

# REPORT

## **South Bank Quay**

### Flood Risk Assessment

Client: Tees Valley Combined Authority

Reference: PC1084-RHD-ZZ-XX-RP-Z-0001

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Appendix A: Correspondence related to Environment Agency Product 5 and 8 data package

## 1 Introduction

Royal HaskoningDHV has been commissioned by Tees Valley Combined Authority (herein 'TVCA') to prepare a Flood Risk Assessment (FRA) to support the submission of a planning application and marine licence application for a proposed new quay at South Bank in the Tees estuary (hereafter referred to as "the proposed scheme").

The purpose of this FRA is to:

- provide the information required to support the aforementioned applications in terms of flood risk, including the application of the Sequential Test and, where appropriate, the Exception Test;
- provide recommendations on potential measures required to reduce flood risk to the proposed scheme, if applicable; and,
- inform potential mitigation options related to resistance and resilience measures.

This FRA has been prepared in accordance with the National Planning Policy Framework (NPPF)<sup>1</sup>, Planning Practice Guidance<sup>2</sup> (PPG) for Flood Risk and Coastal Change and the Environment Agency's Climate Change Allowance<sup>3</sup> guidance. The Climate Change Allowance guidance sets out the Environment Agency's recommended climate change allowances for development, when considering flood risk and coastal change for planning purposes.

The principal aim of these policies and guidance documents is to avoid inappropriate development in areas at risk of flooding and, wherever possible, to direct development away from areas at highest risk.

A separate FRA has been produced to support the South Tees Development Corporation (STDC) landside proposals for general industry and storage or distribution uses within part of the South Industrial Zone (JBA, 2020), immediately south of the proposed scheme footprint (referred to as the SIZ landside development hereafter). A review of the SIZ landside development FRA has been undertaken to support the production of this FRA.

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<sup>1</sup> National Planning Policy Framework, July 2018. Source: Ministry of Housing, Communities & Local Government <https://www.gov.uk/government/publications/national-planning-policy-framework--2> (Accessed 19/08/2020)

<sup>2</sup> Planning Practice Guidance; Flood risk and coastal change, March 2014. Source: Ministry of Housing, Communities & Local Government. <https://www.gov.uk/guidance/flood-risk-and-coastal-change> (Accessed 25/08/2020)

<sup>3</sup> Flood Risk Assessments: Climate Change Allowances. Environment Agency. (Last updated 03/02/2017) <https://www.gov.uk/guidance/flood-risk-assessments-climate-change-allowances> (Accessed 19/08/2020)

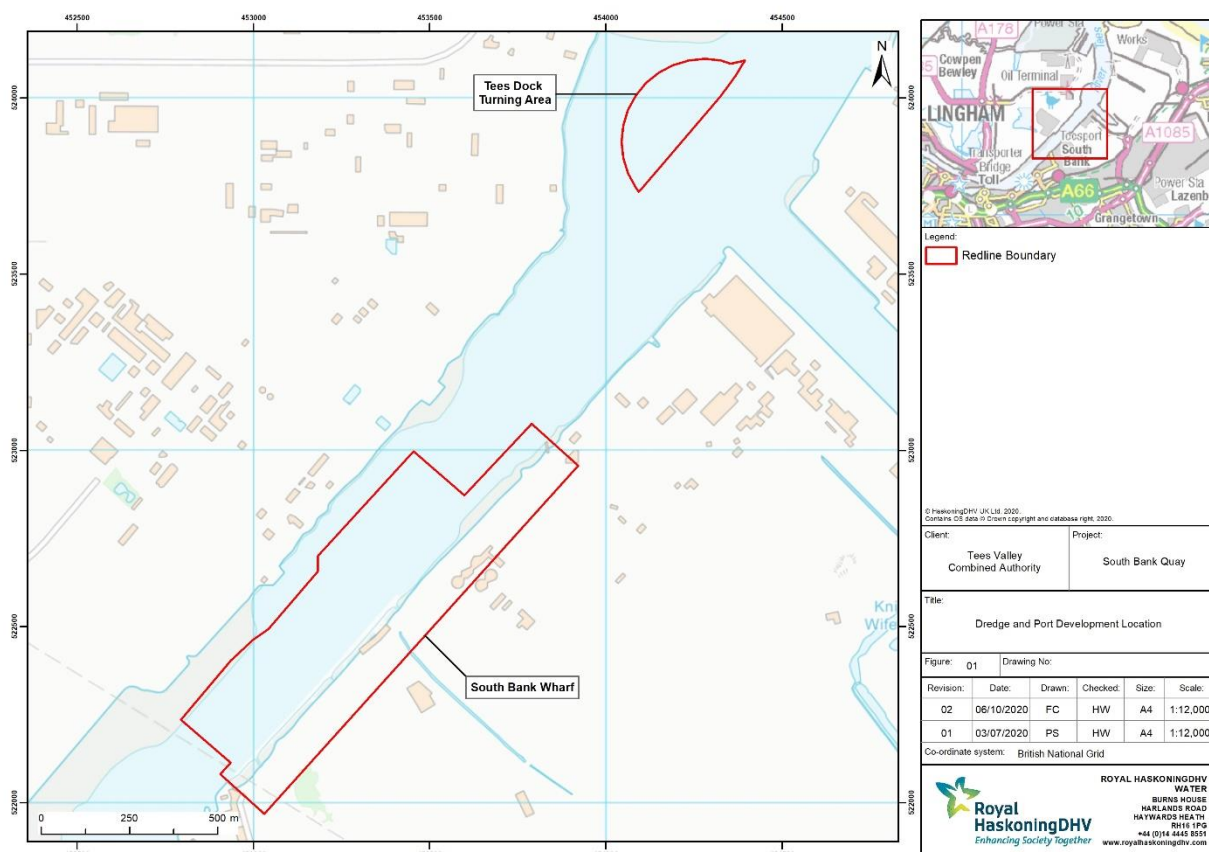
## 2 Location and description of the proposed scheme

### 2.1 Proposed scheme location and existing use

The proposed scheme footprint occupies subtidal and intertidal areas of the Tees estuary, as well as an area of land on the southern bank of the River Tees which comprises currently unused, brownfield land (**Figure 1**). It is understood that the land within the proposed scheme footprint was raised and reclaimed from the River Tees in the 1930/40s and that previous land use at the site includes iron and steel industries.

In terms of estuarine infrastructure, the proposed scheme footprint contains the existing South Bank wharf and three jetty structures located immediately downstream. In addition, a series of pipes are present within the intertidal area which are associated with the pumping station located immediately inland of South Bank wharf, as well as various other smaller infrastructure including outfalls.

The linear strip of land comprises a concrete track running along its length, which provides access to the disused South Bank Wharf. The track continues east and joins with the road infrastructure of the concrete works immediately to the east. Within this linear strip of land there are also a number of small buildings present, including a pumping station and electrical substations.



**Figure 1 Proposed scheme footprint**

## 2.2 Proposed scheme

The proposed scheme is defined in full within the Environmental Impact Assessment (EIA) Report (Royal HaskoningDHV, 2020) which this FRA supports, however in summary comprises:

- demolition of the existing infrastructure;
- capital dredging (to locally deepen the Tees Dock turning circle and approach channel and to create a berth pocket);
- offshore disposal of dredged sediments; and,
- construction and operation of a new quay that will be set back into the riverbank.

The proposed quay is to be constructed at a level of 8.64m Chart Datum (CD). Chart datum at the proposed scheme footprint is approximately 2.8m below Ordnance Datum (m OD). For the purpose of this FRA the proposed quay is to be 5.84m above Ordnance Datum (m AOD).

It is envisaged that the proposed quay would be utilised predominantly by the renewable energy industry, as well as supporting more general industrial and storage or distribution activities.

## 2.3 Hydrology

The proposed scheme footprint is located in the Tees Lower and Estuary catchment<sup>4</sup>. The landside parts of the proposed scheme footprint are entirely located on the south bank of the River Tees, a designated Environment Agency Main River. The proposed quay is to be located approximately 6km upstream from the river mouth, where the River Tees enters the North Sea. The River Tees is a tidally influenced transitional waterbody as defined by the Water Framework Directive (WFD).

Approximately 10.5km upstream of the proposed scheme footprint, the River Tees is controlled by a tidal barrage. The barrage is operated by the Canal and River Trust and maintains a controlled water level upstream of the structure.

There is one unnamed watercourse that runs through the proposed scheme footprint. This watercourse was the former alignment of the Holme Beck, which has since been diverted along the south eastern boundary of the proposed SIZ landside development also being progressed by STDC. The currently unnamed channel that was formerly the alignment of the Holme Beck flows north through the SIZ landside development site via an open channel, before being culverted underneath the access track present within the proposed scheme footprint and discharging into the River Tees.

Within the wider area there are a number of small watercourses. The closest to the proposed scheme footprint comprise the Cleveland Channel and Lackenby Channel. The Cleveland Channel flows into the Lackenby Channel approximately 1.4km south-east of the proposed scheme footprint. The Lackenby Channel flows perpendicular to the River Tees in an open channel, before being culverted and draining into the River Tees approximately 300m north-east of the proposed scheme footprint via the Lackenby Outfall (JBA, 2020).

Review of Ordnance Survey mapping has not indicated any other watercourses that cross the proposed scheme footprint. The proposed scheme footprint is not identified as being located within a Source Protection Zone<sup>5</sup>.

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<sup>4</sup> Environment Agency. Online. Catchment Data Explorer: Available at: <https://environment.data.gov.uk/catchment-planning/> (Accessed 12/07/2020)

<sup>5</sup> DEFRA Magic Map. Online. Source Protection Zones: Available at: <https://magic.defra.gov.uk/MagicMap.aspx>



## 2.4 Existing surface water drainage system

It is understood that there is no formal drainage system from the existing land adjacent to the Tees estuary. It is understood that surface water runoff and drainage from the land is likely to flow directly into the Tees estuary.

## 2.5 Geology

British Geological Survey (BGS) Maps<sup>6</sup> records the Bedrock geology for the entire proposed scheme footprint as undifferentiated Triassic Rocks. This is a sedimentary Bedrock formed approximately 200 to 251 million years ago in the Triassic Period, where the local environment was previously dominated by hot deserts. The BGS Map records the sole superficial geology for the proposed scheme as Tidal Flat Deposits formed during the Quaternary Period. Error! Reference source not found.

A historic borehole record (ref: NZ52SW15054/AS2 referred to as AS2) located approximately 25m from the Tees estuary has been reviewed. This borehole was located in close proximity to the southwestern corner of the proposed scheme footprint and notes that groundwater was recorded at 4.10m below ground level. This borehole was situated at 6.15m AOD, indicating that the groundwater level could be at approximately 2.05m AOD.

An additional borehole (ref: NZ52SW15054/AS4, referred to as AS4), located approximately 200m from the Tees estuary has been reviewed. This borehole was located 150m to the southeast of the proposed scheme footprint, within the SIZ landside development footprint. It found groundwater at 6.2m below ground level. This borehole was situated at 7.15m AOD, indicating that the groundwater level could be at approximately 0.95m AOD.

