Southampton to London Pipeline Project

Volume 6

Environmental Statement (Volume B)
Chapter 8: Water

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8 Water

8.1 Introduction

8.1.1 This chapter describes the assessment of potential surface water and groundwater impacts associated with construction and operation of the project. The chapter describes the existing hydrological and hydrogeological baseline, methods of assessment, likely significant impacts, mitigation measures to address likely significant impacts, and residual impacts assuming implementation of the mitigation. The chapter provides information regarding the following:

- groundwater quality and resource;
- surface water quality and resource;
- fluvial geomorphology (including hydromorphology);
- flood risk; and,
- Water Framework Directive (WFD) compliance.

8.1.2 The groundwater assessment considers the presence, movement, distribution and properties of water in soils and rocks, i.e. the water contained below the ground surface. Groundwater supports rivers, lakes and wetlands, especially through drier periods when there is little direct input from rainfall. Groundwater can be abstracted for supply. Rising groundwater levels can also lead to groundwater flooding.

8.1.3 Water quantity and quality have an important role in supporting flora and fauna in rivers, lakes and wetlands. Fresh surface water can be abstracted for water supply. Flooding from surface water features can have an adverse effect on structures and communities.

8.1.4 Fluvial geomorphology concerns landforms and the processes of erosion and deposition that shape and form river channels and adjacent floodplains. It is also specifically concerned with water and sediment movement in channels.

8.1.5 Aquatic and terrestrial ecology, including water dependent terrestrial ecology, are covered separately in Chapter 7 Biodiversity.

8.1.6 Chapter 11 Soils and Geology considers groundwater quality and human health aspects where there may be a potential contamination issue. Chapter 14 considers Water within the context of potential for Major Accidents. All other water quality aspects are considered within this chapter.

8.1.7 A WFD Compliance Assessment has been prepared (see Appendix 8.6). In line with Planning Inspectorate Advice Note 18, the WFD assessment is a separate assessment to the environmental impact assessment (EIA). The conclusions are summarised within this chapter.

8.1.8 A Flood Risk Assessment Report (FRA) (**application document 7.3**) has been undertaken and is also presented as a stand-alone report (application document 7.3) with results and conclusions summarised within this chapter.

Legislative and Policy Background

8.1.9 Chapter 2 Regulatory and Policy Context sets out the overarching policy relevant to the project including the Overarching National Policy Statement for Energy (EN-1). EN-1 contains the following paragraphs relating to water which have been considered within this chapter:

- Paragraph 5.7.4 states that '*Applications for energy projects of 1 hectare or greater in Flood Zone 1 in England… should be accompanied by a flood risk assessment (FRA)… This should identify and assess the risks of all forms of flooding to and from the project and demonstrate how these flood risks will be managed, taking climate change into account*.'
- Paragraph 5.15.2 states '*Where the project is likely to have effects on the water environment, the applicant should undertake an assessment of the existing status of, and impacts of the proposed project on, water quality, water resources and physical characteristics of the water environment as part of the ES [Environmental Statement] or equivalent'*.

8.1.10 In addition, National Policy Statement for Gas Supply Infrastructure and gas and oil Pipelines (EN-4) states the following:

- Paragraph 2.22.3 states '*Where the project is likely to have effects on water resources or water quality, for example impacts on groundwater recharge or on existing surface water or groundwater abstraction points, or on associated ecological receptors, the applicant should provide an assessment of the impacts... as part of the ES*'.
- Paragraph 2.22.4 states '*Where the project is likely to give rise to effects on water quality, for example through siltation or spillages, discharges from maintenance activities or the discharge of disposals such as wastewater or solvents, the applicant should provide an assessment of the impacts*.'

8.1.11 In addition, Appendix 2.1 Environmental Legislation and Policy describes legislation and national policy relevant to water. Appendix 2.2 Regional and Local Planning Policy provides a review of local policies that have been considered .

8.2 Approach and Methods

Scope of Assessment

8.2.1 The scope of the water assessment has been informed by the Scoping Opinion, provided by the Planning Inspectorate in September 2018, on behalf of the Secretary of State, following the submission of the Scoping Report (Esso, 2018) and through engagement with relevant organisations.

8.2.2 Table 8.1 summarises the scope of the assessment for water. This table includes the references (for example ID 4.6.1) to the relevant paragraph response from the Planning Inspectorate in the Scoping Opinion. The boxes shaded in grey are the matters that have been scoped out of the assessment following the feedback from the Planning Inspectorate.

Table 8.1: Matters Scoped In and Out of the Assessment (Grey Shading Indicates Matters Scoped Out Following Feedback from the Planning Inspectorate)

Receptor	Matter/Potential Effect	Conclusion in the Scoping Report (July 2018)	Comments from the Planning Inspectorate in the Scoping Opinion (September 2018)
Groundwater during construction	Changes to groundwater recharge rates	Scoped out for all locations	(ID 4.2.1) The Inspectorate agrees that there are unlikely to be significant effects and that this matter can be scoped out of the Environmental Statement (ES). **Scoped out**
	Interception of shallow groundwater	Scoped out for all locations except the following: • in the vicinity of all GWDTE with national or international designations or GWDTEs with local designations that have high or moderate groundwater dependency; • in the vicinity of shallow groundwater private water supplies (PWSs); and • where the pipeline runs parallel to watercourses which may be fed by shallow groundwater.	(ID 4.2.2) The Inspectorate agrees that for all locations except those listed, this potential effect can be scoped out of the ES given the likely absence of receptors sensitive to this potential effect and the low likelihood of a significant effect arising. Scoped in for the three locations listed.
	Interception of shallow groundwater in the pipeline trench which could lead to groundwater of poor quality discharging to sensitive receptors	Scoped out for all locations except Groundwater Study Area-D (GWSA-D)	(ID 4.2.3) The Inspectorate agrees that this matter can be scoped out within GWSA-B and GWSA-C due to the very low likelihood of significant effects occurring. However, the Inspectorate notes that GWSA-A has the same amount of water monitoring stations as GWSA-D, a mixture of good and poor quality groundwater and also has shallow groundwater. Accordingly, GWSA-A and GWSA-D are scoped in.
	Connection of two aquifer units at trenchless crossings	Scoped in for all trenchless crossings	Scoped in
	Changes to groundwater quality from migration of dissolved substances (excludes historical contaminated land or landfills which is considered in Chapter 11 Soils and Geology)	Scoped out for all locations	(ID 4.2.4) On the basis that the impact is likely to be on a small scale and unlikely to result in significant effect to groundwater quality, and also that an assessment of historical contaminated land and landfills will be included in the ES, the Inspectorate agrees that this matter can be scoped out of the ES. **Scoped out**

Receptor	Matter/Potential Effect	Conclusion in the Scoping Report (July 2018)	Comments from the Planning Inspectorate in the Scoping Opinion (September 2018)
	Changes to groundwater quality from migration of suspended solids	Scoped out for all locations except for the unconfined Chalk. Where the Chalk is confined, this is scoped out due to the depth of the Chalk aquifer.	(ID 4.2.5) The Inspectorate agrees that there are unlikely to be significant effects and that this matter can be scoped out of the ES. **Scoped out**
	Changes to groundwater levels and groundwater flow direction caused by temporary groundwater dewatering activities	Scoped in for the following locations: • GWDTE in the vicinity of dewatering activities. • Watercourses in the vicinity of dewatering activities. • Groundwater abstractions in the vicinity of dewatering activities. • Buildings in the vicinity of dewatering activities. • The distance from dewatering activities for which features will be considered in the assessment will be determined on a case-by-case basis based on professional judgement.	Scoped in.
	Discharge of dewatering water to ground affecting groundwater quality	Scoped in for all locations where discharge to ground would occur.	(ID 4.2.6) The Inspectorate expects the ES to include an assessment of impacts from silt discharge and any mitigation measures described and secured. Scoped in.
	Change in groundwater levels and flow direction due to discharge of dewatering water to ground	Scoped in for all locations where discharge to ground would occur.	Scoped in.
	Changes to groundwater quality from leaks and spills from chemicals, fuels and oils used in construction	Scoped out for all locations except where trenches cross GWDTE.	(ID 4.2.7) The Inspectorate would expect to see assessment of impacts from leaks and spills in the ES where significant effects are likely. The ES should also explain any mitigation measures described and secured, as appropriate. Scoped in.
Groundwater during operation	Connection of two aquifer units at trenchless crossings	Scoped in for all trenchless crossings.	Scoped in.
	Changes to groundwater flow direction or level due to below ground structures	Scoped out for all locations except in the vicinity of GWDTE.	(ID 4.2.8) The Inspectorate is content that there is a very low likelihood of significant effects arising in other areas; the Inspectorate agrees that this potential effect can be

Receptor	Matter/Potential Effect	Conclusion in the Scoping Report (July 2018)	Comments from the Planning Inspectorate in the Scoping Opinion (September 2018)
			scoped out of the ES outside of GWDTEs. Scoped in for GWDTEs.
	Leaks of aviation fuel	Scoped in for Principal aquifers; Secondary A aquifers; Source Protection Zones (SPZ). Where the Chalk is confined, this is scoped out due to the depth of the Chalk. Scoped out for Secondary Undifferentiated aquifers and Unproductive Strata; the confined Chalk in GWSA-A, GWSA-C and GWSA-D.	(ID 4.2.9) The Inspectorate agrees that where there is no potential impact pathway and no receptor sensitive to the effect, this can be scoped out of the ES. **Scoped out for receptors listed**
Surface water quality during construction	Potential for impact on surface water quality and resource availability due to suspended sediments and/or fuel/chemical spillage	Scoped in for all locations.	Scoped in.
Surface water quality during operation	Potential for impact on surface water quality and resource availability due to fuel leakage or spillage from pigging stations	Scoped in for pigging stations only.	(ID 4.2.14) The Inspectorate agrees that the operation of the project, with the exception of management works at the pigging stations, can be scoped out of the ES as significant effects are unlikely to occur. Scoped in.
Fluvial Geomorphology during construction	Changes to morphological processes and features as a result of open cut crossings	Scoped in for medium and high sensitivity fluvial geomorphology receptors; scoped out for negligible and low sensitivity fluvial geomorphology receptors.	(ID 4.2.10) The Inspectorate expects the ES to provide detail in respect of the proposed mitigation measures to provide confidence as to the efficacy of any good practice measures to control effects. Receptors scoped in/out will remain the same as set out in the Scoping Report, with mitigation measures outlined in this chapter detailing how likely effects will be controlled.
	Changes to morphological processes and features as a result of haul road crossings and culverts in the channel. Removal of riparian vegetation	Scoped in for all fluvial geomorphology receptors.	Scoped in.

Receptor	Matter/Potential Effect	Conclusion in the Scoping Report (July 2018)	Comments from the Planning Inspectorate in the Scoping Opinion (September 2018)
	corridor and disturbance of channel banks		
	Changes to morphological processes and features as a result of directionally drilled crossings	Scoped out for all fluvial geomorphology receptors.	(ID 4.2.11) The Inspectorate notes that the Scoping Report does not provide information such as the proximity of the proposed works adjacent to watercourses proposed to be crossed using trenchless methods. In the absence of this information it is unclear whether there is a potential impact pathway on the geomorphology of watercourses. Where impact pathways exist, and where a likely significant effect may occur, this should be assessed in the ES. Any mitigation and/ or design measures relied upon to exclude likely significant effects on watercourses crossed using trenchless methods should be explained in the ES and appropriately secured. Considering comments from the Inspectorate, watercourses deemed to be of medium or high sensitivity have been scoped in for assessment to ensure assessment of impact pathways that may result in likely significant effects. Scoped in.
Fluvial Geomorphology during operation	Changes to morphological processes and features as a result of operation of pipeline	Scoped out.	(ID 4.2.15) The Inspectorate notes that the ES should include an assessment of impacts to fluvial morphology receptors during operation, where significant effects are likely to occur. Potential effect remains scoped out as it has been assessed that there are unlikely to be any significant effects caused by operation of the project. Further explanation can be found in Paragraphs 8.5.9 and 8.5.10. **Scoped out.**
Flood risk during construction	Change in flood risk	Scoped in where the Order Limits cross medium and high value receptors (including pigging stations); scoped out for low and very low value receptors.	(ID 4.2.13) The Inspectorate does not agree that the receptors/ areas identified in paragraph 8.4.18 of the Scoping Report can be scoped out of the ES. The Scoping Report has not provided sufficient evidence to scope out effects arising from construction in Flood Zone 2 areas. An

Receptor	Matter/Potential Effect	Conclusion in the Scoping Report (July 2018)	Comments from the Planning Inspectorate in the Scoping Opinion (September 2018)
			assessment of flood risk in the above areas should be included in the ES, as supported by the proposed Flood Risk Assessment (FRA). Accordingly, Flood Zone 2 has been scoped in.
Flood risk during operation	Change in flood risk	Scoped out for the pipeline; scoped in for pigging stations where flood risk receptors are assessed to be of high or medium value.	(ID 4.2.16) The Inspectorate agrees that there are unlikely to be significant effects and that this matter can be scoped out of the ES. **Scoped out**
WFD quality elements	Potential effects on WFD quality elements leading to changes in WFD status/potential or achievement of WFD objectives.	Scoped in for 15 WFD surface water bodies and 10 WFD groundwater bodies for: • construction effects from watercourse crossings and haul roads; and • operational effects from potential channel change after open cut crossings.	Scoped in to the WFD Compliance Assessment (Appendix 8.6).

8.2.3 In addition to the points noted in Table 8.1 the Planning Inspectorate also raised the following comments to consider within the assessment, set out below along with an explanation of how the comment has been addressed:

- (ID 4.2.17) The ES should include a table or figure which depicts the location of the monitoring stations used to inform the assessment. This information will aid the reader to understand how the groundwater quality has been established in the area. The Environment Agency monitoring stations have been included in the baseline data assessment in Appendix 8.1 Groundwater Baseline. In addition, the monitoring locations undertaken as part of the project ground investigations are shown on Figures 11.3 and 11.4 under Chapter 11 Soils and Geology;
- (ID 4.2.18) The Scoping Report has not explained why a 500m study area will be used for the assessment of surface water. Within the ES, the study area should be clearly justified and reflect the anticipated extent of potential significant effects. An explanation for the 500m study area used for the assessment of surface water is included within this chapter;
- (ID 4.2.19) The appraisal of the groundwater abstraction location data should be included within the ES. This has been included in Appendix 8.4 Groundwater Abstraction Assessment;
- (ID4.2.20) The Scoping Report has not stated how a Groundwater Dependent Terrestrial Ecosystems (GWDTE) is determined to be of high, medium or low groundwater dependency. A description of the methodology used to classify the GWDTE as being high, medium or low groundwater dependant should be included within the ES. A description of the methodology used to classify the GWDTE is included in Appendix 8.1 Groundwater Baseline;
- (ID 4.2.21) The Scoping Report states that groundwater quality data within GWSA-A and GWSA-D has been obtained from one monitoring station. The Applicant should consult with relevant consultation bodies in effort to agree the sufficiency of baseline information. The baseline assessment in the ES should be sufficiently robust to inform the assessment of groundwater quality across the entire GWSA. Details of consultation and engagement undertaken to confirm robustness of the baseline data used is included in Table 8.2;
- (ID 4.2.22) The Scoping Report states that the Ford Lake Valley GWDTE is susceptible to groundwater flooding and is therefore classified as having a “high” groundwater dependency. However, Wintershill Floodplain is also within an area susceptible to groundwater flooding but has been classified as having a “low” groundwater dependency. Care should be taken to ensure that the approach to determining groundwater dependency classification is consistent in the ES. A check of consistency when determining groundwater dependency classification conceptual models and the degree of dependency on groundwater for each of the potential GWDTEs is in Appendix 8.3 Groundwater Dependent Terrestrial Ecosystems;
- (ID 4.2.23) The Scoping Report list 14 surface water pollution incidents but has not included any other details regarding these events. The ES should state when and where these pollution events occurred in order to inform the baseline information in the assessment. Details of where pollution events occurred, to inform the baseline assessment are included on Figure 8.2;

- (ID 4.2.24) Reference is made in the Scoping Report, to 94 surface water bodies, including two canals and four lakes. The surface water sub-section, which discusses water quality, only refers to rivers and watercourses. The ES should ensure that baseline data adequately describes canal and lake receptors, where they are considered and assessed in the ES. A description of baseline data for canals and lakes where considered. Section 8.3 Baseline Surface Water Quality, and Appendix 8.6 WFD Compliance Assessment, include information on canals and lakes where relevant to the assessment;
- (ID 4.2.25) The Scoping Report suggests that the Basingstoke Canal is considered to be of negligible value as a geomorphological receptor. However, the Inspectorate notes that low and negligible water bodies, including Basingstoke Canal, are also identified elsewhere in the Scoping Report for inclusion in the ES. The ES should ensure that receptors are valued appropriately and cross-refer to information in other relevant aspect chapters where the same receptor(s) are considered. The basis for valuation of receptors and cross-references to other chapters where the same receptors are considered are included in Sections 8.3 Baseline and 8.5 Assessment of Impacts where relevant – most notably cross-referencing to Chapter 7 Biodiversity and Chapter 11 Soils and Geology;
- (ID 4.2.26) The ES should accurately depict the baseline information. The Inspectorate notes that the Scoping Report states the percentage of land within flood zones. Although it is implied by the figures, the Scoping Report does not specifically address overlaps between flood zone categories. The correct depiction of flood zones and overlaps between flood zone categories is included within the FRA (**application document 7.3**);
- (ID 4.2.27) The Scoping Report states that "*Areas in Flood Zone 2 are considered to be of a Low sensitivity*". Table 8.13 in the Scoping Report also identifies Flood Zone 2 as being a receptor of low sensitivity/ value. The ES should justify why this is considered to be the case. Justification for the sensitivity/value assigned to Flood Zone 2 is included within the FRA (**application document 7.3**);
- (ID 4.2.28) The Scoping Report states that Section H is at a risk from reservoir flooding but has not stated the level of risk. The ES should include the Section H reservoir flooding risk level. The level of risk from reservoir flooding in Section H is included within the FRA (**application document 7.3**);
- (ID 4.2.29) The Scoping Report states that further investigations into the flood risk from sewerage will be undertaken. The results from this further investigation should be included within the ES. The results of this are included within the FRA (**application document 7.3**);
- (ID 4.2.30) The Inspectorate notes that the scope of the ES in respect of the surface water bodies to be assessed refers back to those scoped/screened into the WFD assessment. The Inspectorate notes that this does not explain/justify why six surface water bodies are scoped out of the assessment. The ES should clearly justify the scoping out of surface water bodies and include appropriate cross referencing to the WFD assessment, as relevant. The justification for scoping out six surface water bodies from the WFD assessment is included in Appendix 8.6 WFD Compliance Assessment);

