28 WATER FRAMEWORK DIRECTIVE COMPLIANCE ASSESSMENT

28.1 Introduction

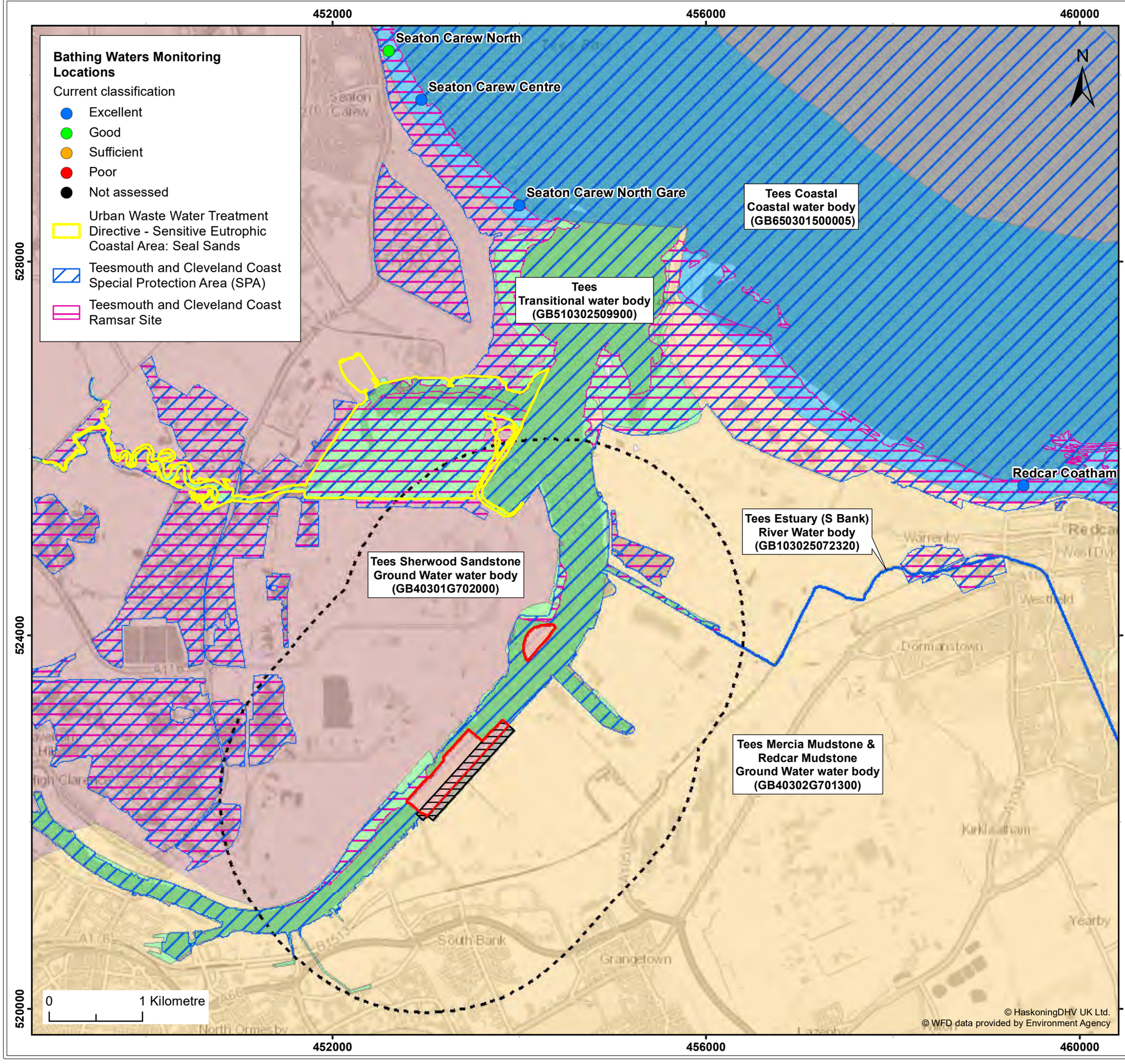
This WFD compliance assessment has been carried out in line with the '*Clearing the Waters for All'* guidance (Environment Agency, 2016) found at https://www.gov.uk/guidance/water-framework-directive-assessment-estuarine-and-coastal-waters. The proposed quay, dredge area, disposal site and WFD water body outlines are shown in **Figure 28.1**. WFD Protected Areas within 2km of the proposed scheme are also shown in **Figure 28.1**.

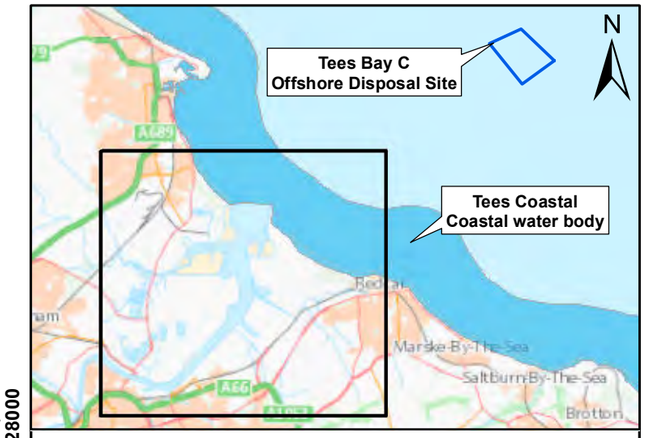
The project is located within the Tees estuary water body (GB510302509900) and the groundwater body Tees Mercia Mudstone & Redcar Mudstone (GB40302G701300) (see **Figure 28.1**). The disposal site is not, however, located within a WFD water body and given the distance of the disposal site to the nearest WFD water body (approximately 6.3km, see **Figure 28.1**) and plume modelling results described in **Section 6,** disposal is screened out of this assessment. Additionally, given that the potential effects associated with maintenance dredging campaigns would be on a significantly smaller scale than the capital dredging and that the estuary is already subject to ongoing maintenance dredging, scoping is undertaken on capital dredging only.

The proposed scheme does not have a planned decommissioning phase (see **Section 3.11**) and therefore decommissioning has not been considered in this assessment.

28.2 Consultation

As noted in **Section 5**, consultation has been undertaken with both the MMO and RCBC most recently during August and September 2020. The comments of relevance to this WFD compliance assessment are contained within **Table 28.1**.





Legend

- 2km Search Area
- Proposed Dredge and Excavation Envelope (including side slopes)
- Proposed Quay Envelope
- Proposed Demolition Area
- Offshore Disposal Site Tees Bay C

WFD River Water Body

- Tees Estuary (S Bank) (GB103025072320)

WFD Coastal Waterbody

- Tees Coastal (GB650301500005)

WFD Transitional Waterbody

- Tees (GB510302509900)

WFD Ground Waterbody

- Tees Mercia Mudstone & Redcar Mudstone (GB40302G701300)
- Tees Sherwood Sandstone (GB40301G702000)

Client:	Project:
Tees Valley Combined Authority	South Bank Quay

Title: WFD water bodies and protected areas

Figure: 28.1

Revision:	Date:	Drawn:	Checked:	Size:	Scale:
0	29/10/2020	TC	CP	A3	1:40,000

Co-ordinate system: British National Grid

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Table 28.1 Summary of scoping consultation responses from the Environment Agency with regard to the WFD

Comment	Response / section of report where comment addressed
The Environment Agency recommended following the *Clearing the Waters for All* guidance before ruling out a quantitative assessment of water quality.	It is confirmed that this guidance has been followed to undertake this assessment.
The applicant must ensure no deterioration in water quality as a result of the development in terms of WFD.	See **Sections 28.4**, **28.5, 28.6, 28.7**
The applicant should identify measures to comply with the requirements of the WFD through carrying out a WFD assessment of the proposal. As part of a WFD assessment, the following must be demonstrated: • Whether the proposed development will lead to a deterioration in status of any WFD waterbody; • Whether the proposed development will compromise the achievement of Good Status or Potential in any WFD waterbody; • Whether the proposed development will contribute towards a cumulative deterioration of WFD status or prevent cumulative enhancement of WFD status in any waterbody; • Whether the proposed development will support the delivery of measures identified in the Northumbrian River Basin Management Plan (RBMP) that are required to achieve waterbody objectives.	These points have been considered throughout this assessment and a summary of findings is provided in **Section 28.11**
The generic mitigation measures deemed applicable to this waterbody include: Enhance ecology, Bank rehabilitation, Remove or soften hard bank, Preserve or restore habitats.	Measures are included in the assessment alongside those listed in the *Clearing the Waters for All guidance* mitigation measures table for the Tees.
The design process for the wharf should look to include an assessment of incorporating bio-engineered designs such as Estuary Edges, to mitigate on site impacts.	See **Section 28.8**
Mention of various reports to inform mitigation to address WFD issues related to enhancement of marine ecology	Consideration of the findings and recommendations of these reports is being fed into the developing South Tees Regeneration Masterplan Environment & Biodiversity Strategy.
The objective for this waterbody is to achieve 'good' ecological potential. These environmental objectives are legally binding. All public bodies must have regard to these objectives when making decisions that could affect the quality of the water environment.	Noted

28.3 Activities and WFD water bodies

As required by the guidance, the proposals have been split into activities for assessment as follows:

During construction;

- C1 Demolition of the existing wharf and three jetties down-stream of the wharf.
- C2 Capital dredging (to deepen the northern half of the Tees Dock turning circle, a section of the existing approach channel and to create a berth pocket) via a combination of TSHD and backhoe dredger.
- C3 Excavation of soils/landside materials within the riverbank to create the berth pocket to be reused on site.

- C4 Installation of rock blanket within the footprint of the proposed berth pocket.
- C5 Construction of the new quay to be set back into the riverbank.
- C6 Accidental spills and leaks.
- C7 Landside works not already consented, such as removal of surface laid pipework to pumping station and demolition of substation.

