Hampshire Water Transfer and Water Recycling Project

Outline Foundation Works Risk Assessment – 3 of 3 documents

Above Ground Plant and Trenchless Crossings

VOLUME NUMBER: 7

PLANNING INSPECTORATE SCHEME NUMBER: WA010002

APPLICATION DOCUMENT REFERENCE: 7.4

APFP REGULATION: 5(2)(q)

May 2026

Version 0

WATER for LIFE

from Southern Water

Contents

Tables

Executive Summary

Introduction

Southern Water Servies Limited (the Applicant) has commissioned this Outline Foundation Works Risk Assessment (FWRA) to support the application for a Development Consent Order (DCO) for the construction of a new Water Recycling Plant (WRP) and water supply infrastructure. The purpose of the Project is to address the sustainability objectives of reduced abstractions on Hampshire's two main rivers – the River Test and the River Itchen - and ensure a resilient water supply for the Applicant's customers.

This Outline FWRA relates to the Above Ground Plant (AGP) sites, including Intermediate Pumping Stations (IPS) and Break Pressure Tanks (BPT), and the trenchless crossings comprising launch and reception shafts and pipe-jacked tunnels. The construction of new AGP and trenchless crossings is part of the Hampshire Water Transfer and Water Recycling Project referred to as the Project herein.

The objective of the Outline FWRA is to demonstrate that the proposed construction methods associated with the AGP and trenchless crossings would not have an adverse impact by creating new pathways for the migration of contamination, considering the protection of both water resources and human health. This assessment has been carried out in accordance with guidance published in March 2025, "Piling and penetrative ground improvement on land affected by contamination". [1]

Setting and conditions

The AGP sites and trenchless crossings (including launch and reception shafts) are located predominantly within areas of agricultural land, with some crossings beneath existing roads, watercourses and woodlands. The historical land uses are similarly predominantly agricultural, with a limited number of potentially contaminative activities in the vicinity, including former gravel and chalk pits, one of which ("Albany Farm" - located within 50m of, but not on the site of IPS-F) was licenced as a landfill to receive inert waste in 1977, as well as a garage, railways (including decommissioned railway land), and small areas of potentially infilled land. Where these Potential Sources of Contamination (PSCs) are present within the land above a trenchless crossing they are not considered to be 'on-site' as the proposed trenchless crossing would not interact with these PSCs, i.e., contamination present would not be mobilised by the construction works as the works are undertaken at depth beneath the PSC.

The ground conditions beneath the 16 structures (4 AGP sites and 12 trenchless crossings) considered within this assessment are variable, as is to be expected where the Project spans multiple kilometres. Details of the ground conditions encountered during the ground investigations for each of the structures are provided in Table 3-2 of the Outline FWRA.

The assessments undertaken have shown that during construction and in the proposed commercial / industrial end use scenario, the potential hazards to human health associated

with the soils are limited to asbestos at the reception shaft for the trenchless crossing beneath Botley Road and the River Hamble only.

The ground investigations undertaken have shown that credible ground gas hazards associated with the potential off-site sources of ground gases are not present and ground gas protection measures are not required in new enclosed structures.

Potential hazards to aquatic ecology associated with the on-site land uses have not been identified. Groundwater monitoring recorded sporadic and marginal exceedances of metals, hydrocarbons, polycyclic aromatic hydrocarbons (PAHs) and ammoniacal nitrogen; however, these do not indicate a widespread or consistent contamination source and are considered to reflect either naturally occurring conditions or off-site influences.

Key sensitive receptors include Secondary A and Principal aquifers, surface watercourses including the Rivers Wallington, Hamble, Meon and Itchen, ecologically designated sites, and construction and operational workers.

Outline foundation works risk assessment

The seven pollution scenarios defined in the CL:AIRE (2025) guidance [1] have been assessed, as follows:

- Scenario 1 - Creation of preferential pathways, through a low permeability layer, to cause contamination of groundwater in an aquifer:
  - Not applicable for the AGP sites and not applicable for all but one of the trenchless crossing sites, as 1) these structures would not encounter groundwater and extend through an aquitard into an underlying aquifer, 2) contamination has not been identified within the groundwater, or 3) a credible PSC has not been identified.
  - Only the trenchless crossing beneath agricultural land, woodland, the River Itchen and Bournemouth (Waterloo to Weymouth) Main Line railway, is assessed under Scenario 1, where a Moderate risk results.
- Scenario 2 - The driving of solid contaminants down into an aquifer during pile driving:
  - Not applicable - contamination within the on-Site soils has not been encountered, with the exception of a single piece of asbestos containing material which is not considered to be a hazard to groundwater.
- Scenario 3 - Contamination of groundwater and subsequently surface waters by turbidity, support fluids, concrete, cement paste or grout:
  - Turbidity – Risk is assessed as Very Low in Secondary A aquifers, Low in surface watercourses, Moderate in the chalk Principal aquifer in the groundwater source protection zone (SPZ) 2, and Very High associated with the Principal chalk aquifer in the SPZ1.
  - Loss of high pH and chloride water from concrete – Risk is assessed as Low for Secondary A aquifers, groundwater in hydraulic continuity with surface waters and the chalk Principal aquifer in the SPZ2, and Moderate in the Principal chalk aquifer in the SPZ1.

  - Bentonite support fluid break out – Risk is assessed as Low in the Secondary A aquifers, and Moderate within surface waters and Principal chalk aquifer within SPZ2 and SPZ1.
  - Fissure grout dispersal – Risk is assessed as Low.
  - Contamination by additives in concrete / slurry / grout – Risk is assessed as Very Low.
- Scenario 4 - Direct contact with contaminated soil or leachate causing degradation of pile material:
  - Risk associated with inhibition of curing is assessed as Very Low due to absence of phenol contamination. Risk associated with degradation of in-ground concrete is assessed as Low based on the recorded conditions and use of an appropriate concrete design.
- Scenario 5 - Creation of preferential pathways to allow migration of landfill gas or contaminant vapours to surface:
  - Not applicable – Credible ground gas hazards to human health have not been identified. It is considered highly unlikely that the landfills in the vicinity of the trenchless crossings and AGP Sites benefit from a low permeability capping layer and none are recent landfills.
- Scenario 6 - Causing off-site migration of ground gas or increased vertical emissions as a result of vibration or other effects from the pile installation process:
  - Not applicable – Credible ground gas hazards to human health have not been identified.
- Scenario 7 – Direct contact with contaminated soil arisings that have been brought to the surface:
  - Potential hazards to human health within the on-Site soils have not been identified with the exception of a single positive detection of asbestos in the Made Ground at the reception shaft for the trenchless crossing beneath Botley Road (B3035) and the River Hamble. On this basis, this scenario is not applicable to all structures except the Botley Road crossing, where the risk is assessed as Moderate. Use of appropriate, good practice mitigation during construction will reduce this to Low.

