Net Zero Teesside Project

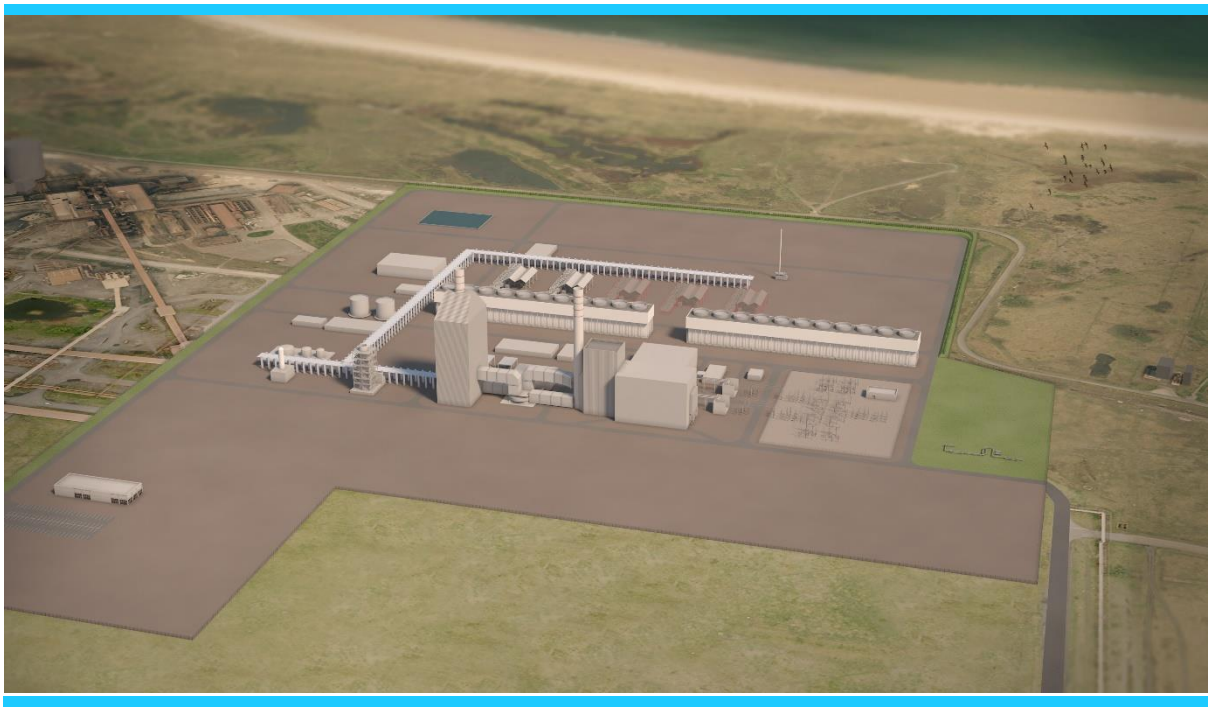
Planning Inspectorate Reference: EN010103

Land at and in the vicinity of the former Redcar Steel Works site, Redcar and in Stockton-on-Tees, Teesside

The Net Zero Teesside Order

Document Reference: 9.36 – Nutrient Nitrogen Briefing Paper

Planning Act 2008



Applicants: Net Zero Teesside Power Limited (NZT Power Ltd) & Net Zero North Sea Storage Limited (NZNS Storage Ltd)

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GLOSSARY

Abbreviation	Description
BEIS	The Department for Business, Energy and Industrial Strategy
CCGT	Combined Cycle Gas Turbine
CCUS	Carbon Capture, Utilisation and Storage
CO_2	Carbon dioxide
DCC	Direct Contact Cooler
DCO	Development Consent Order
dDCO	Draft DCO
DIN	Dissolved inorganic nitrogen
EA	Environment Agency
ECJ	European Court of Justice
EEC	European Economic Community
ES	Environmental Statement
ExA	Examining Authority
EQS	Environmental Quality Standard
FEED	Front End Engineering Design
HP	High Pressure
HRA	Habitats Regulations Assessment
HRSG	Heat Recovery Steam Generator
JNCC	Joint Nature Conservation Committee
km	Kilometres
NE	Natural England
NWL	Northumbrian Water Ltd.
NZT	The Net Zero Teesside Project
NZT Power	Net Zero Teesside Power Limited
NZNS Storage	Net Zero North Sea Storage Limited
PA 2008	Planning Act 2008
PCC	Power Capture and Compressor Site

Abbreviation	Description
PINS	Planning Inspectorate
SoS	Secretary of State
SPA	Special Protection Area
STDC	South Tees Development Corporation
WFD	Water Framework Directive
WwTW	Wastewater Treatment Works

CONTENTS

1.0 INTRODUCTION

1.1 Overview

1.1.1 This briefing paper has been prepared on behalf of Net Zero Teesside Power Limited and Net Zero North Sea Storage Limited (the 'Applicants'). It relates to the application (the 'Application') for a Development Consent Order (a 'DCO'), that has been submitted to the Secretary of State (the 'SoS') for Business, Energy and Industrial Strategy ('BEIS'), under Section 37 of 'The Planning Act 2008' (the 'PA 2008') for the Net Zero Teesside Project (the 'Proposed Development').

1.1.2 The Application was submitted to the SoS on 19 July 2021 and was accepted for Examination on 16 August 2021. ~~-~~Change requests made by the Applicants in respect of the Application were accepted into the Examination by the Examining Authority on 6 May 2022 and 6 September 2022.~~A change request made by the Applicants in respect of the Application was accepted into the Examination by the Examining Authority (the 'ExA') on 6 May 2022. A further change request was submitted to the ExA at Deadline 6 on 23 August 2022.~~

1.2 Description of the Proposed Development

1.2.1 The Proposed Development will work by capturing CO_2 from a new the gas-fired power station in addition to a cluster of local industries on Teesside and transporting it via a CO_2 transport pipeline to the Endurance saline aquifer under the North Sea. The Proposed Development will initially capture and transport up to 4Mt of CO_2 per annum, although the CO_2 transport pipeline has the capacity to accommodate up to 10Mt of CO_2 per annum thereby allowing for future expansion.

1.2.2 The Proposed Development comprises the following elements:

- **Work Number ('Work No.') 1** – a Combined Cycle Gas Turbine electricity generating station with an electrical output of up to 860 megawatts and post-combustion carbon capture plant (the **'Low Carbon Electricity Generating Station'**);
- **Work No. 2** – a natural gas supply connection and Above Ground Installations ('AGIs') (the **'Gas Connection Corridor'**);
- **Work No. 3** – an electricity grid connection (the **'Electrical Connection'**);
- **Work No. 4** – water supply connections (the **'Water Supply Connection Corridor'**);
- **Work No. 5** – waste water disposal connections (the **'Water Discharge Connection Corridor'**);
- **Work No. 6** – a CO_2 gathering network (including connections under the tidal River Tees) to collect and transport the captured CO_2 from industrial emitters (the industrial emitters using the gathering network will be responsible for consenting their own carbon capture plant and connections to the gathering network) (the **'CO_2 Gathering Network Corridor'**);

- **Work No. 7** – a high-pressure CO_2 compressor station to receive and compress the captured CO_2 from the Low Carbon Electricity Generating Station and the CO_2 Gathering Network before it is transported offshore (the **'HP Compressor Station'**);
- **Work No. 8** – a dense phase CO_2 export pipeline for the onward transport of the captured and compressed CO_2 to the Endurance saline aquifer under the North Sea (the **'CO_2 Export Pipeline'**);
- **Work No. 9** – temporary construction and laydown areas, including contractor compounds, construction staff welfare and vehicle parking for use during the construction phase of the Proposed Development (the **'Laydown Areas'**); and
- **Work No. 10** – access and highway improvement works (the **'Access and Highway Works'**).

1.2.3 The electricity generating station, its post-combustion carbon capture plant and the CO_2 compressor station will be located on part of the South Tees Development Corporation (STDC) Teesworks area (on part of the former Redcar Steel Works Site). The CO_2 export pipeline will also start in this location before heading offshore. The generating station connections and the CO_2 gathering network will require corridors of land within the administrative areas of both Redcar and Cleveland and Stockton-on-Tees Borough Councils, including crossings beneath the River Tees.

1.3 The Purpose and Structure of this document

~~1.3.1 The purpose of this document is to explain the sources of effluent containing nitrogen to be discharged from the Proposed Development and set out the work done to date and the proposed approach to the continued assessment of the potential effects of these discharges on the Teesmouth and Cleveland Coast SPA/Ramsar site.~~

~~1.3.2 Computer modelling of the dispersion and dilution of nitrogen in effluent discharges from the Proposed Development is being undertaken. This modelling will be used to inform an assessment of the effects of nitrogen discharges on the qualifying features of the Teesmouth and Cleveland Coast SPA/Ramsar site. This assessment will set out the impacts of the nitrogen discharges and conclude whether or not the nitrogen discharges will have a likely significant effect on the habitats site. The results of this assessment will be documented in an updated Habitats Regulations Assessment (HRA) to be submitted at Deadline 9.~~

~~1.3.3 An assessment of the impact of nitrogen discharges on the Water Framework Directive status of the Tees Coastal Waterbody is also being conducted and will be reported in parallel at Deadline 9.~~

1.3.1 ~~The document is structured as follows:~~The purpose of this document is to explain the sources of effluent containing nitrogen to be discharged from the Proposed Development and the proposed approach to the continued assessment of the potential effects of these discharges on the Teesmouth and Cleveland Coast SPA/Ramsar site.

1.3.2 Computer modelling of the dispersion and dilution of nitrogen in effluent discharges from the Proposed Development has been undertaken. This modelling has been used to inform an assessment of the effects of nitrogen discharges on the qualifying features of the Teesmouth and Cleveland Coast SPA/Ramsar site. This assessment concludes that the Proposed Development will not give rise to nitrogen discharges that will have a likely significant effect on the Teesmouth and Cleveland Coast SPA/Ramsar.

