.3	7.500	71.3
0.300	31.7	1.600	33.8	4.000	52.6	8.000	73.6
0.400	32.6	1.800	35.8	4.500	55.7	8.500	75.8
0.500	32.8	2.000	37.6	5.000	58.6	9.000	77.9
0.600	32.5	2.200	39.4	5.500	61.3	9.500	80.0
0.800	31.4	2.400	41.1	6.000	64.0		
1.000	28.4	2.600	42.7	6.500	66.5		

Cascade Summary of Results for Lagoon With Bund-1-100.SRCX

Upstream Structures	Outflow To	Overflow To
(None)	(None)	(None)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	117.397	0.397	32.8	161.0	O K
30 min Summer	117.472	0.472	32.8	194.7	O K
60 min Summer	117.493	0.493	32.8	204.1	O K
120 min Summer	117.455	0.455	32.8	187.0	O K
180 min Summer	117.413	0.413	32.8	168.3	O K
240 min Summer	117.369	0.369	32.8	148.9	O K
360 min Summer	117.283	0.283	32.8	112.3	O K
480 min Summer	117.207	0.207	32.8	80.8	O K
600 min Summer	117.142	0.142	32.8	54.8	O K
720 min Summer	117.090	0.090	32.8	34.2	O K
960 min Summer	117.022	0.022	32.8	8.3	O K
1440 min Summer	117.000	0.000	27.4	0.0	O K
2160 min Summer	117.000	0.000	19.6	0.0	O K
2880 min Summer	117.000	0.000	15.4	0.0	O K
4320 min Summer	117.000	0.000	11.0	0.0	O K
5760 min Summer	117.000	0.000	8.7	0.0	O K
7200 min Summer	117.000	0.000	7.2	0.0	O K
8640 min Summer	117.000	0.000	6.2	0.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	145.957	0.0	198.4	20
30 min Summer	94.237	0.0	256.1	33
60 min Summer	57.877	0.0	315.8	60
120 min Summer	34.352	0.0	372.7	92
180 min Summer	25.002	0.0	409.4	126
240 min Summer	19.851	0.0	433.6	158
360 min Summer	14.290	0.0	467.0	224
480 min Summer	11.321	0.0	492.8	286
600 min Summer	9.443	0.0	512.9	344
720 min Summer	8.140	0.0	532.3	400
960 min Summer	6.435	0.0	560.7	504
1440 min Summer	4.614	0.0	603.0	0
2160 min Summer	3.304	0.0	647.6	0
2880 min Summer	2.605	0.0	680.8	0
4320 min Summer	1.861	0.0	729.5	0
5760 min Summer	1.465	0.0	765.7	0
7200 min Summer	1.216	0.0	794.5	0
8640 min Summer	1.044	0.0	818.7	0

Cascade Summary of Results for Lagoon With Bund-1-100.SRCX

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
10080 min Summer	117.000	0.000	5.4	0.0	O K
15 min Winter	117.451	0.451	32.8	185.0	O K
30 min Winter	117.542	0.542	32.8	227.0	O K
60 min Winter	117.580	0.580	32.8	244.7	O K
120 min Winter	117.535	0.535	32.8	223.4	O K
180 min Winter	117.474	0.474	32.8	195.6	O K
240 min Winter	117.406	0.406	32.8	165.3	O K
360 min Winter	117.274	0.274	32.8	108.6	O K
480 min Winter	117.160	0.160	32.8	61.8	O K
600 min Winter	117.069	0.069	32.8	26.2	O K
720 min Winter	117.011	0.011	32.8	4.1	O K
960 min Winter	117.000	0.000	27.6	0.0	O K
1440 min Winter	117.000	0.000	19.8	0.0	O K
2160 min Winter	117.000	0.000	14.2	0.0	O K
2880 min Winter	117.000	0.000	11.2	0.0	O K
4320 min Winter	117.000	0.000	8.0	0.0	O K
5760 min Winter	117.000	0.000	6.3	0.0	O K
7200 min Winter	117.000	0.000	5.2	0.0	O K
8640 min Winter	117.000	0.000	4.5	0.0	O K
10080 min Winter	117.000	0.000	3.9	0.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
10080 min Summer	0.918	0.0	839.6	0
15 min Winter	145.957	0.0	221.4	20
30 min Winter	94.237	0.0	286.8	34
60 min Winter	57.877	0.0	353.7	60
120 min Winter	34.352	0.0	418.8	102
180 min Winter	25.002	0.0	457.4	136
240 min Winter	19.851	0.0	483.5	172
360 min Winter	14.290	0.0	523.8	240
480 min Winter	11.321	0.0	552.5	300
600 min Winter	9.443	0.0	576.1	350
720 min Winter	8.140	0.0	595.7	390
960 min Winter	6.435	0.0	627.9	0
1440 min Winter	4.614	0.0	675.3	0
2160 min Winter	3.304	0.0	725.3	0
2880 min Winter	2.605	0.0	762.5	0
4320 min Winter	1.861	0.0	817.1	0
5760 min Winter	1.465	0.0	857.5	0
7200 min Winter	1.216	0.0	889.9	0
8640 min Winter	1.044	0.0	917.0	0
10080 min Winter	0.918	0.0	940.3	0

Cascade Rainfall Details for Lagoon With Bund-1-100.SRCX

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	20.400	Shortest Storm (mins)	15
Ratio R	0.440	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+40

Time Area Diagram

Total Area (ha) 0.726

Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)
0	4	0.363	4	8	0.363

Time Area Diagram

Total Area (ha) 0.000

Time From:	(mins) To:	Area (ha)
0	4	0.000

Cascade Model Details for Lagoon With Bund-1-100.SRCX

Storage is Online Cover Level (m) 118.000

Tank or Pond Structure

Invert Level (m) 117.000

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	373.0	1.000	552.0

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0240-3290-1500-3290
Design Head (m)	1.500
Design Flow (l/s)	32.9
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	240
Invert Level (m)	116.500
Minimum Outlet Pipe Diameter (mm)	300
Suggested Manhole Diameter (mm)	1800

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.500	32.8
Flush-Flo™	0.473	32.8
Kick-Flo®	1.030	27.4
Mean Flow over Head Range	-	28.1

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	7.9	1.200	29.5	3.000	45.8	7.000	69.1
0.200	24.3	1.400	31.8	3.500	49.4	7.500	71.5
0.300	31.7	1.600	33.9	4.000	52.7	8.000	73.7
0.400	32.6	1.800	35.8	4.500	55.8	8.500	76.0
0.500	32.8	2.000	37.7	5.000	58.7	9.000	78.1
0.600	32.5	2.200	39.5	5.500	61.5	9.500	80.2
0.800	31.4	2.400	41.2	6.000	64.1		
1.000	28.4	2.600	42.8	6.500	66.7		

Cascade Summary of Results for Bund With Outfall-1-1.SRCX

Upstream Structures	Outflow To	Overflow To
(None)	Lagoon No Bund-1-1.SRCX	(None)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	119.713	0.213	5.0	97.9	O K
30 min Summer	119.730	0.230	5.0	123.6	O K
60 min Summer	119.744	0.244	5.0	147.9	O K
120 min Summer	119.754	0.254	5.0	167.0	O K
180 min Summer	119.757	0.257	5.0	173.2	O K
240 min Summer	119.758	0.258	5.0	173.7	O K
360 min Summer	119.755	0.255	5.0	168.0	O K
480 min Summer	119.752	0.252	5.0	162.4	O K
600 min Summer	119.749	0.249	5.0	157.6	O K
720 min Summer	119.747	0.247	5.0	153.0	O K
960 min Summer	119.742	0.242	5.0	143.6	O K
1440 min Summer	119.731	0.231	5.0	124.8	O K
2160 min Summer	119.712	0.212	5.0	97.5	O K
2880 min Summer	119.693	0.193	5.0	73.0	O K
4320 min Summer	119.651	0.151	5.0	34.9	O K
5760 min Summer	119.604	0.104	5.0	11.4	O K
7200 min Summer	119.545	0.045	5.0	0.9	O K
8640 min Summer	119.500	0.000	4.5	0.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	45.717	0.0	104.4	22
30 min Summer	29.437	0.0	134.6	36
60 min Summer	18.324	0.0	167.3	66
120 min Summer	11.160	0.0	204.2	124
180 min Summer	8.306	0.0	228.0	182
240 min Summer	6.727	0.0	245.8	240
360 min Summer	4.974	0.0	272.9	314
480 min Summer	4.000	0.0	292.8	376
600 min Summer	3.378	0.0	308.7	438
720 min Summer	2.942	0.0	322.8	506
960 min Summer	2.365	0.0	345.7	644
1440 min Summer	1.739	0.0	381.9	914
2160 min Summer	1.280	0.0	421.5	1304
2880 min Summer	1.030	0.0	451.8	1676
4320 min Summer	0.757	0.0	497.9	2380
5760 min Summer	0.608	0.0	533.8	3048
7200 min Summer	0.514	0.0	563.6	3672
8640 min Summer	0.448	0.0	589.2	0

Cascade Summary of Results for Bund With Outfall-1-1.SRCX

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
10080 min Summer	119.500	0.000	4.0	0.0	O K
15 min Winter	119.722	0.222	5.0	110.5	O K
30 min Winter	119.740	0.240	5.0	140.0	O K
60 min Winter	119.755	0.255	5.0	168.5	O K
120 min Winter	119.767	0.267	5.0	192.6	O K
180 min Winter	119.771	0.271	5.0	202.2	O K
240 min Winter	119.773	0.273	5.0	205.6	O K
360 min Winter	119.771	0.271	5.0	202.4	O K
480 min Winter	119.767	0.267	5.0	192.8	O K
600 min Winter	119.764	0.264	5.0	186.3	O K
720 min Winter	119.761	0.261	5.0	179.7	O K
960 min Winter	119.753	0.253	5.0	165.5	O K
1440 min Winter	119.737	0.237	5.0	135.4	O K
2160 min Winter	119.709	0.209	5.0	92.5	O K
2880 min Winter	119.676	0.176	5.0	55.6	O K
4320 min Winter	119.585	0.085	5.0	6.3	O K
5760 min Winter	119.500	0.000	4.4	0.0	O K
7200 min Winter	119.500	0.000	3.7	0.0	O K
8640 min Winter	119.500	0.000	3.2	0.0	O K
10080 min Winter	119.500	0.000	2.9	0.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
10080 min Summer	0.398	0.0	611.7	0
15 min Winter	45.717	0.0	116.9	22
30 min Winter	29.437	0.0	150.7	36
60 min Winter	18.324	0.0	187.4	64
120 min Winter	11.160	0.0	228.3	122
180 min Winter	8.306	0.0	255.4	180
240 min Winter	6.727	0.0	275.2	236
360 min Winter	4.974	0.0	305.7	344
480 min Winter	4.000	0.0	327.5	438
600 min Winter	3.378	0.0	345.9	472
720 min Winter	2.942	0.0	361.2	548
960 min Winter	2.365	0.0	387.3	702
1440 min Winter	1.739	0.0	427.7	996
2160 min Winter	1.280	0.0	471.6	1404
2880 min Winter	1.030	0.0	505.9	1764
4320 min Winter	0.757	0.0	558.1	2340
5760 min Winter	0.608	0.0	598.0	0
7200 min Winter	0.514	0.0	631.2	0
8640 min Winter	0.448	0.0	659.9	0
10080 min Winter	0.398	0.0	685.1	0

Cascade Rainfall Details for Bund With Outfall-1-1.SRCX

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	1	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	20.400	Shortest Storm (mins)	15
Ratio R	0.440	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+40

Time Area Diagram

Total Area (ha) 1.219

Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)
0	4	0.610	4	8	0.609

Time Area Diagram

Total Area (ha) 0.000

Time From:	(mins) To:	Area (ha)
0	4	0.000

Cascade Model Details for Bund With Outfall-1-1.SRCX

Storage is Online Cover Level (m) 121.500

Tank or Pond Structure

Invert Level (m) 119.500

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	0.0	0.500	7619.0	2.000	7619.0

Pump Outflow Control

Invert Level (m) 118.000

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	5.0000	0.900	5.0000	1.700	5.0000	2.500	5.0000
0.200	5.0000	1.000	5.0000	1.800	5.0000	2.600	5.0000
0.300	5.0000	1.100	5.0000	1.900	5.0000	2.700	5.0000
0.400	5.0000	1.200	5.0000	2.000	5.0000	2.800	5.0000
0.500	5.0000	1.300	5.0000	2.100	5.0000	2.900	5.0000
0.600	5.0000	1.400	5.0000	2.200	5.0000	3.000	5.0000
0.700	5.0000	1.500	5.0000	2.300	5.0000		
0.800	5.0000	1.600	5.0000	2.400	5.0000		

Cascade Summary of Results for Bund With Outfall-1-30.SRCX

Upstream Structures	Outflow To	Overflow To
(None)	Lagoon No Bund-1-30.SRCX	(None)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	119.791	0.291	5.0	249.8	O K
30 min Summer	119.815	0.315	5.0	317.5	O K
60 min Summer	119.835	0.335	5.0	382.1	O K
120 min Summer	119.851	0.351	5.0	440.2	O K
180 min Summer	119.858	0.358	5.0	467.8	O K
240 min Summer	119.862	0.362	5.0	482.5	O K
360 min Summer	119.865	0.365	5.0	494.7	O K
480 min Summer	119.865	0.365	5.0	495.3	O K
600 min Summer	119.864	0.364	5.0	488.9	O K
720 min Summer	119.861	0.361	5.0	477.8	O K
960 min Summer	119.855	0.355	5.0	453.9	O K
1440 min Summer	119.846	0.346	5.0	419.9	O K
2160 min Summer	119.834	0.334	5.0	379.5	O K
2880 min Summer	119.823	0.323	5.0	342.1	O K
4320 min Summer	119.799	0.299	5.0	272.9	O K
5760 min Summer	119.775	0.275	5.0	211.0	O K
7200 min Summer	119.749	0.249	5.0	157.4	O K
8640 min Summer	119.723	0.223	5.0	112.1	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	112.255	0.0	256.5	23
30 min Summer	71.925	0.0	328.8	37
60 min Summer	44.012	0.0	402.0	66
120 min Summer	26.143	0.0	478.2	126
180 min Summer	19.083	0.0	523.7	186
240 min Summer	15.205	0.0	556.0	244
360 min Summer	11.007	0.0	603.8	364
480 min Summer	8.750	0.0	640.2	482
600 min Summer	7.320	0.0	669.5	602
720 min Summer	6.325	0.0	693.9	720
960 min Summer	5.019	0.0	734.5	832
1440 min Summer	3.620	0.0	794.2	1072
2160 min Summer	2.609	0.0	858.1	1472
2880 min Summer	2.066	0.0	906.9	1876
4320 min Summer	1.487	0.0	978.7	2680
5760 min Summer	1.176	0.0	1033.1	3456
7200 min Summer	0.981	0.0	1075.2	4176
8640 min Summer	0.845	0.0	1112.6	4848