Mitigation measures

Mitigation is embedded within the design and construction strategy and is assumed to include:

- Use of a Construction Environmental Management Plan (CEMP) to provide measures during the construction phase, such as the use of personal protective equipment, dust control measures and controls to prevent the release of new contamination.
- Management of construction wastes.
- Suitable design of the Project, including the use of cast in-situ piled foundations, replacement (vs. displacement) construction methodologies, minimising penetration of piles, specification of appropriate concrete classes to resist chemical attack and to limit

bleeding into pore spaces, design of grout and fissure grouting methodology to limit excess dispersal through the chalk, etc.

- Use of an appropriate construction methodology developed by the Contractor to mitigate and remediate bentonite break outs.
- An Outline Water Monitoring Plan (ES Appendix 19.9 Outline Water Monitoring Plan, Volume II (Document reference 6.2, DCO Volume 6)) to identify significant changes in groundwater levels/ contamination levels in key locations during construction, and a Contingency Plan.

Overall, this assessment shows that with appropriate construction and trenchless crossing techniques and associated control measures the potential risks associated with the construction of the proposed AGP sites and trenchless crossings are typically Low to Moderate. The Outline FWRA demonstrates that technical solutions are feasible with mitigation measures that are protective of land quality and ground conditions receptors. The development of the Outline FWRA follows an iterative process, which is dependent on detailed design and therefore the mitigation measures discussed in this Outline FWRA are subject to change.

The assessment is not intended to prescribe a definitive foundation design, nor to preclude alternative technical solutions. Instead, it demonstrates that a viable engineering solution is achievable in principle, subject to detailed design development and appropriate specification at the construction stage.

1 Introduction

1.1 Preamble

1.1.1 Southern Water Services Limited (the Applicant) has commissioned this Outline Foundation Works Risk Assessment (FWRA) to support the application for a Development Consent Order (DCO) for the construction of a new Water Recycling Plant (WRP) and water supply infrastructure. The construction of a new WRP and associated infrastructure is part of the Hampshire Water Transfer and Water Recycling Project (HWTWRP) referred to as the Project herein. The purpose of the Project is to address the sustainability objectives of reduced abstractions on Hampshire's two main rivers, the River Test and the River Itchen and ensure a resilient water supply for the Applicant's customers.

1.2 Assessment context

1.2.1 The purpose of this Outline FWRA is to demonstrate that the proposed foundation construction and trenchless crossing construction methods associated with the proposed Above Ground Plant (AGP) compounds and trenchless crossings would not have an adverse impact by creating new pathways for the migration of contamination, considering the protection of both water resources and human health.

1.2.2 This Outline FWRA version has been produced in light of guidance published by CL:AIRE in March 2025, "Piling and Penetrative Ground Improvement Methods on Land Affected by Contamination: Guidance on Pollution Prevention" [1].

1.2.3 The assessment is not intended to prescribe a definitive foundation design, nor to preclude alternative technical solutions. Instead, it demonstrates that a viable engineering solution is achievable in principle, subject to detailed design development and appropriate specification at the construction stage.

1.2.4 The information presented within this document is based upon an iterative design process, integrating available ground investigation data, conceptual site model development, and engineering judgement at the time of reporting.

1.2.5 It is acknowledged that foundation type, depth, geometry, and construction methodology would be dependent upon the detailed structural design chosen by the contractor.

1.2.6 This Outline FWRA is a dynamic documenting process which following additional site investigation data and detailed foundation design will be revised through the various stages of the Project.

1.3 Description of Project

1.3.1 The Project comprises the construction, operation and maintenance of the following components:

- WRP and associated pumping stations.
- Pipelines between Budds Farm Wastewater Treatment Works (WTW) and the WRP site.
- Pipelines between the WRP site and Bedhampton Springs, connecting to pipelines being delivered by Portsmouth Water between Bedhampton Springs and Havant Thicket Reservoir.
- Pipeline between the WRP site and Otterbourne Water Supply Works (WSW).
- AGP comprising Intermediate Pumping Stations (IPS) and Break Pressure Tanks (BPT) located along the Pipeline between the WRP site and Otterbourne WSW.

1.3.2 The Project would also comprise the use of the following infrastructure:

- Havant Thicket Reservoir (which has been consented separately by Portsmouth Water and is currently under construction) for the storage of recycled water.
- The existing Eastney Long Sea Outfall (LSO), Eastney Pumping Station, and associated Eastney Transfer Tunnel for the release of reject water from the WRP site.
- Pipelines and other related works (which have been consented separately by Portsmouth Water) for the transfer of recycled water and source water between Bedhampton Springs and Havant Thicket Reservoir.

1.3.3 The construction and operation of the Project would be supported by other temporary and permanent works.

1.3.4 The Project will require the demolition, disassembly and/or temporary relocation of a number of small structure.

1.3.5 A detailed description of the Project can be found in Environmental Statement (ES) Chapter 3 Description of the Proposed Development, Volume I (Document reference 6.1, DCO Volume 6). The Application Glossary (Document reference 1.7, DCO Volume 1) sets out the abbreviations and definitions used in the DCO application for the Project.

1.4 Scope of work

1.4.1 This Outline FWRA relates solely to the AGP and the trenchless crossings required for the pipelines. A description of these elements is provided in Section 2.

1.4.2 It presents a summary description of the ground conditions and geo-environmental conditions across the Site and should be read in conjunction with the earlier Desk Studies and Geotechnical and Geo-environmental Interpretative Reports (GIRs) for the various Sections of the Project (GIRs for Sections E, F, G, H, J, K, L and

M), which are all contained within ES Appendix 11.2 Geotechnical and Geo-environmental reports, Volume II (Document reference 6.2, DCO Volume 6).

1.4.3 Outline FWRAs for the elements not listed above are provided under separate cover (Document Reference 7.4, DCO Volume 7).

1.5 Limitations

1.5.1 This assessment is based upon information available at the DCO submission stage. Detailed design would be undertaken post-DCO consent, and this assessment should therefore be updated to a Detailed Foundation Works Risk Assessment by the contractor.

1.5.2 This report draws upon information presented in other studies prepared as part of submissions to support the ES submitted as part of the DCO application. Where referenced, the reports presenting this information should be read in conjunction with this report.

1.5.3 This document should be read as part of the wider ground risk and design information package and is not a substitute for detailed structural design, contractor-led method statements, or project-specific risk assessments required at later stages post-DCO consent.

2 Proposed structures

2.1.1 Table 2-1 presents a description of the various elements of the Project that are relevant to this Outline FWRA. Pipelines (excluding trenchless crossings) are not included in Table 2-1.

2.1.2 The locations of each of the AGP and trenchless crossings are shown on the exploratory hole and potential sources of contamination (PSC) plans presented in Appendix A.