~~1.3.4~~1.3.3 This document is structured as follows:

- Section 2 sets out the legislative background to the assessment of nutrient impact on habitat sites;
- Section 3 identifies potential sources of nitrogen in effluent arising from the NZT project;
- Section 4 summarises the engagement to date with Natural England and the Environment Agency in relation to nitrogen discharges;
- Section ~~6~~5 sets out the qualifying features of the Teesmouth and Cleveland Coast Special Protection Area (SPA) and Ramsar site ~~and the approach to the nutrient neutrality assessment~~;
- ~~Section 5 sets out the approach to the nutrient neutrality assessment;~~
- Section ~~5~~6 summarises the scope of the discharge modelling ~~being~~ undertaken;
- ~~Section 6 sets out the qualifying features of the Teesmouth and Cleveland Coast Special Protection Area (SPA) and Ramsar site and the approach to the nutrient neutrality assessment;~~
- Section 7 identifies the potential impacts that could affect the qualifying features of the SPA/Ramsar;
- Section 8 sets out the position on nutrient neutrality;
- Section 9~~8~~ identifies the potential implications for Water Framework Directive compliance of nitrogen inputs to the Tees Coastal Waterbody; and
- Section 10~~9~~ provides an action plan and identifies the next steps ~~in the assessment of nitrogen discharges~~to be taken.

~~1.3.5~~ In addition to this document, the Habitats Regulations Assessment (Document Ref. 5.13) [REP8-009] and the Water Framework Directive Assessment (Appendix 9C to the ES) [APP-254] will also be updated to incorporate the results of the assessment and resubmitted.

2.0 LEGISLATIVE BACKGROUND TO NUTRIENT IMPACTS ON HABITAT SITES

2.1.1 On 16 March 2022, Natural England published advice to Competent Authorities under the Habitats Regulations~~-~~ to advise that Competent Authorities must carefully consider the nutrient impacts of any new plans and projects on habitats sites and whether those impacts may have an adverse effect on the integrity of a habitats site that requires mitigation, including through 'nutrient neutrality'.

2.1.2 In many designated estuarine and freshwater habitats sites, poor water quality due to nutrient enrichment is one of the main reasons for sites being in an unfavourable condition. Excessive levels of nutrients can cause the rapid growth of certain plants through the process of eutrophication. This in turn can lead to reduced biodiversity, and the condition of a site being considered 'unfavourable'.

2.1.3 Nutrient neutrality has become an issue in many areas of the country, such as the Solent, Somerset Levels, the Wye catchment in Herefordshire, Derbyshire, Yorkshire and the North East of England. It stems from the ruling of the European Court of Justice (ECJ) in combined cases C-293/17 and C-294/17 (the Dutch Nitrogen case). ~~That judgment refined the definition of plans and projects to include operations such as agriculture, confirming that agricultural inputs of nutrients (either from atmosphere or runoff) need to be covered in the 'in combination' requirements of the HRA process. This is significant because the traditional assessment process as applied for example by the Environment Agency distinctly separated treated wastewater from agricultural discharges, largely because the latter is effectively unconsented and outside the remit of the Environment Agency. In addition, t~~This ruling reaffirmed that if a European protected nature conservation site is in a deteriorating condition (such as due to excess nutrient levels that may also be forecast to increase) there are very limited circumstances under which further discharges of nutrients to a site can be permitted.

2.1.4 In this case the relevant Competent Authority is the Secretary of State and the relevant habitats site is the Teesmouth and Cleveland Coast SPA/Ramsar site. Excess baseline nitrogen from a range of diffuse and point sources is already contributing to aspects of this site being in unfavourable condition around the Seal Sands mud flats in particular.

2.1.5 Phosphorus (as phosphate) has ~~been~~ not been identified as a concern for the Teesmouth and Cleveland Coast SPA/Ramsar site and does not require consideration.

2.1.6 As a result, in the absence of any empirically derived threshold by which additional aquatic inputs of nitrogen can be deemed de minimis, the implication of Natural England's nutrient neutrality guidance is that any new development within the Teesmouth and Cleveland Coast SPA/Ramsar catchment that increases nutrients could have potential impacts on features of that SPA/Ramsar and could interfere with the ability of the site to achieve its conservation objectives and thus adversely affect the integrity of the European protected nature conservation site.

3.0 POTENTIAL SOURCES OF NITROGEN IN EFFLUENT

3.1 Overview

3.1.1 The Proposed Development will produce the following sources of effluent containing nitrogen:

- Cooling Water Return;
- Direct Contact Cooler (DCC) Blowdown;
- Heat Recovery Steam Generator (HRSG) Blowdown; and
- Foul waste (excluded hereafter as this will be sent to the Marske-by-the Sea WwTW which discharges out with the Ramsar/SPA boundary).

3.1.2 The assessment of nutrient nitrogen impacts in this briefing paper is based on the assessment of total nitrogen inputs to the water environment. The effluent produced by the NZT development will contain Dissolved Inorganic Nitrogen (DIN) in the form of ammonia in the effluent. There will be no Dissolved Organic Nitrogen (DON) or particulate Nitrogen in the effluent produced by NZT. ~~and nitrate following treatment at Bran Sands.~~ Returned effluent from Bran Sands will include an equivalent nitrogen load to that sent for treatment – which will largely be in the form of DIN, but may also include dissolved organic nitrogen or particulate nitrogen (which would otherwise have been discharged to the Estuary). Data was available for DIN at this stage and as such the modelling is based on the volume of water containing an equivalent nitrogen load in the form of DIN (see calculation ~~given~~ in ~~XXX~~Appendix B). If further data reveals that the Bran Sands effluent contains DON and/or particulate nitrogen, a lower volume of returned effluent would be required to achieve equivalency, however, the total nitrogen load returned from Bran Sands would remain consistent.

3.2 Cooling Water

3.2.1 The potential source of the water used for cooling is raw, untreated, River Tees water provided by Northumbrian Water Ltd (NWL) from three possible abstraction points – Low Worsall, Blackwell and Broken Scar. River water quality monitoring data have been provided by NWL for Broken Scar and a summary dataset of key substances has been provided for Low Worsall and Blackwell. Dissolved Inorganic Nitrogen (DIN) concentrations in the raw water have been calculated by converting nitrate, nitrite and ammonia ~~-~~concentrations recorded for each sample.

3.2.2 Discussions with NWL have confirmed that although the Low Worsall abstraction point is currently out of use, it is expected to return to use as local water requirements increase, for example in response to development of the PCC site. It is also the closest abstraction point to the PCC site. It is therefore assumed that the development will receive the majority of its water supply from Low Worsall and this is used in the assessments.

3.2.3 Based on the use of the raw water in the ~~DCC~~cooling system, nitrogen in the abstracted water will ~~then~~ be ~~further~~ concentrated by up to five times, as the ~~DCC~~

cooling system will evaporate a proportion of the water to atmosphere leaving nitrogen in the blowdown that will periodically be purged from the system.

3.2.4 It ~~is worth noting~~ should be noted that the Proposed Development will not introduce any new nitrogen into the water environment through this effluent stream. The nitrogen is already present in the raw water feed being abstracted from the River Tees. It will simply be abstracted from the Ri~~i~~iver Tees (by NWL), used on ~~passed through~~ the S~~s~~ite and directed ~~returned back~~ into Tees Bay, albeit in a more concentrated form. ~~-~~This ~~, with the~~ abstraction ~~and discharge~~ effectively reduces~~ing~~ the quantity of nitrogen passing through ~~entering~~ the Tees Estuary by 14 kgN/h, by discharging it to Tees Bay. This concentrated discharge to Tees Bay ~~will be~~ has been assessed in the modelling outlined in Section ~~4~~6.0 below.

3.3 DCC Blowdown

3.3.1 Blowdown from the Direct Contact Cooler (DCC) will contain ammonia which will require treatment either on-site or off-site to convert the ammonia to nitrate. The DCC Blowdown Water will make up the majority of the nitrogen containing effluent produced by the PCC site. This is estimated to contain up to 24.7 kgN/hr.

3.4 HRSG Blowdown

3.4.1 A small additional flow of Condensed Water arising from blowdown from the HRSG is expected to be discharged directly into Tees Bay without treatment. This water is expected to contain only one contaminant, ammonia, at concentrations of 5 mg/l equating to 0.015 kgN/hr. The HRSG Blowdown discharge will be diluted with surface water runoff.

3.5 Effluent Handling Options with the draft DCO

3.5.1 There are a number of options to handle the effluent containing nitrogen, namely:

- Direct discharge to the water environment;
- On-site treatment followed by discharge to the water environment;
- Off-site treatment (at Northumbrian Water Ltd.'s Bran Sands Waste Water Treatment Works (WwTW)) followed by discharge to the Dabholm Gut (Tees Estuary) (i.e. the current Base Case as listed in paragraph 3.6.1); or
- Off-site treatment (at Bran Sands WwTW) followed by return to Site for discharge to the sea (Tees Bay) via an outfall (i.e. the current Option A as listed in paragraph 3.6.1).

3.5.2 The dDCO makes provision for all of the above options (including through parts of Work No. 1 (wastewater treatment plant and building, and effluent ponds) and Work No. 5 (wastewater disposal works including pipelines to Bran Sands WwTW and into the Tees Bay), and at this stage no final decisions have been made on how to handle the effluent containing nitrogen.

3.6 Discharge Scenarios

3.6.1 Direct discharge to the water environment without treatment is not considered in this paper. The alternative of using on-site treatment would be designed to not cause likely significant effects on the SPA/Ramsar and is also not assessed. The following discharge scenarios are therefore considered in this paper:

- The pre-development baseline;
- The current Base Case approach to effluent management from the Proposed Development whereby effluent is treated at Bran Sands WwTW and discharged to Dabholm Gut through NWL's consented discharge point;
- Option A, whereby effluent is treated at Bran Sands WwTW and an effluent return line directs treated effluent to the outfall at the PCC Site for discharge into Tees Bay.

