Project: Drainage and SUDS Design, Old Coal Depot, Tavistock Rd, West Drayton, UB7 7RS

Project No: 2842-C-R01

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Executive Summary

This Drainage Assessment reviews the existing drainage arrangement at the application site and proposes a surface water drainage strategy in line with Hillingdon Council guidance.

The site is currently unoccupied and is located at Tavistock Road, West Drayton

The proposed development comprises the construction and use of a temporary building for the transfer of waste with associated infrastructure and site office building for a temporary period of five years.

The site is less than 1 hectare in size and within flood zone 1, so no flood risk assessment is required.

Surface Water Drainage

The proposed strategy presented in detail in this report aims to discharge all surface water to the existing sewers in the street.

Attenuation will be provided for all storm events up to and including the 1 in 100-year storm plus 40% allowance for climate change. All surface water storage is within an attenuation tank on site.

An additional 10% allowance for urban creep has been included in the sizing of attenuation.

SUDS measures include rainwater reuse, an attenuation tank, oil interceptor and a filter strip to enable treatment of the surface water.

Maintenance/management of all onsite drainage infrastructure has been considered within a separate maintenance plan appended to this report. This will be updated through the development process.

The proposed drainage strategy is entirely based on-site with the exception of the connection to the surface water sewer.

Overall, the proposals provide a high level of water treatment, runoff reduction and flooding protection for the proposed development and are in accordance with all requirements of the Lead Local Flood Authority (LLFA).

Foul Drainage

It is proposed to connect the foul drainage from the site to a cesspool.

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1 Introduction

1.1.1 Arcelle Consulting was commissioned to undertake a Drainage Assessment for the proposed development of land located at Old Coal Depot, Tavistock Rd, West Drayton, UB7 7RS

1.1.2 This Drainage Assessment has been produced in support of a planning application and should be read in conjunction with the other planning documents.

1.1.3 The proposed development comprises the construction of a temporary building for the transfer of waste with associated infrastructure and site office building for a temporary period of five years. Development proposals are provided in Appendix A.

1.1.4 The site is less than 1 hectare in size and within flood zone 1, so no flood risk assessment is required.

1.1.5 The total site area is 1990 square metres. The existing development site is all concrete hardstanding.

1.1.6 Since April 2015, Lead Local Flood Authorities (LLFA's) have become a statutory consultee on surface water drainage for many planning applications. For this site, the following is considered to be the required level of details for planning approval.

- SuDS: Designs, Maintenance Plans & Calculations - for SuDS proposed, the LLFA require product specifications or design drawings, all supporting calculations and a maintenance plan. This needs to include details of any SuDS structures, and the type of SuDS system in accordance with the CIRIA C753 SuDS Manual.

2 Site Description

2.1.1 The total site area is 1990 square metres. The existing development site is concrete hardstanding. The proposed development comprises the construction of a temporary building for the transfer of waste with associated infrastructure and site office building for a temporary period of five years.

2.1.2 The site location information is as follows:

- Nearest Postcode: UB7 7RS

2.2 *Topography*

Site Topography

2.2.1 An onsite topographic survey has been carried out and is provided in Appendix B.

2.2.2 The site is rectangular and is generally flat.

3 Design principles and policy requirements

3.1 *General Principles for Proposed Site Run-Off*

3.1.1 The DEFRA Sustainable Drainage Systems Non-Statutory Technical Standards for Sustainable Drainage Systems (March, 2015) states that the following options must be considered for disposal of surface water runoff in order of preference:

- Discharge to ground
- Discharge to a surface water body
- Discharge to a surface water sewer
- Discharge to a combined sewer

Discharge to Ground

3.1.2 The potential for surface water to discharge to ground has been assessed through a review of the likely ground conditions.

3.1.3 The BGS map indicates the ground is impermeable London clay and so infiltration is not possible on this site.

Discharge to Surface Water Body

3.1.4 There are a number of surface water drains in the area however these are located across privately owned land. Should sewers not be available it is proposed to discharge to these drains with permission of the site owners.

Discharge to Surface Water Sewer/Combined Sewer

3.1.5 Discharge to the public sewer network should only be considered once all other options for draining surface water from the site have been exhausted.

3.1.6 There are expected to be sewers in the street which discharge to the Thames Water sewers.

3.2 *Sustainable Drainage Systems (SuDS)*

3.2.1 To maximise the potential use of SuDS at the site, a review has been undertaken as shown in Table 1 in accordance with the SuDS Hierarchy. This review highlights the components referenced in the SuDS Hierarchy and provides recommendations on whether the components could be incorporated into the development.

Table 1: SuDS Selection Based on the SuDS Hierarchy

Component	Recommendation
Green	Whilst the use of green roofs provides additional environmental benefits

Component	Recommendation
(living) roofs	such as enhanced aesthetics and ecology, its exposure to wind and orientation must be considered. Access to undertake the construction and maintenance easily and safely is also a high priority. If feasible, depending on the roof design, a green roof will provide water quality, biodiversity and aesthetic benefits to the site. Additionally, the green roof/s will offer some attenuation for run-off, reducing volumes of run-off and in higher frequency events (i.e. 1in2 year storms) will result in no run-off for the building. The roofs are lightweight industrial roofs and so are not suitable for a green roof.
Basins and Ponds	Ponds and attenuation basins can provide overland storage of surface water whilst also providing additional biodiversity and aesthetic/amenity value. There are no open areas on the site which are suitable for basins or ponds.
Filter Strips and Swales	Swales are linear vegetated drainage features, which provide overland conveyance and storage of surface water whilst trapping sediments and hydrocarbons within run-off. They also create biodiverse areas for planting and habitat. Swales are not considered suitable for this site due to the industrial setting restricting the availability of space and suitability of swales. A filter strip is proposed for the external drainage.
Infiltration Devices	Infiltration devices are not suitable for this site in accordance with the recommendations of the section above.
Permeable Paving	Whilst incorporating attenuation storage, permeable paving also provides treatment through filtration of silt (and attached pollutants), settlement and retention of solids, adsorption of pollutants and biodegradation of organic pollutants, including petrol and diesel. There is no permeable paving proposed for the site.
Tanked Systems	This is the least sustainable option in terms of the SuDS Hierarchy. However, the use of tanked systems would still be of benefit compared to traditional drainage systems as it does allow run-off to be slowed down to an acceptable discharge rate. There is a single tank proposed for the site.
Other	Rainwater reuse is proposed for the entire roof area to be used on site for dust suppression. A rainwater reuse tank, filter strip and interceptor are proposed to treat the surface water from site.

4 Flooding Information

4.1 *Flood Risk from Rivers (Fluvial)*

4.1.1 As the site is within Flood Zone 1, there is a low risk of fluvial flooding to the site.

4.1.2 Based on the above, the risk of flooding from rivers is considered very low.

4.2 *Coastal and Tidal Flood Risk*

4.2.1 The site is located inland and is not near any tidally influenced watercourses; therefore, there is negligible risk of flooding from this source.

4.3 *Geology and Hydrogeology*

4.3.1 Groundwater flooding occurs when the water table rises to the surface and is most likely to occur in low-lying areas underlain by permeable rocks.

4.3.2 The BGS Maps identifies the geology as impermeable clays and so generally impermeable.

4.3.3 As the ground is impermeable, the site is considered to be at Low risk of groundwater flooding.

4.4 *Surface Water Flood Risk (Overland Flows)*

4.4.1 Surface water flooding occurs when the rainwater does not drain away through the normal drainage system or infiltrate the ground, but instead lies on or flows over the ground.

4.4.2 The EA produced a Risk of Flooding from Surface Water Map in December 2013. The maps were produced using 'direct rainfall' modelling. Although they consider local drainage capacity, non-surface water influences such as rivers, seas or groundwater are not considered. The map is based on LIDAR topographic data which is not suitable for site specific assessment and therefore, where available, topographic survey data should be used to provide a more accurate understanding of potential flow paths.

4.4.3 The map shows the entire country within four different risk categories, defined below in Table 2.

Table 2: EA Surface Water Flood Risk Categories

Risk Category	**Definition**
High	Each year, there is a chance of flooding of greater than 1 in 30 (3.3%)

Medium	Each year, there is a chance of flooding of between 1 in 30 (3.3%) and 1 in 100 (1%)
Low	Each year, there is a chance of flooding of between 1 in 100 (1%) and 1 in 1000 (0.1%)
Very Low	Each year, there is a chance of flooding of less than 1 in 1000 (0.1%)

4.4.4 An extract of the map, provided below, shows that the site is at low risk of surface water flooding.

Figure 1: EA Flood Risk from Surface Water Map

4.4.5 There is no surface water flooding shown within the site and thus the development area is not effected by the flooding.

4.4.6 As well as this, proposed floor levels will be raised above the existing ground to ensure the risk of flooding is minimised.

4.4.7 Based on the EA's mapping, historical data and local topography, risk of surface water flooding to the site is considered to be Low.

4.5 *Sewer/Drainage Flood Risk*

4.5.1 Sewer flooding is often caused by excess surface water entering the drainage system when there is insufficient sewer capacity to cope with this excess water, but also due to 'one off' events such as blockages.

4.5.2 Thames Water is the statutory undertaker for the local public sewer network. There are no public sewers nearby to the site, however it is likely there are private sewers which connect to the Public sewer. This is to be confirmed via survey.

4.5.3 A review of the local PFRA does not identify any flooding incidents at or near to the site.

4.5.4 On this basis there is considered to be a very low risk of sewer flooding to the site.

4.6 *Reservoir Flood Risk*

4.6.1 The EA has produced a Reservoir Flood Map that shows that the site is at low risk from reservoir flooding.

4.6.2 It should be emphasised that the risk of flooding from reservoir breach is very small since the EA is the enforcement authority for the Reservoirs Act (1975) and all large raised reservoirs are inspected and supervised by reservoir panel engineers.

4.6.3 On this basis there is considered to be a very low risk of reservoir flooding to the site.

4.7 *Summary of risk levels*

4.7.1 Post-development, the risk of flooding is summarised below.

Table 3: Flood Risk Categories

Source	**Risk Category**
Fluvial (Rivers and Sea)	Very low
Coastal and tidal	Negligible
Groundwater	Low
Surface water	Low
Sewers	Very low
Reservoirs	Very low

5 Surface Water Drainage Design

5.1 *Existing Site Runoff*

5.1.1 The development area currently comprises open hardstanding ground. The existing and proposed areas are summarised below. It is assumed the runoff from the existing site flows to the surrounding areas and drains to sewer (subject to survey) or to the existing 10,000 litre buried tank on site.

Table 4: Site Areas

Parameter	Existing (m2)	Existing (%)	Proposed (m2)	Proposed (%)
Impermeable area	1990	100	1990	100
Permeable area	0	0	0	0
Total area	1990	100	1990	100

5.2 *Design Considerations*

5.2.1 Consideration has been given to the following when calculating the proposed impermeable areas.

- The 2013 EA 'Rainfall Run-off Management for Developments' Report (SC030219) states that urban creep, the process of gradually increasing impermeable area within an urban area (through paving soft landscaped surfaces and constructed outbuildings etc), is an acknowledged issue. To include an allowance for urban creep, the impermeable area used in the drainage calculations would normally be increased by 10% in accordance with the recommendation made in SC030219, however as the site is already 100% impermeable this is not necessary.

5.2.2 The climate change allowance of 40% for the design used in the Drainage Strategy is in line with updated EA guidance values published in February 2016 for increased rainfall intensities by 2115 which is more than beyond the expected lifetime of 5 years for the development.

5.3 *Greenfield Run-Off Rates*

5.3.1 The greenfield run off rates for this site are provided below.

5.4 *Existing Run-Off Rates*

5.4.1 The existing run-off rates for a variety of return periods have been calculated using the Wallingford method.

5.4.2 The total site area of the existing impermeable ground is 1990 square metres. Taking conservative peak 1 year, 30 year and 100 year rainfall rates of 50mm/hr, 125mm/hr and 185mm/hr respectively, the maximum existing peak discharge rates have been calculated as follows.

Contributing Area (ha) x 1 yr Rainfall (mm/hr) x 2.78

1990/1000 x 50 x 2.78 = **27.7 l/s**

Contributing Area (ha) x 30 yr Rainfall (mm/hr) x 2.78

1990/1000 x 125 x 2.78 = **69.2 l/s**

Contributing Area (ha) x 100yr Rainfall (mm/hr) x 2.78

1990/1000 x 185 x 2.78 = **102.3 l/s**

Table 5: Existing Run-off Rates

Parameter	Greenfield Discharge (l/s)	Existing Discharge (l/s)	Proposed Discharge (l/s)
QBAR	0.32	NA	NA
1 year	0.27	27.7	5
30 year	0.73	69.2	5
100 year	1.01	102.3	5
100 year+40%	NA	NA	5

5.4.3 Site discharge should be as close to the greenfield rates as possible. However, as the greenfield rates are low, in accordance with best practice, outflow controls will be set to discharge at 5l/s or less for all storm events up to and including the 100 year + 40% storm.

5.5 *Drainage Design*

5.5.1 As infiltration is not possible on this site, reducing post development run-off volumes to less than pre-development volumes is achieved through attenuation.

5.5.2 All roof water will discharge into a 10,000 litres rainwater reuse tank for dust suppression on site. This tank has not been included in the drainage design.

5.5.3 By controlling run-off rates to less than 5l/s and providing attenuation for all storm events up to and including a 1 in 100-year storm plus climate change allowance, the risk of downstream flooding will be minimised.

5.5.4 Details of the drainage system and attenuation structures are presented in the design drawings and calculations in Appendix C.

5.5.5 A total attenuation volume of approximately 75 cubic metres is proposed to cater for the 100 year +40% storm event.

5.5.6 The attenuation is provided via an attenuation tank with surface water runoff treated through rainwater reuse, a filter strip and an interceptor.

5.6 *Exceedance Flooding*

5.6.1 As the general layout of the site is unchanged, the proposed flow routes will mimic existing, and fall toward the west. See Appendix B for overland flow plan.

