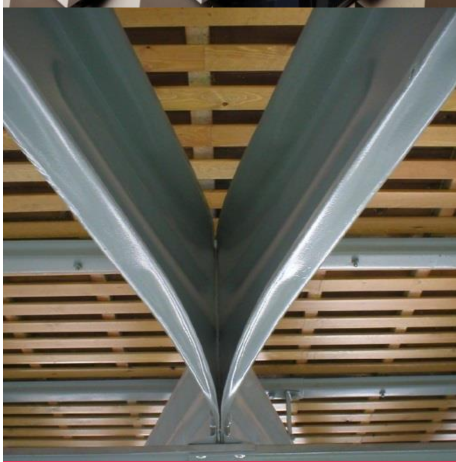
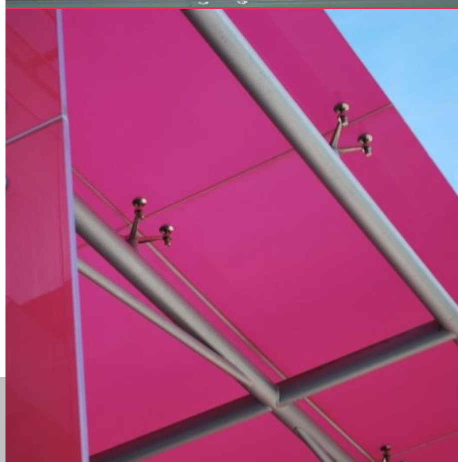


Millom Iron Line

Drainage Strategy Report

Curtins Ref: 081617-CUR-01-ZZ-RP-C-92002

Revision: P01

Issue Date: 18 May 2023

Client Name: Cumberland Council

Client Address:

Site Address: The Iron Line, Millom, Cumbria

Curtins Consulting Limited
Units 24 & 25 Riverside Place
K Village
Lound Road
Kendal
LA9 7FH
Tel: 01539 724 823
Email: kendal@curtins.com
www.curtins.com

Rev	Description	Issued by	Checked	Date
P01	First issue.	CLN	PT	18 May 2023

This report has been prepared for the sole benefit, use, and information for the client. The liability of Curtins Consulting Limited with respect to the information contained in the report will not extend to any third party.

Author	Signature	Date
Craig Noonan BSc (Hons) Senior Engineer		18 May 2023

Reviewed	Signature	Date
Peter Thomas MEng (Hons) CEng MICE Principal Engineer		18 May 2023

Table of Contents

1.0 Introduction

1.1 Project Background

Curtins were instructed by Layer Studio on behalf of Cumberland Council to develop a Drainage Strategy (DS) for the proposed development of a new Welcome Centre and associated car parking at Millom Iron Line, Millom, Cumbria. The purpose of the DS is to support the planning application. The site is centred on National Grid Ref: 317892mE 479009mN. The nearest site postcode is LA18 4LB.

There are also a number of discrete elements of work across the Iron Line site, including Hodbarrow Beacon and the former Windmill as well as isolated areas of landscaping. At the time of preparation of this report it is not envisaged that positive drainage will be provided to any of these elements, rather the existing hydraulic situation will be replicated by the use of porous materials wherever possible. As such, the following drainage strategy report focusses on the Welcome Building and associated hard landscaping only.

The report is based on currently available information at the time of writing.

1.2 Proposed Development

Full planning permission for the erection of a new Welcome Centre, access road, car parking and associated landscaping.

1.3 Future Developments

The development is proposed to be built out in a single phase, with no further proposals or plans to extend the Welcome Centre once it is constructed.

If in the future it did expand, then the drainage network and attenuation features would need to be assessed at the time for capacity to meet the current guidelines at such time.

2.0 SuDS Guidance and Standards

2.1 Introduction

In July 2018, the Government made changes to the National Planning Policy Framework which made Sustainable Urban Drainage Systems[1] (SuDS) a requirement for the determination of planning applications for 'major' developments. The requirements of a sustainable drainage system are set out in the government's Non-statutory technical standards for sustainable drainage systems.

A Drainage Strategy will therefore be required as part of the Planning Application for the development, as the site is considered to be 'major' development by the Town and Country Planning Order 2015 as total floor space will exceed 1,000m^2.

2.2 National Planning Policy and Guidance

National Planning Policy Guidance[2] (NPPF) states that:

Major developments should incorporate sustainable drainage systems unless there is clear evidence that this would be inappropriate. The systems used should:

- take account of advice from the lead local flood authority
- have appropriate proposed minimum operational standards
- have maintenance arrangements in place to ensure an acceptable standard of operation for the lifetime of the development; and
- where possible, provide multifunctional benefits.

Guidance on the design criteria for different site situations in the Non-Statutory Technical Standards for Sustainable Drainage state:-

Peak Flow Control

- Greenfield developments - peak runoff rate from the development for the 1 in 1 year rainfall event and the 1 in 100 year rainfall event should never exceed the peak greenfield runoff rate for the same event.
- Brownfield developments - peak runoff rate from the development for the 1 in 1 year rainfall event and the 1 in 100 year rainfall event must be as close as reasonably practicable to the Greenfield runoff rate from the development for the same rainfall event.

[1] https://www.gov.uk/government/publications/sustainable-drainage-systems-non-statutory-technical-standards
[2] https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/810197/NPPF_Feb_2019_revised.pdf

Volume Control

- Greenfield developments - Where reasonably practicable, the runoff volume from the development in the 1 in 100 year, 6 hour rainfall event should never exceed the Greenfield runoff volume for the same event.
- Brownfield developments - Where reasonably practicable, the runoff volume from the development in the 1 in 100 year, 6 hour rainfall event must be constrained to a value as close as reasonably practicable to the greenfield runoff volume for the same event, but should never exceed the runoff volume from the development site prior to redevelopment for that event.
- Where it is not reasonably practicable to constrain the volume of runoff to any drain, sewer or surface water body in accordance with points above, the runoff volume must be discharged at a rate that does not adversely affect flood risk.

Flood Risk Within the Development

- The drainage system must be designed so that, unless an area is designated to hold and/or convey water as part of the design, flooding does not occur on any part of the site for a 1 in 30 year rainfall event.
- The drainage system must be designed so that, unless an area is designated to hold and/or convey water as part of the design, flooding does not occur during a 1 in 100 year rainfall event.
- The design of the site must ensure that, so far as is reasonably practicable, flows resulting from rainfall in excess of a 1 in 100 year rainfall event are managed in exceedance routes that minimise the risks to people and property.

Sustainable Drainage Hierarchy

Paragraph 056 of the NPPF Planning Practice Guidance (PPG Ref: 7-056-20220825) on Flood risk and coastal Change[3] states:

The types of sustainable drainage system which it may be appropriate to consider, will depend on the proposed development and its location, as well as any planning policies and guidance that apply locally. Where possible, preference should be given to multi-functional sustainable drainage systems, and to solutions that allow surface water to be discharged according to the following hierarchy of drainage options::

- into the ground (infiltration);
- to a surface water body;
- to a surface water sewer, highway drain, or another drainage system;
- to a combined sewer.

[3] https://www.gov.uk/guidance/flood-risk-and-coastal-change

2.3 Climate Change

On 10th May 2022 the Environment Agency published revised climate change allowances[4] for peak rainfall intensities which should be applied to new developments, based on the River Management Catchment the development lies in, and development design life.

2.4 Stakeholder Engagement

Dialog with United Utilities is ongoing surrounding foul water, available connection points and capacity. Noting that the nearest public foul sewer is located a considerable distance from the development and would require pumping.

Extensive discussions have been held with the LLFA/LPA to discuss the development proposals, in particular the drainage strategy options.

Meetings with the ecologist to understand the ecological constraints.

Further details of the planning submission are set out in the accompanying Planning Statement.

2.5 Approach to Determining Appropriate Strategy

The following sections of this strategy follow the above guidance in

- Setting strategic surface water management objectives,
- Assessing the existing site characterisations,
- Setting the SuDS design criteria,
- Identifying suitable points of discharge,
- assessing Opportunities and Constraints and
- producing a drainage strategy appropriate for planning purposes

[4] https://www.gov.uk/guidance/flood-risk-assessments-climate-change-allowances#peak-rainfall-intensity-allowance

3.0 Strategic Surface Water Management (SWM) Objectives

Following CIRIA C753 The SuDS Manual (C753) Section 7.4, the below objectives are considered by Curtins to be suitable for the surface water drainage design, based the output of Section 2.0.

Topic	Strategic objective
Flood risk	Flood risk to the development to be managed and the development is not to increase flood risk for surrounding areas.
Water quality	Surface water outfalls to the tidal lagoon to the west and former Redhills quarry now naturally filled pond/pool to the north are viable. Treated foul water effluent will discharge to a pond within Redhills Quarry which connects to the Duddon Estuary before flowing out into the Irish Sea. Appropriate treatment of discharge will be required.
Urban heating & air pollution	The development is in a low-density suburban environment so urban cooling is not a key driver. However, strategic objectives for flood risk, habitat and biodiversity will contribute to climate resilience.
Replenishing groundwater	Infiltration should be used where feasible.
Biodiversity	Preserve and enhance existing habitat. Areas to the west of the development are ideal for SuDS with biodiversity benefits such as ponds/swales, but the level of disruption and mitigation is still important. It is advisable to keep habitat areas clustered and fenced off to reduce the risk of wildlife and visitors getting too close.
Water resource	There will be a requirement for water at the Welcome Centre. It is thought that this will be supplied from a reliable water source.
Low carbon construction	Selecting paving and drainage systems and materials which have a low embodied carbon, limiting excavation, using systems which provide dual purpose such as permeable sub-base for pavement sub-structure and attenuation, and minimising the use of steel, cement and certain plastics, will all be considered.
Amenity	The main opportunity for providing appropriate amenity value in the SuDS design is the proposed swales/ponds and the habitat on the west side of the site. With appropriate primary treatment, the ponds should not have a heavy pollution load, meaning its potential for amenity and biodiversity value are high. The main beneficiary will be building users who may wish to walk through the amenity areas during their free time, since site access restrictions will be in place.
Approval and adoption	The local planning authority will be the approving body for the surface water management system. The site drainage will be entirely owned and operated by Cumberland Council so operation and maintenance design need only consider the needs of the client.

4.0 Conceptual design

Following the guidance set out in C753 Section 7.5.1, the characterisations set out in the below relating to surface water management were established for the site.

