

National Grid

Cable Tunnel Replacement
Project

Environmental Statement
Volume IV

Chapter 21- Water
Environment- Gravesend

December 2023



Quality information

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21 Water Environment

21.1 Introduction

- 21.1.1 This chapter of the Environmental Statement (ES) assesses the likely effects of the Tilbury to Grain and Tilbury to Kingsnorth (TKRE) Cable Tunnel Replacement Project (hereafter “the Proposed Development”) on the water environment during the construction, operational and decommissioning phases. It also identifies any additional mitigation measures to prevent, minimise or control likely adverse effects on water environment receptors arising from the Proposed Development.
- 21.1.2 This chapter should be read together with the introductory chapters of this Environmental Statement (ES) (Volume II Chapters 1 – 6). This water environment impact assessment has been informed by data from other technical chapters in Volume IV, namely Chapter 15: Biodiversity - Gravesend.
- 21.1.3 This chapter is also supported by the following appendix (ES Volume VI), figures and planning documents:
- ES Appendix 13-1: Water Framework Assessment (Screening and Scoping);
 - Figure 21-1: Gravesend Surface Water Features;
 - Figure 21-2: Gravesend Groundwater Features;
 - Drainage Management Plan (Document Reference 30003364-BHK-XX-XX-RP-C-02060); and
 - Flood Risk Assessment (FRA) (Document Reference 30003364-BHK-XX-XX-RA-C-02002).

21.2 Relevant Legislation, Policy and Guidance

Introduction

- 21.2.1 The section of the chapter provides an overview of the relevant legislation, planning policy and technical guidance relevant to the water environment assessment.

Legislation

- 21.2.2 The following pieces of legislation apply specifically to the water environment assessment:
- Environment Act 2021 (Ref 21-1): enables better environmental protection to be included into law, includes new binding targets for water, which when set will need to be considered by new development that may affect the water environment;
 - Water Act 2014 (Ref 21-2): mainly deals with regulating the impact of water supply on the water environment and the price of water;
 - Flood and Water Management Act 2010 (Ref 21-3): requires flood management authorities to manage risks in connection with flooding and prepare Strategic Flood Risk Assessments, for which new development must consider;
 - Environmental Protection Act 1990 (Ref 21-4): brings together pollution prevention and disposal regulations, imposes duty of care on those involved with any waste stream;
 - Land Drainage Act 1991 (as amended) (Ref 21-5): sets out the functions of internal drainage boards and local authorities (as Lead Local Flood Authority) in relation to land drainage of ordinary watercourses. New development wanting to do works that may affect the flow in ordinary watercourse may require a consent from the relevant authority);
 - Water Resources Act 1991 (as amended) (Ref 21-6): regulates water resources, water quality and pollution and flood defences, for which new developments may need to consider;

- Water Environment (Water Framework Directive) (WFD) (England and Wales) Regulations 2017 (Ref 21-7): these regulations aim to improve and integrate the way water bodies are managed throughout the UK for which new development must be compliant or otherwise be carefully justified and include all necessary mitigation and compensation;
- Environmental Damage (Prevention and Remediation) Regulations 2017 (as amended) (Ref 21-8): aims to prevent and remediate damage to the environment;
- Environmental Permitting (England and Wales) Regulations 2016 (as amended 2018) (Ref 21-9): aims to streamline the legislative system for activities in England and Wales including those for construction activities which may pose an alteration of flood risk. New developments that may need to do works to a Main River or discharge unclean water, trade or process effluent into a controlled water may need to apply for a permit;
- Groundwater (England and Wales) Regulations 2009 (Ref 21-10): aims to prevent the entry into groundwater of any hazardous substances as might be released by, among other things, new developments;
- Control of Pollution (Oil Storage) (England) Regulations 2001 (Ref 21-11): sets out the requirements for the storage of oil for quantities over 200 litres, which is relevant to any development that may involve the storage of oil during construction or operation;
- The Water Resources Act (Amendment) (England and Wales) Regulations 2009 (Ref 21-12): regulates water resources, water quality and pollution and flood defence and should be considered where necessary by any new development;
- Control of Substances Hazardous to Health (Amendment) Regulations 2004 (Ref 21-13): requirements to control and manage risks from hazardous substances, such as may be used on construction sites or as part of the operation of new developments;
- Anti-Pollution Works Regulations 1999 (Ref 21-14): outlines the contents of any-pollution works notices served under the Water Resources Act 1991;
- Water Framework Directive (WFD) (Standards and Classification) Directions 2015 (Ref 21-15): includes directions for classification of surface water and groundwater bodies for which new developments must consider as part of any WFD assessment;
- Building Regulations. Approved Document Part H: Drainage and Waste Disposal (2010) (Ref 21-16) includes details of foul water drainage both above and below ground; and
- Marine and Coastal Access Act 2009: Includes requirements for new development to need a Marine Licence from the Marine Management Organisation (MMO) for works below Mean High Water Spring Tide (Ref 21-17).

National Policy

21.2.3 National planning policy relevant to this water environment impact assessment are detailed in Table 21-1.

Table 21-1: National Planning Policy

Policy Reference	Policy Context
National Policy Statement (NPS) for Energy (EN-1) (2011) (Ref 21-18)	The 2011 version of NPS EN-1 remains in force until the revised NPS are designated in early 2024. This is an overarching policy statement setting out the requirements for consultation, and flood risk assessment.
NPS EN-5 (2011) (Ref 21-19)	The 2011 version of NPS EN-5 remains in force until the revised NPS are designated in early 2024. This includes provision for the inclusion of possible climate change effects on the development of electricity networks infrastructure, specifically in relation to flooding.

Policy Reference	Policy Context
Overarching National Policy Statement for Energy (EN-1) (November 2023) (Ref 21-20)	The 2023 version of NPS EN-1 will come into force in early 2024. It contains revisions relating to surface water and flood risk. Criteria for site specific flood risk assessments is included and that mitigation for surface water runoff should include the use of Sustainable Drainage Systems (SuDS).
National Policy Statement for Electricity Networks (EN-5) (November 2023) (Ref 21-21)	The 2023 version of NPS EN-5 will come into force in early 2024. Includes reference to climate change adaptation in section 2.3.
National Planning Policy Framework (NPPF) (2021) (Ref 21-22)	Sets out the government's planning policies for England and how they are expected to be applied.
National Planning Practice Guidance (NPPG) (2014, updated 2022) (Ref 21-23)	Sets out the requirements for undertaking a flood risk assessment. Includes National Planning Practice Guidance: Flood Risk and Coastal Change.
The UK Government's Future Water Strategy (2011) (Ref 21-24)	Sets out a framework for water management in England.
The UK Government's 25 Year Environment Plan (Ref 21-84)	This document sets out the 25 Year plan of actions that will improve the environment.
The UK Government's Environmental Improvement Plan (Ref 21-85)	This is the first revision of the 25 Year Environment Plan

Local Planning Policy

21.2.4 Local planning policies relevant to this water environment impact assessment are detailed in Table 21-2.

Table 21-2: Local Planning Policy

Policy Reference	Policy Context
Defra and the Environment Agency's Thames Estuary 2100 (TE2100) Thames Estuary 2100 – Policy 3 (Ref 21-27)	Thames Estuary 2100 sets flood risk management policies for each area of the estuary. Gravesend Site is under Policy 3 – Take action to maintain flood defences at their current level, accepting that the flood risk will increase.
Kent County Council's Land drainage policy (2019) (Ref 21-29)	As the LLFA Kent County Council has land drainage authority. This document outlines how they deliver this role.

Guidance

21.2.5 National guidance documents which are relevant include:

- Non-statutory technical standards for Sustainable Drainage Systems (SuDS) (Ref 21-30): includes information on volume and peak flow control in relation to mitigation of flood risk. Please note that the UK Government intends to issue new guidance on SuDS in 2024;
- Water UK Sewerage Sector Guidance (2019) (Ref 21-31): guidance in relation to the adoption of sewerage assets by sewerage companies in England.
- Kent County Council's Drainage and Planning Policy Statement (Ref 21-28): As the Lead Local Flood Authority (LLFA) for the Gravesend Site and a statutory consultee, Kent County Council

will review drainage strategies and surface water management provisions associated with applications for major development.

- Construction Industry Research and Information Association (CIRIA) Report C753 The SuDS Manual 2nd Edition (2016) (Ref 21-32): guidance covers the planning, design, construction, and maintenance of Sustainable Urban Drainage Systems, includes the Simple Index Method for mitigation calculations. CIRIA also publish guidance on how to manage construction water pollution risks, and these are described later when standard mitigation measures are introduced.
- National Highways (2020) Design Manual for Roads and Bridges (DMRB) CD532 Vegetated Drainage Systems for Highways Runoff (Ref 21-33): provides guidance for the design of vegetated drainage systems, with information on their mitigation potential; and
- Environment Agency's Water Framework Directive assessment: estuarine and coastal waters (Ref 21-34). This outlines the WFD process, and the information required to undertake screening, scoping and WFD impact assessment stage assessments for estuarine and coastal waters.

21.2.6 Guidance documents related to the Gravesend side of the Proposed Development include:

- Local Flood Risk Management Strategy, Kent County Council (Ref 21-38). This strategy outlines the aims and actions to reduce the local flooding.
- Local Flood Risk Management Strategy, Medway Council (Ref 21-39). This strategy outlines the aims and actions to reduce the local flooding.
- Strategic Flood Risk Assessment, Medway Council (Ref 21-40). Outlines the drainage requirements which include capturing the first 5mm event or 'first flush'.

21.3 Scope and Methodology

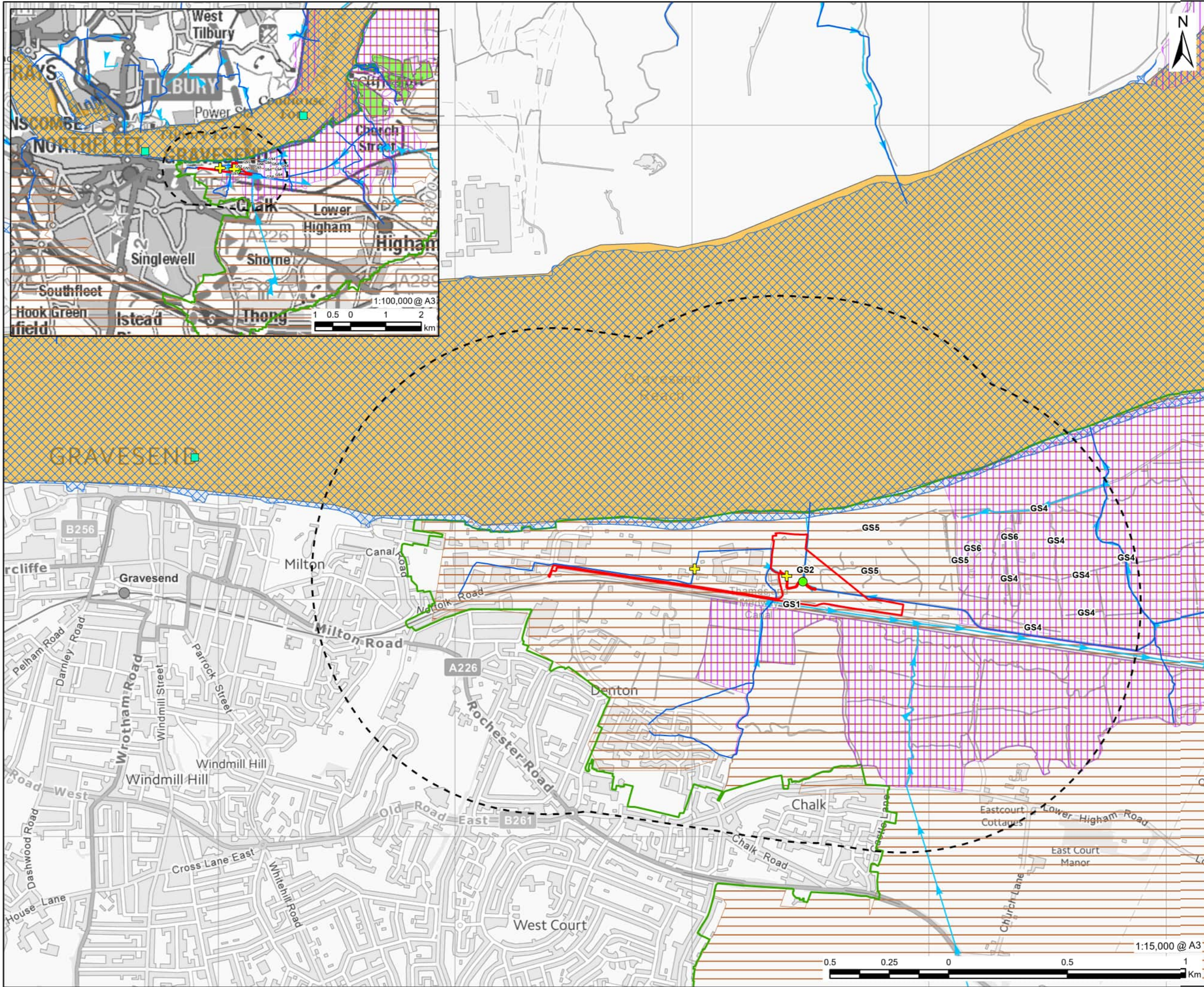
21.3.1 This section describes the methodology proposed for the assessment of effects on the water environment, including the criteria for the determination of the significance of the receptor and the magnitude of change from the baseline condition. Potential impacts of the Proposed Development on the water environment will be assessed by:

- Considering the existing (baseline) status of the water environment within the Proposed Development and relevant surrounds with respect to flood risk, surface water, groundwater, following the source-pathway-receptor approach;
- Identifying potential impacts of the Proposed Development on the water environment during the operational and construction phases including maintenance, as well as cumulative effects.
- Proposing suitable mitigation measures to be incorporated into the Proposed development design, construction, operation and decommissioning to avoid, prevent, minimise or offset any adverse impacts (i.e., embedded and additional mitigation); and
- Reviewing any residual impacts.

Study Area

21.3.2 For the purposes of this assessment, a general study area of approximately 1km around Proposed Development boundary (hereafter "the Site boundary") has been considered in order to identify water features that are hydrologically connected to the Proposed Development and have the potential to be directly impacted by the activities associated with the Proposed Development. The study area is shown on Figure 21-1.