5.6.2 It should be noted that the drainage system has been designed to cater for the 1 in 100 year + 40% climate change storm. ie in this storm event all surface water will be collected on site and slowly released. Thus, the flow route will only be in use in the event of drainage network failure or storms in excess of the 1 in 100 year + 40% climate change storm.

5.7 *Consents, Offsite Works and Diversions*

5.7.1 The proposed surface water drainage strategy is accommodated mostly on-site, with the only requirement for off-site works being the connection to the surface water sewer.

5.8 *Maintenance*

5.8.1 A SuDS maintenance plan has been prepared to outline the management of the potential SuDS features. The maintenance plan is provided in Appendix D.

6 Foul Run-off

6.1 *Discharge to Public Sewer Network*

6.1.1 Thames Water are the foul sewerage suppliers for the area. There are no sewers near to the site.

6.1.2 It is proposed to connect into a cesspool on site.

7 Water Quality

7.1 *Post-Development Water Quality Treatment*

7.1.1 In line with the 2015 SuDS Manual (CIRIA C753), certain criteria should be applied to manage the quality of run-off to support and protect the natural environment effectively. Treatment design, wherever practicable, should be based on good practice, comprising the following principles:

- Manage surface water run-off close to source
- Treat surface water run-off on the surface
- Treat surface water run-off to remove a range of contaminants
- Minimise risk of sediment remobilisation
- Minimise impacts from accidental spills

7.1.2 Managing pollution close to the source can help keep pollutant levels and accumulation rates low, essentially allowing natural treatment processes to be effective. This in turn can help maximise the amenity and biodiversity value of downstream surface SuDS components and keep maintenance activities straightforward and cost-effective.

7.1.3 The proposed development comprises two types of land use; industrial roofs and Commercial yard/delivery. These land uses are classified as having very low and medium hazard pollution levels, respectively. This table is provided below in Table 6.

Table 6: Pollution Hazard Indices from 2015 SuDS Manual (C753)

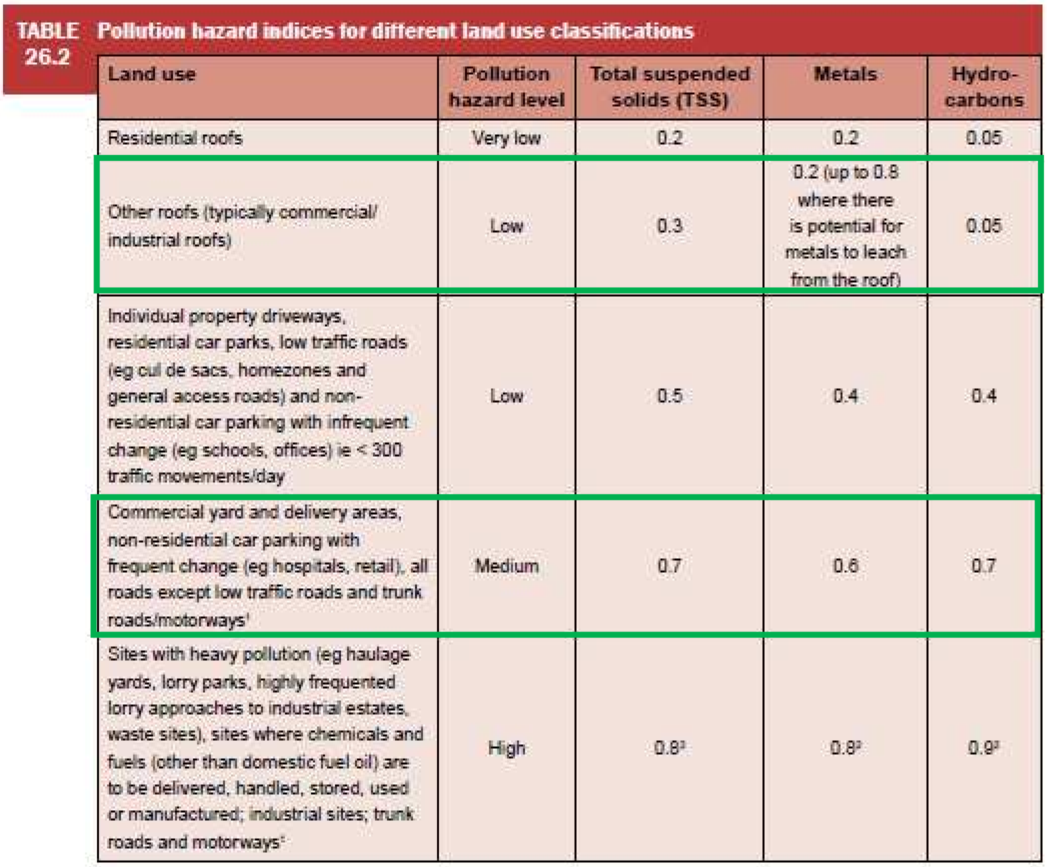


TABLE 26.2 **Pollution hazard indices for different land use classifications**

Land use	Pollution hazard level	Total suspended solids (TSS)	Metals	Hydro-carbons
Residential roofs	Very low	0.2	0.2	0.05
Other roofs (typically commercial/ industrial roofs)	Low	0.3	0.2 (up to 0.8 where there is potential for metals to leach from the roof)	0.05
Individual property driveways, residential car parks, low traffic roads (eg cul de sacs, homezones and general access roads) and non-residential car parking with infrequent change (eg schools, offices) ie < 300 traffic movements/day	Low	0.5	0.4	0.4
Commercial yard and delivery areas, non-residential car parking with frequent change (eg hospitals, retail), all roads except low traffic roads and trunk roads/motorways[1]	Medium	0.7	0.6	0.7
Sites with heavy pollution (eg haulage yards, lorry parks, highly frequented lorry approaches to industrial estates, waste sites), sites where chemicals and fuels (other than domestic fuel oil) are to be delivered, handled, stored, used or manufactured; industrial sites; trunk roads and motorways[1]	High	0.8[2]	0.8[2]	0.9[2]

7.1.4 The proposed drainage strategy utilises the following SuDS features:

- Oil Interceptor
- Filter Strip
- Attenuation Tank

7.1.5 The indicative SuDS mitigation indices, provided in Table 26.3 of the 2015 SuDS Manual (C753) have been reviewed for the drainage. This table is provided below in Table 7.

Table 7: Indicative SuDS Mitigation Indices from 2015 SuDS Manual (C753)

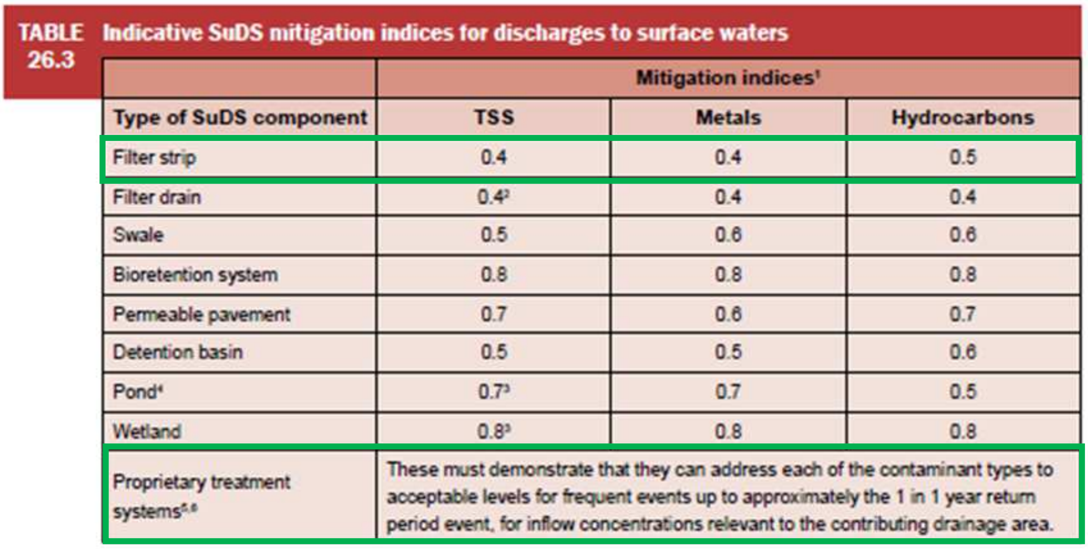


TABLE 26.3 Indicative SuDS mitigation indices for discharges to surface waters

	Mitigation indices[1]		
Type of SuDS component	**TSS**	**Metals**	**Hydrocarbons**
Filter strip	0.4	0.4	0.5
Filter drain	0.4[2]	0.4	0.4
Swale	0.5	0.6	0.6
Bioretention system	0.8	0.8	0.8
Permeable pavement	0.7	0.6	0.7
Detention basin	0.5	0.5	0.6
Pond[4]	0.7[3]	0.7	0.5
Wetland	0.8[3]	0.8	0.8
Proprietary treatment systems[5,6]	These must demonstrate that 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.		

7.1.6 To deliver adequate treatment, the selected SuDS components should have a total pollution mitigation index (for each contaminant type) that equals or exceeds the pollution hazard index (for each contaminant type), as follows:

Total SuDS mitigation index ≥ pollution hazard index

(for each contaminant type) (for each contaminant type)

7.1.7 For each type of land-use, the pollution hazard indices, mitigation indices and concluding hazard have been outlined in Table 8 and 9 below.

Table 8: Roof Space Water Quality Mitigation Summary

Industrial Roofs				SuDS Manual Reference
	TSS	Metals	Hydrocarbons	
Pollution Hazard Index	0.3	0.2	0.05	Table 26.2
Mitigation Index (Oil Interceptor and filter strip)	0.5	0.4	0.8	Table 26.3
Total Mitigation index	0.5	0.4	0.8	Combined
Result	Total SuDS mitigation index ≥ pollution hazard index and therefore hazard is exceeded			

Table 9: Yard/Delivery Water Quality Mitigation Summary

Yard/Delivery area				SuDS Manual Reference
	TSS	Metals	Hydrocarbons	
Pollution Hazard Index	0.7	0.6	0.7	Table 26.2
Mitigation Index (Oil Interceptor)	0.5	0.4	0.8	Table 26.3
Mitigation Index (Filter Strip)	0.4	0.4	0.5	Table 26.3
Total Mitigation index	0.9	0.8	1.3	Combined Effect
Result	Total SuDS mitigation index ≥ pollution hazard index and therefore hazard is exceeded			

7.1.8 Therefore, it can be concluded that the provision of the oil interceptor and a filter strip exceeds the required pollution mitigation indices and provides sufficient treatment as part of the surface water management train, in accordance with the 2015 SuDS Manual (CIRIA C753).

7.1.9 Given that the site is not located in a Source Protection Zone, it is not considered necessary to apply a more cautionary approach.

8 Drainage during construction

8.1 *Construction Run-off Management*

8.1.1 Installing the surface water and foul drainage system, whilst managing temporary run-off, are key aspects of the construction works involved in any development. The information provided below is in accordance with the 'C698 Site handbook for the construction of SUDS' (CIRIA, 2007).

8.1.2 Please note that the measures recommended below are recommendations only and need to be confirmed at the construction stage by the client and the contractor.

8.2 *Management of Construction (Including Drainage)*

8.2.1 Drainage is typically an early activity in the construction stage of a development, taking form during the earthworks phase. However, final construction i.e. piped drainage system connections to the SuDS devices, should not take place until the end of site development work, unless a robust strategy for silt-removal is implemented prior to occupation of the site.

8.2.2 A plan for the management of construction (including phasing of works, details of any offsite works etc.) cannot be provided at this early stage, as construction work plans are not yet known. However, the following key points are general construction issues associated with SuDS which will be addressed when these plans are complete:

- Silt-laden waters from construction sites represent a common form of waterborne pollution;
- These silt-laden waters cannot enter SUDS drainage systems unless specifically designed to accept this as it can clog the systems and pollute receiving waters. Therefore, piped drainage systems should not be connected to the attenuation SuDS devices until the late stages of construction.
- Any gullies and piped systems should be capped off during construction and fully jetted and cleaned prior to connection to the attenuation SuDS devices.

8.3 *Temporary Drainage During Construction*

8.3.1 The three principal aspects of drainage control during construction are trapping sediment, conveying run-off, and controlling run-off.

8.3.2 Sediment traps and barriers can include basin traps and sediment fences (with any necessary boundary controls). The principal basins are to be installed after the construction site is accessed. Sediment fences and barriers will then be installed as needed during grading.

8.3.3 Conveyance of run-off can be achieved through small ditches/stream, storm drains, channels and sloped drains with sufficient inlet/outlet protection.

8.3.4 Slope stability needs to be considered when using any channels to convey run-off across the site into any basins etc.

8.3.5 Run-off control measures will need to be implemented in order not overwhelm the temporary system and cause flooding issues. Run-off rates from the site will be managed so they are no greater than pre-development or in keeping with the best practice guidance to minimise risk of blockage. Any additional conveyance measures are to be installed as needed during grading.

8.3.6 Run-off control to include provision of perimeter ditches or appropriate levels grading to direct any water from the construction site to remain on site.

