Cambois Connection – Onshore Scheme

Environmental Statement Volume 3

Technical Appendix 11.3: Surface and Foul Water Drainage Strategy

Surface and Foul Water Drainage Strategy (Onshore Converter Station)

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SSE Renewables

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Basis of Report

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Acronyms and Abbreviations

aOD	Above Ordnance Datum
AEP	Annual Event Probability
BBWF	Berwick Bank Wind Farm
BGS	British Geological Survey
BV	Britishvolt
CIRIA	Construction Industry Research and Innovation Association
DTM	Digital Terrain Model
CC	Climate Change
EA	Environment Agency
FEH	Flood Estimation Handbook
FWDS	Foul Water Drainage Strategy
FWMA	Flood and Water Management Act
GFRO	Greenfield Run Off
HVAC	High Voltage Alternating Current
HVDC	High Voltage Direct Current
LLFA	Lead Local Flood Authority
PPG	Planning Practice Guidance
NCC	Northumberland County Council
NPPF	National Planning Policy Framework
SPZ	Source Protection Zone
SuDS	Sustainable Drainage Systems
SWDS	Surface Water Drainage Strategy

1.0 Introduction

Berwick Bank Wind Farm Limited (BBWFL) is a wholly owned subsidiary of SSE Renewables (SSER) (hereafter referred to as 'the Applicant'). The Applicant is proposing the development of Offshore Export Cables, Onshore Export Cables, an Onshore Converter Station and associated grid connection at Blyth in Northumberland, known as the 'Cambois Connection' ('the 'Project'). The onshore components of the Project, landward of Mean Low Water Springs (MLWS) comprise the Onshore Scheme.

The purpose of this infrastructure is to facilitate the export of green energy from the generation assets associated with the Berwick Bank Wind Farm (BBWF), located in the outer Firth of Forth. A separate application for developing a grid connection to Branxton, East Lothian, has been included as part of the Applicant's application for consent for BBWF, currently being determined separately[1]. The Project will enable the BBWF to reach full generating capacity by the early 2030's.

The Project comprises two distinct proposals, or 'Schemes', which will require three separate consents. For the Onshore Scheme (all activities and infrastructure landward of MLWS) consent will be sought via an outline planning application to Northumberland County Council (NCC) as the local planning authority (LPA) under Section 57 of the Town and Country Planning Act 1990.

The offshore components of the Project seaward of Mean High Water Springs (MHWS) ('the Marine Scheme') are located within both Scottish and English waters. In Scotland, the Marine Scheme is entirely within offshore waters (i.e., between the 12 nautical miles (nm) limit and the Scottish Exclusive Economic Zone). In England, the Marine Scheme is within offshore waters and inshore waters.

SLR Consulting Limited (SLR) has been appointed by SSE Renewables Developments Ltd (the client) to prepare a Surface Water Drainage Strategy (SWDS) and Foul Water Drainage Strategy (FWDS) for the proposed onshore Converter Station required for the Onshore Scheme.

1.1 Context and Site Location

The Onshore Scheme site (henceforth referred to as 'the Site') is located between the Port of Blyth and Cambois, to the north of the River Blyth, to the east / north-east of Sleek Burn and west of the North Sea.

The red line boundary for this area (hereafter referred to as 'the Site') and the Indicative Zones of Infrastructure are shown on Figure 11.1.1.

The Site is also located to the east of the A189 with access provided off Brock Lane / Harbour View in the west, centred around National Grid Reference: NZ 29199, 83720. The Site lies wholly within the administrative area of Northumberland County Council (NCC).

A Site location plan highlighting the study area is provided in Volume 4 Figure 1.1. The full study area extends across approximately 1.88 km^2. The boundary extent of the proposed Onshore Convertor Station is significantly less at c.0.24 km^2, as identified in Appendix F.

East of the Site is an extensive tract of vacant land previously occupied by the Coal Stocking Yard for the Blyth Power Station, which at the time of writing has planning consent for the development a battery manufacturing plant with ancillary offices, together with associated

[1] BBWF is subject to a separate consenting process. An application for consent under Section 36 of the Electricity Act 1989 (as amended) was submitted to MS-LOT and accepted in December 2022. The Branxton onshore infrastructure is subject to a separate planning application submitted to East Lothian Council and accepted in March 2023.

development and infrastructure works. This site is referred to throughout this report as the former Britishvolt (BV) site.

This SWDS corresponds only to the Onshore Converter Station. The assessment of flood risk (Scoping Report) to the Onshore Convertor Station is provided as part of a separate report undertaken by Stantec in March 2023 (Appendix A).

1.2 Background and Aims

The aim of the SWDS is to ensure that through development of the Site, adequate drainage can be provided to ensure that the Onshore Scheme does not exacerbate the risk of flooding locally or elsewhere.

The report has been produced in accordance with the National Planning Policy Framework[2] (NPPF) and its associated Planning Practice Guidance[3] (PPG), taking due account of current best practice documents relating to assessment of flood risk published by the British Standards Institution BS8533[4] and Surface Water Drainage Principles outlined in CIRIA C753[5].

1.3 Data Sources Considered

In assessing the flood risk to the Site, the following sources have been reviewed:

- Berwick Offshore Wind Connection Flood Risk Scoping Report[6]
- Mapping published on the Environment Agency's (EA) website:
  - Risk of Flooding from Rivers and Sea;
  - Flood Map for Planning[7];
  - Long Term Flood Risk Information[8];
  - Risk of Flooding from Reservoirs;
  - Risk of Flooding from Surface Water;
- British Geological Survey (BGS)[9] mapping for details of superficial and bedrock geology;
- Cranfield Soil and Agrifood Institute Soilscapes map viewer[10] for soil information;
- EA LiDAR data[11] from the Department for Environment Food & Rural Affairs (DEFRA);

2 National Planning Policy Framework: Communities and Local Government (2012, as updated 2021).
3 Planning Practice Guidance: Flood Risk and Coastal Change, Ministry of Housing, Communities and Local Government (Published March 2014, Updated August 2022).
4 BS8533:2017, Assessing and managing flood risk in development: Code of Practice (December 2017).
5 The SuDS Manual, CIRIA C753, London 2015.
6 Berwick Offshore Wind Connection, Flood Risk Scoping Report, Stantec, March 2023.
7 Environment Agency Flood Risk for Planning, https://flood-warning-information.service.gov.uk/long-term-flood-risk/
8 Environment Agency Long Term Flood Risk, https://www.gov.uk/check-long-term-flood-risk
9 British Geological Survey, Geoindex Onshore, https://mapapps2.bgs.ac.uk/geoindex/home.html
10 Soilscapes, Cranfield Soil and Agrifood Institute, Cranfield University, DEFRA, http://www.landis.org.uk/soilscapes/
11 Defra Survey Data Download, Department for Environment Food & Rural Affairs, https://environment.data.gov.uk/DefraDataDownload/?Mode=survey

- Northumberland County Council Level 1 & 2 Strategic Flood Risk Assessment[12,13];
- Northumberland County Council Local Plan 2015-2036[14];
- North-East Lead Local Flood Authorities (LLFA) Sustainable Drainage Local Standards[15]; and
- DEFRA's 'MAGIC'[16] website.

12 Northumberland County Council, Level 1 Strategic Flood Risk Assessment, Scott Wilson, September 2010.
13 Northumberland County Council, Level 2 Strategic Flood Risk Assessment, URS, October 2015.
14 Northumberland County Council, Northumberland Local Plan 2016-2036, Adopted 31 March 2022.
15 North-East Lead Local Flood Authorities Sustainable Drainage Local Standards, July 2020, https://www.northumberland.gov.uk/NorthumberlandCountyCouncil/media/Roads-streets-and-transport/coastal%20erosion%20and%20flooding/SuDS%20%20Planning/NE-LLFA-SuDS-Standards-2020_final-July-2020-1.pdf
16 Magic Map Application, DEFRA, https://magic.defra.gov.uk/MagicMap.aspx

2.0 Baseline Context

2.1 Local Hydrology

The Site is adjacent to the North Sea in Northumberland, inland from the coast in North East England. The River Blyth and Sleek Burn are EA Main Rivers[17]. The reaches of these at the Site are tidal watercourses, located immediately south and west of the Site, conveying flows east into the North Sea. There are two Ordinary Watercourse features present within the Site (Maw Burn and Cow Gut) and others present within close proximity, which outfall into these tidal waterbodies.

All local watercourses are identified below in Figure 11.1.3 and described in further detail in the following sections. It should be noted that some sections of open channel/swale represented in the mapping (which are unlabelled to the north of the Site) form part of the historic drainage for the previous industrial works on the proposed Battery Manufacturing Plant Site and are not considered part of the named watercourses.

Figure 2-1: Local Hydrology

2.1.1 North Sea

The Site is located adjacent to the open coastline associated with the North Sea. The North Sea at Blyth has a semi-diurnal tidal cycle meaning there are 2 high tides and 2 low tides per day. Everyday tidal levels in the North Sea at Blyth vary from around -2.22 m above Ordnance Datum (aOD) to 2.62 m aOD[18].

17 Main River Map, Environment Agency.
18 Tide Times, Blyth Tide Times, https://www.tidetimes.org.uk/blyth-tide-times [Accessed August 2023].

2.1.2 River Blyth

The Site is located immediately north of the River Blyth at its estuary, flowing in an easterly direction past the Site into the north sea. The River Blyth is an Environment Agency (EA) Main River[19], which within the reach past the Site is tidal in nature with water levels changing with the prevailing tide in the North Sea. Due to funnelling effects upriver, everyday water levels in the River Blyth are likely higher than those predicted in the open sea. Blyth port area is located at the southern boundary of the Site. The River Blyth estuary feeds into the Port of Blyth, before discharging into the North Sea.

2.1.3 River Wansbeck

The River Wansbeck is an EA Main River[19], located 900 m north of the Site and flows in a south easterly direction into the North Sea. The channel past the Site is tidal in nature and water levels vary with the incoming tide. Due to its proximity to the River Blyth it is likely the water levels in the River Wansbeck are similar to the River Blyth.

2.1.4 Cow Gut

Cow Gut is an ordinary watercourse which rises at Brock Lane to the north-west of the Site. It is shown on Ordnance Survey mapping to be culverted beneath the A189, on the western boundary of the Site. Cow Gut then forms part of the northern boundary of the Site, running through an area of woodland before passing into a culvert beneath land on the proposed Battery Manufacturing Plant Site. Cow Gut has been rerouted (Photograph 2-1) following initial development of the proposed Battery Manufacturing Plant Site. This includes sections of new culverts and open channel through the Site. The route of Cow Gut mapped from the Site walkover is presented in Figure 11.1.3. Cow Gut routes south out of the Site to outfall into the River Blyth estuary.

Cow Gut flows over predominantly Mudstone and Sandstone geology which is overlain by Glacial Till / Diamicton. This is a very small watercourse which is unlikely to interact with the more permeable bedrock. It would therefore be expected that there would be little to no baseflow (Photograph 2-2) in the watercourse, which is likely sourced from overland flows locally.

[19] Main River Map, Environment Agency.

Photograph 2-1: Re-Routed Channel of Cow Gut

Photograph 2-2: Dry Channel of Cow Gut downstream of A189

2.1.5 Maw Burn

Maw Burn is an ordinary watercourse which drains an upgradient area to the north of the Site of approximately 1.01 km^2 over mudstone and sandstone bedrock overlain by Glacial Till / Diamicton. Similar to Cow Gut watercourse, due to the presence of Diamicton deposits locally, it would be expected that there would be little to no baseflow in the watercourse which is likely sourced from overland flows locally. Baseflows would only be expressed in the downstream reaches which would be drowned out by high tide.

Maw Burn outfalls into the North Sea (Photograph 2-3) to the east of the Site via a culvert (Photograph 2-4) beneath Unity Terrace and the railway line.

Photograph 2-3: Maw Burn Outfall into North Sea

Photograph 2-4: Culvert Outfall of Maw Burn towards North Sea

Photograph 2-5: Open Section of Maw Burn

2.1.6 Other Ordinary Watercourses

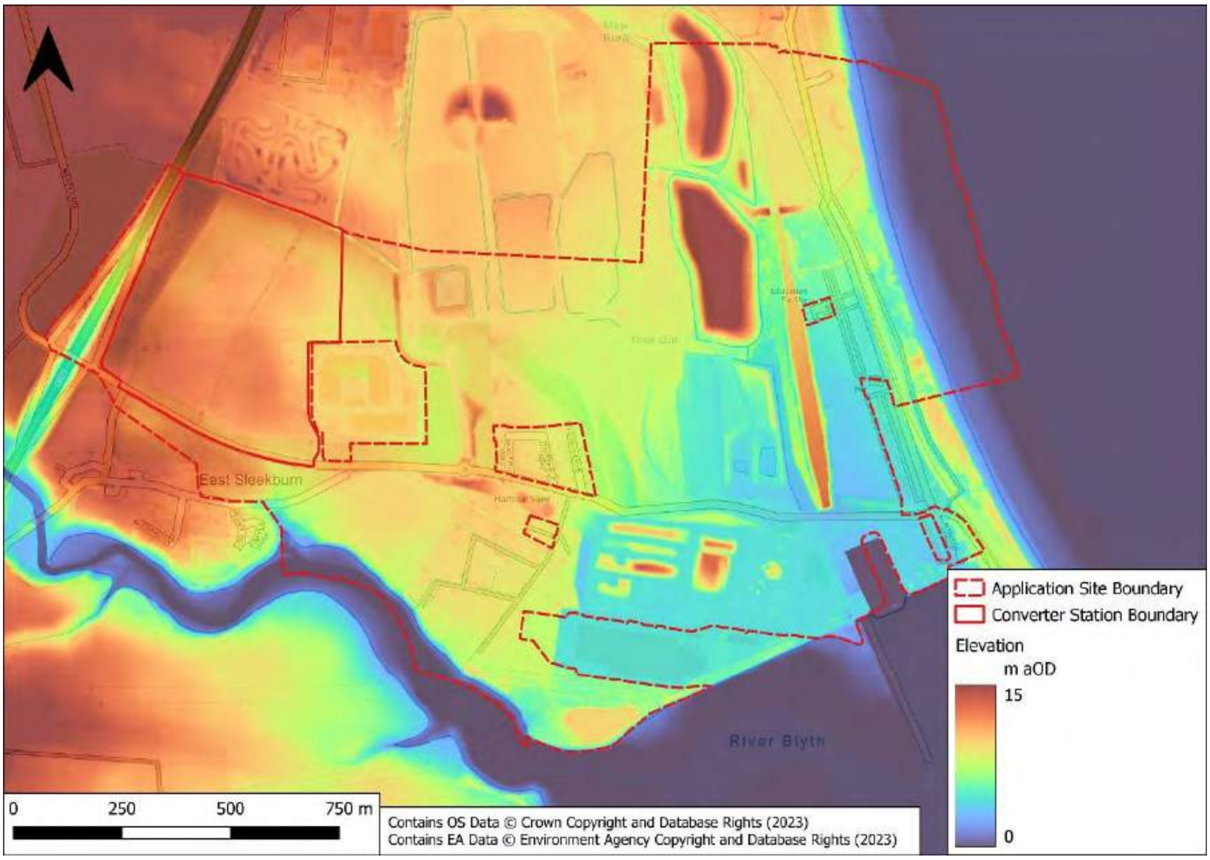
There are a number of Ordinary Watercourses (notably Maw Burn and Cow Gut) and small drainage ditches in the south of the Site (refer to Figure 2-1), south of Harbour View and Brock Lane. It is assumed these watercourses collect overland flows from surrounding land locally and were observed to discharge into Sleek Burn.

2.2 Site Topography

Ground level data across the Site has been obtained from the EA Open Data[20] webSite for 1m resolution aerial photogrammetry (LiDAR) data using a Digital Terrain Model (DTM), which is a bare earth model and therefore excludes built features and vegetation. This data is presented below in Figure 2-2.

20 Environment Agency open data webSite http://environment.data.gov.uk

Figure 2-2: 1m DTM LiDAR Plot of the Site



Ground levels across the Site fall to the south and east towards Sleek Burn, River Blyth estuary and the North Sea. The highest ground levels on Site are found up to 22.5 m above Ordnance Datum (aOD) in an area of raised ground around Maw Burn and fall to -1 m aOD in the channel of Sleek Burn to the south-west.

Ground levels within the Onshore Convertor Station Zone fall in a south and easterly direction towards the North Sea and Sleek Burn, from a topographic high of 14.9 m aOD in the north-eastern corner to 9 m aOD in the east, situated north adjacent to the existing North Sea Link substation.

2.3 Geological and Hydrogeological Features

2.3.1 Geology

The National Soil Resources Institute[21] dataset suggests that the soils at the Site consist of *'Slowly permeable seasonally wet slightly acid but base-rich loamy and clayey soils'.*

BGS mapping[22] indicates that the Onshore Convertor Station Zone is underlain by the Pennine Middle Coal Measures Formation (Sandstone). A change of bedrock strata is noted in the south east and north western extents of the Site to another unit of the Pennine Middle Coal Formation. This is a marked lithological change to a combination of mudstone, siltstone and sandstone.

21 Soilscapes map, http://www.landis.org.uk/soilscapes/ [Accessed August 2023].
22 British Geological Survey, Geoindex, http://mapapps.bgs.ac.uk/geologyofbritain/home.html? [Accessed August 2023].

Superficial deposits of Diamicton overly the bedrock across the entire Onshore Convertor Station Zone.

2.3.2 Hydrogeology

The bedrock geology across the Site is designated by the EA[23] as Secondary A aquifers, defined as permeable layers that can support local water supplies and may form an important source of baseflow to rivers.

The Diamicton deposits are designated by the EA as a Secondary (undifferentiated) aquifer, which are defined as units where it is not possible to attribute A or B status and water storage/permeability is a function of the lithological characteristics locally.

The Site is not located within a Source Protection Zone (SPZ) associated with groundwater abstractions.

Groundwater data provided in BGS Records indicates that groundwater levels across the Site are highly variable (in alignment with the inconsistent geological units) and range from around -2.2 m aOD to -11.1 m aOD. In the north east of the Site, groundwater is identified at 9m aOD, 0.5m below ground level.

Groundwater levels are likely to vary on a semi diurnal cycle in line with the tide locally, particularly closer to the coast and the River Blyth estuary. It is expected that groundwater would flow through the bedrock in an easterly direction towards the sea with some flows expressed via the River Blyth as baseflow to the river.

Given that the Site is overlain by Diamicton, recorded in borehole records as boulder clay, shallow groundwater in the Diamicton deposits is possible in permeable deposits however this would be confined to the permeable lense and not consistent across the Site.

2.4 Existing Site Drainage

The majority of the Site comprises greenfield land and the Onshore Convertor Station is wholly situated on land that has not been previously developed, therefore incidental rainfall shed from the Onshore Convertor Station land will discharge in line with the prevailing topography. Given the existing watercourse network on Site, it is likely that the majority of flows from the wider Site are intercepted by Cow Gut or Maw Burn, or the network of drainage channels across land in the south of the Site.

Existing Site drainage for the Onshore Convertor Station Zone is discussed further in Section 4.2.

2.5 Flood Risk Classification

The flood risk assessment undertaken by Stantec (Appendix A) concludes that the converter station is located within Flood Zone 1 and is therefore at very low risk of flooding from fluvial and tidal sources. Other flood sources have been considered including relevant climate change allowances. None of these sources are considered to impact the Converter Station Zone.

Areas of elevated surface water flood risk within the converter substation boundary are retained within local topographic depressions derived from runoff from the Site itself. These areas of elevated surface water flood risk would be mitigated through the surface water drainage strategy and therefore considered low risk.

23 Magic Map Application, managed by Natural England, delivered by Landmark: https://magic.defra.gov.uk/MagicMap.aspx [Accessed August 2023].

3.0 Planning Policy and Guidance

3.1 Development Proposals

This report is specific to the proposed converter station for the Onshore Scheme. The Onshore Scheme forms part of a larger development for an offshore windfarm and associated onshore development (the Project).

With reference to NPPF, essential utility infrastructure, including infrastructure for electricity supply including generation, storage and distribution systems, are classified as an *'Essential Infrastructure'* development type.

3.2 Local Planning Policy

Northumberland Local Plan[24] was adopted in March 2022 and sets out strategic planning policies of the Council as well as the general scale and distribution of new development requirement to meet Northumberland's needs to 2036. It also provides planning principles and policies which should be factored in to any planning application within the district.

Relevant policy from the Local Plan includes:

Policy WAT 3

'Flooding

1. *In assessing development proposals the potential for both on and off-Site flood risk from all potential sources will be measured, taking into account the policy approach contained within: the relevant Catchment Flood Management Plan; the Northumberland Local Flood Risk Management Strategy; the Northumberland Outline Water Cycle Study; and the findings of Drainage Area Studies.*
2. *Development proposals will be required to demonstrate how they will minimise flood risk to people, property and infrastructure from all potential sources by:*

    a. *Avoiding inappropriate development in areas at risk of flooding and directing the development away from areas at highest risk. Where development is necessary in such areas, the development should be made safe for its lifetime without increasing flood risk elsewhere. The Sequential Test and, if necessary, the Exceptions Test, will be applied (subject to minor development and change of use exemptions) in accordance with national policy and the Northumberland Strategic Flood Risk Assessment. Site Specific Flood Risk Assessments will be required for:*

        i. *All development in Flood Zones 2 and 3; and*
        ii. *In Flood Zone 1, for all proposals involving:*
            - *Sites of 1 hectare or more;*
            - *land which has been identified by the Environment Agency as having critical drainage problems;*
            - *land identified in a strategic flood risk assessment as being at increased flood risk in future; or*
            - *land that may be subject to other sources of flooding, where its development would introduce a more vulnerable use.*

    b. *For developments where (2a) above applies, it will be ensured that:*
        i. *The impact of the development proposal on existing sewerage infrastructure and flood risk management infrastructure is assessed, including whether there is a need to reinforce such infrastructure or provide new infrastructure in consultation with the relevant water authority;*
        ii. *The development takes into account climate change and the vulnerability of its users;*

[24] Northumberland County Council, Northumberland Local Plan 2016-2036, Adopted 31 March 2022.

iii. *The Site is configured so that the most vulnerable development is located in areas of lowest flood risk, unless there are overriding reasons to prefer a different location;*
iv. *The development is made resistant and resilient, in terms of its layout, mix and/or building design, in accordance with national policy and the findings and recommendations of the Northumberland Strategic Flood Risk Assessment;*
v. *Sustainable drainage systems are incorporated as appropriate, in accordance with Policy WAT 4;*
vi. *Any residual flood risk can be safely managed; and*
vii. *Safe access and escape routes are incorporated, where appropriate, as part of an agreed emergency plan.*

c. *Pursuing the full separation of foul and surface water flows as follows:*
   i. *A requirement that all development provides such separation within the development; and*
   ii. *Where combined sewers remain, the Council will work with statutory sewerage providers to progress the separation of surface water from foul;*
d. *Ensuring that built development proposals, including new roads, separate, minimise and control surface water run-off, using Sustainable Drainage Systems, modified as necessary where mine water is present; in relation to this:*
   i. *Surface water should be managed at source wherever possible, so that there is no net increase in surface water run-off for the lifetime of the development;*
   ii. *Surface water should be disposed of in accordance with the following hierarchy for surface water run-off:*
      - *To a soakaway system, unless it can be demonstrated that this is not feasible due to poor infiltration with the underlying ground conditions and/or high groundwater levels;*
      - *To a watercourse, unless there is no alternative or suitable receiving watercourse available;*
      - *To a surface water sewer;*
      - *As a last resort, once all other methods have been explored, disposal to combined sewers;*
   iii. *Where greenfield Sites are to be developed, the surface water run-off rates should not exceed, and where possible should reduce, the existing run-off rates;*
   iv. *Where previously developed Sites are to be developed:*
      - *The peak surface run-off rate from the development to any drain, sewer or surface water body for any given rainfall event should be as close as reasonably practicable to the greenfield run-off rate for the same event, so long as this does not exceed the previous rate of discharge on the Site for that same event; or*
      - *Where it is demonstrated that the greenfield run-off rate cannot be achieved, then surface run-off rate should be reduced wherever possible by a minimum of 50% of the existing Site run-off rate;*

e. *Full consideration should be given to solutions within the wider catchment area, including blue-green infrastructure-based solutions and those providing ecosystem services, with wider solutions especially applied if local solutions could be harmful to biodiversity, landscape or built heritage;*

3. *In relation to flood alleviation schemes:*
   a. *The early implementation of approved schemes will be supported through development decisions;*
   b. *Any proposal for additional schemes should demonstrate that they represent the most sustainable solution and that their social, economic and environmental benefits outweigh any adverse environmental impacts caused by new structure(s), including increasing the risk of flooding elsewhere.*

4. *Any works relating to the above, which impact on natural water systems, should consider the wider ecological implications, applying the ecosystem approach, and link into green infrastructure initiatives wherever practicable.'*

Policy WAT 4

‘Sustainable Drainage Systems

1. *Water sensitive urban design, including Sustainable Drainage Systems (SuDS) will be incorporated into developments whenever necessary, in order to separate, minimise and control surface water run-off, in accordance with national standards and any future local guidance.*

2. *SuDS will be a requirement for any development where it is necessary to manage surface water drainage unless it can be clearly demonstrated:*
    a. *That SuDS are not technically, operationally or financially deliverable or viable and that any surface water drainage issues resulting from the development can be alternatively mitigated; or*
    b. *That the SuDS scheme will itself adversely affect the environment or safety, including where ponds could increase the risk of bird strike close to the airport or where existing minewater problems could be exacerbated.*

3. *SuDS or other water sensitive urban design schemes should be devised to take account of predicted future conditions and, where appropriate, efforts should be made to link them into wider initiatives to enhance the green infrastructure, improve water quality, benefit wildlife and/or contribute to the provision of an ecosystem service.*

4. *Arrangements must be put in place for the management and maintenance of SuDS over the lifetime of the development, with such arrangements taking account of the cumulative effectiveness of SuDs in the area concerned.’*

3.3 Local Guidance

LLFAs in the North East of England including Northumberland County Council have adopted the North-East Lead LLFA Sustainable Drainage Local Standards. The document provides guidance for developing surface water drainage strategies in the region.

The document provides a number of local standards which are reproduced below:

- **Local Standard 1:** Equivalent Greenfield Run-Off (GFRO) discharge rates should be provided for new development at all Sites (Greenfield and Brownfield)
- **Local Standard 2:** The NNE LLFA (North-East Lead Local Flood Authorities) accept either FEH or IOH124 methods for calculating GFRO rates.
- **Local Standard 3:** for calculation GFRO rate the whole Site area minus significant areas of public open space should be used.
- **Local Standard 4:** The NNE LLFA will set allowance discharge rates following Local Standards 1-3, unless the permissible discharge rate Northumbrian Water will allow to sewer is below GFRO rates.
- **Local Standard 5:** Urban creep allowances to be applied up to 10% for residential developments and 0% for commercial developments.
- **Local Standard 6:** The NE LLFA will accept a single Qbar discharge rate from Site or rates no more than the 1 in 1 and 1 in 100-year GFRO in accordance with Defra Standards.
- **Local Standard 7:** The NNE LLFA accepts direct free (unrestricted) discharge to estuarine waters or the sea.
- **Local Standard 8:** – Storm events should be checked as a minimum between 15 minutes and 360 minutes.
- **Local Standard 9:** Climate change allowances to be applied are 40% on the extreme event modelling (100 year return period)
- **Local Standard 10:** 300 mm free board is required in SuDS design.
- **Local Standard 11:** 1D or 2D modelling may be required for ordinary watercourses within or adjacent to new developments.
- **Local Standard 12:** Overland flow modelling for surface water flood routes or other reasons may be required as part of formal submissions.
- **Local Standard 13:** To assess the risk of tide locking a combined tidal and surface water event must be assessed where the development is in or directly adjacent to flood zone 2 or 3.

- **Local Standard 14:** SuDS design should meet the latest CIRIA SuDS Manual, Sewers for Adoption, British Standards and other best practice guidance.
- **Local Standard 15:** A Site specific maintenance plan will be required to detail how SuDS will be maintained and who will maintain them.
- **Local Standard 16:** A construction plan is required to show surface run off, any water receptors and an outline of mitigation measures.
- **Local Standard 17:** The NNE LLFA consider SuDS to be on the surface "green SuDS" that show multifunctional benefit (including quantity control, water quality, biodiversity and amenity) and mimic natural drainage in line with the NPPF (National Planning Policy Framework) and FWMA (Flood and Water Management Act) definitions.
- **Local Standard 18:** The NNE LLFA typically follow LASOO (Local Authority SuDS Officer Organisation) guidance for FRA and Drainage Strategy requirements at Outline and Full planning permission.
- **Local Standard 19:** Infiltration testing is required at all Sites before planning approval.
- **Local Standard 20:** Source control interception (retaining 5mm rainfall on Site) should be applied for the impermeable area of all Sites using the CIRIA SuDS manual method.
- **Local Standard 21:** SuDS can be used as open space outside of the area wetted by a 1-year return storm.
- **Local Standard 22:** Water quality information should be assessed using criteria in the current CIRIA SuDS manual.

3.4 Climate Change

The NPPF requires that flood risk is considered over the lifetime of the development and therefore consideration needs to be given to the potential impacts of climate change.

In February 2016, the EA issued updated guidance on the impacts of climate change on flood risk in the UK to support NPPF. This was most recently updated in May 2022 and advice sets out that peak rainfall intensity, sea level, peak river flow; offshore wind speed and extreme wave heights are all expected to increase in the future as a result of climate change. Consideration of the changes to these parameters should use the allowances outlined below based on the anticipated lifetime of the development.

The climate change allowance guidance acknowledges that there is considerable uncertainty with respect to the absolute level of change that is likely to occur. As such, the document provides estimates of possible changes that reflect a range of different emission scenarios, over different epochs.

The SWDS will require to only account for anticipated changes in peak rainfall intensity over the anticipated operational lifetime of development.

3.4.1 Anticipated Lifetime of Development

The NPPF practice guidance classifies land uses into five categories. Utilities infrastructure, such as these works, is classified as *'Essential Infrastructure'*. The onshore converter station has an anticipated operational development lifetime of 100-years (i.e., to 2123 and therefore falls within the 2070s epoch in relation to climate change allowances.

3.4.2 Peak Rainfall Intensity

For peak rainfall intensity the PPG guidance states that flood risk assessments for *'Essential Infrastructure'* the central allowance for the 2070s epoch for both the 3.3% AEP (Annual Event Probability) storm event and 1% AEP storm event should be used. As detailed in Table 3-1: Peak Rainfall Intensity Allowances, this equates to a 30% uplift on the 3.3% AEP event and 30% uplift for the 1% AEP event.

Northumberland County Council, as detailed in Section 3.3, require an uplift of 40% to account for peak rainfall intensity, which is 10% greater than the predicted 1% AEP uplift presented by the Environment Agency.

Table 3-1: Peak Rainfall Intensity Allowances

Management Catchment	Annual Exceedance Probability (%)	Allowance Category	Total potential change anticipated for the 2050s	Total potential change anticipated for the 2070s
Northumberland Rivers Management Catchment	3.3	Upper End	35%	40%
		Central	20%	30%
	1	Upper End	40%	45%
		Central	25%	30%

4.0 Surface Water Drainage Strategy

This surface water drainage strategy sets out high level principles for managing storm water on the Site in line with best practice and the requirements of the NCC, the LLFA for the area.

It should be noted this strategy is based on an indicative design for the Onshore Scheme and a worst-case scenario of possible drainage solutions based on this indicative concept design. There are some design details related to the Onshore Scheme that are still to be finalised due to further ground investigations required, ongoing engineering design work and the procurement of cable and converter station suppliers. These details will inform the final specification. The Site boundary has been chosen to allow flexibility to accommodate these design details which will be subject to future application(s) for approval of Reserved Matters.

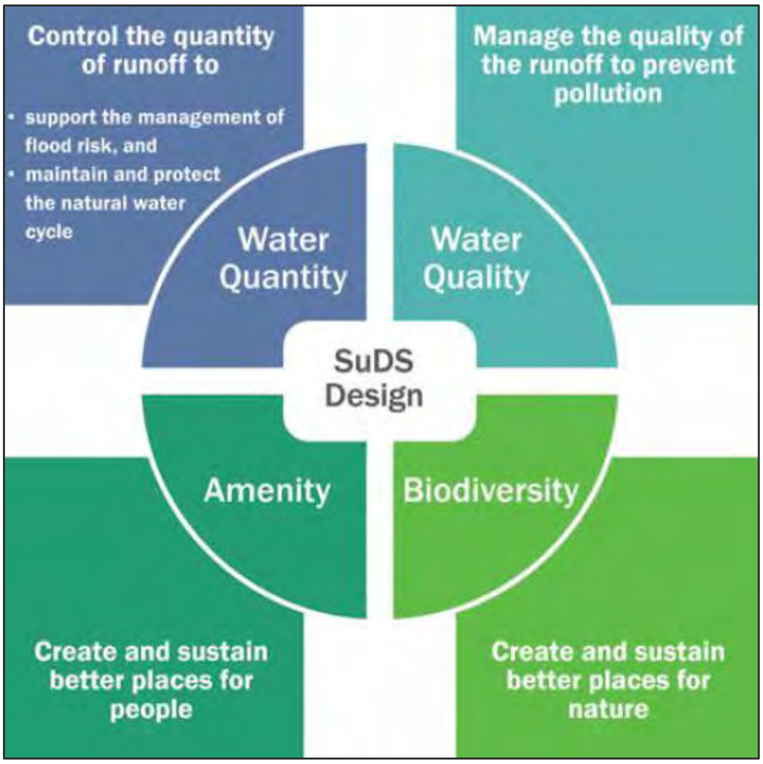
This strategy, based on the proposed indicative design, is intended to demonstrate that, given the nature and quantum of development proposed, it will be feasible to drain the Site in line with planning requirements using the proposed methodology.

4.1 Key Principals of Surface Water Management

4.1.1 Overview

Current best practice guidance document; The Sustainable Drainage System (SuDS) Manual (CIRIA Report C753), promotes sustainable water management through the use of SuDS. There are four main categories of SuDS which are referred to as the 'four pillars of SuDS design' as depicted in Figure 4-1.

Figure 4-1: Four Pillars of SuDS (extract from CIRIA Report C753)

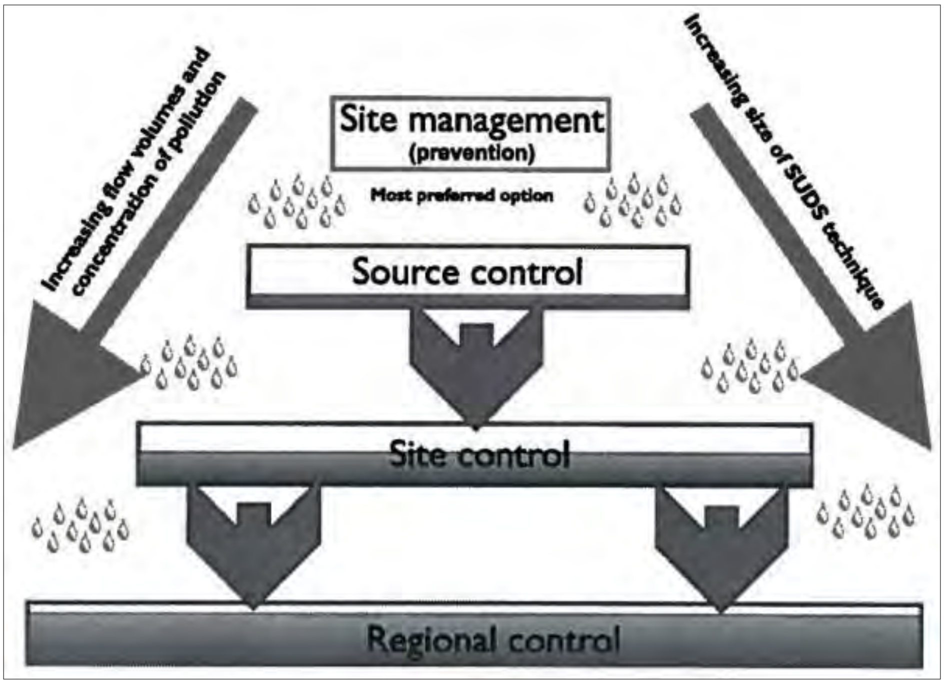


The SuDS Manual identifies a hierarchy of SuDS for managing runoff, which is commonly referred to as a 'management train'. The hierarchy of techniques is identified as:

- **Prevention** – the use of good Site design and housekeeping measures on individual Sites to prevent runoff and pollution (e.g. minimise areas of hard standing).

- **Source Control** – control of runoff at or very near its source (such as the use of rainwater harvesting).
- **Site Control** – management of water from several sub-catchments (including routing water from roofs and car parks to one/several large soakaways for the whole Site).
- **Regional Control** – management of runoff from several Sites, typically in a retention pond or wetland.

Figure 4-2: SuDS Management Train



4.1.2 National Planning Policy Context

Current national planning policy guidance and best practice, namely NPPF and PPG, require development proposals in all Flood Zones to seek opportunities to reduce the overall level of flood risk in the area and beyond through the layout and form of the development, and the appropriate application of SuDS.

4.2 Existing Surface Water Drainage Regime

Ground levels in the Onshore Convertor Station Zone predominantly slope north eastwards towards Cow Gut watercourse. Following incident rainfall, it is likely that some flows discharge to ground, while the remainder of flows discharge overland to the north east and into Cow Gut.

The south-eastern corner of the Onshore Convertor Station Zone slopes slightly to the south; however, at this location, Brock Lane is raised above the Site. Flows here, as identified in the surface water flood mapping, pond at the base of Brock Lane and infiltrate / evaporate accordingly. Waterlogging was noted in this location during the site walkover. During extreme events these flows will likely overtop the road to discharge south over land, ultimately passing into Sleek Burn.

4.2.1 Pre-Development Runoff Rates

Greenfield runoff rates for the drained area of the Site have been estimated through application of the Revitalised Flood Hydrograph Model (ReFH2). ReFH2 is recommended by the Environment Agency as the methodology for estimating flood peaks and hydrographs for small catchments[25].

The ReFH2 method is applied using software 'The Revitalised Flood Hydrograph' modelling tool.

The Flood Estimation Handbook (FEH) parameters (obtained from FEH webservice for 1km grid) have been reviewed with understanding of the local geological context and anecdotal evidence from the Site walkover and are deemed acceptable.

The greenfield runoff results are summarised in Table 4-1 and full results are included as Appendix B.

Table 4-1: Greenfield Runoff Rates

Annual Probability	Greenfield Runoff Rate (l/s/ha)	Drained Area Runoff Rate – 13.059ha (l/s)
100%	4.1	53.5
50%	4.6	60.1
3.3%	10.0	130.6
1%	13.1	171.1

4.3 Constraints on the Use of SuDS

4.3.1 Geology and Hydrogeology

The Onshore Convertor Station Zone is predominantly overlain by poor permeability Diamicton deposits. Infiltration testing was carried out at the former British Volt site within the Diamicton geology. The results of the infiltration testing are provided in Appendix C.

Borehole records note 1.5 m - 2.0 m of made ground underlain by clay deposits, with almost no infiltration of flows and were noted to be practically impervious throughout all tests. Given that the Site is situated on very similar geology and is located in close proximity to the test location, it is unlikely that infiltration to ground is feasible at the Onshore Convertor Station Zone. However, SuDS features should remain unlined to enhance infiltration potential.

4.3.2 Sewers

Sewer plans for the Site are provided in Appendix D. The mapping shows that there is a small section of a surface sewer, to the south of the Onshore Convertor Station Zone beneath Brock Lane, between a foul and combined sewer connection. It is therefore likely that this reach of sewer is actually combined surface and foul water flows.

The Site could potentially connect into the combined sewer; however, connection to the sewer network is considered the least preferable method of surface water discharge.

4.3.3 Watercourses

There are a number of fluvial and tidal watercourses on and around the Site which could accept surplus flows from the Onshore Convertor Station. Under existing conditions, flows will flow overland, likely discharging into Cow Gut or Sleek Burn. Given that no detailed flood modelling of Cow Gut has been undertaken, the drainage strategy should either restrict flows to the lowest feasible level (to reduce any prevailing flood risk) or discharge into a tidal system,

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[25] Environment Agency, Estimating flood peaks and hydrographs for small catchments: Phase 1, Project: SC090031, May 2012

such as Sleek Burn, where increased flows will have no impact on the tidal water levels and inherent flood risk at the estuary.

4.3.4 Topography

Ground levels across the proposed Onshore Convertor Station Zone generally fall in a north easterly and southern direction towards Cow Gut and Sleek Burn respectively. It is envisaged, through the construction of a solid platform for the Onshore Convertor Station, that the ground level for the developed area will become flat. Any SuDS features will need to be located downgradient from this platform (i.e., not to the west where higher ground is present) to allow for a gravity discharge drainage connection.

4.4 Proposed Discharge Arrangement

With reference to the SuDS Manual, the hierarchy of preferred disposal options for surface water runoff from development sites in decreasing order of sustainability is as follows:

1. Infiltration to Ground;
2. Discharge to Surface Waters; or
3. Discharge to Sewer.

Table 4-2 summarises the suitability of disposal methods in the context of the Onshore Convertor Station. Based on this, runoff from the Onshore Convertor Station will be discharged to surface waters within Sleek Burn

Table 4-2: Suitability of Surface Water Disposal Methods

Surface Water Disposal Method (in Order of Preference)	Suitability Description	Method Suitable? (Y / N)
Infiltration to Ground	The converter substation area is underlain by low permeability Diamicton deposits which are unlikely to support infiltration of flows to ground. Infiltration testing undertaken on the adjacent Site (former Britishvolt site) in the same geology suggests that all infiltration tests carried out ultimately failed as flows did not drain away (Appendix C).	N
Surface Water Discharge	There are a number of surface watercourses on and around the Site which would be able to receive surface water discharge. It is understood that drainage arrangements for the southern part of the former BV site discharges flows into Sleek Burn, via Cow Gut watercourse. Similarly the adjacent North Sea Link facility discharges surface water runoff directly into Sleek Burn.	Y
Sewer Discharge	There are no surface water sewers in the vicinity of the Site. A combined sewer is present further east of the converter station beneath Brock Lane serving the developments around Harbour View. Discharging surface water into a combined sewer is possible.	Y

4.5 Conceptual Surface Water Drainage Strategy

The proposed drainage strategy will manage surface water runoff as close to the source as possible within the confines of the Onshore Convertor Station Zone for the 1% AEP event, plus a 40% accommodation for climate change throughout the 100-year anticipated lifetime of development, in line with the requirements of NCC.

It is proposed that runoff from the Site will discharge into the tidal Sleek Burn at unrestricted rates. All flows will be routed through two SuDS ponds prior to discharge from the Onshore Convertor Station. The SuDS ponds have been designed to provide 300 mm freeboard during the critical event and satisfy the simple index method with regards to pollution mitigation. A tidal flap will be required on the outfall into the Sleek Burn to prevent tidal water backing up into the sewer during periods of high tide.

Whilst attenuation of flows is not required for discharge into a tidal estuary, the drainage strategy has however provided attenuation for coincidental 1 in 100 year plus 40% climate change event followed by a 4- hour 1 in 100 year plus 40% climate change event. This is in the event that the system is already at capacity (1 in 100 year 40% climate change event) and a 4-hour 1 in 100 year plus 40% climate change event occurs at the peak capacity of the drainage system during a period of tide lock. It is thought that the typical duration over the high tidal cycle is 4-hours. At this point, free discharge can proceed from the Site.

Modelling of the Site drainage is conservative in nature and yet demonstrates there is sufficient space and capacity on the Site to provide an adequate drainage system. The strategy presented here will be subject to detailed design and relevant approvals before construction commences.

4.6 Proposed Catchment Area Schedule

For the purposes of the drainage calculations, the proposed areas contributing to surface water runoff are derived from the Onshore Converter Station Zone within the Site. In reality, the contributing catchment area to the Onshore Convertor Station surface water drainage regime is smaller and the scheme calculations will be refined as part of the detailed design.

This assessment is therefore conservative and seeks to demonstrate there is sufficient SuDS storage available within the confines of the Site.

For the purposes of this report, the Onshore Convertor Station platform is assumed to be 12.4 hectares. A catchment area schedule noting all impermeable areas is produced below as Table 4-3.

