# STOCKTON DRAINAGE STATEMENT

## CONDITION 20 (HANZARD DRIVE ROUNDABOUT & SECONDARY ACCESS ROAD BASINS, PHASE 2)

Document Ref: STO-ARC-XX-050-RP-CE-0013

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NOVEMBER 2023

# Version Control

| Issue | Revision No. | Date Issued | Page No. | Description | Reviewed By |
|---|---|---|---|---|---|
| 01 | P01 | 21.11.2023 | 9 | | David Ogden |
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# Contents

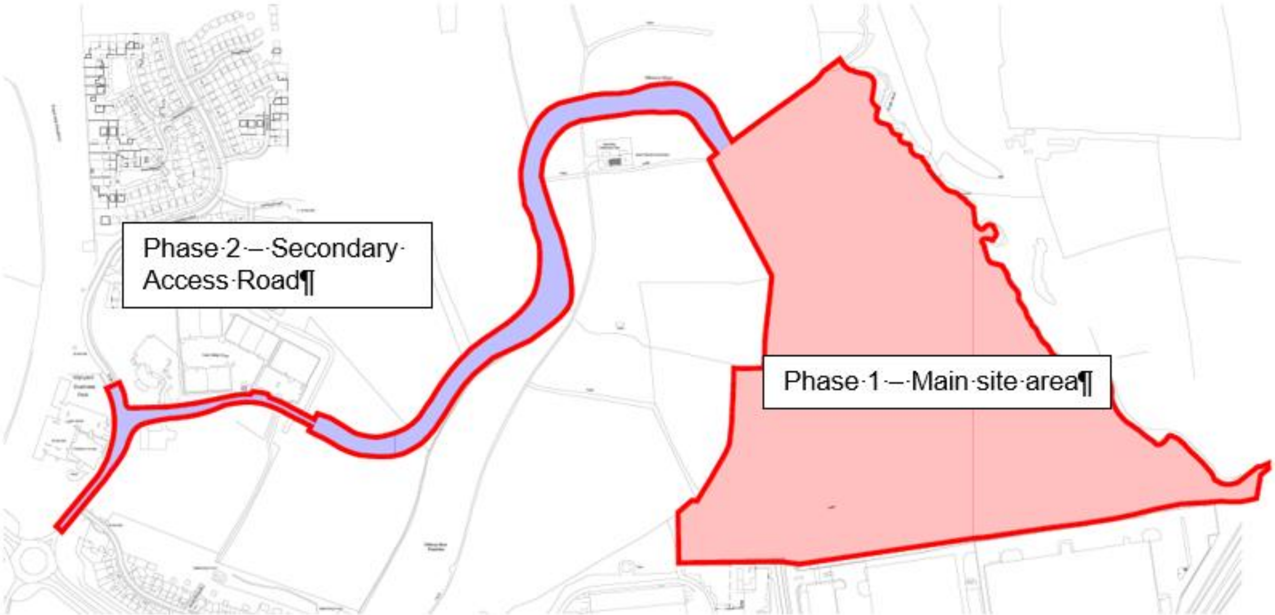


# Appendices

# 1 Introduction

1.1.1 Arcadis Consulting (UK) Limited has been commissioned by the Amazon UK Services Ltd to provide a surface water drainage strategy in support of a planning application for the formation of new access roads, associated ancillary works and new roundabout on the Land Northwest of Wynyard Business Park, Chapel Lane North, Wynyard.

1.1.2 This Drainage Statement has been prepared to set out the details of the highway surface water drainage in support of discharge of planning Condition 20 for the remaining extents of the application site, including the southern 200m of secondary access road, and the proposed junction improvements for Hanzard Drive / Glenarm Road. Phase 1 (the Site) and Phase 2 (the northern section of secondary access road) have been discharged previously. This is the remaining and outstanding section of new highway and part of existing Hanzard Drive/Glenarm Road that can be drained to the proposed attenuation basins. The catchment extends from the previously approved Phase 2 site boundary all the way along Glenarm Road to the proposed Hanzard Drive roundabout.




1.1.3 The purpose of the report is to provide details of the surface water drainage strategy to manage surface water runoff generated by the proposed southern section of the secondary access road and mitigation of any potential downstream impacts resulting from the provision.

1.1.4 This technical statement should be read in conjunction with Arcadis drawings STO-ARC-SW-XX-DR-CE-025 01 (Secondary Access Road Basins) and STO-ARC-SW-XX-DR-CE-0530 01 (Roundabout Drainage Plan), included within ***Appendix A.***

1.1.5 Drawing STO-ARC-XX-XX-DR-CE-0530 also shows the existing/proposed drainage within Glenarm Road and Hanzard Drive and adjacent development parcels that currently drains separately to any new proposed drainage within the secondary access road.

## 1.2 Conditions

1.2.1 Condition 20, as set out below require the details for the proposed drainage to be submitted for approval prior to commencement as well as the build programme and construction management plan.

1.2.2 This report seeks to provide the relevant details to discharge this condition in relation to the Secondary Access Road southern section.

*20 The development hereby approved shall not be commenced on site except piling, until a scheme for 'the implementation, maintenance and management of a Sustainable Surface Water Drainage Scheme has first been submitted to and approved in writing by the Local Planning Authority. The scheme shall be implemented and thereafter managed and maintained in accordance with the approved details, the scheme shall include but not be restricted to providing the following details;*

- *Detailed design of the surface water management system;*
- *A build programme and timetable for the provision of the critical surface water drainage infrastructure;*
- *A management plan detailing how surface water runoff from the site will be managed during the construction phase;*

## 1.3 Existing Site Description

1.3.1 The site is located approximately 3 miles north-west of Billingham, centred on National Grid Reference (NGR) 43755 26999. The site covers an area of approximately 0.9 hectares. The southern secondary access road will cross arable fields, connecting the main site with Glenarm Road. This is the outstanding section of Phase 2. The recently constructed Phase 2 section of highway was approved in February 2022:

1.3.2 The site is bound by Whinny Moor Plantation to the west and north, the North Burn River to the east and Glenarm Road to the west. A small unnamed tributary of the North Burn also runs on an east-west alignment in the south of the site.

1.3.3 The unnamed tributary is located along this field boundary adjacent to the wooded area and then flows across Whinney Moor Plantation and through the main site as shown on ***Figure 2*** below.

1.3.4 As set out within the Approved FRA, the site is underlain by clay and therefore infiltration is not feasible in this location and positive drainage is required.

1.3.5 The existing ground levels slope roughly from northwest to southeast, and an existing tributary runs along the boundary between the arable fields and the woodland area as shown on **Figure 2** below.

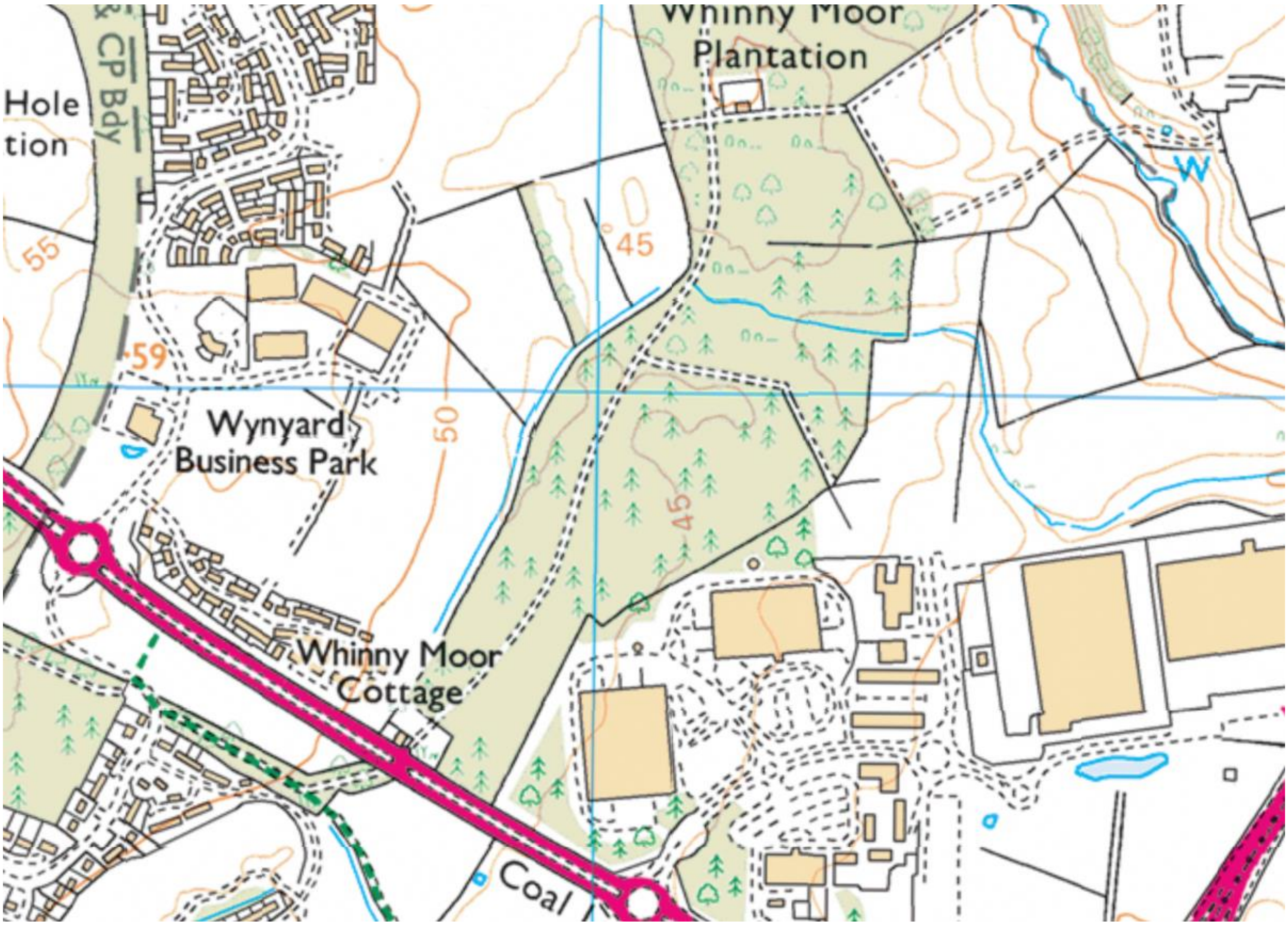



*Figure 2 – Existing Site*

## 1.4 Proposed Scheme

1.4.1 This report relates to the southern section of the secondary access road, which can be drained to the proposed attenuation basins shown. The catchment extends from the Phase 2 site boundary all the way to the proposed Hanzard Drive roundabout. Phase 1 & 2 drainage for Condition 20 was set out separately and approved.

1.4.2 The proposed highway is to be adopted by Stockton Borough Council Highways and as such has Technical Approval pending agreement for the final drainage proposals for the outstanding elements.

1.4.3 The total proposed new highway that will drain to the existing ditchcourse equates to 0.9ha impermeable area with the remaining extents of carriageway to the north draining into the already approved Phase 1 & 2 highway drainage (where appropriate allowance for attenuation was previously made)

1.4.4 As can be seen space within the planning extents is limited outside of the earthworks required to deliver the access road and is further constrained by the proximity of the existing ditchcourse and foul sewer.

# 2 Surface Water Drainage

## 2.1 Existing Surface Water Drainage Mechanisms

2.1.1 The existing drainage is outlined within the Flood Risk Assessment (Ref: STO-ARC-XX-XX-RP-CE-0001), with uncontrolled overland runoff discharging to the North Burn to the east and the tributary that crosses the site.

2.1.2 For the southern secondary access road levels generally fall to the eastern side of the site, towards the existing tributary that sits on the eastern boundary of the arable fields before cutting across the plantation to the main site.

2.1.3 There is currently minimal hardstanding within the site and therefore the existing Mean Annual Greenfield runoff rate has been calculated as 3.7l/s/ha.

2.1.4 Highway drainage and surface water runoff from the existing highways within the wider red line boundary, Glenarm Road and its junction with Hanzard Drive are managed by a private network of sewers as shown within ***Appendix A*** on Drawing STO-ARC-XX-XX-DR-CE-0530 – Roundabout Drainage Plan. This network drains runoff from these existing roads westwards along Glenarm Drive and away from the proposed southern secondary access road and is therefore currently managed separately to any new proposed drainage for new highways.

2.1.5 This existing network also manages runoff from several existing development parcels, before discharging into the existing ditch on the eastern edge of the site, slightly to the north of the route of Glenarm Road, bisecting the proposed highway.

## 2.2 Surface Water Drainage Strategy

2.2.1 Without appropriate control measures, the proposed development could increase the volume and rate of surface water runoff through the addition of impermeable surfaces of pavements and footways which limit infiltration. Storm water should be managed as close to source as possible and copy greenfield characteristics and minimise the amount of runoff transferred downstream.

2.2.2 The aim of this drainage strategy is to demonstrate the detailed drainage proposals for the development that meet the flood risk requirements of the Lead Local Flood Authority and the Council.

2.2.3 The drainage strategy is based on the approved scheme and agreed design principles as set out in the Flood Risk Assessment and includes proposals for a surface water drainage system based on SuDS principles, incorporating source control, ensuring that following large rainfall events the developed site presents no greater flood risk to the surrounding area than the predevelopment site.

2.2.4 The Surface water Drainage Strategy is set out on Drawing STO-ARC-XX-XX-DR-CE-0531-01 (Drainage Plan Basin Area) and STO-ARC-XX-XX-DR-CE-0514-01 (Glenarm Road Drainage Plan) as included in ***Appendix A***.

2.2.5 The total proposed new highway that drains to the existing watercourse equates to 0.9ha impermeable area, with the recently constructed extents of carriageway to the north draining into the already approved phase 1 & 2 highway drainage (where appropriate allowance for attenuation was previously made)

2.2.6 This report covers the southern section of secondary access road which can be drained to the proposed attenuation basins shown – approximately 0.28ha. The remaining 0.62ha of new/diverted impermeable highway at Hanzard Drive/Glenarm Road will be covered under a separate submission. See drawing STO-ARC-XX-XX-DR-CE-0537-01 (Catchment Plan) contained within **Appendix A**.