21.3.3 For the Gravesend Site, the ultimate receptor is the River Thames.



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- LEGEND**
- Red Line Boundary (Above Ground)
 - 1km Study Area
 - EA Discharge License
 - EA Abstraction Licence
 - EA Water Quality Monitoring Point
 - EA Statutory Main River
 - Other Watercourse
 - Site of Special Scientific Interest
 - Drinking Water Protected Area
 - Nitrate Vulnerable Zone:
 - Coastal Streams to Lower Thames
 - North Kent
 - WFD Transitional and Coastal Water Bodies Ecological Class:
 - Moderate

NOTES

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ISSUE PURPOSE
Environmental Statement

PROJECT NUMBER
60677311

FIGURE TITLE
Gravesend Surface Water Features and Attributes

FIGURE NUMBER
Figure 21.1

Scope and Assessment Methodology

General Approach

- 21.3.4 The qualitative assessment of potential likely significant effects during the construction and operational phases of the Proposed Development has been based on a source-pathway-receptor approach. For an impact on the water environment to exist, the following is required:
- An impact source or cause of effect (such as a structure over a watercourse, the release of polluting chemicals, particulate matter, or biological materials that cause harm or discomfort to humans or other living organisms, or the loss or damage to all or part of a water feature, cuttings/excavations and associated dewatering activities capable of causing temporary or permanent changes to groundwater level or flow pattern and quality (as in the case of groundwater));
 - A receptor that is sensitive to that impact (i.e., waterbodies and the services they support) that could potentially be affected;
 - A pathway by which the two are linked; and
 - All three elements must be present before a potential impact linkage can be realised.
- 21.3.5 The first stage in applying the source-pathway-receptor approach is to identify the causes or sources of potential impact from a development. The sources will be identified through a review of the details of the Proposed Development, including the size and nature of the development, potential construction methodologies and timescales.
- 21.3.6 The next step in the approach is to undertake a review of the potential receptors; that is, the water environment receptors themselves that have the potential to be affected. Water features, including their attributes, will be identified through the desk study described above, and will be surveyed through a site visit at the assessment stage.
- 21.3.7 The last stage of the approach is to determine if there is a viable exposure pathway or a 'mechanism' linking the source to the receptor. This is determined in the context of local conditions relative to water receptors within the site, such as topography, geology, climatic conditions and the nature of the impact (e.g., the mobility of a liquid pollutant or the proximity to works that may physically impact a water feature).
- 21.3.8 Consideration has also been given to the activities associated with the future maintenance and management of the Proposed Development, and whether these have the potential to result in significant effects on the water environment.

Methodology for determining baseline conditions and sensitive receptors

- 21.3.9 The study area for the water environment assessment includes the Proposed Development and a 1km radius from the Site boundary in order to identify water bodies that are most likely to be impacted. However, as water pollution may propagate downstream or there could be downstream flood risk effects, it is also necessary to consider a wider study area along watercourses to identify all the relevant attributes that may be impacted and that contribute to the water bodies overall importance.
- 21.3.10 Consideration has also been given to any surface water or groundwater bodies or water dependent ecological sites outside this study area up to 2km from the site boundary if it is considered that they might be hydraulically linked.

Desk Study

- 21.3.11 A desk-based study was carried out to capture information pertaining the Proposed Development that is not attainable through site survey. A review of relevant information relating to the study area

was undertaken to develop a baseline for WFD catchments, watercourses and surrounding areas. The following data sources were used for the desk study:

- British Geological Survey's (BGS) Geological Mapping Viewer 'Geoindex' website (Ref 21-41);
- Canal and River Trust website (Ref 21-42);
- Centre for Ecology and Hydrology (CEH)'s National River Flow Archive website (Ref 21-43);
- Cranfield University's Soilscape online mapping tool (Ref 21-44);
- Defra's Multi-Agency Geographic Information for the Countryside (MAGIC) website (Ref 21-45);
- Environment Agency Ecology & Fish Data Explorer website (Ref 21-46);
- Environment Agency Main River Network mapping tool (Ref 21-47);
- Environment Agency Water Quality Archive website (Ref 21-48);
- Environment Agency Catchment Data Explorer website (Ref 21-49);
- Environment Agency Farmers website (Ref 21-50);
- Environment Agency online Flood Risk Maps (Ref 21-51);
- Flood Map for Planning website (Ref 21-52);
- Long Term Flood Risk website (Ref 21-53); and
- Ordnance Survey maps (Ref 21-54).

21.3.12 In addition to the above online data and information sources, requests for information under the Freedom of Information Act 2000 were issued to the Environment Agency (for non-publicly available water quality, water resource, flood risk, and WFD data and classifications), Gravesham Council and to Kent County Council for information on Private Water Supplies (PWS) (i.e. small potable water abstractions that are used domestically but are less than 20 m³ per day, which is the threshold for a licence being required from the Environment Agency).

Site Walkover

21.3.13 In addition to the desk study, site surveys have been undertaken. A water environment focused site walkover was undertaken on 8 August 2023. The purpose of the walkover was to ground truth water features provisionally identified from online sources (e.g., Ordnance Survey maps and aerial imagery), to consider their hydromorphological character, and to gather site information useful in determining the risk to water bodies or relevant to the design of the Proposed Development so as to avoid and minimise adverse impacts to water bodies (e.g., topography). The conditions of the survey were dry and sunny with some cloud; however, the previous day was very wet, and so water levels were likely to be above base flow when observed.

Methodology for determining construction effects

21.3.14 A qualitative assessment of the risk to the water environment during construction works has been undertaken, with mitigation measures developed where appropriate to avoid, prevent and minimise the risk of adverse effects to the water environment. This has also included mitigation measures to manage, and control works during construction to avoid, prevent and minimise the risk of pollution and any increase in flood risk.

Methodology for determining operational effects

Drainage Management Plan

21.3.15 An Outline Drainage Management Plan has been prepared to support this planning application (see Drainage Management Plan (Document Reference 30003364-BHK-XX-XX-RP-C-02060). The Outline Drainage Management Plan comprises a concept design of the system, proposing to direct

road surface water and roof water towards filtration trenches which collect the water to traditional piped drainage systems. Treatment measures such as a filtration trench and a 'Downstream DefenderTM' (a type of vortex flow separator) are proposed upstream of the flow control chamber. Roof water from the headhouse shall also be captured by a 'Biodiverse Brown Roof' which will help to reduce the flow from the building.

- 21.3.16 SuDS are generally not possible as there is not enough space to implement a full treatment train.
- 21.3.17 Surface water run off and roof water will be collected by filtration trenches which will be directed towards the Downstream Defender and flow control chamber before being discharged to the existing ditch situated to the southeast of the site. Flow will be controlled at a greenfield rate of 0.4 l/s. Discharge will pass through an 18mm Orifice Plate down a 13.5mm pipe with a 100mm diameter into the ditch. This ditch then passes down into the Thames through a sluice gate TQ 67492 74271. As this ditch is tide locked there is potential for flow to be backed up into the drainage system and risk of fine sediment building up in the ditch. Currently the systems can provide up to one day of storage without any flooding of the site if the system becomes surcharged. This has been deemed sufficient as tidal locking only lasts around half a day.
- 21.3.18 Foul drainage will consist of a 9000L cess pit situated to the southeast of the site as no public foul sewers are available for the site. The pit is situated adjacent to a road to allow access for maintenance and emptying.

Assessment of Surface Water Runoff for Operational Phase

- 21.3.19 During operation, surface water runoff from the Proposed Development may contain pollutants derived from impermeable surfaces (e.g. inert particulates, litter, hydrocarbons, metals, nutrients and de-icing salts). This mixture of pollutants is collectively known as 'urban diffuse pollutants,' and although each pollutant may itself not be present in harmful concentrations, the combined effects over the long term can cause chronic adverse impacts to surface water or groundwater. Changes in impermeable surfaced area within the planning boundary may lead to increases in the rate and quantities of these pollutants being runoff to receiving watercourses. An assessment is therefore undertaken to determine the potential risk to the receiving waterbodies and to inform the Proposed Development of suitable treatment measures.
- 21.3.20 The appropriateness of the surface water drainage measures in terms of providing adequate treatment of diffuse pollutants has been assessed with reference to the Simple Index Assessment method described in the SuDS Manual (Ref 21-32). The Simple Index Approach follows three steps:
- Step 1 – Determine suitable pollution hazard indices for the land use(s);
 - Step 2 – Select SuDS with a total pollution mitigation index that equals or exceeds the pollution hazard index (for three key types of pollutants - total suspended solids, heavy metals and hydrocarbons). Only 50% efficiency should be applied to second, third etc. treatment train components; and
 - Step 3 – If the discharge is to a water body protected for drinking water, consider a more precautionary approach.
- 21.3.21 The SuDS Manual (Ref 21-32) only provides a limited number of land use types and so those selected will be the most suitable for the components of the Proposed Development, based on professional judgement. Where more than one pollution hazard category applies to a component of the Proposed Development, the worst pollution hazard will be selected.

Flood Risk Assessment

- 21.3.22 A FRA has been prepared and this is included with the Planning Application.
- 21.3.23 Any effects identified through the FRA, during either construction or operation phases, have been evaluated and a significance value attributed to each effect in accordance with the methodology outline in this chapter. This impact assessment only considers the potential impact of the Proposed Development on flood risk, not the suitability of the Proposed Development in the context of flood

risk acting on the site. For an assessment of the suitability of the Proposed Development in this location, refer to the FRA.

- 21.3.24 The magnitude of impact was determined based on the criteria in Table 21-4: taking into account the likelihood of the effect occurring. The likelihood of an effect occurring is based on a scale of certain, likely or unlikely. Likelihood has been considered in the case of water resources only, as likelihood is inherently included within the FRA.

Water Framework Directive (Screening and Scoping)

- 21.3.25 A WFD screening and scoping has been produced based on a combination of desk study, hydromorphological walkover, aquatic ecology and water quality surveys. This assessment considers whether the Proposed Development has the potential to:

- Cause deterioration in ecological status and potential of water bodies.
- Prevent water bodies from meeting their objective of 'Good' ecological status/ potential.
- Prevent or compromise WFD objectives being met in other water bodies or water dependent protected areas downstream of the Proposed Development.

- 21.3.26 In undertaking the assessment, consideration has been given to the conservation objectives for any ecologically sensitive sites, where these might be more stringent. The WFD assessment is presented in ES Appendix 13-1. Refer to this appendix for full details of the approach and method of assessment.

Significance Criteria

- 21.3.27 The assessment of effect significance outlined within the below sections is consistent with the terminology and criteria outlined within ES Volume II Chapter 4: EIA Methodology and accords with the relevant British Standards and guidance.
- 21.3.28 The sensitivity of receptors, or importance, of the potentially affected water environment features will be established on the basis of a four-point scale, using the criteria presented in Table 21-3:
- 21.3.29 The magnitude of adverse or beneficial impacts will be determined by the seven-point scale presented in Table 21-5 considering DMRB LA 113 Road drainage and the water environment (Ref 21-56).

Table 21-3: Evaluating the importance for Water Environment

Importance	Type of Receptor			
	Groundwater	Surface Water ¹	Morphology ²	Flood Risk
Very High	Principal aquifer providing a regionally important resource and/or supporting a site protected under international and UK legislation Ecology and Nature Conservation. Groundwater locally supports Groundwater Dependent Terrestrial Ecosystems (GWDTE). Source Protection Zone (SPZ) 1.	Watercourse having a WFD classification shown in a River Basin Management Plan (RBMP) and Q95≥1.0 m³/s. Sites protected/designated under international or UK legislation (SAC, SPA, SSSI, Ramsar, salmonid water) / Species protected by international legislation Ecology and Nature Conservation	Unmodified, near to or pristine conditions, with well-developed and diverse geomorphic forms and processes characteristic of river type.	Essential infrastructure or highly vulnerable Development. Essential infrastructure includes essential transport corridors that have to cross the affected area and utilities infrastructure that needs to be located in a flood risk area for operational reasons, but also wind turbines and solar farms. Highly vulnerable infrastructure includes Police/ambulance/fire stations that need to operate at times of flooding, telecommunications facilities, emergency dispersal points, basement dwellings, caravans/mobile/park homes (permanent residential use), and installations requiring hazardous substances consents.
High	Principal aquifer providing locally important resource or supporting river ecosystem. Groundwater supports a GWDTE. SPZ2	Watercourse having a WFD classification shown in a RBMP and Q95<1.0 m³/s. Species protected under international or UK legislation. Ecology and Nature Conservation	Conforms closely to natural, unaltered state and would often exhibit well developed and diverse geomorphic forms and processes characteristic of river type, with abundant bank side vegetation. Deviates from natural conditions due to direct and/or indirect channel, floodplain, and/or catchment development pressures	More vulnerable development. This includes hospitals, residential dwellings and institutions, non-residential health services, nurseries, and educational establishments, landfill and waste management sites, and holiday sites subject to a specific warning and evacuation plan.

Professional judgement is applied when assigning an importance category to all water features.

¹ All controlled waters are protected from pollution under the Environmental Permitting (England and Wales) Regulation 2016 and the Water Resources Act 1991 (as amended), and future WFD targets also need to be considered.

² Based on the water body 'Reach Conservation Status' developed from Environment Agency conservation status guidance as DMRB guidance does not currently provide any importance criteria for morphology.

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21-10

Importance	Type of Receptor			
	Groundwater	Surface Water ¹	Morphology ²	Flood Risk
Medium	Aquifer providing water for agriculture or industrial use with limited connection to surface water. SPZ3	Watercourses not having a WFD classification shown in a RBMP and Q95>0.001m ³ /s	Shows signs of previous alteration and/ or minor flow regulation but still retains some natural features, or may be recovering toward conditions indicative of the higher category	Less vulnerable development. This includes police/ambulance/fire stations that do not need to remain operational during flooding, shops, restaurants, and offices, land and buildings used for agriculture and forestry, waste treatment, mineral working and processing, water treatment works (that do not need to remain operational at times of flood), and sewerage treatment works (if adequate pollution prevention measures at times of flood are provided).
Low	Unproductive strata	Watercourses not having a WFD classification shown in a RBMP and Q95<0.001m ³ /s	Substantially modified by past land use, previous engineering works or flow regulation and likely to possess an artificial cross-section (e.g., trapezoidal) and would probably be deficient in bedforms and bankside vegetation. Could be realigned or channelised with hard bank protection, or culverted and enclosed. May be significantly impounded or abstracted for water resources use. Could be impacted by navigation, with associated high degree of flow regulation and bank protection, and probable strategic need for maintenance dredging. Artificial and minor drains and ditches would fall into this category.	Water compatible development. This includes flood control infrastructure, water / sewerage transmission and pumping stations, sand/gravel workings, docks/marinas, navigational facilities. MoD installations, water-based recreation/coastguard facilities, and amenity open space.