4.1 Site characterisation outcomes

Site topography	Much of the site is sloped down towards the east. There is a sweeping embankment from the east and around to the north of the site. To the west the levels also fall away towards the tidal lagoon. The site levels vary from 16m down to 3m AOD. Immediately North of the Welcome Building, a vertical rock face remains from the former Redhills quarry, c. 10m in height.
Existing flow routes and discharge points	Currently any overland flow will follow the sloping topography down to the east and west. There will be some infiltration and some absorption from the vegetation which will also slow any overland flows. An existing tidal lagoon is located approximately 250m southwest that is a potential surface water outfall. Former Redhills quarry now naturally filled pond/pool to the north is located approximately 70m from the site.
Potential for infiltration	British Geological Survey and Soilscapes mapping information for the surrounding land the site appears to be based on Devensian Till (loamey and clayey) and further away Raised Marine Deposits (sand and gravel) classified as *'Naturally wet'* with *'impeded infiltration potential'* suggest that infiltration techniques may not be possible (subject to Phase 2 Ground Investigation reporting – yet to be commissioned).
Potential for surface water discharge	Runoff from the existing catchment is mainly drained to east where the lower lying ground levels are. From here it would drain to the north as the ground levels drop away slightly. This is where the quarry pool/pond is located and which would be the natural flow path. Runoff from the top part of the site would also drain to the south and west towards the tidal lagoon following the sloping topography. The proposed discharge points to these two locations will be restricted up to the 1:100 year rainfall to a 1:1year Greenfield runoff rate. Therefore, the change to a point discharge is not considered to adversely impact the waterbodies.
Site flood risks	See the site-specific Flood Risk Assessment.
Existing site land use	The site was previously used as an Iron Mine. The Welcome Building site is coincident with a former reservoir which has since been back filled. The scope of demolition/site clearance following closure of the mine and quarry is not clear, however the majority of structures shown on historic maps are no longer present above ground..
Existing site infrastructure	The site is not believed to have any existing infrastructure.
Existing soils	British Geological Survey and Soilscapes mapping information for the surrounding land the site appears to be based on Devensian Till (loamey and clayey) and further away Raised Marine Deposits (sand and gravel) classified as *'Naturally wet'.*
Local habitats and biodiversity	The site is considered to be of significant ecological importance. The vegetation and RSPB Reserve provides an important habitat for wildlife. Overlooking the Duddon

	Estuary SSSI and the Morecambe Bay and Duddon Estuary SPA, Hodbarrow reserve comprises a freshwater lagoon within the seawall with rich flower and insect communities living on the limestone slag. Grasssland and scrub stretches inland to provide a haven for insects and breeding songbirds. This coastal lagoon and grasslands, located on the site of a former iron mine, support breeding terns, ringed plovers, redshanks and oystercatchers. Great crested grebes nesting on the island too.

4.2 Development characterisation outcomes

Proposed topography, land use and landscape characteristics	The site is to be plateaued where the Welcome Centre is located at around 13.70m AOD. There will be a top car park and a lower car park with a new access road linking the two and providing access to the existing Redhills Quarry Householе Waste Centre. The site will be split into two catchments from a proposed drainage perspective. This is considered the most sustainable strategy to avoid subtracting available volume from the fluvial flood path. This is discussed in section 5.0.
Proposed flood risk management strategy	Rates of surface water discharge will be controlled, as outlined in section 5.0.
Proposed site infrastructure	The proposed drainage system should be possible to install with minimal disruption to the Previously developed as part of the Iron Mine, since been revegetated. Existing features including a mine shaft and derelict building located to the west of the new Welcome Centre are to remain without interference.
Proposed building style and form	Steel rotunda at upper first floor level with cast in situ concrete buildings to the lower ground floor level, with retaining walls, tarmac access roads, permeable parking areas and open swales.
Proposed adoption and maintenance of surface water management system	The networks are to remain private ownership.

4.3 SuDS Design Criteria

	Delivery of Design Criteria
Water quantity	All surface water discharge shall be restricted to the 1:1 year greenfield rate from each catchment. Runoff from the 1:30 year event should be attenuated below ground (i.e. not cause flooding) and the 1:100 year should be attenuated on site without posing a risk to people or property. The site lies in the Southwest Lakes Management Catchment, for the EA guidance[5] on peak rainfall allowances. Therefore, attenuation will be provided for the 1:30 year +35% climate change and the 1:100 year +35% events, based on a 60 year design life.

[5] https://www.gov.uk/guidance/flood-risk-assessments-climate-change-allowances

Water quality	Surface Water runoff areas at risk from contamination should receive water quality treatment. The development land uses can be categorised as follows. The simple index approach has been used from C753. The pollution hazard indices from Table 26.2 are: Building roofs = Low hazard, TSS: 0.3, metals: 0.2, HCs: 0.05 Car parking and site roads = Medium hazard, TSS: 0.7, metals: 0.6, HCs: 0.7
Amenity	Provide open SuDS which provide pleasant areas for visitors to look over from the centre and feel like they are in nature.
Biodiversity	Design to minimise the adverse impact on existing biodiversity and ecology, and any open top SuDS features should maximise the biodiversity improvement, providing a net gain. Ponds/swales could provide habitats for Natterjack Toads. • They should have gently sloping sides to ensure safe passage out of the pools for toadlets and hold water down to a maximum water depth of 50 - 70cm that will dry out in late summer in an average year. The use simple pipe sluices could be installed so that the pools can be drained down in late summer. • Vegetation within and surroundings should be kept low-cut • Fenced off from visitors • Nearby sandy banks, stone walls, piles of stones that could act as hibernacula.

4.4 Feasible points of discharge

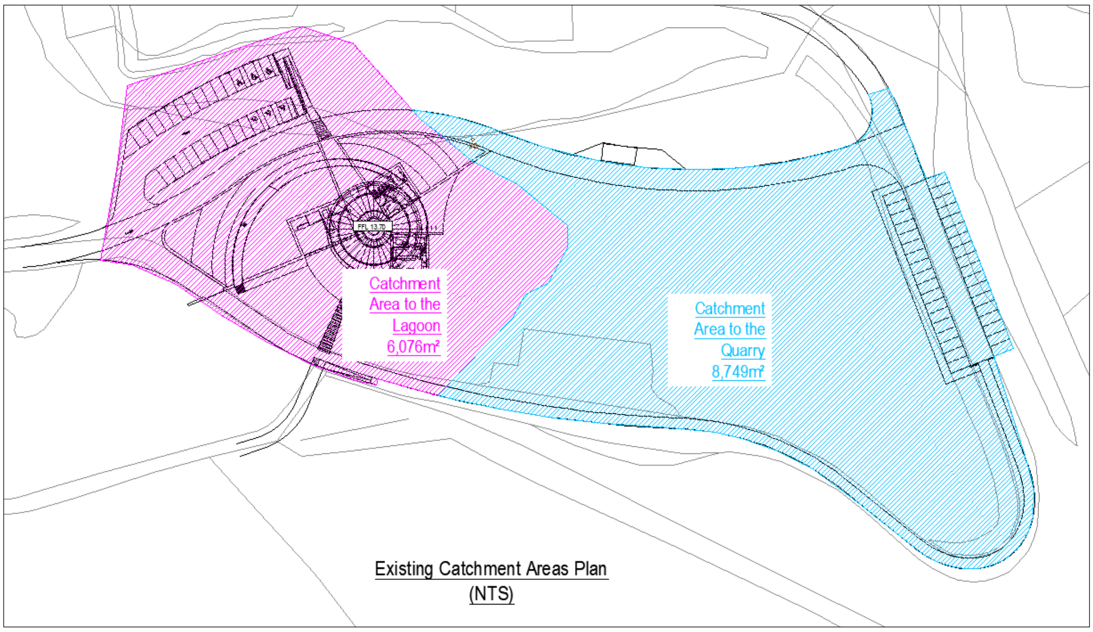
Surface Water Disposal Method	Potential	Description
Infiltration	✗	British Geological Survey and Soilscapes mapping information for the surrounding land the site appears to be based on Devensian Till (loamey and clayey) and further away Raised Marine Deposits (sand and gravel) classified as *'Naturally wet'* with *'impeded infiltration potential'* suggest that infiltration techniques may not be possible (subject to Phase 2 Ground Investigation reporting).
Watercourse/ Waterbody	✓	Tidal lagoon is approximately 250m to the southwest, a former Redhills quarry now naturally filled pond/pool is located approximately 70m to the north, an ordinary watercourse Crook Pool further to the east/ south east approximately 500m from the site and the Duddon estuary (sea) to the south, However due to the nature and importance of the habitat routes careful consideration, discussions and design are required to achieve a suitable outfall.
Existing Private surface water drainage system	✗	There is no formal positive surface water drainage on site.
Surface Water Sewer	✗	There are no surface water sewers within range of the site.
Combined Water Sewer	✗	The nearest combined sewer and potential outfall is chamber '4300' which lies on Mainsgate Road, Millom. This is a considerable distance away. Alternative means of foul water disposal are proposed in this report. However, dialogue with UU is being held to confirm capacity

		within the combined sewer to accommodate unrestricted foul water flows, if needs be.

4.5 Surface water sub-catchments and flow routes

The development catchments are as follows and are shown in detail on the Drainage Area Plan drawings 081617-CUR-01-ZZ-DR-C-92001 and 92002. An extract is shown below.

Catchment Name	Colour	Treatment
Welcome Centre and top car park (Catchment 1)	Magenta	SuDS scheme required.
Access road and lower car park (Catchment 2)	Cyan	



The surface water catchment to the tidal lagoon which consists of the Welcome building and new hardscaping (as much as possible) is to fall towards the lagoon in the west via a gravity greenfield rate restriction. This will relieve some of the catchment draining to the quarry as explained in the next paragraphs. Noting that the lagoon is a SSSI and wildlife haven.

Therefore, the proposed surface water drainage and route to the outfall will consist of a mixture of permeable paving, proprietry treatment units where possible and a series of cascading swales/conveyance swales utilised. Swales are to incorporate biodiversity feature where possible i.e. shallower gradients and low flow channel. Ecologically sensitive areas are to be avoided due to protected grassland/plants. Closer to the lagoon is where the topography is the steepest and the drainage route will most likely be piped. We have modelled the outfall as a surcharged outfall which will help to take any force out for the piped water flow and reduce any erosion.

The balance of surface water catchment from the access roads, parking area and remaining greenfield runoff from the vegetated area shall drain via a formalised route to the former Redhillls Quarry pool/pond directly. An assessment of catchment and existing flows/rates has been undertaken to prove that the flows directed towards the quarry are no worse than the existing situation and offer a betterment by reallocating some of the catchment to the tidal lagoon where restrictions on flow rates and volumes are slightly less onerous.

Surface water treatment from this catchment is provided by stone filled filter trenches, permeable construction and propriety units where possible. The permeable construction provides the attenuation for this catchment to allow restriction back to the 1:1 year greenfield runoff rate for all storm up to and including the 1:100 year + climate change event. Connection to the quarry will be via a newly formed drain or open channel/swale adjacent to the access road.

For context, from discussions with the LLFA, EA and LPA, the former quarry pool/pond has a pumped outfall downstream of the Millom Wastewater Treatment Works (WwTW) further north. There are restrictions on discharge rates and volumes with the Environment Agency and the LLFA. According to the trade effluent permit in place and the outfall agreement with Cumbria County Council and United Utilities with the EA the receiving watercourse/outfall also has a permit/agreement. These are both back-to-back meaning the same flows out one end are expected at the out falling.

Note that there are significant restrictions on volumes and flow rates that Redhills Quarry needs to maintain, hence routing as much surface water as possible towards the tidal lagoon to help provide a betterment on the current situation.

5.0 Outline design

5.1 Assessment of Pre- and Post-development Site Runoff

Pre-development Site Runoff

The site should be considered to have a greenfield discharge in terms of its runoff response.

Post-development Site Runoff

The site wide catchment has been split into two catchments in order to assess the runoff from the overall site. Based on an assessment of catchment areas and constraints associated with the outfalls, namely the rates and volumes to the quarry pool, the catchments have been split and existing flows/rates have been calculated.

Catchment 1 – outfall to the Tidal Lagoon to the west

The post-development discharge rate will be restricted to 1:1 year Greenfield rate, calculated by the IH124 method below. The site will be divided into catchments to suit site constraints so that the total surface water discharge for catchment 1 does not exceed 4.00 l/s (litres/second) for all storms up to and including the 1:100 year plus climate change event.

