REDCAR ENERGY CENTRE

Outline Drainage Strategy

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Contents

1 INTRODUCTION

Strategy Scope

1.1 RPS has been commissioned to produce an Outline Drainage Strategy for the proposed Redcar Energy Centre (REC) located near Redcar on the south bank of the River Tees. The Application Site forms part of the Redcar Bulk Terminal and is located at the approximate grid reference NZ 558 259.

1.2 The purpose of this report is to outline the design principles for surface, foul and process water drainage to be implemented in the proposed development. The report has been produced in conjunction with the Flood Risk Assessment which has been prepared to support the planning application (see Appendix 8.XX).

1.3 The contents of this report are to be read in conjunction with the supporting drawings and/or documents referenced herein, appended to this report or submitted in support of the planning application for the REC.

Site Description

Existing Site

1.4 The Application Site is located approximately 4.5 km west of Redcar town centre and 8.5km north east of Middlesbrough town centre.

1.5 The Application Site forms part of the demise of Redcar Bulk Terminal and occupies an area of approximately 10.1 hectares of what was heavily industrialised land. Redcar Bulk Terminal is a port used for the transhipment of coal and coke and other bulk goods, and for many years was the import dock for iron ore.

1.6 The Application Site is open in character with a small area used for the storage of bulk materials such as coal scrapings. In addition, there are a number of small corrugated metal buildings located on the eastern part of the site.

1.7 The Application Site is underlain by between 6 and 7 metres of Made Ground comprising of steel slag from local industrial processes.

1.8 The topography of the site is relatively flat ranging from 7.1mAOD to 7.6mAOD with localised spoil heaps.

Proposed Development

1.9 The proposed development consists of the following main elements:

- Materials Recovery Facility (MRF)
- Energy Recovery Facility (ERF), including:
  - turbine hall;
  - boiler;
  - waste bunker; and
  - tipping hall.
- Incinerator Bottom Ash (IBA) Recycling Facility;
- offices and associated parking; and
- soft landscaping.

1.10 The proposed site layout is included in Annex A. For the purposes of preliminary design, a proposed finished floor level of 8mAOD has been assumed including allowances for a nominal 500mm construction and capping build up above the average site level of 7.5mAOD

2 PROPOSED SURFACE WATER DRAINAGE

Drainage Strategy Overview

2.1 The Outline Drainage Strategy has been devised to ensure all outline planning requirements and guidelines from the Lead Local Flood Authority (LLFA) and Environment Agency (EA) are satisfied to prevent uncontrolled flooding of the Application Site and its surrounding areas. The site wide drainage strategy has been devised using the Tees Valley Sustainable Drainage (SuDS) Guidance - Design Guide and Local Standards (Darlington Borough Council, Hartlepool Borough Council, Middlesbrough Council, Redcar and Cleveland Borough Council, Stockton-on-Tees Borough Council (DBC, HBC, MC, RCBC and STBC), 2019)

2.2 The outline drainage strategy for the Application Site has been carefully designed to manage water quality, water quantity and promote amenity and biodiversity whilst accommodating design flexibility. The final details of the outline drainage strategy would be refined during detailed design.

2.3 SuDS features would be incorporated into the proposed development to mimic natural drainage routes and control surface water close to where it falls. Source control features may include permeable pavements and filter drains.

2.4 Surface water runoff from the external impermeable areas would be collected as follows;

- Roof areas – The buildings roofs would be drained by a specialist design syphonic roof drainage system with valley and eaves gutters and primary and secondary outlets in accordance with BS EN 12056-3:2000 to accommodate run-off rates in accordance with design rate Category 3.
- External yard / haulage areas – These areas are likely to be drained via traditional slot / channel drains before discharging to a below ground network via suitable oil interceptors.
- Office Parking – Where appropriate the use of permeable paving would be considered for the construction of car parking areas.
- Circulation routes – Circulation routes would be laid to cross falls to direct surface water runoff to a roadside filter drain or swale where there is no significant risk of pollution from high volumes of HGV movements.
- IBA Areas – Surface water from the IBA areas will be managed as part of a sealed system separate from the main surface network, discussed further in Section 5 of this report.

2.5 Although there is no specific requirement for surface water attenuation, an onsite attenuation pond has been incorporated into the site layout to allow some flexibility in the drainage design. The attenuation pond also offers surface water quality benefits and provides an opportunity for rainwater recycling for use in the process and as firefighting water.