Table 21-4: Evaluating Magnitude for Water Environment

Impact	Criteria	Description and Examples
Major Adverse	Results in a loss of attribute and/ or quality and integrity of the attribute.	<u>Surface water:</u> Loss or extensive change to a fishery. Loss of regionally important public water supply. Loss or extensive change to a designated nature conservation site. Reduction in water body WFD classification. <u>Groundwater:</u> Loss of, or extensive change to, an aquifer. Loss of regionally important water supply. Loss of, or extensive change to groundwater dependent terrestrial ecosystem (GWDTE) or baseflow contribution to protected surface water bodies. Reduction in water body WFD classification. Loss or significant damage to major structures through subsidence or similar effects. <u>Flood Risk:</u> Increase in peak flood level >100 mm.
Moderate Adverse	Results in impact on integrity of attribute, or loss of part of attribute.	<u>Surface water:</u> Partial loss in productivity of a fishery. Degradation of regionally important public water supply or loss of major commercial/industrial/agricultural supplies. Contribution to reduction in water body WFD classification <u>Groundwater:</u> Partial loss or change to an aquifer. Degradation or regionally important public water supply or loss of significant commercial/industrial/agricultural supplies. Partial loss of the integrity of GWDTE. Contribution to reduction in water body WFD classification. Damage to major structures through subsidence or similar effects or loss of minor structures. <u>Flood Risk:</u> Increase in peak flood level > 50mm
Minor Adverse	Results in some measurable change in attribute's quality or vulnerability.	<u>Surface water:</u> Minor effects on water supplies. <u>Groundwater:</u> Minor effects on an aquifer, GWDTEs, abstractions and structures. <u>Flood Risk:</u> Increase in peak flood level >10mm
Negligible	Results in impact on attribute, but of insufficient magnitude to affect the use or integrity.	<u>Surface / Groundwater:</u> The proposed project is unlikely to affect the integrity of the water environment. <u>Flood Risk:</u> Negligible change to peak flood level ($\leq \pm 10$mm).
Minor Beneficial	Results in some beneficial impact on attribute or a reduced risk of negative impact occurring.	<u>Surface Water:</u> Contribution to minor improvement in water quality, but insufficient to raise WFD classification. <u>Groundwater:</u> Reduction of groundwater hazards to existing structures. Reductions in waterlogging and groundwater flooding. <u>Flood Risk:</u> Creation of flood storage and decrease in peak flood level (>10 mm).

Impact	Criteria	Description and Examples
Moderate beneficial	Results in moderate improvement of attribute quality.	<u>Surface Water:</u> Contribution to improvement in waterbody WFD classification. <u>Groundwater:</u> Contribution to improvement in water body WFD classification. Improvement in water body catchment abstraction management strategy (CAMS) (or equivalent) classification. Support to significant improvements in damaged GWDTE. <u>Flood Risk:</u> Creation of flood storage and decrease in peak flood level (>50 mm).
Major beneficial	Results in major improvement of attribute quality	<u>Surface Water:</u> Removal of existing polluting discharge or removing the likelihood of polluting discharges occurring to a watercourse. Improvement in water body WFD classification. <u>Groundwater:</u> Removal of existing polluting discharge to an aquifer or removing the likelihood of polluting discharges occurring. Recharge of an aquifer. Improvement in water body WFD classification. <u>Flood Risk:</u> Creation of flood storage and decrease in peak flood level (>100 mm).
No change	No loss or alteration of characteristics features or elements; no observable impact in either direction.	

21.3.30 The significance of effects will be determined using the matrix presented in Table 21-5.

21.3.31 The assessment of effect significance outlined within the below sections is consistent with the terminology and criteria outlined within ES Volume II Chapter 4: EIA Methodology of this ES and accords with the relevant British Standards and guidance.

21.3.32 The assessment will consider the magnitude of impacts and the sensitivity of the resources / receptors that could be affected in order to classify the effect. See Table 21-5 for an example classification and significance of effects. Where the matrix allows a range of effect, professional judgement will be used to determine the residual significance.

Table 21-5: Classification and Significance of effect

Importance of the Resource/Sensitivity of Receptor	Magnitude of Potential Change/Impact				
	Major	Moderate	Minor	Negligible	No Change
Very High	Very Large	Large or Very Large	Moderate or Large	Slight	Neutral
High	Large or Very Large	Moderate or Large	Slight or Moderate	Slight	Neutral
Medium	Moderate or Large	Moderate	Slight	Neutral or Slight	Neutral
Low	Slight or Moderate	Slight	Neutral or Slight	Neutral or Slight	Neutral

21.3.33 The terminology that will be used to describe the significance of effects is described in DMRB LA 104 Environmental assessment and monitoring as follows:

- **Very Large** – Effects at this level are material in the decision-making process;
- **Large** – Effects at this level are likely to be material in the decision-making process;
- **Moderate** – Effects at this level can be considered to be material decision-making factors;
- **Slight** – Effects at this level are not material in the decision-making process; and

- **Neutral** – No effects or those that are beneath levels of perception, within normal bounds of variation or within the margin of forecasting error.

21.3.34 The nature of the effects may be either adverse (negative) or beneficial (positive).

21.4 Limitations and Assumptions

- 21.4.1 This assessment is based on baseline data and Proposed Development design information (see ES Volume II Chapter 3 Project Description) available at the time of writing this ES chapter.
- 21.4.2 A request for Private Water Supply (PWS) data was requested from Kent County Council, however, they do not hold that information. Data has been requested from Gravesham Borough Council, however, at the time of writing is not currently available.
- 21.4.3 Spoil material from the Tilbury and Gravesend Sites are clean and free of any contamination given their depths and location. It is also assumed that the launch and receiving jetties, including dredging for boat access, will use their standard procedures and mitigation measures for the material to be unloaded and disposed of at a selected site for reuse, such as Cliffe Pools (or similar disposal site with habitat restoration benefits) without causing any water pollution risks. Therefore, the disposal site and jetties are not considered any further.
- 21.4.4 Within the impact assessment, flood risk has been considered in terms of the potential for the Proposed Development to change existing flood risk (from all sources) and to impact on receptors including existing infrastructure assets, residential buildings, commercial buildings, agricultural land, and property potentially affected by the Proposed Development.
- 21.4.5 The FRA (Document Reference 30003364-BHK-XX-XX-RA-C-02002) and Outline Drainage Management Plan (Document Reference 30003364-BHK-XX-XX-RP-C-02060) have been based on desktop surveys, a site walkover and site layout proposals. Where available, topographical data has been used to support the FRA. In the absence of topographical data, LiDAR data has been used to inform the FRA and Outline Drainage Management Plan.
- 21.4.6 With regards to the assessment of potential cumulative effects with other committed developments, for any planning applications which are granted and begin construction/are completed, it is assumed they will follow all best practice and legislation and will not cause any significant changes to the baseline conditions of the water resources in the area.

21.5 Consultation Undertaken

- 21.5.1 A summary of the Water Environment related response is included in Table 21-6:. The full list of responses to the comments raised in the Screening Opinion is provided in ES Volume II Chapter 5 Consultation.

Table 21-6: Comments raised in Screening Opinion

Consultee	Comments Raised	Response provided in the ES / Planning Application
Port of London Authority	<i>To note if any new outfall to the tidal Thames is required as part of the works a River Works Licence (RWL) will be required with the PLA and the PLA's Statutory Consents and Compliance Team should be contacted at lic.app@pla.co.uk. Further information on this will be required in the forthcoming Drainage Strategy as part of any forthcoming planning application.</i>	No new outfall is planned to the tidal Thames. All new outfall will be to the adjacent ditches.
Environment Agency	<i>This FRA should demonstrate that the 'development will be safe for its lifetime taking account of the vulnerability of its</i>	The FRA (ES Appendix 12-2) discusses how the Gravesend flood risk will deteriorate over time and how

Consultee	Comments Raised	Response provided in the ES / Planning Application
	<i>users, without increasing flood risk elsewhere, and, where possible, will reduce flood risk overall'.</i>	mitigation measures should reduce this risk.
	<i>Sustainable Drainage Systems (SuDs) should always be carefully considered in discussions with the Lead Local Flood Authority.</i>	Filter trenches and a Downstream Defender have been incorporated into the Proposed Development design. Biodiverse brown roof for the compounds are also planned which will help to treat water runoff. See the Outline Drainage Management Plan for more details.
	<i>For land that may have been affected by contamination as a result of its previous use or that of the surrounding land, sufficient information should be provided with the planning application to satisfy the requirements of the NPPF for dealing with land contamination. This should take the form of a Preliminary Risk Assessment (including a desk study, conceptual model and initial assessment of risk), and <u>provide assurance that the risk to the water environment is fully understood and can be addressed through appropriate measures.</u></i>	Discussions on mitigation measures during construction and operation are discussed in Section 21.8. The Tilbury Site has risk of mobilising historic contamination which could infiltrate the water environment. Following mitigation measures outlined in the Good Practice Guidance (GPGs) and CEMP should help to avoid any adverse impacts. Please refer to Stage 1, Tier 1 PRA Report – Tilbury and Stage 1, Tier 1 PRA Report – Gravesend for more detail.
Lead Local Flood Authority: Kent County Council (Flood Risk Officer) Thurrock Council (Strategic Transport Officer covering flooding matters)	A meeting was held with the LLFAs to discuss the Proposed Development and associated Drainage Management Strategy. The drainage management strategy was discussed consisting of channel drains to pick up surface water, rain water pipes on headhouse, capturing and discharging via an outfall in to the existing drainage ditch. Using SuDS guidance, the site has been determined to be of low/medium risk of surface water pollution. The majority of the site will have free drainage stone chipping with a type 3 sub-base so water will soak away naturally. Impermeable surfacing makes up approximately 25% of the site. The site will have filtration trenches and downstream defenders. It is anticipated the site can hold water for a whole day. A biodiverse brown roof is proposed on the headhouse. SuDS are unable to be incorporated due to National Grid operational requirements which are further explained in the drainage strategy submitted within this planning application.	Filter trenches and a Downstream Defender (a type of vortex flow separator) have been incorporated into the Proposed Development design. Biodiverse brown roof for the compounds are also planned which will help to treat water runoff falling on these surfaces. See the Outline Drainage Management Plan for more information.
Lower Medway Internal Drainage Board (henceforth)	Land Drainage Consent is required from the North Kent Marshes Internal	Land Drainage Consent will be acquired for Ordinary Watercourse and the 'adopted' watercourse when

Consultee	Comments Raised	Response provided in the ES / Planning Application
referred to as the IDB)	Drainage Board for the following scenarios: For an ordinary watercourse within the Board's District, Land Drainage Consent is required from the Board for any works within the cross-sectional area of the channel of a watercourse, under the Land Drainage Act, 1991 and Byelaw 4. For a watercourse that has been 'adopted' by the Board, Land Drainage Consent is required from the Board for any works within the cross-sectional area of the channel of a watercourse, under the Land Drainage Act, 1991 and Byelaw 4 and for any works within 8m from the top of the bank, under Byelaw 10. The 8m should remain clear and be of a suitable gradient to allow machine access for watercourse maintenance.	required as outlined in the Mitigation Section.

21.6 Baseline Environment

21.6.1 This section presents baseline information for the Site and study area where relevant.

Catchment Characteristics

Topography, land use and rainfall

21.6.2 Generally, the topography of the site is flat, with elevations typically ranging 3 m to 7 m with elevations increasing slowly away from the River Thames.

21.6.3 The Gravesend Site is located just to the west of a rifle range (Milton Rifle Range) that has been there for at least 60 years and is partially leased and used as a Police Training Centre for rifle shooting. The land immediately west comprises of the Thameside Campus (National Maritime Training Centre), Metropolitan Police Specialist Training Centre MPSTC and Thames and the Medway Canal Association.

Rainfall

21.6.4 Climate data for the study area has been obtained from the Met office website. The closest historical weather monitoring station is Gillingham Football Club located close to the Medway River approximately 10 km to the southeast. Based on average rainfall data from this monitoring station for the period 1991-2020 the study area is expected to receive approximately 600 mm per year. This is well below the UK average from the same period of 1,116 mm. This demonstrates that the area can be categorised as dry in comparison to most of the United Kingdom.

Geology and Soils

Bedrock Geology

21.6.5 The Gravesend Site and tunnel alignment underlie the Lews Nodular Chalk Formation, Seaford Chalk Formation and Newhaven Chalk Formation. BGS give the following descriptions for each:

- Lews Nodular Chalk Formation (Turonian-Coniacian Age): interbeds of nodular chalks, soft-medium hard chalks, marls and some griotte chalks. Softer chalks are featured towards the top

of the formation. Seams of nodular flint begin at the base and continue throughout. The formation has a thickness ranging from 35 m to 60 m in the east to 80 m in the west (Ref 21-57);

- Seaford Chalk Formation (Coniacian-Santonian Age): Water chalk with semi-continuous nodular and tabular flint seams. The lower beds have hardgrounds and thin marls. The beds are generally 55 m to 60 m thick (Ref 21-58); and
- Newhaven Chalk Formation (Santonian-Campanian Age): Soft to Medium hard white chalks with marl seams and flint bands. Has a thickness of approximately 45 m to 75 m (Ref 21-59).

21.6.6 The Thanet Formation (sand) is situated approximately 950m southeast from the Gravesend Site. This unit rest upon the Chalk Group (Ref 21-60).

Superficial Deposits

21.6.7 The superficial deposits of the area consist of alluvium (clay, silt, sand and peat) which underlies the Gravesend Site.

21.6.8 Borehole records for the southern Gravesend Site show that the superficial deposits also consist of clays, silt, and peats but also gravel layers before reaching the Chalk at around 21 m bgl.