During operation;

- O1 Presence of new permanent structure – quay wall.
- O2 Discharge of surface water.

28.3.1 In-built scheme control measures and screening out of activities

During the construction period there is the potential for pollution from spills or leaks of fuel and oil. The risk of this arising can be minimised by following standard good practice with regard to pollution prevention guidance (see **Section 3**). Additionally, PDT have an oil spill contingency plan in place which has been developed for use in the event of an operational incident. This plan will be modified where appropriate to take account of the risks during the construction phase. A CEMP will be produced and implemented for the construction phase to manage all risks associated with working in and around water (see **Section 3**) including ensuring debris from demolition activities is captured when working close to water and removed from site. Risks to water quality associated with working practices (i.e. activities C6 and C7) will be reduced as far as possible and therefore these activities are screened out of the assessment.

A biosecurity plan or ballast water management plan will be produced to manage the risk of introduction and spread of invasive species. This plan will include management measures such as filtering or treating of ballast water prior to being discharged into the water when not needed and would be produced in line with any management measures relating to biosecurity or ballast water management that are already put in place and enforced by PDT as statutory harbour authority. Additionally, strict biosecurity measures would be implemented to avoid the importing of non-native invasive species. Equipment, plant and PPE brought to site would be clean and free of material and vegetation. To ensure measures are implemented, biosecurity toolbox talks would be given to all site staff and rigorous inspections would be undertaken of all equipment delivered to site, following the Check Clean and Dry campaign. As a result, the risk of introducing INNS is not considered further in this assessment.

28.3.2 WFD water bodies

The assessment considers the pathway for effects for the WFD water body within which the activities will occur. Where a pathway for effect is identified, the potential for effects on adjoining WFD water bodies will be considered in Stage 3. The relevant adjoining water body is the Tees Coastal water body (GB650301500005) which is located downstream of the proposed scheme.

The information for the water body in which the activity will occur and adjoining water body is presented in **Table 28.2**. The protected areas located within 2km are also listed in **Table 28.2** and shown in **Figure 28.1**. The information for the groundwater body is presented in **Table 28.3**.

Table 28.2 Summary of surface water WFD water body information

Water body	Description/notes	Description/notes
WFD water body name	Tees	Tees
Water body ID	GB510302509900	GB650301500005
River basin district name	Northumbria	Northumbria
Water body type (estuarine or coastal)	Transitional	Coastal
Water body total area (hectares)	1144.05	8838.15
Overall water body status (2015)	Moderate	Moderate
Ecological status	Moderate	Moderate
Chemical status	Fail	Fail
Target water body status and deadline	Moderate by 2015	Good by 2027
Hydromorphology status of water body	Supports good	Not assessed
Heavily modified water body and for what use	Yes (Flood Protection, Navigation Ports and Harbours)	Yes (Coastal Protection, Flood protection, Navigation, Ports and Harbours)
Higher sensitivity habitats present	Saltmarsh (46.24ha); Subtidal Kelp Beds (4.13ha)	Saltmarsh Mussel beds, including blue and horse mussel (121.9ha); Subtidal Kelp Beds (175.17ha)
Lower sensitivity habitats present	Cobbles, Gravel and Shingle (0.77ha); Intertidal soft sediments (400.13ha); rocky shore (26.93ha); subtidal rocky reef (4.13ha); subtidal soft sediments (610.31ha).	Cobbles, gravel and shingle (3.36ha), Intertidal soft sediment (845.53ha), Rocky shore (184.33ha), Subtidal rocky reef (7170.93ha), Subtidal soft sediments (1219.64ha)
Phytoplankton status	Good	-
History of harmful algae	Not monitored	Not monitored
WFD protected areas within 2km	See **Figure 28.1**. Note that European designated sites are considered within the Information to inform HRA (**Section 29** of this report) and therefore are not considered further in this assessment.	See **Figure 28.1**. Note that European designated sites are considered within the Information to inform HRA (**Section 29** of this report) and therefore are not considered further in this assessment.
Mitigation measures (taken from Clearing the Waters for All, 2016)	50.Vessel Management 22.Dredging disposal strategy 23.Reduce impact of dredging 24.Reduce sediment resuspension 25.Retime dredging or disposal 26.Sediment management 27. Dredge disposal site selection 28.Manage disturbance 1.Modify channel	None identified
Mitigation measures provided by the Environment Agency (scoping response August 2020)	Enhance ecology Bank rehabilitation Remove or soften hard bank Preserve or restore habitats.	None provided

Table 28.3 Summary of WFD water body information for the Tees Mercia Mudstone and Redcar Mudstone Groundwater body

Water body	Description
WFD water body name	Tees Mercia Mudstone and Redcar Mudstone
Water body ID	GB40302G701300
River basin district name	Northumbria
Water body type (groundwater, estuarine or coastal)	Groundwater
Water body total area (ha)	49457.045
Overall water body status (2016)	Poor
Quantitative status	Good
Chemical status	Poor (Chemical Dependent Surface Water body status)
Target water body status and deadline	Poor by 2015
WFD Protected Areas within the WFD water body	Drinking water protected area

28.4 WFD Scoping

The activities screened in have been compared with the scoping criteria as outlined in the *Clearing the Waters for All* guidance (Environment Agency, 2016). The output of this assessment is provided in **Appendix 16A** for surface waters and **Appendix 16B** for groundwater bodies. A summary of the findings of the scoping assessment is presented in **Tables 28.4** for surface water bodies and **28.5** for groundwater bodies.

Table 28.4 Summary of WFD scoping (Clearing the Waters for All, Environment Agency 2016)

Activity	Hydromorphology	Biology (habitats)	Biology (fish)	Water Quality	Invasive species	Protected Areas
C1 Demolition of wharf and jetties	No – small scale effects only. Removal of the structures would not threaten the WFD mitigation measures identified for the water body.	No – small scale effects only.	No – small scale effects which would be localised to the works and only occur for a matter of hours for each pile removed.		No – control measures to be put in place and materials removed would be disposed of on land therefore limited risk of INNS spread if present.	Detailed assessment regarding designated sites is provided in **Section 29**. The project would not give rise to impacts on nutrient concentrations in the estuary and therefore Seal Sands sensitive area (eutrophic) is scoped out.
C2 Capital dredging	Yes – there is the potential to impact on hydromorphology and WFD mitigation measures identified for the Tees estuary.	Yes in relation to lower sensitivity habitats. There are no higher sensitivity habitats located within 500m.	Yes – there is the potential to impact on water quality due to sediment plumes created during dredging.	Yes – there is the potential to mobilise sediments with concentrations greater than Cefas Action Level 1.	No – control measures to be put in place to reduce risk of introducing INNS. INNS are already present in the estuary in very low numbers. A significant risk of spreading INNS is not predicted.	
C3 Excavation of soils/landside materials	The potential effect of excavating soil to accommodate the new quay wall and berthing pocket on hydromorphology is considered in O1 below.	No - these materials would be excavated on land therefore would not directly affect marine habitats.	No - these materials would be excavated on land and the measures included to reduce risks to water quality when implemented, would not directly affect fish.	A site characterisation study will be undertaken to assess the potential risk associated with contaminants being present. If present, remediation works will be required prior to commencement of any excavation.	No – control measures to be put in place to reduce risk of introducing INNS.	
C4 Installation of rock blanket	The installation and presence of the rock blanket would not impact on hydromorphology. WFD mitigation measures assessment scoped in.	No – the area to be impacted is less than trigger values. There are no higher sensitivity habitats within 500m of the rock blanket.	No - there might be temporary increases in suspended solids associated with working on the seabed however these would be temporary and localised to the works. No effects on fish predicted.	No - there might be temporary increases in suspended solids associated with working on the seabed however these would be temporary and localised to the works.	No – control measures to be put in place to reduce risk of introducing INNS.	
C5 Construction of new quay	The potential for a permanent alteration to the existing riverbank and potential effects in relation to WFD mitigation measures are considered in O1	No - the new quay would be constructed on land therefore there would be no effects on existing	No - the construction of the quay wall would require piling on land. Evidence confirms that	No - the construction of the new quay would be on land therefore effects	No – control measures to be put in place to reduce risk of introducing INNS.	

Activity	Hydromorphology	Biology (habitats)	Biology (fish)	Water Quality	Invasive species	Protected Areas
		intertidal and subtidal habitats.	there is unlikely to be underwater noise impacts on fish as a result.	on water quality are not predicted.		
O1 Presence of new structure	Yes – there is the potential to impact on hydromorphological parameters as a result of changes to the riverbank. WFD mitigation measures also scoped in.	No - the new quay would be constructed on land therefore there would be no effects on existing intertidal and subtidal habitats.	There is no pathway for effects on fish.	There is no pathway for effects on water quality.	No pathway for effect	
O2 Discharge of surface water	No – there is no risk of impacting on hydromorphological parameters or mitigation measures identified for the water body.	No - the discharge of clean surface water is unlikely to affect habitats.	Installation of oil interceptors where required will remove the potential for effects on water quality. No other risks to water quality and fish.		No pathway for effect	

Table 28.5 Summary of scoping for the groundwater body

Activity	Quantitative quality elements	Chemical quality elements	Protected Areas
C1 Demolition of wharf and jetties	No – demolition of the structures would not impact on the groundwater body		Not located within 2km of the proposed scheme.
C2 Capital Dredging	No – dredging will not impact on the groundwater body		
C3 Excavation of soils/landside materials	No – excavation would not alter quantitative quality elements	Yes – there is the potential that contaminants would be present in the made ground which could be mobilised during excavation.	
C4 installation of rock blanket	No – the installation of the rock blanket would not impact on the groundwater body		
C5 Construction of new quay	No – the construction of the new quay would not impact on quantitative parameters.	Yes – there is the potential that contaminants would be present in the made ground which could be mobilised during construction of the quay wall.	
O1 Presence of new quay	No – whilst there may be local alterations to rainfall these are unlikely to be discernible.	No - Drainage managed and no infiltration to groundwater required.	
O2 Discharge of surface water	No – no pathway for effect.	No – no pathway for effect as control measures would be implemented to remove risks to discharging polluted surface water	

The following activities and parameters have been scoped into Stage 3 detailed assessment:

- For C2 - Hydromorphology and RBMP mitigation measures, biology (fish and habitats) and water quality.
- For C3 – Hydromorphology and groundwater – chemical quality elements.
- For C4 – RBMP mitigation measures.
- For C5 – Hydromorphology and RBMP mitigation measures, Groundwater – chemical quality elements.
- For O1 - Hydromorphology and RBMP mitigation measures assessment.

