South Tees Development Corporation

GRAHAM

SOUTH BANK QUAY PHASE 1

FULL DESIGN PACKAGE – DRAINAGE

SBQ1-DCL-CIV-SBKXX-CA-CE-000006-P02

May 2022

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Doran Consulting Limited
Registered Office
Norwood House
96-102 Great Victoria Street
Belfast BT2 7BE

T 028 9033 3443
F 028 9023 5501
E mail@doran.co.uk
W www.doran.co.uk

FS 25466
OHS 507887
EMS 75248

consultancy **engineering** business **environment**

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Contents

1.0 INTRODUCTION

1.1 Description of the proposed Works

The purpose of the Works is to create a staging and manufacture hub, for offshore wind developments, on the River Tees. The proposed works (Phase 1) aims to deliver 450m of operational berth suitable for suitable extension to 1,035m of operational berth in future and comprises the following:

- Demolition of the existing wharf, jetties and associated infrastructure
- Construction of 450m of quay plus transition flares at each end. The quay wall will comprise a steel combi-wall connected by tie rods to an anchor wall inland of the quay.
- Capital dredging to create a new berth pocket and deepen the approach channel
- Pavement construction comprising;
    - Reinforced concrete pavement provided over a 50m wide strip parallel with the Phase 1 quay works as follows:
        - A zone 96m long to the NE of the heavy-lift platform.
        - A zone 100m long to the SW of the heavy-lift platform.
        - A zone 20m wide landward of the heavy lift platform.
    - Unbound pavements shall be provided over a 50m wide strip parallel with the Phase 1 quay works as follows:
        - A zone 90m long at the NE transition flare.
        - A zone 90m long at the Phase 1/Phase 2 transition flare.
- Surface water drainage to bound and unbound pavement areas

- Mechanical and Electrical system, including potable and firewater distribution system and spare duct network.

1.2 Acceptance in Principle Document

The design substantiated by the following calculations complies with the Employer's requirements which have been translated into the Acceptance in Principle (AIP) document (SBQ1-DCL-CIV-SBKXX-RP-CE-000006), included in Appendix A.

1.3 Objectives

The objective of this document is to present the design of the following element of the project:

- Surface water drainage system.

1.4 Design Codes, Standards and Reference Documents

The design shall be carried out in accordance with the codes and standards as stated in the Royal Haskoning DHV document titled *"Specification, South Bank Quay Phase 1, Scope Part 2 – Technical".* A non-exhaustive summary of the principal codes, standards and design guidance used are provided in Table 1-1 below.

Standard No.	Title
Eurocodes	
BS EN 1990	Eurocode 0: Basis of structural design*
BS EN 1991-1	Eurocode 1: Actions on structures*
BS EN 1992-1	Eurocode 2: Design of concrete structures*
BS EN 1993-1	Eurocode 3 Design of steel structures*
BE EN 1993-5	Eurocode 3: Design of steel structures - Part 5: Piling*
BS EN 1997-1	Eurocode 7: Geotechnical design: General rules*
EN 1993-5	Eurocode 3: Design of steel structures: Piling*
*And associated UK National Annexes	
British Standards	
BS 6349-1-1	Maritime works, Part 1-1 – General - Code of practice for planning and design for operations

BS 6349-1-2	Maritime works, Part 1-2 – General - Code of practice for assessment of actions
BS 6349-1-3	Maritime works, Part 1-3 – General - Code of practice for geotechnical design
BS 6349-1-4	Maritime works, Part 1-4 – General - Code of practice for materials
BS 6349-2	Maritime works, Part 2 – Code of practice for design of quay walls, jetties and dolphins
BS 6349-5	Maritime works, Part 5 – Code of practice for dredging and land reclamation
Design Guides and Additional References – Surface Water Drainage System	
Design and Construction Guidance	Design and Construction Guidance for foul and surface water sewers offered for adoption under the Code for adoption agreements for water and sewerage companies operating wholly or mainly in England ("the Code"), May 2021.
BS EN 16933-2:2017	Drain and Sewer Systems Outside Buildings - Design - Part 2: Hydraulic Design.
BS EN 752:2017	Drain and Sewer Systems Outside Buildings – Sewer System Management.
_	Building Regulations Approved Document H – Drainage and Waste Disposal.
_	Sewer Sector Guidance Appendix C – Design and Construction Guidance
BS EN 1295-1: 2019	Structural design of buried pipelines under various conditions of loading
PIANC WG 165	Design and maintenance of Container Terminal Pavements

Table 1-1: Design Codes and Standards

2.0 DEFINITIONS & ABBREVIATIONS

2.1 Acronyms & Abbreviations

Full Title	Abbreviation
Acceptance in Principle	AIP
Accelerated Low Water Corrosion	ALWC
Chart Datum	CD
Geotechnical Design Report	GDR
Geotechnical Interpretative Report	GIR
Highest Astronomical Tide	HAT
Lowest Astronomical Tide	LAT
kilo Newton	kN
Mean High Water Springs	MHWS
Mean Low Water Springs	MLWS
Microbiologically Induced Corrosion	MIC
Ordnance Datum	OD
Percentage Impermeable Proportion	PIMP
Serviceability Limit State	SLS
Ultimate Limit State	ULS
Uniformly Distributed Load	UDL

Table 2-1: Acronyms & Abbreviations

3.0 FUNCTIONAL LAYOUT

The drainage area is defined by the capping beam, concrete pavement area on Drainage Drawing SBQ1-DCL-CIV-SBKXX-DR-CE-400001-P05 (450m x 50m) and the unbound pavements at the 2No. transition zones measuring 90m x 50m.

The run-off from areas immediately landward of the 50m transition pavement, and 50m pavement across the 450m berth, is assumed to be incorporated in the Client's (STDC's) site wide drainage strategy and are therefore not incorporated in this FDP.

The paved area comprises;

- Reinforced concrete pavement provided over a 50m wide strip parallel with the Phase 1 quay works as follows:
  - A zone 96m long to the NE of the heavy-lift platform.
  - A zone 100m long to the SW of the heavy-lift platform.
  - A zone 20m wide landward of the heavy lift platform.
- Unbound pavements shall be provided over a 50m wide strip parallel with the Phase 1 quay works as follows:
  - A zone 90m long at the NE transition flare.
  - A zone 90m long at the Phase 1/Phase 2 transition flare.
- Capping beam, varying in width between 2.75m typically to 1.2m at the NE transition flare.

4.0 DESIGN PHILOSOPHY AND METHODOLOGY

4.1 Design Philosophy

The surface water drainage system has been designed in accordance with the Approval In Principle document. The primary function of the storm water drainage system is to collect surface runoff from the quay paving in an efficient manner. The drainage area includes the capping beam, 450m x 50m concrete pavement and 2No. 90m x 50m unbound transition zone (/flare) pavements. An ACO linear drainage system shall collect run-off from the bound concrete pavement. A filter drain with invert level of 1,500mm below the surface of the unbound granular pavement shall collect run-off from the 90m transition zones.

The surface water drainage system will drain surface water from the paved areas under gravity, and discharge to the River Tees via 4no Klargester NSFA225 Class 1 full retention interceptors and outfalls located within the combi-wall. The full retention separators are located upstream of each outfall to capture hydrocarbons. A penstock is provided downstream of each separator to prevent discharge into the River Tees in the event of an emergency/spillage. 600mm diameter tidal flap valves will be installed to the seaward side of each outfall to prevent water from the River Tees entering the drainage system.

The linear drainage system is aligned along the landward edge of the proposed 30m wide heavy lift platform. This is in lieu of the Tender specified centreline of the 50m pavement strip. This change has been made so to reduce the drainage systems encroachment into the heavy lift platform operational area.

It is assumed that the area landward of the 50m pavement is included within the Client's (STDC's) site wide drainage strategy and therefore is not included within this FDP.

The maximum expected settlement expected during the design life of the pavement is approximately 80mm. The pipe gradient between all key elements has been increased to accommodate a potential 80mm settlement. The minimum gradient of pipes following the predicted settlement will be 1/D for gravity pipes, where D is the diameter in mm. Rocker pipes will be installed at all pipe connects to enable rotation of the pipes.

4.2 Design Parameters

The Design Inputs and Parameters for the Surface Water Drainage design are outlined in Table 4-1 below. References to the relevant sections of the AIP document are provided.

	DESIGN PARAMETERS
Design Life (ref A.I.P 4.2)	Valves, Hydrants and Fittings: 25years (normal and routine maintenance required in accordance with manufacturer's instructions) Surface Water Drainage Pipework: 50 years based on routine maintenance (annual (or as required) inspection for blockages and signs of damage. Removal of blockages, silt and debris is required). Surface Water Drainage Manholes and Gullies: 50 years based on routine maintenance (annual (or as required) inspection for blockages and signs of damage. Removal of blockages, silt and debris is required). Oil Separators: 50 years (normal and routine maintenance required in accordance with manufacturer's instructions)
C.C. Allowance (ref A.I.P 4.2)	40% to be used in the drainage design (Upper end – 2060 to 2115)
Rainfall Data (ref A.I.P 4.2)	NGR – NZ 53556 22656 Bifhost – 0.712 Bfihost19 – 0.744 Propwet – 0.32 SAAR6190 – 594mm Rainfall data – FEH 2013 Obtained using Flood Estimation Handbook (FEH) Web Service
Time of Entry (ref A.I.P 4.2)	4 minutes

Volumetric Runoff Coefficient for Summer (ref A.I.P 4.2)	0.75
Volumetric Runoff Coefficient for Winter (ref A.I.P 4.2)	0.84
Gravity Pipe Roughness (k) (mm) (ref A.I.P 4.2)	Concrete pipes: 0.6 HDPE and uPVC (smooth internal bore): 0.015
PIMP for all hardstanding areas (ref A.I.P 4.2)	100%
Minimum self-cleansing velocity (m/s) 1.0 (ref A.I.P 4.2)	1.0
Minimum depth of cover to crown (ref A.I.P 4.2)	The minimum cover to pipes shall be; Road / Trafficked Area: 1.2m Where the depth of cover is less than the minimum value, pipes shall be protected by a SHW Class Z concrete surround.
Minimum Hydraulic Performance **Requirements per Return Period** (ref A.I.P 4.2)	□ 1 in 2 year – no surcharging of the network □ 1 in 30 year – design not to flood any part of the site □ 1 in 100year + 40% Climate change – flooding to remain on site, buildings to be protected

Differential Settlement	Additional falls shall be provided to ensure that after predicted settlement, the slopes of the pipes will be sufficient for the drainage system to comply with the design criteria.
Minimum Slope	Minimum 1/D for gravity pipes, where D is the diameter in mm.
Catchment Area	Refer to Drawings in Appendix B.

Table 4-1: Design parameters

4.3 Location of Above Ground Equipment

All above ground equipment, such as electrical control cabinets/mini pillars, warning beacons etc) are to be located clear of main trafficked routes and normal plant operating areas. Where they could be vulnerable to accidental impact from vehicles, they will be protected by bollards and vehicle restraint barriers.

An electrical mini pillar is shown on drawing SBQ1-DCL-CIV-SBKXX-DR-CE-400001 in Appendix B, the location of which is to be agreed with the Client. A single electrical pillar is proposed to which the 4No. full retention interceptors shall be electrically connected.

The Client shall confirm the telemetry to be provided at the electrical pillar for each full retention interceptor, and any visual or audible alarms to be provided at the location of each full retention interceptor to suit the Client's monitoring regime.

4.4 Trenching

Warning tape shall be installed above the power cabling for the petrol interceptors. Colour coded tiles for identification at intervals not exceeding 700mm. The tape shall be PVC or polyethylene mesh at least 150mm wide incorporating tracer wire with colour coding in accordance with NJUG Guidelines on the Positioning of Underground Apparatus for New Development Sites.

4.5 Materials and Structural Form

Drains and outlets installed will generally be constructed using low corrosive materials as follows:

- Perforated pipes to be HDPE twin wall.
- Service connections 150mm diameter uPVC.
- Pipes up to 300mm diameter: uPVC or HDPE.
- Pipes 375mm diameter and larger: concrete, HDPE or GRP.

Typical circular manhole sizes to suit specific pipe diameters are listed below.

Largest Pipe in Manhole	Manhole Diameter (internal)
Less than 375mm	1200mm
375 - 450mm	1350mm
500 - 700mm	1500mm
750 - 900mm	1800mm

4.6 Manhole Frames and Covers

Manhole frames and covers, surface boxes and the like, are non-rocking, ductile iron complying with BS EN 124 (Class F900). Ductile iron gratings, covers and frame shall:

A) Provided as an interlocking proprietary product.

B) Coated with epoxy paint to a minimum DFT of 300 microns (2-pack epoxy), not to be applied to the mating faces. Protective treatment to be in accordance with BS EN ISO 12944 Part 5:2007 Table A.5.

However, where ductile iron covers and the like are manufactured with machine faces to fit within the frames, protective treatment shall be confined to exposed, non-machined faces. Machine faces shall be coated with a suitable graphite grease.

Manholes are detailed at all changes in direction and at maximum intervals of 100m. Three sets of lifting keys shall be supplied for each type of:

- Reinforced concrete cover.
- Ductile iron cover.
- Proprietary non-metallic cover.
- Surface box.
- Grating.

All proprietary products shall be installed to manufacturer's specifications and recommendations.

4.7 Oil Separator

Prior to being discharged to the River Tees, the surface water drainage shall pass through 4no Klargester NSFA225 Class 1, full retention separators.

The separators will be provided with electrical connections which will be operated from an external kiosk. The location of the control unit is detailed on drawing SBQ1-DCL-CIV-SBKXX-DR-CE-400001 and shall be integrated into STDC's electrical deign strategy for Phase 1. All separators will be fitted with vent and alarm facilities located in an appropriate position to suit the Site and environment.

Proprietary flow control systems (Hydro-break or similar) will be installed in the chamber immediately upstream of each interceptor. The flow control systems will limit the peak discharge rate to each interceptor to 225l/s.

4.8 Outfalls

The 4no Outfalls are located within the front combi wall, located between tubular piles.

Tidal flap valves are provided on the seaward face of the wall at the outfall location. The flap valves shall be HDPE and fixings shall be stainless steel grade 316.

Penstocks shall be provided immediately upstream of the outfalls to enable safe maintenance works to the networks.

Penstocks are designed and manufactured to comply with BS 7775 with a flush invert. Penstocks will be provided with non-rising stem spindles. The spindles will be adequately supported over their length to ensure efficient operation when opening and closing.

The penstocks are manually operated by means of removable tee bars to be supplied with each Penstock.

4.9 Testing of Gravity Pipeline

All pipelines up to and including DN1000 shall be tested in accordance with Clause E7.3 of the Sewer Sector Guidance Appendix C – Design and Construction Guidance

5.0 ANALYSIS AND DESIGN METHODOLOGY

5.1 Surface Water Drainage System

The surface water drainage system was designed to achieve the most efficient layout with regards pipe sizing, number of manholes and full retention separators, with full consideration for the need to locate manholes and above surface equipment in locations which will cause minimal impact to operational areas.

5.2 Pavement Level Strategy

All surface gradients were set at a fall of 1V:80H with the surfacing falling from the caping beam to the drainage channel and rising again to the landward edge of the pavement (situated 50m landward of the capping beam). The gradients remain uniform over the 450m operational berth and the 2No. 90m transition zones/flares. The unbound pavement also fall towards a linear drain located in a ‘valley’ at the landward end of the heavy lift platform (i.e. circa 30m from the capping beam).

5.3 Pipe and Manhole Sizing

The surface water pipe and manhole sizing were determined using Innovyze Microdrainage which utilises the Modified Rational Method. The input parameters complied with those identified in Table 4-1. The Micro-drainage calculations for the storm networks are Provided in Appendix C.

Manhole sizing also complied with DCG Table B1 for which minimum nominal internal dimension of the manhole considered the nominal internal diameter of the largest pipe in the manhole. The network manhole schedule is presented in Appendix B.

5.4 Linear Drainage System

The linear drainage systems are to be formed using ACO QMax 900, ACO QMax 700 and ACO QMax550 channels. The general arrangement of the linear drainage systems are detailed in drawing SBQ1-DCL-CIV-SBKXX-DR-CE-400001-P05. The channels have been sized so not to flood out in a 1 in 30 year rainfall event. hydraulic design calculations are provided in appendix D.

5.5 Full Retention Interceptor

The 4no Klargester NSFA225 full retention separator will serve the proposed development. The units are stated by Kingspan to suitable for use for areas up to 12,500m^2 and a peak discharge rate of 225l/s.

The on site catchment area of each interceptor unit is approximately 8,310m^2 and the peak discharge rate for each catchment area in a 1 in 30 year event has been limited to 225l/s via the installation of flow control devices upstream of the interceptors.

During a 1 in 100 year + 40% CC storm event (15min winter) the peak discharge rate remains limited to 225l/s for each of the storm systems.

The total volume of flood water out of chamber within the storm drainage system is 200m^3 over the full extent of the drainage system. The total flood storage capacity provided by the 450m length heavy lift zone and concrete pavement is 2,250m^3. This increases to approximately 3,025m^3 if the 180m length of unbound pavements at either end of the quay are included.

Therefore, during a 1 in 100 year +40% CC rainfall event all flood water will be retained within the site boundary as the storage potential of the site exceeds the predicted flood volume generated.

APPENDIX A – ACCEPTANCE IN PRINCIPLE (AIP) DOCUMENT

South Tees Development Corporation

GRAHAM

SOUTH BANK QUAY PHASE 1

ACCEPTANCE IN PRINCIPLE – DRAINAGE

SBQ1-DCL-CIV-SBKXX-RP-CE-000006-P03

February 2022

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SBQ1	PMcM	SJQ	CD	S5	P01	GRAHAM	e*	05/10/21

Doran Consulting Limited
Registered Office
Norwood House
96-102 Great Victoria Street
Belfast BT2 7BE

T 028 9033 3443
F 028 9023 5501
E mail@doran.co.uk
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Contents

1.0 INTRODUCTION

1.1 Description of the proposed Works

The purpose of the Works is to create a staging and manufacture hub, for offshore wind developments, on the River Tees. The proposed works (Phase 1) aims to deliver 450m of operational berth suitable for suitable extension to 1035m of operational berth in future and comprises the following:

- Demolition of the existing wharf, jetties and associated infrastructure
- Construction of 450m of quay plus transition flares at each end. The quay wall will comprise a steel combi-wall connected by tie rods to an anchor wall inland of the quay.
- Capital dredging to create a new berth pocket and deepen the approach channel
- Pavement construction comprising;
    - Reinforced concrete pavement provided over a 50m wide strip parallel with the Phase 1 quay works as follows:
        - A zone 150m long to the NE of the heavy-lift platform.
        - A zone 150m long to the SW of the heavy-lift platform.
        - A zone 20m wide landward of the heavy lift platform.
    - Unbound pavements shall be provided over a 50m wide strip parallel with the Phase 1 quay works as follows:
        - A zone 90m long at the NE transition flare.
        - A zone 90m long at the Phase 1/Phase 2 transition flare.
- Surface water drainage to pavement areas

- Mechanical and Electrical system, including potable and firewater distribution system and spare duct network.

1.2 Objectives

This Acceptance in Principle (AIP) document provides an overview of the design parameters and design approach for elements relating to the Surface Water Drainage System.

1.3 Design Codes, Standards and Reference Documents

The design shall be carried out in accordance with the codes and standards as stated in the Royal Haskoning DHV document titled *"Specification, South Bank Quay Phase 1, Scope Part 2 – Technical".* A non-exhaustive summary of the principal codes, standards and design guidance used are provided in Table 1-1 below. The Project Manager will be informed of any departures from Normal Standards if they are identified during the Detailed Design phase.

Standard No.	Title
Eurocodes	
BS EN 1990	Eurocode 0: Basis of structural design*
BS EN 1991-1	Eurocode 1: Actions on structures*
BS EN 1992-1	Eurocode 2: Design of concrete structures*
BS EN 1993-1	Eurocode 3 Design of steel structures*
BE EN 1993-5	Eurocode 3: Design of steel structures - Part 5: Piling*
BS EN 1997-1	Eurocode 7: Geotechnical design: General rules*
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*And associated UK National Annexes	
British Standards	
BS 6349-1-1	Maritime works, Part 1-1 – General - Code of practice for planning and design for operations
BS 6349-1-2	Maritime works, Part 1-2 – General - Code of practice for assessment of actions
BS 6349-1-3	Maritime works, Part 1-3 – General - Code of practice for geotechnical design
BS 6349-1-4	Maritime works, Part 1-4 – General - Code of practice for materials

BS 6349-2	Maritime works, Part 2 – Code of practice for design of quay walls, jetties and dolphins
BS 6349-5	Maritime works, Part 5 – Code of practice for dredging and land reclamation
Design Guides and Additional References	
CIRIA C760,	Guidance on embedded retaining wall design
CIRIA C504	Engineering in glacial tills
CIRIA C570	Engineering in Mercia Mudstone
EAU 2012	Recommendations of the Committee for Waterfront Structures Harbour and Waterways (9th Edition)
-	Pile Design and Construction Practice, Sixth Edition by MJ Tomlinson and J Woodward
-	ArcelorMittal Piling Handbook 9th Edition
Design Guides and Additional References – Surface Water Drainage System	
Design and Construction Guidance	Design and Construction Guidance for foul and surface water sewers offered for adoption under the Code for adoption agreements for water and sewerage companies operating wholly or mainly in England ("the Code"), May 2021.
BS EN 16933-2:2017	Drain and Sewer Systems Outside Buildings - Design - Part 2: Hydraulic Design.
BS EN 752:2017	Drain and Sewer Systems Outside Buildings – Sewer System Management.
_	Building Regulations Approved Document H – Drainage and Waste Disposal.
_	Sewer Sector Guidance Appendix C – Design and Construction Guidance
BS EN 1295-1: 2019	Structural design of buried pipelines under various conditions of loading
PIANC WG 165	Design and maintenance of Container Terminal Pavements

Table 1-1: Design Codes and Standards

2.0 DEFINITIONS & ABBREVIATIONS

2.1 Acronyms & Abbreviations

Full Title	Abbreviation
Acceptance in Principle	AIP
Accelerated Low Water Corrosion	ALWC
Chart Datum	CD
Geotechnical Design Report	GDR
Geotechnical Interpretative Report	GIR
Highest Astronomical Tide	HAT
Lowest Astronomical Tide	LAT
kilo Newton	kN
Mean High Water Springs	MHWS
Mean Low Water Springs	MLWS
Microbiologically Induced Corrosion	MIC
Ordnance Datum	OD
Percentage Impermeable Proportion	PIMP
Serviceability Limit State	SLS
Ultimate Limit State	ULS
Uniformly Distributed Load	UDL

Table 2-1: Acronyms & Abbreviations

3.0 FUNCTIONAL LAYOUT

The drainage area is defined by the capping beam, concrete pavement area on Definition Drawing PC1084-RHD- SB-DN-DR-C-1392 (450m x 50m) and the unbound pavements at the 2No. transition zones measuring 90m x 50m.

The tie-in levels, and hence drainage strategy landward of the drainage area defined above is to be confirmed by the Client. It is assumed that run-off from areas out with this drainage area is not to be incorporated in the South Bank Quay Phase 1 drainage design covered by this Acceptance in Principle.