Pre-development discharge

Site Makeup	Greenfield
Greenfield Method	IH124
Positively Drained Area (ha)	0.608
SAAR (mm)	1020
Soil Index	4
SPR	0.47
Region	10
Betterment (%)	0
	Calc
QBar (l/s)	4.6

Return Period (years)	Growth Factor	Q (l/s)
1	0.87	4.0
2	0.93	4.2
30	1.70	7.8
100	2.08	9.5

Catchment 2 – outfall to the Quarry Pond to the north

The post-development discharge rate will be restricted to 1:1 year Greenfield rate, calculated by the IH124 method below. The site will be divided into catchments to suit site constraints so that the total surface water discharge for catchment 2 does not exceed 5.70 l/s (litres/second) for all storms up to and including the 1:100 year plus climate change event.

Pre-development discharge

Site Makeup	Greenfield
Greenfield Method	IH124
Positively Drained Area (ha)	0.875
SAAR (mm)	1020
Soil Index	4
SPR	0.47
Region	10
Betterment (%)	0
	Calc
QBar (l/s)	6.6

Return Period (years)	Growth Factor	Q (l/s)
1	0.87	5.7
2	0.93	6.1
30	1.70	11.2
100	2.08	13.7

Note that the proposed foul flows are to be treated as discussed in section 6.0 and also outfall to the quarry pool/pond. So, this flow also needs to be factored in. The combined rate of discharge to the pool/pond will not exceed the 1:1 year rate.

5.2 Water Quantity

The site is divided into the below catchments:

Catchment Name	Area (ha)	Flow (l/s)	Attenuation (m^3)
Catchment 1	0.608	4.0	180
Catchment 2	0.875	5.7	130

Note that the above catchment areas are subject to change through design development, which will affect the flow control allowances. Consult the latest drainage layout drawings and calculations. The above attenuation volumes were calculated using an outline hydraulic model and are subject to further refinement through a detailed hydraulic model which will account for available volumes in the wider surface water drainage system. The principles set out in sections 5.1 for the 1:1 year greenfield rates of 4.00 l/s and 5.70 l/s for design storms up to the 1:100 year and climate change allowances will be adhered to.

The bulk of the attenuation will be provided in below ground attenuation tanks and large diameter pipes. Flows will be pumped to the pond on the north side of the site and then discharged by gravity to the watercourse. The high energy flows from the rising main will be diffused and slowed by a break chamber and a flow diffusing channel before entering the pond. The proposed pond has limited capacity for attenuation as it will be receiving pumped flows from the site which will be difficult to calibrate so that the pond is not overused for attenuation. Instead, the pond will smooth the stop and start flows from the pump.

See document refs: 081617-CUR-01-ZZ-DC-C-00600 and 00601 for surface water drainage calculations.

The calculations include for a permanent surcharge to both outfalls to the lagoon and quarry pool/pond as a worst-case scenario that the drain is full to the crest level at the time of the design rainfall events. The water levels will be confirmed at detailed design stage and levels of the outfall amended as necessary to suit water levels in the tidal lagoon and former quarry pool/pond.

5.3 Designing for Local Drainage System Failure

In accordance with general principles discussed in CIRIA Report C635, Designing for Exceedance in Urban Drainage the proposed surface water drainage, where practical, should be designed to ensure no increased risk of flooding to buildings on the site or elsewhere because of extreme rainfall, lack of maintenance, blockages or other causes. Refer to drawings 081617-CUR-01-ZZ-DR-C-92001 & 92002 - Drainage Strategy Layouts.

Blockage

The site levels design will grade external surfaces away from buildings and into other hardstanding areas. There will be a degree of redundancy where water that cannot be drained by one blocked linear drain or gully will flow overground to the next available linear drain or gully. If blockages are so extensive that this is not possible, the levels will be designed to overland flows drain to the watercourse.

Exceedance

The site drainage has been designed to attenuate the 100-yr rainfall event, including an allowance for climate change. No flooding has been calculated in the worst case event.

Exceedance flows will be retained on site within the drainage system as far as practical however for rainfall events of a greater return period it may be necessary to pass forward more flow or to spill flow from the system. The site levels design will allow overland flows to discharge to the lower part of the site where the permeable parking is located. Additional storage is provided within the extents of the full height kerbs.

Parking areas should be designed to offer additional storage volume should the drainage system be exceeded. Where appropriate, kerb lines should be raised by half batter kerbs (0.1m) to help retain flood water and allow drainage back into the system through the permeable surface.

The drainage system also includes open SuDS features which have been designed to provide generally 300mm of freeboard above the 100-year plus climate change event. These areas can therefore accommodate a certain volume of exceedance runoff.

Following this and should the freeboard within the drainage system be used, flow from the site will occur.

Drainage Contingency

The proposed surface water drainage system has been designed to provide adequate storage volume against flooding, including an allowance for climate change in accordance with current best practice.

Building Layout and Detail

To meet accessibility requirements, new buildings tend to have level access and therefore, external levels will be set wherever possible to fall away from the buildings ensuring any flood water runs away from, rather than towards the building. Anywhere this is not possible thresholds will include drains.

5.4 Water Quality Treatment

The below proprietary treatment systems have also been considered, with the supplier quoted pollution mitigation indices, as of June 2022. While some products have a lower mitigation, they are still appropriate for use when backed up with SuDS secondary treatment, such as the 'Downstream Defender Advanced Vortex', which would be appropriate when used with a swale and a pond.

Proprietary System	Pollution Mitigation Indices		
	TSS	Metals	Hydrocarbons
Hydro-International Downstream Defender Advanced Vortex	0.5	0.4	0.5
Klargester – AquaTreat	0.85	0.64	0.99
Marsh Hydroil Full retention separator	0.8435	0.6326	0.975
ACO QuadraCeptor	0.8	0.8	0.8

The below table summarises the total pollution mitigation indices for each land use category. These are based on the simple index approach from C753. The pollution mitigation indices are from Table 26.3, with the above Klargester – Aqua Treat proprietary system. Where two stages of treatment are required, the mitigation indices for the second stage of treatment have been factored by 0.5 to account for reduced performance due to lower inflows.

Land Use	Hazard Indices	Mitigation Indices
Building roofs	Low hazard, TSS: 0.3, metals: 0.2, HCs: 0.05	Pond/swale TSS: 0.7, metals: 0.7, HCs: 0.5 ✓
Car parking	Medium hazard, TSS: 0.7, metals: 0.6, HCs: 0.7	Pervious paving TSS: 0.7, metals: 0.6, HCs: 0.7 ✓
Site roads	Medium hazard, TSS: 0.7, metals: 0.6, HCs: 0.7	Proprietary treatment & a pond/swale TSS: 0.99, metals: 0.84, HCs: 0.99 ✓

Flows from the site roads have a medium pollution hazard so require two stages of treatment. This is recommended to be a proprietary treatment system followed by a 'polishing' open SuDS system, such as a pond or swale. The choice of proprietary system will affect the type and scale of the open SuDS system. Other methods of initial treatment include the use of Trapped Gullies and Catchpit chambers, which may be used to filter out high volumes of sediment and aid maintenance. Runoff from roofs can be effectively treated by any one SuDS feature.

Permeable paving, a downstream defender and series of cascading swales are proposed as a final stage of treatment for catchment 1 and filter drains and permeable paving are proposed for Catchment 2.

The type(s) of mitigation proposed may be further considered as the site design is finalised i.e. paving surfaces etc. The proposals for pollution protection should be agreed with the lead local flood authority (LLFA).

6.0 Proposed Foul Water Drainage Strategy

A separate foul water drainage system is proposed for the site. This is to drain via a gravity system and through a suitable package treatment plant to the east before it connects to the proposed surface water outfall. From here it will drain out to the former quarry pool/pond. Effectively a treated combined water outfall to the waterbody.

We expect the development runoff to be circa 0.2 l/s (British Water Foul Flows and Loads – Code of Practice). The flow rate from the foul has been factored into the overall allowable 1:1 year greenfield discharge rate and the surface water rate reduced to accommodate the foul flow.

We have held meetings and had discussions with the LLFA during the pre-app advice period and agreed the drainage philosophy in principle.

7.0 Appendices

Appendix A	Proposed site plan
Appendix B	C753 The SuDS Manual – Ponds and wetlands checklist
Appendix C	Proposed Drainage Drawings
Appendix D	Drainage Calculations

Appendix A Proposed Site Plan

GENERAL NOTES FOR CONTRACTORS

The contractor is responsible for checking all dimensions, tolerances and references. Any discrepancy is to be notified to the Architects before proceeding with the work.

Where an item is covered by drawings to different scales, the larger scale drawing is to take precedence.

Do not scale drawings, figured dimensions are to be worked to in all cases.

REVISION NOTES

PROJECT/	MILLOM IRON LINE
ADDRESS /	MILLOM
POSTCODE /	
JOB No. /	GAG 293
DWG TITLE /	**WELCOME BUILDING SITE PLAN**
DWG No. /	3001 Rev -
DRAWN BY /	JF
CHECKED BY /	SG
DATE /	17.01.23
SCALE /	1:500
PAPER SIZE /	A1
STATUS /	**PROPOSED**

GAGARIN Studio

Unit 5
Causey Hall
Dispensary Walk
Halifax
West Yorkshire
HX1 1QR

Tel: 01422 300042
Email: info@gagarinstudio.co.uk

SCALE 1:500
PAPER SIZE A1

PURPOSE OF ISSUE
STAGE 3 DRAFT

Appendix B C753 The SuDS Manual – Ponds and wetlands checklist

Table B.20 Minimum design requirements: ponds/wetlands	
Parameter	**Minimum design requirements (MDRs)**
Length to width ratio	> 3:1
Maximum depth of permanent water	2 m
Maximum side slopes	1 in 3
Maximum depth of aquatic bench below permanent water level	400 mm
Size of permanent pool	≥ treatment volume, V

Table B.21 Minimum design requirements: ponds/wetlands			
General information			
Site ID			
Asset ID(s)			
Pond/wetland location(s) and co-ordinates		Drawing reference(s)	
Date of assessment		Specification reference(s)	
Primary function(s) of pond/wetland	Attenuation/treatment		

Check	**MDR**	**Summary details**[1]	**Acceptable (Y/N)**	**Comments/ remedial actions**
Dimensions (Section 23.2)				
Length (m)				
Maximum and minimum width – at permanent water level (m)				
Length: maximum width ratio	✓			
Top surface area (m^2)				
Side slopes (1 in ?)	✓			
Depth of permanent water – maximum and minimum (m)	✓			
Freeboard (m)				
Aquatic bench width and slope (m, 1 in ?)	✓			
Safety bench width and slope (m, 1 in ?)	✓			
Inflows (Section 23.8.1)				
Provide a description of the contributing catchment land use and its size (m2)				
Does the design include suitable silt Interception upstream of system?				
Does the design include: ▪ a suitable inlet design ▪ appropriate energy dissipation?				
Outfall arrangements (Section 23.8.2)				
Provide details of any flow control systems, overflow arrangements and limiting discharge rate from pond/wetland				
Is a geomembrane required to prevent infiltration? If yes, give reason				
Depth to maximum likely groundwater level (m)				
Storage (Section 23.4)				
Design event return period(s) (years)				
Maximum rise in water level(s) for the design event(s) (mm)	✓			
Maximum water depth(s) at design event conditions (m)				