2.2.7 Runoff from the southern secondary access road will be managed in line with the requirements as set out within the Stockton-on-Tees Design Guide and Specification for Residential and Industrial Estates Development and appropriate drainage, attenuation and flow control will be provided as part of the infrastructure works.

2.2.8 Highway drainage within the new and existing road will be adopted by Stockton Borough Council Highways, however, the attenuation basins will be maintained by the Landowner.

2.2.9 As shown on drawing STO-ARC-XX-XX-DR-CE-0531-01 (Drainage Plan Basin Area) contained within ***Appendix A***, highway drainage will connect to the existing tributary that runs along the eastern edge of the site.

2.2.10 The 1 in 100 year rainfall event attenuation storage requirement (including an allowance for 40% climate change), is set out in ***Table 1*** below.

| Site | Area (m2) | Theoretical Discharge Rate (l/s) | Volume of Storage (m3) |
|---|---|---|---|
| Hanzard Drive (excluding Glenarm Rd Rdbt) | 2819.529 | 1.01 | 196.5 |
| Hanzard Drive + Glenarm Roundabout | 3782.239 | 1.36 | 256.6 |
| Glenarm Road | 3130.26 | 1.13 | 217.4 |
| 200m Secondary access south of the pipe crossing | 2820.139 | 1.01 | 196.5 |
| | | | |
| Total | 9732.638 | 5.50 | 670.5 |

*Table 1*

2.2.11 As shown on drawing STO-ARC-XX-XX-DR-CE-0525-01 (Secondary Access Road Basins GA) contained within ***Appendix A***, attenuation for the southern part of the secondary access road will be provided within a basin to be managed and maintained by Wynyard Park; this has been agreed with the Highway Authority.

2.2.12 Micro-drainage Calculations and Standard Details are included within ***Appendix B***.

## 2.3 Attenuation

2.3.1 Attenuation will be provided in three basins as shown on drawing STO-ARC-SW-XX-DR-CE-0525-01 (Secondary Access Road Basins GA) contained within ***Appendix A***.

2.3.2 The area available for the basins is extremely constrained by an existing foul sewer and easement and adjacent drainage ditch, however, it is still feasible to provide 1 in 3 side slopes for the basins, with a maximum water depth in the 1 in 100 year rainfall event (including an allowance for 40% climate change) of approximately 1.3m. This also conforms with the basin design parameters for the nearby recent basins on the Secondary Access Road and the NCL2 development. Water depths are confirmed on drawing STO-ARC-SW-XX-DR-CE-0525-01 (Secondary Access Road Basins GA) contained within Appendix A. A minimum of 300mm freeboard has been provided above the top design water level and the 3m wide grasscrete maintenance track is located above this level to allow for ease of access and maintenance in all events.

2.3.3 Wildflower meadow mix planting is proposed in this area.

2.3.4 A basin design Checklist and Health and Safety risk assessment, in line with the CIRIA SUDS Manual (C753) have been undertaken and are contained within ***Appendix B***.

2.3.5 Access chambers are located within wheel tracks within running lanes and control chambers will be located within the highway verge for ease of access and maintenance.

2.3.6 The outfall from the basin will be managed and maintained by Wynyard Business Park.

### Outfall from Basin

2.3.7 The basin outfall level is proposed at a level of 44.26m AOD. As with other basins around the development the base of the basin will be slightly lower to allow for sedimentation and vegetation.

2.3.8 The basin will discharge via a new headwall into the existing unnamed ditch tributary.

## 2.4 Pollution Control

2.4.1 Trapped gullies are proposed for intercepting surface water runoff from the carriageway, cycleway and footway, drainage areas not exceeding 200m².

## 2.5 Exceedance Event and Residual Risk

2.5.1 The proposed drainage system has been designed to accommodate flows resulting from the 1 in 100-year storm event including an allowance for climate change. In the case of exceedance events beyond this design return period, surface water could result in overland flows.

2.5.2 Where surface water runoff may exceed the capacity of the piped network, external areas are designed to slope towards open green spaces, as existing, towards the attenuation facilities proposed.

2.5.3 A minimum of 300mm freeboard has been provided within these attenuation basins to accommodate additional storage in the event of a blockage at the control or higher order rainfall events.

## 2.6 Maintenance and Adoption

2.6.1 Control chambers will be located within the highway verge for ease of access and maintenance.

2.6.2 A separate and updated Drainage Management Plan and Maintenance Schedule will be prepared and submitted for agreement as part of discharge of Condition 21 (Preoccupation) and maintenance will be undertaken by Wynyard Park in line with the existing basins across the development.

2.6.3 As noted above, highway drainage will be maintained by the Landowner until such time as the highways are offered for adoption, at which stage this will become adopted and maintained by Stockton Borough Council under a S38 Agreement.

2.6.4 The Basins themselves will remain private, being maintained by Wynyard Park in line with the existing basins across the development.

## 2.7 Build Programme and Timetable

2.7.1 The attenuation basins will be constructed first and used as surface water management during construction of the highway, in advance of the outfalls being constructed into the existing tributary.

2.7.2 Gully pots will be the final items to be installed, connecting into the highway piped drainage before surfacing of these areas.

# 3 Conclusion

3.1.1 This Drainage Statement has been prepared to set out the details of the highway surface water drainage in support of discharge of Conditions 20 (for the secondary access road, southern section)

3.1.2 Details for the surface water drainage for Phase 1 & 2 of the completed Commercial Development at land in Wynyard Business Park, in support of discharge of Conditions 20 (Drainage), have been set out separately and approved.

3.1.3 The purpose of the report is to provide details of the surface water drainage strategy to manage surface water runoff generated by the proposed secondary access road southern section and mitigation of any potential downstream impacts resulting from the provision.

3.1.4 Surface water runoff will be managed and attenuated onsite for up to and including the 1 in 100 year rainfall event including an allowance for 40% climate change. Details of the proposed attenuation basins and outfall have been provided.

3.1.5 The drainage proposals outlined within this report above along will satisfactorily cater for the surface water generated by the proposed development, as agreed with the Highway Authority.

3.1.6 The surface water drainage strategy will ensure that following redevelopment of the site, there will be no significant adverse impact on flood risk in the local area due to surface water runoff.

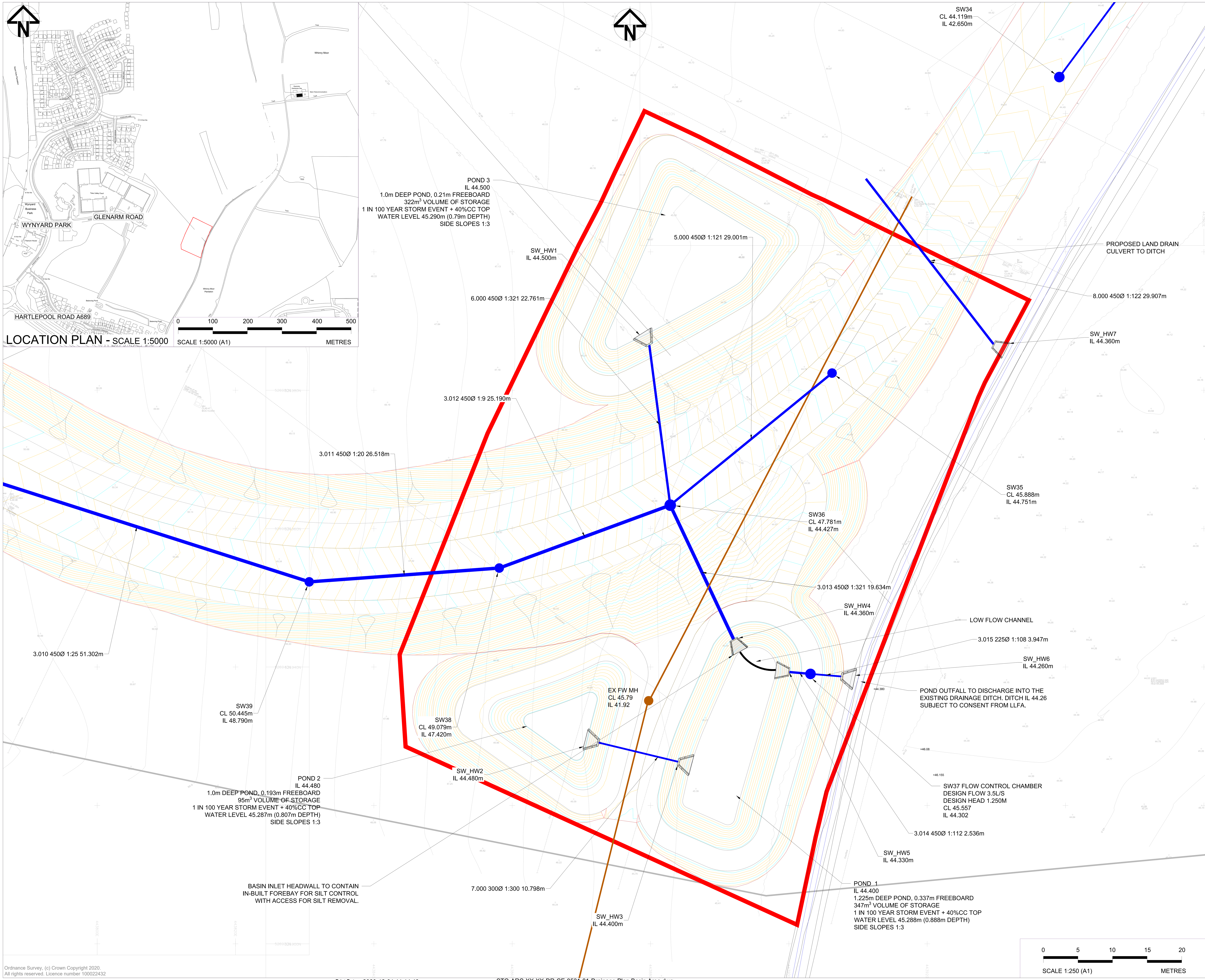
3.1.7 Proposals for pollution control have also been set out and ongoing maintenance will be undertaken by Wynyard Park in line with the agreed approach for the existing basins across the site.

# Appendix A

**Drawing STO-ARC-XX-XX-DR-CE-0531-01 (Drainage Plan Basin Area),**

**Drawing STO-ARC-XX-XX-DR-CE-0525-01 (Secondary Access Road Basins GA)**

**Drawing STO-ARC-XX-XX-SK-CE-0530-01 (Roundabout Drainage Plan)**




NOTES:

1. DO NOT SCALE FROM THIS DRAWING, USE FIGURE DIMENSIONS ONLY.
2. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ALL RELEVANT ARCHITECTS & ENGINEERS DRAWINGS AND SPECIFICATIONS.

LEGEND:

- PLANNING BOUNDARY
- PROPOSED SURFACE WATER MANHOLE
- PROPOSED SURFACE WATER PIPE
- PROPOSED FOUL WATER MANHOLE
- PROPOSED FOUL WATER PIPE
- PROPOSED HEADWALL

| Rev | Date | Description | Drawn | Check | Approv |
|---|---|---|---|---|---|
| 01 | 17/11/23 | FIRST ISSUE | BA | DO | MD |

Client Amazon UK Services LTD

PROJECT: STOCKTON

| Site | Client |
|---|---|
| Chapel Lane North Stockton-on-Tees | Amazon UK Services Ltd |

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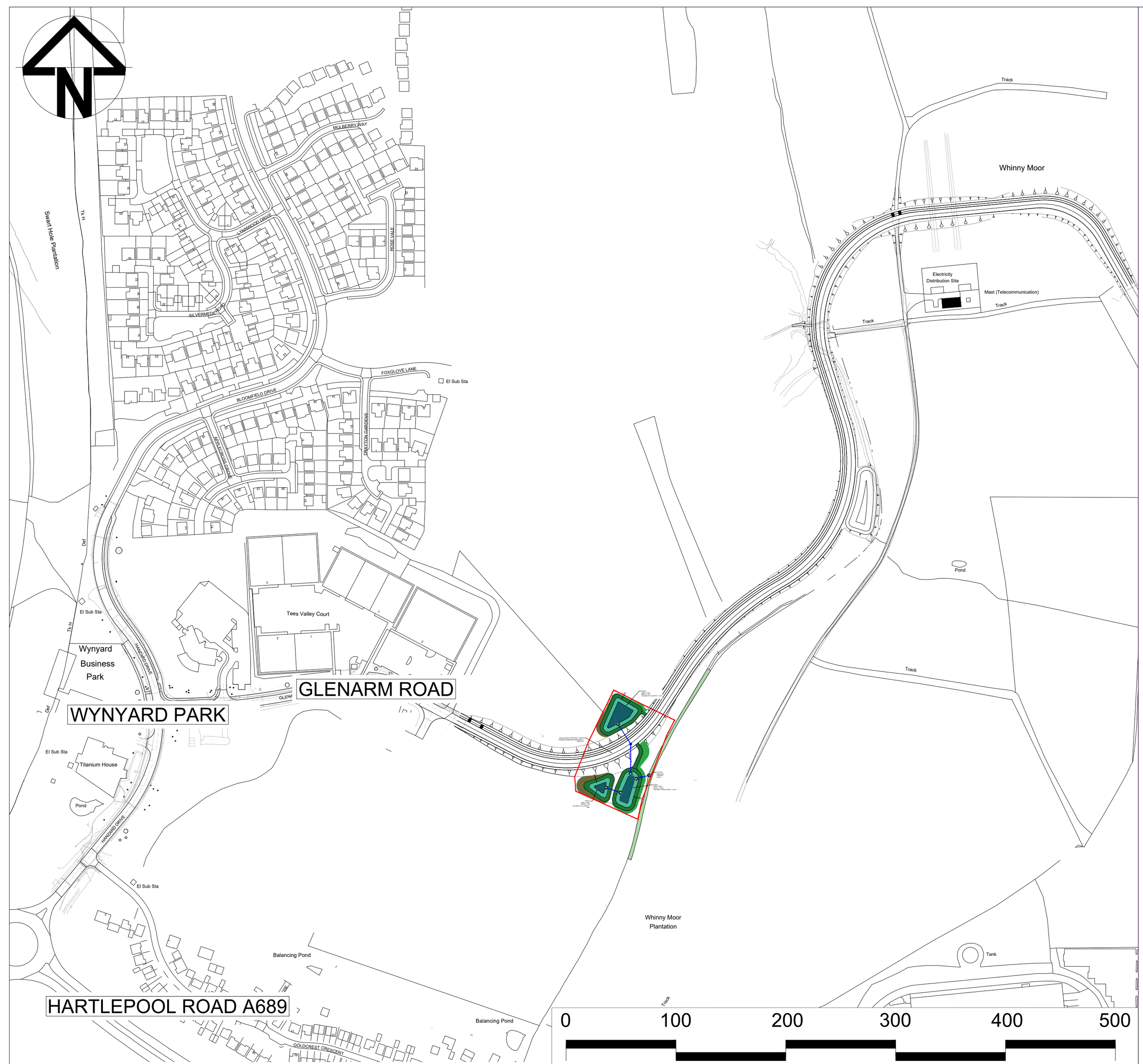
TITLE:

DRAINAGE PLAN BASIN AREA

| | | | |
|---|---|---|---|
| Designed | D.DOYLE | Signed | Date 22/11/2023 |
| Drawn | D.DOYLE | Signed | Date 22/11/2023 |
| Checked | D.OGDEN | Signed | Date 22/11/2023 |
| Approved | M.DAVIES | Signed | Date 22/11/2023 |
| Scale: | 1:250 | Datum: | ODN |
| Original Size: | A1 | Grid: | OS |
| Suitability Code: | S2 | Project Number: | 10042440 |

Suitability Description:
PRELIMINARY
NOT TO BE USED FOR CONSTRUCTION

Drawing Number: STO-ARC-XX-XX-DR-CE-0531 Revision: 01



LOCATION PLAN - SCALE 1:5000


NOTES:

1. DO NOT SCALE FROM THIS DRAWING, USE FIGURE DIMENSIONS ONLY.
2. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ALL RELEVANT ARCHITECTS & ENGINEERS DRAWINGS AND SPECIFICATIONS.

LEGEND:

- PLANNING BOUNDARY
- FILL AREA
- CUT AREA
- MAINTENANCE STRIP
- POND SIDE SLOPE
- BASE OF POND
- EXISTING DITCH

| Rev | Date | Description | Drawn | Check | Approv |
|---|---|---|---|---|---|
| 01 | 20/11/23 | FIRST ISSUE | BA | DO | MD |

Client
Amazon UK Services Ltd

PROJECT:
STOCKTON

Site
Chapel Lane North
Stockton-on-Tees

Client
Amazon UK Services Ltd

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Bristol BS2 0FR
Tel: : +44 (0)11 7372 1200

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TITLE:

POND AREAS
GENERAL ARRANGEMENT

| | | | |
|---|---|---|---|
| Designed | B.ALLEN | Signed | Date 20/11/2023 |
| Drawn | B.ALLEN | Signed | Date 20/11/2023 |
| Checked | D.OGDEN | Signed | Date 20/11/2023 |
| Approved | M.DAVIES | Signed | Date 20/11/2023 |
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Suitability Description:
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Revision: 01



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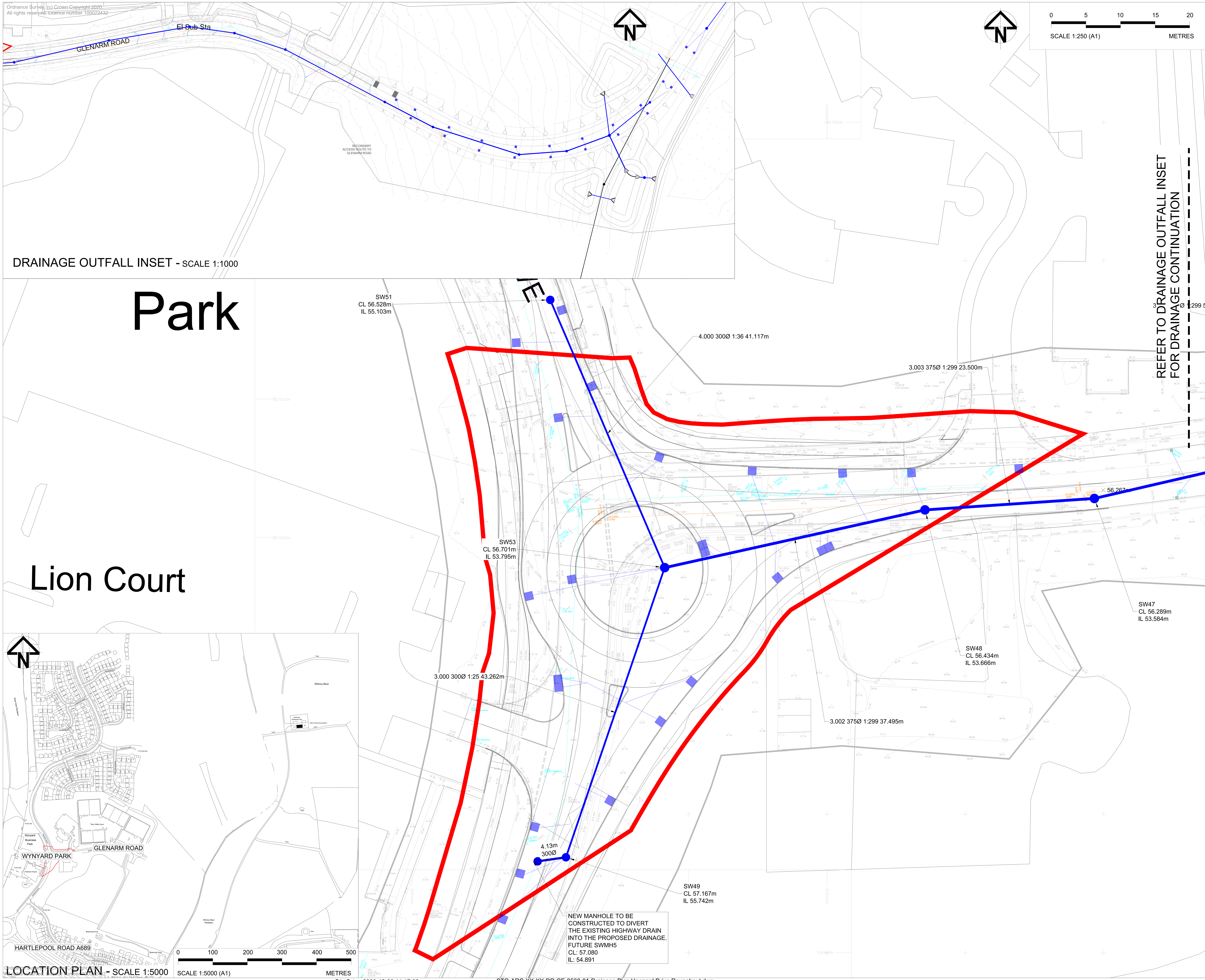


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NOTES:

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2. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ALL RELEVANT ARCHITECTS & ENGINEERS DRAWINGS AND SPECIFICATIONS.

LEGEND:

- PLANNING BOUNDARY
- PROPOSED SURFACE WATER MANHOLE
- PROPOSED SURFACE WATER PIPE
- PROPOSED GULLY
- EXISTING SURFACE WATER DRAINAGE
- EXISTING FOUL WATER DRAINAGE
- REDUNDANT EXISTING DRAINAGE TO BE GROUTED OR REMOVED

| Rev | Date | Description | Drawn | Check | Approv |
|---|---|---|---|---|---|
| 01 | 17/11/23 | FIRST ISSUE | DD | DO | MD |

Client
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PROJECT:
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TITLE:

DRAINAGE PLAN
HANZARD DRIVE ROUNDABOUT

| | | | |
|---|---|---|---|
| Designed | D.DOYLE | Signed | Date 22/11/2023 |
| Drawn | D.DOYLE | Signed | Date 22/11/2023 |
| Checked | D.OGDEN | Signed | Date 22/11/2023 |
| Approved | M.DAVIES | Signed | Date 22/11/2023 |
| Scale: | 1:250 | Datum: | ODN |
| Original Size: | A1 | Grid: | OS |
| Suitability Code: | S2 | Project Number: | 10042440 |

Suitability Description:
PRELIMINARY
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Drawing Number: STO-ARC-XX-XX-DR-CE-0530
Revision: 01

# Appendix B

**Microdrainage Calculations – 1 in 100 year +40% CC**

**Drawing STO-ARC-XX-XX-DR-CE-0537-01 Catchment Plan**

**Drawing STO-ARC-XX-XX-DR-CE-0509-02 S38 Highway Drainage Standard Details Sheet 2**

**C753 Basin Design Assessment Checklist**

**C753 Basin Health and Safety Risk Assessment**

## STORM SEWER DESIGN by the Modified Rational Method

### Design Criteria for Storm

Pipe Sizes STANDARD Manhole Sizes STANDARD

FSR Rainfall Model - England and Wales

| | | | |
|---|---|---|---|
| Return Period (years) | 100 | PIMP (%) | 90 |
| M5-60 (mm) | 19.000 | Add Flow / Climate Change (%) | 0 |
| Ratio R | 0.400 | Minimum Backdrop Height (m) | 0.200 |
| Maximum Rainfall (mm/hr) | 50 | Maximum Backdrop Height (m) | 1.500 |
| Maximum Time of Concentration (mins) | 30 | Min Design Depth for Optimisation (m) | 1.200 |
| Foul Sewage (l/s/ha) | 0.000 | Min Vel for Auto Design only (m/s) | 1.00 |
| Volumetric Runoff Coeff. | 0.750 | Min Slope for Optimisation (1:X) | 500 |

Designed with Level Soffits

### Network Design Table for Storm

# - Indicates pipe length does not match coordinates
« - Indicates pipe capacity < flow

| PN | Length (m) | Fall (m) | Slope (1:X) | I.Area (ha) | T.E. (mins) | Base Flow (l/s) | k (mm) | HYD SECT | DIA (mm) | Section Type | Auto Design |
|---|---|---|---|---|---|---|---|---|---|---|---|
| S3.000 | 25.341 | 0.170 | 149.1 | 0.119 | 10.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | |
| S3.001 | 20.087 | 1.627 | 12.3 | 0.054 | 0.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | |
| S4.000 | 17.843 | 0.120 | 148.7 | 0.054 | 10.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | |
| S4.001 | 24.295 | 1.083 | 22.4 | 0.028 | 0.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | |
| S3.002 | 38.573 | 0.129 | 299.0 | 0.086 | 0.00 | 0.0 | 0.600 | o | 375 | Pipe/Conduit | |
| S3.003 | 24.517 | 0.082 | 299.0 | 0.032 | 0.00 | 0.0 | 0.600 | o | 375 | Pipe/Conduit | |
| S3.004 | 52.742 | 0.176 | 299.7 | 0.065 | 0.00 | 0.0 | 0.600 | o | 375 | Pipe/Conduit | |
| S3.005 | 50.814 | 0.182 | 279.2 | 0.032 | 0.00 | 0.0 | 0.600 | o | 375 | Pipe/Conduit | |

### Network Results Table

| PN | Rain (mm/hr) | T.C. (mins) | US/IL (m) | Σ I.Area (ha) | Σ Base Flow (l/s) | Foul (l/s) | Add Flow (l/s) | Vel (m/s) | Cap (l/s) | Flow (l/s) |
|---|---|---|---|---|---|---|---|---|---|---|
| S3.000 | 50.00 | 10.40 | 55.742 | 0.119 | 0.0 | 0.0 | 0.0 | 1.07 | 42.5 | 16.1 |
| S3.001 | 50.00 | 10.48 | 55.572 | 0.173 | 0.0 | 0.0 | 0.0 | 3.74 | 148.9 | 23.4 |
| S4.000 | 50.00 | 10.28 | 55.103 | 0.054 | 0.0 | 0.0 | 0.0 | 1.07 | 42.5 | 7.3 |
| S4.001 | 50.00 | 10.42 | 54.983 | 0.082 | 0.0 | 0.0 | 0.0 | 2.77 | 110.3 | 11.1 |
| S3.002 | 50.00 | 11.10 | 53.795 | 0.341 | 0.0 | 0.0 | 0.0 | 1.04 | 115.1 | 46.2 |
| S3.003 | 50.00 | 11.49 | 53.666 | 0.374 | 0.0 | 0.0 | 0.0 | 1.04 | 115.2 | 50.6 |
| S3.004 | 50.00 | 12.34 | 53.584 | 0.438 | 0.0 | 0.0 | 0.0 | 1.04 | 115.0 | 59.4 |
| S3.005 | 50.00 | 13.12 | 53.408 | 0.471 | 0.0 | 0.0 | 0.0 | 1.08 | 119.2 | 63.7 |