Cascade Summary of Results for Bund With Outfall-1-30.SRCX

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
10080 min Summer	119.695	0.195	5.0	75.6	O K
15 min Winter	119.802	0.302	5.0	280.5	O K
30 min Winter	119.828	0.328	5.0	357.3	O K
60 min Winter	119.849	0.349	5.0	431.0	O K
120 min Winter	119.866	0.366	5.0	498.5	O K
180 min Winter	119.874	0.374	5.0	532.0	O K
240 min Winter	119.879	0.379	5.0	551.2	O K
360 min Winter	119.883	0.383	5.0	570.0	O K
480 min Winter	119.884	0.384	5.0	576.1	O K
600 min Winter	119.884	0.384	5.0	574.6	O K
720 min Winter	119.882	0.382	5.0	568.4	O K
960 min Winter	119.878	0.378	5.0	547.2	O K
1440 min Winter	119.866	0.366	5.0	497.0	O K
2160 min Winter	119.852	0.352	5.0	441.8	O K
2880 min Winter	119.836	0.336	5.0	386.2	O K
4320 min Winter	119.802	0.302	5.0	280.5	O K
5760 min Winter	119.764	0.264	5.0	187.6	O K
7200 min Winter	119.721	0.221	5.0	110.2	O K
8640 min Winter	119.670	0.170	5.0	50.3	O K
10080 min Winter	119.602	0.102	5.0	10.8	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
10080 min Summer	0.745	0.0	1144.4	5544
15 min Winter	112.255	0.0	287.1	22
30 min Winter	71.925	0.0	368.3	37
60 min Winter	44.012	0.0	450.5	66
120 min Winter	26.143	0.0	535.4	124
180 min Winter	19.083	0.0	586.0	182
240 min Winter	15.205	0.0	622.8	240
360 min Winter	11.007	0.0	676.2	358
480 min Winter	8.750	0.0	716.8	472
600 min Winter	7.320	0.0	749.5	586
720 min Winter	6.325	0.0	777.3	698
960 min Winter	5.019	0.0	822.4	914
1440 min Winter	3.620	0.0	843.4	1154
2160 min Winter	2.609	0.0	961.3	1604
2880 min Winter	2.066	0.0	1016.1	2048
4320 min Winter	1.487	0.0	1095.9	2896
5760 min Winter	1.176	0.0	1156.3	3640
7200 min Winter	0.981	0.0	1205.7	4328
8640 min Winter	0.845	0.0	1245.9	4936
10080 min Winter	0.745	0.0	1281.7	5448

Cascade Rainfall Details for Bund With Outfall-1-30.SRCX

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	30	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	20.400	Shortest Storm (mins)	15
Ratio R	0.440	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+40

Time Area Diagram

Total Area (ha) 1.219

Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)
0	4	0.610	4	8	0.609

Time Area Diagram

Total Area (ha) 0.000

Time From:	(mins) To:	Area (ha)
0	4	0.000

Cascade Model Details for Bund With Outfall-1-30.SRCX

Storage is Online Cover Level (m) 121.500

Tank or Pond Structure

Invert Level (m) 119.500

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	0.0	0.500	7619.0	2.000	7619.0

Pump Outflow Control

Invert Level (m) 118.000

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	5.0000	0.900	5.0000	1.700	5.0000	2.500	5.0000
0.200	5.0000	1.000	5.0000	1.800	5.0000	2.600	5.0000
0.300	5.0000	1.100	5.0000	1.900	5.0000	2.700	5.0000
0.400	5.0000	1.200	5.0000	2.000	5.0000	2.800	5.0000
0.500	5.0000	1.300	5.0000	2.100	5.0000	2.900	5.0000
0.600	5.0000	1.400	5.0000	2.200	5.0000	3.000	5.0000
0.700	5.0000	1.500	5.0000	2.300	5.0000		
0.800	5.0000	1.600	5.0000	2.400	5.0000		

Cascade Summary of Results for Bund With Outfall-1-100.SRCX

Upstream Structures	Outflow To	Overflow To
(None)	Lagoon No Bund.SRCX	(None)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	119.818	0.318	5.0	326.9	O K
30 min Summer	119.846	0.346	5.0	419.4	O K
60 min Summer	119.869	0.369	5.0	509.0	O K
120 min Summer	119.887	0.387	5.0	590.1	O K
180 min Summer	119.896	0.396	5.0	629.9	O K
240 min Summer	119.900	0.400	5.0	652.3	O K
360 min Summer	119.905	0.405	5.0	674.5	O K
480 min Summer	119.907	0.407	5.0	682.9	O K
600 min Summer	119.907	0.407	5.0	682.5	O K
720 min Summer	119.905	0.405	5.0	676.4	O K
960 min Summer	119.901	0.401	5.0	653.1	O K
1440 min Summer	119.890	0.390	5.0	601.7	O K
2160 min Summer	119.878	0.378	5.0	548.7	O K
2880 min Summer	119.868	0.368	5.0	504.8	O K
4320 min Summer	119.847	0.347	5.0	425.2	O K
5760 min Summer	119.826	0.326	5.0	352.5	O K
7200 min Summer	119.805	0.305	5.0	287.2	O K
8640 min Summer	119.782	0.282	5.0	228.1	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	145.957	0.0	333.6	23
30 min Summer	94.237	0.0	430.5	37
60 min Summer	57.877	0.0	529.2	68
120 min Summer	34.352	0.0	628.2	126
180 min Summer	25.002	0.0	685.8	186
240 min Summer	19.851	0.0	725.9	246
360 min Summer	14.290	0.0	783.9	364
480 min Summer	11.321	0.0	828.2	484
600 min Summer	9.443	0.0	863.5	602
720 min Summer	8.140	0.0	863.4	722
960 min Summer	6.435	0.0	863.1	960
1440 min Summer	4.614	0.0	852.4	1198
2160 min Summer	3.304	0.0	1087.2	1560
2880 min Summer	2.605	0.0	1142.9	1960
4320 min Summer	1.861	0.0	1224.9	2768
5760 min Summer	1.465	0.0	1285.2	3568
7200 min Summer	1.216	0.0	1334.9	4320
8640 min Summer	1.044	0.0	1374.1	5024

Cascade Summary of Results for Bund With Outfall-1-100.SRCX

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
10080 min Summer	119.759	0.259	5.0	177.1	O K
15 min Winter	119.831	0.331	5.0	366.9	O K
30 min Winter	119.859	0.359	5.0	471.4	O K
60 min Winter	119.883	0.383	5.0	572.8	O K
120 min Winter	119.903	0.403	5.0	666.3	O K
180 min Winter	119.913	0.413	5.0	713.5	O K
240 min Winter	119.918	0.418	5.0	741.2	O K
360 min Winter	119.923	0.423	5.0	771.2	O K
480 min Winter	119.926	0.426	5.0	785.9	O K
600 min Winter	119.927	0.427	5.0	790.9	O K
720 min Winter	119.927	0.427	5.0	789.7	O K
960 min Winter	119.924	0.424	5.0	775.7	O K
1440 min Winter	119.915	0.415	5.0	723.6	O K
2160 min Winter	119.900	0.400	5.0	648.0	O K
2880 min Winter	119.887	0.387	5.0	587.5	O K
4320 min Winter	119.859	0.359	5.0	469.4	O K
5760 min Winter	119.828	0.328	5.0	359.9	O K
7200 min Winter	119.796	0.296	5.0	262.4	O K
8640 min Winter	119.759	0.259	5.0	177.4	O K
10080 min Winter	119.719	0.219	5.0	106.8	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
10080 min Summer	0.918	0.0	1409.8	5752
15 min Winter	145.957	0.0	373.5	23
30 min Winter	94.237	0.0	432.0	37
60 min Winter	57.877	0.0	592.8	66
120 min Winter	34.352	0.0	703.4	124
180 min Winter	25.002	0.0	767.9	184
240 min Winter	19.851	0.0	813.2	242
360 min Winter	14.290	0.0	862.5	358
480 min Winter	11.321	0.0	861.9	476
600 min Winter	9.443	0.0	861.2	590
720 min Winter	8.140	0.0	860.3	706
960 min Winter	6.435	0.0	858.3	930
1440 min Winter	4.614	0.0	852.2	1356
2160 min Winter	3.304	0.0	1217.9	1684
2880 min Winter	2.605	0.0	1280.5	2136
4320 min Winter	1.861	0.0	1372.3	3024
5760 min Winter	1.465	0.0	1440.0	3856
7200 min Winter	1.216	0.0	1494.8	4608
8640 min Winter	1.044	0.0	1540.4	5280
10080 min Winter	0.918	0.0	1578.7	5952

Cascade Rainfall Details for Bund With Outfall-1-100.SRCX

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	20.400	Shortest Storm (mins)	15
Ratio R	0.440	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+40

Time Area Diagram

Total Area (ha) 1.219

Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)
0	4	0.610	4	8	0.609

Time Area Diagram

Total Area (ha) 0.000

Time From:	(mins) To:	Area (ha)
0	4	0.000

Cascade Model Details for Bund With Outfall-1-100.SRCX

Storage is Online Cover Level (m) 121.500

Tank or Pond Structure

Invert Level (m) 119.500

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	0.0	0.500	7619.0	2.000	7619.0

Pump Outflow Control

Invert Level (m) 118.000

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	5.0000	0.900	5.0000	1.700	5.0000	2.500	5.0000
0.200	5.0000	1.000	5.0000	1.800	5.0000	2.600	5.0000
0.300	5.0000	1.100	5.0000	1.900	5.0000	2.700	5.0000
0.400	5.0000	1.200	5.0000	2.000	5.0000	2.800	5.0000
0.500	5.0000	1.300	5.0000	2.100	5.0000	2.900	5.0000
0.600	5.0000	1.400	5.0000	2.200	5.0000	3.000	5.0000
0.700	5.0000	1.500	5.0000	2.300	5.0000		
0.800	5.0000	1.600	5.0000	2.400	5.0000		

Cascade Summary of Results for Bund No Outfall.SRCX

Upstream Structures	Outflow To	Overflow To
(None)	(None)	(None)

Outflow is too low. Design is unsatisfactory.

Storm Event	Max Level (m)	Max Depth (m)	Max Volume (m^3)	Status
15 min Summer	119.835	0.335	333.6	O K
30 min Summer	119.865	0.365	430.8	O K
60 min Summer	119.890	0.390	529.1	O K
120 min Summer	119.913	0.413	628.1	O K
180 min Summer	119.926	0.426	685.7	O K
240 min Summer	119.934	0.434	725.9	O K
360 min Summer	119.945	0.445	783.9	O K
480 min Summer	119.953	0.453	828.0	O K
600 min Summer	119.960	0.460	863.4	O K
720 min Summer	119.965	0.465	893.0	O K
960 min Summer	119.973	0.473	941.3	O K
1440 min Summer	119.985	0.485	1012.4	O K
2160 min Summer	119.996	0.496	1087.4	O K
2880 min Summer	120.005	0.505	1143.0	O K
4320 min Summer	120.017	0.517	1225.0	O K
5760 min Summer	120.026	0.526	1285.6	O K
7200 min Summer	120.033	0.533	1334.1	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m^3)	Time-Peak (mins)
15 min Summer	145.957	0.0	23
30 min Summer	94.237	0.0	38
60 min Summer	57.877	0.0	68
120 min Summer	34.352	0.0	128
180 min Summer	25.002	0.0	188
240 min Summer	19.851	0.0	248
360 min Summer	14.290	0.0	368
480 min Summer	11.321	0.0	488
600 min Summer	9.443	0.0	608
720 min Summer	8.140	0.0	728
960 min Summer	6.435	0.0	968
1440 min Summer	4.614	0.0	1448
2160 min Summer	3.304	0.0	2168
2880 min Summer	2.605	0.0	2888
4320 min Summer	1.861	0.0	4328
5760 min Summer	1.465	0.0	5768
7200 min Summer	1.216	0.0	7208

Cascade Summary of Results for Bund No Outfall.SRCX

Storm Event	Max Level (m)	Max Depth (m)	Max Volume (m³)	Status
8640 min Summer	120.039	0.539	1374.7	O K
10080 min Summer	120.045	0.545	1409.7	O K
15 min Winter	119.848	0.348	373.6	O K
30 min Winter	119.879	0.379	482.5	O K
60 min Winter	119.905	0.405	592.6	O K
120 min Winter	119.929	0.429	703.5	O K
180 min Winter	119.942	0.442	768.0	O K
240 min Winter	119.950	0.450	813.1	O K
360 min Winter	119.962	0.462	878.0	O K
480 min Winter	119.971	0.471	927.4	O K
600 min Winter	119.977	0.477	967.0	O K
720 min Winter	119.983	0.483	1000.2	O K
960 min Winter	119.991	0.491	1054.2	O K
1440 min Winter	120.003	0.503	1133.9	O K
2160 min Winter	120.016	0.516	1217.9	O K
2880 min Winter	120.025	0.525	1280.2	O K
4320 min Winter	120.039	0.539	1371.9	O K
5760 min Winter	120.049	0.549	1439.9	O K
7200 min Winter	120.057	0.557	1494.2	O K
8640 min Winter	120.064	0.564	1539.7	O K
10080 min Winter	120.070	0.570	1578.9	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)
8640 min Summer	1.044	0.0	8648
10080 min Summer	0.918	0.0	10088
15 min Winter	145.957	0.0	23
30 min Winter	94.237	0.0	38
60 min Winter	57.877	0.0	68
120 min Winter	34.352	0.0	128
180 min Winter	25.002	0.0	188
240 min Winter	19.851	0.0	248
360 min Winter	14.290	0.0	368
480 min Winter	11.321	0.0	488
600 min Winter	9.443	0.0	608
720 min Winter	8.140	0.0	728
960 min Winter	6.435	0.0	968
1440 min Winter	4.614	0.0	1448
2160 min Winter	3.304	0.0	2168
2880 min Winter	2.605	0.0	2888
4320 min Winter	1.861	0.0	4328
5760 min Winter	1.465	0.0	5768
7200 min Winter	1.216	0.0	7208
8640 min Winter	1.044	0.0	8648
10080 min Winter	0.918	0.0	10088

