Thurrock Flexible Generation Plant

Environmental Statement Volume 6
Appendix 17.3: Water Framework Directive Assessment

Date: November 2020

Environmental Statement

Volume 6

Chapter 17.3

Report Number: EOR0750

Version: Post-submission rev. 1

Date: November 2020

This report is also downloadable from the Thurrock Flexible Generation Plant website at:
http://www.thurrockpower.co.uk

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1. Introduction

1.1.1 This report provides a Water Framework Directive (WFD) Assessment in support of a Development Consent Order (DCO) application and associated deemed marine licence (DML) for the Thurrock Flexible Generation Plant under the Planning Act 2008 (the 2008 Act). Thurrock Power Ltd is proposing to develop a new Flexible Generation Plant in Tilbury, Essex. The proposal includes the construction and operation of a new causeway within the Thames Estuary, which will be used alongside a new haul road for vehicles travelling from barges delivering construction materials on site.

1.1.2 According to guidance provided by the Overarching National Policy Statement for Energy (EN-1) (DECC, 2011), consideration of the WFD (2000/60/EC) is required for any DCO application which has the potential to cause deterioration in the ecological and chemical status of a waterbody or to compromise improvements which might otherwise lead to a waterbody meeting its WFD objectives. The WFD aims to protect and enhance waterbodies within Europe and covers all estuarine and coastal waters out to 1 nautical mile.

1.1.3 Under the WFD, coastal waters, estuaries, rivers, man-made docks and canals are divided into a series of waterbodies. Within each waterbody, the WFD sets ecological as well as chemical objectives. The aim of the WFD was for all waterbodies to achieve “good status” by 2015. This aim (“good status” for all waterbodies by 2015) was not achieved and therefore the Environment Agency is subsequently aiming to achieve good status in at least 60% of waters by 2021 and in as many waters as possible by 2027. Under all conditions, it requires that there should be no deterioration in status.

1.1.4 “Good status” comprises two parts. The first is “good ecological status” (or “good ecological potential”, for waterbodies classed as heavily modified or artificial). The second is “good chemical status”. “Good ecological status/potential” includes biological, hydromorphological and physicochemical quality elements and specific pollutants. “Good chemical status” concerns a series of priority substances, including a number of priority hazardous substances. The WFD also requires that relevant protected area objectives are achieved (Environment Agency, 2015).

2. WFD Waterbodies

2.1.1 The current status of waterbodies is detailed within River Basin Management Plans (RBMPs) and supporting appendices. The first RBMPs were published in 2009 and have been superseded by the updated 2015 plans, which included the work undertaken over the previous five years and the plans/objectives for the next six years. The proposed Thurrock Flexible Generation Plant is geographically covered by the updated 2015 Thames River Basin District RBMP (Environment Agency, 2015), and information provided has been drawn upon to provide the characterisation of the environment required for this WFD assessment.

2.1.2 The proposed development has the potential to impact on the transitional waterbody Thames Middle (Figure 2.1). No other waterbodies were considered as part of the assessment as the nearest waterbody to the development with the exception of Thames Middle waterbody is Thames Lower waterbody located over 6 km from the development. None of the activities associated with the development are predicted to cause or contribute to deterioration of status or jeopardise the water body achieving good status of this waterbody.

2.1.3 A baseline description of the biological, physio-chemical and hydromorphological quality elements, as required in the WFD (2000/60/EC) are provided in Table 2.1.

2.1.4 Between 2009 – 2014, and in 2016, the Environment Agency classified the Thames Middle waterbody with an overall classification of ‘moderate’, based on a ‘moderate’ Ecological Status and a ‘failed’ Chemical Status. The reasons behind not achieving good Chemical Status or good Ecological Status include:

- Physical modifications (coastal protection and flood protection);
- Point source contamination (Tributyltin compounds related to landfill leaching, sewage discharge and use of restricted substances); and
- Diffuse source contamination (Tributyltin compounds related to contaminated water bed and urbanisation).

2.1.5 In 2015, the Thames Middle waterbody was classified as ‘moderate’ Ecological Status and ‘good’ Chemical Status. This classification as an overall ‘good’ Chemical Status in 2015 was due to an improvement in priority substances and priority hazardous substances (i.e. tributyltin compounds). In 2016, Chemical Status was assessed as a ‘fail’ due to a ‘fail’ assessment for priority hazardous substances (i.e. Tributyltin compounds), which reflects the patterns observed between 2009 and 2014 outlined above.

2.1.6 As such the target objective for this waterbody is an overall status of ‘Moderate’ by 2015.

Table 2.1: Thames Middle transitional waterbody WFD Features and Objectives.