## Network Design Table for Storm

| PN | Length (m) | Fall (m) | Slope (1:X) | I.Area (ha) | T.E. (mins) | Base Flow (l/s) | k (mm) | HYD SECT | DIA (mm) | Section Type | Auto Design |
|---|---|---|---|---|---|---|---|---|---|---|---|
| S3.006 | 26.285 | 0.285 | 92.2 | 0.043 | 0.00 | 0.0 | 0.600 | o | 375 | Pipe/Conduit | |
| S3.007 | 30.944 | 0.648 | 47.8 | 0.043 | 0.00 | 0.0 | 0.600 | o | 375 | Pipe/Conduit | |
| S3.008 | 64.969 | 0.848 | 76.6 | 0.066 | 0.00 | 0.0 | 0.600 | o | 375 | Pipe/Conduit | |
| S3.009 | 31.389 | 0.510 | 61.5 | 0.038 | 0.00 | 0.0 | 0.600 | o | 450 | Pipe/Conduit | |
| S3.010 | 52.338 | 2.070 | 25.3 | 0.054 | 0.00 | 0.0 | 0.600 | o | 450 | Pipe/Conduit | |
| S3.011 | 27.603 | 1.370 | 20.1 | 0.054 | 0.00 | 0.0 | 0.600 | o | 450 | Pipe/Conduit | |
| S3.012 | 26.271 | 3.033 | 8.7 | 0.027 | 0.00 | 0.0 | 0.600 | o | 450 | Pipe/Conduit | |
| S5.000 | 30.197 | 0.151 | 200.0 | 0.081 | 10.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | |
| S6.000 | 51.000 | 0.113 | 450.0 | 0.000 | 10.00 | 0.0 | 0.600 | o | 450 | Pipe/Conduit | |
| S3.013 | 25.026 | 0.070 | 357.5 | 0.030 | 0.00 | 0.0 | 0.600 | o | 450 | Pipe/Conduit | |
| S3.014 | 10.512 | 0.080 | 131.4 | 0.000 | 0.00 | 0.0 | 0.600 | o | 450 | Pipe/Conduit | |
| S7.000 | 16.000# | 0.046 | 347.8 | 0.000 | 10.00 | 0.0 | 0.600 | o | 450 | Pipe/Conduit | |
| S3.015 | 7.459 | 0.140 | 53.3 | 0.000 | 0.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | |

## Network Results Table

| PN | Rain (mm/hr) | T.C. (mins) | US/IL (m) | Σ I.Area (ha) | Σ Base Flow (l/s) | Foul (l/s) | Add Flow (l/s) | Vel (m/s) | Cap (l/s) | Flow (l/s) |
|---|---|---|---|---|---|---|---|---|---|---|
| S3.006 | 50.00 | 13.35 | 53.226 | 0.514 | 0.0 | 0.0 | 0.0 | 1.89 | 208.4 | 69.6 |
| S3.007 | 50.00 | 13.55 | 52.941 | 0.557 | 0.0 | 0.0 | 0.0 | 2.63 | 290.2 | 75.4 |
| S3.008 | 50.00 | 14.07 | 52.293 | 0.623 | 0.0 | 0.0 | 0.0 | 2.07 | 228.8 | 84.3 |
| S3.009 | 50.00 | 14.27 | 51.370 | 0.661 | 0.0 | 0.0 | 0.0 | 2.60 | 412.7 | 89.5 |
| S3.010 | 50.00 | 14.49 | 50.860 | 0.715 | 0.0 | 0.0 | 0.0 | 4.06 | 645.1 | 96.8 |
| S3.011 | 50.00 | 14.59 | 48.790 | 0.769 | 0.0 | 0.0 | 0.0 | 4.55 | 722.9 | 104.1 |
| S3.012 | 50.00 | 14.65 | 47.420 | 0.796 | 0.0 | 0.0 | 0.0 | 6.94 | 1103.7 | 107.7 |
| S5.000 | 50.00 | 10.45 | 44.751 | 0.081 | 0.0 | 0.0 | 0.0 | 1.11 | 78.3 | 11.0 |
| S6.000 | 50.00 | 10.89 | 44.500 | 0.000 | 0.0 | 0.0 | 0.0 | 0.95 | 151.4 | 0.0 |
| S3.013 | 50.00 | 15.04 | 44.450 | 0.907 | 0.0 | 0.0 | 0.0 | 1.07 | 170.1 | 122.8 |
| S3.014 | 50.00 | 15.14 | 44.380 | 0.907 | 0.0 | 0.0 | 0.0 | 1.77 | 281.8 | 122.8 |
| S7.000 | 50.00 | 10.25 | 44.480 | 0.000 | 0.0 | 0.0 | 0.0 | 1.08 | 172.5 | 0.0 |
| S3.015 | 50.00 | 15.21 | 44.400 | 0.907 | 0.0 | 0.0 | 0.0 | 1.80 | 71.4« | 122.8 |

## Area Summary for Storm

| Pipe Number | PIMP Type | PIMP Name | PIMP (%) | Gross Area (ha) | Imp. Area (ha) | Pipe Total (ha) |
|---|---|---|---|---|---|---|
| 3.000 | - | - | 90 | 0.132 | 0.119 | 0.119 |
| 3.001 | - | - | 90 | 0.060 | 0.054 | 0.054 |
| 4.000 | - | - | 90 | 0.060 | 0.054 | 0.054 |
| 4.001 | - | - | 90 | 0.031 | 0.028 | 0.028 |
| 3.002 | - | - | 90 | 0.096 | 0.086 | 0.086 |
| 3.003 | - | - | 90 | 0.036 | 0.032 | 0.032 |
| 3.004 | - | - | 90 | 0.072 | 0.065 | 0.065 |
| 3.005 | - | - | 90 | 0.036 | 0.032 | 0.032 |
| 3.006 | - | - | 90 | 0.048 | 0.043 | 0.043 |
| 3.007 | - | - | 90 | 0.048 | 0.043 | 0.043 |
| 3.008 | - | - | 90 | 0.073 | 0.066 | 0.066 |
| 3.009 | - | - | 90 | 0.042 | 0.038 | 0.038 |
| 3.010 | - | - | 90 | 0.060 | 0.054 | 0.054 |
| 3.011 | - | - | 90 | 0.060 | 0.054 | 0.054 |
| 3.012 | - | - | 90 | 0.030 | 0.027 | 0.027 |
| 5.000 | - | - | 90 | 0.090 | 0.081 | 0.081 |
| 6.000 | - | - | 90 | 0.000 | 0.000 | 0.000 |
| 3.013 | User | - | 100 | 0.030 | 0.030 | 0.030 |
| 3.014 | - | - | 90 | 0.000 | 0.000 | 0.000 |
| 7.000 | - | - | 90 | 0.000 | 0.000 | 0.000 |
| 3.015 | - | - | 90 | 0.000 | 0.000 | 0.000 |
| | | | | Total | Total | Total |
| | | | | 1.004 | 0.907 | 0.907 |

## Free Flowing Outfall Details for Storm

| Outfall Pipe Number | Outfall Name | C. Level (m) | I. Level (m) | Min I. Level (m) | D,L (mm) | W (mm) |
|---|---|---|---|---|---|---|
| S3.015 | SDitch | 45.033 | 44.260 | 0.000 | 225 | 0 |

## Simulation Criteria for Storm

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

| | | | |
|---|---|---|---|
| Number of Input Hydrographs | 0 | Number of Storage Structures | 3 |
| Number of Online Controls | 1 | Number of Time/Area Diagrams | 0 |
| Number of Offline Controls | 0 | Number of Real Time Controls | 0 |

## Synthetic Rainfall Details

Rainfall Model FSR Return Period (years) 100

## Synthetic Rainfall Details

| | | | |
|---|---|---|---|
| Region | England and Wales | Cv (Summer) | 0.750 |
| M5-60 (mm) | 19.000 | Cv (Winter) | 0.840 |
| Ratio R | 0.400 | Storm Duration (mins) | 30 |
| Profile Type | Summer | | |

## Online Controls for Storm

### Hydro-Brake® Optimum Manhole: S8, DS/PN: S3.015, Volume (m³): 5.6

| | |
|---|---|
| Unit Reference | MD-SHE-0085-3500-1250-3500 |
| Design Head (m) | 1.250 |
| Design Flow (l/s) | 3.5 |
| Flush-Flo™ | Calculated |
| Objective | Minimise upstream storage |
| Application | Surface |
| Sump Available | Yes |
| Diameter (mm) | 85 |
| Invert Level (m) | 44.400 |
| Minimum Outlet Pipe Diameter (mm) | 100 |
| Suggested Manhole Diameter (mm) | 1200 |

| Control Points | Head (m) | Flow (l/s) |
|---|---|---|
| Design Point (Calculated) | 1.250 | 3.5 |
| Flush-Flo™ | 0.372 | 3.5 |
| Kick-Flo® | 0.759 | 2.8 |
| Mean Flow over Head Range | - | 3.1 |

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

| Depth (m) | Flow (l/s) | Depth (m) | Flow (l/s) | Depth (m) | Flow (l/s) | Depth (m) | Flow (l/s) |
|---|---|---|---|---|---|---|---|
| 0.100 | 2.6 | 1.200 | 3.4 | 3.000 | 5.2 | 7.000 | 7.8 |
| 0.200 | 3.2 | 1.400 | 3.7 | 3.500 | 5.6 | 7.500 | 8.1 |
| 0.300 | 3.4 | 1.600 | 3.9 | 4.000 | 6.0 | 8.000 | 8.3 |
| 0.400 | 3.5 | 1.800 | 4.1 | 4.500 | 6.3 | 8.500 | 8.6 |
| 0.500 | 3.4 | 2.000 | 4.3 | 5.000 | 6.7 | 9.000 | 8.8 |
| 0.600 | 3.3 | 2.200 | 4.5 | 5.500 | 7.0 | 9.500 | 9.0 |
| 0.800 | 2.8 | 2.400 | 4.7 | 6.000 | 7.3 | | |
| 1.000 | 3.2 | 2.600 | 4.9 | 6.500 | 7.5 | | |

## Storage Structures for Storm

### Tank or Pond Manhole: S17, DS/PN: S6.000

Invert Level (m) 44.500

| Depth (m) | Area (m²) | Depth (m) | Area (m²) | Depth (m) | Area (m²) |
|---|---|---|---|---|---|
| 0.000 | 255.0 | 1.000 | 515.0 | 2.100 | 800.0 |

### Tank or Pond Manhole: S20, DS/PN: S7.000

Invert Level (m) 44.480

| Depth (m) | Area (m²) | Depth (m) | Area (m²) | Depth (m) | Area (m²) |
|---|---|---|---|---|---|
| 0.000 | 58.0 | 1.000 | 205.0 | 1.650 | 310.0 |

### Tank or Pond Manhole: S8, DS/PN: S3.015

Invert Level (m) 44.400

| Depth (m) | Area (m²) | Depth (m) | Area (m²) | Depth (m) | Area (m²) |
|---|---|---|---|---|---|
| 0.000 | 185.0 | 1.100 | 455.0 | 1.710 | 609.0 |

## +0%% Sensitivity 100 year Return Period
## Summary of Critical Results by Maximum Level (Rank 1) for Storm

### Simulation Criteria

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

| | | | |
|---|---|---|---|
| Number of Input Hydrographs | 0 | Number of Storage Structures | 3 |
| Number of Online Controls | 1 | Number of Time/Area Diagrams | 0 |
| Number of Offline Controls | 0 | Number of Real Time Controls | 0 |

### Synthetic Rainfall Details

| | | | |
|---|---|---|---|
| Rainfall Model | FSR | Ratio R | 0.400 |
| Return Period (years) | 100 | Cv (Summer) | 0.750 |
| Region | England and Wales | Cv (Winter) | 0.840 |
| M5-60 (mm) | 19.000 | | |

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

| | |
|---|---|
| Profile(s) | Summer and Winter |
| Duration(s) (mins) | 15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080 |
| Sensitivity flows(s) (%) | 0, +40 |

| PN | US/MH Name | Storm | Climate Change | First (X) Surcharge | First (Y) Flood | First (Z) Overflow | Overflow Act. | Water Level (m) |
|---|---|---|---|---|---|---|---|---|
| S3.000 | S1 | 15 Winter | +0% | +40%/15 Summer | | | | 55.904 |
| S3.001 | S2 | 15 Winter | +0% | | | | | 55.673 |
| S4.000 | S3 | 15 Winter | +0% | | | | | 55.203 |
| S4.001 | S3 | 15 Winter | +0% | | | | | 55.062 |
| S3.002 | S3 | 15 Winter | +0% | +0%/15 Summer | | | | 54.328 |
| S3.003 | S4 | 15 Winter | +0% | +0%/15 Summer | | | | 54.193 |
| S3.004 | S5 | 15 Winter | +0% | +0%/15 Summer | | | | 54.096 |
| S3.005 | S6 | 15 Winter | +0% | +0%/15 Summer | | | | 53.845 |
| S3.006 | S7 | 15 Winter | +0% | +40%/15 Winter | | | | 53.468 |
| S3.007 | S8 | 15 Winter | +0% | | | | | 53.139 |
| S3.008 | S1 | 15 Winter | +0% | | | | | 52.529 |
| S3.009 | S1 | 15 Winter | +0% | | | | | 51.583 |
| S3.010 | S2 | 15 Winter | +0% | | | | | 51.030 |
| S3.011 | S3 | 15 Winter | +0% | | | | | 48.966 |
| S3.012 | S4 | 15 Winter | +0% | | | | | 47.563 |
| S5.000 | S5 | 600 Winter | +0% | +40%/15 Winter | | | | 45.040 |
| S6.000 | S17 | 600 Winter | +0% | +0%/120 Winter | | | | 45.040 |
| S3.013 | S5 | 600 Winter | +0% | +0%/15 Summer | | | | 45.040 |
| S3.014 | S7 | 600 Winter | +0% | +0%/30 Summer | | | | 45.039 |