Hydrogeology

21.6.9 Groundwater appears to be relatively shallow with level ranging from 0.5 m to 10 m below ground level (bgl). However, there is limited groundwater level data available on BGS GeoIndex. The available data includes:

- TQ67NE36 (NGR 565690 175330): 3 m bgl;
- TQ67NE300 (NGR 565830 175660): 0.53 m bgl; and
- TQ67NE35 (565680 175330): 10.80 m bgl.

21.6.10 A lot of these water levels were taken during the drilling process of the well. Therefore, may not reflect the seasonal and true nature of the underlying aquifer. However, it could be assumed that locally groundwater flows towards the Thames.

21.6.11 The North Kent Medway Chalk Water Body underlies the Gravesend Site (Ref 21-62). This water body has a groundwater (and surface) area of 233.666 km². The aquifer has been classified as Poor overall. The full Cycle 3 (2019) WFD classification for this water body is presented in Table 21-7. It has also been noted is a highly productive aquifer and classified as a Principle aquifer by the Environment Agency. Principle aquifers provide significant quantities of drinking water and water for business needs, they may also support rivers, lakes and wetlands.

21.6.12 According the 625K hydrogeological map of the UK (Ref 21-61) the aquifer yields approximately 50 to 100l/s from a large diameter borehole. Water is categorised as hard to very hard.

21.6.13 The superficial deposits within this area are designated as a Secondary (undifferentiated) aquifer. This aquifer type is defined by having variable characteristics which make them either a Secondary A or Secondary B. Secondary A aquifers comprise of permeable layers which can support local water supplies, and base flow to rivers, while Secondary B aquifers have slightly lower permeability layers. This alluvium superficial aquifer will likely consist of perched isolated aquifer within sands and gravel separated by clays.

Table 21-7: WFD Groundwater Body Classifications - Gravesend (Ref 21-62)

Classification Item	North Kent Medway Chalk Water Body (Cycle 3)
Overall Water Body	Poor
Quantitative	Poor
Quantitative Status element	Poor
Quantitative Dependent Surface Water Body Status	Poor
Quantitative GWDTEs test	Good
Quantitative Saline Intrusion	Good
Quantitative Water Balance	Poor
Chemical (GW)	Poor
Chemical Status element	Poor
Chemical Dependent Surface Water Body Status	Good
Chemical Drinking Water Protected Area	Poor
Chemical GWDTEs test	Good
Chemical Saline Intrusion	Good
General Chemical Test	Poor
Prevent and Limit Objective	Active
Trend Assessment	Upward trend

21.6.14 Groundwater appears to be relatively shallow with level ranging from 2.2 m to 14.4 m bgl. However, there is limited groundwater level data available on BGS GeoIndex. The available data includes:

- TQ67SE149 (566960, 174120): 2.24 m bgl;
- TQ67SE479 (567831, 1742280): 10 m bgl;
- TQ67SE337 (567845, 174234): 14 m bgl; and
- TQ67SE336 (567883,173842): 14.4 m bgl.

21.6.15 A lot of these water levels were taken during the drilling process of the well. Therefore, may not reflect the seasonal and true nature of the underlying aquifer. However, it could be assumed that locally groundwater flows towards the Thames.

Groundwater Dependent Terrestrial Ecosystems

21.6.16 The Thames Estuary and Marshes are located approximately 600 m to the east along the Thames estuary and directly south of the Thames and Medway canal. It is a water dependant designated site with a diversity of habitats including grazing marsh, saltmarsh and mudflats. It has been designated as both a SSSI and Ramsar site. It is unlikely that the Thames Estuary and Marshes will be impacted construction works and operation as they are situated upstream and over 250 m east from the Proposed Development. Therefore, they are scoped out for the remainder of this report.

21.6.17 Ordnance Survey maps (Ref 21-54), list a number of undesignated marshes around the Gravesend Site study area. It is likely that these marshes are groundwater fed from shallow superficial aquifers. The marshes listed include:

- Eastcourt Marshes (280m east of red line boundary);
- Shorne Marshes (1800m east of red line boundary);
- Westcount Marshes (400m southwest of red line boundary);
- Great Clane Lane Marshes (400m south of red line boundary); and

- Filborough Marshes (800m southeast of red line boundary).

21.6.18 The above marshes are undesignated, and the majority are situated upstream of the Proposed Development or over 250m from the Proposed Development. Therefore, it is unlikely there will be any impact, and so they are scoped out for the remainder of this report.

Surface water features

21.6.19 The Thames Estuary is situated approximately 170m north of the Proposed Development. It is the only WFD designated surface water body within the site boundary and study area. It is a large heavily modified water body with a surface area of 44.2km². The Gravesend Site has a freshwater ditch which flows around its perimeter and enters the Thames via a sluice gate at TQ 67492 74271. The ditch starts from TQ 68953 73890 to the east of the site and runs parallel to the Thames and Medway Canal until TQ 67469 74089 where the ditch the splits north and west. Connected at TQ 67553 74043 is another ditch located the east of the site at the riffle range, it has several tributaries. The Thames and Medway Canal was used until 1934 but is now disused and only an isolated open reach approximately 3 km still exists. It is separated from the Proposed Development by Wharf Road. Refer to Figure 21-1: Gravesend Surface Water Features for the locations of the above ditches and the canal.

Thames Estuary

21.6.20 The Thames Estuary is considered a main river and at this location is designated under the Water Environment (Water Framework Directive) (England and Wales) Regulations 2017 and Thames River Basin Management Plan (RBMP) as the Thames Middle transitional water body (TRaC). It is a large heavily modified water body with a surface area of 44.2km². Under cycle 3 (2022) of the Thames RBMP (Ref 21-63) as presented in Table 21-8 it is currently at Moderate Ecological Potential (but Good in regard to fish, invertebrates, macroalgae and phytoplankton) and failing to meet Good Chemical Status in the 2019 results. The Reasons for Not Achieving Good (RNAG) Ecological Status are listed on the catchment data explorer website (CDE) (Ref 21-49) as diffuse pollution from urban development, contaminated sediments, landfill leaching, sewage discharge and physical modifications. This water body is at its lower objective of Moderate Ecological Status by 2015 (due to disproportionate costs and burdens and good status being prevented by an artificial/heavily modified designated use).

Table 21-8: Thames Middle Classifications (Ref 21-63)

WFD Parameter	Thames Middle (Cycle 3: 2019)	Thames Middle (Cycle 3: 2022)
Ecological	Moderate	Moderate
Biological quality elements	Moderate	Moderate
Angiosperms	Moderate	Moderate
Saltmarsh	Moderate	Moderate
Fish	Good	Good
Invertebrates	Good	Good
Infaunal Quality Index	Good	Good
Macroalgae	Good	Good
Fucoid Extent	Good	Good
Opportunistic Macroalgae	High	High
Phytoplankton	Good	Good
Physico-chemical quality elements	Moderate	Moderate
Dissolved Inorganic Nitrogen	Moderate	Moderate

WFD Parameter	Thames Middle (Cycle 3: 2019)	Thames Middle (Cycle 3: 2022)
Dissolved oxygen	Good	Good
Supporting elements (Surface Water)	Moderate	Moderate
Mitigation Measures Assessment	Moderate or less	Moderate or less
Specific pollutants	Moderate	Moderate
2,4-dichlorophenol	High	High
2,4-dichlorophenoxyacetic acid	High	High
Arsenic	High	High
Chlorothalonil	High	High
Chromium (VI)	High	High
Chemical	Fail	Does not require assessment
Priority Hazardous Substances	Fail	Does not require assessment

21.6.21 The Environment Agency monitor water levels along the tidal Thames Estuary with the nearest monitoring station around 2500m upstream, Tilbury Monitoring Station (NGR 562320, 175670) (Ref 21-65). The usual range of the Thames Tideway at Tilbury is between -2.66 m and 3.73 mAOD. It has been between these levels for 90% of the time since monitoring began (Ref 21-65).

Table 21-9 displays the water quality data collected from Ovens Buoy and Note* EQS is Environmental Quality Standard

21.6.22 Table 21-10 displays the results from Thames at Gravesend from January 2023 until July 2023. The results suggest the Thames is well oxygenated with a percentage ranging from 76.5 to 96.5% at Ovens Buoy and 75% to 91.50% at Gravesend.

Table 21-9: Water Quality Data Collected at Thames at Ovens Buoy from 2023

Determinand	Units	EQS* for Estuaries and Coastal Waters	Max	Min	Average
Ammoniacal Nitrogen, Filtered as N	mg/l		0.09	0.01	0.06
Arsenic, Dissolved	ug/l	25	2.30	1.40	1.88
Benzo(a)Pyrene	ug/l		0.06	0.00	0.01
Benzo(b)Fluoranthene	ug/l		0.05	0.00	0.01
Benzo(g,h,i)Perylene	ug/l		0.05	0.00	0.01
Benzo(k)Fluoranthene	ug/l		0.03	0.00	0.01
Cadmium, Dissolved	ug/l		0.07	0.03	0.04
Carbon, Organic, Dissolved as C :- {DOC}	mg/l		5.10	3.50	4.34
Chlorophyll : Acetone Extract	ug/l		17.00	2.50	6.03
Copper, Dissolved	ug/l	3.76	4.10	2.80	3.33
Fluoranthene	ug/l		0.05	0.00	0.01
Indeno(1,2,3-cd)pyrene	ug/l		0.05	0.00	0.01
Lead, Dissolved	ug/l		0.12	0.05	0.09
Mercury, Dissolved	ug/l		0.01	0.01	0.01
Nickel, Dissolved	ug/l		2.10	1.40	1.80

Determinand	Units	EQS* for Estuaries and Coastal Waters	Max	Min	Average
Nitrate, Filtered as N	mg/l		5.97	2.79	4.37
Nitrite, Filtered as N	mg/l		0.03	0.01	0.02
Nitrogen, Dissolved Inorganic : as N	mg/l		6.09	2.83	4.44
Nitrogen, Total Oxidised, Filtered as N	mg/l		6.00	2.80	4.39
Orthophosphate, Filtered as P	mg/l		0.60	0.22	0.38
Oxygen, Dissolved as O2	mg/l		9.78	6.32	8.70
Oxygen, Dissolved, % Saturation	%		96.50	76.60	86.66
Perfluorooctanoate anion	ug/l		0.007	0.000	0.003
Perfluorooctylsulphonate anion	ug/l		0.007	0.000	0.003
Silicate, Filtered as SiO2	mg/l		7.60	2.00	4.37
Zinc, Dissolved	ug/l	6.8	8.20	4.3	6.01

Note* EQS is Environmental Quality Standard

Table 21-10: Water Quality Data Collected at Thames at Gravesend from 2023

Determinand	Units	EQS for Estuaries and Coastal Waters	Max	Min	Average
Ammoniacal Nitrogen, Filtered as N	mg/l		0.10	0.01	0.05
Arsenic, Dissolved	ug/l	25	2.50	1.40	1.90
Atrazine	ug/l		0.01	0.00	0.00
Benzo(a)Pyrene	ug/l		0.04	0.00	0.01
Benzo(b)Fluoranthene	ug/l		0.04	0.00	0.01
Benzo(g,h,i)Perylene	ug/l		0.03	0.00	0.01
Benzo(k)Fluoranthene	ug/l		0.02	0.00	0.00
Cadmium, Dissolved	ug/l		0.07	0.03	0.04
Carbon, Organic, Dissolved as C :- {DOC}	mg/l		6.00	3.60	4.56
Chlorophyll : Acetone Extract	ug/l		13.00	2.20	4.73
Copper, Dissolved	ug/l	3.76	4.20	2.90	3.53
Fluoranthene	ug/l		0.05	0.00	0.01
Indeno(1,2,3-cd)pyrene	ug/l		0.04	0.00	0.01
Lead, Dissolved	ug/l		0.14	0.07	0.11
Mercury, Dissolved	ug/l		0.01	0.01	0.01
Nickel, Dissolved	ug/l		2.20	1.60	1.94
Nitrate, Filtered as N	mg/l		7.16	3.69	5.26
Nitrite, Filtered as N	mg/l		0.04	0.01	0.02
Nitrogen, Dissolved Inorganic : as N	mg/l		7.25	3.74	5.34
Nitrogen, Total Oxidised, Filtered as N	mg/l		7.20	3.70	5.29
Orthophosphate, Filtered as P	mg/l		0.62	0.32	0.45

Determinand	Units	EQS for Estuaries and Coastal Waters	Max	Min	Average
Oxygen, Dissolved as O ₂	mg/l		10.10	6.22	8.62
Oxygen, Dissolved, % Saturation	%		91.50	75.00	84.36
Pentachlorophenol	ug/l		<0.02	<0.02	<0.02
Perfluorooctanoate anion	ug/l		0.01	0.00	0.01
Perfluorooctylsulphonate anion	ug/l		0.01	0.00	0.00
Silicate, Filtered as SiO ₂	mg/l		9.20	2.00	5.29
Zinc, Dissolved	ug/l	6.8	8.50	4.80	6.63

Note* EQS is Environmental Quality Standard

- 21.6.23 There are number of water features within the study area, including drains, ditches and ponds. All of the watercourses are within the Medway Lower operational catchment of the Thames River Basin Management Plan (RBMP) but are not designated as WFD water bodies in their own right. They have been identified on the basis of Ordnance Survey Mapping and a site walkover and are listed in Table 21-11 and illustrated on Figure 21-1: Gravesend Surface Water Features.
- 21.6.24 The following water features are all within the North Kent Internal Drainage Board boundary.
- 21.6.25 The Thames and Medway Canal ('GS1') is a disused canal which is situated south of Wharf Road and approximately 80m south of the Proposed Headhouse Location. This canal was used until 1934 but is now disused and only an isolated open reach of approximately 3 km now still exists.
- 21.6.26 The Proposed Development Site is bounded to the west, south and east by an unnamed drain (listed as 'GS2' below and on Figure 21-1. The drain is connected to the Thames Estuary via a sluice gate at TQ 67492 74271 through the Thames flood defence embankment (see Plate 21-1: Photo 12G and 12H). At the time of the site visit water was flowing out of GS2 on the ebb tide. Observations of the channel, at least close to the sluice gate, suggest that GS2 is tidally influenced with saline ingress from the Thames (as opposed to being simply tide-locked at high tide).