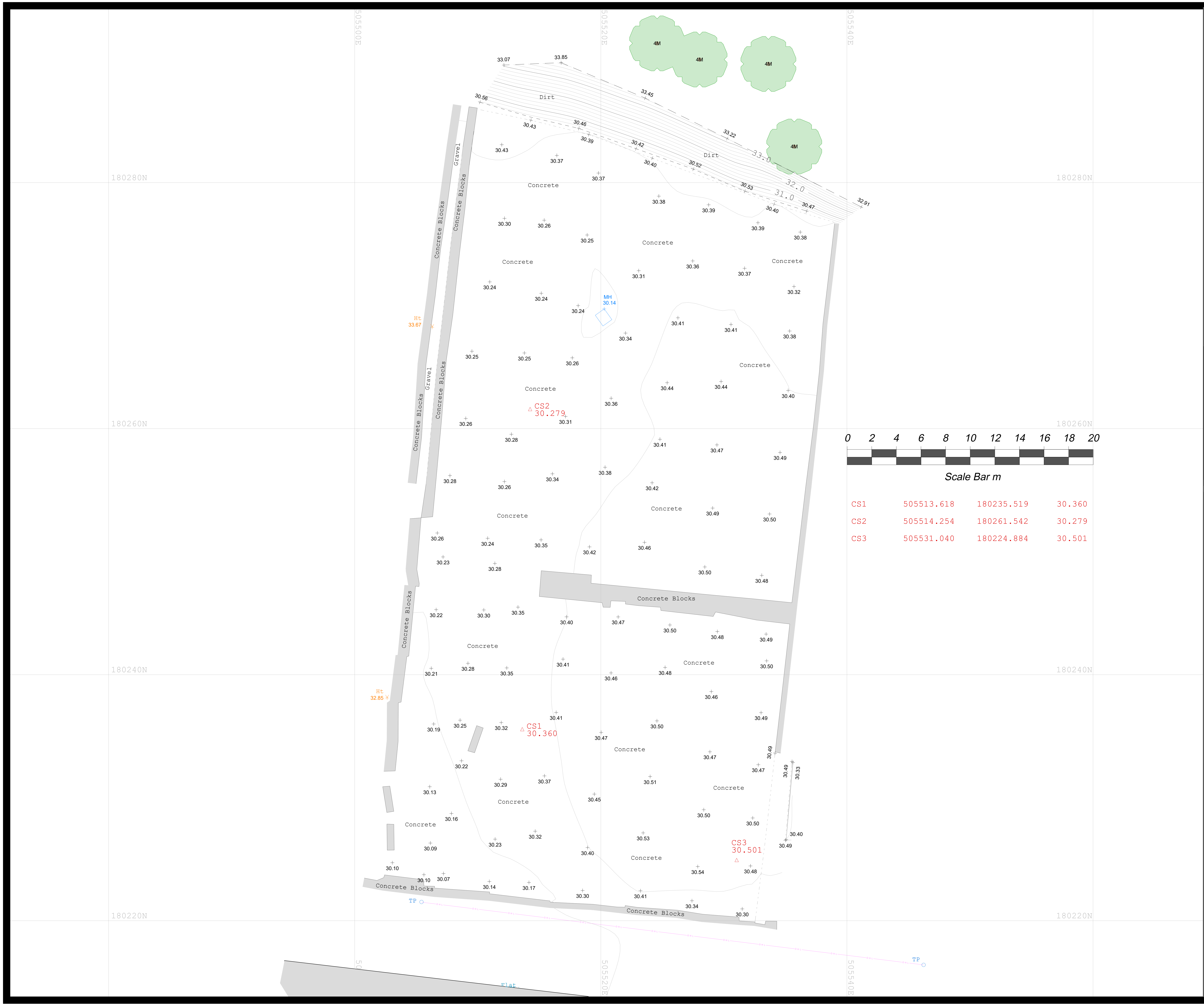
8.3.7 Any necessary surface stabilisation measures are to be applied immediately on all disturbed areas where construction work is either delayed or incomplete.

8.3.8 Maintenance inspections are to be performed weekly, and maintenance repairs to be made immediately after periods of rainfall.

8.4 *Protection of Drainage Infrastructure during Construction*

8.4.1 All drainage infrastructure should be protected from damage by construction traffic and heavy machinery through the implementation of measures such as protective barriers, and storing construction materials away from the drainage infrastructure.

Appendix A: Proposed Development Details



CS1	505513.618	180235.519	30.360
CS2	505514.254	180261.542	30.279
CS3	505531.040	180224.884	30.501

Floor Plan Legend:

SHt 1.00m HHt 2.00m Window Cill & Head Height
SHt: Sill Height From FFL
HHt: Head Height From FFL

Ht 2.00 Door Height From FFL

Overhead Detail

Stairs/Step

RAD Radiator

Ventilation / Overhead

Hatch Access Hatch

TV TV Point
TP Phone Point
S 13A Power Socket
FS Fused Socket
SS Shaver Socket
Extractor Fan
Lantern Light
Down Light
DS Light Dimmer Switch
LS Light Switch
Fixed Lighting

FA Fire Alarm Button
FX Fire Extinguisher
Reception Room Name
Carpet Floor Covering
2.49 Ceiling Height
IFL 145.80 Internal Floor Level

Topographic Legend:

Buildings / Walls
Building Canopy / Overhang
Concrete edge
Kerb line
Centre Line
Barrier
Hedge
Security Fence
Panel Fence
Gate
Overhead Line
SAP Tree / Sapling
Tree Canopy Line
Chambers
CS1 Survey Station & Name
BM 100.00 Bench Mark
TBM 100.00 Temporary Bench Mark

CL Cover level
IL Invert level
Inv Ø 0.25 Pipe invert (diameter)
GU Gully
MH Manhole
IC Inspection chamber

Trig	Trig Pillar	FS	Flag Staff
Ridg	Ridge Level	Mrk	Gas Marker
Eave	Eave Level	EP	Electric Post
DPC	Dpc Level	TP	Telegraph Post
FL	Floor Level	invt	Pipe Invert
Soff	Soffit Level	GU	Gully
T/Bo	Control Box	RP	Rodding Point
LP	Lamp Post	BT	Bt Cover
SP	Sign Post	CO	Cover Unknown
Post	Post	EC	Electricity Cover
WM	Water Meter	TL	Traffic Light
BB	Bellisha Beacon	FH	Fire Hydrant
BOL	Bollard	GAS	Gas Cover
BS	Bus Stop	SV	Stop Valve
ER	Earthing Rod	TV	Tv Cover
Box	Post Box	GV	Gas Valve
MS	Mile Stone	Peg	Peg

THE SURVEY ASSOCIATION

CYBER ESSENTIALS

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UNDERGROUND UTILITY
DRAINAGE CCTV SURVEYS & REPORTS
DRONE SURVEYS & INSPECTION
SCAN TO BIM
DIGITAL TWIN SURVEYS
ACCURATE VERIFIED VIEW SURVEYS
CONSTRUCTION VERIFICATION
AREA MEASUREMENT & REFERENCING
BOREHOLE CLEARANCE
BOUNDARY SURVEYS & DISPUTES
LAND REGISTRY COMPLIANT PLANS
MOBILE MAPPING SURVEYS
HYDROGRAPHIC SURVEYS
STRUCTURAL MONITORING SURVEYS
ARBORICULTURAL SURVEYS

SITE DETAILS:
The Old Coal Yard
Tavistock Road, West Drayton

TITLE:
Topographical

DRAWING NO.: 24169-24-01
REV: -

SCALE: 1: 200
DATE: 19/03/2024

DRAWN: JF
CHECKED:

LEVEL DATUM: OSGB36(15)
Paper Size - A2

Comments:

This plan should only be used for its original purpose. Castle Surveys Ltd dos not accept any responsibility for this plan if supplied to any other party, other than the original client.

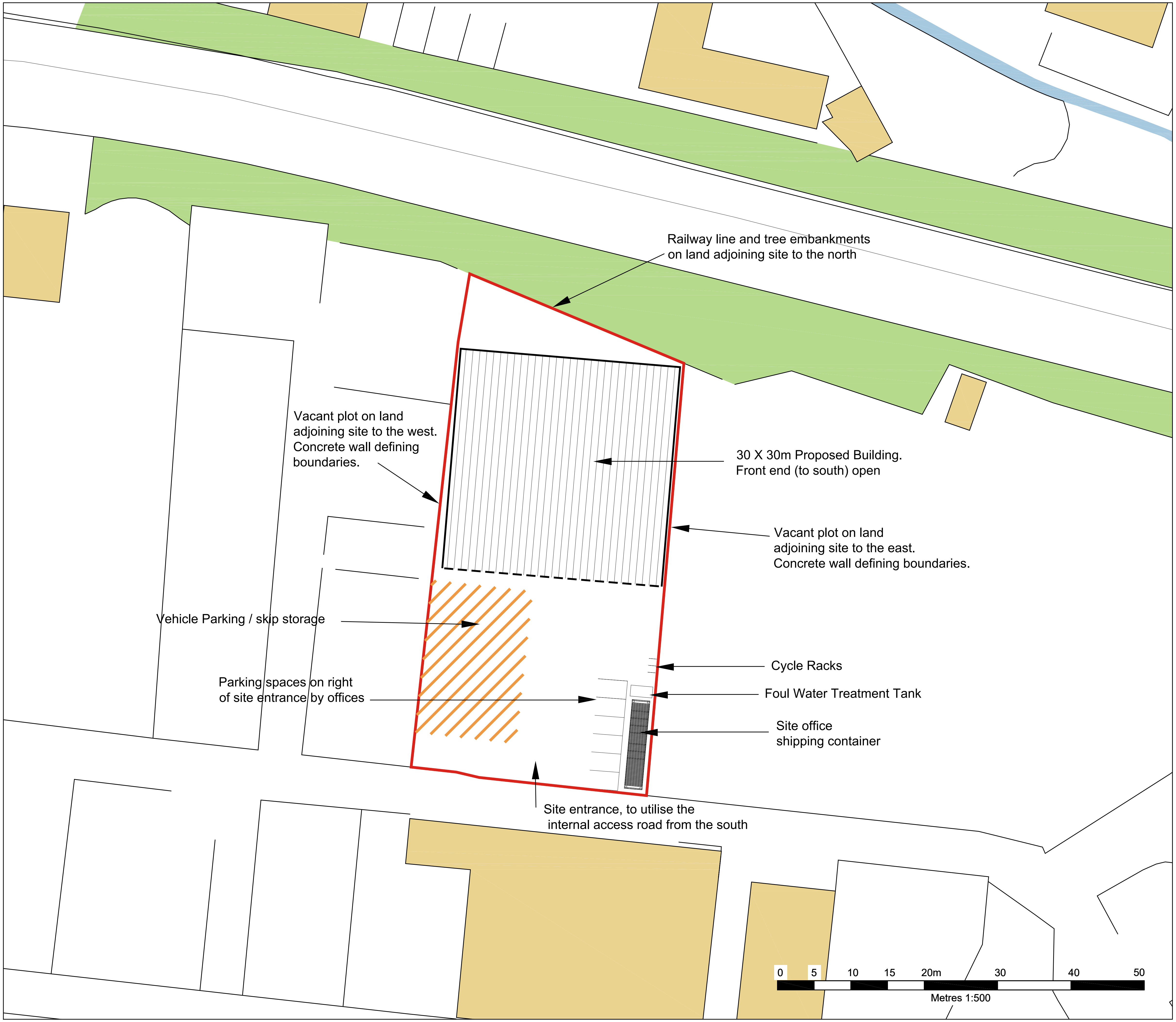
All dimensions and levels should be check on site prior to design and construction.

Drainage information (where applicable) has been visually inspected from the surface and therefore should be treated as approximate only. Some services may have been omitted due to parked vehicles or due to the site being overgrown with vegetation.

Tree information (where applicable) has been surveyed from ground level and therefore should be treated as approximate only. Advise that a tree survey should be carried out.

Roof linework (where applicable) is indicative only.

DO NOT SCALE



240516_HEA043-BlockPlan.dwg

LEGEND

🟥 Application Site

NOTES

This Block Plan shows the site plan at a scale of 1:500.

The direction of north is indicated by northpoint in the titleblock below (and is orientated to the top of the page).

The proposed development of a new main building, vehicle parking / skip storage and site office / shipping container are shown in relation to the site boundaries.

There are no other existing buildings on site, or immediately adjacent as land to the east and west are vacant.

An internal site road would provide access to the proposed development from the south, as shown.

There are no public rights of way crossing or adjoining the site

NORTH

PUNJAB SKIPS

Heatons
Planning Environment Design

SITE
Old Coal Depot

PROJECT
Waste Transfer Station

DRAWING TITLE
Block Plan

DATE	REFERENCE
May 2024	BP

SCALE
1:500 @ A3

STATUS
FINAL

The Arc, 6 Mallard Way, Pride Park, Derby. DE24 8GX
www.heatonplanning.co.uk

Appendix B: Drainage Design

hr wallingford

Greenfield runoff rate estimation for sites

www.uksuds.com | Greenfield runoff tool

Calculated by:	andrew wallace
Site name:	Punjab Skips
Site location:	West Drayton

Site Details

Latitude:	51.51117° N
Longitude:	0.48075° W
Reference:	4025802752
Date:	Apr 23 2024 09:12

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

Runoff estimation approach

IH124

Site characteristics

Total site area (ha): 0.199

Methodology

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

Soil characteristics

	Default	Edited
SOIL type:	2	2
HOST class:	N/A	N/A
SPR/SPRHOST:	0.3	0.3

Hydrological characteristics

	Default	Edited
SAAR (mm):	622	622
Hydrological region:	6	6
Growth curve factor 1 year:	0.85	0.85
Growth curve factor 30 years:	2.3	2.3
Growth curve factor 100 years:	3.19	3.19
Growth curve factor 200 years:	3.74	3.74

Notes

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

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

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

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

(3) Is SPR/SPRHOST ≤ 0.3?

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

Greenfield runoff rates

	Default	Edited

Q_{BAR} (l/s):	0.32	0.32
1 in 1 year (l/s):	0.27	0.27
1 in 30 years (l/s):	0.73	0.73
1 in 100 year (l/s):	1.01	1.01
1 in 200 years (l/s):	1.18	1.18

This report was produced using the greenfield runoff tool developed by HR Wallingford and available at www.uksuds.com. The use of this tool is subject to the UK SuDS terms and conditions and licence agreement , which can both be found at www.uksuds.com/terms-and-conditions.htm. The outputs from this tool are estimates of greenfield runoff rates. The use of these results is the responsibility of the users of this tool. No liability will be accepted by HR Wallingford, the Environment Agency, CEH, Hydrosolutions or any other organisation for the use of this data in the design or operational characteristics of any drainage scheme.