+0%% Sensitivity 100 year Return Period

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

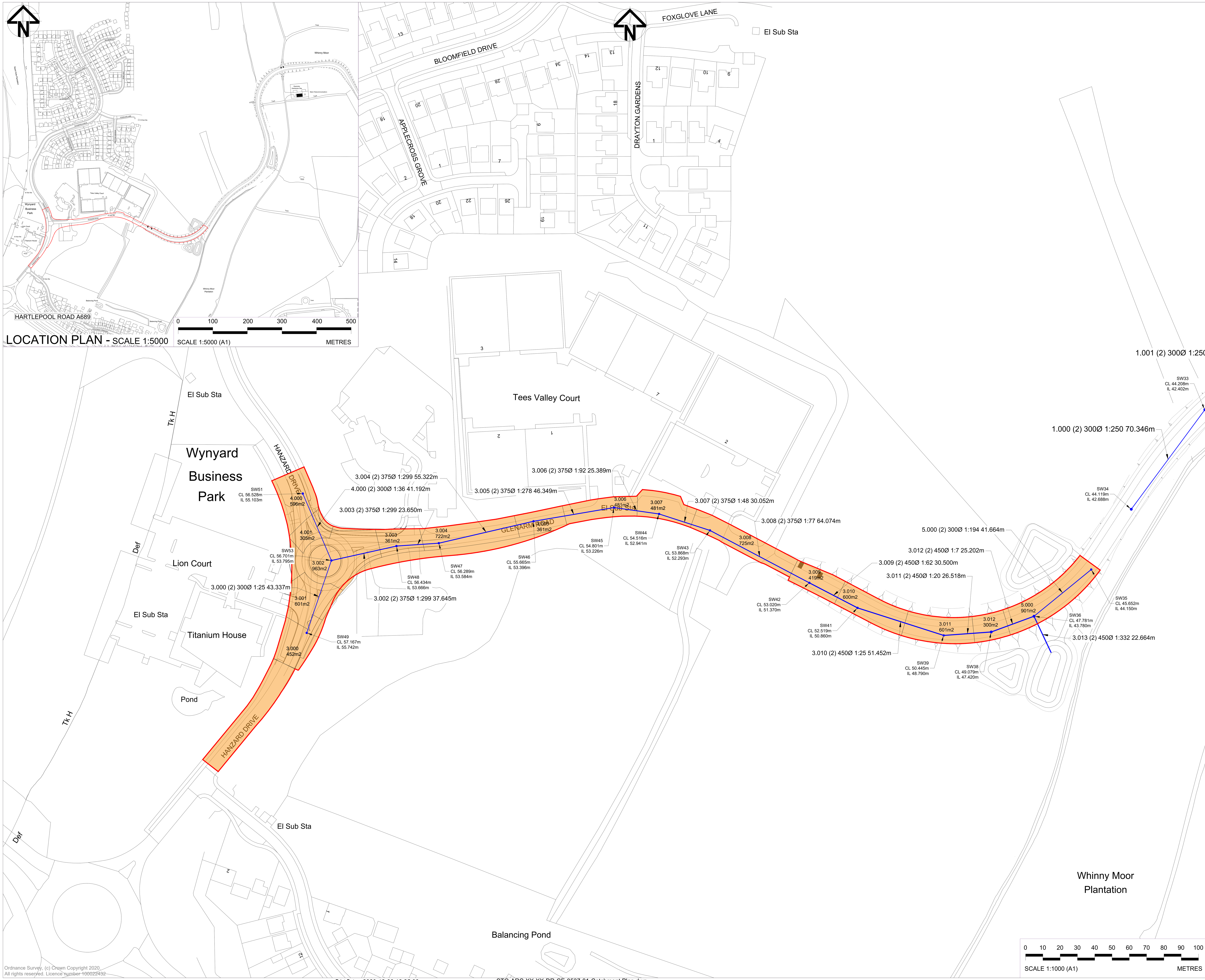
| PN | US/MH Name | Surcharged Depth (m) | Flooded Volume (m³) | Flow / Cap. | Overflow (l/s) | Pipe Flow (l/s) | Status | Level Exceeded |
|---|---|---|---|---|---|---|---|---|
| S3.000 | S1 | -0.063 | 0.000 | 0.87 | | 34.1 | OK | |
| S3.001 | S2 | -0.124 | 0.000 | 0.40 | | 53.6 | OK | |
| S4.000 | S3 | -0.125 | 0.000 | 0.41 | | 15.5 | OK | |
| S4.001 | S3 | -0.146 | 0.000 | 0.26 | | 26.0 | OK | |
| S3.002 | S3 | 0.158 | 0.000 | 1.05 | | 109.6 | SURCHARGED | |
| S3.003 | S4 | 0.152 | 0.000 | 1.17 | | 116.2 | SURCHARGED | |
| S3.004 | S5 | 0.137 | 0.000 | 1.21 | | 129.3 | SURCHARGED | |
| S3.005 | S6 | 0.062 | 0.000 | 1.17 | | 129.5 | SURCHARGED | |
| S3.006 | S7 | -0.133 | 0.000 | 0.74 | | 134.5 | OK | |
| S3.007 | S8 | -0.177 | 0.000 | 0.54 | | 139.7 | OK | |
| S3.008 | S1 | -0.139 | 0.000 | 0.69 | | 149.5 | OK | |
| S3.009 | S1 | -0.237 | 0.000 | 0.45 | | 160.3 | OK | |
| S3.010 | S2 | -0.280 | 0.000 | 0.30 | | 176.1 | OK | |
| S3.011 | S3 | -0.274 | 0.000 | 0.31 | | 192.5 | OK | |
| S3.012 | S4 | -0.307 | 0.000 | 0.22 | | 201.3 | OK | |
| S5.000 | S5 | -0.011 | 0.000 | 0.04 | | 3.1 | OK | |
| S6.000 | S17 | 0.090 | 0.000 | 0.01 | | 1.8 | SURCHARGED | |
| S3.013 | S5 | 0.140 | 0.000 | 0.14 | | 20.2 | SURCHARGED | |
| S3.014 | S7 | 0.209 | 0.000 | 0.12 | | 19.8 | SURCHARGED | |

+0%% Sensitivity 100 year Return Period

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

| PN | US/MH Name | Storm | Climate Change | First (X) Surcharge | First (Y) Flood | First (Z) Overflow | Overflow Act. | Water Level (m) |
|---|---|---|---|---|---|---|---|---|
| S7.000 | S20 | 600 Winter | +0% | +0%/120 Winter | | | | 45.038 |
| S3.015 | S8 | 600 Winter | +0% | +0%/15 Summer | | | | 45.038 |

| PN | US/MH Name | Surcharged Depth (m) | Flooded Volume (m³) | Flow / Cap. | Overflow (l/s) | Pipe Flow (l/s) | Status | Level Exceeded |
|---|---|---|---|---|---|---|---|---|
| S7.000 | S20 | 0.108 | 0.000 | 0.01 | | 0.7 | SURCHARGED | |
| S3.015 | S8 | 0.413 | 0.000 | 0.07 | | 3.5 | SURCHARGED | |






NOTES:

1. DO NOT SCALE FROM THIS DRAWING, USE FIGURE DIMENSIONS ONLY.
2. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ALL RELEVANT ARCHITECTS & ENGINEERS DRAWINGS AND SPECIFICATIONS.

LEGEND:

- PROPOSED SW PIPE
- PROPOSED SW MANHOLE
- CATCHMENT AREAS
- CATCHMENT BOUNDARY

| Rev | Date | Description | Drawn | Check | Approv |
|---|---|---|---|---|---|
| 01 | 21/11/23 | FIRST ISSUE | BA | DO | MD |

Client
Amazon UK Services LTD

PROJECT:
STOCKTON

| Site | Client |
|---|---|
| Chapel Lane North Stockton-on-Tees | Amazon UK Services Ltd |

ARCADIS Design & Consultancy for natural and built assets

Registered office:
Arcadis House
34 York Way
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N1 9AB

Coordinating office:
2 Glass Wharf
Temple Quay
Bristol BS2 0FR
Tel: : +44 (0)11 7372 1200

www.arcadis.com

TITLE:

CATCHMENT PLAN

| | | | |
|---|---|---|---|
| Designed | B.ALLEN | Signed | Date 06/12/2023 |
| Drawn | B.ALLEN | Signed | Date 06/12/2023 |
| Checked | D.OGDEN | Signed | Date 06/12/2023 |
| Approved | M.DAVIES | Signed | Date 06/12/2023 |
| Scale: | 1:1000 | Datum: | ODN |
| Original Size: | A1 | Grid: | OS |
| Suitability Code: | S2 | Project Number: | 10042440 |

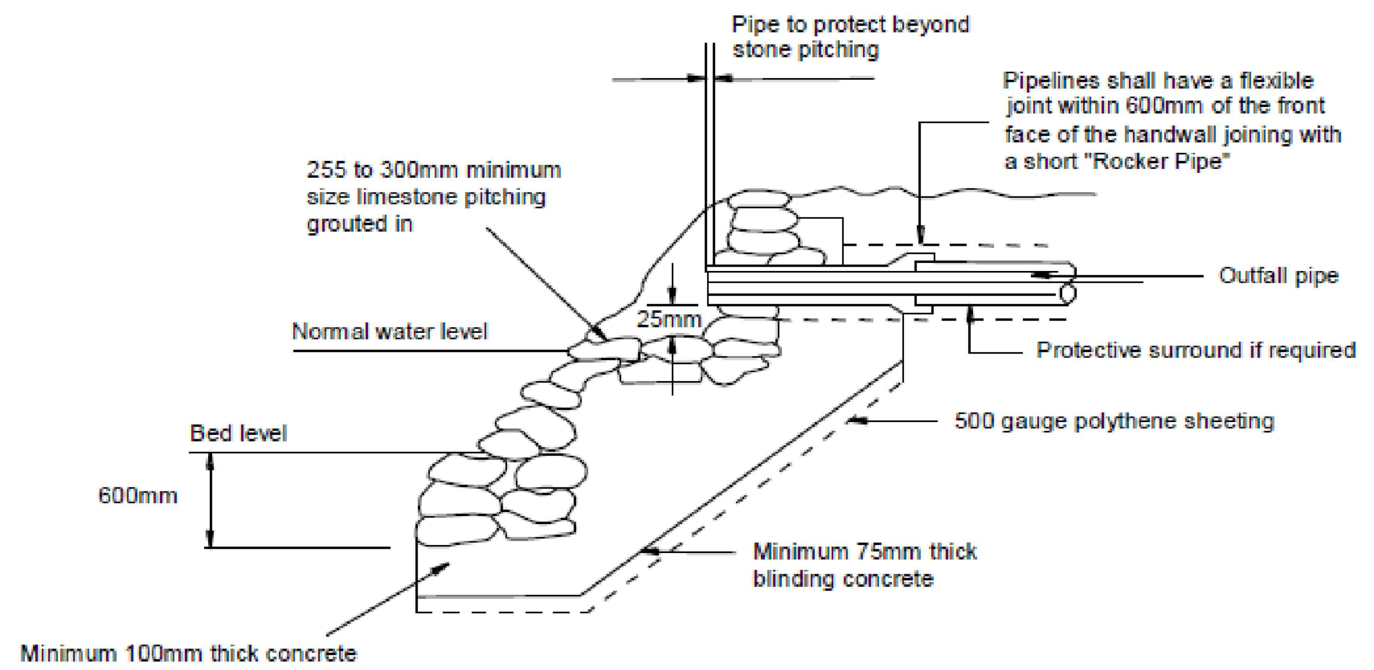
Suitability Description:
PRELIMINARY
NOT TO BE USED FOR CONSTRUCTION

| Drawing Number: | Revision: |
|---|---|
| STO-ARC-XX-XX-DR-CE-0537 | 01 |

100mm on Original

Print Date: 2023-12-08 12:25:08

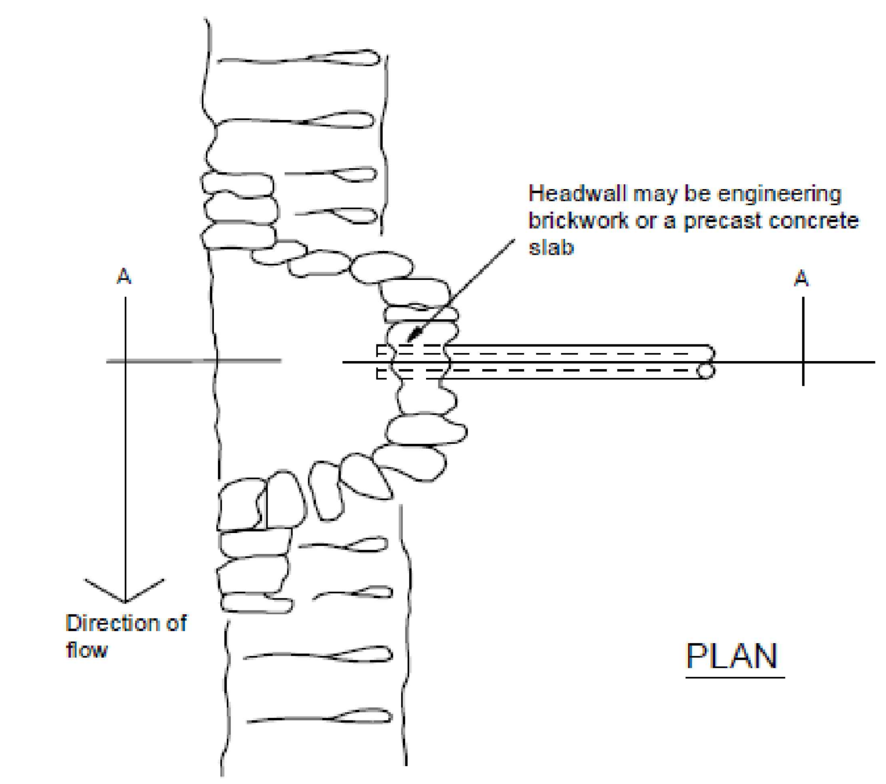
STO-ARC-XX-XX-DR-CE-0537-01-Catchment Plan.dwg