Table 2-1 Proposed structures

Route Section	Structure	Description
Sections E and K	BPT/IPS-E, BPT-K	BPT/IPS-E is a combined Intermediate Pumping Station (IPS) and Break Pressure Tank (BPT). The typical IPS design comprises a pump house with associated switchroom, welfare facilities, electrical transformers with associated kiosks, back-up generators and fuel storage, a compressor kiosk and 2 x surge vessels. The BPT comprises of 2No. cells each providing 500m^3 of storage, with approximate dimensions of 23 m x 11 m x 8 m. BPT/IPS-E would be cut into the hillside with an 8 m high piled retaining wall and a finished ground level (FGL) of approximately 86 m Above Ordnance Datum (m AOD). The piled retaining wall is assumed to extend approximately 12.0 m (i.e., 1.5 times the retained height) below ground level, i.e., to an elevation of approximately 74 m AOD. BPT-K comprises a BPT with supporting infrastructure (e.g. MCC kiosk, welfare etc.). The BPT-K design principally comprises 2No. cells at 1 ML each, measuring approximately 20 m x 15 m x 4 m. BPT-K would be cut into the existing hillside by approximately 4.5 m bgl to give an approximate FGL of 67m AOD. Detailed design of the foundations for these structures has not yet been undertaken. To provide a conservative assessment it has been assumed that piled foundations may be required for the BPTs, assumed to extend to a maximum of 14 m below the FGL, i.e., to approximately 72 m AOD at BPT/IPS-E and approximately 54 m AOD at BPT-K. BPT-K is located within the Wintershill Estate, approximately 20 m north of PSC-474 Wintershill Hall (wartime headquarters of Hampshire Fire Service with temporary accommodation and administrative functions). On-Site PSCs have not been identified. BPT/IPS-E is not located within 50 m of an identified credible PSC.
Sections F and G	IPS-F, IPS- G	The typical IPS design comprises a pump house with associated switchroom, welfare facilities, electrical transformers with associated kiosks, back-up generators and fuel storage, a compressor kiosk and 2 x surge vessels. IPS-F is located immediately north-east of PSC-5 “infilled land”. A review of this PSC indicates that it comprises an historical chalk pit. The EA record the pit as a landfill named “Albany Farm”, with a licence issued in May 1977 that was licenced to accept inert wastes – no further landfill information is available. On-Site PSCs have not been identified. For IPS-F, the GL across the Site is likely to be raised due to how steep the existing Site gradient is from the farm track. GL changes vary from existing GL to being raised by approximately4 m in the north-eastern part of the Site. IPS-G is located within 50 m of only one credible PSC - PSC-475 “Garage”. This PSC comprises the workshop for a company that fits and maintains electrical systems on private and commercial vehicles and inspects for / repairs / prevents damage due to water ingress on leisure vehicles. On-Site PSCs have not been identified.

Route Section	Structure	Description
		For IPS-G, the FGL is proposed as 52 m AOD for landscaping assessment so 1-2 m lower than existing GL at most.
Section F	Trenchless crossing beneath the River Wallington	The trenchless crossing beneath the River Wallington would comprise a launch shaft sunk to a depth of 9.4 m and a reception shaft sunk to a depth of 11.1 m. The trenchless crossing would be constructed by pipe-jacking at 1,200 mm diameter, within the White Chalk Subgroup. This trenchless crossing is not located within 50 m of an identified credible PSC.
Section G / H Interface	Trenchless crossing beneath Winchester Road (A334), south of junction with Titchfield Lane and Blind Lane	The trenchless crossing beneath the A334 would comprise a launch shaft sunk to a depth of 12.0 m and a reception shaft sunk to a depth of 12.0 m. The trenchless crossing would be constructed by pipe-jacking at 1,200 mm diameter. Current proposals indicate that the pipe-jack would be constructed within the Wittering Formation (sand horizon) and the London Clay Formation. PSC-45 (Old Gravel Pit) is located approximately 25 m south of the trenchless crossing, corresponding with an area of woodland, labelled “Gravelpit Copse”. A review of historical mapping shows that this parcel of land has been woodland since at least the 1860s, and it is therefore considered that either a) gravel extraction and infilling of the pit/s occurred at least 165 years ago, or b) that extraction was very small scale within the woodland. In both cases, it is considered that the potential for limited infilling of the historical gravel pit (if any occurred at all) to still be generating ground gases is negligible. No further PSCs have been identified within 50 m of the trenchless crossing.
Section H	Trenchless crossing beneath public footpath and High St. at Shirrell Heath	The trenchless crossing at Shirrell Heath would comprise a launch shaft sunk to a depth of 9.8 m and a reception shaft sunk to a depth of 5.0 m. The trenchless crossing would be constructed by pipe-jacking at 1,200 mm diameter. Current proposals indicate that the pipe-jack would be constructed within the Whitecliff Sand Member of the London Clay Formation. This trenchless crossing is not located within 50 m of an identified credible PSC.
Section H/J Interface	Trenchless crossing beneath woodland, Winchester Road	The trenchless crossing at Winchester Road and St. Anne’s Lane would comprise a launch shaft sunk to a depth of approximately 6.0 m and a reception shaft sunk to a depth of approximately 10.0 m.

Route Section	Structure	Description
	(B2177) and St. Anne's Lane, north of Shedfield	The trenchless crossing would be constructed by pipe-jacking at 1,200 mm diameter. Current proposals indicate that the pipe-jack would be constructed below the water table within the Whitecliff Sand Member. PSCs 102 and 103 (former sand pits) are located in the land above the Site. The proposed trenchless crossing would not interact with these PSCs, i.e., contamination present would not be mobilised by the construction works. Furthermore, the adverse impacts of contamination present within these PSCs would be the responsibility of the landowner to mitigate/remediate. Modern-day LiDAR imagery shows the former pits have not been infilled, noting that localised, small-scale, non-commercial filling, e.g. with residential waste may still have taken place.
Section K	Trenchless crossing beneath Botley Road (B3035) and the River Hamble	The trenchless crossing at Botley Road and the River Hamble would comprise a launch shaft sunk to a depth of approximately 9.7 m and a reception shaft sunk to a depth of approximately 15.0 m. The trenchless crossing would be constructed by pipe-jacking at 1,200 mm diameter. Current proposals indicate that the pipe-jack would be constructed within the London Clay Formation. This trenchless crossing is not located within 50 m of an identified credible PSC. **Changes in the route has resulted in a relocation of this trenchless crossing and has been moved approximately 300 m northeast. This Outline FWRA only assesses the previous location as there is ground investigation data available.**
Section L	Trenchless crossing beneath Winchester Road (B3354)	The trenchless crossing at Winchester Road (B3354) would comprise a launch shaft sunk to a depth of approximately 9.0 m and a reception shaft sunk to a depth of approximately 7.6 m. The trenchless crossing would be constructed by pipe-jacking at 1,200 mm diameter. Current proposals indicate that the pipe-jack would be constructed within the London Clay Formation. PSCs have not been identified within 50 m of the trenchless crossing. It is noted that an historical brick works is present approximately 70 m to the south and an historical landfill is present approximately 130 m to the south. The brick works appears to have been present since the mid- to late 1800s and was demolished by the early 1900s. Contemporary LiDAR imagery indicates the brickfield was not infilled. The landfill (separate from the former brickworks brickfield) does not appear to be an infilling of an earlier feature and was investigated as part of the 2023 SOCOTEC investigations [2], which recorded approximately 0.0 m to 0.5 m of Made Ground overlying natural deposits. On this basis, neither of these features are considered to present a credible gaseous hazard.
Section L	Trenchless crossing beneath Bow Lake (stream)	The trenchless crossing beneath Bow Lake (a stream, not a lake) would comprise a launch shaft sunk to a depth of approximately 9.0 m and a reception shaft sunk to a depth of approximately 7.6 m.