2.6 All SuDS features would be suitably designed to prevent infiltration to prevent mobilisation of ground contaminants.

Surface Water Discharge Location

2.7 The means of surface water discharge for the proposed development has been carefully considered in accordance with the CIRIA SuDS manual's (CIRIA, 2015) hierarchical approach and the Tees Valley SuDS Design Guide and Local Standard LS1 (DBC, HBC, MC, RCBC and STBC, 2019).

2.8 Concurrent with findings from British geological Survey (BGS) borehole logs (accessed online via www.bgs.ac.uk March 2020) indicating extensive Made Ground, Tees Valley SuDS Design Guide and Local Standard LS1 (DBC, HBC, MC, RCBC and STBC, 2019) states that infiltration is not considered a suitable option for the primary method of the disposal of surface water. As such surface water would discharge into the Tees Estuary via a gravity outfall.

2.9 The exact arrangement of the outfall is yet to be confirmed but is likely to take the approximate route as indicated in RPS drawing 019216-RPS-EW-ZZ-DR-D-0302.

2.10 Through detailed design of the surface water drainage network, the outfall level would be determined to assess possible impacts of "tide locking" in accordance with the Tees Valley SuDS Design Guide and Local Standard LS3 (DBC, HBC, MC, RCBC and STBC, 2019). Appropriate allowances for sea level rise would be considered in accordance with LS4 (DBC, HBC, MC, RCBC and STBC, 2019). Further information regarding sea level rise allowances are included in the associated RPS Flood Risk Assessment Report.

Surface Water Quantity

2.11 It is standard practice in the UK to control the peak and volumetric runoff rates from new development to protect the hydraulic response of downstream waterbodies and mitigate flood risk impacts. In the case of the proposed development, the Tees Estuary is considered capable of accommodating uncontrolled surface water discharge without any impact on flood risk as recognised by the Tees Valley SuDS Design Guide and National Standard S1 (DBC, HBC, MC, RCBC and STBC, 2019).

2.12 On this basis, discharge to the Tees Estuary at an uncontrolled rate is proposed. The only limiting factor to discharge rate would, therefore, be the capacity of the gravity outfall pipe which would be appropriately sized during detailed design.

2.13 Although there is no significant requirement for attenuation, an onsite attenuation pond provides the opportunity for surface water storage to allow economic design of the outfall pipe and assist in controlling the peak runoff during low probability short duration storms.

Surface Water Quality and Pollution Control

2.14 Proposed run-off quality control for the site would include a combination of proprietary pollution interceptors, filter drains, and permeable paving. All drainage infrastructure would be suitably designed to prevent infiltration to prevent mobilisation of ground contaminants.

2.15 At the detailed stage, a detailed water quality risk assessment would be carried out using the SuDS hazard mitigation indices in accordance with Chapter 26, of the CIRIA C753 SuDS Manual (CIRIA, 2015). Under this method of assessment, the roof areas, office car parking and yard areas are designated as having a low, medium and high pollution hazard level respectively.

2.16 An appropriate treatment train of SuDS features would be provided relative to the level of risk presented by each area. SuDS features would be suitably designed to reduce total suspended solids, hydrocarbons and metals from the runoff leaving the site.

3 SURFACE WATER DESIGN PARAMETERS

3.1 The proposed surface water drainage would be designed using current MicroDrainage analysis software.

3.2 The following parameters summarise the main objectives of the site wide drainage strategy, devised in accordance with Tees Valley SuDS Design Guide and Local Standards LS20 and LS32 (DBC, HBC, MC, RCBC and STBC, 2019):

- the system would be designed following the modified rational method ensuring no surcharging occurs during the 1 in 2 year storm event;
- flooding would not be permitted in any area of the application site for events up to the critical 1 in 30 year storm event; and
- the system would be designed to allow safe flooding of designated areas in the 1 in 100 year storm, including a +20% allowance for climate change. No flooding to any buildings would be permitted and all surface water would be contained within the demise of the Application Site . Any intentional exceedance shall be limited to a maximum of 0.125 metres in car parking areas and a maximum of 0.3 metres in yard and circulation areas.

