

Millom Iron Line

Drainage Strategy Report

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Client Name: Cumberland Council via Story Contracting

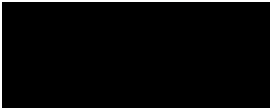
Client Address: Parkhouse Building, Kingmoor Business Park, Carlisle, Cumbria CA6 4SJ

Site Address: Hodbarrow Nature Reserve, Millom, Cumbria

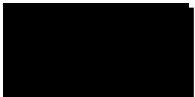
Control Sheet

Rev	Description	Checked	Issued	Date
P01	First Issue	CLN	PT	18 May 2023
P02	Update to clarify existing pumping situation	GW	GW	29 November 2023
P03	Document ref. no. change, rework of boundaries and Visitors Centre proposals	GW/PT	GW	07 April 2025
P04	Redesign of SW drainage outfall to Hodbarrow Lagoon	GW	GW	21 Nov 2025
P05	Updated to reflect ecologist/client comments	GW	GW	27 November 2025

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1.0 Executive Summary

Full planning permission sought for the erection of a new Visitors Centre, access road, car parking and associated landscaping at Millom Iron Line, Millom, Cumbria, nearest site postcode is LA18 4LB.

The General Arrangement Site Masterplan, drawing 289-LYR-XX-ZZ-DWG-L-1000 by Layer Studio is provided in Appendix A.

The overall proposed development comprises:

Erection of Visitor Centre with café/shop, group room, staff/volunteer, toilet facilities and car park; consolidation, repair and installation of interpretive sculpture to Towsey Hole Windmill; refurbishment of existing Tern Island hide; new bird hides, pathways, gateway features and street furniture; enhancement of wildlife habitats; associated landscaping and drainage infrastructure; and maintenance of byway with restricted vehicular access.

The drainage strategy follows English national standards. SuDS (Sustainable Drainage Systems) will be used to treat surface water runoff. The proposal includes:

- Pervious paving which filters flows through the pavement surface and attenuate below ground.
- Filter and fin drains which collect runoff.
- Proprietary vortex separators which spin out suspended solids (e.g. silt), metals and oils, such as ACO Quadrceptor and/or Hydro International Downstream Defender.

Alternative SuDS elements are proposed in the 'Water Quality Assessment' document, noting that certain SuDS elements are restricted/prohibited by land ownership boundaries.

The lifespan of the development is assumed to be 60 years, ending in 2085. The EA guidance states that for a 'development with a lifetime between 2061 and 2100 take the same approach but use the central allowance for the 2070s epoch (2061 to 2125).'

Therefore, the climate change allowances should be 35% for the 1:30 year and 1:100 year event.

SuDs hierarchy feasibility for surface water (SW) and foul water (FW) disposal:

- Infiltration – SW & FW Not viable
- Watercourse/Waterbody – SW - Redhills Quarry pond is discounted due to sensitive trade effluent discharge agreements. Hodbarrow Lagoon outfall is viable but restricted to existing greenfield rates. FW too ecologically sensitive & contractually difficult/not viable.
- Existing Private surface water drainage system – Not viable
- Surface Water Sewer – SW & FW Not viable
- Combined Water Sewer – SW not viable, FW main drainage option (pumped solution required – considerable distance)

2.0 Introduction

2.1 Project Background

Curtins were instructed by Cumberland Council via Story Contracting to develop a Drainage Strategy (DS) for the proposed development of a new Visitors Centre and associated access/car parking at Millom Iron Line, Millom, Cumbria. The purpose of the DS is to support the planning application. The nearest site postcode is LA18 4LB and the site is centred on National Grid Reference (NGR) 317429mE 478489mN. What3Words reference: rebounder.named.graphic.

There are also a number of discrete remote elements of work across the Iron Line site, including Hodbarrow Beacon and the former Windmill, including multiple isolated areas of landscaping. At the time of preparation, 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 Visitors Centre and associated hard landscaping only (where contributing areas dictate a positive outfall).

The report provides information with regards to the proposed drainage elements relating to the proposed development and is based on currently available information at the time of writing.

2.2 Proposed Development

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

The General Arrangement Site Masterplan, drawing 289-LYR-XX-ZZ-DWG-L-1000 by Layer Studio is provided in Appendix A.

The overall proposed development comprises:

Erection of visitors centre with café/shop, group room, staff/volunteer, toilet facilities and car park; consolidation, repair and installation of interpretive sculpture to Towsey Hole Windmill; refurbishment of existing Tern Island hide; new bird hides, pathways, gateway features and street furniture; enhancement of wildlife habitats; associated landscaping and drainage infrastructure; and maintenance of byway with restricted vehicular access.

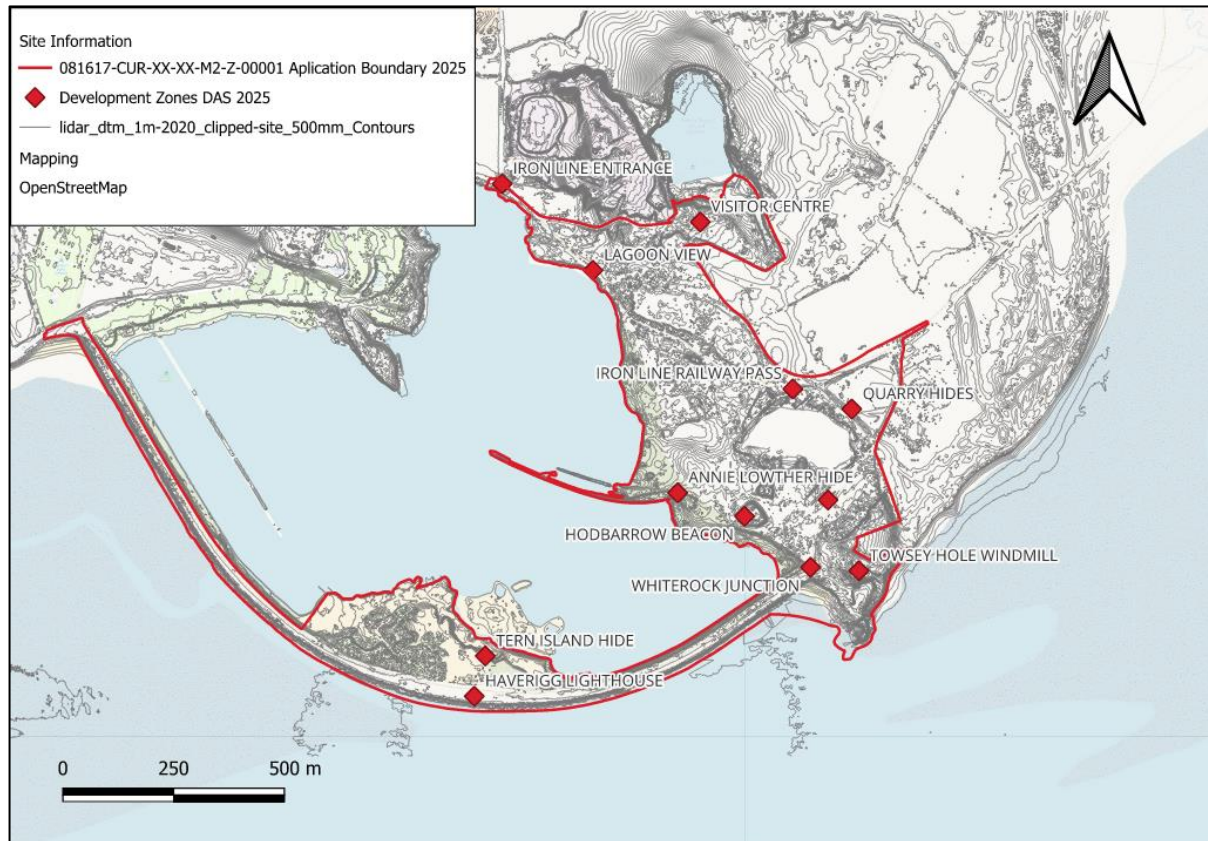


Figure 2-1: Location of landmarks and key spaces

In respect to the Visitors Centre, the approximate building footprint has been measured from the Architect's Plan as 380m². The Finished Floor Level (FFL) is proposed at **14.50mAOD**, allowing for a shallow ramped access from existing ground levels in the northeast quadrant. Car parking to the west and northwest quadrants is to be tiered in concentric arc, rising away from the building, rising from 14.50mAOD to 16.60AOD.

In respect to the other elements of the development, no significant changes to existing ground levels are envisaged by the proposals.

2.3 Future Developments

The development is proposed to be built out in a single phase, with no further proposals or plans to extend the Visitors Centre once it is constructed. Remote small upgrades may be possible but will have little impact on existing drainage philosophies.

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.

3.0 SuDS Guidance and Standards

3.1 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 1,000m².

3.2 National Planning Policy and Guidance

3.2.1 National Planning Policy Guidance² (NPPF) states that:

3.2.2 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.

3.2.3 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 Change³ states:

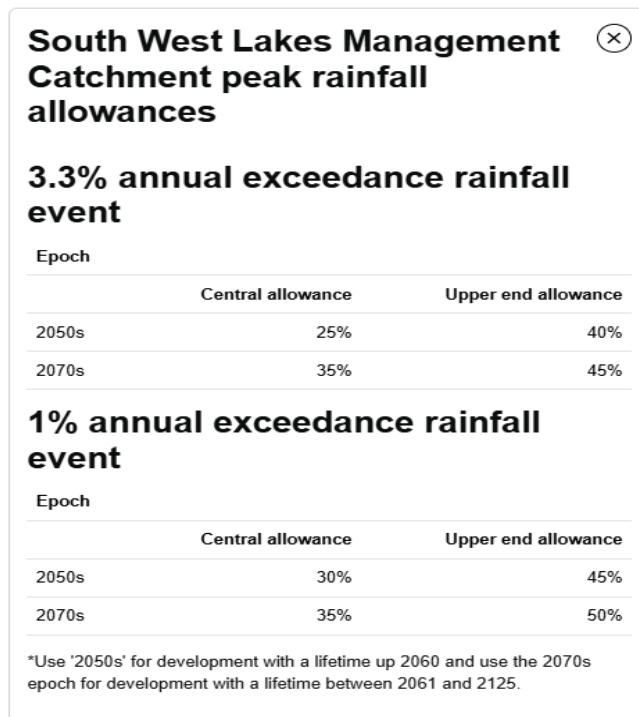
The types of sustainable drainage system which it may be appropriate to consider, will depend on the proposed development and its location, as well as any planning policies and guidance that apply locally. Where possible, preference should be given to multi-functional sustainable drainage systems, and 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>

3.3 Climate Change

On 10th May 2022 the Environment Agency published revised climate change allowances⁴ 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.



South West Lakes Management Catchment peak rainfall allowances

3.3% annual exceedance rainfall event

Epoch	Central allowance	Upper end allowance
2050s	25%	40%
2070s	35%	45%

1% annual exceedance rainfall event

Epoch	Central allowance	Upper end allowance
2050s	30%	45%
2070s	35%	50%

*Use '2050s' for development with a lifetime up to 2060 and use the 2070s epoch for development with a lifetime between 2061 and 2125.

The lifespan of the development is assumed to be 60 years, ending in 2085. The EA guidance states that for a 'development with a lifetime between 2061 and 2100 take the same approach but use the central allowance for the 2070s epoch (2061 to 2125).'

Therefore, the climate change allowances should be 35% for the 1:30 year and 1:100 year event.

This map contains information generated by Met Office Hadley Centre (2019): UKCP Local Projections on a 5km grid over the UK for 1980-2080. Centre for Environmental Data Analysis, 2022

Figure 3-1: South West Lakes Management Catchment peak rainfall allowances

3.4 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 (Mainsgate Road, Millom) 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.

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

3.5 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

4.0 Strategic Surface Water Management (SWM) Objectives

Following CIRIA C753 The SuDS Manual (C753) Section 7.4, the objectives below are considered by Curtins to be suitable for the surface water drainage design, based on the output of Section 3.0.

Topic	Strategic objective
Flood risk	Flood risk to the development is to be managed and the development is not to increase flood risk for surrounding areas. A separate Flood Risk Assessment is available, which reviews all existing and potential sources of flooding.
Water quality	Surface water outfalls to the Hodbarrow Lagoon (former quarry site, now naturally filled pond/lagoon) to the west are potentially viable. Appropriate treatment of discharge will be required. Foul water – treated effluent cannot be viably treated and discharged to the ground and/or any waterbodies.
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. Existing infiltration rates are unknown. The site is contaminated and is of mostly made ground, making infiltration techniques unlikely to be viable.
Biodiversity	Preserve and enhance existing habitat. Incorporating green SuDs should create habitat where possible. Areas to the west of the development are ideal for SuDS (noting limiting land boundaries) 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 potable water at the Visitors Centre. It is thought that this will be supplied from a reliable water source. Use rainwater to irrigate soft landscaping areas where possible, passively.
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 within the habitat on the west side of the site (noting limiting land boundaries). With appropriate primary treatment, any SuDs 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.
Climate Change	The surface water proposals should include allowances for appropriate anticipated climate change based on recognised EA/LLFA guidance. The climate change allowances should be 35% for the 1:30 year and 1:100 year event.
Approval and adoption	The local planning authority will be the approving body for the surface water management system. Noting separate Environment Agency permit potential. The site drainage will be entirely owned and operated by Cumberland Council so the operation and maintenance design need only consider the needs of the client.

Table 1: Strategic Surface Water Management (SWM) Objectives Table

5.0 Conceptual design

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

5.1 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 and the former Redhills Quarry. To the west the levels also fall away towards the Hodbarrow lagoon. The site levels vary from 16m down to 3m AOD. Immediately North of the Visitors Centre, 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 adjacent vegetation, which will also slow any overland flows. An existing Hodbarrow lagoon is located approximately 250m southwest, that being a potential surface water outfall. It is understood that the lagoon has a pumped control to ensure water levels are consistent for the adjacent caravan/holiday development immediately on its north shore. The lagoon is ecologically sensitive, being the centre of the RSPB reserve. Former Redhills quarry, now a naturally filled pond/pool to the north is located approximately 70m from the site. It is understood that the waterbody has a pumped control and methane stripping treatment plant to improve water quality discharges. Water levels are anticipated to remain fairly consistent. For context and note; from discussions with the Lead Local Flood Authority (LLFA), Environment Agency (EA), Local Planning Authority (LPA) and Cumberland Council (CC) as client, the former quarry pond has a pumped outfall to a methane treatment plant before outfalling via the downstream end of the Millom Wastewater Treatment Works (WwTW) effluent discharge pipe further north, out to the estuary. There are restrictions on discharge quality, rates and volumes with the Environment Agency and the LLFA. According to the trade effluent permit in place and the outfall agreement with Cumberland Council (formerly Cumbria County Council) (as owner/operator of the Waste Recycling Centre and quarry pond), and United Utilities (as owner of the receiving WwTW outfall/discharge pipework) and with the EA (as receiving watercourse/outfall) permit/agreement for discharge is in place already. These are both back-to-back, meaning the same flows from one end are expected at the other end. Note that there are significant restrictions on volumes and flow rates that Redhills Quarry needs to be maintained, as such, discussions with the involved parties have discounted approval of utilising Redhills Quarry as a possible surface water discharge due to the sensitive agreements in place.
Potential for infiltration	Reviewing British Geological Survey and Soilsclapes 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 '<i>Naturally wet</i>' with '<i>impeded infiltration potential</i>', suggesting that infiltration techniques may not be possible. Invasive Phase 2 Ground Investigations suggest Made Ground was encountered onsite. Infiltration techniques are deemed unfeasible due to the depth of said Made Ground and contamination risk.
Potential for surface water discharge	The existing runoff catchment from the site of the proposed Visitors Centre (VC) is split between catchments. To the north-east, Redhills Quarry catchment, and to the south and west towards the Hodbarrow lagoon, following both following the existing sloping topography. Due to the sensitive discharge agreements of Redhills Quarry pool/pond, no formal drainage routes can outflow within this catchment. Any of the VC's impermeable areas which lie within the Redhill Quarry catchment would instead be conveyed across the watershed. From here, the whole site would then drain at greenfield rates to the west as the ground levels drop away. This is where Hodbarrow Lagoon is located, and the natural flow path. The change to a point discharge is not considered to adversely impact the waterbodies.

	There is also an ordinary watercourse, Crook Pool, further to the east/ south east approximately 500m from the site and the Duddon estuary (sea) to the south. Areas of access around the VC is restricted by land ownership boundaries and ecological sensitive areas. However due to the nature and importance of the habitat routes careful consideration, discussions and design are required to achieve a suitable outfall.
Site flood risks	See the site-specific Flood Risk Assessment. The bulk of the flood risk is associated to the drainage for the redevelopment with very few other risk anticipated.
Existing site land use	The site was previously used as an Iron Mine. The Visitors Centre site is coincident with a former reservoir and has since been backfilled. 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 Visitors Centre site is not believed to have any existing infrastructure. Some field-type drains are evident, feeding into the Hodbarrow lagoon at much lower elevations. Lower portion of the HWRC access appear to have limited drainage direct for the former Redhills quarry. The nearest combined sewer and potential outfall is United Utilities chamber '4300', which lies on Mainsgate Road, Millom. This is a considerable distance away. Alternative 'non main drainage' means of foul water disposal have been explored but discounted.
Existing soils	British Geological Survey and Soilsmap 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 '<i>Naturally wet</i>'.
Local habitats and biodiversity	The whole 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. Grassland 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. See the site-specific Ecological assessment/reports. These facts limit the available space for drainage components, potentially reducing the possible open top features and their use./placement.

Table 2: Site Characterisation outcomes table

5.2 Development characterisation outcomes

Proposed topography, land use and landscape characteristics	The site is to be plateaued where the Visitors Centre is located with an FFL at around 14.5m AOD. Levels will largely remain as existing, except the Visitors Centre first floor/roof which will reach higher than the local surroundings to provide a better vista. There will be a tiered car park, terraced up the hill radially out from the Visitors Centre. The car park access will be via the existing access to the existing Redhills Quarry Household Waste Centre. Some widening of the access roads will be necessary to facilitate the safe passing of vehicles/vehicle management onsite.
Proposed flood risk management strategy	Rates of surface water discharge will be controlled and restricted for events up to and including the 1:100 year rainfall (plus climate change allowances) to the existing 1:1 year equivalent Greenfield runoff rate. 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 part of the Hodbarrow reserve and former Iron Line, which has since revegetated. Existing features, including a mine shaft and derelict building located to the west of the new Visitors Centre are to remain without interference. Minor footway rerouting may be necessary. The whole Visitors Centre site will be routed towards the Hodbarrow Lagoon, from a proposed drainage catchment perspective.
Proposed building style and form	Passivhaus circular building split over two floors with a balcony to the upper floor. Wall will appear stone faced filled gabions with exposed steelwork structure. Floors will be cast in-situ concrete to the ground floor. Gabion basket retaining walls, tarmac access roads, permeable parking areas are anticipated.
Proposed adoption and maintenance of surface water management system	The SW network(s) are to remain in private ownership. A separate Drainage O7M manual has been developed to aid future maintenance regime.

Table 3: Development characterisation outcomes table

5.3 SuDS Design Criteria

	Preferred Delivery of SuDS Design Criteria
Water quantity	All surface water discharge shall be restricted to the 1:1 year greenfield rate from the combined sub-catchments i.e greenfield rate. 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.
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 (Total suspended solids (TSS), Metals and Hydrocarbons (HC): - Commercial Building roofs = Low hazard, TSS: 0.3, metals: 0.2, HCs: 0.05 - Non-residential Car parking and site roads = Medium hazard, TSS: 0.7, metals: 0.6, HCs: 0.7 - Site with heavy pollution, e.g. highly frequented lorry approaches to waste sites, site where chemicals and fuels are delivered, handled, stored or used = High TSS: 0.8, metals: 0.8, HCs: 0.9
Amenity	Provide open SuDS, where possible, 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

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

	Nearby sandy banks, stone walls, piles of stones that could act as hibernacula.
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Table 4: Preferred Delivery of SuDs Design Criteria table

5.4 Feasible points of discharge

Surface Water Disposal Method	Potential	Description
Infiltration	X	British Geological Survey and Soilscape 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 '<i>Naturally wet</i>' with '<i>impeded infiltration potential</i>' suggest that infiltration techniques may not be possible. Invasive Phase 2 Ground Investigations suggest Made Ground was encountered onsite. Infiltrations techniques are deemed unfeasible due to depth of said Made Ground and contamination risk.
Watercourse/ Waterbody	✓	The existing runoff catchment from the site of the proposed Visitors Centre (VC) is split between catchments. To the north-east, Redhills Quarry catchment, and to the south and west towards the Hodbarrow lagoon, both following the existing sloping topography. The former Redhills Quarry now a naturally filled pond/pool, derived from tip leachate; the decomposition of waste, and rainfall, is located approximately 70m to the north. Due to the sensitive discharge agreements of Redhills Quarry pool/pond, no formal drainage routes can outflow within this catchment – discounted outfall option. The proposed discharge point for the Visitor Centre site will be towards Hodbarrow Lagoon 250m away towards the southwest. With discharge rates restricted up to the 1:100 year rainfall (plus climate change allowances) to the existing equivalent Greenfield runoff rate – viable outfall. It is anticipated a new headwall/reuse of an existing headwall onto the Hodbarrow Lagoon will be necessary. The change to a point discharge is not considered to adversely impact the waterbody given its footprint. There is also an ordinary watercourse, Crook Pool, further to the east/ south east approximately 500m from the site and the Duddon estuary (sea) to the south – neither options here are viable due to SSI designation (Duddon Estuary) and land ownership/distance constraints.
Existing Private surface water drainage system	X	There is no formal positive surface water drainage on site. Some field type drains are evident feeding into the lagoon and the former Redhill Quarry at much lower elevations. There is potential to reuse some of the outfall pipework/spill way to suit the drainage system (subject to further investigations).
Surface Water Sewer	X	There are no surface water sewers within range (<1km) of the site – not viable. No surface water highway drain - within range (<1km) of the site – not viable.
Combined Water Sewer	X	Not viable as a surface water disposal method. FW – viable The nearest combined sewer and potential outfall is United Utilities chamber '4300' which lies on Mainsgate Road, Millom. This is a considerable distance

		away. Alternative 'non main drainage' means of foul water disposal have been explored but discounted. Dialogue with UU must be held to confirm capacity within the combined sewer to accommodate unrestricted foul water flows (formal/updated PDE).
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Table 5: Feasible points of discharge table

5.5 Surface water sub-catchments and flow routes

Existing drainage areas will be retained, except for the north-eastern side of the Visitors Centre site, which will now form part of the western/ Hodbarrow Lagoon catchment. Essentially, all discharge to the Hodbarrow Lagoon will be restricted to existing greenfield equivalent rates with appropriate flow control and attenuation provided upstream.