Route Section	Structure	Description
		The trenchless crossing would be constructed by pipe-jacking at 1,200 mm diameter. Current proposals indicate that the pipe-jack would be constructed within the London Clay Formation. This trenchless crossing is not located within 50 m of an identified credible PSC.
Section M	Trenchless crossing beneath agricultural land to the south-west of Batsford Lane, and un-named tributary of the River Itchen	The trenchless crossing beneath the agricultural land to the south-west of Batsford Lane and the un-named tributary of the River Itchen would comprise a launch shaft sunk to a depth of approximately 10.0 m and a reception shaft sunk to a depth of approximately 13.0 m. The trenchless crossing would be constructed by pipe-jacking at 1,200 mm diameter. Current proposals indicate that the pipe-jack would be constructed within the Lambeth Group and White Chalk Subgroup. This trenchless crossing is not located within 50 m of an identified credible PSC.
Section K	Trenchless crossing beneath Winters Hill (road) and agricultural land	The trenchless crossing beneath Winters Hill would comprise a launch shaft sunk to a depth of approximately 6.0 m and a reception shaft sunk to a depth of approximately 8.0 m. The trenchless crossing would be constructed by pipe-jacking at 1,200 mm diameter. Current proposals indicate that the pipe-jack would be constructed within the London Clay Formation. This trenchless crossing is not located within 50 m of an identified credible PSC.
Section G	Trenchless crossing beneath the River Meon	The trenchless crossing beneath the River Meon would comprise launch and reception shafts sunk to a depth of approximately 14.0 to 17.0 m below ground level (bgl) respectively. The trenchless crossing would be constructed by pipe-jacking at 1,200 mm diameter. Current proposals indicate that the pipe-jack would be constructed within the Whitecliff Sand Member. The following PSCs have been identified within 50 m of the trenchless crossing: ■ PSC 485 – Wastewater Treatment Works. Located approximately 30 m north-east of the reception shaft. ■ PSC 493 – Former (now decommissioned) Meon Railway. Located approximately 30 m north of the launch shaft. ■ PSC 626 – Potentially infilled former drain. Located greater than 50 m from the shafts, within the land above the trenchless crossing. ■ PSC 627 – Potentially infilled former drain. Located greater than 50 m from the shafts, within the land above the trenchless crossing. PSCs 626 and 627 are located in the land above the trenchless crossing. The proposed trenchless crossing would not interact with these PSCs, i.e., contamination present would not be mobilised by the construction works. Furthermore, the

Route Section	Structure	Description
		adverse impacts of contamination present within these PSCs would be the responsibility of the landowner to mitigate/remediate.
Section L	Trenchless crossing beneath agricultural land, woodland, River Itchen and Bournemouth (Waterloo to Weymouth) Main Line railway.	The trenchless crossing beneath the River Itchen would comprise launch and reception shafts sunk to a depth of approximately 33 m bgl. The trenchless crossing would be constructed by pipe-jacking at 1,200 mm diameter. Current proposals indicate that the pipe-jack would be constructed within the Lambeth Group. The following PSCs have been identified within 50 m of the trenchless crossing: ■ PSC 204 – Railway. Located greater than 50 m from the shafts, within the land above the trenchless crossing. ■ PSC 209 – Bugle Farm Landfill. Located greater than 50 m from the shafts, within the land above the trenchless crossing. ■ PSC 437 – Infilled land. Located greater than 50 m from the shafts, within the land above the trenchless crossing. ■ PSC 438 – Infilled land. Located greater than 50 m from the shafts, within the land above the trenchless crossing. ■ PSC 520 – Infilled land. Located greater than 50 m from the shafts, within the land above the trenchless crossing. The PSCs described above are located in the land above the trenchless crossing. The proposed trenchless crossing would not interact with these PSCs, i.e., contamination present would not be mobilised by the construction works as the works are undertaken at depth beneath the PSC. Furthermore, the adverse impacts of ongoing contamination present within/migrating from these PSCs would be the responsibility of the landowner to mitigate/remediate.
Section G	Trenchless crossing beneath Hoad's Hill (A32) south of Wickham	The trenchless crossing beneath the A32 would comprise launch and reception shafts sunk to a depth of approximately 10.0 m. The trenchless crossing would be constructed by pipe-jacking at 1,200 mm diameter. Current proposals indicate that the pipe-jack would be constructed within the Whitecliff Sand Member. This trenchless crossing is not located within 50 m of an identified credible PSC.

3 Site setting

3.1.1 The text within this section is summarised from the Desk Study prepared for the pipeline route and the Geoenvironmental Interpretative Summary Report both contained within ES Appendix 11.2 Geotechnical and Geo-environmental reports, Volume II (Document reference 6.2, DCO Volume 6), which should be read in conjunction with this Outline FWRA.

3.2 Site history

3.2.1 A summary of the land use history at each of the AGP and trenchless crossing locations is provided in Table 3-1.

Table 3-1 Summary of land use history

Structure	Land Use History
BPT/IPS-E	BPT/IPS-E sits within an area that has remained undeveloped since the earliest available historical mapping and is currently used as agricultural land.
BPT-K	BPT-K is located in land that has remained undeveloped since the earliest available historical mapping and is currently used as agricultural land.
IPS-F	IPS-F sits within an area that has remained undeveloped since the earliest available historical mapping. The surrounding land has remained similarly agricultural with the exception of an 'old chalk pit' recorded immediately to the south-west on mapping dated 1888 – 1915 (shown to be wooded), which historical aerial photography shows to have remained as woodland until at least 1946. EA data shows that a licence to carry out landfilling (Albany Farm Landfill) of "inert" waste in the old chalk pit was granted in 1977. Following completion of landfilling, if any occurred (noting that the old pit remains visible on contemporary LiDAR imagery) the pit was returned to woodland.
IPS-G	IPS-G sits within an area that has remained undeveloped since the earliest available historical mapping and is currently used as agricultural land.
Trenchless crossing beneath the River Wallington	This trenchless crossing is located in an area that has remained undeveloped since the earliest available historical mapping. The land above the trenchless crossing is currently used as agricultural land, crossed by the River Wallington.
Trenchless crossing beneath Winchester Road (A334), south of junction with Titchfield Lane and Blind Lane	The shafts for this trenchless crossing are located in areas that have remained undeveloped since the earliest available historical mapping and are currently used as agricultural land. The land above the trenchless crossing appears to have remained as agricultural land, crossed by Winchester Road.
Trenchless crossing beneath public footpath and High St. at Shirrell Heath	The shafts for this trenchless crossing are located in an area that has remained undeveloped since the earliest available historical mapping and is currently used as agricultural/paddock/equestrian land. The land above the trenchless crossing is used as a public footpath, and High St. (a road).