A review of the borehole records indicates that the groundwater level is approximately 1.1m deeper at borehole AS4 than AS2, with AS4 situated 175m further inland than AS2. Therefore, it is highly likely that groundwater is linked to tidal levels in the River Tees, with the groundwater levels deepening with distance from the watercourse. Shallower groundwater levels adjacent to the watercourse are likely due to percolation of water through the existing banks into the adjoining ground.

The Groundwater Vulnerability Map<sup>7</sup> shows:

*“the vulnerability of groundwater to a pollutant discharged at ground level based on the hydrological, geological, hydrogeological and soil properties within a single square kilometre”.*

Groundwater vulnerability classification is a product of soil type and the underlying geology; however, the depth to groundwater is not considered. The proposed scheme footprint falls within an area defined as Medium - High Vulnerability. This is the second highest of the five categories.

The Aquifer Designation Map<sup>8</sup> classifies the bedrock geology for the proposed scheme footprint as a ‘Secondary B’ aquifer. This is defined as:

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<sup>6</sup> British Geological Survey, *Geology of Britain viewer*. Available at [http://scans.bgs.ac.uk/sobj\\_scans/boreholes/918110/images/16767534.html](http://scans.bgs.ac.uk/sobj_scans/boreholes/918110/images/16767534.html) (Accessed 07/07/2020)

<sup>7</sup> Environment Agency, *Groundwater Vulnerability Map*. Available at <https://magic.defra.gov.uk/MagicMap.aspx> (Accessed 23/01/2020)

<sup>8</sup> Environment Agency, *Aquifer Designation Map*. Available at <https://magic.defra.gov.uk/MagicMap.aspx> (Accessed 23/01/2020)

*“Secondary B aquifers are predominantly lower permeability layers which may store and yield limited amounts of groundwater due to localised features such as fissures, thin permeable horizons and weathering. These are generally the water-bearing parts of the former non-aquifers”.*

The Aquifer Designation Map<sup>9</sup> classifies the superficial geology for the entire proposed scheme footprint as a ‘Secondary undifferentiated aquifer. This is defined for:

*“cases where it has not been possible to attribute either category A or B to a rock type. In most cases, this means that the layer in question has previously been designated as both minor and non-aquifer in different locations due to the variable characteristics of the rock type”.*

## 2.6 Topography

Much of the former industrial land within and around the proposed scheme footprint is reclaimed, therefore the topography is generally very flat with the exception of the artificial aggregate stores related to the concrete works and the various watercourses, the latter of which have been heavily modified and many are culverted. Remotely sensed topographic LiDAR data<sup>10</sup> at 1m resolution was downloaded from the DEFRA data portal and was used to produce a Digital Terrain Model (DTM), providing a visual representation of elevation (**Figure 2**).

The DTM shows that from the centre of the proposed scheme footprint, levels gently slope away to both the southwest and northeast. This centre point is located at the north-eastern extent of the existing wharf structure, where several buildings are also located. At this centre point, the highest levels are found at approximately 7.15m AOD.

Assessment of the DTM levels confirm that there are several locations along the riverbank, where levels of 6.05m AOD are found. The lowest levels are found on access ramps down to two jetty structures adjacent to the five cylindrical storage tanks and northeast of the South Bank Wharf. In this location the ground levels reduce to 5.30m AOD.

The topographic data indicates that surface water falling on the SIZ landside development to the immediate south of the proposed scheme footprint is likely to naturally flow across the proposed scheme footprint and into the River Tees.

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<sup>9</sup> Environment Agency, Aquifer Designation Map. Available at <https://magic.defra.gov.uk/MagicMap.aspx> (Accessed 23/01/2020)

<sup>10</sup> Environment Agency; Survey Open Data, LiDAR. Available at <http://environment.data.gov.uk/ds/survey/index.jsp#survey> (Accessed 23/01/2020)

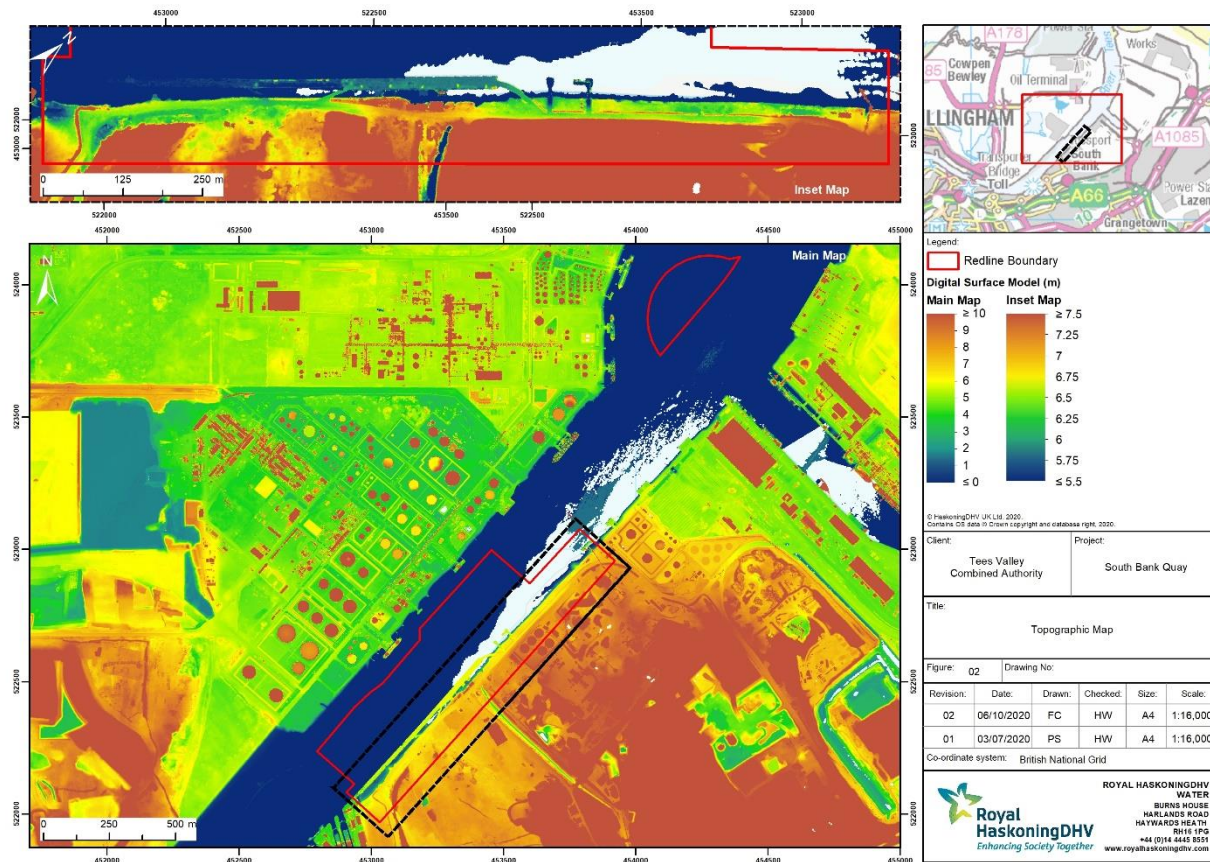


Figure 2 Proposed scheme topography (Source: Environment Agency 1m LiDAR; DTM)

### 3 Development and flood risk

This section of the FRA outlines all national and local planning policies and documents that have been considered in the assessment of flood risk. **Table 3.1** sets out all referenced documents, which are then discussed in greater detail in relation to the proposed scheme throughout **Section 3**.

**Table 3.1** National and Local Planning Policies & Documents referenced in the FRA

<i>National Policies</i>		
<i>Document Name</i>	<i>Published by</i>	<i>Date</i>
National Planning Policy Framework	Ministry of Housing, Communities & Local Government	2012 updated 2019
Planning Practice Guidance (NPPF PPG) for Flood Risk and Coastal Change	Ministry of Housing, Communities & Local Government	2014
Flood risk assessments: climate change allowances guidance	Environment Agency	2016 updated July 2020
<i>Local Policies</i>		
<i>Document Name</i>	<i>Published by</i>	<i>Date</i>
River Tees Catchment Flood Management Plan	Environment Agency	2009
Northumbria River Basin Management Plan	Environment Agency	2009
River Tyne to Flamborough Head Shoreline Management Plan 2	North East Coastal Authorities Group	2007
Redcar and Cleveland Borough Council Local Flood Risk Management Strategy	Redcar and Cleveland Borough Council	2017
Tees Tidal Flood Risk Management Strategy	Environment Agency	2009
Tees Tidal Integrated Flood Risk Modelling Study	Environment Agency	2011
Redcar and Cleveland Borough Council Preliminary Flood Risk Assessment	Redcar and Cleveland Borough Council	2011 (updated 2017)
Redcar and Cleveland Borough Council Level 1 Strategic Flood Risk Assessment	Redcar and Cleveland Borough Council	2016
Surface Water Management Plan	Redcar and Cleveland Borough Council	2014
Tees Valley Water Cycle Study	Stockton-on-Tees Borough Council	2012
Tees Valley Investment Plan 2019-29	Tees Valley Combined Authority	2019
South Industrial Zone Environmental Statement Volume 3 Technical Appendices (Water Management and Flooding)	South Industrial Zone: South Tees	2020

#### 3.1 National Planning Policy Framework and Practice Guidance

The NPPF sets out the Government's planning policies for England. The NPPF seeks to ensure that flood risk is considered at all stages of the planning and development process, to avoid inappropriate development in areas at risk of flooding and to direct development away from areas at risk of flooding.

The PPG for Flood Risk and Coastal Change<sup>11</sup> provides direction on how flood risk should be considered at all stages of the planning and development process, with additional guidance on flood risk vulnerability classifications and managing residual risks (**Table 3.3**). The PPG provides further description of Flood Zones, Vulnerability Classifications and Compatibility in order to assess the suitability of a specific site for a certain type of development.

**Table 3.2** Summary of flood zone definitions

<b>Flood zone</b>	<b>Probability of flooding</b>	<b>Return periods</b>
1	Low	Land having a less than 1 in 1,000 annual probability of river or sea flooding (<0.1%).
2	Medium	Land having between a 1 in 100 and 1 in 1,000 annual probability of river flooding (1% - 0.1%); or Land having between a 1 in 200 and 1 in 1,000 annual probability of sea flooding (0.5% - 0.1%).
3a	High	Land having a 1 in 100 or greater annual probability of river flooding ( $\geq 1\%$ ); or Land having a 1 in 200 or greater annual probability of sea flooding ( $\geq 0.5\%$ ).
3b	High – Functional Floodplain	This zone comprises land where water has to flow or be stored in times of flood. Local planning authorities should identify in their Strategic Flood Risk Assessments areas of functional floodplain and its boundaries accordingly, in agreement with the Environment Agency.

The NPPF directs development away from areas at highest risk of flooding via application of the Sequential Test. If, following application of the Sequential Test, it is not possible for the development to be located in zones with a lower probability of flooding, the Exception Test can be applied if appropriate.

