Energy from Energy Recovery Facility Flood Risk Assessment

Final Report

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Revision History

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Contract

This report describes work commissioned by Kieran Bostock, on behalf of Hartlepool Borough Council. Joseph Landells-Molloy of JBA Consulting carried out this work.

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Purpose

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1 Introduction

1.1 Overview

This Flood Risk Assessment (FRA) has been prepared as a supporting document to planning application R/2019/0587/SCP: the development of a new Energy from Energy Recovery (ERF) Plant at Grangetown Prairie, Grangetown. It is located within the South Tees Development Corporation Master Plan area.

1.2 Scope

This FRA is based on a desktop review of the proposed development layout against available information. An Outline Drainage Strategy has been prepared in accordance with Tees Valley Authorities Local Standards for Sustainable Drainage (version July 2017) and is included in Section 5.

Further, new surface water flood mapping has been undertaken as part of this FRA (see Section 3.2.2), using JFlow (this is the same software that JBA developed for the Environment Agency's surface water flooding outlines) to quantify surface water flow rates and volumes, and to confirm interactions with the proposed development layout.

2 Development Location and Description

2.1 Description

A Site Location Plan has been included in Appendix A for reference.

The proposed development plot will be redeveloped as a new Energy from Energy Recovery Facility (ERF) with associated facilities such as electrical equipment, tipping hall and control room. The development plot is 25 acres, with the area designated for the industrial plant and facilities (Area A) approximately 17.51 acres (7.09 hectares (ha)) in total.

Area B is a designated area of archaeological interest. It is our understanding that this area will not, therefore, be developed. Further, Area C will not be developed, however, will be adapted to provide a Biodiversity Area which could be used to attenuate surface water runoff from development. It is noted that runoff should be uncontaminated.

2.2 Site Location

Grangetown Prairie is located approximately 1.5 kilometres south east of the Tees Estuary (see Figure 2-1).

Figure 2-1 indicates that Holme Beck culvert flows northward at the western bound of the site and outfalls into Cleveland Channel which in turn, outfalls into the tidal Tees Estuary. Knitting Wife Culvert (Knitting Wife Beck upstream) is located 450 metres east of the site and also outfalls into Cleveland Channel. It is noted that a storm drain connects the upstream open channel section of Holme Beck with Knitting Wife Culvert. It is likely that this storm drain allows flows to bypass Holme Beck culvert during flood events. A historic reason for this is not known and may be the result of condition, blockage risk or limited culvert capacity issues.

It is further noted that each watercourse drains relatively small catchment areas that potentially include areas of surface water drainage from the surrounding urban areas, including Grangetown.

It is envisaged that, subject to design (including: capacity, condition assessment, levels), surface water runoff from the proposed development will connect into and discharge to Holme Beck Culvert. CCTV survey and details of culvert condition were unavailable at the time of writing. JFlow modelling in Section 3.2.2 did not include for modelling of culverted watercourses as part of this assessment.

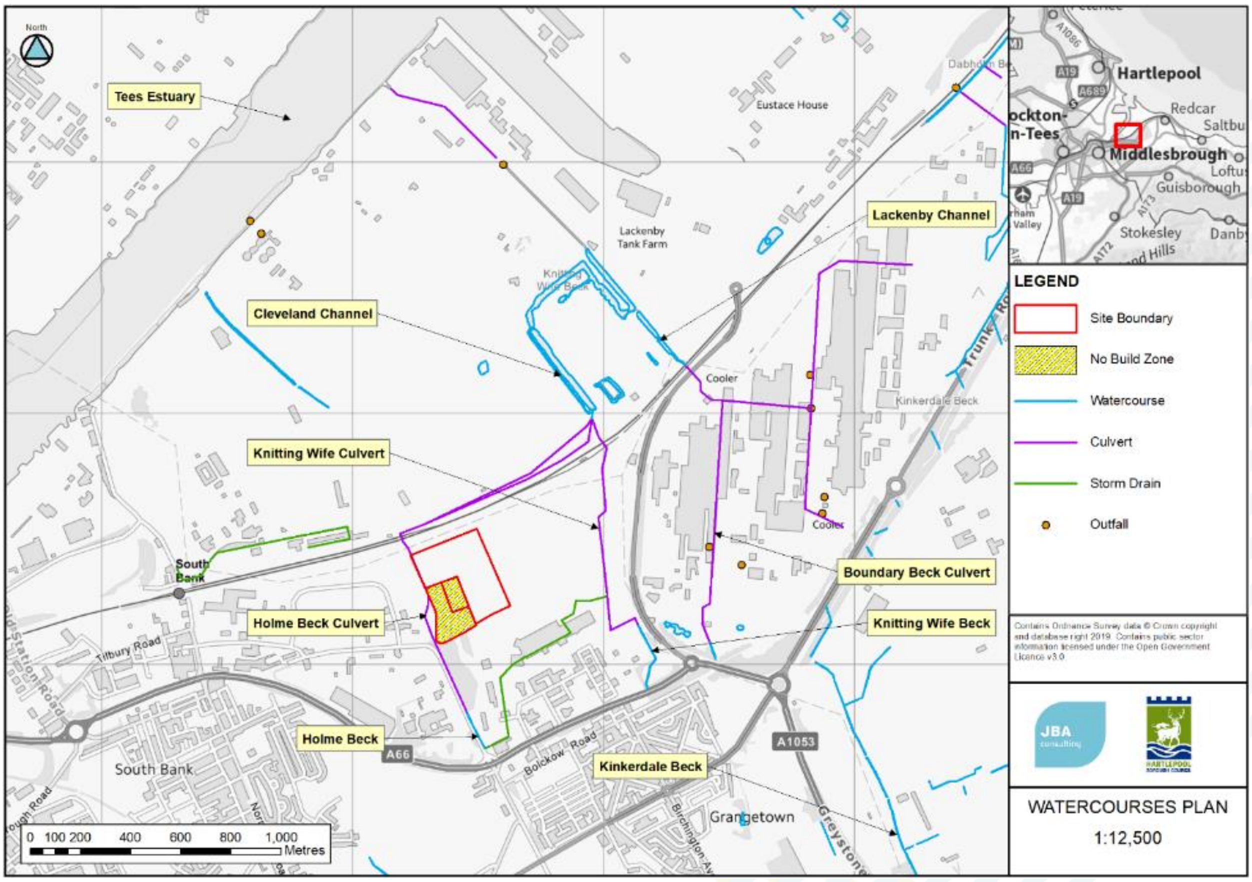

Figure 2-1 – Watercourses at Grangetown Prairie

2.3 Topography

The Grangetown Prairie area is relatively flat with a gentle slope northward (see Figure 2-2) towards the existing railway line, and ultimately Tees Estuary. It is noted that existing ground levels within Area A are generally between eight and nine metres Above Ordnance Datum (AOD), and undulations in LiDAR topography in eastern areas of are due to previous development/use of the site. Areas B and C appear raised in places, however, the majority of the development will lay on Area A.