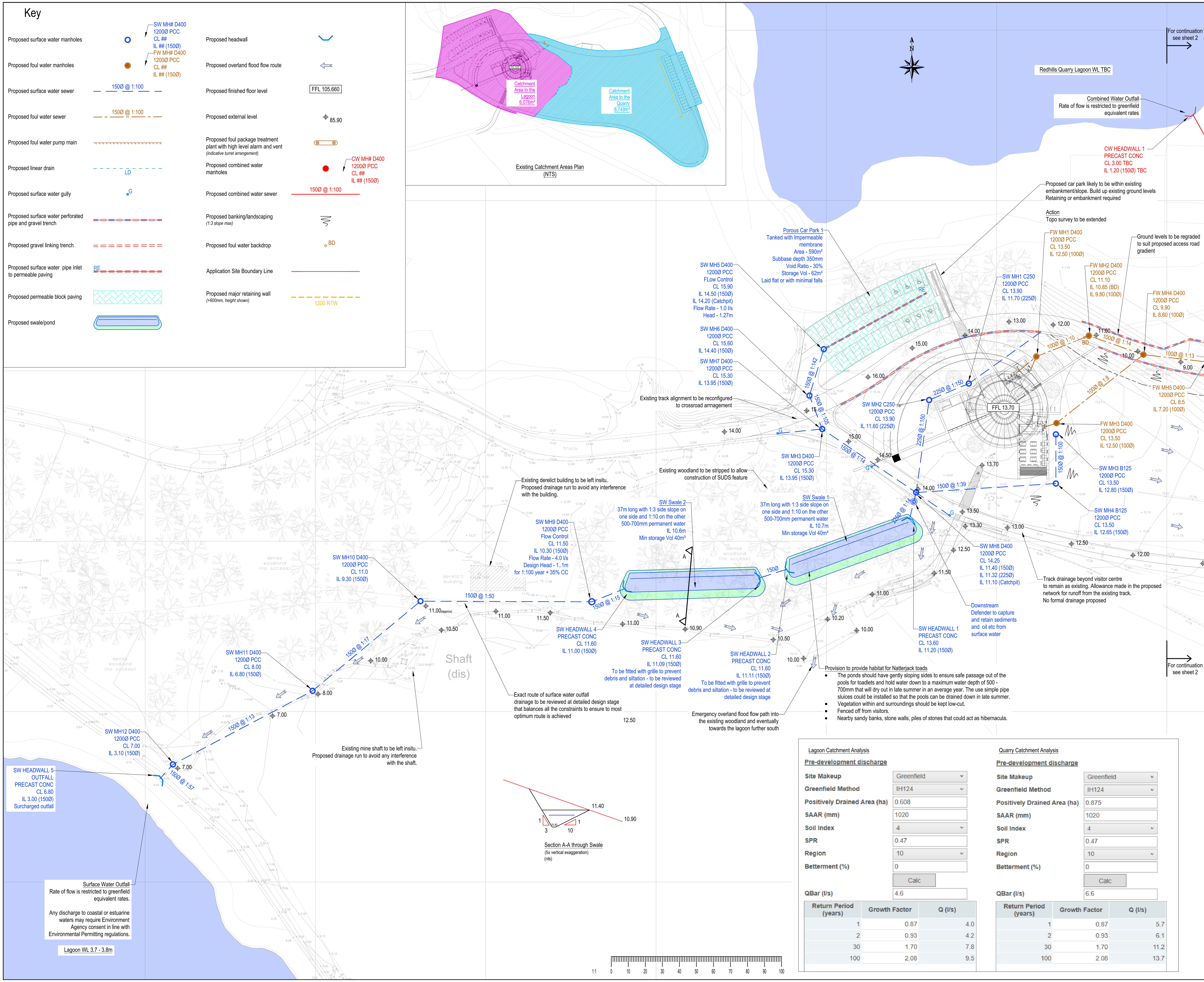
Check	MDR	Summary details[1]	Acceptable (Y/N)	Comments/ remedial actions
Maximum design storage volume(s) (m^3)				
Levels around the edge of the pond/ wetland appropriate to contain design depths of water?				
Water quality treatment (Section 23.5)				
For the 1 year, 30 min event confirm:				
Permanent pool volume is sufficient for effective treatment Or Flow velocity is acceptable for effective treatment	✓ ✓			
Landscape/biodiversity (Sections 23.6, 23.7 and 23.10)				
Is there sufficient treatment upstream of the pond to allow design amenity and biodiversity objectives to be delivered?				
Does the variation in permanent water depth have the potential to create biodiverse habitats?				
Does the design of the pond fulfil objectives of availability of different habitats including: ▪ deep water ▪ marginal ▪ dry/damp ▪ other				
A planting schedule is provided, showing species and planting preferences. Is the planting demonstrated appropriate for the habitat specified?				
Will plantings be established or rely on natural colonisation?				
Have locally appropriate native plant species been used?				
Indicate the number of different plant species used (not a monoculture)				
Is the proposed pond/wetland planting appropriate to the location, and with respect to access and maintenance?				
Where relevant, confirm planting design does not adversely impact highway visibility and safety requirements (check with highway authority)				
Is the proposed topsoil profile suitable to sustain the proposed plant species?				
Critical materials and product specifications (Section 23.9)				
Geomembrane				
Geotextile (non-woven)				

Check	MDR	Summary details[1]	Acceptable (Y/N)	Comments/ remedial actions
Topsoil				
Other (including proprietary systems)				
Constructability (Section 23.11)				
Are there any identifiable construction risks? If yes, state and confirm acceptable risk management measures are proposed				
Maintainability (Section 23.12)				
Confirm that access for maintenance is acceptable and summarise details				
Are there specific features that are likely to pose maintenance difficulties? If yes, identify mitigation measures required				
Pond/wetland design acceptability	**Summary details including any changes required**		**Acceptable (Y/N)**	**Date changes made**
Acceptable: Minor changes required: Major changes required/redesign:				

Note

1 If there is an MDR (as indicated) confirm whether or not this is met and provide details of any variations.

Appendix C Proposed Drainage Drawings



GENERAL NOTES:

1. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ALL RELEVANT ARCHITECTS AND ENGINEERS DRAWINGS AND SPECIFICATIONS.
2. DO NOT SCALE THIS DRAWING. ANY AMBIGUITIES, OMISSIONS AND ERRORS ON DRAWINGS SHALL BE BROUGHT TO THE ENGINEERS ATTENTION IMMEDIATELY. ALL DIMENSIONS MUST BE CHECKED / VERIFIED ON SITE.
3. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS NOTED OTHERWISE.
4. FOR GENERAL NOTES REFER TO DRAWING.

Surface Water Drainage Summary

Outfall to Lagoon (West)

- Existing catchment area: 0.608ha
- Equivalent Qbar runoff rate from catchment: 4.6 l/s
- Proposed Impermeable area: 0.276ha
- Proposed restricted runoff rate: 4.0 l/s (equivalent to 1:1year greenfield runoff rate) - rate to be agreed.
- Rate of runoff equates to a 58% betterment over the 1:100 greenfield runoff rate).
- Attenuation Volume required: 155m³
- A combination of permeable paving, gravel filled filter trenches, catchpit manholes and cascading ponds/swales provide water quality improvement and the required attenuation volume for all storms up to and including the 1:100 yr + 40% climate change.

Outfall to Quarry (North)

- Existing catchment area: 0.875ha
- Equivalent Qbar runoff rate from catchment: 6.6 l/s
- Proposed Impermeable area: 0.269ha
- Allowance for treated foul flow: 0.2 l/s
- Proposed restricted runoff rate: 5.5 l/s + 0.2 l/s = 5.7 l/s (equivalent to 1:1year greenfield runoff rate) - rate to be agreed.
- Rate of runoff equates to a 58% betterment over the 1:100 greenfield runoff rate).
- Attenuation Volume required: 130m³
- A combination of permeable paving, gravel filled filter trenches and catchpit manholes provide water quality improvement and the required attenuation volume for all storms up to and including the 1:100 yr + 40% climate change.

Proposed Foul Loading - TBC

British Water Foul Flows and Loads - Code of Practice

Canteen 275 covers	- 10 l/p/a
Staff 10 works	- 50 l/p/a
Visitor Toilets - 275 visitors	- 10 l/p/a
Total flow	- 6,000 l/d

Over 10h opening time

6,000/(10/3,600) ≈ 0.2 l/s

Lagoon Catchment Analysis

Pre-development discharge

Site Makeup	Greenfield
Greenfield Method	IH124
Positively Drained Area (ha)	0.608
SAAR (mm)	1020
Soil Index	4
SPR	0.47
Region	10
Betterment (%)	0
	Calc
QBar (l/s)	4.6

Return Period (years)	Growth Factor	Q (l/s)
1	0.87	4.0
2	0.93	4.2
30	1.70	7.8
100	2.08	9.5

Quarry Catchment Analysis

Pre-development discharge

Site Makeup	Greenfield
Greenfield Method	IH124
Positively Drained Area (ha)	0.875
SAAR (mm)	1020
Soil Index	4
SPR	0.47
Region	10
Betterment (%)	0
	Calc
QBar (l/s)	6.6

Return Period (years)	Growth Factor	Q (l/s)
1	0.87	5.7
2	0.93	6.1
30	1.70	11.2
100	2.08	13.7

Rev:	Description:	Date:	By:	Chkd:
P01	INITIAL ISSUE	15/05/23	CLN	GW

curtins
Units 24 & 25, Riverside Place, K-Village, Lound Road, Kendal, Cumbria, LA9 7FH
01539 724823
kendal@curtins.com
www.curtins.com

Status: SUITABLE FOR INFORMATION S2

Project: MILLOM IRON LINE

Drg Title: DRAINAGE STRATEGY SHEET 1 OF 2

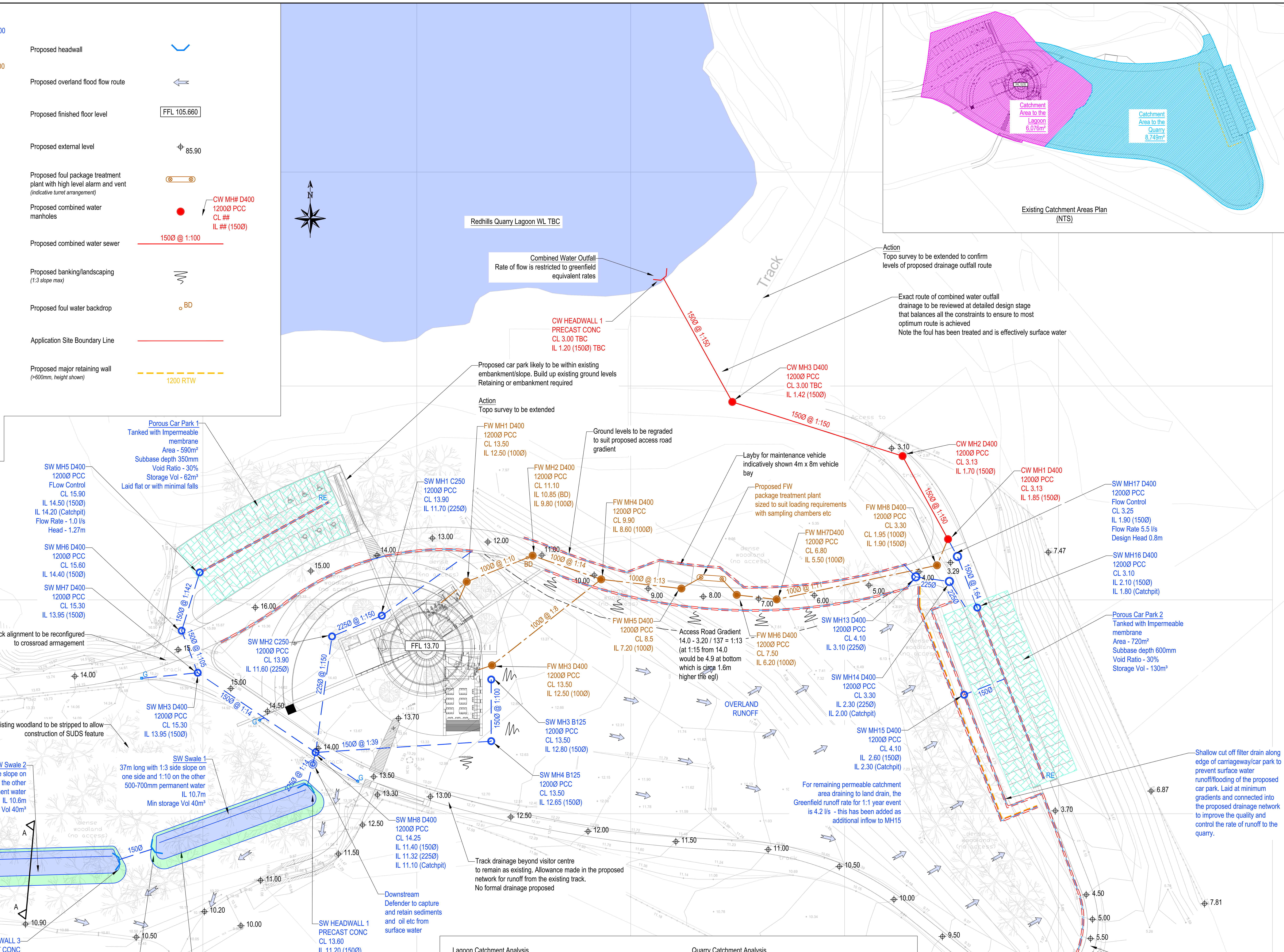
Drawn By	Designed By	Checked By
CLN	CLN	GW
Project No 081617	Date 15/05/23	Scales @ A1 1:500