Whilst not a specific requirement within the NPPF, it is critical that FRAs also identify and mitigate against risks of surface water flooding. The Environment Agency provides national datasets on surface water flood risk, classified into four categories; 'Very low', 'Low', 'Medium' and 'High' (**Table 3.4**).

**Table 3.3** Summary of flood risk from surface water definition

<b>Probability of surface water flooding</b>	<b>Return periods</b>
Very low	Land with less than 1 in 1,000 annual probability of surface water flooding (<0.1%).
Low	Land with between 1 in 1,000 and 1 in 100 annual probability of surface water flooding (0.1% - 1%).
Medium	Land with between 1 in 100 and 1 in 30 annual probability of surface water flooding (1% - 3.3%).
High	Land with greater than 1 in 30 annual probability of surface water flooding (>3.3%).

## 3.2 Flood Risk Assessments: Climate Change Allowances

The Environment Agency's online advice note 'Flood Risk Assessments: Climate Change Allowances', published in February 2016 and last amended in July 2020 has been used to inform this FRA. The latest July 2020 amendments includes guidance on the allowances to be adopted for certain types of development within the sections on peak river flow, sea level rise, wind speed, wave height and storm surge.

This advice note provides guidance on the application of climate change allowances which considers the geographical location, life span of the proposed development, flood zones, vulnerability classification associated with the type of development and critical drainage areas.

<sup>11</sup> PPG for Flood Risk and Coastal Change. March 2014. <https://www.gov.uk/guidance/flood-risk-and-coastal-change#site-specific-flood-risk-assessment-allf> (Accessed 16/07/2020)

Guidance is provided for determining appropriate climate change allowances for fluvial events, tidal / sea level rise and peak rainfall intensities. Further information on the application of climate change within this FRA is included in **Section 6**.

### 3.3 Relevant local policy documents and studies

The Flood and Water Management Act (FWMA) was passed in 2010. It aimed to improve both flood risk management and the way we manage our water resources by creating clearer roles and responsibilities. Redcar & Cleveland Borough Council (RCBC) were delegated as the lead role for Local Authorities, known as the Lead Local Flood Authority (LLFA), responsible for managing local flood risk (from surface water, groundwater and ordinary watercourses) whilst the Environment Agency has a strategic overview role for all flood risk.

The Tees Valley Strategic Flood Risk Management Partnership is made up of an Elected Member from Redcar & Cleveland Borough Council, as well as an elected member from all other Tees Valley Authorities, Environment Agency, Northumbrian Water, and the Tees Valley Emergency Planning Unit. The group's terms of reference are to address flood risk at a Tees Valley regional level, emerging legislation, local priorities, cross boundary working and local standards.

The following sections set out the key policy documents and studies that have been carried out and are of relevance to the proposed scheme.

#### 3.3.1 River Tees Catchment Flood Management Plan (CFMP)

Catchment Flood Management Plans (CFMP) assess inland flood risk including the risk of tidal flooding, but do not assess the risk of coastal flooding, which is covered by Shoreline Management Plans (**Section 3.3.3**). The CFMP helps to understand flood risk and set appropriate policies to inform planning decision in the region.

The Tees Catchment Flood Management Plan<sup>12</sup> (Environment Agency, 2009) area includes three main rivers, divided into eight sub-areas. The proposed scheme footprint sits within the Eastern sub-area of the CFMP. The CFMP states:

*“This sub-area contains the majority of the urban development within the Tees CFMP area. In total around 4,750 properties lie within the one per cent undefended floodplain within the sub-area. As an area identified as a growth point there is development pressure in the sub-area which may increase risk of flooding in the future. Under the climate change future flooding scenario risk to properties increases by around 10 per cent in the lower Tees area. In addition to river flooding the urban areas suffer surface water flooding problems from the drainage systems, these are present in this sub-area”.*

Policy 5 of the CFMP is relevant to the Eastern sub-area:

**“Area of moderate to high flood risk where we can generally take further action to reduce flood risk. This policy will tend to be applied to those areas where the case for further action to reduce flood risk is most compelling, for example where there are many people at high risk, or where changes in the environment have already increased risk. Taking further action to reduce risk will require additional appraisal**

<sup>12</sup> Environment Agency, 2009. Tees Catchment Flood Management Plan.  
[https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment\\_data/file/289194/River\\_Tees\\_Catchment\\_Flood\\_Management\\_Plan.pdf](https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/289194/River_Tees_Catchment_Flood_Management_Plan.pdf) (Accessed 24/07/2020)

*to assess whether there are socially and environmentally sustainable, technically viable and economically justified options”.*

In following Policy 5, the CFMP will look to encourage the development of Surface Water Management Plans and work with the Local Authorities and water companies to reduce surface water flooding. They will also implement the findings of the Tees Tidal Strategy and install defences if economically and environmentally sound and investigate options for providing flood storage to help reduce the risk of flooding.

### **3.3.2 Northumbria River Basin Management Plan**

The Northumbria River Basin Management Plan<sup>13</sup> (2015) provides a framework for protecting and enhancing the benefits provided by the water environment. To achieve this, it also informs decisions on land-use planning. For the Tees catchment, the plan notes that the priority issues this catchment are urban and diffuse pollution, invasive non-native species (INNS) and lost connectivity between estuary and river.

The aims of the plan are to adopt Catchment Based Approach (CaBA) projects to provide enhancements such as natural flood management, habitat improvements, RDP reduction (sediment and nutrients), improving water quality and river habitat, improving fish passage and, where relevant, reducing flood risk. The vision for the Tees Estuary Habitat is to develop and implement a blueprint of improved estuary habitats that link to Teesside tributaries within the thriving industrial heartland.

### **3.3.3 River Tyne to Flamborough Head Shoreline Management Plan 2 (SMP)**

The River Tyne to Flamborough Head Shoreline Management Plan (SMP) 2<sup>14</sup> (2007) provides a large-scale assessment of the risks associated with shoreline evolution, coastal flooding and erosion, and presents a policy framework to address these risks to people and the developed, historic and natural environment in a sustainable manner.

The Tees estuary to the northeast of the proposed scheme falls within SMP management unit MA13 (Tees Bay). The policy plan for this management unit for all three epochs (up to 2025 until 2105) is to ‘Hold-the-Line’ across the Tees estuary, with areas on either side adopting a ‘No-Active-Intervention’ approach. For each epoch, the area that is ‘Hold-the-Line’ across the Tees estuary will gradually reduce, with the ‘No-Active-Intervention’ areas increasing on either side.

### **3.3.4 Redcar and Cleveland Borough Council Local Flood Risk Management Strategy (LFRMS)**

The Local Flood Risk Management Strategy (LFRMS)<sup>15</sup> was written by RCBC in their role as the LLFA and published in 2017.

Whilst the proposed scheme is located within and on the bank of the River Tees, the primary focus of the LFRMS is on 'local flooding' from surface water, groundwater or ordinary water courses such as streams and ditches. It provides guidance on the flood management authorities and their responsibilities in relation to managing flood risk.

<sup>13</sup> Environment Agency. Northumbria River Basin Management Plan (updated 2015).

[https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment\\_data/file/718333/Northumbria\\_RBD\\_Part\\_1\\_river\\_basin\\_management\\_plan.pdf](https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/718333/Northumbria_RBD_Part_1_river_basin_management_plan.pdf) (Accessed 04/09/2020)

<sup>14</sup> River Tyne to Flamborough Head SMP 2 (2007). <https://democracy.scarborough.gov.uk/mqConvert2PDF.aspx?ID=942> (Accessed 24/07/2020)

<sup>15</sup> Redcar and Cleveland Borough Council Local Flood Risk Management Strategy. September 2017. <https://www.redcar-cleveland.gov.uk/resident/flooding/Documents/Redcar%20%26%20Cleveland%20Borough%20Council%20Flood%20Risk%20Strategy.pdf> (Accessed 24/07/2020)

It is noted that the River Tees rarely directly causes flooding in the borough, with the biggest impact being the restriction of flow from watercourses that ultimately discharge into the river. None of the ordinary watercourses within or adjacent to the proposed scheme footprint are identified as those most commonly affected by this type of flooding.

The objectives of the LFRMS relevant to the proposed scheme are as follows:

- Objective 1: To reduce flood risk to communities severely affected by recent flooding
- Objective 2: To reduce the incidence of surface water flooding
- Objective 3: To ensure flood risk is managed in new development

It is also noted in the LFRMS that the Tees Dock Road is currently the only access into Teesport and has been subject to frequent flooding which can restrict access. It is understood that there is access to pumps which can be used to discharge water on the road via pre-agreed points.

### **3.3.5 Tees Tidal Flood Risk Management (FRM) Strategy**

The Tees Tidal Flood Risk Management (FRM) Strategy (Environment Agency, 2009) identified the need for improvements or raising of existing flood defences within the Tees estuary, up to the Tees Barrage. This report also highlighted areas which may be at risk of flooding, either at present or in the future. Areas identified as being at risk are those located where ground levels are less than 5.0m AOD. This level relates to a 0.1% (1 in 1,000) probability of a flood event occurring in any one year. A water level with a 0.5% (1 in 200) probability of occurrence in any one year is classified in the Tees Tidal FRM Strategy as being 4.19m AOD (Environment Agency, 2009). The highest recorded flood event along the Tees occurred in 1953 and reached a level of 4.0m AOD.

### **3.3.6 Tees Tidal Integrated Flood Risk Modelling Study**

The Tidal Tees Integrated Flood Risk Modelling Study (Environment Agency, 2011) expanded upon the Tees Tidal FRM Strategy through development and application of an ESTRY-TUFLOW model that covers the Tees estuary from Teesmouth at the coast to its upstream extent at the Tees Barrage.

The report presented updated extents for Flood Zones 2 and 3, associated with the 1 in 1,000 and 1 in 200-year return period events as a result of tidal flooding risk.

Information from this modelling and report has been used to inform the development of the FRA.

### **3.3.7 Redcar and Cleveland Borough Council Preliminary Flood Risk Assessment (PFRA)**

The Preliminary Flood Risk Assessment<sup>16</sup> (PFRA) for Redcar and Cleveland Borough Council was published in 2011 and updated in 2017 in response to the Flood & Water Management Act 2010, which states that a LLFA is required to produce a PFRA under the Flood Risk Regulations 2009.

As part of the Preliminary Flood Risk Assessment (PFRA) process the LLFA is required to determine whether there is a significant risk in their area based on local flooding (surface water, groundwater, ordinary watercourses and canals) and to identify the part of the area affected by these risks. This is then known as the Flood Risk Area.

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<sup>16</sup> Redcar and Cleveland Borough Council Preliminary Flood Risk Assessment. 2011.  
<https://webarchive.nationalarchives.gov.uk/20140328164121/http://cdn.environment-agency.gov.uk/flho1211bvio-e-e.pdf> (Accessed 24/07/20)



Based on the evidence that was collected, no past flood events were considered to have had ‘significant harmful consequences’. It was therefore concluded that RCBC does not have the evidence to justify the identification of a Flood Risk Area in their administrative area. Therefore, as the LLFA they are not required to produce flood hazard maps, flood risk maps and flood risk management plans for that area.