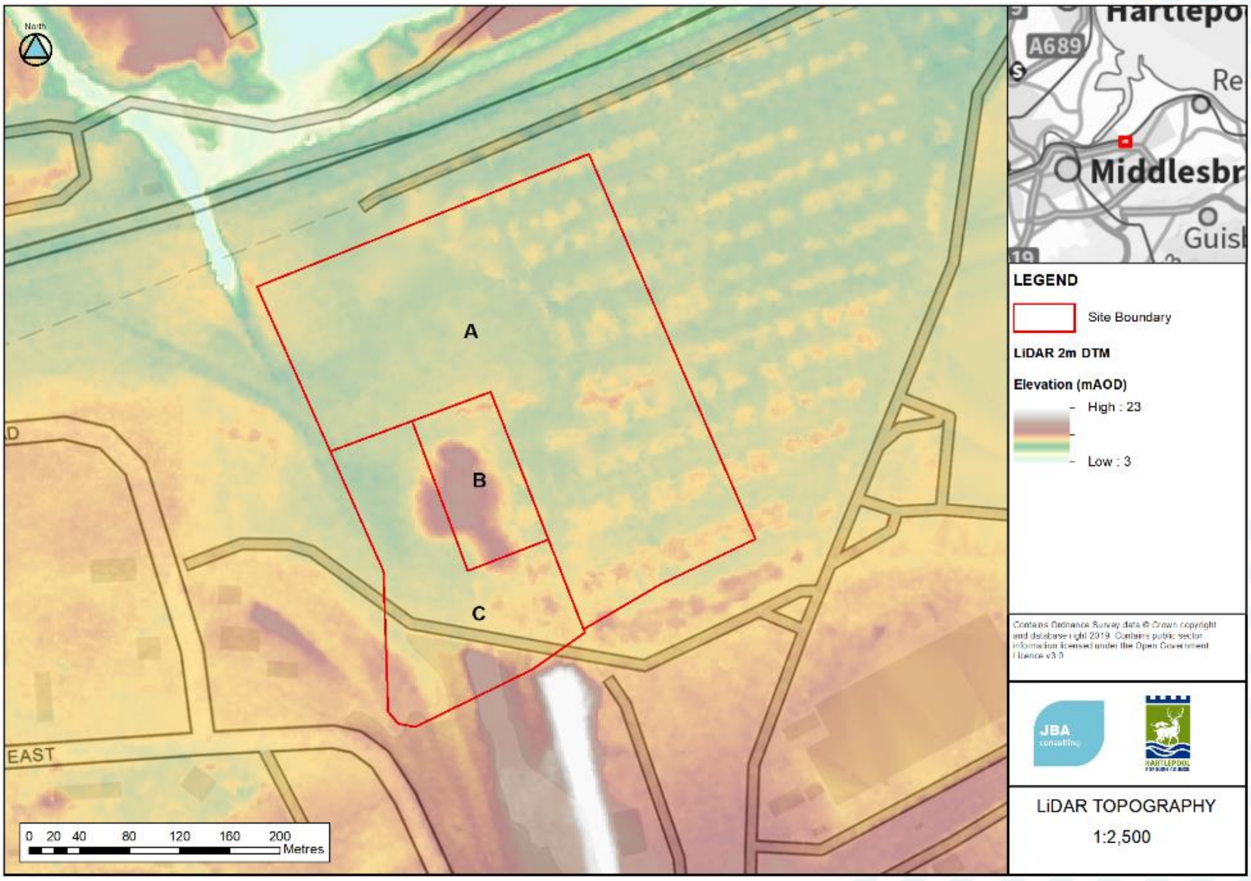

Figure 2-2 - LiDAR Topography

3 Flood Risk

3.1 Fluvial and Tidal

Based on Environment Agency defined Flood Zones (as presented in Figure 3-1), 100% of the proposed facility is located in Flood Zone 1. It is noted that these Flood Zones are based on modelled undefended fluvial and tidal flood extents and do not consider future climate change implications.

It is noted that tidal flood levels are predicted to increase with climate change, in accordance with Environment Agency defined flood risk assessments: climate change allowances[1], the predicted cumulative sea level rise 1990 to 2115 is 0.99 m for the North East. Based on LiDAR data, the lowest elevation of Area A is considered to be 7.4mAOD and the bank level at the Tees Estuary is 4.08mAOD, therefore, climate change sea levels will not exceed existing ground levels at the site. Further to this, the highest tidal river level on record at Tees Dock is 4.09mAOD (correct as of 26th November 2019) – a difference of greater than three metres compared to existing ground levels at the site.

Local Flood Zone 2/3 extents are contained within the estuarine River Tees channel to the north of the site and within the Normanby Beck river corridor two kilometres south west of the site (not shown on Figure 3-1), therefore, the site is not considered to be at risk of fluvial and tidal flooding during present day flood events. JFlow mapping in the subsequent section of this report assumes that Holme Beck Culvert is fully blocked and does not indicate any significant overland flow routes or interactions as a result.

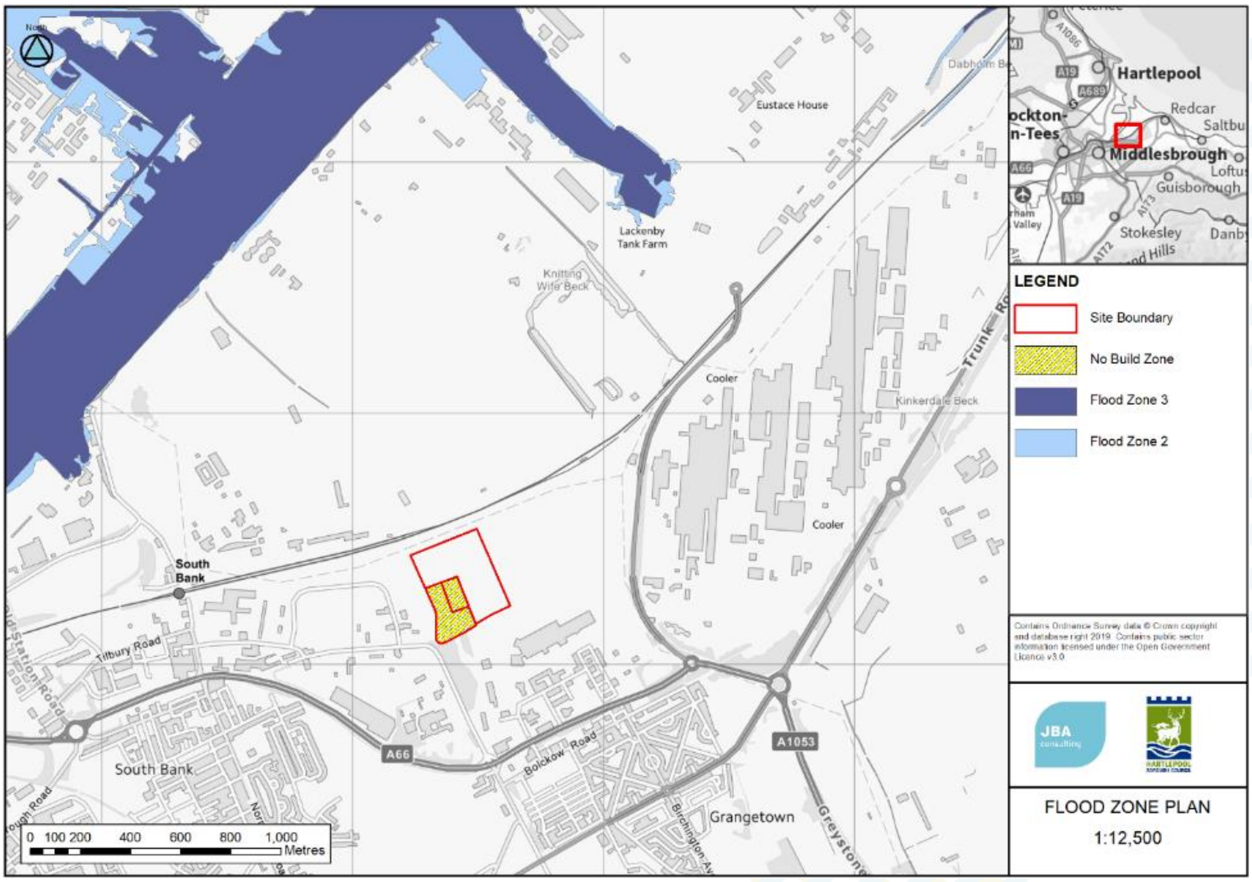

Figure 3-1 - Environment Agency defined Flood Zones

[1] Flood risk assessments: climate change allowances - GOV.UK

In accordance with National Planning Policy Framework (NPPF)[2], the proposed facility is considered to be essential infrastructure, therefore, development is appropriate in Flood Zone 1.