3.6.2 These are discussed in turn below.

Pre-Development Baseline

3.6.3 The pre-development baseline case is illustrated schematically in Figure 3.1. This shows that municipal and industrial effluent is treated at Bran Sands WwTW in three trains:

- Train A (industrial effluent);
- Train B (municipal waste); and
- Train C (municipal waste and industrial effluent from North Tees)

3.6.4 Train A is consented under its own Environmental Permit. Trains B and C are consented under a separate Permit.

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~~Base Case~~

~~3.6.4 The Base Case is illustrated schematically in Figure 3.2. This illustrates the inflows to the PCC site as being:~~

- ~~Raw Water from the River Tees; and~~
- ~~Ammonia delivered for NOx removal.~~

~~3.6.5 Outflows from the PCC Site to the Dabholm Gut (Tees Estuary) are shown as:~~

- ~~DCC Blowdown containing ammonia is exported to Bran Sands WwTW by pipeline for treatment in Trains B or C. This is treated to convert the ammonia to nitrate and the treated comingled effluent is discharged to the Dabholm Gut (Tees Estuary).~~

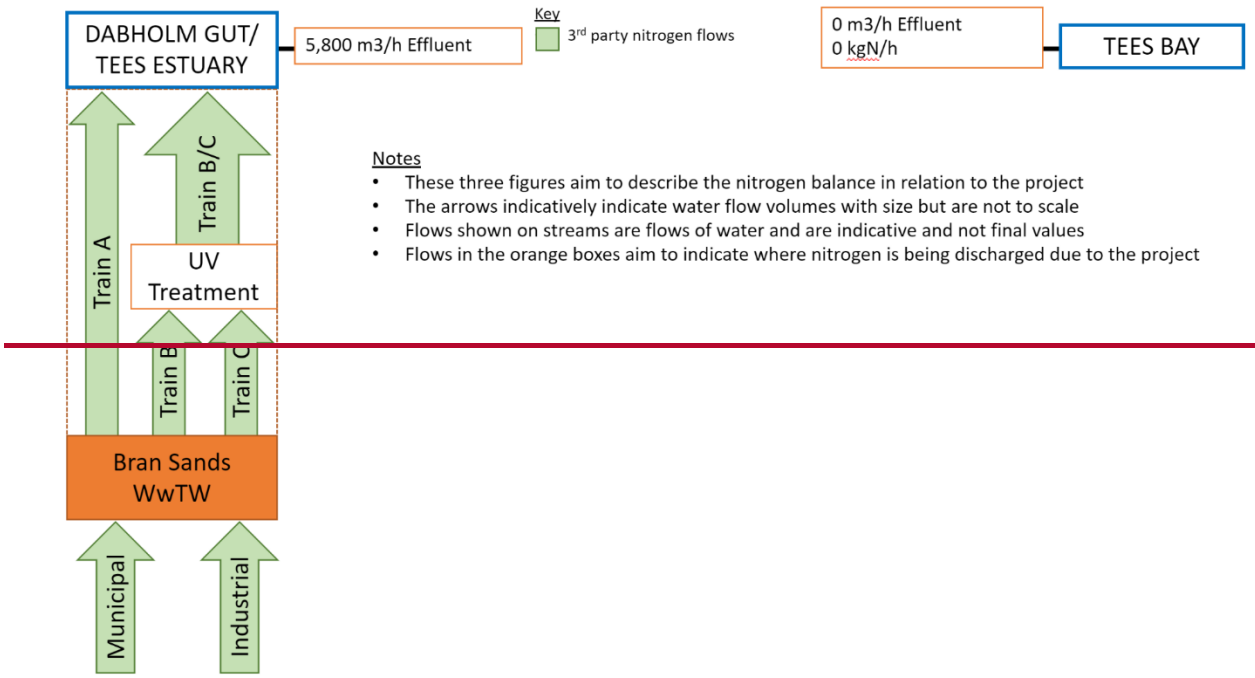
~~3.6.6 Outflows from the PCC Site directly to the Tees Bay are shown as being:~~

- ~~Cooling Water Blowdown (i.e. concentrated Raw Water) plus raw water filtration backwash (unconcentrated) both containing nitrate;~~
- ~~HRSG Blowdown containing ammonia; and~~
- ~~Surface water run-off (clean).~~

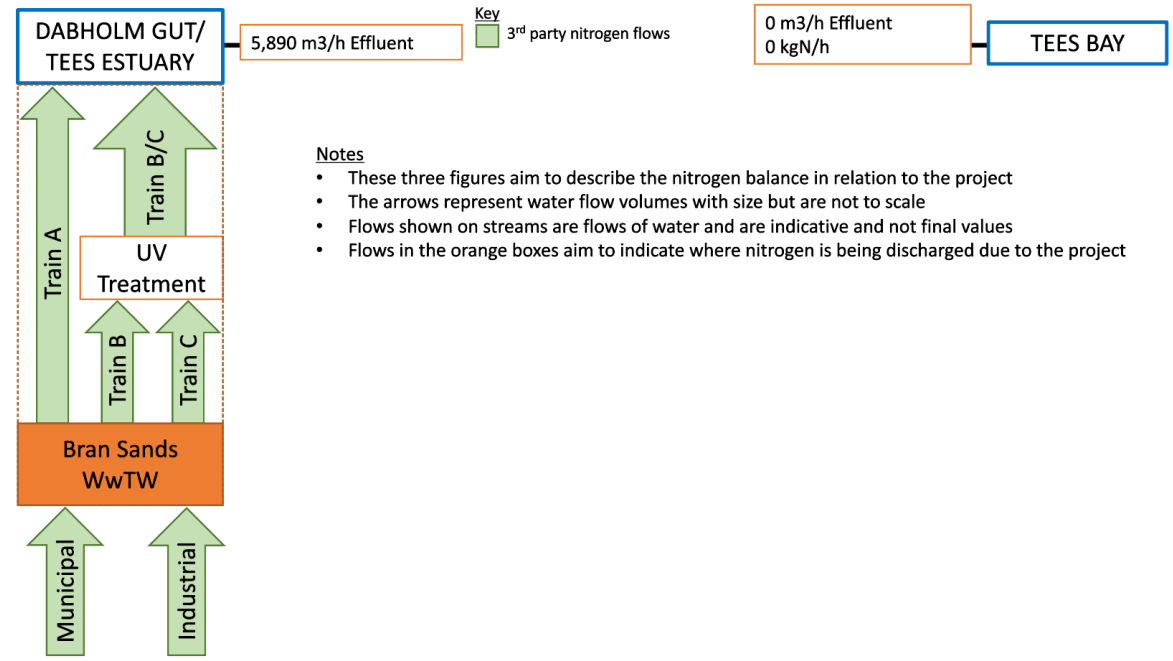
~~Option A~~

~~3.6.7 Option A is illustrated schematically in Figure 3.3. This illustrates the inflows and outflows to the PCC site as being the same as for the Base Case with the exception that a volume of treated Train B/C effluent from Bran Sands WwTW containing an equivalent quantity of nitrogen (in kgN/h) to the DCC Blowdown would be returned to the PCC site for discharge to Tees Bay via the existing or replacement outfalls.~~

~~F~~igure 3.1 Pre-Development Discharges to Dabholm Gut/Tees Estuary



Pre-Development



Base Case

3.6.5 The Base Case is illustrated schematically in Figure 3.2. This illustrates the inflows to the PCC site as being:

- Raw Water from the River Tees; and
- Ammonia delivered for NOx removal.

3.6.6 Outflows from the PCC Site to the Dabholm Gut (Tees Estuary) are shown as:

- DCC Blowdown containing ammonia is exported to Bran Sands WwTW by pipeline for treatment in Trains B or C. This is treated to convert the ammonia to nitrate and the treated comingled effluent is discharged to the Dabholm Gut (Tees Estuary).

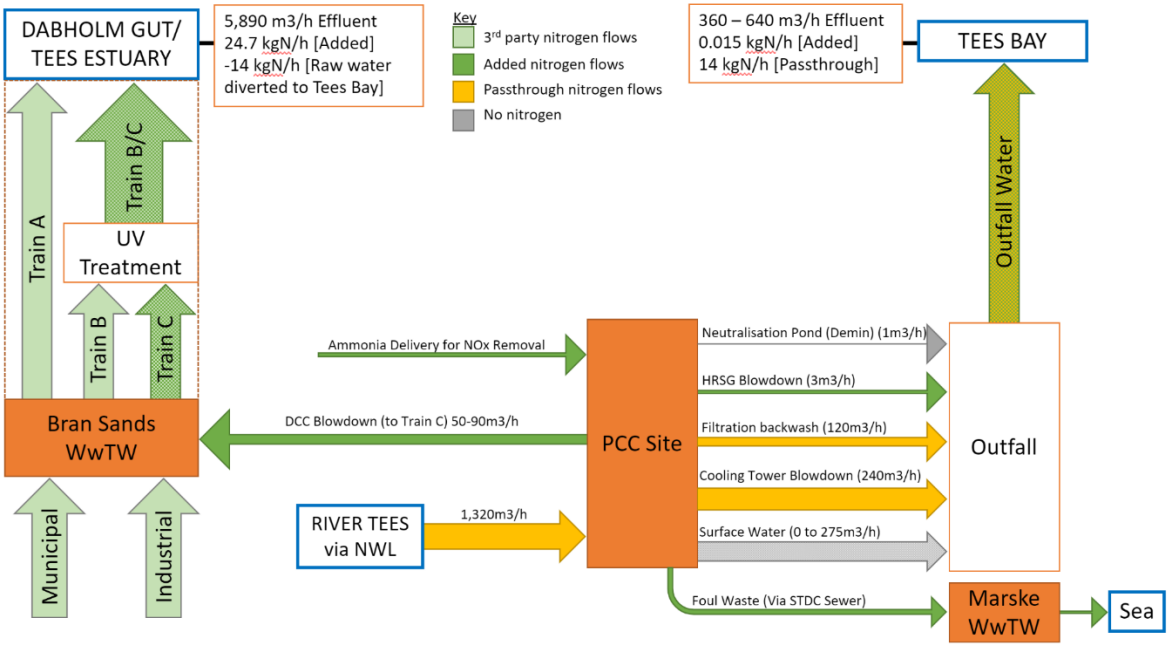
3.6.7 Outflows from the PCC Site directly to the Tees Bay are shown as being:

- Cooling Water Blowdown (i.e. concentrated Raw Water) plus raw water filtration backwash (unconcentrated) both containing nitrate;
- HRSG Blowdown containing ammonia; and
- Surface water run-off (clean).