Structure	Land Use History
Trenchless crossing beneath woodland, Winchester Road (B2177) and St. Anne's Lane, north of Shedfield	The shafts for this trenchless crossing are located in areas that have remained undeveloped since the earliest available historical mapping and are currently used as agricultural/paddock/equestrian land. The land above the trenchless crossing appears to have been used in the 1800s for mineral (sand) extraction, with the historical maps recording sand pits. The pits subsequently became disused and slowly became overgrown with woodland. Modern day LiDAR imagery indicates that the pits were not infilled and extend to a wider extent than shown on the historical mapping.
Trenchless crossing beneath Botley Road (B3035) and the River Hamble.	The shafts for this trenchless crossing are located in areas that have remained undeveloped since the earliest available historical mapping and are currently used as agricultural land. The land above the trenchless crossing appears to have remained as floodplain immediately adjacent to the river, agricultural land, and Botley Road.
Trenchless crossing beneath Winchester Road (B3354)	The shafts for this trenchless crossing are located in areas that have remained undeveloped since the earliest available historical mapping and are currently used as agricultural land. The land above the trenchless crossing appears to have remained as agricultural land, crossed by Winchester Road.
Trenchless crossing beneath Bow Lake (stream)	The shafts for this trenchless crossing are located in areas that have remained undeveloped since the earliest available historical mapping and are currently used as agricultural land. The land above the trenchless crossing appears to have remained as agricultural land, crossed by Bow Lake (a stream).
Trenchless crossing beneath agricultural land to the south-west of Batsford Lane, and un-named tributary of the River Itchen	The shafts for this trenchless crossing are located in areas that have remained undeveloped since the earliest available historical mapping and are currently used as agricultural land. The land above the trenchless crossing appears to have remained as agricultural land, crossed by a tributary of the River Itchen.
Trenchless crossing beneath Winters Hill (road) and agricultural land	The launch and reception shafts for this trenchless crossing are located in land that has remained undeveloped since the earliest available historical mapping. The land above the trenchless crossing appears to have remained as parkland associated with the nearby Wintershill Hall and is crossed by Winters Hill (a road). In more recent years the parkland has been uses as paddocks.
Trenchless crossing beneath the River Meon	The reception shaft for this trenchless crossing is located in land that has remained undeveloped since the earliest available historical mapping and is currently used as agricultural land. The launch shaft for this trenchless crossing is located within land that remained as undeveloped agricultural land until approximately the late 1980s/early 1990s when Wickham Park Golf Course was constructed. The land above the trenchless crossing appears to have remained woodland and floodplain, crossed by the River Meon, with occasional 'drains' recorded. A sewage treatment works was constructed immediately north of the trenchless crossing between approximately 1950 and 1970, which remains present today.

Structure	Land Use History
Trenchless crossing beneath agricultural land, woodland, River Itchen and Bournemouth (Waterloo to Weymouth) Main Line railway.	The launch and reception shafts for this trenchless crossing are located in land that has remained undeveloped since the earliest available historical mapping and is currently used as agricultural land. The land above the trenchless crossing appears to have remained as floodplain, crossed by a tributary of the River Itchen and a railway line until the early 20th Century when mineral extraction took place above the eastern half of the trenchless crossing. The EA records that the resultant void was used as a landfill (Bugle Farm, reference EA HLD20430) but has provided no information relating to operational dates or waste types received. The land recorded as former landfill is now heavily forested.
Trenchless crossing beneath Hoad's Hill (A32) south of Wickham	The launch and reception shafts for this trenchless crossing are located in land that has remained undeveloped since the earliest available historical mapping. The land above the trenchless crossing is currently used as agricultural land and woodland, crossed by the A32.

3.3 Geology and ground conditions

3.3.1 The ground conditions, as encountered during the various phases of ground investigation that have been undertaken at the AGP and trenchless crossing locations are summarised in Table 3-2.

Table 3-2 Summary of encountered ground conditions

Structure	Typical Description of Strata Encountered
BPT/IPS-E	The ground conditions at BPT/IPS-E comprise a limited thickness of topsoil overlying in excess of 30 m (proved to 60.72 m AOD – base not proved) of the Portsdown Chalk Formation.
BPT-K	The ground conditions at BPT-K comprise a limited thickness of topsoil overlying material described by the contractor as 'Possible Alluvium' (sandy SILT/sandy, gravelly CLAY) that could also represent weathered London Clay Formation, to a depth of approximately 3.0 m, overlying in excess of 25 m (proved to 41.69 m AOD – base not proved) of the London Clay Formation.
IPS-F	The ground conditions at IPS-F comprise approximately 0.3 m thickness of topsoil and subsoil, overlying Head Deposits (variably sandy and gravelly CLAY) to a depth of approximately 6.0 m bgl, beneath which the Culver Chalk Formation was proved to a depth of 30 m.
IPS-G	The ground conditions at IPS-G comprise a limited thickness of topsoil overlying between 2.5 m and 3.8 m of River Terrace Deposits (typically a variably silty/clayey and sandy fine to coarse GRAVEL of chert, with occasional cobbles), beneath which the Earnley Sand Formation (medium dense to dense variably clayey and gravelly SAND) was encountered to between 27.0 m and 28.0 m bgl. The Wittering Formation (firm to stiff CLAY with occasional sand pockets) was encountered beneath the Earnley Sand Formation and was proved to 30 m bgl.
Trenchless crossing beneath the River Wallington	The ground conditions at this location, as shown in exploratory holes 2F3502SA and 2F3503SA comprise a limited thickness (0.3 m) of topsoil, overlying between 0.3 m and 3.5 m thickness of Alluvium and Head Deposits (soft to firm, variably sandy and gravelly SILT/CLAY) beneath which CHALK of the White Chalk Subgroup was encountered and proved to a maximum depth of 20 m.