Table 4-3: Contributing Catchment Areas

Land Use	Area (ha)
Onshore Convertor station Platform	12.4
Pond 1	0.409
Pond 2	0.25
Total	13.059

4.7 Surcharged Outfall

It is proposed that all runoff from the Site will discharge into Sleek Burn via a new outfall pipe at unrestricted rates. Whilst attenuation and subsequent restriction of runoff is not required into a tidal body, the outfall will potentially become surcharged during periods of high tide, which will subsequently prevent free discharge from the Site. It is envisaged that the outflow into Sleek Burn will discharge adjacent to the existing North Sea Link outfall, which has an invert level of 2.33 m aOD. It is thought that tidal levels in Sleek Burn will be similar to that of the North Sea. Daily high tide in the North Sea at Blyth is around 2.62 m aOD and therefore the proposed new outfall will become surcharged each day across a period of approximately 4-hours (duration of the tidal peak).

The surface water drainage strategy therefore needs to provide attenuation storage for the 4-hour 1 in 100 year plus 40% climate change rainfall event. The required attenuation volume has been derived using FEH22 Depth-Duration-Frequency modelling. The volumetric calculations used to derive the required attenuation are summarised below in Table 4-4. As part of detailed design, this will be refined to represent a surcharged outfall at the extreme tidal flood level and the attenuation requirements will be adjusted to ensure no flooding occurs from the Site drainage strategy for the design event.

Table 4-4: Outfall Surcharge – Stormwater Attenuation Requirements

Parameter	Value
4-hour 100- year rainfall	52.62mm
4-hour 100- year + 40% climate change rainfall	73.67mm
Drained Area	12,400m^2
Attenuation Volume Required	913.5m^3

4.8 SuDS Assessment of Drainage

4.8.1 Attenuation Storage

Temporary storage volumes required within the drainage system have been estimated using the Source Control function in the WinDes software[26], an appropriate methodology for planning and master planning purposes.

The FEH rainfall model was used with a design standard return period of 1% AEP (1 in 100-year return period) plus an allowance for climate change as recommended within climate change guidance detailed in Section 3.4.2 (applied as a 40% uplift in peak rainfall intensity).

The modelling has been undertaken using the cascade function in WinDes. The impermeable area inputted into the modelling is highly conservative uses the limit of deviation area for the Onshore Convertor Station plus the pond surface area.

It is thought that all flows derived from the Site will discharge into Pond 1, which cascades into Pond 2, before outfalling into Sleek Burn via a new piped outfall. Discharge rates into Sleek Burn will be unrestricted as this is a tidal waterbody and therefore increased flow rates will have negligible impact on flood levels.

An attenuation volume of at least 848.3 m^3 is required to attenuate all flows over a 4-hour period in the event of high tide (surcharged outfall).

The following parameters have been incorporated into the modelling:

Pond 1:

- Impermeable Area: 12.809 ha (12.4 ha converter station area; 0.409 ha pond surface area)
- Cover Level: 12.3 m aOD
- Invert Level:10.9 m aOD
- Basal Area: 3190 m^2
- Side Slope: 1:3
- Surface Area: 4086.3 m^2
- Volume: 5080.5 m^3
- Orifice Outflow Control:

[26] Innovyze, Inc. MicroDrainage, Version 2020.1

- Diameter: 0.9 m
- Coefficient of Discharge: 0.6 m
- Invert Level: 10.9 m aOD

Pond 2:

- Impermeable Area: 0.25 ha
- Cover Level: 10.7 m aOD
- Invert Level: 9.5 m aOD
- Basal Area: 2000 m^2
- Side Slope: 1:3
- Surface Area: 2611.4 m^2
- Volume: 2758.7 m^3
- Pipe Outflow Control:
    - Upstream Invert Level: 9.5 m aOD
    - Downstream Invert Level: 2.33 m aOD
    - Diameter: 0.9 m
    - Slope: 1:48.8
    - Length: 350 m

We would note that the ponds would be a permanently wetted basin with a 600 mm depth of water. The modelling has only accounted for the surplus storage above the 600mm and therefore the actual invert levels would be 10.3 m aOD (Pond 1) and 8.9 m aOD (Pond 2).

Full modelled calculations are provided as Appendix E.

4.8.2 SuDS Performance

The SuDS features have been sized to provide conveyance of all surface water runoff from the Site for the 1 in 100 plus 40% climate change storm. Beyond this, the drainage strategy also provides additional attenuation for a 4-hour 1 in 100 plus 40% climate change storm in the event of a surcharged outfall with coincidental 1 in 100 plus 40% climate change storm, followed by a 4-hour 1 in 100 plus 40% climate change storm (i.e., the system is already at capacity). In line with NCC SuDS guidance, a 300 mm freeboard has been provided on both pond features for the design storm.

The surface water drainage model outputs are provided as Appendix E and summarised below in Table 4-5.

Table 4-5: SuDS Performance – Attenuation Volumes

SuDS Feature	Annual Probability (%)	Critical Event	Peak Water Depth (m)	Freeboard Available (mm)	Maximum Discharge Rate (l/s)	Maximum Volume (m^3)
Pond 1	1 + 40% CC	60 min Winter	1.099	399	1236.5	3880.3

SuDS Feature	Annual Probability (%)	Critical Event	Peak Water Depth (m)	Freeboard Available (mm)	Maximum Discharge Rate (l/s)	Maximum Volume (m^3)
Pond 2	1 + 40% CC	120 min Winter	0.867	333	857.3	1919.1

It is envisaged that under a tide lock scenario, the drainage design would need to accommodate for a surplus volume of 913.5 m^3. This is to allow for the eventuality that the drainage system has reached capacity (i.e., 1 in 100 plus 40% climate change storm) and a 4-hour 1 in 100 plus 40% climate change storm occurs during the period of tide lock. We would note that the probability of occurrence is extremely low.

Irrespective of this, the drainage strategy has been designed withhold a total volume of 8739.2 m^3. Under the design event conditions, a maximum attenuation storage volume of 5799.4 m^3 is required. This means, that even a maximum conservative scenario, there is still 1045.6 m^3 of stormwater available within the drainage design, which is sufficient to retain the runoff generated from a 4-hour 1 in 100 plus 40% climate change storm.

4.9 SuDS Assessment of Water Quality

SuDS provide a number of water quality benefits, and the proposed surface water management uses two ponds for filtration of stormwater flows.

The simple index method, as outlined within the SuDS Manual, provides a way of quantifying the benefit to water quality of the SuDS Management Train. The pollution hazard from the land use and the mitigation from the SUDS component are each assigned an index. The total mitigation index must be greater than the pollution hazard index for adequate treatment to be delivered.

Total SuDS mitigation index ≥ pollution hazard index
(for each contaminant type) (for each containment type)

The total SUDS mitigation is the summation of the first components mitigation index and half the mitigation index of any subsequent component.

With reference to the SuDS Manual, post-development surface water runoff generated from the Onshore Convertor Station is considered to have a *'Low' Pollution Hazard Level* as presented in Table 4-6.

Table 4-6: Pollution Hazard Potential of the Onshore Convertor Station

Land Use	Pollution Hazard Level	Pollution Hazard Indices		
		Total Suspended Solids (TSS)	Metals	Hydro-Carbons
Converter Station (Infrequent Traffic Movements)	Low	0.5	0.4	0.4

The proposed drainage system is required to demonstrate sufficient treatment capability to manage the specified Pollution Hazard Indices. It is envisaged that runoff which is shed from the Onshore Convertor Station and associated low traffic roads will be routed through the proposed SuDS ponds.

The SuDS mitigation indices for the Onshore Convertor Station drainage are provided in Table 4-7.

Table 4-7: SuDS Mitigation Indices for the Proposed Development

SuDS Component	Mitigation Indices		
	Total Suspended Solids (TSS)	*Metals*	*Hydro-Carbons*
Pond	0.7	0.7	0.5

Table 4-8 compares the SuDS Mitigation Indices, provided by the proposed 'Source Control', 'Conveyance' and 'Site Control' measures against the Pollution Hazard Indices.

Table 4-8: SuDS Performance – Water Quality Indices

Land Use	Pollution Hazard Level	*Pollution Hazard and SuDS Mitigation Indices Comparison*					
		Total Suspended Solids (TSS)		Metals		Hydro-Carbons	
		Pollution Index	SuDS Mitigation Index	Pollution Index	SuDS Mitigation Index	Pollution Index	SuDS Mitigation Index
Converter Station (Infrequent Traffic Movements)	Low	0.5	0.7	0.4	0.7	0.4	0.5

As the SuDS Mitigation Index provided by the proposed SuDS measures are ≥ Pollution Hazard Index the water quality assessment criteria are satisfied for the Site.

4.10 SuDS Operation and Maintenance

A full SuDS maintenance plan would be produced as part of the detailed drainage design post-development and the precise requirement would depend on manufacture specification of the final design. The maintenance of the drainage network would be the responsibility of the Site owners and/or operators. This could be secured as an appropriately worded planning condition.

An outline of the typical maintenance requirements for the proposed SuDS features is provided below.

4.10.1 Pond

The typical maintenance requirements of ponds associated with the surface water drainage strategy are reproduced below as Table 4-9.

Table 4-9: Typical Pond Maintenance Requirements

Maintenance Schedule	Required Action	Minimum Frequency
Regular Maintenance	Remove litter and debris.	Monthly, or as required
	Cut the grass – public areas.	Monthly (during growing season).
	Cut the meadow grass.	Half yearly (spring, before nesting season, and autumn).
	Inspect marginal and bankside vegetation and remove nuisance plants (for first three years).	Monthly (at start, then as required).

Maintenance Schedule	Required Action	Minimum Frequency
	Inspect inlets, outlets, banksides, structures, pipework etc for evidence of blockage and/or physical damage.	Monthly.
	Inspect water body for signs of poor water quality.	Monthly (May – October).
	Inspect silt accumulation rates in any forebay and in main body of the pond and establish appropriate silt removal frequencies; undertake contamination testing once some build up has occurred, to inform management and disposal options.	Half yearly.
	Check any mechanical devices, e.g. penstocks	Half yearly.
	Hand cut submerged and emergent aquatic plants (at minimum of 0.1m above pond base; include max 25% of pond surface).	Annually.
	Remove 25% of bank vegetation from water's edge to minimum of 1m above water level.	Annually.
	Tidy all dead growth (scrub clearance) before start of growing season (Note: tree maintenance is usually part of overall landscape management contract).	Annually.
	Remove sediment from any forebay.	Every 1-5 years, or as required.
	Remove sediment and planting from one quadrant of the main body of the pond without sediment forebays.	Every 5 years, or as required.
Occasional Maintenance	Remove sediment from the main body of big ponds when pool volume is reduced by 20%.	With effective pre-treatment, this will only be required rarely, e.g., every 25-50 years.
Remedial Actions	Repair erosion or other damage.	As required.
	Replant, where necessary.	As required.
	Aerate pond when signs of eutrophication are detected.	As required.
	Realign rip-rap or repair other damage.	As required.
	Repair / rehabilitate inlets, outlets and overflows.	As required.

4.11 Exceedance

In the low probability event of exceedance from the Site drainage strategy, flows would overtop both ponds and progress in a south easterly direction overtopping Brock Lane to the south before continuing overland to discharge into Sleek Burn. These exceedance flows would mimic the existing greenfield regime.

5.0 Foul Water Drainage Strategy

This foul water drainage strategy sets an outline scheme for managing foul flows from the Onshore Convertor Station.

It should be noted this strategy is based on an indicative design for the Onshore Scheme. For the purposes of the EIA assessment, a worst case scenario for wastewater management has been considered, which connects the site to the main sewage network. It is recognised that the final solution will be subject to further design and may include on-site treatment (such as a septic tank for example). There are some design details related to the Onshore Scheme that are still to be finalised due to further ground investigations required, ongoing engineering design work and the procurement of cable and converter station suppliers. These details will inform the final specification. The Site boundary has been chosen to allow flexibility to accommodate these design details which will be subject to future application(s) for approval of Reserved Matters.

The Onshore Convertor Station Zone is currently greenfield land and therefore at present there are no foul flows generated from the Site.

5.1 Discharge Volumes

The foul drainage assessment is for an Onshore Convertor Station in Cambois which will connect into the proposed BBWF. It is proposed that personnel will be required on the Site and welfare facilities (kitchens, restrooms, showers etc.) will be provided within the facility itself. It is proposed that the maximum number of people on the operational site at any one time is 5.

Using the British Water Code of Practice: Flows and Loads 4[27], and based on the size of the facility, staff numbers and its context, the projected usage and therefore typically daily foul flows have been derived and are summarised in Table 5-1 below.

As part of this assessment, it is assumed that there are a maximum of 5 full time staff on the Site 24/7. Based on this, and using Flows and Loads 4, typical daily flows derived from the Site are 0.45 m^3/day, which equates to an average of 0.005 l/s.

Table 5-1: Daily Foul Flows

Source	No. of uses per day	Flow per use (litres)	Total estimated flow per source (litres)
Full Time Staff	5	90	450
Total estimated daily flow			450

Peak discharge rates from the Site must also be established to accommodate for scenarios where water use may be at its greatest (multiple occupants using the washroom facilities or kitchen, etc). A peaking factor of 6 has therefore been applied to provide a conservative estimate of maximum flows per second. Using the average daily discharge rate of 0.005 l/s, the conservative maximum peak flow from the Onshore Convertor Station is at around 0.03 l/s.

5.2 Proposed Foul Drainage Scheme

It is proposed that foul flows from the Site discharge into the existing combined sewer beneath Brock Lane into manhole 6403. We would note that the final point of connection will need to be confirmed following a survey of this sewer. There is a private sewer which connects into

27 Flows and Loads -4, Sizing Criteria, Treatment Capacity for Sewage Treatment Systems, British Waterways, 2009.

the foul system beneath Brock Lane to the south of the Site. However, at this stage, it is assumed that permission would not be granted, and the size of the sewer may not be sufficient to accept site flows.

There is also a short reach of surface water sewer which discharges into the combined sewer. This receives foul flow from the private network and is therefore more likely a combined sewer itself. Connection could be made into this sewer however this would be at the discretion of Northumbrian Water.

A pre-development enquiry has been submitted to Northumbrian Water have confirmed capacity is available in the sewer network to receive these surplus flows. This is provided as Appendix D. An S106 sewer connection application will need to be submitted prior to connecting into the network.

6.0 Conclusions

This report therefore sets out high level principles for managing surface water runoff from the Onshore Convertor Station.

Analysis of potential discharge receptors indicates that discharge to surface water is the most preferable option at the Onshore Convertor Station. Infiltration to ground is not considered possible due to poor permeability geology and there are no surface water sewers, only combined sewers, present within the vicinity of the Onshore Convertor Station Zone.

It is therefore proposed that a new outfall into Sleek Burn is made to discharge all runoff from the Onshore Convertor Station Zone. It is envisaged that this outfall will run adjacent to the existing North Sea Link substation outfall and will be fitted with a tide flap to prevent flows backing up during periods of high tide. As surface water runoff from the Onshore Convertor Station is effectively flowing into a tidal waterbody, runoff does not require attenuation and free discharge into the estuary is possible whilst having negligible impact on flood risk. SuDS features are therefore only required to manage water quality of the runoff derived from the Site.

A surface water drainage scheme has been developed which uses two ponds with flows routed through the first pond, into the second before discharging into Sleek Burn. The ponds have been sized to provide 300 mm freeboard during the critical 1% AEP plus 40% climate change event in line with the requirements of NCC. It is assumed that the outfall will discharge into Sleek Burn at an equivalent level as the existing North Sea Link level (2.33 m aOD). During periods of high tide, the outfall will then become surcharged meaning that free discharge from the Onshore Convertor Station would not be possible. The typical duration of a peak tidal cycle is approximately 4-hours and therefore sufficient storage is provided above the peak modelled water level for a 4-hour 1 in 100 plus 40% climate change event. This is conservative, and the likelihood of consecutive extreme rainfall events is very low.

A foul water drainage strategy has also been developed for the Onshore Convertor Station assuming a maximum number of 5 full time staff members present at any one time. Based on this information, it is assumed that the average rate of foul flow discharging from the Onshore Convertor Station is 0.005 l/s. Using a peaking factor of 6, the estimated maximum peak rate of foul flow is set at 0.03 l/s. It is proposed that foul flows from the Onshore Convertor Station will connect into the existing Northumbrian Water foul sewer present beneath Brock Lane to the south of the Site.

The strategy presented here will be subject to detailed design and relevant approvals before construction commences.

Appendix A Stantec, Berwick Offshore Wind Connection, Flood Risk Scoping Report

TECHNICAL NOTE

ob Name:	Berwick Offshore Wind Connection
ob No:	331201346
Note No:	001(Final)
Date:	March 2023
Prepared By:	Hugh Leekam **Reviewed By:** Doug Barker
Approved By:	Doug Barker
Sub ect:	**Flood Risk Scoping Report**

1. Introduction

1.1. This flood risk scoping report has been prepared by Stantec UK Ltd ('Stantec') to provide an overview of flood risk constraints and opportunities for SSE's (client) proposed Berwick Bank Onshore Converter Station, hereafter referred to as the 'site'. The site forms part of SSE's wider proposed development for an offshore windfarm and associated onshore development which includes the converter station and cable route corridor. This area is hereafter referred to as the 'study area'.

1.2. This study does not constitute a Flood Risk Assessment or Drainage Strategy suitable to support any planning application.

2. Site Description

2.1. The proposed development is located to the north of the River Blyth and to west of the North Sea coast, between the Port of Blyth and Cambois. The site is located to the south of the River Wansbeck and to the east of the A189 (M) Trunk Road. The site centre grid reference is NZ 29199, 83720 and nearest postcode is NE22 7FG. The site is located within the Northumberland County Council administrative area.

2.2. **Figure 1** shows the location of the site, it also outlines the wider study area as detailed below:

- **Site** – boundary area considered for the temporary and permanent works associated with the proposed convertor station.
- **Study Area** – flood risk data has been gathered for the wider study area to support the flood risk assessment for the proposed cable route corridor. This flood risk associated with the wider study area has been considered in detail by SLR consulting.

Figure 1 Site and study area

2.3. The site is shown to consist predominantly of open vegetated and agricultural land. The sites southern boundary runs adjacent to Brock Lane, the western boundary borders the A189 motorway, along the site's northern boundary is the off-road racetrack. To the east, brownfield land, greenfield land, and residential properties. The proposed Convertor Station site area covers an approximate total area of 23.9 ha.

3. Neighbouring Developments

3.1. The site is located south west of the former power station managed by British Volt. British Volt submitted a planning application in 2021 (Ref: 21/00818/FULES) the erection of a Battery Manufacturing Plant (i.e., Gigaplant) together with associated development". A review of the British Volt flood risk related planning application documents has been undertaken to inform the baseline assessment of the proposed development.

3.2. The site is located immediately west of the existing Converter Station for the UK-Norway Electricity Connector (NSN Link). A geoenvironmental assessment has been undertaken for this site, referred to as NGPH & NGIL Norway-UK HVDC Interconnector (NSN Link) Land Parcel 2 (Converter Station – Environmental Assessment, Interpretative Site Investigation Report (Worley Parsons, 2014). A review of the geoenvironmental report has been undertaken to inform the baseline assessment of the proposed development.

4. Stakeholder Engagement

4.1. Stakeholder engagement has been undertaken with Northumberland County Council as the Lead Local Flood Authority (LLFA), the Environment Agency (EA) and Northumbrian Water Group (NWG). **Northeast Newcastle** is the regional EA authority managing the Cambois area. The stakeholder engagement has been summarised in **Table 1.**

4.2. The data received from the stakeholders has been used to inform the baseline assessment.

Table 1 Stakeholder Engagement Log

Stakeholder	Date Received	Information
LLFA	Email on 16/11/2022	The LLFA provided the following items: • Available flood risk data • Detail on existing watercourses within the vicinity • Existing drainage network records • Outlined surface water drainage requirements The LLFA also issued their Local Flood Risk Management Strategy and Sustainable Drainage Local Standard guidance which has been further reviewed.
	Email on 14/12/2022	• The LLFA provided maps of existing local highway drainage network and culverts
EA	Email on 17/11/2022	• EA provided Product 4 data set for the site area – includes the Blyth Tidal Flood Nodes locations and table information, Flood Map for Planning and Surface Water Flood Mapping. • The EA suggests contacting NWG, regarding information on flood risk from sewers.
	Email on 28/11/2022	• EA provided Product 4 data for the wider study area
	Email on 19/12/2022	• EA confirmed via email that there are no detailed flood models covering this area. The information provided is based on national coastal dataset.
Northumberland Water Group	Email on 12/01/2023	NWG confirmed that there was no known flooding on site and provided sewer records.

5. Existing Site Characteristics

Hydrology

Coastal Areas

5.1. OS mapping shows that the North Sea Tyne and Wear coastline waters are located just beyond the eastern boundary of the wider site. The coastline waters are located approximately 1.6km from the eastern boundary of the site.

5.2. Blyth Harbour & Port is located just beyond the southern boundary of the site, the River Blyth Estuary feeds into the harbour and port, before discharging into the North Sea, as shown in **Figure 2** (and also in **Appendix A**).

Main Rivers

5.3. The Environment Agency Open-Source data has been used to identify the Environment Agency (EA) designated Main Rivers in proximity to the site, as shown in **Figure 2** and detailed below:

- **Sleek Burn**: flows in a south easterly direction and is referred to as the River Blyth to the east of the A189.

- **River Blyth**: The river is located approximately 0.2km south of the site and flows in a south easterly direction into the North Sea.

- **River Wansbeck**: The river is located approximately 1.3km north of the site's northern boundary and flows in an eastern direction and flows into the North Sea.

Ordinary Watercourses

5.4. The ordinary (minor) watercourses within the wider study area have been identified using OS mapping, Topographical Survey undertaken by Douglas Land Surveys in November 2022 (see **Appendix B**) and the following British Volt's planning application documents: Water Framework Directive (WFD) Screening Report (Rolton Group Ltd, 2021), Watercourse Diversion Drawing (Drawing no: PH -RGL-ZZ-ST-DR-D-010023) and Proposed Outline Surface Water Drainage Strategy (Drawing no: PH -RGL-ZZ-ST-DR-D-100001) see **Appendix C**.

5.5. A review of the topographic survey shows that there is a ditch within the site area that flows west to east. The survey shows that the watercourse ends immediately north of the NSL (North Sea Link) Converter Station on site. It is unclear if the watercourse is connected into a wider network and is advised that further site investigation is undertaken. The survey also identifies a small ditch within the wooded area in close proximity to the southern boundary.

5.6. The OS mapping shows that there are a number of ordinary watercourses (including small ditches) within the wider study area, see **Figure 2**, with particular reference made to Maw Burn and Cow Gut. Watercourse mapping contained within British Volt's WFD Screening Report shows that both watercourses prior to the proposed scheme development were predominantly culverted (see **Appendix C**).

5.7. It is understood that the watercourses have been de-culverted and restored as detailed in the Drainage Strategy drawing (see **Figure 3**) and Watercourse Diversion drawing (PH -RGL-ZZ-ST-DR-D-010023) contained in **Appendix C**. The topographic survey in **Appendix B**, captures part of the restored sections of the Cow Gut watercourse. Based on the available data, the flowpaths are identified to be as follows:

- The **Maw Burn** is shown to enter the study area boundary, via the north-west corner. The watercourse predominantly flows along an open channel to the north of the British Volt's development. The watercourse is shown to flow into an existing drainage ditch network around two large 'pulverised fuel ash (PFA) and furnace bottom ash (FBA) mounds[1] (see **Figure 3**). **Figure 3** indicates that these drainage ditches outfall into the Cow Gut watercourse which discharges into an offsite culvert and tidal estuary. Further information is required to confirm connection into the Cow Gut watercourse.

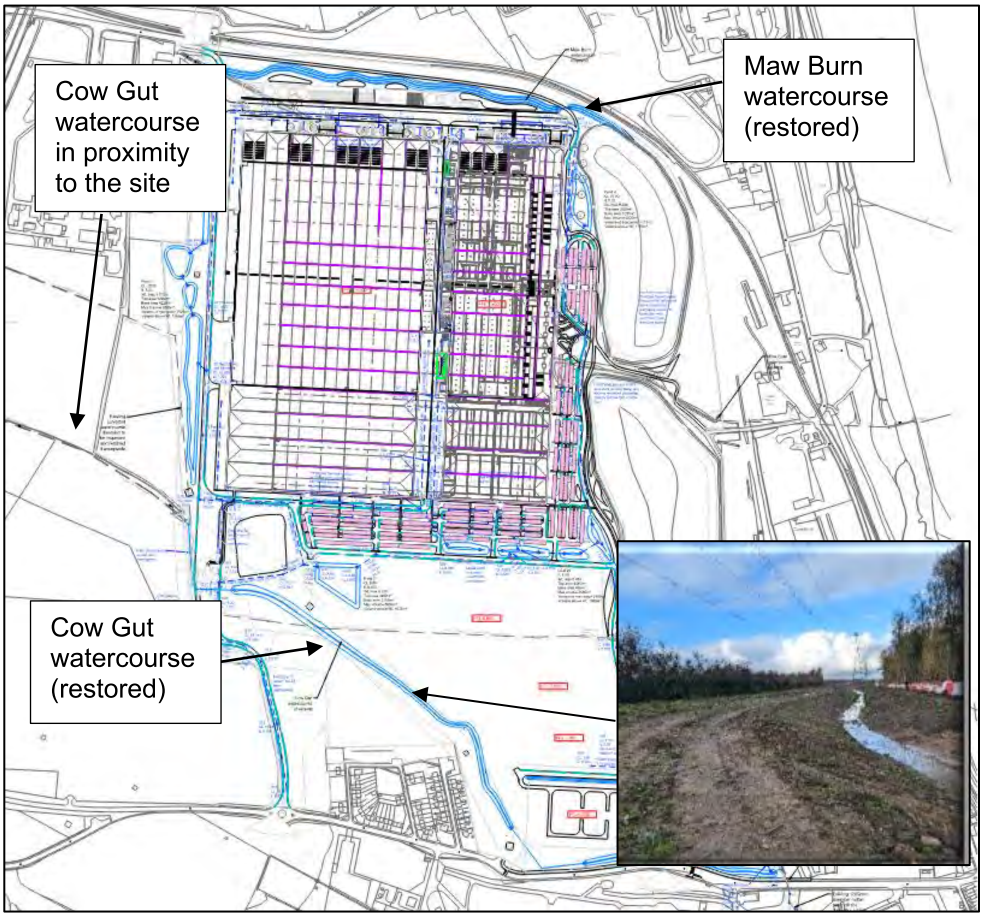
- The **Cow Gut** flows to the north of the site flowing south-east towards the tidal estuary. The watercourse has been partially restored within the British Volt's development area, see **Figure 3**. The Cow Gut watercourse discharges into an offsite culvert and tidal estuary in the south-east corner of the study area.

5.8. Further investigation is required to understand the location of the Cow Gut in proximity to the site and is recommended that additional topographic survey is undertaken. In addition, it is recommended that further information is sought from British Volt on the undertaken river restoration works (i.e. hydraulic modelling outputs, final construction drawings).

[1] These mounds are classified within British Volt' WFD Screening Report as consisting of unbound PFA and FBA. This 'ash' material was likely, discarded industrial material from the adjacent demolished industrial buildings.

Figure 2 Watercourse Mapping (EA Mapping)

Figure 3 British Volt Outline Drainage Strategy (Extract: Rolton Group Ltd) 2021 . Photo credit, Land Surveys (2022)



5.9. The LLFA have no records of existing infrastructure located on the identified watercourses. However, they noted that there is a recorded culvert structure beneath Brock Lane, see **Figure 4**. The LLFA are unclear if this is associated with an ordinary watercourse and request that further investigation is undertaken. A review of the topographic survey shows that there are no watercourses in this location.

Figure 4 Culvert underneath Brock Lane

Other Surface Waterbodies

5.10. A small man-made pond is located adjacent to the hardstanding concrete surfaces in the central area of the study area. The pond is located approximately 210m east of the eastern site boundary.

Topography

5.11. The EA LIDAR data survey as shown in **Figure 5,** and **Appendix A** shows there to be a slight fall from west to east, with levels ranging from 16 to 8m AOD.

5.12. The topographical survey (2022) included in **Appendix B,** provides a more accurate ground level recording (0.5m contours)[2]. The highest levels recorded are typically along the southern boundary with levels ranging from 13.5m AOD in the south-western boundary to 10.5m AOD in the south-eastern boundary. The lowest levels are recorded along the northern boundary where site levels fall to 9.50m AOD in the north-eastern boundary. The far north-western survey recording was taken at top of bank with level recorded to be 14.50m AOD.

[2] It should be noted that the topographic area survey has not surveyed areas between the existing demolished areas and the A189.

Figure 5 EA LIDAR Mapping

Geology

5.13. The British Geological Survey (BGS) Geological Viewer mapping indicates that the underlaying bedrock geology at the site and study area consists of Pennine Middle Coal Measures Formation - Mudstone, siltstone and sandstone and Pennine Middle Coal Measures Formation – Sandstone. There are no superficial deposits recorded within the site.

5.14. The SFRA states that the site area is located on land identified to have a 'High Vulnerability' groundwater vulnerability classification. This information was sourced from the EA's Groundwater Vulnerability (GWV) maps. The EA Source Protection Zone (SPZ) maps indicate that the site is not located with a Source Protection Zone, see **Appendix A**.

5.15. EA has provided information that the area is within the C2 category for North East Mining & Groundwater Constraints. This area is part of the coalfield area with shallow minewater. This may increase the groundwater flood risk across the site and may need to be considered within the proposed drainage and infiltration SuDS design. Further information is found online - https://www.gov.uk/guidance/mining-and-groundwater-constraints-for-development. This has been discussed further in **Section 8**.

5.16. NSN's geo environmental assessment report (2014) details that shallow perched groundwater was recorded at approximately 9m AOD in the north-east area of the site. The elevation of perched groundwater was noted to be consistent across the site and it is considered that shallow perched groundwater within the Glacial Till is broadly in hydraulic continuity locally across the site. Further ground investigation is advised to understand seasonal fluctuations of groundwater on site.

Existing Drainage Arrangements

5.17. The site consists primarily of open fields and woodland areas, such that surface water would either drain via natural infiltration into the ground or would drain to the ordinary watercourses within the vicinity via subsurface flow or overland flow. The LLFA further detailed that the watercourses to the north of the site which forms part of the Cow Gut watercourse provides existing drainage to the site.

5.18. The LLFA provided a map outlining the gully locations along the A189 and Brock Lane, see **Figure 6**. No further information was provided in regard to the existing highway drainage arrangements and in particular where the drainage outfalls are located.

Figure 6 Highway drainage system and gully's locations within Brock Lane

Existing Flood Defences

5.1. The EA online Flood Map for Planning does not show any flood defence structures located within the vicinity of the site or study area.

5.2. The Level 2 SFRA states that *"information provided by the Environment Agency and obtained from AIMS does not identify any fluvial defences in the immediate Blyth area. The National Flood and Coastal Defence Database (NFCDD) however indicate a number of private and EA maintained raised defences (man-made) located along the south bank of the River Blyth Estuary."*

5.3. The Level 1 SFRA has also states that the existing topography adjacent to the Blyth Estuary, is high ground which provides protection from fluvial/tidal flooding.

6. Local Policy Requirements

Northumberland Local Plan 2016 to 2036

6.1. Local planning policy is contained within the **Northumberland Local Plan 2016 to 2036 (March 2022)**, with particular reference to Policy WAT 1 - 'Water Quality', Policy WAT 3 - 'Flooding' and Policy WAT 4 – 'Sustainable Drainage Systems', which states:

Policy WAT 1 - Water Quality

This policy seeks to ensure that the development improves the quality of the water environment and surface water bodies. In particular, it recommends that new developments should seek to achieve a 'good status' in line the Water Framework Directive's 'River Basin Management Plans' and policies regarding the Protection of Water Bodies.

Policy WAT 3 - Flooding

1. Development proposal should take into account the *"policy approach* contained with local strategies and guidance documents

2. *"Development proposals will be required to demonstrate how they will minimise flood risk to people, property and infrastructure from all potential sources…Avoiding inappropriate development in areas at risk of flooding and directing the development away from areas at highest risk."*

2d. Details the requirements for the management of surface runoff. It outlines that the drainage hierarchy should be followed and that runoff rates should not exceed existing. As a minimum a 50% betterment should be achieved for previously development sites

4. "Any works relating to the above, which impact on natural water systems, should consider the wider ecological implications, applying the ecosystem approach, and link into green infrastructure

Policy WAT 4 - Sustainable Drainage Systems

''1. Water sensitive urban design, including Sustainable Drainage Systems (SuDS) will be incorporated into developments whenever necessary, in order to separate, minimise and control surface water run-off, in accordance with national standards and any future local guidance.

2. SuDS will be a requirement for any development where it is necessary to manage surface water drainage unless it can be clearly demonstrated:

a. That SuDS are not technically, operationally or financially deliverable or viable and that any surface water drainage issues resulting from the development can be alternatively mitigated; or

b. That the SuDS scheme will itself adversely affect the environment or safety, including where ponds could increase the risk of bird strike close to the airport or where existing minewater problems could be exacerbated.

3. SuDS or other water sensitive urban design schemes should be devised to take account of predicted future conditions and, where appropriate, efforts should be made to link them into wider initiatives to enhance the green infrastructure, improve water quality, benefit wildlife and/or contribute to the provision of an ecosystem service.

4. Arrangements must be put in place for the management and maintenance of SuDS over the lifetime of the development, with such arrangements taking account of the cumulative effectiveness of SuDs in the area concerned.''

NCC Level 1 Strategic Flood Risk Assessment

6.2. **NCC Level 1 Strategic Flood Risk Assessment (SFRA)** was published in September 2010, and forms part of the Local Plan evidence base, to inform future spatial planning and to assist in developing planning policies to address flood risk. Moreover, the document provides an overall understanding of the flood risk within the study area taking into account all potential sources.

6.3. The Level 1 SFRA report is a presentation of flood sources and risk, which is based on data collected following consultation with and input from the LPA and relevant stakeholders.

6.4. The SFRA shows the site and wider study area is located within a Northumbria '**Potential Development Area** . Following completion of the Level 1 SFRA, Northumberland County Council has identified a limited number of locations to be further evaluated in the Level 2 SFRA. These locations are named as **Potential Development Areas (PDAs)** and have been identified as particular locations at flood risk in the Level 1 SFRA.

NCC Level 2 Strategic Flood Risk Assessment

6.5. **NCC Level 2 SFRA** was published in October 2015 and forms part of the Local Plan evidence base similar to Level 1 SFRA. The Level 2 SFRA primarily focuses on fluvial and coastal flood zones. The main purpose of the Level 2 SFRA is to increase the scope undertaken for provide a more detailed assessment of sites than present in the Level 1 SFRA and provide sufficient information for the application of the Exception Test. The Level 2 SFRA will be based on information collected in the Level 1 SFRA and additional works where necessary.

6.6. The SFRA shows that the site and wider study area is located within the Blyth '**Estuary Strategic Employment Area .** The Blyth Estuary Strategic Employment Area is classified within the SFRA, as a Potential Development Area (PDA). This area is proposed to deliver employment opportunities in green industries, comprising of both brownfield and greenfield land. The land along the north bank of the River Blyth Estuary predominately comprises the demolished Blyth Power Station, whilst the land along the south bank comprises of various industrial properties.

7. Sequential Test

7.1. The National Planning Policy Framework follows a sequential risk-based approach in determining the suitability of land for development in flood risk areas, with the intention of steering all new development to the lowest flood risk areas.

7.2. The assessment undertaken by the council in preparing their local plan, which includes the allocation of the subject site as part of a wider Blyth Estuary Strategic Employment Area, has been captured in the Level 2 SFRA.

7.3. In summary, the Council has undertaken an extensive assessment of the employment opportunities in the borough in order to demonstrate that the wider site is a sequentially preferable location suitable for development when considering employment development. The proposed development focuses on the infrastructure development which forms part of wider employment site area. Therefore, it is considered that the Sequential Test has been passed.

8. Impact of Climate Change

8.1. The NPPF and PPG place emphasis on the need to fully consider – and design for – the impacts of climate change as set out in the planning guidance. This guidance provides contingency allowances for potential increases due to climate change in:

- Peak river flow;
- Rainfall intensity;
- Sea level rise.

8.2. These elements are discussed in turn below.

Peak River Flow

8.3. The peak river flow allowances provide a range of allowances based on percentile (i.e. the degree of certainty of an event occurring, based on the range of climate change scenarios assessed through scientific investigations). The applicable values for a site are dependent on the 'River Management Catchment' in which the site is located, which can be confirmed via the online mapping tool embedded within the guidance.

8.4. The peak river flow allowances provide a range of scenarios based on percentile (i.e., the degree of certainty of an event occurring, based on the range of climate change scenarios assessed through scientific investigations). The provided allowances are subject to the sub-catchments of river basin district (known as management catchments) and the vulnerability classification of the proposed use of the site.

8.5. The applicable allowances are subject to the Flood Zone classification of a site, and the vulnerability classification of the proposed use. The Central allowance is identified as the design standard for most forms of proposed development in all appropriate Flood Zones (the exception being 'Essential Infrastructure' which requires the 'Higher Central' value).

8.6. The Climate Change Peak River Flow Allowances to be considered for new developments, in the River Blyth Estuary Northumberland Rivers Management Catchment, are included in **Table 6-1.**

Table 6-1: Climate Change - Peak River Flow Allowances

River Management Catchment	**Flood one**	**Flood Risk Vulnerability Classification**	**Applicable Climate Change Allowance** *(2080s Epoch – 2070-2115)*	
			Central	Higher Central
(Northumberland Rivers Management Catchment)	*Flood Zone 1*	*Essential Infrastructure*	**35%**	**44%**

Peak Rainfall

8.7. The potential increase in peak rainfall intensity needs to be considered in the surface water drainage strategy for new developments.

8.8. The EA climate change allowances guidance was updated in May 2022 to include a GIS based 'peak rainfall allowances' map showing the anticipated changes in rainfall intensity based on river management catchment. The anticipated changes in peak rainfall intensity in small catchments (less than 5km2), or urbanised drainage catchments are summarised in **Table 2**.

Table 2 Climate Change - Peak Rainfall Intensity Allowances (2070s Epoch)

(Northumberland Rivers Management Catchment)	**Total potential change anticipated (2070s epoch – i.e. 2061 to 2125)**	
	Central	**Upper End**
3.3% (1 in 30-year) rainfall	**30%**	**40%**

1% (1 in 100-year) rainfall	**30%**	**45%**

8.9. The guidance specifies that for developments with a lifetime of between 2061 to 2125 (i.e., assuming a 100-year design life) the 2070s epoch is to be applied for design purposes. Therefore a +45% climate change allowance should be assessed within the surface water drainage strategy. This allowance has also been confirmed by the LLFA.

Sea Level Rise

8.10. The climate change guidance sets out per annum impact of climate change on sea level rise in 'Table 2' of the guidance, based on the river basin district of the subject site. Data is provided for both the 'Higher Central' and 'Upper End' scenarios.

8.11. The site lies within the Northumberland Rivers Management Catchment; therefore, the Northumbria sea-level rise allowance is considered for the present study (see **Table 3**).

Table 3 Climate Change – Sea Level Rise in the Northumbria Area

Timescale	**Epoch in mm for each year (based on a 1981 to 2000 baseline)**	
	Higher Central	**Upper End**
2000 to 2035	*4.6 (161)*	*5.8 (203)*
2036 to 2065	*7.5 (225)*	*10 (300)*
2066 to 2095	*10.1 (303)*	*14.3 (429)*
2096 to 2125	***11.2 (336)***	***16.5 (495)***
Cumulative rise 2000 to 2125 (metres)	***1.03 m***	***1.43 m***

8.12. Considering a design life of 100 years the cumulative rise is 1.03 m and 1.43 m for the Higher Central and Upper End allowance, respectively. The impact of sea level rise (tidal flooding) to the site has been detailed in **Section 9**.

9. Flood Risk Overview

EA Flood Map for Planning

9.1. The Environment Agency (EA) Flood Map for Planning (see **Figure 7**) shows that the site and the majority of the study area is located within Flood Zone 1: 'Low Probability' of flooding from river or sea. There are areas of Flood Zone 3: 'High Probability' risk of flooding associated with the River Wransbeck and River Blyth/Sleek Burn limited to the outer extents of the study areas. The area south-east of the PFB mounds is designated as Flood Zone 2: 'Medium Probability' of flooding from rivers or sea.

9.2. There are no formal flood defences shown on the EA Flood Map for Planning and therefore it is assumed that the risk of flooding is controlled by the surrounding ground levels from the natural ground levels formed by the Port of Blyth.

Figure 7 EA Flood Zones Map

9.3. The EA Flood Map for Planning does not differentiate the flood risk associated with tidal or fluvial flood sources. A review of the EA's Product 4 data details that the areas of Flood Zone 2 and 3 are associated with tidal flooding. However, as the data is limited as part of the next stage of works, the project team will look to confirm this with the EA.

Tidal

9.4. The EA confirmed via email that there were no hydraulic models available for the identified watercourses in proximity to the site/study area. The available data is high level and limited. The assessment of tidal flood risk has therefore been based on the best available information at the time of writing this report. It is advised that further discussions are undertaken with the EA to better understand tidal flood risk to the site.

9.5. The EA provided flood levels for the River Blyth based on tidal modelling. The node locations and their relationship to the site is presented in **Figure 8**, and the identified flood levels are detailed in **Table 4**. It is unclear if the data represents the tidal flood risk associated with the Wransbeck River. Therefore, additional flood modelling data to the north of the site near to Newbiggin-by-the-Sea has been reviewed, this is approximately 2km away from the site. The node location in close proximity to the site is Node no. 3610 and the identified flood levels are detailed in **Table 4**

Figure 8 EA Data Node Point Location Plan Blyth

9.6. The EA has assessed a range of return periods. For the purpose of this assessment the 1 in 100 (1%) annual probability (AP) and 1 in 200 (0.5%) AP has been considered. Climate change scenarios have not been run and therefore to assess the impacts of climate change – the 'upper end' cumulative rise value of 1.43m has been assessed (see **Table 3**).

Table 4 Modelled Tidal Flood Node Levels, Tyne and Wear Coastal Waters 2022 m AOD

	Return Periods / Flood Levels			
Node Numbers	**1 in 100 AP**	**1 in 200 AP**	**1 in 100 AP CC**	**1 in 200 AP CC**
3612 (Figure 8)	3.79m AOD	3.9m AOD	5.22m AOD	5.33m AOD
3614 (Figure 8)	3.79m AOD	3.9m AOD	5.22m AOD	5.33m AOD
3610 (Figure 8)	3.79m AOD	3.9m AOD	5.22m AOD	5.33m AOD

9.7. The maximum flood level in the 1 in 200 AP plus climate change allowance is 5.33m AOD. This level does not take into account of the proposed flood level on site which would be influenced by elevated levels at the coast or from wave overtopping. However, based on the minimum site elevation of 9.5m AOD, and it being raised significantly from the maximum tidal flood level it can be assumed that the site is not at risk of tidal flooding when considering impacts of climate change.

9.8. As detailed above, it is however advised that further discussions are undertaken to determine suitability of this data to assess tidal flood risk to the site as part of a Flood Risk Assessment. In addition, to understand timescales to introduce any defence lines along the coastal areas to protect from tidal flooding in the future and determine if any mitigation is required for the proposed development.

Surface Water

9.9. The EA Risk of Flooding from Surface Water mapping indicates that the site is generally at 'Very Low' risk of surface water flooding, see Figure 9 and **Appendix A**. There are however minor areas of 'High' to 'Low' surface water flood risk associated with the identified ordinary watercourses and topographic low points within the study area.

Figure 9 EA Surface Water Mapping

9.10. In the Low-risk scenario, surface water flooding is shown to occur in the north and centre of the site, as well as along the site's eastern boundary. The surface water appears to pool across the site and flood depths are shown to range between less than 150mm to 900mm.

9.11. The SFRA states that significant areas including access roads in the demolished Blyth Power Station site may be at medium to high risk from surface water flooding, with flood depths shown to reach up to 900mm (Figure 4-9 updated Flood Maps for Surface Water – Depth (Blyth Estuary Strategic Employment Area). The LLFA did not provide any further information.

9.12. The LLFA has confirmed that Northumberland does not have any CDA's (Critical Drainage Areas).

9.13. The site is therefore predominantly at a low risk of surface water flooding, with some localised areas of ponding that should be considered within the scheme design.

Groundwater

9.14. The Northumberland Strategic Flood Risk Assessment identified the site area (Blyth Estuary Strategic Employment Area) to be located on land identified to have a 'Low to medium groundwater flood risk (= 50%   75%)'. The SFRA sourced this information from the British Geological Survey (BGS) Areas Susceptible to Groundwater Flooding maps.