- (ID 4.2.31) For the flood risk assessment, the ES should state which future climate model and flood risk allowance will be used and any assumptions and uncertainties within the climate change model. The Applicant should make effort to agree these with relevant consultation bodies. The ES should explain how the assumptions and uncertainties have informed the climate change baseline and risk assessment. The future climate model and flood risk allowance used, together with any assumptions and uncertainties are included in the FRA (**application document 7.3**) where UKCP18 is referenced; however, climate change is not a significant factor in the assessment as the project is primarily concerned with construction and the extent of permanent above ground features is immaterial in this context.
- (ID 4.2.32) The Inspectorate notes that the Scoping Report states that "*haul roads and access tracks are likely to be considered as permanent for the purposes of the assessment as they could be in place for more than one month*." The Scoping Report also describes that works associated with watercourse crossings would be of a "*temporary nature*". The Applicant should ensure that duration of effects are clearly stated in the ES and applied in the context of the receptor that is being assessed. A clear statement on duration of effects and consideration in the assessment (Short term is used in this chapter to reflect the transient nature of the construction works. For the purposes of assessment, short term is assumed to be less than six months and includes mobilisation and reinstatement and is discussed in the impacts significance subsection later in this report and supporting appendices);
- (ID 4.2.32) The Scoping Report states that low and very low value receptors would be scoped out. However, the Scoping Report does not identify any receptors as 'very low value' both within the methodology and in the baseline. The ES should make clear the value/ sensitivity of each receptor and ensure the approach applied is fully explained in the assessment methodology. Clarity on the value/sensitivity of each receptor is included in the FRA (**application document 7.3**) and in Section 8.5 Assessment of Impacts of this chapter; and
- (ID 4.2.34) If Sustainable Drainage Systems (SuDS) are to be implemented at pigging stations, the location of the SuDS and an assessment of their effectiveness at mitigating flood risk should be included within the ES. As explained in the FRA (**application document 7.3**), there is no requirement for SuDS at the pigging station.

Study Area

8.2.4 For the purposes of this assessment, the route and Order Limits are broken down into eight separate sections, further details can be found in Chapter 3 Project Description:

- Section A – Boorley Green to Bramdean;
- Section B – Bramdean to South of Alton;
- Section C – South of Alton to Crondall (via Alton pumping station);
- Section D – Crondall to Farnborough (A327 crossing);
- Section E – Farnborough (A327 crossing) to Bisley and Pirbright Ranges;

- Section F – Bisley and Pirbright Ranges to M25;
- Section G – M25 to M3; and
- Section H – M3 to the West London Terminal storage facility.

Groundwater

8.2.5 The groundwater study area is defined as the Order Limits with a 1km buffer on either side. This buffer allows for the identification of receptors outside the location of the physical works. These could be impacted by activities such as change in groundwater levels caused by dewatering or disturbance (in flow and/or quality) of groundwater flows. These in turn may support receptors such as GWDTEs or provide baseflow to watercourses.

8.2.6 This groundwater study area is split further based on the geology and associated groundwater environment. Figure A8.1.1 shows the bedrock geology and Figure A8.1.2 shows the superficial (drift) deposits. The study areas are as follows, with reference to Sections A-H as described in Chapter 3 Project Description.

- Groundwater Study Area A (GWSA-A): Order Limits from Boorley Green in Hampshire to the southern boundary of the Chalk Principal aquifer at Bishop's Waltham covering part of Section A. This area passes over Palaeogene bedrock geological deposits which mostly form Secondary A aquifers.
- GWSA-B: Order Limits that cross the Chalk Principal aquifer from Bishop's Waltham to Crondall. This covers part of Section A and all of Sections B and C and a very small part of Section D.
- GWSA-C: Order Limits from Crondall to Chertsey South, around 500m west of the M25. This covers most of Section D, all of Section E and most of Section F. This area passes over Palaeogene geological deposits which mostly form Secondary A aquifers, including the Bracklesham Group.
- GWSA-D: Order Limit from Chertsey South to the Esso West London Terminal storage facility covering a small part of Section F and all of Sections G and H. This area passes over Principal aquifers associated with superficial sand and gravel deposits.

Surface Water

8.2.7 The study area for surface water (which includes water quality, fluvial geomorphology and WFD) is defined by a 500m buffer either side of the Order Limits. This buffer allows for the consideration of impacts on receptors outside of the Order Limits, such as impacts on the water quality of receiving water bodies and subsequent downstream reaches, sediment transportation systems and quantity for authorised abstraction. The assessment of the potential impacts of the project upon flood risk has adopted a varying extent of study area to assess the impact upon all receptors.

8.2.8 Figures 8.1 and 8.2 illustrate the extent of the study area, as well as the location of watercourses and watercourse crossings by the pipeline.

Baseline Conditions

Desk-based Assessment

Groundwater

8.2.9 The desk study comprised the analysis of available information, including maps, geological data, soils data, data collected from historical investigations and publicly available data provided by the Environment Agency (EA) and local authorities. The following is a list of the key documentation/data utilised to inform the desk study:

- EA data obtained from their website at http://environment.data.gov.uk or via an information request. This comprises data relating to:
  - licensed groundwater abstractions;
  - pollution incidents which may have affected groundwater;
  - groundwater quality monitoring points; and
  - groundwater levels measured in boreholes monitored by the EA.
- Mapping data including groundwater Source Protection Zones (SPZs) and aquifer designations from the MAGIC mapping tool (Defra, 2018);
- Ordnance Survey (OS) 1:10,000, 1:25,000 and 1:50,000 maps;
- geological maps and borehole logs available at the British Geological Survey's (BGS) Geoindex website at:
- BGS map data identifying the vertical permeability of bedrock and superficial deposits ('Permeability Index');
- BGS map data identifying areas susceptible to groundwater flooding;
- BGS map data identifying where karst features may be present; and
- data on unlicensed private water supplies (PWSs) provided by local authorities. These PWSs relate to groundwater abstractions which abstract less than 20m^3/day of groundwater. Any unlicensed groundwater abstractions where the water is used for human consumption or food production has a 50m radius SPZ associated with it.

8.2.10 In addition to the data outlined above, the EA provided groundwater model output data (predicted groundwater levels) for three groundwater models which model the Chalk and the Upper Greensand. These model data have been used to establish where shallow groundwater may be present.

Surface Water

8.2.11 The following data sources have been used to inform the desk-based assessment of baseline conditions for surface water (including: flood risk, water quality, fluvial geomorphology and WFD):

- Detailed River Network (geospatial data available from the UK Government open data website);
- OS 1:10,000 and 1:25,000 maps;

- EA 'Flood Map for Planning' (geospatial data available from the UK Government open data website);
- Risk of Flooding from Surface Water (RoFSW) extent and depth mapping (available from Government open data website);
- EA 'Risk of Flooding from Reservoirs' depth map (geospatial data available from the UK Government open data website);
- BGS Groundwater Flooding Susceptibility (geospatial data available from the UK Government open data website);
- Surrey County Council and Hampshire County Council Local Flood Risk Management Strategies (available via their respective websites);
- Strategic Flood Risk Assessments for Eastleigh Borough Council, Winchester City Council, East Hampshire District Council, Hart District Council, Rushmoor Borough Council, Waverley Borough Council, Guildford Borough Council, Woking Borough Council, Surrey Heath Borough Council, Runnymede Borough Council and Spelthorne Borough Council;
- Groundsure Report;
- EA Catchment Data Explorer (Environment Agency, 2018);
- Thames River Basin Management Plan (Environment Agency, 2015a);
- South East River Basin Management Plan (Environment Agency, 2015b);
- Historical maps (National Library of Scotland, 2018);
- Designated sites taken from MAGIC (Defra, 2018);
- Contemporary aerial imagery;
- EA 'Water Quality Archive' (available from the UK Government website);
- Surrey County Council flood records;
- Hampshire County Council flood records, Flood Investigations 2012-15 & Recorded Highway Flooding;
- Environment Agency Recorded Flood Outlines;
- Surrey Heath Borough Council – Flood Zone – 3a;
- Surrey Heath Borough Council – Flood Zone – 3b;
- Rushmoor Borough Council – Flood Zone – 3a;
- Rushmoor Borough Council – Flood Zone – 3b;
- EA areas benefitting from Flood Defences;
- EA Flood Storage Areas;
- EA Spatial Flood Defences;
- Lower Thames Flood Risk Map hydraulic model results;
- River Blackwater Flood Study Final Flood Mapping hydraulic model results;
- Flood Estimation Handbook Webservice;

- National River Flow Archive records for stations:
  - 39007 - Blackwater at Swallowfield;
  - 39044 - Hart at Bramshill House;
  - 39078 - Wey (North) at Farnham;
  - 39120 - Caker Stream at Alton;
  - 39128 - Bourne (South) at Addlestone;
  - 42008 - Cheriton Stream at Sewards Bridge; and
  - 42011 - Hamble at Frogmill;
- EA data on:
  - licensed public surface water abstractions;
  - pollution incidents which may have affected surface water;
  - surface water quality monitoring points; and
  - groundwater levels measured in boreholes monitored by the EA.

Site Walkover and Surveys

Groundwater

8.2.12 Hydrogeological reconnaissance surveys comprised site walkovers of a number of potential GWDTEs. For three of these, Chobham Common Site of Special Scientific Interest (SSSI), Folly Bog area of Colony Bog and Bagshot Heath SSSI and Ewshot Meadows, a shallow soil survey was undertaken to identify potential shallow groundwater pathways. Further details of these surveys are provided in Appendix 8.3 Groundwater Dependent Terrestrial Ecosystems.

8.2.13 Data have also been collected as part of ongoing ground investigations (see Appendix 11.1 Soil and Geology Supporting Information for further information). The ground investigations included the installation of groundwater monitoring standpipes to allow groundwater levels to be measured and samples of groundwater to be collected for chemical analysis. Data available up to February 2019 has been included.

8.2.14 Permeability measurements have been undertaken in the majority of the boreholes. Groundwater data loggers have been installed in the majority of the boreholes so that changes in groundwater level over time can be recorded.

Surface Water

8.2.15 Following review of data collected through other surveys (land drainage surveys and the fluvial geomorphology reconnaissance surveys), flood risk specific site walkovers were completed where data to inform the quantitative assessment of flood risk impact were lacking or unclear. Site walkover visits were made at two sites:

- Cove Brook (in the vicinity of former Southwood Golf Course) on the 26 June 2018, and

- an unnamed watercourse to the east of Lower Froyle on the 6 October 2018.

8.2.16 The purpose of the walkovers was to gain an understanding of local topography, the interaction of the watercourse and its floodplain/flood storage area and to obtain measurements of the watercourses suitable to inform quantitative assessment.

8.2.17 Fluvial geomorphology reconnaissance surveys comprised visits to watercourses that were deemed to be potentially sensitive to crossing by the project based upon desk-based assessments. Further information regarding the watercourses visited and length of survey carried out can be found in Appendix 8.6 WFD Compliance Assessment.

8.2.18 The surveys were undertaken between 24 and 26 July 2018. Survey teams consisted of a geomorphologist and ecologist walking a pre-defined length of each watercourse, with the length walked depending on potential sensitivity and land access constraints. The walkovers also informed the WFD assessment, providing information on the biological, physico-chemical and hydromorphological elements of the watercourse.

Consultation and Engagement

8.2.19 Table 8.2 summarises the consultation and engagement that has been undertaken for the water environment topic.

Table 8.2: Consultation and Engagement Undertaken in Relation to the Water Environment

Consultee	Meeting Date or Communication Method	Topic Outline	Key Issues
Environment Agency	9 April 2018	Optioneering and assessment methodologies	Route corridor selection within the context of groundwater sensitivity and land quality constraints.
	17 May 2018	Surface water and flood risk	Scoping and methodologies for surface water assessment (including aquatic ecology and WFD) and flood risk assessment.
	9 July 2018	Groundwater and land quality	Scoping and methodologies for land quality and groundwater assessment; pipeline integrity measures.
	6 September 2018	WFD/ geomorphology/ aquatic ecology	Watercourse sensitivity and proposed watercourse crossing techniques (open cut versus trenchless).
	12 September 2018	Flood risk assessment	Detailed methodologies for flood risk assessment within constraints of available hydraulic models.
	11 October 2018	River Thames Scheme	Consideration of EA River Thames Scheme with the project as construction schedules potentially overlap.
	19 November 2018	Herts & North London Area	Land quality and groundwater issues due to presence of landfills; temporary construction works within the Thames floodplain.
	24 January 2019	Flood risk assessment	Results of flood risk assessment

Consultee	Meeting Date or Communication Method	Topic Outline	Key Issues
Lead Local Flood Authorities (LLFA): Surrey County Council and Hampshire County Council)	30 August 2018	Scoping Workshop	LLFA advice on planned capital drainage schemes; ordinary watercourse crossing methodologies; Development Consent Order (DCO) permitting procedures.
	8 November 2018	Ordinary watercourse crossing review	Methodologies for flood risk assessment at ordinary watercourse crossings; disapplication of consents in the DCO process.
Portsmouth Water	7 June 2018	Impacts of the project on groundwater abstractions	Portsmouth Water has particular concerns around potential impacts to their Northbrook abstraction due to the karstic nature of the chalk and the potential for rapid movement of contamination in karstic features.
Affinity Water	1 November 2018	Impacts of the project on groundwater abstractions	Potential impacts on Chertsey SPZ including potential mobilisation of contaminants associated with neighbouring landfills; pipeline integrity measures; ground investigation and monitoring.
	26 February 2019	Project update	Design refinements; risk assessment outputs for the Chertsey abstraction; pipeline integrity measures.
Southern Water	Email communication (various dates)	Impacts of the project on groundwater abstractions	Southern Water stated in an email of 29 September 2018 that they considered that the project would not impact on any Southern Water public water supply sources.
South East Water	Email communication (various dates)	Baseline data collection	N/A
Natural England (NE)	23-24 July 2018 including site walkovers of sites with potential GWDTEs	Impacts of the project on designated ecological sites, including GWDTE.	Possible impacts and mitigation measures relating to wetland habitats were discussed at Bourley and Long Valley SSSI. At Chobham Common, NE agreed that it was preferable for the proposed pipeline to follow the existing access track as closely as practicable. Possible impacts and mitigation measures relating to wetland habitats were discussed.

Future Baseline in the Absence of the Project

8.2.20 The latest projections of the impact of climate change from the UK Meteorological Office (UKCP18 National Climate Projections, 2018) vary by the emissions scenario, but overall, predict that summers are likely to be drier (although summer storms could be more intense) and winters wetter in England by the 2070s.

8.2.21 The direct impact of climate change on groundwater resources depends primarily upon the change in the volume and distribution of groundwater recharge. If drier, warmer summers lead to the seasonal deficits in the moisture content of soils extending into the autumn, the winter groundwater recharge season may be shortened. This could be compensated, at least to some extent, by an increase in winter rainfall. However, aquifers are recharged more effectively by prolonged

steady rain, which continues into the spring, rather than short periods of intense rainfall, which often result in a high proportion of rapid surface runoff rather than infiltration.

8.2.22 In general, the effects of climate change on groundwater in the southeast of England may therefore include:

- a long-term decline in groundwater storage;
- increased frequency and severity of groundwater droughts;
- increased frequency and severity of groundwater-related floods; and
- mobilisation of pollutants due to seasonally high water tables.

8.2.23 With respect to the project and surrounding area, these effects could result in local impacts on the stream flows that are sustained in part by groundwater flow. In addition, a reduction in groundwater levels during prolonged dry periods could affect PWSs and GWDTEs that are sustained by shallow groundwater flows. If seasonally high groundwater levels are encountered, due to increased winter rainfall, then groundwater levels could rise into trenches in which the pipeline is to be laid.

8.2.24 The evolution of the future baseline for fluvial geomorphology receptors is unlikely to change substantially in the absence of the project. Many of the watercourses exhibit stable planforms and are low to moderate energy environments, with limited competence to actively adjust the course of the channel. Some watercourses have been identified as currently adjusting; however, this is typically at a local scale and would only cause minor adjustments to fluvial geomorphological features and processes. It is anticipated that if left undisturbed, the watercourses would continue to adjust slowly laterally and potentially through incision within the defined wider corridor.

8.2.25 For watercourses identified as artificial field drains, these could potentially continue receiving fine sediment, which would become deposited and, in the absence of maintenance to remove accumulated deposits, remain on the channel bed.

8.2.26 Climate change could potentially alter the hydrological regime of the watercourses. An increased frequency/severity of droughts and/or floods could potentially lead to the watercourses adjusting to different patterns of erosion and deposition. However, it is likely that the adjustment would remain localised and of relatively low magnitude given the channel types within the study area.