Notes

1. This drawing is for construction. It should be read in conjunction with all relevant series design drawings, specifications and documentation.
2. Location and levels of existing sewers are assumed only and should not be relied upon until confirmed by survey.
3. Dimensions must not be scaled from this drawing.
4. The contractor shall be responsible for the setting out of the works and the accuracy of all dimensions. he shall satisfy himself that the information given is correct and notify the relevant parties immediately of any discrepancies.
5. The building contractor is responsible for the design and coordination of all temporary works required on this project.
6. All services are to be located by the contractor and clearly marked prior to commencing work on site.
7. Construction to be in accordance with all British and European standards and building regulations.
8. All dimensions are in millimetres and levels in metres above local datum.
9. Any discrepancies in the details shown are to be reported to the employer's representative/engineer prior to construction.
10. The general specification of materials and workmanships for the construction of the access road, footpaths and other areas of hardstanding shall be the manual of contract documents for highway works, volume 1. specification of highway works (shw) published by the stationary office.
11. All surface water drainage is subject to detailed design and all RWP and FO shown are indicative only and subject to approval and setting out by the architect.
12. Node numbers refer to calculations within drainage report
13. Unless noted otherwise, pipes to be:
    foul pipes under building Ø100@1:40,
    foul pipes external Ø100@1:80,
    surface water pipes Ø150@1:100

DRAINAGE KEY

Ø100@1:100>	Stormwater Pipe - Diameter and fall
Ø100@1:100>	Perforated Pipe - Diameter and fall
SWIC Ø450	Polypropylene Inspection Chamber (PPIC)
◦ RWP	Rain Water Pipe
SMH Ø1200 CL 80.90 IL 80.00	Manhole type - SMH Surface Water Diameter Cover Level Invert Level
FMH Ø1200 CL 80.90 IL 80.00	Manhole type - FMH Foul Water Diameter Cover Level Invert Level
Ø150@1:100>	Foul Pipe - Diameter and fall
FWIC Ø450	Polypropylene Inspection Chamber (PPIC)
◦ FO	Sewer Vent Pipe/Sub Stack/Foul Outlet
▦	Attenuation Tank

EXTERNAL WORKS KEY

18.30+	Proposed Level
FFL 80.90	Finished floor level

Rev	Description	Drawn Date	Checked Date

Drawn By AW Date 24.04.24	Checked By AW Date 24.04.24	Approved By AW Date 24.04.24

Base drawing scale 1:200 at A1

Client HEATONS

Project
OLD COAL DEPOT
TAVISTOCK ROAD
WEST DRAYTON

Title SITE DRAINAGE PLAN

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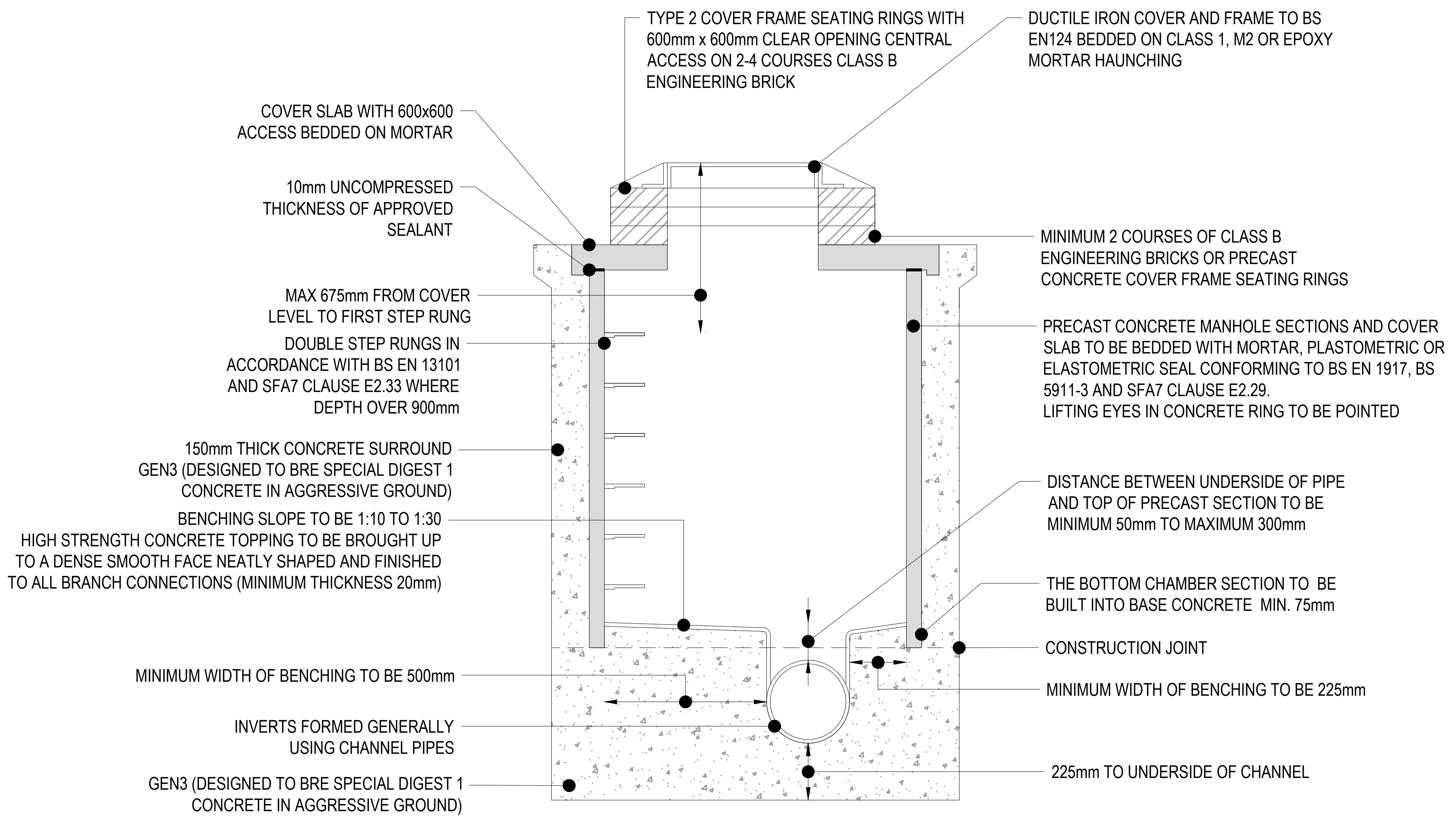
London Office
49 Constable House Adelaide Road London NW3 3QA

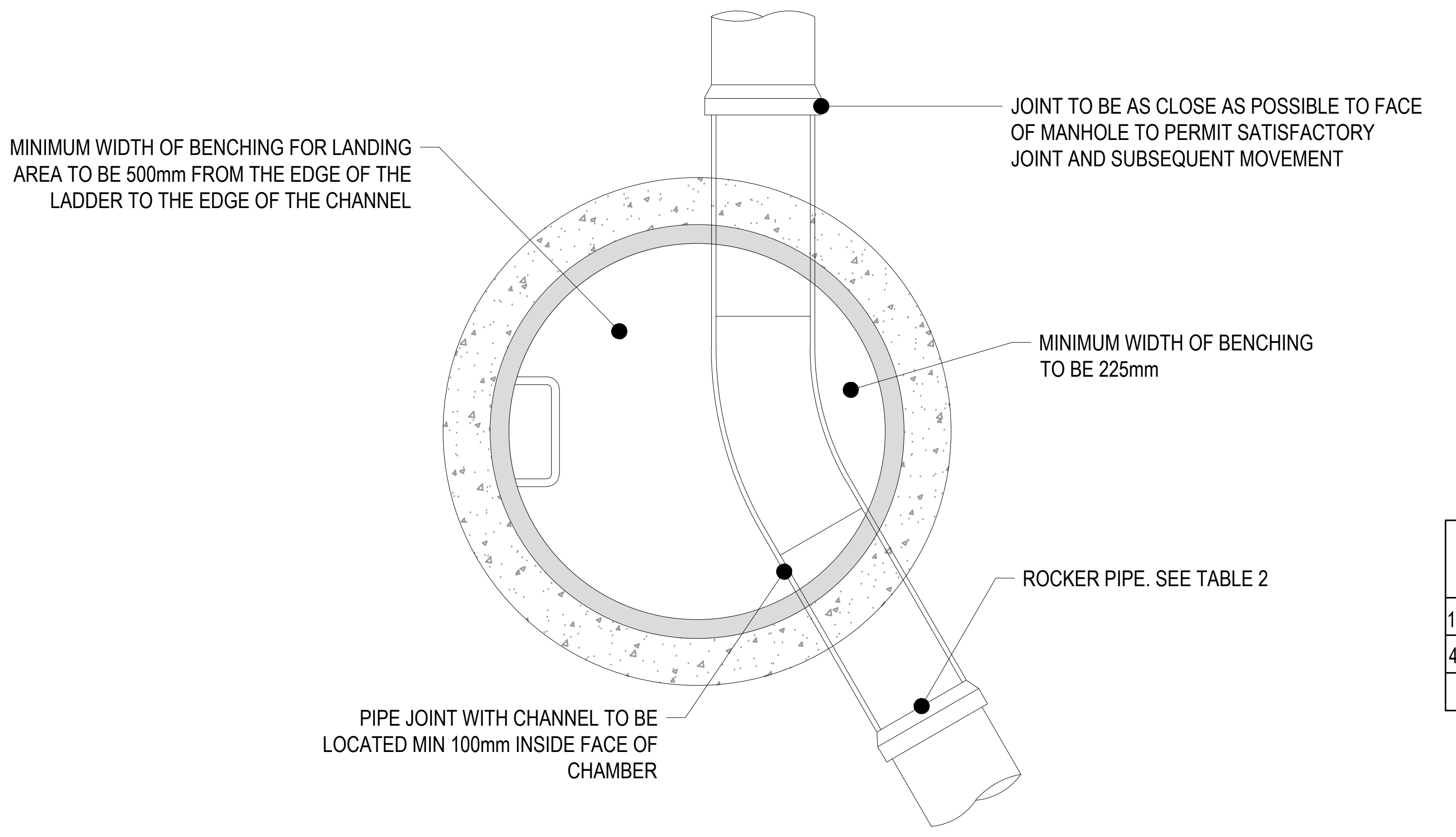
Architect HEATONS

Drawing No. 2842-C01

Revision -

Status	
Preliminary	●
Tender	
Construction	
As Built	





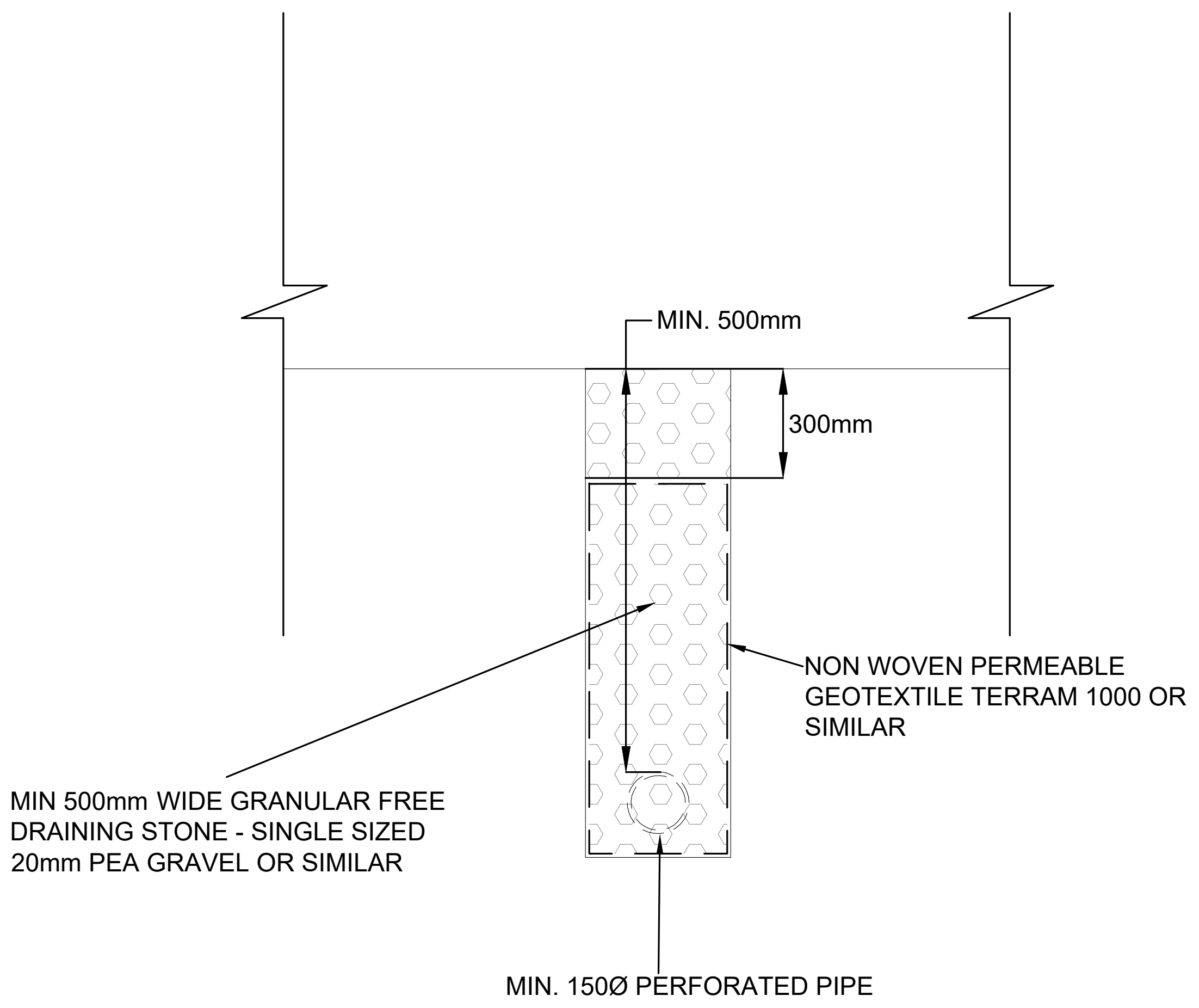
NOTES:
CHAMBERS WITH OUTGOING PIPES GREATER THAN 500mm DIAMETER SHALL BE FITTED WITH GUARD BARS, SAFETY CHAINS OR OTHER SAFETY DEVICES. TOE HOLES TO BE PROVIDED IN BENCHING OF SEWERS GREATER THAN 450mm DIAMETER FOR ACCESS TO INVERT. WHERE INTERNAL HEIGHT EXCEEDS 1800mm MANHOLE MAY BE PROVIDED WITH REDUCING COVER AND SHAFT. SHAFT DIAMETER TO BE 600mm DIAMETER OR 900mm DIAMETER IF LONGER THAN 900mm.