This paved area comprises;

- Reinforced concrete pavement provided over a 50m wide strip parallel with the Phase 1 quay works as follows:
  - A zone 150m long to the NE of the heavy-lift platform.
  - A zone 150m long to the SW of the heavy-lift platform.
  - A zone 20m wide landward of the heavy lift platform.
- Unbound pavements shall be provided over a 50m wide strip parallel with the Phase 1 quay works as follows:
  - A zone 90m long at the NE transition flare.
  - A zone 90m long at the Phase 1/Phase 2 transition flare.
- Capping beam, varying in width between 2.75m typically to 1.2m at the NE transition flare.

The drainage strategy immediately landward of the 50m transition pavement, and 50m pavement across the 450m berth, is assumed to be incorporated in the Client's (STDC's) site wide drainage strategy and not incorporated in this AIP.

4.0 DESIGN PHILOSOPHY AND METHODOLOGY

4.1 Design Philosophy

The surface water drainage system will be designed in accordance with Scope Part 2. The primary function of the storm water drainage system is to collect surface runoff from the quay paving in an efficient manner. The drainage area shall include the capping beam, 450m x 50m concrete pavement and 2No. 90m x 50m unbound transition zone (/flare) pavements.

The surface water drainage system shall drain surface water from the paved areas under gravity, and discharge to the River Tees via Class 1 full retention interceptors and outfalls located within the combi wall. Full retention separators shall be located upstream of each outfall to capture hydrocarbons and debris. A penstock shall be provided downstream of each separator to prevent discharge into the River Tees where required. Tidal flap valves shall be fitted to the seaward side of the outfall to prevent water from the River Tees entering the drainage system.

A linear drainage system at the landward edge of the proposed 30m wide heavy lift platform, is proposed in lieu of the centreline of the 50m pavement strip, so as to reduce encroachment into the heavy lift platform operational area.

It is assumed that the area landward of the 50m pavement shall be included within the Client's (STDC's) site wide drainage strategy.

The design of the surface water drainage system shall accommodate ground settlement expected during the design life.

4.2 Design Parameters

The Design Inputs and Parameters for the Surface Water Drainage design are outlined in Table 4-1 below. References to the relevant sections of the Employer's Requirements are provided.

	DESIGN PARAMETERS
Design Life	Ref Scope Part 2: Cl 1.4 Valves, Hydrants and Fittings: 25years (normal and routine maintenance required in accordance with manufacturer's instructions) Surface Water Drainage Pipework: 50 years based on routine maintenance (annual (or as required) inspection for blockages and signs of damage. Removal of blockages, silt and debris is required). Surface Water Drainage Manholes and Gullies: 50 years based on routine maintenance (annual (or as required) inspection for blockages and signs of damage. Removal of blockages, silt and debris is required). Oil Separators: 50 years (normal and routine maintenance required in accordance with manufacturer's instructions)
Climate Change Allowance (ref Scope 2 Cl 14.2)	40% to be used in the drainage design (Upper end – 2060 to 2115)
Rainfall Data (ref Scope 2 Cl 14.2)	To be obtained using Flood Studies Report (FSR) Flood Estimation Handbook (FEH) 2013
Time of Entry (ref Scope 2 Cl 14.2)	4 minutes
Volumetric Runoff Coefficient for Summer (ref Scope 2 Cl 14.2)	0.75

Volumetric Runoff Coefficient for Winter (ref Scope 2 Cl 14.2)	0.84
Gravity Pipe Roughness (k) (mm) (ref Scope 2 Cl 14.2)	Concrete pipes: 0.6 HDPE and uPVC (smooth internal bore): 0.015
PIMP for all hardstanding areas (ref Scope 2 Cl 14.2)	100%
Minimum self-cleansing velocity (m/s) 1.0 (ref Scope 2 Cl 14.2)	1.0
Minimum depth of cover to crown (ref Scope 2 Cl 14.6)	The minimum cover to pipes shall be; Road / Trafficked Area: 1.2m Where the depth of cover is less than the minimum value, pipes shall be protected by a concrete surround.
Minimum Hydraulic Performance Requirements per Return Period (ref Scope 2 Cl 14.2)	□ 1 in 2 year – no surcharging of the network □ 1 in 30 year – design not to flood any part of the site □ 1 in 100year + Climate change – flooding to remain on site, buildings to be protected
Differential Settlement	Additional falls shall be provided to ensure that after predicted settlement, the slopes of the pipes will be sufficient for the drainage system to comply with the design criteria.
Minimum Slope	Generally 1/D for gravity pipes, where D is the diameter in mm.
Catchment Area	Refer to Drawings in Appendix B.

Table 4-1: Design parameters

4.3 Location of Above Ground Equipment

All above ground equipment, such as electrical control cabinets/mini pillars, warning beacons etc) shall be located clear of main trafficked routes and normal plant operating areas. Where they could be vulnerable to accidental impact from vehicles, they shall be protected by bollards and vehicle restraint barriers.

An electrical mini pillar is shown on drawing SBQ1-DCL-CIV-SBKXX-DR-CE-400001 in Appendix B, the location of which is to be agreed with the Client. A single electrical pillar is proposed to which the 4No. full retention interceptors shall be electrically connected.

The Client shall confirm the telemetry to be provided at the electrical pillar for each full retention interceptor, and any visual or audible alarms to be provided at the location of each full retention interceptor to suit the Client's monitoring regime.

4.4 Trenching

Warning tape shall be installed above surface water ducts. Colour coded table shall be suitably inscribed for identification at intervals not exceeding 700mm. The tape shall be PVC or polyethylene mesh at least 150mm wide incorporating tracer wire with colour coding in accordance with NJUG Guidelines on the Positioning of Underground Apparatus for New Development Sites (Note that red tape is to be installed above surface water pipes).

4.5 Materials and Structural Form

Drains and outlets installed shall generally be constructed using low corrosive materials as follows:

- Perforated pipes to be HDPE twin wall.
- Service connections 150mm diameter uPVC.
- Pipes up to 300mm diameter: uPVC or HDPE.
- Pipes 350mm diameter and larger: concrete, HDPE or GRP.

Typical circular manhole sizes to suit specific pipe diameters are listed below. These should be used as a guide for the minimum size required when developing the gravity designs.

Largest Pipe in Manhole	Manhole Diameter (internal)
Less than 375mm	1200mm
375 - 450mm	1350mm
500 - 700mm	1500mm
750 - 900mm	1800mm

4.6 Manhole Frames and Covers

Manhole frames and covers, surface boxes and the like, shall be non-rocking, ductile iron complying with BS EN 124 (Class F900). Ductile iron gratings, covers and frame shall:

A) Provided as an interlocking proprietary product.

B) Coated with epoxy paint to a minimum DFT of 300 microns (2-pack epoxy), not to be applied to the mating faces. Protective treatment to be in accordance with BS EN ISO 12944 Part 5:2007 Table A.5.

However, where ductile iron covers and the like are manufactured with machine faces to fit within the frames, protective treatment shall be confined to exposed, non-machined faces. Machine faces shall be coated with a suitable graphite grease.

Manholes shall be located at changes in direction and at maximum interval of 100m (ref. Scope Part 2 Cl 14.6).

Three sets of lifting keys shall be supplied for each type of:

- Reinforced concrete cover.
- Ductile iron cover.
- Proprietary non-metallic cover.
- Surface box.
- Grating.

All proprietary products shall be installed to manufacturer's specifications and recommendations.

Where manholes are provided with concrete covers, these shall be designed to resist the effects of:

(a) Repetitive heavy wheel loads due to heavy port equipment.

(b) Adequate space to allow for easy maintenance access.

(c) Limiting the size of cover for ease of handling and/ or having smaller personnel access covers.

(d) The provision of suitable lifting sockets.

(e) The seating of the cover within its frame to ensure non-rocking.

4.7 Oil Separator

Prior to being discharged to the River Tees, the surface water drainage shall pass through a Class 1, full retention separator certified to BS EN 858 and in accordance with Environment Agency guidance.

All separators will be provided with electrical connections which shall be operated from an external kiosk. The location of the control units will be finalised during the final detailed design stage and shall be integrated into STDC's electrical deign strategy for Phase 1. All separators will be fitted with vent facilities located in an appropriate position to suit the Site and environment.

All fittings for the separators shall suit the geology and surroundings of the Site (Maritime Environment).

4.8 Outfalls

Outfalls shall be located within the front combi wall, located between tubular piles.

Tidal flap valves shall be provided on the seaward face of the wall at the outfall location. The opening angle of the flap valve shall be considered with regards mitigating interference with berth operations. The flap valves shall be HDPE and fixings shall be stainless steel grade 316.

Penstocks shall be provided immediately upstream of the outfalls to enable safe maintenance works to the networks.

Where required, penstocks shall be designed and manufactured to comply with BS 7775 with a flush invert. Penstocks shall be provided with non-rising stem spindles. Spindles shall be adequately supported over their length to ensure efficient operation when opening and closing.

Penstocks shall be manually operated by means of removable tee bars to be supplied with each Penstock.

4.9 Testing of Gravity Pipeline

All pipelines up to and including DN1000 shall be tested in accordance with Clause E7.3 of the Sewer Sector Guidance Appendix C – Design and Construction Guidance

5.0 ANALYSIS AND DESIGN METHODOLOGY

5.1 Surface Water Drainage System

The surface water drainage system shall be designed to achieve the most efficient layout with regards pipe sizing, number of manholes and full retention separators, with full consideration for the need to locate manholes and above surface equipment in locations which will cause minimal impact to operational areas.

5.2 Pavement Level Strategy

A fall of 1V:80H will be considered from the 'peaks' at the seaward edge of the capping beam and landward edge of the pavement situated 50m landward of the capping beam (over the 450m operational berth and 2No. 90m transition zones/flares). The pavement shall fall towards a linear drain located in a 'valley' at the landward end of the heavy lift platform (i.e. circa 30m from the capping beam). Autodesk Civils 3D shall be used to model the finished ground level and hence shall be used to obtain catchment areas.

A settlement analysis will be undertaken to determine the predicted settlement across the site for which the effect on the pavement and pipe gradients shall be determined. The hydraulic design shall make allowance for this. The gatic / linear drain outlet to the interceptor shall be provided with a steeper gradient than required by design, and rocker pipe connection provided, to allow for settlement and maintain gravity flow.

5.3 Pipe and Manhole Sizing

The surface water pipe and manhole sizing shall be determined using Innovyze Microdrainage which utilises the Modified Rational Method. The input parameters will comply with those identified in Table 4-1.

Manhole sizing shall also comply with DCG Table B1 for which minimum nominal internal dimension of the manhole shall consider the nominal internal diameter of the largest pipe in the manhole.

5.4 Full Retention Interceptor

The full retention separator size shall be selected based on the catchment area and shall be sized to ensure throttling does not occur.

6.0 PROPOSED OUTLINE OF FULL DESIGN PACKAGE

The Full Design Package will include the following in accordance with Scope Part 2 Cl 7.6:

1. Accepted Acceptance in Principle Document
2. Detailed Design Calculations and Design Risk Assessments;
    a. Introduction
        i. Objectives
        ii. Reference Documents
        iii. Design Standards
    b. Definitions
    c. Functional Layout
    d. Design Philosophy and Methodology
        i. Structural description
        ii. Design philosophy
        iii. Analysis and design methodology
    e. Structural Analysis Input
        i. Structural model geometry
        ii. Materials properties
        iii. Section properties
        iv. Model supports and connections
        v. Basic loads

vi. Load combinations

f. Structural Analysis Output

g. Structural Design

3. Design Calculations Engineering Sketches
4. Construction Sequence
5. Design Certificate and Design Check Certificate

APPENDIX B: GENERAL ARRANGEMENT DRAWINGS

Rev.	Date	By	Check	Details	Appr.
P01	12/11/21	CB	PMM	First Issue	CD
P02	03/02/22	CB	PMM	Drainage plan amended.	CD
P03	10/02/22	CB	PMM	Unbound Area Amended.	CD
P04	24/03/22	CB	PMM	Manholes Numbered. Pipe sizes amended. Notes added.	CD
P05	05/05/22	CB	PMM	HLP Extended. Qmax sizes updated. Notes added. Manholes updated.	CD

Notes

1. All dimensions in mm unless noted otherwise.
2. All levels in metres to Chart Datum (CD).
3. Full retention separators to be Karlgester NSFA225 or approved equal.
4. Tidal flap valves to be Althon 600mm tidal flap valves or approved equal.
5. The Multispan access cover located over the 4no filter access points on top of the full retention seperator to be DM/F Loading Class F900 4000mm x 1200mm Gatic Access Cover
6. Covers to storm chambers to be load class F900 in accordance with BS EN 124. Covers shall be coated with epoxy paint to a minimum DFT of 300 microns (2 Pack epoxy) protective treatment to be in accordance with BS EN ISO 12944 Part 5.
7. Penstocks shall be provided with non–rising stem spindles. Spindles shall be adequately supported over their length to ensure efficient operation when opening and closing the door. Penstocks shall be manually operated by means of removable tee bars to be supplied with each Penstock
8. Traffic Bollard protective coating finish colour shall be RAL 1016 Sulphur Yellow.

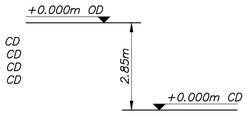
Legend

- ACO Channel
- Storm Pipe
- Petrol Interceptor
- Filter Drain
- Storm chamber with F900 cover
- ACO QMAX Access Chamber F900
- Drainage Area
- Petrol Interceptor Alarm Probe Ducting Route and Chamber
- Petrol Interceptor Mlni Pillar
- Unbound Pavement
- Jointed Reinforced Concrete Pavement

ISSUED FOR APPROVAL

Tide Levels CD:

HAT	= +6.100m CD
MHWS	= +5.500m CD
MLWS	= +0.900m CD
LAT	= +0.000m CD



South Tees Development Corporation

GRAHAM

Project Title:

South Bank Quay (Phase 1)
Teesworks

Drawing Title:

River Quay
Proposed Drainage Layout
Sheet 1

Client/Architect:	GRAHAM		
Drawn by:	CB	Date:	Nov 2021
Checked by:	RH	Scales:	1:1000
Approved by:	CD	Sheet Size:	A1
Doran Project No.	2110118B	Status:	S5

Project No.	Orig.	Role.	Volume/Level.	Form.	Disc.	Number.	Rev:
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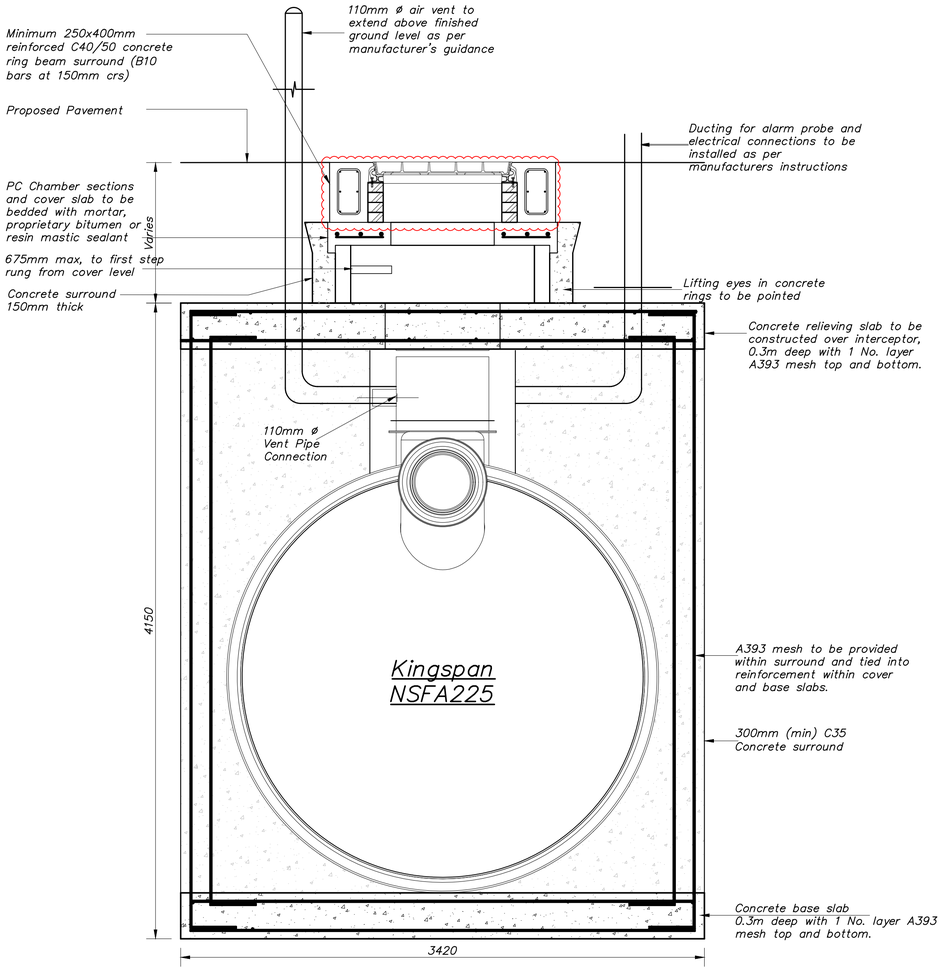
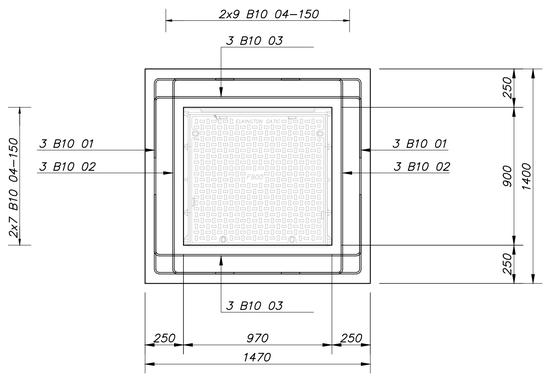
Doran CONSULTING
DELIVERING ENGINEERING EXCELLENCE
Norwood House
96-102 Great Victoria Street,
Belfast BT2 7BE
T 028 90333443
F 028 90235501
E mail@doran.co.uk
W www.doran.co.uk

Rev.	Date	By	Check	Details	Appr.
P01	12/11/21	CB	PMM	First Issue	CD
P02	29/01/22	CB	PMM	Petrol Interceptor Updated.	CD
P03	11/02/22	CB	PMM	Status Updated to S5.	CD
P04	23/03/22	CB	PMM	Table added.	CD
P05	05/05/22	CB	PMM	Ring Beam Amended	CD



NSFA225 Class 1 Full Retention Separator Detail

1:20

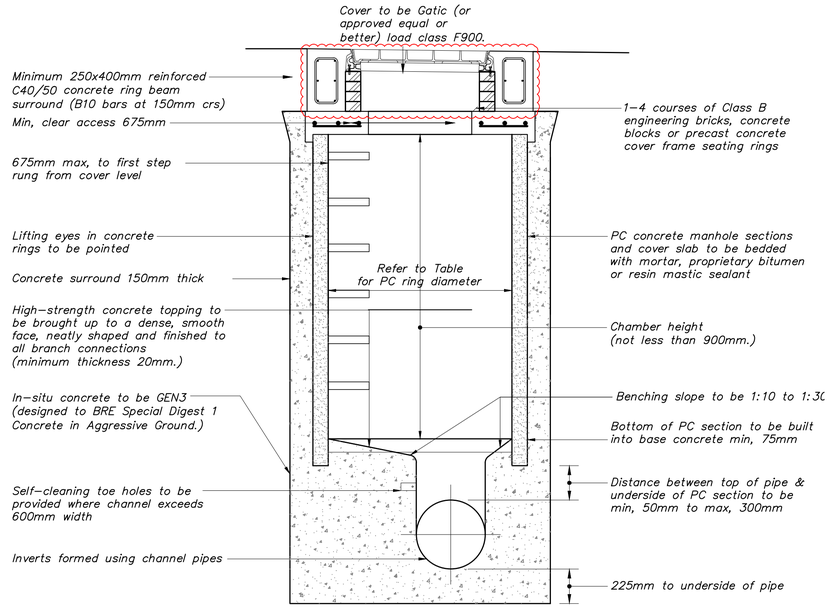


Typical Manhole Ring Beam Reinforcement Details

1:20

Member	Bar mark	Type and size	No. of nbrs.	No. of bars in each	Total no.	Length of each bar + mm	Shape code	A* mm	B* mm	C* mm	D* mm	E/R* mm	Rev letter
Manhole Ring Beam	01	B10	1	6	6	3150	21	950	1275	(950)			
	02	B10	1	6	6	2050	21	400	1275	(400)			
	03	B10	1	6	6	2125	21	400	1350	(400)			
	04	B10	1	32	32	1075	51	150	300	(130)	(130)		

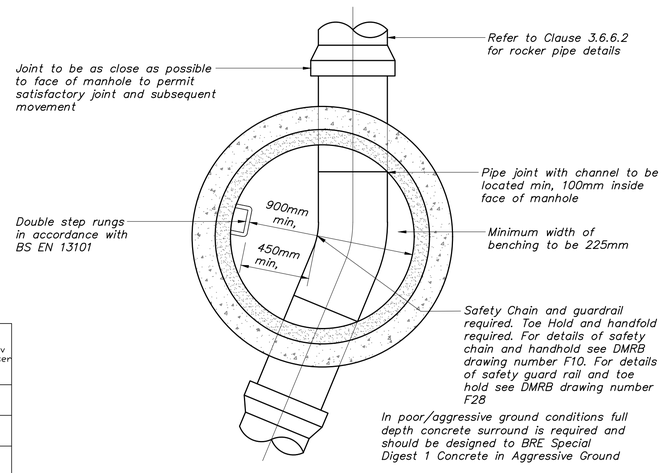
This schedule conforms to BS 8666:2005
* Specified in multiples of 5 mm + Specified in multiples of 25 mm



Typical Manhole Detail – A

1:20

Maximum depth from cover level to soffit of pipe 3.0m
Pipe size ≤450mm



Typical Manhole – A Sectional Plan

1:20

Maximum depth from cover level to soffit of pipe 3.0m
Pipe size ≤450mm

Nominal diameter of largest pipe in manhole (mm)	Mnimum nominal internal diameter of manhole (mm)
Less than 375	1200
375–400	1350
500–700	1500
750–900	1800
Greater than 900	Pipe diamter + 900

Notes

1. All dimensions in mm unless otherwise stated.
2. All levels in metres above Chart Datum (CD) unless outherwise noted
3. Chart datum at Teesport is 2.850m below Ordnance Datum (OD)
4. Full retention separators to be Klargester NSFA225 or approved equal.
5. Tidal flap valves to be Althon 450mm tidal flap vales or approved equal
6. The Multispan access cover located over the 4no filter access points on top of the full retention seperator to be DM/F Loading Class F900 4000mm x 1200mm Gatic Access Cover.
5. Covers to storm chambers to be load class F900 in accordance with BS EN 124. Covers shall be coated with epoxy paint to a minimum DFT of 300 microns (2 Pack epoxy) protective treatment to be in accordance with BS EN ISO 12944 Part 5.