Design Variables

3.3 The design of the surface water drainage would include the following variables:

- rainfall: Simulated using FEH Point Descriptors, Grid Ref 455784 525998 for storms 60mins to 1440mins duration. Additional sensitivity checks using Flood Studies Report (FSR) rainfall data would be undertaken for storm durations greater than 60min;
- design return period: 2, 30 and 100 year storm events;
- climate change: rainfall profiles increased by 20% for 100 year return period;
  - Sensitivity checks to be undertaken with 40% in accordance with Local Standard LS19;
- volumetric Runoff coefficient (Cv): 1 Summer, 1 Winter;
- global time of entry: 4mins to all areas, 2 mins to roof areas;
- infiltration: ignore for peak flow design;
- backdrops: allow in design; maximum depth of 1.5m; and
- velocity: minimum 0.75 m/s for self-cleansing (private drainage)

Storm Intensities and Durations

- The site drainage system would be designed using the following storm intensities and durations:
  - 2 year return period – 15mins to 1440mins storm duration;
  - 30 year return period – 15mins to 1440mins storm duration; and
  - 100 year return period (+20% climate change) – 15mins to 1440mins storm duration.

3.4 Preliminary calculations hydraulic calculations assuming a 600mmØ outfall pipe have been included as Appendix 2. These calculations indicate that the pond is adequately sized to accommodate the surface water runoff in the all storms up to and including the 1 in 100 year + 40% cc event by providing a balance between incoming runoff and the discharge capacity of the pipe.

4 PROPOSED FOUL WATER DRAINAGE

4.1 A new foul water drainage system is required to serve the new site offices and any associated catering facilities on the proposed development. It is proposed that the new foul drainage from the REC would be connected to the existing pumped sewerage system referred to as the Redcar Flygt System. This is subject to negotiations with the Development Corporation/Site Company.

4.2 The foul water drainage system would be designed in accordance with the frequency factors and discharge units set out in BS EN 12056-2:2000, 'Gravity drainage systems inside buildings – Part 2: Sanitary pipework, layout and calculation' (BSi, 2000). The network would accommodate foul water discharge from all welfare sanitary ware facilities, hand washing facilities and wash-down areas as required.

5 PROPOSED PROCESS DRAINAGE

5.1 All process water would be recycled in the waste to energy process. No process effluent or boiler water is to be discharged to the surface water system. Any excess process water produced in planned outages would be directed to an onsite waste water tank before any surplus is tankered off site and disposed of in accordance with relevant waste regulations.

5.2 All water tanks would be constructed in accordance with BS EN 1992-3:2006 'Design of Concrete Structures – Part 3: Liquid retaining and containment structures' (BSi, 2006).

Rainwater Harvesting

5.3 The operation of the REC would be designed to minimise water consumption and maximise water re-use where possible. In order to supplement the plant's reliance on mains water, roof water from the proposed REC would be collected and stored in a rainwater tank. Location to be determined through detailed design A by-pass from the rainwater tank would be in place to ensure roof water enters the main surface water drainage system in the event that the tank is full. This tank would feed the top up of the process washing systems and feeding the demineralised water plant which includes water for boiler blowdown.

Fire Water Containment

5.4 Fire water runoff from the sprinkler discharge would be managed principally by containment within the REC. Proposed levels for the Application Site would be set such that all firefighting water runoff would be fully contained inside the buildings and bunker, thus removing the risk of uncontrolled contaminated runoff entering the surface water network.

5.5 A manual penstock will be located immediately downstream of the attenuation pond and in the penultimate chamber before leaving the site as a minimum to allow containment of firefighting water.

5.6 Fire water contained in such an event would be classed as contaminated runoff and hence require off-site disposal by tanker.

IBA Areas

5.7 In the IBA storage area, continuous perimeter concrete upstand bunds with vehicle access ramps will allow for full containment of IBA material washout during rainfall events. Rainwater build up within the bunded areas shall be managed by the site operation.

5.8 Surface water drainage runoff from IBA process areas would be collected via an underground gravity drainage system and discharged to a concrete lined settlement lagoon. The settlement lagoon shall be constructed with a fully lined concrete base and stepped side walls to prevent direct infiltration to the ground. The lagoon would contain a permanent body of water, which would provide reduction in runoff flows, thus aiding sediment removal.

5.9 There would be a facility to return excess water to the process water system (bottom ash quench) from the IBA area. Excess surface water in the IBA area would be retained and recycled into ash as a dust suppressant. In the event of a contamination incident it will be possible to tanker contaminated water from the IBA area sump for disposal off site.

5.10 In the event of a planned or unplanned plant closure it will not be possible for the excess surface water to be reused in the process. In these circumstances excess surface water would be retained in concrete lined settlement lagoon.