~~Option A~~

~~Option A is illustrated schematically in Figure 3.3. This illustrates the inflows and outflows to the PCC site as being the same as for the Base Case with the exception that a volume of treated Train B/C effluent from Bran Sands WwTW containing an equivalent quantity of nitrogen (in kgN/h) to the DCC Blowdown would be returned to the PCC site for discharge to Tees Bay via the existing or replacement outfalls.~~

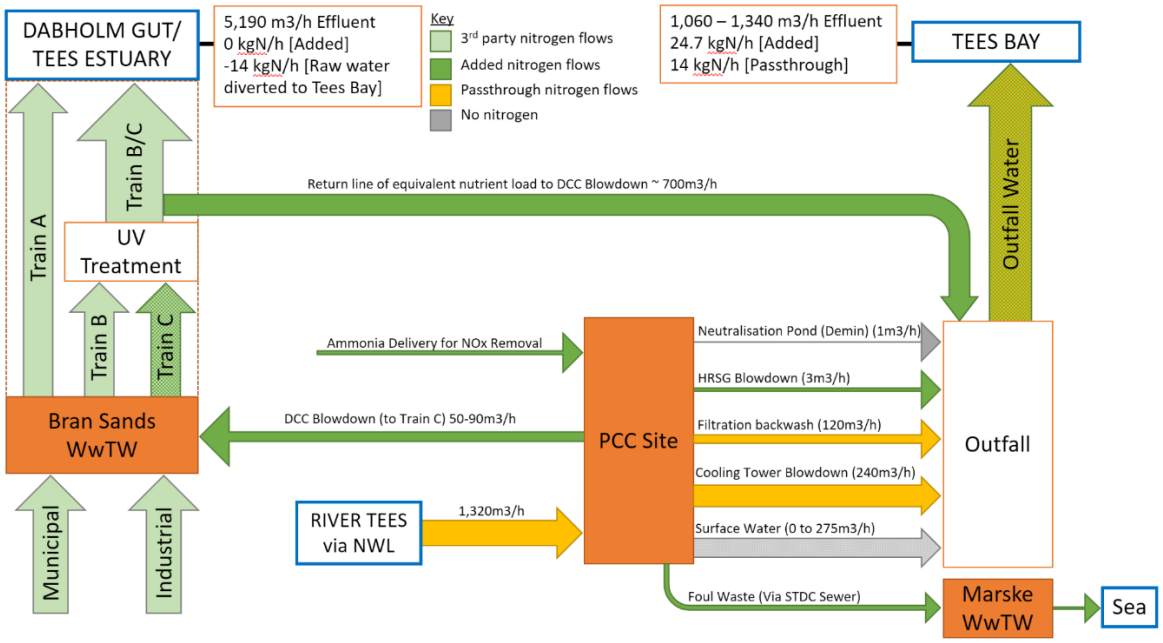
Figure 3.2: Base Case – Discharges to Dabholm Gut/Tees Estuary and Tees Bay



Option A

3.6.8 Option A is illustrated schematically in Figure 3.3. This illustrates the inflows and outflows to the PCC site as being the same as for the Base Case with the exception that a volume of treated Train B/C effluent from Bran Sands WwTW containing an equivalent quantity of nitrogen (in kgN/h) to the DCC Blowdown would be returned to the PCC site for discharge to Tees Bay via the existing or replacement outfalls.

Figure 3.3: Option A – Discharges to Dabholm Gut/Tees Estuary and Tees Bay



4.0 ENGAGEMENT

4.1.1 As requested in Natural England's Relevant Representation [RR-026], the Applicants agreed to assess the impacts of the discharge of effluent containing nitrogen into the Tees Estuary.

4.1.2 Preliminary modelling was undertaken by the Applicants in June 2022. The results of the modelling were discussed with the EA and NE at meetings on 7th July 2022 and 13th July 2022 respectively, and the draft modelling report was shared with the NE and EA on 29th July 2022. Detailed comments on the preliminary modelling were received from the NE on 19th August 2022 and the EA on 22nd August 2022. The draft modelling report was submitted into Examination as Appendix A to Version 1.0 of the Nutrient Nitrogen Briefing Paper [REP8-050].

4.1.3 Further discussions have been held with Northumbrian Water Ltd. to obtain more accurate effluent concentrations for use in the model. This data was received in the week ending 12th August and is used for the modelling reported in Appendix B~~modelling using this data is currently ongoing~~. The approach to modelling is explained in section ~~5~~6.0 below.

4.1.4 A meeting was held with NE on 15th September to discuss the discharge of treated effluent containing nitrogen from the PCC site, amongst other issues. In that meeting NE confirmed that the features of the habitat currently in unfavourable condition are the mudflats in the vicinity of Seal Sands within the Tees Estuary. Several of the qualifying features of the SPA/Ramsar rely on those habitats and their wading and feeding grounds are being impacted by the growth of algal mats[1]. It was confirmed by Natural England that the focus of their concern is on nutrients reaching those habitat features. It was explained~~outlined~~ that modelling of nutrient discharges from the Proposed Development was being updated, and the modelling and the potential for likely significant effects on the habitats site and specifically those features would be discussed with Natural England prior to submission at Deadline 9.

~~4.1.4~~ A further meeting was held with NE on 30th September to discuss the updated discharge modelling and subsequent nutrient nitrogen assessment. ~~E~~

4.1.5 A meeting will also be held with the EA ~~prior to Deadline 9~~ in early October 2022 to discuss the modelling and the outcome of the assessment into the effect on the Water Framework Directive status of the Tees Coastal Water Body.

[1] Site Improvement Plan Teesmouth & Cleveland Coast, Natural England, 2014.

~~5.0 DISCHARGE MODELLING~~

~~5.1.1 Modelling of discharges to Tees Bay will assess potential impacts on the qualifying features of the Teesmouth and Cleveland Coast SPA/Ramsar and the potential for effluent to disperse into the Tees Estuary e.g. by tidal effects. The modelling scenarios are summarised in Table 5.1 below:~~

~~5.1.2 The impacts on the Tees Estuary will be assessed on the basis of identifying whether there is a net increase or decrease in nitrogen discharged to the Dabholm Gut/Tees Estuary or if the discharge modelling identifies the potential for effluent return from discharged into the Tees Bay via the outfall to disperse back into the estuary due to tidal effects.~~

~~(Work No. 5B), previously undertaken.~~

~~Discharge modelling for the existing outfall (Work No. 5A) has not yet been completed. There are outstanding technical and commercial matters with us of the existing outfall and therefore the Applicants modelling has focused on the replacement outfall. The Applicants note that should the existing outfall be selected that additional discharge modelling will be required. for Option Ain some locations although these are local to the discharge location;;However, any such dispersion of DIN from the outfall discharge back into the estuary is offset by the reduction in DIN in the Tees estuary as a result of the water abstracted for use on the PCC Site. This is discussed further in Section XXX.~~

Table 5.1: Summary of Modelling Scenarios

Scenario			Discha	
			Cooling Water (concentrated raw water)	Returne fro
Base Case	Direct Contact Cooler (DCC) blowdown treated at Bran Sands and discharged to Dabholm Gut.	Modelled and reported on in Preliminary Discharge Modelling Report (see Appendix A)	X	
Option A	Direct Contact Cooler (DCC) blowdown treated at Bran Sands. Returned effluent to PCC discharged to Tees Bay.	Modelling of Option A ongoing and will be reported at Deadline 9	X	

~~6.0~~5.0 THE TEESMOUTH AND CLEVELAND COAST SPECIAL PROTECTION AREA AND RAMSAR

~~6.1~~ Introduction

~~6.1.1~~5.1.1 The Teesmouth and Cleveland Coast SPA / Ramsar[2] is a 12,211 ha estuarine and coastal site located on the north-eastern coast of England as shown in the image below extracted from ES Figure 15-3 Statutory [ecological] Designated Sites REP6-082. It comprises a range of coastal habitats, such as sand and mudflats, rocky shore, saltmarsh, freshwater marsh and sand dunes. The SPA / Ramsar lies along a stretch of coast that has been significantly modified by human activity. The site provides feeding and roosting opportunities for a significant number of waterfowl in winter and the passage period.

~~6.1.2~~5.1.2 The site qualifies as a SPA under Article 4.1 of the Birds Directive (79/409/EEC) by supporting populations of the following features, as per the conservation objectives for the SPA updated in May 2020:

- *Recurvirostra avosetta*; Pied avocet (Breeding);
- *Calidris canutus*; Red knot (Non-breeding);
- *Calidris pugnax*; Ruff (Non-breeding);
- *Tringa totanus*; Common redshank (Non-breeding);
- *Sterna sandvicensis*; Sandwich tern (Non-breeding);
- *Sterna hirundo*; Common tern (Breeding);
- *Sterna albifrons*; Little tern (Breeding); and
- Waterbird assemblage.