Cascade Rainfall Details for Bund No Outfall.SRCX

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	20.400	Shortest Storm (mins)	15
Ratio R	0.440	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+40

Time Area Diagram

Total Area (ha) 1.219

Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)
0	4	0.610	4	8	0.609

Time Area Diagram

Total Area (ha) 0.000

Time From:	(mins) To:	Area (ha)
0	4	0.000

Cascade Model Details for Bund No Outfall.SRCX

Storage is Online Cover Level (m) 121.500

Tank or Pond Structure

Invert Level (m) 119.500

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	0.0	0.500	6670.0	2.000	6670.0

APPENDIX VIII

Yard – Process Storage Calculations

Cascade Summary of Results for Contaminated 1-1.SRCX

Upstream Structures	Outflow To	Overflow To
(None)	Process Storage Contaminated Rev 1-1.SRCX	(None)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	120.262	2.462	146.6	51.6	O K
30 min Summer	121.150	3.350	220.0	52.6	O K
60 min Summer	122.208	4.408	220.0	53.8	O K
120 min Summer	120.273	2.473	168.6	51.6	O K
180 min Summer	120.252	2.452	127.4	51.6	O K
240 min Summer	120.252	2.452	127.4	51.6	O K
360 min Summer	120.238	2.438	101.4	51.6	O K
480 min Summer	120.222	2.422	69.8	51.6	O K
600 min Summer	120.209	2.409	44.8	51.6	O K
720 min Summer	118.791	0.991	28.0	49.6	O K
960 min Summer	118.303	0.503	28.0	25.1	O K
1440 min Summer	117.821	0.021	28.0	1.0	O K
2160 min Summer	117.800	0.000	21.9	0.0	O K
2880 min Summer	117.800	0.000	17.9	0.0	O K
4320 min Summer	117.800	0.000	13.6	0.0	O K
5760 min Summer	117.800	0.000	11.1	0.0	O K
7200 min Summer	117.800	0.000	9.6	0.0	O K
8640 min Summer	117.800	0.000	8.4	0.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	40.860	0.0	132.0	17
30 min Summer	27.161	0.0	173.9	23
60 min Summer	17.618	0.0	226.2	38
120 min Summer	11.222	0.0	288.1	72
180 min Summer	8.586	0.0	331.6	110
240 min Summer	7.095	0.0	364.2	132
360 min Summer	5.367	0.0	413.5	190
480 min Summer	4.401	0.0	452.6	272
600 min Summer	3.773	0.0	484.6	334
720 min Summer	3.327	0.0	513.7	412
960 min Summer	2.729	0.0	561.4	526
1440 min Summer	2.066	0.0	637.7	740
2160 min Summer	1.561	0.0	722.7	0
2880 min Summer	1.280	0.0	790.2	0
4320 min Summer	0.969	0.0	897.0	0
5760 min Summer	0.795	0.0	982.3	0
7200 min Summer	0.682	0.0	1052.5	0
8640 min Summer	0.600	0.0	1111.2	0

Cascade Summary of Results for Contaminated 1-1.SRCX

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
10080 min Summer	117.800	0.000	7.5	0.0	O K
15 min Winter	120.287	2.487	195.5	51.7	O K
30 min Winter	122.215	4.415	220.0	53.8	O K
60 min Winter	120.758	2.958	220.0	52.2	O K
120 min Winter	120.262	2.462	147.5	51.6	O K
180 min Winter	120.246	2.446	115.8	51.6	O K
240 min Winter	120.238	2.438	100.5	51.6	O K
360 min Winter	120.213	2.413	53.4	51.6	O K
480 min Winter	120.211	2.411	49.6	51.6	O K
600 min Winter	118.652	0.852	28.0	42.6	O K
720 min Winter	118.221	0.421	28.0	21.1	O K
960 min Winter	117.800	0.000	27.6	0.0	O K
1440 min Winter	117.800	0.000	20.9	0.0	O K
2160 min Winter	117.800	0.000	15.8	0.0	O K
2880 min Winter	117.800	0.000	13.0	0.0	O K
4320 min Winter	117.800	0.000	9.8	0.0	O K
5760 min Winter	117.800	0.000	8.1	0.0	O K
7200 min Winter	117.800	0.000	6.9	0.0	O K
8640 min Winter	117.800	0.000	6.1	0.0	O K
10080 min Winter	117.800	0.000	5.4	0.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
10080 min Summer	0.538	0.0	1163.5	0
15 min Winter	40.860	0.0	147.2	16
30 min Winter	27.161	0.0	195.9	22
60 min Winter	17.618	0.0	252.8	36
120 min Winter	11.222	0.0	323.8	64
180 min Winter	8.586	0.0	369.6	94
240 min Winter	7.095	0.0	408.2	132
360 min Winter	5.367	0.0	463.1	220
480 min Winter	4.401	0.0	506.4	272
600 min Winter	3.773	0.0	544.2	366
720 min Winter	3.327	0.0	574.5	420
960 min Winter	2.729	0.0	629.0	0
1440 min Winter	2.066	0.0	714.2	0
2160 min Winter	1.561	0.0	809.4	0
2880 min Winter	1.280	0.0	885.0	0
4320 min Winter	0.969	0.0	1004.6	0
5760 min Winter	0.795	0.0	1100.1	0
7200 min Winter	0.682	0.0	1178.8	0
8640 min Winter	0.600	0.0	1244.5	0
10080 min Winter	0.538	0.0	1303.1	0

Cascade Rainfall Details for Contaminated 1-1.SRCX

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	1	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	19.700	Shortest Storm (mins)	15
Ratio R	0.350	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+40

Time Area Diagram

Total Area (ha) 1.715

Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)
0	4	0.429	4	8	0.429	8	12	0.429	12	16	0.428

Time Area Diagram

Total Area (ha) 0.000

Time From:	(mins) To:	Area (ha)
0	4	0.000

Cascade Model Details for Contaminated 1-1.SRCX

Storage is Online Cover Level (m) 122.600

Tank or Pond Structure

Invert Level (m) 117.800

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	50.0	1.001	1.1	4.400	1.1
1.000	50.0	4.100	1.1	4.800	1860.0

Pump Outflow Control

Invert Level (m) 117.500

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	2.0000	0.900	28.0000	1.700	28.0000	2.500	28.0000
0.200	5.0000	1.000	28.0000	1.800	28.0000	2.600	28.0000
0.300	28.0000	1.100	28.0000	1.900	28.0000	2.700	28.0000
0.400	28.0000	1.200	28.0000	2.000	28.0000	2.800	220.0000
0.500	28.0000	1.300	28.0000	2.100	28.0000	2.900	220.0000
0.600	28.0000	1.400	28.0000	2.200	28.0000	3.000	220.0000
0.700	28.0000	1.500	28.0000	2.300	28.0000		
0.800	28.0000	1.600	28.0000	2.400	28.0000		

Cascade Summary of Results for Contaminated 30.SRCX

Upstream Structures	Outflow To	Overflow To
(None)	Process Storage Contaminated Rev 30.SRCX	(None)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	122.446	4.646	220.0	115.6	O K
30 min Summer	122.495	4.695	220.0	158.4	Flood Risk
60 min Summer	122.484	4.684	220.0	147.4	Flood Risk
120 min Summer	122.417	4.617	220.0	96.8	O K
180 min Summer	122.305	4.505	220.0	59.4	O K
240 min Summer	120.297	2.497	213.8	51.7	O K
360 min Summer	120.269	2.469	161.0	51.7	O K
480 min Summer	120.270	2.470	161.9	51.6	O K
600 min Summer	120.251	2.451	126.4	51.6	O K
720 min Summer	120.245	2.445	114.9	51.6	O K
960 min Summer	120.236	2.436	96.6	51.6	O K
1440 min Summer	120.223	2.423	71.7	51.6	O K
2160 min Summer	120.214	2.414	54.4	51.6	O K
2880 min Summer	118.494	0.694	28.0	34.7	O K
4320 min Summer	117.800	0.000	25.1	0.0	O K
5760 min Summer	117.800	0.000	20.1	0.0	O K
7200 min Summer	117.800	0.000	17.0	0.0	O K
8640 min Summer	117.800	0.000	14.8	0.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	100.138	0.0	321.9	23
30 min Summer	66.644	0.0	428.3	31
60 min Summer	42.476	0.0	544.8	46
120 min Summer	26.265	0.0	674.8	76
180 min Summer	19.594	0.0	754.4	104
240 min Summer	15.832	0.0	814.5	128
360 min Summer	11.728	0.0	905.2	188
480 min Summer	9.466	0.0	973.6	240
600 min Summer	8.011	0.0	1031.2	300
720 min Summer	6.988	0.0	1078.0	382
960 min Summer	5.628	0.0	1158.2	492
1440 min Summer	4.142	0.0	1279.3	700
2160 min Summer	3.045	0.0	1410.8	1172
2880 min Summer	2.445	0.0	1509.8	1532
4320 min Summer	1.793	0.0	1660.4	0
5760 min Summer	1.438	0.0	1775.1	0
7200 min Summer	1.211	0.0	1869.5	0
8640 min Summer	1.053	0.0	1951.3	0

Cascade Summary of Results for Contaminated 30.SRCX

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
10080 min Summer	117.800	0.000	13.1	0.0	O K
15 min Winter	122.486	4.686	220.0	149.2	Flood Risk
30 min Winter	122.521	4.721	220.0	187.0	Flood Risk
60 min Winter	122.493	4.693	220.0	156.6	Flood Risk
120 min Winter	122.359	4.559	220.0	71.6	O K
180 min Winter	120.288	2.488	197.4	51.7	O K
240 min Winter	120.284	2.484	188.8	51.7	O K
360 min Winter	120.250	2.450	123.5	51.6	O K
480 min Winter	120.245	2.445	113.9	51.6	O K
600 min Winter	120.235	2.435	95.7	51.6	O K
720 min Winter	120.230	2.430	86.1	51.6	O K
960 min Winter	120.217	2.417	60.2	51.6	O K
1440 min Winter	120.209	2.409	45.8	51.6	O K
2160 min Winter	118.230	0.430	28.0	21.5	O K
2880 min Winter	117.800	0.000	24.7	0.0	O K
4320 min Winter	117.800	0.000	18.1	0.0	O K
5760 min Winter	117.800	0.000	14.5	0.0	O K
7200 min Winter	117.800	0.000	12.3	0.0	O K
8640 min Winter	117.800	0.000	10.7	0.0	O K
10080 min Winter	117.800	0.000	9.5	0.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
10080 min Summer	0.936	0.0	2023.2	0
15 min Winter	100.138	0.0	359.9	23
30 min Winter	66.644	0.0	479.3	32
60 min Winter	42.476	0.0	610.9	48
120 min Winter	26.265	0.0	757.7	76
180 min Winter	19.594	0.0	846.7	104
240 min Winter	15.832	0.0	912.3	138
360 min Winter	11.728	0.0	1014.9	196
480 min Winter	9.466	0.0	1090.7	234
600 min Winter	8.011	0.0	1154.9	316
720 min Winter	6.988	0.0	1207.2	380
960 min Winter	5.628	0.0	1296.9	468
1440 min Winter	4.142	0.0	1432.9	708
2160 min Winter	3.045	0.0	1579.7	1192
2880 min Winter	2.445	0.0	1690.8	0
4320 min Winter	1.793	0.0	1859.7	0
5760 min Winter	1.438	0.0	1988.1	0
7200 min Winter	1.211	0.0	2093.9	0
8640 min Winter	1.053	0.0	2185.4	0
10080 min Winter	0.936	0.0	2266.0	0

Cascade Rainfall Details for Contaminated 30.SRCX

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	30	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	19.700	Shortest Storm (mins)	15
Ratio R	0.350	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+40

Time Area Diagram

Total Area (ha) 1.715

Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)
0	4	0.429	4	8	0.429	8	12	0.429	12	16	0.428

Time Area Diagram

Total Area (ha) 0.000

Time From:	(mins) To:	Area (ha)
0	4	0.000

Cascade Model Details for Contaminated 30.SRCX

Storage is Online Cover Level (m) 122.600

Tank or Pond Structure

Invert Level (m) 117.800

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	50.0	1.001	1.1	4.400	1.1
1.000	50.0	4.100	1.1	4.800	1860.0

Pump Outflow Control

Invert Level (m) 117.500

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	2.0000	0.900	28.0000	1.700	28.0000	2.500	28.0000
0.200	5.0000	1.000	28.0000	1.800	28.0000	2.600	28.0000
0.300	28.0000	1.100	28.0000	1.900	28.0000	2.700	28.0000
0.400	28.0000	1.200	28.0000	2.000	28.0000	2.800	220.0000
0.500	28.0000	1.300	28.0000	2.100	28.0000	2.900	220.0000
0.600	28.0000	1.400	28.0000	2.200	28.0000	3.000	220.0000
0.700	28.0000	1.500	28.0000	2.300	28.0000		
0.800	28.0000	1.600	28.0000	2.400	28.0000		