C1 and O2 were scoped out of requiring detailed assessment.

28.5 Detailed assessment – C2 Capital dredging

The potential effects of this activity that were scoped in at the end of Stage 2 are summarised in **Table 28.6**.

Table 28.6 Summary of water bodies, quality elements, RBMP mitigation measures and protected areas scoped in for assessment for C2

Water body	Quality elements	RBMP mitigation measures	Protected areas
Tees transitional water body	Hydromorphology, biology (habitat and fish), water quality	All	Whilst the SPA is located within 2km, detailed assessment is covered in **Section 29**. The activity would not give rise to increases in nutrients within the estuary and therefore Seal Sands sensitive area (eutrophic) is scoped out.

28.5.1 Hydromorphology

To assess the potential effects of deepening areas of the channel, numerical modelling was undertaken (see **Section 6** for more detail). The model runs also included the presence of the new quay (see activity O1) and therefore this assessment considers the cumulative effects of the channel deepening and the new quay together.

Baseline conditions indicate that maximum current speeds are greater on the spring tides than the neap tides with an ebb dominance during neap tides and flood dominance during spring tides. The 'with scheme' conditions were compared against the baseline conditions and the resulting difference plots show the changes in peak current speeds on the ebbing and flooding phases of neap and spring tides, respectively. An example plot is shown in **Figure 28.2** for the flood phase of a spring tide. The spring tide results for peak flood and ebb phases exhibit similar patterns to those described for the corresponding phases of the neap tide, but the area of effect is slightly larger and, in local areas, the magnitude of effect slightly larger.

The area of effect does not, however, extend significantly further along the axis of the channel (i.e. upstream or downstream), just across the width of the channel opposite the new quay. For example, during the peak of the flood much of the channel immediately opposite the quay experiences a slight reduction in baseline flows, whereas under the corresponding neap conditions is was only parts of the channel width (with changes elsewhere being less than 0.05 m/s). **Section 6** summaries the changes as follows:

- The proposed new quay alignment and capital dredging to deepen the Tees Dock turning circle and approach channel and to create a berth pocket will not significantly affect the existing baseline hydrodynamic conditions.
- There will be flow newly occurring in the area of the new quay because it is being set-back from the existing riverbank, but the peak flows in this area will be low.
- Elsewhere, there will be a general small magnitude reduction in baseline flows varying during different phases of the tidal cycle, but always remaining within the reach immediately opposite the new quay. This reduction in baseline flows is caused by both a slight widening of the channel (due to the new quay alignment) and the local deepening of the bed due to the capital dredging.
- The reductions in baseline current speeds in these areas may lead to a slight increase in deposition of sediment. In areas adjacent to the north bank opposite the quay, this is deemed to be a positive effect as it will help the existing mudflat be sustained in light of sea level rise. In the main channel the deposition will require periodic dredging to maintain the design depths.
- There is no predicted effect on local wind-generated waves at the site since the changes in hydrodynamics are small and localised.
- There are no estuary scale effects on baseline hydrodynamic conditions.

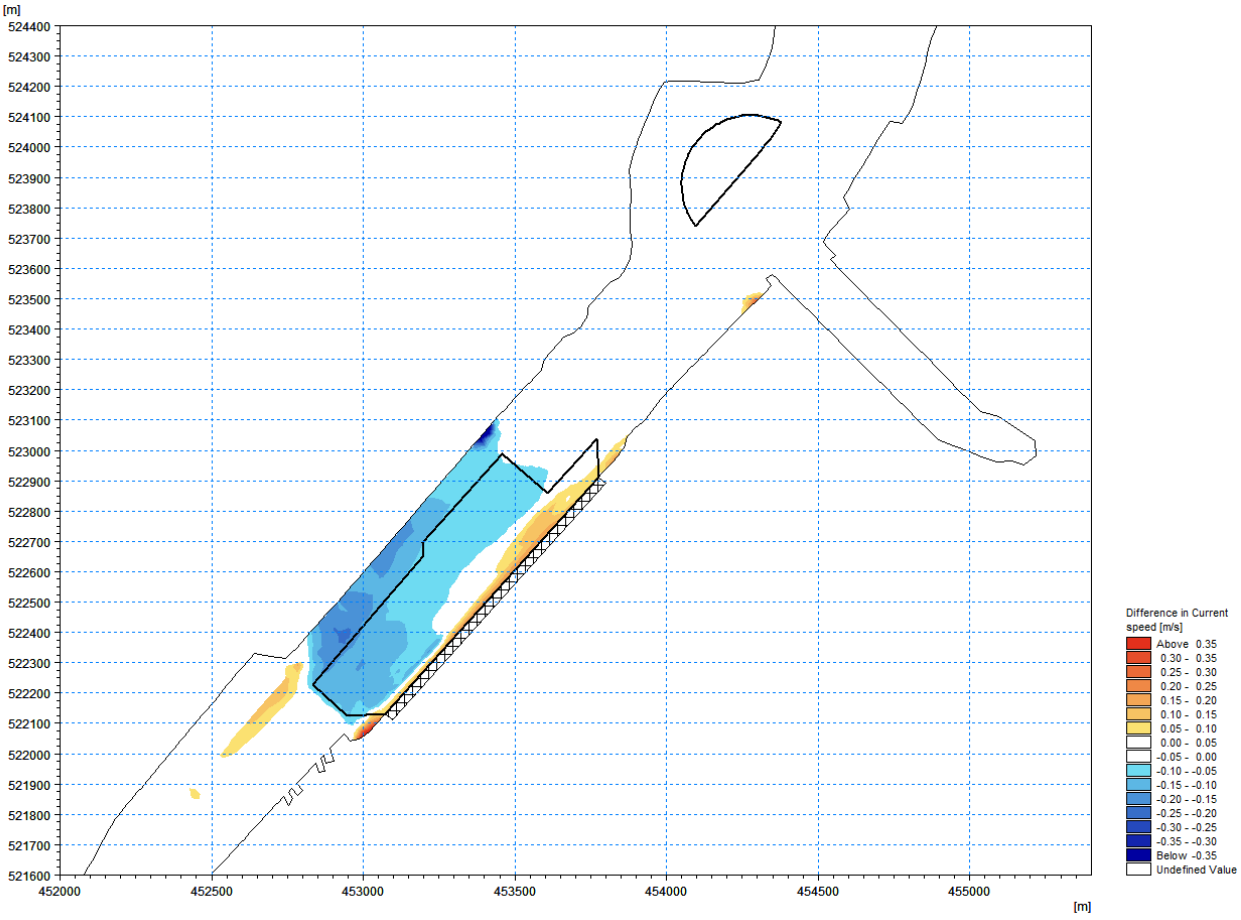


Figure 28. 2 Change in peak current velocities due to the scheme during the flood phase of a spring tide with ***mean daily river flow***

In terms of alterations to the tidal prism, design calculations for the proposed scheme show that the increase in mean tidal prism as a result of the new quay's set-back alignment and dredging of part of the existing estuary bed is 150,901 m^3. This represents an increase in the existing tidal prism of the estuary by 0.8%

and would not cause significant estuary-wide change to existing hydrodynamic processes (see **Section 6** for further information).

Overall therefore, the effects of the capital dredging and presence of new quay wall on the flow conditions and tidal prism of the estuary, would not impact on intertidal communities of the WFD water body and therefore a non-temporary deterioration in ecological class status is not predicted.

28.5.2 Water quality

Capital dredging within the river would result in sediment plumes. To consider the potential extent and severity of effect on suspended solid concentrations within the Tees, hydrodynamic modelling was undertaken. Full detail of the modelling is presented in **Section 6** (and **Appendix 5**) but the key points are summarised here for ease of reference.