ISSUED FOR APPROVAL

South Tees Development Corporation

GRAHAM

Project Title:

South Bank Quay (Phase 1)
Teesworks

Drawing Title:

Drainage Standard Details
Sheet 1

Client/Architect:	GRAHAM		
Drawn by:	CB	Date:	Nov 2021
Checked by:	RH	Scales:	As Shown
Approved by:	CD	Sheet Size:	A1
Doran Project No.	2110118B	Status:	S5

Project No.	Orig.	Role.	Volume/Level.	Form.	Disc.	Number.	Rev:
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Doran CONSULTING
DELIVERING ENGINEERING EXCELLENCE
Norwood House
96-102 Great Victoria Street,
Belfast BT2 7BE
T 028 90333443
F 028 90235501
E mail@doran.co.uk
W www.doran.co.uk

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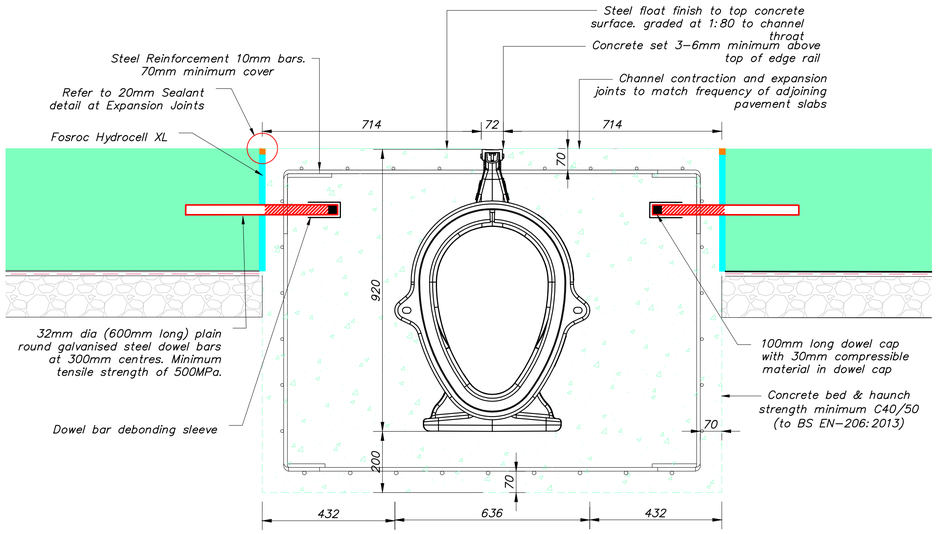
P01	12/11/21	CB	PMM	First Issue	CD
P02	02/02/22	CB	PMM	Details updated.	CD
P03	10/02/22	CB	PMM	Filter Drain Added.	CD
P04	24/03/22	CB	PMM	Filter Drain Amended.	CD
P05	05/05/22	CB	PMM	QMAX900 Added.	CD

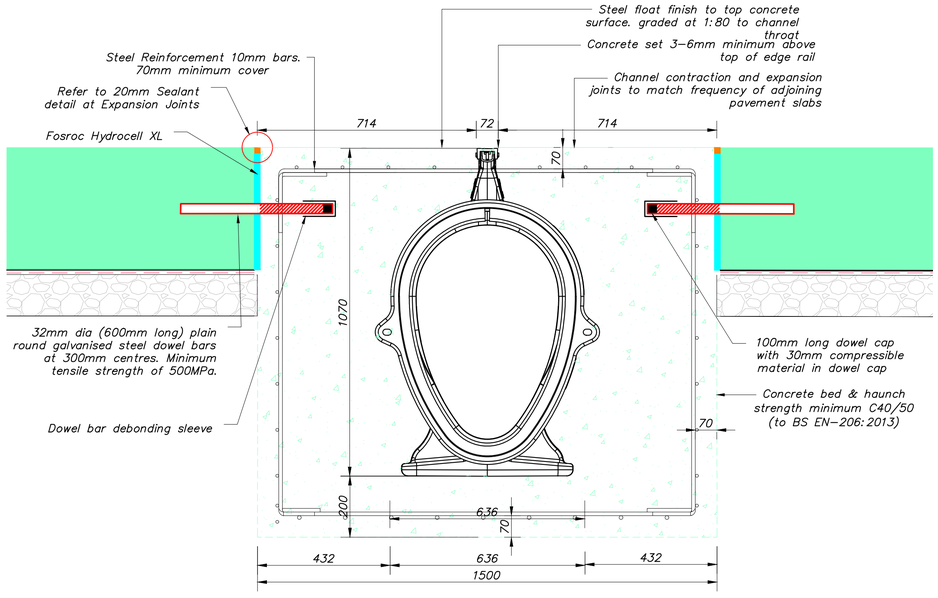
Notes

1. All dimensions in mm unless otherwise stated.
2. All levels in metres above Chart Datum (CD) unless outherwise noted
3. Chart datum at Teesport is 2.850m below Ordnance Datum (OD)



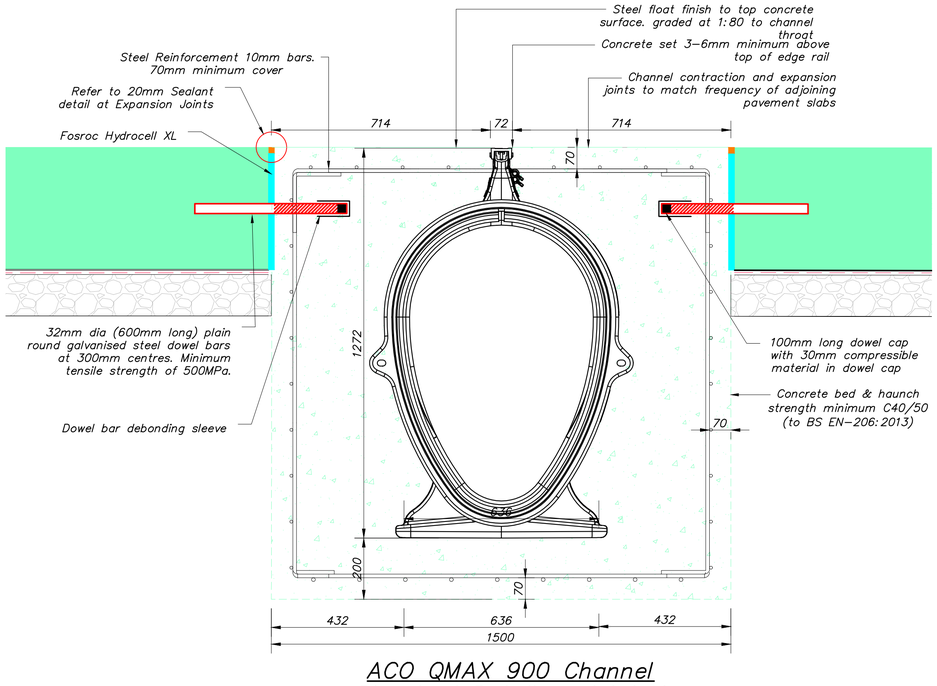
ACO QMAX 550 Channel Standard Detail – Jointed Reinforced Concrete Surfacing

1:10



ACO QMAX 700 Channel Standard Detail – Jointed Reinforced Concrete Surfacing

1:10



ACO QMAX 900 Channel Standard Detail – Jointed Reinforced Concrete Surfacing

1:10

ISSUED FOR APPROVAL

South Tees Development Corporation

GRAHAM

Project Title:

South Bank Quay (Phase 1)

Teesworks

Drawing Title:

Drainage Standard Details

Sheet 2

Client/Architect:	GRAHAM		
Drawn by:	CB	Date:	Nov 2021
Checked by:	RH	Scales:	As Shown
Approved by:	CD	Sheet Size:	A1
Doran Project No.	2110118B	Status:	S5

Project No.	Orig.	Role.	Volume/Level.	Form.	Disc.	Number.	Rev.
SBQ1	DCL	CIV	SBKXX	DR	CE	400003	P05

Doran CONSULTING
DELIVERING ENGINEERING EXCELLENCE

Norwood House
96-102 Great Victoria Street,
Belfast BT2 7BE

T 028 90333443
F 028 90235501
E mail@doran.co.uk
W www.doran.co.uk

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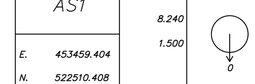
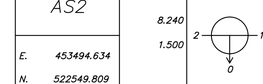
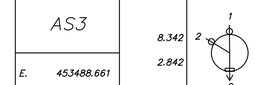
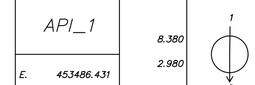
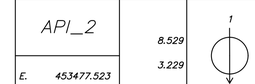
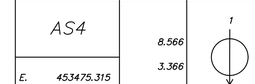
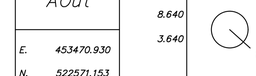
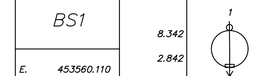
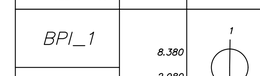
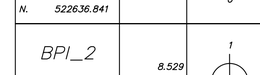
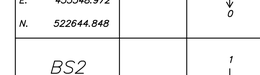
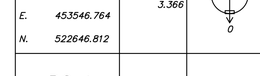
P01	16/03/22	CB	PMM	First Issue	CD
P02	05/05/22	CB	PMM	Schedule Updated.	CD

MANHOLE SCHEDULE

Sheet 1 of 2

Manhole Number / Coordinates	Cover Level / Depth To Invert	Connections	Pipe: Code	Pipe: Inverts	Pipe: Dimensions (mm)	Manhole Size	Types: Manhole	Types: Cover
AS1 E. 453459.404 N. 522510.408	8.240 1.500		0 0	1.000 1.000	6.740 6.740	300 300	1200	Type 3A	F900
AS2 E. 453494.634 N. 522549.809	8.240 1.500		1 2 0	1.000 2.000 1.000	6.740 6.740 6.740	300 300 600	1800	Type 3C Silt Pit	F900
AS3 E. 453488.661 N. 522555.193	8.342 2.842		1 2 0	1.001 1.001 1.002	6.418 7.207 5.500	600 600 600	1800	Type 3C Back Drop & Hydrobrake	F900
API_1 E. 453486.431 N. 522557.245	8.380 2.980		1 0	1.002 1.003	5.400 5.400	600 600		Petrol Interceptor Inlet	F900
API_2 E. 453477.523 N. 522565.252	8.529 3.229		1 0	1.003 1.004	5.300 5.300	600 600		Petrol Interceptor Outlet	F900
AS4 E. 453475.315 N. 522567.216	8.566 3.366		1 0	1.004 1.005	5.200 5.200	600 600	1800	Type 3C Penstock	F900
AOut E. 453470.930 N. 522571.153	8.640 3.640		1	1.005	5.000	600		Outfall	
BS1 E. 453560.110 N. 522634.789	8.342 2.842		1 0	1.001 1.002	6.944 5.500	600 600	1800	Type 3C Back Drop & Hydrobrake	F900
BPI_1 E. 453557.880 N. 522636.841	8.380 2.980		1 0	1.002 1.003	5.400 5.400	600 600		Petrol Interceptor Inlet	F900
BPI_2 E. 453548.972 N. 522644.848	8.529 3.299		1 0	1.003 1.004	5.300 5.300	600 600		Petrol Interceptor Outlet	F900
BS2 E. 453546.764 N. 522646.812	8.566 3.366		1 0	1.004 1.005	5.200 5.200	600 600 600	1800	Type 3C Penstock	F900
BOut E. 453542.402 N. 522650.727	8.640 3.640		1	1.005	5.000	600		Outfall	

MANHOLE SCHEDULE

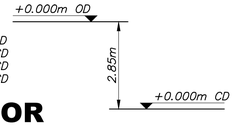
Sheet 2 of 2

Manhole Number / Coordinates	Cover Level / Depth To Invert	Connections	Pipe: Code	Pipe: Inverts	Pipe: Dimensions (mm)	Manhole Size	Types: Manhole	Types: Cover
CS1 E. 453737.534 N. 522832.446	8.342 2.842		1 0	1.001 1.002	6.944 5.500	600 600	1800	Type 3C Back Drop & Hydrobrake	F900
CPI_1 E. 453735.304 N. 522834.498	8.380 2.980		1 0	1.002 1.003	5.400 5.400	600 600		Petrol Interceptor Inlet	F900
CPI_2 E. 453726.396 N. 522842.505	8.529 3.299		1 0	1.003 1.004	5.300 5.300	600 600		Petrol Interceptor Outlet	F900
CS2 E. 453724.188 N. 522844.469	8.566 3.366		1 0	1.004 1.005	5.200 5.200	600 600	1800	Type 3C Penstock	F900
COut E. 453719.826 N. 522848.384	8.640 3.640		1	1.005	5.000	600		Outfall	
DS1 E. 453847.983 N. 522943.301	8.240 1.500		1 0	1.000 1.000	6.740 6.740	300 300	1200	Type 3A	F900
DS2 E. 453812.509 N. 522903.931	8.240 1.500		1 2 0	1.000 2.000 1.000	6.740 6.740 6.740	300 300 600	1500	Type 3C Silt Pit	F900
DS3 E. 453806.536 N. 522909.316	8.342 2.842		1 2 0	1.001 1.001 1.002	6.418 7.207 5.500	600 600 600	1800	Type 3C Back Drop & Hydrobrake	F900
DPI_1 E. 453804.306 N. 522911.368	8.380 2.980		1 0	1.002 1.003	5.400 5.400	600 600		Petrol Interceptor Inlet	F900
DPI_2 E. 453795.398 N. 522919.375	8.529 3.229		1 0	1.003 1.004	5.300 5.300	600 600		Petrol Interceptor Outlet	F900
DS4 E. 453793.190 N. 522921.338	8.566 3.366		1 0	1.004 1.005	5.200 5.200	600 600	1800	Type 3C Penstock	F900
DOut E. 453788.828 N. 522925.254	8.640 3.640		1	1.005	5.000	600		Outfall	

General Notes

1. All levels in metres to Chart Datum (CD).
2. All dimensions in mm unless noted otherwise.
3. Chart datum at Teesport is 2.850m below Ordnance Datum (OD).

Tide Levels CD:



HAT = +6.100m CD
MHWS = +5.500m CD
MLWS = +0.900m CD
LAT = +0.000m CD

ISSUED FOR APPROVAL

South Tees Development Corporation

GRAHAM

Project Title:

South Bank Quay (Phase 1)
Teesworks

Drawing Title:

Manhole Schedule

Client/Architect:	GRAHAM		
Drawn by:	CB	Date:	March 2022
Checked by:	PMM	Scales:	Not to Scale
Approved by:	CD	Sheet Size:	A1
Doran Project No.	211018B	Status:	S5

Project No.	Orig.	Role.	Volume/Level.	Form.	Disc.	Number.	Rev:
SBQ1	DCL	CIV	SBKXX	DR	CE	400004	P02

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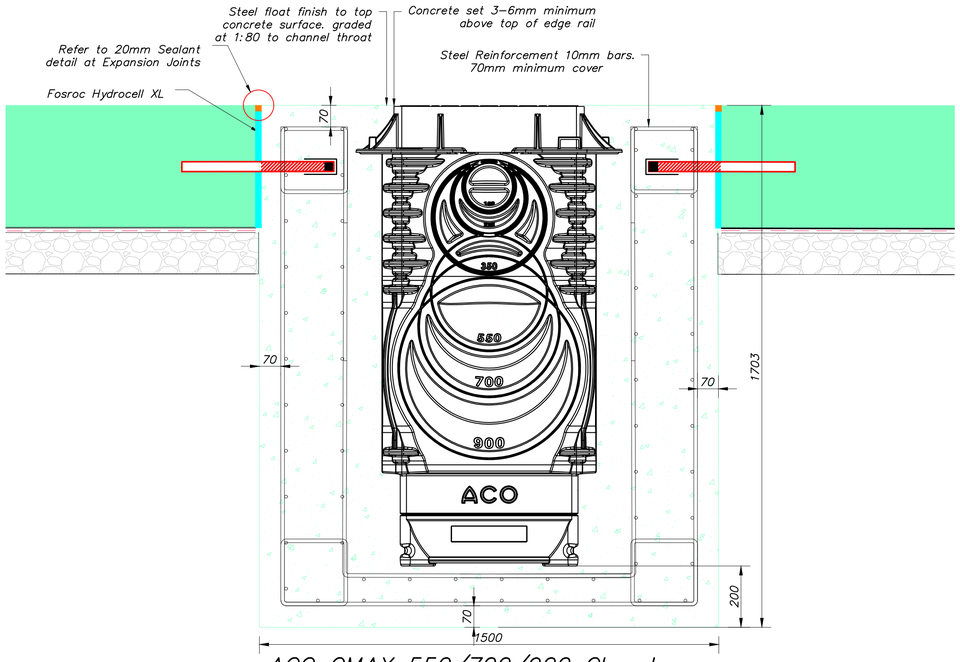
Norwood House
96-102 Great Victoria Street,
Belfast BT2 7BE

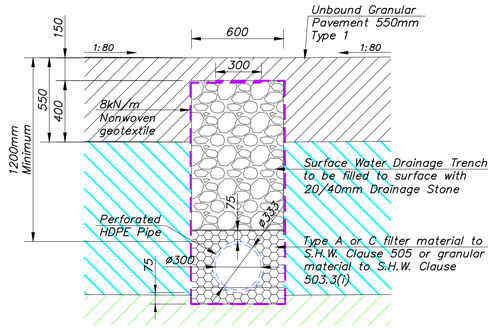
T 028 90333443
F 028 90235501
E mail@doran.co.uk
W www.doran.co.uk

Rev.	Date	By	Check	Details	Appr.
P01	05/05/22	CB	PMM	First Issue for Approval	CD



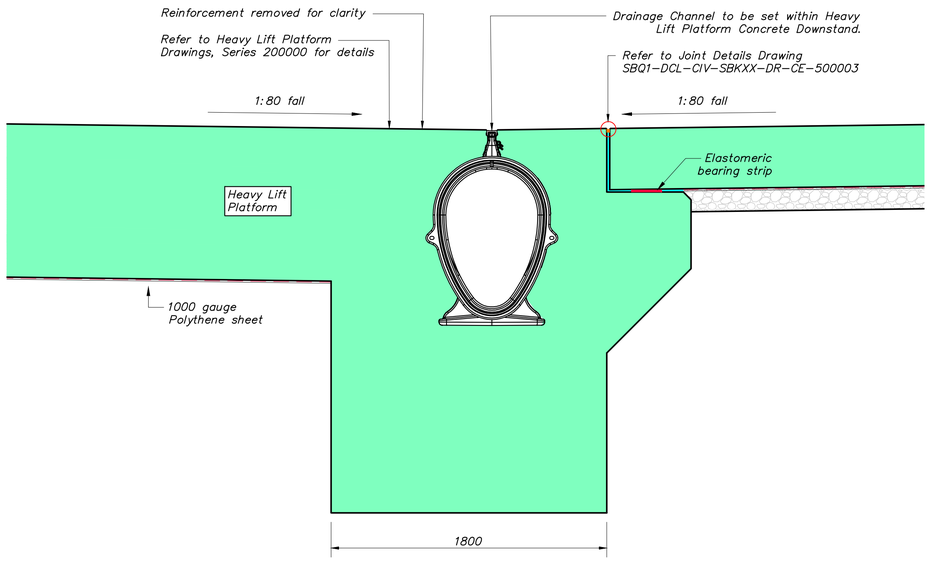
ACO QMAX 550/700/900 Chamber Standard Detail

1:10



Filter Drain – Construction Detail

1:20



ACO QMAX 900 Channel Standard Detail – Heavy Lift Platform

1:20

Notes

1. All dimensions in mm unless otherwise stated.
2. All levels in metres above Chart Datum (CD) unless outherwise noted
3. Chart datum at Teesport is 2.850m below Ordnance Datum (OD)

ISSUED FOR APPROVAL

South Tees Development Corporation

GRAHAM

Project Title:

South Bank Quay (Phase 1)
Teesworks

Drawing Title:

Drainage Standard Details
Sheet 3

Client/Architect:	GRAHAM		
Drawn by:	CB	Date:	April 2022
Checked by:	RH	Scales:	As Shown
Approved by:	CD	Sheet Size:	A1
Doran Project No.	2110118B	Status:	S5

Project No.	Orig.	Role.	Volume/Level.	Form.	Disc.	Number.	Rev.
SBQ1	DCL	CIV	SBKXX	DR	CE	400006	P01

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Norwood House
96-102 Great Victoria Street,
Belfast BT2 7BE
T 028 90333443
F 028 90235501
E mail@doran.co.uk
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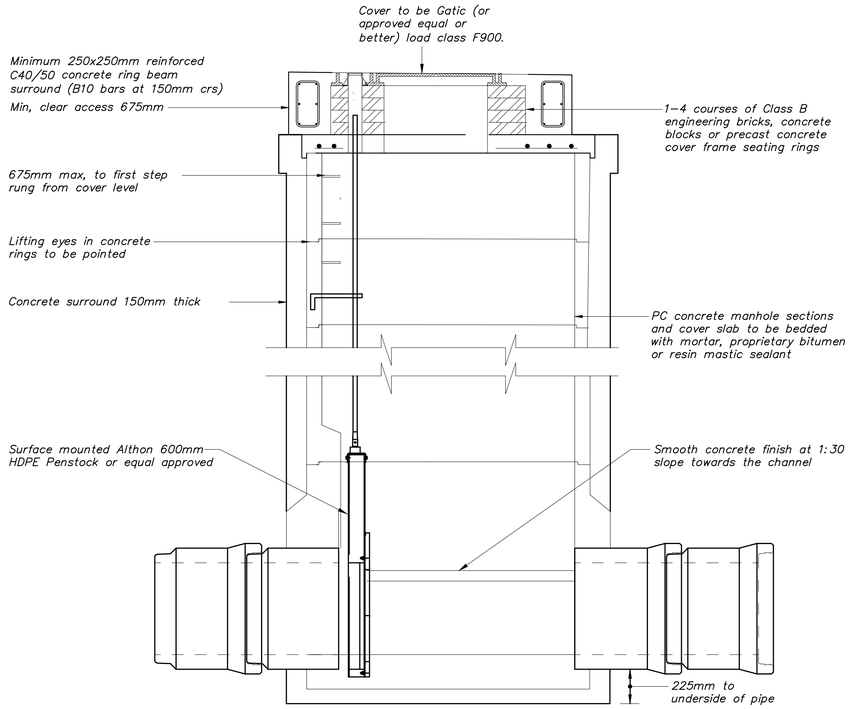
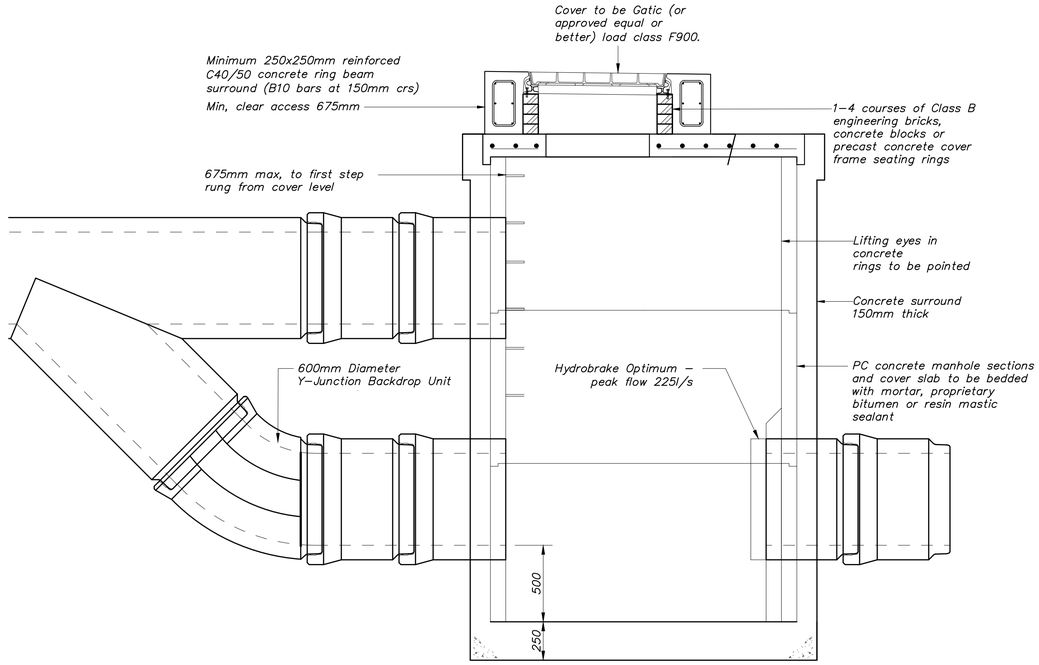
Rev.	Date	By	Check	Details	Appr.
P01	05/05/22	CB	PMM	First Issue for Approval	CD



Typical Penstock Manhole Detail

1:20

Maximum depth from cover level to soffit of pipe 3.0m

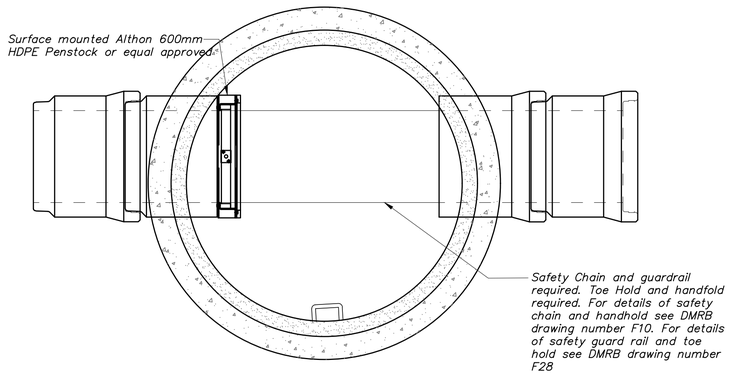


Detail of External Backdrop Manhole.