5.11 The IBA settlement lagoon would be designed and sized in accordance with CIRIA Guide C736. Containment Systems for the Prevention of Pollution. Based on the CIRIA design guidance for sizing, whereby a 1 in 10 year rainfall event of 24 hours duration is preceded by a system failure, then followed by a further 1 in 10 year rainfall event of 8 days duration.

6 MAINTENANCE

6.1 The maintenance for all on plot drainage infrastructure would be the responsibility of the operator of each facility or appointed management company. Details of the maintenance activities for the constructed drainage infrastructure would be passed to the end user as part of an Operation and Maintenance Manual post completion. Typical maintenance activities may include;

Table 6: Typical Maintenance Activities

Element	Access Method	Method of Maintenance	Frequency Required
Roof Gutters	Scaffolding / Cherry pickers to be used where required.	General cleaning of gutters. Jet cleaning where required.	Periodic inspection of gutters to ensure rainwater outlets do not become blocked. Periodic renewal of gutter coatings to prevent corrosion.
Oil / Petrol Separators	In accordance with H&S regulations and confined spaces requirements.	Refer to manufacturer's guidance.	Bi-annual inspection and emptying.
Channel Drains / Kerb Drainage	In accordance with H&S regulations.	Monitor to ensure no blockages develop. Jet cleaning where required.	Bi-annual jet cleaning of channel drains.
Silt-traps and Gullies	In accordance with H&S regulations.	Monitor to ensure no blockages develop.	Bi-annual inspection and emptying of all silt traps and gullies.
Penstock Valves/ Non-Return Flap Valves	In accordance with health and safety regulations and confined spaces requirements.	Monitored to ensure no blockages develop in accordance with the manufacturers recommendations.	Bi-annual inspection or in accordance with the manufacturers recommendations, whichever occurs sooner.
Surface Water Ponds and Swales	In accordance with H&S regulations	General cleaning and monitoring to ensure no blockage. Remove litter and debris. Cut grass and manage vegetation. Inspect inlets and outlets	Bi-annual inspection, cleaning and removal of silt and/or debris
Pumps	In accordance with health and safety regulations and confined spaces requirements.	Monitored via visual and audible alarms in development gatehouse to ensure no blockages develop in accordance with the manufacturer's recommendations.	Bi-annual inspection or in accordance with the manufacturers recommendations, whichever occurs sooner.
Headwall	In accordance with health and safety regulations.	Monitored to ensure no blockages develop.	Bi-annual inspection and clearance of any debris