9.15. A review of several BGS borehole records located within the site area, up to 20m deep, did not provide a clear indication of groundwater levels at the site. However, as detailed in **Section 5.16** a geoenvironmental assessment undertaken in 2004 identifies that groundwater was struck in proximity to the site at approximately 9m AOD, this is approximately a minimum of 0.5m below ground level.

9.16. The risk of flooding from groundwater is therefore considered at the present stage to be of medium risk. It is recommended that further ground investigation is undertaken to determine groundwater levels. The EA has identified that this site falls within a 'Mining and Groundwater Constraints' area, and where seasonal changes (i.e., increased rainfall) could lead to groundwater flooding.

Reservoir

9.17. The EA 'Risk of flooding from Reservoirs' map shows the risk of flooding in the event of a breach from reservoirs in dry day scenarios and wet day scenarios when there is also flooding from rivers. The mapping indicates that the site is not shown to be located within a reservoir breach flood extent, see **Appendix A**.

Other Flood Sources

9.18. The SFRA indicates that the site and Blyth area, is located in an area classified as having a 'Medium Incidence' level for reported incidents of sewer flooding. The LLFA and Northumbrian Water Group however confirmed there to be no known flooding on site. As such it can concluded that the risk of flooding to the site from sewer flooding is low.

9.19. The SFRA states that there are no canals, reservoirs or other artificial water sources that may provide a flood risk in the vicinity of Blyth– as such there is not considered to be a significant risk to any of the proposed Potential Development Areas.

10. Mitigation Requirements and Next Steps

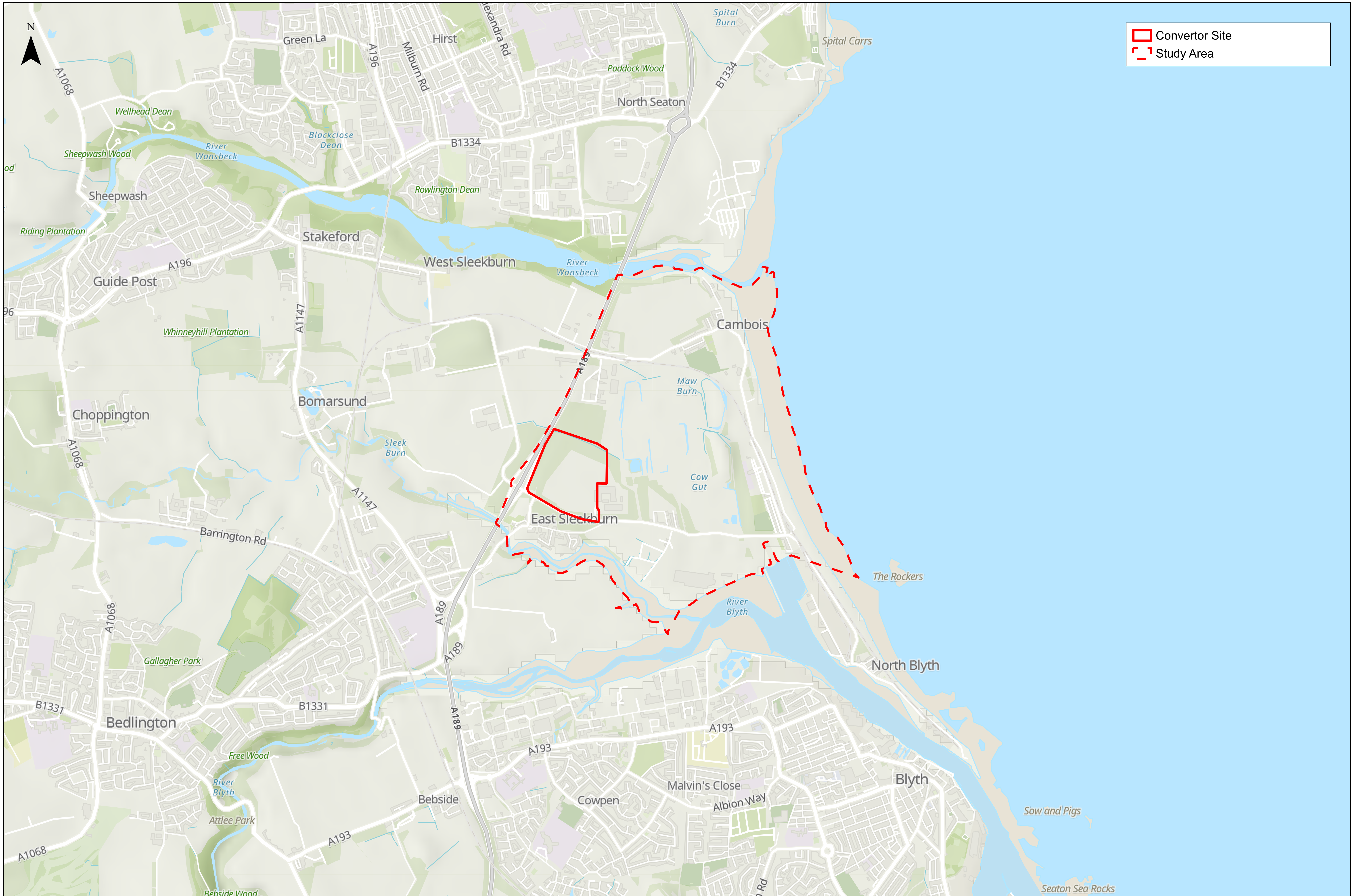
10.1. Based on the available information the flood risk to the site is considered to be predominantly low. **Table 5** details the proposed mitigation recommendations and next steps.

Table 5 Mitigation Recommendations and Next Steps

Flood Source	Flood Risk	Mitigation Requirements and Next Steps
Fluvial	Low	As part of the next stage of works it is recommended that a meeting is arranged with the EA to confirm that the risk of fluvial flooding is low and that no further assessment is required.
Tidal	Low	At present, no mitigation is deemed necessary. It is recommended that further discussion is undertaken with the EA to determine data suitability for assessment of tidal flood risk and gain an understanding of any long-term projects in the vicinity that may impact tidal flood risk.

Surface Water	Low	A surface water drainage strategy shall be designed to manage surface water runoff for all events up to and including the 1 in 100 (1%) annual probability plus climate change scenario. In accordance with local planning policy guidance, it should be demonstrated that there is no detrimental impact to the surface water runoff quality. The LLFA recommend the implementation of above ground SuDS and do not consider attenuation tanks as suitable options. The Council may adopt features located in greens open spaces such as basins and swales. A Section 106 agreement would need to be in place and an agreed commuted sum. It is recommended that the LLFA's SuDS guidance document is further reviewed. The drainage parameters and principles for the proposed surface water drainage strategy should be discussed and agreed with the LLFA. It is recommended that the project team confirm if the site sits within a coalfield / mine area. If so, the requirements listed in Category C2 of NE Mining & Groundwater Constraints needs to be taken into consideration. This is further elaborated in **Appendix D**. The proposed development should avoid severing any existing watercourses or overland flow paths on site. It is recommended that a suitable 'development free' buffer zone is provided around the existing watercourses to allow for ongoing maintenance. Any proposed works within a watercourse may disrupt flows and will require approval from the LLFA under the Land Drainage Act. Where proposed development is built on areas identified to be at risk of flooding, additional attenuation may be required within the proposed drainage network. It is recommended that the client obtain additional information or undertake a site verification exercise to confirm the status of river restoration works on the British Volt site. This is to confirm what infrastructure has been delivered on the site to ensure connectivity of the watercourses and drainage systems in the area. This is to ensure that there isn't a residual risk of flooding associated with blockage or implementation stage/status of the downstream infrastructure.
Groundwater	Medium	It is recommended that ground investigation is undertaken to determine ground water levels across the site. Where ground water levels are identified to be high it is recommended that flood proofing measures are implemented to prevent the ingress of water in the proposed converter station. The measures can include the following: • Waterproof tight flooring material (i.e., concrete) shall be used to prevent water rising through the floorboards • Raising electrical equipment • Use non-return vales • Impermeable membrane will be required on the base of the SuDS features.

Appendix A Open Data Flood Maps



Stantec

Client: sse

SSE BERWICK BANK

Site Location

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Contains data from OS Zoomstack, Contains OS data Crown Copyright and database right 2019

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Date: 08/12/2022

Drawn: ZW

Checked: HL

Figure: 001

Rev: A

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				Figure: 002	Rev: A

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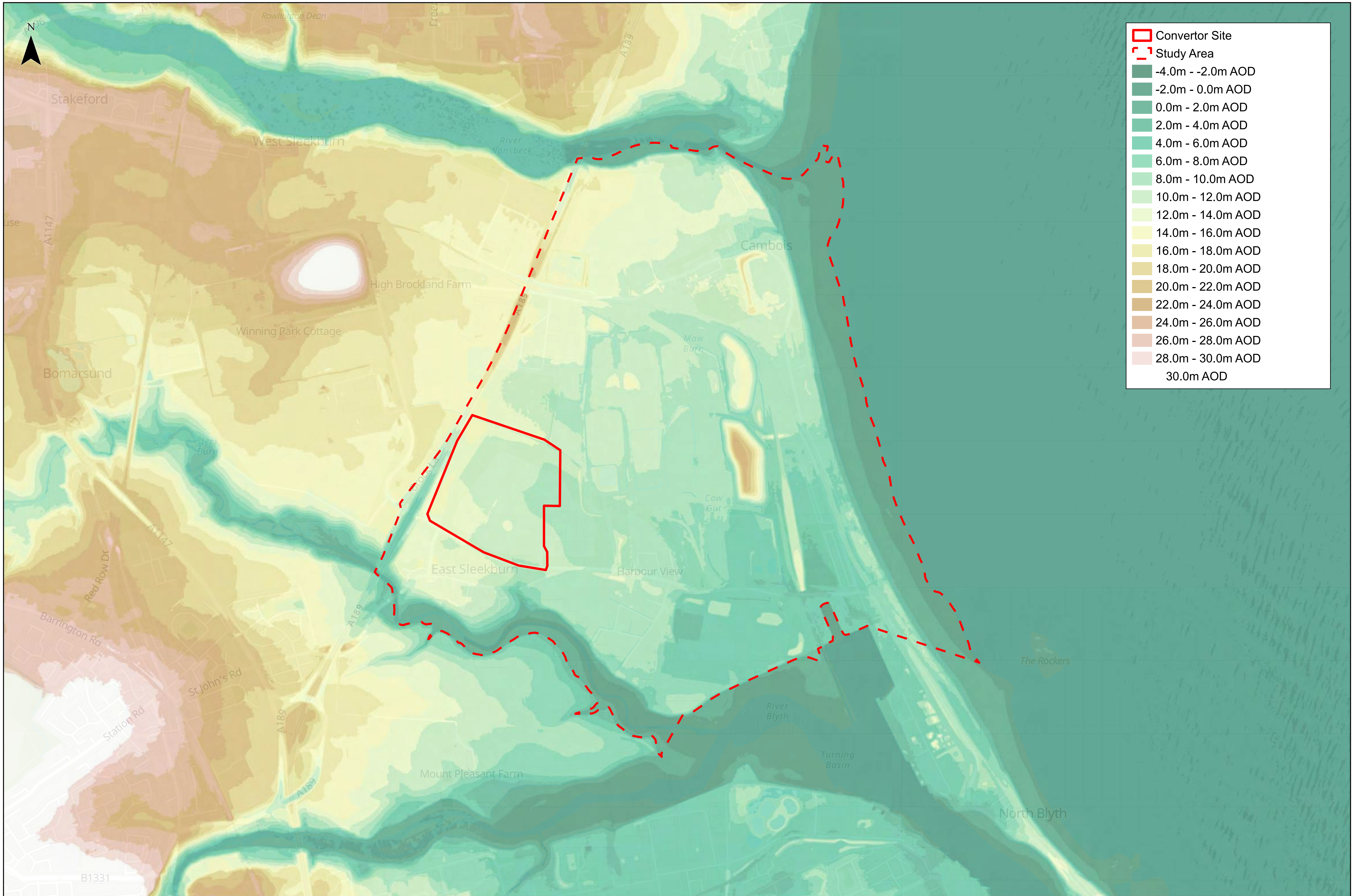

Stantec

Client

sse

SSE BERWICK BANK

Topography - Detailed

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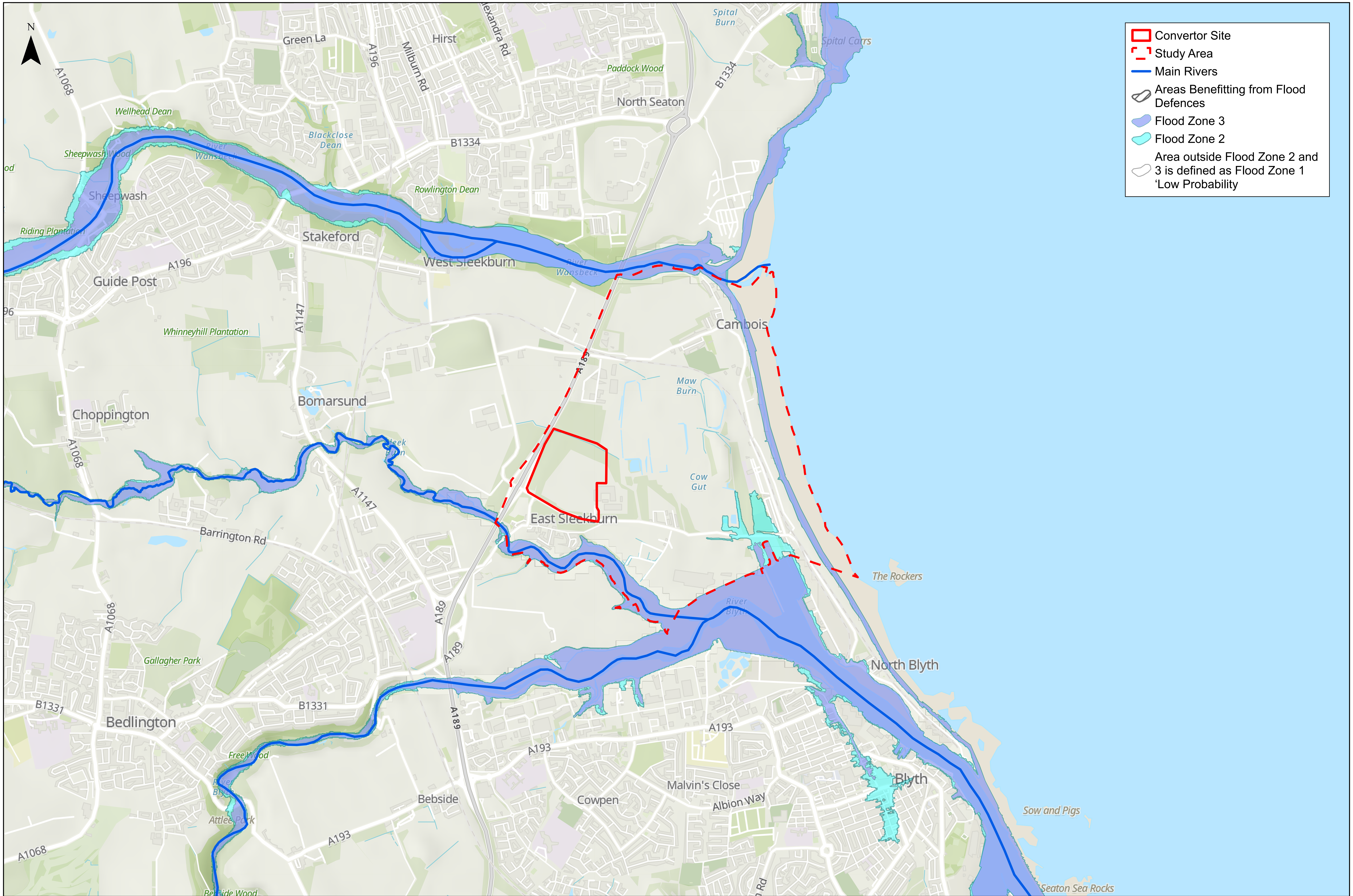

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SSE BERWICK BANK

EA Flood Zone

Flood Zones refer to the probability of river and/or sea flooding, ignoring the presence of defences.

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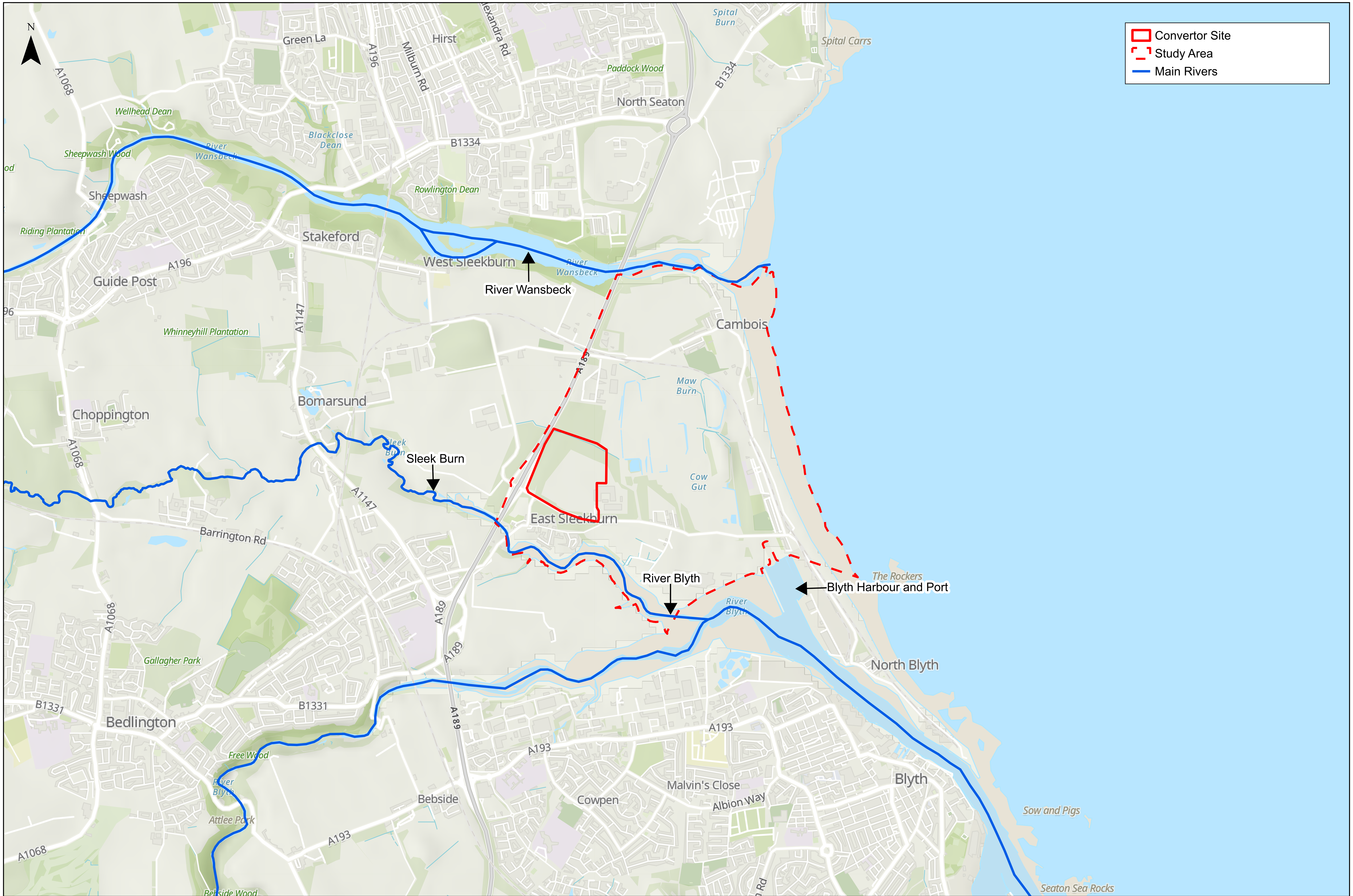

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Watercourses Map

0 1 2 Km

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Figure: 004a	Rev: A

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EA Surface Water Flood Risk

Maps based on EA updated 'Flood Map for Surface Water' ('uFMfSW') released in 2013 as the latest iteration of a national scale surface water modelling exercise.

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Figure: 005	Rev: A

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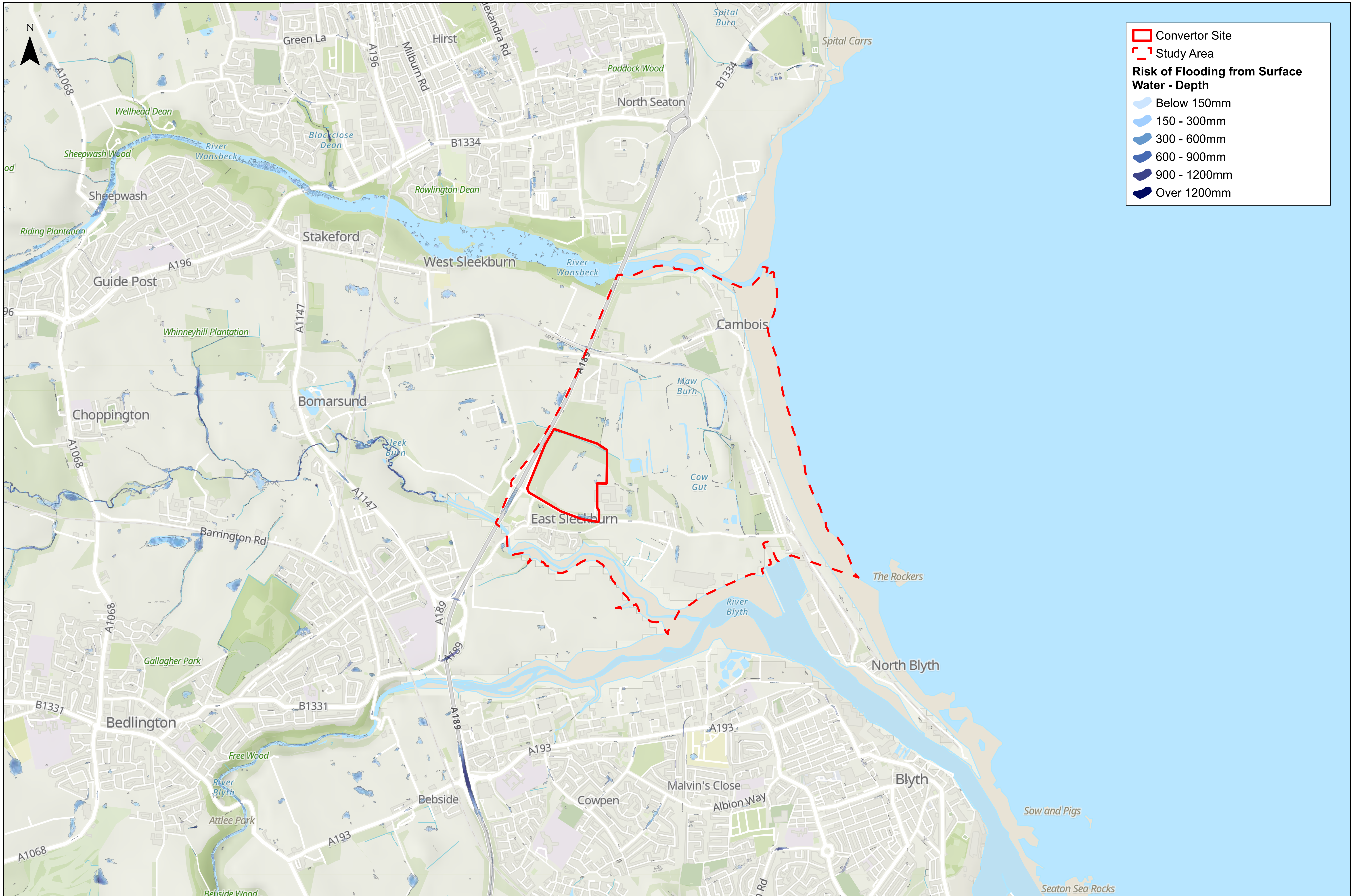

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EA Surface Water Flood Risk - Depth
3.3 Percent Chance

Maps based on EA updated 'Flood Map for Surface Water' ('uFMfSW') released in 2013 as the latest iteration of a national scale surface water modelling exercise.

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Figure: 005a	Rev: A

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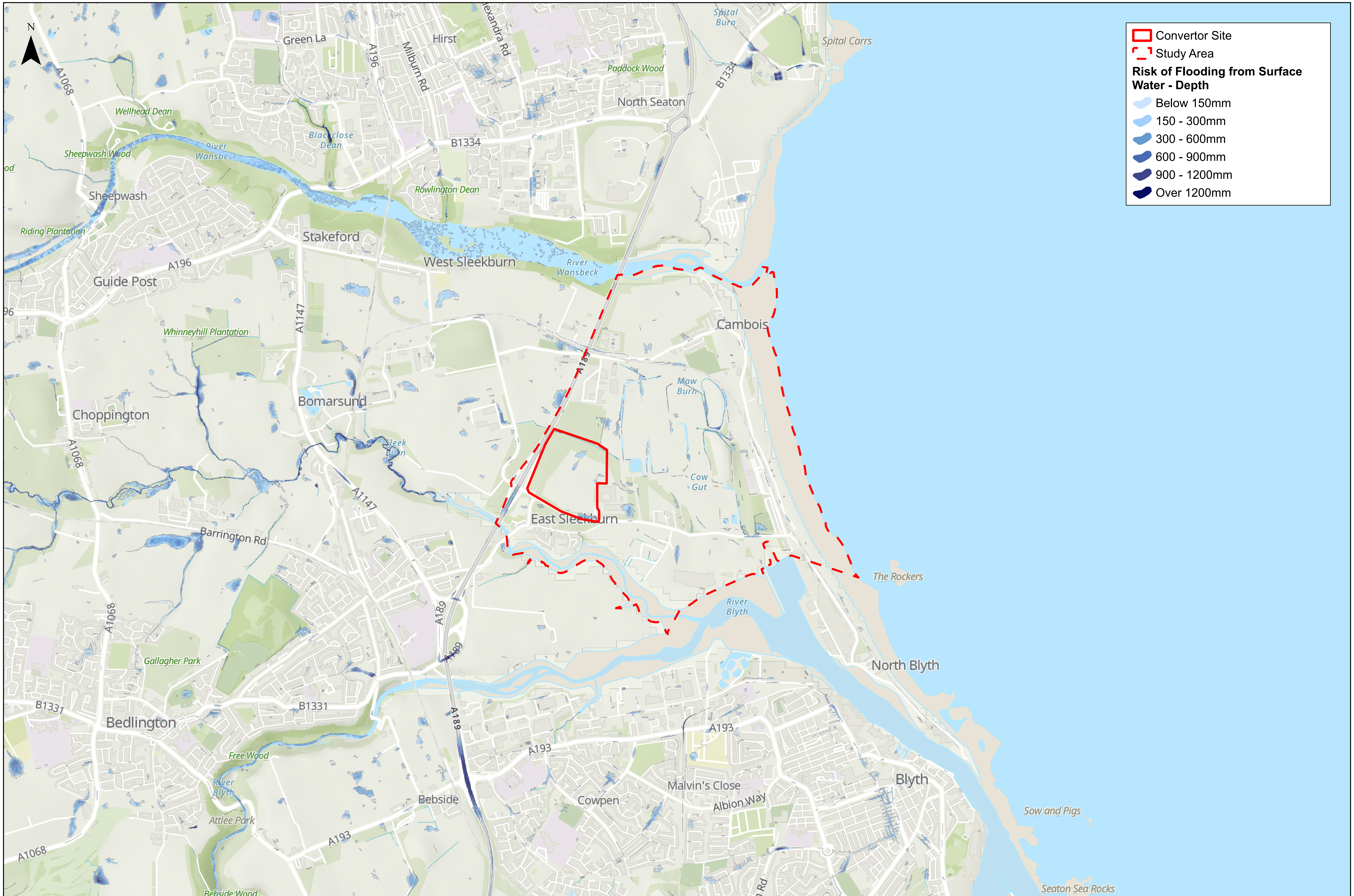

Stantec	Client: sse	**SSE BERWICK BANK** EA Surface Water Flood Risk - Depth 1.0 Percent Chance	0 1 2 Km Contains OS data Crown Copyright and database right 2022 Contains data from OS Zoomstack, Contains OS data Crown Copyright and database right 2019 Contains Environment Agency information Environment Agency and database right. Maps based on EA updated 'Flood Map for Surface Water' ('uFMfSW') released in 2013 as the latest iteration of a national scale surface water modelling exercise.	1:25,000 A3 Drawn: ZW Figure: 005b	Date: 08/12/2022 Checked: HL Rev: A

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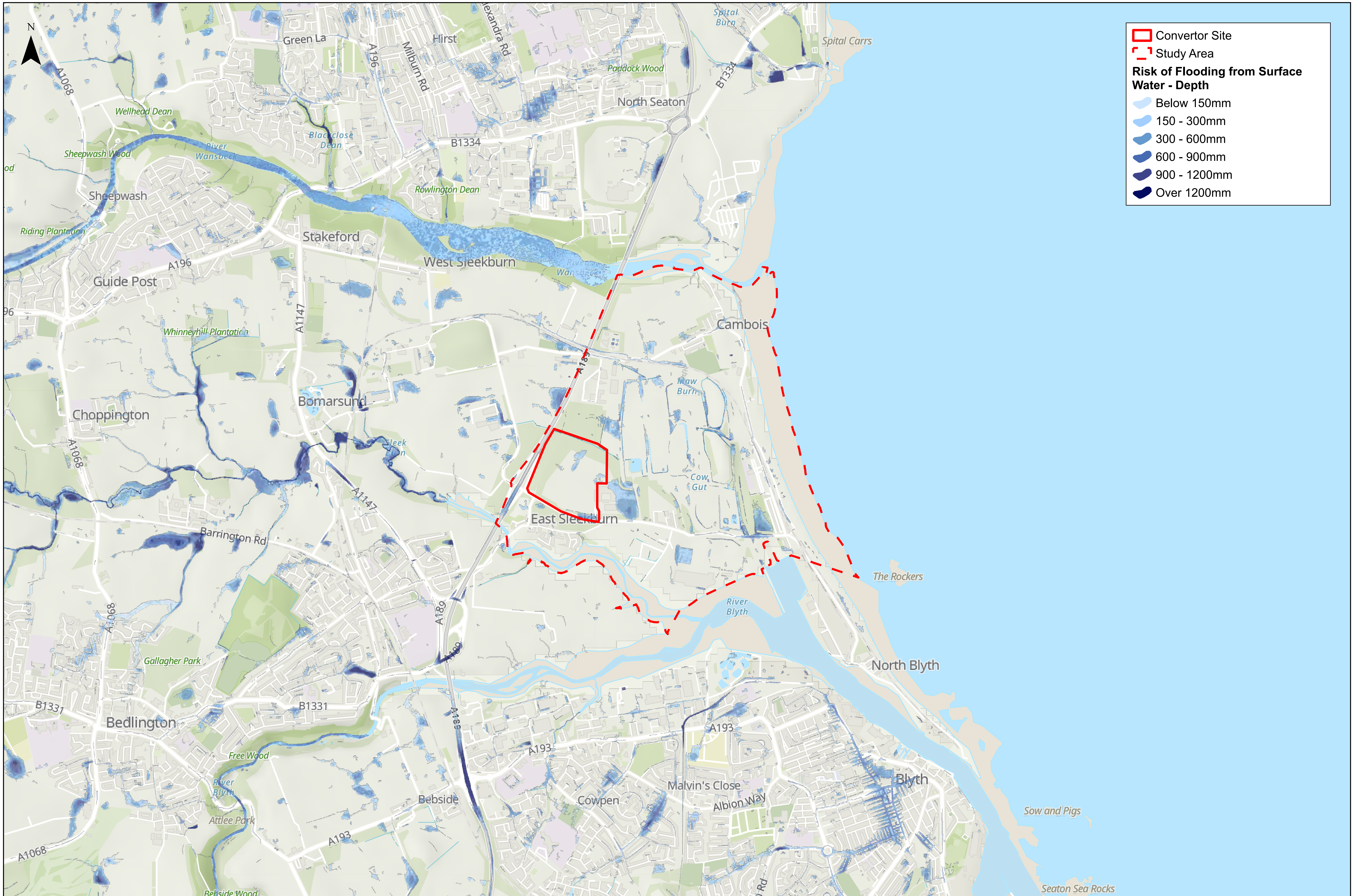

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EA Surface Water Flood Risk - Depth
0.1 Percent Chance

Maps based on EA updated 'Flood Map for Surface Water' ('uFMfSW') released in 2013 as the latest iteration of a national scale surface water modelling exercise.

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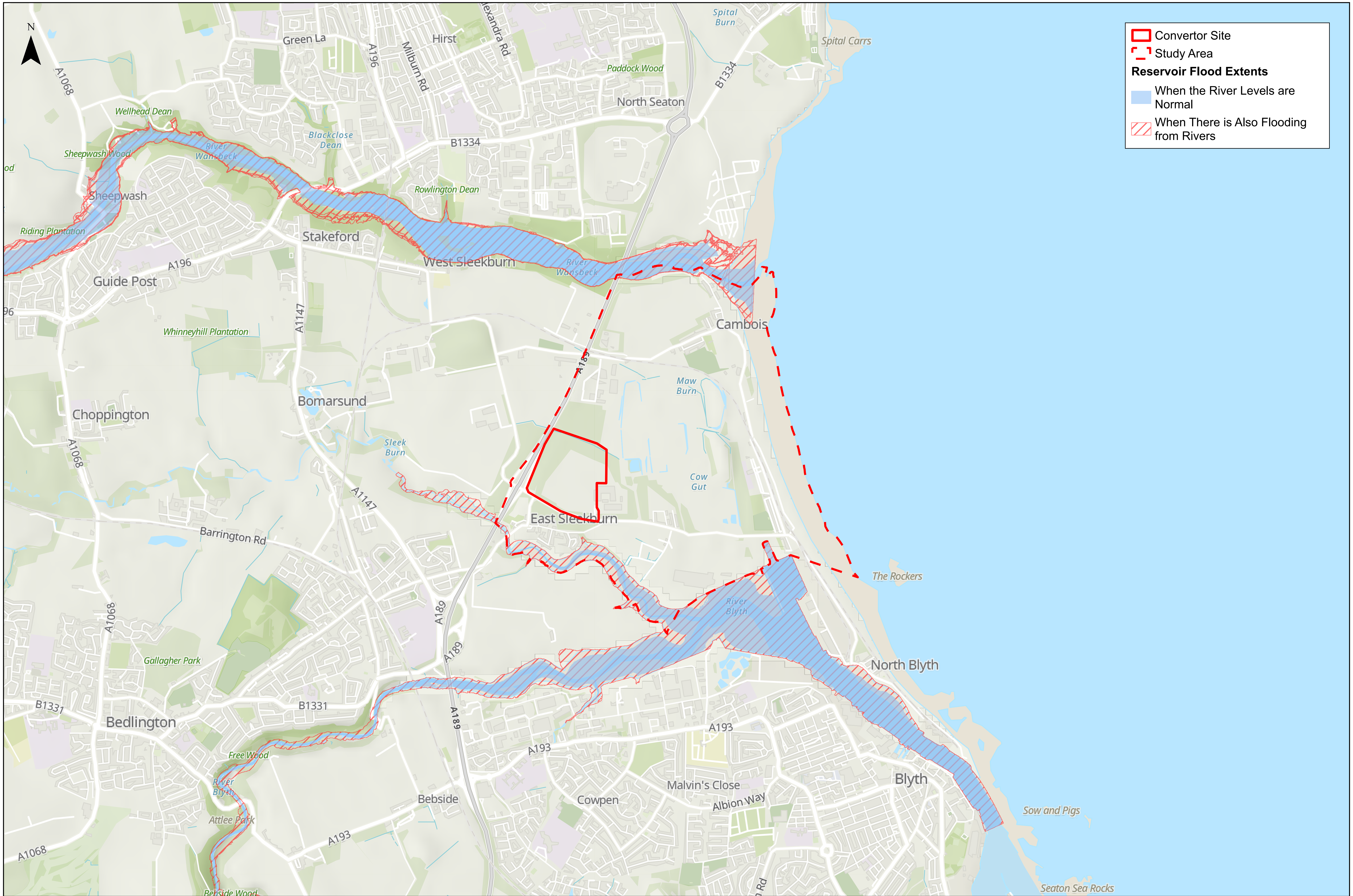

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Risk of Flooding from Reservoirs - Maximum Flood Extent

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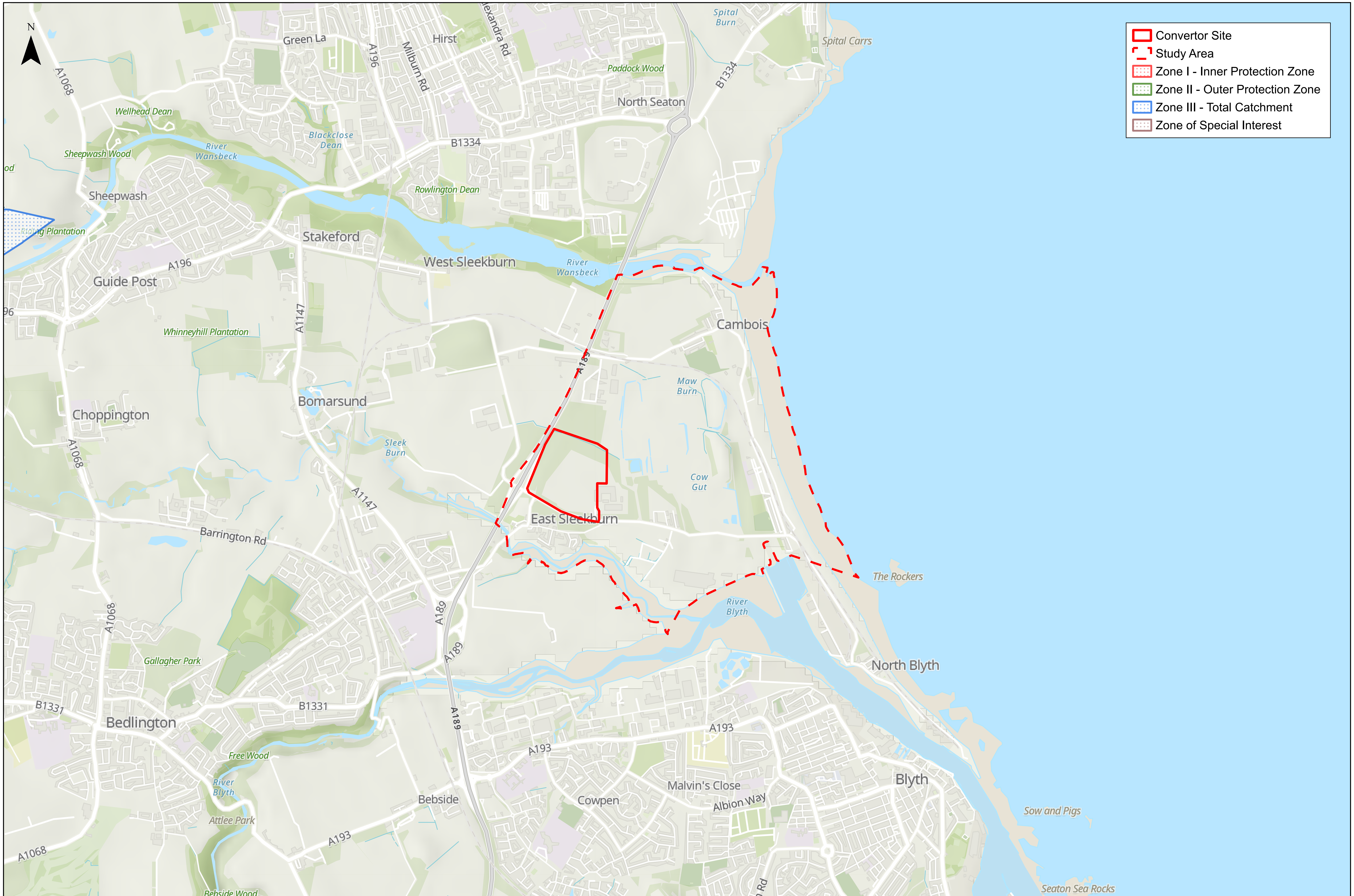

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EA Ground Water Source Protection Zones

0 1 2 Km

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Contains Environment Agency information Environment Agency and database right.

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EA Recorded Historic Flood Extents

Historic Flood Map shows the maximum extent of all individual Recorded Flood Outlines from river, the sea and groundwater springs and shows areas of land that have previously been subject to flooding in England.
Recorded Flood Outlines shows all EA records of historic flooding from rivers, the sea, groundwater and surface water

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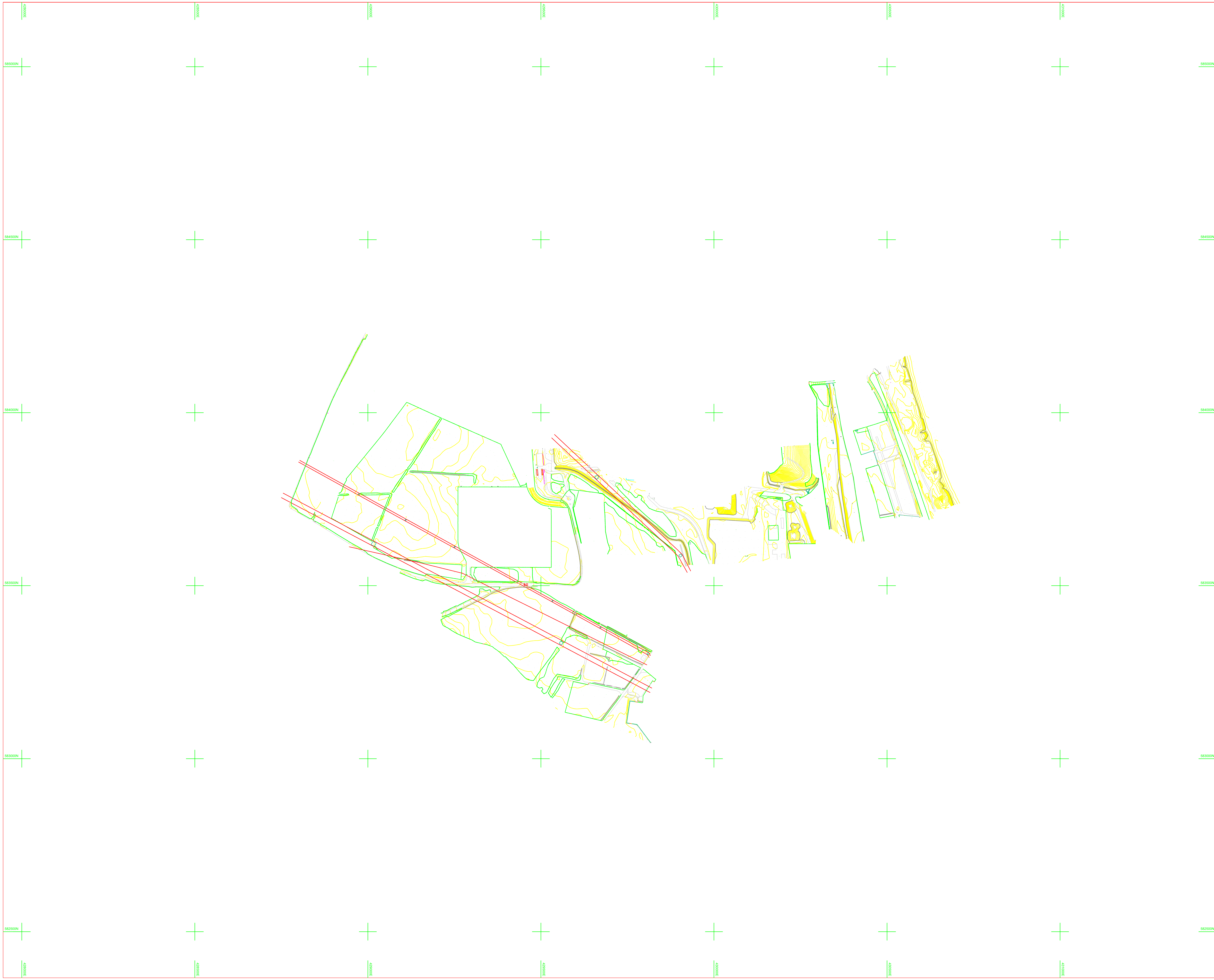
Appendix B Topographical Survey



LEGEND

SYMBOLS

- BOREHOLE
- CONTROL STATION
- GATE
- SERVICE COVER
- STUMP
- TRIAL PIT
- TREE

LINE STYLES

- BOTTOM OF BANK
- BUILDING FOOTPRINT
- BUSH CANOPY
- CHANGE OF SURFACE
- CHANNEL LINE
- FENCE
- HEDGE
- OVERHEAD WIRES
  - ELECTRIC
  - TELECOM
- PATH EDGE
- ROAD CENTRE LINE
- STRIP GULLY
- TOP OF BANK
- TOP OF KERB
- TREE CANOPY
- WALL

ABBREVIATIONS

AV = AIR VALVE
BH = BOREHOLE
BOL = BOLLARD
BO = ELEC / BT BO
BT = BRITISH TELECOM
EA = EAVES LEVEL
EC = ELECTRICITY COVER
EP = ELECTRICITY POLE
FFL = FINISHED FLOOR LEVEL
FP = FLAG POLE
G = GULLY
GAS = BRITISH GAS
HY = FIRE HYDRANT
IC = INSPECTION COVER
IL = INVERT LEVEL
SG = STRIP GULLY
LP = LAMPOST
MH = MANHOLE
MKR = MARKER
PIT = TRIAL PIT
PEG = MARKER PEG
RD = RIDGE LEVEL
RS = ROAD SIGN
SB = SIGN BOARD
SC = STOP COCK
SV = STOP VALVE
TCB = TELEPHONE CALL BO
TL = TRAFFIC LIGHT
TOW = TOP OF WALL
TP = TELEGRAPH POLE
TV = TELEVISION
WM = WATER METER

NOTES

1. GRID IS RELATED TO O.S. GRID
2. ALL LEVELS RELATE TO O.S.B.M. ASCERTAINED BY LOGGING G.P.S. DATA
3. CONTOURS ARE AT 0.50 (m) INTERVALS
4. CONTOURS AT VERTICAL FEATURES ARE INDICATIVE
5. LEVELS FOR ROAD ARE TAKEN ALONG CHANNEL LINE
6. WHILE EVERY EFFORT HAS BEEN MADE TO LOCATE THE POSITION OF ALL SERVICE COVERS (eg. manholes) IT SHOULD BE NOTED THAT THIS MAY NOT HAVE BEEN POSSIBLE AT THE TIME OF SURVEY DUE TO GROUND COVER OR LOCAL OBSTRUCTIONS.
7. ISOLATED MATURE TREES ARE DENOTED BY TRUNK AND ESTIMATED AVERAGE OUTER CANOPY.
8. ALL CONTROL STATION COORDINATES SHOULD BE CHECKED AND VERIFIED ON SITE PRIOR TO USE. DOUGLAS LAND SURVEYS SHOULD BE INFORMED OF ANY DISCREPANCIES FOUND.
9. OWNERSHIP OF SURVEY DATA REMAINS WITH DOUGLAS LAND SURVEYS, UNTIL INVOICE RELATING TO SUCH DATA HAS BEEN PAID IN FULL.