1:20

Notes

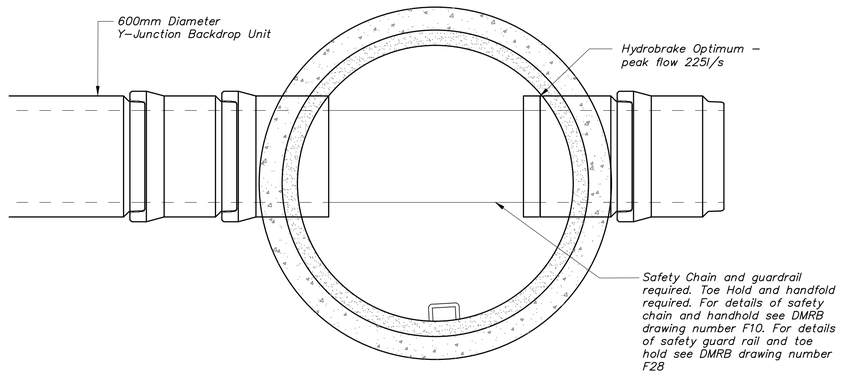
1. All dimensions in mm unless otherwise stated.
2. All levels in metres above Chart Datum (CD) unless outherwise noted
3. Chart datum at Teesport is 2.850m below Ordnance Datum (OD)



Typical Penstock Manhole Detail

1:20

Maximum depth from cover level to soffit of pipe 3.0m



Detail of External Backdrop Manhole.

1:20

ISSUED FOR APPROVAL

South Tees Development Corporation

GRAHAM

Project Title:

South Bank Quay (Phase 1)
Teesworks

Drawing Title:

Drainage Standard Details
Sheet 4

Client/Architect:	GRAHAM		
Drawn by:	CB	Date:	April 2022
Checked by:	RH	Scales:	As Shown
Approved by:	CD	Sheet Size:	A1
Doran Project No.	2110118B	Status:	S5

Project No.	Orig.	Role.	Volume/Level.	Form.	Disc.	Number.	Rev.
SBQ1	DCL	CIV	SBKXX	DR	CE	400007	P01

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96-102 Great Victoria Street,
Belfast BT2 7BE

T 028 90333443
F 028 90235501
E mail@doran.co.uk
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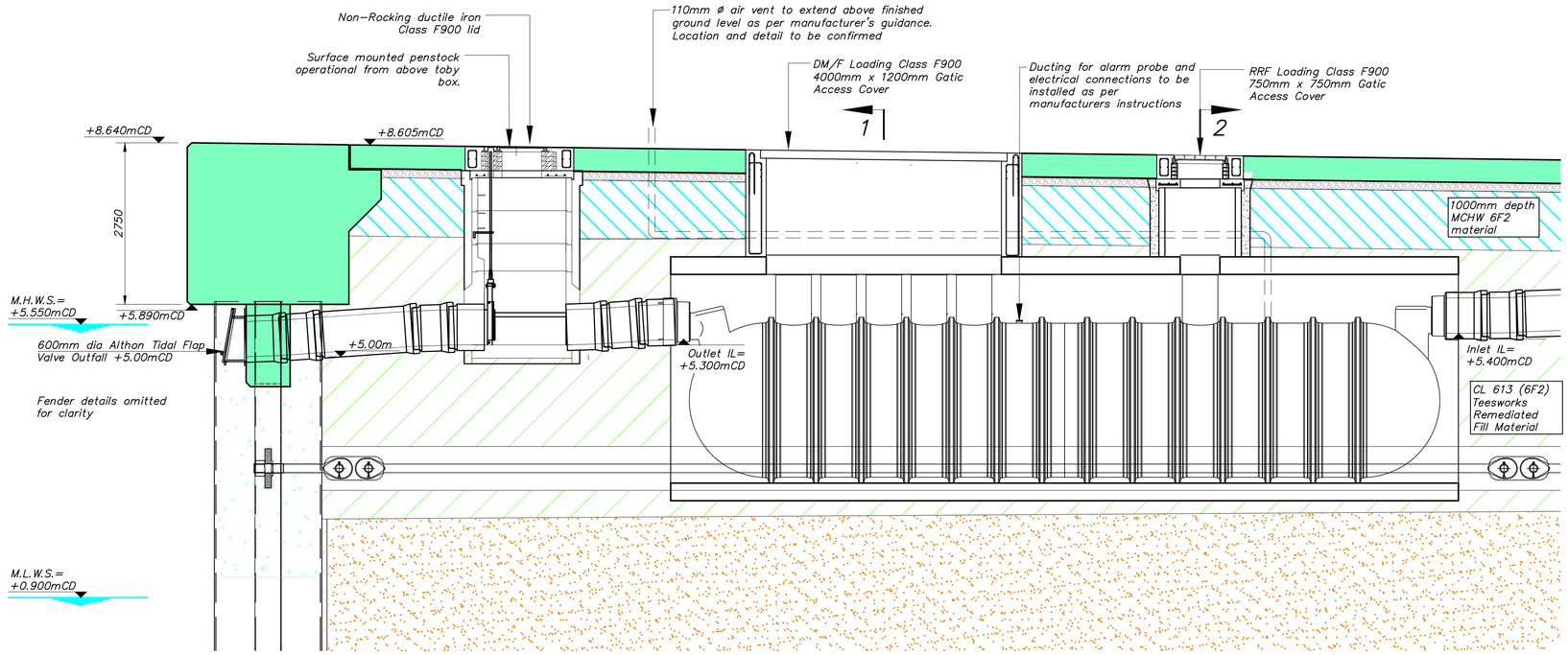
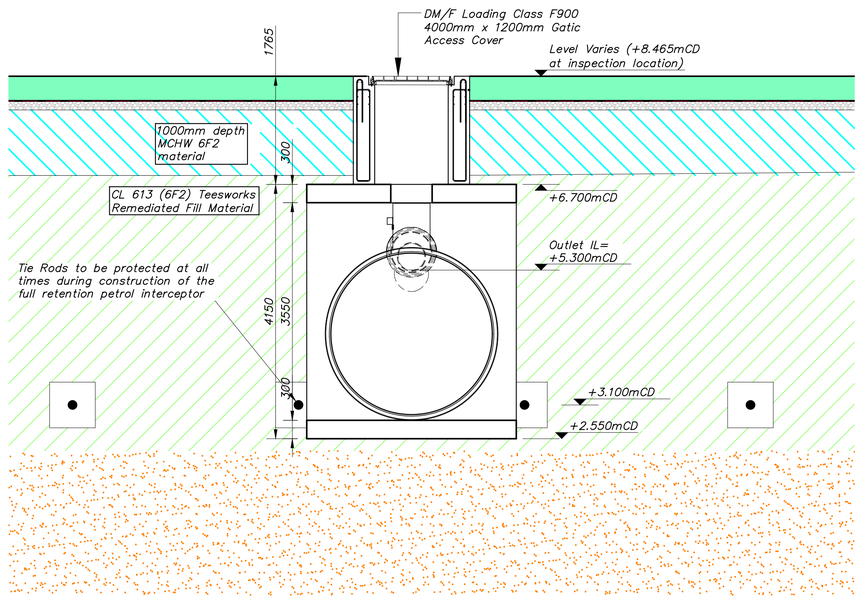
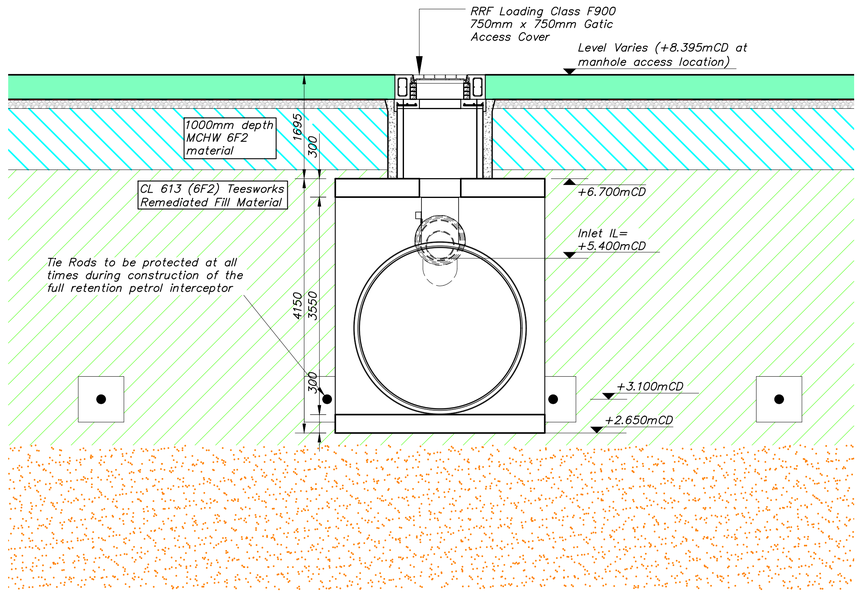
Rev.	Date	By	Check	Details	Appr.
P01	03/02/22	CB	FD	First Issue	CD
P02	10/02/22	CB	FD	Rocker Pipe Added	CD
P03	24/03/22	CB	FD	Notes Updated.	CD
P04	05/05/22	CB	FD	Sections Updated.	CD



Longitudinal Section
1:50



Section 1–1
1:50



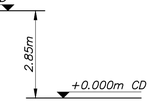
Section 2–2
1:50

General Notes

1. All levels in metres to Chart Datum (CD).
2. All dimensions in mm unless noted otherwise.
3. Chart datum at Teesport is 2.850m below Ordnance Datum (OD).
4. Formation level of interceptor to have minimum ground bearing pressure of 160kN/m2/

Tide Levels CD:

HAT	= +6.100m CD
MHWS	= +5.500m CD
MLWS	= +0.900m CD
LAT	= +0.000m CD



ISSUED FOR APPROVAL

South Tees Development Corporation

GRAHAM

Project Title:

South Bank Quay (Phase 1)

Teesworks

Drawing Title:

Petrol Interceptor Sections

Client/Architect:	GRAHAM		
Drawn by:	PDB	Date:	Jan 2022
Checked by:	RH	Scales:	1:50
Approved by:	CD	Sheet Size:	A1
Doran Project No.	211018B	Status:	S5

Project No.	Orig.	Role.	Volume/Level.	Form.	Disc.	Number.	Rev.
SBQ1	DCL	CIV	SBKXX	DR	CE	400011	P04

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Norwood House
96-102 Great Victoria Street,
Belfast BT2 7BE

T 028 90333443
F 028 90235501
E mail@doran.co.uk
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APPENDIX C: MICRODRAINAGE CALCULATIONS

STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for Storm

Pipe Sizes DC PIPES Manhole Sizes DC MHs

FSR Rainfall Model - England and Wales

Return Period (years)	2	PIMP (%)	100
M5-60 (mm)	18.000	Add Flow / Climate Change (%)	0
Ratio R	0.350	Minimum Backdrop Height (m)	0.000
Maximum Rainfall (mm/hr)	200	Maximum Backdrop Height (m)	0.000
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

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
S1.000	26.488	0.001	26488.3	0.140	5.00	0.0	0.600	O	-5	Pipe/Conduit	
S2.000	16.376	0.001	16376.0	0.173	5.00	0.0	0.600	O	-6	Pipe/Conduit	
S2.001	16.376	0.001	16376.0	0.000	0.00	0.0	0.600	O	-6	Pipe/Conduit	
S2.002	16.376	0.001	16376.0	0.173	0.00	0.0	0.600	O	-6	Pipe/Conduit	
S2.003	16.376	0.001	16376.0	0.000	0.00	0.0	0.600	O	-6	Pipe/Conduit	
S2.004	16.376	0.001	16376.0	0.173	0.00	0.0	0.600	O	-7	Pipe/Conduit	
S2.005	16.376	0.001	32752.7	0.000	0.00	0.0	0.600	O	-7	Pipe/Conduit	
S2.006	16.377	0.001	16377.0	0.173	0.00	0.0	0.600	O	-7	Pipe/Conduit	
S2.007	16.377	0.001	16377.0	0.000	0.00	0.0	0.600	O	-7	Pipe/Conduit	
S1.001	8.143	0.137	59.4	0.000	0.00	0.0	0.600	o	600	Pipe/Conduit	
S1.002	3.030	0.100	30.3	0.000	0.00	0.0	0.600	o	600	Pipe/Conduit	
S1.003	11.944	0.100	119.4	0.000	0.00	0.0	0.600	o	600	Pipe/Conduit	
S1.004	2.988	0.100	29.8	0.000	0.00	0.0	0.600	o	600	Pipe/Conduit	
S1.005	5.861	0.200	29.3	0.000	0.00	0.0	0.600	o	600	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)
S1.000	45.32	8.96	7.440	0.140	0.0	0.0	0.0	0.11	17.2	17.2
S2.000	52.36	6.62	7.290	0.173	0.0	0.0	0.0	0.17	42.2	24.6
S2.001	47.25	8.23	7.289	0.173	0.0	0.0	0.0	0.17	42.2	24.6
S2.002	43.18	9.85	7.288	0.347	0.0	0.0	0.0	0.17	42.2	40.6
S2.003	39.85	11.47	7.287	0.347	0.0	0.0	0.0	0.17	42.2	40.6
S2.004	37.48	12.84	7.086	0.520	0.0	0.0	0.0	0.20	82.2	52.8
S2.005	34.64	14.81	7.085	0.520	0.0	0.0	0.0	0.14	57.2	52.8
S2.006	32.95	16.18	7.085	0.694	0.0	0.0	0.0	0.20	82.2	61.9
S2.007	31.45	17.56	7.084	0.694	0.0	0.0	0.0	0.20	82.2	61.9
S1.001	31.40	17.60	7.083	0.834	0.0	0.0	0.0	3.16	894.2	70.9
S1.002	31.39	17.61	5.500	0.834	0.0	0.0	0.0	4.44	1254.0	70.9
S1.003	31.30	17.70	5.400	0.834	0.0	0.0	0.0	2.23	629.8	70.9
S1.004	31.29	17.71	5.300	0.834	0.0	0.0	0.0	4.47	1263.5	70.9
S1.005	31.26	17.73	5.200	0.834	0.0	0.0	0.0	4.51	1275.1	70.9

Manhole Schedules for Storm

MH Name	MH CL (m)	MH Depth (m)	MH Connection	MH Diam.,L*W (mm)	PN	Pipe Out Invert Level (m)	Diameter (mm)	PN	Pipes In Invert Level (m)	Diameter (mm)	Backdrop (mm)
S10	8.240	0.800	Open Manhole	750 x 750	S1.000	7.440	-5				
S11	8.240	0.950	Junction		S2.000	7.290	-6				
S12	8.240	0.951	Junction		S2.001	7.289	-6	S2.000	7.289	-6	
S13	8.240	0.952	Open Manhole	750 x 750	S2.002	7.288	-6	S2.001	7.288	-6	
S14	8.240	0.953	Junction		S2.003	7.287	-6	S2.002	7.287	-6	
S15	8.240	1.154	Open Manhole	750 x 750	S2.004	7.086	-7	S2.003	7.286	-6	
S16	8.240	1.155	Junction		S2.005	7.085	-7	S2.004	7.085	-7	
S17	8.240	1.155	Open Manhole	750 x 750	S2.006	7.085	-7	S2.005	7.085	-7	
S18	8.240	1.157	Junction		S2.007	7.084	-7	S2.006	7.084	-7	
S19	8.240	1.158	Open Manhole	750 x 750	S1.001	7.083	600	S1.000	7.439	-5	307
								S2.007	7.083	-7	
S1	8.342	2.842	Open Manhole	1500	S1.002	5.500	600	S1.001	6.946	600	1446
S2	8.380	2.980	Open Manhole	1500	S1.003	5.400	600	S1.002	5.400	600	
S3	8.529	3.229	Open Manhole	1500	S1.004	5.300	600	S1.003	5.300	600	
S4	8.566	3.366	Open Manhole	1500	S1.005	5.200	600	S1.004	5.200	600	
S	8.640	3.640	Open Manhole	0		OUTFALL		S1.005	5.000	600	

MH Name	Manhole Easting (m)	Manhole Northing (m)	Intersection Easting (m)	Intersection Northing (m)	Manhole Access	Layout (North)
S10	453548.489	522609.652	453548.489	522609.652	Required	
S11	453653.694	522726.862			No Entry	
S12	453642.756	522714.675			No Entry	
S13	453631.817	522702.488	453631.817	522702.488	Required	
S14	453620.878	522690.300			No Entry	
S15	453609.940	522678.113	453609.940	522678.113	Required	
S16	453599.001	522665.926			No Entry	
S17	453588.062	522653.739	453588.062	522653.739	Required	
S18	453577.122	522641.551			No Entry	

Manhole Schedules for Storm

MH Name	Manhole Easting (m)	Manhole Northing (m)	Intersection Easting (m)	Intersection Northing (m)	Manhole Access	Layout (North)
S19	453566.183	522629.364	453566.183	522629.364	Required	
S1	453560.110	522634.789	453560.110	522634.789	Required	
S2	453557.880	522636.841	453557.880	522636.841	Required	
S3	453548.994	522644.822	453548.994	522644.822	Required	
S4	453546.767	522646.815	453546.767	522646.815	Required	
S	453542.405	522650.730			No Entry	

PIPELINE SCHEDULES for Storm

Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
S1.000	O	-5	S10	8.240	7.440	0.250	Open Manhole	750 x 750
S2.000	O	-6	S11	8.240	7.290	0.250	Junction	
S2.001	O	-6	S12	8.240	7.289	0.251	Junction	
S2.002	O	-6	S13	8.240	7.288	0.252	Open Manhole	750 x 750
S2.003	O	-6	S14	8.240	7.287	0.253	Junction	
S2.004	O	-7	S15	8.240	7.086	0.254	Open Manhole	750 x 750
S2.005	O	-7	S16	8.240	7.085	0.255	Junction	
S2.006	O	-7	S17	8.240	7.085	0.255	Open Manhole	750 x 750
S2.007	O	-7	S18	8.240	7.084	0.257	Junction	
S1.001	o	600	S19	8.240	7.083	0.558	Open Manhole	750 x 750
S1.002	o	600	S1	8.342	5.500	2.242	Open Manhole	1500
S1.003	o	600	S2	8.380	5.400	2.380	Open Manhole	1500
S1.004	o	600	S3	8.529	5.300	2.629	Open Manhole	1500
S1.005	o	600	S4	8.566	5.200	2.766	Open Manhole	1500

Downstream Manhole

PN	Length (m)	Slope (1:X)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
S1.000	26.488	26488.3	S19	8.240	7.439	0.251	Open Manhole	750 x 750
S2.000	16.376	16376.0	S12	8.240	7.289	0.251	Junction	
S2.001	16.376	16376.0	S13	8.240	7.288	0.252	Open Manhole	750 x 750
S2.002	16.376	16376.0	S14	8.240	7.287	0.253	Junction	
S2.003	16.376	16376.0	S15	8.240	7.286	0.254	Open Manhole	750 x 750
S2.004	16.376	16376.0	S16	8.240	7.085	0.255	Junction	
S2.005	16.376	32752.7	S17	8.240	7.085	0.255	Open Manhole	750 x 750
S2.006	16.377	16377.0	S18	8.240	7.084	0.257	Junction	
S2.007	16.377	16377.0	S19	8.240	7.083	0.258	Open Manhole	750 x 750
S1.001	8.143	59.4	S1	8.342	6.946	0.796	Open Manhole	1500
S1.002	3.030	30.3	S2	8.380	5.400	2.380	Open Manhole	1500
S1.003	11.944	119.4	S3	8.529	5.300	2.629	Open Manhole	1500
S1.004	2.988	29.8	S4	8.566	5.200	2.766	Open Manhole	1500
S1.005	5.861	29.3	S	8.640	5.000	3.040	Open Manhole	0

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)
S1.005	S	8.640	5.000	0.000	0	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	0.000
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 Offline Controls 0 Number of Time/Area Diagrams 0
Number of Online Controls 1 Number of Storage Structures 0 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model	FSR	Profile Type	Summer
Return Period (years)	2	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	18.000	Storm Duration (mins)	30
Ratio R	0.350		

Online Controls for Storm

Hydro-Brake® Optimum Manhole: S2, DS/PN: S1.003, Volume (m³): 5.7

Unit Reference	MD-SHE-0528-2250-2980-2250
Design Head (m)	2.980
Design Flow (l/s)	225.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	528
Invert Level (m)	5.400
Minimum Outlet Pipe Diameter (mm)	Site Specific Design (Contact Hydro International)
Suggested Manhole Diameter (mm)	Site Specific Design (Contact Hydro International)

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	2.980	225.0	Kick-Flo®	2.065	188.1
Flush-Flo™	0.962	225.0	Mean Flow over Head Range	-	191.2

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	13.0	1.200	223.2	3.000	225.7	7.000	341.9
0.200	48.1	1.400	220.0	3.500	243.4	7.500	353.7
0.300	98.5	1.600	215.4	4.000	259.9	8.000	365.1
0.400	155.1	1.800	208.0	4.500	275.3	8.500	376.2
0.500	204.7	2.000	194.7	5.000	289.9	9.000	386.9
0.600	216.6	2.200	194.0	5.500	303.8	9.500	397.3
0.800	223.7	2.400	202.4	6.000	317.0		
1.000	224.9	2.600	210.5	6.500	329.7		

Summary Wizard of 15 minute 2 year Winter I+0% 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	0.000
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 Offline Controls 0 Number of Time/Area Diagrams 0
Number of Online Controls 1 Number of Storage Structures 0 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model FSR M5-60 (mm) 18.000 Cv (Summer) 0.750
Region England and Wales Ratio R 0.350 Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 300.0 DVD Status ON
Analysis Timestep Fine Inertia Status ON
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
Return Period(s) (years)	2, 30, 100
Climate Change (%)	0, 0, 40