Waterbody	Description, notes or more information
WFD waterbody name	Thames River Basin District
Waterbody ID	GB530603911402
River basin district name	Thames
Waterbody type (estuarine or coastal)	Estuarine
Waterbody total area (ha)	4,392
Current waterbody quality status	Moderate
Target waterbody status and deadline	Moderate, 2015
Hydromorphological status of waterbody	Not assessed
Heavily modified waterbody and for what use	Heavily modified: Coastal protection, flood protection, navigation, ports & harbours
WFD habitats present	Saltmarsh and Intertidal soft sediment
Phytoplankton status	Good
Algal blooms	Not monitored
WFD protected areas present	Yes

Figure 2.1: WFD Waterbodies associated with Thurrock Flexible Generation Plant.

3. WFD Assessment Process

3.1.1 A WFD assessment can comprise of up to three stages. All stages may not require completion depending on the outcomes of each stage. The stages are:

- Stage 1: Screening – excludes any activities that do not need to go through the scoping or impact assessment stages;
- Stage 2: Scoping – identifies the receptors that are potentially at risk from the proposed activity and which need an impact assessment; and
- Stage 3: Impact assessment – considers the potential impacts of your activity, identifies ways to avoid or minimise impacts, and shows if your activity may cause deterioration of the waterbody status or jeopardise the waterbody achieving good status.

3.1.2 This WFD Assessment report has been undertaken following the Environment Agency (2017) *Clearing the Waters for All* guidance for assessing impacts in estuarine (transitional) and coastal waters for the WFD.

4. Screening

4.1.1 The aim of the screening stage is to ensure that only those activities that may cause deterioration or prevent a waterbody from meeting its objectives are assessed further. The screening stage excludes any low risk activities that do not require a WFD scoping assessment to be undertaken and subsequent impact assessment.

4.1.2 According to the Environment Agency (2017) *Clearing the Waters for All* guidance, detailed assessment is required for the proposed development as a number of the activities described in the project description (Volume 2, Chapter 2: Project Description) do not fall into any of the listed categories of activities where assessment is not required (Environment Agency, 2017).

5. Scoping

5.1.1 Scoping assists with identifying elements within waterbodies which may be impacted as a result of the activity, these will then progress to detailed impact assessment. As part of scoping, the focus is on identifying components of the activity or project that have the potential to cause an impact and the quality elements potentially impacted (Environment Agency, 2017). A scoping assessment should be undertaken for each waterbody potentially affected by the project. Waterbodies can be scoped out at this stage if it can be robustly demonstrated that there will be no impacts.

5.1.2 Scoping was completed for proposed activities against the receptors and criteria provided in the *Clearing the Waters for All* guidance (Environment Agency, 2017) for the Thames Middle waterbody, in which the proposed development is located. Receptors that proposed development activities were assessed against included:

- Hydromorphology;
- Biology – habitats;
- Biology – fish;
- Water quality;
- Protected areas; and
- Invasive non-native species (INNS).

5.1.3 Results of the scoping assessment are provided in Annex A. A summary of the scoping results is provided below in Table 5.1.

Table 5.1: Summary of Results from Scoping Assessment.

Receptor	Potential risk to receptor?	Note the risk issue(s) for impact assessment
Hydromorphology	Yes	The presence of both the causeway and the RoRo vessel (Volume 2, Chapter 2: Project Description) during material offloading has the potential to impact the hydromorphology of the waterbody by restricting flow causing changes to the hydrodynamic regime. Dredging of the riverbed to accommodate construction of the causeway and allow vessel access has the potential to impact on the bed morphology.
Biology: habitats	Yes	The proposed development footprint is located within identified saltmarsh habitats, which are considered to be of high sensitivity in accordance with guidance (Environment Agency, 2017).
Biology: fish	Yes	The proposed development is located within the Thames Estuary. Increases in suspended sediments from dredging and underwater noise emissions during construction and vessel movements during operation could impact on fish migration within the estuary.
Water quality	Yes	The proposed activity includes dredging activities which will mobilise sediments causing an increase in suspended sediment concentrations with the potential to also release sediment bound contaminants following disturbance.
Protected areas	Yes	The proposed development is located within 2 km of the Thames Estuary and Marshes Special Protection Area (SPA). The bird features of which could be affected by construction and operation activities of the proposed development.
Invasive non-native species (INNS)	No	All vectors that could potentially introduce or spread INNS have not been identified. It is assumed that any vessels originating from outside the Thames Estuary are in compliance with the International Maritime Organization (IMO) ballast water management guidelines. All rock material will be sourced onshore.

6. Detailed Impact Assessment

6.1.1 This section considers the potential impacts of an activity, identifies ways to avoid or minimise impacts, and concludes if the activity may prevent any quality element within any waterbody achieving good status/potential or may cause deterioration.

6.1.2 Receptors or features identified as part of the scoping stage have been brought through for detailed assessment. Information provided in this document is based on the assessment and conclusions provided in this Environmental Statement (ES) for the proposed development. The aim for this document is to summarise as much of the information from the ES and provide reference where possible.

6.2 Hydromorphology

Baseline Description

6.2.1 A baseline description of the hydromorphology associated with the proposed development is provided in detail in Section 3.1 of Volume 3, Chapter 17: Marine Environment.