CONTROL STATIONS

CONTROL STATIONS				
Station No.	Description	Easting	Northing	Level
STN03	HILTI	429785.436	583256.246	8.556
STN04	HILTI	429751.012	583199.168	8.743
STN1000	NAIL	429908.991	583660.925	7.778

23/11/2022

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A1

Title: **NSL CONVERTER STATION , BLYTH.**

Drawn By:	Scale:	Date:
L.Burns	1/5000	30/11/2022

Drawing Number: 36022

Revision: 01

Appendix C British Volt Planning Application Deliverables

WATER FRAMEWORK DIRECTIVE SCREENING REPORT

FOR

FORMER COAL STOCKING YARDS, CAMBOIS

PROJECT NUMBER:	20-0473
DOCUMENT REFERENCE:	PHX-RGL-XX-XX-RP-D-000006
REVISION:	S2-P02

	NAME	POSITION	SIGNATURE
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REVISION

REVISION	ISSUE DATE	REASON FOR ISSUE
S2-P01	13.05.2021	Issued for information.
S2-P02	20.05.2021	Updated in line with Ecology Comments.

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CONTENTS

1.0 INTRODUCTION

1.1 OVERVIEW

Rolton Group Ltd, was commissioned on behalf of British Volt (the applicant'), to undertake a Water Framework Directive Screening (WFD) Assessment as part of an Environmental Impact Assessment (EIA) for the proposed development of former coal stocking yard, Cambois, referred to as 'the proposed development site'.

1.2 SITE LOCATION AND SETTING

The proposed development site is located in Cambois, Northumberland, approximately 2km north of Blyth town centre. The site lies between the Wansbeck Estuary to the north, the Blyth Estuary to the south and the North Sea to the east, in a semi-rural area south-west of the village of Cambois.

The site is irregular in shape and covers approximately 92.2 hectares, measuring approximately 1200m north-south at its longest section and 825m east-west at its widest section.

The approximate centre of the site can be found using grid reference 429860, 584130.

The site was historically used as a coal stocking yard associated with the former Blyth Power Station. The main power station buildings were located to the south of the site, beyond Brock Lane. Coal supplies were transported via overhead conveyors to the neighbouring site.

The site comprises large areas of tarmac and concrete hardstanding, pulverised fuel ash (PFA) storage mounds, ash settlement lagoons and shallow concrete foundations associated with former structures. Hardstanding concrete and tarmac roads are present around the site with gravel ballast covering areas of former railway sidings. Mature vegetation covers two large PFA mounds located along the eastern boundary and further mature vegetation and trees cover the south western corner of the site.

There are two main water courses crossing the site, Maw Burn in the north and Cow Gut in the south, both of which have been culverted for most of their length across the site. Each run from west to east, with Maw Burn entering in the north western corner of the site, exiting along the eastern boundary and out falling into the North Sea, 260m east from the site. Cow Gut enters along the western site boundary, exits along the southern boundary and outfalls into the Blyth Estuary, 280m south of the site.

A series of pylons support a high voltage overhead electricity supply running parallel to the western boundary and located within the site.

Brock Lane provides access to the site and forms the southern boundary and Wembley gardens is in close proximity to the north of the site.

A site location plan is included in Appendix A.

1.3 PROPOSED SCHEME

It is proposed to redevelop the site with a large manufacturing facility together with a number of smaller industrial units and offices with associated yards, car parking and access roads.

The following briefly summarises the likely development:

- A large manufacturing facility constructed in the northern half of the site with ancillary offices and parking.
- Construction of a new substation in the south.
- Access to the development will be off Brock Lane in the south with an internal road network, loading bays, yards and car parking.
- Overhead pylons currently running down the western and south western area of the site will remain.
- Existing 'mounds' of PFA in the east will be maintained as ecological mitigation areas.
- Landscaping including an area of existing trees will cover the south western corner of the site.
- Some re-profiling of the site levels will be required.

The proposed developments main structures will be very large buildings housing specialist equipment and are expected to be steel framed structures, likely to utilise a piled foundation design with piles terminating within the significant thickness of glacial till deposits overlying the coal measures. Floor slabs will be constructed for the building, with ground improvement likely to take place within areas of shallow made ground.

There are no significant underground structures or basements anticipated to be required for these structures. A relatively small amount of cut and fill will be required to provide a large, generally flat and level platform for the development.

The site layout for the proposed development is included in the proposed watercourse diversion plans contained in Appendix A. Further information can be found in the planning submissions plans and drawings.

1.4 WFD REQUIREMENT

A WFD Screening Assessment determines whether a proposed development is compliant with the objectives of the WFD, or if further assessment is required.

In relation to the proposed development site, the works that are most relevant to this assessment are the realignment of part of two watercourses that flow through the site to accommodate the construction of the main building and ancillary sites.

The Maw Burn to the North of the site is currently largely culverted through the site and it is proposed to provide an open channel route as part of the development proposals to the North of the site, connecting back into the original channel prior to discharge off site. This existing channel would then continue within a culverted section and ultimately discharge to the beach and North Sea.

The Cow Gut to the central section of the site is also largely culverted and it is proposed to divert this, mainly in open channel, to the west and southern side of the site, connecting back into the channel prior to its discharge beneath Brock Lane to the south East of the site.

This document sets out the findings of the screening assessment and is structured as follows:

- Introduction, background and overview of the proposed development;
- The WFD;
- Assessment Methodology;
- Stage 1 – Defining the study area;
- Stage 2 – Collating baseline data;
- Stage 3 – Relationship of the proposed Development with WFD waterbodies;
- Stage 4 – WFD preliminary assessment;
- Cumulative Assessment; and
- Conclusions.

2.0 THE WATER FRAMEWORK DIRECTIVE

The WFD (Directive 2000/60/EC) came into effect in the UK through the Water Environment (WFD) (England and Wales) Regulations 2003 (UK Government 2003). The WFD was put in place to:

- enhance the status, and prevent further deterioration of aquatic ecosystems and associated wetlands which depend on those aquatic ecosystems;
- promote the sustainable use of water;
- reduce pollution of water, especially by 'priority' and 'priority hazardous' substances;
- ensure progressive reduction of groundwater pollution; and
- contribute to mitigating the effects of floods and droughts.

The WFD sets objectives for all water bodies in Europe classified under the WFD and the overarching requirement was that they should reach at least 'good' status (or potential) by 2015. This date has been extended to 2027 for many water bodies.

The WFD requires European Member States to establish river basin districts and, for each, a management plan. WFD-related actions are managed through the River Basin Management Plan (RBMP) process. For the proposed development at former coal stocking yard, Cambois, the relevant plan is the Northumbria River Basin district RBMP (Defra / Environment Agency 2015).

The WFD has important implications when planning works that may affect water bodies covered under the Framework. Development should not cause deterioration in waterbody status, and ideally, such development should contribute to improving the status of the affected water bodies. Development also must not prejudice the implementation of any planned mitigation measures (as documented in the RBMP) to improve water body status.

The WFD states that, if a proposed development will result in an adverse effect on a waterbody, which could cause a deterioration in its WFD status or could prevent actions which are required to raise the WFD status of the waterbody, then the proposed development must be assessed and justified. As part of the assessment, the actions proposed to mitigate the adverse impacts on the status of the waterbody must be examined.

3.0 METHODOLOGY

In order to assess whether the proposed development is compliant with the objectives set out in the WFD, the following steps have been undertaken:

- Stage 1 – Defining the study area, based on the distance of waterbodies from the proposed Development and the hydrological connectivity of waterbodies to the development (screening out water bodies not considered to have the potential to be impacted).
- Stage 2 – Collating baseline data on the water bodies that are screened in, defining their current WFD status, their specific objectives and any mitigation measures in place or planned.
- Stage 3 – Defining the relationship of the proposed Development's components with the screened in water bodies (screening out components not considered to have the potential to cause impacts).
- Stage 4 – A preliminary assessment of the remaining components of the proposed Development against the WFD elements (for surface waterbodies - biological, chemical and hydro- morphological) that make up the overall WFD status of screened in waterbodies.

Should the preliminary assessment conclude that there could be impacts on the WFD elements of the water bodies, then the steps below will be undertaken:

- Stage 5 - Undertake a detailed assessment based on the findings of the preliminary assessment in respect of any components of the proposed Development identified as likely to have an impact upon the WFD elements. This assessment will also consider any conflicts between the proposed Development and relevant RBMP mitigation measures, and any cumulative effects of the development.
- Stage 6 - Proposed programme of compliance of development, required in accordance with Article 4.7 of the WFD.

4.0 STAGE 1 – DEFINING THE STUDY AREA

The study area (or Zone of Influence [ZoI]) for this assessment includes land within the proposed development site boundary, in addition to surface waters within 1km of this boundary. Refer to site location plan in Appendix A for location of WFD Watercourses referred to below.

The study area has been defined to reflect the surrounding water environment and is sufficient for the inclusion of all potentially affected surface water receptors. The WFD waterbodies within the ZoI are described below.

SURFACE WATER BODIES

The Blyth Estuary (WFD waterbody ID GB510302203200), an EA designated main river, flows beyond the southern boundary of the proposed development site in a south easterly direction. The Blyth Estuary drains a total catchment area of approximately 320km^2 and receives an average annual rainfall of approximately 650mm. The Blythe Estuary is not specifically noted in the Northumbria RBMP but its hydrological relationship with the proposed development is noted in Table 1 below.

The Cow Gut Ordinary Watercourse flows through the proposed development site. It enters along the western site boundary, flows through the site mainly within culverts and exits along the southern boundary and outfalls into the Blyth Estuary, 280m south of the site. This watercourse drains approximately 0.424km^2 upstream f the proposed development site and has been scoped into the assessment due to its hydrological relationship to the proposed development as per Table 1 below.

The Tyne and Wear coastal water (WFD waterbody ID GB650301500002) is located beyond the eastern boundary of the site. The Tyne and Wear coastal water is not specifically noted in the Northumbria RBMP but its hydrological relationship with the proposed development is noted in Table 1 below.

The Maw Burn Ordinary watercourse flows through the proposed development site. It enters in the north western corner of the site, flows through the site mainly in culverts and exits along the eastern boundary out falling into the North Sea, 260m east from the site. This watercourse drains approximately 0.136km^2 upstream of the proposed development site and has been scoped into the assessment due to its hydrological relationship to the proposed development as per Table 1 below.

WATERBODY (NAME AND WFD REFERENCE NUMBER)	HYDROLOGICAL RELATIONSHIP TO PROPOSED DEVELOPMENT
Blyth Estuary (GB510302203200)	The Blyth Estuary flows beyond the southern boundary of the proposed development site. The Cow Gut Ordinary Watercourse flows through the proposed development site and discharges into the Blyth Estuary beyond the southern boundary of the site. The proposed development includes reduction in the extent of existing culverting of the Cow Gut and realignment of the watercourse within the proposed development site. The Hydrological catchment of the Blyth Estuary drains a large proportion of the southern side of the proposed development site. The Cow Gut (and therefore the Blyth Estuary) would receive discharges from drainage of surface water runoff from the proposed development site.
Tyne and Wear Coastal Water (GB650301500002)	The Tyne and Wear Coastal Waters are located beyond the proposed development site to the east. The Maw Burn ordinary watercourse flows through the proposed development site and discharges into the Coastal Waters. The proposed development includes reduction in the extent of existing culverting of the Maw Burn and realignment of the watercourse within the proposed development site. The Hydrological catchment of the Maw Burn drains a small proportion of the northern side of proposed development site. The Cow Gut (and therefore the Blyth Estuary) would receive limited discharges from drainage of surface water runoff from the proposed development site.

Table 1: The hydrological relationship between each of the water bodies identified within the Northumbria RBMP and the proposed development.

5.0 STAGE 2 – COLLATING BASELINE DATA

5.1 COLLATING BASELINE DATA

Baseline data is provided below. The information presented has been taken from the Northumbria RBMP (Environment Agency's Catchment Data Explorer website, Cycle 2 2019 data, (Environment Agency 2019).

Data has also been obtained from the following sources to define baseline conditions for the WFD waterbody of the Tyne and Wear Coastal Water and Blyth Estuary:

- The ordinary watercourses (Cow Gut and Maw Burn) have been assessed Hydrologically to understand their flood flow conveyance and have been subject to a topographical survey and a site walkover survey. The surveys recorded the channel dimensions and culvert sizes throughout the length of the watercourses within the site.
- An Ecological Assessment undertaken of the site in general including the watercourses.

5.2 WATER FRAMEWORK DIRECTIVE BASELINE CONDITIONS

The area is not within a reportable freshwater WFD waterbody; however, the Blyth Estuary and the Tyne and Wear Coastal waters fall within the Transitional (Estuarine) or Coastal waterbodies. The information below summarises the available data.

The catchment data table extracts below, summarise baseline conditions for the Blythe Estuary and Tyne and Wear Coastal waters. A limited summary is provided following each waterbody below.

5.2.1 BLYTH ESTUARY BASELINE DATA

Ecological and chemical classification for surface waters | 2019 Cycle 2

2019 Cycle 2

	Ecological status or potential					Chemical status	
Number of water bodies	Bad	Poor	Moderate	Good	High	Fail	Good
1	0	0	1	0	0	1	0

Summary of objectives (ecological status or potential and chemical status) for surface water bodies (number of water bodies)

	Ecological status or potential						Chemical status			
	Bad	Poor	Moderate	Good	High	Total	Fail	Good	Total	
By 2015	0	0	1	0	0	1	0	1	1	
By 2021	0	0	0	0	0	0	0	0	0	
By 2027	0	0	0	0	0	0	0	0	0	Extended Deadline
Beyond 2027	0	0	0	0	0	0	0	0	0	
Total	0	0	1	0	0	1	0	1	1	
	Less Stringent						Less Stringent			

Reasons for not achieving good status and reasons for deterioration in this Operational Catchment

The table below shows the number of reasons for not achieving good status (RNAGS) and reasons for deterioration (RFD), split by sector.

Sector	RFD	RNAG	Grand Total
Agriculture and rural land management	0	1	1
Domestic General Public	0	0	0
Industry	0	1	1
Local and Central Government	0	0	0
Mining and quarrying	0	0	0
Navigation	0	0	0
No sector responsible	0	0	0
Other	0	0	0
Recreation	0	0	0
Sector under investigation	0	0	0
Urban and transport	0	0	0
Waste treatment and disposal	0	0	0
Water Industry	0	0	0
Grand Total	0	2	2

The issues preventing waters reaching good status and the sectors identified as contributing to them are unavailable at present within the dataset.

In summary, the Blyth Estuary is currently moderate ecologically and good chemically. The reasons for not achieving a good status are due to industry and agriculture/rural land management.

5.2.2 TYNE AND WEAR COASTAL WATERS BASELINE DATA

Ecological and chemical classification for surface waters | 2019 Cycle 2

2019 Cycle 2

	Ecological status or potential					Chemical status	
Number of water bodies	Bad	Poor	Moderate	Good	High	Fail	Good
1	0	0	0	1	0	1	0

Summary of objectives (ecological status or potential and chemical status) for surface water bodies (number of water bodies)

	Ecological status or potential						Chemical status			
	Bad	Poor	Moderate	Good	High	Total	Fail	Good	Total	
By 2015	0	0	0	1	0	1	0	1	1	
By 2021	0	0	0	0	0	0	0	0	0	
By 2027	0	0	0	0	0	0	0	0	0	Extended Deadline
Beyond 2027	0	0	0	0	0	0	0	0	0	
Total	0	0	0	1	0	1	0	1	1	
	Less Stringent						Less Stringent			

Reasons for not achieving good status and reasons for deterioration in this Operational Catchment

The table below shows the number of reasons for not achieving good status (RNAGS) and reasons for deterioration (RFD), split by sector.

Sector	RFD	RNAG	Grand Total
Agriculture and rural land management	0	0	0
Domestic General Public	0	0	0
Industry	0	0	0
Local and Central Government	0	0	0
Mining and quarrying	0	0	0
Navigation	0	0	0
No sector responsible	0	0	0
Other	0	0	0
Recreation	0	0	0
Sector under investigation	0	1	1
Urban and transport	0	0	0
Waste treatment and disposal	0	0	0
Water Industry	0	0	0
Grand Total	0	1	1

The issues preventing waters reaching good status and the sectors identified as contributing to them are unavailable at present within the dataset.

In summary, the Tyne and Wear Coastal Waters is currently good ecologically and fails chemically. The reasons for not achieving a good status are under investigation.

At present, there are no measures within these catchments which the predicted improvements in the status of water bodies by 2021 are based upon. Other measures may be taking place, but there is not enough confidence (in location or scale of improvement) to predict specific outcomes based upon them. Additional measures will have been identified and shown to be worthwhile in an economic appraisal, but funding has not yet been secured to progress these measures.

With regards to the Northumbria River Basin district RBMP, the Blyth estuary there are no specific measures associated with the improvement of the specific waters within this assessment, however the below is an extract of the statistics associated with the overall catchment.

MITIGTION MEASURES TABLE			
WFD WATER BODY NAME	WATER BODY ID	HEAVILY MODIFIED WATER DESIGNATED USE	MITIGATION MEASURE
Blyth (N)	GB510302203200	Navigation, ports and harbours use	50.Vessel Management
Blyth (N)	GB510302203200	Navigation, ports and harbours use	21.Avoid the need to dredge
Blyth (N)	GB510302203200	Navigation, ports and harbours use	22.Dredging disposal strategy
Blyth (N)	GB510302203200	Navigation, ports and harbours use	23.Reduce impact of dredging

MITIGTION MEASURES TABLE			
WFD WATER BODY NAME	WATER BODY ID	HEAVILY MODIFIED WATER DESIGNATED USE	MITIGATION MEASURE
Blyth (N)	GB510302203200	Navigation, ports and harbours use	24.Reduce sediment resuspension
Blyth (N)	GB510302203200	Navigation, ports and harbours use	25.Retime dredging or disposal
Blyth (N)	GB510302203200	Navigation, ports and harbours use	27. Dredge disposal site selection
Blyth (N)	GB510302203200	Navigation, ports and harbours use	28.Manage disturbance
Blyth (N)	GB510302203200	Navigation, ports and harbours use	15.Flow manipulation

Table 2: Northumbria River Basin district RBMP Mitigation Measures Table

The summary of the issues that may be applicable to the development sites discharge would be avoiding sediment re-suspension, managing disturbance and flow manipulation which the proposed development and mitigation measures would not jeopardise.

The plan in Appendix A indicates the current alignment of the Cow Gut and Maw Burn Watercourses through the site. The Maw Burn has a short section of open channel with approximate bed width of 1m and depth 0.5 to 1.0m prior to it entering a significant culverted section which is 300mm diameter. The Cow Gut approaches the site beyond the western boundary within a channel width of approximately 1.0m and 1.0-1.5m depth and enters a 750mm diameter culvert within the site prior to discharging off site on the eastern boundary.

5.2.3 ECOLOGY

Both the Maw Burn and the Cow Gut are heavily modified, and little more than field drains over much of their course. On the 1865 25” OS map, which pre-dates most of the development in the area, both water courses are only named close to their outfall points, and they primarily follow field boundaries.

On the 1896 6” OS map the Maw Burn appears to originate at a point that would now lie within the development site, with the upstream drainage appearing to have been altered by the construction of the railway. The Cow Gut is shown in colour only from a point close to the current Brock Lane, about 300m from its outfall into the estuary.

On the 1924 6” OS sheets both water courses appear to have their origins close the upper limits that can be identified on current maps, with the Maw Burn starting in rises close to the railway line, in a location that would now be just west of the A189, and the Cow Gut originating at a point mid-way between East Sleekburn and the railway, in a location that now lies on the edge of a small industrial area immediately west of the A189.

A 2014 Report by TEP for National Grid described the section of Cow Gut to the west of the Britishvolt site as:

> *A ditch, known as Cow Gut, forms the southern boundary of the motorcycle scrambling field. This ditch has very steep banks with dense hawthorn and bramble Rubus fruticosus agg. scrub along both banks making the ditch very shaded. There was a noticeable chemical smell along sections of the ditch but, due to the dense scrub, it was very difficult to clearly see the bottom, but it looked virtually dry in the south-east corner of the scrambling field. Himalayan balsam Impatiens glandulifera, another Schedule 9 species, is also present at the western end of Cow Gut with dense stands of rosebay willowherb.*

For ditches that flow into Cow Gut it is reported that:

> *The water at the southern end of the ditch appeared milky looking and it is understood that there is an outfall into this ditch from a nearby chemical factory upstream. Anecdotal evidence suggests that European eels are present in the ditch.*

Ecological survey work for this development found:

> *The site was historically drained by two watercourses the Maw Burn (northern section) and Cow Gut (southern section) which flow from northwest to south east before discharging into the Blyth Estuary to the south. Extensive lengths of the watercourses are culverted underground (refer to Appendix A) but some sections flow above ground within the site although in modified and diverted channels. The steam channels appear to have been straightened and re-routed (at least in sections) with earth mounding forming the banks along some sections (TN 14 and 15). The stream channels were c.2m wide with aquatic and inundation vegetation present and a low water flow. A short section of the banks of the Maw Burn had been reinforced with stone gabions in the east of the site whilst a section of the stream had been widened to form an online pond area with abundant inundation vegetation (TN13). Lengths of the Maw Burn banks support continuous scrub – mostly hawthorn, blackthorn, rose and bramble.*
>
> *A ditch which carries water around the eastern side of the PFA/FBA mounds is also categorised as running water habitat due to its size (2m width), evidence of flow and natural (albeit modified) channel form. Although there was evidence of water pollution (a dense white sediment) at one point, there was an extensive cottongrass bed downstream of the pollution point suggestive of acidic water conditions (TN40).*

Overall, both watercourses were considered to be highly modified, in poor condition and unlikely to support habitats or species of interest other than the presence of one patch of cotton grass, which is unusual in this area of the county. No stickleback or other fish were recorded during the amphibian surveys completed on the site.

6.0 STAGE 3 – RELATIONSHIP BETWEEN THE PROPOSED DEVELOPMENT AND SCREENED IN WATERBODIES

6.1 OPTIONEERING

The section below details the proposals for the proposed re-alignment and de-culverting of the Maw Burn and Cow Gut Watercourses. It is indicated in Appendix A, split into three drawings. The first indicates the current alignments and overall proposals and two further plans indicate in more detail the proposed diversion geometry including cross sections. Also included in Appendix A is the proposed drainage strategy indicating the location of proposed outfalls from the proposed development site.

6.1.1 MAW BURN

The existing Maw Burn bed level falls approximately 5m across the site from an invert level of 10.7 in the north west corner to 5.7 in the eastern edge of the site.

In creating a level platform, service yard and access road, the current alignment of the watercourse requires diversion and to enable the longest open channel section to be provided, it is proposed to divert the watercourse to the northern boundary of the site. This enables the original largely culverted watercourse to be mainly open channel throughout the site.

The proposed geometry of the realigned watercourse provides a bed width of 1m and minimum depth of 1m to accord with the current open channel geometry. There are three proposed crossing points of the watercourse route, which require a short section of culvert and these are proposed to be 750mm diameter pipes to ensure sufficient capacity is provided.

The extent of current site flow to the watercourse is difficult to assess but due to the shallow levels, it is unlikely this will be a significant area and therefore minimal area has been added to the Maw Burn associated with the future proposals. Also, as the outfall from the Maw Burn enters a long culvert prior to discharging into the North Sea, it is considered that this provides a potential risk to the flows.

6.1.2 COW GUT

The existing Cow Gut bed level falls approximately 3.4m across the site from an invert level of 7.92 just beyond the western boundary to 5.7 in the eastern edge of the site.

In creating a level platform for the development parcels, sub-station and access road, the current alignment of the watercourse requires diversion and to enable the longest open channel section to be provided, it is proposed to divert the watercourse to the southern boundary of the site. This enables the original largely culverted watercourse to be mainly open channel throughout the site.

The proposed geometry of the realigned watercourse provides a bed width of 1m and minimum depth of 1.2m to accord with the current open channel geometry. There are four proposed lengths of culvert for the two entrance roads, the edge of the pylon bae/substation and the bridleway on the outlet in the south east corner. These are identified as 900mm diameter to match the downstream culvert beneath Brock Lane.

As the full diversion of the watercourse bypasses a section of watercourse which is outside the site, in developing the strategy the continuation of this flow was also considered. The current site design has made provision for the initial flow from the site to enter this watercourse with an overflow to the lower system and outfall to the south east of the site. Thus, the provision of a continuation of the flow will maintain the channel running beyond the eastern boundary of the site to prevent this from drying out.

The design of the proposed development has undergone significant optioneering to minimise its impact on the water environment, with emphasis on components of the proposed development where there is likely to be interaction with a waterbody. This has resulted in the maximum open channel length of diverted watercourses.

6.2 RELATIONSHIP WITH SCREENED IN WATERBODIES

PROPOSED DEVELOPMENT PHASE	DEVELOPMENT ACTIVITIES	MITIGATION PROPOSED	SCOPED IN / SCOPED OF STAGE 4 ASSESSMENT
Construction Phase	General construction away from riparian corridors	The design of the proposed development has incorporated a development free riparian corridor for the limited extent of retained watercourses to the outside of the site, with a minimum width of 3m from the banks of the watercourse channels to avoid impacts to these existing surface water bodies. Within this corridor existing vegetation will be retained to reduce the likelihood of soil or other construction materials entering the water bodies.	**Blyth Estuary (GB510302203200)** **Tyne and Wear Coastal Water (GB650301500002)** Scoped out - given the implementation of the mitigation measures proposed, general construction would have negligible impacts on the surface water bodies within the study area including the retained Maw Burn, Cow Gut, Blyth Estuary and the Tyne and Wear Coastal Waters. This development activity has therefore been scoped out of any further assessment.
	Works in, over or adjacent to waterbodies including the realignment / culverting of open channels.	To ensure the quality of the water environment does not deteriorate during construction, a Construction Environmental Management Plan (CEMP) will be implemented and works would also be undertaken in accordance with a Landscape and Ecological Management Plan (LEMP). These plans will document best practice construction methodologies and describe procedures for the management of environmental impacts during construction, including a Pollution Control Plan, to safeguard the quality of surface water during the construction phase. Method statements will be prepared, and activities will be managed and monitored, to include the following best practice measures: • Avoiding the storage of any potentially polluting materials near any waterbodies, including stockpiles of soil to reduce potential for sedimentation. Where this is not possible works will be undertaken in accordance with approved method statements and in accordance with environmental permitting requirements / restrictions in order to safeguard the water environment; • Fuels and chemicals will be stored, and refuelling will take place within bunded areas to prevent leakage, and these will be located away from waterbodies. Drainage from these areas will incorporate an isolation facility such that the outlet could be sealed in the event of a spill; • Concrete will be laid only following the suitable preparation of the ground surface and temporary shuttering used to contain potential leaks; • Designated washing out areas will be set up for concrete lorries with impermeable liners to protect the soil and groundwater below, and • Waste water generated from the construction compound(s) will be disposed of via appropriate means, for example pumped out and removed from site by tanker. An emergency spillage response plan will document measures to be implemented to prevent pollutants infiltrating into the soils beneath the site and reaching surface and groundwater receptors. Appropriate equipment (e.g. absorption mats) will also be made easily accessible on site to deal with accidental spillages and the plan will also provide a full list of protocols and communication channels with the EA in the event of an accidental pollution incident. Should any pollution incidents occur, the EA incident hotline will be called immediately in tandem with dealing with any spillages. A suitably qualified and experienced ecologist will be available throughout the duration of the works to act as the Ecological Clerk of Works, providing ongoing advice to the construction team and undertaking site visits to assess any specific issues, where considered necessary. To ensure surface water drainage is managed suitably during construction, elements of the sustainable drainage systems for the proposed development would be put in place early in the construction process prior to any significant increase in impermeable area on site.	**Blyth Estuary (GB510302203200)** **Tyne and Wear Coastal Water (GB650301500002)** Scoped in - these development activities carry a higher risk of causing deterioration of waterbody status and preventing future improvements in status. Note: no works are proposed in, over, adjacent to or within 8m of the channel of the Blyth Estuary therefore it is the Maw Burn and Cow Gut Waterbodies that are to be assessed further.

Operational Phase	Changes in flow conveyance and/or local hydraulics of watercourse being realigned and culverted. Increase in flood risk – increased surface water runoff from impermeable areas and due to soil compaction / disturbance. Pollution due to receipt of development site surface water drainage	The development has been sited outside of the mapped 1 in 100 year flood extents for the Blyth Estuary as defined by the on line maps. The proposed diversions provide an improved open channel where possible which has improved capacity compared to the existing largely culverted watercourses. The channels and culverts have been assessed to ensure they are capable of conveying the flow calculated for the individual routes. It has also been realigned with geometry significantly greater than the current largely culverted systems. An ordinary watercourse consent application under the Land Drainage Act 1991 will be obtained as required from Northumbria County Council, as the LLFA, for works impacting on the flow conveyance of the Maw Burn and Cow Gut. The ordinary watercourse consent application will demonstrate that: • The design of the watercourse realignment and the culverting of the watercourse will cause no increase in flood risk either upstream or downstream. • Access to the watercourse network for maintenance and improvement will not be prejudiced. • Works will be carried out in such a way as to avoid environmental damage, including detriment to water quality. Surface water drainage from the proposed development site would be managed using a sustainable drainage system (SuDS) designed to minimise impacts on the water environment and to comply with national and local policy requirements. A detailed Surface Water Drainage Strategy has been produced as part of the current planning application process for review by the LLFA (Northumberland County Council). The drainage strategy is designed to ensure the proposed development results in no detriment to existing drainage patterns. Permeable paving, filter strips, swales, oil separators and storage basins would be incorporated into the SuDS system. It is proposed that clean roof water would enter a separated, sealed surface water system, likely via syphonic roof drainage. Roof water would be connected to the site wide rainwater harvesting system systems via their own drainage network. Surface water runoff from the proposed highways would discharge into swales, filter strips and kerb drainage systems, which would limit ingress of debris into the downstream system. Car park areas would be permeable and surface water would be directed through the permeable media into the drainage system. The service yards would be directed through a class 1 full retention petrol interceptor to act as further water quality control. The use of SuDS would promote good water quality standards for discharge effluents and would be integrated into the landscaping plans to create new wildlife spaces and valuable open amenity areas. The SuDs proposals would ensure that existing discharge rates would not be exceeded during rainfall events up to a 1 in 100 (1%) annual probability including an allowance for climate change. Runoff would be managed in line with the requirements set out in the North-East LeadLocal Flood Authorities Sustainable Drainage Local Standards, and appropriate drainage, attenuation and flow control would be provided. During the lifetime of the proposed development, the SuDS drainage infrastructure would be subject to a suitable maintenance regime to ensure that design standards of attenuation and water quality treatment are sustained.	**Blyth Estuary (GB510302203200)** **Tyne and Wear Coastal Water (GB650301500002)** Scoped in - these development activities carry a higher risk of causing deterioration of the screened in surface waterbody status and preventing future improvements in status. Note: no works are proposed in, over, adjacent to or within 8m of the channel of the Blyth Estuary therefore it is the Maw Burn and Cow Gut Waterbodies that are to be assessed further.

Table 3 details the components of the proposed development and their relationship to the screened in waterbodies where relevant. This stage of the assessment establishes which components of the proposed development have the potential to affect the WFD objectives of these waterbodies.

Construction and operational components of the proposed development associated with the realignment and de-culverting of the Cow Gut and Maw Burn are to be taken forward to Stage 4. At this stage, further consideration is given as to whether the construction / operational activities pose a residual risk to causing waterbody deterioration following consideration of the mitigation and compensation measures proposed to be integrated into the proposed development design.

7.0 STAGE 4 – WFD PRELIMINARY ASSESSMENT

7.1 APPROACH

For those development activities screened in, an assessment has been undertaken to determine whether the works undertaken, are likely to result in:

- failure to achieve good ecological status or good ecological potential;
- failure to prevent any deterioration in the status, of a waterbody;
- permanent exclusion, or compromised achievement, of WFD objectives for a waterbody;
- non-compliance or compromised implementation of other EU legislations; and/or
- prevention of implementing any of the mitigation measures specified in the Northumbria RBMP, 2016 or detailed on the Environment Agency's Catchment Data Explorer website.

The assessment has been informed by the results of several desktop studies, ecological surveys and hydraulic modelling (including of the realignment and culverting works).

7.1.1 STATUTORY CONSULTATION

Consultation has been carried out with Natural England (NE), Northumberland County Council's Ecologist and the Environment Agency with reference to the ecological surveys that have been undertaken on the site in general. Following extensive consultation, no objections or concerns were raised on the basis of the mitigation measures outlined in Section 7.2 below.

7.2 WFD MITIGATION MEASURES ASSESSMENT

The realignment and culverting works proposed to the Maw Burn and Cow Gut is under an EA Risk Category 5, classified as a Red activity under the traffic light system of WFD risk screening for rivers (EA, 2016). The red designation identifies the potential for risk to WFD objectives, and the works therefore require further review.

As detailed in Section 5.2, the Maw Burn and Cow Gut have no specific mitigation measures stated in the RBMP or on the Environment Agency's Catchment Data Explorer website. The proposed realignment and culverting works would not impede the implementation of any specific measures or programme of works planned for in the RBMP for the Blyth Estuary or the Tyne and Wear coastal waters.

Regardless, to satisfy WFD objectives it will be necessary to implement specific construction and operational phase embedded design and mitigation. These mitigations and design features would aim to reduce the detrimental impacts of the works, such that when considered at the waterbody scale, residual effects are negligible.

Construction and operational phase mitigation measures are summarised in Table 3 above. As noted, the design of the realignment and de-culverting of the Maw Burn and Cow Gut has been informed by hydraulic assessment as well as ecological surveys and appraisal. The works would be designed to ensure the maximum extent of the watercourse is de-culverted and where provided the culverts will be sized appropriately. The detailed design will be subject to a full Land Drainage approval from Northumberland County Council.

Although there were no fish identified during the survey undertaken on the site, the design of the re-routed watercourses aims to remove and/or limit any barriers for migratory fish movement, for example eels. This will therefore be creating a much better-quality habitat for any potential fish or amphibians.

7.3 RESIDUAL IMPACTS

Table 4 below provides a summary of the assessment of the residual effects of the realignment and culverting works comprising the proposed development on surface water bodies within the ZoI.

WATER BODY	PROPOSED DEVELOPMENT ACTIVITY	MITIGATION MEASURES	RESIDUAL RISK OF DETERIORATION AT THE WATER BODY SCALE
Cow Gut and Maw Burn Watercourses	Channel Realignment de-culverting and limited re-culverting	Hydraulic assessment and ecological surveys have informed design. Culvert and channel design significantly increased capacity provision. Most of the waterbody is affected by channel realignment and de-culverting. Natural materials would be used, including appropriate planting of vegetation. Significant improvement to the extent of open channel provision throughout the site in comparison to the current mainly culverted watercourses.	Negligible
	Surface water runoff discharges into the watercourse	On site SuDs and pollution prevention measures will ensure no detriment to the water quality of discharges	Negligible

Table 4: Summary of Residual Effects

8.0 CUMULATIVE IMPACTS

As the site drainage connects to watercourses linked directly to the estuary and North Sea, cumulative impacts of potential surrounding development sites would be negligible.

9.0 SUMMARY AND CONCLUSIONS

A screening assessment has been undertaken in relation to the proposed development of the former Coal Stocking Yard, Cambois against WFD objectives.

The WFD waterbodies that were screened in were limited to the Blyth Estuary (GB510302203200), Tyne and Wear Coastal Water (GB650301500002) and the Cow Gut and Maw Burn watercourses within the site which outfall to the WFD waterbodies.

The North Burn main river was scoped out of any further assessment owing to the distance of the water body from the proposed development and the inclusion of an 8m , development free riparian corridor along the stretch of the river that borders the north east of the proposed development site.

The review of the development components concluded the potential for negative effects linked to some specific construction activities and during operation. These activities were taken forward to stage 4 of the assessment.

Stage 4 has concluded negligible residual effects on waterbody status following implementation of the mitigation measures outlined in Table 3 and Section 7.2 of this assessment.

This assessment concludes that the proposed development is compliant with the objectives of the WFD and on this basis, no further assessment is proposed.

10.0 REFERENCES

- DEFRA / Environment Agency (2009). Northumbria River Basin District Management Plan: 2016.
- Environment Agency (2016). Catchment Data Explorer website. https://environment.data.gov.uk/catchment-planning/OperationalCatchment/3037
- European Commission (Joint Nature Conservation Committee (JNCC)) (1992). Directive 92/43/EEC on the Conservation of natural habitats and of wild fauna and flora.
- UK Government (2003). The Water Environment (Water Framework Directive) (England and Wales) Regulations 2003
- UK Government (2010). Conservation of Habitats and Species Regulations 2010.