Wider periphery areas of redevelopment will remain as per existing catchments.

Catchment Name	Colour	Treatment
Hodbarrow Lagoon Catchment (South-western - Visitors Centre, car park and access road entrance)	Gold	SuDS scheme required.
Red Hills Quarry Catchment (Northern-Eastern – Visitors Centre, and car park)	Blue	SuDS scheme required.

Table 6: Sub Catchments

The development catchment is as follows and are shown in detail on the Proposed Drainage Plan drawings 081617-CUR-01-ZZ-D-C-92001. An extract is shown below.

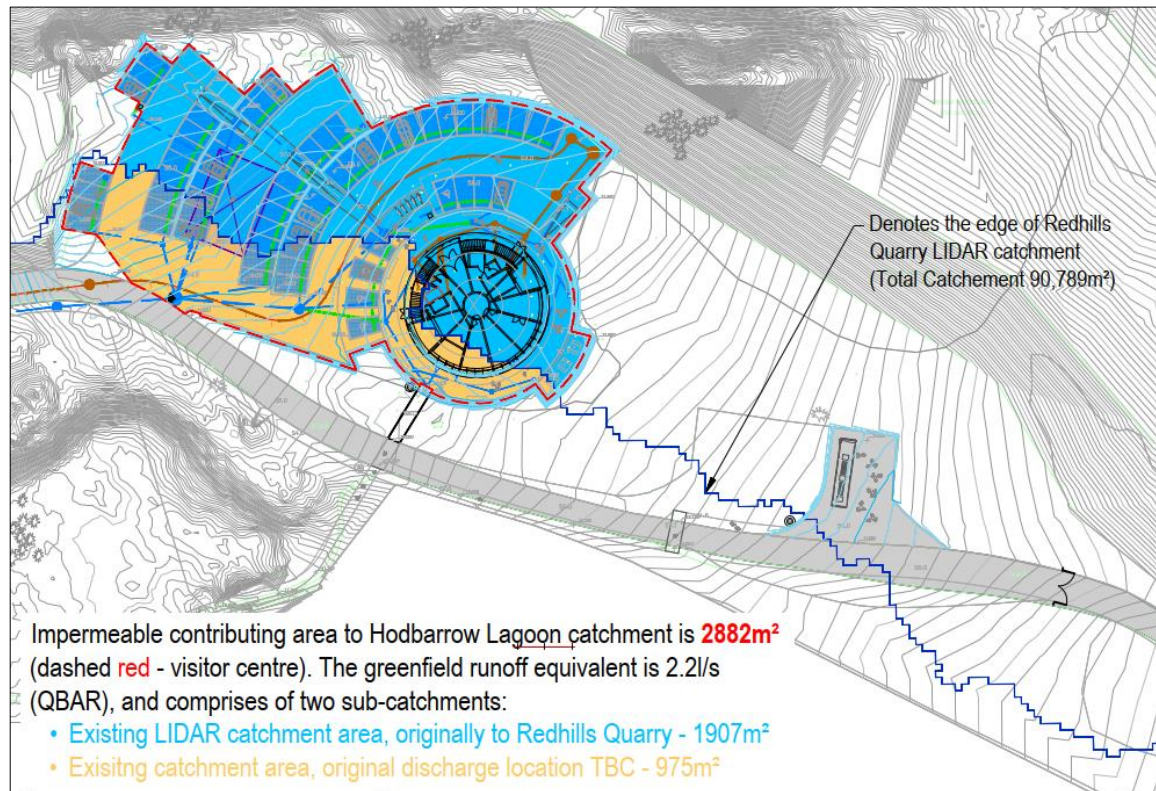


Figure 5-1: Existing/Proposed Catchment Area extract

5.6 Selection of SuDS components for the management train

Water quantity	Runoff collection mechanism	Standard roof downpipes from roofs. External areas drain to permeable paving. Where this is not possible, gullies and channel drains shall be used.
	Interception mechanism	No interception currently proposed. Rainwater harvesting is to be explored at detailed design stage. Infiltration not feasible, as noted previously.
	Storage	The majority of attenuation will be provided by below ground storage attenuation tanks, with some provided by permeable construction.
	Conveyance	Piped conveyance to downstream components.
	Exceedance	See section 5.3.
Water quality	Discharges to surface waters and Surface water protection measures	Suitable protection measures for this development are identified in 081617-CUR-ZZ-XX-T-C-92701 - Water Quality Assessment in Appendix D. Most areas will be treated by pervious pavements. Vortex separator's, for example Downstream Defender) will be provided to treat runoff from all other areas and provide final refinement ahead of discharge offsite.

Amenity	It is noted that space/land take is heavily constrained by existing wider ecological/ecology, as such dedicated amenity space is not being sought from the proposals. If a bioretention system can be provided, it may be an educational benefit.
Biodiversity	It is noted that space/land take is heavily constrained by existing wider ecological/ecology, as such dedicated amenity space is not being sought from the proposals. If a bioretention system can be provided, it may be an educational benefit.

Table 7: SuDS components for the management train

6.0 Outline SW Design

6.1 Design Proposals

Refer to the following plans/calculations:

- 081617-CUR-01-ZZ-D-C-92001-P06 - Drainage Strategy Sheet 1
- 081617-CUR-01-ZZ-D-C-92002-P06 - Drainage Strategy Sheet 2
- 081617-CUR-01-ZZ-D-C-92003-P05 - Drainage Strategy Sheet 3
- 081617-CUR-01-ZZ-D-C-92101-P03 – Surface Water Longsection
- 081617-CUR-XX-XX-D-C-92200-P04 - Drainage Details Sheet 1
- 081617-CUR-XX-XX-D-C-92201-P04 - Drainage Details Sheet 2
- 081617-CUR-XX-XX-T-C-00001-P04 - Surface water drainage calculations
- 081617-CUR-ZZ-XX-T-C-92701-P02 - Water Quality Assessment.

6.2 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. The existing catchment of Visitor Centre site is split into two following the existing topography: Hodbarrow Lagoon Catchment (0.098ha) and Redhills Quarry Catchment (0.191ha). The south-western side falls towards the lagoon in the south-west, while the north-eastern side falls towards the Redhills Quarry in the north-east.

Pre-development discharge

Site Makeup

Greenfield Method

Positively Drained Area (ha)

SAAR (mm)

Soil Index

SPR

Region

Betterment (%)

QBar (l/s)

Return Period (years)	Growth Factor	Q (l/s)
1	0.85	0.6
2	0.93	0.7
10	1.38	1.0
30	1.95	1.4
100	2.48	1.8

Figure 6-1: Pre-dev. Lagoon Catchment Analysis

Pre-development discharge

Site Makeup

Greenfield Method

Positively Drained Area (ha)

SAAR (mm)

Soil Index

SPR

Region

Betterment (%)

QBar (l/s)

Return Period (years)	Growth Factor	Q (l/s)
1	0.85	1.2
2	0.93	1.3
10	1.38	2.0
30	1.95	2.8
100	2.48	3.6

Figure 6-2: Pre-dev. Redhill Quarry Catchment Analysis

Redhills Quarry is not a suitable method of continued surface water disposal due to it being a trade effluent pool derived from 'tip leachate: the decomposition of waste, and rainfall' and restrictions on both its pumped water quality, flow and volumes. Formal trade effluent and discharge agreements exist with United Utilities (UU) and Environment Agency (EA).

Post-development Site Runoff - Visitors Centre

Based on an assessment of catchment areas and constraints associated with the outfalls, namely the Redhills Quarry discharge sensitivity agreements between associated 3rd parties. The Redhills Quarry catchment is no longer viable as an option and has been discounted. Consequently, flows and volumes have been combined into the Hodbarrow Lagoon catchment but restricted back to existing greenfield discharge rates.

The post-development discharge rate will be restricted to 1:1 year Greenfield rate, calculated by the IH124 method below. To suit site constraints, the total surface water discharge for the combined sub-catchment will not exceed the equivalent greenfield rate of 1.8 l/s (litres/second) for 1:1 year, up to a maximum 5.4 l/s in the 1:100 year plus climate change event (equivalent Qbar runoff rate from catchment is 2.2l/s)

Simulation Settings

Rainfall Methodology	FSR	Additional Storage (m ³ /ha)	0.0
Rainfall Events	Singular	Starting Level (m)	
FSR Region	England and Wales	Check Discharge Rate(s)	✓
M5-60 (mm)	17.000	1 year (l/s)	1.8
Ratio-R	0.300	2 year (l/s)	2.0
Summer CV	0.750	10 year (l/s)	3.0
Winter CV	0.840	30 year (l/s)	4.2
Analysis Speed	Normal	100 year (l/s)	5.4
Skip Steady State	x	Check Discharge Volume	✓
Drain Down Time (mins)	240	100 year 360 minute (m ³)	66

Figure 6-3: Post Development Catchment Design/Simulation Criteria

6.3 Water Quantity

Catchment Name	Area (ha)	Flow (l/s)	Attenuation (m ³)
Proposed Visitor Centre impermeable area	0.2880	5.4l/s	108 to 172m ³ (150m ³ provided through refined model/ design)

Table 8: Proposed catchment area, restriction/flow and attenuation/storage

Note that the above catchment areas may be subject to change through design development, which will affect the flow control and attenuation volumes. The above attenuation volumes were calculated

using a hydraulic model which accounts for available volumes in the wider surface water drainage system from the principles set out in sections 6.1 and 6.2.

The bulk of the attenuation will be provided in a combination of permeable paving, below ground attenuation tanks and/or large diameter pipes.

The Hodbarrow Lagoon water levels remain unknown, as are the maximum and minimum anticipated levels. Calculations may need to include for a permanent surcharge to the Hodbarrow Lagoon 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 need to be confirmed to complete this design requirement, and levels of the outfall amended as necessary to suit actual water levels in the Lagoon. Alternatively the outfall level (and limited upstream extent) could be adjusted to avoid any surcharging or pipework due to Hodbarrow Lagoon water level changes. A buried outfall may offer less habitat disturbance.

6.4 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.

Blockage

The site levels design will grade immediate 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 for overland flows to drain to the Redhills Quarry and/or Hodbarrow Lagoon Catchments (as per the existing overland condition).

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 towards the existing vegetation. Additional temporary storage could be provided within the terraced car parking extents with the use of full-height kerbs.

Parking areas could 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.

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.

6.5 Water Quality Treatment

The design should incorporate the following components where possible:

Type of SuDs component	Pollution Mitigation Indices			Viability
	TSS	Metals	Hydrocarbons	
Filter strips	0.4	0.4	0.5	Potentially viable
Filter drain	0.4	0.4	0.4	Potentially viable - incorporated
Swale	0.5	0.6	0.6	Unviable due to land take/space
Bioretention system	0.8	0.8	0.8	Potentially viable but significantly limited in available footprint
Permeable pavements	0.7	0.6	0.7	Viable - incorporated
Detention basin	0.5	0.5	0.6	Unviable due to land take/space
Pond	0.7	0.7	0.5	Unviable due to land take/space
Wetland	0.8	0.8	0.8	Unviable due to additional land take/space
Proprietary treatment systems (see below)	These must demonstrate they can address each of the contaminant types to acceptable levels for frequent events up to approximately the 1 in 1 year return period event, for inflow concentrations relevant to the contributing drainage area.			Necessary and viable – incorporated (see below)

Table 9: C753, Table 26.3 Indicative SuDs mitigation indices for discharges to surface waters

Unfortunately, many SuDs features/components are not viable due to their land take/footprints given the site ecological constraints and third party land boundaries. Consequently, proprietary treatment systems must be used to achieve the necessary water quality treatment.

The below proprietary treatment systems have also been considered, with the supplier quoted pollution mitigation indices, as of March 2025. While some products have a lower mitigation, they are still appropriate for use when backed up with secondary treatment, such as the 'Downstream

Defender', which would be appropriate when used with upstream sediment traps/permeable paving etc.

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

Table 10: C753, Table 26.3 Proprietary treatment pollution mitigation Indices examples

The table below 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/ commercial roofs	Low hazard, TSS: 0.3, metals: 0.2, HCs: 0.05	Sediment trap TSS: 0.4, metals: 0.4, HCs: 0.4 ✓
Car parking/ aisles access road	Medium hazard, TSS: 0.7, metals: 0.6, HCs: 0.7	Pervious paving, sediment trap and downstream defender (min)/ ACO Quadraceptor <TSS: 1.15, metals: 1.0, HCs: 1.15 ✓
Site wide industrial roads (HWRC/tip access – not formally drained)	High hazard, TSS: 0.8, metals: 0.8, HCs: 0.9	Filter drains, sediments traps and proprietary treatment TSS: 1.0, metals: 1.0, HCs: 1.0 ✓

Table 11: Pollution hazard indices and mitigation indices/measures

The Water Quality Assessment calculations can be seen in Appendix D.

Surface water treatment from the catchment is provided by stone-filled filter trenches, permeable construction and proprietary treatment units where possible. The permeable construction provides some attenuation for this catchment, but a dedicated attenuation tank and flow control (Hydrobrake) beneath the proposed car parking allows a restriction back to the equivalent greenfield runoff rate for all storms up to and including the 1:100 year + 35% climate change event. Connection to the Lagoon will be via a newly formed drain adjacent to the access road.

Flows from the Visitor Centre access road/aisles have a medium pollution hazard so require two stages of treatment. The first stage being SuDs components, sediment traps, filter drains where possible followed by a proprietary treatment 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, aid future maintenance and treatment.

Permeable paving/ filter drain, and an Hydro-International Downstream Defender Advanced Vortex are proposed as a final stage of treatment for the contributing catchment.

Runoff from roofs can be effectively treated by frequent sediment traps.

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, Cumberland Council), Environment Agency (EA) and Natural England (NE).

7.0 Proposed Foul Water Drainage Strategy

7.1 Design Proposals

Refer to the following plans/calculations:

- 081617-CUR-01-ZZ-D-C-92001-P06 - Drainage Strategy Sheet 1
- 081617-CUR-01-ZZ-D-C-92002-P06 - Drainage Strategy Sheet 2
- 081617-CUR-01-ZZ-D-C-92003-P05 - Drainage Strategy Sheet 3
- 081617-CUR-XX-XX-D-C-92200-P04 - Drainage Details Sheet 1
- 081617-CUR-XX-XX-D-C-92201-P04 - Drainage Details Sheet 2
- 081617-CUR-ZZ-XX-T-C-92702-P01 - BW Foul Flows and Loads 4

7.2 Design Detail

A separate foul water drainage system is proposed for the Visitor Centre site. This is to drain via an immediate gravity system to a convenient location within the service yard directly north of the building. From here it shall be pumped along the access road, and up Mainsgate Road. The outfall being the nearest combined sewer and potential outfall is United Utilities chamber '4300' which lies on Mainsgate Road, Millom. This is a considerable distance away. Alternative 'non main drainage' means of foul water disposal have been explored but discounted due to treated effluent discharge concerns.

Design based on the following person use rates/notes:

Description	No.
Canteen (provides hot drinks, pre-prepared sandwiches, cakes, confectionary etc) (Assumed Calc value of Restaurants - Snack Bars & bar meals)	58
Staff workers - (Office / Factory without canteen)	10
Visitor toilets (Toilet (WC) (per use)	150

Table 12 British Water Foul Flows and Loads Code of Practice

We therefore expect the development runoff to be circa 0.1 l/s (British Water Foul Flows and Loads – Code of Practice – Appendix C).

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

8.0 Appendices

Appendix A Proposed site plan

Appendix B Proposed Drainage Drawings

Appendix C Drainage Calculations

Appendix D Water Quality Assessment

Appendix A Proposed Site Plan

FURNITURE / BOUNDARIES

- F1.0 - PICNIC TABLE**
Location: Site wide
Material: Corten Steel / Timber / Concrete
- F2.0 - BENCH**
Location: Site wide
Material: Corten Steel / Timber / Concrete
- F2.1 - BENCH (EXISTING)**
Location: Site wide
Material: Timber
- F3.0 - WAYFINDING - SITE NAVIGATION**
Location: Site wide
Material: Corten Steel w/ laser cuttings
- F4.0 - WAYFINDING - ARRIVAL**
Location: Site wide
Material: Corten Steel w/ laser cuttings
- F5.0 - INFO BOARD: ECOLOGY**
Location: Site wide
Material: Corten Steel w/ laser cuttings
- F5.1 - INFO BOARD: MAP LOCATION**
Location: Site wide
Material: Corten Steel w/ laser cuttings
- F5.2 - INFO BOARD: HERITAGE**
Location: Site wide
Material: Corten Steel w/ laser cuttings
- F6.0 - VIEWING SCREEN**
Location: To Hidden Lagoon
Material: Timber
- F7.0 - DOUBLE LEAF GATE**
Location: Road to Welcome Building / HWRC
Material: Subject to future detail
- F7.1 - SINGLE LEAF GATE**
Location: To Tern Island fence
Material: Subject to future detail
- F8.0 - FEATURE FENCE**
Location: Site wide
Material: Timber
- F8.1 - EXISTING FENCE**
Location: Site wide
Material: Timber

- F9.0 - FEATURE ARTWORK**
Location: Site wide
Refer to Design & Access Statement Chapter 7
- F10.0 - CAR PARK PAY MACHINE**
Location: To Visitor Centre car park
Material: -
- F11.0 - FEATURE CONC BENCH w/ TIMBER TOP**
Location: Site wide
Material: Concrete / Timber
- F12.0 - CYCLE PARKING**
Location: Site wide
Material: Steel
- F13.0 - TIMBER LOGS**
Location: To car parking spaces
Material: Timber
- F14.0 - EV CHARGING LOCATIONS**
Location: To welcome building car park
Material: -
- F15.0 - THRESHOLD DETAIL**
Location: To key thresholds
Material: Corten
- F16.0 - BIRD HIDE**
Location: To Hidden Lagoon / Lagoon
Material: Timber
- F17.0 - PV CANOPY**
Location: To welcome building car park
Material: Subject to future detail
- F18.0 - WASTE BIN**
Location: Site wide
Material: Corten
- F19.0 - HAND RAIL**
Location: To entrance steps
Material: Steel
- F20.0 - BOLLARD**
Location: To Byway Entrances
Material: Timber

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07/04/25	P02		Issued for planning	MDM

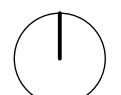
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GENERAL INFORMATION

APPLICATION BOUNDARY

HARDWORKS

- S1.0 - SELF BINDING GRAVEL WITHOUT EDGINGS EXCEPT ON STEEP GRADIENTS (P)**
Location: To primary pedestrian routes
Dims: 15m wide
- S2.0 - STONE TO DUST SURFACE (V)**
Assumed: Existing surface planned - pot holes filled - Type 1 dressing with Grano Dust surface finish
Location: To Byway
Dims: As existing
- S3.0 - TIMBER BOARDWALK (P)**
Location: To sand dune raised walkway
Dims: 1.8m wide w/ low upstand
- S4.0 - VEHICULAR MACADAM (V)**
Location: Visitor Centre car park / Access Road Trench
Dims: 15m wide trench cover w/ passing places
- S5.0 - VEHICULAR ROUTE (MACADAM) (V)**
Assumed: Some resurfacing as per S4.0 specification
Location: To access road from Mainsgate Road to visitor centre - existing surface made good
Dims: 4.8m wide
- S6.0 - NATURAL STONE PAVING (P)**
Location: To Towsey Hole Windmill
- S7.0 - INSITU CONCRETE w/ SMOOTH FINISH (P)**
Location: To in ground railway details / Visitor Centre / Hoadbarrow Lighthouse
- S7.1 - INSITU CONCRETE w/ EXPOSED AGGREGATE FINISH (P / V)**
Location: To Visitor Centre / Whiterock Junction
- S8.0 - REINFORCED GRAVEL (P)**
Location: To Visitor Centre car park / Annie Lowther Hide
- S9.0 - RAISED STEEL WALKWAY w TIMBER EDGE (P)**
Location: To Visitor Centre
- SE - SURFACE EXISTING**
Location: As noted