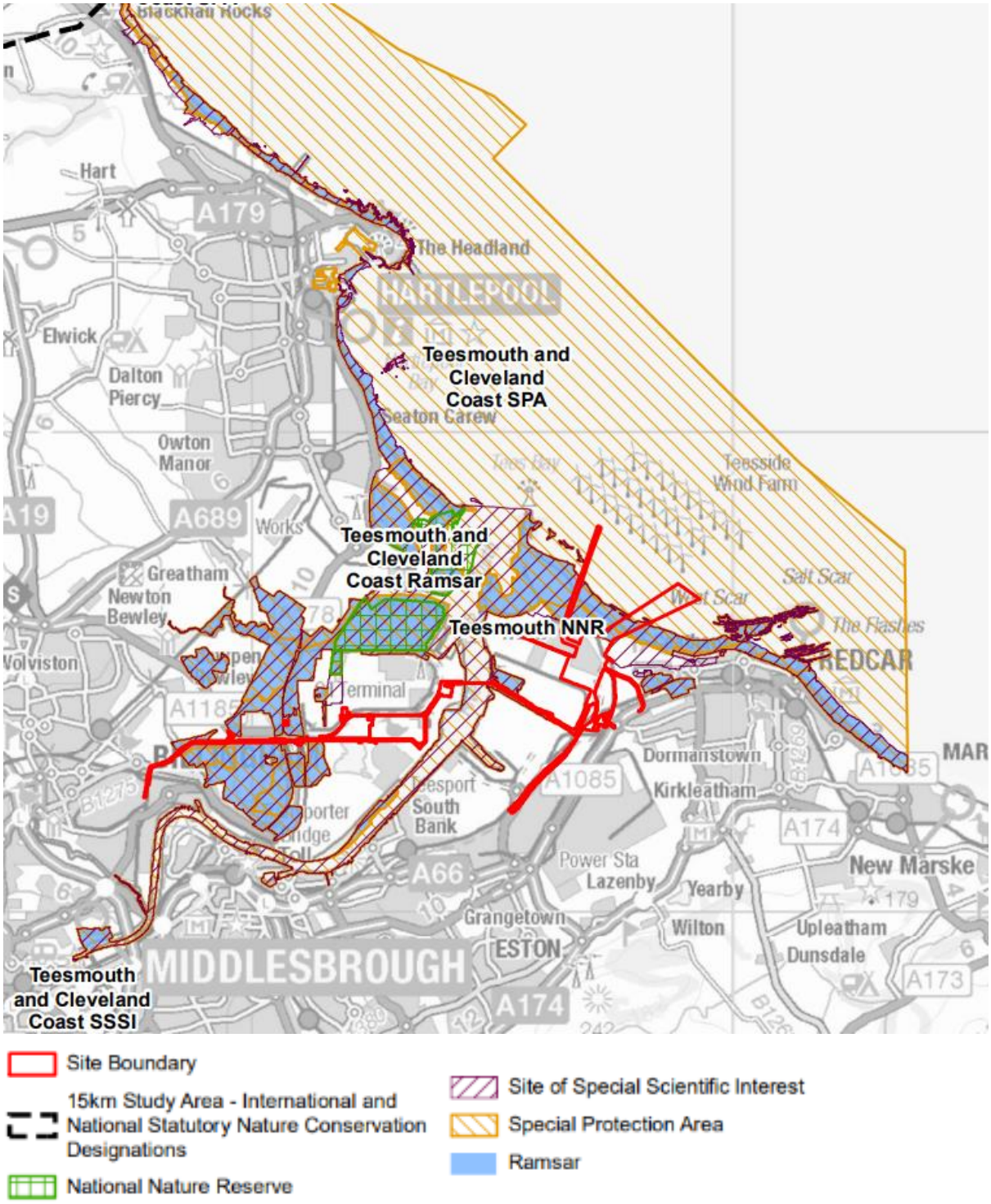
~~6.1.3~~5.1.3 The Teesmouth and Cleveland Coast SPA/Ramsar was extended in 2020 to improve seabird protection within the SPA network.

~~6.1.4~~5.1.4 Ramsar qualifying features[3] include:

- Criterion 5 – Assemblages of international importance; species with peak counts in winter are 26,786 waterfowl (5 year peak mean 2011/12-2015/16); and
- Criterion 6 – Species/populations occurring at levels of international importance; qualifying species/populations (as identified at designation); species with peak counts in spring / autumn - common redshank *Tringa totanus*; 1,648 individuals representing an average of 1.1% of the East Atlantic population (1987-91); Species

[2] JNCC Teesmouth and Cleveland Coast SPA Standard Data Form. Available at https://jncc.gov.uk/jncc-assets/SPA-N2K/UK9006061.pdf
[3] Ramsar Sites Information Service (2020) Teesmouth & Cleveland Coast Ramsar.

with peak counts in winter - red knot Calidris *Canutus islandica*; 5,509 individuals representing an average of 1.6% of the Canada/Greenland/Iceland/UK population (5 year peak mean 1991/92-1995/96), and Sandwich tern *Thalasseus sandvicensis* - 1,900 individuals representing an average of 4.3% of the GB population (1988-1992).



~~6.1.5~~5.1.5 The Teesmouth and Cleveland Coast SPA/ Ramsar Nutrient Neutrality evidence pack provided in Annex E of the NE guidance from March 2022 states that the target for the site is to "restore water quality to mean winter dissolved inorganic nitrogen levels where biological indicators of eutrophication (opportunistic macroalgal and phytoplankton blooms) do not affect the integrity of the site and features."

~~6.1.6~~5.1.6 A 'weight of evidence' approach adopted from the WFD is used to determine whether the site is meeting standards in terms of nutrient levels. Failure to achieve Good Ecological Status in dissolved inorganic nitrogen (DIN), macroalgae and phytoplankton indicate that the site would be in an unfavourable condition with regards to nutrients.

~~6.1.7~~5.1.7 The Teesmouth and Cleveland Coast SPA / Ramsar covers two WFD water bodies, the Tees Estuary and the Tees Coastal ('Tees Bay' referred to herein is part of the Tees Coastal water body). The latest WFD classification data suggests that DIN and macroalgae are only at moderate status in the Tee Estuary (phytoplankton are good). However, none of these parameters are monitored and reported for the Tees Bay on the Environment Agency's Catchment Data Explorer website[4], and a review of background Environment Agency water quality data suggests that mean DIN levels would be meeting high ecological status (which does not imply nutrient enrichment outside of the estuary area). In particular, the evidence pack goes on to state that "algal mats can be observed on intertidal mud and sandflats across the site during the summer months, particularly at Seal Sands, indicating excess nutrient levels.". Seal Sands lies to the northwest within the outer estuary area and is a shallower and wider area that is surrounded by heavy industry.

~~6.1.8~~5.1.8 Correspondence with NE in March 2022 ~~(via correspondence from an NE officer on 24/3/22)~~ contains the following advice: "If [modelling] shows that the offshore discharges do not flow back into the [Tees] river, and there is therefore no pathway to add to the nutrient levels within the terrestrial or inter-tidal sections of the SPA then there is no issue~~…if the foul water does go to Marske for treatment it is very unlikely this will be an issue, as there is no pathway for impacts [as currents tend to flow away from the SPA and Tees Estuary]~~". NE also stated that if new emissions with a nitrogen load were to be discharged via Bran Sands Waste Water Treatment Works to the Dabholm Gut and ultimately the Tees Estuary, this would be introducing a new nutrient load direct to the SPA and mitigation to ensure nutrient neutrality would be required.

~~6.1.9 The effluent sources of nitrogen that have been considered are detailed in Table 6.1.~~

[4] https://environment.data.gov.uk/catchment-planning/WaterBody/GB650301500005

Table 6.1. Sources of nitrogen and consideration as to whether they need to be considered by the assessment

Nitrogen source	Discussion	Include in assessment?
Cooling Water – Blowdown Waters from the gas fired power station cooling system	Cooling water will be provided by NWL from abstraction sources along the River Tees upstream of Middlesbrough near Darlington. This water contains DIN and will be concentrated due to operational processes prior to emission from the site to the Tees Bay. However, as the Proposed Development will not be adding to the nutrients that were already within the catchment of the Teesmouth and Cleveland Coast SPA / Ramsar, this is considered to be a neutral nutrient effect. Furthermore, water quality modelling of a range of scenarios for DIN has shown that, if the existing outfall continues to be used, DIN emissions at the predicted effluent concentrations are rapidly diluted within the Tees Bay and do not reach the Tees Estuary. Under some scenarios (i.e. alternative outfall) the effluent plume may interact with the intertidal shore areas along the Coatham Sands frontage, but the modelling does not take account of wave dispersion in line with Natural England advice. As described earlier, nitrogen levels within the Tees Bay are at high ecological status and Natural England have indicated that their concern is primarily within the Tees Estuary.	No – although a concentrated emission will be made as a result of the operational processes, the Proposed Development will not add any nitrogen to the receiving water and only nitrogen that was present in the original abstraction from the Tees upstream of the Site would be discharged (i.e. this is a neutral emission). The effluent will also not enter the Tees Estuary.
Process Water – Condensed Waters from the Carbon Capture Facility (HRSG)	The Condensed Water flows are significantly smaller than the Blowdown Water but this water may contain concentrations of ammonia up to 5 mg/l. Please refer to the summary of recent water quality modelling above.	Yes - The discharge of condensed water, diluted with surface water, will be to the Tees Bay and modelling will be used to identify whether it exceeds the EQS for high status and whether it will enter the Tees Estuary.
Process Water – DCC Blowdown	The DCC blowdown process effluent is proposed to be sent to Bran Sands Wastewater Treatment Works for treatment, and either discharged by Northumbrian Water through their licensed discharge to Dabholm Gut or an equivalent volume of treated effluent would be returned to the Proposed Development for discharge to Tees Bay via an existing or new outfall. Any amine production will be isolated for appropriate disposal off-site.	Yes – this discharge will contain ammonia generated by the Proposed Development and the treated effluent (i.e. a volume of treated effluent containing an equivalent quantity of DIN returned from Bran Sands WwTW) would be discharged to the Tees Estuary via the Dabholm Gut or to the Tees Bay via the selected outfall. Modelling of the discharge of process water to Tees Bay is on-going.
Surface water runoff	Nutrient load in surface water can be determined using the catchment specific calculator. This includes different leaching rates for different land uses. As the site is a former steel works, and will remain an industrial site, there will be no significant change in land use for the purposes of this	No – the proposed development does not constitute a significant change in land use and thus there is no potential for the development to alter the

Nitrogen source	Discussion	Include in assessment?
	assessment, and thus no change in leaching potential for nutrients.	nutrient load from existing site runoff.
Foul water	The nutrient neutrality assessment method from NE is intended to estimate the nutrient budget from all types of development that would result in a net increase in population served by a wastewater system. This is indicated by development that would include overnight accommodation. It states that "*other types of business or commercial development, not involving overnight accommodation, will generally not need to be included in the assessment unless they have other (non-sewerage) water quality implications.*" In addition, foul wastewater is to be discharged to Marske-on-Sea Waste Water Treatment Works to the south. Given the direction of prevailing current from the Marske outfall to the south and based on initial hydrodynamic modelling, the prevailing direction of flow is away from the Tees Estuary, so there would therefore be no pathway to the Teesmouth and Cleveland Coast SPA/Ramsar site. Natural England have indicated during a meeting to discuss their Relevant Representation on the 4th of March 2022, that the use of this WwTW for foul effluent would alleviate their concerns with regards to foul drainage.	No – NE guidance assumes that staff will also live in the catchment and thus foul water generated is already part of the baseline. Foul water will also not be discharged to the Tees Estuary but from Marske-on-Sea WwTW to the Tees Bay to the south of the Proposed Development, where the prevailing flow would be away from the SPA/ Ramsar to the south.
Atmospheric deposition of nitrogen	Atmospheric emissions of nitrogen have been modelled and an estimation of the load across the Tees Bay has been made. Initial analysis suggests that this will have a negligible impact on ambient DIN concentrations. Annual loads of between 0.1 and 0.45 kg N/ha/yr have been determined, with the highest values restricted to relatively small areas just off Coatham Sands. Given the very small deposition rates nitrogen contributions from this source are very small and insignificant when considered alongside loads from other process sources. It will also only affect the Tees Bay and Natural England have indicated that they are primarily concerned by emissions of nitrogen to the Tees Estuary.	No – Due to the very small loads emitted by this source and its distribution and dilution across a wide area of Tees Bay it is considered not necessary to consider this emission any further.