Plate 21-1: Photos 12G (left) and 12H (right) – GS2 and sluice gate taken during site visit



Table 21-11: Water features within the Gravesend Study Area (see Figure 21-1)

Name	ID	Grid reference	Proximity to Site	Description	Scoped In/Scoped Out
Thames and Medway Canal	GS1	TQ 67421 73981	Approx. 10m south from temporary works area	This canal was used until 1934 but is now disused and only an isolated open reach approximately 3 km long still exists. As this water feature is upstream of the site, it is unlikely to be impacted.	Scoped In Although it is upstream of site it is very close to the temporary works area
Unnamed Watercourse surrounding Site	GS2	TQ 67479 74127	Drain which runs around the Site development.	From TQ 68953 73890 the drain runs parallel to the Thames and Medway Canal. At TQ 67469 74089 the drain split north and west. The west drain curves around the southern end of the site and then travel north until TQ 67342 74247. The northern drain travel north until it meets a sluice gate TQ 67492 74271, where it will then enter the Thames. GS2 has been designated as an ordinary watercourse within the IDB.	Scoped In Within the vicinity of the works and permanent structure. Will receive surface water discharges from the Proposed Development.
Unnamed Watercourses collectively referred to as GS3	GS3	See Figure 21-1	A number of drains situated south of the Site and the disused Thames and Medway Canal	These drains outline field, paths and tracks.	Scoped Out They are upgradient of the proposed works and any contaminants that would travel south from the Site would likely be intercepted by the Thames and Medway Canal.
Unnamed Watercourse	GS4	TQ 68830 74178, TQ 68640 74105, TQ 68662 73946, TQ 68534 74250, TQ 68437 73884, TQ 68463 74386, TQ 68337 74090	Approx. 300m east of closest approach	These drains outline fields, paths and tracks.	Scoped Out More than 250m away from works, so unlikely to be impacted
Unnamed Watercourses	GS5	TQ 67750 74122 TQ 67754 74304 TQ 68130 74167	Approx. 70m east of closest approach	These watercourses are situated within the riffle range area. One is located in the centre between TQ 67957 74088 to TQ 67553 74043 with around four watercourses joining. Another is situated around the northern edge of the riffle range. GS5 appears to be connected to GS2 at TQ	Scoped In Within 250m of the Proposed Development works

Name	ID	Grid reference	Proximity to Site	Description	Scoped In/Scoped Out
				67553 74043. These drains have also been designated as adopted watercourses by the Internal Drainage Board.	
Ponds	GS6	TQ 68183 74218 TQ 68339 74266	Approx. 300m east of closest approach	Small water bodies with the largest having an 11,500m ² area. These ponds appear to be unconnected to any nearby drains and watercourses and appear man made.	Scoped Out More than 250m away from works, so unlikely to be impacted and there are no obvious flow paths from the Proposed Development.

21.6.27 For the remainder of this chapter the following watercourses that will be discussed include GS1, GS2 and GS5 for the Gravesend Site.

Water Resources

Water Abstractions and Discharges

21.6.28 There are three abstraction points and three active discharge points located within the Gravesend study area. They are described below in Table 21-12 and Table 21-13 and shown on Figure 21-2 . The majority of abstraction and discharge points are over 250m outside of the red line boundary. Therefore, are unlikely to be impacted by the site activities so will be scoped out for the remainder of this report.

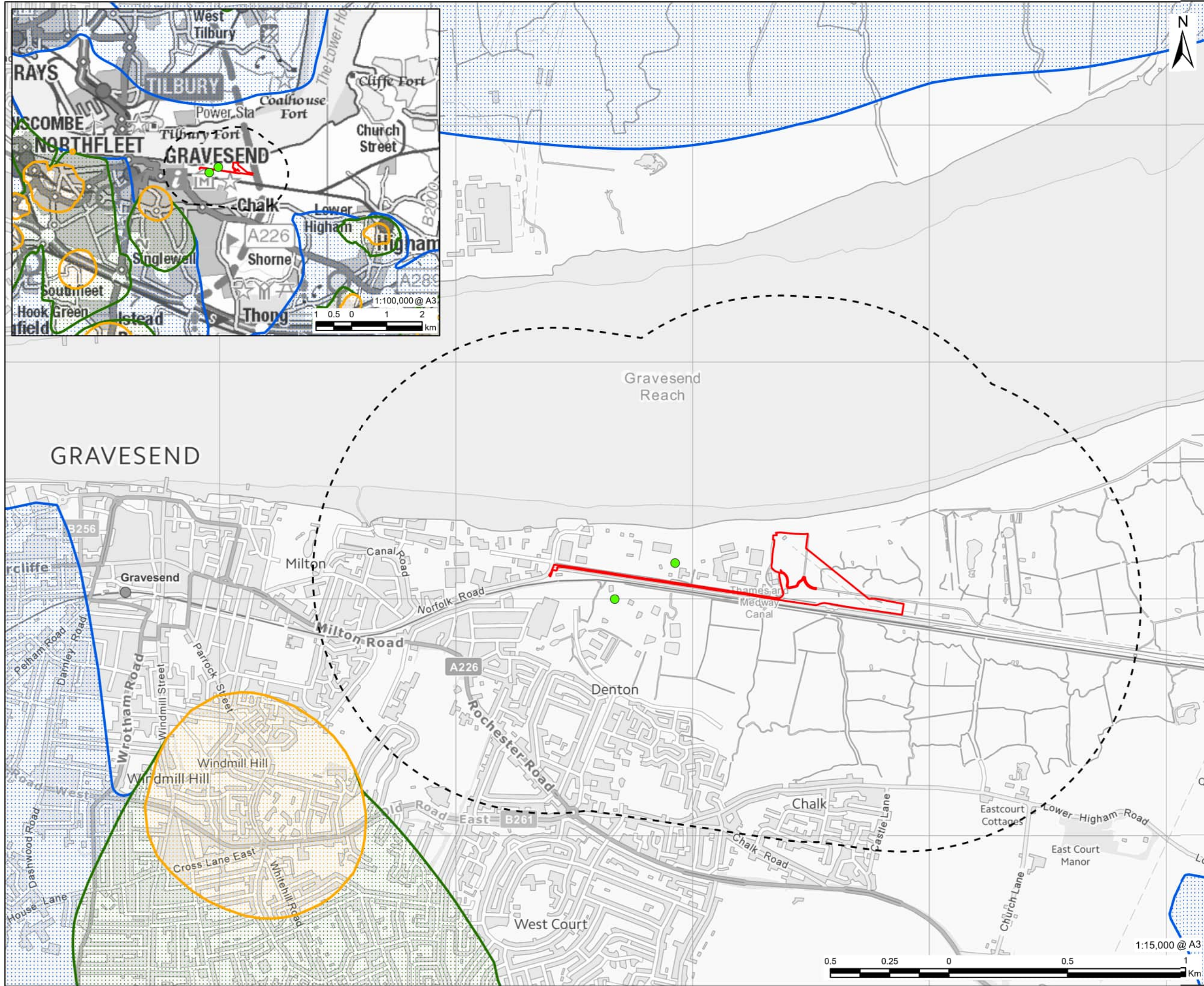
Table 21-12: Abstraction Points situated with Gravesend Study Area (Data received from Environment Agency)

	Point A, S Drift, Underground Gravel Strata	Denton New Cut-Canal Restoration	Point 1, Borehole at Gravesend Sewage works in Kent
Licence Holder Name	J Clubb Ltd	Gravesham Borough Council	Southern Water Services Ltd
Abstraction Licence Number	9/40/01/0498/G	SO/040/0001/001/R01	9/40/01/0508/G
Grid reference	TQ6692574152	TQ6746874076	TQ6667074000
Proximity to Site	450m west of the red line boundary	Situated on GS2	750m west of the red line boundary
Source Type	Groundwater (River and River Terrace Gravels)	Surface Water	Groundwater (HSME Medway Estuary Chalk)
Use Description	Mineral Washing (Industrial, Commercial and Public Services)	River/Wetland Support (Environmental)	General Washing/Process Washing (Industrial, Commercial and Public Services)
Max Daily Quantity (m ³)	336	1,728	340
Max Annual Quantity (m ³)	83,969	50,000	55,000

Table 21-13: Discharge Points situated within the Gravesend Study Area (Data received from Environment Agency)

Permit Number	Permit Holder	Start Date	Grid Reference	Site	Permit Number
SO/P09285/001	Service Support (Gravesend) Ltd	20/03/2001	TQ6701074130 (360m west the red line boundary)	Gravesend Training Complex (Domestic property (single) (incl farm house))	SO/P09285/001
TH/CATM.2969/007	Southern Water Services Ltd	30/11/2021	TQ6701074130 (400m west the red line boundary)	Gravesend WWTW (WwTW/Sewage Treatment Works)	TH/CATM.2969/007
SO/P06840/001	Mr P Bell	22/08/1997	TQ6740074100 (situated on GS2)	Fire Fighting Training Centre (Education/Nursery/School/College/University/Training Venue)	SO/P06840/001

21.6.29 A data request has also been sent to all local authorities within the study area for information on Public Water Supplies (i.e., unlicensed water abstractions as they are less than 20m³ per day but that are used for domestic supply). Kent County Council and Medway Council do not hold any information. Data has also been requested from Gravesham Borough Council but nothing had been received at the time of writing.



PROJECT
TKRE National Grid

CLIENT
National Grid

CONSULTANT
AECOM Limited
100 Embankment
Cathedral Approach
Manchester, M3 7FB
www.aecom.com

LEGEND

- Red Line Boundary (Above Ground)
- 1km Study Area
- EA Abstraction Licence

Source Protection Zone:

- Zone I - Inner Protection Zone
- Zone II - Outer Protection Zone
- Zone III - Total Catchment

NOTES

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ISSUE PURPOSE
Environmental Statement

PROJECT NUMBER
60677311

FIGURE TITLE
Gravesend Groundwater Features

FIGURE NUMBER
Figure 21.2

Drinking Water Protected Areas

21.6.31 Drinking Water Protected Areas (DrWPA) are, within the WFD, where raw water is abstracted from rivers and reservoirs. They are defined as locations where raw water abstracted is used for human consumption providing around 10m³ a day or serving more than 50 people. All groundwater bodies including North Kent Medway Chalk Water Body and South Essex Thurrock Chalk Water Body are considered as a DrWPA in England.

Drinking Water Safeguard Zones

21.6.32 Drinking Water Safeguard Zones are catchment areas that influence the water quality for their respective Drinking Water Protected Area, which are at risk of failing the drinking water protection objectives. In these areas the use of certain substances, such as pesticides, must be carefully managed to prevent the pollution of raw water sources that are used to provide drinking water.

21.6.33 There are two groundwater Drinking Water Safeguard Zones situated 3,200m southeast and 2,000m southwest. They are unlikely to be impacted as they are over 1,000m from the study area.

Nitrate Vulnerable Zones

21.6.34 Nitrate Vulnerable Zones (NVZs) are statutory designated areas as being at risk from agricultural nitrate pollution and includes about 55% of land in England.

21.6.35 The entire Gravesend Site is situated within the North Kent NVZ which is a groundwater NVZ (ID: 65) and the Coastal Streams to lower Thames NVZ which is a surface water NVZ (ID: 665).

Source Protection Zones

21.6.36 Source Protection Zones (SPZs) are defined zones centred on groundwater sources such as wells, boreholes and springs used for public drinking water supply. These zones show the risk of contamination from any activities that might cause pollution to the source and surrounding area. The closer the activity to the source, the greater the risk.

21.6.37 No SPZs are situated within the Gravesend study area. However, there are two inner protection zones (Zone II) situated 2000 m southwest and 4000 m southeast (See Figure 21-2). They are unlikely to be impacted by the Proposed Development as it is situated over 1,000 m away from the Site.

Water Pollution Incidents

21.6.38 According to the data available on the Environmental Pollution Incidents Portal (Ref 21-71) there have been no category 1 or 2 water pollution events within the study area between 2018 and 2023.

Water Dependent Ecological Areas

Aquatic Ecology

21.6.39 According to the Environment Agency the following surveys have taken place over the last ten years:

- There have been fish surveys carried out at Denton Wharf (TQ6664674338) located on the southern side of the River Thames, approximately 700 m west from the Gravesend Site. The surveys included 33 surveys at Denton Wharf Seine net (38689), 15 surveys at Denton Wharf Kick sample (38690) and 16 surveys at Denton Wharf Beam Trawl (38691) between 2011 and 2019. In September 2019 at Denton Wharf Seine net (38689) found a total of 39 fish from 15 different species including Herring (13 fish counted), flounder (7 fish counted) and common goby (6 fish counted).
- A Benthic Invertebrate survey was carried out in May 2015 at TQ5600077000 (ID: 161276). A total of 898 of invertebrates were collected ranging from 17 different species. These include: 468 Corophium Volutator and 272 Corophiidae.

- Numerous Phytoplankton surveys have been carried out at TQ6490074600 (ID: 156465) between 2013 and 2023. In 2023, 13 different species were collected.

21.6.40 There was no confirmed evidence of water voles during the site visit for the Gravesend Site. However, due to suitability for the site and discussions with National Cycle Route operator, Sustrans, it is likely that water voles are present in at least low numbers in all of the ditches within or adjacent to the site (GS2), see ES Volume VI Appendix 7.5 for further details. GCN eDNA surveys were also carried out and showed that crested newt are considered likely to be absent from the Gravesend Site. No surveys were carried out at the Thames and Medway Canal, but ES Appendix 7.5 identify the canal would contain suitable habitat for water voles. The Kent and Medway Biological Records Centre (Ref 21-91) did identify a water vole record situated 15m south of the Gravesend Site. However, these water bodies are separated from the Proposed Development by areas of retained terrestrial habitat and there is negligible risk of any species using these watercourses being subject to impacts.

Designated Sites of Importance

21.6.41 The South Thames Estuary and Marshes Special Protection Area (SPA), Ramsar and SSSI is located approximately 670 m to the east from the Proposed Gravesend SEC along the Thames Estuary. It is a water dependant designated site with a diversity of habitats including grazing marsh, saltmarsh and mudflats. The risk from water pollution impacts from the Proposed Development to these designated sites would be indirect and will be significantly limited by available dilution and dispersion of any potential contamination in the estuary, as well as potential tidal influences on the impact pathway. For further information on designated sites of ecological importance refer to ES Volume IV Chapter 15: Biodiversity – Gravesend.