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The Iron Line
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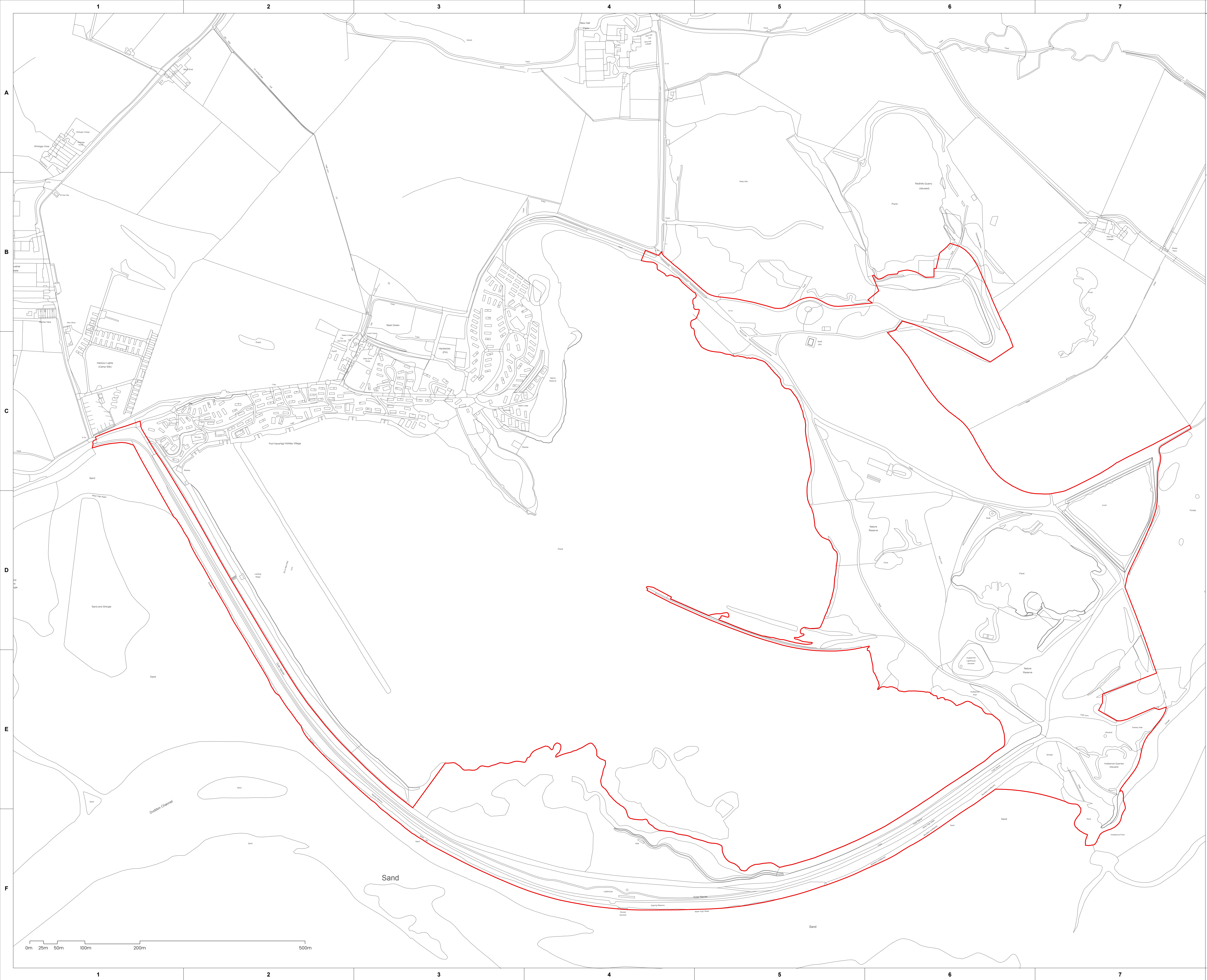
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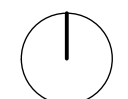
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07/04/25	P02		Issued for planning	MDM

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GENERAL INFORMATION



APPLICATION BOUNDARY



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Client

Cumberland Council

Project

The Iron Line
Millom, Cumbria

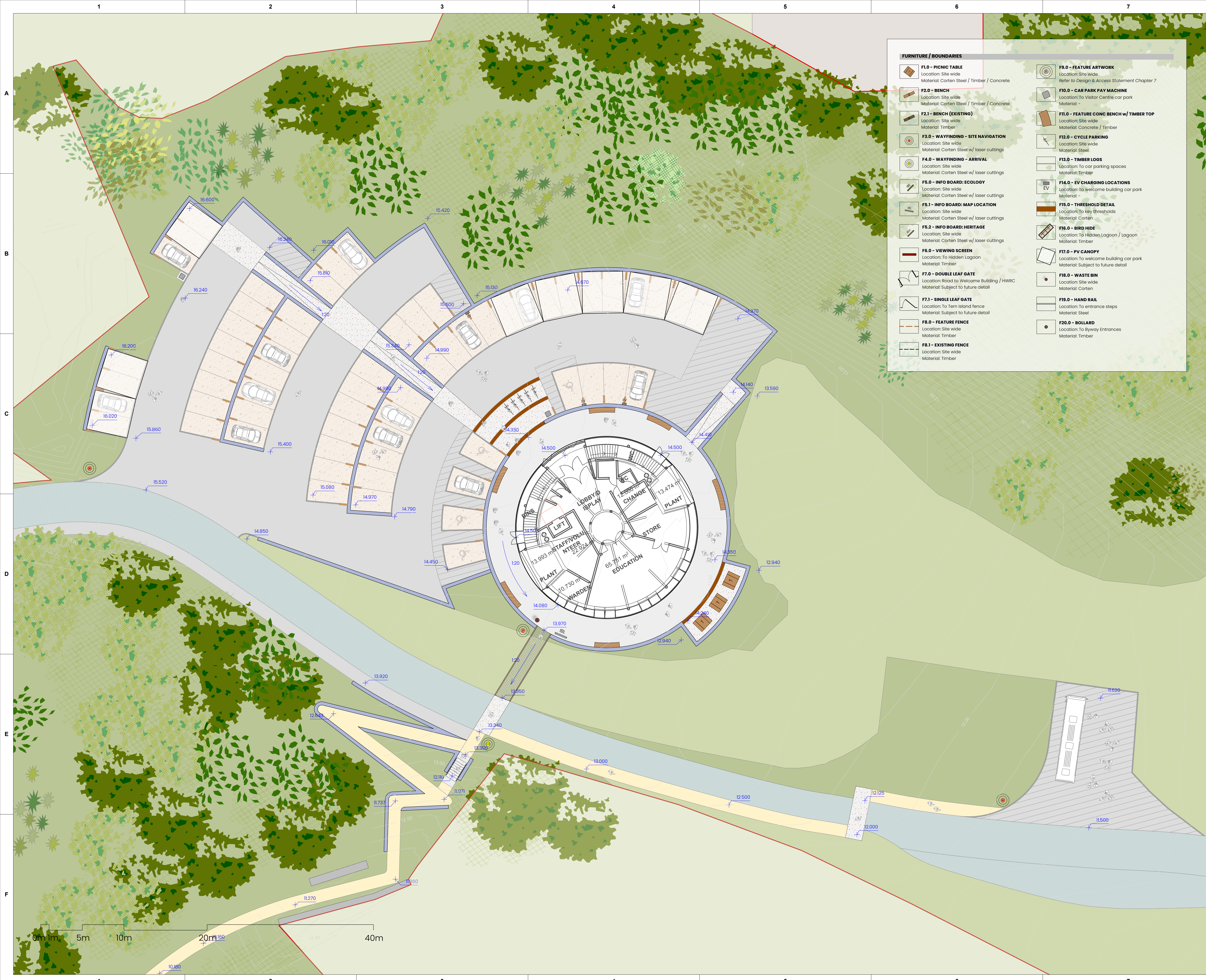
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07/04/25	P02		Issued for planning	MD

KEY

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	S4.0 – VEHICULAR MACADAM (V) Location: Visitor Centre car park / Access Road Tren Dims: 15m wide trench cover w/ passing piles
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	S7.0 – IN-SITU CONCRETE W/ SMOOTH FINISH (P) Location: To in ground railway details / Visitor Centre Hobbarrow Lighthouse
	S7.1 – IN-SITU CONCRETE W/ EXPOSED AGGREGATE FINISH (P / V) Location: To Visitor Centre / Whitecroft Junction
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	SE – SURFACE EXISTING Location: As noted



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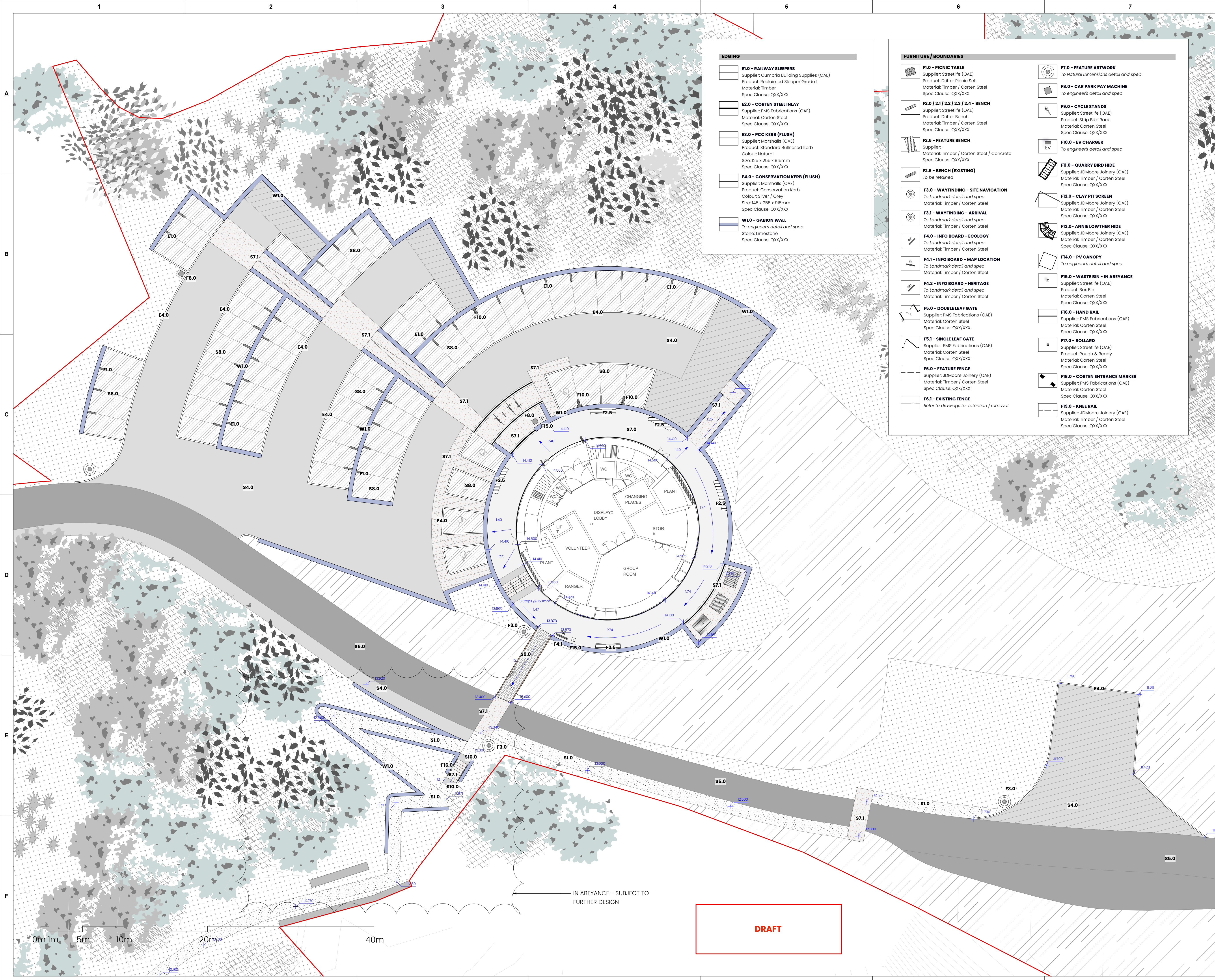
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The Iron Line

Millom, Cumbria

GA | Visitor Centre 1:200

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THIS DRAWING WAS PLOTTED ON:
11/07/2025

DATE	REV	ZONE	DESCRIPTION	CHK
07/04/25	P03		Issued for planning	MDM
10/07/25	P04		Issued for coordination	MDM
11/07/25	P05		Updated with annos	MDM

KEY	
GENERAL INFORMATION	
	APPLICATION BOUNDARY
HARDWORKS	
	S1.0 - SELF BINDING GRAVEL (P) Supplier: Breedon (OAE) Colour: Golden Amber Depth: 50mm Unit Size: 0-12mm Spec Clause: QXX/XXX
	S2.0 - STONE TO DUST SURFACE (V) To engineer's detail and spec Note: Extents / treatment subject to condition survey Material: Crushed Rock (Locally Sourced) Depth: 40mm Unit Size: 0-10mm Spec Clause: QXX/XXX
	S3.0 - TIMBER BOARDWALK (P) Supplier: Brampton Woodworks (OAE) Material: Timber Spec Clause: QXX/XXX
	S4.0 - VEHICULAR MACADAM (V) To engineer's detail and spec Depth: To eng detail and spec Spec Clause: QXX/XXX
	S5.0 - VEHICULAR MACADAM (V) To engineer's detail and spec Note: Extents / treatment subject to condition survey Depth: To eng detail and spec Spec Clause: QXX/XXX
	S6.0 - NATURAL STONE PAVING (P) Supplier: - (OAE) Colour: - Depth: - Unit Size: - Spec Clause: QXX/XXX
	S7.0 - INSITU CONCRETE w/ SMOOTH FINISH (P / V) To engineer's detail and spec Colour: Grey Finish: Smooth Trowel Finish Depth: 150mm Spec Clause: QXX/XXX
	S7.1 - INSITU CONCRETE w/ EXPOSED AGGREGATE FINISH (P / V) To engineer's detail and spec Colour: Grey Finish: Exposed Aggregate Depth: 150mm Etch Depth: 0-3mm Spec Clause: QXX/XXX
	S8.0 - REINFORCED GRAVEL (P / V) Grid Supplier: Geosynthetics (OAE) / Grey Gravel Supplier: SBS (OAE) Colour: Buff/Grey Unit Size: 6-10mm Spec Clause: QXX/XXX
	S9.0 - RAISED STEEL WALKWAY w TIMBER EDGE (P) Supplier: - (OAE) Material: Steel Spec Clause: QXX/XXX
	S10.0 - TACTILE PAVING Supplier: xxx Colour: xxx Unit Size: 400 x 400 x 50mm Spec Clause: QXX/XXX
	SE - SURFACE EXISTING Location: As noted



ORIGINATOR

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Newcastle-upon-Tyne
NE1 1EW

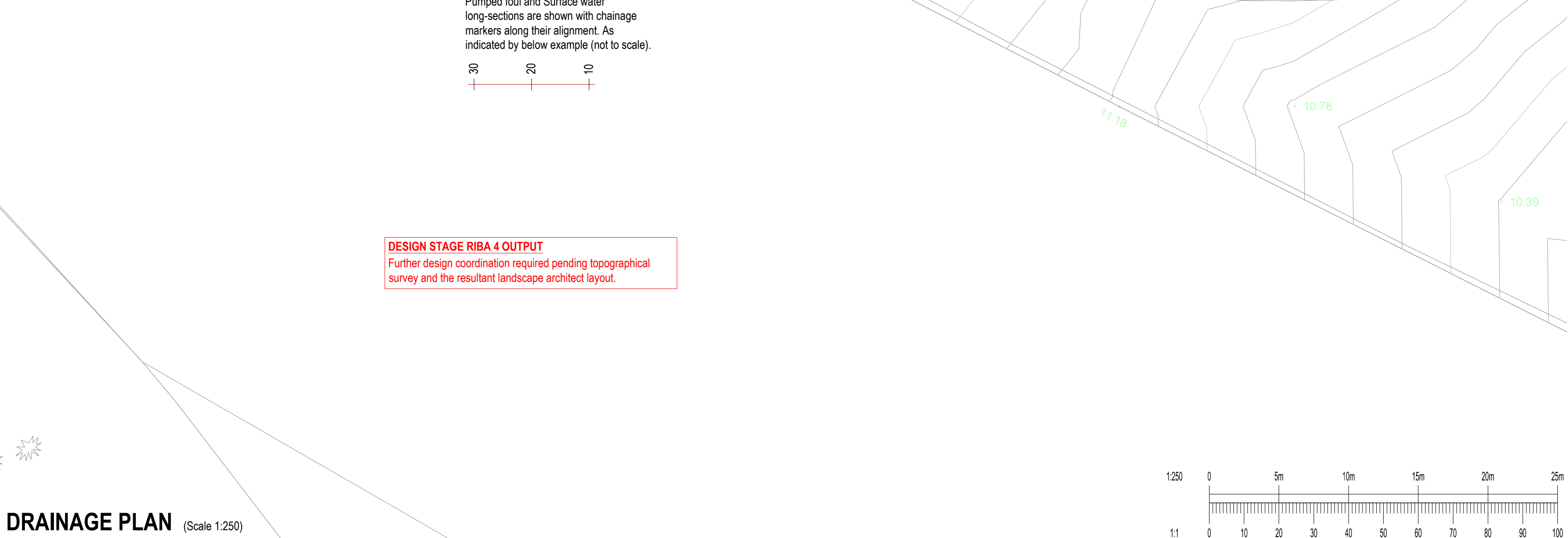
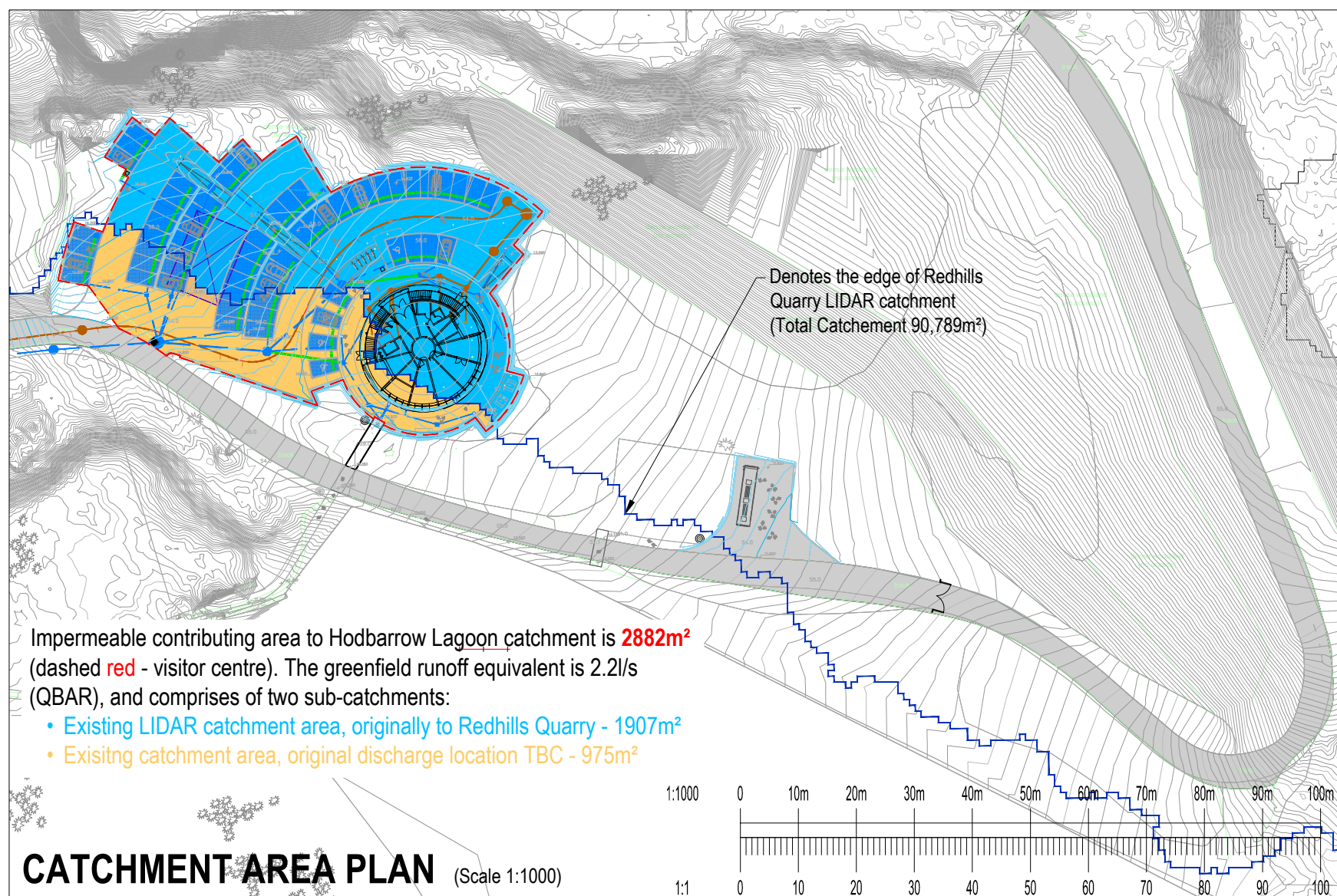
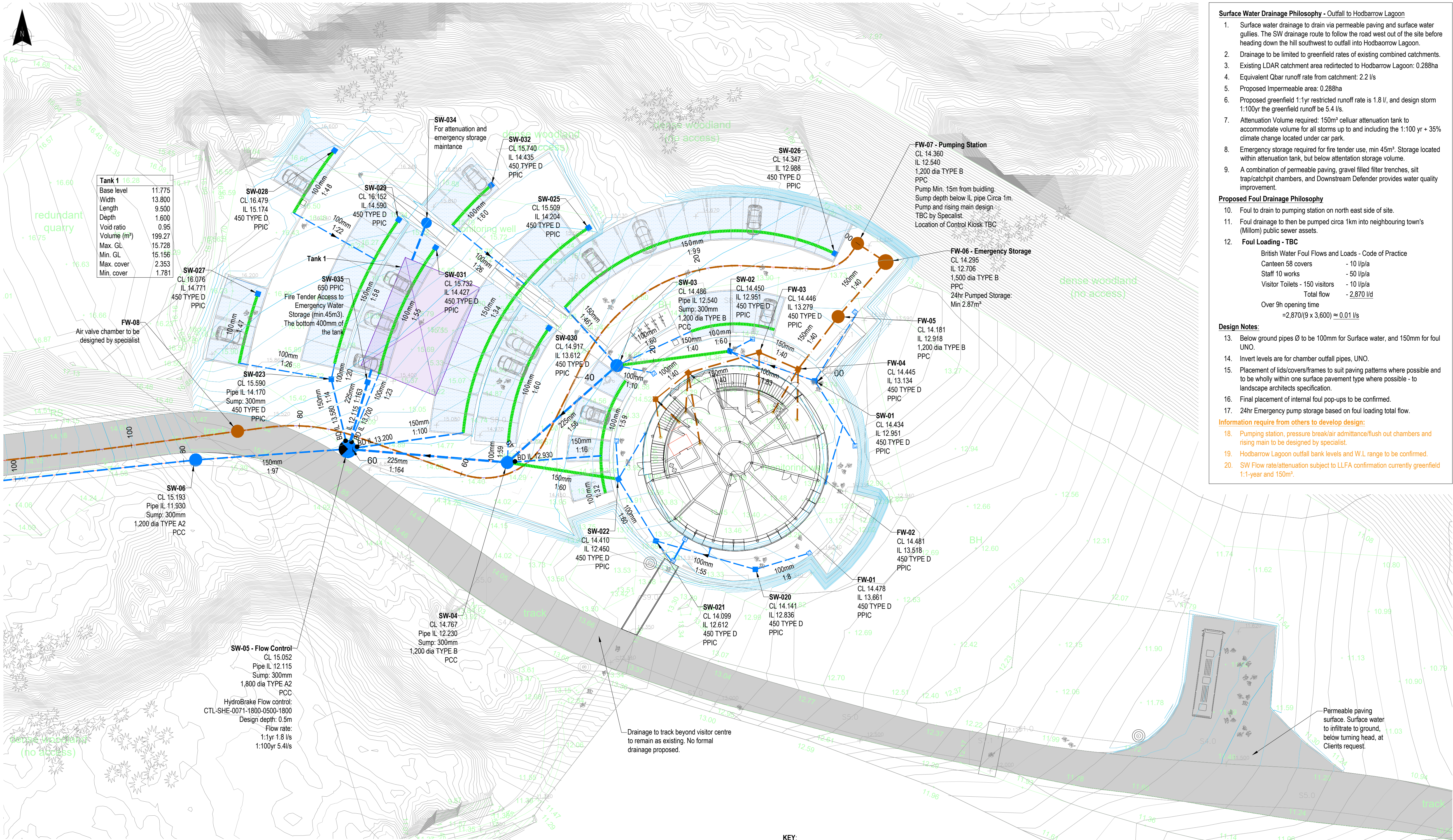
Client
Cumberland Council