PIPE DIAMETER	ROCKER PIPE * LENGTH
150mm-450mm	500mm-750mm
475mm-750mm	750mm-1000mm
OVER 750mm	1200mm

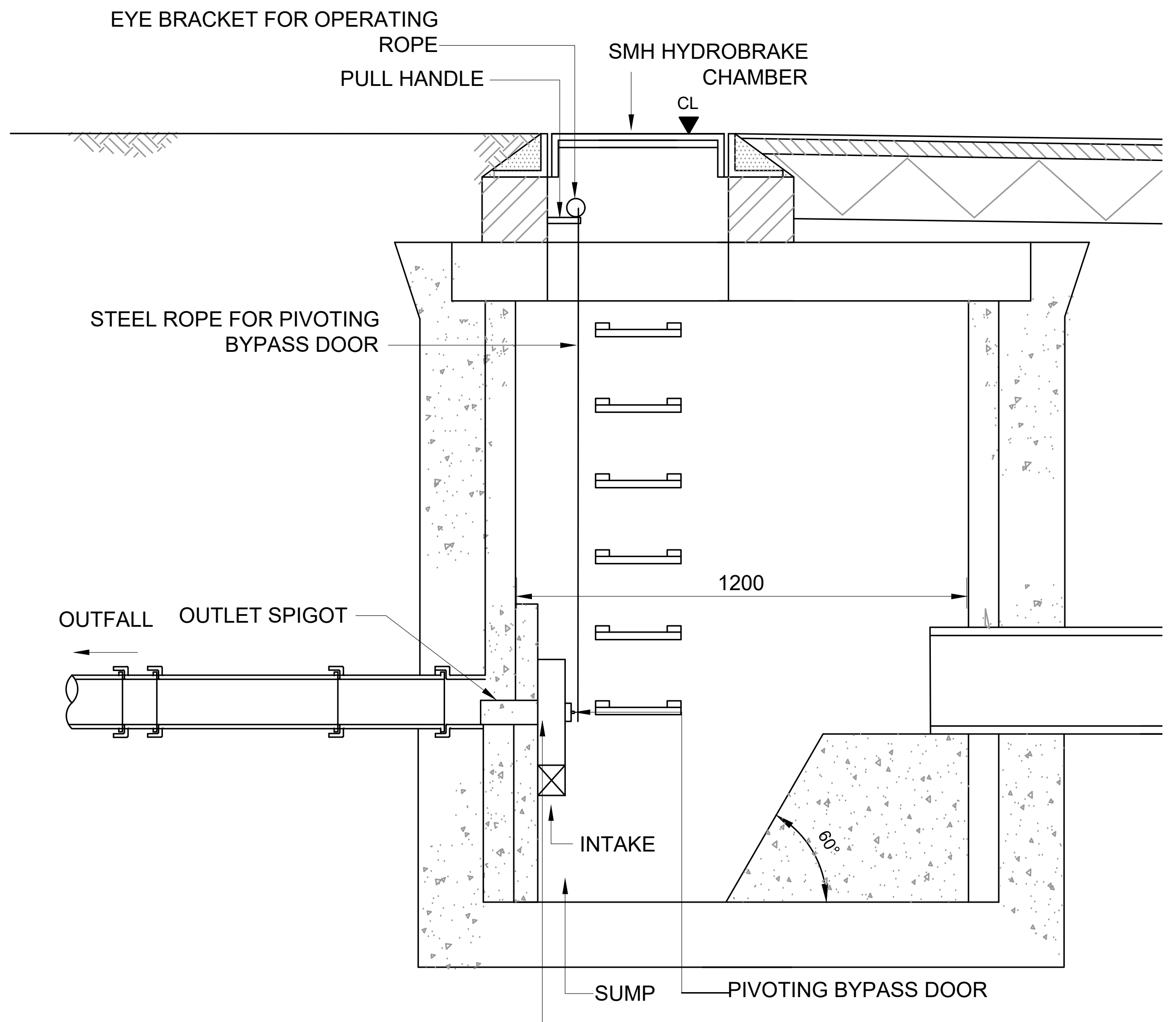
* OR LINTEL AND COMPRESSIBLE SEALANT IN ACCORDANCE WITH CLAUSE 689 OF THE SPECIFICATION.

TYPICAL PCC MANHOLE DETAIL

SCALE 1:20



TYPICAL FILTER STRIP



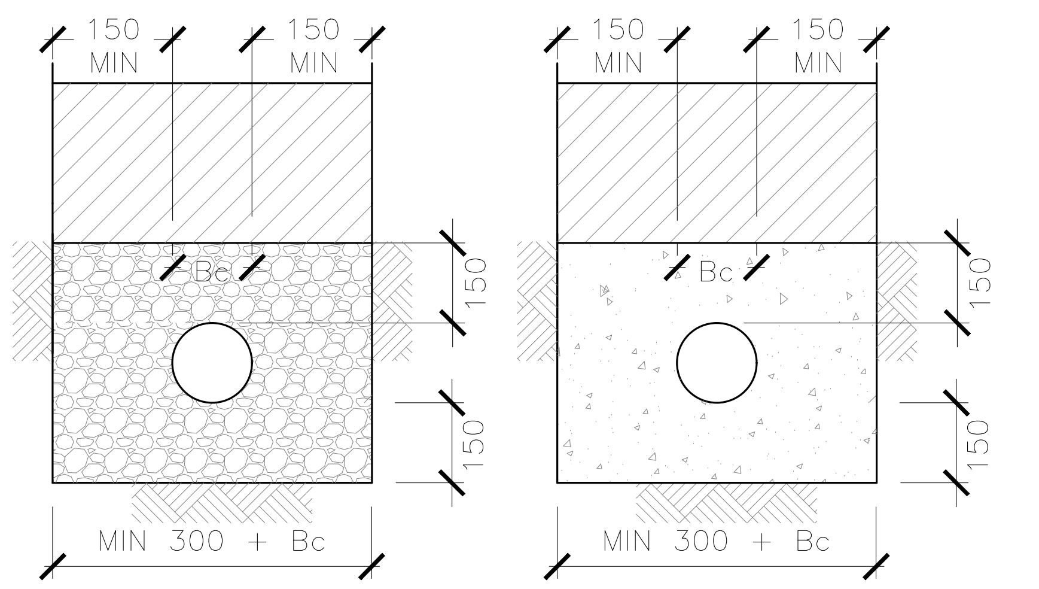
'HYDROBRAKE' FLOW CONTROL DEVICE BY HYDRO INTERNATIONAL LTD (OR SIMILAR APPROVED) TO RESTRICT OUTFLOW TO MAXIMUM OF 5 l/s AT AN OPERATING HEAD OF 1.5m (SUBJECT TO DETAILED DESIGN)
HYDROBRAKE FLOW CONTROL MOUNTING DETAILS ARE SHOWN INDICATIVELY - EXACT MOUNTING DETAILS TO BE AS ADVISED BY THE MANUFACTURER / SUPPLIER

HYDROBRAKE OUTLET DETAIL

SCALE 1:20

Notes

1. This drawing is for planning only and is to be read in conjunction with all relevant series design drawings, specifications and documentation.
2. Construction to be in accordance with all British and European standards and building regulations.
3. All dimensions are in millimetres and levels in metres above local datum.
4. Any discrepancies in the details shown are to be reported to the employer's representative/engineer prior to construction
5. all existing services are to be located prior to the commencement of any works. the contractor must notify the engineer immediately of any conflict with the proposed works.
6. For gravity sewers, all drainage and fittings are to be flexibly jointed UPVC to BSEN 1401-1 or clayware to BSEN 295 or concrete to BS5911 part 100
7. Chamber walls 225 thick to be constructed in class B engineering bricks to SHW series 2400 in designation (i) mortar or in-situ strength class C16/20 concrete to clause 2602
8. Chamber walls and cover slab to be constructed in precast concrete to BSEN 1917 and BS 5911-3.
9. Concrete mixes indicated on this drawing are designated mixes in accordance with BS8500-1:2006. all concrete to be sulphate resistant
10. Backfill to all trenches under carriageways to be type 1 sub-base material, elsewhere backfill to be in accordance with the specification, free draining readily compactible material, free from rubbish and organic matter, frozen soil clay lumps and large stones. to be compacted in layers not exceeding 150mm thick.
11. A flexible joint shall be provided as close as is feasible to outside face of any structure into which a pipe is built, in accordance with the detail.
12. The general specification of materials and workmanships for the construction of the access road, footpaths and other areas of hardstanding shall be the manual of contract documents for highway works, volume 1. specification of highway works (SHW) published by the stationary office.
13. All pipes to be laid soffit to soffit unless noted otherwise.
14. Manhole covers and frames shall comply with BSEN124 and shall be of a non-rocking design which does not rely on the use of cushion inserts. class D covers shall be used in carriageways, hard shoulders and parking areas used by all type of road vehicles. class C shall be used in footways, pedestrian areas and all comparable locations.



GENERAL PIPE BEDDING DETAIL

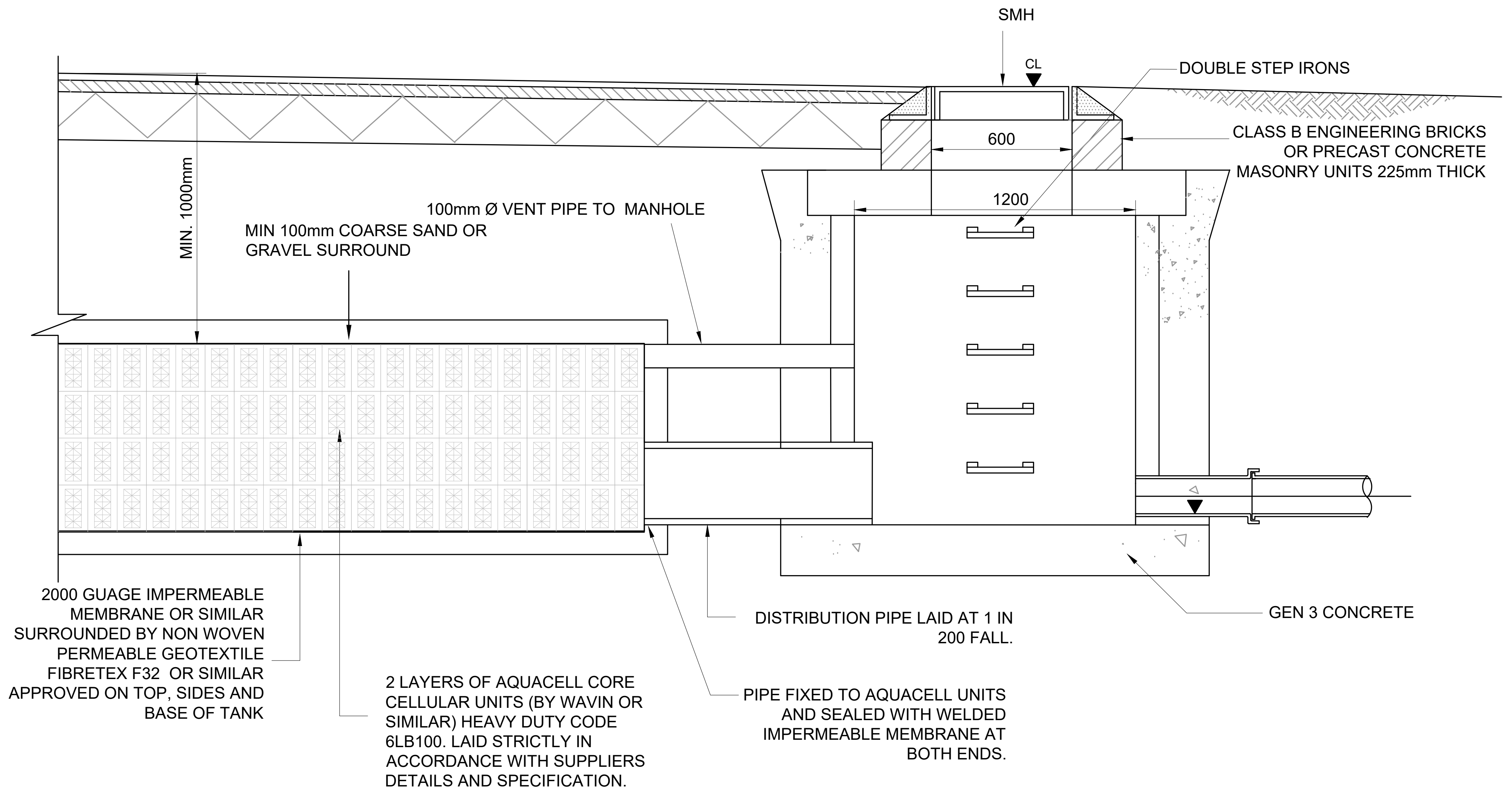
PIPE BEDDING DETAIL FOR ALL PIPES THAT PASS BELOW OR NEAR FOUNDATIONS, PIPES WITH LESS THAN 600mm COVER IN ALL EXTERNAL AREAS AND PIPES WITH LESS THAN 1200mm COVER BELOW ROADS AND DRIVEWAYS

▨	SELECTED FILL: FREE FROM STONES LARGER THAN 40mm, LUMPS OF CLAY OVER 100mm, TIMBER, FROZEN MATERIAL, VEGETABLE MATTER.
▨	GRANULAR MATERIAL: TO CONFORM TO BS EN 1610 ANNEX B TABLE B.15 AND SHOULD BE SINGLE SIZE MATERIAL OR GRADED MATERIAL FROM 5mm UP TO A MAXIMUM SIZE OF 10mm FOR 100mm PIPES, 14mm FOR 150mm PIPES, 20mm FOR PIPES FROM 150mm UP TO 600mm DIAMETER AND 40mm FOR PIPES MORE THAN 600mm DIAMETER.
☐	GEN1 CONCRETE IN ACCORDANCE WITH BS 8500–1:2002.