3.2 Surface Water

3.2.1 Environment Agency Maps

Environment Agency defined Risk of Flooding Surface Water (RoFSW) mapping (as presented in Figure 3-2) indicates that the proposed development is at low risk of surface water flooding. It is noted that there is no significant flow route indicated in Holme Beck upstream of the site as this is upstream of the Grangetown Prairie catchment (based on defined catchments in Figure 3-3).

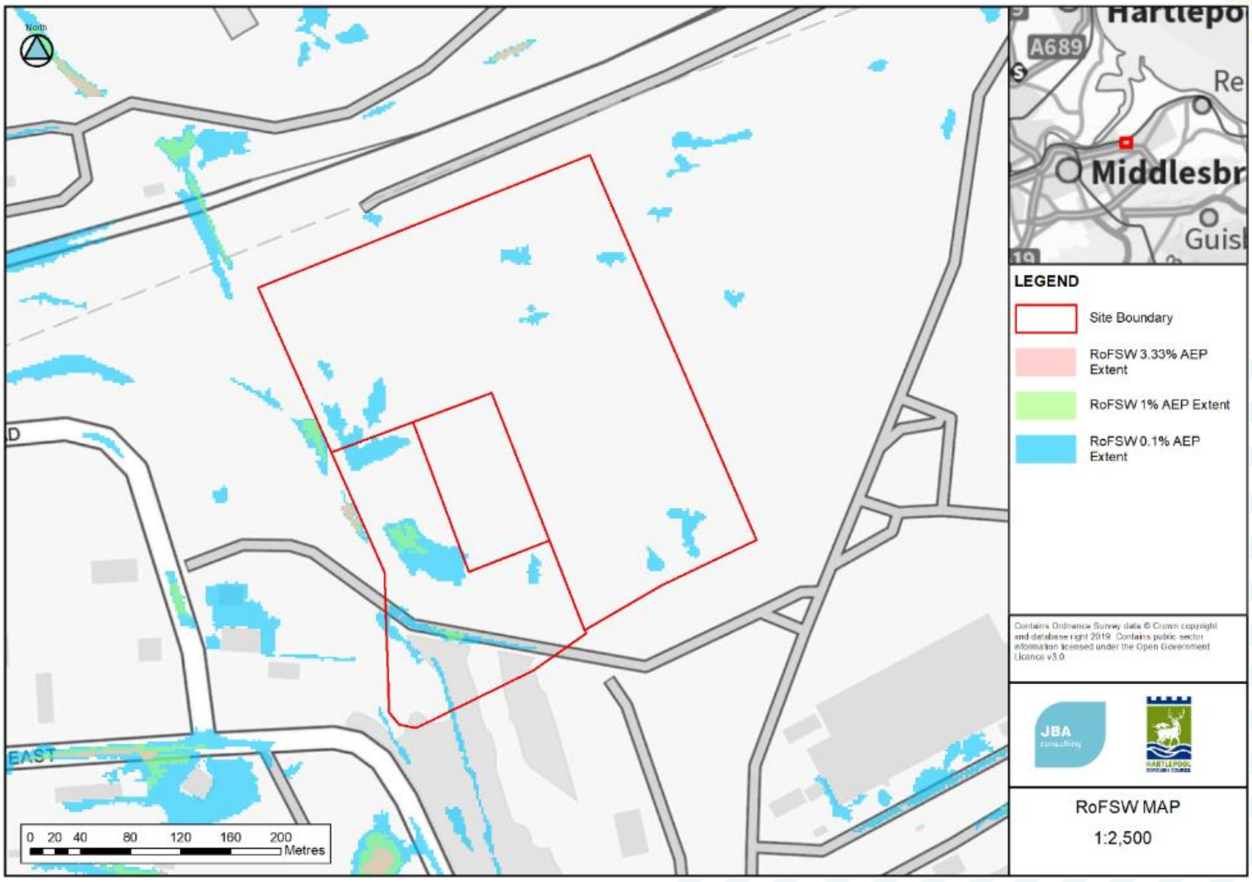

Figure 3-2 - Risk of Flooding from Surface Water Suitability

RoFSW mapping indicates localised areas of ponding in Area C in the 1% AEP event, becoming more significant (but remains localised) in the 0.1% AEP event.

It is understood that Area A is to be bunded at the perimeter to contain spillage within areas of hardstanding, therefore, JFlow modelling has been undertaken to quantify offsite flows (if any) that will need to be managed as part of development proposals and ensure that flood risk following development is not increased elsewhere.

Based on topographical catchment analysis (see Figure 3-3), it is understood that the site at Grangetown Prairie drains to Cleveland Channel, overland and/or via the existing culverted watercourses (Holme Beck and Knitting Wife Beck).

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[2] National Planning Policy Framework - GOV.UK

3.2.2 JFlow Modelling

Introduction

JFlow modelling of the wider catchment at the site was undertaken to delineate surface water flow routes and quantify associated flow rates and volumes. Further, interactions with the development layout were considered to inform the management of offsite surface water flows (if any).

Catchment Delineation

Arc Hydro tools were used to define catchment boundaries based on topography, therefore, natural land drainage routes. Figure 3-3 below shows the locations of catchment boundaries and streams that define the downstream extents of each catchment.

Based on the modelling outputs, the Grangetown Prairie site drains to Cleveland Channel to the east, further, there are no obvious upstream catchment that drains through the catchment and development area. It is noted that existing drainage systems could outfall into Holme Beck, therefore, drain through the Grangetown Prairie catchment. Based on a review of Google Street View, it appears that areas of Eston Road drain to the adjacent Holme Beck.