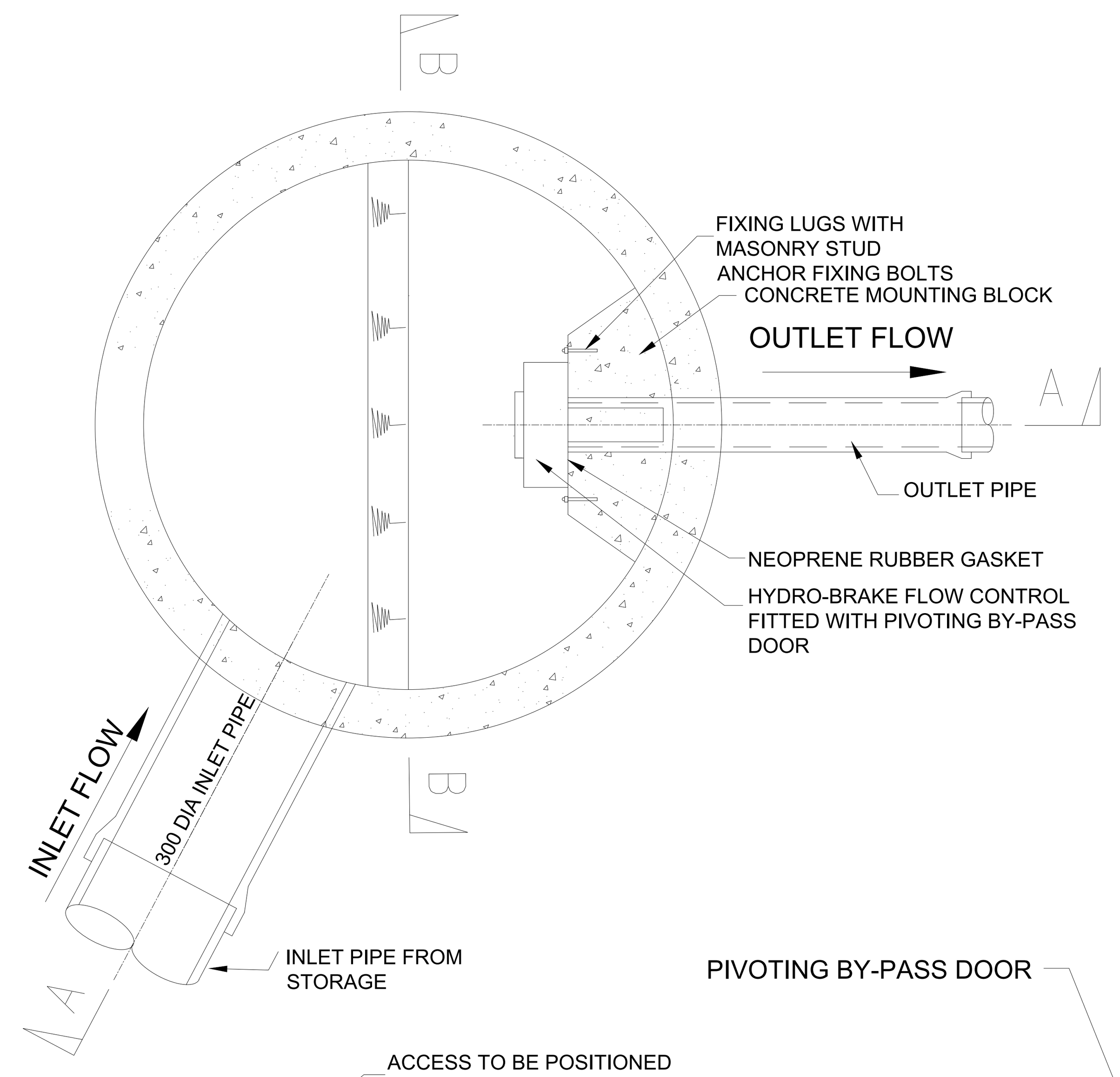

SECTION TAKEN ON LINE A -A

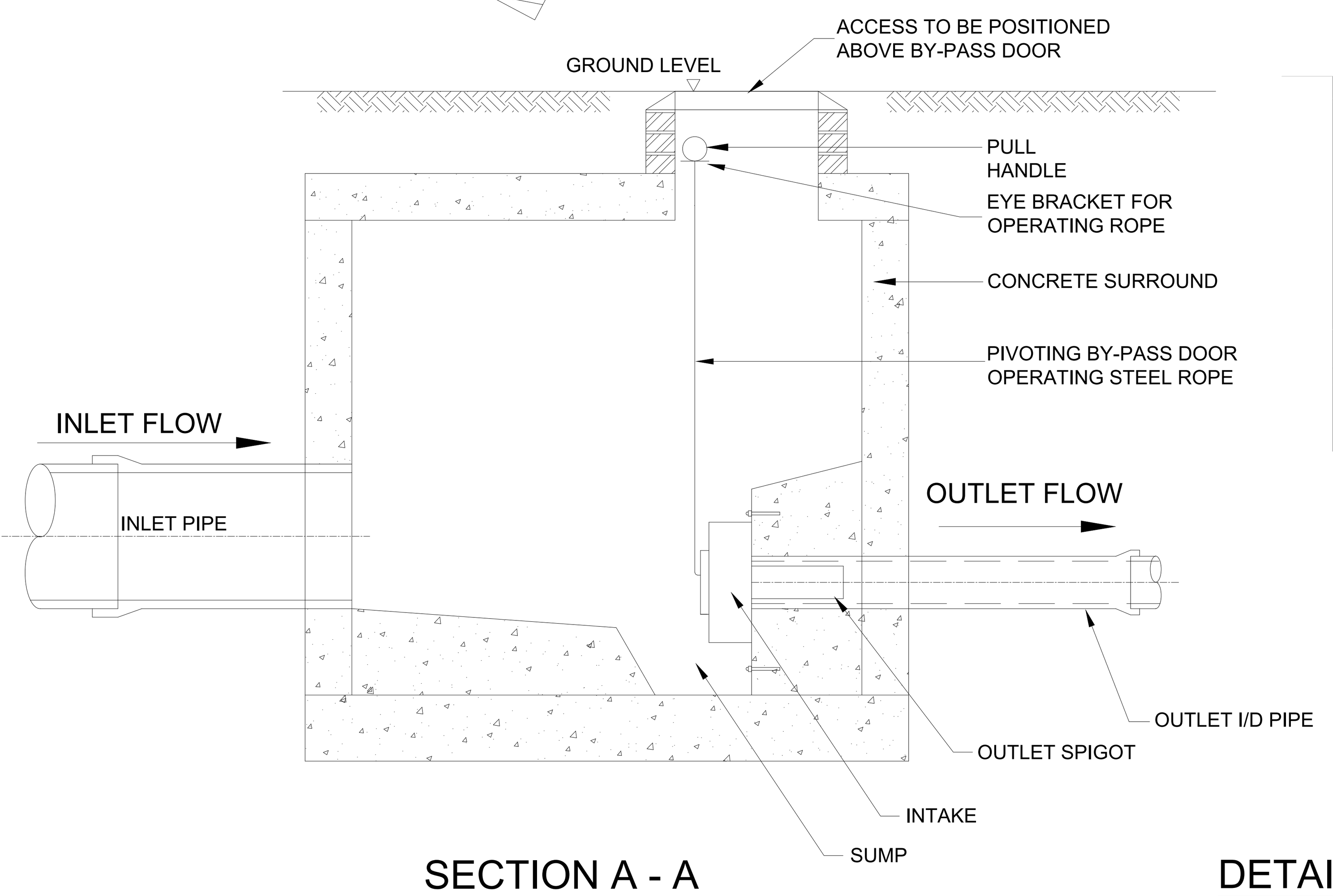
GENERAL NOTES
1. The exact location of the outfall mustbe indicated.
2. Pipe outfall exit velocity should not exceed 1.2 m/s.
3. The headwall and wingwalls should not project beyond or above the line of the bank.
4. No part of the structure should cut into any flood embankment.
5. All surplus spoil from excavations for structure and pipe must be removed from site.
6. Stone pitching may be required to protect the bed and opposite bank downstream of the outfall.

| ROCKER DETAILS | |
|---|---|
| PIPE DIAMETER | ROCKER PIPE LENGTH |
| 150 - 450 | 500 - 750 |
| 500 - 750 | 750 - 1000 |
| >750 | SEEK GUIDANCE |