8.2.27 Predicted increases in flood risk due to climate change would result in greater extents of land within Flood Zones 2 and 3. The potential increased intensity of summer storms could increase the predicted extents of surface water flooding as represented in the Risk of Flooding from Surface Water (RoFSW) mapping. More intense summer storms could result in an increased risk of flooding in urban areas, with local drainage networks less able to cope with the increased intensity of rainfall.

Water Framework Directive

8.2.28 The Thames and South East River Basin Management Plans (RBMP) (Environment Agency 2015a and 2015b) provide details of the anticipated WFD status/potential

for the WFD water bodies within the study area for years 2021 and subsequently 2027. As RBMP measures are put in place, it is anticipated that the WFD water body status/potential and the quality elements would improve. The future baseline for WFD receptors would, therefore, either improve (where not currently achieving Good Ecological Status/Potential) or remain the same (where Good Ecological Status/Potential is already being achieved) to remain compliant with the legislation.

8.2.29 It is not anticipated that climate change would result in any substantial changes to the baseline.

Limitations of Assessment

8.2.30 Requests for the location of PWSs have been made to Hart District Council and East Hampshire District Council (March 2018) but no responses have been received at the point of assessment. Therefore, private groundwater abstractions, potentially for potable supply, may exist within or close to the Order Limits in these districts. Public consultation events identified one additional groundwater abstraction in East Hampshire District Council's area and this demonstrates that other abstractions may exist within or close to the Order Limits. Active PWSs within the Order Limits would be identified as part of negotiations with landowners within the Order Limits which are affected by the project (G144).

Impact Significance

8.2.31 Impacts reported in this ES are adverse unless otherwise stated, and, are considered 'likely significant effects' in the context of the EIA Regulations when of moderate significance or above.

8.2.32 As explained in Chapter 6 Overview of Assessment Process, significance is determined using a three-step process:

1) Identify value/sensitivity of a receptor.
2) Determine magnitude of potential impact.
3) Assign impact significance.

8.2.33 Tables 8.3 and 8.4 set out the criteria used to assess value/sensitivity and magnitude. Impact significance was then determined taking both these assessments into account, using the matrix approach provided in Section 6.3 of Chapter 6.

8.2.34 Short term is used in this chapter to reflect the transient nature of the construction works. For the purposes of assessment, short term is assumed to be less than six months and includes mobilisation and reinstatement.

8.2.35 WFD compliance has been assessed separately as a standalone assessment in line with Planning Inspectorate Advice Note 18. The methodology is outlined in Appendix 8.6 and, therefore, is not included in Table 8.3 and Table 8.4.

Value/Sensitivity

Table 8.3: Value/Sensitivity Criteria for the Water Environment

Sensitivity/Value	Criteria
High	**Groundwater:** Principal aquifer. Groundwater flow and yield associated with licensed groundwater abstractions. Groundwater quality associated with Source Protection Zone (SPZ) 1 (Inner Protection Zone) associated with licensed abstractions. Buildings of regional or national importance, such as scheduled monuments, hospitals, power stations and industrial buildings. Water feeding GWDTEs with a high or moderate groundwater dependence with a high environmental importance and international or national value, such as Ramsar sites, Special Areas of Conservation (SACs), Special Protection Areas (SPAs) and Sites of Special Scientific Interest (SSSIs). **Surface Water Quality:** Water feeding highly or moderately Surface Water Dependent Ecosystem (SWDE) with a high environmental importance and international or national value, such as Ramsar sites, SACs, SPAs and SSSIs. Supports licensed large-scale abstraction for potable supply. WFD physico-chemical and chemical quality status of good or better. **Fluvial Geomorphology:** A watercourse that appears to be in complete natural equilibrium and exhibits a natural range of morphological features (such as pools and riffles). There is a diverse range of fluvial processes present, free from any modification or anthropogenic influence. **Flood Risk:** The assessment criteria for flood risk are aligned with those used in the FRA (**application document 7.3**). The FRA explains that the construction phase and pipeline operation have been assessed separately due to the relatively short duration of the construction phase. Therefore, the sensitivity/value criteria for flood risk differ for the construction phase and pipeline operation and are consistent with the assessment of flood likelihood presented in the FRA. During construction, taking into account the probability of a flood event occurring, there are no areas considered to be high sensitivity/value as the likelihood of a flood event occurring is considerably reduced. An exception to this is locations where water generated by construction activities is discharged to a surface water sewer. During pipeline operation, high sensitivity/value includes areas of Flood Zone 3b, areas of surface water flooding occurring with a greater than a 1 in 30 (3.3%) annual chance and areas with potential for groundwater flooding to occur at the surface defined by the Areas Susceptible to Groundwater Flooding mapping.
Medium	**Groundwater:** Secondary A aquifer. Groundwater flow and yield and quality associated with extensive non-licensed private water abstractions (i.e. feeding ten or more properties or supplying large farming / animal estates). Groundwater quality associated with SPZ2 (Outer Protection Zone) associated with licensed abstractions. Residential and commercial properties. Water feeding GWDTEs of low groundwater dependence with a high environmental importance and international or national value, such as Ramsar sites, SACs, SPAs and SSSIs; or water feeding highly or moderately groundwater dependent GWDTE with a national non-statutory UK Biodiversity Action Plan (BAP) priority. **Surface Water Quality:** Water feeding low SWDE sites with a high environmental importance and international or national value, such as Ramsar sites, SACs, SPAs and SSSIs; or water feeding highly or moderately SWDE with a national non-statutory UK Biodiversity Action Plan (BAP) priority. Supports licensed small-scale substitutable abstraction for potable supply or extensive non-licensed private water abstractions (i.e. feeding ten or more properties or supplying large farming / animal estates). WFD physico-chemical status of moderate and chemical status of good. **Fluvial Geomorphology:** A watercourse that appears to be in natural equilibrium and exhibits a natural range of morphological features (such as pools and riffles).

Sensitivity/Value	Criteria
	There is a diverse range of fluvial processes present, with very limited signs of modification or other anthropogenic influences. **Flood Risk:** During the construction phase, medium sensitivity/value includes areas of Flood Zone 3b, areas of surface water flooding occurring with a greater than a 1 in 30 (3.3%) annual chance and areas with potential for groundwater flooding to occur at the surface defined by the Areas Susceptible to Groundwater Flooding mapping. During the operation of the pipeline, medium sensitivity/value includes areas of Flood Zone 3a, areas of surface water flooding occurring with between a 1 in 100 (1%) and 1 in 30 (3.3%) annual chance and areas with potential for groundwater flooding of property situated below ground level defined by the Areas Susceptible to Groundwater Flooding mapping.
Low	**Groundwater:** Secondary B or Secondary Undifferentiated aquifer. Groundwater flow and yield and quality associated with small scale private water abstractions (i.e. feeding fewer than ten properties). Groundwater quality associated with SPZ3 (Source Catchment Protection Zone) associated with licensed abstractions and with licensed abstractions for which no SPZ is defined. Vacant residential properties and buildings. Water feeding GWDTEs of low groundwater dependence with a national non-statutory UK BAP priority; or water feeding highly or moderately groundwater dependent GWDTE sites with no conservation designation. **Surface Water Quality:** Water feeding low SWDE with a national non-statutory UK BAP priority; or water feeding highly or moderately SWDE sites with no conservation designation. Supports limited non-licensed abstraction for non-potable supply. WFD physico-chemical status of poor or chemical status of fail. **Fluvial Geomorphology:** A watercourse showing signs of modification, recovering to a natural equilibrium, and exhibiting a limited range of morphological features (such as pools and riffles). The watercourse is one with a limited range of fluvial processes and is affected by modification or other anthropogenic influences. **Flood Risk:** During the construction phase, low sensitivity/value includes areas of Flood Zone 3a, areas of surface water flooding occurring with between a 1 in 100 (1%) and 1 in 30 (3.3%) annual chance, areas with potential for groundwater flooding of property situated below ground level defined by the Areas Susceptible to Groundwater Flooding mapping and areas at risk of flooding from breaches to water infrastructure. During pipeline operation, low sensitivity/value includes areas of Flood Zones 1 or 2, areas of surface water flooding occurring with a less than a 1 in 100 (1%) annual chance, areas with limited potential for groundwater flooding defined by the Areas Susceptible to Groundwater Flooding mapping and areas at risk of flooding from breaches to water infrastructure.
Negligible	**Groundwater:** Very poor groundwater quality and/or very low permeability make exploitation of groundwater unfeasible. No active groundwater supply. Industrial buildings that are currently not utilised, all derelict buildings and infrastructure that serves a single dwelling. Water feeding GWDTEs of low groundwater dependence with no designation or groundwater that supports a wetland not classified as a GWDTE, although may receive some minor contribution from groundwater. **Surface Water Quality:** Surface water that supports a wetland not classified as a SWDE, although may receive some minor contribution from surface water. No surface water abstractions. WFD physico-chemical status of bad and chemical status of fail. **Fluvial Geomorphology:** A highly modified watercourse that has been changed by channel modification or other anthropogenic pressures. The watercourse exhibits no morphological diversity and has a uniform channel, showing no evidence of active fluvial processes and not likely to be affected by modification. Highly likely to be

Sensitivity/Value	Criteria
	affected by anthropogenic factors. Heavily engineered or artificially modified and could dry up during summer months. **Flood Risk:** During the construction phase, negligible sensitivity/value includes areas of Flood Zones 1 or 2, areas of surface water flooding occurring with a less than a 1 in 100 (1%) annual chance, areas with limited potential for groundwater flooding defined by the Areas Susceptible to Groundwater Flooding mapping and areas at risk of flooding from reservoirs or canals. During pipeline operation, low sensitivity/value includes areas of Flood Zone 1, areas of surface water flooding occurring with a less than a 1 in 1,000 (0.1%) annual chance, areas not considered to be prone to groundwater flooding defined by the Areas Susceptible to Groundwater Flooding mapping and areas at risk of flooding from reservoirs or canals.

8.2.36 The Environment Agency sought further clarification on the value criteria for SPZs in their scoping consultation response, however this was not raised in subsequent meetings with the EA. The values assigned are to acknowledge the differing sensitivities between the three SPZ categories and are based on assessment criteria that have been widely used and accepted for other development projects. It should be noted that although the criteria distinguish between the different SPZ categories, this does not detract from the need for the assessment to identify appropriate mitigation measures for aquifer and source protection.

Impact Magnitude

Table 8.4: Impact Magnitude Criteria for the Water Environment

Magnitude	Description
Large	**Groundwater Adverse:** Major or irreversible change to groundwater aquifer(s) flow, water level, quality or available yield which endangers the resources currently available. Groundwater resource use / abstraction is irreparably impacted upon, with a major or total loss of an existing supply or supplies. Changes to water table level or quality would result in a major or total change in, or loss of, a groundwater dependent area, where the value of a site would be severely affected. Changes to groundwater aquifer(s) flow, water level and quality would result in major changes to groundwater baseflow contributions to surface water and/ or alterations in surface water quality, resulting in a major shift away from baseline conditions such as change to WFD status. Dewatering effects create significant differential settlement effects on existing infrastructure and buildings leading to extensive repairs required. **Groundwater Beneficial:** Major increase in groundwater resource availability. Results in the achievement of Good Status for a WFD groundwater body or GWDTE which is currently failing its WFD objectives. Removal of existing or potential polluting discharge to groundwater.
	Surface Water Quality Adverse: Reduces resource availability resulting in change to assessment point status. Reduction in major potable abstraction (quantity or quality). Derogates existing water quality or impacts on ability of water body to achieve WFD objective. **Surface Water Quality Beneficial:** Increases resource availability resulting in change to assessment point status. Accelerates achievement of WFD Good Status. Removes existing polluting discharge or removes the likelihood of polluting discharges occurring to a watercourse.
	Fluvial Geomorphology Adverse: Loss or extensive damage to habitat due to extensive modification. Replacement of a large extent of the natural bed and/or banks with artificial material. Extensive change to channel planform.

Magnitude	Description
	Fluvial Geomorphology Beneficial: Removal of an existing superfluous structure or artificial channel bed/bank. Removal of existing polluting discharge or removing the likelihood of polluting discharges occurring to a watercourse.
	Flood Risk Adverse: Increase in flood risk to highly sensitive receptors (Risk to life, flooding of residential property, evacuation required, extensive areas affected). **Flood Risk Beneficial:** Reduction of flood risk to highly sensitive receptors (Risk to life, flooding of residential property, evacuation required, extensive areas affected).
Medium	**Groundwater Adverse:** Moderate long term or temporary significant changes to groundwater aquifer(s) flow, water level, quality or available yield which results in moderate long term or temporarily significant decrease in resource availability. Groundwater resource use / abstraction is impacted slightly, but existing supplies remain sustainable. Changes to water table level or groundwater quality would result in partial change in or loss of a groundwater dependent area, where the value of the site would be affected, but not to a major degree. Changes to groundwater aquifer(s) flow, water level and quality would result in moderate changes to groundwater baseflow contributions to surface water and/ or alterations in surface water quality, resulting in a moderate shift from baseline conditions upon which the WFD status rests. Dewatering effects create moderate differential settlement effects on existing infrastructure and buildings leading to consideration of undertaking minor repairs. **Groundwater Beneficial:** Moderate increase in groundwater resource availability. Contributes, in combination with other effects, to the achievement of Good Status for a WFD groundwater body or GWDTE which is currently failing its WFD objectives. Significant reduction of existing or potential polluting discharge to groundwater.
	Surface Water Quality Adverse: Impacts on the potential for a WFD water body to have improved physico-chemical quality element(s) or chemical status. Reduces local small-scale resource availability but no discernible change to assessment point status. **Surface Water Quality Beneficial:** Contributes towards achievement of WFD water body objectives. Increase in resource availability but no discernible change to assessment point status.
	Fluvial Geomorphology Adverse: Loss or damage to habitat due to modifications. Replacement of the natural bed and/or banks with artificial material. **Fluvial Geomorphology Beneficial:** Partial creation of both in-channel and riparian habitat. Removal of an existing superfluous structure or artificial channel bed/bank.
	Flood Risk Adverse: Increase in flood risk to receptors (Disruption to communities, flooding of non-residential property, local evacuation may be necessary). **Flood Risk Beneficial:** Reduction of flood risk to receptors (Disruption to communities, flooding of non-residential property, local evacuation may be necessary).
Small	**Groundwater Adverse:** Minor changes to groundwater aquifer(s) flow, water level, quality or available yield leading to a noticeable change, confined largely to the Project area. Changes to water table level, groundwater quality and yield result in little discernible change to existing resource use. Changes to water table level or groundwater quality would result in minor change to groundwater dependent areas, but where the value of the site would not be affected. Changes to groundwater aquifer(s) flow, water level and quality would result in minor changes to groundwater baseflow contributions to surface water and / or alterations in surface water quality, resulting in a minor shift from baseline conditions (equivalent to minor but measurable change within WFD status). Dewatering effects create minor differential settlement effects on existing infrastructure and buildings which may need to be monitored but where repairs may be avoidable. **Groundwater Beneficial:** Minor increase in groundwater resource availability. Leads to improvement of a WFD groundwater body which is currently failing its WFD objectives but insufficient effect to achieve Good Status. Minor reduction of existing or potential polluting discharge to groundwater.
	Surface Water Quality Adverse: Impacts on individual WFD quality elements, but not on successful delivery of specific mitigation measures or WFD objectives within assessment period. Localised small scale reduction in resource availability.

Magnitude	Description
	Surface Water Quality Beneficial: Contributes towards improvement of individual WFD quality elements. Localised small scale increase in resource availability.
	Fluvial Geomorphology Adverse: Slight change/deviation from baseline conditions due to modifications. **Fluvial Geomorphology Beneficial:** Slight change/deviation from baseline conditions or partial improvement in riparian or in-channel habitat.
	Flood Risk Adverse: Increase in flood risk causing some local disruption (flooding of minor road). **Flood Risk Beneficial:** Reduction of flood risk causing some local disruption (flooding of minor road).
Negligible	**Groundwater:** Very slight change from groundwater baseline conditions, approximating to 'no change' conditions. Dewatering effects create no or no noticeable differential settlement effects on existing infrastructure and buildings.
	Surface Water Quality: No impact on WFD quality elements and/or the ability to achieve WFD water body objectives. No change in resource availability.
	Fluvial Geomorphology: Very slight change from surface water baseline conditions, approximating to a 'no change' situation.
	Flood Risk: Field flooding or local ponding.

8.3 Baseline Conditions

8.3.1 This section summarises the baseline conditions for the water environment. Further details can be found in the following:

- Groundwater Baseline – Appendix 8.1;
- Detailed Trenchless and Targeted Open Cut Assessment – Appendix 8.2;
- Groundwater Dependent Terrestrial Ecosystems – Appendix 8.3;
- Groundwater Abstraction Assessment – Appendix 8.4;
- WFD Compliance Assessment – Appendix 8.6; and
- Flood Risk Assessment – standalone report (**application document 7.3**).

Groundwater

8.3.2 The groundwater study area is divided into four separate areas based on the geology and associated hydrogeological conditions. Tables 8.5 to Table 8.8 summarise the key baseline conditions in each of these study areas.

Table 8.5: Summary of Groundwater Baseline Information for GWSA-A

Aspect of the Groundwater Environment	Description
Bedrock groundwater resource	The Order Limits cross the following bedrock formations: • Wittering Formation - Secondary A aquifer (medium value); • Whitecliff Sand Member - Secondary A aquifer (medium value); • Durley Sand Member - Secondary A aquifer (medium value); • London Clay Formation - Unproductive strata (negligible value); and • Lambeth Group - Secondary A aquifer (medium value).