Project
The Iron Line
Millom, Cumbria

Drawing Title
GA | Visitor Centre 1:200

Created By	Checked By	Scale	Sheet Size
MDM	CL	1:200	A1
Project Number	Originator	Volume	Level
289	LYR	XX-ZZ-DWG-L-1203	
Work Stage	Status	Revision	
Stage 4	S1	P05	

Appendix B Proposed Drainage Drawings



Surface Water Drainage Philosophy - Outfall to Hodbarrow Lagoon

- Surface water drainage to drain via permeable paving and surface water gullies. The SW drainage route to follow the road west out of the site before heading down the hill southwest to outfall into Hodbarrow Lagoon.
- Drainage to be limited to greenfield rates of existing combined catchments.
- Existing LDAR catchment area redirected to Hodbarrow Lagoon: 0.288ha
- Equivalent Qbar runoff rate from catchment: 2.2 l/s
- Proposed Impermeable area: 0.288ha
- Proposed greenfield 1:1yr restricted runoff rate is 1.8 l/s, and design storm 1:100yr the greenfield runoff be 5.4 l/s.
- Attenuation Volume required: 150m³ cellular attenuation tank to accommodate volume for all storms up to and including the 1:100 yr + 35% climate change located under car park.
- Emergency storage required for fire tender use, min 45m³. Storage located within attenuation tank, but below attenuation storage volume.
- A combination of permeable paving, gravel filled filter trenches, silt trap/catchpit chambers, and Downstream Defender provides water quality improvement.

Proposed Foul Drainage Philosophy

- Foul to drain to pumping station on north east side of site.
- Foul drainage to then be pumped circa 1km into neighbouring town's (Millom) public sewer assets.

Foul Loading - TBC

British Water Foul Flows and Loads - Code of Practice

Canteen 58 covers	- 10 l/p/a
Staff 10 works	- 50 l/p/a
Visitor Toilets - 150 visitors	- 10 l/p/a
Total flow	- 2,870 l/d

Over 9h opening time
= 2,870 / (9 x 3,600) ≈ 0.01 l/s

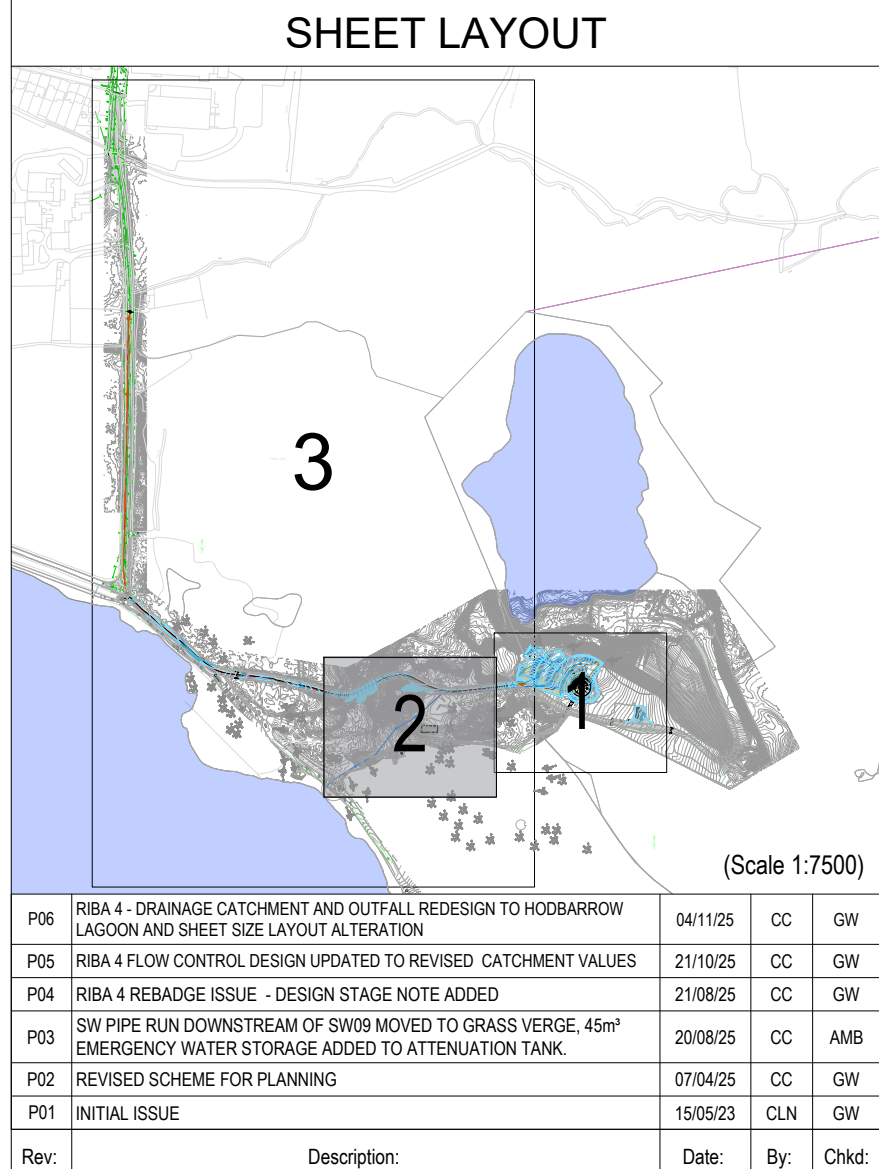
Design Notes:

- Below ground pipes Ø to be 100mm for Surface water, and 150mm for foul UNO.
- Invert levels are for chamber outfall pipes, UNO.
- Placement of lids/covers/frames to suit paving patterns where possible and to be wholly within one surface pavement type where possible - to landscape architects specification.
- Final placement of internal foul pop-ups to be confirmed.
- 24hr Emergency pump storage based on foul loading total flow.

Information require from others to develop design:

- Pumping station, pressure break/air admittance/flush out chambers and rising main to be designed by specialist.
- Hodbarrow Lagoon outfall bank levels and W.L range to be confirmed.
- SW Flow rate/attenuation subject to LLFA confirmation currently greenfield 1:1-year and 150m³.

- GENERAL NOTES:**
- This drawing is to be read in conjunction with all relevant architects and engineers drawings and specifications.
 - 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.
 - All dimensions are in metres unless noted otherwise.
 - For general notes refer to drawing.
- KEY:**
- Surface water private drain
 - Surface water flow control
 - Incoming backdrop IL
 - Rainwater pipe
 - Surface water private gully
 - Surface water highway gully
 - Filter drain (perforated pipe)
 - Channel drain (with Access, and Sump box)
 - Pervious pavement
 - Below ground surface water storage tank
 - Foul water private drain
 - Foul water rising pump main
 - Foul water pop-up
 - Existing major (0.5m) and minor (0.1) contours
 - Proposed major (0.5m) and minor (0.1m) contours
 - Existing Topographical information



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Status: **SUITABLE FOR INFORMATION** **S2**

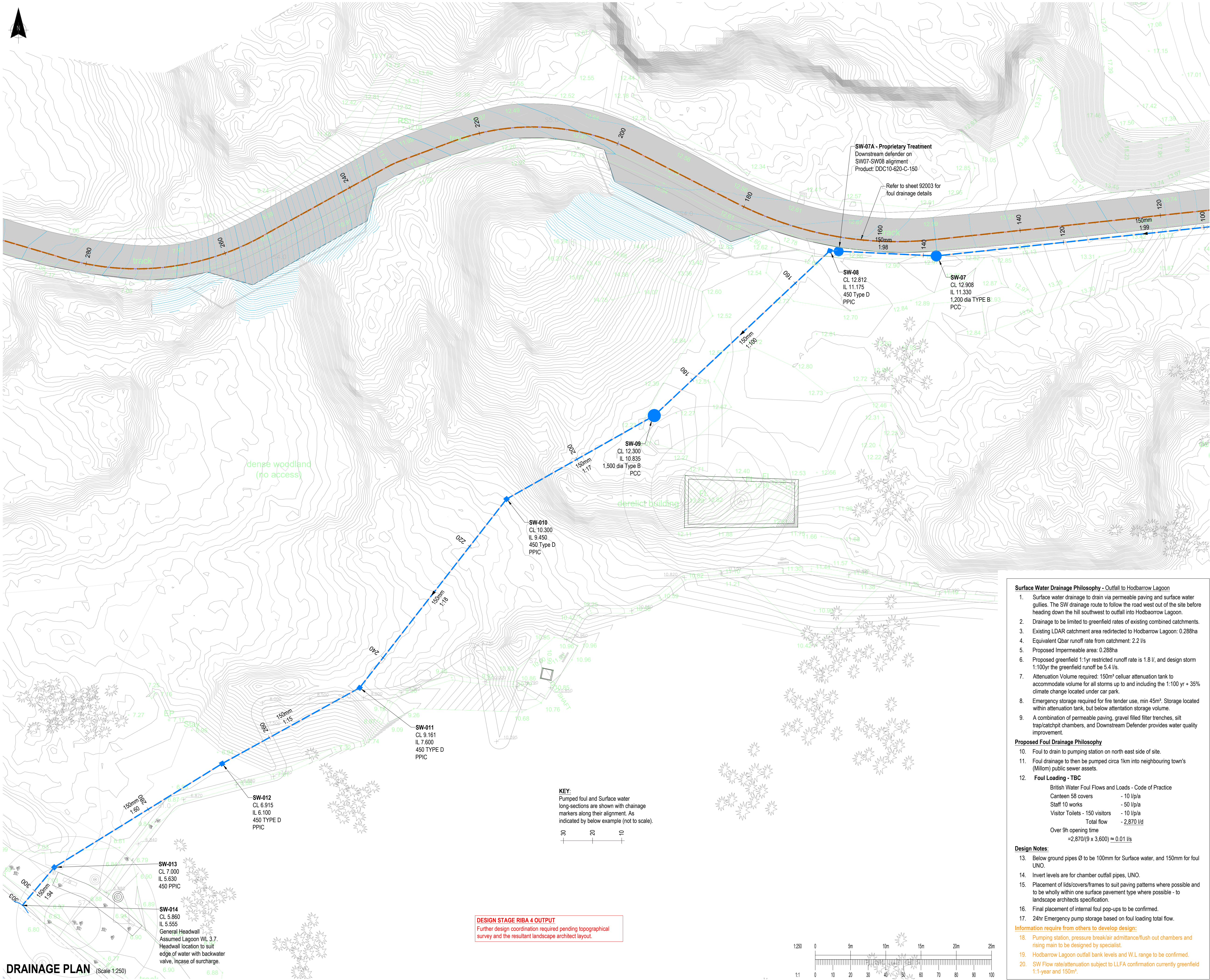
Client: **STORY** **Cumberland Council**

Project: **MILLOM IRON LINE**

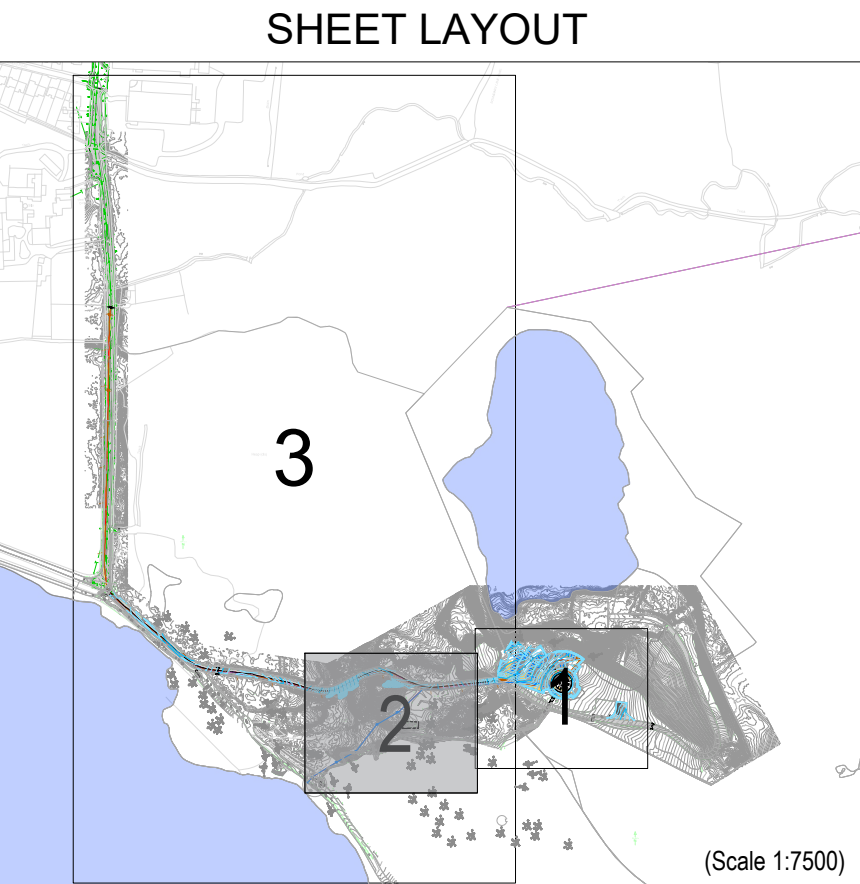
Dwg Title: **DRAINAGE STRATEGY SHEET 1**

Drawn By: CC	Designed By: CC	Checked By: GW
Date: 04/04/25	Scale: @ A1	Revision: 1:250
Project No - Originator - Function - Spatial - Form - Discipline - Number		Revision

081617 - CUR - 01 - ZZ - D - C - 92001 P06



- GENERAL NOTES:**
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 - Existing major (0.5m) and minor (0.1) contours
 - Proposed major (0.5m) and minor (0.1m) contours
 - Existing Topographical information



P06	RIBA 4 - SW DRAINAGE CATCHMENT AND OUTFALL REDESIGN TO HODBARROW LAGOON AND SHEET SIZE LAYOUT ALTERATION	04/11/25	CC	GW
P05	RIBA 4 FLOW CONTROL DESIGN UPDATED TO REVISED CATCHMENT VALUES	21/10/25	CC	GW
P04	RIBA 4 REBASE ISSUE - DESIGN STAGE NOTE ADDED	21/08/25	CC	GW
P03	SW PIPE RUN DOWNSTREAM OF SW09 MOVED TO GRASS VERGE	20/08/25	CC	AMB
P02	REVISED SCHEME FOR PLANNING	08/04/25	CC	GW
P01	INITIAL ISSUE	15/05/23	CLN	GW
Rev:	Description:	Date:	By:	Chk:

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Status: **SUITABLE FOR INFORMATION** **S2**

Client: **STORY** **Cumberland Council**

Project: **MILLOM IRON LINE**

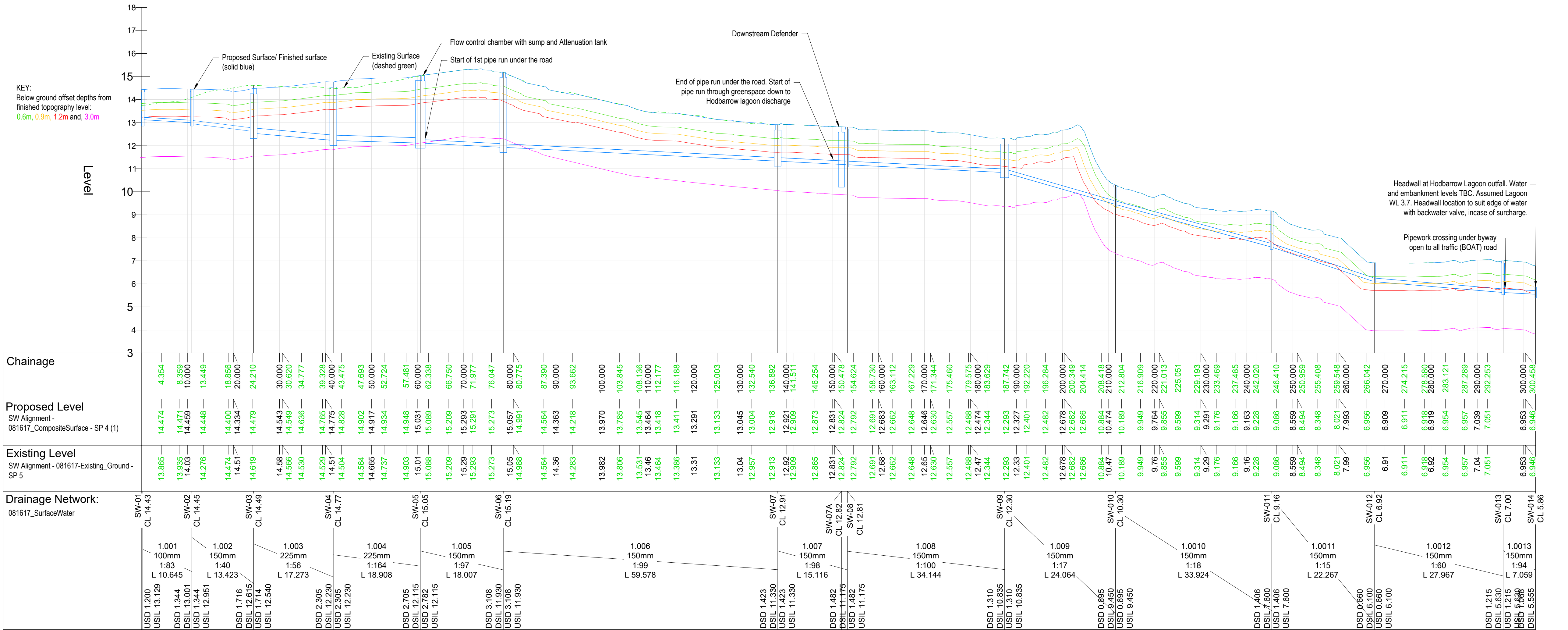
Dig Title:

DRAINAGE STRATEGY SHEET 1

Drawn By	Designed By	Checked By
CC	CC	GW
Date	04/04/25	Scales @ A1
1:250		
Project No - Originator - Function - Spatial - Form - Discipline - Number	Revision	
081617 - CUR - 01 - ZZ - D - C - 92001	P06	

- Surface Water Drainage Philosophy - Outfall to Hodbarrow Lagoon**
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- British Water Foul Flows and Loads - Code of Practice
- | | |
|--------------------------------|-------------|
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=2,870/(9 x 3,600) ≈ 0.01 l/s
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SW Alignment - Longsection
(Scale: H 1:500 | V 1:50 | Datum: 3.000m)



GENERAL NOTES:

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DESIGN STAGE RIBA 4 OUTPUT

Further design coordination required pending topographical survey and the resultant landscape architect layout.

P03	RIBA 4 - SW DRAINAGE CATCHMENT AND OUTFALL REDESIGN TO HODBARROW LAGOON	04/11/25	CC	GW
P02	RIBA 4 REBAGGE ISSUE - DESIGN NOTE ADDED	21/08/25	CC	GW
P01	INITIAL ISSUE	19/08/25	CC	GW
Rev.	Description:	Date:	By:	Chkd:

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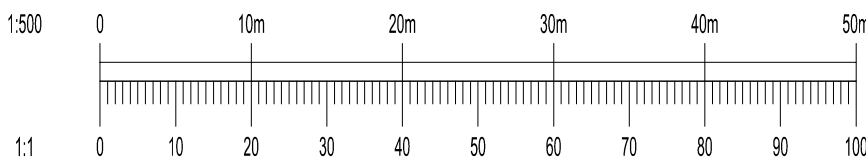
Status:
SUITABLE FOR INFORMATION **S2**

Client:
STORY 
Cumberland Council

Project:
MILLOM IRON LINE

Orig Title:
**SURFACE WATER DRAINAGE
LONG SECTION**

Drawn By CC	Designed By CC	Checked By GW
Date 04/04/25	Scales @ A1 1:250	Revision
Project No - Originator - Function - Spatial - Form - Discipline - Number		
081617 - CUR - 01 - ZZ - D - C - 92101		
P03		



GENERAL NOTES:

- THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ALL RELEVANT ARCHITECTS AND ENGINEERS DRAWINGS AND SPECIFICATIONS.
- 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.
- ALL DIMENSIONS ARE IN METRES UNLESS NOTED OTHERWISE.
- FOR GENERAL NOTES REFER TO DRAWING.