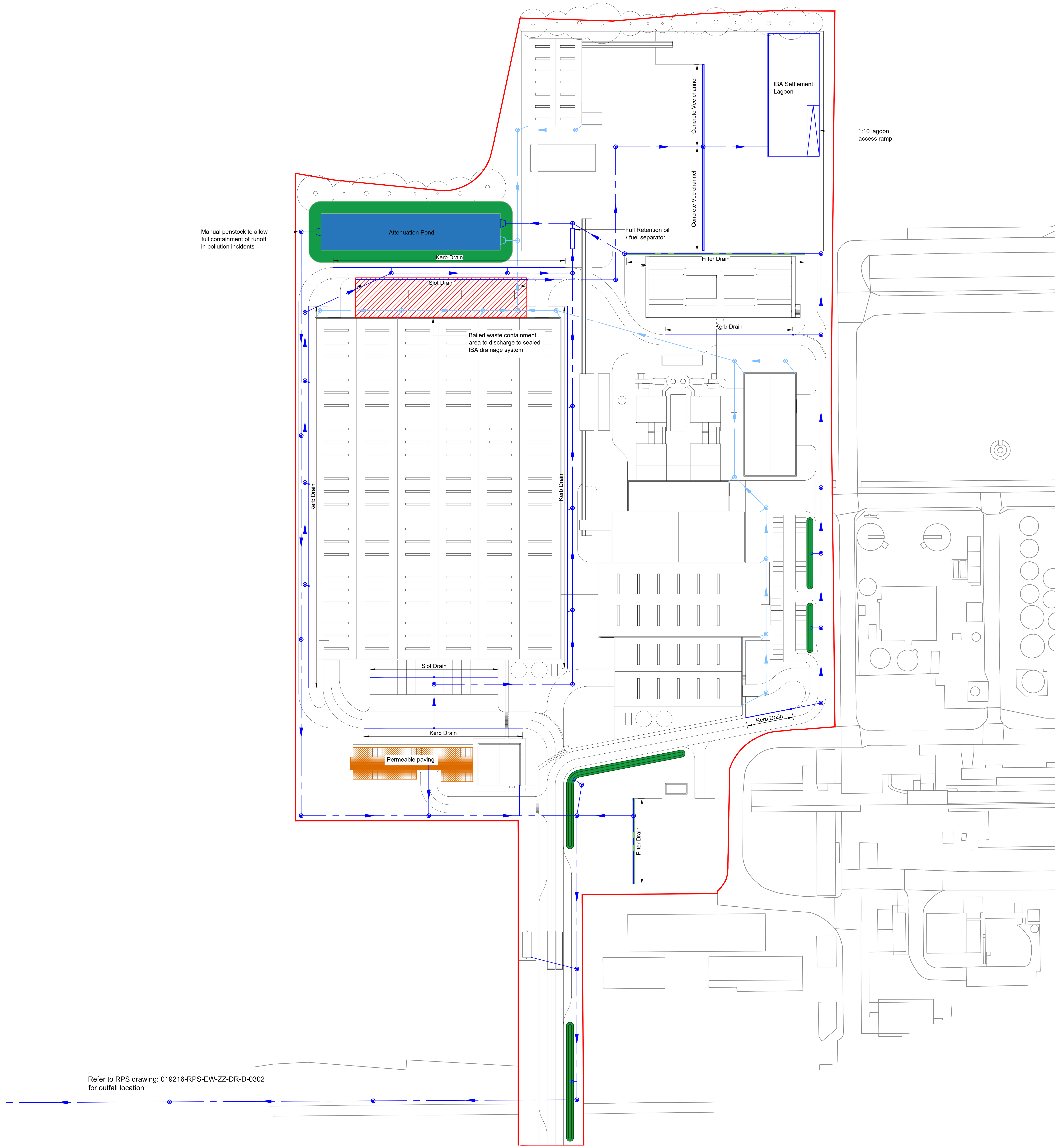
REFERENCES

CIRIA, 2015. The SuDS Manual (C753)

Darlington Borough Council, Hartlepool Borough Council, Middlesborough Council, Redcar and Cleveland Borough Council, Stockton-on-Tees Borough Council, 2019. Sustainable Drainage (SuDS) Guidance - Design Guide and Local Standards

BS EN 1992-3:2006 ‘Design of Concrete Structures – Part 3: Liquid retaining and containment structures’ (BSi, 2006).

Appendix A RPS Drawings



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Key:

- Surface Water Drain
- Roof Water Drain
- Linear Drainage e.g. kerb / slot drain
- Surface Water Manhole
- Roof Water Manhole
- Headwall
- Localised Containment area
- Attenuation Pond
- Grassed Conveyance Swale

10m SCALE 1:1000

Rev	Description	By	Ckd	Date
P01	First Issue	LJS	DW	22.06.20

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Client low carbon

Project Redcar Energy Centre

Title Indicative Drainage Layout

Status	Scale	Date Created
S0	1:1000 @A1	22.06.2020

Task Team Manager	Information Author	Task Information Manager
GB	LJS	DW

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RPS Project Number	Suitability	Revision
NK019216	S2	P01