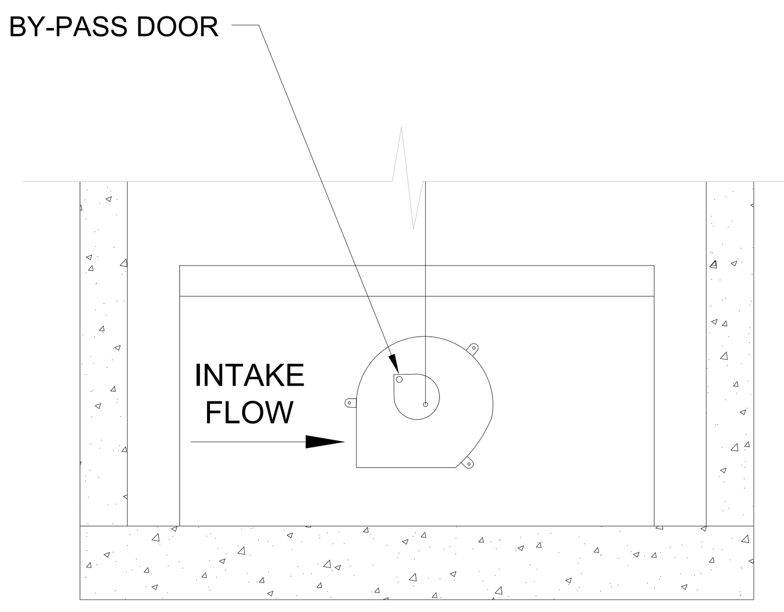



HEADWALL DETAIL
SCALE NTS



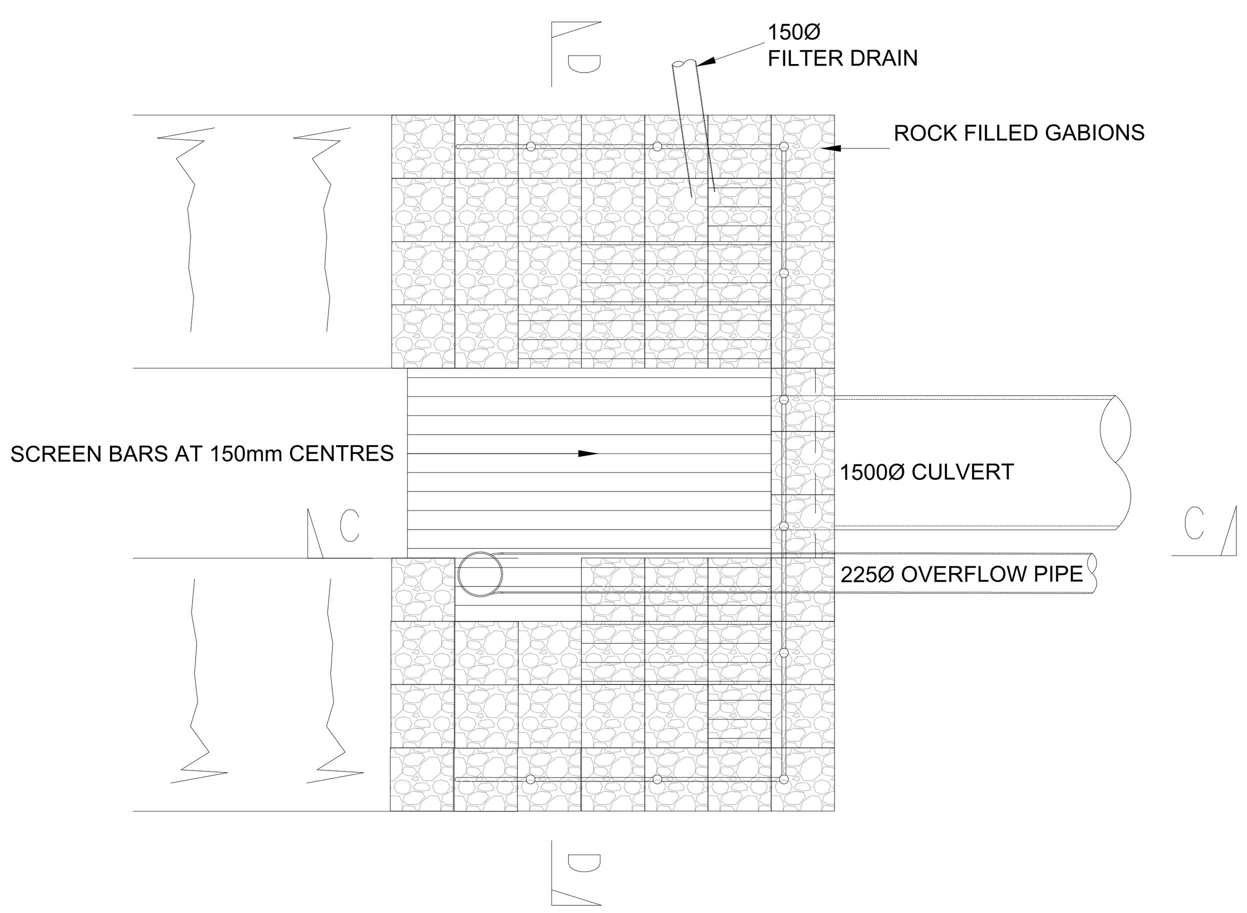




SECTION A - A
SCALE 1:20

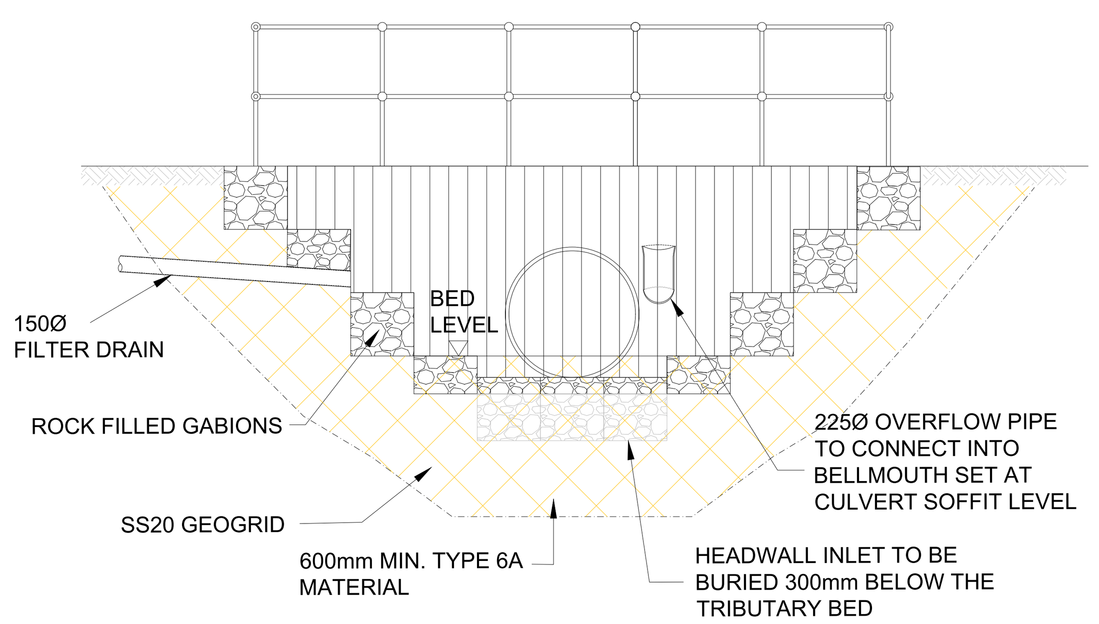



SECTION B - B
SCALE 1:20

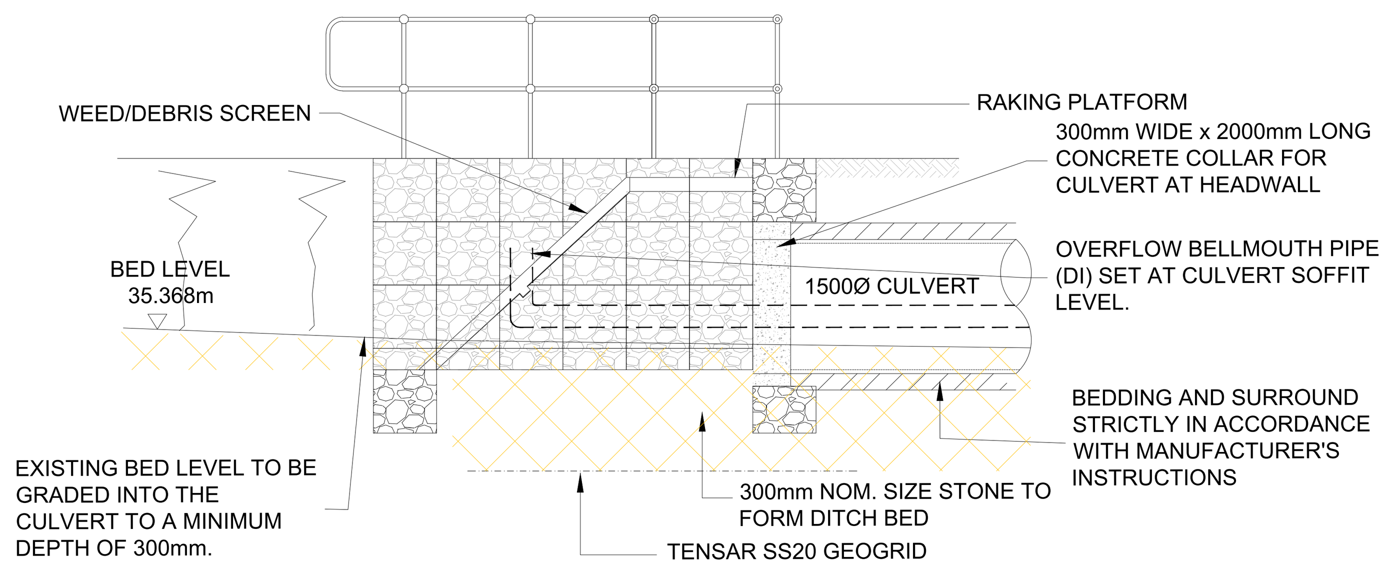
DETAIL OF FLOW CHAMBER
SCALE 1:20




CULVERT GABION HEADWALL - PLAN




CULVERT GABION HEADWALL - SECTION D-D




CULVERT GABION HEADWALL SECTION C-C

NOTES:
1. ALL DIMENSIONS ARE IN METRES UNLESS OTHERWISE STATED.
2. DO NOT SCALE FROM THIS DRAWING, USE FIGURE DIMENSIONS ONLY.
3. SPECIFICATION TO BE THE STOCKTON BOROUGH COUNCIL HIGHWAYS DESIGN GUIDE. SPECIFIC ATTENTION IS DRAWN TO THE CONSTRUCTION (DESIGN AND MANAGEMENT) REGULATIONS 2007 DEFINED WITHIN THE STATUTORY REQUIREMENTS CHAPTER.

| Rev | Date | Description | Drawn | Check | Approv |
|---|---|---|---|---|---|
| 07 | 08/12/23 | CLIENT UPDATE | BA | DO | MD |
| 06 | 20/07/22 | HEADWALL DETAILS REMOVED | LR | DO | MD |
| 05 | 20/10/21 | GABION PLAN UPDATED | AK | DO | MD |
| 04 | 19/10/21 | SECTION C-C AMENDED | AK | DO | MD |
| 03 | 13/10/21 | GABION HEADWALL AMENDED | AK | DO | MD |
| 02 | 13/09/21 | GABION HEADWALL ADDED | AK | DO | MD |
| 01 | 08/07/21 | FIRST ISSUE | GW | DO | MD |

Client
AMAZON UK SERVICES LTD

PROJECT:
STOCKTON

Site
Chapel Lane North
Stockton-on-Tees

Client
ISG

ARCADIS Design & Consultancy for natural and built assets

Registered office:
Arcadis House
34 York Way
London
N1 9AB

Coordinating office:
2 Glass Wharf
Temple Quay
Bristol BS2 0FR
Tel: : +44 (0)11 7372 1200

www.arcadis.com

TITLE:
S38 HIGHWAY DRAINAGE DETAILS SHEET 2 OF 2

| | | | |
|---|---|---|---|
| Designed | G.WARSAMA | Signed | Date 08/07/21 |
| Drawn | G.WARSAMA | Signed | Date 08/07/21 |
| Checked | D.OGDEN | Signed | Date 08/07/21 |
| Approved | M.DAVIES | Signed | Date 08/07/21 |
| Scale: | NTS | Datum: | AOD |
| Original Size: | A1 | Grid: | OS |
| Suitability Code: | S2 | Project Number: | 10042440 |

Suitability Description:
PRELIMINARY
NOT TO BE USED FOR CONSTRUCTION

Drawing Number: STO-ARC-XX-XX-DR-CE-0509
Revision: 07

| Check | MDR | Summary details[1] | Acceptable (Y/N) | Comments/ remedial actions |
|---|---|---|---|---|
| **Dimensions (Sections 13.2 and 22.2)** | | | | |
| Length (m) | | 55m (max) | Y | |
| Width - at top and at base (m) | | 20m (max) | Y | |
| Top surface area ($m^2$) | | 1100$m^2$ | Y | |
| Side slope (1 in ?) | | 1in3 | Y | |
| Depth - maximum and minimum (m) | | 1.7m & 1.0m | Y | |
| Freeboard(m) | | 0.3m | Y | |
| Longitud inal slope (1 in ?) | | 1in100 | Y | |
| **Inflows (Sections 13.8.1 and 22.8.1)** | | | | |
| Provide a description of the contributing catchment land use and its size ($m^2$) | | Access Road 9,732$m^2$ | | |
| Does the design include suitable silt Interception upstream of system, where required? | | Road gullies | | |
| Where required, does the design include: suitable flow spreading appropriate energy dissipation? | | Headwall bases | | |
| **Outfall arrangements (Sections 13.8.2 and 22.8.2)** | | | | |
| Provide details of any flow control systems, overflow arrangements arid limiting discharge rate(s) from the basin | | Discharge rate limited to the greenfield runoff rate, limited to 2.73l/s with the use of a flow control. | | |
| Is the basin designed to allow infiltration? If yes, attach infiltration assessment | | No | | |
| Does the design include infiltration trenches or blankets beneath the base to promote improved infiltration? | | No | | |
| Is a geomembrane required to prevent infiltration? If yes, give reason | | No | | |
| Depth to maximum likely groundwater level (m) | | Not known | | |
| Is topsoil of sufficient permeability to allow infiltration or underdrainage (where required)? | | N/A | | |
| **Storage (Sections 13.4 and 22.4)** | | | | |
| Design return period(s) (years) | | 100yr +40CC | | |

| Check | MDR | Summary details[1] | Acceptable (Y/N) | Comments/ remedial actions |
|---|---|---|---|---|
| Maximum design water depth(s) and level(s) | | 1.0m max water depth (300mm freeboard)<br>Base of basin level 44.30<br>Level at top of basin is 45.59 | Y | |
| Maximum design storage volume(s) ($m^3$)<br>Note: It would be unusual for this volume to exceed 10,000 $m^3$. If i t does, the design may have to comply with the Reservoirs Act 1975 (as amended by the Flood and Water Managemen t Act (FWMA) 2010). Checks should be made of the design to confirm suitability of such a large volume | | 1) 347$m^3$<br>2) 95$m^3$<br>3) 322$m^3$ | Y | |
| Levels around the edge of the pond/ wetland appropriate to contain design depths of water? | | Yes. The level around the edge of the basin is lower than the proposed road level. | | |
| **Water quality treatment (Sections 13.5 and 22.5)** | | | | |
| For the 1 year, 30 min event confirm: | | | | |
| Average residence time in detention basin is acceptable for effective treatment<br>Or<br>Ma ximum velocity is acceptable for effective treatment | | Max flow velocity is 0.4m/s | Y | |
| **Landscape/biodiversity (SecUons 13.6, 13.7, 13.10, 22.6, 22.7 and 22.10)** | | | | |
| Does the proposed planting have potential to create biodiverse habitats? | | | | |
| Have native plant species been used? (Note: if ornamental species are proposed, give reasons and describe measures that prevent their migration to natural water bodies.) | | | | |
| Is the proposed planting appropriate to the location, visually, relative to gradient, water depths etc and with respect to access and maintenance? | | | | |
| Where relevant , confirm planting design does not adversely impact highway visibility and safety requirements (check with highway authority) | | | | |
| Is the proposed topsoil profile suitable to sustain the proposed plant species and as permeable as the filter bed? | | | | |
| **Critical materials and product specifications (Sections 13.9 and 22.9)** | | | | |
| Geomembrane | | | | |
| Geotextile (non-woven) | | | | |
| Topsoil | | | | |
| Other (including proprietary systems} | | | | |

| Check | MDR | Summary details[1] | Acceptable (Y/N) | Comments/ remedial actions |
|---|---|---|---|---|
| **Constructability (Sections 13.11 and 22.11)** | | | | |
| Are there any identifiable construction risks? If yes, state and confirm acceptable risk management measures are proposed | | | | |
| **Maintainability (Sections 13.12 and 22.12)** | | | | |
| Confirm that access for maintenance is acceptable and summarise details | | 3m maintenance path circling the perimeter of the basin. | | |
| Are there specific features that are likely to pose maintenance difficulties? If yes, identify mitigation measures required | | No | | |
| **Basin design acceptability** | **Summary details including any changes required** | | **Acceptable (Y/N)** | **Date changes made** |
| Acceptable:<br>Minor changes required:<br>Major changes required/redesign: | | | | |

| Table B.5 SuDS health and safety risk assessment checklist | |
|---|---|
| **Site/system overview** | |
| Site ID | Stockton |
| Asset ID | Secondary Access Road Basins |
| Location | Basin coordinates<br>X (Easting): 444<br>Y (Northing): 526 |
| SuDS component | Detention basin |
| Assessment date | 16/11/2023 |
| Date of next assessment | After construction |
| **1 Establish context** | |
| General description of component and its operation | Detention basin is normally dry except during and following storm events. It is designed to attenuate surface water incoming from drainage network serving adopted highway. |
| **2 Identify potential hazards** | Are hazards present? (Y/N) |
| Drowning or falling through ice in winter | If YES complete Section 3 Y |
| Slips, trips and falls | If YES complete Section 4 Y |
| Entry into pipes or confined spaces (note this is for inadvertent public access; follow relevant legislation and guidance for worker access) | If YES complete Section 5 |
| Water quality – health risk | If YES complete Section 6 Y |

| 3 Drowning or falling through ice in winter | | |
|---|---|---|
| **Consider factors that might affect:**<br>• **the likelihood of people entering the water/accessing the ice**<br>• **the potential consequence of entering the water/accessing the ice** | **Summary of influence of factor on likelihood of entry/access, including justification (consider for children < 5 years, children ≥ 5 years, adults)** | **Summary of influence of factor on consequence of entry or access, including justification (consider for children < 5 years, children ≥ 5 years, adults)** |
| **Environmental factors** | | |
| Proximity to populated areas: schools, inns, retail/tourism, picnic areas, play areas, car park, roads, especially attractive features likely to be visited | Normally dry basin will be in proximity to industrial estate car park, roads and roundabout serving industrial units. There is no proximity to populated areas and attractive features.<br><br>It is assumed that the route adjacent to the basin will be mostly used by professionals going to and from industrial unit being their workplace. It is also expected that access to this zone will be authorized at the entrance to the entire industrial zone. | In case of entry to the basin with water there is a chance that such event can be spotted by people from the road. |
| Features allowing or encouraging access (eg paths) | Footway / cycleway adjacent the basin will be used by pedestrians and cyclists as a route to and from their workplace i.e. industrial units nearby.<br><br>According to Ciria C753 drowning more frequently occurs from accidentally falling in rather than by deliberately accessing a body of water and then getting into difficulty. | In case of entry to the basin with water there is a chance that such event can be spotted by people from the road. |