Modelling was undertaken using a MIKE3-MT sediment dispersion model coupled with the 3D hydrodynamic model MIKE3-HD and run for the four-month period over which dredging is predicted to occur. The simulations also accounted for the movement of dredgers and transport barges (including dredging, sailing, disposal and downtime) and four stages were modelled to allow for the potential timing of phasing in the proposed construction. The results of the modelling are presented in **Table 28.7.**

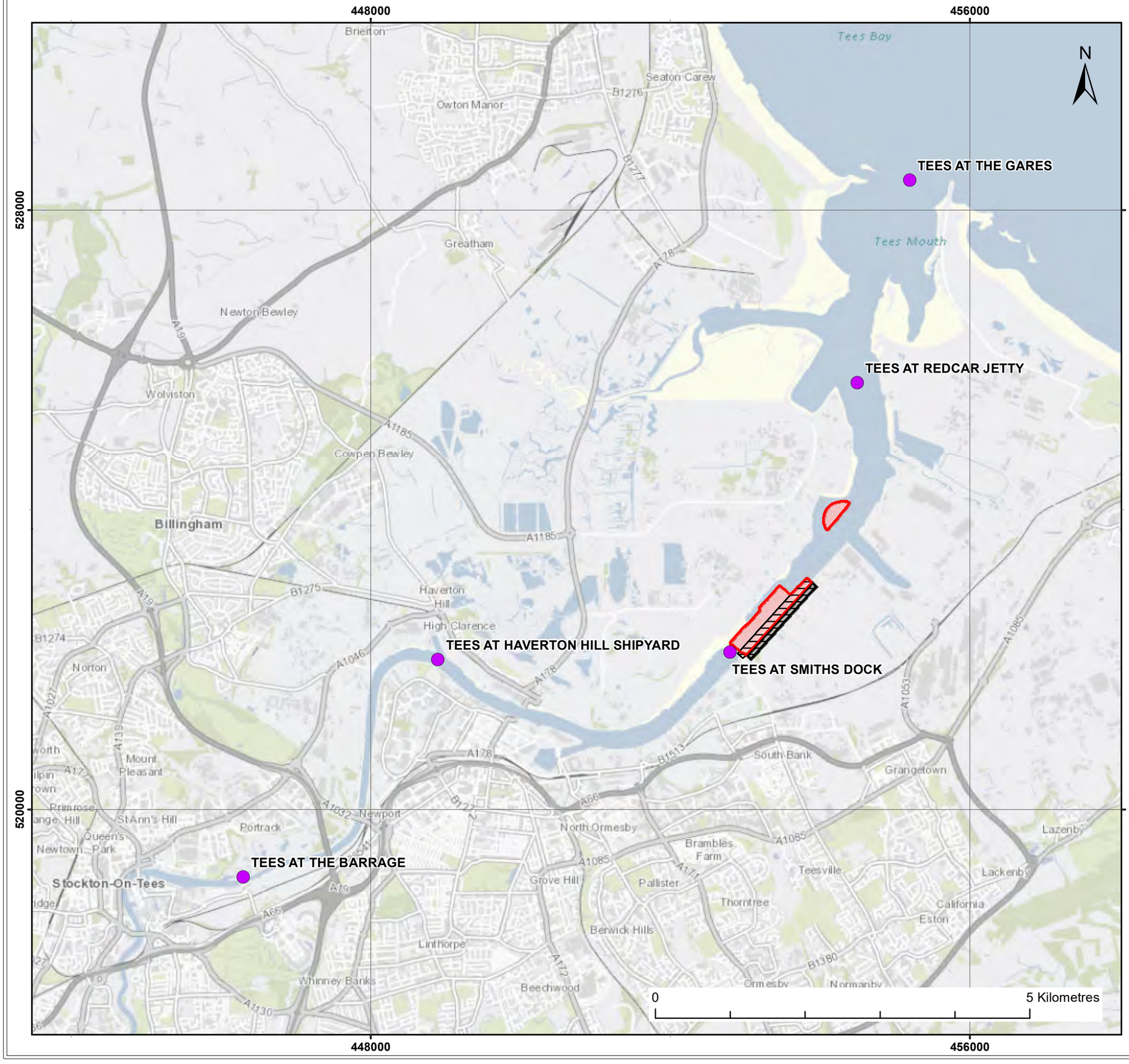
Table 28.7 Summary of output of hydrodynamic modelling (see Section 6 for further detail)

Stage	Description	Findings of the modelling study
1	BHD working to dredge the upper soft material in the berthing pocket and river channel.	In all tidal conditions modelled, the lateral extent of the plume across the river channel is very narrow and the magnitude of concentrations within the plume beyond a few hundred metres from the point of release is in the order of 10 - 20mg/l and in the extremities of the plume, reduces further to concentrations 0-10mg/l.
2	BHD and TSHD working in parallel to dredge the middle soft material in the berthing pocket and river channel.	Results for this stage were similar to those in Stage 1 but with separate plumes created by the different dredgers. At some points in the cycle, areas of these initially separate plumes combine as they move upstream and downstream according to the tidal phase, albeit at relatively low (typically <30mg/l and often <10 mg/l) concentrations once a few hundred metres away from the point of initial release.
3	BHD working to dredge the bottom hard material in the berthing pocket and river channel.	The maximum concentrations and the spatial extents of the plume arising from Stage 3 of the dredging are much lower than those experienced during Stage 1 largely because the material being released is coarser and the production rate of dredging is notably lower. Plume very small and located close to the dredging activity.
4	BHD and TSHD working in parallel to dredge the material in the Tees Dock turning circle.	Again, peak concentrations close to the dredger are shown in the plume modelling output. On the ebb phase, the plume can extend at low concentrations (<30mg/l) along the jetties of the Oil Terminal towards (but not entering) the Conoco Phillips Inset Dock, whilst on the flood phase it remains close to the northern bank over a narrow channel width extending along the North Tees Works jetties.

To investigate potential levels of suspended solid concentrations at the WFD water quality monitoring points (see **Figure 28.3**), time series plots were produced as follows:

- WQ1 – Water quality monitoring point (Tees at the Gares);
- WQ2 – Water quality monitoring point (Tees at Redcar Jetty);
- WQ3 – Water quality monitoring point (Tess at Smiths Dock);
- WQ4 – Water quality monitoring point (Tees at Haverton Hill Shipyard);
- WQ5 – Water quality monitoring point (Tees at the Barrage);

The results are presented in **Figure 28.4**.



Legend

- Proposed Dredge and Excavation Envelope (including side slopes)
- Proposed Quay Envelope
- Proposed Demolition Area
- Water Quality Monitoring Points

Client:	Project:
Tees Valley Combined Authority	South Bank Quay

Title: Water Quality Monitoring Points

Figure: 28.2

Revision:	Date:	Drawn:	Checked:	Size:	Scale:
0	29/10/2020	TC	CP	A3	1:50,000

Co-ordinate system: British National Grid

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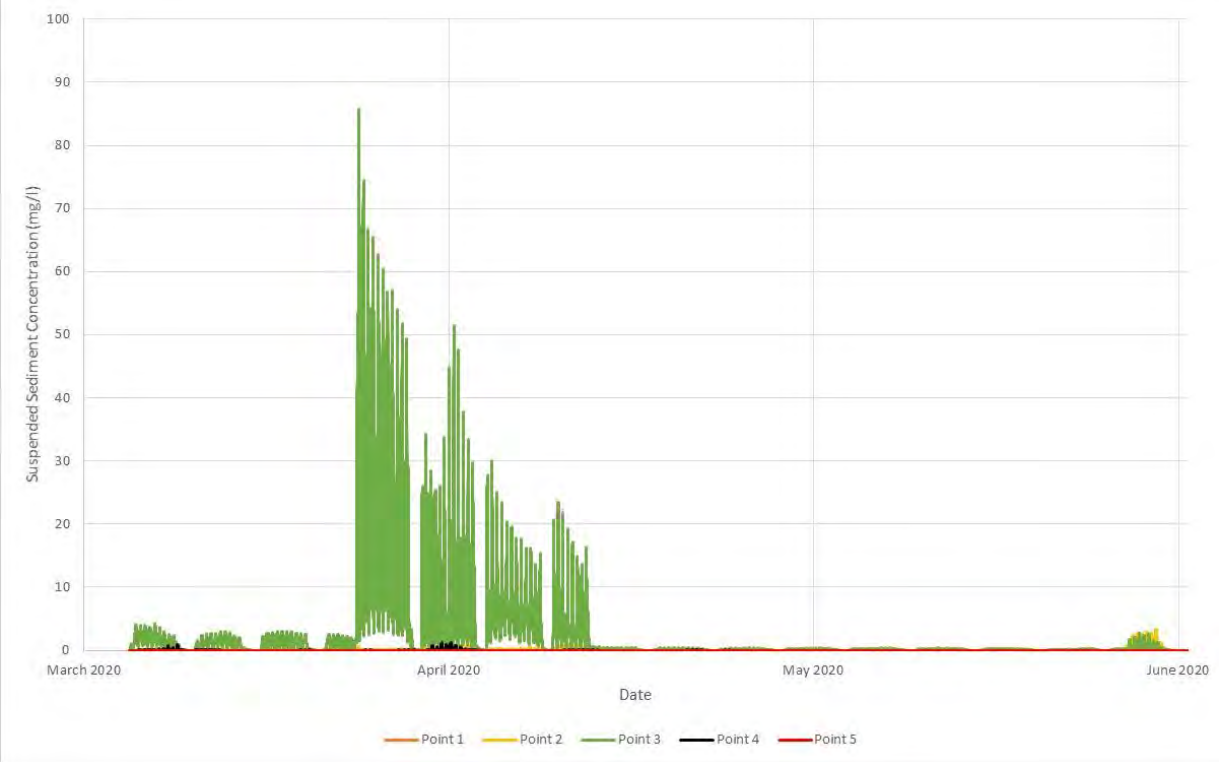

Figure 28.4 Timeseries of changes in suspended sediment concentrations at water quality monitoring points in the Tees estuary

Only water quality monitoring point WQ3 (Smiths Dock) shows elevated levels of suspended solid concentrations by any appeciable effect. Peak concentrations reach 85mg/l which reduce back to baseline within an hour followed by subsequent, but lower concentration peaks, again reducing to baseline concentations within an hour. All other stages of proposed dredging either do not cause elevations or only elevate concentrations by very small amounts (i.e. up to 5mg/l).

The resuspension of sediment could also potentially affect dissolved oxygen levels in the water. This is due to the introduction of organic matter and nutrients into the water column which are broken down by microbial activity (i.e. respiration) resulting in a short-term demand on dissolved oxygen concentrations.