APPENDIX A – SUPPORTING INFORMATION

200473-RGL-ZZ-XX-DR-Z-100-0002	Site Location Plan
PHX-RGL-ZZ-ST-SK-D-010042	Watercourse and Waterbody location plan
PHX-RGL-ZZ-ST-DR-D-010021	Watercourse Diversion Details Sheet 1
PHX-RGL-ZZ-ST-DR-D-010022	Watercourse Diversion Details Sheet 2
PHX-RGL-ZZ-ST-DR-D-010023	Watercourse Diversion Details Sheet 3
PHX-RGL-ZZ-ST-DR-D-100001	Drainage Strategy Layout

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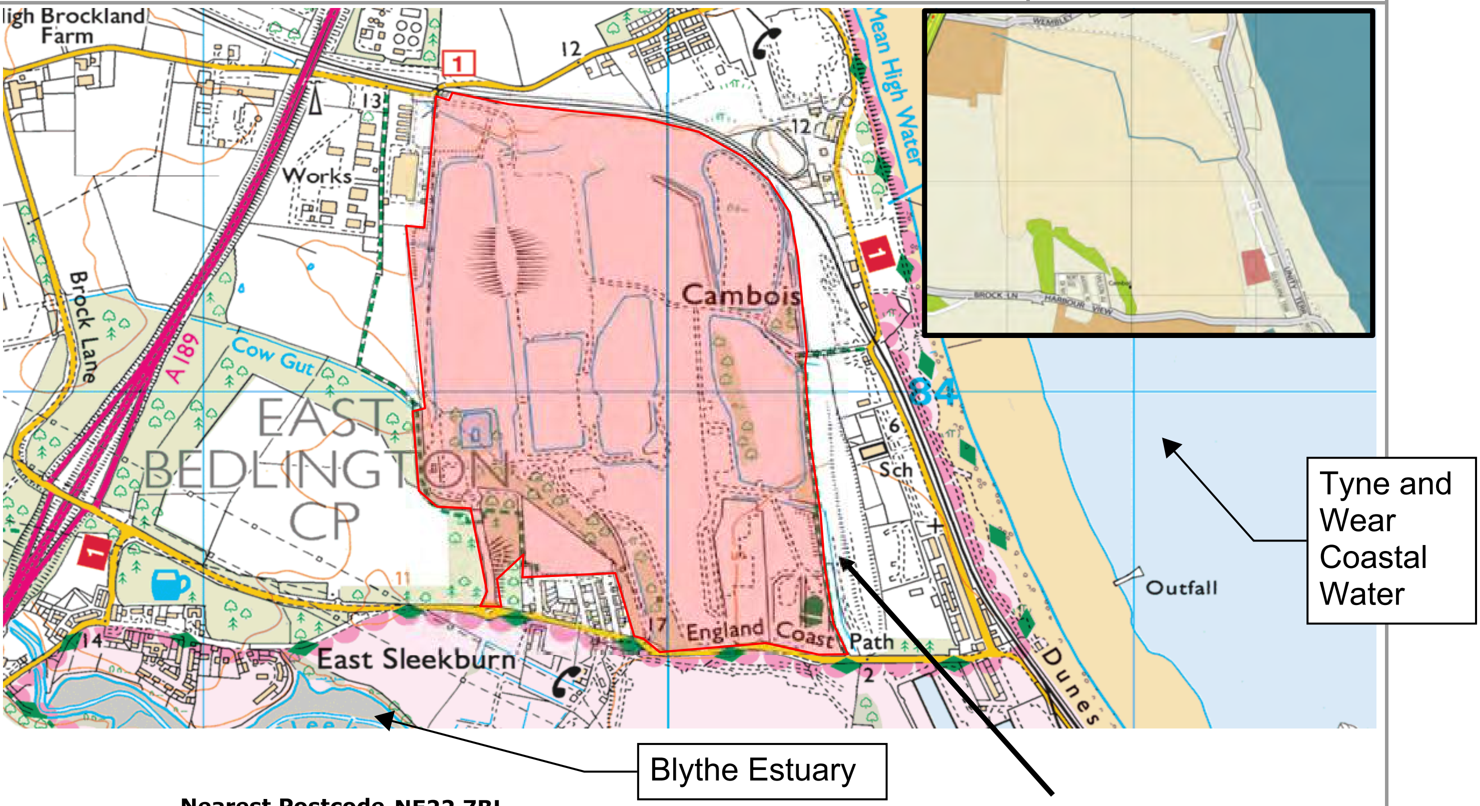
Project No.	20-0473 - Project Phoenix
Figure No & Title	1. Site Location Plan
Date	February 2021
Scale	N.T.S.
Prepared by	EMS



Nearest Postcode NE22 7BL
Approx Grid Reference 429898 / 584020

DO NOT SCALE

Standard construction hazards that a competent contractor would be aware of have not been identified on this drawing. Risks that may not be immediately apparent are listed below:

Status	Date	Description	Dwn	Eng	Chkd	Veri
S2-P01	13.05.21	Issued for Information	CBo	JRW	SDP	SDP

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Project:
BRITISHVOLT
PROJECT PHOENIX

Drawing Title:
Watercourse and Waterbody location plan

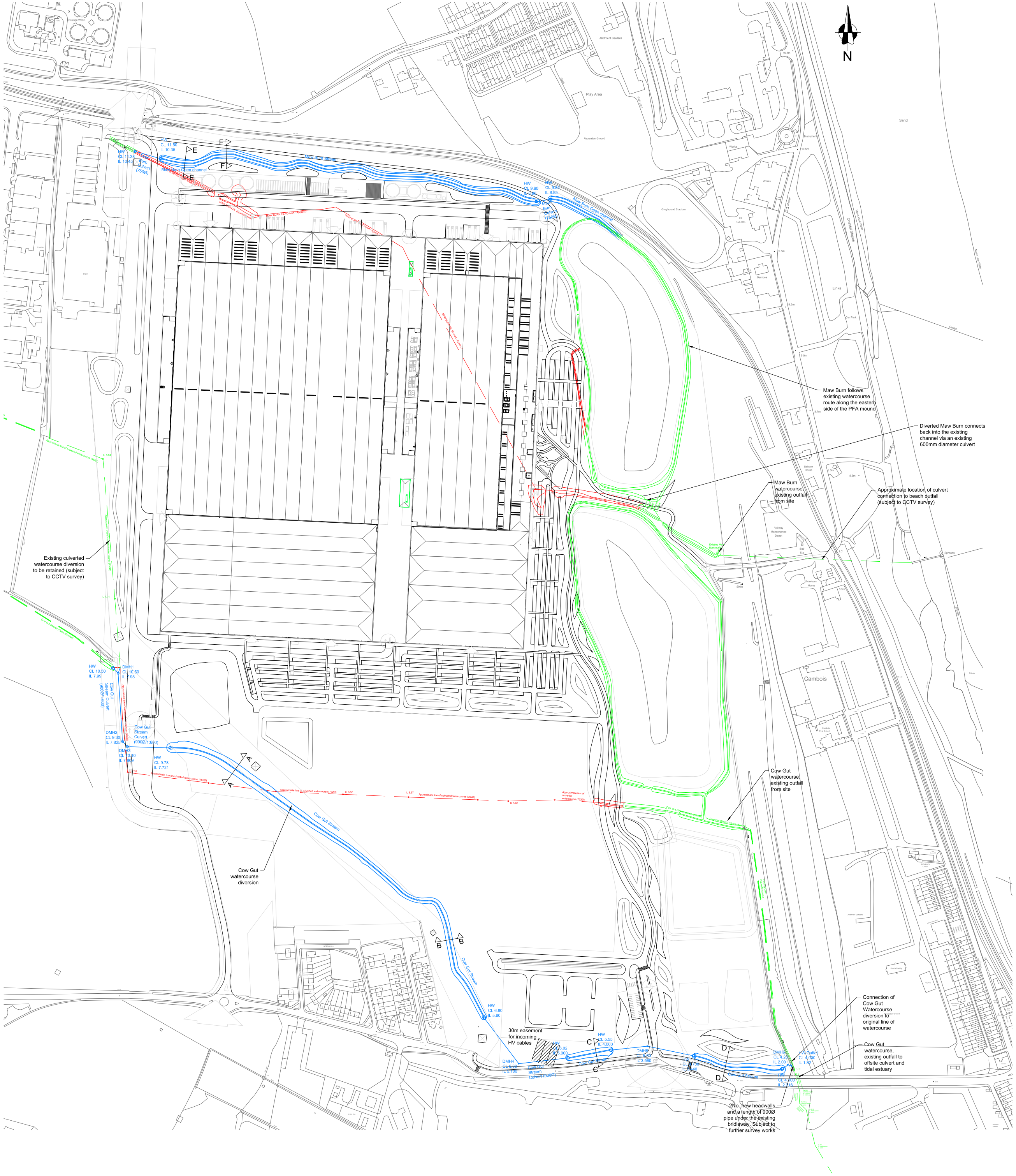
RGL Project Ref:	Scale@A1	Scale@A3
20-0473	1:4000	1:8000

Specification(s):

Drawing Number:
PHX-RGL-ZZ-ST-SK-D-010042
Project-Originator-Zone-Level-Type-Role-Classification-Number

Issue Purpose: INFORMATION

Status: S2-P01
Suitability-Revision



Watercourse Plan key

- Existing watercourse to be retained
- Existing watercourse to be removed
- Proposed watercourse diversion route

Notes

1. This drawing is to be read in conjunction with all the relevant contract documentation.
2. All dimensions are in mm unless otherwise stated. Dimensions to be checked on site prior to construction and any discrepancies reported to the Rolton Group Engineer.
3. Only drawings that indicate CONSTRUCTION as the issue purpose should be used for construction.
4. Any CONSTRUCTION status issue does not provide or imply approval or validation of any third party information.
5. Revision clouds are shown for assistance only, the whole drawing is to be checked for new / amended information.
6. Not all hatches and linetypes shown on legends and keys may be present on this drawing. Drawings to be printed in colour by default, typical material colours are for clarity only
7. All existing inlets and outlets to Cow Gut Stream and Maw Burn to be cleared of any debris.
8. Existing sections of watercourses that are to be retained are to be cleared of any debris.

DO NOT SCALE

Standard construction hazards that a competent contractor would be aware of have not been identified on this drawing. Risks that may not be immediately apparent are listed below:

Status	Date	Description	Dwn	Eng	Chkd	Veri
D3-P01	13.04.21	Issued for Contractor design, drawing ref renamed from PHX-RGL-ZZ-ST-SK-D-01002	CBo	JRW	SDP	SDP
D3-P02	07.05.21	Cow gut stream culverts updated. Maw Burn existing route updated to new survey info	CBo	JRW	SDP	SDP

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Project:
BRITISHVOLT
PROJECT PHOENIX

Drawing Title:
Watercourse Diversion Details Sheet 1

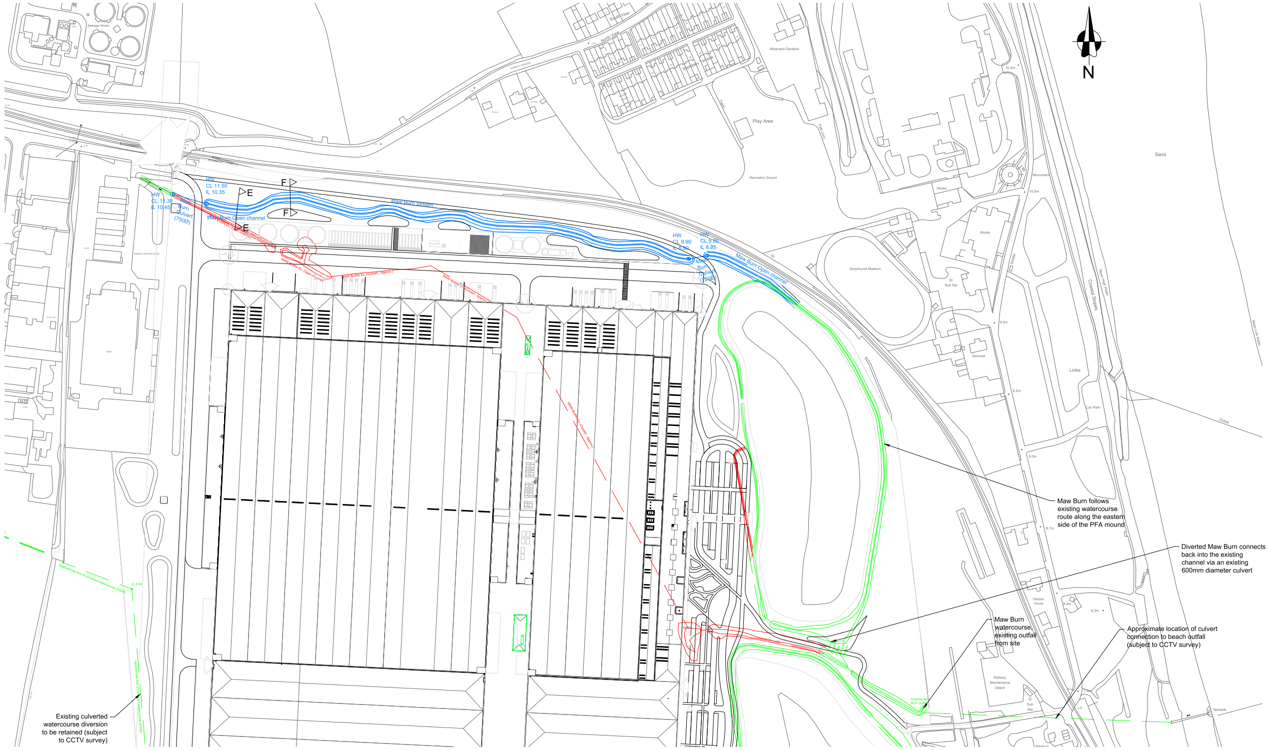
RGL Project Ref:	Scale@A0	Scale@A3
20-0473	1:2000	NTRS

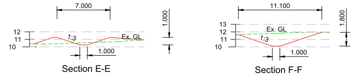
Specification(s):

Drawing Number:
PHX-RGL-ZZ-ST-DR-D-010021
Project-Originator-Zone-Level-Type-Role-Classification-Number

Issue Purpose: CONTRACTOR DESIGN

Status: D3-P02
Suitability-Revision





Section E-E
Scale 1:250 Datum: 10.000

Section F-F
Scale 1:250 Datum: 10.000

Notes

1. This drawing is to be read in conjunction with all the relevant contract documentation.
2. All dimensions are in mm unless otherwise stated. Dimensions to be checked on site prior to construction and any discrepancies reported to the Rolton Group Engineer.
3. Only drawings that indicate CONSTRUCTION as the issue purpose should be used for construction.
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7. All existing inlets and outlets to Cow Gut Stream and Maw Burn to be cleared of any debris.
8. Existing sections of watercourses that are to be retained are to be cleared of any debris.

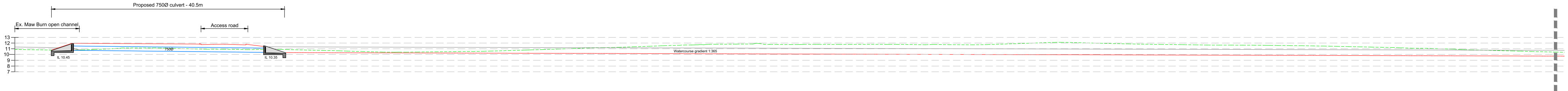
DO NOT SCALE

Standard construction hazards that a competent contractor would be aware of have not been identified on this drawing. Risks that may not be immediately apparent are listed below:

Status	Date	Description	Dwn	Eng	Chkd	Veri
D3-P01	07.05.21	Issued for Contractor design	JRW	JRW	SDP	SDP

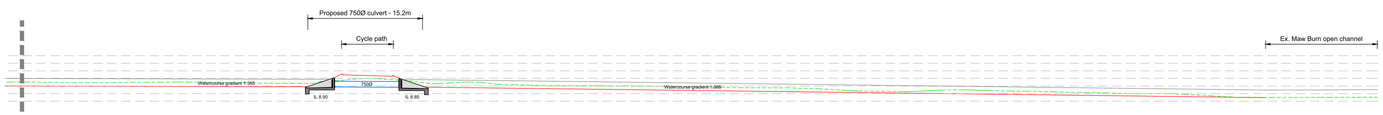
Watercourse Plan key

Existing watercourse to be retained
Existing watercourse to be removed
Proposed watercourse diversion route



Maw Burn Longsection
Scale 1:250 Datum: 7.000

Maw Burn Longsection
Scale 1:250 Datum: 7.000



Maw Burn Longsection
Scale 1:250 Datum: 7.000

Watercourse Section key

Existing ground level
Proposed ground level
Top of watercourse beyond

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Project:
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PROJECT PHOENIX

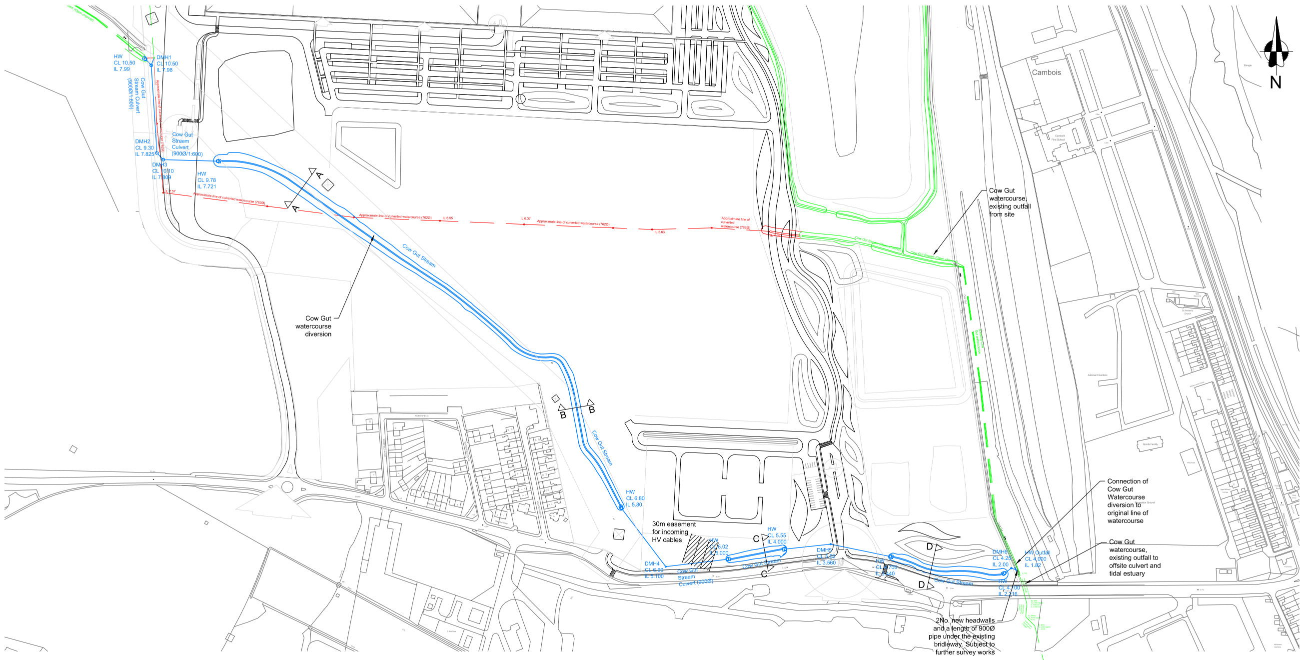
Drawing Title:
Watercourse Diversion Details Sheet 2

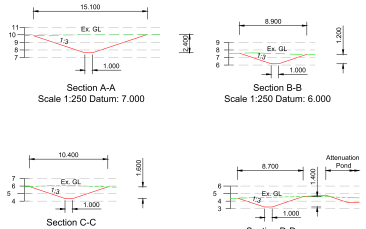
RGL Project Ref:	Scale@A0	Scale@A3
20-0473	1:2000	NTRS

Specification(s):

Drawing Number:
PHX-RGL-ZZ-ST-DR-D-010022
Project-Originator-Zone-Level-Type-Role-Classification-Number

Issue Purpose: CONTRACTOR DESIGN
Status: D3-P01
Suitability-Revision





Section A-A
Scale 1:250 Datum: 7.000

Section B-B
Scale 1:250 Datum: 6.000

Section C-C
Scale 1:250 Datum: 4.000

Section D-D
Scale 1:250 Datum: 3.000

Notes

1. This drawing is to be read in conjunction with all the relevant contract documentation.
2. All dimensions are in mm unless otherwise stated. Dimensions to be checked on site prior to construction and any discrepancies reported to the Rolton Group Engineer.
3. Only drawings that indicate CONSTRUCTION as the issue purpose should be used for construction.
4. Any CONSTRUCTION status issue does not provide or imply approval or validation of any third party information.
5. Revision clouds are shown for assistance only, the whole drawing is to be checked for new / amended information.
6. Not all hatches and linetypes shown on legends and keys may be present on this drawing. Drawings to be printed in colour by default, typical material colours are for clarity only
7. All existing inlets and outlets to Cow Gut Stream and Maw Burn to be cleared of any debris.
8. Existing sections of watercourses that are to be retained are to be cleared of any debris.

Standard construction hazards that a competent contractor would be aware of have not been identified on this drawing. Risks that may not be immediately apparent are listed below:

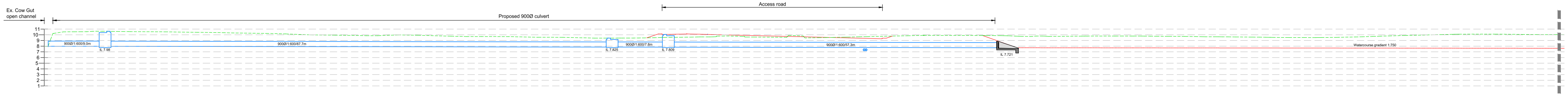
Status	Date	Description	Dwn	Eng	Chkd	Veri
D3-P01	07.05.21	Issued for Contractor design	JRW	JRW	SDP	SDP

Watercourse Plan key

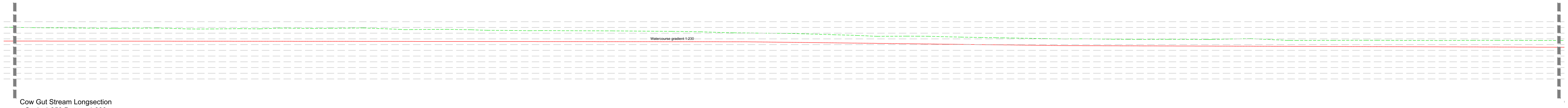
- Existing watercourse to be retained
- Existing watercourse to be removed
- Proposed watercourse diversion route

Watercourse Section key

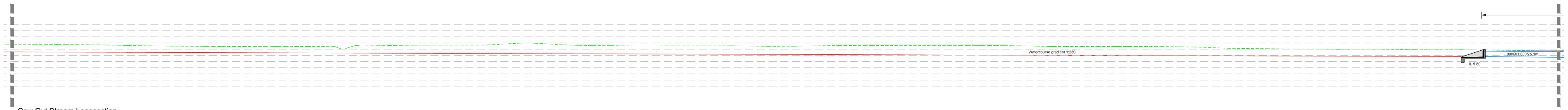
- Existing ground level
- Proposed ground level



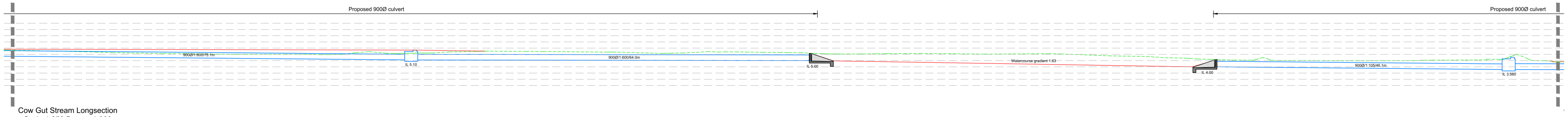
Cow Gut Stream Longsection
Scale 1:250 Datum: 1.000



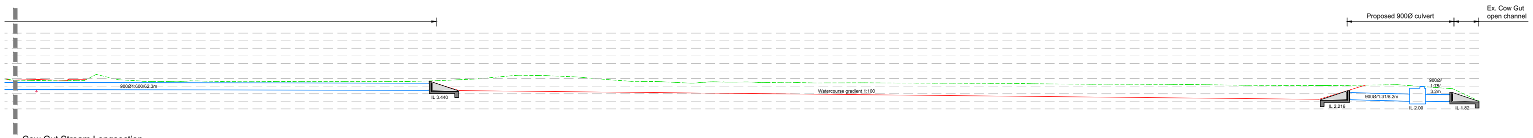
Cow Gut Stream Longsection
Scale 1:250 Datum: 1.000



Cow Gut Stream Longsection
Scale 1:250 Datum: 1.000



Cow Gut Stream Longsection
Scale 1:250 Datum: 1.000



Cow Gut Stream Longsection
Scale 1:250 Datum: 1.000

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Project:
BRITISHVOLT
PROJECT PHOENIX

Drawing Title:
Watercourse Diversion Details Sheet 3

RGL Project Ref:	Scale@A0	Scale@A3
20-0473	1:2000	NTRS

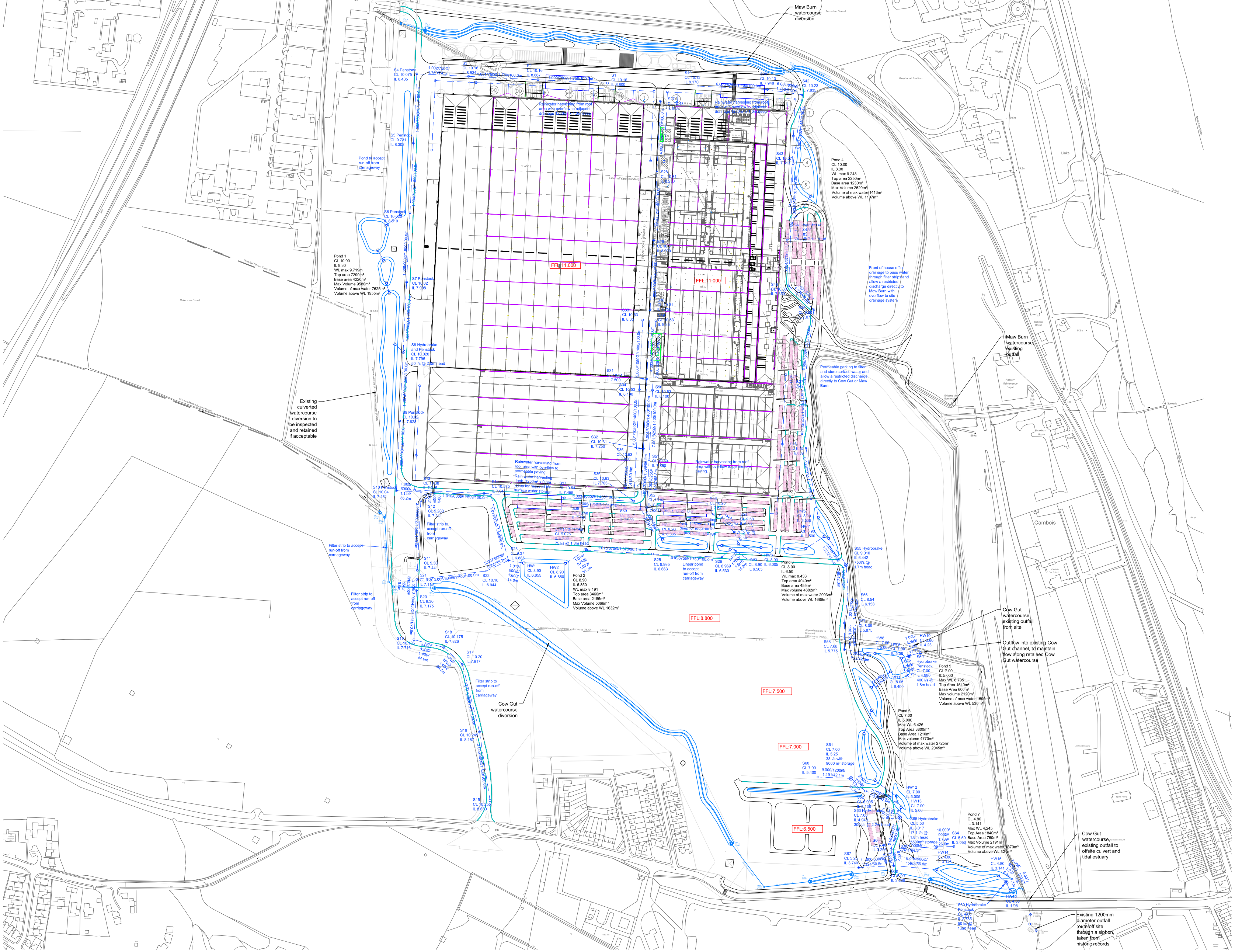
Specification(s):

Drawing Number:
PHX-RGL-ZZ-ST-DR-D-010023
Project-Originator-Zone-Level-Type-Role-Classification-Number

Issue Purpose: CONTRACTOR DESIGN
Status: D3-P01
Suitability-Revision

Notes

1. This drawing is to be read in conjunction with all the relevant contract documentation.
2. All dimensions are in mm unless otherwise stated. Dimensions to be checked on site prior to construction and any discrepancies reported to the Rolton Group Engineer.
3. Only drawings that indicate CONSTRUCTION as the issue purpose should be used for construction.
4. Any CONSTRUCTION status issue does not provide or imply approval or validation of any third party information.
5. Revision clouds are shown for assistance only, the whole drawing is to be checked for new / amended information.
6. Not all hatches and linetypes shown on legends and keys may be present on this drawing. Drawings to be printed in colour by default, typical material colours are for clarity only.



Standard construction hazards that a competent contractor would be aware of have not been identified on this drawing. Risks that may not be immediately apparent are listed below:

Status	Date	Description	Dwn	Eng	Chkd	Veri
S2-P01	23.10.20	Issued for information	JW	JW	SP	SP
S2-P02	15.12.20	Drainage updated to suit new site plan	JW	JW	SP	SP
S2-P03	15.01.21	Ponds updated to suit new site and landscape plan	JW	JW	SP	SP
S2-P04	19.01.21	Site plan updated Rainwater harvesting drainage added	JW	JW	SP	SP
S2-P05	06.05.21	Drainage layout updated	JW	JW	SP	SP

PROPOSED SURFACE WATER DRAINAGE KEY

- Existing Watercourse [open/culverted] to be removed
- Existing Watercourse [open/culverted] to be retained
- Proposed Watercourse [open/culverted]
- Proposed Storm Water Gravity Sewer
- Permeable Paving
- SW Linear Drainage
- Proposed Storm Water Filter strip
- Storm water attenuation ponds /Bioretention areas
- Proposed Swale / Ditch
- Proposed rainwater harvesting tanks
- Proposed Watercourse attenuation
- Storm Water PCC MH/CP
- Surface Water Hydrobrake Chamber
- Headwall (shown NTS)
- FFL:11.000 Proposed Finished Floor Level
- Proposed Overland flow route

NOTES:

1. Drainage layout is indicative only based on current site plan and constraints survey level data.
2. Drainage design is based on a Greenfield run-off with no allowance for infiltration.
3. Total impermeable area = 56.909Ha.
4. Proposed Levels subject to completion of site topographical survey
5. Future development plots are assumed as 100% impermeable and indicated with the required run-off rate (Qbar) and approximate storage to ensure the flows can be accommodated by the main site network
6. Separators have not been indicated due to the scale of the drawing, however they will be required to protect the service yard upstream of MHS1 and S13 and will be identified on the detailed drainage plans.
5. Drainage strategy subject to LLFA and EA approval.

Surface Water Drainage Strategy brief description:

Surface water run-off from the roof will be directed to rainwater harvesting tanks where possible which will contain a degree of attenuation storage. Overflow from these will be directed to the network of surface water drainage which will also accommodate the external areas. Where possible the external areas will receive a primary suds treatment in the form of swales/filter strips prior to entering the below ground drainage system. The drainage enters a linked system of ponds to provide on line treatment and attenuation to accommodate the 1 in 30 year return period storm event with final discharge to the Cow Gut watercourse in the South East corner of the site. For storms in excess of 1 in 30 year return period events surface water flooding of roads/parking areas to shallow depths only has been assumed to ensure this is contained within the site, prior to off site discharge. All future plots will be required to self-attenuate to Greenfield run-off flows.

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Project:
Project Phoenix

Drawing Title:
Proposed Outline Surface Water Drainage Strategy

RGL Project Ref:	Scale@A0	Scale@A3
20-0473	1:2000	NTRS

Specification(s):

Drawing Number:
PHX-RGL-ZZ-ST-DR-D-100001
Project-Originator-Zone-Level-Type-Role-Classification-Number

Issue Purpose:	Status:
INFORMATION	S2-P05 Suitability-Revision

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DEFINITIONS

The Client: Britishvolt

The Development: Former Coal Stockings yard, Cambois

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Appendix D - C2 category for North East Mining Groundwater Constraints

The below provides extracts from the of the drainage consideration for sites within a coalfield area that may experience shallow mine water. Further information can be found online https://www.gov.uk/guidance/mining-and-groundwater-constraints-for-development.

Drainage consideration for a development located on a **Coalfield Area –** The Coal Authority: *Mining and Groundwater Constraints for Sustainable Development and Drainage Systems (North East England only) Document*:

Coalfield Area:

- *"The site may be affected by shallow mine water, or shallow mine workings. shallow mine water could be a perched water level, lying high above the regional level.*
- *The site may lay over land containing mining features which may form groundwater pathways, such as mine entries (shafts, or adits), geological fault lines, opencast backfill, or high walls.*
- *In some areas of the United Kingdom aquifer rocks are prone to coal mine related fissuring. Previous coal mine activities could increase the natural fissuring within aquifer rock. Since fissures are near surface features, they have potential to affect site drainage systems."*

Drainage consideration for a development located on land with **Shallow Mine Water Present:**

Shallow Mine Water Present:

- *"The presence of mine water at shallow depths below surface, and associated saturated ground conditions, could limit the effectiveness of infiltration type SuDS (including any SuDS which have an infiltration component). In the worst case, the mine water level may rise sufficiently in response to rainfall events, or seasonal changes, that it becomes artesian. This could lead to groundwater flooding events. The source of the flood water would be the mine water, and the pathway would be the installed infiltration SuDS acting with a reverse, upwards flow.*
- *In low lying areas, site developments may disturb the ground and create new pathways for mine water to flow through the ground. Mine water also typically contains iron and iron rich deposits can build up, that can render SuDS ineffective as they become clogged by iron deposits. Increasing the risk of groundwater/ mine water flooding.*
- *It is important to consider the overall design lifetime of any site drainage system within an area where shallow mine water is present."*

Action to take when **Category C2**

Category C2 - Shallow Mine Water Present

- If there is no hydraulic connection to the mine workings, for example a mine entry, pathway or borehole, including site investigation works, no specific consultation is required.
- However, impacts of the proposal and suitability of the subsurface coalfield environment should be considered.
- Follow CIRIA's SuDS manual (C753) for assessing pollution and flood risk on controlled waters, including groundwater, to provide a fully justified risk assessment to support sustainable development.
- If there is hydraulic connection to the mine workings, for example a mine entry, pathway or borehole, including site investigation works, infiltration SuDS may not work either now, or in the future. All SuDS could be impacted by mine water.
- The developer should suggest alternative methodologies and must undertake pre-application consultation with the Coal Authority and pre-consultation with Lead Local Flood Authority for drainage proposals, other than drainage to the network.

Appendix B Greenfield Runoff Rate Calculations

UK Design Flood Estimation

Generated on 05 May 2023 12:16:50 by chloenelson
Printed from the ReFH2 Flood Modelling software package, version 3.3.8355.27598

Summary of estimate using the Flood Estimation Handbook revitalised flood hydrograph method (ReFH2)

Site details

Checksum: D204-DAAE

Site name: FEH_Point_Descriptors_429185_583779_v5_0_1

Easting: 429185

Northing: 583779

Country: England, Wales or Northern Ireland

Catchment Area (km²): 0.01 [0.5]*

Using plot scale calculations: Yes

Model: 2.3

Site description: None

Model run: 1 year

Summary of results

Rainfall - FEH 2013 model (mm):	16.13	Total runoff (ML):	0.05
Total Rainfall (mm):	10.22	Total flow (ML):	0.10
Peak Rainfall (mm):	3.45	Peak flow (m /s):	0.00

Parameters

Where the user has overriden a system-generated value, this original value is shown in square brackets after the value used.
** Indicates that the user locked the duration/timestep*

Rainfall parameters (Rainfall - FEH 2013 model)

Name	Value	User-defined?
Duration (hh:mm:ss)	03:30:00	No
Timestep (hh:mm:ss)	00:30:00	No
SCF (Seasonal correction factor)	0.64	No
ARF (Areal reduction factor)	1	No
Seasonality	Winter	No

Loss model parameters

Name	Value	User-defined?
Cini (mm)	126.16	No
Cmax (mm)	266.38	No
Use alpha correction factor	No	No
Alpha correction factor	n/a	No

Routing model parameters

Name	Value	User-defined?
Tp (hr)	2.05 [1]	Yes
Up	0.65	No
Uk	0.8	No

Baseflow model parameters

Name	Value	User-defined?
BF0 (m^3/s)	0	No
BL (hr)	30.72 [22.83]	Yes
BR	1.03	No

Urbanisation parameters

Name	Value	User-defined?
Urban area (km^2)	0	No
Urbext 2000	0	No
Impervious runoff factor	0.7	No
Imperviousness factor	0.4	No
Tp scaling factor	0.75	No
Depression storage depth (mm)	0.5	No
Exporting drained area (km^2)	0.00	Yes
Sewer capacity (m^3/s)	0.00	Yes

Time series data

Time (hh:mm:ss)	Rain (mm)	Sewer Loss (m³/s)	Net Rain (mm)	Runoff (m³/s)	Baseflow (m³/s)	Total Flow (m³/s)
00:00:00	0.4153	0.0000	0.1970	0.0000	0.000393	0.000393
00:30:00	0.9296	0.0000	0.4433	0.0000	0.000387	0.000408
01:00:00	2.0382	0.0000	0.9834	0.0001	0.000381	0.000492
01:30:00	3.4521	0.0000	1.7012	0.0004	0.000379	0.000733
02:00:00	2.0382	0.0000	1.0254	0.0009	0.000383	0.00127
02:30:00	0.9296	0.0000	0.4728	0.0017	0.000398	0.00208
03:00:00	0.4153	0.0000	0.2123	0.0025	0.000427	0.00297
03:30:00	0.0000	0.0000	0.0000	0.0032	0.000468	0.00371
04:00:00	0.0000	0.0000	0.0000	0.0035	0.000517	0.00406
04:30:00	0.0000	0.0000	0.0000	0.0034	0.000566	0.00392
05:00:00	0.0000	0.0000	0.0000	0.0029	0.000609	0.00353
05:30:00	0.0000	0.0000	0.0000	0.0024	0.000643	0.00304
06:00:00	0.0000	0.0000	0.0000	0.0019	0.000669	0.00258
06:30:00	0.0000	0.0000	0.0000	0.0015	0.000687	0.00222
07:00:00	0.0000	0.0000	0.0000	0.0012	0.000698	0.00191
07:30:00	0.0000	0.0000	0.0000	0.0009	0.000705	0.00163
08:00:00	0.0000	0.0000	0.0000	0.0006	0.000706	0.00135
08:30:00	0.0000	0.0000	0.0000	0.0004	0.000704	0.0011
09:00:00	0.0000	0.0000	0.0000	0.0002	0.000697	0.000893
09:30:00	0.0000	0.0000	0.0000	0.0001	0.000688	0.000764
10:00:00	0.0000	0.0000	0.0000	0.0000	0.000678	0.0007
10:30:00	0.0000	0.0000	0.0000	0.0000	0.000667	0.000671
11:00:00	0.0000	0.0000	0.0000	0.0000	0.000656	0.000656
11:30:00	0.0000	0.0000	0.0000	0.0000	0.000646	0.000646
12:00:00	0.0000	0.0000	0.0000	0.0000	0.000635	0.000635
12:30:00	0.0000	0.0000	0.0000	0.0000	0.000625	0.000625
13:00:00	0.0000	0.0000	0.0000	0.0000	0.000615	0.000615
13:30:00	0.0000	0.0000	0.0000	0.0000	0.000605	0.000605
14:00:00	0.0000	0.0000	0.0000	0.0000	0.000595	0.000595
14:30:00	0.0000	0.0000	0.0000	0.0000	0.000586	0.000586
15:00:00	0.0000	0.0000	0.0000	0.0000	0.000576	0.000576
15:30:00	0.0000	0.0000	0.0000	0.0000	0.000567	0.000567
16:00:00	0.0000	0.0000	0.0000	0.0000	0.000558	0.000558
16:30:00	0.0000	0.0000	0.0000	0.0000	0.000549	0.000549
17:00:00	0.0000	0.0000	0.0000	0.0000	0.00054	0.00054

Time (hh:mm:ss)	Rain (mm)	Sewer Loss (m³/s)	Net Rain (mm)	Runoff (m³/s)	Baseflow (m³/s)	Total Flow (m³/s)
17:30:00	0.0000	0.0000	0.0000	0.0000	0.000531	0.000531
18:00:00	0.0000	0.0000	0.0000	0.0000	0.000523	0.000523
18:30:00	0.0000	0.0000	0.0000	0.0000	0.000514	0.000514
19:00:00	0.0000	0.0000	0.0000	0.0000	0.000506	0.000506
19:30:00	0.0000	0.0000	0.0000	0.0000	0.000498	0.000498
20:00:00	0.0000	0.0000	0.0000	0.0000	0.00049	0.00049
20:30:00	0.0000	0.0000	0.0000	0.0000	0.000482	0.000482
21:00:00	0.0000	0.0000	0.0000	0.0000	0.000474	0.000474
21:30:00	0.0000	0.0000	0.0000	0.0000	0.000466	0.000466
22:00:00	0.0000	0.0000	0.0000	0.0000	0.000459	0.000459
22:30:00	0.0000	0.0000	0.0000	0.0000	0.000451	0.000451
23:00:00	0.0000	0.0000	0.0000	0.0000	0.000444	0.000444
23:30:00	0.0000	0.0000	0.0000	0.0000	0.000437	0.000437
24:00:00	0.0000	0.0000	0.0000	0.0000	0.00043	0.00043
24:30:00	0.0000	0.0000	0.0000	0.0000	0.000423	0.000423
25:00:00	0.0000	0.0000	0.0000	0.0000	0.000416	0.000416
25:30:00	0.0000	0.0000	0.0000	0.0000	0.000409	0.000409
26:00:00	0.0000	0.0000	0.0000	0.0000	0.000403	0.000403
26:30:00	0.0000	0.0000	0.0000	0.0000	0.000396	0.000396

Appendix

Catchment descriptors *

Name	Value	User-defined value used?
BFIHOST	0.31	No
BFIHOST19	0.33	No
PROPWET	0.33	No
SAAR (mm)	647	No

Values in square brackets are the original values loaded from the FEH Web Service or FEH CD-ROM

UK Design Flood Estimation

Generated on 05 May 2023 12:19:20 by chloenelson
Printed from the ReFH2 Flood Modelling software package, version 3.3.8355.27598

Summary of estimate using the Flood Estimation Handbook revitalised flood hydrograph method (ReFH2)

Site details

Checksum: D204-DAAE

Site name: FEH_Point_Descriptors_429185_583779_v5_0_1

Easting: 429185

Northing: 583779

Country: England, Wales or Northern Ireland

Catchment Area (km²): 0.01 [0.5]*

Using plot scale calculations: Yes

Model: 2.3

Site description: None

Model run: 2 year

Summary of results

Rainfall - FEH 2013 model (mm):	18.37	Total runoff (ML):	0.06
Total Rainfall (mm):	11.63	Total flow (ML):	0.12
Peak Rainfall (mm):	3.93	Peak flow (m /s):	0.00

Parameters

Where the user has overriden a system-generated value, this original value is shown in square brackets after the value used.
** Indicates that the user locked the duration/timestep*

Rainfall parameters (Rainfall - FEH 2013 model)

Name	Value	User-defined?
Duration (hh:mm:ss)	03:30:00	No
Timestep (hh:mm:ss)	00:30:00	No
SCF (Seasonal correction factor)	0.64	No
ARF (Areal reduction factor)	1	No
Seasonality	Winter	No

Loss model parameters

Name	Value	User-defined?
Cini (mm)	126.16	No
Cmax (mm)	266.38	No
Use alpha correction factor	No	No
Alpha correction factor	n/a	No

Routing model parameters

Name	Value	User-defined?
Tp (hr)	2.05 [1]	Yes
Up	0.65	No
Uk	0.8	No

Baseflow model parameters

Name	Value	User-defined?
BF0 (m^3/s)	0	No
BL (hr)	30.72 [22.83]	Yes
BR	1.02	No

Urbanisation parameters

Name	Value	User-defined?
Urban area (km^2)	0	No
Urbext 2000	0	No
Impervious runoff factor	0.7	No
Imperviousness factor	0.4	No
Tp scaling factor	0.75	No
Depression storage depth (mm)	0.5	No
Exporting drained area (km^2)	0.00	Yes
Sewer capacity (m^3/s)	0.00	Yes

Time series data

Time (hh:mm:ss)	Rain (mm)	Sewer Loss (m³/s)	Net Rain (mm)	Runoff (m³/s)	Baseflow (m³/s)	Total Flow (m³/s)
00:00:00	0.4728	0.0000	0.2243	0.0000	0.000393	0.000393
00:30:00	1.0582	0.0000	0.5052	0.0000	0.000387	0.000411
01:00:00	2.3202	0.0000	1.1223	0.0001	0.000382	0.000508
01:30:00	3.9298	0.0000	1.9470	0.0004	0.00038	0.000784
02:00:00	2.3202	0.0000	1.1767	0.0010	0.000385	0.0014
02:30:00	1.0582	0.0000	0.5434	0.0019	0.000403	0.00233
03:00:00	0.4728	0.0000	0.2441	0.0029	0.000436	0.00334
03:30:00	0.0000	0.0000	0.0000	0.0037	0.000484	0.0042
04:00:00	0.0000	0.0000	0.0000	0.0041	0.00054	0.00459
04:30:00	0.0000	0.0000	0.0000	0.0038	0.000596	0.00444
05:00:00	0.0000	0.0000	0.0000	0.0033	0.000645	0.00399
05:30:00	0.0000	0.0000	0.0000	0.0027	0.000685	0.00343
06:00:00	0.0000	0.0000	0.0000	0.0022	0.000714	0.00291
06:30:00	0.0000	0.0000	0.0000	0.0018	0.000735	0.00249
07:00:00	0.0000	0.0000	0.0000	0.0014	0.000749	0.00214
07:30:00	0.0000	0.0000	0.0000	0.0011	0.000757	0.00181
08:00:00	0.0000	0.0000	0.0000	0.0007	0.00076	0.0015
08:30:00	0.0000	0.0000	0.0000	0.0005	0.000757	0.00121
09:00:00	0.0000	0.0000	0.0000	0.0002	0.000751	0.000975
09:30:00	0.0000	0.0000	0.0000	0.0001	0.000741	0.000828
10:00:00	0.0000	0.0000	0.0000	0.0000	0.00073	0.000756
10:30:00	0.0000	0.0000	0.0000	0.0000	0.000719	0.000722
11:00:00	0.0000	0.0000	0.0000	0.0000	0.000707	0.000707
11:30:00	0.0000	0.0000	0.0000	0.0000	0.000696	0.000696
12:00:00	0.0000	0.0000	0.0000	0.0000	0.000684	0.000684
12:30:00	0.0000	0.0000	0.0000	0.0000	0.000673	0.000673
13:00:00	0.0000	0.0000	0.0000	0.0000	0.000663	0.000663
13:30:00	0.0000	0.0000	0.0000	0.0000	0.000652	0.000652
14:00:00	0.0000	0.0000	0.0000	0.0000	0.000641	0.000641
14:30:00	0.0000	0.0000	0.0000	0.0000	0.000631	0.000631
15:00:00	0.0000	0.0000	0.0000	0.0000	0.000621	0.000621
15:30:00	0.0000	0.0000	0.0000	0.0000	0.000611	0.000611
16:00:00	0.0000	0.0000	0.0000	0.0000	0.000601	0.000601
16:30:00	0.0000	0.0000	0.0000	0.0000	0.000591	0.000591
17:00:00	0.0000	0.0000	0.0000	0.0000	0.000582	0.000582