PN	US/MH Name	Storm Rank	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status
S1.000	S10	16	7.648	-0.342	0.000	0.37		21.6	OK
S2.000	S11	18	7.613	-0.377	0.000	0.21		25.7	OK
S2.001	S12	18	7.605	-0.384	0.000	0.19		24.3	OK
S2.002	S13	18	7.597	-0.391	0.000	0.49		45.1	OK
S2.003	S14	19	7.546	-0.441	0.000	0.36		44.6	OK
S2.004	S15	19	7.492	-0.494	0.000	0.38		63.5	OK
S2.005	S16	19	7.469	-0.516	0.000	0.26		62.9	OK
S2.006	S17	19	7.455	-0.529	0.000	0.48		80.3	OK
S2.007	S18	19	7.403	-0.580	0.000	0.33		79.8	OK
S1.001	S19	20	7.285	-0.398	0.000	0.25		94.1	OK
S1.002	S1	19	5.810	-0.290	0.000	0.27		93.3	OK
S1.003	S2	19	5.805	-0.195	0.000	0.27		93.7	OK
S1.004	S3	19	5.512	-0.388	0.000	0.27		93.9	OK
S1.005	S4	19	5.385	-0.415	0.000	0.21		93.7	OK

Rainfall Hyetograph for 15 minute 2 year Winter I+0% (Storm)

Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)
1	8.189	4	19.703	7	73.442	10	51.601	13	15.565
2	14.944	5	31.893	8	85.309	11	31.893	14	14.944
3	15.565	6	51.601	9	73.442	12	19.703	15	8.189

Summary Wizard of 15 minute 30 year Winter I+0% 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	0.000
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 Offline Controls 0 Number of Time/Area Diagrams 0
Number of Online Controls 1 Number of Storage Structures 0 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model	FSR	M5-60 (mm) 18.000	Cv (Summer) 0.750
Region	England and Wales	Ratio R 0.350	Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 300.0 DVD Status ON
Analysis Timestep Fine Inertia Status ON
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
Return Period(s) (years)	2, 30, 100
Climate Change (%)	0, 0, 40

PN	US/MH Name	Storm Rank	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status
S1.000	S10	6	7.745	-0.245	0.000	0.69		40.7	OK
S2.000	S11	7	7.758	-0.232	0.000	0.39		49.1	OK
S2.001	S12	7	7.751	-0.238	0.000	0.38		48.0	OK
S2.002	S13	7	7.743	-0.245	0.000	1.02		94.4	OK
S2.003	S14	7	7.698	-0.289	0.000	0.74		91.9	OK
S2.004	S15	7	7.661	-0.325	0.000	0.81		134.4	OK
S2.005	S16	7	7.636	-0.349	0.000	0.56		134.3	OK
S2.006	S17	7	7.623	-0.362	0.000	1.03		172.0	OK
S2.007	S18	7	7.532	-0.451	0.000	0.70		169.6	OK
S1.001	S19	7	7.400	-0.282	0.000	0.55		205.4	OK
S1.002	S1	7	6.266	0.166	0.000	0.59		206.1	SURCHARGED
S1.003	S2	7	6.168	0.168	0.000	0.60		206.6	SURCHARGED
S1.004	S3	7	5.633	-0.267	0.000	0.59		205.6	OK
S1.005	S4	7	5.486	-0.314	0.000	0.46		204.3	OK

Rainfall Hyetograph for 15 minute 30 year Winter I+0% (Storm)

Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)
1	15.475	4	37.233	7	138.780	10	97.507	13	29.412
2	28.240	5	60.266	8	161.203	11	60.266	14	28.240
3	29.412	6	97.507	9	138.780	12	37.233	15	15.475

Summary Wizard of 15 minute 100 year Winter I+40% 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	0.000
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 Offline Controls 0 Number of Time/Area Diagrams 0
Number of Online Controls 1 Number of Storage Structures 0 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model FSR M5-60 (mm) 18.000 Cv (Summer) 0.750
Region England and Wales Ratio R 0.350 Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 300.0 DVD Status ON
Analysis Timestep Fine Inertia Status ON
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
Return Period(s) (years)	2, 30, 100
Climate Change (%)	0, 0, 40

WARNING: The analysis maybe unstable. Please see the method of analysis help for more details.

PN	US/MH Name	Storm Rank	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status
S1.000	S10	2	8.240	0.250	0.836	1.23		72.6	FLOOD
S2.000	S11	1	8.247	0.257	6.975	0.71		88.3	FLOOD
S2.001	S12	1	8.246	0.257	6.225	0.66		82.4	FLOOD
S2.002	S13	1	8.246	0.258	6.079	1.78		164.7	FLOOD
S2.003	S14	1	8.245	0.258	4.813	1.27		159.1	FLOOD
S2.004	S15	1	8.246	0.260	5.822	1.43		237.5	FLOOD
S2.005	S16	1	8.244	0.259	4.080	0.93		225.2	FLOOD
S2.006	S17	1	8.244	0.259	4.497	1.78		296.5	FLOOD
S2.007	S18	1	8.241	0.258	2.008	1.08		261.8	FLOOD
S1.001	S19	3	7.973	0.291	0.295	0.78		289.5	FLOOD
S1.002	S1	4	7.694	1.594	0.000	0.72		250.0	SURCHARGED
S1.003	S2	4	7.587	1.587	0.000	0.64		223.9	SURCHARGED
S1.004	S3	3	5.652	-0.248	0.000	0.65		224.6	OK
S1.005	S4	3	5.501	-0.299	0.000	0.50		224.6	OK

Rainfall Hyetograph for 15 minute 100 year Winter I+40% (Storm)

Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)	Time (mins)	Rain (mm/hr)
1	27.961	4	67.274	7	250.754	10	176.180	13	53.144
2	51.025	5	108.892	8	291.270	11	108.892	14	51.025
3	53.143	6	176.180	9	250.754	12	67.274	15	27.961

APPENDIX D: ACO DRAINAGE SYSTEM CALCULATIONS

ACO HYDRAULIC DESIGN

+ DETAILED RUN REPORT - Page 1

Project Name: 211018A **Designer:** Ciaran Black **Project Date:** 4th May 2022

Location: HRWM+J3 Middlesbrough, UK **Print Date:** 4th May 2022

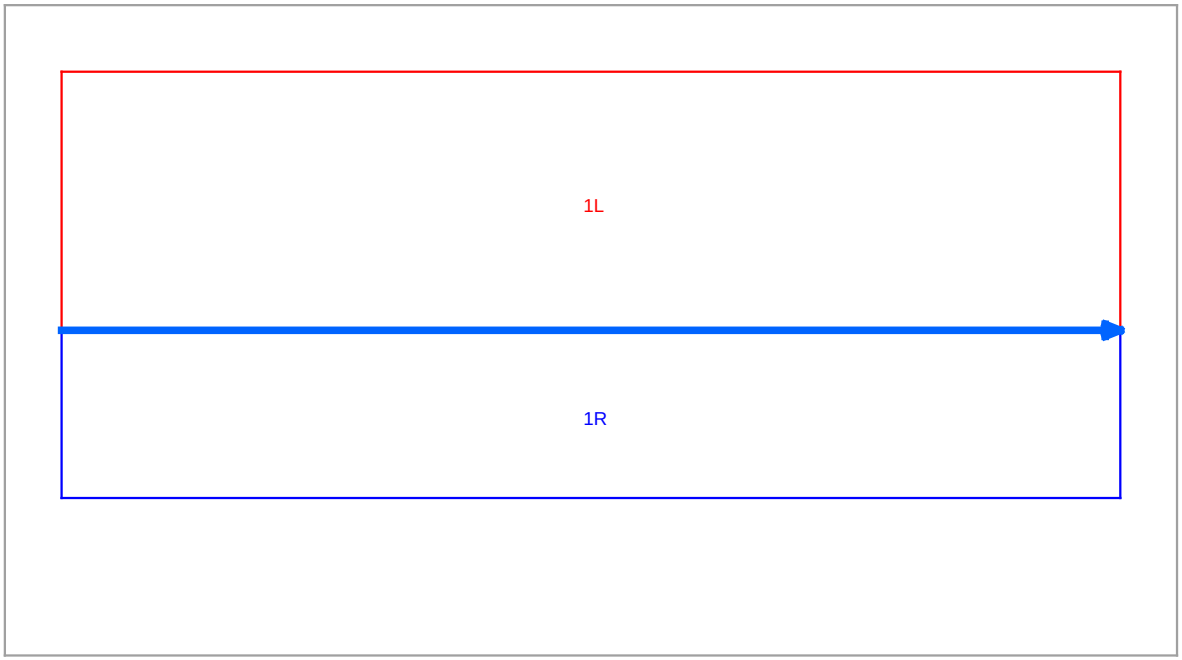
Project Notes:

+ INPUT DATA:- Run 1: 'ACO Calcs', Option A '131m'

M5-60: 17.3mm/hr **Ratio R:** 0.34

LENGTH (m)	AREA (m2)	SLOPE (%)	IMPERMEABILITY FACTOR	RETURN PERIOD (years)	CLIMATE CHANGE (%)	STORM DURATION (mins)	RAINFALL INTENSITY (mm/hr)	INFLOW CONTROL (l/s/m)	Point Inflow Interlinked from	Cumulative Point Inflows l/s
131.00	6,910.25	0.00	1.00	30	0.00	-	118.91	None	None	0.00

+ CHANNEL LAYOUT



+ RAINFALL DATA

Duration	Intensity (mm/h)
5 mins	96.19
10 mins	75.16
15 mins	65.21
30 mins	41.82
1 hour	27.23
2 hours	16.93
4 hours	10.09
6 hours	7.52
10 hours	5.14
24 hours	2.67
48 hours	1.53

ACO HYDRAULIC DESIGN

+ DETAILED RUN REPORT - Page 2

Project Name: 211018A **Designer:** Ciaran Black **Project Date:** 4th May 2022

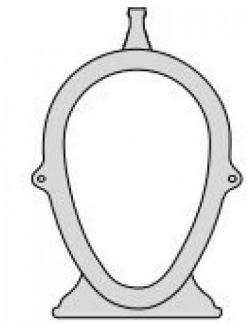
Location: HRWM+J3 Middlesbrough, UK **Print Date:** 4th May 2022

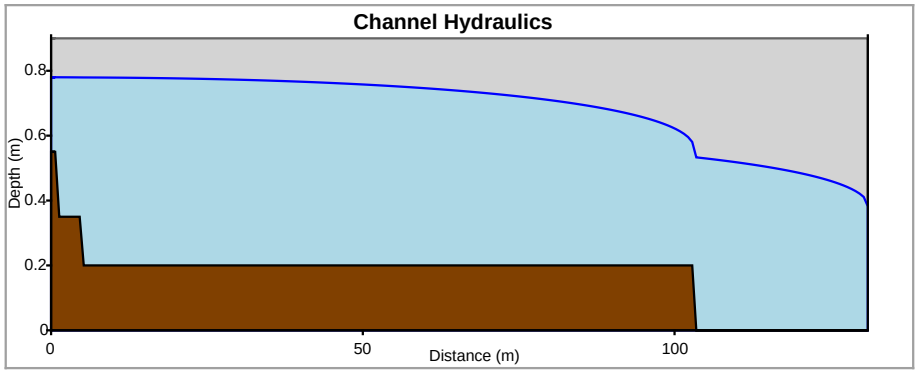
+ OUTPUTS:- Run 1: 'ACO Calcs', Option A '131m'

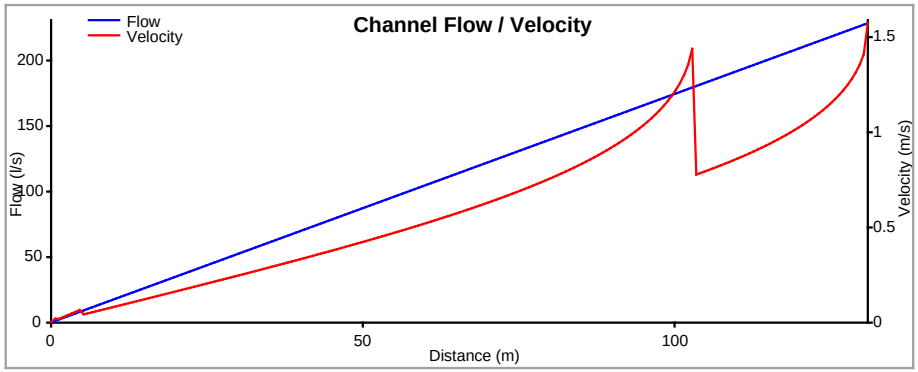
OUTFLOW (l/s)	CAPACITY (%)	MAX* VELOCITY (m/s)	MIN FREEBOARD (m)	EXCAVATION VOLUME (m3)	CONCRETE VOLUME (m3)
228.49	86.00	1.57	0.12	132.61	82.52

Qmax

	1	2	3	4
System	Qmax 350	Qmax 550	Qmax 700	Qmax 900
W - Width (mm)	350	367	467	600
H - Invert (mm)	550	800	950	1155
Length (m)	1.00	4.00	98.00	28.00







ACO HYDRAULIC DESIGN

+ DETAILED RUN REPORT - Page 1

Project Name: 211018A **Designer:** Ciaran Black **Project Date:** 4th May 2022

Location: HRWM+J3 Middlesbrough, UK **Print Date:** 4th May 2022

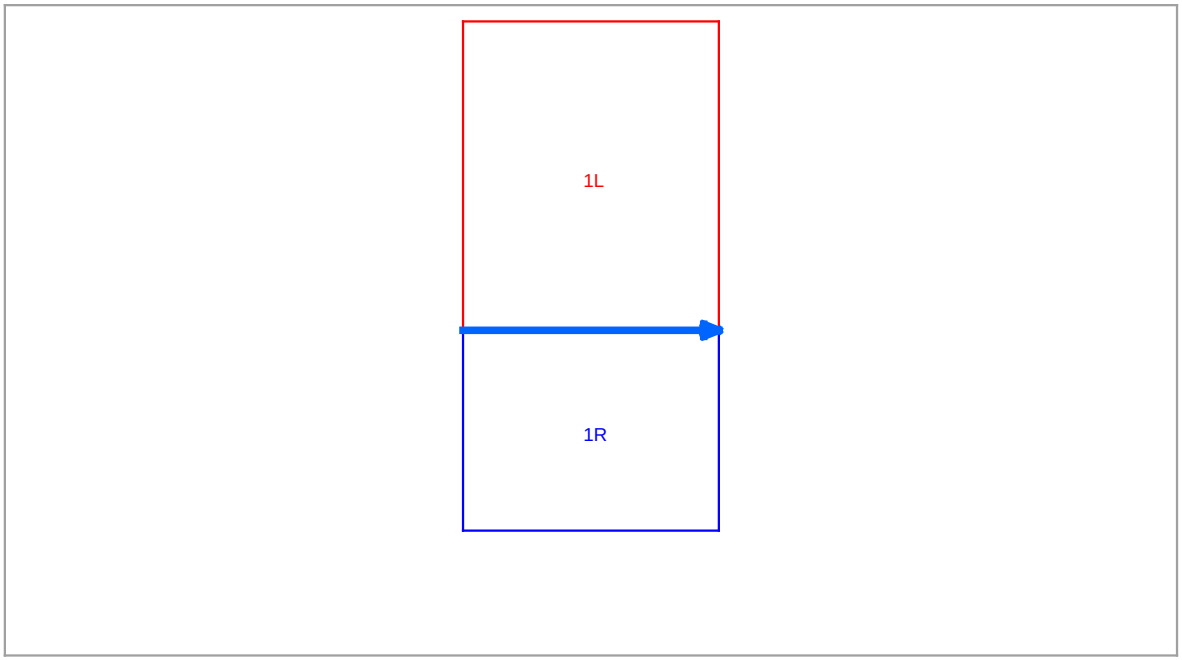
Project Notes:

+ INPUT DATA:- Run 1: 'ACO Calcs', Option B '26.5m'

M5-60: 17.3mm/hr **Ratio R:** 0.34

LENGTH (m)	AREA (m2)	SLOPE (%)	IMPERMEABILITY FACTOR	RETURN PERIOD (years)	CLIMATE CHANGE (%)	STORM DURATION (mins)	RAINFALL INTENSITY (mm/hr)	INFLOW CONTROL (l/s/m)	Point Inflow Interlinked from	Cumulative Point Inflows l/s
26.50	1,397.88	0.00	1.00	30	0.00	5 mins	96.19	None	None	0.00

+ CHANNEL LAYOUT



+ RAINFALL DATA

Duration	Intensity (mm/h)
5 mins	96.19
10 mins	75.16
15 mins	65.21
30 mins	41.82
1 hour	27.23
2 hours	16.93
4 hours	10.09
6 hours	7.52
10 hours	5.14
24 hours	2.67
48 hours	1.53

ACO HYDRAULIC DESIGN

+ DETAILED RUN REPORT - Page 2

Project Name: 211018A **Designer:** Ciaran Black **Project Date:** 4th May 2022

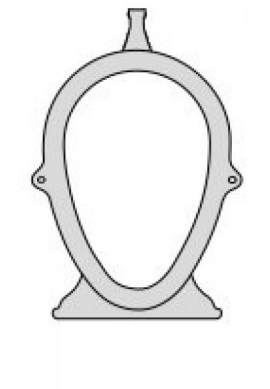
Location: HRWM+J3 Middlesbrough, UK **Print Date:** 4th May 2022

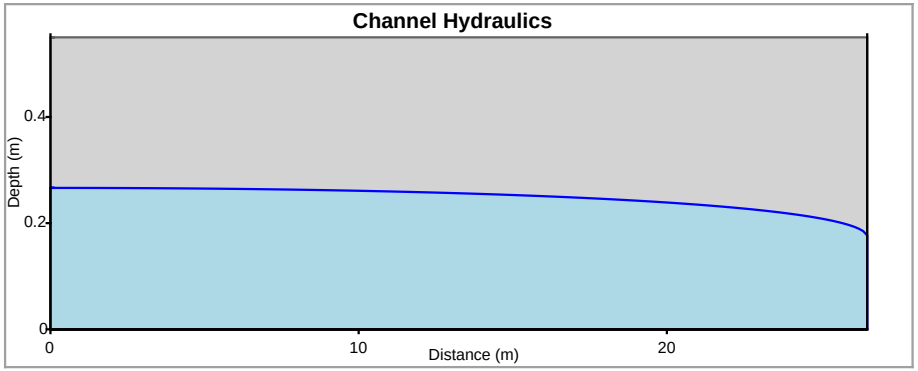
+ OUTPUTS:- Run 1: 'ACO Calcs', Option B '26.5m'

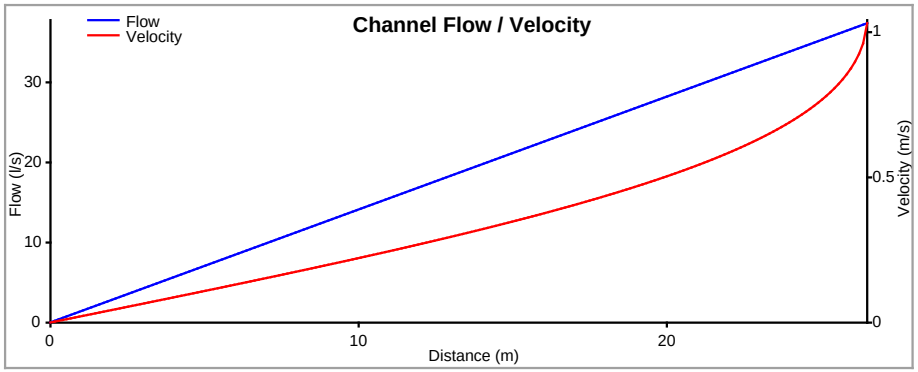
OUTFLOW (l/s)	CAPACITY (%)	MAX* VELOCITY (m/s)	MIN FREEBOARD (m)	EXCAVATION VOLUME (m3)	CONCRETE VOLUME (m3)
37.39	42.39	1.03	0.28	17.65	12.06

Qmax

	1
System	Qmax 550
W - Width (mm)	367
H - Invert (mm)	800
Length (m)	26.50







ACO HYDRAULIC DESIGN

+ DETAILED RUN REPORT - Page 1

Project Name: 211018A **Designer:** Ciaran Black **Project Date:** 4th May 2022

Location: HRWM+J3 Middlesbrough, UK **Print Date:** 4th May 2022

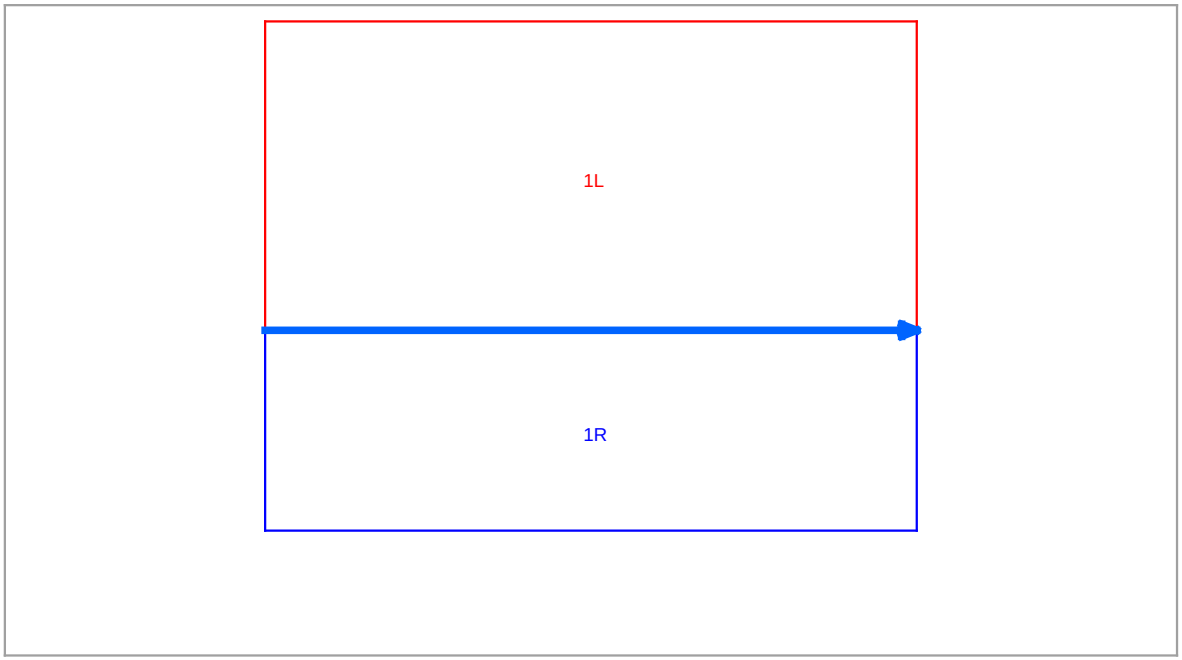
Project Notes:

+ INPUT DATA:- Run 1: 'ACO Calcs', Option C '67.5m'

M5-60: 17.3mm/hr **Ratio R:** 0.34

LENGTH (m)	AREA (m2)	SLOPE (%)	IMPERMEABILITY FACTOR	RETURN PERIOD (years)	CLIMATE CHANGE (%)	STORM DURATION (mins)	RAINFALL INTENSITY (mm/hr)	INFLOW CONTROL (l/s/m)	Point Inflow Interlinked from	Cumulative Point Inflows l/s
67.50	3,560.63	0.00	1.00	30	0.00	5 mins	96.19	None	None	0.00