Design Notes:

- This drawing is to be read in conjunction with all relevant architects and engineers drawings and specifications.
- Do not scale this drawing. Any ambiguities, omissions or errors on drawings shall be brought to the engineers attention immediately. All dimensions must be checked / verified on site.
- Design based on available topographical survey and cctv survey information at the time of design.
- All drainage works to be in accordance with the Civil Engineering Specification for the Water Industry (CESWI) as included in Sewer Sector Guidance (SSG), the requirements of The Building Regulations: Approved Document H (Part H) and Current drainage Specification.
- All dimensions are in mm and levels are in above Ordnance datum unless otherwise noted. Diameters are expressed in millimetres and denoted by a Ø symbol.
- It is advised that the contractor survey retained existing drainage prior to commencement to confirm location and condition, with clearing to facilitate survey if required.
- Existing sewer locations where the proposed drainage is to connect, are to be surveyed and exact levels confirmed and provided to engineer prior to commencement of works.
- All existing services to be located prior to commencement of any drainage works, and where necessary protection or diversions to be undertaken to avoid conflict with the proposed work.
- All existing drains to be abandoned shall be either removed or grouted up if not possible. Grouting to be performed by capping at ends / connectors and filling the remaining void with grout, in accordance with CESWI.
- All soft spots to be removed from bottom of excavations and to be refilled to formation level in accordance with groundworks specifications.
- Revised ground must be filled in accordance with groundworks specifications and consolidated before any sewer works are carried out.
- All private drainage works to be in accordance with CESWI, BS EN 752 2017 Drain And Sewer Systems Outside Buildings and the Part H.
- All drains, unless agreed otherwise stated, shall be:
 - 100mm to 300mm diameter to be verified only.
 - All diameters given are nominal internal pipe diameters.
- Pipe materials in accordance with the following:
 - All vitrified clay pipes to BS EN 255-1.
 - All concrete pipes to be to BS EN 1916.
 - All concrete manholes to be to BS EN 1917.
- As an alternative the contractor may use an approved unplasticised polythylene (UPVC).
- All private drainage pipes with a cover of less than 600mm in non-trafficked areas and less than 1200mm in trafficked areas to have a concrete protection slab or be bedded and surrounded in concrete (Class 2). Compressible material shall be provided at every pipe joint. Where cover exceeds this depth, pipes are typically bedded and surrounded in Class 5. Refer to pipe embedment details drawing for specific types.
- Backfill to drainage trenches under hardstanding areas to be Type 1 sub base material, elsewhere backfill to be free draining readily compressible material free from debris, organic matter, frozen soil clay lumps and large stones. To be compacted in layers not exceeding 150mm thick.
- Bedding and backfill materials to conform to the requirements of WIS 4-08-02 (Table A2).
- Where foul drains run above surface drains, concrete protection may be required at crossroads to prevent any potential contamination.
- The first pipe out of manholes to be as short as practicable so as to provide a flexible joint as close as possible to the outside face of the concrete surround and connected to a length of roker pipe.
- All connections passing through bases or edge beams to be in sealed sleeves. Alternatively connections may be cast-in with flexible joints not greater than 150mm from face of concrete.
- Where drainage pipes are less than 300mm below the underside of the ground floor slab, concrete encasement is required (Class 2). Compressible joints are to be provided at every pipe joint within the concrete.
- Where pipes are more than 300mm below the underside of the slab, Class 5 bedding is acceptable.
- Drain pipes to be laid in maximum 3 metres lengths unless there is a specific operational need to lay longer lengths.
- Plastic channel sections will not be permitted within manhole chambers. Clayware channels shall be used within manholes for pipe sizes up to and including 300mm diameter.
- All new connections into existing manholes (or into existing sewers) to be 'soffit level' unless otherwise noted.
- Substrate resistant cement (C20-DC2) and precast concrete products must be used or a laboratory report provided to prove that such precautions are not required subject to SI.
- Sewers must have 5m clearance from trees and hedges or to have suitable root protection in accordance with SSG requirements.
- The chamber size of manholes with more than one connection in them may need to be increased to accommodate the connections and bends.
- All internal drainage connections are provided to the penetration positions shown on architect and M&E drawings. Refer to dimensioned locations on architect's ground floor setting-out plans.
- Rainwater and foul water pop-up locations and sizes to be confirmed by others.
- All underground foul drainage should be suitably vented at or near to the head of run.
- All access fittings, stacks, RHPs and gullies to be roddable. All to have low level rodding access plates unless an alternative means of access is agreed. Access point to be above any ground floor connected appliance spill level.
- Large access fitting required above ground where greater than 12m up to 22m to a junction. Small access fitting required up to 12m to a junction.
- All gully and channel drain outlets and termination points to be trapped and roddable. Internal gullies and channel drains to be specified by others.
- All branch connections to be made with sweep bends in the direction of flow in the main sewer.
- Where no WCs are connected upstream, under slab foul water drainage to be laid at 1:40 min. After the connection of at least 1m WC, a min. fall of 1:50 applies.
- All internal covers to have mechanically pinned corners and be double sealed with recessed trap fly finishes.
- All manhole covers in backfills and external paving areas to have recessed covers of the appropriate grade to accept architects paving proposal.
- Unless noted otherwise in the manhole schedule, all manhole, gully and channel covers (internally) should be the following specification:
 - B125 load class in pedestrian areas.
 - D400 load class in vehicular areas.
- Cover levels, gully positions, and building locations are approximate and shall be confirmed by architect/landscape architect. Contractor to allow for adjustment to suit agreed positions and finished levels, and confirm all cover levels on site.
- Outlet connection(s) subject to agreement with the approving authority.
- The contractor shall comply with the following:
 - (i) All operations should be carried out in accordance with the general health and safety policy of the developer as required by sections 2 of the Health and Safety at Work Act 1974 and in particular: The Construction (Health, Safety and Welfare) Regulations 1996.
 - (ii) The local authority and utility companies are to be notified prior to commencement of work on site.
 - (iii) Prior to construction the actual positions and depths of services likely to be affected by the works should be established by means of hand dig in close liaison with the utility companies. The contractor shall immediately advise the engineer of any services exposed which may affect the design.
 - (iv) All operatives working on the highway works must have street works accreditation.
- The contractor shall be responsible for ensuring that pipes are adequately protected from concentrated loading by construction traffic during the construction period.
- The contractor shall allow for the protection, temporary and permanent support, and temporary and permanent diversion works, as necessary to all existing services.
- The contractor shall allow for keeping trenches and excavations as dry as practicable by pumping from temporary sumps and de-watering as appropriate. The point and method of discharge to be agreed with the drainage authority & LPA and environment agency.
- It is advised that drainage works are to be constructed from the outfall towards the head of run to ensure the outfall can be achieved.
- All drains to be CCTV surveyed on completion of the works.
- Cessae traps should be provided above ground within an enzyme treatment system, by appropriate specialist designer.

DESIGN STAGE RIBA 4 OUTPUT
Further design coordination required pending topographical survey and the resultant landscape architect layout.

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Client: **STORY** **Cumberland Council**

Project: **MILLOM IRON LINE**

Drp Title: **DRAINAGE DETAILS SHEET 1**

Project No - Originator - Function - Spatial - Form - Discipline - Number Revision

081617 - CUR - XX - XX - D - C - 92200 P04

Drawn By: **AMG** Designed By: **GW** Checked By: **GW**

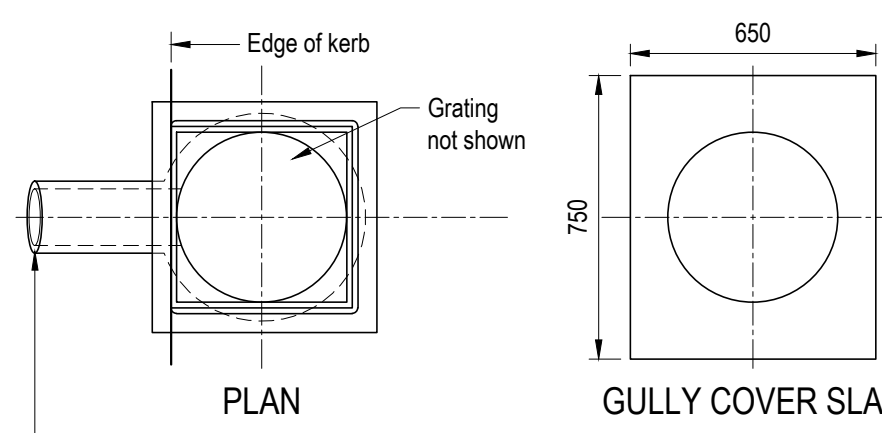
Date: **JULY 23** Scale: **AS SHOWN**

Project No - Originator - Function - Spatial - Form - Discipline - Number Revision

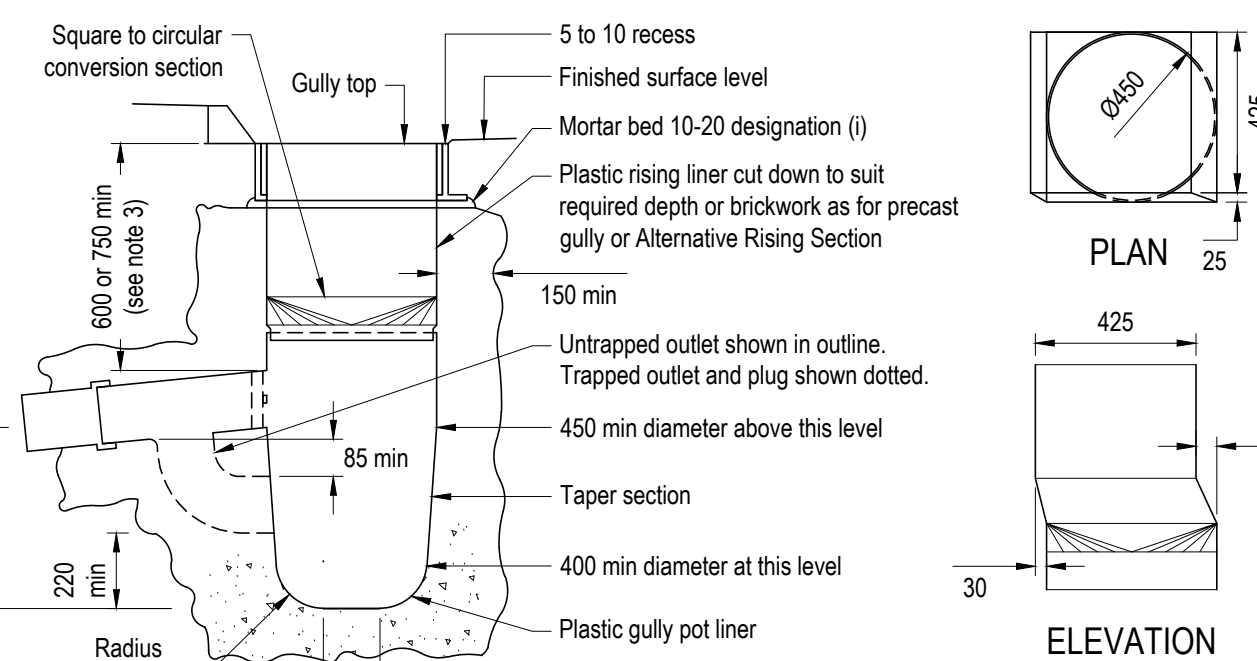
081617 - CUR - XX - XX - D - C - 92200 P04

NOTES

- Precast concrete gullies and cover slabs shall be to BS 5911-6.
- When an in-situ cast gully has a trap, the stoppers shall comply with the requirements of BS 5911-4 and BS EN 1917.
- The minimum depth from top of the grating to the top of the gully outlet is to be 750 when the connecting pipe is under carriageway or hard shoulder and 600 elsewhere.
- A plastic internal shutter shall be used as shown, bedded on an in-situ concrete slab of 150 minimum thickness and surrounded by concrete 150 minimum thickness extending to the sides of the excavation.
- All in-situ concrete shall be ST4 to SHW, Clause 2602.



ALTERNATIVE IN-SITU CAST SUMP (PARALLEL SIDES)



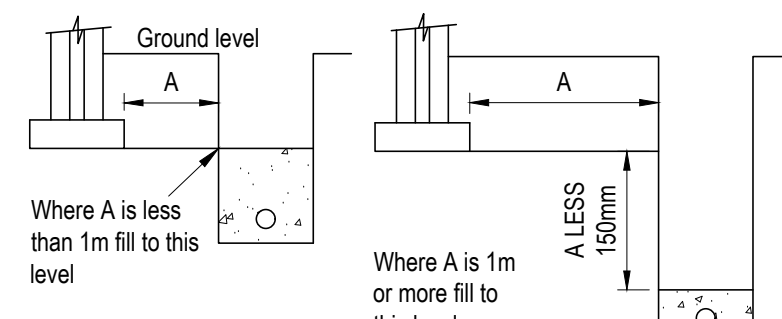
ELEVATION ALTERNATIVE RISING SECTION

HIGHWAY GULLIES

Design code: MHCV Volume 3 Section 1 - Highway Construction Details - F Series - Drainage - Figures F13 and F14
Preferred gully material is precast concrete.
(Scale 1:20)

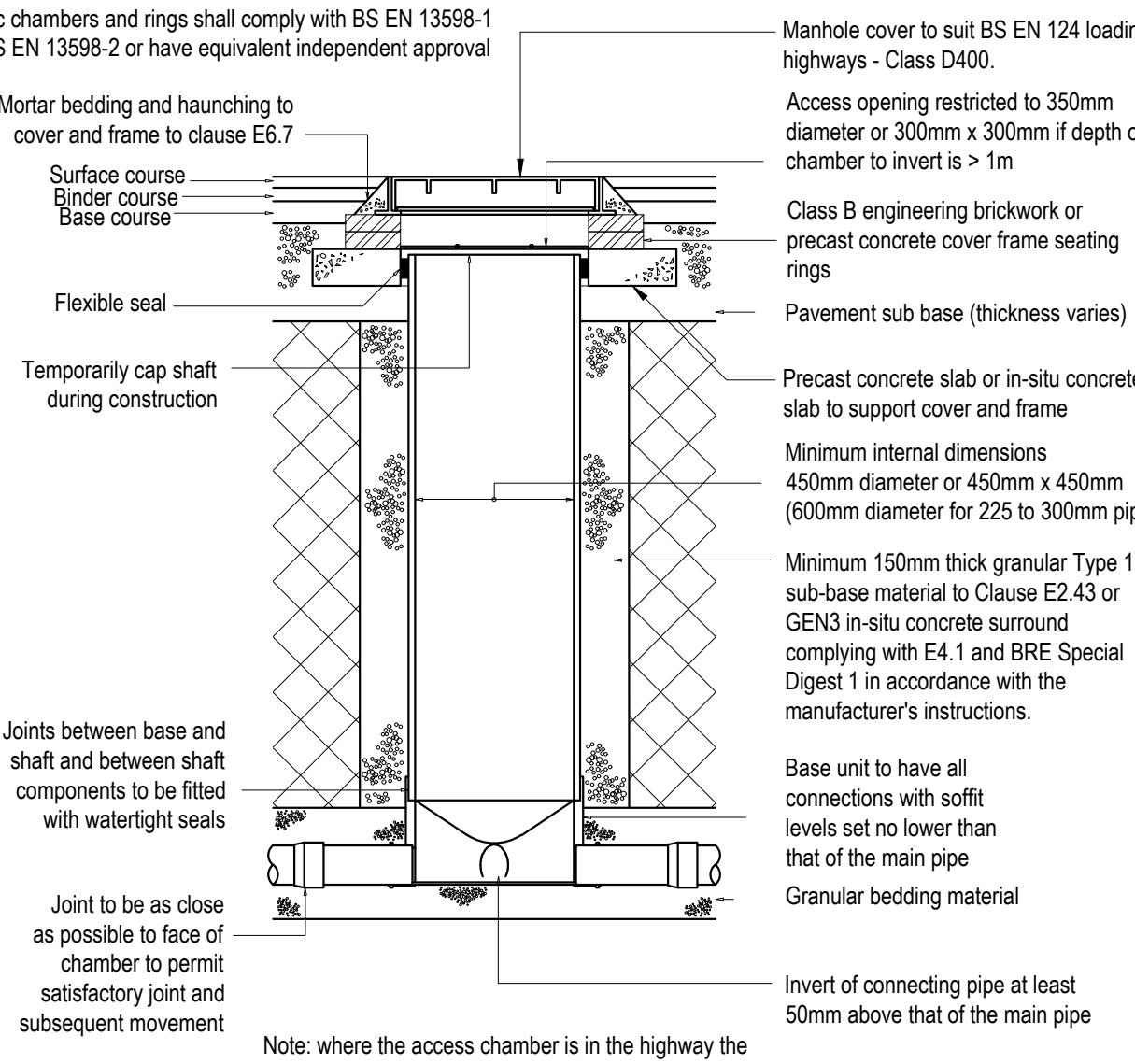
TYPICAL VERTICAL BACKDROP DETAIL (RIGID MATERIALS)

For use in manhole types A to D
Design code: SSG Appendix C Figure 16
(Scale 1:20)



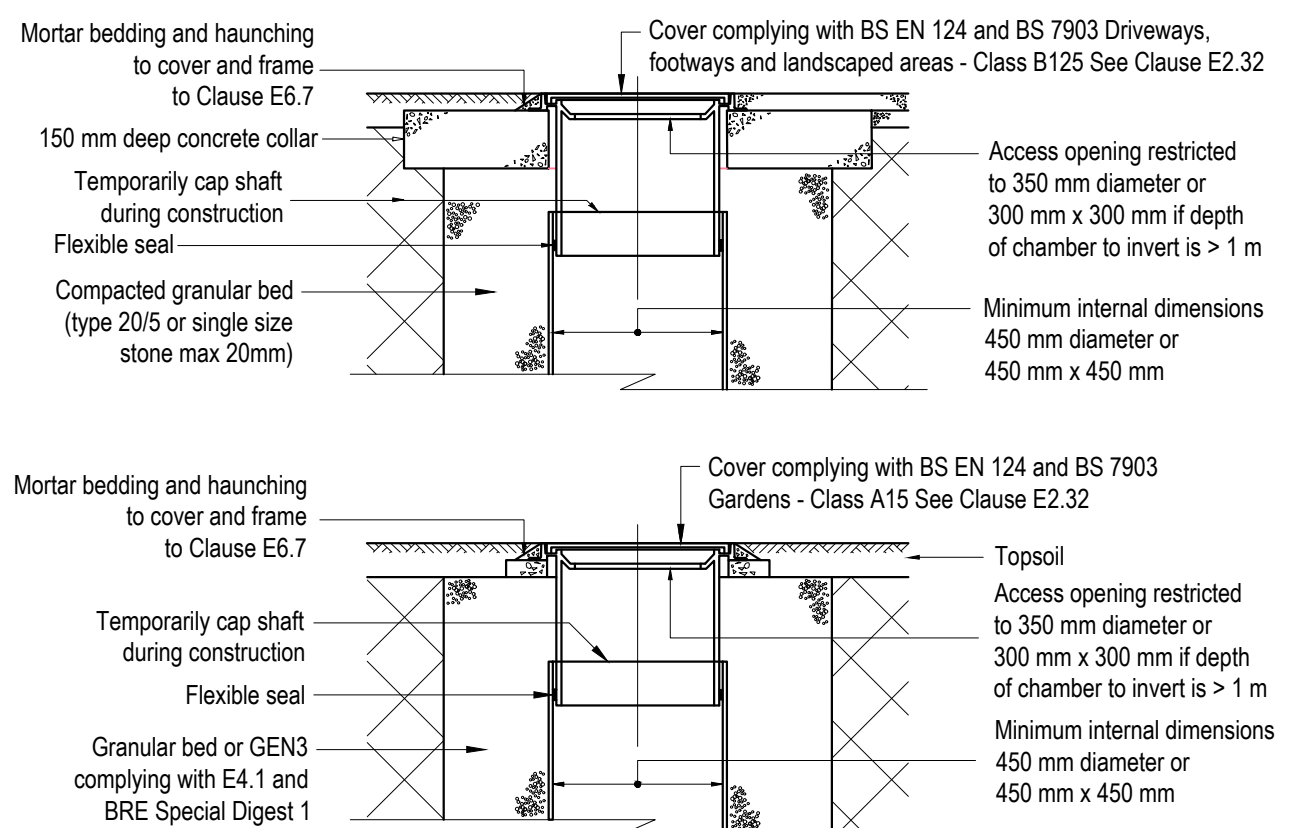
PIPE RUNS NEAR BUILDINGS

Based on Building Regulations H1 Diagrams 8 & 12
(Not to scale)



TYPICAL INSPECTION CHAMBER DETAIL - TYPE D

Depth from cover level to soffit of pipe up to 3m
Flexible material construction for use in areas subject to vehicle loading
Design code: SSG Appendix C Figure 18 (see Part E for clauses)
(Scale 1:20)