Project Code - Originator - Function - Spatial - Form - Discipline - Number: 081617 - CUR - 01 - ZZ - D - C - 92001

Revision: P01

Key

Proposed surface water manholes	SW MH# D400 1200Ø PCC CL ## IL ## (150Ø)	Proposed headwall	
Proposed foul water manholes	FW MH# D400 1200Ø PCC CL ## IL ## (150Ø)	Proposed overland flood flow route	
Proposed surface water sewer	150Ø @ 1:100	Proposed finished floor level	FFL 105.660
Proposed foul water sewer	150Ø @ 1:100	Proposed external level	85.90
Proposed foul water pump main		Proposed foul package treatment plant with high level alarm and vent (indicative turret arrangement)	
Proposed linear drain	LD	Proposed combined water manholes	CW MH# D400 1200Ø PCC CL ## IL ## (150Ø)
Proposed surface water gully	G	Proposed combined water sewer	150Ø @ 1:100
Proposed surface water perforated pipe and gravel trench		Proposed banking/landscaping (1:3 slope max)	
Proposed gravel linking trench		Proposed foul water backdrop	BD
Proposed surface water pipe inlet to permeable paving	RE	Application Site Boundary Line	
Proposed permeable block paving		Proposed major retaining wall (>600mm, height shown)	1200 RTW
Proposed swale/pond			



For continuation see sheet 1

Existing derelict building to be left insitu. Proposed drainage run to avoid any interference with the building.

SW Swale 2
37m long with 1:3 side slope on one side and 1:10 on the other side
500-700mm permanent water
IL 10.6m
Min storage Vol 40m³

SW MH9 D400
1200Ø PCC
Flow Control
CL 11.50
IL 10.30 (150Ø)
Flow Rate - 4.0 l/s
Design Head - 1..1m
for 1:100 year + 35% CC

SW HEADWALL 4
PRECAST CONC
CL 11.60
IL 11.00 (150Ø)

SW HEADWALL 3
PRECAST CONC
CL 11.60
IL 11.09 (150Ø)
To be fitted with grille to prevent debris and siltation - to be reviewed at detailed design stage

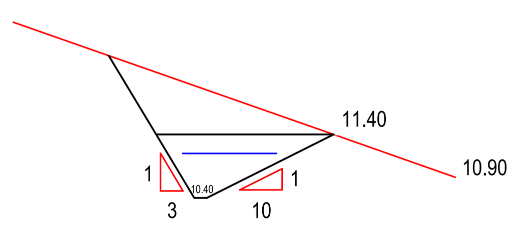
SW HEADWALL 2
PRECAST CONC
CL 11.60
IL 11.11 (150Ø)
To be fitted with grille to prevent debris and siltation - to be reviewed at detailed design stage

Exact route of surface water outfall drainage to be reviewed at detailed design stage that balances all the constraints to most optimum route is achieved

Emergency overland flood flow path into the existing woodland and eventually towards the lagoon further south

Provision to provide habitat for Natterjack toads
- The ponds should have gently sloping sides to ensure safe passage out of the pools for toadlets and hold water down to a maximum water depth of 500 - 700mm that will dry out in late summer in an average year. The use simple pipe sluices could be installed so that the pools can be drained down in late summer.
- Vegetation within and surroundings should be kept low-cut.
- Fenced off from visitors.
- Nearby sandy banks, stone walls, piles of stones that could act as hibernacula.

For continuation see sheet 1



Section A-A through Swale
(5x vertical exaggeration)
(nts)

Lagoon Catchment Analysis

Pre-development discharge

Site Makeup	Greenfield
Greenfield Method	IH124
Positively Drained Area (ha)	0.608
SAAR (mm)	1020
Soil Index	4
SPR	0.47
Region	10
Betterment (%)	0
	Calc
QBar (l/s)	4.6

Return Period (years)	Growth Factor	Q (l/s)
1	0.87	4.0
2	0.93	4.2
30	1.70	7.8
100	2.08	9.5

Quarry Catchment Analysis

Pre-development discharge

Site Makeup	Greenfield
Greenfield Method	IH124
Positively Drained Area (ha)	0.875
SAAR (mm)	1020
Soil Index	4
SPR	0.47
Region	10
Betterment (%)	0
	Calc
QBar (l/s)	6.6

Return Period (years)	Growth Factor	Q (l/s)
1	0.87	5.7
2	0.93	6.1
30	1.70	11.2
100	2.08	13.7

1:1 0 10 20 30 40 50 60 70 80 90 100

GENERAL NOTES:

1. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ALL RELEVANT ARCHITECTS AND ENGINEERS DRAWINGS AND SPECIFICATIONS.
2. DO NOT SCALE THIS DRAWING. ANY AMBIGUITIES, OMISSIONS AND ERRORS ON DRAWINGS SHALL BE BROUGHT TO THE ENGINEERS ATTENTION IMMEDIATELY. ALL DIMENSIONS MUST BE CHECKED / VERIFIED ON SITE.
3. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS NOTED OTHERWISE.
4. FOR GENERAL NOTES REFER TO DRAWING.

Surface Water Drainage Summary

Outfall to Lagoon (West)
- Existing catchment area: 0.608ha
- Equivalent Qbar runoff rate from catchment: 4.6 l/s
- Proposed Impermeable area: 0.276ha
- Proposed restricted runoff rate: 4.0 l/s (equivalent to 1:1year greenfield runoff rate) - rate to be agreed.
- Rate of runoff equates to a 58% betterment over the 1:100 greenfield runoff rate).
- Attenuation Volume required: 155m³
- A combination of permeable paving, gravel filled filter trenches, catchpit manholes and cascading ponds/swales provide water quality improvement and the required attenuation volume for all storms up to and including the 1:100 yr + 40% climate change.

Outfall to Quarry (North)
- Existing catchment area: 0.875ha
- Equivalent Qbar runoff rate from catchment: 6.6 l/s
- Proposed Impermeable area: 0.269ha
- Allowance for treated foul flow: 0.2 l/s
- Proposed restricted runoff rate: 5.5 l/s + 0.2 l/s = 5.7 l/s (equivalent to 1:1year greenfield runoff rate) - rate to be agreed.
- Rate of runoff equates to a 58% betterment over the 1:100 greenfield runoff rate).
- Attenuation Volume required: 130m³
- A combination of permeable paving, gravel filled filter trenches and catchpit manholes provide water quality improvement and the required attenuation volume for all storms up to and including the 1:100 yr + 40% climate change.

Proposed Foul Loading - TBC

British Water Foul Flows and Loads - Code of Practice

Canteen 275 covers	- 10 l/p/a
Staff 10 works	- 50 l/p/a
Visitor Toilets - 275 visitors	- 10 l/p/a
Total flow	- 6,000 l/d

Over 10h opening time
6,000/(10/3,600) ≈ 0.2 l/s

Rev:	Description:	Date:	By:	Chkd:
P01	INITIAL ISSUE	15/05/23	CLN	GW

curtins
Units 24 & 25, Riverside Place, K-Village, Lound Road, Kendal, Cumbria, LA9 7FH
01539 724823
kendal@curtins.com
www.curtins.com
Civils & Structures • Transport Planning • Environmental • Infrastructure • Geotechnical • Conservation & Heritage • Principal Designer
Birmingham • Bristol • Cambridge • Cardiff • Douglas • Dublin • Edinburgh • Glasgow • Kendal • Leeds • Liverpool • London • Manchester • Nottingham

Status: SUITABLE FOR INFORMATION S2

Project: MILLOM IRON LINE

Drg Title: DRAINAGE STRATEGY SHEET 2 OF 2

Drawn By	Designed By	Checked By
CLN	CLN	GW
Project No 081617	Date 15/05/23	Scales @ A1 1:500

Project Code - Originator - Volume - Spatial - Form - Discipline - Number: 081617 - CUR - 01 - ZZ - D - C - 92002

Revision: P01

Appendix D Drainage Calculations

Design Settings

Rainfall Methodology	FSR	Maximum Time of Concentration (mins)	30.00
Return Period (years)	2	Maximum Rainfall (mm/hr)	50.0
Additional Flow (%)	0	Minimum Velocity (m/s)	1.00
FSR Region	England and Wales	Connection Type	Level Soffits
M5-60 (mm)	17.000	Minimum Backdrop Height (m)	0.200
Ratio-R	0.300	Preferred Cover Depth (m)	1.200
CV	0.750	Include Intermediate Ground	✓
Time of Entry (mins)	5.00	Enforce best practice design rules	✓

Nodes

Name	Area (ha)	T of E (mins)	Cover Level (m)	Diameter (mm)	Sump (m)	Depth (m)
SW1	0.062	5.00	13.900	1200	0.300	2.500
SW2	0.027	5.00	13.900	1200	0.300	2.600
SW3	0.025	5.00	13.500	1200		0.700
SW4	0.025	5.00	13.500	1200		0.850
SW5 FC	0.059	5.00	15.900	1200	0.300	1.700
SW6	0.011	5.00	15.600	1200		1.400
SW7	0.016	5.00	15.300	1200		1.350
SW8	0.012	5.00	14.000	1200	0.300	2.900
HW1			13.600	1200		2.400
HW2			11.600	1200		0.490
HW3			11.600	1200		0.510
HW4			11.600	1200		0.600
SW9 FC			11.500	1500		1.200
SW10			11.000	1200		1.700
SW11			8.000	1200		1.200
SW12			7.000	1200		3.900
HW5 OUTFALL			6.800	1200		3.800