Cascade Summary of Results for Contaminated Rev 100.SRCX

Upstream Structures	Outflow To	Overflow To
(None)	Process Storage Contaminated Rev 100.SRCX	(None)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	122.523	4.723	220.0	190.5	Flood Risk
30 min Summer	122.574	4.774	220.0	262.8	Flood Risk
60 min Summer	122.567	4.767	220.0	250.6	Flood Risk
120 min Summer	122.526	4.726	220.0	193.0	Flood Risk
180 min Summer	122.463	4.663	220.0	128.4	Flood Risk
240 min Summer	122.382	4.582	220.0	79.8	O K
360 min Summer	120.502	2.702	220.0	51.9	O K
480 min Summer	120.280	2.480	182.1	51.7	O K
600 min Summer	120.269	2.469	160.0	51.7	O K
720 min Summer	120.252	2.452	128.3	51.6	O K
960 min Summer	120.239	2.439	102.4	51.6	O K
1440 min Summer	120.225	2.425	76.5	51.6	O K
2160 min Summer	120.214	2.414	55.4	51.6	O K
2880 min Summer	120.209	2.409	44.8	51.6	O K
4320 min Summer	118.105	0.305	28.0	15.3	O K
5760 min Summer	117.800	0.000	24.5	0.0	O K
7200 min Summer	117.800	0.000	20.5	0.0	O K
8640 min Summer	117.800	0.000	17.8	0.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	129.682	0.0	417.0	23
30 min Summer	87.133	0.0	559.6	32
60 min Summer	55.837	0.0	717.0	48
120 min Summer	34.509	0.0	887.8	80
180 min Summer	25.637	0.0	988.9	110
240 min Summer	20.604	0.0	1061.0	136
360 min Summer	15.169	0.0	1171.9	186
480 min Summer	12.185	0.0	1254.3	248
600 min Summer	10.272	0.0	1321.9	302
720 min Summer	8.930	0.0	1377.6	356
960 min Summer	7.152	0.0	1471.1	482
1440 min Summer	5.221	0.0	1611.4	740
2160 min Summer	3.803	0.0	1759.3	1068
2880 min Summer	3.033	0.0	1871.2	1504
4320 min Summer	2.201	0.0	2038.3	2248
5760 min Summer	1.751	0.0	2162.0	0
7200 min Summer	1.466	0.0	2263.4	0
8640 min Summer	1.270	0.0	2351.5	0

Cascade Summary of Results for Contaminated Rev 100.SRCX

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
10080 min Summer	117.800	0.000	15.7	0.0	O K
15 min Winter	122.557	4.757	220.0	235.7	Flood Risk
30 min Winter	122.600	4.800	220.0	307.4	Flood Risk
60 min Winter	122.587	4.787	220.0	284.1	Flood Risk
120 min Winter	122.510	4.710	220.0	174.3	Flood Risk
180 min Winter	122.384	4.584	220.0	80.5	O K
240 min Winter	120.292	2.492	205.1	51.7	O K
360 min Winter	120.278	2.478	178.2	51.7	O K
480 min Winter	120.255	2.455	133.1	51.6	O K
600 min Winter	120.241	2.441	107.2	51.6	O K
720 min Winter	120.235	2.435	95.7	51.6	O K
960 min Winter	120.225	2.425	75.5	51.6	O K
1440 min Winter	120.214	2.414	55.4	51.6	O K
2160 min Winter	120.210	2.410	47.7	51.6	O K
2880 min Winter	118.336	0.536	28.0	26.8	O K
4320 min Winter	117.800	0.000	22.3	0.0	O K
5760 min Winter	117.800	0.000	17.7	0.0	O K
7200 min Winter	117.800	0.000	14.8	0.0	O K
8640 min Winter	117.800	0.000	12.8	0.0	O K
10080 min Winter	117.800	0.000	11.4	0.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
10080 min Summer	1.124	0.0	2428.7	0
15 min Winter	129.682	0.0	466.6	24
30 min Winter	87.133	0.0	627.6	33
60 min Winter	55.837	0.0	805.6	50
120 min Winter	34.509	0.0	993.5	82
180 min Winter	25.637	0.0	1108.3	110
240 min Winter	20.604	0.0	1185.5	122
360 min Winter	15.169	0.0	1310.8	162
480 min Winter	12.185	0.0	1404.0	258
600 min Winter	10.272	0.0	1479.9	288
720 min Winter	8.930	0.0	1543.4	374
960 min Winter	7.152	0.0	1648.8	484
1440 min Winter	5.221	0.0	1804.8	786
2160 min Winter	3.803	0.0	1971.3	1132
2880 min Winter	3.033	0.0	2096.6	1588
4320 min Winter	2.201	0.0	2282.9	0
5760 min Winter	1.751	0.0	2421.4	0
7200 min Winter	1.466	0.0	2535.0	0
8640 min Winter	1.270	0.0	2633.7	0
10080 min Winter	1.124	0.0	2720.2	0

Cascade Rainfall Details for Contaminated Rev 100.SRCX

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	19.700	Shortest Storm (mins)	15
Ratio R	0.350	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+40

Time Area Diagram

Total Area (ha) 1.715

Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)
0	4	0.429	4	8	0.429	8	12	0.429	12	16	0.428

Time Area Diagram

Total Area (ha) 0.000

Time From:	(mins) To:	Area (ha)
0	4	0.000

Cascade Model Details for Contaminated Rev 100.SRCX

Storage is Online Cover Level (m) 122.600

Tank or Pond Structure

Invert Level (m) 117.800

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	50.0	1.001	1.1	4.400	1.1
1.000	50.0	4.100	1.1	4.800	1860.0

Pump Outflow Control

Invert Level (m) 117.500

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	2.0000	0.900	28.0000	1.700	28.0000	2.500	28.0000
0.200	5.0000	1.000	28.0000	1.800	28.0000	2.600	28.0000
0.300	28.0000	1.100	28.0000	1.900	28.0000	2.700	28.0000
0.400	28.0000	1.200	28.0000	2.000	28.0000	2.800	220.0000
0.500	28.0000	1.300	28.0000	2.100	28.0000	2.900	220.0000
0.600	28.0000	1.400	28.0000	2.200	28.0000	3.000	220.0000
0.700	28.0000	1.500	28.0000	2.300	28.0000		
0.800	28.0000	1.600	28.0000	2.400	28.0000		

Cascade Summary of Results for Process Storage Contaminated Rev 1-1.SRCX

Upstream Structures	Outflow To	Overflow To
Contaminated 1-1.SRCX	(None)	(None)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	120.178	0.428	1.0	128.5	O K
30 min Summer	120.316	0.566	1.0	169.7	O K
60 min Summer	120.485	0.735	1.0	220.4	O K
120 min Summer	120.681	0.931	1.0	279.3	O K
180 min Summer	120.816	1.066	1.0	319.9	O K
240 min Summer	120.913	1.163	1.0	348.9	O K
360 min Summer	121.054	1.304	1.0	391.1	O K
480 min Summer	121.160	1.410	1.0	423.0	O K
600 min Summer	121.243	1.493	1.0	447.9	O K
720 min Summer	121.316	1.566	1.0	469.8	O K
960 min Summer	121.427	1.677	1.0	503.1	O K
1440 min Summer	121.586	1.836	1.0	550.7	O K
2160 min Summer	121.726	1.976	1.0	592.7	O K
2880 min Summer	121.807	2.057	1.0	617.1	O K
4320 min Summer	121.876	2.126	1.0	637.7	O K
5760 min Summer	121.879	2.129	1.0	638.7	O K
7200 min Summer	121.874	2.124	1.0	637.1	O K
8640 min Summer	121.861	2.111	1.0	633.2	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	40.860	0.0	86.4	59
30 min Summer	27.161	0.0	86.4	71
60 min Summer	17.618	0.0	172.8	98
120 min Summer	11.222	0.0	172.8	146
180 min Summer	8.586	0.0	172.8	194
240 min Summer	7.095	0.0	172.8	254
360 min Summer	5.367	0.0	172.8	374
480 min Summer	4.401	0.0	172.8	492
600 min Summer	3.773	0.0	172.7	612
720 min Summer	3.327	0.0	172.7	732
960 min Summer	2.729	0.0	172.7	970
1440 min Summer	2.066	0.0	172.7	1450
2160 min Summer	1.561	0.0	345.4	2168
2880 min Summer	1.280	0.0	345.4	2884
4320 min Summer	0.969	0.0	345.3	4320
5760 min Summer	0.795	0.0	690.0	5368
7200 min Summer	0.682	0.0	682.7	6064
8640 min Summer	0.600	0.0	670.8	6840

Cascade Summary of Results for Process Storage Contaminated Rev 1-1.SRCX

	Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
10080	min Summer	121.846	2.096	1.0	628.9	O K
15	min Winter	120.229	0.479	1.0	143.7	O K
30	min Winter	120.389	0.639	1.0	191.6	O K
60	min Winter	120.573	0.823	1.0	247.0	O K
120	min Winter	120.800	1.050	1.0	314.9	O K
180	min Winter	120.943	1.193	1.0	358.0	O K
240	min Winter	121.061	1.311	1.0	393.3	O K
360	min Winter	121.221	1.471	1.0	441.2	O K
480	min Winter	121.341	1.591	1.0	477.4	O K
600	min Winter	121.444	1.694	1.0	508.2	O K
720	min Winter	121.522	1.772	1.0	531.5	O K
960	min Winter	121.656	1.906	1.0	571.9	O K
1440	min Winter	121.847	2.097	1.0	629.0	O K
2160	min Winter	122.024	2.274	1.0	682.3	O K
2880	min Winter	122.137	2.387	1.0	716.2	O K
4320	min Winter	122.262	2.512	1.0	753.5	O K
5760	min Winter	122.310	2.560	1.0	768.1	O K
7200	min Winter	122.308	2.558	1.0	767.4	O K
8640	min Winter	122.270	2.520	1.0	756.0	O K
10080	min Winter	122.233	2.483	1.0	745.0	O K

	Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
10080	min Summer	0.538	0.0	655.9	7656
15	min Winter	40.860	0.0	86.4	59
30	min Winter	27.161	0.0	86.4	72
60	min Winter	17.618	0.0	172.8	98
120	min Winter	11.222	0.0	172.7	150
180	min Winter	8.586	0.0	172.7	196
240	min Winter	7.095	0.0	172.6	250
360	min Winter	5.367	0.0	172.5	368
480	min Winter	4.401	0.0	172.5	486
600	min Winter	3.773	0.0	172.4	604
720	min Winter	3.327	0.0	172.3	722
960	min Winter	2.729	0.0	172.1	956
1440	min Winter	2.066	0.0	171.8	1428
2160	min Winter	1.561	0.0	344.0	2128
2880	min Winter	1.280	0.0	343.2	2824
4320	min Winter	0.969	0.0	341.2	4192
5760	min Winter	0.795	0.0	684.2	5528
7200	min Winter	0.682	0.0	680.7	6784
8640	min Winter	0.600	0.0	676.0	7960
10080	min Winter	0.538	0.0	667.6	8176

Cascade Rainfall Details for Process Storage Contaminated Rev 1-1.SRCX

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	1	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	19.700	Shortest Storm (mins)	15
Ratio R	0.350	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+40

Time Area Diagram

Total Area (ha) 0.000

Time (mins) From:	To:	Area (ha)
0	4	0.000

Time Area Diagram

Total Area (ha) 0.000

Time (mins) From:	To:	Area (ha)
0	4	0.000

Cascade Model Details for Process Storage Contaminated Rev 1-1.SRCX

Storage is Online Cover Level (m) 127.750

Tank or Pond Structure

Invert Level (m) 119.750

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	300.0	8.000	300.0

Pump Outflow Control

Invert Level (m) 119.500

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	1.0000	0.900	1.0000	1.700	1.0000	2.500	1.0000
0.200	1.0000	1.000	1.0000	1.800	1.0000	2.600	1.0000
0.300	1.0000	1.100	1.0000	1.900	1.0000	2.700	1.0000
0.400	1.0000	1.200	1.0000	2.000	1.0000	2.800	1.0000
0.500	1.0000	1.300	1.0000	2.100	1.0000	2.900	1.0000
0.600	1.0000	1.400	1.0000	2.200	1.0000	3.000	1.0000
0.700	1.0000	1.500	1.0000	2.300	1.0000		
0.800	1.0000	1.600	1.0000	2.400	1.0000		

Cascade Summary of Results for Process Storage Contaminated Rev 30.SRCX

Upstream Structures	Outflow To	Overflow To
Contaminated 30.SRCX	(None)	(None)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	120.811	1.061	1.0	318.4	O K
30 min Summer	121.163	1.413	1.0	424.0	O K
60 min Summer	121.546	1.796	1.0	538.7	O K
120 min Summer	121.968	2.218	1.0	665.3	O K
180 min Summer	122.222	2.472	1.0	741.5	O K
240 min Summer	122.412	2.662	1.0	798.5	O K
360 min Summer	122.692	2.942	1.0	882.7	O K
480 min Summer	122.896	3.146	1.0	943.9	O K
600 min Summer	123.065	3.315	1.0	994.4	O K
720 min Summer	123.197	3.447	1.0	1034.0	O K
960 min Summer	123.416	3.666	1.0	1099.8	O K
1440 min Summer	123.724	3.974	1.0	1192.1	O K
2160 min Summer	124.019	4.269	1.0	1280.6	O K
2880 min Summer	124.205	4.455	1.0	1336.4	O K
4320 min Summer	124.419	4.669	1.0	1400.8	O K
5760 min Summer	124.514	4.764	1.0	1429.1	O K
7200 min Summer	124.541	4.791	1.0	1437.3	O K
8640 min Summer	124.526	4.776	1.0	1432.7	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	100.138	0.0	86.4	59
30 min Summer	66.644	0.0	86.4	73
60 min Summer	42.476	0.0	172.8	102
120 min Summer	26.265	0.0	172.8	160
180 min Summer	19.594	0.0	172.8	216
240 min Summer	15.832	0.0	172.8	268
360 min Summer	11.728	0.0	172.8	374
480 min Summer	9.466	0.0	172.8	494
600 min Summer	8.011	0.0	172.8	614
720 min Summer	6.988	0.0	172.8	734
960 min Summer	5.628	0.0	172.8	974
1440 min Summer	4.142	0.0	172.8	1452
2160 min Summer	3.045	0.0	345.6	2172
2880 min Summer	2.445	0.0	345.5	2892
4320 min Summer	1.793	0.0	345.5	4328
5760 min Summer	1.438	0.0	691.1	5768
7200 min Summer	1.211	0.0	691.1	7208
8640 min Summer	1.053	0.0	691.0	8640