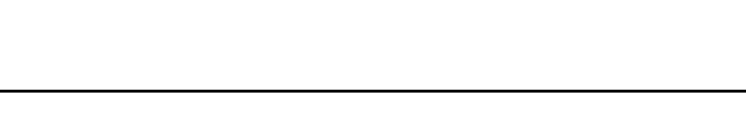
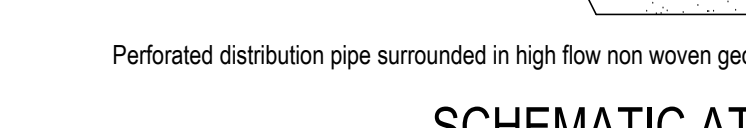
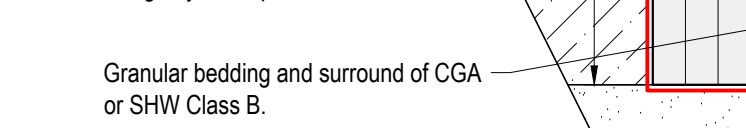
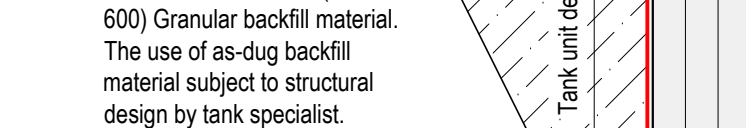
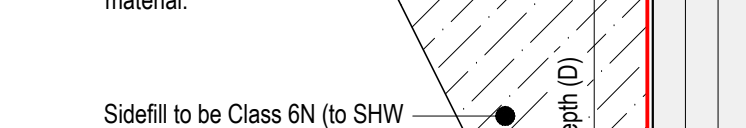
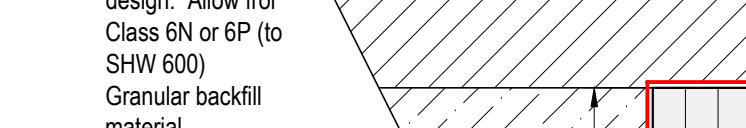
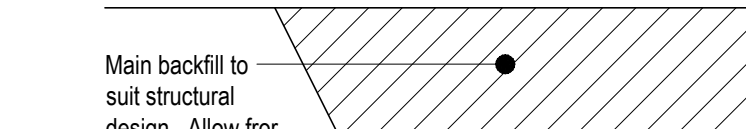
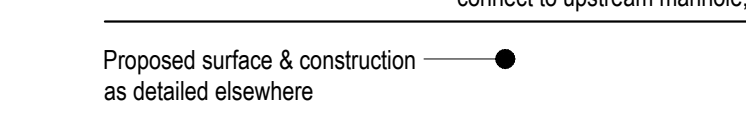
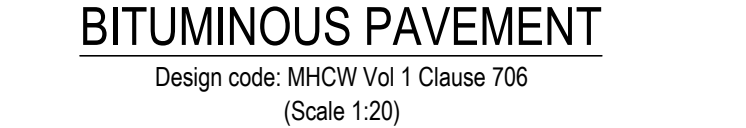
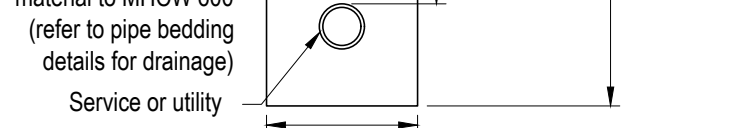
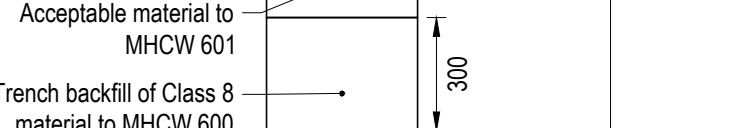
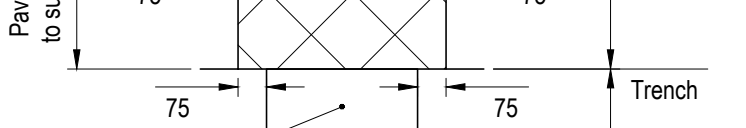
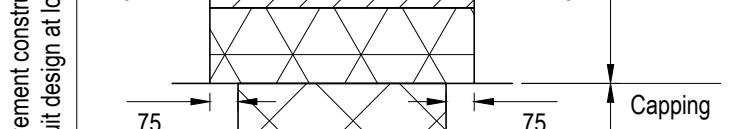
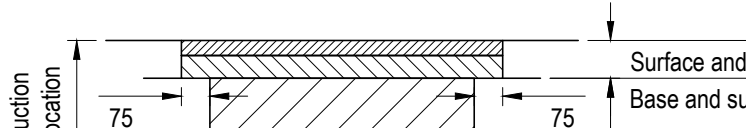


TYPICAL INSPECTION CHAMBER DETAIL - TYPE D

Flexible material construction alternative top details for use in areas of light vehicle loading or landscaped areas
Design code: SSG Appendix C Figure 19 (see Part E for clauses)
(Scale 1:20)

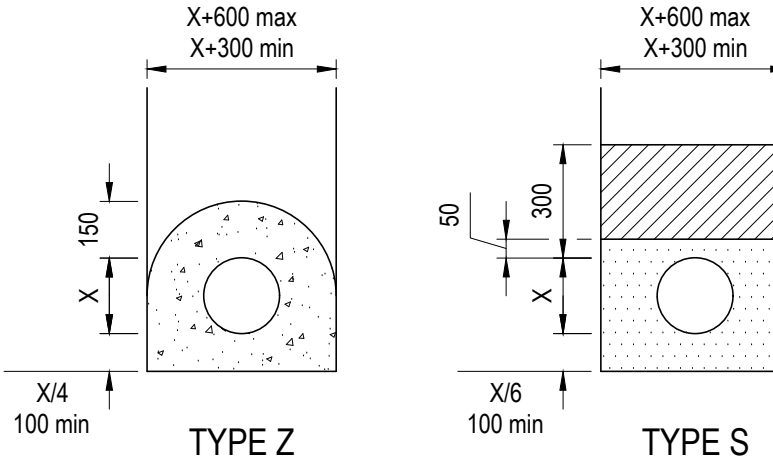
TYPICAL MANHOLE DETAIL - TYPE B

Design code: SSG Appendix C Figure 9 (See SSG for noted clauses)
Depth from cover level to soffit of pipe 1.5m to 3m
Rigid material construction without concrete surround
(Scale 1:20)



TRENCH AND BEDDING DETAILS

Design code: MHCV Volume 3 Section 1 - Highway Construction Details - F Series - Drainage - Figures F1
(Scale 1:20)



KEY

- Granular material to SHW Clause 503.3(i).
- Concrete to SHW Clause 503.3(iii).
- Class 8 material to SHW Clause 503.3(v).

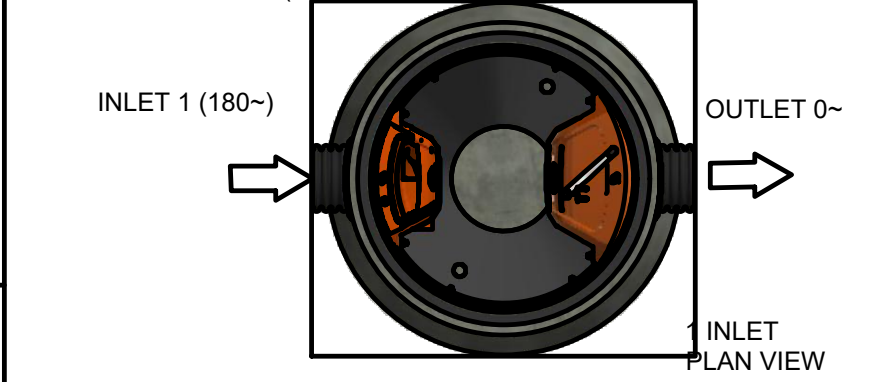
NOTES

- Dimension X is the external diameter of the pipe.
- The minimum or maximum width of the trench applied on and below a line 300mm above the outside top of the pipe. Above the 300mm line the trench backfill shall be as described in SHW Clause 505.
- The concrete bed or surround may extend to the sides of the trench or be of minimum width. Class 8 material is to be used to fill any voids so formed.
- For Type Z trench the concrete cover may be formed to a radius batter or horizontal or surface. Min. cover of concrete shall be 150.

PIPEWORK SHOWN FOR ILLUSTRATION PURPOSES

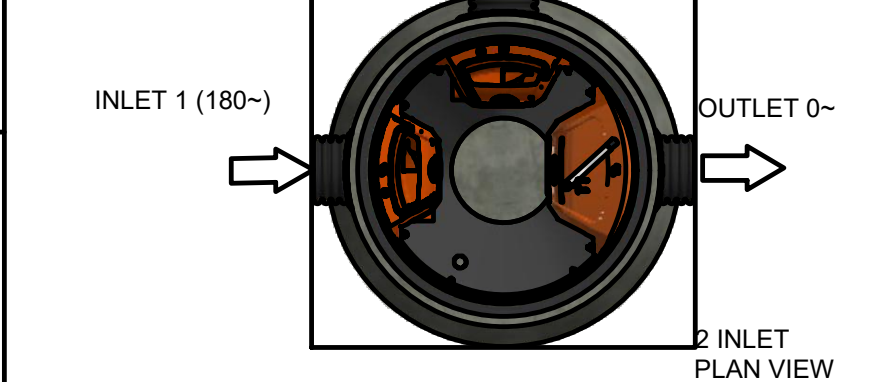
SINGLE INLET

THE INLET CAN BE POSITIONED AT ANY ANGLE BETWEEN 90°-270° FROM THE OUTLET (O-)



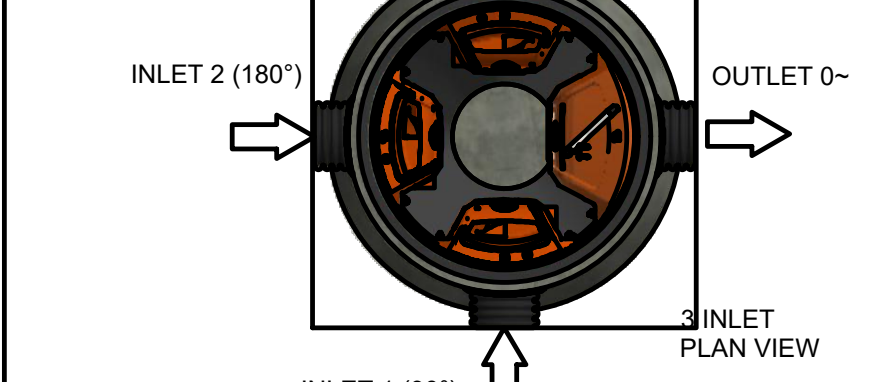
DUAL INLET

THE SECOND, INLET 2, CAN BE POSITIONED 90°-270° FROM THE OUTLET (O-), BUT MUST BE AT LEAST 90° FROM INLET 1

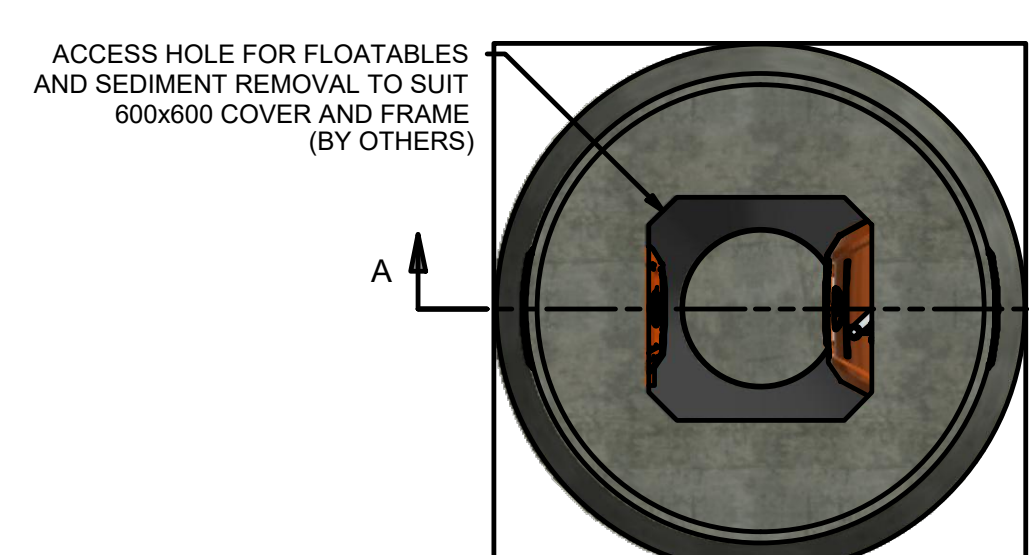


TRIPLE INLET

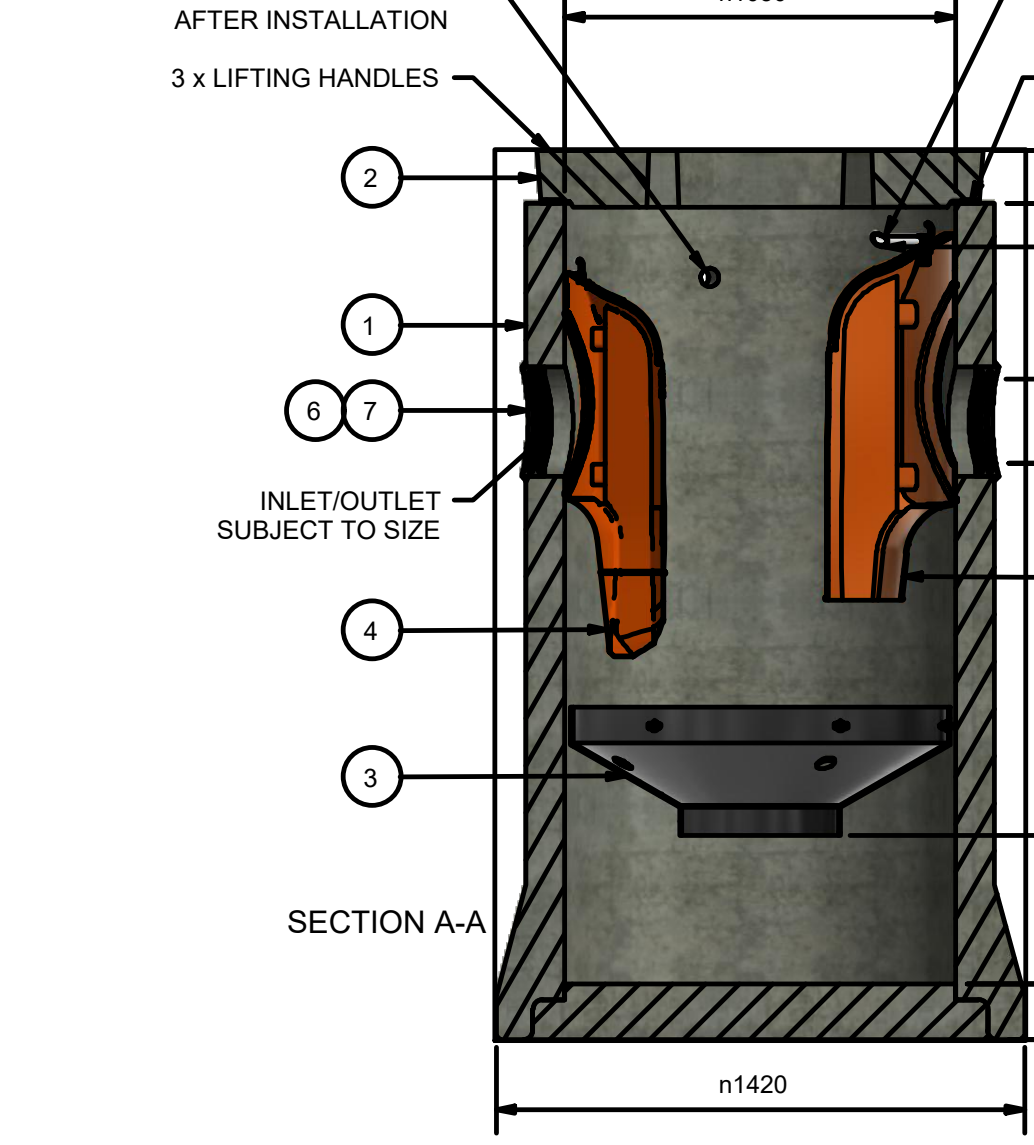
ALL CHUTES TO BE 90° APART - AS SHOWN IN ILLUSTRATION



ACCESS HOLE FOR FLOATABLES AND SEDIMENT REMOVAL TO SUIT 600x600 COVER AND FRAME (BY OTHERS)



SECTION A-A



PARTS LIST	
ITEM	DESCRIPTION
1	Concrete Chamber
2	Cover Slab
3	Benching Skirt
4	Inlet Chute
5	Outlet Hood
6	DN150/225/300 Pipe Connection
7	Concrete F90 Seal
8	PVC Flexible Hose Assembly

Note:
1. Angles can be adjusted to suit.
Minimum angle between inlets and outlets is 90°.
2. Maximum number of inlets is 3.
3. Allowable concrete chamber dimensional variations:
Height: 4%, Diameter: 8mm,
Wall Thickness: 8mm

REV	DESCRIPTION	DATE
1	ISSUED FOR TENDER	19/09/2020
2	REVISED TO SUIT DESIGN	06/01/2021
3	REVISED TO SUIT DESIGN	06/01/2021

IF IN DOUBT ASK
DATE: 16/07/2022
DRAWN BY: KJP
CHECKED BY: CG
APPROVED BY: RWB

XXXXPROJECT-1000CAV
Downstream Defender Select 1000 Concrete, Advanced Vortex

Hydro-International
hydro-int.com
©2022 HYDRO-INTERNATIONAL

WEIGHT	DESCRIPTION
N/A	PROJECT NUMBER
N/A	PROJECT NAME
N/A	PROJECT LOCATION
N/A	PROJECT DATE
N/A	PROJECT SIZE
N/A	PROJECT TYPE
N/A	PROJECT STATUS
N/A	PROJECT COMMENTS

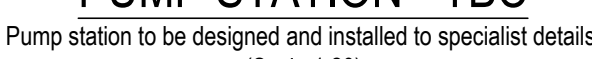
VORTEX SEPARATOR - HYDRO-INTERNATIONAL

DOWNSTREAM DEFENDER ADVANCED

To be installed to manufacturers' instructions.
(Scale 1:20)

120 0 5m 1m 15m 2m

15 0 10 20 30 40 50 60 70 80 90 100



DESIGN STAGE RIBA 4 OUTPUT
Further design coordination required pending topographical survey and the resultant landscape architect layout.

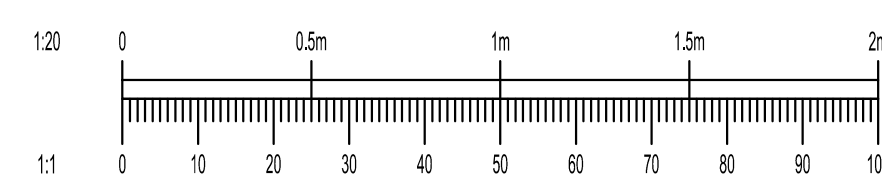
Curtins
Units 24-25 Riverside Place K Village Lound Road Kendal LA9 7FH
01539 724 823
kendal@curtins.com
www.curtins.com

STORY

MILLOM IRON LINE

Drawn By	Designed By	Checked By
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Project No - Originator - Function - Spatial - Form - Discipline - Number	Revis
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Appendix C Drainage Calculations

Design Settings

Rainfall Methodology	FSR	Maximum Time of Concentration (mins)	30.00
Return Period (years)	100	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	0.470	Preferred Cover Depth (m)	1.200
CV	0.750	Include Intermediate Ground	x
Time of Entry (mins)	4.00	Enforce best practice design rules	x

Inspection Chamber Manhole Type

Max Width (mm)	Diameter (mm)	Max Width (mm)	Diameter (mm)
150	450	300	600

>300 Link+99999 mm

Max Depth (m)	Diameter (mm)	Max Depth (m)	Diameter (mm)
3.000	450	99.999	99999

SSG Type B Manhole Type

Max Width (mm)	Diameter (mm)	Max Width (mm)	Diameter (mm)
374	1200	749	1500
499	1350	900	1800

>900 Link+900 mm

Max Depth (m)	Diameter (mm)	Max Depth (m)	Diameter (mm)	Max Depth (m)	Diameter (mm)
1.500	99999	3.000	1200	99.999	99999

SW-Default Cover Link Type

Template	Freeform Carrier	Follow Ground	x
Shape	Circular	Velocity	Colebrook-White
Barrels	1	ks (mm) / n	0.600
Auto Increment (mm)	75		

Available Diameters (mm)

150	225	300	375	450	525	600	675	750
-----	-----	-----	-----	-----	-----	-----	-----	-----

SW-500mm Cover Link Type

Template	Freeform Carrier	Preferred Cover (m)	0.500
Shape	Circular	Follow Ground	x
Barrels	1	Velocity	Colebrook-White
Auto Increment (mm)	75	ks (mm) / n	0.600

Available Diameters (mm)

150	225	300	375	450	525	600	675	750
-----	-----	-----	-----	-----	-----	-----	-----	-----

SW-900mm Cover Link Type

Template	Freeform Carrier	Preferred Cover (m)	0.900
Shape	Circular	Follow Ground	x
Barrels	1	Velocity	Colebrook-White
Auto Increment (mm)	75	ks (mm) / n	0.600

Available Diameters (mm)

150	225	300	375	450	525	600	675	750
-----	-----	-----	-----	-----	-----	-----	-----	-----