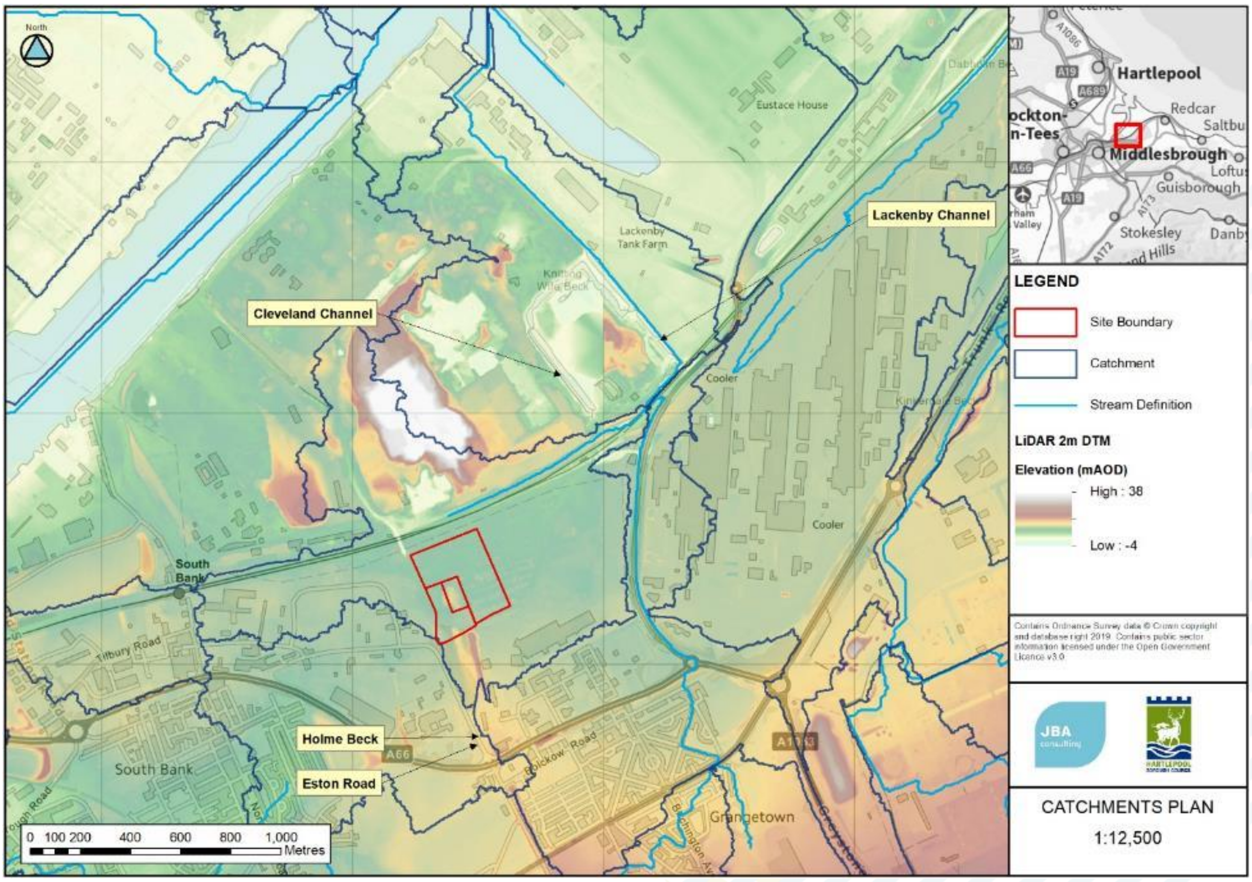

Figure 3-3 - Catchment Delineation

Modelling Approach

Appendix B contains the JFlow Model Configuration Note which defines modelling considerations in detail.

Grangetown Prairie is considered to be mixed permeable and impermeable surfaces, with evidence of limited previous use/development (see Figure 3-4).

Figure 3-4 - Example of mixed permeable and impermeable surface with evidence of limited previous use/development

It was assumed that all culverted watercourses are effectively blocked (this approach increases the extent of any overland flows). Buildings were not defined in modelling because runoff from development to the south of Grangetown Prairie does not drain naturally through the proposed development site.

Modelling Outputs

In accordance with flood risk assessments: climate change allowances, 20% and 40% uplifts were applied to rainfall intensity to simulate the total potential change anticipated for the '2080s' (2070 to 2115). 1% Annual Exceedance Probability (AEP) plus 40% climate change (CC) surface water flood depths have been modelled and are presented in Figure 3-5. 1% AEP + 40% CC (6 hour storm) flood outlines indicate that surface water flooding is comprised of highly localised ponding to shallow depths below 0.30 metres with localised areas of 0.30-0.60 metres. Further, modelling outputs indicate that there are no clear offsite impacts that need to be managed.

It is noted that no further return periods or climate change scenarios have been modelled at this stage.

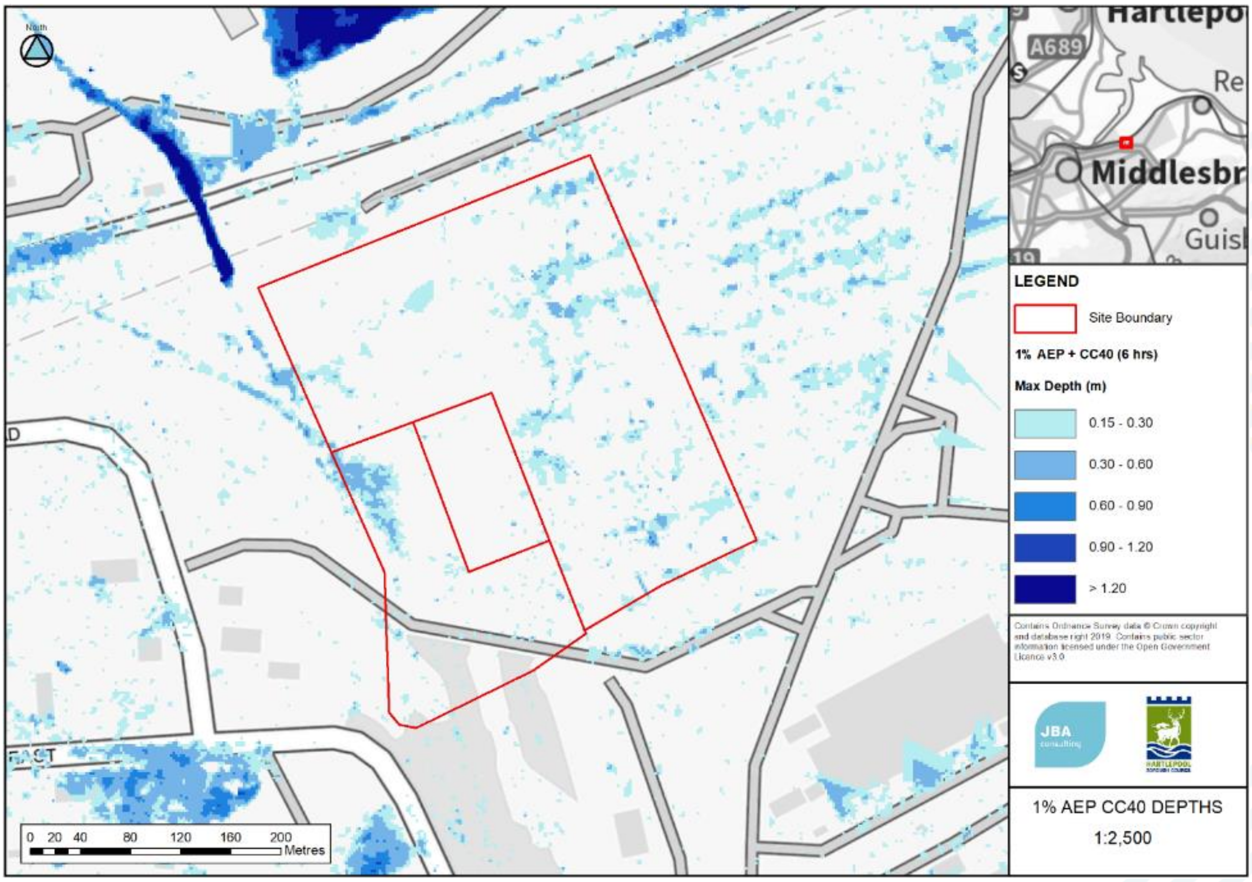

Figure 3-5 – 1% AEP + 40% climate change (6 hour storm duration): maximum surface water flood depths

Outside and to the north west of the site boundary, model outputs indicate depths exceeding 1.20 metres are associated with ponding due to a track beneath the existing railway line.