However, it must be noted that there are a number of locations across Redcar and Cleveland that are subject to frequent flooding from local sources, particularly from surface water. Based on the Environment Agency's national surface water modelling approximately 4,200 properties are estimated to be at risk from flooding to a depth of 0.3m during a rainfall event with a 0.5% annual probability.

The high-level screening exercise compiled information on significant local flood risk from past and potential future flood events for the administrative area. The mapping indicates that the proposed scheme is within a 1km grid square where over 75% of the land is susceptible to groundwater emergence, this is likely due to the proximity to the River Tees.

High level mapping has recorded no historic flood events at the proposed scheme footprint or its surrounding area. It does however show that there are areas of the proposed scheme footprint that may be at some form of surface water flood risk (see **Section 4.3** for more detailed surface water flood risk analysis).

### **3.3.8 Redcar and Cleveland Borough Council Level 1 Strategic Flood Risk Assessment (SFRA)**

The RCBC Level 1 Strategic Flood Risk Assessment (SFRA)<sup>17</sup> was updated in 2016 to initiate the sequential risk-based approach to the allocation of land for development and to identify whether application of the Exception Test is likely to be necessary.

Parts of the proposed scheme footprint are identified in the SFRA mapping as ‘Employment Land Developed’ with reference code ELD12. This indicates that the proposed scheme footprint has been allocated as part of the local council’s development plan as suitable land for development.

### **3.3.9 Redcar Surface Water Management Plan**

The Redcar Surface Water Management Plan was not reviewed as part of this FRA, as it was not publicly available online. However, an extract taken from the RCBC Level 1 Strategic Flood Risk Assessment notes that:

*“Part of this study looked at the possibility of upstream flood storage to reduce flooding to areas downstream. It was found that a flood storage scheme at Dormanstown could be feasible utilising a modest dam (of maximum height 2.5 m) to store a significant volume of water (82,626 m<sup>3</sup>). A flood storage scheme on Roger Dyke (upstream of the A174) was also examined however this would be at a significant cost (compared to the estimated benefits).”*

Due to the distance from the proposed scheme footprint, the potential flood storage scheme at Dormanstown is unlikely to interact with the proposed scheme, should it be constructed.

<sup>17</sup> Redcar and Cleveland Borough Council Level 1 Strategic Flood Risk Assessment. 2016. [https://www.redcar-cleveland.gov.uk/resident/planning-and-building/local-plan/Local%20Plan%20Documents/Redcar%20and%20Cleveland%20Strategic%20Flood%20Risk%20Assessment%20\(Level%201\)/RCBC%20Level%201%20SFRA%20Update%202016.pdf](https://www.redcar-cleveland.gov.uk/resident/planning-and-building/local-plan/Local%20Plan%20Documents/Redcar%20and%20Cleveland%20Strategic%20Flood%20Risk%20Assessment%20(Level%201)/RCBC%20Level%201%20SFRA%20Update%202016.pdf) (Accessed 24/07/2020)

### 3.3.10 Tees Valley Water Cycle Study

The Tees Valley Water Cycle Study (WCS) was published in December 2012. The objective of the study was to identify any constraints on housing and employment growth planned for the area up to 2026 that may be imposed by the water cycle and how these can be resolved i.e. by ensuring that appropriate water infrastructure is provided to support the proposed development.

In terms of flood risk, the WCS states that flood risk in the region is dominated by the North Sea and the River Tees, although there are areas of Flood Zones 2 and 3 associated with smaller watercourses across the area. This assessment was based on an older version of the EA's Flood Map for Planning i.e. prior to 2012.

### 3.3.11 Tees Valley Investment Plan 2019-29

The Tees Valley Investment Plan<sup>18</sup> is prioritised across six growth generating themes of: Transport, Education, Employment & Skills, Business Growth, Culture & Tourism, Research, Development & Innovation and Place. The Investment Plan is reviewed annually with a total of £588.2m available to invest over the ten-year plan.

Parts of this Plan which are relevant to the proposed scheme footprint include strategic road investment in the form of the improved east-west connectivity along the A66 corridor from the A1M to Teesport and the rail investment upgrades of the line from Northallerton to Middlesbrough / Teesport, including gauge clearance for freight. Once completed, both of these planned investments will improve transport links to and from the proposed scheme footprint.

### 3.3.12 Redcar & Cleveland Development Plan (Local Plan)

The Redcar and Cleveland Local Plan<sup>19</sup> was adopted in May 2018. It sets out the vision and overall development strategy for the Council's area and how it will be achieved for the period until 2032. It is the most important planning document in the borough and is the result of a long process of preparation that has involved all parts of the Council.

Increased flood risk is identified as a key issue within the Local Plan. It was noted in Section 1.117 of the Local Plan that the Council has worked closely with the Environment Agency and Northumbrian Water to ensure new development is located in areas which are at least risk of flooding.

Furthermore, Section 1.118 noted that the Council has produced a number of surface water management plans for the highest surface water risk areas within the borough. These plans have identified a number of infrastructure improvement solutions to reduce flood risk in these areas, both for existing properties and new development.

The proposed scheme footprint is situated within Policy Area LS 4 – South Tees Spatial Strategy. As part of this strategy, the Council aims to:

- deliver significant economic growth and job opportunities through the STDC;
- grow the environmental and recycling sector;

<sup>18</sup> Tees Valley Combined Authority. 2019. Tees Valley Investment Plan 2019-29. <https://teesvalley-ca.gov.uk/wp-content/uploads/2019/03/Investment-Plan-2019-20-Digital.pdf> (Accessed 07/09/20)

<sup>19</sup> Redcar & Cleveland Borough Council. 2018. Redcar & Cleveland Local Plan. <https://www.redcar-cleveland.gov.uk/resident/planning-and-building/strategic%20planning/Documents/Local%20Plan%20Adopted%20May%202018.pdf> (Accessed 07/09/20)

- investigate opportunities to create a new energy hub to support the offshore wind and sub-sea engineering sectors; and
- support the expansion and protection of the port and logistics sector.

Policy SD 4 of the Local Plan (General Development Principles) highlights that in assessing the suitability of a site or location, development will be permitted where it will not increase flood risk either on site or downstream of the development.

Policy SD 5 of the Local Plan (Developer Contributions) highlights that, subject to economic viability, the Council may secure developer contributions in order to fund necessary infrastructure and other community benefits required as a consequence of development. Planning obligations will be sought where it is not possible to mitigate the impacts of development through the use of a condition and the contributions are fair, reasonable, directly related to the development and necessary to make the development acceptable in planning terms. Examples of matters for which contributions relevant to the nature and scale of the development will be sought will include drainage and flood prevention measures.

Policy SD 7 of the Local Plan (Flood and Water Management) states that: *“Flood risk will be taken into account at all stage in the planning process to avoid inappropriate development in areas at current or future risk”*. It is noted that development in areas at risk of flooding will only be granted where:

- The proposal meets the Sequential and Exception Tests (where required) in relation to the National Planning Policy Framework;
- A site-specific flood risk assessment demonstrates that the development will be safe, including the access and egress, without increasing flood risk elsewhere, and, where possible, will reduce flood risk overall; and
- New site drainage systems are well designed, taking account of events that exceed the normal design standard.

Further guidance is provided on when an FRA should be provided and the methods of managing surface water runoff. It is noted that:

*“where the drainage system discharges to a surface water body that can accommodate uncontrolled surface water discharges without any impact on flood risk from that surface water body (e.g. the sea or River Tees) the peak flow control standards and volume control standards need not apply”.*

Nevertheless, major developments will be required to submit a drainage plan to show the site drainage can be adequately dealt with. The proposed drainage scheme should incorporate SuDS unless it can be demonstrated that they would be inappropriate. The drainage system must be designed and constructed so surface water discharged does not adversely impact the water quality of receiving water bodies, both during construction and when operational. New development should seek to improve water quality where possible, as well maintaining and enhancing the biodiversity and habitat of watercourses.

### **3.3.13 South Industrial Zone Environmental Statement Volume 3 Technical Appendices (Water Management and Flooding)**

STDC submitted an Environmental Statement (ES) (July 2020) for general industry and storage or distribution uses within the SIZ landside development footprint. The ES assessed the flood risk in a separate FRA<sup>20</sup>, undertaken by JBA in July 2020. The SIZ landside development ES and FRA were reviewed in order

<sup>20</sup> JBA. 2020. *South Industrial Zone Environmental Statement Volume 3 Technical Appendices (Water Management and Flooding)*

to understand the interactions between this site and the proposed scheme footprint which is the subject of this report.

The SIZ landside development FRA identified that the site of that is situated in Flood Zone 1 and is at very low risk from fluvial flooding. Previous modelling information indicated that there is a moderate risk of tidal / coastal flooding. However, the ground level for the SIZ application site is to be set above the 1 in 200-year tidal flood level, including climate change adjustment until 2100.

Modelling of overland flows within the FRA for the SIZ landside development indicates that there is a moderate risk from surface water flooding, with water pools forming in low spots on the proposed scheme footprint, notably the depressions at the landfill area. However, surface flows are shallow and do not follow any clear overland flow paths.

## **3.4 Consultation**

### **3.4.1 Environment Agency**

The Environment Agency was contacted to request the Product 5 and 8 data packages relevant to the proposed scheme. This was received from the Environment Agency on 22nd July 2020 (**Appendix A**) and included the Tidal Tees Integrated Flood Risk Modelling Study as well as data from the 2011 ISIS-TUFLOW model which covers the Tees estuary from Teesmouth at the coast to the Tees Barrage upstream.

Additionally, consultation was undertaken with the Environment Agency via the September 2020 scoping consultation undertaken to inform the EIA. The Environment Agency confirmed the requirement to consider all sources of flooding, any mitigation measures required to ensure a safe development in a 1 in 200 year event, guidance on the climate change guidelines to be reviewed and information related to the potential consents / permits that may be needed for the proposed scheme. The consultation with the Environment Agency has been used to inform the assessment for this FRA and the flood risk and coastal defence section of the EIA Report (Royal HaskoningDHV, 2020).

### **3.4.2 Lead Local Flood Authority**

Following consultation with the LLFA as part of the September 2020 EIA scoping consultation, which for the proposed scheme is RCBC, they offered no additional comments regarding the contents and methodology outlined in the scoping note with regard to the assessment of flood risk (Royal HaskoningDHV, 2020).

The LLFA commented on the proposed SIZ landside development located to the immediate south of the proposed scheme footprint, which as noted earlier has been subject to a separate FRA. In its response, the LLFA raised no objection to the proposed SIZ landside development. However, the LLFA did make a comment regarding compliance with planning policy, suggesting that an appropriately worded condition would need to be agreed to allow for alterations to be carried out on Holme Beck and Knitting Wife Beck. These are not of direct relevance to the proposed scheme for which this FRA has been developed. No comments were raised with regard to the former course of the Holme Beck which flows through both the SIZ landside development and the proposed scheme footprint.