Nodes

Name	Area (ha)	T of E (mins)	Cover Level (m)	Diameter (mm)	Easting (m)	Northing (m)	Depth (m)
SW-01	0.026	4.00	14.434	450	317913.620	478989.659	1.305
SW-02	0.013	4.00	14.450	450	317903.571	478993.174	1.549
SW-03	0.056	4.00	14.486	1200	317890.258	478991.464	1.916
SW-04	0.037	4.00	14.767	1200	317877.316	478980.023	2.537
SW-05	0.074	4.00	15.052	1800	317858.475	478981.611	2.937
SW-05_Tank	0.000	4.00	15.592	450	317859.955	478991.509	3.417
SW-06	0.000		15.193	1200	317840.515	478980.322	3.263
SW-07	0.000		12.908	1200	317781.273	478974.008	1.578
SW-08	0.000		12.812	450	317766.174	478974.735	1.637
SW-09	0.000		12.300	450	317741.283	478951.363	1.465
SW-010	0.000		10.300	450	317720.333	478939.523	0.850
SW-011	0.000		9.161	450	317699.500	478912.750	1.565
SW-013	0.000		7.000	450	317656.206	478887.303	1.370
SW-012	0.000		6.915	450	317680.000	478902.000	0.820
SW-014	0.000		5.905	450	317651.670	478881.895	0.350
SW-020	0.006	4.00	14.141	450	317906.598	478967.391	1.305
SW-021	0.019	4.00	14.099	450	317894.853	478970.757	1.487
SW-022	0.013	4.00	14.410	450	317890.431	478978.056	1.960
SW-023	0.042	4.00	15.590	450	317856.578	478989.854	1.420

Links

Name	US Node	DS Node	Length (m)	ks (mm) / n	US IL (m)	DS IL (m)	Fall (m)	Slope (1:X)	Dia (mm)	T of C (mins)	Rain (mm/hr)
1.001	SW-01	SW-02	10.645	0.600	13.129	12.951	0.178	59.8	100	4.18	50.0
1.002	SW-02	SW-03	13.422	0.600	12.901	12.645	0.256	52.4	150	4.34	50.0
1.003	SW-03	SW-04	17.274	0.600	12.570	12.230	0.340	50.8	225	4.50	50.0
1.004	SW-04	SW-05	18.908	0.600	12.230	12.115	0.115	164.4	225	4.88	50.0
1.005	SW-05	SW-06	17.964	0.600	12.115	11.930	0.185	97.1	150	4.68	50.0
1.006	SW-06	SW-07	59.615	0.600	11.930	11.330	0.600	99.4	150	5.89	50.0
1.007	SW-07	SW-08	15.111	0.600	11.330	11.175	0.155	97.5	150	6.12	50.0

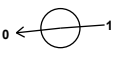
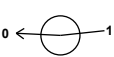
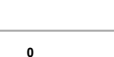
Name	Vel (m/s)	Cap (l/s)	Flow (l/s)	US Depth (m)	DS Depth (m)	Σ Area (ha)	Σ Add Inflow (l/s)	Pro Depth (mm)	Pro Velocity (m/s)
1.001	0.998	7.8	3.5	1.205	1.399	0.026	0.0	47	0.974
1.002	1.392	24.6	5.3	1.399	1.691	0.039	0.0	47	1.112
1.003	1.839	73.1	12.9	1.691	2.312	0.095	0.0	64	1.394
1.004	1.017	40.4	23.0	2.312	2.712	0.170	0.0	122	1.049
1.005	1.020	18.0	38.8	2.787	3.113	0.286	0.0	150	1.039
1.006	1.008	17.8	38.8	3.113	1.428	0.286	0.0	150	1.027
1.007	1.018	18.0	38.8	1.428	1.487	0.286	0.0	150	1.037

Name	US Node	DS Node	Length (m)	ks (mm) / n	US IL (m)	DS IL (m)	Fall (m)	Slope (1:X)	Dia (mm)	T of C (mins)	Rain (mm/hr)
1.008	SW-08	SW-09	34.144	0.600	11.175	10.835	0.340	100.4	150	6.81	50.0
1.009	SW-09	SW-010	24.064	0.600	10.835	9.450	1.385	17.4	150	6.95	50.0
1.0010	SW-010	SW-011	33.924	0.600	9.450	7.596	1.854	18.3	150	7.19	50.0
1.0011	SW-011	SW-012	22.267	0.600	7.600	6.095	1.505	14.8	150	7.33	50.0
1.0012	SW-012	SW-013	27.967	0.600	6.100	5.630	0.470	59.5	150	7.69	50.0
3.001	SW-023	SW-05	8.469	0.600	14.170	13.582	0.588	14.4	150	4.05	50.0
1.0013	SW-013	SW-014	7.058	0.600	5.630	5.555	0.075	94.1	150	7.87	50.0
3.000	SW-05_Tank	SW-05	10.008	0.600	12.175	12.115	0.060	166.8	225	4.17	50.0
2.004	SW-020	SW-021	12.218	0.600	12.836	12.612	0.224	54.5	100	4.19	50.0
2.005	SW-021	SW-022	8.534	0.600	12.612	12.500	0.112	76.2	100	4.36	50.0
2.006	SW-022	SW-04	13.262	0.600	12.450	12.305	0.145	91.5	150	4.57	50.0

Name	Vel (m/s)	Cap (l/s)	Flow (l/s)	US Depth (m)	DS Depth (m)	Σ Area (ha)	Σ Add Inflow (l/s)	Pro Depth (mm)	Pro Velocity (m/s)
1.008	1.002	17.7	38.8	1.487	1.315	0.286	0.0	150	1.021
1.009	2.428	42.9	38.8	1.315	0.700	0.286	0.0	112	2.741
1.0010	2.365	41.8	38.8	0.700	1.415	0.286	0.0	115	2.677
1.0011	2.632	46.5	38.8	1.411	0.670	0.286	0.0	105	2.938
1.0012	1.306	23.1	38.8	0.665	1.220	0.286	0.0	150	1.330
3.001	2.668	47.1	5.7	1.270	1.320	0.042	0.0	35	1.803
1.0013	1.036	18.3	38.8	1.220	0.200	0.286	0.0	150	1.055
3.000	1.009	40.1	0.0	3.192	2.712	0.000	0.0	0	0.000
2.004	1.045	8.2	0.8	1.205	1.387	0.006	0.0	21	0.667
2.005	0.882	6.9	3.4	1.387	1.810	0.025	0.0	50	0.879
2.006	1.051	18.6	5.1	1.810	2.312	0.038	0.0	54	0.903

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	MH Type	Connections	Link	IL (m)	Dia (mm)	
SW-01	317913.620	478989.659	14.434	1.305	450	Inspection Chamber		0	1.001	13.129	100
SW-02	317903.571	478993.174	14.450	1.549	450	Inspection Chamber		1	1.001	12.951	100
SW-03	317890.258	478991.464	14.486	1.916	1200	SSG Type B		0	1.002	12.901	150
SW-04	317877.316	478980.023	14.767	2.537	1200	SSG Type B		1	1.002	12.645	150
SW-05	317858.475	478981.611	15.052	2.937	1800	Inspection Chamber		0	1.003	12.570	225
								1	2.006	12.305	150
								2	1.003	12.230	225
								0	1.004	12.230	225
								1	3.001	13.582	150
								2	3.000	12.115	225
								3	1.004	12.115	225
								0	1.005	12.115	150

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	MH Type	Connections	Link	IL (m)	Dia (mm)
SW-05_Tank	317859.955	478991.509	15.592	3.417	450	Inspection Chamber	 0	3.000	12.175	225
SW-06	317840.515	478980.322	15.193	3.263	1200	SSG Type B	 0	1.005	11.930	150
SW-07	317781.273	478974.008	12.908	1.578	1200	SSG Type B	 0	1.006	11.930	150
SW-08	317766.174	478974.735	12.812	1.637	450	Inspection Chamber	 0	1.007	11.330	150
SW-09	317741.283	478951.363	12.300	1.465	450	Inspection Chamber	 0	1.007	11.175	150
SW-10	317720.333	478939.523	10.300	0.850	450	Inspection Chamber	 0	1.008	10.835	150
SW-11	317699.500	478912.750	9.161	1.565	450	Inspection Chamber	 0	1.008	10.835	150
SW-13	317656.206	478887.303	7.000	1.370	450	Inspection Chamber	 0	1.009	9.450	150
SW-12	317680.000	478902.000	6.915	0.820	450	Inspection Chamber	 0	1.0010	7.596	150
SW-014	317651.670	478881.895	5.905	0.350	450	Inspection Chamber	 0	1.0011	7.600	150
SW-020	317906.598	478967.391	14.141	1.305	450	Inspection Chamber	 0	1.0012	5.630	150
SW-021	317894.853	478970.757	14.099	1.487	450	Inspection Chamber	 0	1.0013	6.095	150
SW-022	317890.431	478978.056	14.410	1.960	450	Inspection Chamber	 0	1.0013	6.100	150
							 0	2.004	12.450	150

Site Makeup	Greenfield	Return Period (years)	100
Greenfield Method	FSR/FEH	Climate Change (%)	0
Positively Drained Area (ha)	0.288	Storm Duration (mins)	360
Soil Index	4	Betterment (%)	0
SPR	0.47	PR	0.508
CWI	125.050	Runoff Volume (m³)	89

Node SW-05 Online Hydro-Brake® Control

Flap Valve	x	Objective	(HE) Minimise upstream storage
Replaces Downstream Link	x	Sump Available	✓
Invert Level (m)	12.115	Product Number	CTL-SHE-0071-1800-0500-1800
Design Depth (m)	0.500	Min Outlet Diameter (m)	0.100
Design Flow (l/s)	1.8	Min Node Diameter (mm)	1200

Node SW-05 Tank Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	12.175
Side Inf Coefficient (m/hr)	0.00000	Porosity	0.95	Time to half empty (mins)	560

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	131.0	131.0	1.200	131.0	179.7	1.201	0.0	179.7

Approval Settings

Node Size	✓	Minimum Proportional Velocity (m/s)	0.750
Node Losses	✓	Maximum Proportional Velocity (m/s)	3.000
Link Size	✓	Surcharged Depth	✓
Minimum Diameter (mm)	100	Return Period (years)	1
Link Length	✓	Maximum Surcharged Depth (m)	0.100
Maximum Length (m)	90.000	Flooding	✓
Coordinates	x	Return Period (years)	30
Crossings	✓	Time to Half Empty	✓
Cover Depth	✓	Return Period (years)	100
Minimum Cover Depth (m)	1.200	Discharge Rates	✓
Maximum Cover Depth (m)	3.000	1 year (l/s)	1.8
Backdrops	✓	2 year (l/s)	2.0
Minimum Backdrop Height (m)	0.300	10 year (l/s)	3.0
Maximum Backdrop Height (m)	1.600	30 year (l/s)	4.2
Full Bore Velocity	x	100 year (l/s)	5.4
Proportional Velocity	✓	Discharge Volume	x
Return Period (years)	100		

Rainfall

Event	Peak Intensity (mm/hr)	Average Intensity (mm/hr)
1 year 15 minute summer	84.280	23.848
1 year 15 minute winter	59.144	23.848
1 year 30 minute summer	57.102	16.158
1 year 30 minute winter	40.072	16.158
1 year 60 minute summer	40.398	10.676
1 year 60 minute winter	26.839	10.676
1 year 120 minute summer	26.432	6.985
1 year 120 minute winter	17.561	6.985
1 year 180 minute summer	21.115	5.434
1 year 180 minute winter	13.725	5.434
1 year 240 minute summer	17.197	4.545
1 year 240 minute winter	11.425	4.545
1 year 360 minute summer	13.694	3.524
1 year 360 minute winter	8.901	3.524
1 year 480 minute summer	11.066	2.925

Rainfall

Event	Peak Intensity (mm/hr)	Average Intensity (mm/hr)
1 year 480 minute winter	7.352	2.925
1 year 600 minute summer	9.254	2.531
1 year 600 minute winter	6.323	2.531
1 year 720 minute summer	8.394	2.250
1 year 720 minute winter	5.641	2.250
1 year 960 minute summer	7.097	1.869
1 year 960 minute winter	4.701	1.869
1 year 1440 minute summer	5.374	1.440
1 year 1440 minute winter	3.611	1.440
1 year 2160 minute summer	4.012	1.109
1 year 2160 minute winter	2.764	1.109
1 year 2880 minute summer	3.437	0.921
1 year 2880 minute winter	2.310	0.921
1 year 4320 minute summer	2.717	0.710
1 year 4320 minute winter	1.789	0.710
1 year 5760 minute summer	2.311	0.591
1 year 5760 minute winter	1.496	0.591
1 year 7200 minute summer	2.002	0.511
1 year 7200 minute winter	1.292	0.511
1 year 8640 minute summer	1.776	0.453
1 year 8640 minute winter	1.146	0.453
1 year 10080 minute summer	1.605	0.409
1 year 10080 minute winter	1.036	0.409
2 year 15 minute summer	109.066	30.862
2 year 15 minute winter	76.538	30.862
2 year 30 minute summer	73.782	20.878
2 year 30 minute winter	51.777	20.878
2 year 60 minute summer	51.720	13.668
2 year 60 minute winter	34.361	13.668
2 year 120 minute summer	33.252	8.787
2 year 120 minute winter	22.092	8.787
2 year 180 minute summer	26.258	6.757
2 year 180 minute winter	17.069	6.757
2 year 240 minute summer	21.199	5.602
2 year 240 minute winter	14.084	5.602
2 year 360 minute summer	16.686	4.294
2 year 360 minute winter	10.846	4.294
2 year 480 minute summer	13.415	3.545
2 year 480 minute winter	8.912	3.545
2 year 600 minute summer	11.170	3.055
2 year 600 minute winter	7.632	3.055
2 year 720 minute summer	10.095	2.706
2 year 720 minute winter	6.784	2.706
2 year 960 minute summer	8.482	2.233
2 year 960 minute winter	5.619	2.233
2 year 1440 minute summer	6.362	1.705
2 year 1440 minute winter	4.276	1.705
2 year 2160 minute summer	4.707	1.301
2 year 2160 minute winter	3.243	1.301
2 year 2880 minute summer	4.006	1.074
2 year 2880 minute winter	2.693	1.074
2 year 4320 minute summer	3.136	0.820

Rainfall

Event	Peak Intensity (mm/hr)	Average Intensity (mm/hr)
2 year 4320 minute winter	2.065	0.820
2 year 5760 minute summer	2.646	0.677
2 year 5760 minute winter	1.712	0.677
2 year 7200 minute summer	2.285	0.583
2 year 7200 minute winter	1.475	0.583
2 year 8640 minute summer	2.021	0.516
2 year 8640 minute winter	1.304	0.516
2 year 10080 minute summer	1.822	0.465
2 year 10080 minute winter	1.176	0.465
10 year 15 minute summer	163.157	46.168
10 year 15 minute winter	114.496	46.168
10 year 30 minute summer	110.362	31.229
10 year 30 minute winter	77.447	31.229
10 year 60 minute summer	77.042	20.360
10 year 60 minute winter	51.185	20.360
10 year 120 minute summer	49.087	12.972
10 year 120 minute winter	32.612	12.972
10 year 180 minute summer	38.430	9.889
10 year 180 minute winter	24.980	9.889
10 year 240 minute summer	30.773	8.132
10 year 240 minute winter	20.445	8.132
10 year 360 minute summer	23.902	6.151
10 year 360 minute winter	15.537	6.151
10 year 480 minute summer	19.082	5.043
10 year 480 minute winter	12.678	5.043
10 year 600 minute summer	15.796	4.321
10 year 600 minute winter	10.793	4.321
10 year 720 minute summer	14.204	3.807
10 year 720 minute winter	9.546	3.807
10 year 960 minute summer	11.834	3.116
10 year 960 minute winter	7.839	3.116
10 year 1440 minute summer	8.760	2.348
10 year 1440 minute winter	5.888	2.348
10 year 2160 minute summer	6.395	1.767
10 year 2160 minute winter	4.406	1.767
10 year 2880 minute summer	5.388	1.444
10 year 2880 minute winter	3.621	1.444
10 year 4320 minute summer	4.151	1.085
10 year 4320 minute winter	2.734	1.085
10 year 5760 minute summer	3.461	0.886
10 year 5760 minute winter	2.240	0.886
10 year 7200 minute summer	2.968	0.757
10 year 7200 minute winter	1.916	0.757
10 year 8640 minute summer	2.610	0.666
10 year 8640 minute winter	1.685	0.666
10 year 10080 minute summer	2.342	0.597
10 year 10080 minute winter	1.512	0.597
30 year +35% CC 15 minute summer	276.846	78.338
30 year +35% CC 15 minute winter	194.278	78.338
30 year +35% CC 30 minute summer	189.258	53.553
30 year +35% CC 30 minute winter	132.813	53.553
30 year +35% CC 60 minute summer	133.130	35.182

Rainfall

Event	Peak Intensity (mm/hr)	Average Intensity (mm/hr)
30 year +35% CC 60 minute winter	88.448	35.182
30 year +35% CC 120 minute summer	85.102	22.490
30 year +35% CC 120 minute winter	56.540	22.490
30 year +35% CC 180 minute summer	66.535	17.122
30 year +35% CC 180 minute winter	43.249	17.122
30 year +35% CC 240 minute summer	53.115	14.037
30 year +35% CC 240 minute winter	35.288	14.037
30 year +35% CC 360 minute summer	40.963	10.541
30 year +35% CC 360 minute winter	26.627	10.541
30 year +35% CC 480 minute summer	32.550	8.602
30 year +35% CC 480 minute winter	21.625	8.602
30 year +35% CC 600 minute summer	26.841	7.342
30 year +35% CC 600 minute winter	18.339	7.342
30 year +35% CC 720 minute summer	24.056	6.447
30 year +35% CC 720 minute winter	16.167	6.447
30 year +35% CC 960 minute summer	19.930	5.248
30 year +35% CC 960 minute winter	13.202	5.248
30 year +35% CC 1440 minute summer	14.628	3.921
30 year +35% CC 1440 minute winter	9.831	3.921
30 year +35% CC 2160 minute summer	10.579	2.924
30 year +35% CC 2160 minute winter	7.289	2.924
30 year +35% CC 2880 minute summer	8.849	2.372
30 year +35% CC 2880 minute winter	5.947	2.372
30 year +35% CC 4320 minute summer	6.744	1.763
30 year +35% CC 4320 minute winter	4.441	1.763
30 year +35% CC 5760 minute summer	5.575	1.427
30 year +35% CC 5760 minute winter	3.609	1.427
30 year +35% CC 7200 minute summer	4.753	1.213
30 year +35% CC 7200 minute winter	3.068	1.213
30 year +35% CC 8640 minute summer	4.160	1.061
30 year +35% CC 8640 minute winter	2.685	1.061
30 year +35% CC 10080 minute summer	3.717	0.948
30 year +35% CC 10080 minute winter	2.399	0.948
100 year +35% CC 15 minute summer	355.680	100.645
100 year +35% CC 15 minute winter	249.600	100.645
100 year +35% CC 30 minute summer	245.990	69.607
100 year +35% CC 30 minute winter	172.625	69.607
100 year +35% CC 60 minute summer	174.491	46.113
100 year +35% CC 60 minute winter	115.928	46.113
100 year +35% CC 120 minute summer	111.942	29.583
100 year +35% CC 120 minute winter	74.372	29.583
100 year +35% CC 180 minute summer	87.390	22.488
100 year +35% CC 180 minute winter	56.806	22.488
100 year +35% CC 240 minute summer	69.529	18.374
100 year +35% CC 240 minute winter	46.193	18.374
100 year +35% CC 360 minute summer	53.204	13.691
100 year +35% CC 360 minute winter	34.584	13.691
100 year +35% CC 480 minute summer	42.061	11.115
100 year +35% CC 480 minute winter	27.944	11.115
100 year +35% CC 600 minute summer	34.537	9.447
100 year +35% CC 600 minute winter	23.598	9.447
100 year +35% CC 720 minute summer	30.841	8.266

Rainfall

Event	Peak Intensity (mm/hr)	Average Intensity (mm/hr)
100 year +35% CC 720 minute winter	20.727	8.266
100 year +35% CC 960 minute summer	25.396	6.687
100 year +35% CC 960 minute winter	16.823	6.687
100 year +35% CC 1440 minute summer	18.467	4.949
100 year +35% CC 1440 minute winter	12.411	4.949
100 year +35% CC 2160 minute summer	13.217	3.653
100 year +35% CC 2160 minute winter	9.107	3.653
100 year +35% CC 2880 minute summer	10.969	2.940
100 year +35% CC 2880 minute winter	7.372	2.940
100 year +35% CC 4320 minute summer	8.259	2.159
100 year +35% CC 4320 minute winter	5.439	2.159
100 year +35% CC 5760 minute summer	6.766	1.732
100 year +35% CC 5760 minute winter	4.379	1.732
100 year +35% CC 7200 minute summer	5.731	1.462
100 year +35% CC 7200 minute winter	3.699	1.462
100 year +35% CC 8640 minute summer	4.990	1.273
100 year +35% CC 8640 minute winter	3.221	1.273
100 year +35% CC 10080 minute summer	4.439	1.132
100 year +35% CC 10080 minute winter	2.865	1.132