Flood Risk Baseline

Fluvial/Tidal Flood Risk

21.6.42 The Environment Agency Flood Map for Planning (Ref 21-65) shows that the Gravesend Site is located within Flood Zone 3. Flood Zone 3 is defined as land which in any year has a 1% or more chance of flooding from rivers, or a 0.5% or more chance of flooding from the sea when flood defences are not considered. The Environment Agency's Reduction in Risk of Flooding from Rivers and the Sea due to Defences (Ref 21-66) shows that the majority of the Gravesend Sites are in an area where there is a reduction in risk of flooding from rivers and the sea due to defences present along the banks of the Thames estuary. The design standard of protection of the defences for both sites is up to the 0.1% AEP event. The main source of flooding for both sites is due to the Thames estuary. As mentioned in the previous sections there are a series of ditches that are part of Eastcourt Marshes which are recognised as Main River which bound the east and south of the Gravesend Site.

21.6.43 According to the FRA there is a potential risk of tidal flooding and for fluvial flooding on the Gravesend Site. Fluvial and tidal flooding from the Thames Estuary is said to have a very low risk to low risk of flooding. The main risk of flooding is the overtopping or breaching of the flood defences. The risk of flooding is said to increase over time due to flood defence levels being maintained at their current levels under TE2100 Policy Plans (Ref 21-30).

Surface Water Flood Risk (Pluvial)

21.6.44 The Environment Agency Flood Risk from Surface Water (Ref 21-67) map indicates that the majority of the site is located within an area of very low risk from surface water flooding. Very low means that the area has a chance of flooding of less than 0.1% each year. At the southern and eastern boundary of the Site, there are areas of medium risk associated with the Main River. See Figure 3b Appendix A in the FRA.

21.6.45 The Gravesend Site is currently greenfield, and it is therefore assumed that surface water runoff from the site infiltrates into the ground. A Drainage Management Plan will be required to confirm the management of surface water runoff from the Proposed Development to ensure no increase in flood

risk. The FRA identifies Pluvial flooding as a potential risk. The main risk of flooding will occur from the overwhelming of compound drainage system or overtopping of silt retention ponds.

Groundwater Flood Risk

21.6.46 According to the FRA groundwater flooding on the Gravesend Site is negligible. Groundwater flooding will not be taken any further for the Gravesend Site.

Other Sources Flood Risk

21.6.47 The Environment Agency Flood Risk from Reservoirs (Ref 21-51) map indicates that the Gravesend Site is not located within an area at risk of flooding from reservoirs when river levels are normal or when there is also flooding from rivers. According to the FRA there is no risk of flooding from reservoirs or canals for the Gravesend Site. Flood risk from canals or reservoirs are scoped out for the remainder of this chapter.

Importance of Receptors

21.6.48 The importance of the water resource receptors identified within the baseline are described in Table 21-14:. A hydromorphological importance value has only been given to those surface water features that may be physically impacted.

Table 21-14: Importance (Sensitivity) of Receptors

Water Feature	Value (Importance)
North Kent Medway Chalk Water Body (groundwater)	High Importance North Kent Medway Chalk is a Principal Aquifer with a poor overall quality (Cycle 3 2019). It also supports local groundwater abstractions used for industrial purposes and possibly provide groundwater support for the Thames Estuary and Marshes. Therefore, the chalk aquifer is classified as having a <u>High Importance</u> .
Superficial Aquifers (Gravesend)	Medium Importance Classified as <u>Medium Importance</u> on the basis of it being a secondary (undifferentiated) aquifer that can support local agriculture and industry and supporting a GWDTE such as local South Thames Estuary and Marshes which is designated as a Ramsar site, SPA and a SSSI. also supports local groundwater abstractions used for industrial purposes
Thames Estuary	High Importance Thames estuary is a WFD classified main river and so is classified as having a <u>High Importance</u> . It has no designations or protected species associated according to the available Environment Agency information. There will be no changes to the existing jetty or no new outfalls to the Thames, therefore hydromorphology won't be considered.
Thames and Medway Canal (GS1)	Low Importance The Thames and Medway Canal is a disused canal which is situated south of the Proposed Development and Wharf Road. It has also been substantially modified by past land use and previous engineering works and now has reduced to an isolated 3km. It is not a WFD waterbody. Water voles have been recorded within the Thames and Medway Canal, however, the terrestrial environment between the canal and the Proposed Development means there is negligible risk of any species using these watercourses being subject to impacts. Therefore, the Thames Medway Canal has been classified as <u>Low Importance</u> .
Unnamed watercourses GS2	Medium Importance for Surface Water GS2 is a narrow ditch which flows north towards the Thames with a sluice gate situated at the northern end. It runs around the perimeter of

Water Feature	Value (Importance)
	the Proposed Development. GS2 is not a WFD body. There is a water abstraction point and discharge point located at GS2. There is a Water abstraction point to supply the Denton New Cut-Canal Restoration (not a plottable water abstraction). There were no records of water voles from the September 2023 surveys or from any other source at GS2. However, due to its suitability of habitat it can be assumed that there are likely water voles present. Therefore, due to its proximity to the site and the presence of water voles it has been identified as having a <u>Medium Importance</u>. Low Importance for Hydromorphology GS2 has been heavily modified and features a sluice gate at its southern end. Photographs from the site visit also evidence the low flows within the ditch. Therefore, GS2 has been deemed as having a <u>Low Importance</u> for Hydromorphology.
Unnamed watercourse GS5	Low Importance GS5 is a ditch which runs through the centre of the riffle range and enters GS2 at TQ 67553 74043. It is unknown whether there are any water voles are located within GS5 but could be likely due to its proximity to GS2. It has been designated as an 'adopted' watercourse by the Internal Drainage Board. GS5 has been given a <u>Low Importance</u>
Fluvial/Tidal	Very High Importance The vulnerability classification dictates the importance, therefore as the site lies within a Flood Zone 3a Vulnerability (Essential Infrastructure), this gives a <u>Very High Importance</u>
Pluvial	Very High Importance The vulnerability classification dictates the importance, therefore as the site lies within a Flood Zone 3a Vulnerability (Essential Infrastructure), this gives a <u>Very High Importance</u>

21.7 Key Parameters for Assessment

21.7.1 A detailed description of the Proposed Development is provided in ES Volume II Chapter 3 - The Project Description. The following aspects of the Proposed Development relevant to this chapter comprise:

- The site preparation and construction works, especially:
 - Vegetation clearance;
 - Removal of topsoil;
 - Areas for plant maintenance, site offices and compound areas;
 - Storage areas for construction and for excavated materials; and
 - Dust generation.
- Land uses within the operational Proposed Development in particular:
 - New Sealing End Compound and headhouse;
 - New access roads and utilities; and
 - New drainage.

21.8 Embedded Mitigation

- 21.8.1 The Proposed Development has been designed, as far as possible, to avoid and minimise impacts and effects on the water environment through the process of design development, and by embedding measures into the design of the Proposed Development.
- 21.8.2 A number of standard and embedded measures have been identified, which would be implemented during construction to manage the impacts and reduce the effects that the construction of the Proposed Development would have on the water environment.

Embedded Mitigation

Construction

- 21.8.3 The excavated material from construction of the tunnel would be approximately 72,700m³ (all to be removed in Tilbury) and the excavated material from the construction of the Tilbury shaft would be approximately 13,000m³. The composition of the tunnel spoil is chalk. The composition of the shaft spoil will be a mix of chalk, made ground, alluvium and river terrace deposits. Suitable spoil material would be sent via the River Thames to a suitable receiver, such as local RSPB sites such as Cliffe Pools who would accept the tunnel spoil and reuse it for ecological benefits. The existing and working jetty to the south-east of the Proposed Development on the Tilbury side will be utilised, delivering the tunnel spoil to the jetty via HGV and transferring to barge. Alternatively spoil material will be transported from Berth 5 at Port of Tilbury if using the jetty fails to work. There is an existing road extending to the jetty and no works are proposed to the jetty including any dredging of the Thames.

Operation

- 21.8.4 An Outline Drainage Management Plan is included in the Planning Application. The strategy aims to direct surface water from the hard standing surfaces (e.g. road and roof runoff) and tunnel seepage to 'French Drain' style filtration trenches, which will collect and convey the water to a traditional piped drainage system before being discharge to GS2 at the Gravesend Site. Land Drainage consent will need to be acquired from the IDB for this new outfall if it may affect the flow by protruding into the existing cross-section area of the channel.
- 21.8.5 The roof water will be captured by a 'Biodiverse Brown oof' system which will reduce the flow from the building and treat any contaminants present on the roof from windblown deposition or the accumulation of detritus etc. Filter trenches and pipework will convey all Site surface water runoff through a 'Downstream Defender TM' (a type of Vortex Flow Separator by Hydro International) and then through a flow control system to restrict the flow to an agreed rate. The proposed systems will be restricted back to greenfield run-off rates for the Site, which has been calculated to be 0.4 l/s. The low discharge is due to the low amount of hardstanding areas that are being positively drained.
- 21.8.6 The selected SUDS components, filter trenches and the Downstream Defender TM have been integrated into the design to minimise any contamination risk to the water environment (the greatest risk being from fine sediment/particulates as no oils will be stored on Site in plant and the tide influenced flow regime of receiving watercourses means settlement rates in the channel may be high). SUDS options are limited as these options are prohibited within the compound area due to health and safety reasons, and this can only be provided outside of the Site boundary. Therefore, the drainage design is limited by the size of the Site area.
- 21.8.7 Regarding foul wastewater, the preferred option would be to discharge foul water to an existing sewer. However, there are no available public sewers to connect to. Therefore, it is proposed to provide a 9000L underground cess pit. It will be located adjacent to a road to allow access for maintenance/emptying. There will be no discharge from the cess pit to any water feature or to ground thus foul water will not be considered any further.

21.9 Potential Impacts and Assessment of Effects

- 21.9.1 A number of activities during construction, operation and maintenance that are likely to generate impacts, which have the potential to affect the water environment, if unmitigated. The impacts and effects (both beneficial and adverse) are outlined in the sections below.

Surface Water Quality - Construction Effects

- 21.9.2 Construction activities such as earthworks, excavations, site preparation, levelling and grading operations result in the disturbance of soils. Exposed soil is more vulnerable to erosion during rainfall events due to loosening and removal of vegetation to bind it, compaction, and increased runoff rates. Surface runoff impact from such areas can contain excessive quantities of fine sediment, which may eventually be transported to watercourses where it can result in adverse impacts on water quality, flora and fauna. Other potential sources of fine sediment during construction works include water runoff from earth stockpiles, dewatering of excavations (surface and groundwater), mud deposited on site and local access roads, and that which is generated by the construction works themselves or from vehicle washing. Approximately 12,850m² of material from the Gravesend Shaft will be excavated. The Gravesend Site is a greenfield site and so has no existing hardstanding. The muck handling area will be situated northwest of the shaft and the muck bay (18mx12m) is situated beside the access track (TQ 67382 74142). To the north beside the existing structures will be the topsoil stockpile (TQ 67381 74182). Both the muck area and the stockpile have the access track and terrestrial environment between them and the nearby ditch (GS2).
- 21.9.3 Generally, excessive fine sediment in runoff is chemically inert and affects the water environment through smothering riverbeds and plants, temporarily changing water quality (e.g., increased turbidity and reduced photosynthesis) and causing physical and physiological adverse impacts on aquatic organisms (such as abrasion or irritation).
- 21.9.4 During construction, fuel, hydraulic fluids, solvents, grouts, paints and detergents and other potentially polluting substances will be stored and/or used on-site. Leaks and spillages of these substances could pollute the nearby surface watercourses if their use or removal is not carefully controlled, and spillages enter existing flow pathways or waterbodies directly. Like excessive fine sediment in construction site runoff, the risk is greatest where works occur close to and within waterbodies.
- 21.9.5 During construction, all works will be carried out in accordance with the mitigation measures set out in the CEMP. The implementation of standard mitigation measures will help avoid or reduce any potential adverse effects on surface water quality during construction.
- 21.9.6 The construction activities that will likely impact water quality is the excavation of the shafts and tunnels, and then the temporary storage and transportation to Cliffe Pools (or similar with habitat restoration benefits). On the Gravesend Site the excavated material from the shaft will be required to be temporarily stored in the muck away areas (TQ 67382 74142) until it can be transported by road to Cliffe Pools.
- 21.9.7 Thames and Medway Canal (GS1) is situated upstream of the construction area. Therefore, is unlikely to be contaminated from construction activities. The surrounding unnamed drains (GS2 and GS5) could be at risk from contamination during construction from site runoff. The drain, GS2, also flows into the Thames estuary and so poses risk of transporting contaminants into the estuary. There is also a water abstraction from GS2 which supplies the Denton New Cut-Canal Restoration.
- 21.9.8 With the application of the good practice mitigation measures set out in this ES chapter it is predicted that a direct, short term, temporary **minor adverse** impact on GS1 and GS5 (low Importance) resulting in a neutral effect (not significant). The Thames Estuary (High Importance) and GS2 (medium Importance) are predicted to have temporary **minor adverse** impact resulting in a temporary **slight adverse effect** (not significant).

Effects on Hydromorphology – Construction

- 21.9.9 During construction there is the potential for impacts on the hydromorphology of GS2 from the construction of the new outfall for the drainage system. This could require intrusive works and physically impact the ditch. GS2 has a low importance for hydromorphology and the size (13.5mm pipe with a 100m diameter) and flow rate of the new outfall is relatively small.

21.9.10 Overall, physical works are considered to give a localised negligible impact against hydromorphological status for GS2. As low importance receptor this results in a **neutral effect** (not significant).

Effects on Groundwater – Construction

21.9.11 Groundwater is at risk to new sources of contamination such as fuel, hydraulic fluids, solvents, grouts, paints and detergents and other potentially polluting substances that will be stored and/or used on-site. There are a number of potential pathways that construction activities could create, such as open excavations which could allow potential contaminants in unsaturated soils to leach into groundwater. Mobilising existing contamination in soil and groundwater as a result of ground disturbance (due to the installation of foundations/ structures) and dewatering (if needed) during construction could also occur.

21.9.12 Dewatering may also be required during the excavation of the shafts and the creation of the tunnel. Depending on the rate and volume of dewatering required, this has the potential to change the direction of flow and supply to local PWS, public resources and GWTDE. Discharge of abstracted groundwater if discharged to surface watercourses also risk contaminants entering the wider water environment.