### **3.4.3 Northumbrian Water**

Northumbrian Water commented on the proposed SIZ landside development planning application, specifically stating that the application did not provide sufficient detail with regards to the management of foul and surface water from the development for Northumbrian Water to be able to assess its capacity to

treat the flows from the development. Northumbrian Water requested the following condition on any planning permission issued by RCBC for the SIZ landside development:

*“Development shall not commence until a detailed scheme for the disposal of foul and surface water from the development hereby approved has been submitted to and approved in writing by the Local Planning Authority in consultation with Northumbrian Water and the Lead Local Flood Authority. Thereafter the development shall take place in accordance with the approved details”*

It has been noted that a number of assets cross the boundary of the proposed SIZ landside development. Northumbrian Water have stated that they do not permit buildings over or close to their apparatus. The SIZ landside application has accepted this planning condition and the reserved matters applications will need to take account of apparatus across the proposed scheme footprint. Although this requirement is not of direct relevance to the proposed scheme for which this FRA has been developed, it has been included for completeness given the proximity of the SIZ landside development to the proposed scheme footprint.

## 4 Definition of flood hazard

An FRA must consider the issues associated with all sources of flooding in accordance with the NPPF and the supporting PPG for Flood Risk and Coastal Change. These have been considered in this FRA with respect to the proposed scheme. The following sections have reviewed publicly available information and relevant planning documents to assess the risk of flooding from tidal, fluvial, surface water, groundwater, reservoirs and other sources.

### 4.1 Historic flooding

The LFRMS indicates that there have been no recorded flood events for the proposed scheme footprint. However, it should be noted the absence of flood records does not necessarily confirm that no flooding has occurred.

### 4.2 Flooding from rivers (fluvial)

The Environment Agency Flood Map for Planning (Rivers and Sea) identifies that the proposed scheme footprint is partially located in Flood Zones 1, 2 and 3 (**Figure 3**).

Flood Zone 3 is defined as “*Land having a 1 in 100 or greater annual probability of river flooding ( $\geq 1\%$ )*”.

Due to the location of the proposed scheme within the Tees estuary downstream of the Tees Barrage where tidal and coastal processes dominate, the risk of fluvial flooding is not significant. The flood risk associated with the River Tees is identified as tidal/coastal and is covered in **Section 4.3**. Therefore, the risk of fluvial flooding to the proposed scheme is low.

### 4.3 Flooding from the sea (tidal/coastal)

The Environment Agency Flood Map for Planning (Rivers and Sea) identifies that the proposed scheme footprint is partially located in Flood Zones 1, 2 and 3 (**Figure 3**) whereby the in-channel elements are located in either Flood Zone 2 or Flood Zone 3 and the landside elements (i.e. the quay) are located in Flood Zone 1.

Flood Zone 3 is defined as “*Land having a 1 in 200 or greater annual probability of sea flooding ( $\geq 0.5\%$ )*”.

Due to the proposed scheme being partially located within the banks of the tidally influenced River Tees, the risk of tidal and coastal flooding is assessed to be high. However, it is noted that as a new quay, the proposed scheme is considered ‘Water Compatible’ under the NPPF.

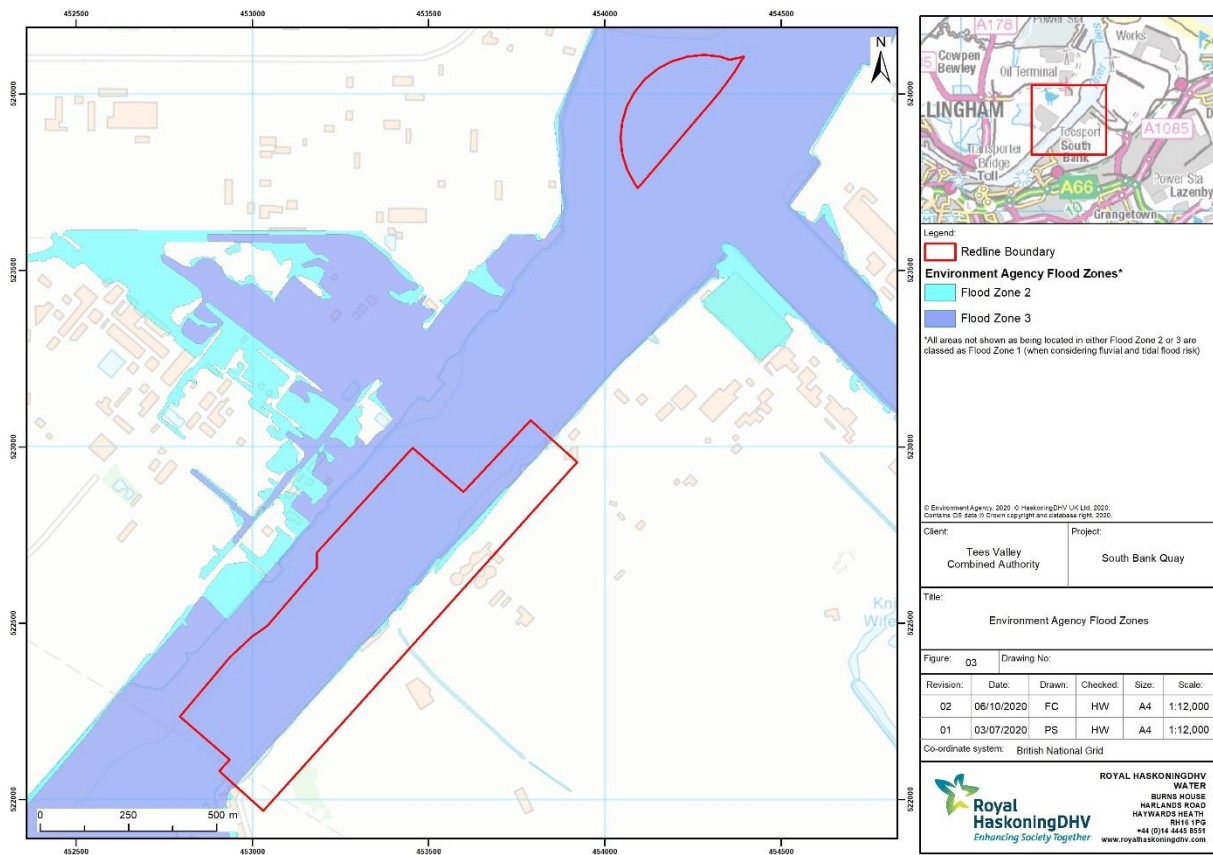
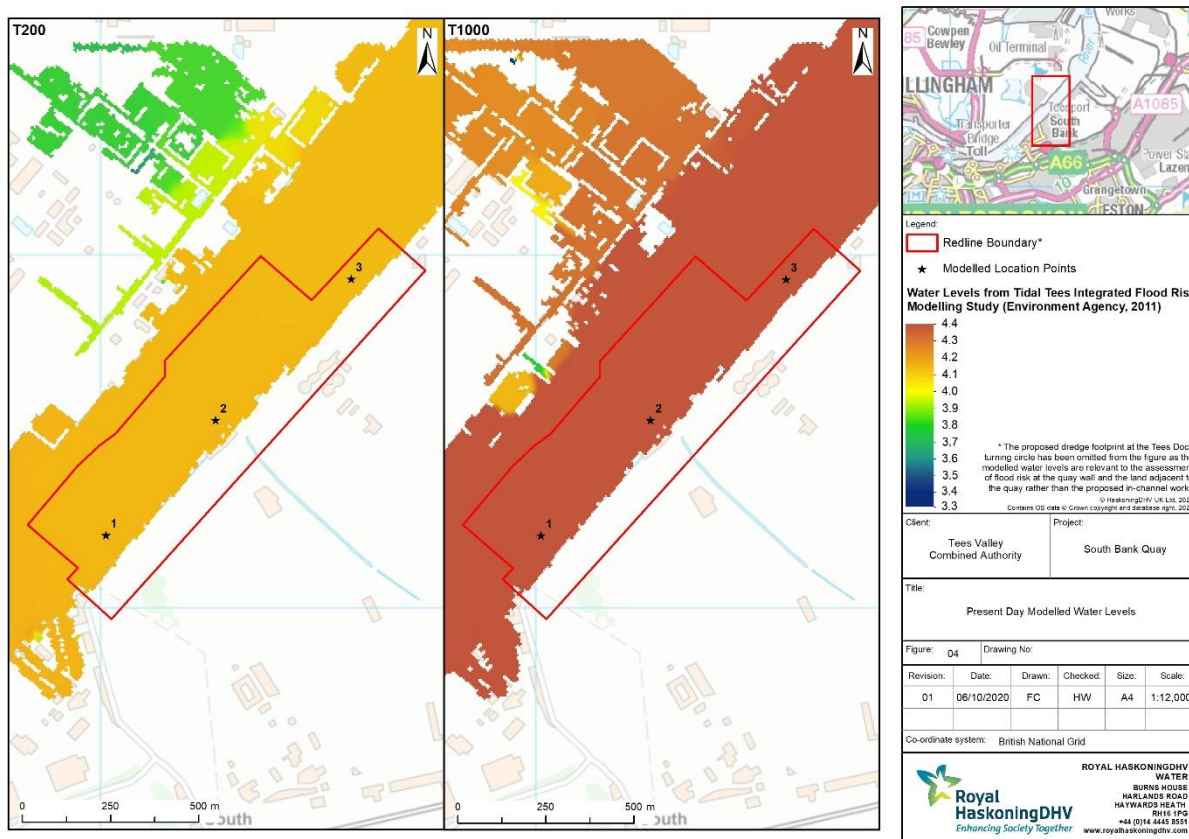


Figure 3 Environment Agency Flood Map for Planning

The ISIS-TUFLOW model which forms part of the Tidal Tees Integrated Flood Risk Modelling Study (2011) presented updated extents for Flood Zone 2 (1 in 1,000-year) and Flood Zone 3 (1 in 200-year). **Figure 4** presents the predicted water levels (in m AOD) for the 1 in 200 year and 1 in 1,000-year return periods within and adjacent to the proposed scheme. Three baseline water level measurements were recorded spaced across the entire quay frontage (**Figure 4**) and are presented in **Table 4.1**.



**Figure 4** Location of the three data points along the quay frontage measuring baseline water levels (m AOD) for a 1 in 200-year (T200) and 1 in 1,000-year (T1000) return period

For the purposes of this assessment, it is assumed that the baseline water levels relevant to the proposed scheme should be rounded to two decimal places, which for the 1 in 200-year and 1 in 1000-year return periods are 4.13m AOD and 4.39m AOD respectively.

**Table 4.1** Data taken from the 2011 Tidal Tees Integrated Flood Risk Modelling Study

Study node point name	Return period (years)	Modelled Water Level (m AOD)
Point ID 1	200	4.133
	1,000	4.392
Point ID 2	200	4.128
	1,000	4.390
Point ID 3	200	4.125
	1,000	4.386

#### 4.4 Flooding from groundwater

As noted in **Section 2.5**, two publicly available borehole records have been reviewed which were sited within and immediately south of the proposed scheme footprint. The review of groundwater levels from the borehole records indicates that it is highly likely that groundwater levels are linked to tidal levels in the River Tees, with the groundwater level decreasing with distance from the watercourse. There is likely to be percolation of water from the River Tees through the existing banks into the adjacent ground.