Time (hh:mm:ss)	Rain (mm)	Sewer Loss (m³/s)	Net Rain (mm)	Runoff (m³/s)	Baseflow (m³/s)	Total Flow (m³/s)
17:30:00	0.0000	0.0000	0.0000	0.0000	0.000572	0.000572
18:00:00	0.0000	0.0000	0.0000	0.0000	0.000563	0.000563
18:30:00	0.0000	0.0000	0.0000	0.0000	0.000554	0.000554
19:00:00	0.0000	0.0000	0.0000	0.0000	0.000545	0.000545
19:30:00	0.0000	0.0000	0.0000	0.0000	0.000536	0.000536
20:00:00	0.0000	0.0000	0.0000	0.0000	0.000528	0.000528
20:30:00	0.0000	0.0000	0.0000	0.0000	0.000519	0.000519
21:00:00	0.0000	0.0000	0.0000	0.0000	0.000511	0.000511
21:30:00	0.0000	0.0000	0.0000	0.0000	0.000502	0.000502
22:00:00	0.0000	0.0000	0.0000	0.0000	0.000494	0.000494
22:30:00	0.0000	0.0000	0.0000	0.0000	0.000486	0.000486
23:00:00	0.0000	0.0000	0.0000	0.0000	0.000478	0.000478
23:30:00	0.0000	0.0000	0.0000	0.0000	0.000471	0.000471
24:00:00	0.0000	0.0000	0.0000	0.0000	0.000463	0.000463
24:30:00	0.0000	0.0000	0.0000	0.0000	0.000456	0.000456
25:00:00	0.0000	0.0000	0.0000	0.0000	0.000448	0.000448
25:30:00	0.0000	0.0000	0.0000	0.0000	0.000441	0.000441
26:00:00	0.0000	0.0000	0.0000	0.0000	0.000434	0.000434
26:30:00	0.0000	0.0000	0.0000	0.0000	0.000427	0.000427
27:00:00	0.0000	0.0000	0.0000	0.0000	0.00042	0.00042
27:30:00	0.0000	0.0000	0.0000	0.0000	0.000413	0.000413
28:00:00	0.0000	0.0000	0.0000	0.0000	0.000407	0.000407
28:30:00	0.0000	0.0000	0.0000	0.0000	0.0004	0.0004

Appendix

Catchment descriptors *

Name	Value	User-defined value used?
BFIHOST	0.31	No
BFIHOST19	0.33	No
PROPWET	0.33	No
SAAR (mm)	647	No

Values in square brackets are the original values loaded from the FEH Web Service or FEH CD-ROM

UK Design Flood Estimation

Generated on 05 May 2023 12:19:51 by chloenelson
Printed from the ReFH2 Flood Modelling software package, version 3.3.8355.27598

Summary of estimate using the Flood Estimation Handbook revitalised flood hydrograph method (ReFH2)

Site details Checksum: D204-DAAE

Site name: FEH_Point_Descriptors_429185_583779_v5_0_1

Easting: 429185

Northing: 583779

Country: England, Wales or Northern Ireland

Catchment Area (km²): 0.01 [0.5]*

Using plot scale calculations: Yes

Model: 2.3

Site description: None

Model run: 30 year

Summary of results

Rainfall - FEH 2013 model (mm):	39.78	Total runoff (ML):	0.13
Total Rainfall (mm):	25.19	Total flow (ML):	0.25
Peak Rainfall (mm):	8.51	Peak flow (m /s):	0.01

Parameters

Where the user has overriden a system-generated value, this original value is shown in square brackets after the value used.
** Indicates that the user locked the duration/timestep*

Rainfall parameters (Rainfall - FEH 2013 model)

Name	Value	User-defined?
Duration (hh:mm:ss)	03:30:00	No
Timestep (hh:mm:ss)	00:30:00	No
SCF (Seasonal correction factor)	0.64	No
ARF (Areal reduction factor)	1	No
Seasonality	Winter	No

Loss model parameters

Name	Value	User-defined?
Cini (mm)	126.16	No
Cmax (mm)	266.38	No
Use alpha correction factor	No	No
Alpha correction factor	n/a	No

Routing model parameters

Name	Value	User-defined?
Tp (hr)	2.05 [1]	Yes
Up	0.65	No
Uk	0.8	No

Baseflow model parameters

Name	Value	User-defined?
BF0 (m^3/s)	0	No
BL (hr)	30.72 [22.83]	Yes
BR	0.92	No

Urbanisation parameters

Name	Value	User-defined?
Urban area (km^2)	0	No
Urbext 2000	0	No
Impervious runoff factor	0.7	No
Imperviousness factor	0.4	No
Tp scaling factor	0.75	No
Depression storage depth (mm)	0.5	No
Exporting drained area (km^2)	0.00	Yes
Sewer capacity (m^3/s)	0.00	Yes

Time series data

Time (hh:mm:ss)	Rain (mm)	Sewer Loss (m³/s)	Net Rain (mm)	Runoff (m³/s)	Baseflow (m³/s)	Total Flow (m³/s)
00:00:00	1.0240	0.0000	0.4869	0.0000	0.000393	0.000393
00:30:00	2.2919	0.0000	1.1041	0.0001	0.000387	0.000439
01:00:00	5.0253	0.0000	2.4900	0.0003	0.000383	0.000658
01:30:00	8.5114	0.0000	4.4335	0.0009	0.000385	0.00127
02:00:00	5.0253	0.0000	2.7454	0.0022	0.000402	0.00264
02:30:00	2.2919	0.0000	1.2836	0.0043	0.000444	0.00474
03:00:00	1.0240	0.0000	0.5799	0.0065	0.000518	0.00705
03:30:00	0.0000	0.0000	0.0000	0.0084	0.00062	0.00903
04:00:00	0.0000	0.0000	0.0000	0.0092	0.000741	0.00997
04:30:00	0.0000	0.0000	0.0000	0.0088	0.000863	0.00965
05:00:00	0.0000	0.0000	0.0000	0.0077	0.000971	0.00863
05:30:00	0.0000	0.0000	0.0000	0.0063	0.00106	0.00735
06:00:00	0.0000	0.0000	0.0000	0.0050	0.00113	0.00615
06:30:00	0.0000	0.0000	0.0000	0.0040	0.00118	0.0052
07:00:00	0.0000	0.0000	0.0000	0.0032	0.00121	0.0044
07:30:00	0.0000	0.0000	0.0000	0.0024	0.00123	0.00366
08:00:00	0.0000	0.0000	0.0000	0.0017	0.00124	0.00296
08:30:00	0.0000	0.0000	0.0000	0.0011	0.00124	0.0023
09:00:00	0.0000	0.0000	0.0000	0.0005	0.00123	0.00176
09:30:00	0.0000	0.0000	0.0000	0.0002	0.00122	0.00142
10:00:00	0.0000	0.0000	0.0000	0.0001	0.0012	0.00126
10:30:00	0.0000	0.0000	0.0000	0.0000	0.00118	0.00119
11:00:00	0.0000	0.0000	0.0000	0.0000	0.00116	0.00116
11:30:00	0.0000	0.0000	0.0000	0.0000	0.00115	0.00115
12:00:00	0.0000	0.0000	0.0000	0.0000	0.00113	0.00113
12:30:00	0.0000	0.0000	0.0000	0.0000	0.00111	0.00111
13:00:00	0.0000	0.0000	0.0000	0.0000	0.00109	0.00109
13:30:00	0.0000	0.0000	0.0000	0.0000	0.00107	0.00107
14:00:00	0.0000	0.0000	0.0000	0.0000	0.00106	0.00106
14:30:00	0.0000	0.0000	0.0000	0.0000	0.00104	0.00104
15:00:00	0.0000	0.0000	0.0000	0.0000	0.00102	0.00102
15:30:00	0.0000	0.0000	0.0000	0.0000	0.00101	0.00101
16:00:00	0.0000	0.0000	0.0000	0.0000	0.00099	0.00099
16:30:00	0.0000	0.0000	0.0000	0.0000	0.000974	0.000974
17:00:00	0.0000	0.0000	0.0000	0.0000	0.000958	0.000958

Time (hh:mm:ss)	Rain (mm)	Sewer Loss (m³/s)	Net Rain (mm)	Runoff (m³/s)	Baseflow (m³/s)	Total Flow (m³/s)
17:30:00	0.0000	0.0000	0.0000	0.0000	0.000943	0.000943
18:00:00	0.0000	0.0000	0.0000	0.0000	0.000927	0.000927
18:30:00	0.0000	0.0000	0.0000	0.0000	0.000912	0.000912
19:00:00	0.0000	0.0000	0.0000	0.0000	0.000898	0.000898
19:30:00	0.0000	0.0000	0.0000	0.0000	0.000883	0.000883
20:00:00	0.0000	0.0000	0.0000	0.0000	0.000869	0.000869
20:30:00	0.0000	0.0000	0.0000	0.0000	0.000855	0.000855
21:00:00	0.0000	0.0000	0.0000	0.0000	0.000841	0.000841
21:30:00	0.0000	0.0000	0.0000	0.0000	0.000828	0.000828
22:00:00	0.0000	0.0000	0.0000	0.0000	0.000814	0.000814
22:30:00	0.0000	0.0000	0.0000	0.0000	0.000801	0.000801
23:00:00	0.0000	0.0000	0.0000	0.0000	0.000788	0.000788
23:30:00	0.0000	0.0000	0.0000	0.0000	0.000775	0.000775
24:00:00	0.0000	0.0000	0.0000	0.0000	0.000763	0.000763
24:30:00	0.0000	0.0000	0.0000	0.0000	0.000751	0.000751
25:00:00	0.0000	0.0000	0.0000	0.0000	0.000738	0.000738
25:30:00	0.0000	0.0000	0.0000	0.0000	0.000726	0.000726
26:00:00	0.0000	0.0000	0.0000	0.0000	0.000715	0.000715
26:30:00	0.0000	0.0000	0.0000	0.0000	0.000703	0.000703
27:00:00	0.0000	0.0000	0.0000	0.0000	0.000692	0.000692
27:30:00	0.0000	0.0000	0.0000	0.0000	0.000681	0.000681
28:00:00	0.0000	0.0000	0.0000	0.0000	0.00067	0.00067
28:30:00	0.0000	0.0000	0.0000	0.0000	0.000659	0.000659
29:00:00	0.0000	0.0000	0.0000	0.0000	0.000648	0.000648
29:30:00	0.0000	0.0000	0.0000	0.0000	0.000638	0.000638
30:00:00	0.0000	0.0000	0.0000	0.0000	0.000628	0.000628
30:30:00	0.0000	0.0000	0.0000	0.0000	0.000617	0.000617
31:00:00	0.0000	0.0000	0.0000	0.0000	0.000607	0.000607
31:30:00	0.0000	0.0000	0.0000	0.0000	0.000598	0.000598
32:00:00	0.0000	0.0000	0.0000	0.0000	0.000588	0.000588
32:30:00	0.0000	0.0000	0.0000	0.0000	0.000578	0.000578
33:00:00	0.0000	0.0000	0.0000	0.0000	0.000569	0.000569
33:30:00	0.0000	0.0000	0.0000	0.0000	0.00056	0.00056
34:00:00	0.0000	0.0000	0.0000	0.0000	0.000551	0.000551
34:30:00	0.0000	0.0000	0.0000	0.0000	0.000542	0.000542
35:00:00	0.0000	0.0000	0.0000	0.0000	0.000533	0.000533

Time (hh:mm:ss)	Rain (mm)	Sewer Loss (m³/s)	Net Rain (mm)	Runoff (m³/s)	Baseflow (m³/s)	Total Flow (m³/s)
35:30:00	0.0000	0.0000	0.0000	0.0000	0.000525	0.000525
36:00:00	0.0000	0.0000	0.0000	0.0000	0.000516	0.000516
36:30:00	0.0000	0.0000	0.0000	0.0000	0.000508	0.000508
37:00:00	0.0000	0.0000	0.0000	0.0000	0.0005	0.0005
37:30:00	0.0000	0.0000	0.0000	0.0000	0.000492	0.000492
38:00:00	0.0000	0.0000	0.0000	0.0000	0.000484	0.000484
38:30:00	0.0000	0.0000	0.0000	0.0000	0.000476	0.000476
39:00:00	0.0000	0.0000	0.0000	0.0000	0.000468	0.000468
39:30:00	0.0000	0.0000	0.0000	0.0000	0.000461	0.000461
40:00:00	0.0000	0.0000	0.0000	0.0000	0.000453	0.000453
40:30:00	0.0000	0.0000	0.0000	0.0000	0.000446	0.000446
41:00:00	0.0000	0.0000	0.0000	0.0000	0.000439	0.000439
41:30:00	0.0000	0.0000	0.0000	0.0000	0.000432	0.000432
42:00:00	0.0000	0.0000	0.0000	0.0000	0.000425	0.000425
42:30:00	0.0000	0.0000	0.0000	0.0000	0.000418	0.000418
43:00:00	0.0000	0.0000	0.0000	0.0000	0.000411	0.000411
43:30:00	0.0000	0.0000	0.0000	0.0000	0.000404	0.000404
44:00:00	0.0000	0.0000	0.0000	0.0000	0.000398	0.000398

Appendix

Catchment descriptors *

Name	Value	User-defined value used?
BFIHOST	0.31	No
BFIHOST19	0.33	No
PROPWET	0.33	No
SAAR (mm)	647	No

Values in square brackets are the original values loaded from the FEH Web Service or FEH CD-ROM

UK Design Flood Estimation

Generated on 05 May 2023 12:20:22 by chloenelson
Printed from the ReFH2 Flood Modelling software package, version 3.3.8355.27598

Summary of estimate using the Flood Estimation Handbook revitalised flood hydrograph method (ReFH2)

Site details Checksum: D204-DAAE

Site name: FEH_Point_Descriptors_429185_583779_v5_0_1

Easting: 429185

Northing: 583779

Country: England, Wales or Northern Ireland

Catchment Area (km²): 0.01 [0.5]*

Using plot scale calculations: Yes

Model: 2.3

Site description: None

Model run: 100 year

Summary of results

Rainfall - FEH 2013 model (mm):	51.34	Total runoff (ML):	0.17
Total Rainfall (mm):	32.52	Total flow (ML):	0.33
Peak Rainfall (mm):	10.99	Peak flow (m /s):	0.01

Parameters

Where the user has overriden a system-generated value, this original value is shown in square brackets after the value used.
** Indicates that the user locked the duration/timestep*

Rainfall parameters (Rainfall - FEH 2013 model)

Name	Value	User-defined?
Duration (hh:mm:ss)	03:30:00	No
Timestep (hh:mm:ss)	00:30:00	No
SCF (Seasonal correction factor)	0.64	No
ARF (Areal reduction factor)	1	No
Seasonality	Winter	No

Loss model parameters

Name	Value	User-defined?
Cini (mm)	126.16	No
Cmax (mm)	266.38	No
Use alpha correction factor	No	No
Alpha correction factor	n/a	No

Routing model parameters

Name	Value	User-defined?
Tp (hr)	2.05 [1]	Yes
Up	0.65	No
Uk	0.8	No

Baseflow model parameters

Name	Value	User-defined?
BF0 (m^3/s)	0	No
BL (hr)	30.72 [22.83]	Yes
BR	0.87	No

Urbanisation parameters

Name	Value	User-defined?
Urban area (km^2)	0	No
Urbext 2000	0	No
Impervious runoff factor	0.7	No
Imperviousness factor	0.4	No
Tp scaling factor	0.75	No
Depression storage depth (mm)	0.5	No
Exporting drained area (km^2)	0.00	Yes
Sewer capacity (m^3/s)	0.00	Yes

Time series data

Time (hh:mm:ss)	Rain (mm)	Sewer Loss (m^3/s)	Net Rain (mm)	Runoff (m^3/s)	Baseflow (m^3/s)	Total Flow (m^3/s)
00:00:00	1.3217	0.0000	0.6292	0.0000	0.000393	0.000393
00:30:00	2.9582	0.0000	1.4321	0.0001	0.000387	0.000454
01:00:00	6.4862	0.0000	3.2551	0.0004	0.000384	0.00074
01:30:00	10.9857	0.0000	5.8734	0.0011	0.000388	0.00154
02:00:00	6.4862	0.0000	3.6805	0.0029	0.00041	0.00333
02:30:00	2.9582	0.0000	1.7311	0.0056	0.000464	0.0061
03:00:00	1.3217	0.0000	0.7840	0.0086	0.000556	0.00916
03:30:00	0.0000	0.0000	0.0000	0.0111	0.000686	0.0118
04:00:00	0.0000	0.0000	0.0000	0.0122	0.000839	0.0131
04:30:00	0.0000	0.0000	0.0000	0.0117	0.000993	0.0127
05:00:00	0.0000	0.0000	0.0000	0.0102	0.00113	0.0113
05:30:00	0.0000	0.0000	0.0000	0.0084	0.00124	0.00961
06:00:00	0.0000	0.0000	0.0000	0.0067	0.00133	0.00801
06:30:00	0.0000	0.0000	0.0000	0.0054	0.00139	0.00675
07:00:00	0.0000	0.0000	0.0000	0.0042	0.00144	0.00568
07:30:00	0.0000	0.0000	0.0000	0.0032	0.00147	0.0047
08:00:00	0.0000	0.0000	0.0000	0.0023	0.00148	0.00377
08:30:00	0.0000	0.0000	0.0000	0.0014	0.00148	0.0029
09:00:00	0.0000	0.0000	0.0000	0.0007	0.00147	0.00218
09:30:00	0.0000	0.0000	0.0000	0.0003	0.00146	0.00173
10:00:00	0.0000	0.0000	0.0000	0.0001	0.00144	0.00152
10:30:00	0.0000	0.0000	0.0000	0.0000	0.00141	0.00143
11:00:00	0.0000	0.0000	0.0000	0.0000	0.00139	0.00139
11:30:00	0.0000	0.0000	0.0000	0.0000	0.00137	0.00137
12:00:00	0.0000	0.0000	0.0000	0.0000	0.00135	0.00135
12:30:00	0.0000	0.0000	0.0000	0.0000	0.00132	0.00132
13:00:00	0.0000	0.0000	0.0000	0.0000	0.0013	0.0013
13:30:00	0.0000	0.0000	0.0000	0.0000	0.00128	0.00128
14:00:00	0.0000	0.0000	0.0000	0.0000	0.00126	0.00126
14:30:00	0.0000	0.0000	0.0000	0.0000	0.00124	0.00124
15:00:00	0.0000	0.0000	0.0000	0.0000	0.00122	0.00122
15:30:00	0.0000	0.0000	0.0000	0.0000	0.0012	0.0012
16:00:00	0.0000	0.0000	0.0000	0.0000	0.00118	0.00118
16:30:00	0.0000	0.0000	0.0000	0.0000	0.00116	0.00116
17:00:00	0.0000	0.0000	0.0000	0.0000	0.00114	0.00114

Time (hh:mm:ss)	Rain (mm)	Sewer Loss (m³/s)	Net Rain (mm)	Runoff (m³/s)	Baseflow (m³/s)	Total Flow (m³/s)
17:30:00	0.0000	0.0000	0.0000	0.0000	0.00113	0.00113
18:00:00	0.0000	0.0000	0.0000	0.0000	0.00111	0.00111
18:30:00	0.0000	0.0000	0.0000	0.0000	0.00109	0.00109
19:00:00	0.0000	0.0000	0.0000	0.0000	0.00107	0.00107
19:30:00	0.0000	0.0000	0.0000	0.0000	0.00105	0.00105
20:00:00	0.0000	0.0000	0.0000	0.0000	0.00104	0.00104
20:30:00	0.0000	0.0000	0.0000	0.0000	0.00102	0.00102
21:00:00	0.0000	0.0000	0.0000	0.0000	0.001	0.001
21:30:00	0.0000	0.0000	0.0000	0.0000	0.000988	0.000988
22:00:00	0.0000	0.0000	0.0000	0.0000	0.000972	0.000972
22:30:00	0.0000	0.0000	0.0000	0.0000	0.000957	0.000957
23:00:00	0.0000	0.0000	0.0000	0.0000	0.000941	0.000941
23:30:00	0.0000	0.0000	0.0000	0.0000	0.000926	0.000926
24:00:00	0.0000	0.0000	0.0000	0.0000	0.000911	0.000911
24:30:00	0.0000	0.0000	0.0000	0.0000	0.000896	0.000896
25:00:00	0.0000	0.0000	0.0000	0.0000	0.000882	0.000882
25:30:00	0.0000	0.0000	0.0000	0.0000	0.000868	0.000868
26:00:00	0.0000	0.0000	0.0000	0.0000	0.000854	0.000854
26:30:00	0.0000	0.0000	0.0000	0.0000	0.00084	0.00084
27:00:00	0.0000	0.0000	0.0000	0.0000	0.000826	0.000826
27:30:00	0.0000	0.0000	0.0000	0.0000	0.000813	0.000813
28:00:00	0.0000	0.0000	0.0000	0.0000	0.0008	0.0008
28:30:00	0.0000	0.0000	0.0000	0.0000	0.000787	0.000787
29:00:00	0.0000	0.0000	0.0000	0.0000	0.000774	0.000774
29:30:00	0.0000	0.0000	0.0000	0.0000	0.000762	0.000762
30:00:00	0.0000	0.0000	0.0000	0.0000	0.000749	0.000749
30:30:00	0.0000	0.0000	0.0000	0.0000	0.000737	0.000737
31:00:00	0.0000	0.0000	0.0000	0.0000	0.000725	0.000725
31:30:00	0.0000	0.0000	0.0000	0.0000	0.000714	0.000714
32:00:00	0.0000	0.0000	0.0000	0.0000	0.000702	0.000702
32:30:00	0.0000	0.0000	0.0000	0.0000	0.000691	0.000691
33:00:00	0.0000	0.0000	0.0000	0.0000	0.00068	0.00068
33:30:00	0.0000	0.0000	0.0000	0.0000	0.000669	0.000669
34:00:00	0.0000	0.0000	0.0000	0.0000	0.000658	0.000658
34:30:00	0.0000	0.0000	0.0000	0.0000	0.000647	0.000647
35:00:00	0.0000	0.0000	0.0000	0.0000	0.000637	0.000637

Time (hh:mm:ss)	Rain (mm)	Sewer Loss (m³/s)	Net Rain (mm)	Runoff (m³/s)	Baseflow (m³/s)	Total Flow (m³/s)
35:30:00	0.0000	0.0000	0.0000	0.0000	0.000627	0.000627
36:00:00	0.0000	0.0000	0.0000	0.0000	0.000616	0.000616
36:30:00	0.0000	0.0000	0.0000	0.0000	0.000606	0.000606
37:00:00	0.0000	0.0000	0.0000	0.0000	0.000597	0.000597
37:30:00	0.0000	0.0000	0.0000	0.0000	0.000587	0.000587
38:00:00	0.0000	0.0000	0.0000	0.0000	0.000578	0.000578
38:30:00	0.0000	0.0000	0.0000	0.0000	0.000568	0.000568
39:00:00	0.0000	0.0000	0.0000	0.0000	0.000559	0.000559
39:30:00	0.0000	0.0000	0.0000	0.0000	0.00055	0.00055
40:00:00	0.0000	0.0000	0.0000	0.0000	0.000541	0.000541
40:30:00	0.0000	0.0000	0.0000	0.0000	0.000532	0.000532
41:00:00	0.0000	0.0000	0.0000	0.0000	0.000524	0.000524
41:30:00	0.0000	0.0000	0.0000	0.0000	0.000515	0.000515
42:00:00	0.0000	0.0000	0.0000	0.0000	0.000507	0.000507
42:30:00	0.0000	0.0000	0.0000	0.0000	0.000499	0.000499
43:00:00	0.0000	0.0000	0.0000	0.0000	0.000491	0.000491
43:30:00	0.0000	0.0000	0.0000	0.0000	0.000483	0.000483
44:00:00	0.0000	0.0000	0.0000	0.0000	0.000475	0.000475
44:30:00	0.0000	0.0000	0.0000	0.0000	0.000467	0.000467
45:00:00	0.0000	0.0000	0.0000	0.0000	0.00046	0.00046
45:30:00	0.0000	0.0000	0.0000	0.0000	0.000452	0.000452
46:00:00	0.0000	0.0000	0.0000	0.0000	0.000445	0.000445
46:30:00	0.0000	0.0000	0.0000	0.0000	0.000438	0.000438
47:00:00	0.0000	0.0000	0.0000	0.0000	0.000431	0.000431
47:30:00	0.0000	0.0000	0.0000	0.0000	0.000424	0.000424
48:00:00	0.0000	0.0000	0.0000	0.0000	0.000417	0.000417
48:30:00	0.0000	0.0000	0.0000	0.0000	0.00041	0.00041
49:00:00	0.0000	0.0000	0.0000	0.0000	0.000404	0.000404
49:30:00	0.0000	0.0000	0.0000	0.0000	0.000397	0.000397

Printed from the ReFH2 Flood Modelling software package, version 3.3.8355.27598

Appendix

Catchment descriptors *

Name	Value	User-defined value used?
BFIHOST	0.31	No
BFIHOST19	0.33	No
PROPWET	0.33	No
SAAR (mm)	647	No

Values in square brackets are the original values loaded from the FEH Web Service or FEH CD-ROM

Appendix C Infiltration Test Results from Planning Application: 21/00818/FULES

ROLTON GROUP
ENGINEERING THE FUTURE™
www.rolton.com 01933 410909

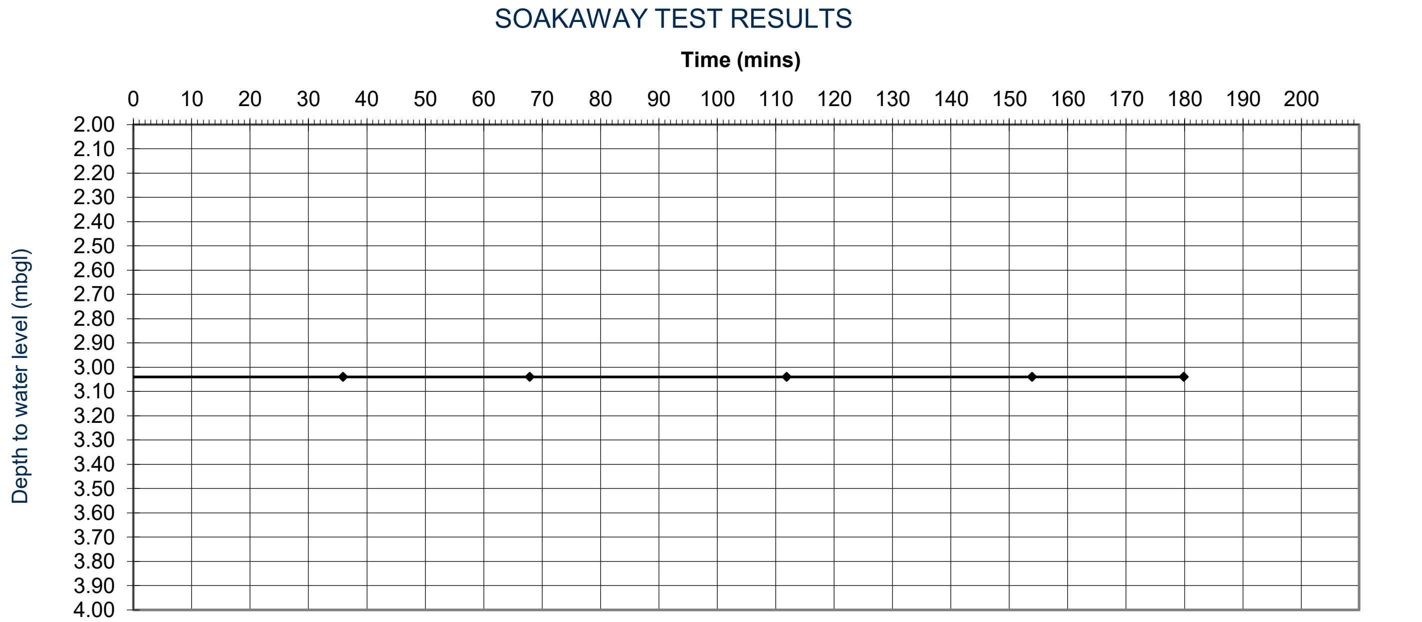
SOAKWAY TESTING SCHEDULE

PROJECT NO :	20-0473
PROJECT:	Project Phoenix
DOC REF:	PHX-XX-XX-SH-G-500-0001

Trial Pit Dimensions (m)	Width	Length	Depth to Base
	0.80	3.50	3.75

Test Date 07/01/2021
Soakaway No. SA1 R1

Calculation of Infiltration Rate in Accordance with BRE Digest 365.



From above graph;

0	m	= Depth drop between 75% and 25% of maximum depth to final depth
0	mins	= Time for outflow between 75% and 25% of maximum depth to final depth

Calculation of Soil Infiltration Rate (f):

where

$$f = \frac{VP75\text{-}25}{ap50 \times tp75\text{-}25}$$

using

VP75-25 = Volume outflowing between 75% and 25% of effective depth.
ap50 = Mean surface area through which the outflow occurs.
tp75-25 = Time for the outflow between 75% and 25% of the effective depth.

VP75-25 = 0 m^3
ap50 = 8.906 m^2
tp75-25 = 0.0 mins

General Geological Profile :

0.0 - 0.8m	MADE GROUND. Compact dark grey sandy gravel. Gravel id of medium to coarse sub-angular basalt and granite (Railway Ballast)
0.8 - 2.15m	MADE GROUND. Stiff brown sandy gravelly clay. Gravel is of fine to coarse sandstone, siltstone, sandstone and burnt shale.
2.15 - 3.0m	Soft to firm dark grey and black organic CLAY with frequent pockets of fibrouse peat. Below 2.45m depth tending to a firm grey silty organic CLAY.
3.0 - 3.75m	Stiff light reddish brown mottled blue grey sandy gravelly CLAY. Gravel is of medium to coarse sub-angualar to rounded siltstone, sandstone, limestone, mudstone and coal fines.

Notes :

No standing water noted.

			Permeability Guideline (m/s)		
Soil Infiltration Rate (f) =	N/A	m/s	Good	Poor	Practically Impervious
			10^{-3} - 10^{-5}	10^{-6} - 10^{-7}	10^{-8} - 10^{-10}

ROLTON GROUP
ENGINEERING THE FUTURE™
www.rolton.com 01933 410909

SOAKWAY TESTING SCHEDULE

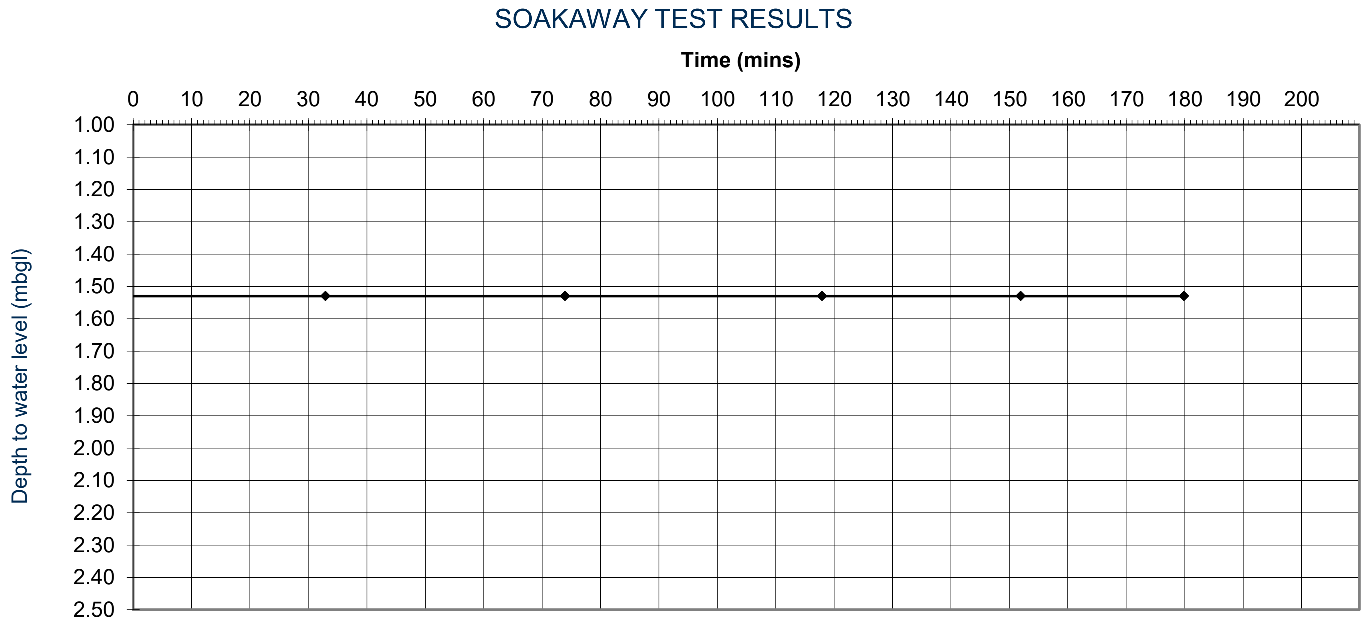
PROJECT NO :	20-0473
PROJECT:	Project Phoenix
DOC REF:	PHX-XX-XX-SH-G-500-0001

Trial Pit Dimensions (m)	Width	Length	Depth to Base
	0.80	2.90	2.32

Test Date 07/01/2021

Soakaway No. SA2 R1

Calculation of Infiltration Rate in Accordance with BRE Digest 365.



From above graph;

0	m	= Depth drop between 75% and 25% of maximum depth to final depth
0	mins	= Time for outflow between 75% and 25% of maximum depth to final depth

Calculation of Soil Infiltration Rate (f):

where

$$f = \frac{VP75\text{-}25}{ap50 \times tp75\text{-}25}$$

using

VP75-25 = Volume outflowing between 75% and 25% of effective depth.

ap50 = Mean surface area through which the outflow occurs.

tp75-25 = Time for the outflow between 75% and 25% of the effective depth.

VP75-25 = 0 m^3

ap50 = 8.166 m^2

tp75-25 = 0.0 mins

General Geological Profile :

0.0 - 0.85m	MADE GROUND. Dark brown grey sandy gravelly clay with occasional cobbles of sub-angular burnt shale, brick and concrete. . Gravel is of medium to coarse sub-angular burnt shale, concrete, brick, clinker, sandstone, plastic and coal fines.
0.85 - 1.45m	MADE GROUND. Compact reddish grey sandy gravelly with frequent cobbles and boulders of sub-angular burnt shale. Gravel is of medium to coarse sub-angular brick, burnt shale, siltstone, sandstone and coal fines.
1.45 - 2.32m	Stiff light reddish brown mottled blue grey sandy gravelly CLAY. Gravel is of medium to coarse sub-angualar to rounded siltstone, sandstone, limestone, mudstone and coal fines.

Notes :

No standing water noted.

Soil Infiltration Rate (f) = N / A m/s

Permeability Guideline (m/s)		
Good	Poor	Practically Impervious
10^{-3} - 10^{-5}	10^{-6} - 10^{-7}	10^{-8} - 10^{-10}

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www.rolton.com 01933 410909

SOAKWAY TESTING SCHEDULE

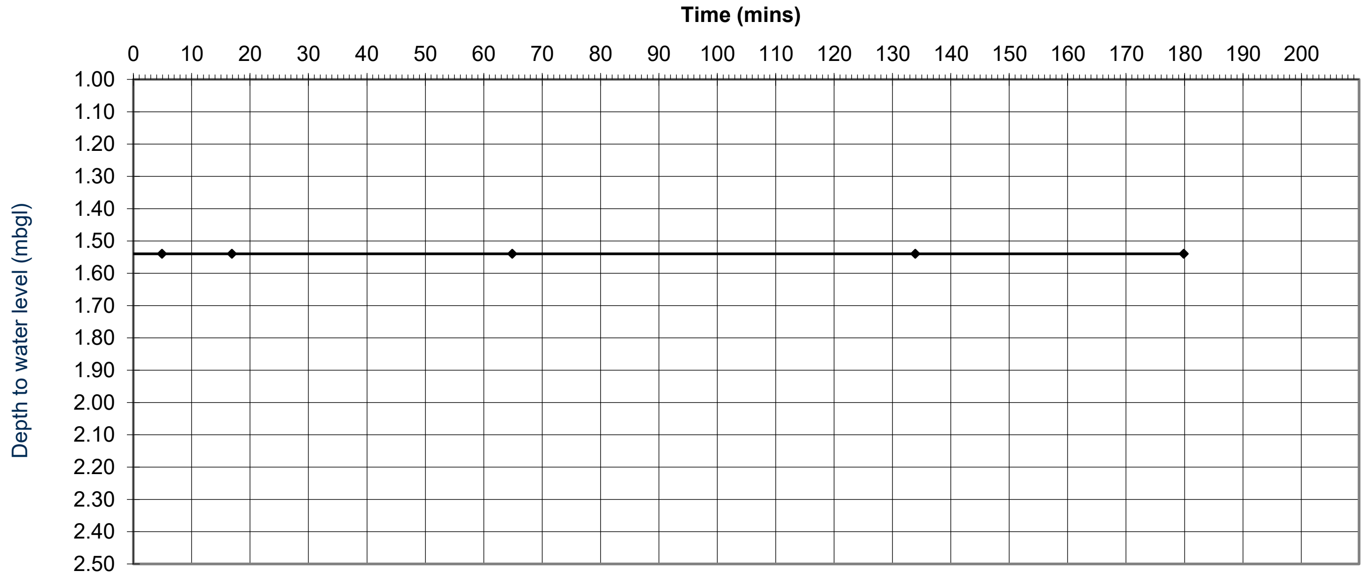
PROJECT NO :	20-0473
PROJECT:	Project Phoenix
DOC REF:	PHX-XX-XX-SH-G-500-0001

Trial Pit Dimensions (m)	Width	Length	Depth to Base
	0.80	2.15	2.42

Test Date 07/01/2021
Soakaway No. SA3 R1

Calculation of Infiltration Rate in Accordance with BRE Digest 365.

SOAKAWAY TEST RESULTS



From above graph;

0	m	= Depth drop between 75% and 25% of maximum depth to final depth
0	mins	= Time for outflow between 75% and 25% of maximum depth to final depth

Calculation of Soil Infiltration Rate (f):

where

$$f = \frac{VP75\text{-}25}{ap50 \times tp75\text{-}25}$$

using

VP75-25 = Volume outflowing between 75% and 25% of effective depth.
ap50 = Mean surface area through which the outflow occurs.
tp75-25 = Time for the outflow between 75% and 25% of the effective depth.

VP75-25 = 0 m^3
ap50 = 6.912 m^2
tp75-25 = 0.0 mins

General Geological Profile :

0.0 - 0.39m	MADE GROUND. Compact dark grey sandy gravel. Gravel id of medium to coarse sub-angular basalt and granite (Railway Ballast)
0.39 - 1.06m	MADE GROUND. Compact reddish grey sandy gravelly with frequent cobbles and boulders of sub-angular burnt shale. Gravel is of medium to coarse sub-angular brick, burnt shale, siltstone, sandstone and coal fines.
1.06 - 1.48m	MADE GROUND. Firm brown sandy gravelly clay with occasional dark grey pockets of fibrous peat and roots. Gravel is of fine to coarse sandstone, siltstone, sandstone and burnt shale.
1.48 - 2.42m	Stiff light reddish brown mottled blue grey sandy gravelly CLAY. Gravel is of medium to coarse sub-angualar to rounded siltstone, sandstone, limestone, mudstone and coal fines.

Notes :

No standing water noted.

			Permeability Guideline (m/s)		
Soil Infiltration Rate (f) =	N/A	m/s	Good	Poor	Practically Impervious
			10^{-3} - 10^{-5}	10^{-6} - 10^{-7}	10^{-8} - 10^{-10}

ROLTON GROUP
ENGINEERING THE FUTURE™
www.rolton.com 01933 410909

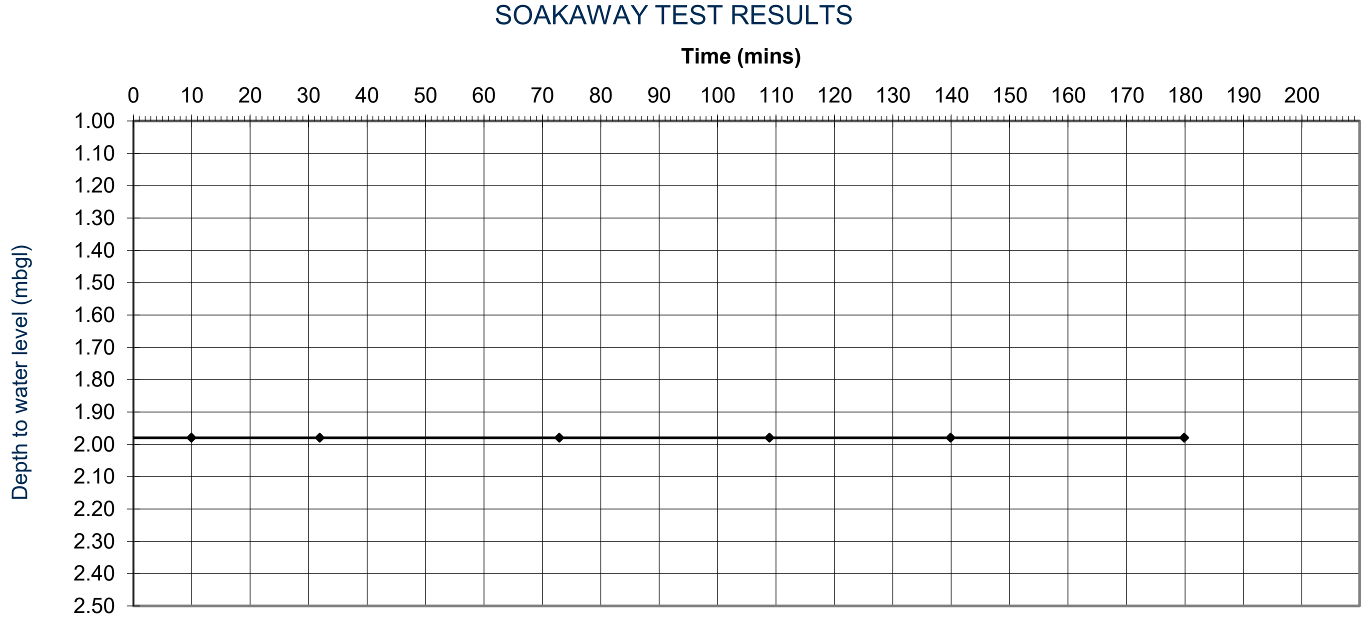
SOAKWAY TESTING SCHEDULE

PROJECT NO :	20-0473
PROJECT:	Project Phoenix
DOC REF:	PHX-XX-XX-SH-G-500-0001

Trial Pit Dimensions (m)	Width	Length	Depth to Base
	0.80	2.40	2.55

Test Date 07/01/2021
Soakaway No. SA4 R1

Calculation of Infiltration Rate in Accordance with BRE Digest 365.



From above graph;

0	m	= Depth drop between 75% and 25% of maximum depth to final depth
0	mins	= Time for outflow between 75% and 25% of maximum depth to final depth

Calculation of Soil Infiltration Rate (f):

where

$$f = \frac{VP75\text{-}25}{ap50 \times tp75\text{-}25}$$

using

VP75-25 = Volume outflowing between 75% and 25% of effective depth.
ap50 = Mean surface area through which the outflow occurs.
tp75-25 = Time for the outflow between 75% and 25% of the effective depth.

VP75-25 = 0 m^3
ap50 = 5.568 m^2
tp75-25 = 0.0 mins

General Geological Profile :

0.0 - 0.12m	MADE GROUND. Dark brown grey sandy gravelly clay. Gravel is of medium to coarse sub-angular coal fines and sandstone.
0.12 - 0.97m	MADE GROUND. Compact dark grey and black sandy gravel (FBA). Gravel is of medium to coarse cemented FBA.
0.97 - 1.95m	MADE GROUND. Stiff brown sandy gravelly clay. Gravel is of fine to coarse sandstone, siltstone, sandstone and burnt shale.
1.95 - 2.55m	Stiff light reddish brown mottled blue grey sandy gravelly CLAY. Gravel is of medium to coarse sub-angualar to rounded siltstone, sandstone, limestone, mudstone and coal fines.

Notes :

No standing water noted.

Soil Infiltration Rate (f) =	N / A	m/s

Permeability Guideline (m/s)		
Good	Poor	Practically Impervious
10^{-3} - 10^{-5}	10^{-6} - 10^{-7}	10^{-8} - 10^{-10}

Appendix D Northumbrian Water Sewer Plans

CHECKED

NWG PROPERTY SOLUTIONS

NWG Property Solutions is part of Northumbrian Water Group (NWG)
Northumbrian Water and Essex & Suffolk Water are also part of NWG

103945 a

SITE AT BROCK LANE A189 BLYTH

Site Enquiry

Plan

We enclose plan(s) showing the location of any Company apparatus in the vicinity of the area of your enquiry.

If your request for plan(s) is part of a C2 enquiry, or relates to development, information about connecting to our water and sewer networks and the protection of existing apparatus, details for further information can be found via the following link https://www.nwl.co.uk/developers.aspx

1. The company is not responsible for private water supply pipes, private drains and sewers that connect the property to the public sewerage system and does not hold details of these.