21.9.13 The above would be managed following standard construction techniques potentially including pumping, damming or shoring up the shafts with sheet piling. A temporary abstraction licence is required from the Environment Agency when abstracting more than 20 m³/day of water per day in accordance with the Water Resources Act 1991 (as amended) (Ref 21-6). Any discharge of groundwater back to ground or to a watercourse may also require an Environmental Permit from the Environment Agency if it is considered to be 'unclean' (in accordance with the Environmental Permitting (England and Wales) Regulations 2016 (Ref 21-9) and the conditions of the Environment Agency's Regulatory Position Statement 'Temporary dewatering from excavations to surface water' cannot be met (Ref 21 89).

21.9.14 Currently, it is not known the number of PWS situated within the Gravesend study area, this information has been requested from Gravesham Borough Council. The Environment Agency noted two abstraction points used for industry located over 250m away from the Proposed Development used for industrial purposes. Given their distance they are unlikely to be impacted by the new Proposed Development. It is likely shallow groundwater supports the nearby Thames Estuary and Marshes.

21.9.15 The shafts and tunnels may require dewatering during construction. As indicated from boreholes found on BGS GeoIndex groundwater levels appear to be shallow between 2mbgl and 14.4mbgl on the Gravesend Site. The shaft is expected to be approximately 35m deep and so the shaft will intercept the water table. This would be managed following standard construction techniques potentially including pumping, damming or shoring up the pits with sheet piling.

21.9.16 Given the potential to encounter groundwater temporarily during construction, but that it would be appropriately managed in line with any required permit conditions and best industry practice as outlined in the CEMP, there is the likelihood of a short term, temporary minor adverse impact on groundwater flow. For the medium importance superficial groundwater aquifer and the high importance chalk aquifer this results in a **slight adverse** effect (not significant).

21.9.17 With the application of the best practice mitigation measures set out in this ES chapter it is predicted that a minor adverse impact on the medium importance superficial aquifers and high importance aquifer which would occur from potential contamination from the mobilisation of contaminants or from construction pollutants. This would result in a **slight adverse** effect (not significant) for the medium superficial aquifers and the high bedrock aquifer.

Flood Risk – Construction

Fluvial/Tidal - Gravesend

- 21.9.18 The chance of flooding is very low risk to low risk from fluvial and tidal sources according to the FRA (ES Appendix 12-2). There are flood defences which reduce the risk of flooding but do not completely stop the chance of flooding as they can be overtopped.
- 21.9.19 With the implementation of standard construction methods and mitigation, this fluvial and tidal flood risk can be effectively managed (for example by monitoring weather forecasts and Environment Agency flood warnings, by undertaking works close to watercourses during periods of dry weather by ensuring an adequate temporary drainage system is in place and maintained throughout the construction phase and avoiding stockpiling material on floodplains).
- 21.9.20 As such, the magnitude of flooding from these sources during construction, on Site and further downstream, is considered to be very low resulting in a **negligible** impact, which land use is a very high importance receptor gives a **slight adverse** effect (not significant).

Pluvial – Gravesend

- 21.9.21 The Proposed Development is in general at a low risk of pluvial flooding according to the FRA.
- 21.9.22 Construction activities will take place with the final CEMP (prepared by the Contractor) in place to ensure no exacerbation of localised flooding from deposition of silt or sediment in drainage and ditches.
- 21.9.23 The magnitude of surface water flooding during construction, on Site and further downstream, is considered to be very low resulting in a **negligible** impact, which as land use is a very high importance receptor gives a **slight adverse** effect (not significant).

Effect on Water Quality – Operational

- 21.9.24 The Outline Drainage Management Plan has applied the SuDS Manual's Simple Index Approach to demonstrate the suitability of the proposed SuDS treatment train for surface water runoff and spillages. The Medium Pollution Hazard Index has been selected to assess runoff from the Proposed Development as a worst-case scenario, as this is described in the SuDS Manual as, *Commercial yard and delivery areas, non-residential car parking with frequent change (e.g., hospitals, retail), all roads except low-traffic roads and trunk roads/motorways*". This has been selected to ensure the design is applicable for a worst-case scenario. The site will be unmanned the majority of the time and so will likely have a lower Pollution Hazard Index.
- 21.9.25 The proposed treatment for the Gravesend Sites includes the use of a filter strip and 'Downstream DefenderTM' (a type of Vortex Flow Separator made by Hydro International). The strategy aims to pass runoff through the Downstream Defender and then through a flow control system with upstream attenuation being supplied by the pipework and filter trenches.
- 21.9.26 Table 21-15: displays the treatment potential of the SuDS solutions when compared against the medium pollution index. To achieve a pass the total mitigation index must meet or surpass the pollution hazard index. On this basis, the mitigation index (filter trenches and downstream defender) passes the indicative assessment for total suspended solids, metals, and hydrocarbons. There are also plans to use a biodiverse brown roof on the Gravesend Site. These will help to reduce flow and contamination from the buildings, but they will not provide treatment of runoff from elsewhere.

Table 21-15: Pollution Hazard Indices and the Total Pollutant Mitigation Index for each pollutant (from the Outline Drainage Management Plan)

Proposed Development Land Use	SuDS Train	Total Suspended Solids	Metals	Hydrocarbons
Commercial yard and delivery areas, non-residential car parking with frequent change (e.g., hospitals, retail), all roads except low-traffic roads and trunk roads/motorways	<i>Filter trenches</i>	0.4	0.4	0.5
	<i>Downstream Defender (Ref 21-90)</i>	0.5	0.4	0.8
	<i>Total</i>	0.9	0.8	1.3
	Comment	The proposed treatment train passes the assessment in all cases. However, appropriate maintenance of the SuDS features will be required to ensure that they remain effective in the long term.		

21.9.28 On the Gravesend Site, drainage will be discharged to GS2 which may possibly have a small water vole population and is also where there is a licenced water abstraction point which supplies the Denton New Cut-Canal Restoration. However, given the implementation of an Outline Drainage Management Plan including SuDS provision, there would be **negligible** impact to the receiving surface water from operational surface water runoff.

21.9.29 For the low importance surface water features (GS1 and GS5), the negligible impact from operational runoff would result in a **neutral** effect (not significant). For the high importance surface water features (Thames) and medium importance (GS2) surface water features, the negligible impact from operational runoff would result in a **slight adverse** effect (not significant).

Effects on Hydromorphology – Operation

21.9.30 During operation there is the potential for impacts on the hydromorphology of GS2 from the new outfall for the drainage system. GS2 has a low importance for hydromorphology and the size (13.5mm pipe with a 100m diameter) and discharge (0.4 l/s) of the new outfall is relatively small.

21.9.31 Overall, physical works are considered to give a negligible impact against hydromorphological status for GS2. As low importance receptor this results in a **neutral effect** (not significant).

Effects on Groundwater – Operation

21.9.32 The change in distribution of groundwater recharge locally is expected to be negligible in terms of its effect on water abstraction and baseflow to rivers. As superficial groundwater is a medium importance receptor and high importance bedrock aquifer this results in a **neutral** effect (not significant).

Flood Risk – Operation

21.9.33 A FRA is included in planning application. A number of potential fluvial and tidal flood risks have been identified for the Gravesend Site; these include:

- Breach of tidal differences at Gravesend culvert;
- Overtopping of tidal defences at Gravesend culvert; and
- Blockage of the Gravesend culvert.

21.9.34 The risk of breaching and overtopping are currently considered negligible but will increase in risk throughout the lifetime of the Proposed Development. To reduce the risk and to keep the negligible flood risk status, additional flood defences and other mitigation designs will be required. Therefore, there would be **negligible impact**, which for land use (very high importance receptor) gives a **slight adverse** effect (not significant).

21.9.35 There is risk from the inundation of the sealing compound drainage, the overtopping of siltation retention ponds and the inundation of flood storage areas. However, with the implementation of an inspection and maintenance programme there would only be a minor impact. Therefore, there would

be **negligible** impact, which for the land use (very high importance receptor) gives a **slight adverse** effect (not significant).

Decommissioning

21.9.36 Potential impacts from the decommissioning of the Proposed Development would be similar in nature to those during construction, as some ground works would be required to remove the infrastructure installed. A detailed Decommissioning Environmental Management Plan (will be prepared prior to decommissioning to identify required measures to prevent pollution and flooding during this phase of the development.

21.9.37 As a result, it is considered the decommissioning impacts and effects would mirror those of the construction phase where no significant effects have been identified.

Potential Cumulative Effects

21.9.38 A number of proposed and consented developments have been identified and are presented on Figure 23.1 in Chapter 23: Cumulative Effects Assessment (ES Volume V). However, providing all developments adopt and implement best practice mitigation measures, the risk of significant cumulative effects can be reduced and minimised through standard best practices, to an extent to which they can no longer be considered significant.

21.10 Additional Mitigation

Standard Mitigation

21.10.1 The Outline Construction Environmental Management Plan (CEMP) (ES Volume VI Appendix 3.1) sets out the additional mitigation measures identified. This section summarises the types of mitigation measures that will be considered to mitigate against the effects on landscape and visual receptors where required.

Good Practice Guidance

21.10.2 The following relevant Guidance of Pollution Prevention (GPPs) have been released to date on the NetRegs website (Ref 21-88) and are listed below. While these are not regulatory guidance in England where the UK government website outlines regulatory requirements, they remain a useful resource for best practice. They will be documented in the Outline CEMP (ES Appendix 3.1 (Volume VI)):

- GPP 1: Understanding your environmental responsibilities – good environmental practices;
- GPP 2: Above ground oil storage;
- GPP 3: Use and design of oil separators in surface water drainage systems;
- GPP 4: Treatment and disposal of wastewater where there is no connection to the public foul sewer;
- GPP 5: Works and maintenance in or near water;
- GPP 8: Safe storage and disposal of used oils;
- GPP 13: Vehicle washing and cleaning;
- GPP 19: Vehicles: Service and Repair;
- GPP 20: Dewatering underground ducts and chambers;
- GPP 21: Pollution Incident Response Plans;
- GPP 22: Dealing with spills; and

- GPP 26: Safe storage – drums and intermediate bulk containers.

21.10.3 Where new GPPs are yet to be published, previous Pollution Prevention Guidance (PPGs) still provide useful advice on the management of construction to avoid, minimise and reduce environmental impacts, although they should not be relied upon to provide accurate details of the current legal and regulatory requirements and processes. Construction phase operations would be carried out in accordance with guidance contained within the following PPGs:

- PPG6: Working at construction and demolition sites (Ref 21-73);
- PPG7: Safe storage – the safe operation of refuelling facilities (Ref 21-74); and
- PPG18: Managing fire water and major spillages (Ref 21-75).

21.10.4 Additional good practice guidance for mitigation to protect the water environment can be found in the following key Construction Industry Research Information Association (CIRIA) documents and British Standards Institute documents:

- British Standards Institute (2009) BS6031:2009 Code of Practice for Earth Works (Ref 21-76);
- British Standards Institute (2013) BS8582 Code of Practice for Surface Water Management of Development Sites (Ref 21-77);
- C753 (2015) The SuDS Manual (second edition) (Ref 21-32);
- C811 (2023) Environmental good practice on site guide (fifth edition) (Ref 21-79);
- C648 (2006) Control of water pollution from linear construction projects, technical guidance (Ref 21-80);
- C532 (2001) Control of water pollution from construction sites – Guidance for consultants and contractors (Ref 21-82); and
- C736F (2014) Containment systems for prevention of pollution (Ref 21-83).

Management of Construction Site Runoff and Sediment

21.10.5 As a minimum the Principal Contractor will adhere to the following measures:

- Site clearance will be kept to a minimum and there will be a 10 m buffer around all water feature. (e.g., using temporary exclusion fencing, fabric silt fences, straw bales, maintaining vegetation etc.) other than at crossings or where there are specific tasks that need to be undertaken close to a water features (in which case see the section later entitled 'Working in, over, under and adjacent to water features');
- Avoidance of wet weather working where practical, especially site clearance, earthworks and works to water features;
- Appropriate separate storage of topsoil/subsoil and materials, and at least 20 m from water Features on flat ground;
- Any earth bund/ stockpile to be present for longer than two weeks will be either seeded, covered using geotextiles, or other pressures provided to ensure it is not a source of excessive fine sediment in runoff to water features;
- The implementation of a temporary drainage system and other measures to manage pollution risk during construction (e.g., fabric silt fences, lagoons, bunds, straw bales, sandbags, lamella clarifiers or other proprietary measures as may be required) etc.;
- Any dewatering of excavations will include measures where necessary to filter the water prior to discharge to a watercourse or ground (there shall be no discharge of any construction site runoff to existing ponds); and
- The control of mud deposits at entry and exits to the Site using wheel washing facilities and/ or road sweepers operating during earthworks or other times as considered necessary.

Management of Spillage Risk

21.10.6 As a minimum the Principal Contractor will adhere to the following measures:

- Spill kits would be available on the site in watertight containers (e.g., works near watercourses) and carried on all mobile plant. They would be regularly checked and topped up, especially after use. Appropriate training would be given to all construction workers in their use.
- Storage of fuel and chemicals would be in accordance with The Control of Pollution (Oil Storage) (England) Regulations 2001 and GPP 8: Safe storage and disposal of used oils.
- Surface water drains on local roads or within the Proposed Development compound and stockpiling areas would be identified and where there is a risk that fine particulates or spillages could enter them, they would be protected (e.g., covers or sandbags).
- Any containers of contaminating substances (e.g., fuel) onsite would be leak-proof and kept in a safe and secure building or compound from which they cannot leak, spill or be open to vandalism. The containers would be protected by temporary impermeable bunds (or drip trays for small containers) with a capacity of 110% of the maximum stored volume. Areas for transfer of contaminating substances (including refuelling areas) would be similarly protected.
- Any permanent oil storage tanks and temporary storage of 201 litres or more of oil in drums and mobile bowzers, and ancillary pipe work, valve, filters, sight gauges and equipment requiring secondary containment, e.g., bunding or drip trays, as defined in the Control of Pollution (Oil Storage) (England) Regulations 2001. Environment Agency guidance on oil storage regulations for business and preventing groundwater pollution from underground fuel storage tanks would be complied with.
- No oil would be stored within 20 m of a watercourse (and potentially further if ground is angled towards a waterbody except for fixed/large plant associated with the construction of new bridges/culverts or hand tools.
- Where possible re-fuelling will be undertaken in designated areas within main compounds or satellite compounds. It is possible that refuelling of mobile plant may be required by mobile fuel bowser. This will not be undertaken within 20 m of a water feature, and only on flat land (or otherwise a greater distance and other measures may be required subject to an on-site risk assessment) and with a drip tray/plant nappy. If there is a need to use semi-mobile very large plant (e.g., crane) that must be located within 20 m of a water feature. Due to the difficulties in moving plant such as this they may need to be refuelled in situ. Again, a site-specific risk assessment will need to be undertaken by the Contractor.
- Biodegradable hydraulic oils would be used where possible in all plant and only in equipment working in or over watercourses.
- Any plant, machinery or vehicles would be regularly inspected and maintained to ensure they are in good working order and clean for use in a sensitive environment. This maintenance is to take place off site if possible or only at designated areas in the site compound.
- All fixed plant used on site to be self-bunded.
- Mobile plant to be in good working order, kept clean and fitted with plant 'nappies' at all times.
- An Emergency Response Plan or similar titled plan would be prepared and included in the CEMP.
- Spill kits and oil absorbent material to be carried by mobile plant and located at high-risk locations across the site and regularly topped up.
- All construction workers would receive spill response training.
- The Site is to be secure to prevent any vandalism that could lead to a pollution incident.
- Construction waste/ debris are to be prevented from entering any surface water drainage or water feature.