6.2.2 The Thames Estuary, including the study area is a well-mixed, highly dynamic, macrotidal estuary with a tidal range in excess of 4 m. Tidal flow ebbs to the east and floods to the west. The fastest tidal flow speeds occur on the ebb tide. Near-bed peak ebb flow speeds have a maximum of about 1.6 m/s in the middle of the channel on spring tides. Speeds over the intertidal areas (where the proposed development is located) are generally less than 0.2 m/s on either side of the estuary. Peak flow speeds in the middle of the channel on the flood tide were marginally slower, with a maximum speed of about 1.2 m/s.

6.2.3 Intertidal mudflats backed by saltmarsh occur along the estuary banks, behind which are tidal defence structures. The upper intertidal (+3.12 m chart datum (CD)) slopes at a gradient of *circa* 1:70 for 100-160 m, before steepening to an average of about 1:65 down to the main channel depth of *circa* 10 m below CD. The main channel is uniform, for about 480 m width before sloping up an average gradient of 1:20 on the south side of the channel. This slope is interrupted by a subtidal ledge circa 60-90 m wide at an elevation 2-3 m below CD. Surficial sediments within the study area comprise sand and mud (Table 5.5 of Volume 6, Appendix 17.1: Phase 1 Intertidal Survey Report and Benthic Ecology Desktop Review).

6.2.4 Sediment transport within the Thames Estuary principally occurs in relation to the tidal characteristics with negligible influence from waves. Within the study area, the historic bank encroachment has resulted in an increase in the speed of tidal currents which have the capability to mobilise large volumes of sediment. Measurement of the total sediment flux measured up to 65,000 tonnes of sediment during the spring tide cycle, reducing to 20,000 tonnes during a neap tidal cycle.

Impacts to Hydromorphology from Physical Presence of Infrastructure

6.2.5 Impacts on seabed morphology from the construction and operation of the causeway has been presented in Section 4.1 of Volume 3, Chapter 17: Marine Environment.

6.2.6 Hydrodynamic numerical modelling was undertaken using two scenarios: with the presence of the causeway alone and the causeway with a RoRo vessel (barge). Modelling results are provided and described in Volume 6, Appendix 17.2: Hydrodynamic Modelling and Sediment Assessment.

6.2.7 The modelling shows that the greatest change to the local flow patterns is as a result of both the causeway and the moored vessel. Effects on the flow regime are confined to within:

- 215 m upstream;
- 250 m downstream;
- 50 m offshore; and
- Across the intertidal mudflat to the shore.

6.2.8 The greatest changes are reductions in the peak flow speeds of up to 0.12 m/s (30%) on the ebb tide. Further small changes are caused by the introduction of the vessel; however these are predominantly within the berth under the vessel and immediately shoreward.

6.2.9 Flow directions are relatively unaffected by the development except in the immediate vicinity of the causeway. The magnitude of change in the estuary flow regime is predicted to be minor with a noticeable change limited to within close proximity of the causeway. Therefore, deterioration of the objectives of the waterbody is not expected.

6.2.10 The small changes in hydrodynamics from the causeway and presence of the RoRo vessel will have negligible morphological effect other than shoreward of the structure. Bed shear stresses (BSS) in the ‘shelter’ of the causeway are generally reduced over the mudflat to the approximate threshold for deposition for the sediment throughout the period of tidal emersion, creating an accretional tendency with little or no scope for re-erosion.

6.2.11 An assessment of the likely sedimentation rates indicates that depths of accumulation of 1 – 1.5 m can be expected over the intertidal area behind the causeway, before a new equilibrium is established circa 3 – 5 years following construction. This sedimentation has the potential to result in saltmarsh developing behind the causeway from about 18 months after construction, however, the mudflat is likely to be maintained behind the berth, albeit at a higher elevation.

6.2.12 At the berth, a slight scour effect is indicated on the flood tide, but the accretional tendency is marginally enhanced on the ebb, due to the 'shelter' effect of the vessel. These differences resulting from the vessel are unlikely to be noticeable from those for the causeway alone.

6.2.13 The magnitude of change in the sediment transport processes at the scale of the Thames Estuary and Gravesend Reach is predicted to be negligible, however a noticeable change in intertidal elevation will occur within proximity of the causeway.

6.2.14 The impact on the sedimentary processes affecting the bed morphology is predicted to be negligible. Over the small area of intertidal mudflat shoreward of the extent of causeway, the predicted accretion effect will not have a substantial effect on the overall objectives of the waterbody.

6.3 Biology: Habitats

Baseline Description

6.3.1 A baseline description of the habitats associated with the proposed development are provided in detail in Section 3.1 of Volume 3, Chapter 17: Marine Environment.