General Notes

A copy of the standard conditions for working near Company apparatus is enclosed for your information. If you require any further assistance to identify Company apparatus, then do not hesitate to make contact with the Area Office at the contact number shown in the standard conditions.

Important:- Please ensure this detail is made available to anyone carrying out any works which may affect our apparatus.

From the 1st October 2011 there may be lateral drains and/or public sewers which are not recorded on the public sewer map.

Signed.

On behalf of Northumbrian Water, Essex & Suffolk Water

Tel : 0370 241 7408

Email : plans@nwl.co.uk
or : assetplans@eswater.co.uk

Date: 04/FEB/2022
Ref: 1156780

NWG PROPERTY SOLUTIONS

NWG Property Solutions is part of Northumbrian Water Group (NWG)
Northumbrian Water and Essex & Suffolk Water are also part of NWG

103945 b

SITE AT BROCK LANE A189 BLYTH

Site Enquiry

Plan

We enclose plan(s) showing the location of any Company apparatus in the vicinity of the area of your enquiry.

If your request for plan(s) is part of a C2 enquiry, or relates to development, information about connecting to our water and sewer networks and the protection of existing apparatus, details for further information can be found via the following link https://www.nwl.co.uk/developers.aspx

1. The company is not responsible for private water supply pipes, private drains and sewers that connect the property to the public sewerage system and does not hold details of these.

General Notes

A copy of the standard conditions for working near Company apparatus is enclosed for your information. If you require any further assistance to identify Company apparatus, then do not hesitate to make contact with the Area Office at the contact number shown in the standard conditions.

Important:- Please ensure this detail is made available to anyone carrying out any works which may affect our apparatus.
From the 1st October 2011 there may be lateral drains and/or public sewers which are not recorded on the public sewer map.

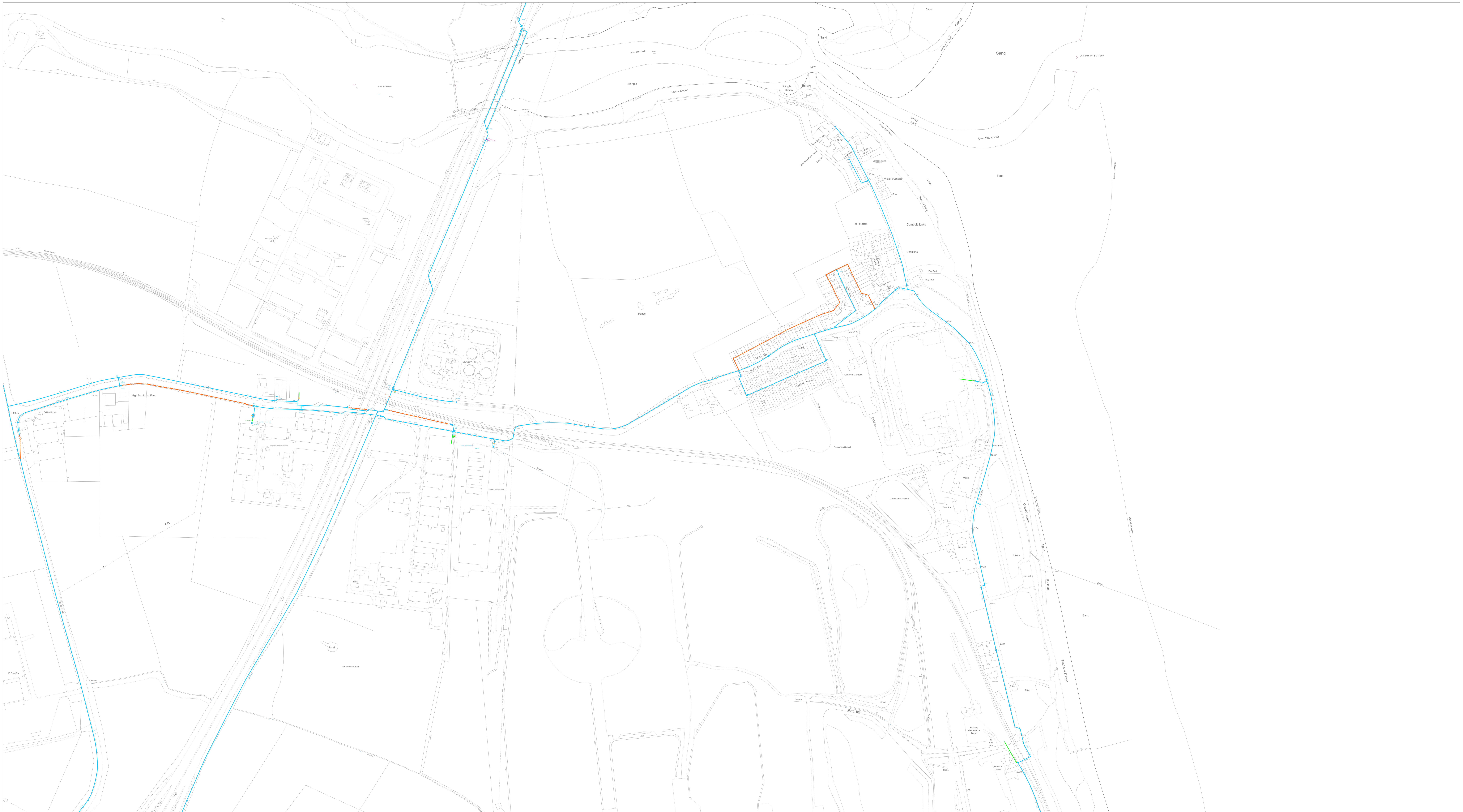
Signed.

JHDawson

On behalf of Northumbrian Water, Essex & Suffolk Water
Tel : 0370 241 7408

Email : plans@nwl.co.uk
or : assetplans@eswater.co.uk

Date: 04/FEB/2022
Ref: 1156781



Valves/Regulators

P1 P2 P3 P4

Fittings/Symbols

C2 D C G I A T S

Storage/Operations

U DAM SR OB ? IR HT ? RI SC ST FT CWT C BPT W C IM BH F CP ABH

Network Types

Distribution

Treated

Raw

Fire

Supply

Specific Main Types

Abandoned Asbestos

Abandoned

Out of Commission

Private

Proposed

Area Types

Water Quality

District Metering

Easement

NORTHUMBRIAN WATER living water

User : DAWSJ1

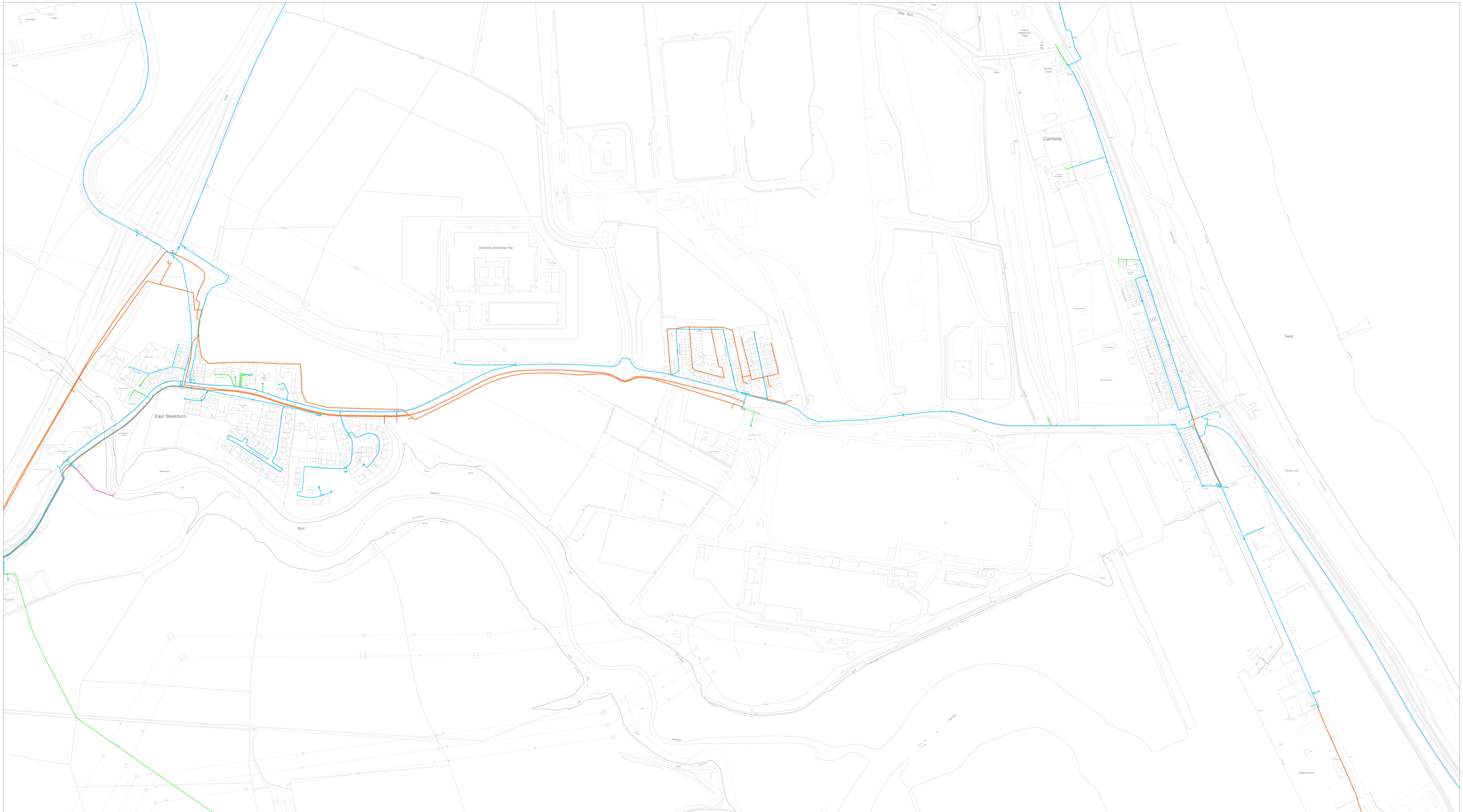
Title : 0000

Date : 25/01/2022

Centre Point : 429916,584743

Map Sheet : NZ2984NE

25 m



Valves/Regulators

P1 P2 P3 P4 EOV

Fittings/Symbols

C2 D C G I A T S

Storage/Operations

U DAM SR OB ? IR HT ? RI SC F CP ABH ST FT CWT C BPT W C IM BH

Network Types

Distribution | Fire
Treated | Supply
Raw

Specific Main Types

Abandoned Asbestos | Private
Abandoned | Proposed
Out of Commission

Area Types

Water Quality | Easement
District Metering

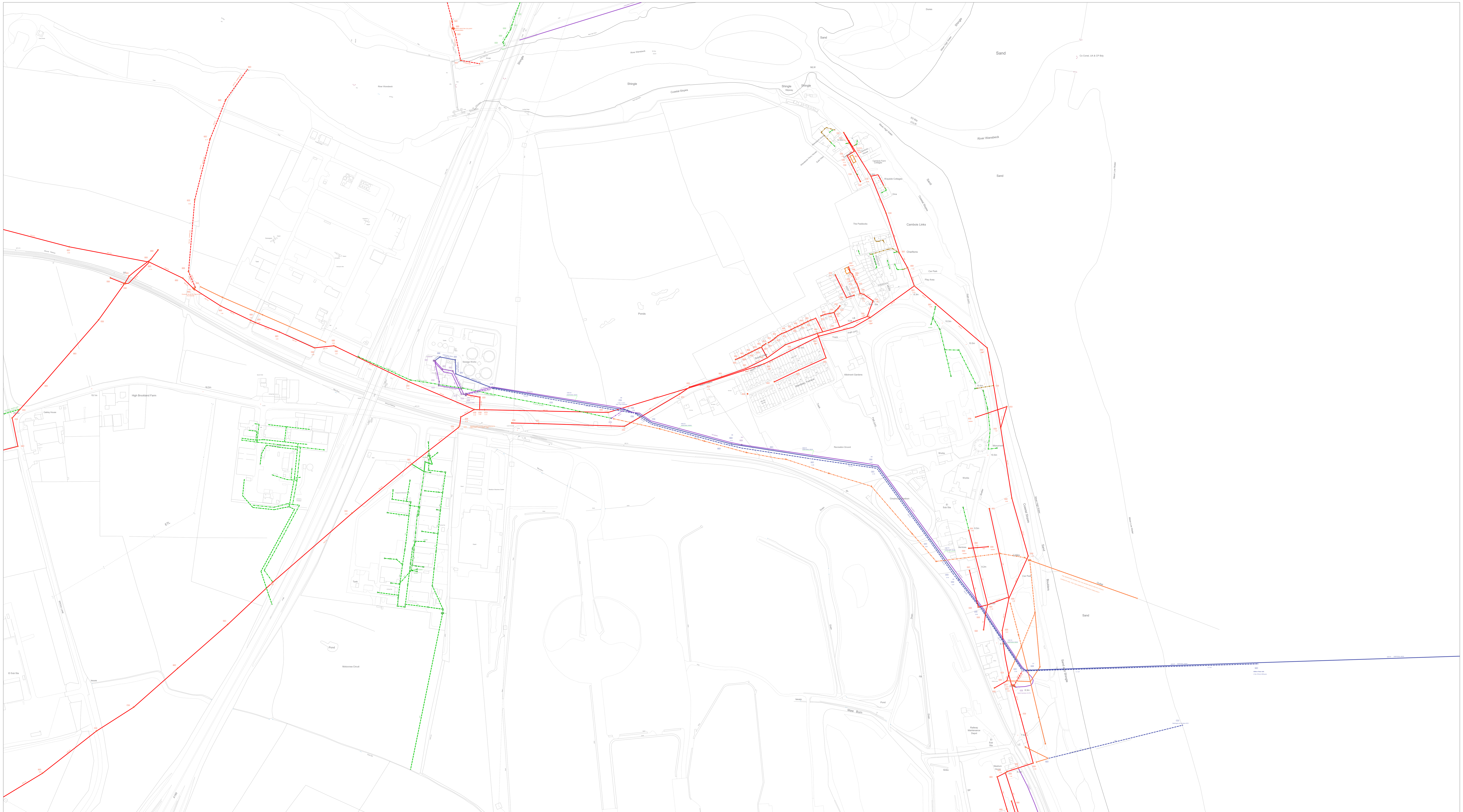
NORTHUMBRIAN WATER *living water*

User : DAWSJ1
Title : 0000

Date : 25/01/2022
Centre Point : 429820,583425

Map Sheet : NZ2983SE

25 m



NWL Responsibility	Private/Non NWL	Proposed
Combined	Combined	Combined
Foul	Foul	Foul
Surface	Surface	Surface
Treated Eff	Treated Eff	
Untreated Eff	Trade Eff	
Overflow	Watercourse	

Annotations

- Abandoned
- Rising Main
- Direction of flow
- Backdrop

Symbols

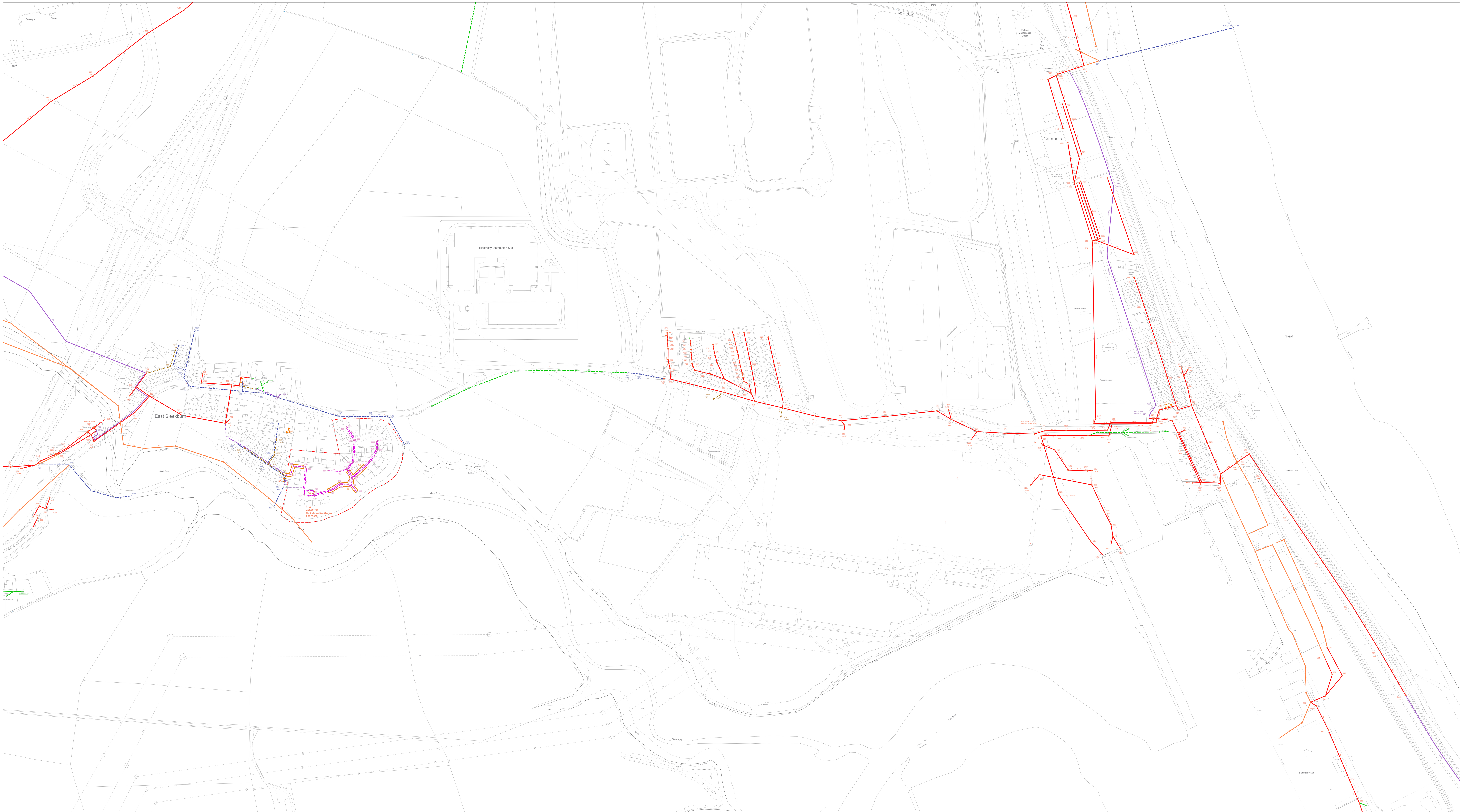
- Chambers
- Inlet/Outlet
- STW Treatment Works
- Pumping Station
- Capped End
- Balancing Pond
- Termination Node
- Rodding Eye
- Unknown End
- Attribute Change
- Air Valve
- Property Connection
- Lamp Hole
- Hatchbox
- Dual Usage Chamber

User : DAWSJ1
Title : 0000

Date : 25/01/2022
Centre Point : 429916,584743

Map Sheet : NZ2984NE

25 m



NWL Responsibility
Combined
Foul
Surface
Treated Eff
Untreated Eff
Overflow

Private/Non NWL
Combined
Foul
Surface
Treated Eff
Trade Eff
Watercourse

Proposed
Combined
Foul
Surface

Annotations
Abandoned
Rising Main
Direction of flow
Backdrop

Symbols
Chambers
Inlet/Outlet
Treatment Works
Pumping Station
Capped End
Balancing Pond
Termination Node
Rodding Eye
Unknown End
Attribute Change
Air Valve
Property Connection
Lamp Hole
Hatchbox
Dual Usage Chamber

NORTHUMBRIAN WATER living water

User : DAWSJ1
Title : 0000

Date : 25/01/2022
Centre Point : 429820,583425

Map Sheet : NZ2983SE

25 m

STANDARD CONDITIONS FOR WORKING NEAR NORTHUMBRIAN WATER APPARATUS

THE FOLLOWING CONDITIONS WILL APPLY TO ALL WORKS IN THE VICINITY OF COMPANY APPARATUS

NWG Property Solutions is part of Northumbrian Water Group (NWG)
Northumbrian Water and Essex & Suffolk Water are also part of NWG

1. Contact should be made with the appropriate Company Area Office prior to the commencement of any work. Arrangements can then be made for the local representative to visit the site and assist in the location and protection of any apparatus affected. The Company must be given two working days notice before any works, including trial holes, are carried out within their easements. Contact **0345 717 1100.**

2. The information shown on any plan provided by the Company is for general guidance only. The position of apparatus shown should not be relied upon as being precise. No service pipes are shown on plans.

3. The actual position of apparatus must be established by taking trial holes in all cases. No machine excavation will be permitted within 1 metre side of a main. The actual position of any apparatus must be found by hand excavation.

4. Where Company apparatus is exposed by excavation, support and protection measures are to be agreed on site. Where excavations are taken out below the invert of a main, adequate support is to be provided to prevent collapse of the excavation and subsequent undermining of the main. Special attention is to be given to the compaction of selected backfill material under the main and the company may require the use of lean mix concrete to replace inadequately compacted or unsuitable support backfill material. The compaction of selected backfill material under, around and up to a level of 300mm above the top of any main shall be carried out by hand. Upon completion of operations, any excavation is to be left open until after inspection by Company¿s representative.

5. No installation of plant may take place within the Company's easements without the prior consent of the Company and with all special conditions and arrangements being finalised before commencement of work.

6. Indiscriminate crossing of the main by heavy construction plant will not be permitted. Where applicable, Crossing Points must be agreed by the Company and any protective measures necessary taken before work begins.

7. Surface boxes and covers should not be removed without obtaining prior consent of the Company. All surface covers to washouts, valves, air valves, hydrants, stopcocks etc., are to be kept clear of obstruction and with free access at all times. If surface boxes or covers have been temporarily removed, positions should be clearly marked.

8. Where the levels of carriageway and footpath surfaces are raised or lowered, then the Company's surface covers must be adjusted as appropriate.

9. No pipes or cables are to be laid or structures placed directly over the line of Company apparatus.

10. Where drains, pipes or cables cross over or under any mains, a minimum clearance of 300mm must be maintained. Where it is necessary for any plant to lay parallel to the pipelines, a minimum distance of 1 metre shall be maintained between the outside of the pipeline and any plant being installed, except in the case of small diameter plant where N.J.U.G 7 dimensions apply. The Company must agree exceptions to these conditions in writing.

11. All crossing of the company's pipelines and easements shall be at right angles where possible. Where skew crossings are necessary, no more than 3 metres of the Company's pipeline shall be exposed at any time.

12. The Company will require three copies of proposal drawings showing the details of any proposed crossing of pipelines above 300mm diameter. The drawings must show the Company's pipelines in relation to the proposed works, to a scale of no less than 1:500 and no work shall commence until the Company has given approval.

13. Where it is necessary to carry out piling works closer than 6m to the Company' apparatus, or to carry out works using plant that is likely to damage the integrity of the Company's apparatus, the Company will require a method statement of the works shall be consulted before work commences.

14. Where the Company's pipeline is protected by a cathodic protection system, the Company will require a suitable joint testing programme to be agreed before the application of any cathodic protection scheme proposed by another authority or utility undertaking. If any bond-wires or test leads associated with the Company's cathodic protection system are damaged, disconnected or found to be in poor condition, the Company should be notified so that repairs can be made.

15. In the case of Trunk mains which cross development sites, no development is to take place within an agreed distance either side of the pipeline. A guide showing the easement widths for the various diameters and depths of pipe is available from the RASWA department.

16. No tree planting or landscaping work is done in close proximity to Company apparatus unless otherwise agreed in writing by the Company. A planting guide is available from the RASWA department.

17. In the event of any damage to any of the Company's plant the Company must be informed immediately. Where any damage occurs to Company apparatus, the appropriate remedial work will be carried out by the Company and charged to the promoter of the works.

18. Every effort should be made to secure the site against vandalism of the Company's plant.

19. A copy of these conditions is to be made available to all Contractors or Sub-Contractors working in the vicinity of Company apparatus.

Issue: RASWA 2. Oct. 02

Appendix E Post Development Runoff Calculations

Cascade Summary of Results for Pond 1.SRCX

Upstream Structures	Outflow To	Overflow To
(None)	Pond 2.SRCX	(None)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	11.107	0.207	62.3	673.8	O K
30 min Summer	11.158	0.258	94.7	844.8	O K
60 min Summer	11.194	0.294	122.6	965.1	O K
120 min Summer	11.242	0.342	165.4	1126.5	O K
180 min Summer	11.263	0.363	184.1	1199.0	O K
240 min Summer	11.273	0.373	192.6	1230.5	O K
360 min Summer	11.275	0.375	194.4	1238.1	O K
480 min Summer	11.269	0.369	189.0	1218.2	O K
600 min Summer	11.260	0.360	181.4	1189.1	O K
720 min Summer	11.251	0.351	173.4	1157.6	O K
960 min Summer	11.233	0.333	157.4	1096.5	O K
1440 min Summer	11.205	0.305	132.0	999.5	O K
2160 min Summer	11.174	0.274	104.6	895.6	O K
2880 min Summer	11.150	0.250	89.6	816.9	O K
4320 min Summer	11.120	0.220	70.6	716.8	O K
5760 min Summer	11.102	0.202	59.2	657.7	O K
7200 min Summer	11.089	0.189	51.2	614.7	O K
8640 min Summer	11.078	0.178	46.1	578.8	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	29.306	0.0	637.6	18
30 min Summer	19.269	0.0	856.7	32
60 min Summer	12.189	0.0	1147.6	56
120 min Summer	8.188	0.0	1548.6	84
180 min Summer	6.406	0.0	1820.7	116
240 min Summer	5.356	0.0	2031.6	150
360 min Summer	4.131	0.0	2352.8	216
480 min Summer	3.425	0.0	2601.2	278
600 min Summer	2.953	0.0	2803.6	340
720 min Summer	2.611	0.0	2974.6	402
960 min Summer	2.141	0.0	3249.6	524
1440 min Summer	1.612	0.0	3659.2	766
2160 min Summer	1.205	0.0	4158.6	1144
2880 min Summer	0.980	0.0	4502.5	1500
4320 min Summer	0.734	0.0	5026.9	2208
5760 min Summer	0.601	0.0	5538.0	2944
7200 min Summer	0.517	0.0	5958.4	3680
8640 min Summer	0.460	0.0	6344.8	4408

Cascade Summary of Results for Pond 1.SRCX

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
10080 min Summer	11.070	0.170	42.5	551.6	O K
15 min Winter	11.131	0.231	77.3	752.3	O K
30 min Winter	11.188	0.288	116.8	942.9	O K
60 min Winter	11.226	0.326	150.7	1072.2	O K
120 min Winter	11.273	0.373	193.0	1232.3	O K
180 min Winter	11.288	0.388	205.9	1282.2	O K
240 min Winter	11.290	0.390	207.7	1288.9	O K
360 min Winter	11.280	0.380	199.3	1256.2	O K
480 min Winter	11.266	0.366	186.3	1207.3	O K
600 min Winter	11.251	0.351	173.4	1157.6	O K
720 min Winter	11.238	0.338	161.4	1111.4	O K
960 min Winter	11.214	0.314	140.5	1032.9	O K
1440 min Winter	11.181	0.281	111.1	921.3	O K
2160 min Winter	11.145	0.245	86.2	798.3	O K
2880 min Winter	11.122	0.222	71.5	721.6	O K
4320 min Winter	11.094	0.194	54.1	631.6	O K
5760 min Winter	11.075	0.175	44.5	566.9	O K
7200 min Winter	11.062	0.162	38.6	524.0	O K
8640 min Winter	11.053	0.153	34.5	494.0	O K
10080 min Winter	11.046	0.146	31.3	471.9	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
10080 min Summer	0.418	0.0	6694.1	5144
15 min Winter	29.306	0.0	721.1	18
30 min Winter	19.269	0.0	966.9	31
60 min Winter	12.189	0.0	1287.9	56
120 min Winter	8.188	0.0	1737.2	88
180 min Winter	6.406	0.0	2042.1	124
240 min Winter	5.356	0.0	2278.4	160
360 min Winter	4.131	0.0	2638.3	226
480 min Winter	3.425	0.0	2916.8	290
600 min Winter	2.953	0.0	3143.7	354
720 min Winter	2.611	0.0	3335.6	416
960 min Winter	2.141	0.0	3644.3	540
1440 min Winter	1.612	0.0	4104.7	792
2160 min Winter	1.205	0.0	4658.9	1152
2880 min Winter	0.980	0.0	5045.0	1524
4320 min Winter	0.734	0.0	5637.6	2248
5760 min Winter	0.601	0.0	6202.7	2992
7200 min Winter	0.517	0.0	6674.4	3680
8640 min Winter	0.460	0.0	7109.3	4408
10080 min Winter	0.418	0.0	7507.2	5144

Cascade Rainfall Details for Pond 1.SRCX

Rainfall Model	FEH
Return Period (years)	2
FEH Rainfall Version	2013
Site Location	GB 429185 583779 NZ 29185 83779
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 %	+0

Time Area Diagram

Total Area (ha) 12.809

Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)
0	4	12.400	4	8	0.409

Cascade Model Details for Pond 1.SRCX

Storage is Online Cover Level (m) 12.300

Tank or Pond Structure

Invert Level (m) 10.900

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	3190.0	1.400	4086.3

Orifice Outflow Control

Diameter (m) 0.900 Discharge Coefficient 0.600 Invert Level (m) 10.900

Cascade Summary of Results for Pond 2.SRCX

Upstream Structures	Outflow To	Overflow To
Pond 1.SRCX	(None)	(None)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	9.612	0.112	20.2	227.5	O K
30 min Summer	9.650	0.150	33.1	305.3	O K
60 min Summer	9.689	0.189	51.2	387.5	O K
120 min Summer	9.749	0.249	88.7	512.6	O K
180 min Summer	9.782	0.282	111.5	583.1	O K
240 min Summer	9.797	0.297	124.9	614.3	O K
360 min Summer	9.814	0.314	140.5	651.9	O K
480 min Summer	9.822	0.322	147.6	669.3	O K
600 min Summer	9.824	0.324	149.4	673.9	O K
720 min Summer	9.823	0.323	148.0	670.5	O K
960 min Summer	9.814	0.314	140.5	652.3	O K
1440 min Summer	9.794	0.294	122.2	608.8	O K
2160 min Summer	9.766	0.266	99.8	550.0	O K
2880 min Summer	9.746	0.246	86.8	506.3	O K
4320 min Summer	9.719	0.219	69.6	448.6	O K
5760 min Summer	9.701	0.201	58.5	412.3	O K
7200 min Summer	9.689	0.189	50.9	385.5	O K
8640 min Summer	9.678	0.178	45.9	363.5	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	29.306	0.0	592.9	169
30 min Summer	19.269	0.0	814.6	140
60 min Summer	12.189	0.0	1141.3	134
120 min Summer	8.188	0.0	1548.9	152
180 min Summer	6.406	0.0	1825.4	184
240 min Summer	5.356	0.0	2039.5	212
360 min Summer	4.131	0.0	2365.2	268
480 min Summer	3.425	0.0	2616.6	328
600 min Summer	2.953	0.0	2821.0	388
720 min Summer	2.611	0.0	2993.3	450
960 min Summer	2.141	0.0	3269.3	572
1440 min Summer	1.612	0.0	3677.9	818
2160 min Summer	1.205	0.0	4224.4	1196
2880 min Summer	0.980	0.0	4568.3	1560
4320 min Summer	0.734	0.0	5076.8	2280
5760 min Summer	0.601	0.0	5639.1	3016
7200 min Summer	0.517	0.0	6064.2	3760
8640 min Summer	0.460	0.0	6448.9	4496

Cascade Summary of Results for Pond 2.SRCX

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
10080 min Summer	9.670	0.170	42.3	346.8	O K
15 min Winter	9.627	0.127	24.2	256.8	O K
30 min Winter	9.667	0.167	41.1	341.6	O K
60 min Winter	9.711	0.211	64.9	433.5	O K
120 min Winter	9.779	0.279	108.8	575.9	O K
180 min Winter	9.811	0.311	137.8	645.7	O K
240 min Winter	9.825	0.325	149.8	675.1	O K
360 min Winter	9.838	0.338	161.4	703.2	O K
480 min Winter	9.838	0.338	161.8	703.9	O K
600 min Winter	9.833	0.333	156.9	692.2	O K
720 min Winter	9.825	0.325	149.8	675.3	O K
960 min Winter	9.808	0.308	134.7	638.6	O K
1440 min Winter	9.779	0.279	108.8	576.0	O K
2160 min Winter	9.744	0.244	85.8	503.1	O K
2880 min Winter	9.722	0.222	71.9	456.1	O K
4320 min Winter	9.695	0.195	54.7	399.4	O K
5760 min Winter	9.676	0.176	45.2	359.4	O K
7200 min Winter	9.663	0.163	39.3	332.4	O K
8640 min Winter	9.654	0.154	34.9	313.2	O K
10080 min Winter	9.647	0.147	32.0	299.2	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
10080 min Summer	0.418	0.0	6779.8	5200
15 min Winter	29.306	0.0	677.5	152
30 min Winter	19.269	0.0	926.5	129
60 min Winter	12.189	0.0	1284.1	126
120 min Winter	8.188	0.0	1741.0	144
180 min Winter	6.406	0.0	2051.0	180
240 min Winter	5.356	0.0	2291.0	210
360 min Winter	4.131	0.0	2656.1	272
480 min Winter	3.425	0.0	2938.2	336
600 min Winter	2.953	0.0	3167.6	400
720 min Winter	2.611	0.0	3361.1	462
960 min Winter	2.141	0.0	3671.5	586
1440 min Winter	1.612	0.0	4131.9	838
2160 min Winter	1.205	0.0	4734.4	1212
2880 min Winter	0.980	0.0	5121.5	1572
4320 min Winter	0.734	0.0	5700.3	2312
5760 min Winter	0.601	0.0	6316.9	3072
7200 min Winter	0.517	0.0	6794.2	3768
8640 min Winter	0.460	0.0	7229.9	4480
10080 min Winter	0.418	0.0	7611.7	5232

Cascade Rainfall Details for Pond 2.SRCX

Rainfall Model	FEH
Return Period (years)	2
FEH Rainfall Version	2013
Site Location	GB 429185 583779 NZ 29185 83779
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 %	+0

Time Area Diagram

Total Area (ha) 0.250

Time (mins) From:	To:	Area (ha)
0	4	0.250

Cascade Model Details for Pond 2.SRCX

Storage is Online Cover Level (m) 10.700

Tank or Pond Structure

Invert Level (m) 9.500

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	2000.0	1.200	2611.4

Pipe Outflow Control

Diameter (m)	0.900	Entry Loss Coefficient	0.500
Slope (1:X)	48.8	Coefficient of Contraction	0.600
Length (m)	350.000	Upstream Invert Level (m)	9.500
Roughness k (mm)	0.600		

Cascade Summary of Results for Pond 1.SRCX

Upstream Structures	Outflow To	Overflow To
(None)	Pond 2.SRCX	(None)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	11.342	0.442	271.3	1471.0	O K
30 min Summer	11.437	0.537	412.8	1801.9	O K
60 min Summer	11.501	0.601	486.6	2029.1	O K
120 min Summer	11.521	0.621	509.6	2100.0	O K
180 min Summer	11.516	0.616	503.3	2079.5	O K
240 min Summer	11.502	0.602	487.1	2030.7	O K
360 min Summer	11.470	0.570	450.3	1916.9	O K
480 min Summer	11.441	0.541	416.9	1813.5	O K
600 min Summer	11.416	0.516	384.1	1728.9	O K
720 min Summer	11.397	0.497	354.4	1659.4	O K
960 min Summer	11.365	0.465	305.6	1547.7	O K
1440 min Summer	11.319	0.419	236.2	1390.3	O K
2160 min Summer	11.267	0.367	187.2	1210.9	O K
2880 min Summer	11.233	0.333	157.4	1096.6	O K
4320 min Summer	11.194	0.294	122.2	963.4	O K
5760 min Summer	11.168	0.268	100.8	875.5	O K
7200 min Summer	11.148	0.248	88.1	809.2	O K
8640 min Summer	11.133	0.233	78.8	760.9	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	66.450	0.0	1524.3	17
30 min Summer	44.708	0.0	2074.2	30
60 min Summer	28.597	0.0	2722.6	44
120 min Summer	17.173	0.0	3274.0	78
180 min Summer	12.734	0.0	3643.6	112
240 min Summer	10.299	0.0	3930.4	144
360 min Summer	7.638	0.0	4373.3	206
480 min Summer	6.179	0.0	4717.0	268
600 min Summer	5.241	0.0	5000.8	328
720 min Summer	4.581	0.0	5244.3	390
960 min Summer	3.703	0.0	5648.8	512
1440 min Summer	2.743	0.0	6263.9	764
2160 min Summer	2.035	0.0	7025.8	1124
2880 min Summer	1.650	0.0	7589.0	1496
4320 min Summer	1.233	0.0	8476.5	2208
5760 min Summer	1.009	0.0	9300.5	2944
7200 min Summer	0.867	0.0	9991.0	3672
8640 min Summer	0.769	0.0	10624.2	4408

Cascade Summary of Results for Pond 1.SRCX

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
10080 min Summer	11.122	0.222	71.9	724.5	O K
15 min Winter	11.390	0.490	344.5	1637.0	O K
30 min Winter	11.497	0.597	481.4	2013.4	O K
60 min Winter	11.561	0.661	555.7	2243.5	O K
120 min Winter	11.561	0.661	555.7	2243.9	O K
180 min Winter	11.537	0.637	527.5	2155.8	O K
240 min Winter	11.509	0.609	495.2	2055.1	O K
360 min Winter	11.458	0.558	436.5	1873.8	O K
480 min Winter	11.419	0.519	388.0	1736.9	O K
600 min Winter	11.390	0.490	344.5	1636.6	O K
720 min Winter	11.367	0.467	309.4	1556.3	O K
960 min Winter	11.332	0.432	256.0	1435.5	O K
1440 min Winter	11.275	0.375	194.8	1239.0	O K
2160 min Winter	11.223	0.323	148.5	1063.4	O K
2880 min Winter	11.194	0.294	122.2	962.3	O K
4320 min Winter	11.153	0.253	91.5	827.4	O K
5760 min Winter	11.128	0.228	75.4	742.8	O K
7200 min Winter	11.112	0.212	65.2	688.8	O K
8640 min Winter	11.100	0.200	57.9	651.0	O K
10080 min Winter	11.092	0.192	52.5	622.6	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
10080 min Summer	0.697	0.0	11202.4	5136
15 min Winter	66.450	0.0	1715.3	17
30 min Winter	44.708	0.0	2331.5	30
60 min Winter	28.597	0.0	3052.2	48
120 min Winter	17.173	0.0	3669.8	84
180 min Winter	12.734	0.0	4083.9	118
240 min Winter	10.299	0.0	4405.2	152
360 min Winter	7.638	0.0	4901.4	216
480 min Winter	6.179	0.0	5286.6	276
600 min Winter	5.241	0.0	5604.8	338
720 min Winter	4.581	0.0	5877.8	400
960 min Winter	3.703	0.0	6331.6	528
1440 min Winter	2.743	0.0	7022.9	778
2160 min Winter	2.035	0.0	7870.3	1144
2880 min Winter	1.650	0.0	8502.0	1500
4320 min Winter	1.233	0.0	9501.8	2248
5760 min Winter	1.009	0.0	10416.9	2944
7200 min Winter	0.867	0.0	11190.9	3672
8640 min Winter	0.769	0.0	11902.4	4408
10080 min Winter	0.697	0.0	12557.6	5144

Cascade Rainfall Details for Pond 1.SRCX

Rainfall Model	FEH
Return Period (years)	30
FEH Rainfall Version	2013
Site Location	GB 429185 583779 NZ 29185 83779
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 %	+0

Time Area Diagram

Total Area (ha) 12.809

Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)
0	4	12.400	4	8	0.409

Cascade Model Details for Pond 1.SRCX

Storage is Online Cover Level (m) 12.300

Tank or Pond Structure

Invert Level (m) 10.900

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	3190.0	1.400	4086.3

Orifice Outflow Control

Diameter (m) 0.900 Discharge Coefficient 0.600 Invert Level (m) 10.900

Cascade Summary of Results for Pond 2.SRCX

Upstream Structures	Outflow To	Overflow To
Pond 1.SRCX	(None)	(None)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	9.756	0.256	93.1	526.8	O K
30 min Summer	9.840	0.340	163.6	708.3	O K
60 min Summer	9.934	0.434	258.3	912.9	O K
120 min Summer	9.986	0.486	337.6	1028.9	O K
180 min Summer	9.999	0.499	358.2	1058.6	O K
240 min Summer	10.006	0.506	368.9	1074.8	O K
360 min Summer	10.008	0.508	371.9	1079.1	O K
480 min Summer	10.000	0.500	359.7	1060.9	O K
600 min Summer	9.988	0.488	340.7	1032.8	O K
720 min Summer	9.974	0.474	320.1	1003.2	O K
960 min Summer	9.950	0.450	282.7	948.7	O K
1440 min Summer	9.907	0.407	223.3	854.0	O K
2160 min Summer	9.861	0.361	181.9	753.4	O K
2880 min Summer	9.831	0.331	155.2	687.6	O K
4320 min Summer	9.793	0.293	121.3	605.7	O K
5760 min Summer	9.767	0.267	100.1	550.3	O K
7200 min Summer	9.747	0.247	87.7	509.3	O K
8640 min Summer	9.734	0.234	79.2	480.3	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	66.450	0.0	1493.5	85
30 min Summer	44.708	0.0	2053.0	77
60 min Summer	28.597	0.0	2745.9	84
120 min Summer	17.173	0.0	3307.1	120
180 min Summer	12.734	0.0	3683.1	148
240 min Summer	10.299	0.0	3974.6	178
360 min Summer	7.638	0.0	4424.4	238
480 min Summer	6.179	0.0	4772.9	298
600 min Summer	5.241	0.0	5060.2	360
720 min Summer	4.581	0.0	5306.3	422
960 min Summer	3.703	0.0	5714.1	544
1440 min Summer	2.743	0.0	6331.8	804
2160 min Summer	2.035	0.0	7147.0	1168
2880 min Summer	1.650	0.0	7713.5	1528
4320 min Summer	1.233	0.0	8591.5	2252
5760 min Summer	1.009	0.0	9475.0	3000
7200 min Summer	0.867	0.0	10175.3	3720
8640 min Summer	0.769	0.0	10810.4	4440

Cascade Summary of Results for Pond 2.SRCX

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
10080 min Summer	9.723	0.223	72.5	458.0	O K
15 min Winter	9.786	0.286	115.5	592.7	O K
30 min Winter	9.881	0.381	199.7	796.2	O K
60 min Winter	9.977	0.477	324.7	1010.2	O K
120 min Winter	10.029	0.529	403.6	1126.6	O K
180 min Winter	10.038	0.538	414.0	1147.3	O K
240 min Winter	10.039	0.539	415.1	1148.9	O K
360 min Winter	10.024	0.524	396.3	1114.9	O K
480 min Winter	10.002	0.502	362.0	1064.9	O K
600 min Winter	9.980	0.480	329.2	1015.8	O K
720 min Winter	9.961	0.461	299.5	972.7	O K
960 min Winter	9.929	0.429	250.7	901.4	O K
1440 min Winter	9.874	0.374	193.5	781.6	O K
2160 min Winter	9.825	0.325	149.8	674.4	O K
2880 min Winter	9.795	0.295	123.1	610.6	O K
4320 min Winter	9.755	0.255	92.8	525.8	O K
5760 min Winter	9.730	0.230	76.6	471.9	O K
7200 min Winter	9.713	0.213	66.1	437.3	O K
8640 min Winter	9.702	0.202	58.8	413.3	O K
10080 min Winter	9.693	0.193	53.4	395.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
10080 min Summer	0.697	0.0	11373.3	5160
15 min Winter	66.450	0.0	1687.9	77
30 min Winter	44.708	0.0	2315.0	71
60 min Winter	28.597	0.0	3081.7	82
120 min Winter	17.173	0.0	3710.5	120
180 min Winter	12.734	0.0	4131.9	150
240 min Winter	10.299	0.0	4458.6	182
360 min Winter	7.638	0.0	4962.8	244
480 min Winter	6.179	0.0	5353.5	306
600 min Winter	5.241	0.0	5675.9	368
720 min Winter	4.581	0.0	5952.1	430
960 min Winter	3.703	0.0	6410.2	558
1440 min Winter	2.743	0.0	7105.7	818
2160 min Winter	2.035	0.0	8007.9	1180
2880 min Winter	1.650	0.0	8644.6	1544
4320 min Winter	1.233	0.0	9637.7	2292
5760 min Winter	1.009	0.0	10613.2	3016
7200 min Winter	0.867	0.0	11398.8	3704
8640 min Winter	0.769	0.0	12115.2	4448
10080 min Winter	0.697	0.0	12758.0	5168