Aspect of the Groundwater Environment	Description
	Groundwater flow in the Secondary A aquifers is principally by intergranular flow. The Chalk Principal aquifer is present beneath the overlying lower permeability London Clay and Lambeth Group bedrock with groundwater being confined in this horizon.
Superficial deposits groundwater resource	River Terrace Deposits - Secondary A aquifer (medium value) Alluvium - Secondary A aquifer (medium value)
Public water supplies and SPZs	There are no public water supplies or mapped SPZs in GWSA-A. However, if the identified unlicensed groundwater abstractions are used for potable supply, they will have a default SPZ1 of 50m radius associated with them.
Licensed groundwater abstractions	There are no licensed groundwater abstractions in GWSA-A
Private water supplies	Five unlicensed PWSs have been identified within GWSA-A (low value) outside the Order Limits
Groundwater levels	It would be anticipated that groundwater levels are shallowest in the watercourse valleys, particularly for the tributary of the River Hamble in the vicinity of Ford Lake Valley. The groundwater flood susceptibility map shows there is the potential for groundwater flooding at the surface here (indicative of shallow groundwater). A further smaller area, where there is susceptibility to groundwater flooding at the surface, is present at Wintershill to the west of Bishop's Waltham. The ground investigation has installed two boreholes in GWSA-A. Within BH124, shallow groundwater levels were recorded at 0.28mbgl. In BH126 at Ford Lake Valley, artesian groundwater conditions were monitored.
Groundwater quality	Given the rural nature of GWSA-A, human influence on groundwater quality is likely to be slight, although elevated agricultural pollutants (most notably nitrate from fertilisers) could be anticipated. The EA has one groundwater monitoring point within GWSA-A which generally, shows the groundwater to be of good quality. However, copper concentrations are slightly elevated. Pesticides and volatile organic compounds (VOCs) are absent. Groundwater quality data from groundwater sampling, completed as part of the 2018 ground investigation works shows at BH124 elevated inorganic substances (including sulphate and chloride).
Groundwater pollution incidents	No groundwater pollution incidents have been identified by the EA within GWSA-A.
Groundwater Dependent Terrestrial Ecosystems	The following GWDTEs have been identified within GWSA-A: • Ford Lake Valley (moderate groundwater dependency with medium value); • Durley Green Lane (low to moderate groundwater dependency with low value); and • Wintershill Floodplain (low groundwater dependency with negligible value).

Table 8.6: Summary of Groundwater Baseline Information for GWSA-B

Aspect of the Groundwater Environment	Description
Bedrock groundwater resource	The Order Limits cross the following bedrock formations: • Chalk – Principal aquifer (high value); and • Upper Greensand Formation – Principal aquifer (high value).

Aspect of the Groundwater Environment	Description
	In GWSA-B the Chalk aquifer is unconfined and is a major source of drinking water in the region. Groundwater flow in the Chalk is mainly controlled by fracture flow. BGS data show that there are a number of karst and solution features within GWSA-B.
Superficial Deposits Groundwater Resource	Principal and Secondary A aquifers are largely absent in GWSA-B. There is, however, a Secondary A Alluvium aquifer (medium value) associated with watercourses which cross the Chalk near Alton.
Public Water Supplies and SPZs	There are no public water supplies within GWSA-B itself. However, the Order Limits do pass through SPZ2 (medium value) and SPZ3 (low value) associated with Portsmouth Water's Northbrook abstraction. GWSA-B passes through SPZ3 (Low value) associated with licensed public and private water supplies at Alton. However, only a very small part of the Order Limits themselves actually pass into this SPZ. In addition to the above SPZs, the Order Limits within GWSA-B also pass through SPZ2s (medium value) and SPZ3s (low value) associated with watercress beds near the village of New Alresford. Furthermore, if the identified unlicensed groundwater abstractions are used for potable supply, they will have a default SPZ of 50m radius associated with them.
Licensed Groundwater Abstractions	13 licensed groundwater abstractions (high value) have been identified within GWSA-B.
Private Water Supplies	25 unlicensed PWSs (low value) have been identified within GWSA-B with one at the boundary of the Order Limits and the remaining ones outside the Order Limits.
Groundwater Levels	Groundwater levels in the Chalk can vary greatly over the course of the year by as much as 20 to 30m. In general, the groundwater level is closer to the ground surface near to watercourses where there are discharges of groundwater than further away in the interfluves. Groundwater modelling results and groundwater level monitoring data provided by the EA does show that generally the depth to groundwater is not significant in relation to the depth that the pipeline trench would penetrate. However, the groundwater susceptibility flooding map does show the potential for shallow groundwater at six principal locations throughout GWSA-B. The 2018 ground investigation has installed ten boreholes in GWSA-B. BH69 recorded the shallowest groundwater level at 2.42mbgl.
Groundwater quality	Given the rural nature of most of GWSA-B, human influence on groundwater quality is likely to be slight, although elevated agricultural pollutants (most notably nitrate from fertilisers) could be anticipated. The EA has seven groundwater monitoring points within GWSA-B with a further eight situated on the Chalk and three on the Upper Greensand within 3.6km of the study area. The monitoring generally shows the groundwater to be of good quality dominated by calcium bicarbonate waters. Two boreholes show elevated concentrations of nitrate. Zinc concentrations are elevated in a number of locations and the copper concentration is slightly elevated. Iron is also occasionally recorded at elevated concentrations. Pesticides and VOCs are generally absent although relatively low concentrations of some herbicides such as atrazine and simazine are recorded in a few locations. Groundwater quality data from groundwater sampling carried out during the 2018 ground investigation works shows the groundwater to be largely uncontaminated. However, relatively low concentrations of hydrocarbons were detected in BH67 and in BH119.
Groundwater pollution incidents	One groundwater pollution incident is reported by the EA within GWSA-B. This relates to an incident in 2010 approximately 900m to the west of the Order

Aspect of the Groundwater Environment	Description
	Limits near Alton. This incident involved the loss of 250 litres of a non-toxic and biodegradable corrosion inhibitor to a soakaway. Given the age of this incident and nature of pollutant it is unlikely that any significant impact on groundwater remains.
Groundwater Dependent Terrestrial Ecosystems	The following GWDTEs have been identified within GWSA-B: • Peck Copse SINC (high groundwater dependency with medium value); • Caker and Lavant Streams Floodplain (moderate groundwater dependency with low value); • Floodplain of River Wey (low groundwater dependency with negligible value); and • Ashley Head Spring (moderate groundwater dependency with low value).

Table 8.7: Summary of Groundwater Baseline Information for GWSA-C

Aspect of the Groundwater Environment	Description
Bedrock groundwater resource	The Order Limits cross the following bedrock formations: • Lambeth Group – Secondary A aquifer (medium value); • London Clay Formation – Unproductive strata (negligible value); • Bagshot Formation – Secondary A aquifer (medium value); • Windlesham Formation – Secondary A aquifer (medium value); and • Camberley Sand Formation – Secondary A aquifer (medium value). Groundwater flow in the Secondary A deposits is principally by intergranular flow. The Chalk Principal aquifer is present beneath the overlying lower permeability London Clay and Lambeth Group bedrock with groundwater being confined in this horizon.
Superficial deposits groundwater resource	There are not many superficial deposits mapped across GWSA-C. However, superficial deposits are present associated with the major river valleys and form Secondary A aquifers (medium value). These are formed by Alluvium associated with the Cove Brook and with River Terrace Deposits and Alluvium for the River Blackwater and Mill Bourne. The Logistics hub at New Road in M3 Junction 3 Windlesham is shown to be situated on a peat deposit which forms Unproductive strata (negligible value).
Public water supplies and SPZs	There are no public water supplies or mapped SPZs in GWSA-C.
Licensed groundwater abstractions	Two licensed groundwater abstractions (high value) have been identified within GWSA-C outside the Order Limits.
Private water supplies	No unlicensed PWSs have been identified within GWSA-C.
Groundwater levels	It would be anticipated that groundwater levels are shallowest in the watercourse valleys, particularly for the River Blackwater where the groundwater flood susceptibility map shows there is the potential for groundwater flooding to below ground property. A further smaller area where there is susceptibility to groundwater flooding at the surface is to the east of Frimley. Further shallow groundwater could be expected from Bagshot Heath to the east of Chobham Common where much of the route runs through areas susceptible to groundwater flooding at the surface or to below ground property. The ground investigation has installed ten boreholes in GWSA-C. BH138 recorded the shallowest groundwater level at 0.08mbgl.

Aspect of the Groundwater Environment	Description
Groundwater quality	Given the rural nature of most of GWSA-C, human influence on groundwater quality is likely to be slight, although elevated agricultural pollutants (most notably nitrate from fertilisers) could be anticipated. Groundwater contamination cannot be ruled out in the more urbanised areas. The EA has two groundwater monitoring points within GWSA-C with a further three situated within 1.1km of the study area. Generally, concentrations of most metals are low. However, elevated nickel, zinc and aluminium concentrations have been recorded at certain locations. Pesticides and VOCs are generally absent in the monitoring data. Groundwater quality data from groundwater sampling carried out during the 2018 ground investigation works shows the groundwater to be largely of good quality although nickel and zinc concentrations were slightly elevated in two boreholes. Ammoniacal nitrogen concentrations were elevated in BH56 and chemical oxygen demand (COD) was elevated in BH35. Groundwater from BH59 showed elevated concentrations for both of these determinands and also showed elevated TPH concentrations. Low concentrations of hydrocarbons were also detected in other boreholes.
Groundwater pollution incidents	One groundwater pollution incident is reported by the EA within GWSA-C. This relates to an incident in 2002 approximately 1km to the east of the Order Limits at Farnborough which involved the loss of an unknown quantity of diesel fuel. Following the incident, approximately 40 tonnes of contaminated soils were excavated and groundwater testing carried out. Pending receipt of the full report, the EA considered remediation to be complete and acceptable.
Groundwater Dependent Terrestrial Ecosystems	The following GWDTEs have been identified within GWSA-C: • Ewshot Meadow SINC (moderate groundwater dependency with medium value); • Bourley and Long Valley SSSI (areas with high groundwater dependency with high value and areas with low groundwater dependency with medium value); • Eelmoor Marsh SSSI (high groundwater dependency at southern end; low groundwater dependency at Order Limits with high value); • South of Ively Road SINC (No groundwater dependency with negligible value); • Cove Brook Grassland SINC (low to moderate groundwater dependency with medium value with the golf course area having no groundwater dependency with negligible value); • Frimley Hatches SNCI (moderate groundwater dependency with medium value); • Colony Bog and Bagshot Heath SSSI (known as Brentmoor Heath and Folly Bog Nature Reserve) (low groundwater dependency at Order Limits with medium value) • Folly Bog (high groundwater dependency with high value); • Chobham Common SSSI (areas with high groundwater dependency with high value and areas with low or no groundwater dependency with medium value); and • Foxhills Golf Club (high to moderate groundwater dependency with low value).

Table 8.8: Summary of Groundwater Baseline Information for GWSA-D

Aspect of the Groundwater Environment	Description
Bedrock groundwater resource	The Order Limits cross the following bedrock formations: • London Clay Formation – Unproductive strata (negligible value); • Bagshot Formation – Secondary A aquifer (medium value); and • Claygate Member – Secondary A aquifer (medium value). Groundwater flow in the Secondary A aquifers is principally by intergranular flow. The Chalk Principal aquifer is present beneath the overlying lower permeability London Clay bedrock with groundwater being confined in this horizon.
Superficial deposits groundwater resource	GWSA-D has been defined based on the superficial deposits as these deposits form Principal aquifers. As such, in this length of the route the bedrock deposits may be of less importance than the superficial deposits in terms of the shallow groundwater. Superficial deposits encountered in GWSA-D comprise: • Alluvium Silt - Secondary A aquifer (medium value); • Kempton Park Gravel Member - Principal aquifer (high value); • Shepperton Gravel Member - Principal aquifer (high value); • Lynch Hill Gravel Member - Secondary A aquifer (medium value); • Head deposits - Secondary Undifferentiated aquifer (low value); and • Langley Silt Member - Unproductive strata (negligible value).
Public water supplies and SPZs	Public water supply boreholes are present within GWSA-D associated with Affinity Water's Chertsey abstraction. The Order Limits pass through SPZ2 (medium value) and SPZ3 (low value) associated with this abstraction. The Chertsey abstraction pumps water from gravel superficial deposits. If the identified unlicensed groundwater abstractions are used for potable supply, they will have a default SPZ of 50m radius associated with them (high value).
Licensed groundwater abstractions	13 licensed groundwater abstractions (high value) have been identified within GWSA-D.
Private water supplies	Three unlicensed PWSs (low value) have been identified within GWSA-D outside the Order Limits.
Groundwater levels	The groundwater flood susceptibility map shows there is the potential for groundwater flooding of below ground property and at the surface for much of the length of the route in GWSA-D. It is therefore anticipated that shallow groundwater levels would be encountered for almost the entire length of the GWSA-D Order Limits. The 2018 ground investigation has installed 14 boreholes in GWSA-D. BH150 recorded the shallowest groundwater level at 0.09mbgl, and seven of the other boreholes also recorded groundwater levels within 1m of the ground surface.
Groundwater quality	There are no EA groundwater monitoring points within GWSA-D itself although there is one 120m outside the GWSA-D boundary at Chertsey. The data show the groundwater to be of good quality with low concentrations of metals. Pesticides and volatile organic compounds (VOCs) are generally absent. However, groundwater quality of GWSA-D is impacted as a result of the urbanised nature of the area and the presence of various landfills and backfilled gravel pits through which the Order Limits run. Groundwater quality data from groundwater sampling carried out during the 2018 ground investigation works typically show elevated concentrations of chloride, sulphate, calcium, organic carbon, and occasionally COD and ammoniacal nitrogen. Certain metals, including boron, chromium, nickel and zinc were also detected at elevated concentrations. Organic compounds were

Aspect of the Groundwater Environment	Description
	also occasionally recorded. pH was elevated (i.e. showed alkaline conditions) in BH03 and cyanide was detected in BH30 on one sampling occasion. Monitoring data provided for the landfills through which the Order Limits run do show some impact, including elevated ammoniacal nitrogen concentrations.
Groundwater pollution incidents	No groundwater pollution incidents are reported by the EA within GWSA-D.
Groundwater Dependent Terrestrial Ecosystems	The following GWDTEs have been identified within GWSA-D: • Addlestone Moor (low groundwater dependency with negligible value); • Chertsey Meads LNR (low groundwater dependency with low value); and • Dumsey Meadow SSSI (no groundwater dependency for higher ground with medium value; low to moderate groundwater dependency in low-lying areas with high value).

Surface Water Quality

8.3.3 The surface water study area contains many watercourses, their corresponding catchments and adjoining catchments. The Order Limits cross 14 Main Rivers, 64 ordinary watercourses, two canals (Basingstoke Canal and King George VI Surface Water Transfer) and one water feature (the Blackwater Valley gravel pits). Some of the watercourses are crossed more than once; the total number of watercourse crossings amounts to 93.

8.3.4 Immediately north of the River Thames the pipeline route passes between a series of lakes formed from earlier gravel extraction activities. Littleton South Lake lies between the Thames and the M3, while Littleton North Lake lies immediately north of the M3. The proposed pipeline route passes just to the east of these two lakes and immediately west of Littleton East Lake.

8.3.5 The Main Rivers are:

- Ford Lake (Section A);
- Caker Stream (Section C);
- River Wey (Section C);
- Gelvert Stream (Section D);
- Ively Brook (Section D/E);
- Cove Brook (Section E);
- River Blackwater (Section E);
- Unnamed watercourse 44 (a tributary of the River Blackwater at Burrow Hill, Farnborough) (Section E);
- Hale Bourne (Section F);
- Unnamed watercourse 57 (a tributary of the Hale/Mill Bourne draining Chobham Common) (Section F);
- The Bourne (Section G);

- River Thames (Section G);
- River Ash (Section H); and
- Unnamed watercourse 85 (a tributary of the River Ash) (Section H).

These are illustrated on Figure 8.1, along with pipeline sections A-H, as described in Chapter 3 Project Description. All unnamed watercourses have been given a unique ID as shown on Figure 8.1.

8.3.6 Two of the most important considerations in relation to surface water quality are potential impacts on aquatic ecology and any downstream surface water abstractions. Appendix 7.5 Aquatic Ecology Factual Report provides a summary of watercourse sensitivity from an aquatic ecology perspective, with only a small number of watercourses crossed by the pipeline route identified as high or moderate sensitivity:

- High sensitivity: Ford Lake Stream/Upper Hamble; River Wey; Hale Bourne; River Thames; and River Ash.
- Moderate sensitivity: Cove Brook; River Blackwater; The Bourne; and Queen Mary Reservoir Intake Channel.

The remainder are low sensitivity watercourses or ephemeral drainage channels.

8.3.7 Licensed surface water abstractions are illustrated on Figure 8.2. Those located within 5km downstream of proposed watercourse crossings are as follows:

- River Hamble (Section A): two abstractions, approximately 600m and 900m downstream of the Ford Lake stream proposed pipeline crossing.
- River Wey (Section C): two abstractions, approximately 2km and 2.4km downstream of the proposed River Wey crossing at the A31.
- Coldrey Farm, Lower Froyle (Section C): agricultural abstraction from a lake (the pipeline route crosses a small watercourse feeding the lake, close to the lake inlet).
- River Thames (Section G): approximately 4.5km downstream of the proposed pipeline crossing.
- River Ash (Section H): approximately 3.5km downstream of the proposed pipeline crossing.

Aside from the small watercourse at Coldrey Farm, which is a proposed open cut crossing, all the above comprise trenchless crossings (as described in Appendix 3.1 Table of Trenchless Crossings).