The occurrence of groundwater flooding does not generally pose a significant risk to life due to the slow rate at which the water level rises. However, groundwater flooding can cause significant damage to property and can pose further risks to the environment and ground stability. There are several mechanisms that increase the risk of groundwater flooding including prolonged rainfall and high in-bank river levels. Development within areas that are susceptible to groundwater flooding will generally not be suited to some SuDS measures; however, this is dependent on detailed site investigation and risk assessment.

No mapping of Areas Susceptible to Groundwater Flooding were available in the Redcar SFRA. Given the proximity to the River Tees and potential connectivity between tidal and groundwater levels, it is considered that there is a medium risk of groundwater flooding; however, as this is likely to be inherently linked to tidal flooding it would comprise a limited flood risk to the proposed scheme when compared with tidal flood risk.

## 4.5 Flooding from surface water

The Environment Agency Surface Water Flood Risk map<sup>21</sup> (**Figure 5Error! Reference source not found.**) highlights that the majority of the proposed scheme footprint subject to surface water flooding is predominantly in areas at 'Very Low' risk of surface water flooding (*i.e. less than 1 in 1,000 years*).

There are two areas on the proposed scheme footprint that have an increased risk of surface water flooding:

- The southernmost corner of the proposed scheme footprint includes areas at 'low' (*i.e. between 1 in 1,000 and 1 in 100 years*) and 'medium' risk (*i.e. between 1 in 100 and 1 in 30 years*); and,
- The area of the proposed scheme footprint associated with the oil depots, boiler house and offices (to be removed prior to the proposed scheme) contains areas at 'low', 'medium' and 'high' (*i.e. greater than 1 in 30 years*) risk.

The pockets of low, medium and high surface water risk predominantly represent localised low points within the current topography. It is understood that prior to construction of the proposed scheme, any residual features associated with the prior use of the site will be removed and the site levelled to remove any potential localised areas of ponding. The layout of the proposed scheme, as well as the drainage strategy, will ensure there are no major issues associated with surface water to the proposed scheme.

It is proposed that the quay would be surfaced with crushed stone, allowing surface water to drain into the underlying material without the need for formal drainage. However, the heavy lift areas are proposed to be surfaced with concrete which will require a series of gullies to collect surface water runoff and discharge into the Tees estuary through the quay wall, via an interceptor.

There remains a risk that, should the drainage outfalls from the proposed scheme footprint be at risk of water ingress or blockage due to raised fluvial or tidal levels in the adjacent waterbodies, the discharge of surface water could be restricted in the drainage system and cause flooding. Details relating to the location and elevation of current drainage outfalls are currently unknown and will be determined during the detailed design phase.

It is expected that following construction, the proposed scheme footprint would be predominantly at 'Very Low' risk of surface water flooding, which would negate any isolated areas of medium or high risk that may remain. As such, the proposed scheme is assessed to be at very low risk of surface water flooding.

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<sup>21</sup> Environment Agency, Long term flood risk information. Available at <https://flood-warning-information.service.gov.uk/long-term-flood-risk/map> (Accessed 23/01/2020)

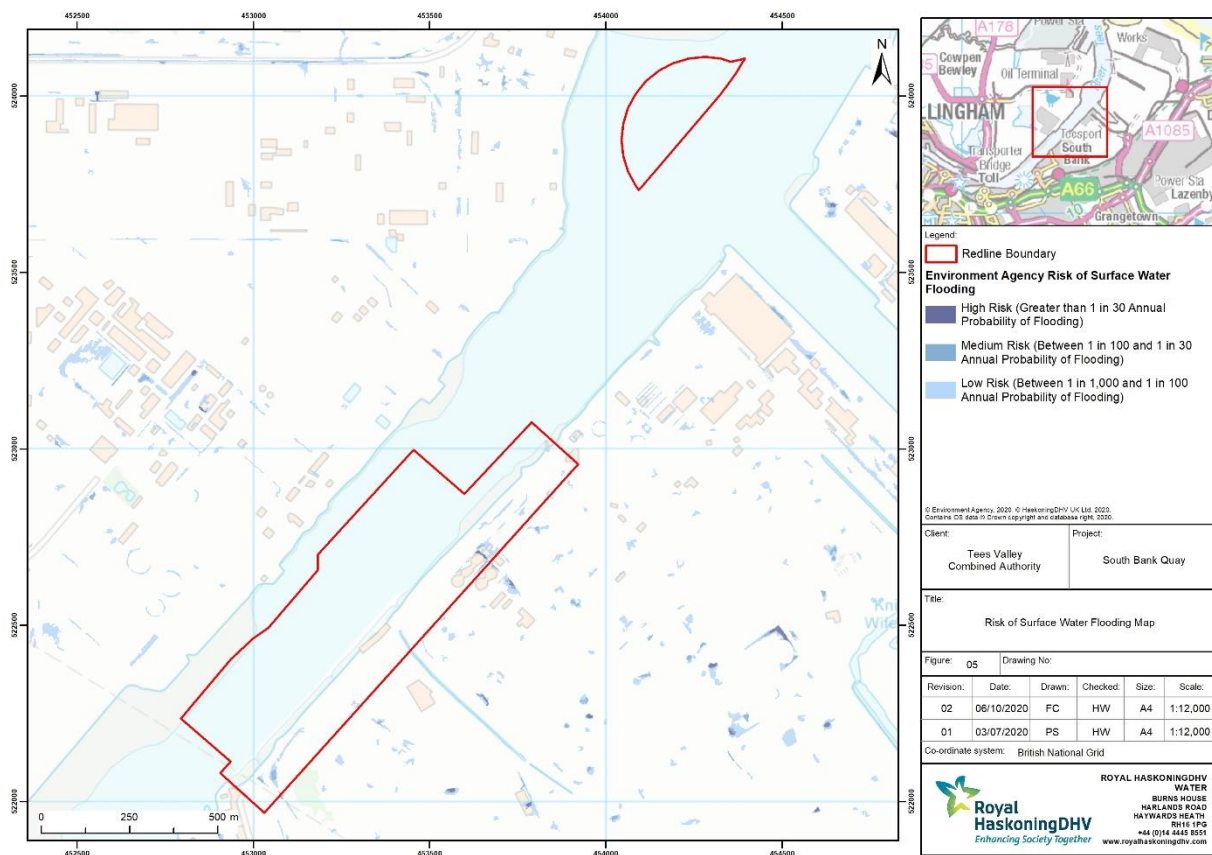


Figure 5 Risk of surface water flooding to the proposed scheme

#### 4.6 Flooding from sewers

It is understood that the proposed scheme footprint is not currently connected to the local sewer system. Welfare facilities are not proposed on the quay in order to maximise the available space to support with operations. Therefore, there is no risk of flooding from sewers and this risk is classified as very low.

#### 4.7 Flooding from reservoirs, canals and other sources

The Environment Agency Flood Risk from Reservoirs' Map<sup>21</sup> was developed to identify areas at risk of flooding from large raised reservoir dam breaches. The map identifies the maximum extent of flooding should these dams breach.

Using the Flood Risk from Reservoirs' Map, the proposed scheme footprint has been identified as being within the maximum flood extent for reservoirs. However, the area of risk is confined to an area within the banks of the River Tees and does not cover the small section of land within the proposed scheme footprint. Furthermore, it is noted that reservoirs are subject to legislation requiring regular monitoring and maintenance with the Environment Agency stating that if a location is at risk, flooding from reservoirs is extremely unlikely, with no loss of life in the UK from reservoir flooding since 1925.

A review of Ordnance Survey mapping has identified no additional canals or artificial sources in the local area. Therefore, the risk of flooding from reservoirs, canals and other sources is considered to be low.

## 4.8 Summary of flood risk

**Table 4.2** summarises the risk of flooding from all sources to the proposed scheme. Whilst the proposed scheme footprint is located predominantly within Flood Zone 3 extents, these aspects of the proposed scheme are related to the quay and therefore will be 'Water Compatible' and less affected by flooding. Overall the risk of flooding to the proposed scheme is considered to be low. However, there remains a residual risk of flooding in the event of a defence failure or overtopping and this is discussed further in **Section 7**.

**Table 4.2** Summary of flood risk

Source of Flood Risk	Probability of flooding	Description
Fluvial	Low	The proposed scheme footprint is partially located within the River Tees and is therefore situated in either Flood Zone 2 or 3. However, at this location the River Tees is tidally influenced. The remaining elements of the proposed scheme footprint i.e. the proposed quay is located in Flood Zone 1. Therefore, the risk of flooding from fluvial sources is assessed to be low.
Tidal / Coastal	High	The proposed scheme is partially located within the River Tees and is therefore situated in Flood Zone 2 or 3. However, the proposed scheme will be 'Water Compatible' and therefore less affected by tidal flooding. The remaining elements of the proposed scheme i.e. the quay are located in Flood Zone 1.
Groundwater	Medium	Publicly available borehole records have been reviewed which indicate that groundwater was encountered at 2.05mAOD. These findings indicate that groundwater level could be linked to tidal levels in the River Tees. Given the close proximity to the River Tees and potential connectivity between tidal and groundwater levels, it is considered that there is a medium risk of groundwater flooding.
Surface water	Low	The Environment Agency's Surface water flood risk map shows that the proposed scheme is primarily at low surface water flood risk, except a few isolated low-lying pockets. Water falling on the proposed scheme footprint is discharged directly into the River Tees.
Sewers	Very Low	There are currently no sewers present within the proposed scheme footprint. During construction there will be no requirement for a connection to the wider sewer system. Additionally, welfare facilities are not proposed on the quay as part of the proposed scheme during the operational phase. Therefore, there is no risk of flooding from sewers and this risk is classified as very low.
Reservoirs and other sources	Low	The proposed scheme footprint has been identified as within the maximum flood extent for reservoirs. However, the area of risk is confined to within the banks of the River Tees and does not cover the small section of land within the proposed scheme footprint.  There are no additional canals or artificial sources in the local area. Therefore, the risk of flooding from reservoirs, canals and other sources is considered to be low.

## 5 Flood risk vulnerability

### 5.1 Sequential and Exception Test

The aim of the Sequential Test is to steer new development to areas with the lowest probability of flooding i.e. Flood Zone 1. Where there are no reasonably available sites in Flood Zone 1 the Local Planning Authority, can consider reasonably available sites in Flood Zone 2. Only when there are no reasonably available sites for development in Flood Zone 1 and 2, should the suitability of sites in Flood Zone 3 be considered.

Following application of the Sequential Test, if it is not possible, consistent with wider sustainability objectives, for the development to be located in zones with a lower probability of flooding, the Exception Test can be applied if appropriate. For the Exception Test to be passed:

- it must be demonstrated that the development provides wider sustainability benefits to the community that outweigh flood risk, informed by a Strategic Flood Risk Assessment where one has been prepared; and,
- a site-specific FRA must demonstrate that the development will be safe for its lifetime taking account of the vulnerability of its users, without increasing flood risk elsewhere, and, where possible, will reduce flood risk overall.