Modelling Conclusions

- Figure 3-5 indicates that there are no clear offsite impacts that need to be managed, however, development proposals must consider intercepting defined areas of localised ponding in addition to managing surface water runoff associated with the proposed development. It is considered that surface water flooding appears highly localised due to the relatively flat topography at Grangetown Prairie.
- It is understood that Area A will be bunded at its perimeter. Based on this updated surface water modelling, this is not considered to require further consideration regarding offsite surface water flows providing that site drainage is well maintained and the bunding is not designed to contain surface water to any significant depth.
- JFlow modelling does not indicate ponding within open channel areas (Holme Beck Culvert was not modelled) of Holme Beck upstream of the site, however, this modelling does not consider outfalls from highways or development drainage.

3.3 Groundwater

Based on the Redcar and Cleveland Strategic Flood Risk Assessment[3] (2016 update), the proposed development is located within an area defined as having a less than 25% risk of groundwater emergence, therefore, risk of flooding from groundwater is considered to be low.

3.4 Reservoir

Based on the Environment Agency defined long term flood risk map for England[4], the proposed development is located outside of the predicted maximum extent of flood risk from reservoirs.

3.5 Canal

There are no canal systems located within the borough of Redcar and Cleveland.

3.6 Foul Drainage

Foul drainage will be subject to detailed design and connection.

4 Emergency Planning

Grangetown is not located within a Flood Warning Area because the site is not considered to be at risk of flooding during present day events (based on Environment Agency defined Flood Zones).

It is considered that safe access and egress is achievable at the site based on a low risk of flooding from all sources, however, an Emergency Plan should consider and avoid areas designated to contain onsite surface water exceedance flows (within kerb lines, for example). Further, it is understood that both processed and pre-processed waste is to be located within bunded areas or raised above existing ground levels to avoid mobilisation of contaminants during higher rainfall events.

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[3] https://www.redcar-cleveland.gov.uk/resident/planning-and-building/local-plan/Pages/Redcar-and-Cleveland-Strategic-Flood-Risk-Assessment.aspx

[4] Long term flood risk map for England - GOV.UK

5 Outline Drainage Strategy

5.1 Introduction

It is envisaged that surface water runoff from development will be attenuated to the greenfield Qbar runoff rate for all return periods up to and including the 1 in 100 year storm event in accordance with Tees Valley Authorities Local Standards for Sustainable Drainage (version July 2017). It is understood that a more recent revision was out for consultation at the time of writing, however, this was yet to be published.

5.2 Concept SuDS

It is recommended that surface water runoff is attenuated in a lined detention basin due to potential contaminants at the site. This approach will preclude infiltration drainage. Detailed design will be subject to ground investigation to confirm contamination and ground water levels on the site.

The South Tees Regeneration Master Plan[5] details that former activities at the Grangetown Prairie site have left a legacy of contamination. Further, the area of Grangetown Prairie allocated for the proposed facility is located within a defined Potential Major Hazard Zone. At this stage, no further site specific information is available and a precautionary approach to surface water attenuation has been assumed.

It is assumed that runoff from this site can connect into Holme Beck (culvert) given that details of existing site drainage are not defined on provided utilities plans. It is envisaged that, subject to design (condition assessment, levels), the proposed detention basin will connect into and discharge via a vortex control device to Holme Beck Culvert at the western bound of the site. In accordance with the provided utilities information, there is no existing infrastructure draining the site to Holme Beck. Further, there is no information regarding Holme Beck Culvert capacity or internal condition down to the Tees Estuary. Unrestricted (free) discharge to the culvert cannot be assumed at this stage. Additional modelling would be required to confirm the culvert capacity and contributing inflows along the entire culvert length before greenfield assumptions could be relaxed.

Area C, a designated Biodiversity Area is proposed to accommodate the detention basin.

LLFA consent will be required to discharge to an Ordinary Watercourse.

In accordance with Tees Valley SuDS requirements, the surface water runoff destination has been considered in order of preference:

1) into the ground

2) into a surface water body

3) into a surface water sewer

4) into a combined sewer

Infiltration has been discounted at this stage (subject to contamination testing and based on likely contaminants at the site. Discharge to Holme Beck is, therefore, proposed as the practical and preferred method of surface water management. Further, the natural ground conditions are not considered suitable for infiltration drainage.

5.2.1 Rainfall Data

Flood Estimation Handbook (FEH) rainfall data was abstracted from the FEH web service for which the 1 in 30 Year (3.33% AEP) and 1 in 100 Year (1% AEP) depths were used to calculate the required attenuation volumes.

5.2.2 Runoff Rates

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[5] https://www.southteesdc.com/wp-content/uploads/2019/04/Masterplan-March-2019-LowResolution.pdf

In accordance with Tees Valley SuDS requirements, surface water runoff from development should be limited to the greenfield QBAR runoff rate for all return periods up to and including the 1% AEP rainfall event. QBAR for this site was calculated to be 44 l/s using the ICP SuDS method (as specified by Tees Valley SuDS requirements).

Appendix C contains the greenfield runoff rate calculations.

5.2.3 Attenuation

Based on a limiting surface water discharge rate of 44 l/s (QBAR for this site), Table 5 1 defines the attenuation requirements for surface water management. It is assumed that discharging to Holme Beck at the greenfield QBAR runoff rate, in accordance with Tees Valley SuDS requirements is acceptable to the Lead Local Flood Authority (LLFA) and that the condition of the receiving culvert is such that a new surface water connection is possible.

Area of storage required is based on an assumed pond depth of 1.5 metres (excluding freeboard) and % of site area considers a total site area of 10.27ha. It should be noted that alternative SuDS measures may be used to attenuate flows on site. Critical storm durations have also been used to provide conservative attenuation volumes, however, this approach does result in an extensive time to empty.

Table 5-1 - Required Attenuation

Design Flood Event (inc. climate change)	Critical storm duration Hours	Inflow volume m^3	Outflow volume m^3	Attenuation required m^3	Time to empty (assuming no infiltration) Hours	Area of storage required (ha) and % of total site area
3.33% AEP	12	6154	1331	4823	43.4	0.322 ha 3.131 %
3.33% AEP + 30% CC	12	8000	1331	6669	60.0	0.445 ha 4.329 %
1% AEP	12*	8029	1331	6699 (1876m3 exceedance above 3.33% AEP)	60.2	0.447 ha 4.349 %
1% AEP + 30% CC	12*	10438	1331	9108 (4285m3 exceedance above 3.33% AEP)	81.9	0.607 ha 5.912 %
*limited to corresponding 3.33% AEP critical storm duration						

5.2.4 Design Storm Event

In accordance with Tees Valley SuDS requirements, there should be sufficient storage within the system to accommodate a 3.33% AEP storm event. In this instance, this is 4823m3 which could be provided by a 0.322ha detention basin (see Figure 5-1) with a 1.5 metre depth (excluding freeboard) located within Area C, a designated Biodiversity Area.