6.3.2 Intertidal habitats within the proposed development footprint are typical for a mid-estuary setting in the UK. Broadly, the upper shore was characterised by established saltmarsh (LS.LMp.Sm) and the majority of the mid to lower shore was characterised by intertidal muddy sediments with two biotopes present *Hediste diversicolor*, *Macoma balthica* and *Scrobicularia plana* in littoral sandy mud (LS.LMu.MEst.HedMacScr) and littoral mud (LS.LMu). Separating the saltmarsh and intertidal mud were areas of rocky habitat colonised in places by seaweeds (LR.LLR.F.Fves and LR.LLR), with some small patches of impoverished mixed sediment.

Temporary Habitat Loss during construction

6.3.3 Impacts on habitats from the construction and operation of the causeway has been presented in Section 4.1 of Volume 3, Chapter 17: Marine Environment.

6.3.4 During the construction phase of the causeway and the associated removal of sediment, dredging of the vessel grounding pocket at the seaward end of the causeway will result in the removal of approximately 13,200 m^3 of sediment over a footprint of 13,900 m^2. This will be limited to above Mean Low Water Springs (MLWS) and will therefore affect intertidal habitat habitats only. This impact (the removal of sediment) is temporary and reversible, being limited to the construction phase only, with sediments expected to infill the vessel grounding pocket within months to a few years following the construction phase of the overall Flexible Generation Plant, and therefore will not affect the objectives of the waterbody from being achieved.

Physical Presence of the Proposed Development

6.3.5 Impacts on habitats from the construction and operation of the causeway has been presented in Section 4.2 of Volume 3, Chapter 17: Marine Environment.

6.3.6 The maximum footprint of the causeway in the intertidal zone is predicted to be 5,380 m^2, with approximately 610 m^2 of habitat loss affecting saltmarsh habitats and approximately 4,700 m^2 of habitat loss within the intertidal mudflat habitats. (The remaining 70 m^2 comprises the rocky habitat that separates the saltmarsh and the intertidal mud mentioned above).

6.3.7 The proportions of intertidal mudflat and saltmarsh habitat affected by habitat loss due to the presence of the causeway are small in the context of the available habitat in the Middle Thames Estuary waterbody (i.e. 0.06% and 0.05%, respectively).

6.3.8 The presence of the causeway structure will lead to the accretion of sediments on the landward side of it, due to the small reductions in hydrodynamic regime in this area. As sediments build up in the lee of the causeway and the level of the mudflat increases to the level of the saltmarsh it is expected that pioneer saltmarsh species will colonise the newly accreted mudflats. As such, it is anticipated that the total area of the saltmarsh habitat in the vicinity of the causeway will increase over a period of 5 years, following construction of the causeway. It is predicted that the presence of the causeway may lead to the development of up to a maximum of 11,000 m^2 (depending on the extent of natural accretion) of saltmarsh habitat. Colonisation of mudflats by saltmarsh plants is a natural process in estuarine environments, which is influenced by a range of factors, including the mudflat being exposed for long enough to allow vegetation to become established. While this will lead to expansion of saltmarsh habitat in the vicinity of the causeway, it will also result in a loss of mudflat habitat where saltmarsh extends over the mudflat.

6.3.9 Given the small area of habitat which will be affected and the high potential for colonisation of lost communities within the footprint adjacent to the causeway, the proposed development will not restrict the objectives of the waterbody from being achieved and may assist with achieving those objectives, particularly with respect to providing additional higher sensitive habitats.

6.4 Biology: Fish

Baseline Description

6.4.1 A baseline description of the fish populations associated with the proposed development is provided in detail in Section 3.1 of Volume 3, Chapter 17: Marine Environment.

6.4.2 Quarterly surveys undertaken adjacent to the proposed development associated with the Tilbury 2 development identified a total of 34 species (18,036 fish) recorded across all sampling gear type during subtidal trawls, and 16 species (1,364 fish) across all intertidal surveys. Species recorded included a range of both commercially important and protected species, including European eel *Anguilla anguilla*, European smelt *Osmerus eperlanus*, river lamprey *Lampetra fluviatilis*, European seabass *Dicentrarchus labrax*, common sole *Solea solea* and Atlantic herring *Clupea harengus.*

6.4.3 The lower Thames Estuary is considered to be an important spawning and nursery ground for common sole. As this species spawns, individuals migrate from deeper water to shallower waters for the summer, before returning to deeper waters during the winter (Walker and Emerson, 1990).

6.4.4 The Thames estuary is known to host important spawning habitat for smelt, with an important UK population known to occur in the region. High numbers of clupeids (European sprat *Sprattus sprattus* and Atlantic herring *Clupea herganus*) were observed within the study area during the winter months, corresponding with utilisation of nursey, spawning and winter grounds nearer to the coast. These species migrate back into offshore deeper waters for the summer season to facilitate greater feeding opportunities (Ellis *et al*., 2012). European smelt caught during the surveys were generally juveniles. This species inhabits the Thames from juvenile stages to mature stages, seeking deeper and cooler waters in the summer (Power and Attrill, 2007).