~~6.2 Nutrient Neutrality Approach~~

~~6.2.1 Nutrient neutrality is an approach which enables decision makers to assess and quantify mitigation requirements of new developments. Natural England considers nutrient neutrality as an acceptable means of counterbalancing nutrient impacts from development to demonstrate no adverse effects on the integrity of habitats sites.~~

~~6.2.2 A generic nutrient neutrality calculation methodology and a catchment specific nutrient budget calculator have been developed by Natural England and these were issued alongside the guidance to LPAs in March 2022. Although primarily directed at residential developments, the guidance states that "other types of business or commercial development, not involving overnight accommodation, will generally not need to be included in the assessment unless they have other (non-sewerage) water quality implications". Given the potential of the Proposed Development to impact on water quality in the Tees Estuary and/or Tees Bay a bespoke assessment is therefore required within the relevant areas of the designated site.~~

~~6.2.3 The main function of the nutrient budget calculators is to estimate the annual nutrient load from foul water and from changes in land use via surface water runoff. However, for the Proposed Development there are no overnight stays (and so foul wastewater is assumed to be neutral already) and for the purposes of this assessment the land use will effectively remain the same. Regardless of this, the principles of Natural England's method decision tree presented in Appendix A of the March 2022 letter hold true and will be applied, and a similar approach to the determination of a nutrient budget for the Proposed Development will be undertaken (i.e. to estimate the annual nitrogen load from each source to provide a total development nitrogen budget per year plus a buffer of 20%). Assumptions may be required for how the nitrogen load from various sources is estimated and this will be detailed in the final report. Once the annual nitrogen load plus buffer has been estimated, options for mitigation may be considered. Table 6.2 provides a summary of the main assessment stages and steps of the Natural England Nutrient Neutrality Generic Guidance with the final column setting out the bespoke approach for determining the budget for the Proposed Development.~~

Table 6.2. Comparison of NE Nutrient Neutrality Generic Methodology Stages and Steps and bespoke approach from NZT

NE Nutrient Neutrality Generic Methodology Stages and Steps		Proposed method for NZT
Stage 1 The increase in nutrient loading to a Habitats Site that results from the increase in wastewater from a new development	Step 1 Calculate increase in population due to development	Estimate annual load of nitrogen from process water (other) discharges to the Tees Estuary in kg N/ yr.
	Step 2 Calculate the increase in wastewater production (from population increase) due to development	
	Step 3 Determine the concentration of nutrients in wastewater and calculate additional wastewater nutrient load	
Stage 2 The nutrient loading from the past/present land use of the development site	Step 1 Obtain nutrient export values from current land use	N/A as land use not changing.
	Step 2 Calculate the annual nutrient export from current land use(s)	
Stage 3 The nutrient loading from the future mix of land use on the development site	Step 1 Calculate the annual nutrient export from future land use(s)	
Stage 4 Calculate the net change in nutrient loading to a Habitats Site with the addition of a buffer (the net change in the nutrient loading + the buffer is the nutrient budget)	Step 1 Calculate the nutrient budget	There is no change in land use so the annual nitrogen load from process water discharges to the Tees Estuary equates to the nutrient budget.
	Step 2 Add the buffer to the nutrient budget	A precautionary buffer of 20% will be added to the Proposed Development Nutrient Budget.

6.0 DISCHARGE MODELLING

6.1.1 Modelling of discharges to Tees Bay assesses potential impacts on the qualifying features of the Teesmouth and Cleveland Coast SPA/Ramsar and the potential for effluent to disperse into the Tees Estuary e.g. by tidal effects.

6.1.2 The effluent sources of nitrogen that have been considered are detailed in Table 6.1.

Table 6.1. Sources of nitrogen and consideration as to whether they need to be considered by the assessment

Nitrogen source	Discussion	Include in assessment?
Cooling Water– Blowdown Waters from the gas fired power station cooling system	Cooling water will be provided by NWL from abstraction sources along the River Tees upstream of Middlesbrough near Darlington. This water contains DIN and will be concentrated due to operational processes prior to emission from the site to the Tees Bay. However, as the Proposed Development will not be adding to the nutrients that were already within the catchment of the Teesmouth and Cleveland Coast SPA / Ramsar, this is considered to be a neutral nutrient effect. Furthermore, water quality modelling of a range of scenarios for DIN has shown that, if the existing outfall continues to be used, DIN emissions at the predicted effluent concentrations are rapidly diluted within the Tees Bay and do not reach the Tees Estuary. Under some scenarios (i.e. alternative outfall) the effluent plume may interact with the intertidal shore areas along the Coatham Sands frontage, but the modelling does not take account of wave dispersion in line with Natural England advice. As described earlier, nitrogen levels within the Tees Bay are at high ecological status and Natural England have indicated that their concern is primarily within the Tees Estuary.	No – although a concentrated emission will be made as a result of the operational processes, the Proposed Development will not add any nitrogen to the receiving water and only nitrogen that was present in the original abstraction from the Tees upstream of the Site would be discharged (i.e. this is a neutral emission).
Process Water – Condensed Waters from the Carbon Capture Facility (HRSG)	The Condensed Water flows are significantly smaller than the Blowdown Water but this water may contain concentrations of ammonia up to 5 mg/l. Please refer to the summary of recent water quality modelling above.	Yes - The discharge of condensed water, diluted with surface water, will be to the Tees Bay and modelling has been used to identify whether it exceeds the EQS for high status and whether it will enter the Tees Estuary.
Process Water – DCC Blowdown	The DCC blowdown process effluent is proposed to be sent to Bran Sands Wastewater Treatment Works for treatment, and either discharged by Northumbrian Water through their licensed discharge to Dabholm Gut or an equivalent volume of treated effluent would be returned to the Proposed Development for discharge to Tees Bay via an existing or new outfall. Any amine production will be isolated for appropriate disposal off-site.	Yes – this discharge will contain ammonia generated by the Proposed Development and the treated effluent (i.e. a volume of treated effluent containing an equivalent quantity of DIN returned from Bran Sands WwTW) would be discharged to the Tees Estuary via the

Nitrogen source	Discussion	Include in assessment?
		Dabholm Gut or to the Tees Bay via the selected outfall. Modelling of the discharge of process water has been undertaken.
Surface water runoff	Nutrient load in surface water can be determined using the catchment specific calculator. This includes different leaching rates for different land uses. As the site is a former steel works, and will remain an industrial site, there will be no significant change in land use for the purposes of this assessment, and thus no change in leaching potential for nutrients.	No – the proposed development does not constitute a significant change in land use and thus there is no potential for the development to alter the nutrient load from existing site runoff.
Foul water	The nutrient neutrality assessment method from NE is intended to estimate the nutrient budget from all types of development that would result in a net increase in population served by a wastewater system. This is indicated by development that would include overnight accommodation. It states that "*other types of business or commercial development, not involving overnight accommodation, will generally not need to be included in the assessment unless they have other (non-sewerage) water quality implications*." In addition, foul wastewater is to be discharged to Marske-on-Sea Waste Water Treatment Works to the south. Given the direction of prevailing current from the Marske outfall to the south and based on initial hydrodynamic modelling, the prevailing direction of flow is away from the Tees Estuary, so there would therefore be no pathway to the Teesmouth and Cleveland Coast SPA/Ramsar site. Natural England have indicated during a meeting to discuss their Relevant Representation on the 4th of March 2022, that the use of this WwTW for foul effluent would alleviate their concerns with regards to foul drainage.	No – NE guidance assumes that staff will also live in the catchment and thus foul water generated is already part of the baseline. Foul water will also not be discharged to the Tees Estuary but from Marske-on-Sea WwTW to the Tees Bay to the south of the Proposed Development, where the prevailing flow would be away from the SPA/ Ramsar to the south.
Atmospheric deposition of nitrogen	Atmospheric emissions of nitrogen have been modelled and an estimation of the load across the Tees Bay has been made. Initial analysis suggests that this will have a negligible impact on ambient DIN concentrations. Annual loads of between 0.1 and 0.45 kg N/ha/yr have been determined, with the highest values restricted to relatively small areas just off Coatham Sands. Given the very small deposition rates nitrogen contributions from this source are very small and insignificant when considered alongside loads from other process sources. It will also only affect the Tees Bay and Natural England have indicated that they are primarily concerned by emissions of nitrogen to the Tees Estuary.	No – Due to the very small loads emitted by this source and its distribution and dilution across a wide area of Tees Bay it is considered not necessary to consider this emission any further.

6.1.3 The modelling scenarios are summarised in Table 6.2 below:

Table 6.2: Summary of Modelling Scenarios

Scenario		Modelling
Base Case	DCC blowdown treated at Bran Sands and discharged to Dabholm Gut.	Modelled and reported on in Preliminary Discharge Modelling Report (see Appendix A)
Option A	DCC blowdown treated at Bran Sands. Returned effluent to PCC discharged to Tees Bay.	Modelling discussed in this report (see also Appendix B)

6.1.4 The impacts on the Tees Estuary have been assessed on the basis of identifying whether there is a net increase or decrease in nitrogen discharged to the Dabholm Gut/Tees Estuary directly (Base Case) or if the discharge modelling identifies the potential for effluent discharged into the Tees Bay via the outfall to disperse back into the Estuary due to tidal effects (Option A).

6.1.5 The Base Case modelling report was submitted into examination as Appendix A to Version 1.0 of the Nutrient Nitrogen Paper [REP8-050] and also forms Appendix A to this updated document. Updated discharge modelling for Option A has been undertaken for the replacement outfall (Work No. 5B), and is presented in Appendix B. Discharge modelling for the existing outfall (Work No. 5A) has not yet been completed[5].

6.1.6 The updated modelling in Appendix B has incorporated comments from NE and EA on the modelling previously undertaken (Appendix A). The modelling has included both continuous discharge and discharging on the ebb tide scenarios without surface water run-off (worst-case). No benefit from discharging on the ebb tide has been identified. The results for continuous discharge are discussed below and shown in Figures 6.1 and 6.2.