8.3.8 As described in Chapter 3 Project Description, there are up to six temporary logistics hubs proposed, four of which are existing brownfield sites and two agricultural land. One of the hubs (Brett Aggregates, Littleton Lane, Shepperton) is contiguous with the pipeline Order Limits. The other five hubs (Hartland Park Village, Farnborough; New Road, Windlesham; Deepcut, Frimley; A31 Ropley Dean; and A31/A32 junction at Alton) are more remote. Hartland Park Village is sited within the Gelvert Stream catchment, downstream of the pipeline crossing of this watercourse. New Road

Windlesham is sited in the Windle Brook catchment, which flows into the Hale Bourne just upstream of the pipeline crossing. Deepcut Bridge Road lies in the upper catchment of unnamed watercourse 46 which flows into the River Blackwater close to the pipeline crossing. The A31 Ropley Dean hub is located in the upper catchment of the River Alre. The hub at the A31/A32 junction at Alton lies in the catchment of the Lavant Stream which flows into the Caker Stream just downstream of the proposed pipeline crossing.

Fluvial Geomorphology

8.3.9 The morphological processes and features of the 14 Main Rivers crossed by the project vary considerably. All the Main Rivers to be crossed, apart from one, were surveyed, the findings of which are reported in the WFD Compliance Assessment (Appendix 8.6). Watercourse 85 which is culverted along much of its length was unable to be accessed.

8.3.10 Many of the ordinary watercourses crossed are land or road drains. They typically have artificially straightened channel planforms with trapezoidal cross-sections. The banks are typically vertical and high in relation to channel width, and the bed substrate primarily consists of fine sediment. These watercourses usually have few sensitive or important morphological features and limited morphological processes (such as erosion). Further information relating to the morphological features and fluvial processes of each of the ordinary watercourses surveyed is provided in the WFD Compliance Assessment (Appendix 8.6).

8.3.11 Table 8.9 provides a summary of the fluvial geomorphology sensitivity/value for each of the receptors identified within the study area. The sensitivity/value of eight receptors has been changed from the Scoping Report based on findings from subsequent site visits. These are detailed in Table 8.10, along with justification as to why the changes have been made.

Table 8.9: Fluvial Geomorphology Receptors and Sensitivities

Receptor Name	Sensitivity/Value	Description
Ford Lake	High	Major watercourses that exhibit a diverse range of natural morphological forms and processes. Although the River Thames is modified in nature, it is considered to have a high value for fluvial geomorphology.
River Wey		
River Blackwater		
Hale Bourne		
River Thames		
Caker Stream	Medium	Watercourses that exhibit a range of morphological features and processes. Some modifications are present which influence the natural processes.
Gelvert Stream		
The Bourne		
River Ash		
Unnamed watercourses 4-6	Low	Modified watercourses showing a limited range of morphological features and processes, although there is some evidence of the channel recovering towards a new equilibrium.
Ryebridge Stream		
Unnamed watercourse 15		
Unnamed watercourses 22-24 29, 31 and 32		
Cove Brook		

Receptor Name	Sensitivity/Value	Description
Blackwater Valley		
Unnamed watercourse 44		
Clappers Brook		
Unnamed watercourses 52, 53 and 57		
Unnamed watercourses 77 and 85		
Unnamed watercourses 2 and 3	Negligible	A highly modified watercourse, with no morphological diversity and no evidence of geomorphological processes that could change the channel form. Heavily modified channel which could dry up during summer months.
Unnamed watercourses 7, 9-10		
Water Lane		
Unnamed watercourses 11-14, 16-20, 87 and 90		
Ively Brook, Unnamed watercourse 46		
Basingstoke Canal		
Unnamed watercourses 25-28 and 34-36		
Unnamed watercourse 38		
Unnamed watercourses 49-51, 59, 60, 62-66, 68 and 88		
Unnamed watercourses 70, 75, 76, 78, 91 and 92		
Queen Mary Reservoir Intake Channel		
King George VI Surface Water Transfer (formerly identified as Staines Aqueduct)		
Unnamed watercourse 81-83 and 89		

Table 8.10 Sensitivity/Value Updates Since the Scoping Report

Receptor Name	Sensitivity/Value Change From Scoping Report	Justification
Ford Lake	From medium to high	The watercourse showed no signs of anthropogenic modifications within the length walked and exhibited a diverse range of morphological features, particularly gravel bars and naturally occurring woody material dams.
Caker Stream	From low to medium	The watercourse showed signs of re-adjusting following historical modifications (i.e. as a result of anthropogenic interventions), with morphological features such as gravel bars and riffles present downstream of the proposed crossing location.
Unnamed watercourse 87	From low to negligible	After further desk-based assessment this watercourse has been deemed to be a drainage channel which is unlikely to exhibit morphological or fluvial diversity.
Unnamed Watercourses 31 and 32	From negligible to low	Previously assumed to be field drains from the information available after undertaking a desk study. However, during the site walkovers, observations were made of some morphological processes leading to localised channel adjustment. This suggests that the watercourses are trying to achieve a natural equilibrium and, therefore, the sensitivity has been increased.
Gelvert Stream	From low to medium	During the walkover surveys, the watercourse was not observed to be as heavily modified as was initially anticipated based on the desk study information. The channel was observed to be incising and eroding with morphological features observed. The sensitivity of the watercourse has therefore been increased to reflect the morphological processes and features observed.
The Hatches	From medium to low	The Hatches are artificially formed lakes and as such show little in the way of natural geomorphological processes, apart from a few island features which are likely to have been artificially formed.
The Bourne	From high to medium	The channel was observed to have been modified during the site walkover including a bridge crossing, several headwalls, outfalls and walls forming lengths of the right-hand bank. The channel also appeared to be overwide and overdeep for much of the surveyed reach, suggesting historical dredging and/or placement of embankments along the watercourse. Therefore, the sensitivity has been reduced to reflect the modification to the channel.

Flood Risk

8.3.12 The project is not located within an area predicted to be at risk of tidal or coastal flooding. Therefore, this source of risk has been scoped out of this assessment.

8.3.13 As noted above, the route of the pipeline crosses numerous watercourses, including Main Rivers, ordinary watercourses and drainage ditches. The project is located within all Flood Zones: 1, 2, 3a and 3b. A full description of the watercourses crossed is included in the FRA (**application document 7.3**).

8.3.14 The project crosses a number of locations at risk of surface water flooding. A number of these coincide with Flood Zones, however some are separate to these and identify potential overland flow routes. These locations are listed in Table 8.1 of the FRA (**application document 7.3**).

8.3.15 British Geological Survey (BGS) defines three categories of susceptibility to groundwater flooding:

- A: Limited potential for groundwater flooding;
- B: Potential for groundwater flooding of property situated below ground level; and
- C: Potential for groundwater flooding to occur at the ground surface.

8.3.16 The project traverses each of these zones. The proportion of the Order Limits within each of these categories is included in Table 9.2 of the FRA (**application document 7.3**).

8.3.17 The project crosses a number of locations predicted to flood in the event of a breach (failure) of a major reservoir (greater than 25,000m^3 capacity) as listed in Table 10.1 of the FRA (**application document 7.3**).

8.3.18 There is one canal within the Order Limits: the Basingstoke Canal and two canal-like structures: the Queen Mary Reservoir Intake Channel and the King George VI Surface Water Transfer (formerly identified as the Staines Reservoir Aqueduct). As the pipeline route crosses all three structures, there is a potential risk of flooding should they fail. There is a risk that the crossing of these features could result in a clash that causes an unintended release of water and subsequently flooding. However, in each of these cases the crossing is via trenchless techniques which, combined with good engineering practice, would reduce the assessed risk to very low.

8.3.19 There are no publicly available sources of information defining areas at risk in the event of water infrastructure failure, such as: sewer flooding, drainage system flooding or water main bursts. However, given that the project traverses urban areas where such infrastructure is prevalent, there is a risk that areas of temporary works could be at risk in the event of infrastructure failure.

8.3.20 Historic reports of flooding have been considered when assessing the risk to and from the project which are included in Appendix C of the FRA (**application document 7.3**).

Water Framework Directive

8.3.21 A total of 39 WFD surface water bodies and 10 WFD groundwater bodies were identified within the study area. Of these, 24 of the WFD surface water bodies have been scoped out of further assessment based on distance from the Order Limits and likelihood of potential long-term direct and indirect effects.

8.3.22 Table 8.11 provides a summary of the baseline conditions for the 15 surface WFD water bodies and 10 WFD groundwater bodies scoped in for detailed assessment.

8.3.23 Figures A.8.6.1 and A.8.6.2 illustrate the locations of the WFD surface water bodies and groundwater bodies respectively.

Table 8.11: WFD Water Bodies Within Study Area (Note: 'Potential' Relates to Those WFD Water Bodies Classified as Heavily Modified Water Bodies)

Water Body Type	Water Body Name	WFD Status/Potential (Cycle 2, 2016 Classification)
Surface water	Horton Heath Stream	Good Potential
	Upper Hamble	Moderate Status
	Caker Stream	Moderate Status
	North Wey (Alton to Tilford)	Moderate Status
	Hart (Crondall to Elvetham)	Poor Status
	Fleet Brook	Moderate Potential
	Cove Brook	Bad Status
	Blackwater (Aldershot to Cove Brook confluence at Hawley)	Poor Status
	Hale/Mill Bourne (Bagshot to Addlestone Bourne confluence near Chobham)	Moderate Status
	Chertsey Bourne (Virginia Water to Chertsey)	Moderate Potential
	Chertsey Bourne (Chertsey to River Thames confluence)	Poor Status
	Thames (Egham to Teddington)	Poor Potential
	Surrey Ash	Moderate Potential
	Basingstoke Canal	Moderate Potential
	King George VI Surface Water Transfer	Moderate Potential
Groundwater	South East Hants Bracklesham Group	Poor Status
	East Hants Lambeth Group	Poor Status
	East Hants Chalk	Poor Status
	River Itchen Chalk	Poor Status
	Alton Chalk	Good Status
	Basingstoke Chalk	Poor Status
	Old Basing Tertiaries	Poor Status
	Farnborough Bagshot Beds	Good Status
	Chobham Bagshot Beds	Good Status
	Lower Thames Gravels	Good Status

8.4 Design and Good Practice Measures

8.4.1 All commitments are listed within the Register of Environmental Actions and Commitments (REAC), which is included within Chapter 16 Environmental Management and Mitigation. Commitments include embedded design measures, good practice measures and mitigation required to reduce a likely significant effect.

8.4.2 This chapter contains a number of project commitments to reduce impacts on the environment. These are indicated by a reference number like this (G20). Good practice measures are set out in the REAC and secured through DCO requirements such as the Code of Construction Practice (CoCP).

8.4.3 Chapter 4 Design Evolution provides a summary of the environmental considerations that have influenced the design through this process, with iterative

updates and improvements to reach the fixed design submitted for development consent. The embedded design measures have been built into the designs, for example through the amendment to the Order Limits to avoid a sensitive feature. Examples relevant to this chapter include using trenchless crossing technology for crossings of waterways over 30m wide (O5), avoiding existing SPZ 1 areas associated with licensed abstractions (O6) and a commitment to only utilise a 10m width when crossing through boundaries between fields where these include hedgerows, trees or watercourses (O1).

8.4.4 In addition, the designs include a number of integrity measures to avoid potential impacts to sensitive environmental receptors:

- The principles of inherent safe design have been incorporated into the design of the pipeline as per Esso design standards for fuel pipelines, relevant industry codes of practice and standards and the requirements of the Pipeline Safety Regulations 1996 (O8).
- The installed pipe would have a nominal wall thickness of 11.9mm. The wall thickness is greater than British Standard PD 8010 (British Standards Institution, 2019) to provide additional long-term protection from deterioration or damage.
- Inclusion of remotely operated valves to allow isolation of sections of the pipeline if required (O9).
- 24-hour remote monitoring of pipeline operation to detect leaks and enable remote shut down of the pipeline if required (O10).

8.4.5 The good practice measures that are most relevant to water are listed in Table 8.12. These are applicable to all areas unless stated otherwise. The following assessment is based on these good practice measures being in place.

Table 8.12: Good Practice Commitments Within the REAC

Ref	Commitment Description
G1	A Construction Environmental Management Plan (CEMP) would be produced in line with the Outline CEMP. It would explain how the activities of sub-contractor(s) comply with its requirements and include subsidiary plans such as the management of waste and soils.
G11	Runoff across the site would be controlled by the use of a variety of methods including header drains, buffer zones around watercourses, on-site ditches, silt traps and bunding.
G12	There would be no intentional discharge of site runoff to ditches, watercourses, drains or sewers without appropriate treatment and agreement of the appropriate authority (except in the case of emergency).
G121	All refuelling, oiling and greasing of construction plant and equipment, would take place above drip trays and also away from drains as far as is reasonably practicable. Vehicles and plant would not be left unattended during refuelling. Appropriate spill kits would be made easily accessible for these activities.

Ref	Commitment Description
G130	The CEMP would follow the principles set out in the Outline CEMP and would set out the water mitigation and management measures and where they would need to be used. These measures would include, but not be restricted to, the following: • details of when dewatering would be likely; • measures to segregate construction site runoff from natural catchment runoff; • details of measures to attenuate runoff rates before discharging at controlled rates to receiving watercourses; • design of any holding or settlement lagoons or other treatment system required prior to discharge to the environment; • details of mitigation measures for all work or compound areas located within flood risk areas; • where construction activities would be located, preferably outside of the floodplain; and • details of any water abstraction and discharge points relating to the works.
G142	Fuels, oils and chemicals would be stored responsibly, away from sensitive water receptors. They would be stored >15m from watercourses, ponds and GWDTE.
Key commitments in relation to the mitigation of potential surface water effects and impacts on watercourses include:	
G39	Appropriate buffer zones would be established within Order Limits adjacent to identified watercourses.
G87	Vegetation clearance, retention, protection and replanting/reinstatement plans would be produced prior to the construction phase. The contractor(s) would implement these plans including agreed mitigation where practicable.
G88	Where possible, reinstatement of vegetation would generally be using the same or similar species to that removed (subject to restrictions for planting over and around pipeline easements).
G116	An Erosion and Sediment Control Plan would be produced by the contractor prior to the start of the construction phase (G116).
G122	For open cut watercourse crossings and installation of vehicle crossing points, mitigation measures would include to: • only use a 10m working width for open cut crossings of a main or ordinary watercourse whilst still ensuring safe working; • install a pollution boom downstream of the works; • use and maintain temporary lagoons, tanks, bunds, silt fences or silt screens as required; • have spill kits and straw bales readily available at all crossing points for downstream emergency use in the event of a pollution incident; • place all static plant such as pumps in appropriately sized spill trays; • prevent re-fuelling of any plant or vehicle within 15m of a watercourse; • inspect all plant prior to work adjacent to watercourses for leaks of fuel or hydraulic fluids; and • re-instate the riparian vegetation and natural bed of the watercourse using the material removed when appropriate on completion of the works and compact as necessary. If additional material is required, appropriately sized material of similar composition would be used.
G123	All works within or adjacent to watercourses would be carried out in accordance with the requirements of permits and licences agreed with either the Environment Agency or relevant Local Lead Flood Authority or in accordance with the provisions of the DCO.
G143	The quality of water generated by dewatering would be tested prior to discharge.
Key commitments in relation to the management of flood risk include:	
G125	With the exception of the Thames floodplain, all construction compounds and logistics hubs would be located outside of Flood Zone 3.

Ref	Commitment Description
G126	Where new or additional surfacing is required on any access tracks and compound areas, these would be permeable surfaces where ground conditions allow.
G127	The contractor(s) would subscribe to the EA's Floodline service which provides advance warning of potential local flooding events. The contractor(s) would implement a suitable flood risk action plan which would include appropriate evacuation procedures should a flood occur or be forecast.
G128	The contractor(s) would comply with all relevant consent conditions or DCO provisions regarding dewatering and other discharge activities. This would particularly be with regard to volumes and discharge rates and would include discharges to land, waterbodies or third-party drains/sewers.
G184	Stockpiles would not be located within 10m of any main rivers or ordinary watercourse crossings.
G185	Temporary haul and access road construction material within Flood Zone 3 and areas of High and Medium RoFSW would be removed at the end of the construction phase and the ground surface would be re-instated to pre-project levels.
G186	Where appropriate, cross-fall would be installed on access and haul roads to direct runoff away from the pipeline trench.
Key commitments in relation to the mitigation of potential groundwater effects include:	
O6	To reduce the risk of potential effects on protected aquifers, the pipeline as laid will not lie within existing SPZ1 areas associated with licensed abstractions.
O7	Where required, water stops (or "stanks") would be installed at intervals through the pipe bedding and side fill. This will reduce groundwater flow along the pipeline and prevent new groundwater flow pathways from being created.
G132	The contractor(s) would ensure that the time the trench is open in the vicinity of certain features would only be as long as necessary for the installation of the pipeline. The required dewatering of the trench would be undertaken only as and when necessary to enable safe working and preparation for pipe installation.
G138	Water levels would be monitored immediately prior to and as dewatering takes place. This would be in the potentially affected abstraction or watercourse as appropriate.
G144	As part of negotiations with landowners within the Order Limits which are affected by the project, active private water supplies (PWSs) would be identified with the landowner. Appropriate mitigation would be considered during construction.
G118	The detailed design for Horizontal Direct Drilling would include depth and profile and consider methods to reduce the risk of groundwater breakout during Horizontal Direct Drilling. This would address potential risks associated with artesian groundwater, such as at the trenchless crossing of Ford Lake Stream.
G199	Specific areas in the vicinity of GWDTEs would be identified where increased frequency of stanks would be required to safeguard sensitive habitats which depend on groundwater. This would address potential risks associated with sensitive springs or habitat identified at Bourley and Long Valley SSSI – southerly wet woodland sub-site and the northeastern sub-site of Folly Bog.
NW12	Working width reduced to 15m and positioned towards the western half of the Order Limits to reduce impacts to a recorded spring over an approximate distance of 47m. (Grid ref: SU8268552667 to SU8269352711).