Of relevance to this potential impact are the findings of the water quality modelling undertaken in the River Tyne for the New Tyne Crossing to predict the consequences of dredging on dissolved oxygen concentrations (Ove, Arup and Partners Ltd, 2002). In summary, under a variety of modelled conditions, such as dredging times, seasonal fluctuations and river flows, the modelling predicted only small differences between background and dredging impacted dissolved oxygen concentrations. No difference was noted between the summer and winter concentrations. Furthermore, dredging in the Tyne is considered to represent a more conservative scenario, as sediment plume modelling outlined above indicates relatively limited plume extents for the majority of the capital dredge for the proposed scheme.

These observations are reflected in the original guidance issued to assist in undertaking WFD compliance assessments *Clearing the Waters* (Environment Agency 2012), which acknowledges that effects on dissolved oxygen concentrations are only likely to be an issue when dredging within an area with an existing dissolved oxygen problem or where sediments have a high chemical oxygen demand and that in practice, monitoring of dredging suggests effects are unlikely. Given the water body has a classification status of high for dissolved oxygen and it is not anticipated that the sediments will have a high chemical oxygen demand, effects on dissolved oxygen concentrations are not predicted.

In terms of contaminants, the concentrations of PAHs and metals within the sediments in the Tees estuary could potentially affect water quality, given the elevated concentrations greater than Cefas Action Level 1 and the lower CSQG. An assessment to look at the potential for the release of sediments exceeding Cefas Action Level 1 to cause EQS failures was therefore undertaken to inform the marine sediment and water quality section of this report (see **Section 7**). To summarise, the calculations for low water volumes and maximum concentrations for baseline water quality and sediments in the estuary indicate that there is a risk of zinc and benzo(b)fluoranthene EQS failure. To provide a sensitivity analysis, calculations were also undertaken for high tide volumes in the estuary (for maximum sediment and water quality baseline conditions) for these two parameters to see whether the risk of EQS exceedance is reduced. The calculations were also re-run using average concentrations.

For high water with maximum water and sediment concentrations and use of average concentrations for both water and sediment quality, the estimated concentrations reduce below EQS. This indicates that the risk of EQS failure only occurs under a certain set of circumstances, but these are unlikely to occur because of the following;

- The calculations assume that all sediment remains in suspension. In reality, it is likely that some settlement will occur and this is demonstrated in **Section 28.5.3** below.
- A relatively large proportion of the total volume of dredged material is anticipated to comprise geological material (i.e. mudstone). It is generally accepted that geological material does not contain contaminants.
- The calculations assume that all contamination is released into the water column. In reality, it is likely that some contamination will remain bound to sediment particles.
- The maximum concentration within the sediments used for each parameter does not occur across the dredge area.
- The maximum values for water quality concentrations are not reflective of sediment conditions across the site.
- The daily dredge volume is likely to be less than that accounted for due to stoppages associated with transiting vessels and disposal activities.
- The calculation is based on loss from a TSHD whereas a considerable component of the dredge will be undertaken with a backhoe dredger which has a lower production rate and therefore releases less sediment into the water column.

Additionally, sediment plume results for Smiths Dock monitoring point (point 3) indicated only temporary increases in suspended solids concentrations above baseline (up to 85mg/l which decreases to baseline with hours) for Stage 2 which reduce as dredging progresses (see **Figure 28.4**).

Overall, whilst there are potential scenarios that indicate there would be effects on water quality, these would be temporary which would disperse following cessation of the works. Plume extents during each of the stages are relatively limited and only experience significant increases above background concentrations of suspended solids when in close proximity to the dredger. As a result, a non-temporary deterioration in water quality for either contamination or on physico-chemical parameters is not predicted.

28.5.3 Biology – habitats

The majority of the proposed dredge footprint is located within the subtidal parts of the Tees estuary and therefore the majority of the dredge would impact on the lower sensitivity habitat 'subtidal soft sediment' of which there is 6,103,100m^2 in the WFD water body (see **Table 28.2**). However, given the proposals to locate the quay in the riverbank (i.e. on land), dredging and excavation in front of the quay wall to create the berth pocket would remove 25,000m^2 of intertidal sediments, of which there are 4,001,300m^2 within the WFD water body (see **Table 28.2**).

Subtidal sediments

Information regarding the habitat located within the dredge footprint is to be confirmed with a site specific benthic ecology survey (see **Section 9**) but it is predicted that the communities recorded in the 2019 dataset collected to inform the ES for NGCT are likely to be similar in nature to those found within the dredge footprint, particularly the turning circle given this was sampled within the 2019 survey.

Results in 2019 indicate a variety of sediment types are present across the survey area and most samples range from poorly sorted to extremely poorly sorted. The samples in the Tees estuary are generally mud and sandy mud in the most upstream locations, becoming sandier with distance downstream.

Biotopes were determined based on the 2019 particle size and macrobenthic data; and those that occurred most frequently in the estuarine locations (and within the area to be dredged for this project) was EUNIS biotope A5.323 '*Nephtys hombergii* and *Tubificoides spp*. in variable salinity infralittoral soft mud'. One station was classified as EUNIS biotope A5.325 '*Capitella capitata* and *Tubificoides spp*. in reduced salinity infralittoral muddy sediment'. Several stations were unable to be classified further than the EUNIS level 4 biotopes A5.32 'Sublittoral mud in variable salinity' and A5.22 'Sublittoral sand in variable salinity', based on the fauna present.

The majority of species recorded during the 2019 benthic survey are typical of sublittoral microbenthic communities. As has been observed in previous surveys within the Tees (summarised in **Section 9**), annelid taxa, particularly polychaetes, dominated the assemblages in terms of abundance and diversity across all stations. Mollusc taxa generally contributed most to biomass. Crustaceans, echinoderms and other taxa all generally contributed little to abundance, diversity and biomass, except for 'other taxa' in the intertidal (discussed below). Unlike the findings from the 2006 and 2014 surveys in the Tees (**Section 9.4.3**), the opportunistic species *Capitella capitata* was only recorded in high numbers at one station. This species was widespread in the 2006 and 2014 surveys.

The biotopes recorded in the 2019 survey are likely to reflect those located in the dredge area given their presence downstream from the berth and in similar environmental conditions.

Whilst capital dredging would remove material from the seabed it would not alter the habitat type available or the exposure conditions (the exception being the rock blanket area considered in activity C4). Additionally, the species likely to be present are typical of a highly disturbed environment (MarLIN) and are dominated by fast growing opportunistic polychaetes. However, MarLIN notes that removal of the substratum to 30cm would result in the loss of the characterising species but that recovery of the biological assemblage may take place before the original topography is restored, if the exposed, underlying sediments are similar to those that were removed. Therefore, whilst there may be a temporary deterioration in species composition and numbers following dredging, it is predicted that the sediment communities would recover relatively quickly. A non-temporary deterioration in status classification of benthic invertebrates in the WFD water body is therefore not predicted.

Intertidal sediments

Section 9 provides a detailed assessment of the habitats within the intertidal area but to summarise, site walkovers confirm that the intertidal area to be lost comprises intertidal mud and gravelly sediment with rocks and high levels of debris (similar to other areas of the Tees estuary) (see **Plate 28.1**). The habitat at the base of the existing structures to be demolished (i.e. within the intertidal area to be lost) was observed to be dominated by brown algae (likely fucoids, such as *Fucus ceranoides*), and the pillars of the South Bank Wharf appear to only support areas of green, mat-like algae (possibly *Rhizoclonium riparium* or *Ulva intestinalis*) and black lichen (possibly *Verrucaria sp*.) No other species were observed during the site visit or from the photographs. The habitat is therefore deemed to be of poor quality (see **Section 9**).

Given the relatively small area to be lost compared to the area of this habitat present within the WFD water body (0.6%) and the poor quality of the habitat, a deterioration in status classification for biological communities this area supports is not predicted. However, it is acknowledged that the extent of intertidal habitat in the Tees has been significantly reduced as the banks of the estuary have been developed. Existing areas of intertidal habitat, especially intertidal mudflat, within the Tees estuary are fragmented and, in this context, intertidal areas are a sensitive resource. To address and compensate this loss, STDC is in the process of developing a South Tees Regeneration Masterplan Environment & Biodiversity Strategy, which will define the works required to offset the loss of habitat arising as a result of works being proposed by STDC (including the proposed scheme which is the subject of this report). The extent and location of compensatory habitat creation and enhancements will be agreed with Natural England, the Environment Agency and RCBC. Additionally, it is considered that incorporation of 'verti-pools' into the quay face would be possible; these pools are pocket rock pools that are designed to be applied to vertical sea defences to create water retentive habitat features. A number of verti-pools would be positioned along the length of the quay face at different heights within the tidal frame to provide a range of different habitat opportunities.

It is also recognised that the proposed dredge footprint is within close proximity to the North Tees mudflat, however, based on the results of the hydrodynamic modelling, erosive effects are not predicted (see **Section 6**).

Plate 28.1 Intertidal area to be lost as a result of excavation to create the berth pocket

Sediment settlement

Sediment suspended within the dredging plumes will fall to the riverbed, either soon after disturbance or spillage occurring during the dredging operation (for coarser-grained sediment fractions), or at a point in time within a few minutes to a few hours after this if it is carried in suspension by the prevailing currents for finer-grained sediment fractions. **Figure 28.5** shows the maximum changes in riverbed thickness caused by deposition. It can be seen that much of the sediment falls to the bed within the dredged areas (from where it will be re-dredged to achieve the necessary bed depths), whilst the deposition that occurs in other

parts of the river is much lower, typically less than 5cm, within the same area of river that is affected by the zone of influence from the sediment plumes. As a result, a deterioration in ecological class status is not predicted.