| | | |
|---|---|---|
| Physical accessibility of proposed drainage feature: consider intended use and inadvertent access (including of small children) | Basin is physically accessible from all sides making it more likely to enter the basin. It is justified in adjacent column. | Accessible basin make it easier to approach drowning person by other people. |
| Visibility and natural surveillance of proposed drainage features | Basin is visible from adjacent roads and footway/cycleway in the daytime reducing likelihood of entry/access. | Consequence of entry is reduced due to roads and footway in proximity. Drowning person can be seen from the distance. |
| **Behavioural factors** | | |
| Category and volume of expected users: swimmers, anglers, walkers, drivers, specialist water users, General public, dog walkers, teenagers, accompanied/unaccompanied children | These user groups are unexpected in the industrial estate.<br><br>Swimming in the basin does not seem to be appealing due to industrial nature of the development. | These user groups are unexpected in the industrial estate. |
| Nature of development (housing, commercial, industrial etc) | Industrial nature of development. Small children are unlikely to be present in this area. It is expected that this zone will not be accessible to unauthorized persons. | Consequences remain the same for all types of development. |
| Any known existing risks (eg records of accidents) posed by water/drainage features at or close to the site? | Not known | Not known |
| **Design factors – water's edge** | | |

| | | |
|---|---|---|
| Type and nature of water-edge planting | Refer to landscape architect drawings for water-edge planting.<br><br>Water edge planting would create natural barrier and therefore reduce likelihood of entry/access. | Refer to landscape architect drawings for water-edge planting.<br><br>Water edge planting would create natural barrier and therefore reduce accessibility to pond. This in turn would make it more difficult to approach drowning person by other people. |
| Definition of water edge and nature of ground (eg soft/hard) | Surface definition not known. Refer to landscape architect drawings<br><br>Edges of the pond should be clearly visible assuming appropriate maintenance. This reduces likelihood of inadvertent access to the pond. | Surface definition not known. Refer to landscape architect drawings.<br><br>Edges of the pond should clearly visible assuming appropriate maintenance making it easier to escape from danger. |
| Natural obstacles, barriers/fencing | Basin is physically accessible from every side. There are no natural obstacles or barriers/fencing to prevent access to the basin. This is justified in adjacent column. | Barriers would make it more difficult to save a drowning person. |
| Height of edge above water | Height of edge above water will vary depending on specific rainfall event. There is reasonable distance between footway/cycleway and basin edge.<br><br>Note that water in the basin should discourage people from accessing the basin.<br><br>There is no clear correlation between likelihood of entry/access to the basin and water depth profile. | Following storm events simulations water will not approach road i.e. road levels are higher than 1 in 100 year + 40% climate change water level. |

| | | |
|---|---|---|
| Gradient and extent of slopes above, at and below water level | All slopes have gradient not greater than 1 in 3 allowing maintenance personnel to mow and clear vegetation.<br><br>In addition, falling into water body by accident is more likely for steeper gradients batters. | All slopes have gradient not greater than 1 in 3. This allows unaided movement in either direction making it easier to leave the basin whenever in danger. |

**Note** For definition of levels, see **Table 36.2 in Chapter 36**.

| **3 Drowning or falling through ice in winter** | | |
|---|---|---|
| **Consider factors that might affect:**<br>• **the likelihood of people entering the water/accessing the ice**<br>• **the potential consequence of entering the water/accessing the ice** | **Summary of influence of factor on likelihood of entry/access, including justification (consider for children < 5 years, children ≥ 5 years, adults)** | **Summary of influence of factor on consequence of entry or access, including justification (consider for children < 5 years, children ≥ 5 years, adults)** |
| **Design factors – water body** | | |
| Water depth profile | Basin will be usually dry. Water will be present during or after extreme storm events.<br><br>There is no clear correlation between likelihood of entry/access to the basin and water depth profile. | Water is a drowning hazard. Just 500mm is deep enough for small child to drown in. However, children won't be expected in monitored industrial estate.<br><br>According to simulations this basin will have 500mm or higher level of water during and after storm events worse than 1 in 2 years (50% probability of occurrence). |
| Water surface area | Surface water from highway is intended to be drained into drainage network, which reduces slipping hazard and likelihood of entry into the basin. | No clear correlation. |
| Clarity | Water is treated upstream by silt traps within road gullies.<br><br>There is no clear correlation between clarity of the water and likelihood of entry/access. | Consequence of entry into water treated by silt trap is less severe. |
| Underwater obstacles or traps | Basin base is meant to be flat or gently sloped without any objects. Maintenance is required to ensure this. | There is no intended underwater obstacles or traps making it is easier to escape from the basin in case of emergency. |

| | | |
|---|---|---|
| Potential currents, velocities | No clear correlation with likelihood of entry/access. | The basin base is flat which means that in general. Water velocity will be close to zero allowing everyone who enters the basins to remain standing.<br><br>However, there might be flowing water at the outfalls i.e. in front of headwalls during and after extreme storm events. To distribute the flow placing cobblestones or concrete blocks in front of headwall needs to be considered.<br><br>Flattening headwall associated pipe should be also considered as long as its capacity will be sufficient. |
| Potential increase in depth of water and rate of rise | No clear correlation with likelihood of entry/access. | Basin will be usually dry. The water will be present during or after storm events. Increase in depth will depend on storm event. After most extreme events i.e. 1 in 100 year + 40% CC it is expected that water level can increase to approx. 1.3m.<br><br>Basin serves a highway. It is expected that rate of rise will be gradual due to even spread in time-area distribution. Gradual rate of rise should give any person in basin more time to escape from dangerous situation and therefore reduce the risk. |
| Potential for ice formation and significant depth of water below in winter | Basin will be usually dry. Water and/or ice can be present during or after extreme storm events.<br><br>There is no clear correlation between likelihood of entry/access to the basin and water depth profile. | Water is drowning hazard. Just 500mm is deep enough for small child to drown in.<br><br>According to simulations this basin will have 500mm or higher level of water during and after storm events worse than 1 in 2y ear. This level of water will be also present after freezing occurs. |

| **Public education** | | |
|---|---|---|
| Signage | No signage.<br><br>Appropriate warning signs could potentially reduce likelihood of entry/access. | Signage does not have influence on consequence of person which already entered the basin. |
| Community engagement strategies | Not known | Not known |
| Local education strategies (eg schools) | Not known. Note this is industrial estate. | Not known. Note this is industrial estate. |
| **Overall assessment of likelihood of entry/access and consequences** | **Likelihood** | **Consequences** |
| Children < 5 years Children > 5 years<br>Adults | Rare<br>Possible | Extreme<br>Moderate |

| Summary of section 3 risk assessment for drowning or falling through ice | | | | | | |
|---|---|---|---|---|---|---|
| **Group** | **Likelihood of entry to water** | **Likely consequence of entry to water** | **Overall level of risk posed by the design[1]** | **Further mitigation measures required** | **Action date** | **Final level of risk[1]** |
| Children < 5 years | Rare | Extreme | Medium risk | Consider life saving equipment. Regular maintenance is required. | N/A | Medium risk |
| Children > 5 years | Rare | Extreme | Medium risk | Consider life saving equipment<br>Regular maintenance is required. | N/A | Medium risk |
| Adults | Possible | Moderate | Medium risk | Consider life saving equipment. Regular maintenance is required. | N/A | Medium risk |

**Note** For definition of levels, see **Table 36.2 in Chapter 36**.

| 4 Slips/trips/falls | | |
|---|---|---|
| **Factors that might affect likelihood of people slipping/tripping/falling** | **Summary of influence of factor on likelihood of slip/ trip/fall, including justification (consider for children < 5 years, children ≥ 5 years, adults)** | **Summary of influence of factor on consequence of slip/ trip/fall, including justification (consider for children < 5 years, children ≥ 5 years, adults)** |
| **Design factors – inlets and outlets or channels** | | |
| Headwall or channel location | Three headwalls are proposed within the basin 3.<br>There is reasonable distance between these headwalls and road. | Three headwalls are proposed within the basin 3.<br>There is reasonable distance between these headwalls and road. |
| Headwall height or channel depth and width | There is no clear correlation between headwall height and likelihood of fall from it. | Backwall height will be approximately 1.0m high. Fall from any height can result in dangerous accident. Therefore, to mitigate this risk it is recommended to provide railing to the headwalls. |
| Slope of headwall or channel profile | There is no clear correlation between slope of headwall and likelihood of fall from it. | There is no clear correlation between slope of headwall and consequence of fall from it. |

| | | |
|---|---|---|
| Channels – profile and risk of freezing water | N/A | N/A |
| **Design factors – surfaces** | | |
| Level changes | Level change is gentle and no unexpected levels change minimises likelihood of slip/trip/fall. | Level change is gentle and no unexpected levels change reduces influence of factor on consequence of slip/trip/fall. |
| Surfacing materials | Refer to landscape architect drawings | Refer to landscape architect drawings |

| Summary of section 4 risk assessment for slips/trips/falls | | | | | | |
|---|---|---|---|---|---|---|
| **Group** | **Likelihood of slips/ trips/falls/other injury** | **Likely consequence of slips/trips/falls/other injury** | **Overall level of risk posed by the design**[1] | **Further mitigation measures required** | **Action date** | **Final level of risk**[1] |
| Children < 5 years | Rare | Moderate | Low risk | Consider adding railing to the headwall | N/A | Low risk |
| Children ≥ 5 years | Rare | Moderate | Low risk | Consider adding railing to the headwall | N/A | Low risk |
| Adults | Possible | Minor | Medium risk | Consider adding railing to the headwall | N/A | Low risk |

**Note**
For definition of levels, see **Table 36.2 in Chapter 36**.

| 5 Entry into pipes or confined spaces (Note: This risk assessment covers inadvertent access by the public. Where specific access is required by workers the requirements of relevant health and safety legislation and guidance should be followed.) | | |
|---|---|---|
| **Factors that might affect likelihood of people entering pipes or confined spaces** | **Summary of influence of factor on likelihood of entry into pipes or confined spaces, including justification (consider for children < 5 years, children ≥ 5 years, adults)** | **Summary of influence of factor on consequence of entering pipe or confined space, including justification (consider for children < 5 years, children ≥ 5 years, adults)** |
| **Design factors – inlets and outlets** | | |
| Pipe diameter | Larger the pipe the likelihood of entry increases. A headwall pipe is larger than 350mm. Therefore, it is necessary to install safety grill. | Inadvertent entry to the pipe can be fatal. Therefore, it is recommended to provide a safety grill. |
| Are grilles provided? | Note safety grills are required due to pipe diameter larger than 350mm to prevent inadvertent entry into pipe via headwall by the public. | Inadvertent entry to the pipe can be fatal. Therefore, it is recommended to provide a safety grill. |

| **Design factors – chambers** | | |
|---|---|---|
| Depth of chamber | N/A. Not part of SUD component. | N/A. Not part of SUD component. |
| Is access possible? | N/A. Not part of SUD component. | N/A. Not part of SUD component. |

| Summary of section 5 risk assessment for entry into pipes/confined spaces | | | | | | |
|---|---|---|---|---|---|---|
| **Group** | **Likelihood of entry into pipes/ confined spaces** | **Likely consequence of entry into pipes/ confined spaces[1]** | **Overall level of risk posed by the design** | **Further mitigation measures required** | **Action date** | **Final level of risk[1]** |
| Children < 5 years | Rare | Extreme | Medium risk | Consider safety grills at the headwalls | N/A | Medium risk |
| Children ≥ 5 years | Rare | Extreme | Medium risk | Consider safety grills at the headwalls | N/A | Medium risk |
| Adults | Unlikely | Major | Medium risk | Consider safety grills at the headwalls | N/A | Low risk |

**Note**
For definition of levels, see Table 36.2 in Chapter 36.

| 6 Health issues | | |
|---|---|---|
| **Factors that might affect likelihood of people suffering from ill health due to SuDS water quality** | **Summary of influence of factor on likelihood of poor health, including justification (consider for children < 5 years, children ≥ 5 years, adults)** | **Summary of influence of factor on consequence of resulting ill health, including justification (consider for children < 5 years, children ≥ 5 years, adults)** |
| **Pollution treatment strategy** | | |
| Level of contamination of publicly accessible water | The water in the basin present during or after extreme storm events, should be cleaner than the water that runs across roads. Pollution levels should be low. | The water in the basin present during or after extreme storm events, should be cleaner than the water that runs across the road. Pollution levels should be low. |

| | | |
|---|---|---|
| Likely contamination from rat urine | The water in the basin present during or after extreme storm events, should be cleaner than the water that runs across roads. Pollution levels should be low. | The water in the basin present during or after extreme storm events, should be cleaner than the water that runs across roads. Pollution levels should be low. |
| Likely contamination from dog or bird fouling | The water in the basin present during or after extreme storm events, should be cleaner than the water that runs across roads. Pollution levels should be very low. | The water in the basin present during or after extreme storm events, should be cleaner than the water that runs across roads. Pollution levels should be low. |
| Likelihood of toxic algal blooms | At worst not greater than in, for example, recreational ponds in parks. | At worst not greater than in, for example, recreational ponds in parks. |
| Likelihood of vectors (organism which carries disease-causing microorganisms from one host to another) | At worst not greater than in, for example, recreational ponds in parks. | At worst not greater than in, for example, recreational ponds in parks. |
| Public accessibility to any sediment accumulation zones | At worst not greater than in, for example, recreational ponds in parks. | At worst not greater than in, for example, recreational ponds in parks. |
| **Public education and risk management** | | |
| Signs | Not fundamental in industrial estate | Not fundamental in industrial estate |
| Community engagement strategies | Not fundamental in industrial estate | Not fundamental in industrial estate |
| Local education strategies (eg schools) | Not fundamental in industrial estate | Not fundamental in industrial estate |
| Litter management and control | Robust litter management strategy will reduce the risks of rats frequenting the area looking for food | Robust litter management strategy will reduce the risks of rats frequenting the area looking for food |
| Dog fouling management and control | Not necessary in industrial estate | Not necessary in industrial estate |

| Summary of section 5 risk assessment for health issues | | | | | | |
|---|---|---|---|---|---|---|
| **Group** | **Likelihood of ill health** | **Likely consequence of ill health** | **Overall level of risk posed by the design** | **Further mitigation measures required** | **Action date** | **Final level of risk** |
| Children < 5 years | Rare | Major | Low | Not required | N/A | Low |
| Children ≥ 5 years | Rare | Major | Low | Not required | N/A | Low |
| Adults | Rare | Moderate | Low | Not required | N/A | Low |

**Note**
For definition of levels, see **Table 36.2 in Chapter 36**.

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