6.1.7 These show that for Option A:

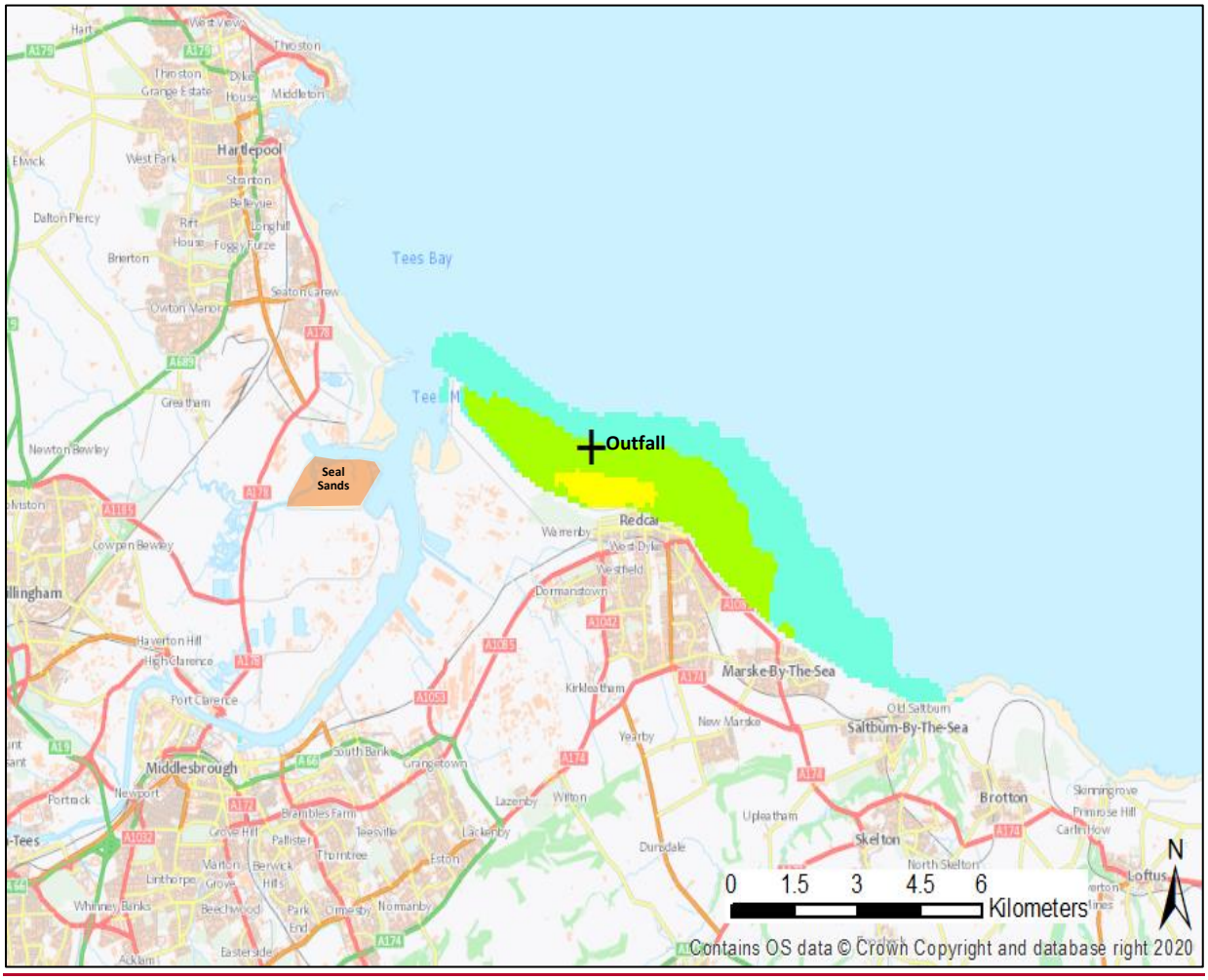
- For Tees Bay, average concentrations of DIN are elevated in some locations by up to 10% above background although these are localised to the outfall location;

[5] There are outstanding technical and commercial matters with use of the existing outfall and therefore the Applicants' modelling has focused on the replacement outfall. The Applicants note that should the existing outfall be selected that additional discharge modelling will be required.

- For the Tees Estuary, average concentrations of DIN are elevated by up to 2.5% above background in some locations but these are confined to the dredged channel of the River Tees, in the bottom half of the water column;
- Average concentrations of DIN over the mudflats at Seal Sands are modelled as less than 1% above background – which is the limit of accuracy of the model.

6.1.8 Any dispersion of DIN from the outfall discharge back into the Estuary is offset by the reduction in DIN in the Tees Estuary as a result of the water abstracted for use on the PCC Site. This is discussed further in Section 7.

Figure 6.1 DIN Concentrations increase above background averaged over tidal cycle – top 5% of water column



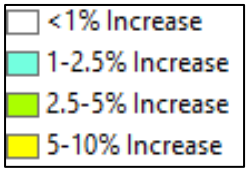
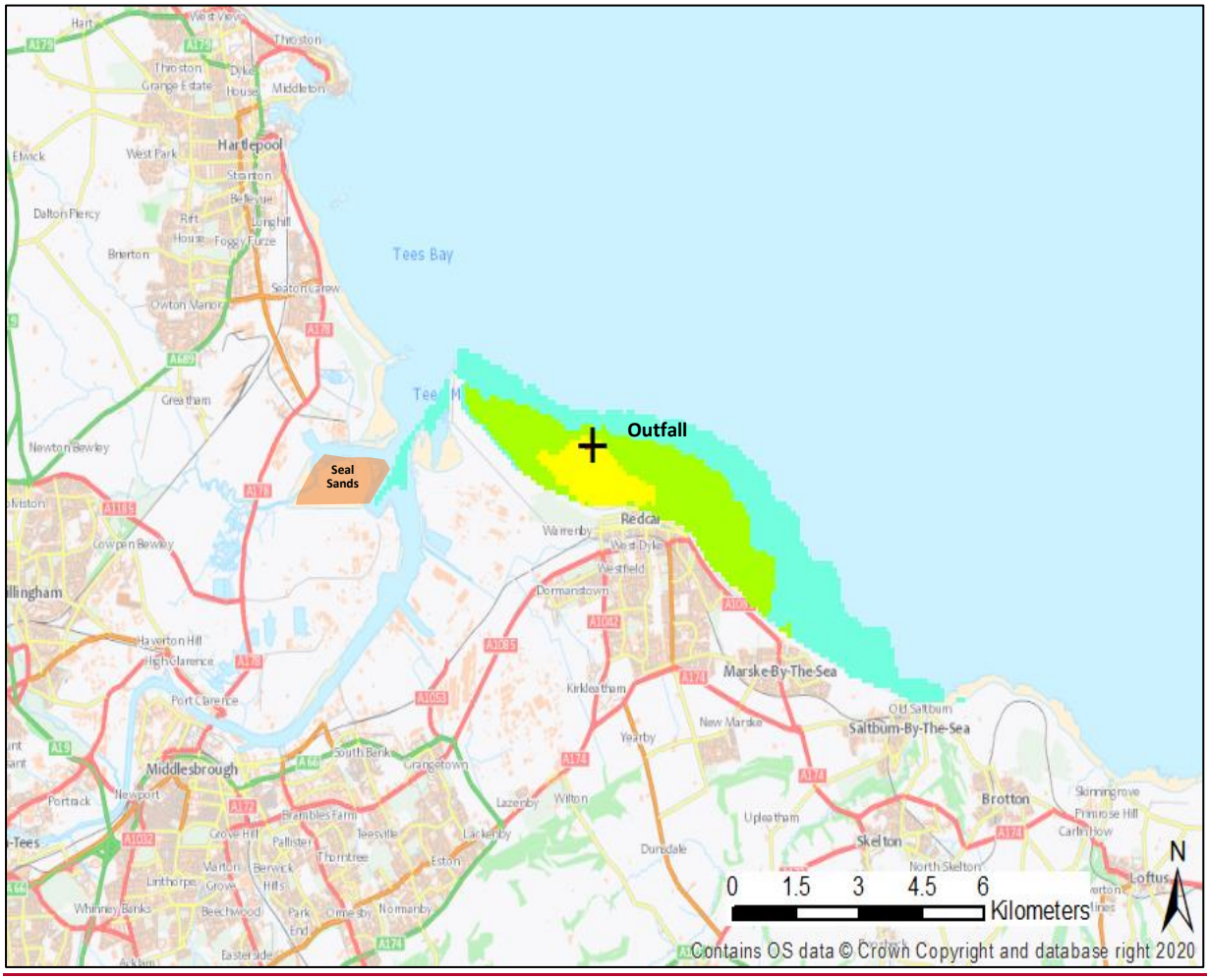


Figure 6.2 DIN Concentrations increase above background averaged over tidal cycle – bottom 10% of water column



- <1% Increase
- 1-2.5% Increase
- 2.5-5% Increase
- 5-10% Increase

7.0 POTENTIAL IMPACTS OF NITROGEN ON QUALIFYING FEATURES OF SPA/RAMSAR

7.1 Tees Bay

7.1.1 The Teesmouth and Cleveland Coast SPA / Ramsar (JNCC, 2001a) is a 12,211 ha estuarine and coastal site comprising a range of coastal habitats, such as sand- and mudflats, rocky shore, saltmarsh, freshwater marsh and sand dunes. The SPA / Ramsar lies along a stretch of coast that has been significantly modified by human activity. The site provides feeding and roosting opportunities for a significant number of waterfowl in winter and the passage period. Furthermore, little tern Sterna albifrons breed on beaches within the site during summer and sandwich tern Sterna sandvicensis use the SPA / Ramsar as a stop-over location on passage.

7.1.2 Tees Bay is included in the SPA designation to protect the open water areas of greatest foraging importance to the little terns at Crimdon Dene and the open water areas of greatest foraging importance to the common terns at Saltholme. The part of Tees Bay within the SPA designation is an area of c. 9,000 ha and neither tern species is a highly selective feeder, foraging on a wide range of fish and invertebrates. As a result, prey biomass is likely to be more important than diversity or species richness. Moreover, Warren (2018) and research reported in Econ (2014) identified that physical parameters such as tidal currents, wave height and wind speed, and biological factors such as the presence of predatory fish competing with the terns, all importantly influence prey available near the surface for both common and little tern, and the spatial and temporal predictability (or otherwise) of these processes may be more important than the absolute density of prey in a given area.