+ CHANNEL LAYOUT



+ RAINFALL DATA

Duration	Intensity (mm/h)
5 mins	96.19
10 mins	75.16
15 mins	65.21
30 mins	41.82
1 hour	27.23
2 hours	16.93
4 hours	10.09
6 hours	7.52
10 hours	5.14
24 hours	2.67
48 hours	1.53

ACO HYDRAULIC DESIGN

+ DETAILED RUN REPORT - Page 2

Project Name: 211018A **Designer:** Ciaran Black **Project Date:** 4th May 2022

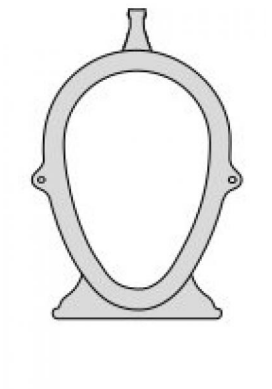
Location: HRWM+J3 Middlesbrough, UK **Print Date:** 4th May 2022

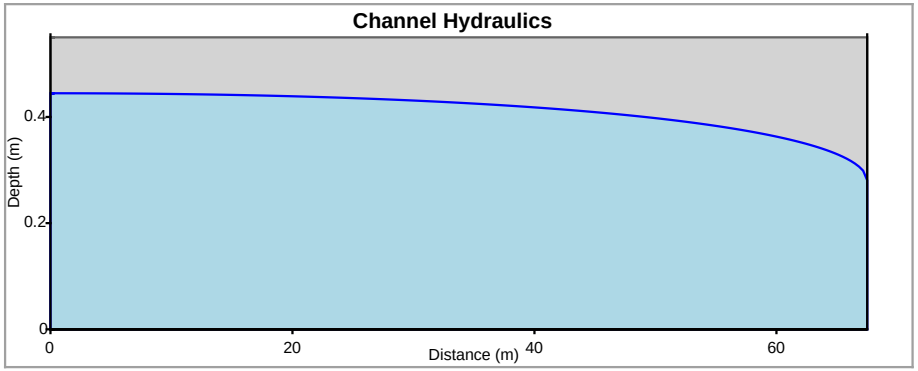
+ OUTPUTS:- Run 1: 'ACO Calcs', Option C '67.5m'

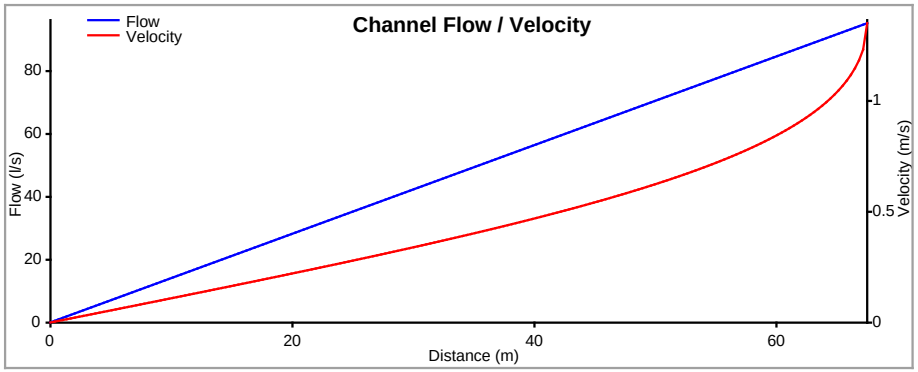
OUTFLOW (l/s)	CAPACITY (%)	MAX* VELOCITY (m/s)	MIN FREEBOARD (m)	EXCAVATION VOLUME (m3)	CONCRETE VOLUME (m3)
95.24	83.75	1.35	0.11	44.96	30.71

Qmax

	1
System	Qmax 550
W - Width (mm)	367
H - Invert (mm)	800
Length (m)	67.50







ACO HYDRAULIC DESIGN

+ DETAILED RUN REPORT - Page 1

Project Name: 211018A **Designer:** Ciaran Black **Project Date:** 4th May 2022

Location: HRWM+J3 Middlesbrough, UK **Print Date:** 4th May 2022

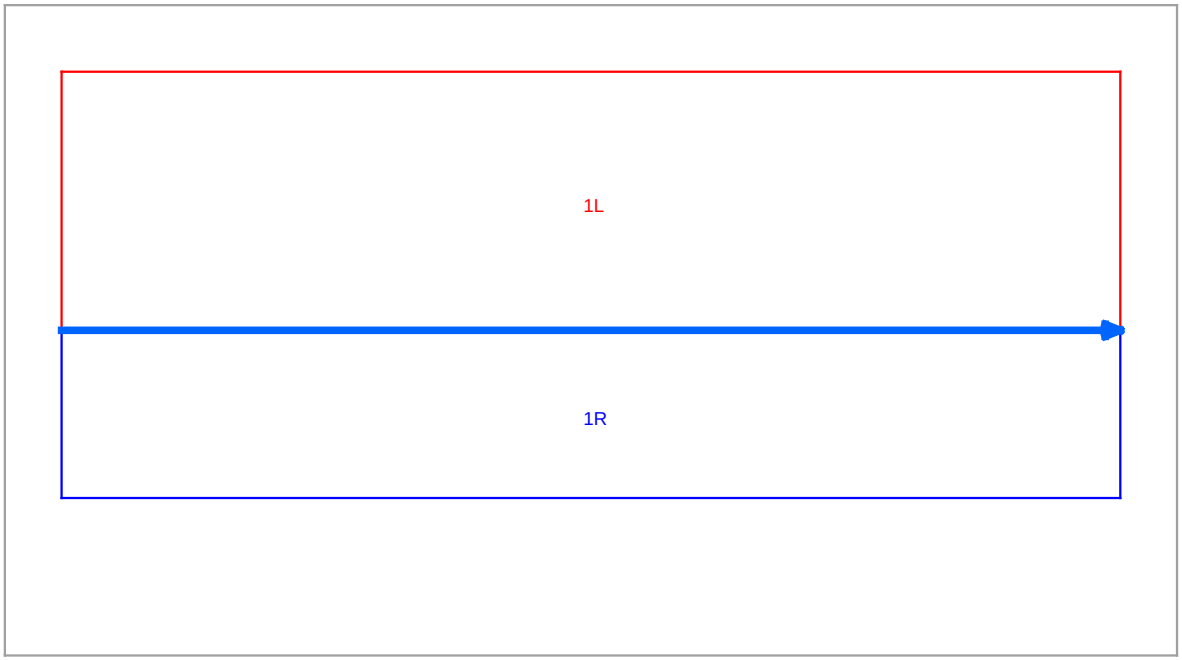
Project Notes:

+ INPUT DATA:- Run 1: 'ACO Calcs', Option A '131m'

M5-60: 17.3mm/hr **Ratio R:** 0.34

LENGTH (m)	AREA (m2)	SLOPE (%)	IMPERMEABILITY FACTOR	RETURN PERIOD (years)	CLIMATE CHANGE (%)	STORM DURATION (mins)	RAINFALL INTENSITY (mm/hr)	INFLOW CONTROL (l/s/m)	Point Inflow Interlinked from	Cumulative Point Inflows l/s
131.00	6,910.25	0.00	1.00	100	40.00	-	166.48	None	None	0.00

+ CHANNEL LAYOUT



+ RAINFALL DATA

Duration	Intensity (mm/h)
5 mins	118.91
10 mins	92.91
15 mins	81.72
30 mins	52.41
1 hour	34.43
2 hours	21.48
4 hours	12.67
6 hours	9.46
10 hours	6.43
24 hours	3.28
48 hours	1.88

ACO HYDRAULIC DESIGN

+ DETAILED RUN REPORT - Page 2

Project Name: 211018A **Designer:** Ciaran Black **Project Date:** 4th May 2022

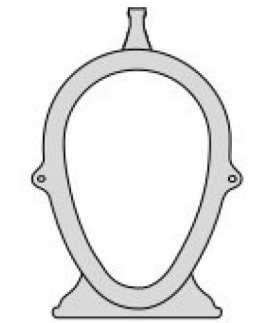
Location: HRWM+J3 Middlesbrough, UK **Print Date:** 4th May 2022

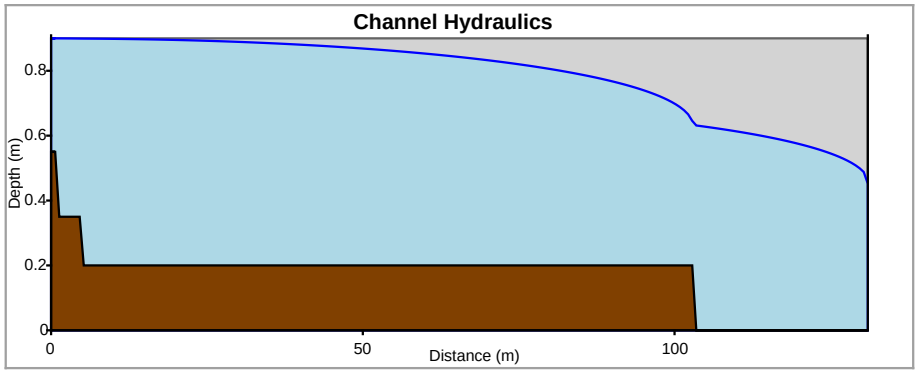
+ OUTPUTS:- Run 1: 'ACO Calcs', Option A '131m'

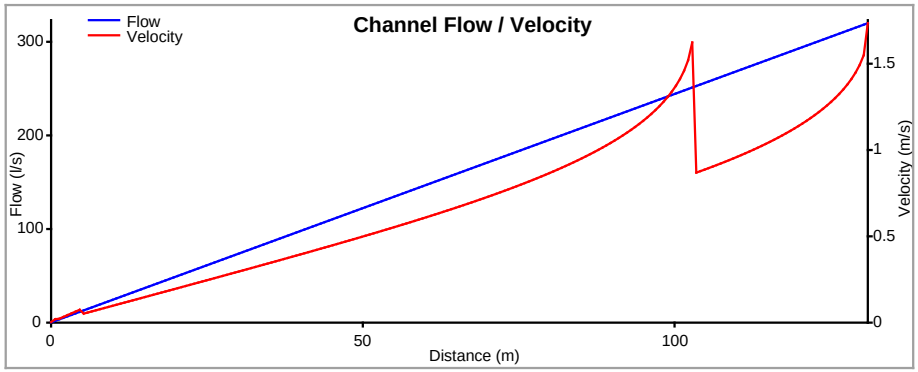
OUTFLOW (l/s)	CAPACITY (%)	MAX* VELOCITY (m/s)	MIN FREEBOARD (m)	EXCAVATION VOLUME (m3)	CONCRETE VOLUME (m3)
319.88	100.00	1.73	0.00	132.61	82.52

Qmax

	1	2	3	4
System	Qmax 350	Qmax 550	Qmax 700	Qmax 900
W - Width (mm)	350	367	467	600
H - Invert (mm)	550	800	950	1155
Length (m)	1.00	4.00	98.00	28.00







ACO HYDRAULIC DESIGN

+ DETAILED RUN REPORT - Page 1

Project Name: 211018A **Designer:** Ciaran Black **Project Date:** 4th May 2022

Location: HRWM+J3 Middlesbrough, UK **Print Date:** 4th May 2022

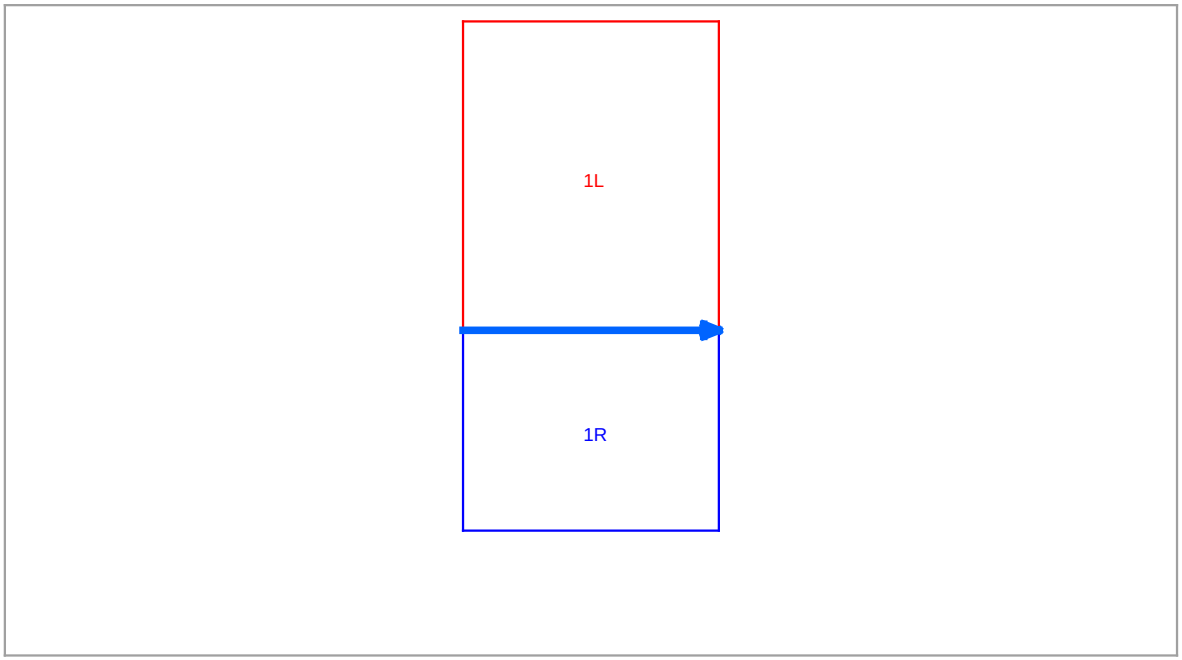
Project Notes:

+ INPUT DATA:- Run 1: 'ACO Calcs', Option B '26.5m'

M5-60: 17.3mm/hr **Ratio R:** 0.34

LENGTH (m)	AREA (m2)	SLOPE (%)	IMPERMEABILITY FACTOR	RETURN PERIOD (years)	CLIMATE CHANGE (%)	STORM DURATION (mins)	RAINFALL INTENSITY (mm/hr)	INFLOW CONTROL (l/s/m)	Point Inflow Interlinked from	Cumulative Point Inflows l/s
26.50	1,397.88	0.00	1.00	100	40.00	5 mins	166.48	None	None	0.00

+ CHANNEL LAYOUT



+ RAINFALL DATA

Duration	Intensity (mm/h)
5 mins	118.91
10 mins	92.91
15 mins	81.72
30 mins	52.41
1 hour	34.43
2 hours	21.48
4 hours	12.67
6 hours	9.46
10 hours	6.43
24 hours	3.28
48 hours	1.88

ACO HYDRAULIC DESIGN

+ DETAILED RUN REPORT - Page 2

Project Name: 211018A **Designer:** Ciaran Black **Project Date:** 4th May 2022

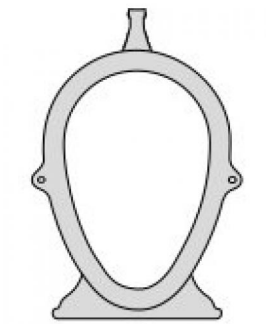
Location: HRWM+J3 Middlesbrough, UK **Print Date:** 4th May 2022

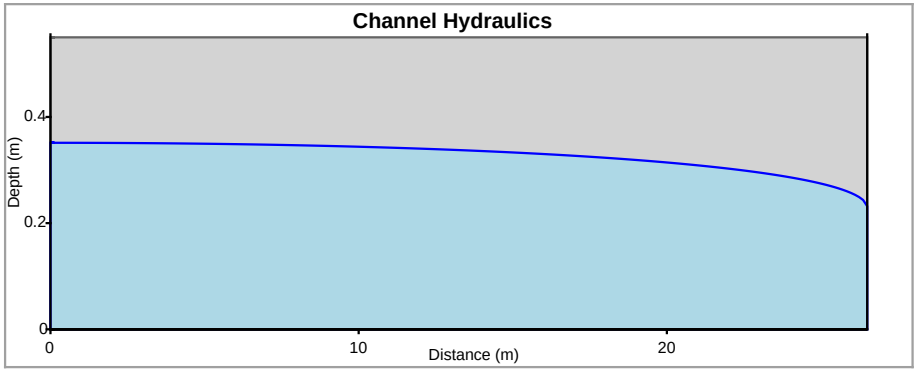
+ OUTPUTS:- Run 1: 'ACO Calcs', Option B '26.5m'

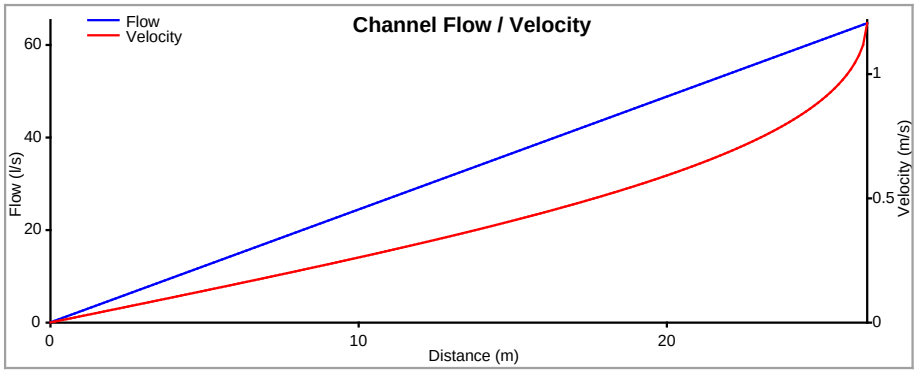
OUTFLOW (l/s)	CAPACITY (%)	MAX* VELOCITY (m/s)	MIN FREEBOARD (m)	EXCAVATION VOLUME (m3)	CONCRETE VOLUME (m3)
64.71	62.17	1.20	0.20	17.65	12.06

Qmax

	1
System	Qmax 550
W - Width (mm)	367
H - Invert (mm)	800
Length (m)	26.50







ACO HYDRAULIC DESIGN

+ DETAILED RUN REPORT - Page 1

Project Name: 211018A **Designer:** Ciaran Black **Project Date:** 4th May 2022

Location: HRWM+J3 Middlesbrough, UK **Print Date:** 4th May 2022

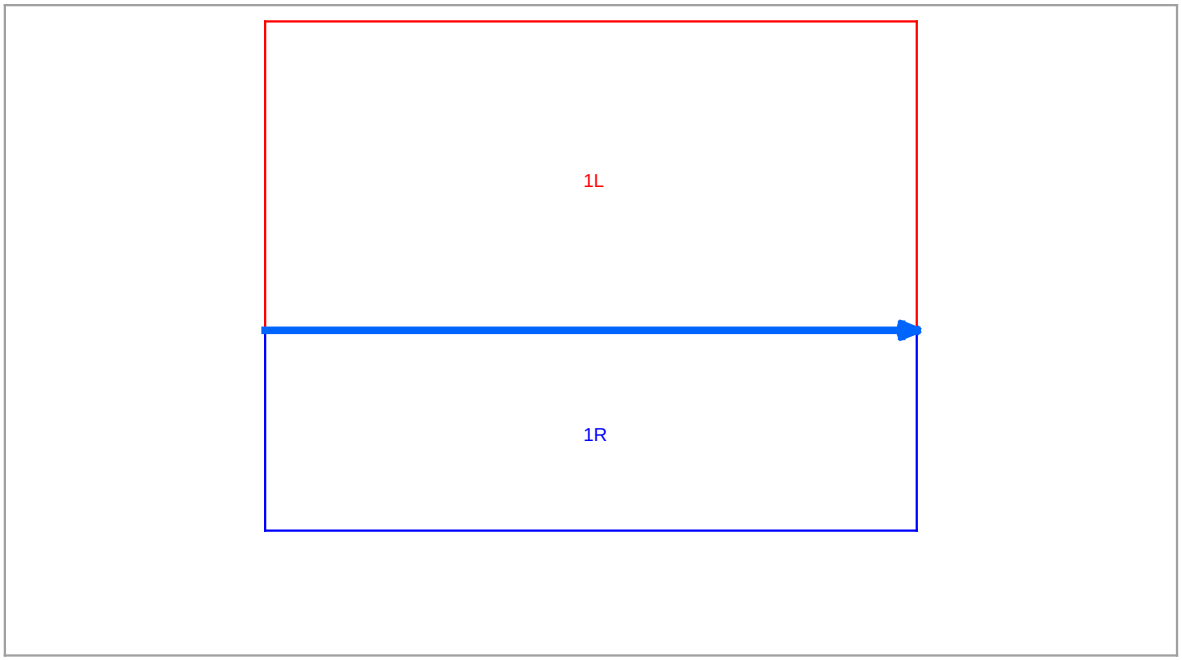
Project Notes:

+ INPUT DATA:- Run 1: 'ACO Calcs', Option C '67.5m'

M5-60: 17.3mm/hr **Ratio R:** 0.34

LENGTH (m)	AREA (m2)	SLOPE (%)	IMPERMEABILITY FACTOR	RETURN PERIOD (years)	CLIMATE CHANGE (%)	STORM DURATION (mins)	RAINFALL INTENSITY (mm/hr)	INFLOW CONTROL (l/s/m)	Point Inflow Interlinked from	Cumulative Point Inflows l/s
67.50	3,560.63	0.00	1.00	100	40.00	5 mins	166.48	None	None	0.00

+ CHANNEL LAYOUT



+ RAINFALL DATA

Duration	Intensity (mm/h)
5 mins	118.91
10 mins	92.91
15 mins	81.72
30 mins	52.41
1 hour	34.43
2 hours	21.48
4 hours	12.67
6 hours	9.46
10 hours	6.43
24 hours	3.28
48 hours	1.88

ACO HYDRAULIC DESIGN

+ DETAILED RUN REPORT - Page 2

Project Name: 211018A **Designer:** Ciaran Black **Project Date:** 4th May 2022

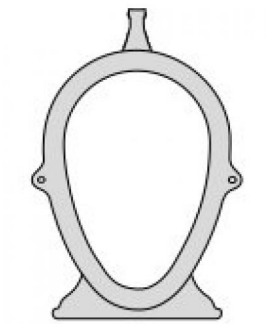
Location: HRWM+J3 Middlesbrough, UK **Print Date:** 4th May 2022

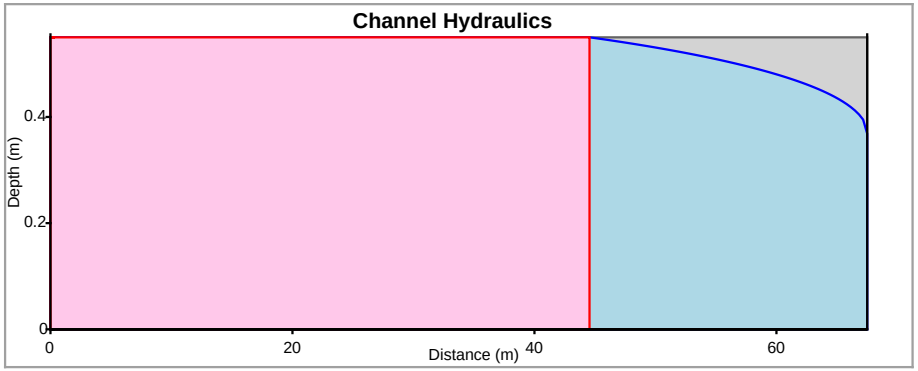
+ OUTPUTS:- Run 1: 'ACO Calcs', Option C '67.5m'

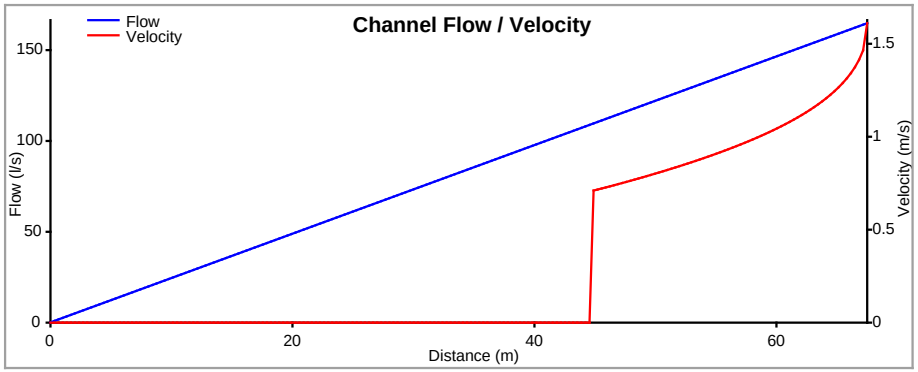
OUTFLOW (l/s)	CAPACITY (%)	MAX* VELOCITY (m/s)	MIN FREEBOARD (m)	EXCAVATION VOLUME (m3)	CONCRETE VOLUME (m3)
164.82	100.00	1.61	0.00	44.96	30.71

Qmax

	1
System	Qmax 550
W - Width (mm)	367
H - Invert (mm)	800
Length (m)	67.50







APPENDIX E: DESIGNERS RISK ASSESSMENT

PROJECT: Teesworks South Bank Quay (Phase 1)
DESIGNERS RISK ASSESSMENT
DRAINAGE

JOB NO: 211018A
DOCUMENT NUMBER: SBQ1-DCL-CIV-SBKXX-RA-CE -000006-P01
STATUS: S5

Coordination between the designer and contractor at the design phase

Weekly review meetings are held, these meetings are attended by the design team and the contracting team. During the meetings the design is discussed so that any H&S issues are identified and considered in line with the principles of prevention. The review of the design also considers construction methodology, phasing, sequencing, and interfaces with temporary and permanent works. The discussions are robust with information shared around the team any highlighted issues are further discussed using screen sharing / BIM model views to ensure everyone can participate and add their input to the discussions. Any actions arising from the discussions are assigned to the relevant team members for action and close out is further reviewed at the next meeting. Any design H&S issues that remain as significant residual risks to be manged during the construction phase or future operations are documented via the DRA and circulated across the contracting team, so everyone has sight of the relevant information.