NOTE:
PIPES LESS THAN 1200mm BELOW ROADS AND LESS THAN 600mm BELOW OTHER EXTERNAL AREAS SHALL HAVE A 150mm GEN1 CONCRETE SURROUND. OTHER THAN PIPES CAST WITHIN PILECAPS ALL PIPES BELOW SUSPENDED SLAB SHALL HAVE GRANULAR SURROUND AS SHOWN.

PIPE BEDDING DETAIL

SCALE 1:10



TYPICAL SECTION THROUGH STORM WATER STORAGE/ATTENUATION TANK

SCALE 1:20

Rev	Description	Drawn Date	Checked Date
A	Construction	AW 25.10.23	AW 25.10.23

Drawn By AW
Date 24.04.24
Checked By AW
Date 24.04.24
Approved By AW
Date 24.04.24
Base drawing scale As Shown

Client HEATONS

Project OLD COAL DEPOT
TAVISTOCK ROAD
WEST DRAYTON

Title DRAINAGE DETAILS

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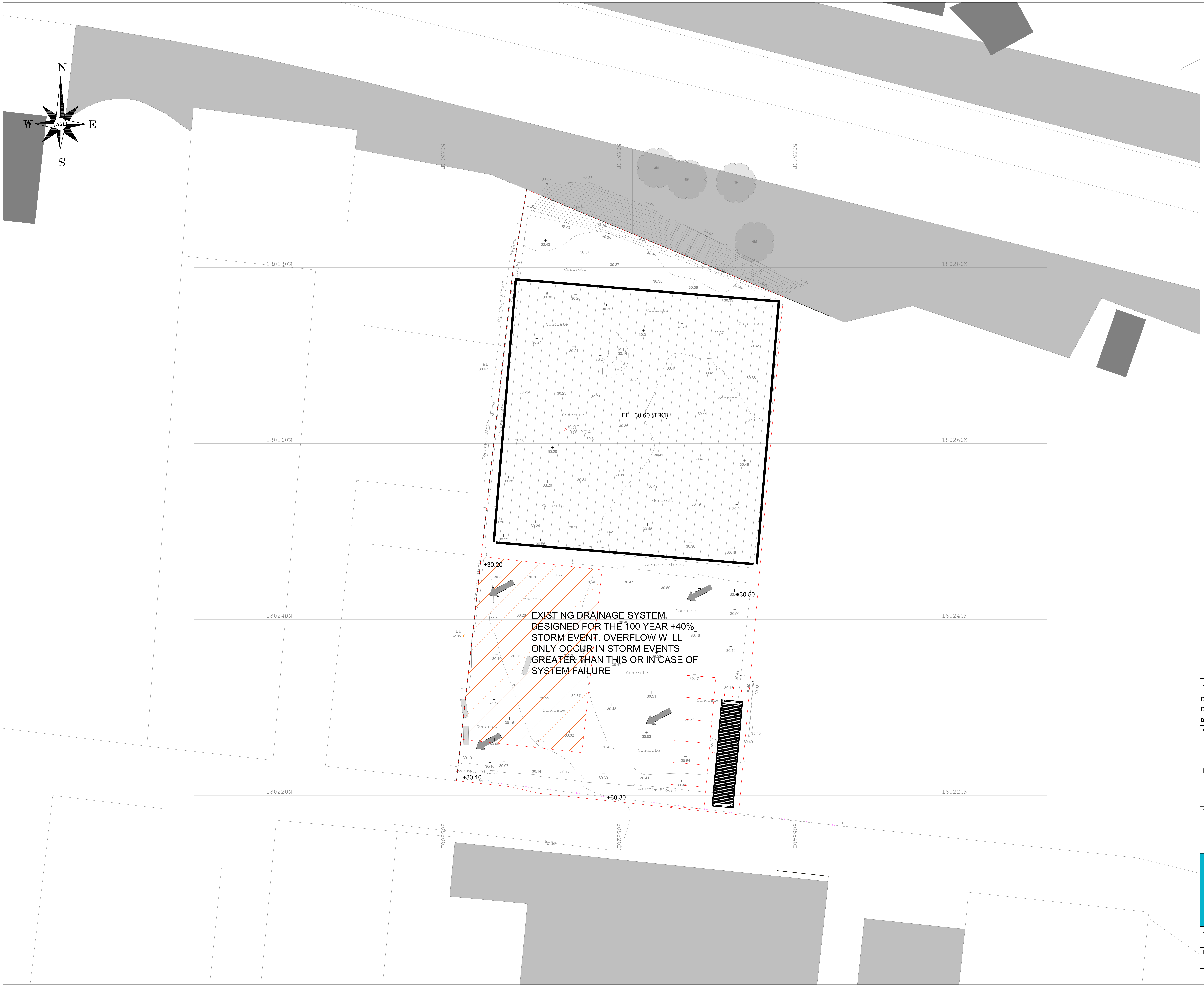
Architect HEATONS

Drawing No. 2842-C02

Revision -

Status	
Preliminary	●
Tender	
Construction	
As Built	



EXISTING DRAINAGE SYSTEM DESIGNED FOR THE 100 YEAR +40% STORM EVENT. OVERFLOW W ILL ONLY OCCUR IN STORM EVENTS GREATER THAN THIS OR IN CASE OF SYSTEM FAILURE

Notes

1. This drawing is to be read in conjunction with all relevant series design drawings, specifications and documentation.
2. Construction to be in accordance with all British and European standards and building regulations.
3. All dimensions are in millimetres and levels in metres above local datum.
4. Any discrepancies in the details shown are to be reported to the employer's representative/engineer prior to construction

STORMWATER CONCEPT LEGEND

18.30x	Proposed Level
←	Overland flow

Rev	Description	Drawn Date	Checked Date

Drawn By AW
Date 24.04.24
Checked By AW
Date 24.04.24
Approved By AW
Date 24.04.24

Base drawing scale 1:200 at A1

Client HEATONS

Project OLD COAL DEPOT
TAVISTOCK ROAD
WEST DRAYTON

Title OVERLAND FLOW PLAN

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London Office
49 Constable House Adelaide Road London NW3 3QA

Architect HEATONS

Drawing No. 2842-C03

Revision -

Status
Preliminary ●
Tender
Construction
As Built

Design Settings

Rainfall Methodology	FSR	Maximum Time of Concentration (mins)	30.00
Return Period (years)	10	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)	20.000	Minimum Backdrop Height (m)	0.200
Ratio-R	0.400	Preferred Cover Depth (m)	0.600
CV	0.750	Include Intermediate Ground	x
Time of Entry (mins)	2.00	Enforce best practice design rules	x

Adoptable 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)
1.500	1050	99.999	1200

Circular Link Type

Shape	Circular	Auto Increment (mm)	75
Barrels	1	Follow Ground	x

Available Diameters (mm)

100	150

Nodes

Name	Area (ha)	T of E (mins)	Cover Level (m)	Diameter (mm)	Easting (m)	Northing (m)	Depth (m)
1			30.300	1200	100.000	100.000	2.000
2			30.300	1200	100.000	105.000	1.900
3			30.400	1200	100.000	108.000	1.900
4	0.100	2.00	30.500	1200	100.000	128.000	1.400
5	0.100	2.00	30.100	1200	80.000	105.000	1.000

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)
1.002	2	1	5.000	0.600	28.400	28.300	0.100	50.0	150	2.23	50.0
1.001	3	2	3.000	0.600	28.500	28.400	0.100	30.0	150	2.18	50.0
2.000	4	3	20.000	0.600	29.100	28.500	0.600	33.3	225	2.15	50.0
1.000	5	3	20.224	0.600	29.100	28.500	0.600	33.7	225	2.15	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)
1.002	1.426	25.2	27.1	1.750	1.850	0.200	0.0	150	1.453
1.001	1.845	32.6	27.1	1.750	1.750	0.200	0.0	105	2.058
2.000	2.273	90.4	13.6	1.175	1.675	0.100	0.0	58	1.644
1.000	2.261	89.9	13.6	0.775	1.675	0.100	0.0	58	1.635

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)
										2.24	50.0
										2.53	50.0
										2.21	50.0

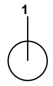
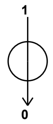
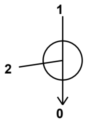
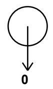
Name	Vel (m/s)	Cap (l/s)	Flow (l/s)	US Depth (m)	DS Depth (m)	Σ Area (ha)	Σ Add Inflow (l/s)	Pro Depth (mm)	Pro Velocity (m/s)

Pipeline Schedule

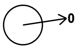
Link	Length (m)	Slope (1:X)	Dia (mm)	Link Type	US CL (m)	US IL (m)	US Depth (m)	DS CL (m)	DS IL (m)	DS Depth (m)
1.002	5.000	50.0	150	Circular	30.300	28.400	1.750	30.300	28.300	1.850
1.001	3.000	30.0	150	Circular	30.400	28.500	1.750	30.300	28.400	1.750
2.000	20.000	33.3	225	Circular	30.500	29.100	1.175	30.400	28.500	1.675
1.000	20.224	33.7	225	Circular	30.100	29.100	0.775	30.400	28.500	1.675

Link	US Node	Dia (mm)	Node Type	MH Type	DS Node	Dia (mm)	Node Type	MH Type
1.002	2	1200	Manhole	Adoptable	1	1200	Manhole	Adoptable
1.001	3	1200	Manhole	Adoptable	2	1200	Manhole	Adoptable
2.000	4	1200	Manhole	Adoptable	3	1200	Manhole	Adoptable
1.000	5	1200	Manhole	Adoptable	3	1200	Manhole	Adoptable

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections		Link	IL (m)	Dia (mm)
1	100.000	100.000	30.300	2.000	1200		1	1.002	28.300	150
2	100.000	105.000	30.300	1.900	1200		1	1.001	28.400	150
							0	1.002	28.400	150
3	100.000	108.000	30.400	1.900	1200		1	2.000	28.500	225
							2	1.000	28.500	225
							0	1.001	28.500	150
4	100.000	128.000	30.500	1.400	1200		0	2.000	29.100	225

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)
5	80.000	105.000	30.100	1.000	1200	 0	1.000	29.100	225

Simulation Settings

Rainfall Methodology	FSR	Analysis Speed	Normal
FSR Region	England and Wales	Skip Steady State	x
M5-60 (mm)	19.000	Drain Down Time (mins)	240
Ratio-R	0.400	Additional Storage (m³/ha)	5.0
Summer CV	0.750	Check Discharge Rate(s)	✓
Winter CV	0.840	Check Discharge Volume	x

Storm Durations

15	60	180	360	600	960	2160	4320	7200	10080
30	120	240	480	720	1440	2880	5760	8640	

Return Period (years)	Climate Change (CC %)	Additional Area (A %)	Additional Flow (Q %)
1	0	0	0
30	0	0	0
100	0	0	0
100	40	0	0

Pre-development Discharge Rate

Site Makeup	Greenfield	Growth Factor 30 year	1.95
Greenfield Method	IH124	Growth Factor 100 year	2.48
Positively Drained Area (ha)		Betterment (%)	0
SAAR (mm)		QBar	
Soil Index	1	Q 1 year (l/s)	
SPR	0.10	Q 30 year (l/s)	
Region	1	Q 100 year (l/s)	
Growth Factor 1 year	0.85		

Node 3 Online Hydro-Brake® Control

Flap Valve	x	Objective	(HE) Minimise upstream storage
Replaces Downstream Link	✓	Sump Available	✓
Invert Level (m)	28.500	Product Number	CTL-SHE-0098-5000-1500-5000
Design Depth (m)	1.500	Min Outlet Diameter (m)	0.150
Design Flow (l/s)	5.0	Min Node Diameter (mm)	1200

Node 3 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	28.600
Side Inf Coefficient (m/hr)	0.00000	Porosity	0.95	Time to half empty (mins)	156

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	98.0	0.0	0.800	98.0	0.0	0.801	0.1	0.0

Other (defaults)

Entry Loss (manhole)	0.250	Entry Loss (junction)	0.000	Apply Recommended Losses	x
Exit Loss (manhole)	0.250	Exit Loss (junction)	0.000	Flood Risk (m)	0.300

Approval Settings

Node Size	x	Coordinates	x	Full Bore Velocity	x	Time to Half Empty	✓
Node Losses	x	Crossings	x	Proportional Velocity	x	Return Period (years)	100
Link Size	x	Cover Depth	x	Surcharged Depth	x	Discharge Rates	x
Link Length	x	Backdrops	x	Flooding	x	Discharge Volume	x

Rainfall

Event	Peak Intensity (mm/hr)	Average Intensity (mm/hr)
1 year 15 minute summer	103.832	29.381
1 year 15 minute winter	72.865	29.381
1 year 30 minute summer	67.515	19.105
1 year 30 minute winter	47.379	19.105
1 year 60 minute summer	45.726	12.084
1 year 60 minute winter	30.379	12.084
1 year 120 minute summer	28.340	7.489
1 year 120 minute winter	18.828	7.489
1 year 180 minute summer	21.894	5.634
1 year 180 minute winter	14.231	5.634
1 year 240 minute summer	17.401	4.599
1 year 240 minute winter	11.561	4.599
1 year 360 minute summer	13.397	3.448
1 year 360 minute winter	8.709	3.448
1 year 480 minute summer	10.573	2.794
1 year 480 minute winter	7.024	2.794
1 year 600 minute summer	8.677	2.373
1 year 600 minute winter	5.929	2.373
1 year 720 minute summer	7.750	2.077
1 year 720 minute winter	5.209	2.077
1 year 960 minute summer	6.393	1.683
1 year 960 minute winter	4.235	1.683
1 year 1440 minute summer	4.671	1.252
1 year 1440 minute winter	3.140	1.252
1 year 2160 minute summer	3.372	0.932
1 year 2160 minute winter	2.323	0.932
1 year 2880 minute summer	2.820	0.756
1 year 2880 minute winter	1.895	0.756
1 year 4320 minute summer	2.149	0.562
1 year 4320 minute winter	1.415	0.562
1 year 5760 minute summer	1.779	0.455
1 year 5760 minute winter	1.151	0.455
1 year 7200 minute summer	1.517	0.387
1 year 7200 minute winter	0.979	0.387
1 year 8640 minute summer	1.329	0.339
1 year 8640 minute winter	0.858	0.339
1 year 10080 minute summer	1.188	0.303
1 year 10080 minute winter	0.767	0.303
30 year 15 minute summer	254.498	72.014
30 year 15 minute winter	178.595	72.014