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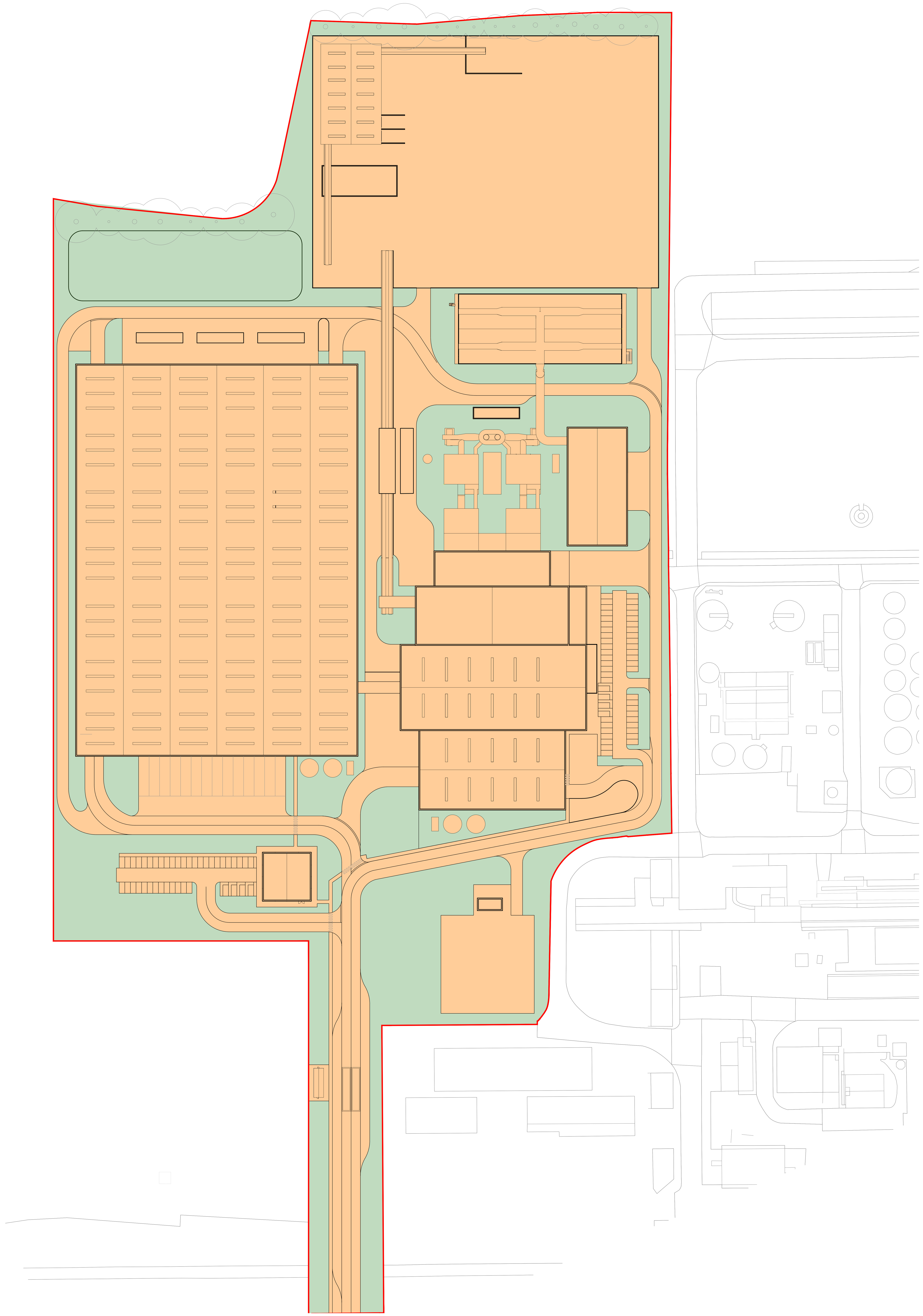

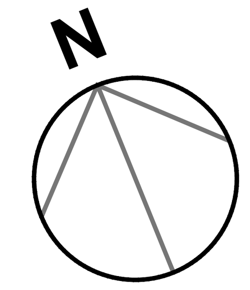

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Key

Impermeable Areas

Permeable Areas

Total Areas:
Impermeable = 74,580m³
Permeable = 26,540m³

10m SCALE 1:1000

Rev	Description	By	Ckd	Date
P01	First Issue	CW	LJS	22.06.20

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Project Redcar Energy Centre

Title Impermeable Areas Layout

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Task Team Manager	**Information Author**	**Task Information Manager**
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NK019216	S2	P01