Effects on fish migration from increases in suspended sediment concentrations (SSC) during construction

6.4.5 Impacts from suspended sediment concentrations (SSC) as a result of the construction and operation of the causeway has been presented in Section 4.1 of Volume 3, Chapter 17: Marine Environment.

6.4.6 Capital dredging will be required at the seaward section of the causeway within the vessel grounding pocket. The total dredging and excavation quantities are estimated to be circa 16,100 m^3, of which about 3,000 m^3 will be excavated beneath the foundation of the causeway by land-based plant at low states of tide and the remainder to be removed by Water Injection Dredging (WID).

6.4.7 During construction, dredge plumes are likely to occur from either dredge method, which can only occur for a limited period over high water. Realistic dredge rates mean that the 13,000 m^3 of dredging by water injection is likely to take around 17 days. The assessment of effects of increases in SSC in Section 4.1 of Volume 3, Chapter 17: Marine Environment predicted that sediment may be dispersed up to 20 km up and down river and over its full width, however increases in average SSC are unlikely to exceed 10 mg/l greater than 1 km either side of the dredge. Isolated 'spikes' in SSC of the order of 100 mg/l above background are likely close to the dredge location during the dredge. It should be noted, however, that this assessment was based on the Tilbury2 modelling and therefore this is likely to be highly conservative, due to the considerably smaller volumes of sediment to be dredged for the current project.

6.4.8 The plume extends over a wide area; however, the average concentrations are predicted to be low and the sediment is fine grained with a slow settling velocity. Any permanent accretion arising from the dredge over the wider area is likely to occur on the lower intertidal within the extent of the plume, however depths of accumulation will be low (of the order of 1 mm) and therefore unmeasurable against the background sediment transport regime within the estuary.

6.4.9 Estuarine fish are expected to have limited sensitivity to increases in SSC and associated deposition. In the immediate vicinity of dredging operations, SSC are expected to be high and these receptors would be expected to avoid the immediate vicinity of dredging operations. However, with increasing distance from the dredging footprint, it would be expected that SSC would be reduced to a level that would not represent a significant shift from the baseline situation. Given the low magnitude (marginal increases in SSC above baseline), impacts on fish are not expected to cause deterioration on the objectives of the waterbody from being achieved.

Effects on fish migration from underwater noise emissions during construction

6.4.10 Impacts from underwater noise emissions during construction of the causeway on fish has been presented in Section 4.1 of Volume 3, Chapter 17: Marine Environment.

6.4.11 The main sources of underwater noise will be dredging for the construction of the causeway and for the vessel grounding pocket at the end of the causeway and vessel movements. These noise sources are received as a low-level chronic exposure and can affect fish receptors by masking sounds in the sea soundscape (Popper and Hastings, 2009; Richardson *et al.,* 1995). Noise levels associated with dredging are characterised as broadband noise (i.e. main energy below 1 kHz) and are similar to those associated with a typical merchant vessel (Robinson *et al.,* 2011). As such, noise levels associated with dredging are not expected to increase noise levels much beyond the background noise levels (i.e. typical noise levels associated with the neighbouring port area). Dredging activities associated with construction of the marine elements of the Thurrock Flexible Generation Plant will be short term activities (17 days) in the context of the overall construction programme of up to six years.

6.4.12 Some increase in underwater noise may also result from the movement of vessels both during dredging operations, dependent on ship size, speed, load, condition, age, and engine type, sound pressure levels can range from <150 dB re 1 µPa (decibels at a reference pressure of 1 micropascals) to over 190 dB re 1 µPa (McKenna e*t al.*, 2012).

6.4.13 Sound plays an important role for fish, allowing them to communicate with one another, detect predators and prey, navigate their environment, and avoid hazards. In some circumstances noise may act as barrier to migration particularly within a channel such as a river or estuary. For non-impulsive noise (including vessel movement and dredging), Popper *et al.* (2014) considered that there was a moderate to high risk of behavioural effects on fish in the near field (i.e. tens of metres), an intermediate risk of behavioural effects in the intermediate field (i.e. hundreds of metres) and a low risk in the far field (i.e. kms from the source). Noise associated with dredging and vessel movements are however not expected to lead to injury effects on fish (and marine mammals), except where these occur in very close proximity to the noise source for long periods of time (which is unlikely as receptors would be expected to move away from the noise source before injury could occur). As such, effects on fish are expected to be limited to behavioural effects, such as avoidance reactions, masking and changes in behaviour (e.g. swimming or schooling behaviour in fish). It is unlikely that migrating fish will therefore be affected and will migrate through the zone of influence. Noting also that the Thames is heavily urbanised with background levels already high from frequent underwater noise sources such as vessel movements and 3rd party port activities. The objectives of the waterbody will therefore not be restricted from being achieved.

6.5 Water Quality (including sediment quality)

Baseline Description

6.5.1 A baseline description of the water quality within the study area associated with the proposed development is provided in detail in Section 3.1 of Volume 3, Chapter 17: Marine Environment.