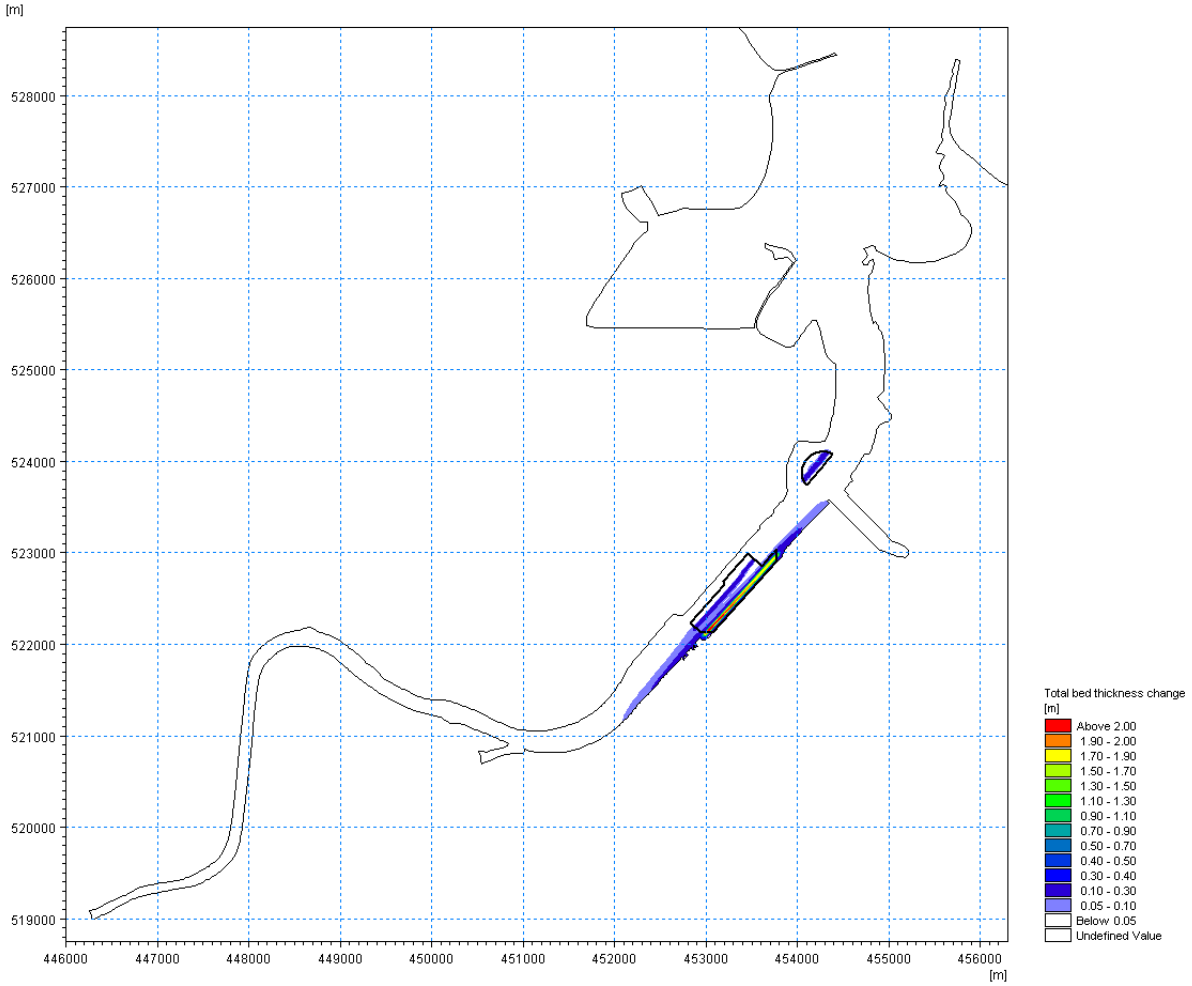

Figure 28.5 Maximum river bed thickness change due to sediment deposition arising from dredging activities during Stages 1 - 4 inclusive of the capital dredging programme

28.5.4 Biology – Fish

An increase in suspended sediment in the water column may lead to physiological effects in finfish, including impaired swimming ability, immunosuppression (i.e. increased susceptibility to disease) and reduced rates of growth and larval development (Robertson *et al*., 2006). Particles in the water column may also increase the risk of asphyxiation due to inhibition of gaseous exchanges at the gill lamellae or blockage of the opercular cavity. Water quality effects can also result in decreased foraging efficiency and a reduction in the ability to detect and evade predators.

As outlined in **Section 13**, estuarine fish and shellfish have a degree of resilience to relatively large changes in sediment concentrations due to the natural fluctuations associated with tidal activity, discharge from the river during high rainfall and increased wave action during storms. Sensitivity of lobsters and velvet swimming crabs, the species of highest commercial interest within the Tees Estuary (see **Section 13.4.2**) to increased suspended solids is low, according to the MarLIN sensitivity scoring index. Mobile species (including most adult finfish) are generally able to detect early onset of increased sediment concentrations and relocate away from the affected area. Some juveniles and larvae finfish, however, may be more

susceptible given their sensory systems may be less developed. Similarly, juvenile and larval shellfish are more sensitive than adults as they have more limited mobility and hence are less capable of avoiding affected areas (Appleby and Scarratt, 1989). However, given that maintenance dredging is regularly undertaken with the Tees (almost daily), it can be reasonably assumed that resident individuals within the affected area would likely be relatively tolerant / acclimatised to the disturbances associated with dredging activity.

Migratory species move upstream and downstream within the Tees (see **Section 13.4.1.2**) and during the peak migratory season, when a sediment plume creating a 'barrier' effect could cause a significant disruption to the annual migration pattern, such species are considered to be more sensitive than resident species. However, as outlined above, water quality effects are only anticipated to be temporary and limited to certain areas of the estuary at any one time. Additionally, it is proposed that dredging would be limited to one side of the river at a time with operations undertaken in long strips along the axis of the estuary to reduce the extent and impact of the plume. This allows a passage through which migratory fish will be able to move past the dredging activity (and for resident species to relocate to largely undisturbed areas), thus reducing the magnitude of the impact. As a result, a non-temporary deterioration in fish species which could lead to a deterioration in classification status is not predicted.

28.5.5 River Basin Management Plan mitigation measures

The RBMP mitigation measures identified for the water body in which the activity would occur and the potential effects of the proposed scheme on these measures are outlined in **Table 28.8**.

Table 28.8 Summary of mitigation measures and assessment (taken from Clearing the Waters for All, Environment Agency 2016)

Mitigation measure	Assessment
Vessel management	There would be a temporary presence of dredging vessels but following completion of the works baseline conditions would be resumed.
Dredging disposal strategy	Whilst there would be a temporary increase in material that would require disposal, this would be a one-off event and would not alter significantly the maintenance dredging and disposal activities currently ongoing. Disposal would be undertaken at a licenced disposal site in discussion with the MMO and their advisors Cefas. Dredging would be managed in line with mitigation measures agreed for various environmental topics which include dredging along the axis of the river to ensure the plumes are minimised as far as possible and only to certain areas of the channel at any one time.
Reduce impact of dredging	
Reduce sediment resuspension	
Retime dredging or disposal	
Sediment management	
Dredge and disposal site selection	
Manage disturbance	
Modify channel	Whilst the channel would be modified, there are currently derelict structures which would be removed and replaced by a new quay set back into the riverbank. As a result, the channel would be widened and not further restricted.
Enhance ecology	The assessment regarding the potential effects on ecology as a result of the capital dredge is provided in **Section 28.5.3**. There will be a small loss of intertidal habitat as a result of the berth which equates to 0.6% of this type of habitat within the WFD water body. To compensate for this, STDC is in the process of developing a South Tees Regeneration Masterplan Environment & Biodiversity Strategy, which will define the
Bank rehabilitation	
Remove or soften hard bank	

Mitigation measure	Assessment
Preserve or restore habitats.	works required to offset the loss of habitat arising as a result of works being proposed by STDC (including the proposed scheme which is the subject of this report). The extent and location of compensatory habitat creation and enhancements will be agreed with the Environment Agency.

28.5.6 Adjoining water bodies

The predicted impacts are localised to the Tees transitional WFD water body and therefore effects are not predicted to occur on adjoining water bodies.

28.6 Detailed Assessment – C3 Riverbank excavation

The potential effects of this activity that were scoped in at the end of Stage 2 are summarised in **Table 28.9.**

Table 28.9 Summary of water bodies, quality elements, RBMP mitigation measures and protected areas scoped in for assessment for C3

Water body	Quality elements	RBMP mitigation measures	Protected Areas
Tees transitional water body	Hydromorphology, water quality	All	Whilst the SPA is located within 2km, detailed assessment is covered in **Section 29**. The activity would not give rise to increases in nutrients within the estuary and therefore Seal Sands sensitive area (eutrophic) is scoped out.
Tees Mercia Mudstone and Redcar Mudstone Groundwater body	Chemical quality	N/A	None located within 2km of proposed scheme

28.6.1 Hydromorphology

The combined effects of the dredge area and presence of new quay wall set back in the embankment are presented in **Section 28.3.1**.

28.6.2 RBMP mitigation measures

The RBMP mitigation measures identified for the water body in which the activity would occur and the potential effects of the proposed scheme on these measures are outlined in **Table 28.10**.

Table 28.10 Summary of mitigation measures and assessment (taken from Clearing the Waters for All, Environment Agency 2016)

Mitigation measure	Assessment
Vessel management	There may be the requirement for marine vessels to support construction, but these would only be present for the duration of the works. Effects are therefore not predicted on this mitigation measure.
Dredging disposal strategy	

Mitigation measure	Assessment
Reduce impact of dredging	Riverbank excavation would not impact on these mitigation measures
Reduce sediment resuspension	
Retime dredging or disposal	
Sediment management	
Dredge and disposal site selection	
Manage disturbance	
Modify channel	See C5 and O1
Enhance ecology	See C5 and O1
Bank rehabilitation	
Remove or soften hard bank	
Preserve or restore habitats.	