- Concrete will not be batched on site and would instead be delivered on an 'as and when' basis in ready mixed lorries.
- Particular care would be taken with the delivery and use of concrete and cement as it is highly corrosive and alkaline. No washing out of delivery vehicles to take place on site without suitable provision for the washing out water and provision of a suitable location that is lined with a geotextile to prevent infiltration to ground. Such washing would not be allowed to flow into any drain, watercourse or other waterbody, and the CEMP contains a methodology for dealing with any washing out water, or wheel wash. Wash water would be adequately contained, prevented from entering any drain/watercourse, and removed from site for appropriate disposal at a suitably licenced waste facility or otherwise treated and discharge under any required consent from the Environment Agency.

Management of Flood Risk during Construction

21.10.7 As a minimum the Principal Contractor will adhere to the following measures:

- Works adjacent to watercourses will be kept to a minimum, with any stockpiling of materials or stripped soils to be located away from watercourses as far as reasonably practicable.
- Where construction works do encroach on the channel of watercourses works will be undertaken to ensure water flows are unobstructed and that flood risk does not increase elsewhere.
- Suitable de-watering methods will be used to maintain a dry working area or to maintain flows where they are being pumped around the works. This will require spare pumps to be stored on site. After each day, equipment and debris will be removed from the channel and a portion of flow allowed to flow through any temporary dam that has been constructed.
- Weather forecasts will be monitored on a daily basis and works planned accordingly.
- Contractors will be required to sign up to Environment Agency flood warning alerts and prepare and implement an Emergency Response Plan or similar entitled plan in the event of a possible flood event (based on weather forecasts, flood alerts and observations on site), enforceable from the first day of construction works through to the end of all works on site, 24 hours per day, seven days per week.

21.10.8 The main flood risks found for the Gravesend Site was inundation of the sealing compound drainage and the overtopping of siltation retention ponds. It has been suggested in the FRA that an inspection and maintenance programme should help to mitigate this. Another potential impact is a breach, overtopping and inundation of the tidal flood defences. The current tidal flood risk is considered to be low, however, throughout the Proposed Development lifetime these risks are said to increase. The FRA suggests that additional flood defence method would be required to keep the flood risk low in the future.

Management of Groundwater Activities

21.10.9 There may be localised lowering/control of groundwater required to enable the construction of the shafts and tunnel.

21.10.10 To minimise the impact of any groundwater control activities during construction on the water receptors, a Construction Groundwater Control Strategy will need to be prepared by the Contractor at the detailed design stage. Furthermore, best practice mitigation measures will be followed to avoid and or minimise impact on groundwater and will be included in the Final CEMP. The mitigation measures will be informed by the findings from the ground investigation which will provide information of site-specific ground conditions, including groundwater quality and quantity data.

21.10.11 As a minimum the Principal Contractor will adhere to the following mitigation measures:

- A Development of groundwater control would be implemented to ensure water levels in adjacent water features are maintained and any discharge is of a suitable quality.
- A programme of water monitoring of the dewatering discharges.

- If discharging water to a nearby watercourse, the rate of discharge will need to be agreed with the relevant authority to ensure that there is no unacceptable increase in flood risk or risk of scour. Any discharge will need to be undertaken with the agreement of the relevant statutory regulator and will need to comply with the pollution prevention requirements set out in the future CEMP.
- Managing the risk from groundwater flooding through appropriate working practices (during excavations) and with adequate plans and equipment in place for de-watering to ensure safe dry working environments.

Secondary Consents

- 21.10.12 A temporary abstraction licence is required from the Environment Agency when abstracting more than 20 m³/day of water per day in accordance with the Water Resources Act 1991 (as amended) (Ref 21-6).
- 21.10.13 Any discharge of groundwater back to ground or to a watercourse may also require an Environmental Permit from the Environment Agency if it is considered to be 'unclean' (in accordance with the Environmental Permitting (England and Wales) Regulations 2016 (Ref 21-9) and the conditions of the Environment Agency's Regulatory Position Statement 'Temporary dewatering from excavations to surface water' cannot be met (Ref 21-89).
- 21.10.14 Land drainage Consent will be acquired from the IDB for any works that may affect the flow of an Ordinary Watercourse within the Board's District. In particular, land drainage consent will be acquired from the IDB for any works within the cross-sectional area of the channel of a watercourse, under the Land Drainage Act 1991 and (local) Byelaw 4 (Ref 21-5). If a watercourse has been 'adopted' by the IDB, land drainage consent will be acquired for any works within the cross-sectional area of the channel of a watercourse, under the Land Drainage Act 1991 and (local) Byelaw 4 (Ref 21-5) and for any works within 8m from the top of the bank, under (local) Byelaw 10 (Ref 21-5). The 8m should remain clear and be of a suitable gradient to allow machine access for watercourse maintenance. GS5 is the closest 'adopted' watercourse to the Proposed Development and is at least 25m away on nearest approach. GS2 will require a land drainage consent as a new outfall for the drainage system will be constructed.

GS2 Abstraction Point

- 21.10.15 There is a water abstraction point to supply the Denton New Cut-Canal Restoration from GS2 close to the proposed works. Although the measures outlined above, if implemented correctly by the Contractor, will manage the risk of water pollution occurring to GS2, it is also recommended that the Principal Contractor consults with the Thames and Medway Canal Associated before and during the works. This is to ensure that there will be no interruption to their supply.

21.11 Assessment of Residual Effects

- 21.11.1 This assessment of water environment effects has been undertaken after the implementation of embedded and additional mitigation. Refer to Table 21-16.

Table 21-16: Summary of Predicted Effects on the Water Environment (Gravesend)

Receptor	Importance	Potential Impact	Embedded Mitigation	Additional Mitigation	Magnitude	Significance
Construction Phase						
Thames Middle (water quality)	High	Temporary deterioration of water quality due to construction activity (run off)	Spoil material will only be temporarily stored at site and will be transferred to Cliffe Pools during weekdays.	Implementation of CEMP	Minor Adverse	Slight Adverse (not significant)
Thames and Medway Canal (GS1)	Low	Temporary deterioration of water quality due to construction activity (run off)	Spoil material will only be temporarily stored at site and will be transferred to Cliffe Pools during weekdays.	Implementation of CEMP	Minor Adverse	Neutral (not significant)
Unnamed watercourses (GS2)	Medium (water quality)	Temporary deterioration of water quality due to construction activity (run off)	Spoil material will only be temporarily stored at site and will be transferred to Cliffe Pools during weekdays.	Implementation of CEMP	Minor Adverse	Slight Adverse (not significant)
Unnamed watercourses (GS5)	Low	Temporary deterioration of water quality due to construction activity (run off)	Spoil material will only be temporarily stored at site and will be transferred to Cliffe Pools during weekdays.	Implementation of CEMP	Minor Adverse	Neutral (not significant)
North Kent Medway Chalk Water Body (groundwater)	High	Temporary change in groundwater level and flow		Works to be controlled by a CEMP and any permissions required from the Environment Agency.	Minor Adverse	Slight Adverse (not significant)
Superficial Aquifers (Gravesend)	Medium	Temporary change in groundwater level and flow		Works to be controlled by a CEMP and any permissions required from the Environment Agency.	Minor Adverse	Slight Adverse (not significant)
North Kent Medway Chalk Water Body (groundwater)	High	Change in water quality due to construction activity	Spoil material will only be temporarily stored at site and will be transferred to Cliffe Pools during weekdays.	Works to be controlled by a CEMP and any permissions required from the Environment Agency.	Minor Adverse	Slight Adverse (not significant)

Receptor	Importance	Potential Impact	Embedded Mitigation	Additional Mitigation	Magnitude	Significance
Superficial Aquifers (Gravesend)	Medium	Change in water quality due to construction activity	Spoil material will only be temporarily stored at site and will be transferred to Cliffe Pools during weekdays.	Works to be controlled by a CEMP and any permissions required from the Environment Agency.	Minor Adverse	Slight Adverse (not significant)
Fluvial/Tidal	Very high (workers)	Risk of flooding form the River Thames		Implementation of the CEMP	Negligible	Slight Adverse (not significant)
Pluvial	Very high (workers)	Surface water flooding		Implementation of the CEMP	Negligible	Slight Adverse (not significant)
Operational Phase						
Thames Middle (water quality)	High	Long term deterioration of water quality due Proposed Development	Implementation of biodiverse brown roof, filter trenches and a downstream defender		Negligible	Slight Adverse (not significant)
Thames and Medway Canal (GS1)	Low	Long term deterioration of water quality due Proposed Development	Implementation of biodiverse brown roof, filter trenches and a downstream defender		Negligible	Neutral (not significant)
Unnamed watercourses (GS2)	Medium	Long term deterioration of water quality due Proposed Development	Implementation of biodiverse brown roof, filter trenches and a downstream defender		Negligible	Neutral (not significant)
Unnamed watercourses (GS5)	Low	Long term deterioration of water quality due Proposed Development	Implementation of biodiverse brown roof, filter trenches and a downstream defender		Negligible	Neutral (not significant)
Fluvial/Tidal	Very high	Risk of flooding form the River		Additional flood defences and other mitigation	Negligible	Slight Adverse

Receptor	Importance	Potential Impact	Embedded Mitigation	Additional Mitigation	Magnitude	Significance
		Thames to the Proposed Development		designs will be required keep the risk low for the long term		(not significant)
Pluvial	Very high	Surface water flooding to the Proposed Development	Implementation of filter trenches and a downstream defender		Negligible	Slight Adverse (not significant)

21.12 Summary

- 21.12.1 An assessment has been undertaken of the likely effects of the Proposed Development on the Water Environment. It has considered the likely effects on water environment receptors.
- 21.12.2 The study area is generally flat and is located west of Milton Rifle Range. The study area is expected to receive approximately 600 mm of rain per year which is below the UK average. The Gravesend Site and tunnel alignment underlie the Lews Nodular Chalk Formation, Seaford Chalk Formation and Newhaven Chalk Formation. The superficial deposits of the area consist of alluvium (clay, silt, sand and peat) which underlies the Gravesend Site.
- 21.12.3 The North Kent Medway Chalk Water Body underlies the Gravesend Site, the aquifer has been classified as Poor overall. Groundwater appears to be relatively shallow with level ranging from 2.2 m to 14.4 m bgl.
- 21.12.4 The Thames Estuary is situated approximately 170m north of the Proposed Development. It is the only WFD designated surface water body within the site boundary and study area. There are number of water features within the study area, including drains, ditches and ponds. All of the watercourses are within the Medway Lower operational catchment of the Thames River Basin Management Plan.
- 21.12.5 The Proposed Development Site is bounded to the west, south and east by an unnamed drain which is connected to the Thames Estuary via a sluice gate at TQ 67492 74271 through the Thames flood defence embankment.
- 21.12.6 The Gravesend Site is located within Flood Zone 3; the main source of flooding is from the Thames estuary.
- 21.12.7 The Proposed Development has been designed, as far as possible, to avoid and minimise impacts and effects on the water environment through the process of design development, and by embedding measures into the design of the Proposed Development.
- 21.12.8 The Proposed Development at Tilbury will incorporate a number of embedded mitigation measures for the construction and operational phase, such as the removal of tunnel and shaft spoil via barge to a suitable receiver site to reuse for ecological benefit. For operation, an Outline Drainage Management Plan sets out the design of the operational drainage.
- 21.12.9 A number of good practice measures relating to the Water Environment have been incorporated into the Outline CEMP.
- 21.12.10 The assessment of residual effects has concluded there would be no likely significant residual effects on the water environment during the construction or operational phases.

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21.14 Abbreviations

Abbreviation	Meaning
AEP	Annual Exceedance Probability
BGL	Below Ground Level
BGS	British Geological Survey
CDE	Catchment Data Explorer
CEH	Centre for Ecology and Hydrology
CEMP	Construction Environmental Management Plan
CIRIA	Construction Industry Research and Information Association
DMRB	Design Manual for Roads and Bridges
DWPA	Drinking Water Protected Areas
EIA	Environmental Impact Assessment
ES	Environmental Statement
FRA	Flood Risk Assessment
GPP	Guidance of Pollution Prevention
GPG	Good Practice Guidance
GWDTE	Groundwater locally supports Groundwater Dependent Terrestrial Ecosystems
HGV	Heavy Goods Vehicle
LLFA	Lead Local Flood Authority
MAGIC	Defra's Multi-Agency Geographic Information for the Countryside
MMO	Marine Management Organisation
NPPF	National Planning Policy Framework
NPS	National Policy Statement
NVZ	Nitrate Vulnerable Zones
PPG	Planning Practice Guidance
PWS	Private Water Supplies
RBMP	River Basin Management Plan
RNAG	Reasons for Not Achieving Good
SAC	Special Area of Conservation
SPA	Special Protection Area
SPG	Supplementary Planning Guidance
SPZ	Source Protection Zone
SSSI	Site of Special Scientific Interest
SuDS	Sustainable urban Drainage Systems
TKRE	Tilbury to Grain and Tilbury to Kingsnorth
WFD	Water Framework Directive