Results for 1 year Critical Storm Duration. Lowest mass balance: 99.63%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute winter	SW-01	10	13.174	0.045	3.0	0.0071	0.0000	OK
15 minute summer	SW-02	10	12.946	0.045	4.5	0.0071	0.0000	OK
15 minute summer	SW-03	10	12.628	0.058	10.9	0.0661	0.0000	OK
15 minute summer	SW-04	10	12.622	0.392	19.5	0.4432	0.0000	SURCHARGED
15 minute summer	SW-05	10	12.585	0.470	34.6	1.1972	0.0000	SURCHARGED
360 minute winter	SW-05_Tank	264	12.356	0.181	3.9	22.5447	0.0000	OK
15 minute winter	SW-06	7	11.963	0.033	1.8	0.0374	0.0000	OK
30 minute winter	SW-07	12	11.362	0.032	1.8	0.0366	0.0000	OK
30 minute winter	SW-08	13	11.210	0.035	1.8	0.0056	0.0000	OK
30 minute winter	SW-09	13	10.856	0.021	1.8	0.0034	0.0000	OK
30 minute winter	SW-010	13	9.471	0.021	1.8	0.0034	0.0000	OK
30 minute winter	SW-011	14	7.620	0.024	1.8	0.0039	0.0000	OK
30 minute winter	SW-013	15	5.663	0.033	1.8	0.0053	0.0000	OK
30 minute winter	SW-012	14	6.128	0.033	1.8	0.0053	0.0000	OK
30 minute winter	SW-014	15	5.587	0.032	1.8	0.0000	0.0000	OK
15 minute summer	SW-020	10	12.856	0.020	0.7	0.0031	0.0000	OK
15 minute summer	SW-021	9	12.658	0.046	2.9	0.0073	0.0000	OK
15 minute summer	SW-022	10	12.631	0.181	4.4	0.0288	0.0000	SURCHARGED
15 minute summer	SW-023	10	14.204	0.034	4.8	0.0053	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	SW-01	1.001	SW-02	3.0	0.911	0.383	0.0351	
15 minute summer	SW-02	1.002	SW-03	4.5	1.041	0.183	0.0580	
15 minute summer	SW-03	1.003	SW-04	10.9	0.579	0.149	0.4141	
15 minute summer	SW-04	1.004	SW-05	23.5	0.590	0.580	0.7520	
15 minute summer	SW-05	1.005	SW-06	1.8	0.734	0.100	0.0506	
360 minute winter	SW-05_Tank	3.000	SW-05	-3.9	-0.207	-0.097	0.3703	
15 minute winter	SW-06	1.006	SW-07	1.8	0.755	0.101	0.1654	
30 minute winter	SW-07	1.007	SW-08	1.8	0.619	0.101	0.0445	
30 minute winter	SW-08	1.008	SW-09	1.8	0.796	0.102	0.0788	
30 minute winter	SW-09	1.009	SW-010	1.8	1.190	0.042	0.0366	
30 minute winter	SW-010	1.0010	SW-011	1.8	1.076	0.043	0.0571	
30 minute winter	SW-011	1.0011	SW-012	1.8	1.114	0.039	0.0482	
30 minute winter	SW-013	1.0013	SW-014	1.8	0.646	0.099	0.0197	18.1
30 minute winter	SW-012	1.0012	SW-013	1.8	0.780	0.078	0.0724	
15 minute summer	SW-020	2.004	SW-021	0.7	0.318	0.085	0.0279	
15 minute summer	SW-021	2.005	SW-022	2.9	0.804	0.418	0.0480	
15 minute summer	SW-022	2.006	SW-04	6.0	0.654	0.325	0.2335	
15 minute summer	SW-023	3.001	SW-05	4.8	1.675	0.102	0.0243	

Results for 2 year Critical Storm Duration. Lowest mass balance: 99.62%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute winter	SW-01	10	13.181	0.052	3.9	0.0083	0.0000	OK
15 minute winter	SW-02	10	12.952	0.051	5.8	0.0082	0.0000	OK
15 minute summer	SW-03	10	12.700	0.130	14.1	0.1472	0.0000	OK
15 minute summer	SW-04	10	12.686	0.456	28.3	0.5159	0.0000	SURCHARGED
15 minute winter	SW-05	9	12.627	0.512	45.4	1.3031	0.0000	SURCHARGED
360 minute winter	SW-05_Tank	280	12.423	0.248	5.1	30.8469	0.0000	SURCHARGED
15 minute summer	SW-06	7	11.963	0.033	1.8	0.0376	0.0000	OK
30 minute winter	SW-07	11	11.362	0.032	1.8	0.0366	0.0000	OK
30 minute winter	SW-08	12	11.210	0.035	1.8	0.0056	0.0000	OK
30 minute winter	SW-09	12	10.856	0.021	1.8	0.0034	0.0000	OK
30 minute winter	SW-010	12	9.471	0.021	1.8	0.0034	0.0000	OK
30 minute winter	SW-011	13	7.620	0.024	1.8	0.0039	0.0000	OK
30 minute summer	SW-013	14	5.663	0.033	1.8	0.0053	0.0000	OK
30 minute winter	SW-012	13	6.128	0.033	1.8	0.0053	0.0000	OK
30 minute summer	SW-014	14	5.587	0.032	1.8	0.0000	0.0000	OK
15 minute winter	SW-020	10	12.858	0.022	0.9	0.0036	0.0000	OK
15 minute summer	SW-021	10	12.733	0.121	3.7	0.0193	0.0000	SURCHARGED
15 minute summer	SW-022	10	12.702	0.252	5.8	0.0401	0.0000	SURCHARGED
15 minute summer	SW-023	10	14.208	0.038	6.2	0.0061	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	SW-01	1.001	SW-02	3.9	0.971	0.498	0.0428	
15 minute winter	SW-02	1.002	SW-03	5.8	1.114	0.236	0.0699	
15 minute summer	SW-03	1.003	SW-04	16.6	0.603	0.227	0.5489	
15 minute summer	SW-04	1.004	SW-05	31.2	0.786	0.773	0.7520	
15 minute winter	SW-05	1.005	SW-06	1.8	0.761	0.100	0.0502	
360 minute winter	SW-05_Tank	3.000	SW-05	-5.1	-0.210	-0.126	0.3980	
15 minute summer	SW-06	1.006	SW-07	1.8	0.752	0.101	0.1656	
30 minute winter	SW-07	1.007	SW-08	1.8	0.622	0.101	0.0446	
30 minute winter	SW-08	1.008	SW-09	1.8	0.796	0.102	0.0789	
30 minute winter	SW-09	1.009	SW-010	1.8	1.191	0.042	0.0366	
30 minute winter	SW-010	1.0010	SW-011	1.8	1.077	0.043	0.0572	
30 minute winter	SW-011	1.0011	SW-012	1.8	1.018	0.039	0.0482	
30 minute summer	SW-013	1.0013	SW-014	1.8	0.647	0.099	0.0197	20.7
30 minute winter	SW-012	1.0012	SW-013	1.8	0.759	0.078	0.0724	
15 minute winter	SW-020	2.004	SW-021	0.9	0.315	0.110	0.0558	
15 minute summer	SW-021	2.005	SW-022	4.2	0.786	0.607	0.0668	
15 minute summer	SW-022	2.006	SW-04	7.1	0.700	0.384	0.2335	
15 minute summer	SW-023	3.001	SW-05	6.2	1.795	0.131	0.0293	

Results for 10 year Critical Storm Duration. Lowest mass balance: 99.63%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute winter	SW-01	10	13.197	0.068	5.8	0.0108	0.0000	OK
15 minute winter	SW-02	10	12.963	0.062	8.7	0.0098	0.0000	OK
15 minute summer	SW-03	10	12.880	0.310	21.1	0.3501	0.0000	SURCHARGED
15 minute summer	SW-04	10	12.839	0.609	38.1	0.6891	0.0000	SURCHARGED
15 minute winter	SW-05	9	12.720	0.605	64.1	1.5405	0.0000	SURCHARGED
360 minute winter	SW-05_Tank	336	12.606	0.431	8.1	53.7358	0.0000	SURCHARGED
15 minute winter	SW-06	10	11.963	0.033	1.9	0.0376	0.0000	OK
15 minute summer	SW-07	11	11.363	0.033	1.9	0.0373	0.0000	OK
15 minute winter	SW-08	11	11.211	0.036	1.9	0.0056	0.0000	OK
15 minute summer	SW-09	12	10.857	0.022	1.9	0.0034	0.0000	OK
15 minute winter	SW-010	12	9.472	0.022	1.9	0.0034	0.0000	OK
15 minute winter	SW-011	12	7.621	0.025	1.9	0.0039	0.0000	OK
15 minute winter	SW-013	13	5.664	0.034	1.9	0.0053	0.0000	OK
15 minute summer	SW-012	13	6.129	0.034	1.8	0.0054	0.0000	OK
15 minute winter	SW-014	13	5.587	0.032	1.9	0.0000	0.0000	OK
15 minute summer	SW-020	11	12.929	0.093	1.3	0.0148	0.0000	OK
15 minute winter	SW-021	10	12.919	0.307	5.4	0.0488	0.0000	SURCHARGED
15 minute summer	SW-022	10	12.863	0.413	8.1	0.0656	0.0000	SURCHARGED
15 minute summer	SW-023	10	14.218	0.048	9.3	0.0076	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	SW-01	1.001	SW-02	5.8	1.056	0.740	0.0584	
15 minute winter	SW-02	1.002	SW-03	8.7	1.122	0.354	0.1638	
15 minute summer	SW-03	1.003	SW-04	21.5	0.644	0.293	0.6870	
15 minute summer	SW-04	1.004	SW-05	40.5	1.018	1.002	0.7520	
15 minute winter	SW-05	1.005	SW-06	1.9	0.809	0.106	0.0520	
360 minute winter	SW-05_Tank	3.000	SW-05	-8.1	-0.217	-0.201	0.3980	
15 minute winter	SW-06	1.006	SW-07	1.9	0.770	0.106	0.1710	
15 minute summer	SW-07	1.007	SW-08	1.9	0.626	0.104	0.0455	
15 minute winter	SW-08	1.008	SW-09	1.9	0.804	0.105	0.0807	
15 minute summer	SW-09	1.009	SW-010	1.9	1.202	0.043	0.0373	
15 minute winter	SW-010	1.0010	SW-011	1.9	1.089	0.045	0.0583	
15 minute winter	SW-011	1.0011	SW-012	1.9	1.124	0.040	0.0490	
15 minute winter	SW-013	1.0013	SW-014	1.9	0.652	0.101	0.0201	24.5
15 minute summer	SW-012	1.0012	SW-013	1.9	0.790	0.080	0.0738	
15 minute summer	SW-020	2.004	SW-021	1.5	0.299	0.185	0.0942	
15 minute winter	SW-021	2.005	SW-022	6.5	0.920	0.945	0.0668	
15 minute summer	SW-022	2.006	SW-04	10.5	0.628	0.568	0.2335	
15 minute summer	SW-023	3.001	SW-05	9.3	2.000	0.197	0.0394	

Results for 30 year +35% CC Critical Storm Duration. Lowest mass balance: 99.38%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute winter	SW-01	11	13.609	0.480	9.8	0.0764	0.0000	SURCHARGED
15 minute winter	SW-02	10	13.340	0.439	12.9	0.0698	0.0000	SURCHARGED
15 minute winter	SW-03	10	13.264	0.694	32.7	0.7845	0.0000	SURCHARGED
15 minute winter	SW-04	10	13.175	0.945	58.1	1.0693	0.0000	SURCHARGED
600 minute winter	SW-05	495	13.035	0.920	11.9	2.3411	0.0000	SURCHARGED
600 minute winter	SW-05_Tank	495	13.035	0.860	10.0	107.1509	0.0000	SURCHARGED
600 minute winter	SW-06	495	11.967	0.037	2.3	0.0416	0.0000	OK
600 minute winter	SW-07	495	11.367	0.037	2.3	0.0417	0.0000	OK
600 minute winter	SW-08	495	11.215	0.040	2.3	0.0063	0.0000	OK
600 minute winter	SW-09	495	10.859	0.024	2.3	0.0038	0.0000	OK
600 minute winter	SW-010	495	9.474	0.024	2.3	0.0038	0.0000	OK
600 minute winter	SW-011	495	7.623	0.027	2.3	0.0043	0.0000	OK
600 minute winter	SW-013	495	5.668	0.038	2.3	0.0060	0.0000	OK
600 minute winter	SW-012	495	6.132	0.037	2.3	0.0059	0.0000	OK
600 minute winter	SW-014	495	5.591	0.036	2.3	0.0000	0.0000	OK
15 minute winter	SW-020	11	13.409	0.573	3.1	0.0910	0.0000	SURCHARGED
15 minute winter	SW-021	11	13.396	0.784	7.7	0.1247	0.0000	SURCHARGED
15 minute winter	SW-022	10	13.233	0.783	11.8	0.1245	0.0000	SURCHARGED
15 minute summer	SW-023	10	14.235	0.065	15.8	0.0103	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	SW-01	1.001	SW-02	9.0	1.149	1.147	0.0833	
15 minute winter	SW-02	1.002	SW-03	14.6	1.092	0.592	0.2363	
15 minute winter	SW-03	1.003	SW-04	33.5	0.843	0.458	0.6870	
15 minute winter	SW-04	1.004	SW-05	59.5	1.497	1.472	0.7520	
600 minute winter	SW-05	1.005	SW-06	2.3	0.694	0.130	0.0604	
600 minute winter	SW-05_Tank	3.000	SW-05	-10.0	-0.251	-0.249	0.3980	
600 minute winter	SW-06	1.006	SW-07	2.3	0.697	0.131	0.1997	
600 minute winter	SW-07	1.007	SW-08	2.3	0.660	0.130	0.0535	
600 minute winter	SW-08	1.008	SW-09	2.3	0.857	0.132	0.0945	
600 minute winter	SW-09	1.009	SW-010	2.3	1.283	0.054	0.0438	
600 minute winter	SW-010	1.0010	SW-011	2.3	1.178	0.056	0.0673	
600 minute winter	SW-011	1.0011	SW-012	2.3	0.931	0.050	0.0567	
600 minute winter	SW-013	1.0013	SW-014	2.3	0.694	0.128	0.0238	94.9
600 minute winter	SW-012	1.0012	SW-013	2.3	0.749	0.101	0.0873	
15 minute winter	SW-020	2.004	SW-021	3.6	0.466	0.444	0.0956	
15 minute winter	SW-021	2.005	SW-022	9.0	1.144	1.292	0.0668	
15 minute winter	SW-022	2.006	SW-04	13.8	0.781	0.741	0.2335	
15 minute summer	SW-023	3.001	SW-05	15.8	2.285	0.335	0.0586	

Results for 100 year +35% CC Critical Storm Duration. Lowest mass balance: 99.30%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute winter	SW-01	11	14.097	0.968	12.6	0.1539	0.0000	SURCHARGED
15 minute winter	SW-02	11	13.734	0.833	15.5	0.1325	0.0000	SURCHARGED
15 minute winter	SW-03	11	13.604	1.034	40.2	1.1696	0.0000	SURCHARGED
15 minute winter	SW-04	11	13.481	1.251	67.3	1.4145	0.0000	SURCHARGED
480 minute winter	SW-05	456	13.340	1.225	17.9	3.1164	0.0000	SURCHARGED
480 minute winter	SW-05_Tank	456	13.340	1.165	15.5	145.1128	0.0000	SURCHARGED
480 minute winter	SW-06	456	11.969	0.039	2.7	0.0446	0.0000	OK
480 minute winter	SW-07	456	11.370	0.040	2.7	0.0447	0.0000	OK
480 minute winter	SW-08	456	11.218	0.043	2.7	0.0068	0.0000	OK
480 minute winter	SW-09	456	10.861	0.026	2.7	0.0041	0.0000	OK
480 minute winter	SW-010	456	9.476	0.026	2.7	0.0041	0.0000	OK
480 minute winter	SW-011	464	7.624	0.028	2.7	0.0045	0.0000	OK
480 minute winter	SW-013	464	5.671	0.041	2.7	0.0064	0.0000	OK
480 minute winter	SW-012	464	6.134	0.039	2.7	0.0063	0.0000	OK
480 minute winter	SW-014	464	5.594	0.039	2.7	0.0000	0.0000	OK
15 minute winter	SW-020	12	13.797	0.961	4.0	0.1528	0.0000	SURCHARGED
15 minute winter	SW-021	12	13.771	1.159	9.2	0.1843	0.0000	SURCHARGED
15 minute winter	SW-022	11	13.573	1.123	13.4	0.1785	0.0000	SURCHARGED
15 minute summer	SW-023	10	14.246	0.076	20.3	0.0120	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	SW-01	1.001	SW-02	10.3	1.317	1.315	0.0833	
15 minute winter	SW-02	1.002	SW-03	16.8	1.058	0.685	0.2363	
15 minute winter	SW-03	1.003	SW-04	38.9	0.978	0.532	0.6870	
15 minute winter	SW-04	1.004	SW-05	67.2	1.691	1.663	0.7520	
480 minute winter	SW-05	1.005	SW-06	2.7	0.721	0.148	0.0666	
480 minute winter	SW-05_Tank	3.000	SW-05	-15.5	-0.390	-0.387	0.3980	
480 minute winter	SW-06	1.006	SW-07	2.7	0.723	0.150	0.2201	
480 minute winter	SW-07	1.007	SW-08	2.7	0.685	0.149	0.0590	
480 minute winter	SW-08	1.008	SW-09	2.7	0.890	0.151	0.1041	
480 minute winter	SW-09	1.009	SW-010	2.7	1.334	0.062	0.0482	
480 minute winter	SW-010	1.0010	SW-011	2.7	1.235	0.064	0.0734	
480 minute winter	SW-011	1.0011	SW-012	2.7	0.976	0.057	0.0618	
480 minute winter	SW-013	1.0013	SW-014	2.7	0.720	0.146	0.0262	212.2
480 minute winter	SW-012	1.0012	SW-013	2.7	0.777	0.116	0.0963	
15 minute winter	SW-020	2.004	SW-021	4.3	0.551	0.525	0.0956	
15 minute winter	SW-021	2.005	SW-022	10.4	1.325	1.496	0.0668	
15 minute winter	SW-022	2.006	SW-04	16.0	0.908	0.860	0.2335	
15 minute summer	SW-023	3.001	SW-05	20.3	2.422	0.431	0.0710	

Job Title: Millom Iron Line

Job No: 081617

Made by: CC **Checked:** GW **Sheet No.** 1

Date: 07/04/2025 **Date:** 07/04/2025 **of** 1

Calculation 081617-CUR-ZZ-XX-T-C-92702 Revision: P01

Curtins

SOURCE OF WASTE: British Water Flows and Loads 4

BW COP: 18.11/14

Description	No.	FLOW (LITRES / DAY)		BOD (GRAMS / DAY)		NH ₃	
		Per head	TOTAL	Per head	TOTAL	Per head	TOTAL
Canteen (provides hot drinks, pre-prepared sandwiches, cakes, confectionary etc) (Assumed Calc value of Restaurants - Snack Bars & bar meals)	58	15	870	19	1102	2.5	145
Staff workers - (Office / Factory without canteen)	10	50	500	25	250	5	50
Visitor toilets (Toilet (WC) (per use)	150	10	1500	12	1800	2.5	375
TOTAL LOADS	218	75	2870	56	3152	10	570

Average Discharge Rate - (l/s) (DWF) 0.089 *

Design Peak Discharge Rate (l/s) (6DWF) 0.531

Notes:

- 1 ***Visitor centre operating hours 9am to 6pm (daily) - Discharge rates reflect demand over 9hr operating period.**
- 2 Effluent quality required to satisfy freshwater bathing water quality requirements (UK)
- 3 If discharging to ground, an Environment Agency Permit is required for daily discharge of 2 cubic metres (2,000 litres) a day
- 4 If discharging to ground, treated effluent must be discharged to a drainage field, designed in accordance with BS 6297:2007
- 5 If discharging to a watercourse, an Environment Agency Permit is required for daily discharge of 5 cubic metres (5,000 litres) a day
- 6 Treatment plants should only be used where there is no foul water drain or sewer within "reasonable" distance. The EA has a formula to assess

Appendix D Water Quality Assessment

Water Quality Assessment - Simple Index Approach - Options

Discharges to surface waters - Commerical Roof, footway/car park, carriageway/access and potentially an industrial access road (TBC)

Required for events up to 1:1 year Simple index approach (SuDs Manual, Ch 26)

Land use classification	Pollution Hazard Level	Note	TSS	Metals	HCS
Residential roofs	Very Low	Residential roofs	0.2	0.2	0.05
Commercial roofs	Low	Typically commercial/ industrial roofs	0.3	0.4	0.05
Individual property driveway	Low	Driveways/car parks, low traffic access roads, schools, offices, <300 movements/day	0.5	0.4	0.4
Commercial yards	Medium	Yards and delivery areas/access	0.7	0.6	0.7
Docks	Medium	Commerical loading docks/ramps	0.7	0.6	0.7
Car parking	Medium	Non residential car parks with frequent change areas - hospital, retail	0.7	0.6	0.7
Roads	Medium	All roads except for low traffic and trunk roads/motorways	0.7	0.6	0.7
Industrial Yards	High	Haulage yards, lorry parks, highly frequent industrial estates, sites with chemicals and fuel delivery, handled, stores, used or manufactured: industrial sites, trunk roads and motorways	0.8	0.8	0.9

Surface water protection measures

Catchment	Hazard Indices				SuDS Treatment Train			Mitigation Indices		
	Hazard	TSS	metals	HCS	Step 1	Step 2	Step 3	TSS.	metals.	HCS.
Footway, Car Park Option 1	Medium	0.7	0.6	0.7	Sediment trap			0.4	0.4	0.4
Footway, Car Park Option 2	Medium	0.7	0.6	0.7	Filter drain	Sediment trap		0.6	0.6	0.6
Footway, Car Park Option 3	Medium	0.7	0.6	0.7	Permeable pavement	Sediment trap	'Downstream Defener Adv	1.15	1	1.15
Footway, Carriageway Option 1	Medium	0.7	0.6	0.7	Sediment trap	'Downstream Defener Adv. Vortex'		0.65	0.6	0.65
Footway, Carriageway Option 2	Medium	0.7	0.6	0.7	Sediment trap	'QuadraCeptor'		0.8	0.8	0.8
Carriageway - industrial access to tip Option 1 (if drained)	High	0.8	0.8	0.9	Sediment trap	'QuadraCeptor'		0.8	0.8	0.8
Carriageway - industrial access to tip Option 2 (if drained)	High	0.8	0.8	0.9	Filter drain	Sediment trap	'QuadraCeptor'	1	1	1
Commercial roofs	Low	0.3	0.4	0.05	Sediment trap			0.4	0.4	0.4

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