28.6.3 Groundwater body – chemical quality

Section 8.4.5 highlights a number of potential sources of contamination with the soils in the study area. Land affected by contamination is primarily managed in the UK through the Town Country Planning Act, 1990 but also by Part 2A of the Environmental Protection Act, 1990 (EPA,1990). Part 2A of the Environmental Protection Act requires local authorities to identify contaminated land and ensure potential risks are assessed and mitigated accordingly.

Prior to the commencement of construction activities, a programme of site characterisation works will be undertaken which would comprise a programme of intrusive ground investigation works across the proposed scheme footprint (landside) to facilitate the recovery of soil and groundwater samples for laboratory analysis, and to facilitate the monitoring of groundwater and ground gases. The findings of the intrusive investigation will allow appropriate assessments to be undertaken to ascertain if contaminants are present at concentrations that could result in harm to human health and controlled waters.

Following the execution of a pre-construction ground investigation, it will be possible to determine whether contaminated groundwater and mobile contaminants are present within the footprint of the proposed scheme. If identified, remediation will be required to mitigate the impact it may have to either the proposed scheme or the neighbouring sites / controlled waters. Given the above control measures, non-temporary effects on the groundwater body are not predicted.

28.6.4 Adjoining water bodies

The effects are localised to the water bodies in which activities will occur and therefore effects are not predicted to occur on adjoining water bodies.

28.7 Detailed Assessment – C5 Construction of the quay wall and O1 presence of new quay wall

The potential effects of these two activities that were scoped in at the end of Stage 2 are summarised in **Table 28.11.**

Table 28.11 Summary of water bodies, quality elements, RBMP mitigation measures and protected areas scoped in for assessment for C5

Water body	Quality elements	RBMP mitigation measures	Protected Areas
Tees transitional water body	Hydromorphology	All	Whilst the SPA is located within 2km, detailed assessment is covered in **Section 29**. The activity would not give rise to increases in nutrients within the estuary and therefore Seal Sands sensitive area (eutrophic) is scoped out.
Tees Mercia Mudstone and Redcar Mudstone Groundwater body	Chemical quality	N/A	None located within 2km of proposed scheme

28.7.1 Hydromorphology

The combined effects of the dredge area and presence of new quay wall set back in the embankment are presented in **Section 28.3.1**.

28.7.2 RBMP mitigation measures

The RBMP mitigation measures identified for the water body in which the activity would occur and the potential effects of the proposed scheme on these measures are outlined in **Table 28.12**.

Table 28.12 Summary of RBMP mitigation measures and assessment

Mitigation measure	Assessment
Vessel management	It is proposed that all piling works will be undertaken using land-based plant, with a safety / workboat proposed to support any activities following the removal of material in front of the quay. As a result, an effect on this mitigation measure is not predicted.
Dredging disposal strategy	The construction and presence of the new quay wall would not affect these mitigation measures
Reduce impact of dredging	
Reduce sediment resuspension	
Retime dredging or disposal	
Sediment management	
Dredge and disposal site selection	
Manage disturbance	
Modify channel	Whilst the channel would be modified, there are currently derelict structures which would be removed and replaced by a new quay set back into the riverbank. As a result, the channel would not be further restricted.
Enhance ecology	The quay wall would be effectively constructed above mean high water on land and therefore would not impact on marine habitats. The effects on marine ecology are related to dredging of the berth and are assessed in S**ection 28.5.3** and **Table 28.7**. It is proposed that 'verti-pools' would be installed into the quay face; these pools are pocket rock pools that are designed to be applied to vertical sea defences to create water retentive habitat features. A number of verti-pools would be positioned along the length of the quay face at different heights within the tidal frame to provide a range of different habitat opportunities.
Bank rehabilitation	
Remove or soften hard bank	
Preserve or restore habitats.	

28.7.3 Groundwater body - Chemical quality

Piling has the potential to create preferential pathways allowing contaminant migration to the Secondary B Aquifer associated with the bedrock, particularly if they penetrate material that may have previously being acting as an impermeable protective barrier between the Made Ground / superficial deposits and the Mercia Mudstone Group. Piling also has the potential to physically drag down contaminants from the overlying Made Ground deposits as well as allowing for potentially contaminated perched / shallow groundwater to migrate to the underlying aquifers.

A pre-construction piling risk assessment and hydrogeological risk assessment would be undertaken prior to the commencement of the works to reduce the above risks as far as possible. As a result, a non-temporary effect on a water body scale is not predicted.

28.7.4 Adjoining water bodies

There is the possibility that any contamination identified in the soils could be mobilised and discharged into the Tees estuary transitional water body. The control measures outlined above would remove the risks associated with this pathway and therefore effects on the transitional water body are not predicted.

28.8 Summary of water body enhancement

It is proposed that 'verti-pools' would be installed into the quay face; these pools are pocket rock pools that are designed to be applied to vertical sea defences to create water retentive habitat features. It is proposed that a number of verti-pools are positioned along the length of the quay face at different heights within the tidal frame to provide a range of different habitat opportunities.

Additionally, the South Tees Regeneration Masterplan Environment & Biodiversity Strategy will define the works required to offset the loss of intertidal habitat arising as a result of the proposed scheme. The extent and location of compensatory habitat creation and enhancements will be agreed with Natural England, the Environment Agency and RCBC.

28.9 Ability of water body to achieve objectives

The objective for this waterbody is to achieve 'good' ecological potential. Whilst the provision of a new quay wall would remove a small area of intertidal soft sediment, the measures outlined in **Section 28.8** would assist the water body in meeting its future objectives by providing opportunities to support pocket rock pools within the quay wall face and compensatory intertidal habitat with the opportunity to support higher value ecological communities thus potentially improving classification status for these quality elements (delivered via to the South Tees Regeneration Masterplan Environment & Biodiversity Strategy).

28.10 Cumulative impacts assessment

28.10.1 Within-project cumulative effects

The within project cumulative effects have been identified as:

- Combined effect of the proposed new quay wall set back into the riverbank and presence of deepened areas associated with the capital dredge which could have effects on ecological habitats in the WFD water body via effects on hydromorphology.
- The combined effect of the loss of intertidal habitat (dredged berth), loss of subtidal (rock blanket) and temporary disturbance of subtidal habitat (capital dredge) on ecological potential of the WFD water body.

- The combined effect of piling and riverbank excavation on the groundwater body (potentially affecting groundwater chemical quality).
- The combined effect of dredging and effects associated with piling and riverbank excavation on water quality.

The combined hydromorphological effects of the scheme have already been assessed in **Section 28.5.1**. The effects associated with soil excavation and piling on groundwater will be managed via appropriate control measures required to be implemented for potentially contaminated soils i.e. site characterisation and remediation, in addition, to the undertaking of a piling risk assessment. As a result, the combined effect is assessed as being the same as the individual effects (i.e. no non-temporary effect on the WFD water bodies).

In terms of combined effects on water quality, as outlined above the landside works would be managed with appropriate control measures therefore the combined effect of the scheme on water quality remains the same as the effects predicted for the capital dredging alone.

For marine ecology, whilst it is noted that there will be a loss of intertidal habitat, this will be compensated via development of intertidal habitat elsewhere in the water body in line with the developing South Tees Regeneration Masterplan Environment & Biodiversity Strategy. The majority of the subtidal effects are predicted to be temporary and a significant portion of the dredge area is already subject to maintenance dredging so is already disturbed and supports communities habituated to this disturbance. The remaining effect is therefore limited to the subtidal area lost under the rock blanket which equates to 50,000m^2. This is below the trigger value included in the *Clearing the Waters for All guidance* to indicate the potential for a deterioration in soft subtidal habitats.

Within project cumulative effects are therefore not predicted over and above those assessed for the individual activities.

28.10.2 Between project cumulative effects

Section 27 identifies the following projects that could potentially lead to cumulative effects on the WFD transitional water body Tees:

- NGCT.
- Anglo American Harbour Facilities schemes.
- Ongoing maintenance dredging in the Tees estuary.

All schemes require dredging and construction of new riverbank structures and therefore the following risks to the water body have been identified:

Construction:

- Cumulative effects of sediment plumes and associated effects on water quality and fish
- Disturbance of marine habitats associated with dredging.

Operation

- Permanent loss of marine habitats (both intertidal and subtidal) associated with new riverbank structures and rock blanket.
- Permanent alterations to hydrodynamic parameters which could lead to effects on marine habitats.

Construction

Section 27 considers the potential cumulative effects of the proposed schemes on sediment plumes and marine water quality. To summarise, whilst the sediment plumes could combine to cover a larger area of the estuary, additive effects in terms of increasing sediment peaks are not predicted. This is because the maximum concentrations of suspended solids are localised to the dredging activity and quickly disperse with distance from the dredger. Additionally, peaks are relatively short lived (approximately an hour at a time for the proposed scheme for example) and associated with specific dredging phases of each scheme. The chances of these peaks occurring at the same time is considered to be remote.

With respect to water quality, given the above, it is not predicted that concentrations of contaminants in the water column would be significantly increased by the projects all dredging at the same time. Where contaminated material has been identified in the Anglo American Harbour Facilities sediments (i.e. above Cefas Action Level 2 concentrations), additional mitigation measures would be implemented to reduce the risk of this material being released into the water.

Any alterations to water quality both in terms of concentrations or spatial extent, could potentially reduce the areas in which resident fish could shelter or for migratory fish to move past the works. NGCT and the proposed project both include mitigation measures to dredge in long strips to reduce the effects of sediment plumes spreading across the width of the channel. Additionally, due to navigational safety, it is unlikely that dredgers would be working on different sides of the estuary and therefore clear channels would be maintained for fish movements.