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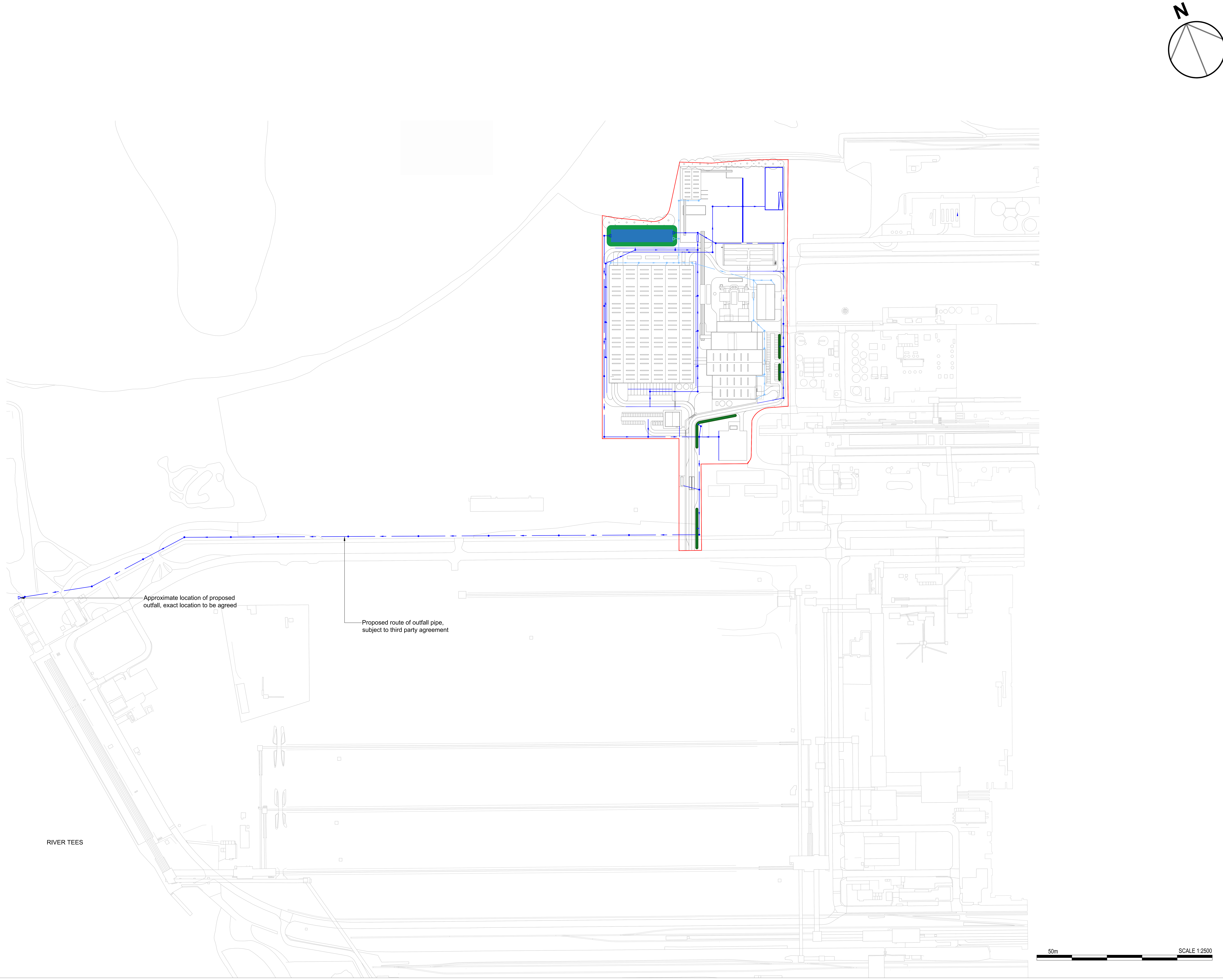

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P01	First Issue	CW	LJS	22.06.20

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Client: low carbon

Project: Redcar Energy Centre

Title: Surface Water Discharge Layout

Status	Scale	Date Created
S2	1:2500 @A1	22.06.2020
Task Team Manager	**Information Author**	**Task Information Manager**
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RPS Project Number	Suitability	Revision
NK019216	S2	P01

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Appendix B Preliminary Calculations

Summary of Results for 100 year Return Period (+20%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	6.756	0.756	293.2	1371.3	O K
30 min Summer	6.943	0.943	293.4	1767.9	O K
60 min Summer	7.081	1.081	300.5	2075.3	O K
120 min Summer	7.103	1.103	301.6	2126.3	O K
180 min Summer	7.088	1.088	300.8	2091.2	O K
240 min Summer	7.057	1.057	299.3	2021.8	O K
360 min Summer	6.981	0.981	295.3	1851.3	O K
480 min Summer	6.900	0.900	293.2	1675.5	O K
600 min Summer	6.823	0.823	293.1	1511.9	O K
720 min Summer	6.754	0.754	293.2	1367.3	O K
960 min Summer	6.636	0.636	293.2	1130.5	O K
1440 min Summer	6.519	0.519	260.6	903.7	O K
2160 min Summer	6.443	0.443	203.2	760.7	O K
2880 min Summer	6.394	0.394	172.1	669.4	O K
4320 min Summer	6.338	0.338	134.5	569.6	O K
5760 min Summer	6.310	0.310	110.8	519.3	O K
7200 min Summer	6.291	0.291	95.5	486.2	O K
8640 min Summer	6.277	0.277	83.8	462.2	O K
10080 min Summer	6.261	0.261	76.1	433.6	O K
15 min Winter	6.841	0.841	293.1	1548.6	O K
30 min Winter	7.049	1.049	298.9	2004.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	113.448	0.0	1562.9	23
30 min Summer	76.164	0.0	2106.0	35
60 min Summer	49.002	0.0	2729.1	58
120 min Summer	29.301	0.0	3265.9	90
180 min Summer	21.726	0.0	3633.5	124
240 min Summer	17.590	0.0	3923.2	158
360 min Summer	13.087	0.0	4379.2	226
480 min Summer	10.623	0.0	4740.1	290
600 min Summer	9.043	0.0	5043.9	352
720 min Summer	7.932	0.0	5309.3	412
960 min Summer	6.457	0.0	5762.4	528
1440 min Summer	4.839	0.0	6476.0	754
2160 min Summer	3.636	0.0	7313.6	1116
2880 min Summer	2.972	0.0	7968.1	1476
4320 min Summer	2.236	0.0	8986.4	2204
5760 min Summer	1.831	0.0	9827.9	2936
7200 min Summer	1.571	0.0	10536.9	3672
8640 min Summer	1.388	0.0	11172.1	4408
10080 min Summer	1.253	0.0	11751.7	5136
15 min Winter	113.448	0.0	1753.1	23
30 min Winter	76.164	0.0	2361.3	35