Cascade Summary of Results for Process Storage Contaminated Rev 30.SRCX

	Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
10080	min Summer	124.478	4.728	1.0	1418.3	O K
15	min Winter	120.937	1.187	1.0	356.2	O K
30	min Winter	121.332	1.582	1.0	474.7	O K
60	min Winter	121.767	2.017	1.0	605.1	O K
120	min Winter	122.244	2.494	1.0	748.2	O K
180	min Winter	122.530	2.780	1.0	833.9	O K
240	min Winter	122.737	2.987	1.0	896.2	O K
360	min Winter	123.059	3.309	1.0	992.7	O K
480	min Winter	123.288	3.538	1.0	1061.5	O K
600	min Winter	123.479	3.729	1.0	1118.6	O K
720	min Winter	123.629	3.879	1.0	1163.8	O K
960	min Winter	123.881	4.131	1.0	1239.4	O K
1440	min Winter	124.240	4.490	1.0	1347.0	O K
2160	min Winter	124.588	4.838	1.0	1451.3	O K
2880	min Winter	124.817	5.067	1.0	1520.1	O K
4320	min Winter	125.099	5.349	1.0	1604.8	O K
5760	min Winter	125.249	5.499	1.0	1649.7	O K
7200	min Winter	125.325	5.575	1.0	1672.4	O K
8640	min Winter	125.357	5.607	1.0	1682.0	O K
10080	min Winter	125.353	5.603	1.0	1680.8	O K

	Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
10080	min Summer	0.936	0.0	691.0	10080
15	min Winter	100.138	0.0	86.4	62
30	min Winter	66.644	0.0	86.4	76
60	min Winter	42.476	0.0	172.8	98
120	min Winter	26.265	0.0	172.8	160
180	min Winter	19.594	0.0	172.7	216
240	min Winter	15.832	0.0	172.7	272
360	min Winter	11.728	0.0	172.6	372
480	min Winter	9.466	0.0	172.6	490
600	min Winter	8.011	0.0	172.5	608
720	min Winter	6.988	0.0	172.5	726
960	min Winter	5.628	0.0	172.4	964
1440	min Winter	4.142	0.0	172.1	1436
2160	min Winter	3.045	0.0	344.6	2148
2880	min Winter	2.445	0.0	344.2	2856
4320	min Winter	1.793	0.0	343.1	4248
5760	min Winter	1.438	0.0	687.3	5648
7200	min Winter	1.211	0.0	685.7	7056
8640	min Winter	1.053	0.0	683.5	8392
10080	min Winter	0.936	0.0	681.2	9776

Cascade Rainfall Details for Process Storage Contaminated Rev 30.SRCX

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	30	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	19.700	Shortest Storm (mins)	15
Ratio R	0.350	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+40

Time Area Diagram

Total Area (ha) 0.000

Time (mins) From:	To:	Area (ha)
0	4	0.000

Time Area Diagram

Total Area (ha) 0.000

Time (mins) From:	To:	Area (ha)
0	4	0.000

Cascade Model Details for Process Storage Contaminated Rev 30.SRCX

Storage is Online Cover Level (m) 127.750

Tank or Pond Structure

Invert Level (m) 119.750

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	300.0	8.000	300.0

Pump Outflow Control

Invert Level (m) 119.500

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	1.0000	0.900	1.0000	1.700	1.0000	2.500	1.0000
0.200	1.0000	1.000	1.0000	1.800	1.0000	2.600	1.0000
0.300	1.0000	1.100	1.0000	1.900	1.0000	2.700	1.0000
0.400	1.0000	1.200	1.0000	2.000	1.0000	2.800	1.0000
0.500	1.0000	1.300	1.0000	2.100	1.0000	2.900	1.0000
0.600	1.0000	1.400	1.0000	2.200	1.0000	3.000	1.0000
0.700	1.0000	1.500	1.0000	2.300	1.0000		
0.800	1.0000	1.600	1.0000	2.400	1.0000		

Cascade Summary of Results for Process Storage Contaminated Rev 100.SRCX

Upstream Structures	Outflow To	Overflow To
Contaminated Rev 100.SRCX	(None)	(None)

Outflow is too low. Design is unsatisfactory.

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	121.127	1.377	1.0	413.1	O K
30 min Summer	121.599	1.849	1.0	554.7	O K
60 min Summer	122.120	2.370	1.0	710.9	O K
120 min Summer	122.677	2.927	1.0	878.1	O K
180 min Summer	123.002	3.252	1.0	975.7	O K
240 min Summer	123.231	3.481	1.0	1044.4	O K
360 min Summer	123.580	3.830	1.0	1149.1	O K
480 min Summer	123.832	4.082	1.0	1224.6	O K
600 min Summer	124.033	4.283	1.0	1285.0	O K
720 min Summer	124.195	4.445	1.0	1333.5	O K
960 min Summer	124.459	4.709	1.0	1412.7	O K
1440 min Summer	124.831	5.081	1.0	1524.2	O K
2160 min Summer	125.180	5.430	1.0	1629.0	O K
2880 min Summer	125.409	5.659	1.0	1697.7	O K
4320 min Summer	125.678	5.928	1.0	1778.5	O K
5760 min Summer	125.803	6.053	1.0	1815.9	O K
7200 min Summer	125.853	6.103	1.0	1831.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	129.682	0.0	86.4	65
30 min Summer	87.133	0.0	86.4	82
60 min Summer	55.837	0.0	172.8	102
120 min Summer	34.509	0.0	172.8	162
180 min Summer	25.637	0.0	172.8	220
240 min Summer	20.604	0.0	172.8	278
360 min Summer	15.169	0.0	172.8	380
480 min Summer	12.185	0.0	172.8	494
600 min Summer	10.272	0.0	172.8	614
720 min Summer	8.930	0.0	172.8	734
960 min Summer	7.152	0.0	172.8	974
1440 min Summer	5.221	0.0	172.8	1454
2160 min Summer	3.803	0.0	345.6	2172
2880 min Summer	3.033	0.0	345.6	2892
4320 min Summer	2.201	0.0	345.5	4328
5760 min Summer	1.751	0.0	691.2	5768
7200 min Summer	1.466	0.0	691.1	7208

Cascade Summary of Results for Process Storage Contaminated Rev 100.SRCX

	Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
8640	min Summer	125.859	6.109	1.0	1832.8	O K
10080	min Summer	125.829	6.079	1.0	1823.6	O K
15	min Winter	121.292	1.542	1.0	462.6	O K
30	min Winter	121.825	2.075	1.0	622.4	O K
60	min Winter	122.414	2.664	1.0	799.2	O K
120	min Winter	123.030	3.280	1.0	983.9	O K
180	min Winter	123.401	3.651	1.0	1095.4	O K
240	min Winter	123.647	3.897	1.0	1169.2	O K
360	min Winter	124.043	4.293	1.0	1287.8	O K
480	min Winter	124.332	4.582	1.0	1374.7	O K
600	min Winter	124.562	4.812	1.0	1443.5	O K
720	min Winter	124.750	5.000	1.0	1499.9	O K
960	min Winter	125.054	5.304	1.0	1591.1	O K
1440	min Winter	125.479	5.729	1.0	1718.7	O K
2160	min Winter	125.892	6.142	1.0	1842.6	O K
2880	min Winter	126.169	6.419	1.0	1925.6	O K
4320	min Winter	126.507	6.757	1.0	2027.2	O K
5760	min Winter	126.689	6.939	1.0	2081.7	O K
7200	min Winter	126.790	7.040	1.0	2112.0	O K
8640	min Winter	126.842	7.092	1.0	2127.5	O K
10080	min Winter	126.855	7.105	1.0	2131.5	O K

	Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
8640	min Summer	1.270	0.0	691.1	8648
10080	min Summer	1.124	0.0	691.0	10080
15	min Winter	129.682	0.0	86.4	68
30	min Winter	87.133	0.0	86.4	88
60	min Winter	55.837	0.0	172.8	108
120	min Winter	34.509	0.0	172.8	160
180	min Winter	25.637	0.0	172.7	218
240	min Winter	20.604	0.0	172.7	274
360	min Winter	15.169	0.0	172.7	386
480	min Winter	12.185	0.0	172.6	490
600	min Winter	10.272	0.0	172.6	608
720	min Winter	8.930	0.0	172.5	728
960	min Winter	7.152	0.0	172.4	964
1440	min Winter	5.221	0.0	172.2	1440
2160	min Winter	3.803	0.0	344.8	2148
2880	min Winter	3.033	0.0	344.3	2860
4320	min Winter	2.201	0.0	343.5	4280
5760	min Winter	1.751	0.0	688.0	5656
7200	min Winter	1.466	0.0	686.5	7064
8640	min Winter	1.270	0.0	684.9	8464
10080	min Winter	1.124	0.0	682.9	9792

Cascade Rainfall Details for Process Storage Contaminated Rev 100.SRCX

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	19.700	Shortest Storm (mins)	15
Ratio R	0.350	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+40

Time Area Diagram

Total Area (ha) 0.000

Time (mins) From:	To:	Area (ha)
0	4	0.000

Time Area Diagram

Total Area (ha) 0.000

Time (mins) From:	To:	Area (ha)
0	4	0.000

Cascade Model Details for Process Storage Contaminated Rev 100.SRCX

Storage is Online Cover Level (m) 127.750

Tank or Pond Structure

Invert Level (m) 119.750

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	300.0	8.000	300.0

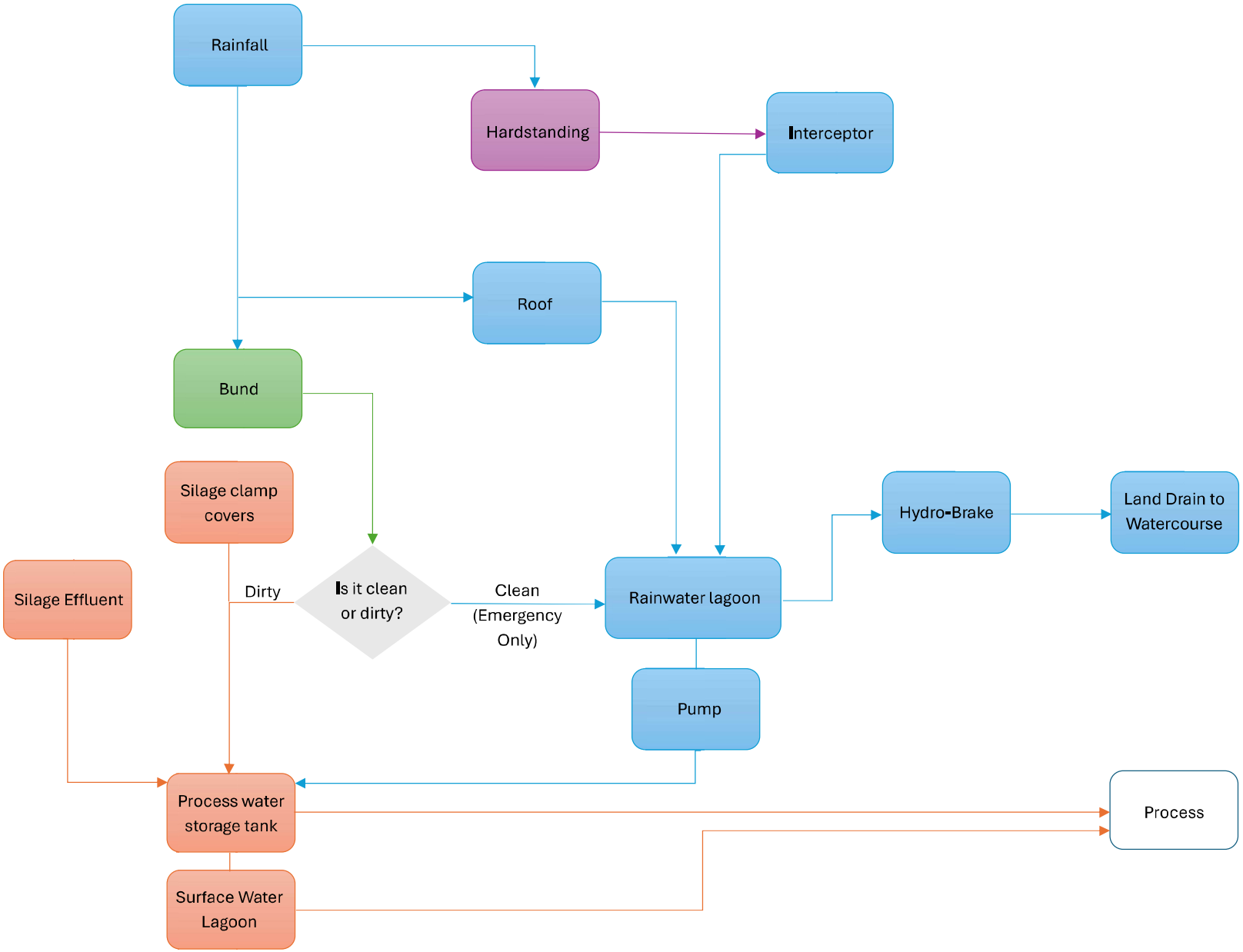
Pump Outflow Control

Invert Level (m) 119.500

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	1.0000	0.900	1.0000	1.700	1.0000	2.500	1.0000
0.200	1.0000	1.000	1.0000	1.800	1.0000	2.600	1.0000
0.300	1.0000	1.100	1.0000	1.900	1.0000	2.700	1.0000
0.400	1.0000	1.200	1.0000	2.000	1.0000	2.800	1.0000
0.500	1.0000	1.300	1.0000	2.100	1.0000	2.900	1.0000
0.600	1.0000	1.400	1.0000	2.200	1.0000	3.000	1.0000
0.700	1.0000	1.500	1.0000	2.300	1.0000		
0.800	1.0000	1.600	1.0000	2.400	1.0000		