Pipeline Schedule

Link	Length (m)	Slope (1:X)	Dia (mm)	US CL (m)	US IL (m)	US Depth (m)	DS CL (m)	DS IL (m)	DS Depth (m)
1.000	12.608	126.1	225	13.900	11.700	1.975	13.900	11.600	2.075
1.001	27.401	137.0	225	13.900	11.600	2.075	14.000	11.400	2.375
2.000	14.423	96.2	150	13.500	12.800	0.550	13.500	12.650	0.700
2.001	41.120	34.3	150	13.500	12.650	0.700	14.000	11.450	2.400
3.000	14.263	47.5	150	15.900	14.500	1.250	15.600	14.200	1.250
3.001	10.508	42.0	150	15.600	14.200	1.250	15.300	13.950	1.200
3.002	33.276	13.0	150	15.300	13.950	1.200	14.000	11.400	2.450
1.002	7.904	39.5	225	14.000	11.400	2.375	13.600	11.200	2.175
1.003	38.900	432.2	150	13.600	11.200	2.250	11.600	11.110	0.340
1.004	8.100	405.0	150	11.600	11.110	0.340	11.600	11.090	0.360
1.005	38.900	432.2	150	11.600	11.090	0.360	11.600	11.000	0.450

Link	US Node	Dia (mm)	Sump (m)	Node Type	MH Type	DS Node	Dia (mm)	Sump (m)	Node Type	MH Type
1.000	SW1	1200	0.300	Manhole	HCD Catchpit	SW2	1200	0.300	Manhole	HCD Catchpit
1.001	SW2	1200	0.300	Manhole	HCD Catchpit	SW8	1200	0.300	Manhole	HCD Catchpit
2.000	SW3	1200		Manhole	HCD Manhole	SW4	1200		Manhole	HCD Manhole
2.001	SW4	1200		Manhole	HCD Manhole	SW8	1200	0.300	Manhole	HCD Catchpit
3.000	SW5 FC	1200	0.300	Manhole	HCD Catchpit	SW6	1200		Manhole	HCD Manhole
3.001	SW6	1200		Manhole	HCD Manhole	SW7	1200		Manhole	HCD Manhole
3.002	SW7	1200		Manhole	HCD Manhole	SW8	1200	0.300	Manhole	HCD Catchpit
1.002	SW8	1200	0.300	Manhole	HCD Catchpit	HW1	1200		Manhole	Headwall
1.003	HW1	1200		Manhole	Headwall	HW2	1200		Manhole	HCD Manhole
1.004	HW2	1200		Manhole	HCD Manhole	HW3	1200		Manhole	HCD Manhole
1.005	HW3	1200		Manhole	HCD Manhole	HW4	1200		Manhole	HCD Manhole

Pipeline Schedule

Link	Length (m)	Slope (1:X)	Dia (mm)	US CL (m)	US IL (m)	US Depth (m)	DS CL (m)	DS IL (m)	DS Depth (m)
1.006	10.400	14.9	150	11.600	11.000	0.450	11.500	10.300	1.050
1.007	50.304	50.3	150	11.500	10.300	1.050	11.000	9.300	1.550
1.008	41.201	16.5	150	11.000	9.300	1.550	8.000	6.800	1.050
1.009	46.330	12.5	150	8.000	6.800	1.050	7.000	3.100	3.750
1.010	5.700	57.0	150	7.000	3.100	3.750	6.800	3.000	3.650

Link	US Node	Dia (mm)	Sump (m)	Node Type	MH Type	DS Node	Dia (mm)	Sump (m)	Node Type	MH Type
1.006	HW4	1200		Manhole	HCD Manhole	SW9 FC	1500		Manhole	HCD Manhole
1.007	SW9 FC	1500		Manhole	HCD Manhole	SW10	1200		Manhole	HCD Manhole
1.008	SW10	1200		Manhole	HCD Manhole	SW11	1200		Manhole	HCD Manhole
1.009	SW11	1200		Manhole	HCD Manhole	SW12	1200		Manhole	HCD Manhole
1.010	SW12	1200		Manhole	HCD Manhole	HW5 OUTFALL	1200		Manhole	Headwall

Simulation Settings

Rainfall Methodology	FSR	Drain Down Time (mins)	240
FSR Region	England and Wales	Additional Storage (m³/ha)	0.0
M5-60 (mm)	17.000	Check Discharge Rate(s)	✓
Ratio-R	0.300	1 year (l/s)	4.0
Summer CV	0.750	2 year (l/s)	4.2
Winter CV	0.840	30 year (l/s)	7.8
Analysis Speed	Normal	100 year (l/s)	9.5
Skip Steady State	x	Check Discharge Volume	x

Storm Durations

15	30	60	120	180	240	360	480	600	720	960	1440

Return Period (years)	Climate Change (CC %)	Additional Area (A %)	Additional Flow (Q %)	Return Period (years)	Climate Change (CC %)	Additional Area (A %)	Additional Flow (Q %)
1	0	0	0	30	0	0	0
2	0	0	0	100	35	0	0

Pre-development Discharge Rate

Site Makeup	Greenfield	SPR	0.47	Betterment (%)	0
Greenfield Method	IH124	Region	10	QBar	4.6
Positively Drained Area (ha)	0.608	Growth Factor 1 year	0.85	Q 1 year (l/s)	
SAAR (mm)	1020	Growth Factor 30 year	1.95	Q 30 year (l/s)	
Soil Index	4	Growth Factor 100 year	2.48	Q 100 year (l/s)	

Node SW9 FC Online Hydro-Brake® Control

Flap Valve	x	Objective	(HE) Minimise upstream storage
Replaces Downstream Link	x	Sump Available	✓
Invert Level (m)	10.300	Product Number	CTL-SHE-0095-4000-1010-4000
Design Depth (m)	1.010	Min Outlet Diameter (m)	0.150
Design Flow (l/s)	4.0	Min Node Diameter (mm)	1200

Node SW5 FC Online Orifice Control

Flap Valve	x	Design Depth (m)	1.270	Discharge Coefficient	0.600
Replaces Downstream Link	✓	Design Flow (l/s)	1.0		
Invert Level (m)	14.500	Diameter (m)	0.020		

Node SW5 FC Carpark Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Invert Level (m)	15.400	Slope (1:X)	500.0
Side Inf Coefficient (m/hr)	0.00000	Time to half empty (mins)	200	Depth (m)	0.350
Safety Factor	2.0	Width (m)	16.000	Inf Depth (m)	
Porosity	0.30	Length (m)	37.000		

Node HW1 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	10.700
Side Inf Coefficient (m/hr)	0.00000	Porosity	1.00	Time to half empty (mins)	0

Depth (m)	Area (m^2)	Inf Area (m^2)	Depth (m)	Area (m^2)	Inf Area (m^2)	Depth (m)	Area (m^2)	Inf Area (m^2)	Depth (m)	Area (m^2)	Inf Area (m^2)
0.000	46.0	0.0	0.300	136.0	0.0	0.600	226.0	0.0	0.900	316.0	0.0
0.100	76.0	0.0	0.400	166.0	0.0	0.700	256.0	0.0	1.000	345.0	0.0
0.200	106.0	0.0	0.500	196.0	0.0	0.800	286.0	0.0			

Node HW3 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	10.600
Side Inf Coefficient (m/hr)	0.00000	Porosity	1.00	Time to half empty (mins)	

Depth (m)	Area (m^2)	Inf Area (m^2)	Depth (m)	Area (m^2)	Inf Area (m^2)	Depth (m)	Area (m^2)	Inf Area (m^2)	Depth (m)	Area (m^2)	Inf Area (m^2)
0.000	46.0	0.0	0.300	136.0	0.0	0.600	226.0	0.0	0.900	316.0	0.0
0.100	76.0	0.0	0.400	166.0	0.0	0.700	256.0	0.0	1.000	345.0	0.0
0.200	106.0	0.0	0.500	196.0	0.0	0.800	286.0	0.0			

Results for 1 year Critical Storm Duration. Lowest mass balance: 92.50%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute winter	SW1	10	11.760	0.060	6.7	0.0677	0.0000	OK
15 minute winter	SW2	10	11.671	0.071	9.5	0.0803	0.0000	OK
15 minute winter	SW3	10	12.840	0.040	2.7	0.0447	0.0000	OK
15 minute winter	SW4	11	12.693	0.043	5.4	0.0484	0.0000	OK
60 minute winter	SW5 FC	49	15.442	0.942	3.6	3.1997	0.0000	SURCHARGED
15 minute winter	SW6	10	14.228	0.028	2.0	0.0315	0.0000	OK
15 minute winter	SW7	10	13.978	0.028	3.7	0.0311	0.0000	OK
15 minute winter	SW8	11	11.482	0.082	19.5	0.0925	0.0000	OK
120 minute winter	HW1	82	11.260	0.060	7.9	12.2159	0.0000	OK
120 minute winter	HW2	82	11.189	0.079	4.7	0.0890	0.0000	OK
240 minute winter	HW3	184	11.143	0.053	4.4	10.6924	0.0000	OK
240 minute winter	HW4	184	11.027	0.027	3.3	0.0308	0.0000	OK
240 minute winter	SW9 FC	184	10.450	0.150	3.3	0.2643	0.0000	OK
240 minute winter	SW10	184	9.329	0.029	3.3	0.0323	0.0000	OK
240 minute winter	SW11	188	6.826	0.026	3.3	0.0296	0.0000	OK
120 minute winter	SW12	102	3.707	0.607	2.8	0.6867	0.0000	SURCHARGED
15 minute summer	HW5 OUTFALL	1	3.700	0.700	1.1	0.0000	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute winter	SW1	1.000	SW2	6.6	0.692	0.143	0.1208	
15 minute winter	SW2	1.001	SW8	9.4	0.799	0.211	0.3237	
15 minute winter	SW3	2.000	SW4	2.7	0.687	0.148	0.0562	
15 minute winter	SW4	2.001	SW8	5.3	1.290	0.173	0.1687	
60 minute winter	SW5 FC	Orifice	SW6	0.8				
15 minute winter	SW6	3.001	SW7	2.0	0.885	0.072	0.0234	
15 minute winter	SW7	3.002	SW8	3.6	0.913	0.073	0.1997	
15 minute winter	SW8	1.002	HW1	19.6	1.607	0.236	0.0964	
120 minute winter	HW1	1.003	HW2	4.7	0.595	0.452	0.3092	
120 minute winter	HW2	1.004	HW3	4.7	0.580	0.542	0.0660	
240 minute winter	HW3	1.005	HW4	3.3	0.875	0.318	0.1516	
240 minute winter	HW4	1.006	SW9 FC	3.3	0.317	0.072	0.1028	
240 minute winter	SW9 FC	1.007	SW10	3.3	1.124	0.132	0.1499	
240 minute winter	SW10	1.008	SW11	3.3	1.520	0.076	0.0902	
240 minute winter	SW11	1.009	SW12	3.3	0.310	0.066	0.4553	
120 minute winter	SW12	1.010	HW5 OUTFALL	2.8	0.159	0.118	0.1003	20.7