Cascade Rainfall Details for Pond 2.SRCX

Rainfall Model	FEH
Return Period (years)	30
FEH Rainfall Version	2013
Site Location	GB 429185 583779 NZ 29185 83779
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 %	+0

Time Area Diagram

Total Area (ha) 0.250

Time From:	(mins) To:	Area (ha)
0	4	0.250

Cascade Model Details for Pond 2.SRCX

Storage is Online Cover Level (m) 10.700

Tank or Pond Structure

Invert Level (m) 9.500

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	2000.0	1.200	2611.4

Pipe Outflow Control

Diameter (m)	0.900	Entry Loss Coefficient	0.500
Slope (1:X)	48.8	Coefficient of Contraction	0.600
Length (m)	350.000	Upstream Invert Level (m)	9.500
Roughness k (mm)	0.600		

Cascade Summary of Results for Pond 1.SRCX

Upstream Structures	Outflow To	Overflow To
(None)	Pond 2.SRCX	(None)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	11.458	0.558	437.0	1875.5	O K
30 min Summer	11.577	0.677	574.1	2301.6	O K
60 min Summer	11.664	0.764	695.0	2617.5	O K
120 min Summer	11.672	0.772	707.6	2646.3	O K
180 min Summer	11.656	0.756	681.6	2585.5	O K
240 min Summer	11.633	0.733	645.4	2502.1	O K
360 min Summer	11.584	0.684	582.2	2326.2	O K
480 min Summer	11.542	0.642	533.2	2172.7	O K
600 min Summer	11.506	0.606	491.7	2043.9	O K
720 min Summer	11.476	0.576	457.2	1937.5	O K
960 min Summer	11.430	0.530	404.2	1774.7	O K
1440 min Summer	11.374	0.474	320.1	1581.4	O K
2160 min Summer	11.324	0.424	243.1	1405.8	O K
2880 min Summer	11.282	0.382	201.0	1263.6	O K
4320 min Summer	11.233	0.333	156.9	1094.2	O K
5760 min Summer	11.203	0.303	130.2	993.8	O K
7200 min Summer	11.183	0.283	112.4	926.7	O K
8640 min Summer	11.166	0.266	99.5	869.9	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	86.400	0.0	2002.4	17
30 min Summer	58.298	0.0	2726.0	29
60 min Summer	37.749	0.0	3601.5	44
120 min Summer	22.356	0.0	4269.5	78
180 min Summer	16.472	0.0	4720.5	110
240 min Summer	13.270	0.0	5071.7	144
360 min Summer	9.795	0.0	5616.1	206
480 min Summer	7.905	0.0	6043.1	268
600 min Summer	6.696	0.0	6398.1	328
720 min Summer	5.848	0.0	6704.1	390
960 min Summer	4.722	0.0	7214.0	510
1440 min Summer	3.498	0.0	8001.9	750
2160 min Summer	2.593	0.0	8955.0	1124
2880 min Summer	2.100	0.0	9665.2	1476
4320 min Summer	1.567	0.0	10781.9	2204
5760 min Summer	1.279	0.0	11793.1	2936
7200 min Summer	1.097	0.0	12642.9	3672
8640 min Summer	0.971	0.0	13419.7	4408

Cascade Summary of Results for Pond 1.SRCX

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
10080 min Summer	11.152	0.252	90.6	822.8	O K
15 min Winter	11.519	0.619	507.3	2093.6	O K
30 min Winter	11.652	0.752	676.1	2573.8	O K
60 min Winter	11.735	0.835	806.1	2877.3	O K
120 min Winter	11.715	0.815	774.6	2803.3	O K
180 min Winter	11.675	0.775	712.3	2658.7	O K
240 min Winter	11.636	0.736	650.9	2515.1	O K
360 min Winter	11.564	0.664	558.6	2253.2	O K
480 min Winter	11.507	0.607	492.9	2048.1	O K
600 min Winter	11.462	0.562	441.6	1890.8	O K
720 min Winter	11.429	0.529	403.0	1771.3	O K
960 min Winter	11.384	0.484	335.3	1616.2	O K
1440 min Winter	11.330	0.430	253.0	1429.3	O K
2160 min Winter	11.269	0.369	189.5	1219.5	O K
2880 min Winter	11.231	0.331	155.6	1089.7	O K
4320 min Winter	11.188	0.288	117.3	944.3	O K
5760 min Winter	11.160	0.260	95.7	849.0	O K
7200 min Winter	11.139	0.239	82.3	779.2	O K
8640 min Winter	11.124	0.224	73.1	730.6	O K
10080 min Winter	11.113	0.213	66.1	694.7	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
10080 min Summer	0.879	0.0	14130.5	5136
15 min Winter	86.400	0.0	2251.0	17
30 min Winter	58.298	0.0	3061.6	29
60 min Winter	37.749	0.0	4036.6	46
120 min Winter	22.356	0.0	4784.9	82
180 min Winter	16.472	0.0	5290.0	118
240 min Winter	13.270	0.0	5683.6	150
360 min Winter	9.795	0.0	6293.5	216
480 min Winter	7.905	0.0	6772.0	278
600 min Winter	6.696	0.0	7169.9	338
720 min Winter	5.848	0.0	7513.0	396
960 min Winter	4.722	0.0	8084.9	518
1440 min Winter	3.498	0.0	8969.7	766
2160 min Winter	2.593	0.0	10031.1	1144
2880 min Winter	2.100	0.0	10827.6	1500
4320 min Winter	1.567	0.0	12084.1	2208
5760 min Winter	1.279	0.0	13208.7	2944
7200 min Winter	1.097	0.0	14161.1	3680
8640 min Winter	0.971	0.0	15033.6	4408
10080 min Winter	0.879	0.0	15837.5	5144

Cascade Rainfall Details for Pond 1.SRCX

Rainfall Model	FEH
Return Period (years)	100
FEH Rainfall Version	2013
Site Location	GB 429185 583779 NZ 29185 83779
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 %	+0

Time Area Diagram

Total Area (ha) 12.809

Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)
0	4	12.400	4	8	0.409

Cascade Model Details for Pond 1.SRCX

Storage is Online Cover Level (m) 12.300

Tank or Pond Structure

Invert Level (m) 10.900

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	3190.0	1.400	4086.3

Orifice Outflow Control

Diameter (m) 0.900 Discharge Coefficient 0.600 Invert Level (m) 10.900

Cascade Summary of Results for Pond 2.SRCX

Upstream Structures	Outflow To	Overflow To
Pond 1.SRCX	(None)	(None)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	9.829	0.329	153.8	684.9	O K
30 min Summer	9.943	0.443	272.0	933.5	O K
60 min Summer	10.042	0.542	418.6	1155.8	O K
120 min Summer	10.093	0.593	476.8	1271.2	O K
180 min Summer	10.106	0.606	491.7	1300.4	O K
240 min Summer	10.110	0.610	496.9	1311.7	O K
360 min Summer	10.104	0.604	490.0	1297.6	O K
480 min Summer	10.087	0.587	470.4	1258.9	O K
600 min Summer	10.067	0.567	447.4	1213.2	O K
720 min Summer	10.048	0.548	424.9	1168.6	O K
960 min Summer	10.015	0.515	382.6	1095.2	O K
1440 min Summer	9.967	0.467	309.4	986.8	O K
2160 min Summer	9.918	0.418	234.7	879.3	O K
2880 min Summer	9.879	0.379	198.4	793.4	O K
4320 min Summer	9.831	0.331	155.6	689.3	O K
5760 min Summer	9.803	0.303	130.2	627.2	O K
7200 min Summer	9.783	0.283	112.8	585.2	O K
8640 min Summer	9.766	0.266	99.8	549.5	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	86.400	0.0	1980.2	69
30 min Summer	58.298	0.0	2716.8	65
60 min Summer	37.749	0.0	3641.6	80
120 min Summer	22.356	0.0	4321.9	118
180 min Summer	16.472	0.0	4780.8	146
240 min Summer	13.270	0.0	5138.0	176
360 min Summer	9.795	0.0	5691.2	238
480 min Summer	7.905	0.0	6124.6	300
600 min Summer	6.696	0.0	6484.4	360
720 min Summer	5.848	0.0	6794.2	420
960 min Summer	4.722	0.0	7309.3	536
1440 min Summer	3.498	0.0	8103.0	780
2160 min Summer	2.593	0.0	9113.6	1156
2880 min Summer	2.100	0.0	9829.6	1528
4320 min Summer	1.567	0.0	10940.8	2252
5760 min Summer	1.279	0.0	12016.3	2968
7200 min Summer	1.097	0.0	12878.9	3696
8640 min Summer	0.971	0.0	13659.9	4440

Cascade Summary of Results for Pond 2.SRCX

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
10080 min Summer	9.753	0.253	91.2	521.0	O K
15 min Winter	9.868	0.368	188.1	768.2	O K
30 min Winter	9.987	0.487	339.9	1031.6	O K
60 min Winter	10.098	0.598	482.5	1282.9	O K
120 min Winter	10.153	0.653	546.5	1410.5	O K
180 min Winter	10.158	0.658	552.2	1422.7	O K
240 min Winter	10.151	0.651	544.2	1405.8	O K
360 min Winter	10.120	0.620	507.9	1333.0	O K
480 min Winter	10.083	0.583	465.8	1249.4	O K
600 min Winter	10.050	0.550	427.8	1174.1	O K
720 min Winter	10.024	0.524	395.6	1113.6	O K
960 min Winter	9.983	0.483	333.8	1022.6	O K
1440 min Winter	9.931	0.431	253.7	905.9	O K
2160 min Winter	9.871	0.371	190.8	774.7	O K
2880 min Winter	9.833	0.333	157.4	693.0	O K
4320 min Winter	9.790	0.290	119.1	600.3	O K
5760 min Winter	9.762	0.262	96.9	540.5	O K
7200 min Winter	9.741	0.241	83.6	495.6	O K
8640 min Winter	9.726	0.226	74.4	464.5	O K
10080 min Winter	9.715	0.215	67.4	441.1	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
10080 min Summer	0.879	0.0	14357.5	5160
15 min Winter	86.400	0.0	2233.3	64
30 min Winter	58.298	0.0	3058.7	64
60 min Winter	37.749	0.0	4085.0	80
120 min Winter	22.356	0.0	4847.1	118
180 min Winter	16.472	0.0	5361.3	148
240 min Winter	13.270	0.0	5761.7	182
360 min Winter	9.795	0.0	6381.7	246
480 min Winter	7.905	0.0	6867.6	306
600 min Winter	6.696	0.0	7271.2	366
720 min Winter	5.848	0.0	7618.7	422
960 min Winter	4.722	0.0	8197.3	542
1440 min Winter	3.498	0.0	9089.8	794
2160 min Winter	2.593	0.0	10210.8	1176
2880 min Winter	2.100	0.0	11014.9	1536
4320 min Winter	1.567	0.0	12269.3	2260
5760 min Winter	1.279	0.0	13459.5	3016
7200 min Winter	1.097	0.0	14426.9	3744
8640 min Winter	0.971	0.0	15306.8	4432
10080 min Winter	0.879	0.0	16100.9	5184

Cascade Rainfall Details for Pond 2.SRCX

Rainfall Model	FEH
Return Period (years)	100
FEH Rainfall Version	2013
Site Location	GB 429185 583779 NZ 29185 83779
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 %	+0

Time Area Diagram

Total Area (ha) 0.250

Time From:	(mins) To:	Area (ha)
0	4	0.250

Cascade Model Details for Pond 2.SRCX

Storage is Online Cover Level (m) 10.700

Tank or Pond Structure

Invert Level (m) 9.500

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	2000.0	1.200	2611.4

Pipe Outflow Control

Diameter (m)	0.900	Entry Loss Coefficient	0.500
Slope (1:X)	48.8	Coefficient of Contraction	0.600
Length (m)	350.000	Upstream Invert Level (m)	9.500
Roughness k (mm)	0.600		

Cascade Summary of Results for Pond 1.SRCX

Upstream Structures	Outflow To	Overflow To
(None)	Pond 2.SRCX	(None)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	11.655	0.755	680.8	2584.9	O K
30 min Summer	11.804	0.904	916.3	3134.7	O K
60 min Summer	11.911	1.011	1091.7	3540.4	O K
120 min Summer	11.908	1.008	1087.6	3530.6	O K
180 min Summer	11.876	0.976	1035.1	3409.5	O K
240 min Summer	11.839	0.939	974.5	3268.4	O K
360 min Summer	11.770	0.870	862.0	3010.3	O K
480 min Summer	11.713	0.813	772.2	2798.6	O K
600 min Summer	11.666	0.766	698.2	2625.2	O K
720 min Summer	11.627	0.727	635.9	2480.2	O K
960 min Summer	11.558	0.658	552.2	2233.3	O K
1440 min Summer	11.469	0.569	449.1	1912.3	O K
2160 min Summer	11.397	0.497	355.2	1661.5	O K
2880 min Summer	11.357	0.457	294.2	1523.1	O K
4320 min Summer	11.303	0.403	219.7	1335.1	O K
5760 min Summer	11.262	0.362	182.8	1193.6	O K
7200 min Summer	11.235	0.335	158.7	1101.3	O K
8640 min Summer	11.215	0.315	140.9	1034.6	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	120.960	0.0	2831.2	17
30 min Summer	81.617	0.0	3845.0	27
60 min Summer	52.848	0.0	5051.7	44
120 min Summer	31.298	0.0	5987.4	76
180 min Summer	23.061	0.0	6619.1	110
240 min Summer	18.579	0.0	7111.2	142
360 min Summer	13.713	0.0	7874.0	204
480 min Summer	11.067	0.0	8472.7	266
600 min Summer	9.375	0.0	8970.7	328
720 min Summer	8.187	0.0	9400.1	390
960 min Summer	6.611	0.0	10116.3	512
1440 min Summer	4.897	0.0	11225.7	750
2160 min Summer	3.630	0.0	12541.2	1104
2880 min Summer	2.940	0.0	13538.1	1472
4320 min Summer	2.193	0.0	15113.8	2204
5760 min Summer	1.791	0.0	16511.0	2936
7200 min Summer	1.536	0.0	17701.9	3672
8640 min Summer	1.360	0.0	18793.4	4408

Cascade Summary of Results for Pond 1.SRCX

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
10080 min Summer	11.200	0.300	128.0	985.3	O K
15 min Winter	11.736	0.836	808.4	2883.0	O K
30 min Winter	11.899	0.999	1072.0	3495.0	O K
60 min Winter	11.999	1.099	1236.5	3880.3	O K
120 min Winter	11.955	1.055	1164.6	3711.5	O K
180 min Winter	11.893	0.993	1062.2	3471.9	O K
240 min Winter	11.835	0.935	967.1	3251.8	O K
360 min Winter	11.739	0.839	813.1	2894.3	O K
480 min Winter	11.667	0.767	699.7	2629.1	O K
600 min Winter	11.609	0.709	611.0	2417.6	O K
720 min Winter	11.558	0.658	552.2	2233.0	O K
960 min Winter	11.483	0.583	465.8	1963.7	O K
1440 min Winter	11.400	0.500	359.7	1671.7	O K
2160 min Winter	11.341	0.441	269.7	1467.6	O K
2880 min Winter	11.301	0.401	218.0	1328.1	O K
4320 min Winter	11.241	0.341	164.1	1122.7	O K
5760 min Winter	11.208	0.308	134.7	1010.5	O K
7200 min Winter	11.187	0.287	116.0	939.1	O K
8640 min Winter	11.170	0.270	102.3	884.4	O K
10080 min Winter	11.155	0.255	92.8	833.5	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
10080 min Summer	1.230	0.0	19800.2	5136
15 min Winter	120.960	0.0	3179.4	17
30 min Winter	81.617	0.0	4315.1	28
60 min Winter	52.848	0.0	5660.9	46
120 min Winter	31.298	0.0	6708.9	82
180 min Winter	23.061	0.0	7416.5	116
240 min Winter	18.579	0.0	7967.8	148
360 min Winter	13.713	0.0	8822.4	212
480 min Winter	11.067	0.0	9493.3	276
600 min Winter	9.375	0.0	10051.3	340
720 min Winter	8.187	0.0	10532.7	400
960 min Winter	6.611	0.0	11335.7	520
1440 min Winter	4.897	0.0	12580.9	752
2160 min Winter	3.630	0.0	14047.7	1124
2880 min Winter	2.940	0.0	15165.5	1500
4320 min Winter	2.193	0.0	16936.5	2208
5760 min Winter	1.791	0.0	18492.7	2936
7200 min Winter	1.536	0.0	19827.3	3672
8640 min Winter	1.360	0.0	21052.3	4408
10080 min Winter	1.230	0.0	22188.0	5136

Cascade Rainfall Details for Pond 1.SRCX

Rainfall Model	FEH
Return Period (years)	100
FEH Rainfall Version	2013
Site Location	GB 429185 583779 NZ 29185 83779
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 %	+40

Time Area Diagram

Total Area (ha) 12.809

Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)
0	4	12.400	4	8	0.409

Cascade Model Details for Pond 1.SRCX

Storage is Online Cover Level (m) 12.300

Tank or Pond Structure

Invert Level (m) 10.900

Depth (m)	**Area (m²)**	**Depth (m)**	**Area (m²)**
0.000	3190.0	1.400	4086.3

Orifice Outflow Control

Diameter (m) 0.900 Discharge Coefficient 0.600 Invert Level (m) 10.900

Cascade Summary of Results for Pond 2.SRCX

Upstream Structures	Outflow To	Overflow To
Pond 1.SRCX	(None)	(None)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	9.958	0.458	294.9	965.8	O K
30 min Summer	10.084	0.584	467.0	1251.9	O K
60 min Summer	10.236	0.736	650.1	1603.7	O K
120 min Summer	10.292	0.792	739.1	1738.2	O K
180 min Summer	10.305	0.805	759.6	1769.7	O K
240 min Summer	10.306	0.806	761.2	1771.6	O K
360 min Summer	10.286	0.786	728.9	1723.4	O K
480 min Summer	10.255	0.755	680.0	1649.0	O K
600 min Summer	10.221	0.721	627.3	1569.1	O K
720 min Summer	10.187	0.687	585.6	1490.2	O K
960 min Summer	10.134	0.634	524.0	1366.0	O K
1440 min Summer	10.059	0.559	437.6	1193.0	O K
2160 min Summer	9.995	0.495	351.4	1049.2	O K
2880 min Summer	9.956	0.456	292.6	962.5	O K
4320 min Summer	9.902	0.402	218.4	842.1	O K
5760 min Summer	9.862	0.362	182.8	754.7	O K
7200 min Summer	9.835	0.335	159.2	698.0	O K
8640 min Summer	9.817	0.317	142.7	657.1	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	120.960	0.0	2824.3	56
30 min Summer	81.617	0.0	3856.8	61
60 min Summer	52.848	0.0	5119.9	76
120 min Summer	31.298	0.0	6072.9	110
180 min Summer	23.061	0.0	6716.1	138
240 min Summer	18.579	0.0	7217.0	168
360 min Summer	13.713	0.0	7992.8	232
480 min Summer	11.067	0.0	8601.2	294
600 min Summer	9.375	0.0	9106.7	358
720 min Summer	8.187	0.0	9542.3	422
960 min Summer	6.611	0.0	10267.7	542
1440 min Summer	4.897	0.0	11388.8	780
2160 min Summer	3.630	0.0	12769.5	1136
2880 min Summer	2.940	0.0	13777.2	1500
4320 min Summer	2.193	0.0	15355.8	2248
5760 min Summer	1.791	0.0	16826.0	2968
7200 min Summer	1.536	0.0	18036.7	3688
8640 min Summer	1.360	0.0	19137.5	4416

Cascade Summary of Results for Pond 2.SRCX

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
10080 min Summer	9.802	0.302	129.8	626.4	O K
15 min Winter	10.002	0.502	362.0	1065.0	O K
30 min Winter	10.149	0.649	541.3	1399.9	O K
60 min Winter	10.313	0.813	771.4	1787.9	O K
120 min Winter	10.367	0.867	857.3	1919.1	O K
180 min Winter	10.367	0.867	856.5	1918.4	O K
240 min Winter	10.349	0.849	828.9	1875.9	O K
360 min Winter	10.296	0.796	744.6	1747.0	O K
480 min Winter	10.242	0.742	659.6	1618.1	O K
600 min Winter	10.190	0.690	589.1	1496.9	O K
720 min Winter	10.147	0.647	539.6	1396.9	O K
960 min Winter	10.080	0.580	462.4	1242.3	O K
1440 min Winter	10.002	0.502	362.8	1065.2	O K
2160 min Winter	9.944	0.444	273.6	935.1	O K
2880 min Winter	9.904	0.404	220.2	846.8	O K
4320 min Winter	9.844	0.344	166.7	715.7	O K
5760 min Winter	9.810	0.310	136.9	643.2	O K
7200 min Winter	9.789	0.289	117.7	597.6	O K
8640 min Winter	9.773	0.273	104.3	563.9	O K
10080 min Winter	9.758	0.258	94.4	531.2	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
10080 min Summer	1.230	0.0	20136.4	5152
15 min Winter	120.960	0.0	3179.1	55
30 min Winter	81.617	0.0	4335.9	60
60 min Winter	52.848	0.0	5740.8	74
120 min Winter	31.298	0.0	6808.4	110
180 min Winter	23.061	0.0	7529.0	142
240 min Winter	18.579	0.0	8090.2	174
360 min Winter	13.713	0.0	8959.7	238
480 min Winter	11.067	0.0	9641.6	302
600 min Winter	9.375	0.0	10208.4	370
720 min Winter	8.187	0.0	10696.9	430
960 min Winter	6.611	0.0	11510.9	550
1440 min Winter	4.897	0.0	12770.6	780
2160 min Winter	3.630	0.0	14305.5	1144
2880 min Winter	2.940	0.0	15436.8	1536
4320 min Winter	2.193	0.0	17215.1	2256
5760 min Winter	1.791	0.0	18846.7	2960
7200 min Winter	1.536	0.0	20203.7	3704
8640 min Winter	1.360	0.0	21442.1	4456
10080 min Winter	1.230	0.0	22573.9	5160

Cascade Rainfall Details for Pond 2.SRCX

Rainfall Model	FEH
Return Period (years)	100
FEH Rainfall Version	2013
Site Location	GB 429185 583779 NZ 29185 83779
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 %	+40

Time Area Diagram

Total Area (ha) 0.250

Time (mins) From:	To:	Area (ha)
0	4	0.250

Cascade Model Details for Pond 2.SRCX

Storage is Online Cover Level (m) 10.700

Tank or Pond Structure

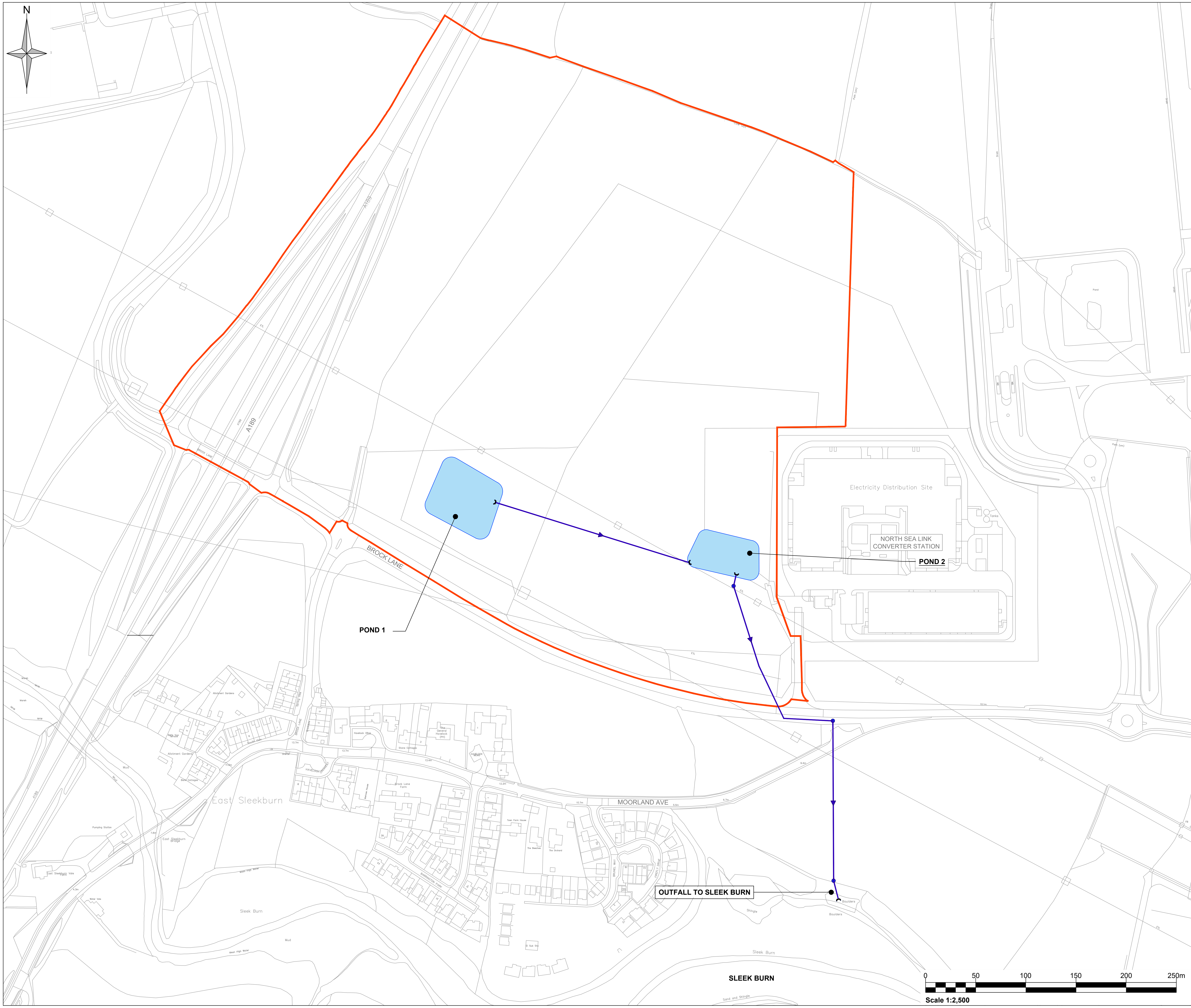
Invert Level (m) 9.500

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	2000.0	1.200	2611.4

Pipe Outflow Control

Diameter (m)	0.900	Entry Loss Coefficient	0.500
Slope (1:X)	48.8	Coefficient of Contraction	0.600
Length (m)	350.000	Upstream Invert Level (m)	9.500
Roughness k (mm)	0.600		

Appendix F Indicative / Conceptual Surface Water Drainage Drawing



Notes:

Client: SSE Renewables

Legend:

- INDICATIVE CONVERTER STATION ZONE
- INDICATIVE POND LOCATION
- PIPED CONNECTION

Rev	Amendments	Date	By	Chk	Auth
1	SITE LAYOUT AMENDED	10/23	TS	SP	

SLR

www.slrconsulting.com

Client
CAMBIOS CONNECTION ONSHORE SCHEME

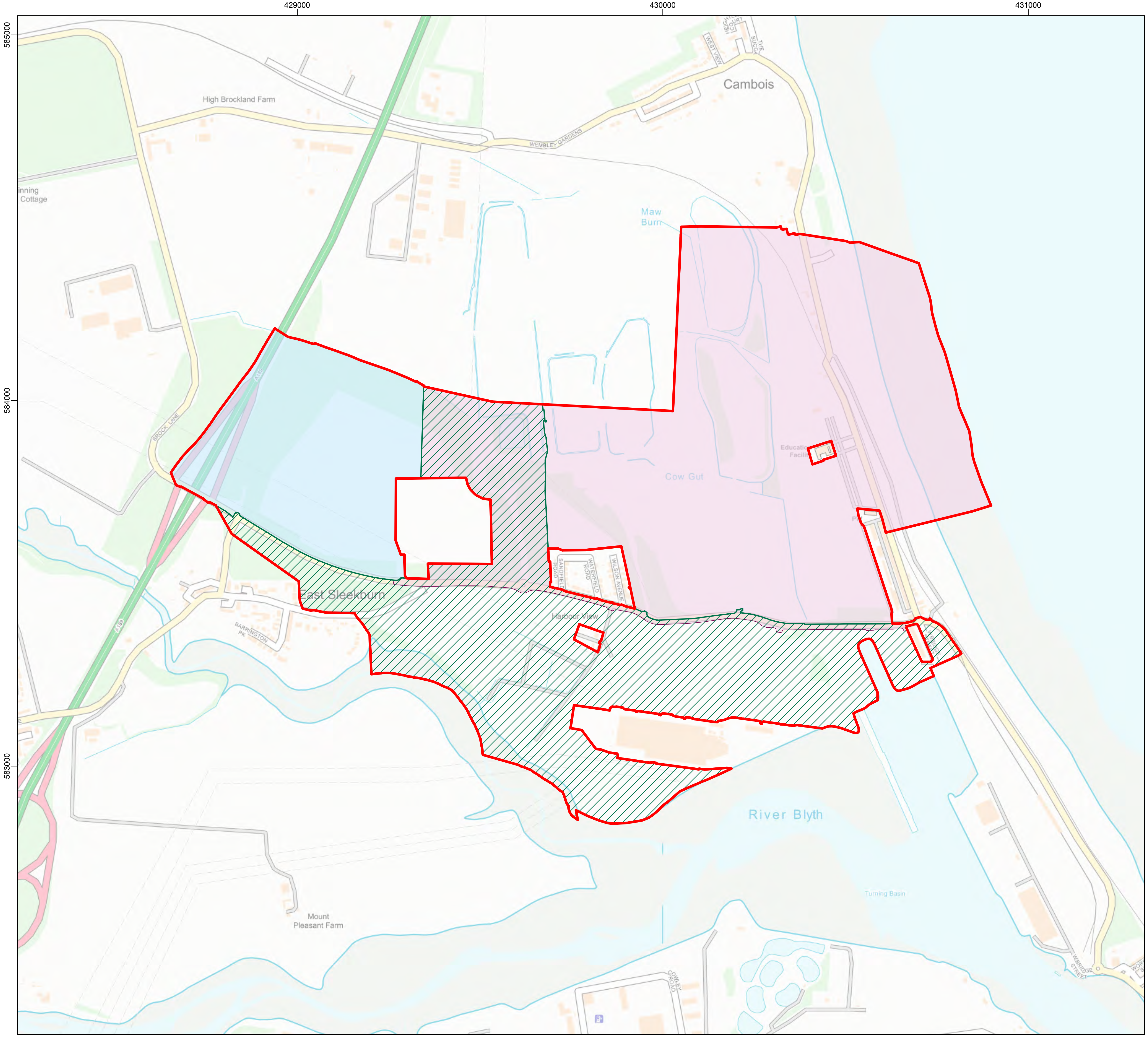
Project
BERWICK BANK WINDFARM, CAMBOIS CONNECTION

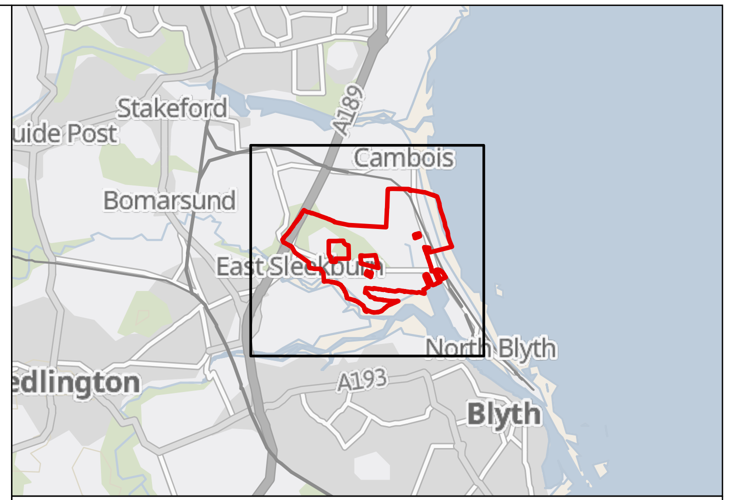
Figure Title
INDICATIVE SURFACE WATER DRAINAGE STRATEGY

Scale		SLR Project No.	
1:2,500	A2	404.000041.00001	
Designed: CN	Drawn: TKS	Checked: CN	Authorised:
Date: JULY 2023	Date: JULY 2023	Date: JULY 2023	Date:

Figure Number: SW1 | Rev.: 1

Appendix G Figures





Legend

- Site Boundary
- Landfall and High-Voltage Direct Current (HVDC) Zone
- High-Voltage Alternating Current (HVAC) Zone
- Converter Station Zone

Rev	Date	Status	Drwn	Chkd	Appd
04	-	-	-	-	-
03	-	-	-	-	-
02	-	-	-	-	-
01	25/10/2023	First Issue	FG	JS	SP

Project

CAMBOIS CONNECTION ONSHORE SCHEME

Title

FIGURE 11.3.2: SITE BOUNDARY PLAN

0 100 200 300 400 500 Metres

N

Scale	Plot Size	Datum	Projection
1:10,000	A3	OSGB36	BNG

Drawing Number	Sheet No.
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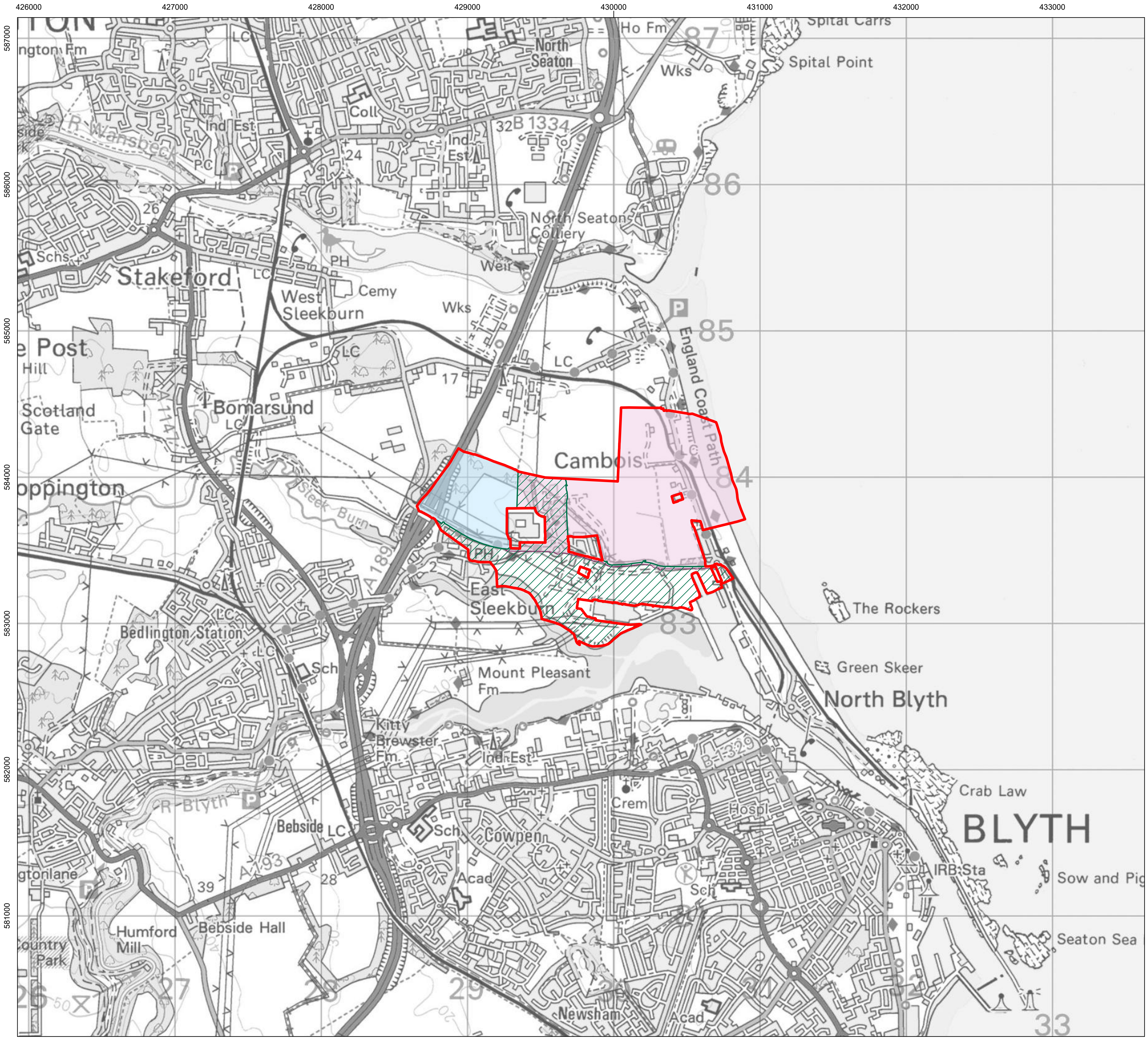

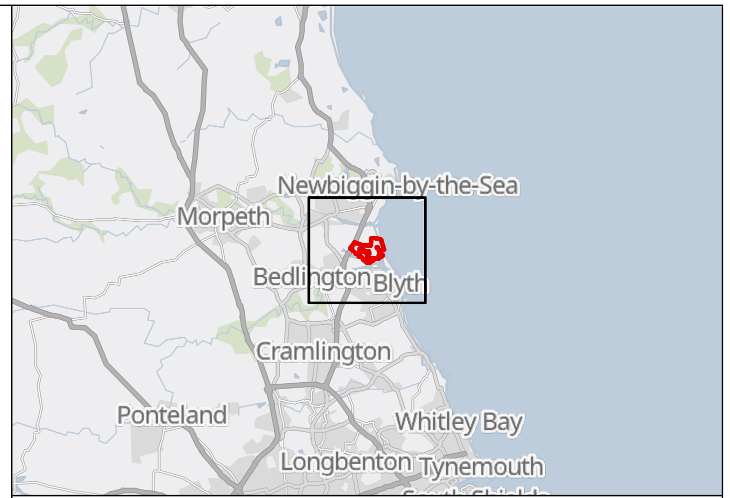

Legend

- Site Boundary
- Landfall and High-Voltage Direct Current (HVDC) Zone
- High-Voltage Alternating Current (HVAC) Zone
- Converter Station Zone

Rev	Date	Status	Drwn	Chkd	Appd
04	-	-	-	-	-
03	-	-	-	-	-
02	-	-	-	-	-
01	20/10/2023	First Issue	FG	JS	SP

sse Renewables SLR

Project

CAMBOIS CONNECTION ONSHORE SCHEME

Title

FIGURE 11.3.1: SITE LOCATION

0 0.5 1 1.5 Kilometres

N

Scale	Plot Size	Datum	Projection
1:25,000	A3	OSGB36	BNG

Drawing Number	Sheet No.
404.000041.00001.0072.0	1

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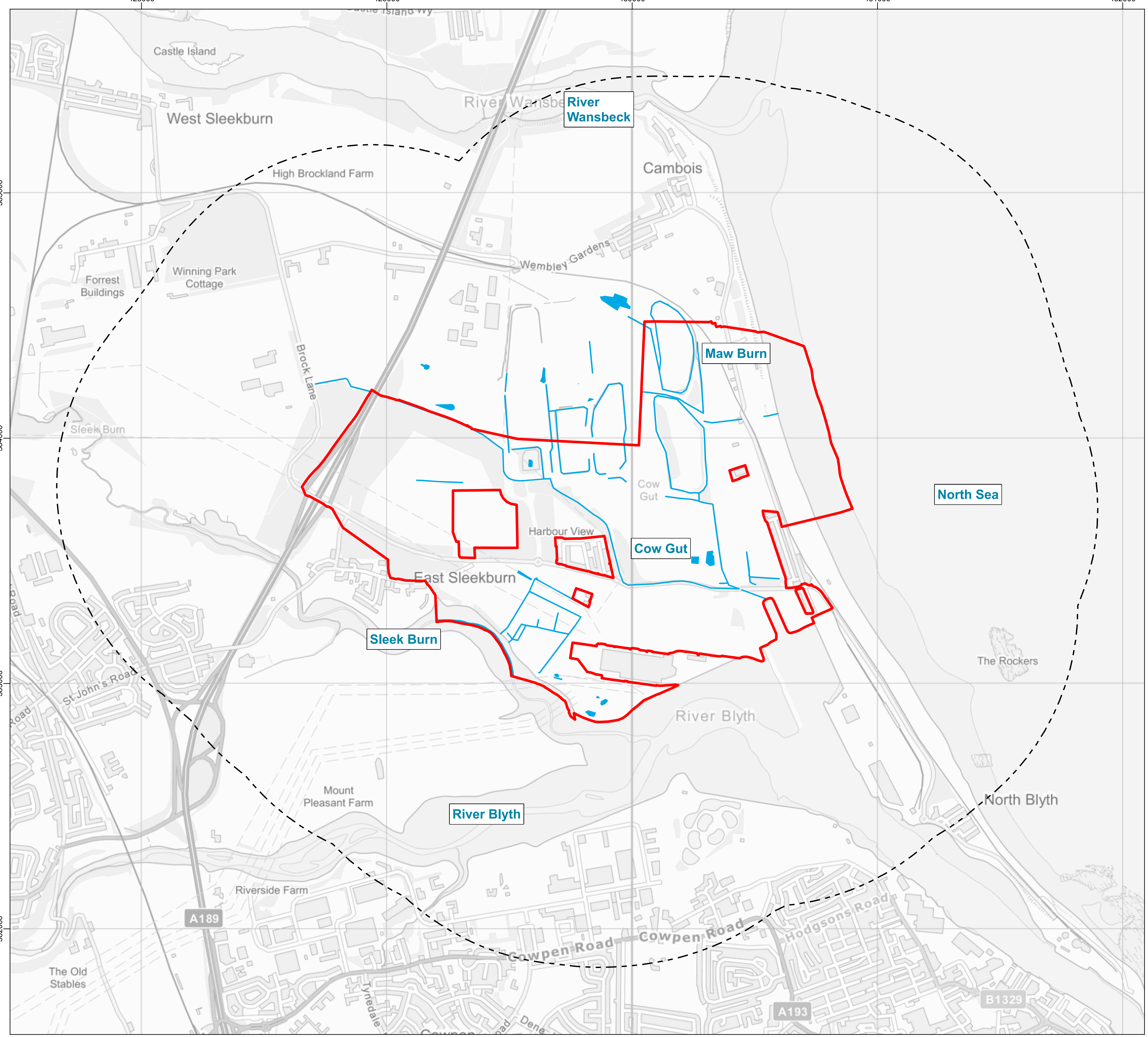

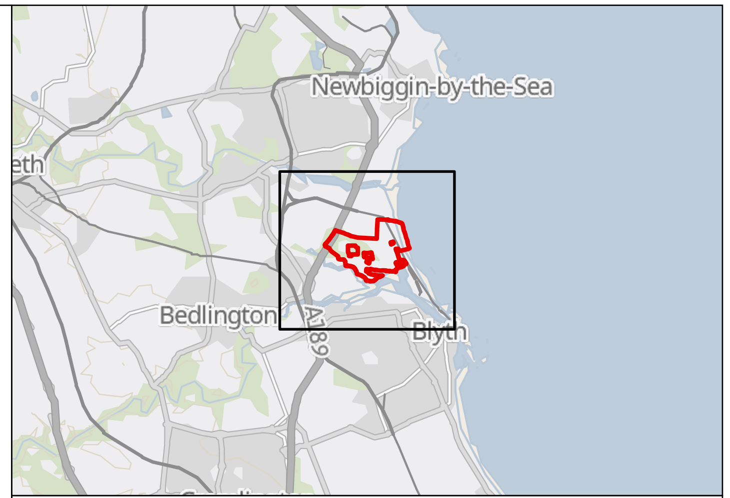

Legend

- Site Boundary
- Site Boundary 1 km Buffer
- Waterbody

Rev	Date	Status	Drwn	Chkd	Appd
04	-	-	-	-	-
03	-	-	-	-	-
02	-	-	-	-	-
01	20/10/2023	First Issue	FG	JS	SP

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SLR

Project

CAMBOIS CONNECTION ONSHORE SCHEME

Title

FIGURE 11.1.3: LOCAL HYDROLOGY

0 0.2 0.4 0.6 0.8 1 Kilometres

N

Scale	Plot Size	Datum	Projection
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Drawing Number	Sheet No.
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