Our Design service is managed through our BSI accredited Integrated Management System. Our service meets the requirements of the CDM Regulations, and our working practices adhere to HSE's L153 document. Doran Consulting has procedures in place to ensure compliance with the Designer's duties under the CDM Regulations and Regulation 9 in particular. The procedures to be followed by our team providing design services are detailed in our in-house Construction Design Management (CDM) Manual.

Standard Tasks

Table 1 – Standard and Non-standard tasks summary table related to the drainage construction & installation

Task	**Standard Task?** **Refer to Table 4 and 5 for further information**
Working near or over deep water	Non-Standard
Trenching works	Standard
Pipe laying	Standard
Manhole chamber construction	Standard
Steel fixing to interceptor surround	Standard
Concrete casting of interceptor surround	Standard
Steel fixing to ACO channel system	Standard
Concrete casting of ACO channel system	Standard
Installation of tidal flap valve	Non-Standard
Operational Loading	Non-Standard

Table 2 – Designer's Risk Assessment for the Construction Phase

No	Element	Hazard Information	Who might be harmed and how	Efforts to eliminate by design	Level of risk (based on what you are doing)	Further measures to Reduce, Inform and Control	Action by who and when	Revised level of risk	Open / closed
CONSTRUCTION									
1	Edge Protection	Construction of drainage elements immediately adjacent to capping beam	Construction operatives	Not possible	High	Contractor to install edge protection along the length of the capping beam during the pavement construction works.	Action by Principal Contractor	Low	Open
1	Tidal Flap Valve	Installation of tidal flap valve over deep water	Construction operatives	Not possible	High	Contractor to provide appropriate PPE to all operatives. Contractor to provide appropriate temporary working platform for installation works. Safety boat to be employed.	Action by Principal Contractor	Low	Open

Table 3 – Designer's Risk Assessment for the Operational Phase

No	Element	Hazard Information	Who might be harmed and how	Efforts to eliminate by design	Level of risk (based on what you are doing)	Further measures to Reduce, Inform and Control	Action by who and when	Revised level of risk	Open / closed
OPERATIONAL PHASE									
1	Pavement	Failure of drainage elements due to the due to the overloading of the concrete pavement by the future operator	Future use	Cannot eliminate by design due to the nature of the works	Low	The concrete Pavement has been designed in accordance with the Structural Design of heavy duty Pavements for Ports and other industries (4th Edition) and through finite element modelling. Loads have been defined by the Client to suit the proposed operations at the facility.	Concrete pavement loading and assumptions presented in Design Acceptance in Principle and Calculation packages, which shall be included in H&S file/Operations manual. Client and future tenants to review design loading prior to their operations.	Low	Open

Table 4 – Hazard and risk review form

Project: **Teesworks South Bank Quay (Phase 1)**			Prepared by: **PMM**
Element of project and identifier: **Concrete Pavement**			Date: **16/02/2022**
Stage: **Construction build**			Reviewed by: **FD**
Job no: **211018B**			Date: **16/02/2022**
1	Is element made up of ‘standard tasks”?	**YES**	If ‘NO’ go to 3
	IF ‘YES’.		
2	Does it comply with any contemporary advice?	**N/A**	Schedule advice adopted
		N/A	Has an explanation been produced? An explanation must always be produced
	If ‘YES’. PROCESS ENDS		
3	Does element contain ‘non-standard tasks’	**YES**	
	Are these items covered by any amended contemporary industry practice?	**NO**	
	If ‘YES’. PROCESS ENDS. If ‘NO’,		
4	Using reasonable engineering judgement		
	FOR EACH RISK ISSUE		
	Has the issue been discussed with contactors/operators etc as appropriate?	**YES**	Explanation, if ‘NO’
	If ‘YES’, does the design and information provided align with the advice received?	**YES**	Explanation, if ‘NO’
	If no discussion has occurred with other parties, has an explanation been recorded as to the engineering judgement used to form a solution?		There must be an explanation
SIGNIFICANT RESIDUAL RISK INFORMATION			
5	Has significant residual risk information been made available to other?	**YES** **To Principal Contractor / PM Team**	This will only apply to ‘non-standard tasks’ The answer must be ‘YES’

Table 5 – List of guidance

Activity	UK Regs	Performance standards
Hazardous substances		
Construction Dust	Code of Practice for Demolition BS6187: 2000	CIS36 - Construction dust https://www.citb.co.uk/media/e3kgvp1o/cis36.pdf
Skin exposure *From products such as:* *Cement*	The Control of Substances Hazardous to Health Regulations 2002	HSG262 - Managing skin exposure risks at work https://www.hse.gov.uk/pubns/priced/hsg262.pdf Skin checks for dermatitis (HSE) https://www.hse.gov.uk/skin/posters/skindermatitis.pdf
Working with substances hazardous to health *Such as:* *Isocyanates*	The Control of Substances Hazardous to Health Regulations 2002	ING136 - Working with substances hazardous to health https://www.hse.gov.uk/pubns/indg136.pdf L5 - Control of substances hazardous to health https://www.hse.gov.uk/pubns/priced/l5.pdf
Lead	The Control of Lead at Work Regulations 2002	L132 – Control of lead at work https://www.hse.gov.uk/pubns/priced/l132.pdf
Solvent	The Solvent Emissions (England and Wales) Regulations 2004	CIS27- Solvents https://www.hse.gov.uk/pubns/cis27.pdf
Workplace exposure limits	The Control of Substances Hazardous to Health Regulations 2002	EH40/2005 - Workplace exposure limits https://www.hse.gov.uk/pubns/priced/eh40.pdf
Physical Ill health risks		
Noise	The Control of Noise (Code of Practice for Construction and Open Sites) (England) Order 2015	L108 - Controlling noise at work https://www.hse.gov.uk/pubns/priced/l108.pdf INDG362 - Noise at work https://www.hse.gov.uk/pubns/indg362.pdf
Vibration	The Control of Vibration at Work Regulations 2005	L140 - Hand-arm vibration https://www.hse.gov.uk/pubns/priced/l140.pdf

Activity	UK Regs	Performance standards
Manual handling	The Manual Handling Operations Regulations 1992 The Lifting Operations and Lifting Equipment Regulations 1998	L23 - Manual handling https://www.hse.gov.uk/pubns/priced/l23.pdf INDG143 - Manual handling at work A brief guide https://www.hse.gov.uk/pubns/indg143.pdf L22 - Safe use of work equipment https://www.hse.gov.uk/pubns/priced/l22.pdf
Repetitive work	The Manual Handling Operations Regulations 1992 The Provision and Use of Work Equipment Regulations 1998	L22 - Safe use of work equipment https://www.hse.gov.uk/pubns/priced/l22.pdf
Cancer and Construction		
Asbestos	The Control of Asbestos Regulations 2012	HSG247 - Asbestos: The licensed contractors' guide https://www.hse.gov.uk/pubns/priced/hsg247.pdf L143 - Managing and working with asbestos https://www.hse.gov.uk/pubns/priced/l143.pdf
Silica	The Control of Substances Hazardous to Health Regulations 2002	INDG463 - Control of exposure to silica dust https://www.hse.gov.uk/pubns/indg463.pdf EH40/2005 - Workplace exposure limits https://www.hse.gov.uk/pubns/priced/eh40.pdf
Diesel engine exhaust	The Control of Substances Hazardous to Health Regulations 2002	INDG286- Diesel engine exhaust emissions https://www.hse.gov.uk/pubns/indg286.pdf
Paint	The Control of Substances Hazardous to Health Regulations 2002	See: 'Solvents', 'lead', 'construction dust' and asbestos' above. EIS32 - Chromate Primer paints https://www.hse.gov.uk/pubns/eis32.pdf -
Skin Cancer	The Control of Substances Hazardous to Health Regulations 2002	ING136- Working with substances hazardous to health https://www.hse.gov.uk/pubns/indg136.pdf

Activity	UK Regs	Performance standards
Site Organisation		
Welfare facilities	The Workplace (Health, Safety and Welfare) Regulations 1992	CIS59 - Provision of welfare facilities during construction work https://www.hse.gov.uk/pubns/cis59.pdf CIS62 - Welfare facilities https://www.hse.gov.uk/pubns/cis62.pdf HSG150 - Health and safety in construction https://www.hse.gov.uk/pubns/priced/hsg150.pdf L153 - Managing health and safety in construction https://www.hse.gov.uk/pubns/priced/l153.pdf
Site rules and Induction	The Construction (Design and Management) Regulations 2015	CIS80 Construction Phase Plan (CDM 2015) What you need to know as a busy builder https://www.hse.gov.uk/pubns/cis80.pdf HSG 263 - Involving your workforce in health and safety https://www.hse.gov.uk/pubns/priced/hsg263.pdf HSG150 - Health and safety in construction https://www.hse.gov.uk/pubns/priced/hsg150.pdf

Activity	UK Regs	Performance standards
Traffic management	The Construction (Design and Management) Regulations 2015	HSG144 The safe use of vehicles on construction sites https://www.hse.gov.uk/pubns/priced/hsg144.pdf HSG150- Health and safety in construction https://www.hse.gov.uk/pubns/priced/hsg150.pdf INDG199 - Workplace transport safety https://www.hse.gov.uk/pubns/indg199.pdf CIS52 - Construction site transport safety: Safe use of site dumpers https://www.hse.gov.uk/pubns/cis52.pdf INDG378 - Safe use of skip loaders https://www.hse.gov.uk/pubns/indg378.pdf HSG268 - The health and safety toolbox How to control risks at work https://www.hse.gov.uk/pubns/priced/hsg268.pdf
Site lighting	The Construction (Design and Management) Regulations 2015	HSG38- Lighting at work https://www.hse.gov.uk/pubns/priced/hsg38.pdf
Protecting the public	The Construction (Design and Management) Regulations 2015	HSG151 - Protecting the public https://www.hse.gov.uk/pubns/priced/hsg151.pdf
Materials storage and waste management	The Construction (Design and Management) Regulations 2015	HSG150- Health and safety in construction https://www.hse.gov.uk/pubns/priced/hsg150.pdf
Administration	The Construction (Design and Management) Regulations 2015	HSG150 Health and safety in construction https://www.hse.gov.uk/pubns/priced/hsg150.pdf INDG344 https://www.hse.gov.uk/pubns/indg344.pdf
Excavations		

Activity	UK Regs	Performance standards
Collapse of excavations	The Construction (Design and Management) Regulations 2015	HSG47 – The absolutely essential health and safety toolkit https://www.hse.gov.uk/pubns/priced/hsg47.pdf HSG150 - Health and safety in construction https://www.hse.gov.uk/pubns/priced/hsg150.pdf
Falling or dislodging material	The Construction (Design and Management) Regulations 2015	HSG47 – The absolutely essential health and safety toolkit https://www.hse.gov.uk/pubns/priced/hsg47.pdf HSG150 - Health and safety in construction https://www.hse.gov.uk/pubns/priced/hsg150.pdf
Falling into excavations	The Construction (Design and Management) Regulations 2015	HSG47 – The absolutely essential health and safety toolkit https://www.hse.gov.uk/pubns/priced/hsg47.pdf HSG150 - Health and safety in construction https://www.hse.gov.uk/pubns/priced/hsg150.pdf
Undermining nearby structures	The Construction (Design and Management) Regulations 2015	HSG47 – The absolutely essential health and safety toolkit https://www.hse.gov.uk/pubns/priced/hsg47.pdf HSG150 - Health and safety in construction https://www.hse.gov.uk/pubns/priced/hsg150.pdf

Activity	UK Regs	Performance standards
Underground and overhead services	The Construction (Design and Management) Regulations 2015	HSG47 – The absolutely essential health and safety toolkit https://www.hse.gov.uk/pubns/priced/hsg47.pdf HSG85 - Electricity at work https://www.hse.gov.uk/pubns/priced/hsg85.pdf CIS65- Avoiding concealed services and overhead power lines: https://www.hse.gov.uk/pubns/cis65.pdf GS6- Avoiding danger from overhead power lines https://www.hse.gov.uk/pubns/gs6.pdf
Inflow of ground and surface water	The Construction (Design and Management) Regulations 2015	HSG47 – The absolutely essential health and safety toolkit https://www.hse.gov.uk/pubns/priced/hsg47.pdf HSG150 - Health and safety in construction https://www.hse.gov.uk/pubns/priced/hsg150.pdf
Damage to trees	The Construction (Design and Management) Regulations 2015	NJUG GUIDELINES FOR THE PLANNING, INSTALLATION AND MAINTENANCE OF UTILITY APPARATUS IN PROXIMITY TO TREES http://streetworks.org.uk/wp-content/uploads/V4-Trees-Issue-2-16-11-2007.pdf
Other aspects of excavation safety *Such as:* *Hazardous fumes*	The Construction (Design and Management) Regulations 2015	HSG47 – The absolutely essential health and safety toolkit https://www.hse.gov.uk/pubns/priced/hsg47.pdf HSG150 - Health and safety in construction https://www.hse.gov.uk/pubns/priced/hsg150.pdf
Inspection	The Construction (Design and Management) Regulations 2015	HSG47 – The absolutely essential health and safety toolkit https://www.hse.gov.uk/pubns/priced/hsg47.pdf HSG150 - Health and safety in construction https://www.hse.gov.uk/pubns/priced/hsg150.pdf

Activity	UK Regs	Performance standards
Mobile Plant and vehicles		
Excavators	The Lifting Operations and Lifting Equipment Regulations 1998	HSG144 -The safe use of vehicles on construction sites https://www.hse.gov.uk/pubns/priced/hsg144.pdf HSG150 - Health and safety in construction https://www.hse.gov.uk/pubns/priced/hsg150.pdf HSG47 -Avoiding danger from underground services https://www.hse.gov.uk/pubns/priced/hsg47.pdf L113- Safe use of lifting equipment https://www.hse.gov.uk/pubns/priced/l113.pdf
Telescopic handlers	The Lifting Operations and Lifting Equipment Regulations 1998	HSG144 - The safe use of vehicles on construction sites https://www.hse.gov.uk/pubns/priced/hsg144.pdf HSG150 - Health and safety in construction https://www.hse.gov.uk/pubns/priced/hsg150.pdf L113 - Safe use of lifting equipment https://www.hse.gov.uk/pubns/priced/l113.pdf
MEWPS	The Lifting Operations and Lifting Equipment Regulations 1998	HSG150 - Health and safety in construction https://www.hse.gov.uk/pubns/priced/hsg150.pdf GEIS6 - The selection, management and use of mobile elevating work platforms https://www.hse.gov.uk/pubns/geis6.pdf
Dumper trucks	The Construction (Design and Management) Regulations 2015	HSG144 - The safe use of vehicles on construction sites https://www.hse.gov.uk/pubns/priced/hsg144.pdf HSG150 - Health and safety in construction https://www.hse.gov.uk/pubns/priced/hsg150.pdf CIS52 - Construction site transport safety: Safe use of site dumpers https://www.hse.gov.uk/pubns/cis52.pdf

Activity	UK Regs	Performance standards
Slips, trips, and falls		
Uneven surfaces	The Construction (Design and Management) Regulations 2015	HSG150 Health and safety in construction https://www.hse.gov.uk/pubns/priced/hsg150.pdf
Obstacles	The Construction (Design and Management) Regulations 2015	HSG150 Health and safety in construction https://www.hse.gov.uk/pubns/priced/hsg150.pdf
Trailing cables	The Construction (Design and Management) Regulations 2015	HSG150 Health and safety in construction https://www.hse.gov.uk/pubns/priced/hsg150.pdf
Wet or slippery surfaces	The Construction (Design and Management) Regulations 2015	HSG150 Health and safety in construction https://www.hse.gov.uk/pubns/priced/hsg150.pdf
Changes in level	The Construction (Design and Management) Regulations 2015	HSG150 Health and safety in construction https://www.hse.gov.uk/pubns/priced/hsg150.pdf
Fire		
Fire safety	The Construction (Design and Management) Regulations 2015	INDG168 - Fire safety in construction https://www.hse.gov.uk/pubns/priced/hsg168.pdf
Working at Height		
Roof work	The Work at Height Regulations 2005	HSG150 Health and safety in construction https://www.hse.gov.uk/pubns/priced/hsg150.pdf HSG33- Health and safety in roof work https://www.hse.gov.uk/pubns/priced/hsg33.pdf

Activity	UK Regs	Performance standards
Fragile surfaces	The Work at Height Regulations 2005	GEIS5 - Fragile roofs https://www.hse.gov.uk/pubns/geis5.pdf HSG33 - Health and safety in roof work https://www.hse.gov.uk/pubns/priced/hsg33.pdf HSG150 Health and safety in construction https://www.hse.gov.uk/pubns/priced/hsg150.pdf
Ladders	The Work at Height Regulations 2005	LA455- Safe Use of Ladders and Stepladders - a brief guide https://ladderassociation.org.uk/la455/
Tower scaffolds	The Work at Height Regulations 2005	CIS47- Inspection and reports https://www.hse.gov.uk/pubns/cis47.pdf HSG150 Health and safety in construction https://www.hse.gov.uk/pubns/priced/hsg150.pdf
Mobile elevating moving platforms (MEWP)	The Work at Height Regulations 2005	GEIS6 - The selection, management and use of mobile elevating work platforms https://www.hse.gov.uk/pubns/geis6.pdf HSG150 Health and safety in construction https://www.hse.gov.uk/pubns/priced/hsg150.pdf
Suspended access equipment	The Work at Height Regulations 2005	INDG367- Inspecting fall arrest equipment made from webbing or rope https://www.hse.gov.uk/pubns/indg367.pdf HSG150 Health and safety in construction https://www.hse.gov.uk/pubns/priced/hsg150.pdf
Safety harness	The Work at Height Regulations 2005	HSG33- Health and safety in roof work https://www.hse.gov.uk/pubns/priced/hsg33.pdf HSG150 Health and safety in construction https://www.hse.gov.uk/pubns/priced/hsg150.pdf

Activity	UK Regs	Performance standards
Prevention of drowning		
Prevention of drowning	The Construction (Design and Management) Regulations 2015	AIS1 - Personal buoyancy equipment on inland and inshore waters https://www.hse.gov.uk/pubns/ais1.pdf HSG150 Health and safety in construction https://www.hse.gov.uk/pubns/priced/hsg150.pdf
Temporary work		
Temporary work	The Construction (Design and Management) Regulations 2015	BS 5975:2019 Code of practice for temporary works procedures and the permissible stress design of falsework

APPENDIX F: CAT 2 DESIGN CHECK COMMENTS

Contractor		GRAHAM
Project		South Bank Quay, Teesworks
DORAN Doc Reference Number		SBQ1-DCL-CIV-SBKXX-RP-CE-000016
Document		Category 2 Design Check Comments for; **Drainage**
Revision		P01
Date		02/17/2022

#	Section	Comment	Comment Date	Status	Response	Response Date	Status	Comment	Comment Date	Status
1	Drainage details	interceptor vent pipe to be indicated on the drawings	17/02/2022	open	Interceptor vent pipe notes added to drawings 400001, 400002 and 400003	15/03/2022	Closed			
2	Drainage details	Manhole schedule is required	17/02/2022	open	Manhole schedule has been produced. Refer to drawing 400004	15/03/2022	Closed			
3	Drainage details	The use of Rocker Pipes is to be noted on the drainage drawings	17/02/2022	open	rocker pipe notes added to drawing 400002 and 400011	15/03/2022	Closed			
4	Settlement	Consideration to be given to the impact on drainage of settlement in the areas that are not pilled. Outfall level at quay wall is fixed and so should be set at a level required for the design and accounting for maximum settlement. Connection details to consider static outfall with settling drainage network.	23/02/2022	open	The maximum expected settlement expected during the design life of the pavement is approximately 80mm. The pipe gradient between all key elements has been increased to accommodate a 80mm settlement. The minimum gradient following 80mm settlement remains at 1 in 150. Rocker pipe will be installed at all pipe connects to enable rotation of the pipes.	15/03/2022	Closed			

APPENDIX G: DESIGN AND CHECK CERTIFICATES

SOUTH BANK QUAY PHASE 1

CHECK CERTIFICATE – CATEGORY 2 STRUCTURE

Name of Structure: Drainage

Certificate No. **SBQ1-DCL-CIV-SBKXX-CC-CE-000006 – Rev P02**

1. We certify that reasonable skill, care and diligence has been used in the preparation of the check of the above structure with a view to securing that:
    i. It has been checked in accordance with

The Acceptance in Principle (AIP) No:	SBQ1-DCL-CIV-SBKXX-RP-CE-000006
Dated:	February 2022

    ii. It has been accurately translated into Drawings and Specification. The unique numbers of these Drawings and Specifications are:-

Drawing / Document Number	Drawing/Document Title	Revision
SBQ1-DCL-CIV-SBKXX-CA-CE-000006	Full Design Package – Drainage	P02

Design Organisation Authorising Representative

for Category 2 Structure Design Check

Signed: 

Position Held: Associate

Name: David Whiteside

Date: 04/05/2022

2. The Certificate is accepted by the **Employer's Representative**.

Signed …

EMPLOYER'S REPRESENTATIVE

Name …

Organisation ...