Structure	Typical Description of Strata Encountered
Trenchless crossing beneath Winchester Road (A334), south of junction with Titchfield Lane and Blind Lane	The ground conditions in exploratory hole 3G4102SA (launch shaft) and 3H4600SA (reception shaft) comprise approximately0.4 m of topsoil. Beneath the topsoil, River Terrace Deposits comprising slightly sandy, gravelly, silty CLAY and slightly sandy clayey GRAVEL were encountered to a depth of between 3.0 m and 4.0 m bgl. Beneath the superficial deposits, dense to very dense silty fine SAND of the Wittering Formation was encountered to between 10.0 and 13.1 m bgl, beneath which the stiff to very stiff slightly sandy CLAY of the London Clay Formation was proved to the base of the boreholes at 20.0 m bgl.
Trenchless crossing beneath public footpath and High St. at Shirrell Heath	At the launch shaft location in 2H4501DR, the stiff to very stiff CLAY of the London Clay Formation was encountered to a depth of 5.45 m, beneath which a lens of the Whitecliff Sand Member (dense to very dense, clayey SAND) was encountered to 11.75 m (6.3 m thickness), following which the CLAY of the London Clay Formation was again encountered and proved to a depth of 20 m. At the reception shaft in 2H4500DR the Whitecliff Sand Member was encountered immediately beneath the topsoil and extended to a depth of at least 5.2 m, beneath which the CLAY of the London Clay Formation was again encountered and proved to a depth of 20 m.
Trenchless crossing beneath woodland, Winchester Road (B2177) and St. Anne's Lane, north of Shedfield	The ground conditions at this location, as shown in exploratory holes 3J5002SA (launch shaft) and 3H4517SA (reception shaft), comprise a limited thickness (approximately 0.25 m) of topsoil, directly overlying the Whitecliff Sand Member (dense to very dense, clayey SAND) to a depth of between 7.1 m and 7.7 m bgl, following which the stiff to very stiff CLAY of the London Clay Formation was encountered and proved to a maximum depth of 20 m.
Trenchless crossing beneath Botley Road (B3035) and the River Hamble.	The ground conditions in exploratory hole 2K5500SR (launch shaft) comprise 0.7 m thickness of Made Ground (gravelly clay with fragments of brick and burnt wood) overlying Alluvium/River Terrace Deposits (Soft slightly sandy gravelly CLAY) to 4.9 m bgl (4.2 m thickness), beneath which the stiff to very stiff CLAY of the London Clay Formation was encountered and proved to a depth of 20 m. The ground conditions in exploratory hole 2K5501SR (reception shaft) comprise 0.1 m of topsoil overlying Head Deposits (firm variably gravelly and cobbly CLAY) to 2.0 m bgl, beneath which the stiff to very stiff CLAY of the London Clay Formation was encountered and proved to a depth of 20 m.
Trenchless crossing beneath Winchester Road (B3354)	The ground conditions in exploratory hole 2L6008DR (launch shaft) and 2L6007DR (reception shaft) comprise approximately 0.3 m of topsoil overlying Alluvium (Soft, slightly sandy gravelly CLAY) to between 1.8 m and 2.0 m bgl, overlying (in 2L6008DR only) Head Deposits (soft locally firm sandy very gravelly CLAY). Beneath the superficial deposits bedrock deposits of the stiff to very stiff CLAY of the London Clay Formation was encountered and proved to a depth of between approximately 17.5 and 18.5 m bgl, beneath which the stiff to very stiff locally sandy CLAY of the Lambeth Group was encountered and proved to a depth of 20 m.
Trenchless crossing beneath Bow Lake (stream)	The ground conditions in exploratory hole 2L6010DR (launch shaft) and 2L6009DR (reception shaft) comprise approximately 0.4 m of topsoil and subsoil (in 2L6009 classified as Made Ground due to occasional gravel of brick) beneath which Alluvium (soft, slightly sandy gravelly CLAY) was encountered to between 2.6 m and 3.9 m bgl. Beneath the superficial deposits bedrock deposits of the stiff to very stiff CLAY of the London Clay Formation was encountered and proved to a depth of between approximately 17.8 and 20.0 m bgl, beneath which (in 2L6010DR only) the stiff to very stiff locally sandy CLAY of the Lambeth Group was encountered and proved to a depth of 20 m.
Trenchless crossing beneath agricultural land to the south-west of Batsford Lane, and un-named tributary of the River Itchen	The ground conditions in exploratory hole 2M6508SA (launch shaft) and 2M6507SA (reception shaft) comprise approximately 0.3 m of topsoil. In 2M6508SA, Alluvium (soft, slightly sandy gravelly CLAY) was encountered to 2.55 m bgl. Beneath the topsoil (and Alluvium, where present) River Terrace Deposits comprising slightly clayey, gravelly clayey SAND were encountered to a depth of between 4.5 m and 5.7 m bgl. Beneath the superficial deposits, 2M6508SA encountered CHALK bedrock of the White Chalk Subgroup, which was proved to a depth of 20 m, whilst 2M6507SA encountered the stiff to

Structure	Typical Description of Strata Encountered
	very stiff locally sandy CLAY of the Lambeth Group to a depth of 14.1 m, beneath which the CHALK was encountered.
Trenchless crossing beneath Winters Hill (road) and agricultural land	The ground conditions in exploratory hole 3K5606SA (launch shaft) and 3K5513HP (a hand-dug pit sunk approximately 50 m south of the proposed reception shaft) comprise approximately 0.15 m of topsoil overlying Alluvium (soft, slightly sandy gravelly CLAY) to a depth of between 0.8 m and 2.0 m. Beneath the superficial deposits, the stiff to very stiff CLAY of the London Clay Formation was encountered and proved to a depth of 20 m.
Trenchless crossing beneath the River Meon	The ground conditions in exploratory hole 3W8536SA (launch shaft) comprise 0.35 m of Made Ground, overlying River Terrace Deposits (typically sandy, gravelly SILT and sandy GRAVEL) to a depth of 3.6 m. Beneath the superficial deposits, bedrock of the Whitecliff Sand Member (medium dense to dense silty SAND) were encountered and proved to a depth of 20.45 m bgl. The ground conditions in exploratory hole 3W8535SA (reception shaft) comprise 0.3 m of topsoil, overlying Head Deposits (silty, variably gravelly CLAY) to a depth of 2.5 m bgl, beneath which bedrock of the Wittering Formation (soft to firm variably sandy CLAY) was encountered to a depth of 12.4 m. Below the Wittering Formation, the stiff silty CLAY of the London Clay Formation was encountered and proved to a depth of 20 m.
Trenchless crossing beneath agricultural land, woodland, River Itchen and Bournemouth (Waterloo to Weymouth) Main Line railway.	The ground conditions in exploratory holes BH502 and BH503 (launch shaft) comprise 0.30 m of topsoil, overlying (in BH502, closer to the River Itchen) River Terrace Deposits (typically sandy and silty GRAVEL of chert) to a depth of 4.25 m. Further from the river the topsoil overlies a limited thickness of Alluvium (soft, silty, slightly gravelly CLAY) to a depth of 0.8 m, beneath which River Terrace Deposits were encountered to 1.10 m bgl. Beneath the River Terrace Deposits the firm to stiff CLAY of the London Clay Formation was encountered to a depth of 17.75 m beneath which it was encountered predominantly as a dense grey SAND to a depth of 28.55 m bgl. The Lambeth Group was encountered beneath the London Clay Formation and predominantly comprised stiff to very stiff CLAY to a depth of 44.05 m beneath which the weak to very weak medium to high density CHALK of the Culver Chalk was encountered and proved to a depth of 55.0 m bgl. The ground conditions in exploratory holes 2L6011SR, 2L6012SR and BH501 (reception shaft) comprise approximately 0.5 m of topsoil and subsoil, overlying River Terrace Deposits (a variable mix of gravelly SAND, sandy GRAVEL and sandy/gravelly CLAY) to a depth of between 2.2 m and 3.5 m bgl. Beneath the River Terrace Deposits the firm to stiff CLAY of the London Clay Formation was encountered to a depth of between 12.4 and 17.25 m. A limited thickness (0.25 m to 2.0 m) of the Harwich Formation, comprising SAND or sandy, silty CLAY was encountered, overlying (at between 14.4 m and 15.6 m bgl) the firm to stiff CLAY of the Lambeth Group, which was proved to a depth of 42 m bgl, beneath which weak low to medium density CHALK of the Culver Chalk Formation was encountered, and proved to a depth of 45.15 m bgl.
Trenchless crossing beneath Hoad's Hill (A32) south of Wickham	The ground conditions in exploratory hole 3W8530SA (launch shaft) and 3W8529SA (reception shaft) comprise approximately 0.35 m of topsoil overlying the Wittering Formation (beds of silty SAND and sandy silty CLAY) to a depth of between 6.0 m and 9.0 m. Beneath the Wittering Formation, the silty SAND of the Whitecliff Sand Member was encountered and proved to a depth of 20 m.