8.5 Potential Impacts (Without Mitigation)

8.5.1 This section sets out the potential significant effects of the project on the water environment, based on the theoretical scenario of project implementation with design and good practice measures in place but without any additional mitigation. This step in the EIA process is necessary to enable identification of additional appropriate mitigation commitments as set out in Section 8.6 and facilitates the

demonstration of how potential impacts would be avoided, reduced or offset to achieve the residual impacts reported in Section 8.7.

Construction

Groundwater

8.5.2 This section of the report relies on the information and assessments provided in the associated groundwater appendices as follows.

- Appendix 8.2 Detailed Trenchless and Targeted Open Cut Assessments which assesses whether each of the trenchless crossings could impact on groundwater levels due to dewatering and whether the trenchless crossing is likely to connect two aquifers or release artesian pressures. Where dewatering for the construction of a trenchless crossing is required, the appendix identifies which groundwater receptors may be impacted by a drawdown in groundwater levels. Appendix 8.2 also assesses the effect of dewatering where the open cut runs parallel to a watercourse and whether dewatering could impact on flow in the watercourse.
- Appendix 8.3 Groundwater Dependent Terrestrial Ecosystems which determines the groundwater dependency of each potential GWDTE. For each GWDTE, a Conceptual Site Model (CSM) describes conceptually the relative importance of sources of water supporting the GWDTE. The appendix then determines the potential magnitude of change that the installation of the pipeline could have on the GWDTE.
- Appendix 8.4 Groundwater Abstraction Assessment which identifies and assesses the risk posed due to potential geological/hydrogeological pathways between the Order Limits and identified groundwater abstractions.

8.5.3 This is a receptor-based assessment with the potential impacts on receptors discussed. In defining the potential receptors, the following criteria have been applied.

- For GWDTEs with local designations, those that have been determined in Appendix 8.3 Groundwater Dependent Terrestrial Ecosystems as having high or moderate groundwater dependency have been considered.
- For PWSs, those which have been determined in Appendix 8.4 Groundwater Abstraction Assessment as being at moderate risk or greater, based on the infiltration and groundwater flow pathways have been considered.
- For watercourses that run parallel to the pipeline, those which are considered to have a moderate risk of impact or greater, based on the CSMs, have been considered.

8.5.4 The paragraphs below summarise the likely significant effects identified during construction.

8.5.5 Table 8.5.1 in Appendix 8.5 Potential Effects on Groundwater assesses the potential significance of effects for interception of shallow groundwater in the pipeline trench that could lead to the reduction of flows to shallow groundwater receptors such as watercourses, shallow wells and GWDTE. Over much of the Order Limits, this would not be a significant effect because the pipeline trench is shallow (typically 1.5m deep

but deeper under certain features where trenchless techniques are being used) and is unlikely to penetrate any substantial thickness of saturated aquifer. Areas where groundwater is most likely to be encountered are those areas on the BGS maps showing susceptibility to groundwater flooding at the surface. This assessment is supported by Appendix 8.2 Detailed Trenchless and Targeted Open Cut Assessments, which reviewed in more depth where dewatering of trenches running parallel to watercourses could lead to an impact on river flows by causing drawdown of groundwater levels adjacent to a river.

8.5.6 Table 8.5.1 in Appendix 8.5 Potential Effects on Groundwater identifies two GWDTE sites where a likely significant effect could occur. At Bourley and Long Valley SSSI – southerly wet woodland sub-site, localised dewatering of the trench could cause drawdown of water levels and reduce discharge at the identified spring located downgradient of the Limits of Deviation and in the western end of the Order Limits, which supports the wetland habitats. At Folly Bog, the northeastern sub-site of Colony Bog and Bagshot Heath SSSI, localised dewatering may reduce groundwater levels in part of the site. In both cases it has been assessed that a medium magnitude of impact could result, with a moderate significance of effect.

8.5.7 Table 8.5.2 in Appendix 8.5 Potential Effects on Groundwater assesses the potential significance of effects for interception of shallow groundwater in the pipeline trench which could lead to groundwater of poor quality discharging to sensitive receptors, i.e. GWDTE and groundwater abstractions, but also watercourses crossed by the trench. Areas where poor quality shallow groundwater is most likely to be encountered are those areas shown on the BGS maps showing susceptibility to groundwater flooding at the surface, which are within urbanised areas. This is most likely in GWSA-D where there are a number of landfills, and groundwater is shown to be shallow. GWSA-A has also been considered due to the presence of shallow groundwater and background groundwater monitoring data provided by the EA showing slightly elevated metal concentrations.

8.5.8 Where the ground investigation work has identified impacted groundwater, the effect of shallow groundwater migration in the trench has also been considered. Over much of the aquifer, this is unlikely to have a significant effect as the pipeline installation trench is shallow (typically 1.5m depth) and it is unlikely to penetrate any substantial thickness of saturated aquifer. Table 8.5.2 identifies one location where a likely significant effect could occur. The ordinary watercourse crossing at Wintershill (within GWSA-A) is located where monitoring has identified elevated sulphate and chloride concentrations in shallow groundwater. There is a potential risk that impacted groundwater in the pipeline trench could leach through the ground into the watercourse. The potential magnitude of impact has been assessed as large, with a moderate significance of effect.

8.5.9 Changes to groundwater quality from the removal of vegetation and disturbance of ground could lead to increased suspended solid concentrations in the groundwater. Migration of suspended solids could then affect the quality of groundwater in the aquifer and water used for drinking or other uses. It could also affect the quality of groundwater discharging to surface waters, including water discharging to GWDTE. Due to the filtering effect of the unsaturated zone and aquifer material, suspended solids would not migrate to any substantial extent in intergranular aquifers or Unproductive strata. For aquifers with fracture flow, particularly for flow in aquifers

with karstic features, suspended solids can move considerable distances and rapidly. The risks would be greatest for the chalk unconfined Principal aquifer in GWSA-B which has high value and in karstic areas of the chalk where solution features are present. However, with the good practice measure G132 described in Section 8.4, whereby the trench excavation period would only be as long as necessary, the potential magnitude of change is considered to be small with a potential minor significance of effect.

8.5.10 No substantial dewatering is expected to result from horizontal directional drilling activities. However, trenchless crossings using auger bores have the potential to generate dewatering impacts as launch and reception shafts are deeper. All shafts must be dewatered to allow access for construction workers. Table 8.5.3 in Appendix 8.5 Potential Effects on Groundwater summarises the potential significance of effects for changes to groundwater levels and groundwater flow direction caused by temporary groundwater dewatering activities during construction of auger bore shafts. This is based on the trenchless assessment presented in Appendix 8.2 Detailed Trenchless and Targeted Open Cut Assessments. A reduction of groundwater levels due to shaft dewatering could potentially lead to the following.

- Groundwater levels falling in GWDTE, so that the flora and fauna that rely on groundwater are affected.
- A reduction in groundwater discharging to surface watercourses such that flows in the watercourses are reduced or there is a reversal of flow from the river into the aquifer.
- Wells and boreholes which are relied upon for water supply (licensed and unlicensed abstractions) drying out or yields reducing.
- Settlement of the ground beneath buildings such that the building integrity is threatened. It is usually excessive differential settlement that causes damage to buildings. However, uniform settlement may still cause problems where services (e.g. sewer pipes) enter the structures.

8.5.11 Table 8.5.3 only identifies likely significant effects in relation to settlement of ground beneath buildings within the theoretical radii of influence for dewatering activities. No assessment has been made to determine the foundation type of the buildings which may be affected, nor whether the buildings are founded on superficial or bedrock deposits. As a worst case, a magnitude of impact of medium has been assigned for 12 auger bore crossings, with a moderate significance of effect. One of the buildings potentially affected is of heritage interest, namely the Grade II listed Steep Acre Farm.

8.5.12 Trenchless crossings also have the potential to release artesian pressures and water and this is also considered for the trenchless crossings in Appendix 8.2 Detailed Trenchless and Targeted Open Cut Assessments. One crossing has been identified where this could occur at Ford Lake Stream. Here the Secondary A aquifer has a medium value, but taking into account good practice measure G118, the potential magnitude of impact would be small with a negligible effect.

8.5.13 Consideration has also been given to the potential at trenchless crossings for the works to connect two aquifers that are currently not connected. For example, if the

bores went through a clay layer between two aquifer units this could then lead to cross contamination of an aquifer. Based on the assessment in Appendix 8.2 Detailed Trenchless and Targeted Open Cut Assessments, for the majority of the trenchless crossings, the crossings would not connect two aquifers or aquifer units in the same geological unit. For two crossings, TC034 and TC035, the assessment has identified that there is potential to connect two aquifer units if the crossings were to reach a depth of 16mbgl. In both cases it is considered that as the geological logs for the nearby boreholes show only thin and predominantly silty or sandy clay horizons connecting the two units, the lower permeability horizon separating the aquifer units are likely to be leaky aquitards rather than aquicludes. In addition, the HDD method would not provide a significant gap between the installed pipe and surrounding aquiclude in which groundwater could flow. Therefore, for these two locations the potential magnitude of change on the Secondary A aquifers, which have medium value, would be negligible with a negligible effect. This assessment also applies to the operational phase of the project.

8.5.14 During construction works, surface water drainage would need to be controlled. In most instances, the drainage would be discharged to local surface watercourses. However, for a small number of locations, there is potential that the groundwater would need to be discharged to ground. In addition, discharges to ground could occur from groundwater dewatering activities, either where the trench is shallow and requires dewatering prior to the installation of the pipe (likely areas of shallow groundwater conditions are identified in Appendix 8.1 Groundwater Baseline) or where dewatering is likely to be required for the construction of shafts at trenchless crossings (locations shown in Appendix 8.2 Detailed Trenchless and Targeted Open Cut Assessments). Table 8.5.4 in Appendix 8.5 Potential Effects on Groundwater summarises the potential significance of effects on groundwater quality as a result of discharge to ground where there are no suitable watercourses to receive the drainage and where abstracted groundwater discharged to ground could result in changes to groundwater quality if dissimilar groundwaters are mixed. Where water with a high silt content is discharged to the ground this could also impact on groundwater quality. No likely significant effects were identified in this respect.

8.5.15 Table 8.5.5 in Appendix 8.5 Potential Effects on Groundwater identifies the potential significance of effects on groundwater flow as a result of discharges to ground where there are no suitable surface water discharge routes. This could cause the groundwater level to rise locally and the groundwater flow direction to change and lead to discharges of water to areas where groundwater is currently not discharging, potentially affecting sensitive locations. No likely significant effects were identified in this respect. Any considerations of how discharges may affect groundwater flooding are considered in the FRA (**application document 7.3**).

8.5.16 Table 8.5.6 in Appendix 8.5 Potential Effects on Groundwater summarises the potential significance of effects for changes to groundwater quality from leaks and spills from chemicals, fuels and oils from construction plant or materials used in the installation of the pipeline. This includes the storage of materials, including fuel storage areas in construction compounds. The assessment in Table 8.5.6 draws upon more detailed work presented in Appendices 8.3 Groundwater Dependent Terrestrial Ecosystems and 8.4 Groundwater Abstraction Assessment. Risks identified in Appendix 8.4 on groundwater abstractions relate to infiltration and

pathway risks only. The potential magnitude of change in groundwater quality as a result of potential leaks or spillages during construction is thereafter derived in Table 8.5.6. The assessment assumes the use of good practice measures listed in Section 8.4 (measures G1, G130, G121, G142 and G122).

8.5.17 Table 8.5.6 in Appendix 8.5 Potential Effects on Groundwater identifies potential significant effects in relation to unknown PWSs in close proximity to the proposed pipeline. As part of good practice measure G144, active PWSs within the Order Limits would be identified as part of negotiations with landowners within the Order Limits which are affected by the project. Taking into account good practice measures (G1, G130, G121, G142 and G122) the likelihood of pollution incidents during construction is considered to be very low and the potential significance of effect is negligible on known PWSs. However, where currently unknown PWSs are present, the potential magnitude of change could range from medium to negligible depending on the location of other PWSs located outside the Order Limits. As a result, measures are required to address the potential presence of unknown PWSs in proximity to the Order Limits.

8.5.18 Table 8.13 summarises the likely significant effects identified above.

Logistics Hubs

8.5.19 There are six proposed logistics hubs. Each of the hubs would include a pipe laydown area, secure plant storage area, bunded fuel storage, single storey offices, staff welfare facilities and a vehicle parking area. Topsoil would be stripped where required and the sites would be surfaced with stone on a geotextile membrane to provide an all-weather surface.

8.5.20 The logistics hubs at the A31 Ropley Dean and A31/A32 junction at Alton lie on the high value Chalk Principal aquifer. Construction of the hubs would only involve removal of shallow soils and as such mobilisation of suspended solids into the Chalk aquifer is unlikely. The magnitude of change for impacts of the logistics hubs on groundwater quality from suspended solids is considered to be negligible with a minor significance of effect on groundwater quality.

8.5.21 The logistics hub at the A31/A32 junction at Alton lies partly within a groundwater SPZ3 for a public water supply which has a low value. With the good practices proposed, including use of bunded fuel storage and implementation of pollution prevention measures through the Construction Environmental Management Plan (CEMP) (measure G1), the magnitude of change for impacts of the logistics hub at A31/A32 junction on the quality of groundwater abstractions at Alton is considered to be small with a minor significance of effect.

Table 8.13: Potential Significance of Effects for Groundwater During Construction

Receptor Group	Potential Receptor	GWSA	Value of Receptor(s)	Potential Magnitude of Change	Potential Significance of Effect
Potential effects for interception of shallow groundwater in the pipeline trench					
GWDTEs with national or international designations and high or moderate groundwater dependency.	Bourley and Long Valley SSSI – southerly wet woodland sub-site	GWSA-C	High	Localised dewatering of the trench would potentially cause drawdown of water levels and reduce discharge at the identified spring, located downgradient of the Limits of Deviation and supporting the wetland habitats. The resultant magnitude of change is considered to be **medium**.	Moderate
	Folly Bog – northeastern sub-site of Colony Bog and Bagshot Heath SSSI	GWSA-C	High	Locally, dewatering would reduce groundwater levels during construction. This area may already be affected by the presence of drainage ditches. The habitats at risk are located immediately adjacent to where dewatering would take place, affected by a direct and immediate although temporary impact. The resultant magnitude of change is considered to be **medium**.	Moderate
Potential significance of effects for interception of shallow groundwater in the pipeline trench leading to groundwater of poor quality discharging to sensitive receptors					
Surface waters within GWSA-D and GWSA-A where the watercourse is crossed by an open trench.	Ordinary watercourse at Wintershill	GWSA-A	Low	Groundwater monitoring as part of the ground investigation has identified elevated sulphate and chloride concentrations in shallow groundwater at this location where the watercourse would be crossed using trenched techniques. The construction activities have the potential to create a pathway for the identified impacted groundwater to discharge into the watercourse at Wintershill. Good practice measure G71 which predominantly relates to land contamination (and which includes	Moderate

Receptor Group	Potential Receptor	GWSA	Value of Receptor(s)	Potential Magnitude of Change	Potential Significance of Effect
				production of contamination reports including desk study and limited and targeted ground investigation information) would provide a better understanding of the potential contamination risks in this area. This further characterisation will be helpful in confirming the level of risks, however this will not mitigate against potential transfer of impacted groundwater to the watercourse. The potential magnitude of change is considered to be **large** due to the potential for reduction in water quality.	
Potential significance of effects for changes to groundwater levels and groundwater flow direction caused by temporary groundwater dewatering activities during construction of shafts at trenchless crossings					
Buildings and key infrastructure in the vicinity of dewatering activities for auger bore trenchless crossings	TC 015: Residential properties along Nash Close Railway	GWSA-C	High	Identified buildings and key infrastructure are within the radius of influence for dewatering activities. No assessment has been made to determine the foundation type of the buildings which may be affected, and whether the buildings are founded on superficial or bedrock deposits. The maximum drawdown for all abstractions at the abstraction point has been determined to be relatively small (up to 4.5m). As a worst-case scenario, the potential magnitude of change is determined to be **medium**.	Moderate
	TC 020: Residential roads and properties, Retail park	GWSA-C	High		Moderate
	TC 023: Residential and farm properties	GWSA-C	Medium		Moderate
	TC 031: Residential properties	GWSA-D	Medium		Moderate
	TC 032: Chertsey High School buildings Jubilee Church	GWSA-D	High		Moderate
	TC 032: Residential properties	GWSA-D	Medium		Moderate

Receptor Group	Potential Receptor	GWSA	Value of Receptor(s)	Potential Magnitude of Change	Potential Significance of Effect
	TC 036: Unidentified buildings (unlabelled on OS maps)	GWSA-D	Medium		Moderate
	TC 037: Unidentified buildings (unlabelled on OS maps)	GWSA-D	Medium		Moderate
	TC 040: Educational facilities Commercial properties Railway	GWSA-D	High		Moderate
	TC 041: Railway	GWSA-D	High		Moderate
	TC 042: Residential properties	GWSA-D	Medium		Moderate
Listed buildings and scheduled monuments in the vicinity of dewatering activities for auger bore trenchless crossings	TC 023: Steep Acre Farm, Grade II Listed	GWSA-C	Medium	The identified building is within the radius of influence for dewatering activities. No assessment has been made to determine the foundation type of the buildings which may be affected and whether the buildings are founded on superficial or bedrock deposits. The maximum drawdown at the abstraction point has been determined to be relatively small (up to 4.5m). As a worst-case scenario, the potential magnitude of change is determined to be **medium**.	Moderate
Potential significance of effects for changes to groundwater quality from leaks and spills from chemicals, fuels and oils from construction plant or materials used in the installation of the pipeline					
Groundwater quality of unlicensed small scale PWSs	PWSs unknown at the time of writing in close proximity of the pipeline	All	Low	Other PWS, unknown at the time of writing may be directly or indirectly impacted by the installation of the pipeline. As part of good practice measure G144, active PWSs within the Order Limits would be identified as part of	Moderate to negligible

Receptor Group	Potential Receptor	GWSA	Value of Receptor(s)	Potential Magnitude of Change	Potential Significance of Effect
				negotiations with landowners within the Order Limits which are affected by the project. Taking into account good practice measures as set out in the REAC (G1, G121, G122, G130, G142) the likelihood of pollution incidents during construction is considered to be very low. However, measures are required to address the potential presence of unknown PWSs in proximity to the Order Limits. As a result, the potential magnitude of change could range from **medium** to **negligible** depending on the location of other PWSs located outside the Order Limits.	