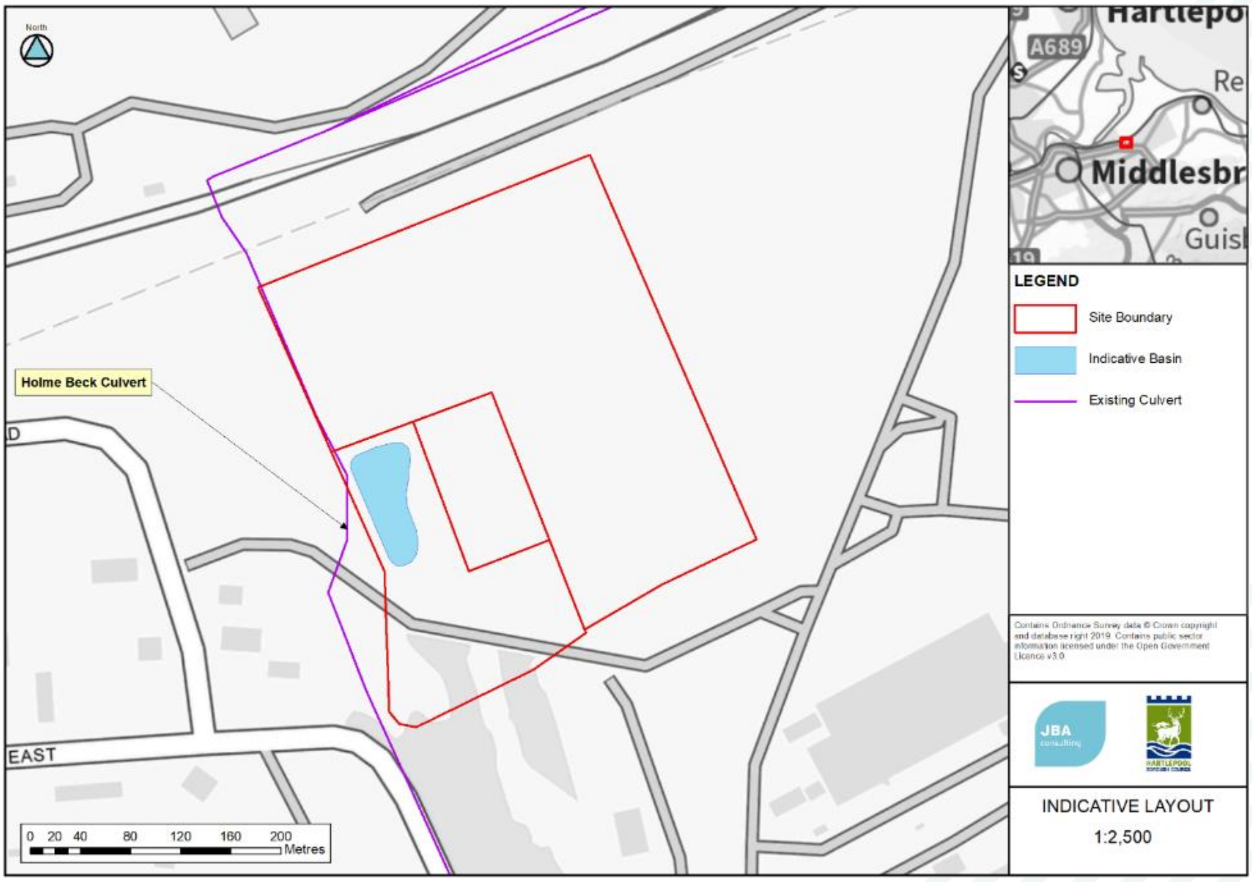


Figure 5-1 - Indicative Drainage Layout

5.2.5 Exceedance Flows

It is recommended that exceedance flows are contained within bunded areas of hardstanding (Area A) or within kerb lines. Based on Table 5-1, 4285m^3 of exceedance storage should be provided to meet Tees Valley SuDS requirements for the safe storage of the 1% AEP event plus 30% climate change.

5.3 Detention Basins

In accordance with Tees Valley SuDS requirements, the proposed detention basin should be designed with:

- Measures to intercept silt at source wherever possible or in a forebay where surface water runoff enters the basin;
- Measures to reduce the risk of erosion but if entry is uncontrolled through a point inlet then an erosion control structure will be necessary to manage the flow;
- A 2:1 to 5:1 length to width ratio to provide maximum opportunities for settlement at the inlet and filtration of surface water runoff;
- A gentle fall to the outlet of about 1 in 100 to encourage surface sheet flow by gravity;
- A controlled outfall at or just below ground level is usual to ensure drain down unless preceded by a micro-pool. This ensures a generally dry surface when it is not raining. A micro-pool enhances treatment, avoids a muddy area at the outlet and provides biodiversity interest;
- 1 in 4 maximum side slopes to the basin, with clear access for maintenance; and
- An overflow to allow for design exceedance or outlet blockage.

Further to this, the document defines that good practice for health and safety is to include for a minimum freeboard of 150mm in design.

5.4 Water Quality

Tees Valley SuDS requirements define that surface water runoff from roads and hard standing should pass through a filtering structure like under-drained swales, bioretention and permeable pavement to enhance trapping of potential contamination. However, this is not considered appropriate for the proposed development based on known contaminants at the site.

It is recommended that the proposed drainage layout includes for a fuel/oil interceptor based on the nature of the development as the site will require frequent deliveries of waste, therefore, potential for HGVs.

Further to this, potential sources of contamination such as oil and recyclates, (as defined on development layout in Appendix A) are located within the bunded Area A to avoid runoff from contaminated areas entering attenuation features.

6 Conclusions

This Flood Risk Assessment (FRA) has been prepared as a supporting document to planning application R/2019/0587/SCP: the development of a new Energy Recovery Facility and associated facilities at Grangetown Prairie, Grangetown.

In accordance with NPPF, the proposed facility is considered to be essential infrastructure, therefore, development is appropriate at this location as it is located in Flood Zone 1. Further to this, based on a desktop review of available information including initial drainage strategy, other sources of flood risk have not been identified.

Environment Agency guidance defines a cumulative sea level rise 1990 to 2115 of 0.99m at the Tees Estuary, however, this will not exceed ground levels at the site. Based on LiDAR data, the lowest elevation of Area A is considered to be 7.4mAOD and the bank level at the Tees Estuary is 4.08mAOD.

Based on Environment Agency defined Risk of Flooding Surface Water (RoFSW) mapping, the proposed development is considered to be at low risk of surface water flooding.

JFlow modelling of the wider catchment at the site was undertaken to delineate surface water flow routes, quantify associated flow rates and volumes, and confirm interactions with the development layout. JFlow modelling outputs indicated that there are no clear offsite impacts that need to be managed, however, development proposals must consider intercepting defined areas of localised ponding in addition to managing surface water runoff associated with the proposed development. Further, updated modelling does not indicate ponding within open channel areas of Holme Beck (Holme Beck Culvert was not modelled) upstream of the site, however, this modelling does not consider outfalls from highways or development drainage.

A safe access and egress route are not considered to be inhibited by flood risk based on available information and the updated JFlow modelling.

In order to ensure that flood risk is not increased offsite, surface water runoff must be managed on site. It is recommended to fully attenuate surface water on site so that flood risk downstream can be effectively managed. It is proposed to attenuate runoff and discharge at the greenfield QBAR rate (in accordance with Tees Valley SuDS requirements) to Holme Beck Culvert. However, this is dependent on culvert capacity and a recommended condition assessment.