3.4 Hydrogeological setting

3.4.1 A summary of the groundwater levels recorded during post-investigation monitoring at each of the AGP and trenchless crossing locations is provided in Table 3-3, alongside a summary of the aquifer classifications, groundwater

vulnerability, and the presence of groundwater Source Protection Zones (SPZs) and abstractions at (or within 250 m of) each location.

Table 3-3 Summary of hydrogeological setting

Structure	Aquifer Designations[1]	Groundwater Vulnerability[2]	In groundwater SPZ and abstractions within 250 m?	Groundwater Levels Recorded During Post GI Monitoring and Commentary Relating to Abstractions/SPZs
BPT/IPS-E	Superficial deposits were not encountered. Chalk = Principal aquifer.	High	No Groundwater abstractions not identified within 250 m.	Groundwater monitoring installations were constructed within the Chalk beneath BPT/IPS E. Shallow superficial deposits were not encountered. Groundwater levels in the Chalk were recorded between 27.46 m and 39.83 m bgl.
BPT-K	Possible Alluvium = Probable Secondary A aquifer London Clay Formation = Unproductive stratum.	Medium	No Groundwater abstractions not identified within 250 m.	Groundwater monitoring installations were installed within the Weathered London Clay Formation/Possible Alluvium beneath BPT-K. Installations were not constructed within the functionally impermeable London Clay Formation encountered beneath the Alluvium. Groundwater levels in the shallow superficial deposits were recorded. between 1.09 m and 1.78 m bgl.
IPS-F	Head Deposits = Secondary Undifferentiated aquifer Chalk = Principal aquifer.	Medium to High	Yes - Zone 2. Groundwater abstractions not identified within 250 m.	Groundwater monitoring installations were constructed within the Head Deposits and Chalk beneath IPS-F to a depth of 10 m bgl. The boreholes were found to be dry during subsequent monitoring. Groundwater strikes were not recorded during drilling.

Structure	Aquifer Designations[1]	Groundwater Vulnerability[2]	In groundwater SPZ and abstractions within 250 m?	Groundwater Levels Recorded During Post GI Monitoring and Commentary Relating to Abstractions/SPZs
IPS-G	River Terrace Deposits, Earnley Sand Formation and Wittering Formation = Secondary A aquifers.	Medium	No Groundwater abstractions not identified within 250 m.	Groundwater monitoring installations were installed within the Earnley Sand Formation beneath IPS-G. Installations were not constructed within the overlying River Terrace Deposits, which are considered likely to be in hydraulic conductivity with the underlying Earnley Sand Formation. Groundwater levels within the bedrock of the Earnley Sand Formation were recorded between 9.70 and 10.74 m bgl.
Trenchless crossing beneath the River Wallington	Alluvium = Secondary A aquifer. Head Deposits = Secondary Undifferentiated aquifer. Chalk = Principal aquifer.	Medium to High	Yes – Zone 2 Groundwater abstractions not identified within 250 m.	Groundwater levels in 2F3502SA, as measured in the response zone between 2.0 m and 20.0 m bgl within the superficial Alluvium and Chalk bedrock, were recorded at between 1.20 m bgl and 6.80 m bgl. Groundwater levels in 2F3503SA, as measured in the response zone between 2.0 m and 20.0 m bgl within the superficial Alluvium and Chalk bedrock, were recorded at between 0.93 m bgl and 5.81 m bgl.
Trenchless crossing beneath Winchester Road (A334), south of junction with Titchfield Lane and Blind Lane	River Terrace Deposits and Wittering Formation = Secondary A aquifers.	Medium	No Groundwater abstractions not identified within 250 m.	Groundwater levels in 3G4102SA, as measured in the response zone between 4.0 m and 13.0 m bgl within the Wittering Formation, were recorded at between 10.73 m bgl and 11.1 m bgl. Groundwater levels in 3H4600SA, as measured in the response zone between 7.0 m and 10.0 m bgl within the Wittering Formation, were recorded at between 5.50 m bgl and 6.45 bgl. Installations were not constructed within the overlying River Terrace Deposits, which are considered likely to be in hydraulic conductivity with the Wittering Formation.

Structure	Aquifer Designations[1]	Groundwater Vulnerability[2]	In groundwater SPZ and abstractions within 250 m?	Groundwater Levels Recorded During Post GI Monitoring and Commentary Relating to Abstractions/SPZs
Trenchless crossing beneath public footpath and High St. at Shirrell Heath	Head Deposits = Secondary Undifferentiated aquifer. Whitecliff Sand = Secondary A aquifer. London Clay Formation = Unproductive stratum.	High	No Groundwater abstractions not identified within 250 m.	Groundwater levels in 2H4500DR, as measured in the response zone between 1.0 m and 6.5 m bgl within the Head Deposits and London Clay, were recorded at between 0.81 m bgl and 4.0 m bgl. Groundwater levels in 2H4501DR, as measured in the response zone between 3.0 m and 11.0 m bgl within the Whitecliff Sand Member, were recorded at between 8.05 m bgl and 9.7 m bgl.
Trenchless crossing beneath woodland, Winchester Road (B2177) and St. Anne's Lane, north of Shedfield	Whitecliff Sand Member = Secondary A aquifer. London Clay Formation = Unproductive stratum.	High	No Groundwater abstractions not identified within 250 m.	Groundwater levels in 3J5002SA, as measured in the response zone between 1.5 m and 7.0 m bgl within the Whitecliff Sand Member, were recorded at between 2.31 m bgl and 2.74 m bgl. Groundwater levels in 3H4517SA, as measured in the response zone between 5.0 m and 11.0 m bgl within the Whitecliff Sand Member and the London Clay Formation, were recorded at between 1.52 m bgl and 2.55 m bgl.
Trenchless crossing beneath Botley Road (B3035) and the River Hamble.	Head Deposits = Secondary Undifferentiated aquifer. Alluvium and River Terrace Deposits = Secondary A aquifers. London Clay Formation = Unproductive stratum.	Medium to Low	No Groundwater abstractions not identified within 250 m.	Groundwater levels in 2K5500SR, as measured in the response zone between 3.0 m and 7.0 m bgl within the River Terrace Deposits, were recorded at between 1.49 m bgl and 2.97 m bgl. Groundwater levels in 2K5501SR, as measured in the response zone between 1.0 m and 2.0 m bgl within the Head Deposits, were recorded at between 0.95 m bgl and ground level.