Both elements of the test will have to be passed for development to be allocated or permitted. Within each flood zone, surface water and other sources of flooding also need to be taken into account in applying the sequential approach to the location of development.

### 5.2 Vulnerability classification

The vulnerability of different types of development is set out in the PPG for Flood Risk and Coastal Change. The descriptions of Highly Vulnerable, More Vulnerable, Less Vulnerable and Water Compatible are as follows:

- Highly Vulnerable – Buildings used for police, ambulance and fire stations and command centres; basement dwellings; caravans and mobile homes; and installations requiring hazardous substances consent.
- More Vulnerable – Buildings used for hospitals; dwellings and accommodation; residential institutional accommodation; non-residential health services, educational facilities; drinking establishments; nightclubs and hotels.
- Less Vulnerable – Buildings used for shops; financial, professional and other services; restaurants and cafes; hot food and takeaways; offices; general industry and storage etc.
- Water Compatible – Development used for flood control infrastructure; amenity open space, nature conservation and outdoor sports facilities; water / sewerage pumping stations; docks, marinas and wharves; and navigation facilities.

The PPG Flood risk and Coastal Change sets out the appropriateness of different development types based on their Flood Risk Vulnerability and the Flood Zone they would be located within. This table has been reproduced in **Table 5.1**.

**Table 5.1** Flood risk vulnerability and flood zone 'compatibility', PPG Table 3

Flood Zones	Flood Risk Vulnerability Classification				
	Essential Infrastructure	Highly Vulnerable	More Vulnerable	Less Vulnerable	Water Compatible
1	✓	✓	✓	✓	✓
2	✓	Exception Test required	✓	✓	✓
3a	Exception Test required	X	Exception Test required	✓	✓
3b	Exception Test required	X	X	X	✓

### 5.3 Site vulnerability assessment

The proposed scheme is primarily located within Flood Zone 3, an area with a high probability of tidal flooding, although the landward parts of the proposed scheme footprint are located in Flood Zone 1. The nature of the proposed scheme is such that under the PPG Flood Risk and Coastal Change, it is classed as 'Water Compatible', as the proposed quay is in line with the description for "...docks, marinas and wharves".

Given the review of the flood zones and the flood risk vulnerability classification, the proposed scheme is considered to be appropriate development in all flood zones. Additionally, it is required to be located within and adjacent to the Tees estuary for operational purposes. Therefore, there is no requirement for the application of the Exception Test.

Notwithstanding the above, the presence of the proposed scheme within and adjacent to Flood Zone 3 means that an assessment of the potential residual risk to it is required and this has been considered and summarised in **Section 7**.

## 6 Climate change

The risk of flooding from tidal, fluvial and surface water sources will all be amplified in the future as a result of the predicted increase in sea level, storm frequency and rainfall intensity.

Given the potential sources of flooding outlined within **Section 4**, there are two main aspects of climate change likely to impact the proposed scheme in the future, comprising sea level rise and an increase in the duration and intensity of rainfall events likely to affect surface water flooding. Due to the location of the proposed scheme footprint within the Tees estuary where tidal and coastal processes are dominant, the influence of fluvial flows are less critical. As a result, increases in peak fluvial flows as a result of climate change are not considered further.

This FRA draws guidance from the Environment Agency's online advice note 'Flood Risk Assessments: Climate Change Allowances' (Environment Agency, 2020).

### 6.1 Peak rainfall intensity

**Table 6.1** shows the Environment Agency's anticipated changes in extreme rainfall intensity in small and urban catchments. The Environment Agency guidance states both the central and upper end allowances should be assessed to understand the range of impact this could have on a proposed scheme. The proposed scheme is anticipated to have a 50-year lifespan, from 2023 to 2073. As such consideration of a 20% (central) and 40% (upper end) allowance for peak rainfall intensity is considered appropriate.

The peak rainfall intensity is only relevant for the surface water flood risk, for which the proposed scheme is determined to be at low risk under baseline conditions. Appropriate allowances will be applied, where necessary, within the drainage strategy.

**Table 6.1** Peak rainfall intensity allowance in small and urban catchments (use 1961-90 baseline) (Source: Table 2, Environment Agency Climate Change Allowances 29/09/20)

Applies across all of England	Total Potential Change Anticipated for the '2020s' (2015-2039)	Total Potential Change Anticipated for the '2050s' (2040-2069)	Total Potential Change Anticipated for the '2070s' (2070-2115)
Upper End	10%	20%	40%
Central	5%	10%	20%

### 6.2 Sea level rise

The Environment Agency online advice note 'Flood Risk Assessments: Climate Change Allowances' (Environment Agency, 2020) provides sea level rise allowances by river basin district ranging from 2000 to 2115. A higher central and upper end allowance is given and are based on the 70<sup>th</sup> and 95<sup>th</sup> percentile respectively.

**Table 6.2** presents the predicted total sea level rise of 1.03m for a higher central allowance and 1.43m for an upper end allowance over 100 years to 2115 for the Northumbria river basin district.

**Table 6.2** Environment Agency Predicted Sea Level rise allowance for each epoch in millimetres (mm) per year with cumulative sea level rise for each epoch in brackets (Source: Table 3, Environment Agency Climate Change Allowances 29/09/20)

Area of England	Allowance	2000 to 2035	2036 to 2065	2066 to 2095	2096 to 2125	Cumulative rise 2000 to 2115 / metres (m)
Northumbria	Higher Central	4.6 (161)	7.5 (225)	10.1 (303)	11.2 (336)	1.03
Northumbria	Upper End	5.8 (203)	10 (300)	14.3 (429)	16.5 (495)	1.43

**Table 6.3** outlines the uplift calculations from the baseline (2011) over the lifetime of the proposed scheme (2023-2073), based on the predicted rise per epoch presented in **Table 6.2**.

**Table 6.3** Calculated uplift levels (mm) over the lifetime of the proposed scheme for higher central and upper end allowances

Epoch (years)	Higher Central		Upper End	
	Uplift (mm)	Cumulative (mm)	Uplift (mm)	Cumulative (mm)
2011 - 2023	55.2	55.2	69.6	69.6
2023 - 2035	55.2	110.4	69.6	139.2
2035 - 2065	225	335.4	300	439.2
2065 - 2073	80.8	416.2	114.4	553.6

The extreme still water levels (m AOD) for the proposed scheme at the start (2023) and end (2073) of its lifetime are shown in **Table 6.4**. This was calculated by taking the baseline (2011) water levels of 4.13m AOD (1 in 200-year) and 4.39m AOD (1 in 1,000-year) (**Table 4.1**) and adding the expected uplift for higher central and upper end allowances (**Table 6.3**).

**Table 6.4** Change in still water level across the operational phase of the proposed scheme

Extreme Water Level Analysis Results (m AOD)				
	Higher Central		Upper End	
	1 in 200 year	1 in 1,000 year	1 in 200 year	1 in 1,000 year
Still water level (2011)	4.13	4.39	4.13	4.39
Still water level (2023)	4.19	4.45	4.20	4.46
Still water level (2073)	4.55	4.81	4.68	4.94

The proposed quay would be constructed at a level 5.84m AOD. When reviewing the current baseline modelled water levels with the predicted increase, as a result of sea level rise, the results indicate that the proposed quay would provide suitable protection against the 0.5% (1 in 200) and 0.1% (1 in 1,000) annual exceedance probability event for both the higher central and upper end scenarios throughout the 50-year lifetime of the proposed scheme (i.e. 2023 - 2073).

## 7 Residual risk and flood risk management measures

There is always a potential for there to be a residual flood risk to people and property due to the failure of systems and defences, more extreme events than those defined in the NPPF, or uncertainties associated with modelled water levels. Residual risk may remain after flood management or mitigation measures have been installed. Therefore, an FRA should consider the residual flood risk and the need for any further measures to ensure the residual risk is managed appropriately. This residual risk is explored in this section with appropriate mitigation measures also discussed.

### 7.1 Design mitigation

It is proposed that surface water would drain through the crushed stone on the quay deck into the underlying material without the need for a formal drainage system. A drainage system would however be required on the heavy lift areas of the quay, as such areas are proposed to be surfaced with concrete. Such a system would capture surface water runoff from the heavy lift areas through a series of gullies. The collected water will be discharged into the Tees estuary through the quay wall, via an interceptor. This mitigates the potential risk associated with surface water flooding.

Welfare facilities are not proposed on the quay itself in order to maximise the available space to support with operations; there would therefore be no foul sewage, or associated flood risk, generated on the quay itself.

As discussed in the preceding sections, there is a need for the proposed scheme to be located within and adjacent to the channel of the River Tees. The proposed scheme is considered to be 'Water Compatible' development and must "*remain operational and safe for users in times of flood*".

Additionally, the predominant risk of flooding to the proposed scheme footprint (including the quay footprint) is a tidal risk which is mitigated through the design of the revised defence line and the setting of the quay wall at a level of 5.84m AOD.

Whilst the proposed quay wall will provide protection throughout the lifetime of the proposed scheme it is important to consider potential residual risk should the flood defence fail or be overtopped.

### 7.2 Setting of finished floor levels

The proposed scheme includes the construction of a substation that will be constructed on the quay and as a result, there is a requirement to set finished floor levels 0.3m above ground level or 0.6m above the design flood levels, depending on which is the worst-case scenario.

Taking the worst-case scenario for the proposed scheme, which would be 0.3m above ground level, the finished floor level of the substation should be at least 0.3m above the current ground level of the proposed quay, which is to be constructed at 5.84m AOD. As such, the finished floor level for the substation, or the plant contained within it, should be set at a minimum of 6.14m AOD.

The new quay will be constructed from water resistant and resilient materials given the requirements to provide a durable facility in a tidal location and its operation as a working quay.



### 7.3 Flood warning

As detailed above, the site of the new quay is at risk from tidal flooding. Since it is positioned relatively upstream within the tidal estuary, it will receive a greater level of protection from tidal inundation than the open coastal frontage. However, there still remains a risk of tidal flooding during extreme events.

It is therefore proposed that during both construction and operation the operators of the quay would sign up to the Flood Warning Service provided by the Environment Agency so that they can be made aware of potential extreme events and prepare accordingly. The flood warning lead time for tidal events is usually in excess of 12 hours, thus ample time is available for non-essential staff and visitors to vacate the proposed scheme footprint safely in the event of a flood warning.

### 7.4 Flood Risk and Emergency Plan

A Flood Risk and Emergency Plan (FREP) should be developed, both for the construction and operational phase, to ensure that those on site are aware of what to do in the case of a flood or flood warning. A FREP should assess the risk and include a list of steps to be taken in the case of a flood including practical steps for protecting the premises.

In line with the Environment Agency guidance on planning for a flood, the following aspects must be considered:

- a list of important contacts, including Floodline, building services, suppliers and evacuation contacts for staff;
- a description or map showing locations of key property, protective materials and service shut-off points;
- basic strategies for protecting property, preventing operational disruption and assisting recovery; and
- checklists of procedures that can be quickly accessed by staff during a flood.