6.5.2 Observed near bed SSC in proximity to the power station jetty recorded fine (silt and clay) concentrations of between approximately 1,300 mg/l and 1,600 mg/l (HR Wallingford, 2017). Average sand concentrations of 80 mg/l (near bed) and 30 mg/l (mid depth) indicated a dynamic system.

6.5.3 The samples collected and analysed for sediment chemistry were compared with Cefas action levels 1 and 2 (AL1 and AL2), which give an indication of how suitable the sediments are for disposal at sea. Contaminant levels which are below AL1 are of no concern and are unlikely to influence the marine licensing decision while those above AL2 are considered unsuitable for disposal at sea. Those between AL1 and AL2 would require further consideration before a licensing decision can be made.

6.5.4 Sediment chemistry analysis indicated that most metals were below the Cefas AL1, with the exception of chromium and mercury, both of which exceeded AL1 at all three sampling locations (although chromium was below the Canadian TEL[1] for two of these). Zinc and nickel also exceeded the Cefas AL1, although at one location only. In all cases, although the Cefas AL1 was exceeded, these were small exceedances and still well below the Cefas AL2 (and the Canadian PEL). The results for Polycyclic Aromatic Hydrocarbons (PAHs) were also found to be elevated above the Cefas AL1 for 11 of the 17 determinants tested. There is no Cefas AL2 for PAHs, although the concentrations of all PAHs were well below the Canadian PEL thresholds[2].

Increased suspended sediment concentrations from dredging activities during construction

6.5.5 Impacts on effects from SSC on water quality from the construction and operation of the causeway has been presented in Section 4.1 of Volume 3, Chapter 17: Marine Environment.

6.5.6 Capital dredging by WID at the seaward section of the causeway within the vessel grounding pocket will result in increases in SSC and associated sediment deposition. Sediment plume modelling undertaken as part of the impact assessment for the ES (Volume 6, Appendix 17.2: Hydrodynamic Modelling and Sediment Assessment) showed that sediment is likely to be dispersed 20 km up and down river and over its full width, however increases in average SSC are unlikely to exceed 10 mg/l greater than 1 km either side of the dredge. Isolated ‘spikes’ in SSC of the order of 100 mg/l above background are likely close to the dredge location during the dredge. However as outlined in paragraph 6.4.7 above, these are likely to be conservative as the assessment was based on plume modelling for Tilbury2 which involved dredging of considerably larger volumes of sediment than those associated with the Proposed Thurrock Flexible Generation Plant. Given the small increases in SSC (compared with background conditions) and short duration over which SSC will increase, it is concluded that the water quality objectives of the waterbody will not be affected by the proposed development.

Release of contaminants from dredging activities during construction

6.5.7 Impacts from SSC on water quality resulting from the construction and operation of the causeway have been presented in Section 4.1 of Volume 3, Chapter 17: Marine Environment.

6.5.8 Disturbance of sediments during the construction phase may result in the release of sediment bound contaminants. Plume modelling has shown that SSC will be quickly diluted and dispersed within the Thames Estuary and the maximum volumes of sediment which may be resuspended are small (i.e. <16,100 m^3) and therefore any contaminants brought into suspension will also be dispersed to levels which are not harmful to marine ecology receptors and water quality. Water quality objectives of the waterbody will not be affected by the proposed development.

6.6 Protected areas

Effects on Features of the Thames Estuary and Marshes SPA

6.6.1 A full assessment of effects on the integrity of Natura 2000 has been carried out and is contained within the Habitat Regulations Assessment Report (HRAR) for Thurrock Flexible Generation Plant which accompanies the ES (application document A5.2).

6.6.2 In summary all impacts on the SPA were screened out as no Likely Significant Effect (LSE) with the exception of water quality from surface water drainage inputs to the ditch network and hydrological changes from changes to the ditches required for construction of the development. These effects were considered further within the Appropriate Assessment.

6.6.3 The overall philosophy for the design of the surface water pollution prevention system for the site is to manage surface water sustainably and to ensure that discharged waters do not constitute a pollution risk. This is described in the Conceptual Drainage Strategy (application document A7.3). Discharges to water and environmental management of the flexible generation plant, including safe storage of potentially polluting substances and spillage response procedures, will be regulated through the Environmental Permit for the facility in operation.

6.6.4 Implementation of these measures during both the construction and operational phases of the proposed development limits the risk of a significant pollution incident. Following implementation of mitigation measures, no adverse effect on site integrity of the Thames Estuary and Marshes SPA/Ramsar site is anticipated as a result of the proposed development.

[1] Canadian threshold effect levels, which is the minimal effect range at which adverse effects rarely occur, were adopted as these guidelines provide further context to the level of toxicity indicated by an exceedance of CEFAS AL1.

[2] Canadian Probably Effect Levels were adopted as a suitable threshold level for comparison against sediment PAH concentrations in the absence of CEFAS AL2 guideline criteria and are widely accepted by the EA.