Currently, there is no available information regarding CCTV or topographical survey, condition or capacity of Holme Beck Culvert. Further to this, there is added complexity associated with 3rd party landowners downstream of the proposed development. Although further modelling of the culverted watercourses could be undertaken, it would be dependent on 3rd party assets further downstream. It is noted that the culvert capacity downstream is assumed and the LLFA may require further survey to validate assumptions made.

Holme Beck is an Ordinary Watercourse, therefore, LLFA must be consulted.

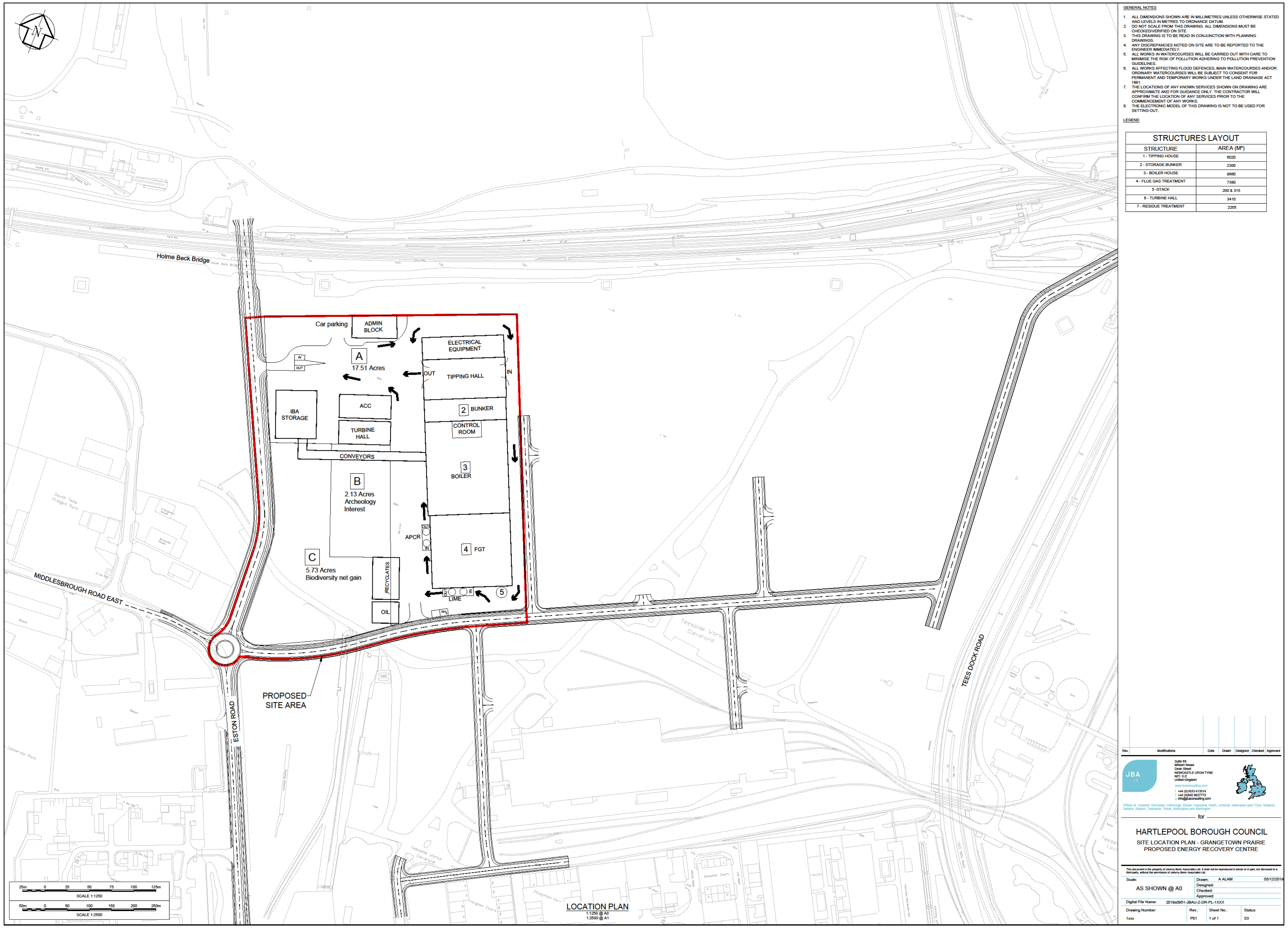
7 Recommendations

In terms of the proposed measures for surface water management, an assessment of the condition of Holme Beck Culvert should be undertaken to determine the potential requirements for a new surface water connection, otherwise, discharge could be dependent on maintenance/repair works or revised to outfall instead into the section of open channel at the upstream extent of Holme Beck.

Holme Beck is an Ordinary Watercourse, therefore, proposed discharge rates (if any) must be agreed with the LLFA.

It is recommended to model Holme Beck Culvert to confirm the culvert capacity and contributing inflows along the entire culvert length, confirming levels to CCTV, culvert condition and the implications of blockage on flood risk at the site. It is also recommended to confirm the invert level of the proposed Holme Beck outfall to the Tees Estuary (via Cleveland/Lackenby Channel) to determine the implications of tidal locking of the outfall. Further, other inflows that drain via this outfall should be quantified to ensure the proposed site drainage infrastructure does not surcharge during high tide events, however, based on the elevation of the site, this is considered to be unlikely.

A Site Location Plan



B JFlow Model Configuration Note

B.1 Introduction

JFlow surface water modelling has been used to quantify surface water flow rates and volumes, and to confirm interactions with the proposed development layout.

This technical note provides a record of the adopted JFlow model configuration.

B.2 Model Configuration

- Model extent defined by Arc Hydro catchment delineation
- 2 metre (m) model grid based on a model surface derived from 2m resolution filtered LIDAR
- Manning's *n* roughness values applied based on land type grid (see Section 2.1)
- Revitalised Flood Hydrograph (ReFH) method used to develop hyetographs simulated as direct rainfall (see Section 3)
- Hyetograph losses applied based on land type grid (see Section 3.1)
- Simulation end time defined by multiplying the latest time point from the selected hyetograph by three
- Boundary condition set as "Transmissive"

B.2.1 Manning's *n*

Based on OS Mastermap polygons to define the model surface, the catchment was manually processed to categorise areas by land type to assign appropriate roughness values.

By inspection, five surfaces were defined and assigned different Manning's *n* values (see Figure 2-3 showing the modelled delineated Mastermap):

- Permeable surfaces;
- Impermeable surfaces;
- Mixed permeable and impermeable surfaces, with evidence of significant previous use/development (see Figure 2-1);
- Mixed permeable and impermeable surfaces, with evidence of limited previous use/development (see Figure 2-2); and,
- Water.