Summary of Results for 100 year Return Period (+20%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
60 min Winter	7.205	1.205	306.7	2363.4	O K
120 min Winter	7.212	1.212	307.1	2380.1	O K
180 min Winter	7.176	1.176	305.3	2295.3	O K
240 min Winter	7.122	1.122	302.6	2169.0	O K
360 min Winter	6.994	0.994	296.0	1880.3	O K
480 min Winter	6.865	0.865	293.1	1600.1	O K
600 min Winter	6.746	0.746	293.1	1351.6	O K
720 min Winter	6.640	0.640	293.2	1137.0	O K
960 min Winter	6.528	0.528	268.3	920.8	O K
1440 min Winter	6.446	0.446	204.7	765.1	O K
2160 min Winter	6.370	0.370	157.1	626.4	O K
2880 min Winter	6.333	0.333	129.9	559.8	O K
4320 min Winter	6.295	0.295	98.4	492.1	O K
5760 min Winter	6.270	0.270	80.2	448.9	O K
7200 min Winter	6.247	0.247	69.0	408.5	O K
8640 min Winter	6.230	0.230	61.0	380.1	O K
10080 min Winter	6.218	0.218	55.2	359.2	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
60 min Winter	49.002	0.0	3058.0	60
120 min Winter	29.301	0.0	3659.1	98
180 min Winter	21.726	0.0	4070.9	136
240 min Winter	17.590	0.0	4395.4	172
360 min Winter	13.087	0.0	4906.2	242
480 min Winter	10.623	0.0	5310.5	306
600 min Winter	9.043	0.0	5650.9	368
720 min Winter	7.932	0.0	5948.2	424
960 min Winter	6.457	0.0	6455.9	520
1440 min Winter	4.839	0.0	7255.7	766
2160 min Winter	3.636	0.0	8192.3	1128
2880 min Winter	2.972	0.0	8925.7	1476
4320 min Winter	2.236	0.0	10067.8	2204
5760 min Winter	1.831	0.0	11008.1	2944
7200 min Winter	1.571	0.0	11802.4	3672
8640 min Winter	1.388	0.0	12514.4	4408
10080 min Winter	1.253	0.0	13165.6	5120

Rainfall Details

Rainfall Model	FEH
Return Period (years)	100
FEH Rainfall Version	2013
Site Location	GB 455784 525998 NZ 55784 25998
Data Type	Point
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	0.750
Cv (Winter)	0.840
Shortest Storm (mins)	15
Longest Storm (mins)	10080
Climate Change %	+20

Time Area Diagram

Total Area (ha) 7.458

Time From:	**(mins) To:**	**Area (ha)**	**Time From:**	**(mins) To:**	**Area (ha)**	**Time From:**	**(mins) To:**	**Area (ha)**
0	4	2.500	4	8	2.500	8	12	2.458

Time Area Diagram

Total Area (ha) 0.000

Time From:	**(mins) To:**	**Area (ha)**
0	4	0.000

Model Details

Storage is Online Cover Level (m) 8.000

Tank or Pond Structure

Invert Level (m) 6.000

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	1583.0	2.000	2970.0

Pipe Outflow Control

Diameter (m)	0.600	Entry Loss Coefficient	0.500
Slope (1:X)	600.0	Coefficient of Contraction	0.600
Length (m)	1500.000	Upstream Invert Level (m)	6.000
Roughness k (mm)	0.600		