6.6.5 As set out in the Conceptual Drainage Strategy (application document A7.3), drainage ditches removed by the proposed development will be replaced with a reconfigured ditch network that will not alter the hydrological regime overall outside the main development site itself. Runoff from the flexible generation plant will be suitably managed via an attenuation system such that the greenfield runoff rate is not exceeded. With implementation of these mitigation measures, no adverse effect on site integrity of the Thames Estuary and Marshes SPA/Ramsar site is anticipated as a result of the proposed development.

6.6.6 As such the Protected Areas objectives of the waterbody will not be affected by the proposed development.

7. Conclusions

7.1.1 The proposed development has been assessed in accordance with the WFD. As part of the scoping stage, the Thames Middle waterbody had the potential to be impacted by the proposed development. The proposed development was assessed against the following WFD receptor groups in accordance with the Clearing the Water for All guidance (EA, 2017):

- Hydromorphology
- Habitats;
- Fish;
- Water quality; and
- Protected areas.

7.1.2 Following completion of the detailed impact assessment, it was identified that each receptor group would not deteriorate, or the objectives of the waterbody be restricted from being achieved as a consequence of the proposed development activities.

8. References

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Annex A Scoping Table

The following tables detail the findings of the Scoping stage of the WFD Assessment for the Proposed Thurrock Flexible Generation Plant. This template follows guidance produced by the Environment Agency, i.e. '*Clearing the Waters For All'* for assessing impacts on estuarine and coastal waters for the WFD (Environment Agency, 2017). Findings from the assessment have been undertaken for one identified waterbodies that could be potentially affected by the project:

Activity	Description, notes or more information
Applicant name	Thurrock Power Ltd
Name of activity	Thurrock Flexible Generation Plant
Brief description of activity	Construction and operation of a causeway within the Thames Middle Waterbody proposed to support transportation of construction materials during development of the Thurrock Flexible Generation Plant.
Location of activity (central point XY coordinates or national grid reference)	X: 566579 Y: 175353
Footprint of activity (ha)[1]	4.82 ha (0.0482 km^2). Includes 1.928 ha (0.01928 $km^{2)}$) of causeway and dredging footprint in addition to 2.892 ha (0.02892 km^2) which includes zone of influence associated with dredging including causeway bed preparation (1.5 times dredge footprint[1]).
Timings of activity (including start and finish dates)	Three months for construction of the causeway. Operation may be undertaken over one phase of 12-24 months' duration or two phases each of 18 months' duration, consecutively or with a gap of around 9 months.
Extent of activity (for example size, scale frequency, expected volumes of output or discharge)	The causeway will extend out from the foreshore covering an area of 5,380 m^2. 3000 m^3 surface sediments within the causeway footprint will be removed and replaced with crushed rock reinforced by layers of geotextile. Works will be undertake using a backhoe working progressively outward from the river bank, replacing the excavated/dredged material with the crushed rock fill, laying the geotextile layers and completing the rock mound to the design level, prior to placing the precast concrete pads. Beyond the causeway a total of 13,000 m^3 of material will be also be removed by WID to allow vessel access. During operation of the causeway it is expected that up to 60 barge deliveries will occur over the construction phases as described above. Maximum frequency of one delivery per three days is predicted.
Use or release of chemicals? State which ones	Not applicable.

[1]: as defined by Environment Agency (2017), for dredging activity, the footprint should be defined as 1.5 times the dredge area.

A.1 Specific Risk Information

The potential risks of the activity to each of the key receptor groups are considered in the sections below.

Hydromorphology

Consider if your activity:	Yes	No	Hydromorphology risk issue(s)
Could impact on the hydromorphology (for example morphology or tidal patterns) of a high status waterbody.	Requires impact assessment	Impact assessment not required	No. Impact assessment not required. Waterbody has not been classified as having a *high status*.
Could significantly impact the hydromorphology of a waterbody at less than high status.	Requires impact assessment	Impact assessment not required	Yes. Impact assessment required. The presence of both the causeway and the RoRo vessel during material offloading has the potential to impact the hydromorphology of the waterbody by restricting flow causing changes to hydrodynamic regime. Dredging of the riverbed to accommodate construction of the causeway and allow vessel access to the causeway has the potential to impact on the bed morphology.

Consider if your activity:	Yes	No	Hydromorphology risk issue(s)
Is in a waterbody that is heavily modified for the same use as your activity.	Requires impact assessment	Impact assessment not required	Yes. Impact assessment required. The Thames Middle waterbody is heavily modified by port and harbour development which include similar activities to those proposed for the project.

Section 2 Biology

Habitats

Habitat Summary as per the data provided in the waterbody table for entire Thames Middle waterbody.

Higher sensitivity habitats[1]	Size (ha)	Lower sensitivity habitats[2]	Size (ha)
chalk reef	-	cobbles, gravel and shingle	-
clam, cockle and oyster beds	-	intertidal soft sediments like sand and mud	838.78
intertidal seagrass	-	rocky shore	-
maerl	-	subtidal boulder fields	-
mussel beds, including blue and horse mussel	-	subtidal rocky reef	-
polychaete reef	-	subtidal soft sediments like sand and mud	-
saltmarsh	130.06		
subtidal kelp beds	-		
subtidal seagrass	-		

[1] Higher sensitivity habitats have a low resistance to, and recovery rate, from human pressures.