It is considered likely that access to the quay would be required continuously during operation, even during flood events, so a mechanism for access should be considered within the FREP.

It should also consider timelines prior to predicted onset of flooding, in order to ensure that staff can be safely evacuated (and if safe to do so with adequate warning lead time, vehicles or removable assets).

It is recommended that the following measures are included, as part of the proposed scheme:

- Development of a construction phase FREP.
- Prior to works commencing, all construction workers will undergo site induction training prior to being allowed access to the site. This will include actions required in the event of a flood risk emergency incident, such as those included in the FREP including obtaining flood warnings/alerts, responding to warning sirens and following escape routes in the event of a site evacuation.
- No workers would be allowed on site unless they have undergone a site induction.
- Arrangements will be identified and made for safe access to and from the site.
- In the event of tidal surge and / or significant storm events, prior warning will be given to the site users in order to cease construction works and evacuate site workers to higher ground.

## 7.5 Access and egress

The proposed scheme spans across Flood Zones 1, 2 and 3, whereby the in-channel elements are located in either Flood Zone 2 or Flood Zone 3 and the landside elements (i.e. the quay) are located in Flood Zone 1.

Whilst the finished quay wall and hardstanding levels provide protection from an extreme tidal event (e.g. 1 in 10,000 years), an egress route is required in an emergency given its proximity to the watercourse.

A review of the adjacent ground levels indicates that the ground rises to the south east away from the tidal frontage, to a natural ground level in excess of 10m AOD. On this basis, it is considered that there is sufficient access away from the quay should an extreme event be forecast.

## 8 Conclusions

This FRA has reviewed the flood risk to the proposed scheme to support the development of the EIA Report and for submission with the planning application and marine licence application. The following are key conclusions identified as part of the FRA:

- The proposed scheme footprint comprises the construction of a new quay at South Bank in the Tees estuary. As such, the majority of the proposed scheme footprint falls within the River Tees channel. The linear strip of land within the proposed scheme footprint will facilitate the construction of the new quay, which will be set back from the existing defence line.
- The proposed scheme is on land which has previously been subject to development and is therefore classified as a brownfield site.
- The proposed scheme is classified as 'Water Compatible' under the NPPF as development used for docks, marinas and wharves.
- The proposed scheme footprint spans across Flood Zones 1, 2 and 3, whereby the in-channel elements are located in either Flood Zone 2 or Flood Zone 3 and the landside elements (i.e. the quay) are located in Flood Zone 1.
- The nature of the proposed scheme is such that it passes the Sequential Test and there is no requirement for the application of the Exception Test.
- The proposed revised defence line and quay wall provide a design crest level of 5.84m AOD. This ensures that the proposed quay provides continued protection against the 1 in 200-year and 1 in 1,000-year event for both the higher central and upper end scenarios throughout the 50-year lifetime of the proposed scheme (i.e. 2023 - 2073).
- The proposed scheme requires the construction of a substation that is to be situated on the quay. As a result, based on the residual risk to the proposed scheme, the finished floor levels for the substation, or the plant contained within it, should be set 0.3m above the ground level, which is a level of 6.14m AOD.
- During both construction and operation, the operators of the quay will sign up to the Flood Warning Service provided by the Environment Agency so that they can be made aware of potential extreme events and prepare accordingly.
- A FREP should be developed, both for the construction and operational phase, to ensure that those on site are aware of what to do in the case of a flood or flood warning.
- A review of the adjacent ground levels indicates that the ground rises to the south east away from the tidal frontage, to a natural ground level in excess of 10m AOD. On this basis, it is considered that there is sufficient access away from the quay should an extreme event be forecast.

On the basis of the flood risk identified both to and from the proposed scheme and its design i.e. a new quay with a revised defence line, it is considered that the proposed scheme is appropriate in terms of flood risk and is in accordance with the NPPF.

## **Appendix A: Correspondence related to Environment Agency Product 5 and 8 data package**

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**From:** Northeast Newcastle, Customer Contact <northeast-newcastle@environment-agency.gov.uk>  
**Sent:** 22 July 2020 15:15  
**To:** Royal HaskoningDHV FloodRisk UK  
**Subject:** 176607. 200705/CLW08 EA Product 5 and 8 data request - River Tees South Bank

Our Ref: 176607

Dear Paul,

**Enquiry regarding Product 5 and 8 data request - River Tees South Bank**

Thank you for your enquiry which was received on 03 July 2020.

**2015 1,000 year + Climate Change ISIS-TUFLOW Report** = <https://ea.sharefile.com/d-s49a40b66e6c4b32b>\*

**2011 ISIS-TUFLOW Model Report and Plans** = <https://ea.sharefile.com/d-s4cd2c87bac94abf9>\*

*\*These links are active for 20 days. Please download the information before the links expire*

Please note: Our Data team have explained that updated modelling for the above models is currently being reviewed by Evidence & Risk (E&R) following some additional work. We are hoping that this will be the final review and will shortly be in a position to share the model. We will be able to confirm our position within the next couple of weeks. If you require the updated models please contact us again in the future to request this.

We hope we have answered your query. Please see below for details of permitted use:

Name	Product 5 - Report
Description	<b>2015 1,000 year + Climate Change ISIS-TUFL &amp; 2011 ISIS-TUFLOW Model Report and Plans</b>
Licence	<a href="#">Environment Agency Conditional Licence</a>
Conditions	1.0 You may use the Information for your internal or personal purposes and may only sublicense others to use it if you do so under a written licence which includes the terms of these conditions and the agreement and in particular may not allow any period of use longer than the period licensed to you.  2.0 Notwithstanding the fact that the standard wording of the Environment Agency Conditional Licence indicates that it is perpetual, this Licence has a limited duration of 5 years at the end of which it will terminate automatically without notice.  3.0 We have restricted use of the Information as a result of legal restrictions placed upon us to protect the rights or confidentialities of others. In this instance it is because of third party data. If you contact us in writing (this includes email) we will, as far as

confidentiality rules allow, provide you with details including, if available, how you might seek permission from a third party to extend your use rights.

4.1 The Information may contain some data that we believe is within the definition of “personal data” under the Data Protection Act 1998 but we consider that we will not be in breach of the Act if we disclose it to you with conditions set out in this condition and the conditions above. This personal data comprises names of individuals or commentary relating to property that may be owned by an individual or commentary relating to the activities of an individual.

4.2 Under the Act a person who holds and uses or passes to others personal data is responsible for any compliance with the Act and so we have no option but to warn you that this means you have responsibility to check that you are compliant with the Act in respect of this personal data.

5.0 The location of public water supply abstraction sources must not be published to a resolution more detailed than 1km<sup>2</sup>. Information about the operation of flood assets should not be published.

6.1 Where we have supplied model data which may include model inputs or outputs you agree to supply to the Environment Agency copies of any assessments/studies and related outputs, modifications or derivatives created pursuant to the supply to you of the Information, all of which are hereinafter referred to as “the Data”.

6.2 You agree, in the public interest to grant to the Environment Agency a perpetual royalty free non-exclusive licence to use the Data or any part thereof for its internal purposes or to use it in any way as part of Environment Agency derivative products which it supplies free of charge to others such as incorporation into the Environment Agency's Open Data mapping products.

Attribution	<p>Contains Environment Agency information © Environment Agency and/or database rights.</p> <p>May contain Ordnance Survey data © Crown copyright 2017 Ordnance Survey 100024198.</p>
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Name	Product 8 – Breach Hazard Map
Description	<b>2015 1,000 year + Climate Change ISIS-TUFL &amp; 2011 ISIS-TUFLOW Model Report and Plans</b>
Licence	<a href="#">Open Government Licence</a>
Information Warnings	1.0 This map shows the level of flood hazard to people (called a hazard rating) if our flood defences are breached at certain locations, for a range of scenarios. The hazard rating depends on the depth

	<p>and velocity of floodwater, and maximum values of these are also mapped.</p> <p>2.0 The map is based on computer modelling of simulated breaches at specific locations. Each breach has been modelled individually and the results combined to create this map. Multiple breaches, other combinations of breaches, different sized tidal surges or flood flows may all give different results.</p> <p>3.0 The map only considers the consequences of a breach, it does not make any assumption about the likelihood of a breach occurring. The likelihood of a breach occurring will depend on a number of different factors, including the construction and condition of the defences in the area. A breach is less likely where defences are of a good standard, but a risk of breaching remains.</p> <p>4.0 Please contact the Environment Agency for further information on emergency planning associated with flood risk in this area.</p>
Information Warning - OS background mapping	<p><i>The mapping of features provided as a background in this product is © Ordnance Survey. It is provided to give context to this product. The Open Government Licence does not apply to this background mapping. You are granted a non-exclusive, royalty free, revocable licence solely to view the Licensed Data for non-commercial purposes for the period during which the Environment Agency makes it available. You are not permitted to copy, sub-license, distribute, sell or otherwise make available the Licensed Data to third parties in any form. Third party rights to enforce the terms of this licence shall be reserved to OS.</i></p>
Attribution	<p>Contains Ordnance Survey data © Crown copyright 2017 Ordnance Survey 100024198.</p> <p>Contains Environment Agency information © Environment Agency and/or database rights.</p>

## Data Available Online

Many of our flood datasets are available online:

- Flood Map For Planning ([Flood Zone 2](#), [Flood Zone 3](#), [Flood Storage Areas](#), [Flood Defences](#), [Areas Benefiting from Defences](#), , )
- [Risk of Flooding from Rivers and Sea](#)
- [Historic Flood Map](#)
- [Current Flood Warnings](#)

We respond to requests for recorded information that we hold under the Freedom of Information Act 2000 (FOIA) and the associated Environmental Information Regulations 2004 (EIR).

If you are not satisfied with our response to your request for information you can contact us within 2 calendar months to ask for our decision to be reviewed.

We now have over 100 datasets available as Open Data. Open Data allows access to our data free of charge and free of restriction, even for commercial use under an Open Government Licence. You can find out about the data we have available our new page on Gov.uk <https://www.gov.uk/environmental-data>

Please don't hesitate to contact me if you have any further queries.

Kind regards,

Anna

**Anna Chadwick**

Operations & FCRM Secretary, Customers and Engagement Team **(Working days Monday)**

Customers and Engagement Officer **(Working days Tuesday - Friday)**

**Environment Agency** | Tyneside House, Skinnerburn Road, Newcastle, NE4 7AR

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For all Freedom of Information related enquiries please contact: [northeast-newcastle@environment-agency.gov.uk](mailto:northeast-newcastle@environment-agency.gov.uk)

For all business related enquiries please contact [ne\\_amt\\_support@environment-agency.gov.uk](mailto:ne_amt_support@environment-agency.gov.uk)



Please note that all Environment Agency staff are working from home due to the Coronavirus (COVID-19) pandemic. All staff can be contacted via e-mail or telephone as usual. Please accept our apologies in advance for any delays in our service during this time.

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