APPENDIX X

Rainfall & Process Water Flow Diagram


Rainfall
Hardstanding
Interceptor
Roof
Bund
Silage clamp covers
Silage Effluent
Dirty
Is it clean or dirty?
Clean (Emergency Only)
Rainwater lagoon
Hydro-Brake
Land Drain to Watercourse
Pump
Process water storage tank
Process
Surface Water Lagoon

APPENDIX XI

Hydro – Brake Manufacturers Details

Technical Specification

Control Point	Head (m)	Flow (l/s)
Primary Design	2.000	32.800
Flush-Flo™	0.594	32.684
Kick-Flo®	1.281	26.437
Mean Flow		28.345

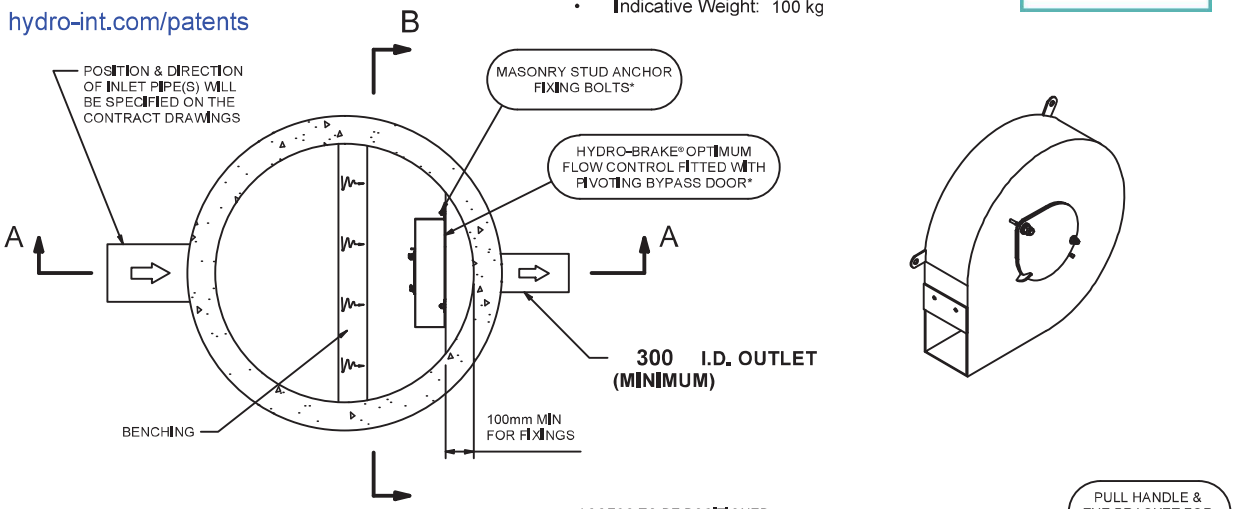
hydro-int.com/patents

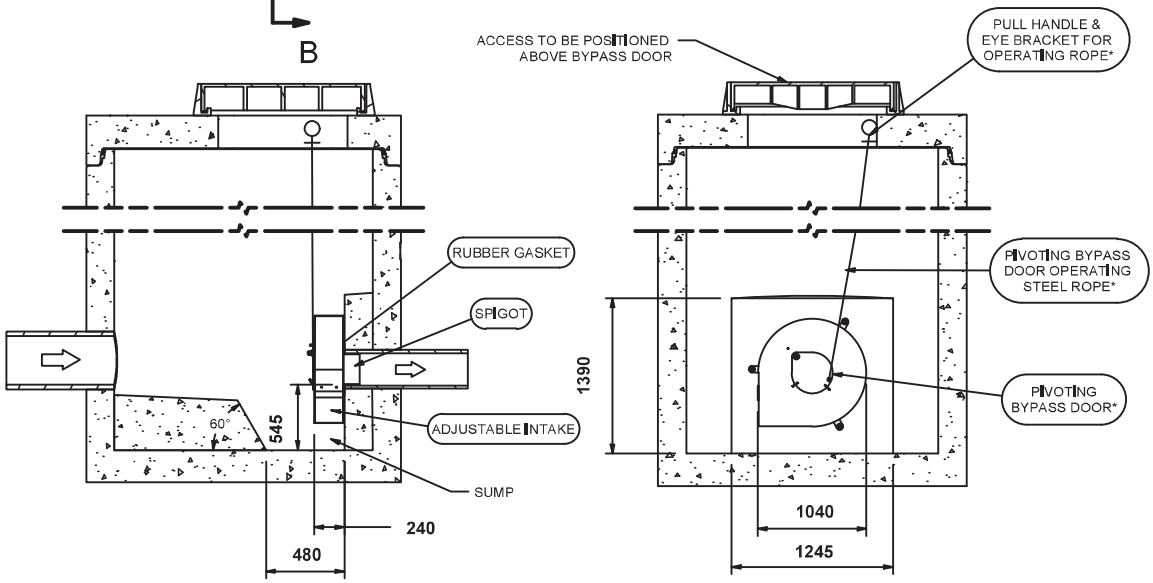
Hydro-Brake® Optimum Flow Control including:

- 5 mm grade 304L stainless steel
- Integral stainless steel pivoting by-pass door allowing clear line of sight through to outlet, c/w stainless steel operating rope
- Beed blasted finish to maximise corrosion resistance
- Stainless steel fixings
- Rubber gasket to seal outlet
- Variable flow rate post installation via adjustable inlet
- Indicative Weight: 100 kg

BBA APPROVAL INSPECTION TESTING CERTIFICATION CERTIFICATE 08/4596

wrc approved PT/503/0422





SECTION A-A

SECTION B-B

IMPORTANT: ⬭ LIMIT OF HYDRO INTERNATIONAL SUPPLY
THE DEVICE WILL BE HANDED TO SUIT SITE CONDITIONS
FOR SITE SPECIFIC DETAILS AND MINIMUM CHAMBER SIZE REFER TO HYDRO INTERNATIONAL
ALL CIVIL AND INSTALLATION WORK BY OTHERS
* WHERE SUPPLIED
HYDRO-BRAKE® FLOW CONTROL & HYDRO-BRAKE® OPTIMUM FLOW CONTROL ARE REGISTERED TRADEMARKS FOR FLOW CONTROLS DESIGNED AND MANUFACTURED EXCLUSIVELY BY HYDRO INTERNATIONAL

THIS DESIGN LAYOUT IS FOR ILLUSTRATIVE PURPOSES ONLY. NOT TO SCALE.

DESIGN ADVICE

The head/flow characteristics of this SHE-0232-3280-2000-3280 Hydro-Brake® Optimum Flow Control are unique. Dynamic hydraulic modelling evaluates the full head/flow characteristic curve.
The use of any other flow control will invalidate any design based on this data and could constitute a flood risk.

Hydro International
A CRH COMPANY

DATE	07/05/2024 09:49
SITE	Horse Close
DESIGNER	Jensen Hattersley
REF	MD-SHE-0104-5000-1100-5000

SHE-0232-3280-2000-3280
Hydro-Brake® Optimum

Hydro International Ltd • Unit 2, Rivermead Court • Kenn Business Park • Windmill Road • Kenn • Clevedon • BS21 6FT • Tel: 01275 878371 • www.hydro-int.com • Email: enquiries@hydro-int.com

jensenhattersley@ggpconsult.co.uk

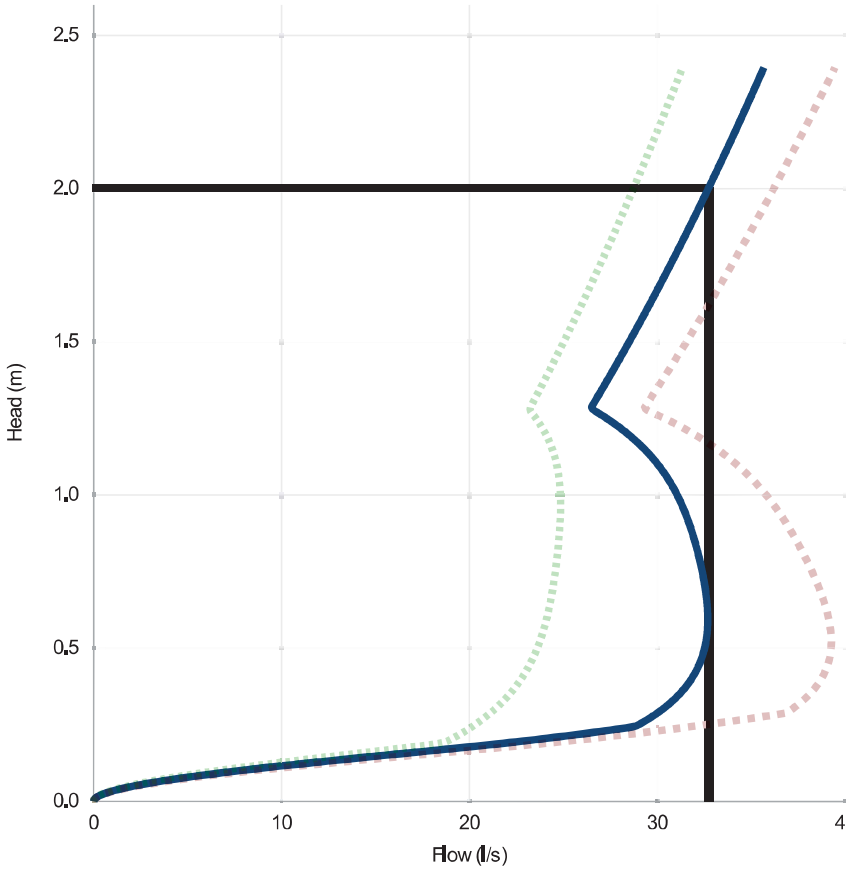
Technical Specification

	Original Setting		Minimum Setting		Maximum Setting	
Control Point	Head (m)	Flow (l/s)	Head (m)	Flow (l/s)	Head (m)	Flow (l/s)
Primary Design	2.000	32.800	2.000	28.731	2.000	36.194
Flush-Flo™	0.594	32.684	0.968	24.850	0.522	39.262
Kick-Flo®	1.281	26.437	1.276	23.157	1.280	29.258
Mean Flow		28.345		22.980		32.475

BBA APPROVAL INSPECTION TESTING CERTIFICATION
CERTIFICATE No 08/4596

wrc approved
PT/503/0422

hydro-int.com/patents



Head (m)	Flow (l/s)
0.000	0.000
0.069	3.883
0.138	13.440
0.207	24.235
0.276	29.698
0.345	31.095
0.414	31.959
0.483	32.443
0.552	32.654
0.621	32.674
0.690	32.563
0.759	32.362
0.828	32.093
0.897	31.754
0.966	31.322
1.034	30.753
1.103	29.983
1.172	28.933
1.241	27.514
1.310	26.722
1.379	27.385
1.448	28.030
1.517	28.661
1.586	29.276
1.655	29.879
1.724	30.468
1.793	31.046
1.862	31.612
1.931	32.168
2.000	32.714

DESIGN ADVICE

The head/flow characteristics of this SHE-0232-3280-2000-3280 Hydro-Brake® Optimum Flow Control are unique. Dynamic hydraulic modelling evaluates the full head/flow characteristic curve.

! **The use of any other flow control will invalidate any design based on this data and could constitute a flood risk.**

Hydro International
A CRH COMPANY

DATE	07/05/2024 09:49
Site	Horse Close
DESIGNER	Jensen Hattersley
Ref	MD-SHE-0104-5000-1100-5000

SHE-0232-3280-2000-3280

Hydro-Brake® Optimum

Hydro-Brake® Optimum

The Hydro-Brake® Optimum is Hydro International's flagship passive flow control device and the most advanced vortex flow control available.

Hydro-Brake® Optimum is the only vortex flow control for which the head and discharge relationship can be fine-tuned to optimise your design. Designers can size a Hydro-Brake® Optimum to achieve the perfect hydraulic performance curve and engineer the best possible passive flow control performance.

Surface water management and SuDS

Combined drainage systems and CSOs

Watercourse flood prevention

Sewer network optimisation

Wastewater treatment plants

- ✓ No external energy source.
- ✓ No moving parts.
- ✓ Future-proof.
- ✓ Large outlet clearances prevent blockages.

There is No Equivalent

Hydro-Brake® Optimum dispenses with the need to choose from a range of sizes and types and instead offers built-in flexibility to size each unit for absolute fit. Each Hydro-Brake® Optimum is individually-sized, so you achieve performance without compromise for every project.

Maximise Storage Savings

The increased hydraulic efficiency of the Hydro-Brake® Optimum means you can reduce on-site storage by up to 15% than if an alternative vortex control is used. With reduced storage, you can lower construction and excavation costs as well as saving project time and overall land-use.

Best Value for Every Project

Selecting the superior performance of Hydro-Brake® Optimum does not mean a higher cost for your project. On the contrary, because your upstream storage can be fine-tuned to achieve the smallest volumes, construction, excavation and material costs are reduced.

Easy to Install

Hydro-Brake® Optimum comes with a range of installation options and accessories to make construction and installation as simple as possible.

Setting the Standard

The Hydro-Brake® Optimum is the culmination of more than 40 years of research and development by Hydro International, and the company continues to take an international lead in vortex technology and expertise. Hydro-Brake® Optimum is the only vortex flow control to be independently certified by BBA and WRc for the control of stormwater or combined flows.

Minimal Maintenance

With up to 20% larger outlet clearances compared to other vortex devices, there is significantly less risk of blockage with a Hydro-Brake® Optimum. With no power source or moving parts, it offers minimal, predictable maintenance.

Future-Proofed

Hydro-Brake® Optimum can be supplied with an adjustable inlet so flows can be altered by up to 40% post-installation, to allow for future changes in operating conditions, for example as a result of site expansion or climate change.

Flow Control Chamber

A Hydro-Brake® Optimum flow control can be supplied prefitted in a precast reinforced concrete chamber. Custom options including high level emergency bypass, rodding pipe and removable units are also available.