Rainfall

Event	Peak Intensity (mm/hr)	Average Intensity (mm/hr)
30 year 30 minute summer	165.775	46.909
30 year 30 minute winter	116.334	46.909
30 year 60 minute summer	110.635	29.238
30 year 60 minute winter	73.503	29.238
30 year 120 minute summer	66.994	17.704
30 year 120 minute winter	44.509	17.704
30 year 180 minute summer	50.789	13.070
30 year 180 minute winter	33.014	13.070
30 year 240 minute summer	39.713	10.495
30 year 240 minute winter	26.384	10.495
30 year 360 minute summer	29.789	7.666
30 year 360 minute winter	19.364	7.666
30 year 480 minute summer	23.214	6.135
30 year 480 minute winter	15.423	6.135
30 year 600 minute summer	18.859	5.158
30 year 600 minute winter	12.885	5.158
30 year 720 minute summer	16.698	4.475
30 year 720 minute winter	11.222	4.475
30 year 960 minute summer	13.576	3.575
30 year 960 minute winter	8.993	3.575
30 year 1440 minute summer	9.708	2.602
30 year 1440 minute winter	6.524	2.602
30 year 2160 minute summer	6.844	1.892
30 year 2160 minute winter	4.716	1.892
30 year 2880 minute summer	5.625	1.508
30 year 2880 minute winter	3.780	1.508
30 year 4320 minute summer	4.184	1.094
30 year 4320 minute winter	2.755	1.094
30 year 5760 minute summer	3.402	0.871
30 year 5760 minute winter	2.202	0.871
30 year 7200 minute summer	2.859	0.729
30 year 7200 minute winter	1.845	0.729
30 year 8640 minute summer	2.473	0.631
30 year 8640 minute winter	1.596	0.631
30 year 10080 minute summer	2.187	0.558
30 year 10080 minute winter	1.411	0.558
100 year 15 minute summer	329.664	93.284
100 year 15 minute winter	231.343	93.284
100 year 30 minute summer	216.648	61.304
100 year 30 minute winter	152.034	61.304
100 year 60 minute summer	145.356	38.413
100 year 60 minute winter	96.571	38.413
100 year 120 minute summer	88.100	23.282
100 year 120 minute winter	58.532	23.282
100 year 180 minute summer	66.650	17.151
100 year 180 minute winter	43.325	17.151
100 year 240 minute summer	51.959	13.731
100 year 240 minute winter	34.521	13.731
100 year 360 minute summer	38.732	9.967
100 year 360 minute winter	25.177	9.967
100 year 480 minute summer	30.068	7.946
100 year 480 minute winter	19.977	7.946

Rainfall

Event	Peak Intensity (mm/hr)	Average Intensity (mm/hr)
100 year 600 minute summer	24.351	6.660
100 year 600 minute winter	16.638	6.660
100 year 720 minute summer	21.505	5.763
100 year 720 minute winter	14.452	5.763
100 year 960 minute summer	17.408	4.584
100 year 960 minute winter	11.531	4.584
100 year 1440 minute summer	12.367	3.314
100 year 1440 minute winter	8.311	3.314
100 year 2160 minute summer	8.657	2.393
100 year 2160 minute winter	5.965	2.393
100 year 2880 minute summer	7.077	1.897
100 year 2880 minute winter	4.756	1.897
100 year 4320 minute summer	5.223	1.365
100 year 4320 minute winter	3.439	1.365
100 year 5760 minute summer	4.221	1.080
100 year 5760 minute winter	2.732	1.080
100 year 7200 minute summer	3.530	0.900
100 year 7200 minute winter	2.278	0.900
100 year 8640 minute summer	3.041	0.776
100 year 8640 minute winter	1.962	0.776
100 year 10080 minute summer	2.680	0.684
100 year 10080 minute winter	1.729	0.684
100 year +40% CC 15 minute summer	461.530	130.597
100 year +40% CC 15 minute winter	323.881	130.597
100 year +40% CC 30 minute summer	303.307	85.825
100 year +40% CC 30 minute winter	212.847	85.825
100 year +40% CC 60 minute summer	203.498	53.779
100 year +40% CC 60 minute winter	135.199	53.779
100 year +40% CC 120 minute summer	123.340	32.595
100 year +40% CC 120 minute winter	81.944	32.595
100 year +40% CC 180 minute summer	93.311	24.012
100 year +40% CC 180 minute winter	60.654	24.012
100 year +40% CC 240 minute summer	72.743	19.224
100 year +40% CC 240 minute winter	48.329	19.224
100 year +40% CC 360 minute summer	54.225	13.954
100 year +40% CC 360 minute winter	35.248	13.954
100 year +40% CC 480 minute summer	42.096	11.125
100 year +40% CC 480 minute winter	27.967	11.125
100 year +40% CC 600 minute summer	34.091	9.325
100 year +40% CC 600 minute winter	23.293	9.325
100 year +40% CC 720 minute summer	30.106	8.069
100 year +40% CC 720 minute winter	20.233	8.069
100 year +40% CC 960 minute summer	24.371	6.417
100 year +40% CC 960 minute winter	16.144	6.417
100 year +40% CC 1440 minute summer	17.314	4.640
100 year +40% CC 1440 minute winter	11.636	4.640
100 year +40% CC 2160 minute summer	12.120	3.350
100 year +40% CC 2160 minute winter	8.351	3.350
100 year +40% CC 2880 minute summer	9.908	2.656
100 year +40% CC 2880 minute winter	6.659	2.656
100 year +40% CC 4320 minute summer	7.312	1.912
100 year +40% CC 4320 minute winter	4.815	1.912

Rainfall

Event	Peak Intensity (mm/hr)	Average Intensity (mm/hr)
100 year +40% CC 5760 minute summer	5.909	1.513
100 year +40% CC 5760 minute winter	3.824	1.513
100 year +40% CC 7200 minute summer	4.942	1.261
100 year +40% CC 7200 minute winter	3.189	1.261
100 year +40% CC 8640 minute summer	4.257	1.086
100 year +40% CC 8640 minute winter	2.747	1.086
100 year +40% CC 10080 minute summer	3.751	0.957
100 year +40% CC 10080 minute winter	2.421	0.957

Results for 1 year Critical Storm Duration. Lowest mass balance: 99.21%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m^3)	Flood (m^3)	Status
30 minute winter	1	26	28.342	0.042	4.4	0.0000	0.0000	OK
30 minute winter	2	25	28.446	0.046	4.4	0.0519	0.0000	OK
30 minute winter	3	25	28.695	0.195	22.1	9.0988	0.0000	SURCHARGED
15 minute summer	4	9	29.167	0.067	17.7	0.1003	0.0000	OK
15 minute summer	5	9	29.168	0.068	17.7	0.1102	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m^3)	Discharge Vol (m^3)
30 minute winter	2	1.002	1	4.4	1.020	0.175	0.0216	16.0
30 minute winter	3	Hydro-Brake®	2	4.4				
15 minute summer	4	2.000	3	17.8	1.059	0.197	0.3734	
15 minute summer	5	1.000	3	17.8	1.055	0.198	0.3781	

Results for 30 year Critical Storm Duration. Lowest mass balance: 99.21%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
30 minute winter	1	29	28.345	0.045	4.9	0.0000	0.0000	OK
30 minute winter	2	29	28.449	0.049	4.9	0.0549	0.0000	OK
60 minute winter	3	58	28.948	0.448	34.3	32.9770	0.0000	SURCHARGED
15 minute summer	4	9	29.209	0.109	43.5	0.1628	0.0000	OK
15 minute summer	5	9	29.210	0.110	43.5	0.1791	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)
30 minute winter	2	1.002	1	4.9	1.048	0.194	0.0234	39.4
60 minute winter	3	Hydro-Brake®	2	4.9				
15 minute summer	4	2.000	3	43.6	1.535	0.482	0.5891	
15 minute summer	5	1.000	3	43.6	1.530	0.485	0.5966	

Results for 100 year Critical Storm Duration. Lowest mass balance: 99.21%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m^3)	Flood (m^3)	Status
60 minute summer	1	35	28.345	0.045	4.9	0.0000	0.0000	OK
30 minute winter	2	19	28.449	0.049	4.9	0.0549	0.0000	OK
60 minute winter	3	59	29.104	0.604	44.9	47.6083	0.0000	SURCHARGED
15 minute summer	4	9	29.234	0.134	56.3	0.2000	0.0000	OK
15 minute summer	5	9	29.235	0.135	56.3	0.2199	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m^3)	Discharge Vol (m^3)
30 minute winter	2	1.002	1	4.9	1.048	0.194	0.0234	51.5
60 minute winter	3	Hydro-Brake®	2	4.9				
15 minute summer	4	2.000	3	56.0	1.660	0.620	0.6451	
15 minute summer	5	1.000	3	56.0	1.655	0.623	0.6532	

Results for 100 year +40% CC Critical Storm Duration. Lowest mass balance: 99.21%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute summer	1	10	28.345	0.045	4.9	0.0000	0.0000	OK
15 minute summer	2	10	28.449	0.049	4.9	0.0549	0.0000	OK
120 minute winter	3	116	29.694	1.194	38.2	75.9509	0.0000	SURCHARGED
120 minute winter	4	116	29.694	0.594	19.1	0.8837	0.0000	SURCHARGED
120 minute winter	5	116	29.694	0.594	19.1	0.9686	0.0000	SURCHARGED

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 summer	2	1.002	1	4.9	1.048	0.194	0.0234	49.1
120 minute winter	3	Hydro-Brake®	2	4.9				
120 minute winter	4	2.000	3	19.1	0.637	0.211	0.7954	
120 minute winter	5	1.000	3	19.1	0.637	0.212	0.8043	

Design Data

Downstream Defender®

Advanced Hydrodynamic Vortex Separator

The Downstream Defender® is an advanced hydrodynamic vortex separator for the effective and reliable removal of fine particles, oils and other floatable debris from surface water runoff.

Its innovative design delivers high efficiency across a wide range of flows in a much smaller footprint than conventional or other swirl-type devices and it is the perfect choice for any catchment likely to convey high quantities of contamination.

1. Access for removal of floatables and sediments.
2. Inlet pipe.
3. Inlet chute.
4. Centre shaft.
5. Dip plate.
6. Centre cone.
7. Benching skirt.
8. Floatables and oil storage.
9. Isolated sediment storage zone.
10. Outlet pipe.

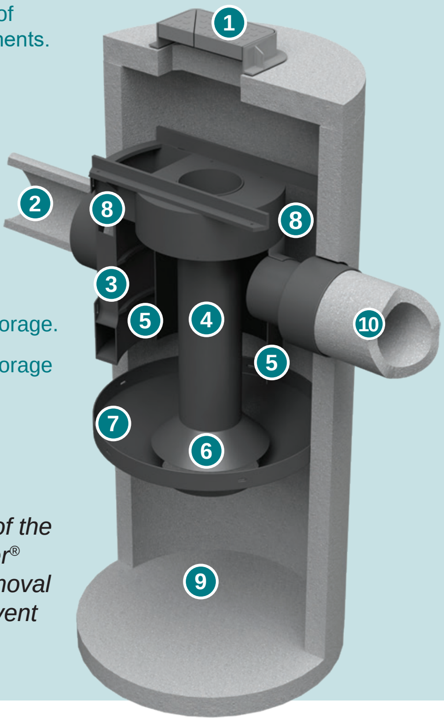


Figure 1 - The unique internal components of the Downstream Defender® enhance pollutant removal performance and prevent wash out.

Unique Flow Modifying Components

The Downstream Defender® consists of a choice of concrete or HDPE chamber with unique flow modifying internal components. It is these internal components that differentiate the Downstream Defender® from catchpits, sedimentation basins or sedimentation sumps. They facilitate advanced hydrodynamic vortex separation by reducing turbulence, lengthening the flow path to increase chamber residence time and introducing shear planes.

The internal components also ensure that the pollutant storage zones are isolated and protected from high flows that could cause pollutant re-entrainment or wash out.

Compared to devices that have poorly designed internal components, the Downstream Defender® captures and retains more of the annual pollutant load.

Watch a short video showing the Downstream Defender® components and operation at:

http://www.hydro-int.com/en-gb/products/downstream-defender-0

Repeatable, reliable performance

The Downstream Defender® delivers high removal of pollutants through advanced, hydrodynamic separation across a wide range of flows. The device has a proven track record of tackling an assortment of pollutants including:

Sediment (or Total Suspended Solids)

The Downstream Defender® is a highly effective sediment/TSS removal device. It can be sized in a number of ways to suit the application and level of protection required (see Table 1).

Gross Pollutants

100% removal of floatable debris, such as food wrappers, Styrofoam cups and drinks cartons

Liquid Hydrocarbons

Effective spill containment device that meets the BS EN 858-1:2002 Class I and Class II effluent targets at low flow rates. Note these systems are not considered oil separators according to the BS EN 858-1 and must not be used in applications where full certification is required.

Sediment Bound Hydrocarbons (including Polycyclic Aromatic Hydrocarbons - PAHs)

PAHs have low solubility in water and are readily adsorbed onto sediment particles. Effective removal of sediment particles will also ensure the removal of many PAHs.

Sediment Bound Heavy Metals and Nutrients

Heavy Metals **Nutrients**

As an efficient device for removal of fine sediment, the Downstream Defender® is also effective for the removal of sediment bound pollutants.

No Risk of Pollutant Wash Out

The Downstream Defender® has been specially designed to isolate the pollutant storage zones and is proven to prevent pollutant wash out.