7.1.3 ~~Whilst the discharge modelling is ongoing, i~~The modelling shows the presence of elevated concentrations of DIN in areas of the Tees Bay (see Figures 6.1 and 6.2). ~~It should be noted that although m~~Marine water clarity can be affected by pollution (such as by nutrients, including DIN, ~~-~~causing plankton blooms in the water column) spatial differences in water turbidity can have both negative effects (obscuring prey from the predator) and positive effects (making it less likely the prey detect the predator and increasing food for prey drawing more of them to the surface). Holbech et al (2018) found that water clarity had no effect on prey capture success by common terns, while Econ (2014) suggests turbid waters may be an essential prerequisite for foraging little terns.

7.1.4 Given the major role of physical and biological (competition) factors in influencing predation behaviour and success, the variability in some of these factors, and the 9,000 ha size of the designated part of Tees Bay compared to the population of terns (approximately 480 pairs based on the Defra departmental brief at the time the SPA was extended into the marine environment), it is considered unlikely that an increase in dissolved inorganic nitrogen to the Tees Bay as a result of the Proposed Development would materially affect its ability to provide adequate sustenance to maintain the tern populations.

7.1.5 Based on Natural England's advice that the concern is over the Tees Estuary, and specifically the Seal Sands mud flats, under Option A the Proposed Development redirects effluent containing an equivalent quantity of nitrogen away from Dabholm Gut and to Tees Bay, specifically in order to avoid exacerbating existing nutrient issues in Tees Estuary.

7.2 Impacts on the Dabholm Gut/Tees Estuary (Seal Sands)

7.2.1 Under the Base Case, the discharge from Bran Sands to Dabholm Gut causes discharge of a net addition of nutrient nitrogen to Dabholm Gut and the Tees Estuary. At the meeting with the Applicants on 15th September 2022, Natural England confirmed that they considered that adopting the Base Case would not be acceptable from a nutrient nitrogen perspective.

7.2.2 Option A ~~allows for~~ takesing an equivalent quantity of nitrogen back from Bran Sands to that exported for treatment for discharge to Tees Bay. There would therefore be no direct input of nitrogen from Bran Sands to the Dabholm Gut as a result of the Proposed Development under this option. In addition, raw water would be extracted from the Tees upstream of the Tees Barrage and discharged after use to Tees Bay via the existing or replacement outfall. This would effectively reduce the baseline nutrient nitrogen flux in the estuary by 14 kgN/hr.

7.2.3 Modelling of Option A has shown that even with conservative assumptions ~~less~~ there is an increase in background DIN concentrations of less than ~~<~~1% at Seal Sands mudflats arising from the discharge of treated effluent via the replacement outfall. This equates to less than 0.94 kgN/hr ~~of the discharge~~ reaching~~enters into~~ the Seal Sands mudflats from the dispersed treated effluent~~.~~. For reference, the ambient water quality shows a background DIN concentration at Tees Mouth of 0.5 mg/l (500 ug/l).

7.2.4 The amount of additional nitrogen reaching Seal Sands mudflats has been estimated as follows:

- the worst case average increase in DIN concentrations over the current 14 day model run period for the Seal Sands area –is approximately $9x10^{-6}$ kg/m^3.
- the average water depth[6] at a central location in Seal Sands over the tidal cycle is 0.7 m. Using an area of 181 ha (1,810,000 m^2) gives a volume of water of 1,267,000 m^3 ; and
- this gives an additional volume of DIN of 11.4 kg per high tide, or 0.95 kgN/hr given a duration of elevated DIN of 12 hours over a tidal cycle.

7.2.5 To assess the degree to which this is offset by the removal of nitrogen from the estuary, the reduction in the nitrogen flux due to abstraction at Low Worsall has been

[6] using the average water depth instead of the maximum water depth takes account of the fact that there is no need to offset DIN increases during the ebb tide

partitioned by the ratio between the area of the Seal Sands mudflats and the total area of the Tees Estuary. Seal ~~s~~Sands has an area of 181 ha and represents 16% of the Tees Estuary (as the Tees Transitional Waterbody with an area of 11.4 km^2). Based on this the effect of this removal over the area of Seal Sands is 14 x 0.16 = 2.2 kg~~/~~N/hr.

7.2.6 The net additional load of nutrient nitrogen at Seal Sands from the Proposed Development is therefore less than 0.94 kgN/hr minus 2.2 kgN/hr ~~as a worst case~~, i.e. a net removal of potentially ~~over~~ 1.2 kgN/hr from the Tees Estuary. As such it is considered there will be no average net increase in nutrient nitrogen deposition on the mudflats at Seal Sands arising from the P~~p~~roposed D~~d~~evelopment. Consequently, it is considered that there would be ~~will confirm whether or not there would be an adverse effect on the dissolved inorganic nitrogen levels in the Estuary relating to discharges from the existing or replacement outfalls in Tees Bay (based on analysis of mixing zones) through dispersion of effluent back into the Tees Estuary. The results of the modelling will confirm whether there would be~~ no adverse effect on the integrity of the SPA/Ramsar site due to ~~an increase in~~ nutrient nitrogen discharges ~~s~~ to the Tees Estuary ~~under this option~~.

7.2.7 This assessment is considered conservative because:

- The less than 0.94 kgN/hr rate of nitrogen is ultimately derived from the <1% average increase in DIN at Seal Sands predicted by the modelling. The 1% figure is the effective limit of for ~~modelling~~ accuracy detecting ~~detection~~ an increase in DIN in the estuary. As the actual concentration increase will be lower than 1% then the actual rate of nitrogen increase would be lower than this.
- The calculation of the nutrient nitrogen load at Seal Sands is based on the total increased mass of nitrogen in sea water 0.7 m deep on average over the mudflats. In reality, only a fraction of this nitrogen would be ~~–~~available for macroalgae nutrition.

7.2.8 ~~On the basis of this assessment therefore, t~~The Applicants' assessment ~~have~~ demonstrates ~~ed~~ that by installing and using the return line from Bran Sands WwTW and installing a new purpose built outfall (and so not discharging treated effluent to the Dabholm Gut), nutrient nitrogen ~~levels~~effects on the qualifying features of the SPA at Seal Sands mudflats can be avoided or even reduced as a result of the Proposed Development. The Applicants therefore propose to commit to using such measures – or alternative measures that achieve the same outcome – for the Proposed Development, through the addition of a suitably worded requirement to the draft DCO.

7.2.9 It is important to understand that Option A is only one potential means by which nutrient neutrality can be achieved. It demonstrates that this is readily achievable within the scope of the Proposed Development, but there may well be other approaches which would be at least as good if not better. It is therefore neither necessary nor desirable to constrain the scope for optimising the approach at the detailed design stage. Instead, it is proposed that the requirement will provide that the undertaker must submit details of the final design measures for approval, and

that it must be demonstrated to the satisfaction of the discharging authority that these measures will ensure that there is no net increase in nutrient nitrogen loads at Seal Sands. This is considered further in Section 10.0 below.~~with the final design measures to be used to be secured by requirement~~

8.0 NUTRIENT NEUTRALITY

8.1.1 Nutrient neutrality is an approach which enables decision makers to assess and quantify mitigation requirements of new developments. Natural England considers nutrient neutrality as an acceptable means of counterbalancing nutrient impacts from development to demonstrate no adverse effects on the integrity of habitats sites.

8.1.2 As this assessment demonstrates that Proposed Development does not have the potential to impact on water quality on the identified receptor in the Tees Estuary no nutrient nitrogen assessment is therefore required.

~~8.0~~9.0 WATER FRAMEWORK DIRECTIVE AND EQS COMPLIANCE

~~8.1.1~~9.1.1 During the operational phase potential water environment impacts may occur associated with changes in water quality within Tees Bay from operational discharges from the PCC Site including the discharge of treated process wastewater and water from the cooling system.

~~8.1.2~~9.1.2 ~~On~~ Following completion of the discharge modelling, an updated Water Framework Directive assessment ~~will be~~ is being prepared, considering water quality impacts from emissions to the Tees Bay and any effects on the WFD status of the Tees Coastal Water Body~~.~~.

~~9.0~~10.0 ACTION PLAN / NEXT STEPS

~~9.1.1~~10.1.1 The Applicants ~~intend to continue / undertake the following activities by~~ have undertaken the following by Deadline 9.

- ~~Modelling of Option A discharges to Tees Bay using CORMIX (near field) and Delft3D (far field models);~~
- Update of the ~~WFD Compliance Report~~ and Habitat Regulations Assessment Report; and
- ~~Consultation with both~~ Natural England ~~and Environment Agency; and~~
- ~~Address any comments from NE/EA~~.

~~These will be followed by~~ The submission at Deadline 9 of ~~the~~ this ~~final~~ updated nitrogen discharges briefing paper to the ExA, supported by:

- ~~Effluent Discharge Modelling Report for Option A;~~
- ~~Updated Water Framework Directive Compliance Report (Appendix 9C to the ES);~~ and
- Updated Habitat Regulations Assessment report (DCO Document Ref. 5.13).

10.1.2 The Updated Water Framework Directive Compliance Report (Appendix 9C to the ES) and associated consultation with the EA on Water Framework Directive Compliance will be undertaken following the next meeting between the Applicants and the EA.

10.1.3 In the finalised DCO submission (scheduled for Deadline 12 on 1 November 2022) the Applicants will include a requirement that would secure the position on nutrient nitrogen in this briefing paper.

10.1.4 The replacement outfall and the return pipeline from Bran Sands are already included in the dDCO.

10.1.5 The form and wording of the proposed requirement will be discussed with Natural England, but it is likely to provide that the undertaker must submit a detailed design for approval (following consultation with Natural England) and demonstrate to the satisfaction of the discharging authority that it achieves no net increase in nutrient loads at Seal Sands. The requirement is also likely to provide that the undertaker must instigate a monitoring programme for nitrogen in the Tees Estuary to provide baseline water quality and undertake monitoring of nitrogen concentrations during site operation.

Appendix A: Discharge Modelling – Base Case

Appendix B: Discharge Modelling – Option A