Case Studies

Tight Fit for New Homes

Engineers challenged to solve a "tight fit" surface water management challenge on a West Yorkshire housing development used the Hydro-Brake® Optimum Design Tool to calculate a solution that optimised the limited pipe storage area. Using conventional flow control devices would have required more back up storage than would fit in the space available, but by using Hydro-Brake® Optimum flood protection measures, challenging discharge limits were met for a 1 in 100 year storm.

'Optimum' Savings for Developer with 21st Century Drainage

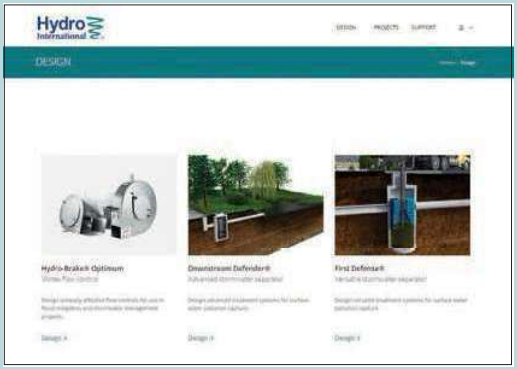
The first phase of Edinburgh City Council's 21st Century Homes project, the Gracemount development showcases sustainable construction. A major feature of the drainage solution is Hydro International's high performance Hydro-Brake Optimum® to control surface water which saved the developers over 30% in storage construction costs.

Photo courtesy of Edinburgh City Council

Hydro-Brake® Optimum Selection Criteria

Suitability:	Most sites, from very low to very high flow rates		
Flow Range (l/s)	Head Range (m)	Ability to match greenfield discharge rate	On-site water storage requirement
0.7 – 550 *	0.4 – 4.0	Very good	Low
Moving Parts?	External Power?	Risk of blockage?	
No	No	Very low	

* lower flows may be possible (contact Hydro International to discuss)



Explore the Options with our Online Design Tool

Our online design tool is a sizing engine that gives you the flexibility to compare flow control design options, output detailed design drawings and hydraulic data and import the results into commercially-available hydraulic modelling software.

The tool also has the added options to size and design the First Defense® and Downstream Defender® stormwater treatment separators.

hydro-int.design

Hydro-Brake® Hotline: 01275 337937
hydrobrake@hydro-int.com

APPENDIX XII

Draft Maintenance Schedule

DRAINAGE INSPECTION & MAINTENANCE PLAN

FOR

PROPOSED ANAEROBIC DIGESTION PLANT

AT

HORSECLOSE

ON BEHALF OF

Project ref:	**GGP-29384-CD-I&MP-HorseClose**
Date First Issued:	**13th May 2024**
Issue:	**01**
Revision Date:	**N/A**
Prepared by:	**Will Brown** HND
Checked by:	**J. Collins** BSc. (Hons), MCIWEM.

GGP Consult
2 Hallam Road
Priory Park East
Hull
HU4 7DY
United Kingdom

Tel: +44 (0) 1482 627963
Fax: +44 (0) 1482 641736
Email: jeremycollins@ggpconsult.co.uk
Website: www.ggpconsult.co.uk

CONTENTS

APPENDICES

Document Revision Box			
Revision	Date	Description	Author
01	13th May 2024	First issued	JHC

Section 1.0 - Introduction

The following management and maintenance plan has been prepared by GGP Consult on behalf of Horse Close Green Power Ltd AD Plant.
Horse Close Green Power Ltd will remain under ownership of the development, and consequently, will be responsible for the ongoing upkeep and maintenance of the site, including drainage and SuDS systems.

Horse Close Green Power Ltd should undertake all required inspections & ongoing maintenance in accordance with the recommended within this document.
During the life of the development, additional inspections / maintenance requirements shall be appended to this document.
Where defects have been encountered, relevant maintenance should be undertaken in accordance with the maintenance schedule, additionally an appropriately qualified engineer should be consulted to determine an appropriate solution.
A CCTV survey of the entire external drainage system is to be undertaken on a 5 year basis to check for defects not visible from ground level.

Section 2.0 - Maintenance and Periodic Inspection of Drainage Systems

2.1 General

The drainage systems at Horse close AD Plant comprise of separate foul water, Clean surface water & Potential Contaminated surface water systems.

Three primary drainage systems can be found on site; clean and dirty surface water and foul water.

Dirty Water runoff, caused by silage residue, from the silage clamps and sections of hardstanding area will be collected through a series of drainage channels, pipes, and chambers and be brought into a below ground holding pumping chamber.

From this pumping chamber, runoff will be pumped to 3nr 400m³ holding tanks within the bund where it will be reused within the process.

The process has a yearly demand of 30,000m³, equating to 1l/s continuous flow. This offers a sustainable drainage system, compliant with the hierarchy.

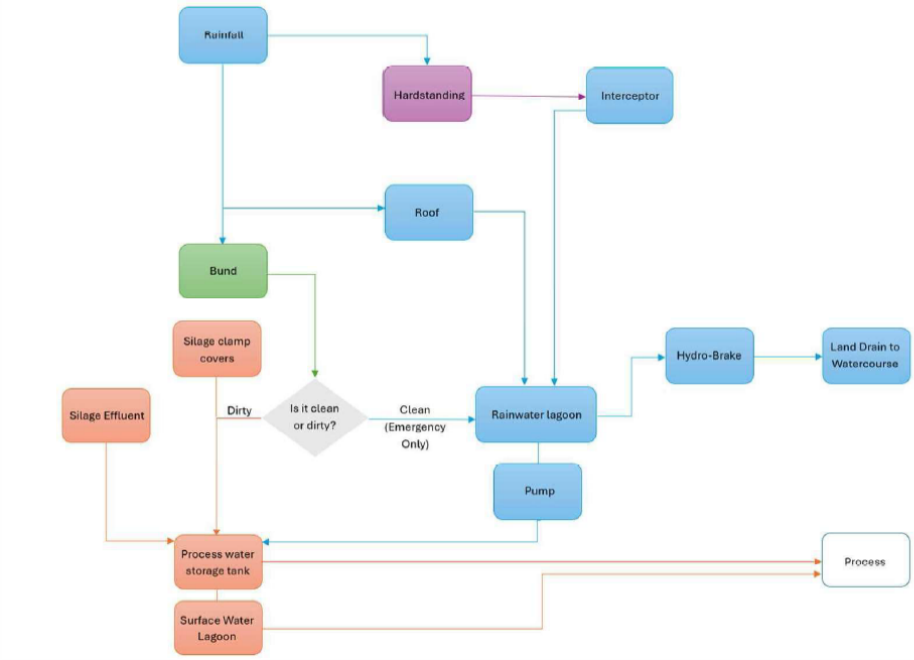
Clean runoff will be collected from buildings and sections of hardstanding and discharged into an open lagoon in the north west corner before out falling into an existing watercourse to the north west corner via a flow control.

Petrochemicals may be present within the clean hardstanding runoff, which will be mitigated through a full retention petrol interceptor.

Bund runoff has the potential to become contaminated through process residue. This will be collected through a channel drain and discharged into a pump chamber where it will be sampled and pumped to the open lagoon (if clean) or reused in the process (if contaminated).

Foul water from the site welfare shall be collected into a cesspit and emptied. High alarm shall be linked to the sites SCADA providing continuous monitoring.

To illustrate the principals adopted, the below rainfall / process flow diagram has been provided.



All drainage systems should be inspected at regular intervals and, where necessary, be cleaned and repaired to ensure system performance is maintained.

This document has been prepared as a guide to include recommendations on the type and frequency of inspection and cleaning.

However local factors may influence the ongoing maintenance. Any additional requirement should be appended to this document.

2.2 Inspection and Cleaning of Piped Drainage Systems

Inspection chambers, gullies and channels should be fully inspected regularly, not less than annually, by removing covers and checking for obstructions, silt, damage.

The following should be carried out during the periodic inspection.

- Covers of inspection chambers and manholes should be removed and the sides, benching and channels cleaned.
- Main and branch drains should be cleaned and afterwards should be flushed with clean water. Any obstructions found should be removed and not flushed into the system.
- Accumulated deposits in gullies and channels should be removed and traps plunged and flushed out with clean water.
- Covers of inspection chambers and gullies should be replaced, bedded in suitable grease or other sealing material and/or bolted down as appropriate. Missing bolts and broken items should be renewed.

To clear blockages, silt or debris, the drainage system should be cleaned, as appropriate, using one or more of the following methods:

- Rodding
- Jetting

2.3 Rodding

To avoid damage to pipework and it is important that correctly designed propriety ends are used on rods. Makeshift devices attached to the ends of rods are not effective and can become detached in the pipeline. If the rods have brass ferrules, they should be checked to ensure that their fastenings are secure and that there are no protruding shoulders or fastenings, as these can cause damage to drain lines, especially when entering through rodding eyes.

2.4 Jetting

High pressure jetting techniques are suitable for use with all currently available pipe materials and should also be considered. Jetting to clear blockages should be carried out by a specialist contractor.

Section 3.0 - Maintenance of Pump Stations

Failure of pumps can be very serious. During a failure, runoff from the silage clamp / hardstanding areas will begin to backup and cause above ground flooding. While this is not necessary a serious issue given the site is designed to hold runoff and prevent it from leaving the site.
Cross contamination could occur from vehicle movements around site / through any above ground runoff.

The operator should assess the situation and consider isolating any downstream clean water system if there is potential of cross contamination.
.
It is therefore vital that the pumps are regularly inspected and maintained in accordance with the manufacturers' recommendations.

It is strongly recommended that all pumps are linked to the site SCADA to provide automated fault alerts ensuring any faults are detected allowing them to be fixed promptly.

Section 4.0 - Inspection and Maintenance of the Sustainable Urban Drainage Systems (SUDS)

Surface water from the development is drained through a series of pipes, manholes, gullies, channels and Sustainable Urban Drainage System (SUDS) structures. SUDS systems comprise of various components that are designed to;

- Reduce flooding
- Improve runoff water quality
- Create a better environment

The SUDS components used at Horse Close AD Plant are listed below,

- Filter Drains – (Process Equipment)
- Detention Basins – (Rainwater Lagoon)
- Petrol Interceptors

The maintenance recommendations on the following pages are general and should be in addition to the manufacturer's recommendations of specialist equipment such as vortex flow control devices.

All open headwalls and orifice flow control devices and their chambers should be inspected monthly and cleared of any silt or debris.

TABLE 32.1 **Typical key SuDS components operation and maintenance activities (for full specifications, see Chapters 11–23)**

Operation and maintenance activity	SuDS component												
	Pond	Wetland	Detention basin	Infiltration basin	Soakaway	Infiltration trench	Filter drain	Modular storage	Pervious pavement	Swale/bioretention/ trees	Filter strip	Green roofs	Proprietary treatment systems
Regular maintenance													
Inspection	■	■	■	■	■	■	■	■	■	■	■	■	■
Litter and debris removal	■	■	■	■	□	■	■	□	■	■	■		□
Grass cutting	■	■	■	■	□	■	■	□	□	■	■		
Weed and invasive plant control	□	□	□	□		□	□		□		□	■	
Shrub management (including pruning)	□	□	□	□					□	□	□		
Shoreline vegetation management	■	■	□										
Aquatic vegetation management	■	■	□										
Occasional maintenance													
Sediment management[1]	■	■	■	■	■	■	■	■	■	■	■		■
Vegetation replacement	□	□	□	□						□	□	■	
Vacuum sweeping and brushing									■				
Remedial maintenance													
Structure rehabilitation /repair	□	□	□	□	□	□	□	□	□	□	□	□	
Infiltration surface reconditioning				□	□	□	□		□	□	□		

Key

■ will be required

□ may be required

Notes

1 Sediment should be collected and managed in pre-treatment systems, upstream of the main device.

Written by:-

W.Brown

Project Civil Engineer

Checked by:-

J. H. Collins BSc. (Hons), MCIWEM

Associate Director
Drainage & Infrastructure

Section 5.0

Maintenance Schedule

Item	Defect Check	Maintenace Regime	Maintenance Frequency	Additional Comments
Flow Check	Surface water ponding	Inspection shall cover, - Grates and Frames - Gully Pots - Gully leads	Weekly during rainfall events After filling of silage clamps	Where persistence issues occur, it is recommended a CCTV survey is undertaken of the affected system. (Refer to pipework for requirements)
Manhole Covers	Broken lids.	- Lift gratings and lids, check hinges and fitment.	Quarterly	
Manhole	Blockages, surcharging.	- Check integrity of metal frame and replace as necessary. - Remove items of debris - Vac out remaining silt and debris - Jet gully pots, leads and channels.	Quarterly	
Drainage Channel	Blockages, surcharges, broken grates		Quarterly After filling of silage clamps	
Inspection Chamber	Blockages, surcharging.		Quarterly	
Silt traps/ catchpits	Blockages, slit build up		Quarterly After filling of silage clamps	
Pipework	Surcharging, Blockages, Cracking	Inspection shall cover, - CCTV - Blockages - Rodding - Cracks / displaced pipes - Pressure testing - Removal of silt / debris - Repairs / replacements	5 years As required As Required 5 years Annually As Required Or when defect is remains after rainfall events	CCTV footage should be review by competent person to assess any defects found and provide recommendation on remediation inline with the site permit and operating conditions.
Guttering	Blockages overtopping	Inspection shall cover - Cleaning and removal of debris	Quarterly & seasonally	Consider local factors i.e. leaves from trees during spring, autumn. Also dust during harvester and or dry periods.
Access road	Surface damage, standing water, rutting	Inspection shall cover, - Walk over survey with pictures. - Sweeping / pressure washing - Monitoring of any breaking / surface crumbling - Repairs / Replacements	When damaged. Quarterly Quarterly (As Required) Quarterly (As Required) As Required Surfacing to be patched to original specification.	Ongoing issues to be check with appropriately qualified engineer
Detention Basin	Standing water on site	Inspection should cover, - Litter, debris and trash removal. - Landscaping – Grass cutting to upper embankments. - Removal of silt built up in the base. - Repair, clear replace inlets / outlet structures. - Inspection inlet/outlet and downstream catchpits for blockages and clear if required.	Monthly Seasonally As Required As Required Monthly	