The Simple Index Approach (SIA)

The Simple Index Approach outlined in CIRIA C753 The SuDS Manual is a water quality design method for sites with a low to medium risk pollution hazard level. Sites with a high risk pollution hazard level should consider a more precautionary approach.

The approach assigns pollution hazard indices to the given land use for three pollutant groups, total suspended solids (TSS), metals and hydrocarbons. SuDS components are then selected until their combined pollution mitigation index score is greater than the pollution hazard index for each pollutant group.

Downstream Defender® SuDS Mitigation Indices		
Total Suspended Solids (TSS)	**Metals**	**Hydrocarbons**
0.5	0.4	0.8

Notes:
(a) All mitigation indices supplied by Hydro International Ltd are independently verified and calculated using the methods laid out in the British Water How To Guide: Applying the CIRIA SuDS Manual Simple Index Approach to Proprietary / Manufactured Stormwater Treatment Devices. Performance declarations are available on request or on the British Water website.

Table 1 - SuDS Mitigation Indices for Downstream Defender®.

Sizing

The Downstream Defender® can be sized for different treatment goals and objectives. For design purposes, the selected model's Treatment Flow Rate should be greater than or equal to the site's Water Quality Flow Rate.

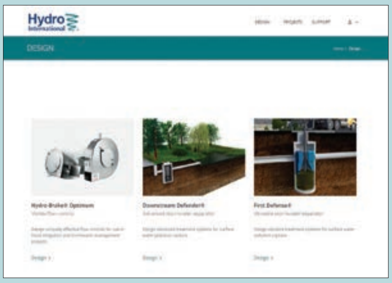
The hydraulic capacity of the selected model should be considered with respect to the peak discharge flow rate from the site.

If there is no treatment objective, just betterment, do not use a treatment flow rate and only compare the hydraulic capacity to the peak discharge flow rate.

Model Diameter (m)	Treatment Flow Rate - Fine (a)(b) (l/s)	Hydraulic Capacity (c) (l/s)	Minimum Oil Storage Capacity (l)	Minimum Sediment Storage Capacity (d) (m^3)	Maximum Headloss at Treatment Flow Rate (mm)
1.2	30	120	283	0.39	150
1.8	69	270	1356	0.73	225
2.55	138	542	2535	2.89	300
3.0	190	750	4693	3.10	375

Notes:
(a) Treatment Flow Rate - Fine is based on an annualised removal efficiency of >50% of all particles up to 1000 microns with a mass-median particle size (D50) of 75 microns and a specific gravity of 2.65. The test procedure is WRc approved and in line with the British Water Code of Practice.
(b) Alternative sizing based on different sediment grades available on request.
(c) Maximum flow rate that can pass through the chamber with a maximum headloss of 500mm.
(d) Additional sediment storage capacity can be provided to extend maintenance intervals if required.

Table 2 - Downstream Defender® design information.



Design a Downstream Defender® with our Online Design Tool

Our online design tool now enables you to design your own Downstream Defender® or First Defense® stormwater treatment separators as well as Hydro-Brake® Optimum.

The tool also allows you to save project designs and submit them to our expert technical team for a free design review.

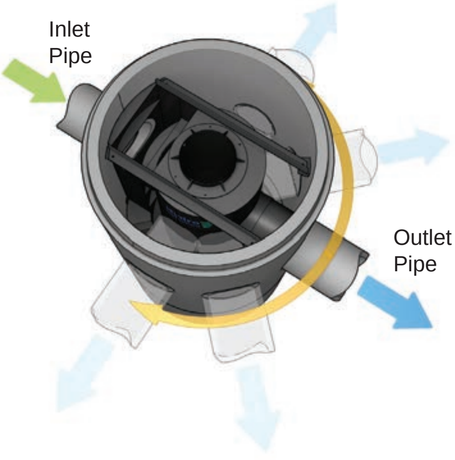
hydro-int.design

Setting out

The Downstream Defender® can accommodate a change in pipe direction to suit site specific requirements. Combined with the high rate internal bypass, this helps to avoid the need for additional manholes on site. Head loss across the chamber is kept to a minimum (see Table 2). The inlet and outlet pipes should be sized in accordance with Table 3 (opposite), and a minimum of 90 degrees between inlet and outlet is required.

Inlet and outlet pipe connections are at the same invert level.

Additional manhole sections can be provided to extend the chamber to meet site cover and invert levels or provide additional pollutant storage where required.



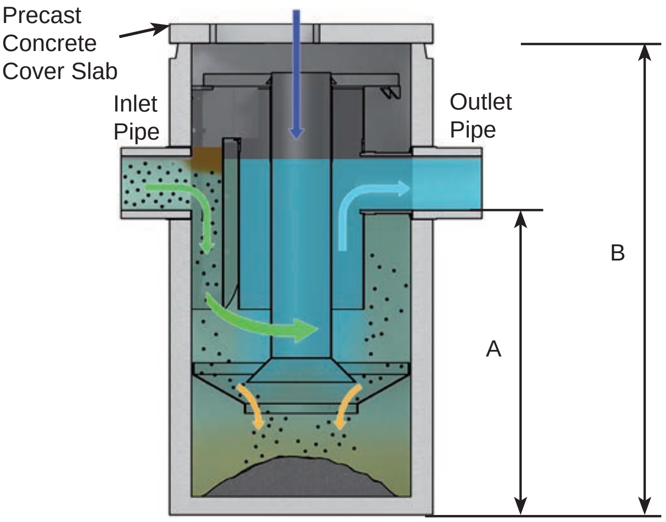
Dimensions and weights

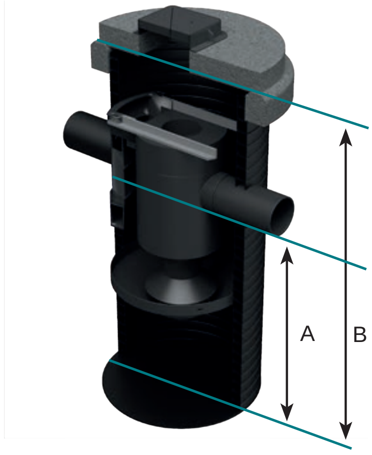
General arrangement drawings of all units are available for download from:
http://www.hydro-int.com/en-gb/products/downstream-defender-0

Model	Material	Chamber Diameter - Internal (mm)	Chamber Diameter - External (mm)	Inlet and Outlet ID (mm)	Depth to invert (m) (A) (1)	Chamber Depth (m) (B) (2)	Maximum Component Lift Weight (kg)
PQL1320.1000	Concrete	1200	1460	300	1.916	2.830	2200
PQL1320.1030	Concrete	1800	2160	450	2.495	4.029	5450
PQL1320.1060	Concrete	2550	2850	600	2.95	4.95	8700
PQL1320.1090	Concrete	3000	3350	750	3.12	5.20	12100
PQL1320.1020	HDPE Single Wall	1188	1200	300	1.55	2.3	140
PQL1320.1051	HDPE Single Wall	1776	1812	500	2.11	3.41	460
PQL1320.1081	HDPE Single Wall	2530	2570	600	2.94	4.8	900
PQL1320.1111	HDPE Single Wall	2974	3000	800	3.13	5.3	1300
PQL1320.1025	HDPE Twin Wall	1200	1300	300	1.56	2.22	400
PQL1320.1055	HDPE Twin Wall	1800	2200	560	2.467	3.75	1100

Notes:
1) Minimum depth to invert shown. Depth to invert can be increased if required.
2) Minimum chamber depth shown. Additional sediment storage capacity or increased depth to invert can be provided if required.

Table 3 - Downstream Defender® unit types, dimensions and weights.





Easy to install

The Downstream Defender® is delivered to site as a near finished manhole with internal components already installed. Installation is therefore similar to any other manhole installation on site. Full installation guidelines are available.

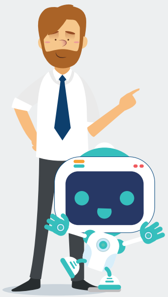
We can provide structural concrete systems for simple plug-and-play installation or choice of lightweight single and twin wall plastic chambers.

Simple, safe and cost-effective maintenance

Maintenance is carried out from the surface, using a standard vacuum tanker and personnel are not required to enter the device.

With a large capacity to store sediments and oils (see Table 2), and with a proven ability to prevent wash out, maintenance intervals can be years rather than months - depending on site conditions. The unit can also be fitted with a Hydro-Logic® Smart Monitoring system to alert the site operator when maintenance is required and provide peace of mind that the unit is operating normally at other times.

Additional pollutant storage can be built into the chamber to extend maintenance intervals if required.



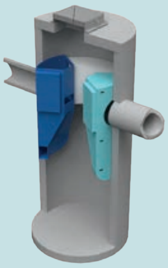
Make it Smart

Add Hydro-Logic® Smart Monitoring and your Downstream Defender® will let you know when it needs maintenance

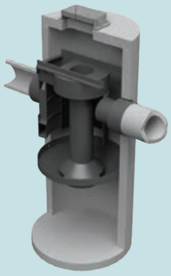
Get monitoring maintenance alerts from your Downstream Defender®
Save time and money by only visiting your Downstream Defender® when it actually needs emptying.

Our full range of surface water treatment devices

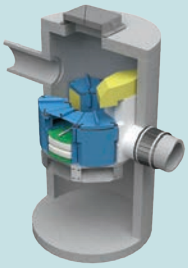
The Downstream Defender® is one of a range of surface water treatment devices. Each device delivers proven, measurable and repeatable surface water treatment performance. Each can be used independently to meet the specific needs of a site or combined to provide higher levels of treatment. They can be used alongside natural SuDS features to protect, enable or enhance them.



First Defense®
Vortex Separator



Downstream Defender®
Advanced Hydrodynamic
Vortex Separator



Up-Flo™ Filter
Fluidised Bed Up Flow
Filtration System

Hydro Biofilter™
Biofiltration System

Patent: www.hydro-int.com/patents

Appendix C: SuDS Maintenance

Project: Drainage and SUDS Maintenance, Old Coal Depot, Tavistock Rd, West Drayton, UB7 7RS

Project No: 2842-C-R02

Date: Apr 2024

Revision	Date	Author	Checker
-	26.04.24	AW	CA

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1.0 *General*

1.1 Sustainable Drainage Systems (SuDS) are an environmentally friendly approach to managing rainfall. SuDS techniques use landscape features to deal with surface water with the aim to:

1.1.1 Control the flow, volume and frequency of water leaving a development.

1.1.2 Prevent pollution by intercepting silt and cleaning runoff from hard surfaces.

1.1.3 Provide attractive surroundings for the community.

1.2 The surface water drainage strategy for this development utilises an attenuation tank, filter strip and oil interceptor as the main SUDS features. The following sections provides a brief description of these features and outlines the maintenance programme that should be adopted.

2.0 *Cleaning of the Drainage System*

2.1 Drainage systems should be inspected at regular intervals and where necessary, thoroughly cleaned out at the same time. Any defects discovered should be made good.

2.2 The following operations should be carried out during the periodic cleaning of a drainage system:-

Product Type	Period	Responsibility	Maintenance Methods
Silt Trap	As necessary and before wet season	Owner/ Maintenance company	• Sediment and debris that accumulated during summer needs to be removed before the wet season. • Inspect and clean out routinely prior to inlet pipework to minimise debris reaching the tank. • Conduct inspections more frequently during the wet season for the area where sediment or trash accumulates more often. Clean and repair as needed.
Standard Manholes/ Inspection Chambers	As necessary	Owner/ Maintenance Company	• Remove and clean any soil and vegetation that covers the manhole cover to prevent blockage of the drainage system at the manhole. • Renew/replace any damaged/missing bolts and damaged/missing manhole covers.

Product Type	Period	Responsibility	Maintenance Methods
Drainage Pipes	Six monthly interval	Owner/ Maintenance Company	• Inspect underground drainage pipes to ensure that the distribution pipework arrangement is operational and free from blockages. If required, take remedial action.
Filter Strip	As required	Owner/ Maintenance Company	• Inspect the surface after any precipitation to ensure no displacement of any organic matter onto the surface of the strip.
	Annually and after large storms	Owner/ Maintenance Company	• Inspection/check of all inlets to ensure that they are in good condition and operating as designed.
	Monthly for 3 months	Owner/ Maintenance Company	• Inspect and identify any areas that are not operating correctly. If required, take remedial action.
	Annually and after large storms	Owner/ Maintenance Company	• Inspection/check of all inlets to ensure that they are in good condition and operating as designed.
Hydrobrake	Monthly for 3 months	Owner/ Maintenance Company	• Inspect and identify any areas that are not operating correctly. If required, take remedial action.
	Monthly	Owner/ Maintenance Company	• Debris removal from catchment surface (where may cause risks to performance).
	Annually	Owner/ Maintenance Company	• Remove sediment from pre-treatment structures.
	Annually and after large storms	Owner/ Maintenance Company	• Inspection/check all inlets and outlets to ensure that they are in good condition and operating as designed.
Oil Interceptor	Monthly for 3 months	Owner/ Maintenance Company	• Inspect and identify any areas that are not operating correctly. If required, take remedial action.

Product Type	Period	Responsibility	Maintenance Methods
	Monthly	Owner/ Maintenance Company	- Debris removal from catchment surface (where may cause risks to performance).
	Annually	Maintenance Company	- Remove sediment and oil as required.
	Annually and after large storms	Maintenance Company	- Inspection/check all inlets and outlets to ensure that they are in good condition and operating as designed.
Attenuation Tank	As required	Owner/ Maintenance Company	- Inspect the surface after any precipitation to ensure no displacement of any organic matter onto the surface of the strip.
	Annually and after large storms	Owner/ Maintenance Company	- Inspection/check of all inlets to ensure that they are in good condition and operating as designed.
	Monthly for 3 months	Owner/ Maintenance Company	- Inspect and identify any areas that are not operating correctly. If required, take remedial action.
	Annually and after large storms	Owner/ Maintenance Company	- Inspection/check of all inlets to ensure that they are in good condition and operating as designed.

3.0 *Sketches and Plans*

3.1 The locations of the above features can be found by examining Drawing 2842/C01