Results for 2 year Critical Storm Duration. Lowest mass balance: 92.50%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute winter	SW1	10	11.769	0.069	8.7	0.0784	0.0000	OK
15 minute winter	SW2	10	11.682	0.082	12.4	0.0929	0.0000	OK
15 minute winter	SW3	10	12.845	0.045	3.5	0.0513	0.0000	OK
15 minute winter	SW4	11	12.699	0.049	7.0	0.0551	0.0000	OK
120 minute winter	SW5 FC	92	15.454	0.954	3.0	4.5433	0.0000	SURCHARGED
15 minute winter	SW6	11	14.230	0.030	2.3	0.0339	0.0000	OK
15 minute winter	SW7	10	13.981	0.031	4.5	0.0345	0.0000	OK
15 minute winter	SW8	11	11.495	0.095	25.0	0.1073	0.0000	OK
120 minute winter	HW1	80	11.269	0.069	10.0	14.3027	0.0000	OK
120 minute winter	HW2	82	11.201	0.091	6.0	0.1026	0.0000	OK
240 minute winter	HW3	176	11.150	0.060	5.3	12.1354	0.0000	OK
240 minute winter	HW4	176	11.031	0.031	4.2	0.0345	0.0000	OK
240 minute winter	SW9 FC	192	10.645	0.345	4.2	0.6093	0.0000	SURCHARGED
240 minute winter	SW10	196	9.331	0.031	4.0	0.0354	0.0000	OK
240 minute winter	SW11	192	6.829	0.029	4.0	0.0323	0.0000	OK
60 minute summer	SW12	75	3.707	0.607	2.3	0.6861	0.0000	SURCHARGED
15 minute summer	HW5 OUTFALL	1	3.700	0.700	1.0	0.0000	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute winter	SW1	1.000	SW2	8.6	0.735	0.186	0.1479	
15 minute winter	SW2	1.001	SW8	12.2	0.851	0.275	0.3943	
15 minute winter	SW3	2.000	SW4	3.5	0.735	0.191	0.0678	
15 minute winter	SW4	2.001	SW8	6.8	1.382	0.223	0.2020	
120 minute winter	SW5 FC	Orifice	SW6	0.8				
15 minute winter	SW6	3.001	SW7	2.3	0.913	0.084	0.0266	
15 minute winter	SW7	3.002	SW8	4.5	0.916	0.090	0.2376	
15 minute winter	SW8	1.002	HW1	25.2	1.708	0.304	0.1166	
120 minute winter	HW1	1.003	HW2	6.0	0.633	0.578	0.3712	
120 minute winter	HW2	1.004	HW3	6.0	0.624	0.694	0.0784	
240 minute winter	HW3	1.005	HW4	4.2	0.935	0.401	0.1783	
240 minute winter	HW4	1.006	SW9 FC	4.2	0.345	0.090	0.1049	
240 minute winter	SW9 FC	1.007	SW10	4.0	1.184	0.159	0.1710	
240 minute winter	SW10	1.008	SW11	4.0	1.605	0.091	0.1028	
240 minute winter	SW11	1.009	SW12	4.0	0.335	0.079	0.4619	
60 minute summer	SW12	1.010	HW5 OUTFALL	2.3	0.133	0.099	0.1003	16.6

Results for 30 year Critical Storm Duration. Lowest mass balance: 92.50%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute winter	SW1	10	11.800	0.100	16.4	0.1131	0.0000	OK
15 minute winter	SW2	10	11.719	0.119	23.3	0.1349	0.0000	OK
15 minute winter	SW3	10	12.865	0.065	6.6	0.0730	0.0000	OK
15 minute winter	SW4	10	12.718	0.068	13.1	0.0771	0.0000	OK
180 minute winter	SW5 FC	148	15.496	0.996	4.4	11.5193	0.0000	SURCHARGED
15 minute winter	SW6	10	14.238	0.038	3.7	0.0428	0.0000	OK
15 minute winter	SW7	10	13.990	0.040	7.9	0.0456	0.0000	OK
15 minute winter	SW8	11	11.541	0.141	46.9	0.1595	0.0000	OK
60 minute winter	HW1	45	11.313	0.113	27.3	24.1480	0.0000	OK
60 minute winter	HW2	46	11.249	0.139	11.5	0.1574	0.0000	OK
240 minute winter	HW3	220	11.228	0.138	9.5	29.5192	0.0000	OK
240 minute winter	HW4	220	11.221	0.221	6.3	0.2494	0.0000	SURCHARGED
240 minute winter	SW9 FC	220	11.214	0.914	6.2	1.6158	0.0000	FLOOD RISK
960 minute summer	SW10	495	9.331	0.031	4.0	0.0354	0.0000	OK
30 minute winter	SW11	56	6.829	0.029	4.0	0.0323	0.0000	OK
60 minute winter	SW12	56	3.712	0.612	4.0	0.6919	0.0000	SURCHARGED
15 minute summer	HW5 OUTFALL	1	3.700	0.700	2.8	0.0000	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute winter	SW1	1.000	SW2	16.2	0.846	0.351	0.2420	
15 minute winter	SW2	1.001	SW8	23.0	0.973	0.519	0.6474	
15 minute winter	SW3	2.000	SW4	6.5	0.867	0.360	0.1084	
15 minute winter	SW4	2.001	SW8	12.9	1.465	0.423	0.3875	
180 minute winter	SW5 FC	Orifice	SW6	0.8				
15 minute winter	SW6	3.001	SW7	3.7	1.008	0.134	0.0383	
15 minute winter	SW7	3.002	SW8	7.8	0.921	0.157	0.3480	
15 minute winter	SW8	1.002	HW1	46.7	1.958	0.563	0.1885	
60 minute winter	HW1	1.003	HW2	11.5	0.725	1.095	0.6089	
60 minute winter	HW2	1.004	HW3	11.4	0.763	1.313	0.1191	
240 minute winter	HW3	1.005	HW4	6.3	1.043	0.598	0.6719	
240 minute winter	HW4	1.006	SW9 FC	6.2	0.488	0.133	0.1831	
240 minute winter	SW9 FC	1.007	SW10	4.0	1.183	0.159	0.1705	
960 minute summer	SW10	1.008	SW11	4.0	1.605	0.091	0.1028	
30 minute winter	SW11	1.009	SW12	4.0	0.988	0.079	0.4619	
60 minute winter	SW12	1.010	HW5 OUTFALL	5.2	0.293	0.219	0.1003	40.1

Results for 100 year +35% CC Critical Storm Duration. Lowest mass balance: 92.50%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute winter	SW1	11	11.846	0.146	28.4	0.1649	0.0000	OK
15 minute winter	SW2	11	11.823	0.223	40.5	0.2524	0.0000	OK
15 minute winter	SW3	10	12.891	0.091	11.4	0.1031	0.0000	OK
15 minute winter	SW4	10	12.746	0.096	22.7	0.1081	0.0000	OK
240 minute winter	SW5 FC	232	15.574	1.073	6.4	25.4595	0.0000	SURCHARGED
15 minute winter	SW6	10	14.248	0.048	5.8	0.0543	0.0000	OK
15 minute winter	SW7	10	14.002	0.052	13.1	0.0593	0.0000	OK
15 minute winter	SW8	11	11.662	0.262	79.9	0.2959	0.0000	SURCHARGED
60 minute winter	HW1	48	11.397	0.197	47.8	44.4362	0.0000	SURCHARGED
240 minute winter	HW2	232	11.326	0.216	12.7	0.2446	0.0000	FLOOD RISK
360 minute winter	HW3	320	11.320	0.230	11.6	52.4823	0.0000	FLOOD RISK
360 minute winter	HW4	320	11.311	0.311	6.1	0.3520	0.0000	FLOOD RISK
360 minute winter	SW9 FC	320	11.305	1.005	5.1	1.7750	0.0000	FLOOD RISK
15 minute summer	SW10	40	9.331	0.031	4.0	0.0354	0.0000	OK
15 minute summer	SW11	41	6.829	0.029	4.0	0.0323	0.0000	OK
60 minute summer	SW12	51	3.713	0.613	4.0	0.6929	0.0000	SURCHARGED
15 minute summer	HW5 OUTFALL	1	3.700	0.700	5.3	0.0000	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute winter	SW1	1.000	SW2	28.1	0.924	0.608	0.4219	
15 minute winter	SW2	1.001	SW8	39.1	1.056	0.881	1.0889	
15 minute winter	SW3	2.000	SW4	11.3	0.979	0.623	0.1662	
15 minute winter	SW4	2.001	SW8	22.4	1.497	0.735	0.6054	
240 minute winter	SW5 FC	Orifice	SW6	0.9				
15 minute winter	SW6	3.001	SW7	5.8	1.117	0.210	0.0543	
15 minute winter	SW7	3.002	SW8	13.0	0.949	0.262	0.3841	
15 minute winter	SW8	1.002	HW1	76.7	2.092	0.925	0.2835	
60 minute winter	HW1	1.003	HW2	14.3	0.811	1.365	0.6848	
240 minute winter	HW2	1.004	HW3	12.7	0.787	1.452	0.1426	
360 minute winter	HW3	1.005	HW4	6.1	1.014	0.579	0.6848	
360 minute winter	HW4	1.006	SW9 FC	5.1	0.409	0.109	0.1831	
360 minute winter	SW9 FC	1.007	SW10	4.0	1.184	0.159	0.1710	
15 minute summer	SW10	1.008	SW11	4.0	1.605	0.091	0.1028	
15 minute summer	SW11	1.009	SW12	4.0	1.044	0.079	0.4619	
60 minute summer	SW12	1.010	HW5 OUTFALL	3.9	0.224	0.167	0.1003	55.4

Design Settings

Rainfall Methodology	FSR	Maximum Time of Concentration (mins)	30.00
Return Period (years)	2	Maximum Rainfall (mm/hr)	50.0
Additional Flow (%)	0	Minimum Velocity (m/s)	1.00
FSR Region	England and Wales	Connection Type	Level Soffits
M5-60 (mm)	17.000	Minimum Backdrop Height (m)	0.200
Ratio-R	0.300	Preferred Cover Depth (m)	1.200
CV	0.750	Include Intermediate Ground	✓
Time of Entry (mins)	5.00	Enforce best practice design rules	✓

Nodes

Name	Area (ha)	T of E (mins)	Add Inflow (l/s)	Cover Level (m)	Diameter (mm)	Depth (m)
SW13	0.063	5.00		4.100	1200	1.000
SW14	0.020	5.00		3.300	1200	1.000
SW15		5.00	4.2	4.100	1200	1.500
SW16	0.084	5.00		3.100	1200	1.000
SW17 FC				3.250	1500	1.350
CW1				3.130	1200	1.280
CW2				3.100	1200	1.400
CW3				3.000	1200	1.580
HW1				2.500	1200	1.300

Pipeline Schedule

Link	Length (m)	Slope (1:X)	Dia (mm)	US CL (m)	US IL (m)	US Depth (m)	DS CL (m)	DS IL (m)	DS Depth (m)
1.000	7.920	9.9	150	4.100	3.100	0.850	3.300	2.300	0.850
1.002	7.240	36.2	150	3.300	2.300	0.850	3.100	2.100	0.850
2.000	12.600	25.2	150	4.100	2.600	1.350	3.100	2.100	0.850
1.004	12.820	64.1	150	3.100	2.100	0.850	3.250	1.900	1.200
1.005	4.610	92.2	150	3.250	1.900	1.200	3.130	1.850	1.130
1.006	22.140	147.6	150	3.130	1.850	1.130	3.100	1.700	1.250
1.007	41.740	149.1	150	3.100	1.700	1.250	3.000	1.420	1.430
1.008	33.110	150.5	150	3.000	1.420	1.430	2.500	1.200	1.150