Surface Water Quality

8.5.22 Potential adverse impacts on surface water quality receptors from the construction phase of the project considered within this assessment include:

- discharge of surface water runoff with elevated concentrations of sediment, as a result of site clearance works and installation of access roads along the pipeline working strip, and from temporary construction compounds and logistics hubs, leading to increases in suspended sediment load in receiving watercourses;
- increased sediment load and potential for spills at watercourse crossings as a result of in- and near-channel working;
- disturbance of sites which may potentially be affected by contamination during pipeline trenching and drainage works leading to potential runoff of pollutants into surface waters; and
- disturbance of sites which may potentially be affected by contamination during trenchless crossings with potential to discharge pollutants during dewatering of shafts.

8.5.23 No significant effects are anticipated from leaks and spillages of oils/hydrocarbons or other chemicals. Good practice measures set out in the REAC and described in Section 8.4 would reduce any risk of such effects occurring.

8.5.24 No significant effects on surface water quality receptors are anticipated during pressure testing of the pipeline at the end of construction for the following reasons:

- Water for hydrotesting would be sourced from a local water supply for each of the test sections. Should this not be available, water would be tankered in.
- On completion of the hydrostatic tests, the water would be discharged at three locations: Boorley Green, Alton Pumping Station and the Esso West London Terminal storage facility. Appropriate discharge consents would be sought for the discharge of the water to suitable public sewers. If discharge consents cannot be obtained, the used test water would be tankered away and disposed of with a sewerage undertaker.

Control of Sediment Runoff

8.5.25 Runoff across the site would be controlled by the use of a variety of methods including header drains, buffer zones around watercourses, on-site ditches, silt traps and bunding (G11). Reinstatement of any existing land drains once the pipeline construction has been completed forms part of land reinstatement.

8.5.26 In addition to header drains, there would be a requirement for surface water drainage from working areas. There would be no intentional discharge of site runoff to ditches, watercourses, drains or sewers without appropriate treatment and agreement of the appropriate authority (except in the case of emergency) (G12). There would be a need to control sediment runoff through the use of appropriate on-site treatment. The contractor(s) would comply with all relevant consent conditions or DCO provisions regarding dewatering and other discharge activities. This would particularly be with regard to volumes and discharge rates and would include

discharges to land, waterbodies or third-party drains/sewers (G128). It is envisaged that consent conditions may include the need for water quality monitoring, to be agreed with the Environment Agency.

8.5.27 There are also up to six temporary logistics hubs proposed, four of which are existing brownfield sites and two agricultural land. Each of the hubs would include a pipe laydown area, secure plant storage area, bunded fuel storage, single storey offices, staff welfare facilities and a vehicle parking area. Where applicable the topsoil would be stripped from the logistics area and stockpiled around the hub perimeter within the site fence. A stone road and apron would be laid on a geotextile membrane to provide an all-weather surface access to the local highway.

8.5.28 Potential impacts from increased fine sediment load in watercourses include adverse impacts on aquatic ecology. Smothering of substrate can limit habitat availability and adversely affect the population density and structure of invertebrates and aquatic plant growth, which in turn can reduce food supply to fish. Increased fine sediment load can also directly impact fish through clogging of gills and smothering of spawning sites. Watercourses most at risk from the pipeline working strip and contiguous construction compounds would be the five, high sensitivity and four moderate sensitivity watercourses identified in Section 8.3.

8.5.29 The contractor would be required to comply with good practice measures as set out in the REAC for control of sediment discharges, as described in Table 8.12 and above, for the pipeline working strip, construction compounds and logistics hubs. The surfacing at temporary working areas would be permeable so there should be no requirement for installation of positive drainage. An Erosion and Sediment Control Plan would be produced by the contractor(s) prior to the start of the construction phase (G116). This plan would include sediment-related measures as described in the REAC (e.g. G11, G30 (a measure predominantly for air quality but which includes measures for control of run-off to reduce the spread of particulates), G130, G157 (Soil Management Plan), G184, G186). With the implementation of these good practice measures, no significant effects are anticipated on receiving watercourses.

Watercourse Crossings

8.5.30 There are 14 Main Rivers, and 64 ordinary watercourse crossings along the pipeline route. Five of these watercourses have been identified as of high sensitivity, and four of moderate sensitivity, from an aquatic ecology perspective. Five watercourses are noted as having downstream surface water abstractions.

8.5.31 All of the high and moderate sensitivity watercourses are proposed to be crossed by trenchless methods (either HDD or auger bore) so no direct effects would result from in-channel works. Appropriate buffer zones would be established within Order Limits adjacent to identified watercourses (G39) which would reduce the risk of construction works impinging on sensitive riparian habitat. With these measures in place no significant direct effects are anticipated from trenchless watercourse crossings. There would be a need for dewatering at some of the trenchless crossing points and the potential impacts from discharge of the dewatering is discussed later in this section.

8.5.32 The remaining watercourse crossings would be by open cut using the construction methods described in Chapter 3 Project Description. Given the low sensitivity of these watercourses, combined with the good practice measures contained within the REAC and described in Section 8.4, no significant effects are anticipated for open cut watercourse crossings.

Pollutant Discharge from Dewatering at Trenchless Crossings

8.5.33 Appendix 3.1 Table of Trenchless Crossings provides a list of trenchless crossings along the pipeline route, of roads, railways and watercourses. Trenchless crossings that intersect sites potentially affected by contamination are presented in Appendix 11.1 Soils and Geology Supporting Information (as part of the Soils and Geology assessment) along with a CLR11 risk assessment, including potential risks of contamination to groundwater receptors. A potential risk exists for any of these sites where groundwater dewatering is required to enable shaft construction. Appendix 8.2 Detailed Trenchless and Targeted Open Cut Assessments provides an assessment of the likely radius of influence for groundwater dewatering, indicating potential for pollutants to be drawn into the dewatering zone.

8.5.34 For many of the proposed trenchless crossings, horizontal directional drilling (HDD) is proposed for the method of construction (see Chapter 3 Project Description). The launch and reception shafts are very shallow (less than 2m) for this technique and would not require any substantial dewatering; therefore, dewatering effects have not been assessed for this crossing technique. For those sites where auger boring is proposed as the crossing technique (see Chapter 3 Project Description), launch and reception shafts would be required, and although still relatively shallow there would be a need for dewatering if groundwater levels are high.

8.5.35 Table 8.14 lists those sites where auger boring is the proposed crossing technique and where the potential radius of groundwater influence could intersect with sites potentially affected by contamination. Observations from the CLR11 risk assessment for groundwater receptors are included in this table, although these observations do not take into account the potential for contaminated groundwater to be drawn into the dewatering zone as the dewatering proceeds.

8.5.36 Table 8.15 provides estimated dewatering rates for each of the launch and reception pits for the proposed auger bore crossings and provides an assessment of the likely effects based on risks of groundwater contamination and sensitivity of the proposed receiving waters for dewatering discharges.

8.5.37 A potential moderate adverse effect was identified for TC 036 (Shepperton Road crossing), although uncertainty surrounds this as it assumes potential contamination sources within the Laleham and Home Farm landfills, separate to the inert waste deposits that these landfills were licensed to receive. However, the quality of water generated by dewatering would be tested prior to discharge (G143) which would reduce the effect to minor.

Table 8.14: Proposed Auger Bore Trenchless Crossings at Sites Potentially Affected by Contamination

Auger Bore Crossing	Site Potentially Affected by Contamination	Launch Pit		Reception Pit		Potential Risks from Potentially Impacted Groundwater
		Proximity of Site	Radius of GW Influence (m)	Proximity of Site	Radius of GW Influence (m)	
Blackwater Valley (TC 020) – three auger bore crossings	Frimley Station (former railway sidings)	Approximately 65m northeast from closest shaft	125-205	Approximately 50m north from closest shaft	123 for all three augers	Historic potential for heavy metals, sulphate, fuels and oils, Polycyclic Aromatic Hydrocarbons (PAHs), solvents. However current use (allotments) suggests low risk of contamination and the CLR11 assessment concludes low risk to groundwater.
	Farnborough (north) (former railway)	Approximately 12m west from closest shaft		Approximately 90m west from closest shaft		A short-lived railway track dating from the 1870s which the CLR11 risk assessment concludes is not considered to be a significant potential contaminant source. Very low risk to groundwater.
	South of Frimley Station (former landfill)	Closest shaft located within site		Approximately 20m west from closest shaft		Site potentially affected by contamination primarily comprises previously excavated natural soils, although also potential for unauthorised inert wastes. CLR11 concludes low risk to groundwater.
	Johnson Wax Ltd, Frimley	Approximately 155m northeast from closest shaft		Approximately 75m northeast from closest shaft		Potential contaminants include diesel fuel, oils, hydrocarbons, hazardous chemicals and solvents. Previous investigations and groundwater sampling in 2001 and 2004 did not record elevated concentrations. CLR11 concludes low risk to groundwater.
Chertsey Branch railway line (TC 031)	Abbey Moor Golf Club (former landfill)	Located within the site	134	Approximately 55m south west	106	Site potentially affected by contamination primarily comprises previously excavated natural soils, although also potential for unauthorised inert wastes. CLR11 concludes low risk to groundwater.
B376 Shepperton Road (TC 036)	Laleham Landfill	Located within the site	138	Approximately 51m	137	Landfill licensed for inert waste but potential contamination from hydrocarbons from gravel extraction and processing activities. CLR11 concludes very low risk of shallow groundwater contamination.

Auger Bore Crossing	Site Potentially Affected by Contamination	Launch Pit		Reception Pit		Potential Risks from Potentially Impacted Groundwater
		Proximity of Site	Radius of GW Influence (m)	Proximity of Site	Radius of GW Influence (m)	
	Home Farm Landfill	Approximately 37m		Located within the site		Landfill licensed for inert waste and groundwater monitoring data suggest that this is not a significant contaminant source. Low risk to groundwater.
Queen Mary Reservoir Intake Canal (TC 037)	Queen Mary Quarry	Approximately 60m	62	Approximately 10m	61	Former landfill with potential to contain inert waste, gas oil, automotive wastes, waste oils and metals. However, given the age of the landfill, contaminants are likely to have been diluted and/or attenuated. Low risk to groundwater.
	S of Queen Mary Reservoir Landfill	Approximately 12m		Approximately 57m		S of Queen Mary Reservoir Landfill received primarily inert waste and also site of fuel oil tanks. Low risk to groundwater.
B378 Church Road (TC 040)	Hitchcock & King (former railway sidings)	Approximately 6m	37	Approximately 33m (just beyond radius)	36	Currently a timber yard but various historic contaminative uses. Potential contaminants include timber, ash, clinker, tarmac, organic traces, diesel fuel, chemicals (hazardous and non-hazardous), lubricating and waste oils, heavy metals, herbicides, solvents, paints, coatings and adhesives, lead, PAHs and benzo(a)pyrene. However, given the time passed since historic land use activity and distance from the site, dilution and attenuation of contaminants is likely to result in low risks to groundwater.
Waterloo to Reading Railway Line (TC 041)	St David's School (former landfill)	Approximately 2m	37	Approximately 32m (just beyond radius)	36	Former landfill and unauthorised fly-tipping waste. Potential contaminants include PCBs, hydrocarbons, ashes and clinker and unpermitted waste types (from reported fly-tipping). CLR11 concludes low to moderate risk to groundwater.
	Hitchcock & King (former railway sidings)	Beyond radius of influence		Approximately 36m (on edge of radius)		Currently a timber yard but various historic contaminative uses. Potential contaminants include timber, ash, clinker, tarmac, organic traces, diesel fuel, chemicals (hazardous and non-hazardous), lubricating and waste oils, heavy metals, herbicides, solvents, paints, coatings and adhesives, lead, PAHs and benzo(a)pyrene. However, given the time passed since historic land use activity and distance from the site, dilution and

Auger Bore Crossing	Site Potentially Affected by Contamination	Launch Pit		Reception Pit		Potential Risks from Potentially Impacted Groundwater
		Proximity of Site	Radius of GW Influence (m)	Proximity of Site	Radius of GW Influence (m)	
						attenuation of contaminants is likely to result in low risks to groundwater.
Staines Road A30 (TC 042)	St David's School (former landfill)	Located within the site	54	Approximately 40m	53	Former landfill and unauthorised fly-tipping waste. Potential contaminants include PCBs, hydrocarbons, ashes and clinker and unpermitted waste types (from reported fly-tipping). CLR11 concludes low to moderate risk to groundwater.

Table 8.15: Potential Effects From Discharge of Potentially Contaminated Dewatering

Auger Bore Crossing	Potential Discharge Point	Sensitivity	Estimated Dewatering Rate (l/s)		Magnitude of Impact	Significance of Effect
			Launch Pit	Reception Pit		
Blackwater Valley (TC 020)	River Blackwater	Medium	Up to 25.6	15.7	Low to very low risks of groundwater contamination. Combined with proximity of shafts, and relatively high dilution within River Blackwater, the magnitude of impact is assessed as small.	Minor
Chertsey Branch railway line (TC 031)	Unnamed watercourse leading to Chertsey Bourne	Medium	9.28	7.24	Low risk of groundwater contamination – magnitude assessed as small.	Minor
B376 Shepperton Road (TC 036)	Highway drainage leading to River Ash	Negligible (downstream River Ash high)	12.6	10.7	Low to very low risks of groundwater contamination – magnitude assessed as small.	Moderate but reduced to minor with water quality testing (G143)

Auger Bore Crossing	Potential Discharge Point	Sensitivity	Estimated Dewatering Rate (l/s)		Magnitude of Impact	Significance of Effect
			Launch Pit	Reception Pit		
Queen Mary Reservoir Intake Canal (TC 037)	Drain leading to River Ash	Negligible (downstream tributary of River Ash low)	0.41	0.35	Low risk of groundwater contamination combined with very low estimated dewatering rate – magnitude assessed as negligible to small.	Negligible
B378 Church Road (TC 040)	Highway drainage leading to tributary of River Ash	Negligible (downstream tributary of River Ash low)	0.17	0.14	Low risk of groundwater contamination combined with very low estimated dewatering rate – magnitude assessed as negligible.	Negligible
Waterloo to Reading Railway Line (TC 041)	Highway drainage leading to tributary of River Ash	Negligible (downstream tributary of River Ash low)	0.17	0.14	Low to moderate risk of groundwater contamination combined with very low estimated dewatering rate – magnitude assessed as small.	Negligible
Staines Road A30 (TC 042)	Highway drainage leading to tributary of River Ash	Negligible (downstream tributary of River Ash low)	0.32	0.26	Low to moderate risk of groundwater contamination combined with very low estimated dewatering rate – magnitude assessed as small.	Negligible

Fluvial Geomorphology

8.5.38 Potential effects from construction of the project on fluvial geomorphology receptors considered within this assessment include:

- Changes to sediment processes which could lead to the smothering of existing bed substrate or homogenisation of the channel bed. This would likely arise from in-channel working, as well as construction activities in the floodplain and working in close proximity (within 10m) to the watercourses.
- Changes to flow processes, altering stream power (i.e. the energy of the watercourse), arising from working in the channel and open cut or haul road crossings. Potential to affect channel stability by altering rates and extent of erosion and/or deposition.
- Localised loss of riparian vegetation resulting from vegetation clearance to accommodate open cut crossings, haul roads, access tracks and launch/reception pit compounds for directionally drilled crossings. Potential to lead to bank instability if root networks are removed from the bank face.
- Knickpoint formation arising from in-channel working and unsuitable reinstatement of bed and/or banks, following open cut or haul road crossings. Potential for channel bed and/or bank erosion to occur as a result of channel adjusting to the modifications during construction. This would be of increased significance if hard engineered structures (i.e. concrete bed and/or banks) were removed and the channel not reinstated appropriately.
- Disturbance of channel bed and banks, morphological features and compacting of bed substrate resulting from open-channel and haul road crossings.
- Bank instability, absence of riparian vegetation and/or geomorphological features resulting from temporary, yet prolonged, presence of haul road crossings.

8.5.39 All of the construction compounds and logistics hubs are located over 15m from a watercourse, with four exceptions. At unnamed watercourse 44, a low sensitivity receptor, the construction compound is approximately 8m away. There are also three compounds located within 10-15m from a watercourse (unnamed watercourses 7, 32 and 93). With appropriate good practice as outlined in the REAC, the siting of the compounds is unlikely to have significant effects on these watercourses.