[2] Lower sensitivity habitats have a medium to high resistance to, and recovery rate from, human pressures.

Consider if the footprint[1] of your activity is:	Yes	No	Biology habitats risk issue(s)
0.5 km^2 or larger	Requires impact assessment	Impact assessment not required	No. Impact assessment not required. Footprint is 0.0482 km^2.
.1% or more of the waterbody's area	Requires impact assessment	Impact assessment not required	Yes. Impact assessment required. Footprint represents 0.110% of the waterbody
Within 500 m of any higher sensitivity habitat[1]	Requires impact assessment	Impact assessment not required	Yes. Impact assessment required. Footprint is located within identified saltmarsh habitats considered higher sensitivity [1].
1% or more of any lower sensitivity habitat[2]	Requires impact assessment	Impact assessment not required	No. Impact assessment not required. The footprint will disturb approximately 0.1% of lower sensitivity habitat.

[1]: includes dredging footprint assumed as 1.5 times the dredge area in accordance with guidance provided by Environment Agency (2017).

[2]: as defined by Environment Agency (2017)

Fish

Consider if your activity:	Yes	No	Biology fish risk issue(s)
Is in an estuary and could affect fish in the estuary, outside the estuary but could delay or prevent fish entering it or could affect fish migrating through the estuary.	Continue with questions	Go to next section	Yes. Activity is located within the Thames Estuary. Increases in suspended sediments and underwater noise emissions from the activity could impact on fish migration.
Could prevent normal fish behaviour like movement, migration or spawning (for example creating a physical barrier, noise, chemical change or a change in depth or flow).	Requires impact assessment	Impact assessment not required	Yes. Impact assessment is required. As per description provided above.
Could cause entrainment or impingement of fish.	Requires impact assessment	Impact assessment not required	No. Impact assessment not required. The proposed activity would not cause entrainment or impingement of fish.

Section 3 Water Quality

Consider if your activity:	Yes	No	Water quality risk issue(s)
Could affect water clarity, temperature, salinity, oxygen levels, nutrients or microbial patterns continuously for longer than a spring-neap tidal cycle (about 14 days)?	Requires impact assessment	Impact assessment not required	Yes. Impact assessment required. The proposed activity includes dredging which will mobilise sediments.
Is in a waterbody with a phytoplankton status of moderate, poor or bad.	Requires impact assessment	Impact assessment not required	No. Impact assessment not required. The waterbody has a phytoplankton status of Good.
Is in a waterbody with a history of significant and persistent algal blooms or toxic algal blooms.	Requires impact assessment	Impact assessment not required	No. Impact assessment not required. No history of harmful algal blooms has been identified.

If your activity uses or releases chemicals (for example through sediment disturbance or building works) consider if:	Yes	No	Water quality risk issue(s)
The chemicals are on the Environmental Quality Directive (EQSD) list.	Requires impact assessment	Impact assessment not required	No. Impact assessment not required. No chemicals are expected to be released during the works.
It disturbs sediment with contaminants above Cefas Action Level 1.	Requires impact assessment	Impact assessment not required	Yes. Impact assessment required. Sediment samples collected within dredge area returned contaminant concentrations above Cefas Action Level 1.
If your activity has a mixing zone (like a discharge pipeline or outfall) consider if:	**Yes**	**No**	**Water quality risk issue(s)**
The chemicals released are on the Environmental Quality Standards Directive (EQSD) list.	Requires impact assessment	Impact assessment not required	No. Impact assessment not required. The project will not have a mixing zone associated with the activity and therefore no chemicals listed on Environmental Quality Standards Directive (EQSD) list that will be released as part of the project activities.

Section 4: WFD Protected Areas

An assessment as to whether the following protected areas were considered at risk from the proposed activities:

- special areas of conservation (SAC);
- bathing waters;

- special protection areas (SPA);
- nutrient sensitive areas; and
- shellfish waters.

Consider if your activity:	Yes	No	Protected areas risk issue(s)
Within 2 km of any WFD protected area[1]	Requires impact assessment	Impact assessment not required	Yes. Impact assessment required. Within 2 km of the project footprint the following WFD protected area is found Thames Estuary and Marshes Special Protection Area (SPA) (1.4 km)

[1]:as defined by Environment Agency (2017).

Section 5: Invasive non-native species (INNS)

Consider if your activity:	Yes	No	INNS risk issue(s)
Introduce or spread INNS	Requires impact assessment	Impact assessment not required	All vectors that could potentially introduce or spread INNS have not been identified. It is assumed that any vessels originating from outside the Thames Estuary are in compliance with the International Maritime Organization (IMO) ballast water management guidelines. All rock material will be sourced onshore.