Date …

SOUTH BANK QUAY PHASE 1

DESIGN CERTIFICATE – CATEGORY 2 STRUCTURE

Name of Structure: Drainage

Certificate No. **SBQ1-DCL-CIV-SBKXX-DC-CE-000006 Rev P02**

1. We certify that reasonable skill, care and diligence has been used in the preparation of the design of the above structure with a view to securing that:
    i. It has been designed in accordance with

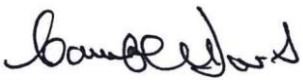
The Acceptance in Principle (AIP) No:	SBQ1-DCL-CIV-SBKXX-RP-CE-000006
Dated:	February 2022

    ii. It has been accurately translated into Drawings and Specification. The unique numbers of these Drawings and Specifications are:-

Drawing / Document Number	Drawing/Document Title	Revision
SBQ1-DCL-CIV-SBKXX-CA-CE-000006	Full Design Package – Drainage	P02

2. The relevant Check Certificate is attached. The unique number of this certificate is: **SBQ1-DCL-CIV-SBKXX-CC-CE-000006 Rev P02**

Design Organisation Authorising Representative

Signed: 

Position Held: Director

Name: Campbell Davis

Date: 04/05/2022

3. The Certificate is accepted by the **Employer's Representative**.

Signed …

EMPLOYER'S REPRESENTATIVE

Name …

Organisation …

Date …

APPENDIX H: SPECIFICATION

South Tees Development Corporation

GRAHAM

SOUTH BANK QUAY PHASE 1

DRAINAGE SPECIFICATION

SBQ1-DCL-CIV-SBKXX-SP-CE-000011-P02

May 2022

Doran CONSULTING

DELIVERING ENGINEERING EXCELLENCE

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SOUTH BANK QUAY PHASE 1

DRAINAGE SPECIFICATION

SBQ1-DCL-CIV-SBKXX-SP-CE-000011

May 2022

Job no	Prepared by	Checked by	Approved by	Status	Rev	Issued to	No of copies	Date
SBQ1	PMM	FD	CD	S5	P02	GRAHAM	e*	04/05/22
SBQ1	PMM	FD	CD	S5	P01	GRAHAM	e*	21/03/22

Doran Consulting Limited
Registered Office
Norwood House
96-102 Great Victoria Street
Belfast BT2 7BE

T 028 9033 3443
F 028 9023 5501
E mail@doran.co.uk
W www.doran.co.uk

FS 25466
OHS 507887
EMS 75248

consultancy **engineering** business **environment**

NI Reg No. NI055181

Contents

1.0 BRIEF DESCRIPTION AND SITE CONDITIONS

1.1 THE WORKS

1.1.1 The construction of the new quay will primarily service the offshore sector, offering some 125 acres of hard standing for manufacturing, storage and mobilisation. The project is part of the wider Teesworks development scheme to provide some 4,500,000ft² of land for manufacturing, logistics and distribution.

1.1.2 The concrete pavement construction is to be undertaken to this method specification with specified classification, control and verification testing.

1.2 SITE INFORMATION

1.2.1 The site is located on the south bank of the River Tees at Redcar approximately 6km east of Billingham. The National Grid reference of the approximate centre of the site is NZ 545 227. This can be found on Ordnance Survey 1:50,000 Sheet No. 93 (Middlesbrough, Darlington & Hartlepool). Part of this sheet is reproduced as Figure 1.

1.2.2 The site comprises a stretch of approximately 1km land on the south bank of the River Tees which is largely disused land/ derelict. A number of disused oil storage tanks are present on site along with existing local roads and areas of hardstanding. The site is bound to the south and east by further disused land and to the south-west by Teesport Commerce Park.

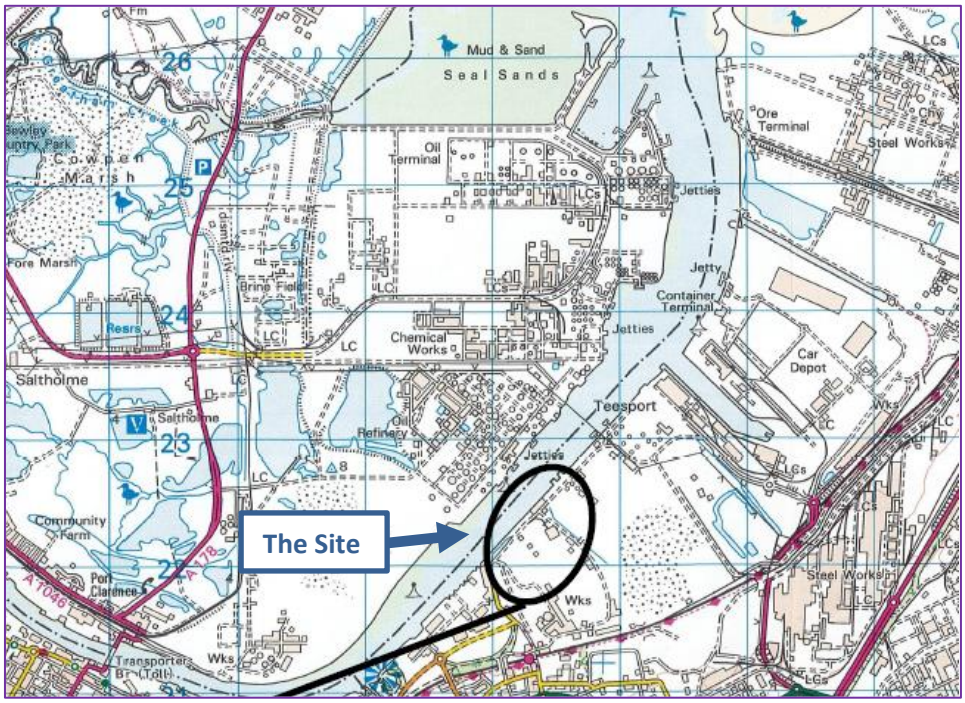

Figure 1. Site Location

(Ordnance Survey Crown Copyright and database rights 2021. Licence Number 1000050411)

2.0 DRAINAGE SPECIFICATION

2.1 PREAMBLE TO THE DRAINAGE SPECIFICATION

2.1.1 The Drainage Specification shall be the 'Specification for Highway Works', published by the Stationery Office (formerly HMSO) as Volume 1 of the Manual of Contract Documents for Highway Works, as modified and extended by the following contract specific items:

I. Appendix 0/1: Contract specific Additional, Substitute and Cancelled Clauses, Tables and Figures;
II. Appendix 0/2: Contract specific minor alterations to existing Clauses, Tables and Figures;
III. The contract specific Numbered Appendices listed in Appendix 0/3;

Appendix 0/4 contains a list of the Drawings.

2.1.2 The relevant publication date of each page of the Specification for Highway Works is given in the Schedule of Pages and Relevant Publication Dates.

2.1.3 Insofar as any of the contract specific Numbered Appendices may conflict or be inconsistent with any provision of the Specification for Highway Works the Numbered Appendices shall always prevail.

2.1.4 Any reference in the Contract to a Clause number or contract specific Appendix shall be deemed to refer to the corresponding Substitute Clause number or contract specific Appendix listed in Appendix 0/1 or 0/2.

2.1.5 Where a Clause is altered any original Table/Figure referred to in the Clause shall apply unless the Table/Figure is also altered. Where a Table/Figure is altered any reference in a Clause to the original Table/Figure shall apply to the altered Table/Figure.

2.1.6 Where a Clause in the Specification relates to work goods or materials which are not required for the Works it shall be deemed not to apply.

2.1.7 Any Appendix referred to in the Specification which is not used shall be deemed not to apply.

2.1.8 Where Standards and other documents are incorporated into the Contract by reference the respective edition used shall be that which is current on the Contract Reference Document Date unless otherwise stated in the Specification.

APPENDIX 0/1 : CONTRACT - SPECIFIC ADDITIONAL, SUBSTITUTE AND CANCELLED CLAUSES AND TABLES INCLUDED IN THE CONTRACT

0.1.1 List of Additional Clauses, Tables and Figures

Additional Clauses, Tables and Figures

Clause Table, Or Fig No	Title
172 AR	**REMOVAL OF SURPLUS MATERIAL** 1. The Contractor shall not allow rubbish, debris and surplus material of any description to accumulate but shall clear away all such material on the same day as it is excavated. 2. The Contractor shall as far as possible prevent any material entering a gully, drainage channel or chamber and shall remove immediately any material which may enter.

APPENDIX 0/2: CONTRACT - SPECIFIC MINOR ALTERATIONS TO EXISTING CLAUSES AND TABLES INCLUDED IN THE CONTRACT

Clause No (etc)	Alterations to be made
	None

APPENDIX 0/3: CONTRACT SPECIFIC NUMBERED APPENDICES REFERRED TO IN THE SPECIFICATION AND INCLUDED IN THE CONTRACT

Appendix No.	Title
	INTRODUCTION
0/1	Contract Specific Additional, Substitute and Cancelled Clauses, Tables and Figures included in the Contract
0/2	Contract Specific Minor Alterations to Existing Clauses, Tables and Figures included in the Contract
0/3	List of Numbered Appendices Referred to in the Specification and Included in the Contract.
0/4	List of Drawings and Other Documents Included in the Contract.
	DRAINAGE AND SERVICE DUCTS
5/1	Drainage Requirements
5/2	Service Duct Requirements
5/4	Fin Drains and Narrow Filter Drains
5/6	Linear drainage channel systems
5/7	Termoplastic structural wall pipes and fittings

APPENDIX 0/4: LIST OF DRAINAGE DRAWINGS

0.4.1 Doran Consulting Drawings included in the Contract

Drawing No	Drawing Title
Doran Consulting Drawings	
SBQ1-DCL-CIV-SBKXX- DR-CE-400001	Proposed Drainage Layout Sheet 1
SBQ1-DCL-CIV-SBKXX- DR-CE-400002	Drainage Standard Details Sheet 1
SBQ1-DCL-CIV-SBKXX- DR-CE-400003	Drainage Standard Details Sheet 2
SBQ1-DCL-CIV-SBKXX- DR-CE-400004	Manhole Schedule
SBQ1-DCL-CIV-SBKXX- DR-CE-400006	Drainage Standard Details Sheet 4
SBQ1-DCL-CIV-SBKXX- DR-CE-400007	Drainage Standard Details Sheet 5
SBQ1-DCL-CIV-SBKXX- DR-CE-400011	Petrol Interceptor Sections

0.4.2 Standard Drawings

Brought Into the Contract by Reference

HCD published by HMSO as Volume 3 of the Manual of Contract Documents for Highway Works contains the following drawings brought into the Contract by reference. Unless otherwise stated below the whole drawing is brought into the Contract.

Drawing No	Title	Date
F1	Surface Water Drains – Trench and Bedding Details	Dec 91
F2	Filter Drains – Trench and Bedding Details	Nov 03
F5	Type 3 Chamber (Precast Concrete Manhole)	May 06
F10	Chamber Fittings – Ladder, Handhold and Safety Chain	Nov 03
F17	Details of Keyways and Keys for Manhole Tops and Kerb type Gully Tops	Mar 98
F28	Chamber Fittings – Guardrail	Nov 03

SERIES 100 - PRELIMINARIES

APPENDIX 1/5: TESTING TO BE CARRIED OUT BY THE CONTRACTOR

General

1 Details of the testing to be carried out by the Contractor is shown below in Table 1/5.

2 Routine tests carried out by manufacturers and suppliers in compliance with British Standard or other standard specification are not included, but where a standard or specification makes provision for a test certificate this is indicated.

Notes:

1. All sampling and testing will be carried out by the contractor to the frequency stated below and at the Contractor's expense. All tests must be carried out by an independent NAMAS approved Testing House which has UKAS accreditation for that specific test.
2. Test equivalent to those specified in this Appendix will be necessary for any equivalent work, goods materials proposed by the Contractor.
3. (N) indicates that a UKAS sampling and test report certificate is required.
4. For imported materials sampled at source the sample must be representative of the material used in the works and the test certificate shall be no more than 12 months old.
5. Unless otherwise shown in this Appendix tests and test certificates for work, goods or materials as scheduled under any one Clause are required for all such work, goods or materials.
6. All laboratory testing shall be carried out by a testing house which is independent of the Contractor and is not within the same group of companies as the Contractor.
7. Cube strength tests are required for all cast in-situ concrete elements.
8. The Contractor shall allow the Engineer every reasonable opportunity and facility to inspect and monitor the sampling and testing processes. The Contractor shall notify the Engineer of who, where and when samples and testing are being carried

out and be able to demonstrate that the UKAS accreditation required above is being complied with.

9. As part of the provision of samples and testing undertaken by the Contractor, the Contractor shall keep a daily record of samples of goods and materials taken by or on behalf of the Contractor for testing. Records shall be in sufficient detail to record the nature and the source of goods and materials and shall identify the locations and means of selection and sampling. A copy of the daily record shall be provided by the Contractor on the next working day for retention and use by the Overseeing Organisation.
10. Test reports and certificates shall bear suitable identification compatible with the Contractors registration of samples.
11. Additionally, all test results shall be presented in accordance with the relevant testing standard and shall incorporate the following information:
    a. Specimen reference;
    b. Material brief description;
    c. Manufacturer's, supplier's name or origin as appropriate;
    d. Batch reference number (proprietary material only);
    e. Quantity of material;
    f. Location of material in the works;
    g. Date sampled, by whom and method used;
    h. Date(s) tested;
    i. Results of all tests.

Clause	Work, Goods or Material	Test	Frequency of Testing	Test Certificate	Comments
Series 500					
501	Pipes for drainage and service ducts				Product certification scheme applies
	Vitrified Clay		`	Required for pipes not quality marked by an UKAS or equivalent accredited body listed in Appendix B	
	Concrete-PC/SRC (Not exceeding 900 mm dia)				
	Concrete Prestressed (Not exceeding 900 mm dia)				
	Iron- cast				
	Iron- ductile				
	PVC-U				
	GRP				
	Plastics, see Table 5/1				
	Corrugated Steel	Manufacturers test		Required (AASHTO)	
	Corrugated steel bitumen protection (Not exceeding 900 mm dia)				
	Other materials			Required	BBA certification (or equivalent) applies
503	Pipe Bedding	Grading and fines content	1 per 250m^3	Required	
		Water-soluble sulphate (WS) content (N)	5 per source		
		Oxidisable sulfides (OS) content and total potential sulphate (TPS) content (N)	5 per source		
		Resistance to fragmentation (N)	1 per source		

Clause	Work, Goods or Material	Test	Frequency of Testing	Test Certificate	Comments
Series 500					
505	Filter medium backfill	Plastic index (N)	1 per source	Required	
		Resistance to fragmentation (N)	1 per source		
		Water-soluble sulphate (WS) content (N)	5 per course		
		Oxidisable sulfides (OS) content and total potential sulphate (TPA) content (N)	5 per source		
		Grading and fines content	1 per 500 tonnes		
		Permeability (N)	1 per source*		
506	Sealing existing drains				
	Concrete				
	Grout				
507	Chambers				
	Precast concrete				Product certification scheme
	Corrugated galvanized steel	(Manufacturer's tests)		Required	Product certification scheme
	Manhole steps				
	Steel fitments				
	Covers, grates and frames				Product certification scheme applies
	Cover bolts				Quality management scheme applies

Clause	Work, Goods or Material	Test	Frequency of Testing	Test Certificate	Comments
Series 500					
508	Gullies and pipe junction				Product certification applies
	Precast concrete				Product certification applies
	Clay				
	Cast iron and steel				
509	Watertightness of joints	Air test Pressure test	All pipelines with watertight joints All watermains	Required	Specification for the Water Industry Section 7
512	Backfill to pipe bays	Grading	1 per 50 tonnes (min of 3)	Required	
		Water-soluble sulphate (WS) content (N)	5 per source		Minimum to allow for natural variability of sulphur compounds
		Oxidisable sulfides (OS) content and total potential sulfate (TPA) content (N)	5 per source		

Clause	Work, Goods or Material	Test	Frequency of Testing	Test Certificate	Comments
Series 500					
513	Permeable backing to earth retaining structures	Plastic index (N)	1 per source	Required	
		Water-soluble sulphate (WS) content (N)	5 per source	Required	
		Oxidisable sulfides (OS) content and total potential sulphate (TPS) content (N)	5 per source		
		Resistance to fragmentation (N)	1 per source		
		Grading	1 per 200 tonnes (min of 3)*		
		Permeability (N)	1 per source		
	Precast hollow concrete blocks	(Manufacturer's test)		Required	
515	Narrow filter drains	Manufacturer's test		Required	BBA Certification (or equivalent) applies
	Geotextile, pipes and fittings				
	Granular fill	Plastic index (N)	1 per source		
		Resistance to fragmentation (N)			
		Water-soluble sulphate (WS) content (N)	5 per source		
		Oxidisable sulfides (OS) content and total potential sulphate (TPS) content (N)	5 per source		
		Grading and fines contents	1 per 200 tonnes (Min of 3)		
		Permeability (N)	1 per source		

Clause	Work, Goods or Material	Test	Frequency of Testing	Test Certificate	Comments
Series 500					
516	Combined drainage and kerb systems	Load test - to confirm load classification in accordance with Appendix 5/5	A minimum of 1 test and not less than 1 test per 500 m for each type and source	Required	Certification that the systems comply with Clause 516 is required
517	Linear drainage systems	Load test - to confirm load classification in accordance with Appendix 5/6	A minimum of 1 test and not less than 1 test per 500m for each type and source	Required	Certification that the systems comply with Clause 517 is required
518	Thermoplastic structured wall pipes and fittings	(Manufacturer's test)		Required	BBA Certification (or equivalent) applies

1. (N) indicates that a NAMAS test report or certificate is required.

2. Certificate to be provided monthly. Quality management and certification schemes apply.

3. Results of routine control test by the manufacturer/supplier to be provided. Product certification schemes apply.

SERIES 500 - DRAINAGE

APPENDIX 5/1: DRAINAGE REQUIREMENTS

5.1.1 The pipe sizes, material type and class for the drainage system are detailed on the Drawings listed in Appendix 0/4 and should be in accordance with Table 5/1 Series 500 SHW:

5.1.2 The bedding detail to filter drains to be Type K as shown on Drawing No. F2, MCDHW, Volume 3, “Highway Construction Details”. All filter material to be Type A.

5.1.3 Class S granular surround where pipes achieve cover depth of greater than or equal to 1200mm.

5.1.4 Class Z concrete surround where pipes achieve cover depth of less than 1200mm.

5.1.5 All standard chamber covers and frames shall be Gatic RRF F900 750mm x 750mm clear opening, or approved equal. Gatic covers are to be supplied with two sets of lifters for each cover type. Reinforced concrete surround to chamber covers.

5.1.6 Hydro-brake Optimum with peak flow of 225l/s, or approved equal, to be installed on each drainage line in the chamber immediately up line of the full retention separator. Hydro-brake to be installed in strict accordance with the manufacturer’s instructions.

5.1.7 Full retention separators to be Klargester NSFA225, or approved equal, to be installed on each storm drainage line. Full retention separators are to be installed in accordance with the manufacturers instructions. Each full retention separator is to be vented and fitted with a Klargester oil level alarm. Refer to drawing SBQ1-DCL-CIV-SBKXX_DR_CE_400002 for reinforced surround details.

5.1.8 Multi-span cover to full retention separator to be DM/F load class 900 4,000mm x 1,200mm clear opening. or approved equal. Multi-span covers to be supplied with two sets of lifters.

5.1.9 Tidal flap valves to be 600mm diameter Athlon PTK-A HDPE Flap Valve, or approved equal, to be installed on each drainage line under the proposed quay structure. Flap vale to be installed in strict accordance with the manufacturer's instructions.

5.1.10 Emergency stormwater shut of valves to be Athlon 600mm HDPE penstock, or approved equal, to be installed in the storm chambers immediately downline of each full retention separators. Flap valve to be installed in strict accordance with the manufacturer's instructions.

5.1.11 CCTV survey of the system with the exception of gully connections shall be carried out on completion of the works and again before the end of the maintenance period. A copy of the footage and survey reports including gradient profile shall be supplied free of charge to the Client.

APPENDIX 5/2: SERVICE DUCT REQUIREMENTS

5.2.1 Refer to the M&E Drawings and Specification for the location, size and type of the service ducts required

APPENDIX 5/4: FIN DRAINS AND NARROW FILTER DRAINS

5.4.1 Refer to drawing SBQ1-DCL-CIV-SBKXX_DR_CE_400001 and 400006 for filter drain location and standard construction detail respectively .

5.4.2 Surround geotextile to be TERRAM T1000 or approved equal.

5.4.3 Geotextile permeability to be 90l/m2/s

5.4.4 Drainage pipe to be fully perforated 300mm diameter HDPE pipe.

5.4.5 Trench to be filled with 20mm/40mm clean drainage stone

APPENDIX 5/6: LINEAR DRAINAGE CHANNEL SYSTEMS

5.6.1 Refer to drawing SBQ1-DCL-CIV-SBKXX_DR_CE_400001 location, length, and sizing of linear drainage channels.

5.6.2 All linear drainage channels to be ACO Q-Max system. All Q-Max components to have a reinforced concrete surround. Slot drainage to be installed as per the manufacture's instructions. Channels to be F900 load rating (BS EN 124).

5.6.3 Refer to drawing SBQ1-DCL-CIV-SBKXX_DR_CE_400003 for reinforced surround details for each Q Max channel type. Concrete surround to all Ultra Slot system components to have a minimum compressive strength of C40/50

5.6.4 All linear drainage system chambers to be ACO Q-Max 550/700/900 sump chamber units. Chambers to have reinforced concrete surround. Refer to drawing SBQ1-DCL-CIV-SBKXX_DR_CE_400006 for surround details. Chamber and covers to be F900 load rating (BS EN 124).

APPENDIX 5/7: termoplastic structural wall pipes and fittings

5.7.1 The Contractor shall provide the following information, in accordance with sub-Clause 518.2 for the range of pipes and fittings (To be verified by the Certification body – see sub-Clause 518.15):

Technical Drawings showing dimensions and tolerances including sealing rings and weight per metre, together with properties, as specified in sub-Clauses 518.3 and 518.5.

Material specification, as required in sub-Clause 518.2:

Table 1: Un-plasticised Polyvinyl Chloride

Property	Test Method Reference	Specification
Tensile Properties	BS EN ISO 6259 BS EN ISO 527-1	
Vicat	BS EN 727	
Longitudinal revision	BS EN 743	
K-value	BS EN 922	
PVC Content	BS EN 1905	
Density	BS EN ISO 1183-3, ISO 4451	
Heat Revision	ISO 12091	
Effects of heat (injection moulded fittings only)	BS EN 763	

Table 2: Polyethylene (PE)

Property	Test Method Reference	Specification
Tensile Properties	BS EN ISO 6259 BS EN ISO 527-1	
Oxygen induction time	BS EN 728	
Melt Flow Rate	BS EN ISO 1133	
Density	BS EN ISO 1183-3, ISO 4451	
Heat Revision	ISO 12091	
Effects of heat (injection moulded fittings only)	BS EN 763	

Table 3: Polyethylene (PP)

Property	Test Method Reference	Specification
Tensile Properties	BS EN ISO 6259 BS EN ISO 527-1	
Oxygen induction time	BS EN 728	
Melt Flow Rate	BS EN ISO 1133	
Density	BS EN ISO 1183-3, ISO 4451	
Heat Revision	ISO 12091	
Effects of heat (injection moulded fittings only)	BS EN 763	