Link	US Node	Dia (mm)	Node Type	MH Type	DS Node	Dia (mm)	Node Type	MH Type
1.000	SW13	1200	Manhole	HCD Manhole	SW14	1200	Manhole	HCD Catchpit
1.002	SW14	1200	Manhole	HCD Catchpit	SW16	1200	Manhole	HCD Catchpit
2.000	SW15	1200	Manhole	HCD Manhole	SW16	1200	Manhole	HCD Catchpit
1.004	SW16	1200	Manhole	HCD Catchpit	SW17 FC	1500	Manhole	HCD Manhole
1.005	SW17 FC	1500	Manhole	HCD Manhole	CW1	1200	Manhole	HCD Manhole
1.006	CW1	1200	Manhole	HCD Manhole	CW2	1200	Manhole	HCD Manhole
1.007	CW2	1200	Manhole	HCD Manhole	CW3	1200	Manhole	HCD Manhole
1.008	CW3	1200	Manhole	HCD Manhole	HW1	1200	Manhole	Headwall

Simulation Settings

Rainfall Methodology	FSR	Drain Down Time (mins)	240
FSR Region	England and Wales	Additional Storage (m³/ha)	0.0
M5-60 (mm)	17.000	Check Discharge Rate(s)	✓
Ratio-R	0.300	1 year (l/s)	5.6
Summer CV	0.750	2 year (l/s)	6.1
Winter CV	0.840	30 year (l/s)	12.8
Analysis Speed	Normal	100 year (l/s)	16.3
Skip Steady State	x	Check Discharge Volume	x

Storm Durations

15	30	60	120	180	240	360	480	600	720	960	1440

Return Period (years)	Climate Change (CC %)	Additional Area (A %)	Additional Flow (Q %)	Return Period (years)	Climate Change (CC %)	Additional Area (A %)	Additional Flow (Q %)
1	0	0	0	30	0	0	0
2	0	0	0	100	35	0	0

Pre-development Discharge Rate

Site Makeup	Greenfield	Region	10	QBar	6.6
Greenfield Method	IH124	Growth Factor 1 year	0.85	Q 1 year (l/s)	5.6
Positively Drained Area (ha)	0.875	Growth Factor 2 year	0.93	Q 2 year (l/s)	6.1
SAAR (mm)	1020	Growth Factor 30 year	1.95	Q 30 year (l/s)	12.8
Soil Index	4	Growth Factor 100 year	2.48	Q 100 year (l/s)	16.3
SPR	0.47	Betterment (%)	0		

Node SW17 FC Online Hydro-Brake® Control

Flap Valve	x	Objective	(HE) Minimise upstream storage
Replaces Downstream Link	✓	Sump Available	✓
Invert Level (m)	1.900	Product Number	CTL-SHE-0113-5500-0800-5500
Design Depth (m)	0.800	Min Outlet Diameter (m)	0.150
Design Flow (l/s)	5.5	Min Node Diameter (mm)	1200

Node SW16 Carpark Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Invert Level (m)	2.100	Slope (1:X)	500.0
Side Inf Coefficient (m/hr)	0.00000	Time to half empty (mins)		Depth (m)	0.600
Safety Factor	2.0	Width (m)	16.000	Inf Depth (m)	
Porosity	0.30	Length (m)	45.000		

Results for 1 year Critical Storm Duration. Lowest mass balance: 99.78%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute winter	SW13	10	3.135	0.035	6.8	0.0396	0.0000	OK
15 minute winter	SW14	10	2.360	0.060	9.0	0.0684	0.0000	OK
60 minute winter	SW15	1	2.644	0.044	4.2	0.0499	0.0000	OK
180 minute winter	SW16	140	2.210	0.110	9.5	14.1228	0.0000	OK
180 minute winter	SW17 FC	140	2.199	0.299	5.8	0.5280	0.0000	SURCHARGED
15 minute winter	CW1	11	1.915	0.065	5.5	0.0739	0.0000	OK
15 minute winter	CW2	12	1.765	0.065	5.5	0.0732	0.0000	OK
15 minute summer	CW3	15	1.485	0.065	5.5	0.0737	0.0000	OK
15 minute summer	HW1	15	1.264	0.064	5.5	0.0000	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute winter	SW13	1.000	SW14	6.8	1.407	0.119	0.0386	
15 minute winter	SW14	1.002	SW16	8.9	1.331	0.300	0.0502	
60 minute winter	SW15	2.000	SW16	4.4	1.987	0.124	0.1003	
180 minute winter	SW16	1.004	SW17 FC	5.8	0.490	0.260	0.2014	
180 minute winter	SW17 FC	Hydro-Brake®	CW1	5.5				
15 minute winter	CW1	1.006	CW2	5.5	0.753	0.376	0.1619	
15 minute winter	CW2	1.007	CW3	5.5	0.762	0.379	0.3043	
15 minute summer	CW3	1.008	HW1	5.5	0.758	0.380	0.2397	68.2

Results for 2 year Critical Storm Duration. Lowest mass balance: 99.78%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute winter	SW13	10	3.140	0.040	8.8	0.0451	0.0000	OK
15 minute winter	SW14	10	2.371	0.071	11.6	0.0801	0.0000	OK
60 minute winter	SW15	1	2.644	0.044	4.2	0.0499	0.0000	OK
240 minute winter	SW16	188	2.230	0.130	9.8	18.6146	0.0000	OK
240 minute winter	SW17 FC	188	2.218	0.318	5.8	0.5616	0.0000	SURCHARGED
15 minute summer	CW1	11	1.915	0.065	5.5	0.0739	0.0000	OK
15 minute winter	CW2	11	1.765	0.065	5.5	0.0732	0.0000	OK
15 minute summer	CW3	78	1.485	0.065	5.5	0.0737	0.0000	OK
30 minute winter	HW1	149	1.264	0.064	5.5	0.0000	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute winter	SW13	1.000	SW14	8.8	1.486	0.154	0.0472	
15 minute winter	SW14	1.002	SW16	11.5	1.463	0.387	0.0600	
60 minute winter	SW15	2.000	SW16	4.4	1.987	0.124	0.1150	
240 minute winter	SW16	1.004	SW17 FC	5.8	0.490	0.259	0.2171	
240 minute winter	SW17 FC	Hydro-Brake®	CW1	5.5				
15 minute summer	CW1	1.006	CW2	5.5	0.754	0.376	0.1619	
15 minute winter	CW2	1.007	CW3	5.5	0.766	0.379	0.3043	
15 minute summer	CW3	1.008	HW1	5.5	0.758	0.380	0.2397	70.4

Results for 30 year Critical Storm Duration. Lowest mass balance: 99.78%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute winter	SW13	10	3.155	0.055	16.6	0.0627	0.0000	OK
15 minute winter	SW14	10	2.410	0.110	21.9	0.1250	0.0000	OK
60 minute winter	SW15	1	2.644	0.044	4.2	0.0499	0.0000	OK
360 minute winter	SW16	344	2.348	0.248	11.9	44.1352	0.0000	SURCHARGED
360 minute winter	SW17 FC	344	2.334	0.434	5.6	0.7664	0.0000	SURCHARGED
60 minute winter	CW1	18	1.915	0.065	5.5	0.0739	0.0000	OK
15 minute winter	CW2	10	1.765	0.065	5.5	0.0733	0.0000	OK
15 minute summer	CW3	186	1.485	0.065	5.5	0.0737	0.0000	OK
15 minute winter	HW1	215	1.264	0.064	5.5	0.0000	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute winter	SW13	1.000	SW14	16.6	1.657	0.291	0.0785	
15 minute winter	SW14	1.002	SW16	21.7	1.780	0.732	0.0941	
60 minute winter	SW15	2.000	SW16	4.4	1.987	0.124	0.1304	
360 minute winter	SW16	1.004	SW17 FC	5.6	0.485	0.251	0.2257	
360 minute winter	SW17 FC	Hydro-Brake®	CW1	5.5				
60 minute winter	CW1	1.006	CW2	5.5	0.751	0.376	0.1617	
15 minute winter	CW2	1.007	CW3	5.5	0.782	0.380	0.3043	
15 minute summer	CW3	1.008	HW1	5.5	0.758	0.380	0.2397	78.9

Results for 100 year +35% CC Critical Storm Duration. Lowest mass balance: 99.78%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute winter	SW13	10	3.184	0.084	28.8	0.0956	0.0000	OK
15 minute winter	SW14	11	2.673	0.373	37.8	0.4213	0.0000	SURCHARGED
60 minute winter	SW15	1	2.644	0.044	4.2	0.0499	0.0000	OK
720 minute winter	SW16	705	2.599	0.499	12.2	98.6494	0.0000	SURCHARGED
720 minute winter	SW17 FC	705	2.586	0.686	5.5	1.2116	0.0000	SURCHARGED
30 minute summer	CW1	11	1.915	0.065	5.5	0.0739	0.0000	OK
15 minute winter	CW2	8	1.765	0.065	5.5	0.0738	0.0000	OK
480 minute winter	CW3	96	1.485	0.065	5.5	0.0737	0.0000	OK
480 minute winter	HW1	96	1.264	0.064	5.5	0.0000	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute winter	SW13	1.000	SW14	28.6	1.825	0.502	0.1102	
15 minute winter	SW14	1.002	SW16	36.6	2.090	1.235	0.1275	
60 minute winter	SW15	2.000	SW16	4.4	1.987	0.124	0.1304	
720 minute winter	SW16	1.004	SW17 FC	5.5	0.477	0.250	0.2257	
720 minute winter	SW17 FC	Hydro-Brake®	CW1	5.5				
30 minute summer	CW1	1.006	CW2	5.5	0.751	0.376	0.1617	
15 minute winter	CW2	1.007	CW3	5.5	0.811	0.381	0.3041	
480 minute winter	CW3	1.008	HW1	5.5	0.758	0.380	0.2397	216.0

Our Locations

Birmingham
2 The Wharf
Bridge Street
Birmingham
B1 2JS
T. 0121 643 4694
birmingham@curtins.com

Bristol
Quayside
40-58 Hotwell Road
Bristol
BS8 4UQ
T. 0117 302 7560
bristol@curtins.com

Cambridge
50 Cambridge Place
Cambridge
CB2 1NS
T. 01223 631 799
cambridge@curtins.com

Cardiff
3 Cwrt-y-Parc
Earlswood Road
Cardiff
CF14 5GH
T. 029 2068 0900
cardiff@curtins.com

Douglas
Varley House
29-31 Duke Street
Douglas
Isle of Man
IM1 2AZ
T. 01624 624 585
douglas@curtins.com

Dublin
11 Pembroke Lane
Dublin 2
D02 CX82
Ireland
T. +353 1 507 9447
dublin@curtins.com

Edinburgh
1a Belford Road
Edinburgh
EH4 3BL
T. 0131 225 2175
edinburgh@curtins.com

Glasgow
Queens House
29 St Vincent Place
Glasgow
G1 2DT
T. 0141 319 8777
glasgow@curtins.com

Kendal
Units 24 & 25 Riverside Place
K Village
Lound Road
Kendal
LA9 7FH
T. 01539 724 823
kendal@curtins.com

Leeds
Ground Floor
Rose Wharf
78-80 East Street
Leeds
LS9 8EE
T. 0113 274 8509
leeds@curtins.com

Liverpool
51-55 Tithebarn Street
Liverpool
L2 2SB
T. 0151 726 2000
liverpool@curtins.com

London
40 Compton Street
London
EC1V 0BD
T. 020 7324 2240
london@curtins.com

Manchester
Merchant Exchange
17-19 Whitworth Street West
Manchester
M1 5WG
T. 0161 236 2394
manchester@curtins.com

Nottingham
56 The Ropewalk
Nottingham
NG1 5DW
T. 0115 941 5551
nottingham@curtins.com

curtins

Curtins Consulting Ltd registered in England and Wales No: 2054159
Registered office: 51-55 Tithebarn Street, Liverpool, L2 2SB