8.5.40 Construction activities associated with the project have typically been considered to be temporary. The impacts on the fluvial geomorphology receptors associated with activities outside of the channel (e.g. removal of riparian vegetation, sediment mobilisation) are also likely to be temporary and therefore the magnitude of impact is typically considered to be small or negligible. However, where effects are associated with in-channel working and the presence of in-channel structures, effects could be longer term or permanent. This would be particularly pertinent if the works or structures are in place during periods of high flows, as this is typically when channels have the energy and capacity to adjust. Therefore, the assessment of the magnitude of impact concerning these effects has been conservative and based on a worst-case scenario (i.e. channel forming flow being experienced during the construction phase).

8.5.41 An assessment has been undertaken of the potential effects on each of the watercourses scoped in for further assessment. Table 8.16 and Table 8.17 show the results of the assessment.

8.5.42 The watercourse most susceptible to construction effects is Caker Stream. The likely significance of these effects can largely be reduced by good practice measures, including the commitment where afflux at temporary main river and ordinary watercourse crossings would be maintained at less than 100mm (W4) where in-channel structures are required to reduce impact on flow processes and reinstatement of riparian vegetation. Crossing of this watercourse is likely to be relatively short in duration, further reducing the likely significance of these effects.

8.5.43 Table 8.16 includes an assessment of the River Blackwater in relation to access road. Whilst the River Blackwater is not physically crossed by an access road, during construction there may be a requirement for the use of approximately 550m of existing right of way that passes within 5m-10m of the watercourse banks. It has been assumed for the purposes of this assessment that the nature of the path would not be changed (i.e. not widened) and that there would be limited removal of riparian vegetation reducing potential impacts.

8.5.44 This assessment does not cover watercourses that have a low or negligible sensitivity, as these were scoped out of this ES. However, they are considered as part of the WFD Compliance Assessment (Appendix 8.6).

Table 8.16: Likely Significance of Effects on Fluvial Geomorphological Receptors From Open Cut and Haul Road Crossings

Potential Receptors	Receptor Sensitivity/Value	Potential Effects	Magnitude of Change	Likely Significance of Effect (Worst Case Scenario)
Caker Stream	Medium	Change to sediment processes	Medium	Minor
		Change to flow processes	Medium	Minor
		Loss of riparian vegetation	Small	Minor
		Knickpoint formation	Medium	Minor
		Bed and bank disturbance	Medium	Minor
River Blackwater	High	Loss of riparian vegetation	Small	Minor
		Change to sediment regime	Small	Minor
All watercourses	Low	Loss of riparian vegetation (haul road crossing only)	Small	Minor
		Bed and bank disturbance (haul road crossing only)	Small	Minor
	Negligible	Loss of riparian vegetation (haul road crossing only)	Negligible	Negligible
		Bed and bank disturbance (haul road crossing only)	Negligible	Negligible

8.5.45 The magnitude of impact to sediment processes and loss of riparian vegetation varies in Table 8.17 for the receptors being crossed by trenchless crossing

techniques. It typically depends on the distance of the launch/reception pits and associated drilling compounds to the watercourse.

Table 8.17: Likely Significance of Effects on Fluvial Geomorphological Receptors From Trenchless Crossings

Potential Receptors	Receptor Sensitivity/ Value	Potential Effects	Magnitude of Change	Likely Significance of Effect
Ford Lake	High	Change to sediment regime	Negligible	Negligible
		Loss of riparian vegetation	Negligible	Negligible
River Wey	High	Change to sediment regime	Negligible	Negligible
		Loss of riparian vegetation	Negligible	Negligible
Gelvert Stream	Medium	Change to sediment regime	Negligible	Negligible
		Loss of riparian vegetation	Negligible	Negligible
River Blackwater	High	Change to sediment regime	Negligible	Negligible
		Loss of riparian vegetation	Negligible for HDD sub-option Small for auger bore sub-option	Negligible for HDD sub-option Minor for auger bore sub-option
Hale Bourne	Medium	Change to sediment regime	Small	Minor
		Loss of riparian vegetation	Small	Minor
The Bourne	Medium	Change to sediment regime	Small	Minor
		Loss of riparian vegetation	Small	Minor
River Thames	High	Change to sediment regime	Negligible	Negligible
		Loss of riparian vegetation	Negligible	Negligible
River Ash	Medium	Change to sediment regime	Small	Minor
		Loss of riparian vegetation	Small	Minor

Flood Risk

8.5.46 Potential significant effects have been identified during the construction phase of the project on flood risk receptors. The project has the potential to increase flood risk within the Order Limits and to other receptors by:

- reducing floodplain storage due to storage of materials;
- compartmentalisation of the floodplain;
- entrainment of stockpiled excavation arisings reducing capacity of watercourses and sewers;
- temporary obstacles redirecting fluvial and surface water flow paths;
- conveyance of flood water along open excavations;
- compaction of access and haul roads due to plant movement, reducing ground permeability resulting in an increase in runoff against the existing state;
- reduction in channel conveyance capacity at temporary watercourse crossings by the installation of culverts and cofferdams; and
- interception and redirection of groundwater flows.

8.5.47 Section 4 of the FRA (**application document 7.3**) summarises the assessment approach taken to define the risk of impact of the project on all sources of flood risk. Risk has been assessed as a product of the likelihood of occurrence (value/sensitivity) and severity (magnitude) of impact. Overall impacts of high or medium risk are determined to be significant, while low or very low are determined to be not significant.

8.5.48 A summary of the likely significance of impact of the project upon sources of flood risk during the construction phase is included in Table 8.18. In a number of cases there is a range of likely significance. Table 8.18 includes the worst-case while the FRA (**application document 7.3**) includes the assessment for each receptor and crossing.

Table 8.18: Likely Significance of Effects on Flood Risk (Without Mitigation)

Potential Receptors	Receptor Sensitivity/Value	Potential Effects	Magnitude of Change	Likely Significance of Effect
Fluvial	High to negligible	Increase in flood risk	Large to negligible	Major
Surface water	Medium to negligible		Large to negligible	Major
Groundwater	Medium to negligible		Small to negligible	Minor
Reservoirs	Negligible		Large to negligible	Moderate
Canals	Medium to negligible		Large to negligible	Moderate
Water Infrastructure	High to low		Large to negligible	Moderate

8.5.49 The assessment of likely significance summarised in Table 8.18 includes ranges of classification given the number of receptors in each classification. For example, the project crosses 98 watercourses each with their own assessment of sensitivity, magnitude and significance of impact. Furthermore, the assessment does not take into account additional flood risk mitigation measures included in Section 8.6. Appendix B of the FRA (**application document 7.3**) includes a summary of the assessment for each individual watercourse.

Water Framework Directive

8.5.50 The WFD Compliance Assessment (Appendix 8.6) provides a detailed assessment of the potential impacts on the scoped-in WFD water bodies. The WFD typically considers permanent impacts, but where construction activities could lead to longer term effects these have been assessed. At a WFD water body scale, there are not anticipated to be any significant effects on the WFD water bodies.

Operation

Groundwater

8.5.51 Table 8.5.7 in Appendix 8.5 Potential Effects on Groundwater identifies potential effects on GWDTEs due to long term changes in groundwater flow direction. However, specific areas in the vicinity of GWDTEs would be identified where increased frequency of stanks would be required to safeguard sensitive habitats which depend on groundwater (G199). This would address potential risks

associated with sensitive springs or habitat identified at Bourley and Long Valley SSSI – southerly wet woodland sub-site and the northeastern sub-site of Folly Bog.

8.5.52 Table 8.5.8 in Appendix 8.5 Potential Effects on Groundwater provides an assessment of changes to groundwater quality in the unlikely event of a leak of aviation fuel from the pipeline. The assessment draws upon more detailed work presented in Appendices 8.3 Groundwater Dependent Terrestrial Ecosystems and 8.4 Groundwater Abstraction Assessments. Risks identified in Appendix 8.4 on groundwater abstractions relate to infiltration and pathway risks only. The potential magnitude of change in groundwater quality as a result of unlikely pipeline leaks is thereafter derived in Table 8.5.8 with design measures taken into account.

8.5.53 Given the embedded design measures associated with pipeline integrity (measures O8, O9, O10 and a pipe thickness of 11.9mm, which is greater than British Standard PD 8010 (British Standards Institution, 2019), to provide additional long-term protection from deterioration or damage), leaks of aviation fuel from the pipeline are unlikely to occur. As set out in Chapter 3 Project Description, the replacement pipeline is designed to limit the potential risk for release (e.g. corrosion protection and inclusion of remotely operated valves to allow isolation of sections of the pipeline if required (O9), and as such the pollution risks are considered to be negligible. Further information is provided in Chapter 14 Major Accidents.

8.5.54 The pipe would comprise a three-layer polyethylene coating or equivalent surrounding a steel pipe. Cathodic protection would also be provided to the pipe. As a result, no significant effect is anticipated as a result of corrosive or reactive groundwater conditions.

Surface Water Quality

8.5.55 The only potential operational impact scoped into the surface water quality assessment was the risk of fuel leakage or spills at the proposed pigging station at Boorley Green. As described in Chapter 3 Project Description, the pigging station is a small facility (<0.1ha), which allows entry and exit for gauges to undertake pipeline inspections. Pigging operations require the pipework at the pigging station to be drained. The drained fluid is contained and transported back to Fawley refinery for re-processing.

8.5.56 Operational impacts are not likely to have a significant effect on surface water quality receptors.

Fluvial Geomorphology

8.5.57 Potential impacts arising from the operation of the project on the fluvial geomorphology receptors could include a reduction in lateral connectivity caused by pipeline infrastructure and disruption of morphological features and processes whilst carrying out operational maintenance.

8.5.58 The replacement pipeline would be buried underground for its entire length with associated infrastructure (pigging station and valves) sited away from watercourse banks. Operational maintenance is likely to be non-intrusive as outlined in Chapter 3 Project Description.

8.5.59 As a result, it has been assessed that these operational impacts are unlikely to have a significant effect on any fluvial geomorphological receptors.

Flood Risk

8.5.60 There is a risk that the pipeline bedding material could introduce a preferential flow path for groundwater increasing flood risk to receptors.

8.5.61 Given the pigging station is the only substantial above ground feature and this is also relatively small, it has been assessed that there would be no significant effects from the operation of the pipeline on any other flood risk sources/receptors.

Water Framework Directive

8.5.62 Potential impacts arising from the operation of the project on WFD compliance are covered in detail in the WFD Compliance Assessment (Appendix 8.6). In total 25 surface water and groundwater WFD water bodies were assessed and it has been determined that there would not be any deterioration in WFD status as a result of the project. The project would also not prevent any of the WFD water bodies from achieving Good Status/Potential in the future, or the implementation of WFD specific mitigation measures.

8.5.63 As part of the assessment, compliance with other pieces of relevant EU legislation, such as the Drinking Water Directive and EU Habitats Directive, was also considered. The project is also deemed to be compliant with these regulations, therefore the project has been assessed as compliant with WFD legislative measures and objectives.

8.6 Mitigation

Construction Mitigation

8.6.1 As noted in Section 8.5, the project would be required to meet all relevant legislative and regulatory requirements, and the measures and commitments contained in the REAC. Mitigation measures to address likely significant effects identified in Section 8.5 are identified below.

Groundwater

8.6.2 Mitigation to address likely significant effects identified in Table 8.13 would comprise the following measures:

- Dewatering would be limited in areas where abstraction/drainage of shallow groundwater may lead to a fall in groundwater levels in the vicinity of GWDTEs or adversely affect surface water quality (W11)
- To protect active PWSs, including any not identified in the ES, the following would be put in place (W12):
  - In the event of a landowner or tenant complaining that installation activities have affected their PWSs, an initial response would be provided within 24 hours.

- Where the installation works have affected a PWS, an alternative water supply would be provided, as appropriate.
- In the event of a significant spill during construction:
  - all landowners/tenants would be contacted within 24 hours, within 250m of the spill, to determine if there are any PWSs that might be affected;
  - an assessment of the likelihood of groundwater contamination supplying identified PWSs would be undertaken;
  - where requested by the relevant landowner, monitoring of well water would be undertaken for a determined period of time, taking into account pollution travel time in groundwater, to determine whether pollution has occurred; and
  - where a PWS is affected, an alternative water supply would be provided, as appropriate.

Bullets 1 and 2 would address impacts to a PWS from general construction activity e.g. cloudy water from sediment, while bullet 3 identifies actions in the event of a spill.

- Temporary sheet piling or similar for control of groundwater would be put in place at the following trenchless crossings: TC 014, TC 015, TC 020, TC 023, TC 031, TC 032, TC 036, TC 037, TC 040 and TC 042, unless a detailed assessment is undertaken which demonstrates that no building or infrastructure is at risk of differential settlement (W13).

Flood Risk

8.6.3 The following flood risk specific mitigation measures are included to address the potential significant effects during the construction phase:

- the extent of Flood Zone 3 and areas of risk of flooding from surface water (RoFSW) would be identified and marked where appropriate (W1);
- screening and fencing within logistics hubs and construction compounds would be designed to reduce the impedance of flood water. This would be subject to any commitments regarding great crested newts (W2);
- temporary buildings within Flood Zone 3 and areas of High and Medium RoFSW would be elevated above the 1 in 10 (10%) Annual Exceedance Probability (AEP) event peak water level, or a minimum of 300mm if this is not practicable (W3);
- afflux at temporary Main River and ordinary watercourse crossings would be maintained at less than 100mm (W4);
- topsoil and subsoil would be stockpiled for as short a duration as practicable within Flood Zone 3 and areas of High and Medium RoFSW (W5);
- stockpiles in Flood Zone 3 or areas of High or Medium RoFSW would not exceed 25m between breaks. Breaks in between stockpiles would be at least 5m. Breaks would be located opposite each other on either side of the excavation where practicable (W6);
- stockpiles would not be stored within Ively Brook Flood Zone 3, east of the A327 (W7);

- works on the Cove Brook flood storage area would be scheduled taking advantage of long-term forecasts making use of dry weather conditions (W8); and
- the Cove Brook flood storage area embankment dam would be reinstated to its former condition as soon as is practicable (W9).

Operational Mitigation

8.6.4 There are no significant effects identified during operation of the pipeline. Therefore, no mitigation measures are required.

8.7 Residual Impacts (With Mitigation)

Construction

8.7.1 Table 8.20 provides a summary of the residual effects during the construction phase for those effects initially identified as significant effects prior to the mitigation identified in Section 8.6.

Groundwater

8.7.2 Following the implementation of the mitigation measures described in Section 8.6, no likely significant effects are forecast for the construction phase.

Surface Water Quality

8.7.3 No significant construction effects are likely to occur on surface water quality. Therefore, no residual impacts have been identified

Fluvial Geomorphology

8.7.4 No significant construction effects are likely to occur on fluvial geomorphological receptors; therefore, no residual impacts have been identified.

Flood Risk

8.7.5 Following the implementation of the flood risk mitigation measures included in Section 8.6, there are considered to be no significant effects for flood risk, with all risks reduced to minor or negligible (Table 8.19).

8.7.6 While the project includes measures to mitigate against the exacerbation of existing levels of flood risk during its construction phase, a residual risk of flooding remains for extreme events, as explained in Section 14 of the FRA (**application document 7.3**).

Table 8.19: Likely Significance of Effects on Flood Risk (With Mitigation)

Potential Receptors	Receptor Sensitivity/Value	Potential Effects	Magnitude of Change	Likely Significance of Effect
Fluvial	High to negligible	Increase in flood risk	Negligible	Minor
Surface water	Medium to negligible		Low to negligible	Minor
Groundwater	Medium to negligible		Negligible	Minor
Reservoirs	negligible		Low to negligible	Minor
Canals	Medium to negligible		Low to negligible	Minor
Water Infrastructure	High or low		Low to negligible	Minor

Water Framework Directive

8.7.7 The WFD Compliance Assessment (Appendix 8.6) has concluded that, at a WFD water body scale, there would be no significant effects arising from the construction of the project. The project is therefore compliant with the legislation.

Operation

8.7.8 No significant residual effects were identified for the operation of the pipeline.

Table 8.20: Residual Effects For Construction

Receptor (or Group of Receptors)	Value of Receptor(s)	Description of Potential Effect	Potential Magnitude of Change	Potential Significance of Effect	Mitigation Measure	Post-mitigation Magnitude of Change	Significance of Residual Effect
Groundwater							
GWDTEs with national or international designations and high or moderate groundwater dependency. (Bourley and Long Valley SSSI – southerly wet woodland sub-site, Folly Bog – northeastern sub-site of Colony Bog and Bagshot Heath SSSI)	High	Interception of shallow groundwater in the pipeline trench which could lead to the reduction of flows to GWDTE.	Medium	Moderate	W11	Small	Minor
Unlicensed groundwater PWSs which may not have been identified	Low	Interception of shallow groundwater in the pipeline trench which could lead to the reduction of flows to shallow licensed and unlicensed groundwater PWSs. No significant effect is expected on known abstractions. However not all PWSs may have been identified.	Medium to negligible	Moderate to negligible	W12	Negligible	Negligible
Ordinary watercourse at Wintershill	Low	Poor quality groundwater discharging to the watercourse via the trench.	Large	Moderate	W11	Small	Minor
Buildings identified at trenchless crossings	High	Dewatering of shafts for trenchless crossings leading to subsidence of buildings and a Grade II Listed building at Steep Acre Farm.	Medium	Moderate	W13	Small	Minor
	Medium		Medium	Moderate	W13	Small	Minor
Surface Water Quality							

Receptor (or Group of Receptors)	Value of Receptor(s)	Description of Potential Effect	Potential Magnitude of Change	Potential Significance of Effect	Mitigation Measure	Post-mitigation Magnitude of Change	Significance of Residual Effect
No significant effects identified							
Fluvial Geomorphology							
No significant effects identified							

8.8 References

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