Figure 7-1 – Example of mixed permeable and impermeable surface with evidence of significant previous use/development

Figure 7-2 – Example of mixed permeable and impermeable surface with evidence of limited previous use/development

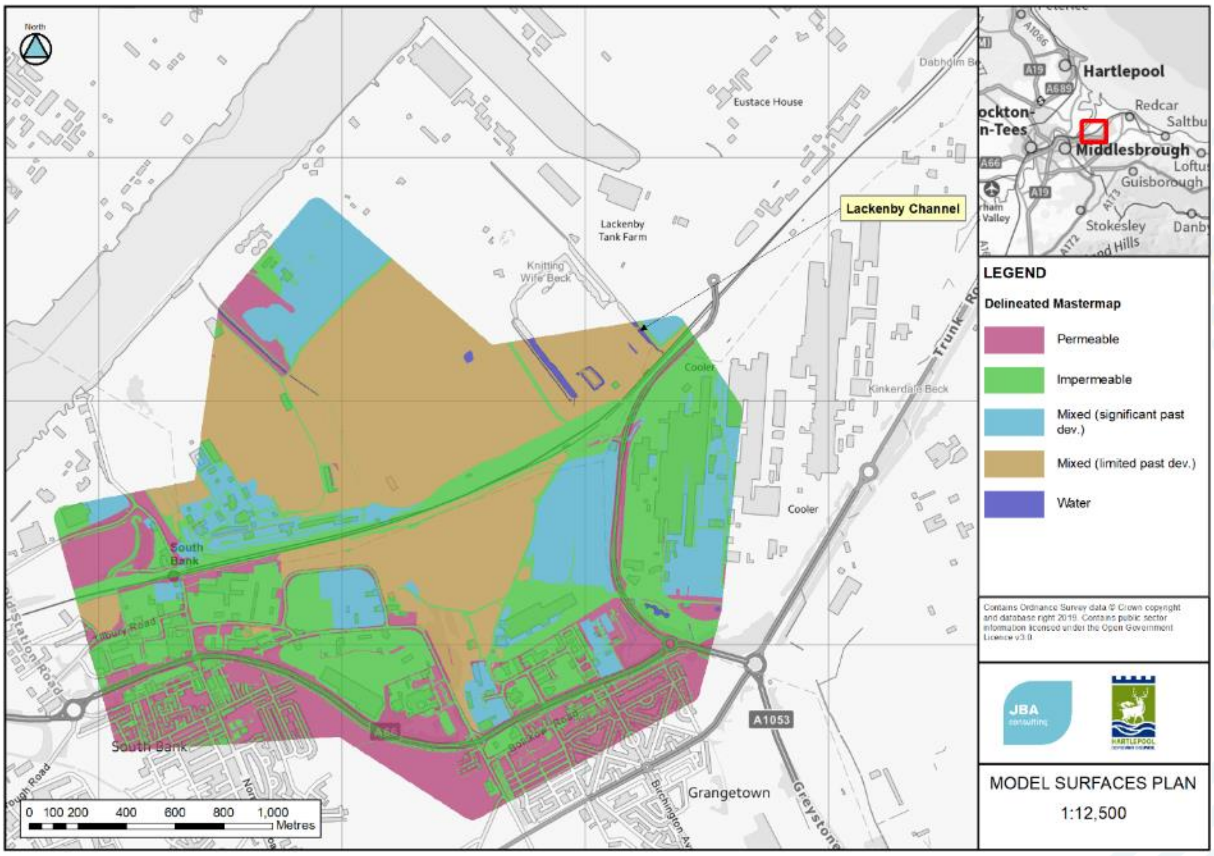


Figure 7-3 – OS Mastermap surface type delineation

Manning's N values for each defined land type are presented in the table below. It is noted that depth-varying values for *n* were not considered.

Land Type	Manning's *n* assigned
Default (permeable greenfield)	0.035
Impermeable (buildings, roads, hardstanding)	0.015
Permeable with evidence of significant previous use/development (building footprints)	0.025
Permeable with evidence of limited previous use/development (gravel tracks, rubble)	0.020
Water	0.015

B.3 Hyetographs

- Catchment at 453400, 522500
- ReFH method
- Default DDF parameters from catchment descriptors used
- Areal Reduction Factor (ARF) set to 1.0 (model extent is similar size to descriptor catchment so no ARF required)
- Summer storm profile (urban catchment)
- 6 hour modelled critical storm duration based on flood depths/extent increasing with storm duration. 6 hours was considered as an upper limit to be consistent with the longest modelled storm event as part of the updated Flood Map for Surface Water (uFMfSW)
- ReFH rainfall has been increased by 20% and 40% to reflect the central and upper end total potential change anticipated for the '2080s' (2070 to 2115).
- 3.33%, 1% and 0.1% AEP rainfall events have been modelled with 20% and 40% climate change allowances included for

B.3.1 Hyetograph Losses

A combined approach to calculate net rainfall was used, incorporating the ReFH loss method for permeable (greenfield) areas and the Percentage Runoff method for impermeable areas and areas constituting a mix of impermeable and permeable surfaces.

Percentage Runoff

A value of 80% was applied as a fixed percentage runoff for impermeable areas (buildings and roads as defined by OS Mastermap).

Further, a reduced percentage runoff of 65% and 50% was used for areas defined as a mix of permeable and impermeable surfaces with significant previous use/development and permeable with limited previous use/development respectively.

It is understood that there are several storm drains within the defined catchment at the site, however, the area appears to be unmaintained based on satellite mapping, therefore, condition of surface water sewers cannot be assumed to be functional hence no drainage infrastructure losses have been included for.

A wider model boundary has been set incorporating areas of both residential and non-residential development for which there would be losses due to local surface water drainage systems, however, these are outside of the modelled catchment, therefore, have not been modelled and are considered unlikely to have a significant impact on surface water flood risk at the site.

ReFH Losses

The ReFH loss method was used for undeveloped surfaces (green areas) and inland waterbodies within the model extent. The ReFH model allows the percentage runoff to increase throughout the storm as the catchment becomes more saturated.

ReFH losses are based on the principle that for any given land type there is a range of soil moisture capacities. These soil moisture capacities vary linearly between 0 (i.e. fully saturated) and a maximum value that is dependent on the land type properties. The maximum soil capacity C_{max} is dependent on catchment descriptor values BFIHOST and PROPWET.

In order to represent changing values of C_{max} for different land uses across the catchment, a simplified approach has been used by varying BFIHOST due to its close linear relationship with C_{max}.

C Greenfield Runoff Rate Calculations

HR Wallingford
Working with water

Greenfield runoff rate estimation for sites

www.uksuds.com | Greenfield runoff tool

Calculated by:	Joseph Landells-Molloy
Site name:	GRANGETOWN PRAIRIE SITE
Site location:	GRANGETOWN

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

Site Details

Latitude:	54.58432° N
Longitude:	1.15867° W
Reference:	2262581161
Date:	Nov 25 2019 10:33

Runoff estimation approach: IH124

Site characteristics

Total site area (ha): 23.24

Methodology

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

Soil characteristics

	Default	Edited
SOIL type:	4	4
HOST class:	N/A	N/A
SPR/SPRHOST:	0.47	0.47

Hydrological characteristics

	Default	Edited
SAAR (mm):	600	635
Hydrological region:	3	3
Growth curve factor 1 year:	0.86	0.86
Growth curve factor 30 years:	1.75	1.75
Growth curve factor 100 years:	2.08	2.08
Growth curve factor 200 years:	2.37	2.37

Notes

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

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

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

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

(3) Is SPR/SPRHOST ≤ 0.3?

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

Greenfield runoff rates

	Default	Edited
Q_{BAR} (l/s):	93.68	100.11
1 in 1 year (l/s):	80.57	86.09
1 in 30 years (l/s):	163.95	175.19
1 in 100 year (l/s):	194.86	208.23
1 in 200 years (l/s):	222.03	237.26

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