Any project that requires dredging would disturb the marine communities within the sediments to be dredged. However, PDT undertake maintenance dredging in the majority of the estuary. Consequently, all projects report communities in the subtidal environment which are typically associated with regular disturbance. Given dredging for all projects would not alter the substrate type or exposure, subtidal communities would be expected to recover and therefore alterations in the benthic invertebrate classification index are not predicted given the existing maintenance dredging which would be accounted for in the baseline sample data.

In terms of wider effects, significant deposition of sediment again is generally only predicted in close proximity to the dredging over the slack water period for all projects. In practice, much of this deposited material will be re-dredged as part of the capital works for each scheme. Beyond the immediate deposition footprint, significant deposition was not predicted for any of the schemes (with deposition in the order of a few millimetres only). Furthermore, as the deposited material will be unconsolidated, it is expected to disperse as tidal currents increase with no long-term accumulation on the seabed at the initial point of deposition.

Operation

There would be small permanent loss of soft subtidal habitat under the rock blanket for the proposed scheme, however, the other projects do not identify any permanent losses of subtidal habitat. As a result, cumulative effects on this habitat type are not predicted.

In terms of intertidal habitat loss, it is acknowledged that the extent of intertidal habitat in the Tees has been significantly reduced as the banks of the estuary have been developed and the projects identified require removal of intertidal habitat areas differing in condition and size. Therefore, to address this, each project is progressing proposals and measures to offset these losses in discussion with Natural England, RCBC and the Environment Agency. With these measures in place, a cumulative effect is not predicted.

Alterations to the channel either via deepening or installation of new hard riverbank structures could combine to cumulatively impact on hydrodynamic processes in the water body. **Table 28.13** summaries the potential effects on each hydrodynamic parameter.

Table 28.13 Summary of cumulative effects on hydrodynamic parameters

Hydrodynamic parameter	Assessment
Tidal propagation	Calculations for the proposed scheme showed an increase in the existing tidal prism of the estuary by 0.8%, which is not deemed to be a cause of significant estuary-wide change in hydrodynamics. The NGCT is predicted to have a very small effect on water levels (tidal range in the Tees estuary is predicted to be increased by less than 4mm, with the tide arriving up to 2 minutes earlier). The EIA studies undertaken for the Anglo American Harbour Facilities predicted that there will be no impact on tidal propagation or water levels due to the limited area of proposed dredging for this project. Cumulative effects are therefore not predicted over and above those identified for the scheme alone.
Wave conditions	There is no predicted effect on local wind-generated waves at the site of the proposed scheme and swell waves do not penetrate far enough into the estuary to be affected. Wave modelling for the NGCT were predicted to be affected by the reflective properties of the terminal but unaffected by the increased depth of the channel. Swell waves would also be affected by the increased depth of the channel in the lower estuary required by NGCT. No effects were identified on waves for the Anglo American Harbour Facilities. Cumulative effects are therefore not predicted over and above those identified for NGCT.
Currents	Modelling for the proposed scheme showed that the new quay alignment and capital dredge would have very small localised effects predominantly near to the quay wall but these alterations would not be estuary wide. Modelling studies undertaken for the NGCT predict that current speed changes, of low magnitude, would occur in the vicinity of the NGCT development (1.5km downstream of the proposed scheme) and at the mouth of the estuary. A decrease in current speeds of up to 0.10m/s is predicted in the vicinity of the terminal, with increases of a similar order of magnitude closer to the shores of the estuary. This area (adjacent to the proposed reclamation) is predicted to experience the greatest effect on flows. Further downstream at the mouth of the estuary, very little effect on tidal current speeds is predicted (decreases in current speeds of the order of 0.05m/s). Modelling for Anglo American Harbour Facilities predicted that currents would be reduced within the deepened areas but effects are shown to be relatively localised to the proposed works. As a result, no cumulative effects over and above those identified for the proposed scheme are not predicted.
Sediment transport processes	Hydrodynamic modelling showed that the proposed scheme would give rise to only a small magnitude reduction in baseline flows varying during different phases of the tidal cycle, but always remaining largely within the reach immediately opposite the new quay. This reduction in baseline flows may lead to a slight increase in deposition of sediment at the North Tees mudflat which could be seen to be a positive effect in areas adjacent to the north bank opposite the quay. In the main channel, deposition will require periodic dredging equivalent to a 10% increase in annual maintenance dredging requirement. Hydrodynamic modelling for NGCT concluded that the effect of construction on tidal propagation will be minor, with no change in elevation of either high or low water downstream of the site of the proposed scheme. A minor increase in the level of low water of the order of 2mm (at low water on spring tides) was predicted at the site of the NGCT. The effect of this change would be to convert approximately 30 to 40m^2 of intertidal habitat at the North Tees mudflat to subtidal habitat. For the deepened approach channel, reduced through-depth flows were predicted which, combined with a strengthened near-bed landward flow, were expected to result in the increased import of fine material to the Tees estuary from offshore; with the potential to increase the maintenance dredging requirements by about 10%. No increase in sandy infill was predicted. A small morphological effect is predicted at Seal Sands, with an increase in the supply of fine material to Seal Sands via Seaton Channel. No changes to tidal flow were predicted in this area. No significant effects were predicted at North Gare and Bran Sands. Modelling for the Anglo American Harbour Facilities concluded that the only effects were likely to be localised redistribution of sediment deposition in response to predicted changes in current speeds but that this would not alter the present frequency of, or methodology used for, maintenance dredging. Additionally, no effect was identified on sediment supply to intertidal areas throughout the Tees estuary.

Hydrodynamic parameter	Assessment
	The ongoing maintenance dredging programme in the Tees estuary represents a potential supply of fine material to Seal Sands. However, the latest annual update to the Maintenance Dredging Baseline Document (Royal HaskoningDHV, 2019) concludes that the current maintenance dredging regime does not adversely affect the overall estuary morphology and the ongoing morphological processes at work. Additionally, maintenance dredging forms part of the baseline for WFD classification given that it is ongoing through WFD assessment periods. Cumulative effects with the other schemes, are therefore not predicted.

It can be seen in **Table 28.13** that whilst small effects are identified for the proposed scheme, these are localised and would not combine with the effects predicted as a result of the other schemes. As a result, cumulative effects on habitats of the WFD water body are not predicted.

Section 27 identifies that all landside schemes that could potentially impact on the Tees Mercia Mudstone and Redcar Mudstone Groundwater body by creation of pathways via excavation or piling for example, would require site characterisation and remediation/ mitigation (such as piling risk assessments to be undertaken) where the potential for an impact is identified. As a result, cumulative effects on the quality of the WFD water body are not predicted.

28.11 Overall findings

The comparison of the activities against the WFD scoping criteria identified the following risks to WFD compliance parameters:

- Surface waters: Hydromorphology (including the RBMP mitigation measures assessment)
- Surface waters: Water Quality
- Surface waters: Biology (habitats and fish)
- Groundwater: chemical quality

These parameters were therefore carried forward to Stage 3 detailed assessment. The activity 'capital dredging' identified risks to all WFD quality elements but detailed assessment deemed that the impacts would be temporary, and that the subtidal habitat would exhibit recovery. For the permanent loss of a small area of intertidal habitat (equating to 0.6% of this habitat type in the WFD water body) it is proposed to compensate for this loss via the developing South Tees Regeneration Masterplan Environment & Biodiversity Strategy. This will also support the implementation of the RBMP mitigation measures identified for this water body around enhancing ecology.

Whilst concentrations of contaminants in the sediments indicated a risk to water quality EQS', assessment concludes that conditions around the assumptions to undertake the assessment limit this possibility. Additionally, modelling concludes that any mixing zone, should an exceedance occur, would be limited to the locality of the dredger and only for hours at a time during Stage 2 of the proposed dredge programme. All other stages of dredging required for the proposed scheme did not indicate significant concentrations of suspended sediment thus reducing the risk of significant water quality effects. Mitigation measures to protect resident and migratory fish further reduce this risk as dredging will be limited to occurring in long strips thus limiting the plume extent. As a result, non- temporary effects on water quality and associated parameters that rely on water quality, such as fish, are not predicted.

Effects associated with construction of the proposed new quay are due to the need for excavation and piling in potentially contaminated soils. Effective mitigation measures to ensure contamination is managed and remediated appropriately remove the risk to both the groundwater and the transitional water body.

The assessment to look at the potential for hydromorphological effects was undertaken for the whole scheme (i.e. included both the deepened areas of channel and the new quay set back in the riverbank). Effects were limited to the local area of the quay wall and would not lead to significant alterations to baseline conditions in the estuary. Both removal of derelict structures during the construction phase and discharge of surface water during the operational phase of the development were scoped out of requiring detailed assessment.

Consideration of the potential for cumulative effects identified a number of possibilities 'within project' but it was concluded that combined effects of various activities would not be greater than those identified for the proposed activities alone.

Three projects were identified as being potentially at risk of leading to cumulative effects 'between projects'. These were NGCT, Anglo American Harbour Facilities and ongoing maintenance dredging in the estuary. Whilst each project is predicted to give rise to various effects, the only impact that could potentially overlap would be sediment plumes associated with dredging simultaneously. However, on further consideration, peak concentrations for all projects are restricted to close proximity to the dredger and disperse with distance. Additionally, peak concentrations are short lived (hours) therefore it is unlikely that peaks from all projects would occur at the same time. Mitigation measures such as dredging in long strips as required for the proposed project and NGCT to keep areas of the channel unaffected would also reduce any effects on biological parameters, particularly fish.

A non-temporary deterioration in WFD quality elements was therefore not identified. Additionally, mitigation to be provided by the developing South Tees Regeneration Masterplan Environment & Biodiversity Strategy is considered to be supportive of the implementation of the RBMP mitigation measures around ecological enhancement and contributing to achievement of good ecological potential of the transitional water body in the future.