		- Inspect liner for rips / tears and repair.	Bi Monthly & Large Storms	
Hydro-Brake	Low flow, no flow & high flow	Inspection should cover, - Chamber - Flow Control Unit - Penstock Bypass - Remove all debris from chamber. - Jet channel and benching - Inspect unit for damage - Check operation of bypass penstock	During & after large rainfall events Monthly Quarterly Monthly Quarterly	Please refer to manufacturer's guidance document within appendix II.
Inlets & Outlets (Headwalls)	Low, no, or high flow. Scouring occurring between inline / outlet of structure	Inspection should cover, - Headwall structures - Grates / Trash screen - Inspect inlets outlets for blockages and clear as required - Inspect structural integrity of head wall - Check integrity of metal work and replace as necessary - Replace surface level of aggregates where part of riprap when build up of debris is seen to be affecting performance	 Monthly Annually Annually 5 – 7 years or as required	Ongoing issues or areas of concerns shall be check with appropriately qualified engineer
Filter Drain	Surcharging, ponding of water	Inspection should cover, - Access chambers - Perforated pipes - Inlet / outlets - Surface granular material - Removal of litter and debris to surface - Inspection inlet & outlets for debris and removal of silt - Remove surface geotextile and replace, and wash or replace overlaying filter medium - Clear performed pipes	 Weekly Quarterly 5 years or as required As required (See Note 1)	<u>Note 1</u> CCTV survey to be carried out in line with pipework recommendations.
Penstocks	Difficult to open and close. No, low or high flow upstream	Inspections should cover, - Chamber - Handle - Penstock - Remove all debris from chamber - Clean penstock seat to ensure correct closing seal - Check handle fitment and ensure located near to penstock - Inspect for damage - Check operation of penstock - Repair / replacement	 Monthly Monthly Monthly Monthly Monthly As Required	
Petrol Interceptors		Inspections should cover, - Access chambers - Oil levels - Silt level / capacity - Downstream outfall - Remove litter debris - Remove oils and silts - Replacement of Parts - Inspect downstream for oil / poor performance - Inspect sediment accumulation rates and establish appropriate removal frequencies	 Six Monthly As necessary – indicated by system inspections or immediately following significant spill Quarterly Monthly during first half year of operation, then every six months	Please refer to manufacturer's guidance document within appendix III.

Silage Effluent Tank		Inspection should cover, - Access Chambers - Leak Detection Chamber - Main Tank - Check leak detection chamber for any liquid - Inspect lids, check hinges and fitment - Check integrity of metal frame and replace as necessary - Remove items of debris - Vac out remaining silt and debris - Jet tank and CCTV Survey - Repair / replacement	 Bi Weekly Quarterly Quarterly Quarterly Annually 3 years (See Note 1) As Required (See Note 2)	Leak Detection shall be checked to ensure the tanks integrity is maintained. <u>Note 1</u> The tank should be jetted and cleaned, and CCTV inspection carried out to monitor the tanks integrity over the plants design life. Also, this shall be carried out if any liquid is noted in the leak detection chamber during the bi weekly checks. <u>Note 2</u> Any repairs or replacement shall be carried out under the strict guidance of an appropriately qualified engineer
Effluent Pump System	No flow, low flow, SCADA fault. Upstream surcharging	Inspection should cover, - Chamber - Pump Rails - Pumps - Mains - Valves - Electronic - Downstream outfall - Lift gratings and lids, check hinges and fitment. - Check integrity of metal frame and replace as necessary. - Remove items of debris - Vac out remaining silt and debris - Damage to internal pipework - Pump performance & Checks - Electrical system checks	Pump system shall be checked monthly with detailed inspection quarterly. (See Note 1) Quarterly Quarterly Monthly Annually As Required Monthly Quarterly	Pump shall be linked to SCADA and data log <u>Note 1</u> Proposed Frequency and maintenance to be reviewed with manufacturers recommendation.
Bund Water Pump System	No flow, low flow, SCADA fault. Upstream surcharging	Inspection should cover, - Chamber - Pump Rails - Pumps - Mains - Valves - Electronic - Downstream outfall - Lift gratings and lids, check hinges and fitment. - Check integrity of metal frame and replace as necessary. - Remove items of debris - Vac out remaining silt and debris - Damage to internal pipework - Pump performance & Checks Electrical system checks	Pump system shall be checked monthly with detailed inspection quarterly. (See Note 1) Quarterly Quarterly Monthly Annually As Required Monthly Quarterly	Pump shall be linked to SCADA and data log <u>Note 1</u> Proposed Frequency and maintenance to be reviewed with manufacturers recommendation.
Watercourse (Outfall)	Surcharging, Low flow, Dirty Water	Inspect Watercourse - Cut back overgrown vegetation to aid flow - Clear headwall from debris - Low flow checks upstream for flow / blockages - Water quality samples	Monthly & Large Storms Water quality inline with EA permit requirements	Reference to be made to final permit conditions and document updated.

Section 6.0 – Structure Details Operation & Maintenance Requirements

6.1 Operation & Maintenance Requirement for Filter Drain

Note: Filter strips / Drains will require routine maintenance to ensure continuing operation to design performance standard.

Regular inspection and maintenance are important for the effective operation of a filter drain. Litter (including leaf litter) and debris removal should be undertaken as part of general landscape maintenance for the site and before any other SuDS management tasks. All litter should be removed from site.

TABLE 16.1 Operation and maintenance requirements for filter drains

Maintenance schedule	Required action	Typical frequency
Regular maintenance	Remove litter (including leaf litter) and debris from filter drain surface, access chambers and pre-treatment devices	Monthly (or as required)
	Inspect filter drain surface, inlet/outlet pipework and control systems for blockages, clogging, standing water and structural damage	Monthly
	Inspect pre-treatment systems, inlets and perforated pipework for silt accumulation, and establish appropriate silt removal frequencies	Six monthly
	Remove sediment from pre-treatment devices	Six monthly, or as required
Occasional maintenance	Remove or control tree roots where they are encroaching the sides of the filter drain, using recommended methods (eg NJUG, 2007 or BS 3998:2010)	As required
	At locations with high pollution loads, remove surface geotextile and replace, and wash or replace overlying filter medium	Five yearly, or as required
	Clear perforated pipework of blockages	As required

6.2 Operation & Maintenance Requirement for Attenuation Basin

Note: The operations contained within this section specific to the maintenance of landscaping, shall be read in conjunction with any development landscape maintenance plan(s).

The land drainage system including the attenuation basin and associated inlet / outlet headwalls and pipework will be subject to a routine monitoring and maintenance schedule as part of the general site management. This will be carried out at monthly intervals between 1 April and 31 October and once between 1 November and 31 March unless otherwise detailed.

A record of maintenance visits and remedial operations shall be maintained. The following guidelines are offered as an initial regime, but maybe either increased or decreased by the management company depending on the local environment and any external contributing factors.

The key maintenance requirement for the attenuation basin and associated inlet / outlet headwalls and pipework will be the maintenance of vegetation and mowing of grass within and on the banks/verges and the removal of accumulated sediments and collection of litter and debris.

During the inspections the general operation, and structural condition of the inlet / outlet headwalls and any erosion of banks or scour control features should be identified and rehabilitated as required.

Vegetation within on the banks of the pond should be trimmed twice a year, preferably in April and October to a height of 100mm to establish a dense sward and provide long grass margins which will discourage public access down to the water's edge.
Cuttings from any clearance work should be removed from the pond to avoid it causing blockages downstream.

De-silting of the attenuation ponds will usually be on a 10-15 year cycle depending on the ongoing silt level checking. The desilting work will be carried out under the supervision of consulting engineers and to a pre-agreed method statement.

Prior to desilting works commencing, a suitably qualified ecologist shall be appointed to undertake an assessment of the ecological interest within the pond and its margins.
In the event that the attenuation ponds develop particular ecological interest, then careful consideration will be given to the timing of this operation.

Sediments excavated from the pond that receive runoff from greenfield areas are not toxic or hazardous material and can be safely disposed of by either land application or landfilling. However, consultation should take place with the environmental regulator to confirm appropriate protocols. As long as the silt is nonhazardous it can be put it on the bank of the pond / swale and depositing silt on top of the banks allows for any organisms to re-establish.

TABLE 22.1 Operation and maintenance requirements for detention basins

Maintenance schedule	Required action	Typical frequency
Regular maintenance	Remove litter and debris	Monthly
	Cut grass – for spillways and access routes	Monthly (during growing season), or as required
	Cut grass – meadow grass in and around basin	Half yearly (spring – before nesting season, and autumn)
	Manage other vegetation and remove nuisance plants	Monthly (at start, then as required)
	Inspect inlets, outlets and overflows for blockages, and clear if required.	Monthly
	Inspect banksides, structures, pipework etc for evidence of physical damage	Monthly
	Inspect inlets and facility surface for silt accumulation. Establish appropriate silt removal frequencies.	Monthly (for first year), then annually or as required
	Check any penstocks and other mechanical devices	Annually
	Tidy all dead growth before start of growing season	Annually
	Remove sediment from inlets, outlet and forebay	Annually (or as required)
	Manage wetland plants in outlet pool – where provided	Annually (as set out in Chapter 23)
Occasional maintenance	Reseed areas of poor vegetation growth	As required
	Prune and trim any trees and remove cuttings	Every 2 years, or as required
	Remove sediment from inlets, outlets, forebay and main basin when required	Every 5 years, or as required (likely to be minimal requirements where effective upstream source control is provided)
Remedial actions	Repair erosion or other damage by reseeding or re-turfing	As required
	Realignment of rip-rap	As required
	Repair/rehabilitation of inlets, outlets and overflows	As required
	Relevel uneven surfaces and reinstate design levels	As required

6.3 Operation & Maintenance Requirement for Proprietary Treatment Systems

Proprietary treatment systems will require routine maintenance to ensure continuing operation to design performance standard. The manufacturers shall provide detailed specifications and frequencies for the required maintenance activities along with likely machinery requirement and typical annual costs.

The treatment performance is strongly dependant on maintenance, and robust management plan will be required. There are examples where maintenance has not been carried out led pollution and the companies subsequently fined. Lack of routine maintenance is more likely to cause poor outflow water quality than with other SuDS due to resuspension of solids and anaerobic conditions developing within the devices.

During the first few months after installation, subsurface treatment units should be visually inspected after rainfall events, and the amount of deposition measured to give the operator an idea of the expected rate of sediment and oil deposition. After this initial period, system should be inspected every 6months to verify the appropriate level of maintenance.
During these inspections, the floating debris and any floating oils should normally be removed. This may be done using a vac tanker. Silt should be removed when it reaches 75% of the capacity of the sump. In most cases the unit should be fully cleaned out at least annually. If there is a significant spill of oil (Or other pollutant) the system should be cleared immediately.

Given the site shall operator under an Environmental Permit which this document and its proposed maintenance required shall form part of the permit along with the year auditing. All maintenance shall be audited yearly to ensure the requirements of this plan have been met.

Proper disposal of oils, solids and floating debris removed from components must be ensured, and the environmental regulator should be approached for advice where there are any doubts concerning disposal options.
General inspection of the integrity of oil/water separators should occur at a maximum frequency of five years, and should cover the following,

- Watertightness of system
- Structural condition
- Internal coatings
- In-Built parts
- Electrical devices and installations
- Adjustment of automatic closure devices.
-

It is usually required that separators are filled with clean water before being put into operation and each time after emptying for maintenance. Failure to do so will cause the separator to malfunction until surface water build up the required permanent water level in the unit. It is possible to fit an alarm to separators that will indicate when the collected oil volume is at maximum, and this may be a regulatory requirement. The alarms should be placed in a location that is clearly visible to those responsible for maintenance of the system.

TABLE 14.2 An example of operation and maintenance requirements for a proprietary treatment system

Maintenance schedule	Required action	Typical frequency
Routine maintenance	Remove litter and debris and inspect for sediment, oil and grease accumulation	Six monthly
	Change the filter media	As recommended by manufacturer
	Remove sediment, oil, grease and floatables	As necessary – indicated by system inspections or immediately following significant spill
Remedial actions	Replace malfunctioning parts or structures	As required
Monitoring	Inspect for evidence of poor operation	Six monthly
	Inspect filter media and establish appropriate replacement frequencies	Six monthly
	Inspect sediment accumulation rates and establish appropriate removal frequencies	Monthly during first half year of operation, then every six months

APPENDIX XIII

Letter Confirming Rights of Surface Water Discharge

Courteenhall Estate Office,
Northamptonshire,
NN7 2QD,
England

To whomever It concerns,

I confirm that Horse Close Green Power, once their existing option has been exercised, will have the right to discharge clean water into the watercourse as shown by the green arrow in the image below as per granted in their lease agreement.

Signed: John Wake.....

Title: .....

Date: .....

Signature: John Wake
John Wake (May 8, 2024 13:17 GMT+1)

Email: jw@courteenhall.co.uk

Confirmation of right to discharge_

Final Audit Report 2024-05-08

Created:	2024-05-08
By:	Katy Doctor (kd@courteenhall.co.uk)
Status:	Signed
Transaction ID:	CBJCHBCAABAAjJq5gM53HzAc6gdSbuOAaUDmyk9hHdGF

"Confirmation of right to discharge_" History

Document created by Katy Doctor (kd@courteenhall.co.uk)
2024-05-08 - 11:14:57 AM GMT

Document emailed to Johnny Wake (jw@courteenhall.co.uk) for signature
2024-05-08 - 11:15:01 AM GMT

Email viewed by Johnny Wake (jw@courteenhall.co.uk)
2024-05-08 - 12:16:07 PM GMT

Signer Johnny Wake (jw@courteenhall.co.uk) entered name at signing as John Wake
2024-05-08 - 12:17:31 PM GMT

Document e-signed by John Wake (jw@courteenhall.co.uk)
Signature Date: 2024-05-08 - 12:17:33 PM GMT - Time Source: server

Agreement completed.
2024-05-08 - 12:17:33 PM GMT