Structure	Aquifer Designations[1]	Groundwater Vulnerability[2]	In groundwater SPZ and abstractions within 250 m?	Groundwater Levels Recorded During Post GI Monitoring and Commentary Relating to Abstractions/SPZs
Trenchless crossing beneath Winchester Road (B3354)	Alluvium = Secondary A aquifer. London Clay Formation = Unproductive stratum.	Medium to Low	No Groundwater abstraction identified 80 m to the north.	Groundwater levels in 2L6008DR, as measured in the response zone between 1.0 m and 2.5 m bgl within the Alluvium, were recorded at between 1.24 m bgl and ground level. A groundwater abstraction is located approximately 80 m to the north at "Fish farm/Cress pond throughflow" and is operated by Fishers Pond Ltd. The permit for this abstraction (11/42/22.9/160) permits the abstraction of approximately 1,091 m^3 of groundwater per day. Groundwater is assumed to be abstracted from the Chalk aquifer.
Trenchless crossing beneath Bow Lake (stream)	Head Deposits = Secondary Undifferentiated aquifer. Alluvium and River Terrace Deposits = Secondary A aquifer. London Clay Formation = Unproductive stratum.	Medium to Low	No Groundwater abstractions not identified within 250 m.	Groundwater levels in 2L6010DR, as measured in the response zone between 1.0 m and 6.0 m bgl within the River Terrace Deposits and London Clay Formation, were recorded at between 0.10 m bgl and 0.94 m bgl. Groundwater levels in 2L6009DR, as measured in the response zone between 1.0 m and 4.0 m bgl within the Head Deposits and the London Clay Formation, were recorded at between 0.91 m bgl and ground level.

Structure	Aquifer Designations[1]	Groundwater Vulnerability[2]	In groundwater SPZ and abstractions within 250 m?	Groundwater Levels Recorded During Post GI Monitoring and Commentary Relating to Abstractions/SPZs
Trenchless crossing beneath agricultural land to the south-west of Batsford Lane, and un-named tributary of the River Itchen	Alluvium and River Terrace Deposits = Secondary A aquifers. Chalk = Principal aquifer.	Medium to High	Yes – Zone 1 Two abstractions within 250 m.	Groundwater levels in 2M6508SA, as measured in the response zone between 7.0 m and 20.0 m bgl within the Chalk, were recorded at between 3.88 m bgl and ground level. Groundwater levels in 2M6507SA, as measured in the response zone between 1.0 m and 4.0 m bgl within the River Terrace Deposits, were recorded at between 0.98 m bgl and 4.03 m bgl. This trenchless crossing is located within 250 m of two groundwater abstractions. - The first abstraction is located approximately 160 m to the north at “Otterbourne PS Point D” and is operated by the Applicant. The permit for this abstraction (11/42/22.7/94) permits the abstraction of approximately 71,601 m^3 of groundwater per day for public drinking water supply and “make-up or top up water”. It is assumed that water is abstracted from the Chalk aquifer. - The second abstraction is located approximately 230 m to the south-east at “Otterbourne PS Point J”. The permit for this abstraction (11/42/22.7/94) permits the abstraction of approximately 71,600 m^3 of groundwater per day for public drinking water supply and “make-up or top up water”. It is assumed that water is abstracted from the Chalk aquifer.
Trenchless crossing beneath Winters Hill (road) and agricultural land	Alluvium = Secondary A aquifer. London Clay Formation = Unproductive stratum.	Medium	No Groundwater abstractions not identified within 250 m.	Groundwater levels in 3K5606SA, response zone between 6.0 m and 10.0 m bgl within the London Clay Formation, were recorded at between 1.17 m bgl and 1.99 m bgl. The geology across the response zone is described as a locally sandy clay, and this is not considered likely to be conducive to substantial groundwater flow. A further review of the groundwater levels indicates that levels have risen from 1.99 m bgl in November 2023 to 1.44 m in March 2024. Whilst a seasonal rise in groundwater level over winter is not unexpected, there is also the potential that the borehole may be slowly filling up with surface water that has seeped into the installation.
Trenchless crossing beneath the River Meon	Alluvium and River Terrace Deposits = Secondary A aquifers.	Low to High	No Groundwater abstractions not	Groundwater levels in 3W8536SA, as measured in the response zone between 12.0 m and 17.0 m bgl within the Whitecliff Sand Member, were recorded at between 2.19 m bgl and 2.52 m bgl.

Structure	Aquifer Designations[1]	Groundwater Vulnerability[2]	In groundwater SPZ and abstractions within 250 m?	Groundwater Levels Recorded During Post GI Monitoring and Commentary Relating to Abstractions/SPZs
	Head Deposits = Secondary Undifferentiated aquifer. Wittering Formation and Whitecliff Sand = Secondary A aquifers. London Clay Formation = Unproductive stratum.		identified within 250 m.	Groundwater levels in 3W8535SA, as measured in the response zone between 7.0 m and 12.5 m bgl within the Wittering Formation and the Whitecliff Sand Member, were recorded at between 0.41 m bgl and 0.70 m bgl.
Trenchless crossing beneath agricultural land, woodland, River Itchen and Bournemouth Main Line (Waterloo to Weymouth) Main Line railway.	Alluvium and River Terrace Deposits = Secondary A aquifers. London Clay Formation = Unproductive stratum. Lambeth Group = Secondary A aquifer	Medium to Low	Yes – Zone 1 Groundwater abstractions not identified within 250 m.	At the launch shaft, groundwater levels as recorded in BH502 and BH503 in the shallow response zones in the River Terrace Deposits and Alluvium were between 0.10 m and 1.19 m bgl. In BH503, within the response zone at depth within the Lambeth Group groundwater levels were recorded between 0.10 m and 0.86 m bgl. Groundwater in the Lambeth Group appears to be confined both by clay layers within the Lambeth Group, and also by the overlying clay of the London Clay Formation. At the reception shaft, groundwater levels in 2L6011SR and BH501, response zones between 1.0 m and 5.0 m bgl in the River Terrace Deposits and London Clay Formation, were typically between 0.5 m bgl and 1.0 m bgl.
Trenchless crossing beneath Hoad's Hill (A32) south of Wickham	Superficial deposits were not encountered at this trenchless crossing. Wittering Formation and Whitecliff Sand Member = Secondary A aquifers.	Medium	No Groundwater abstractions not identified within 250 m.	Groundwater levels in 3W8530SA, response zone between 6.0 m and 10.0 m bgl within the Wittering Formation and Whitecliff Sand Member, were recorded at between 1.28 m bgl and 1.45 m bgl. Groundwater levels in 3W8529SA, response zone between 6.0 m and 11.0 m bgl within the Wittering Formation, were recorded at between 1.23 m bgl and 1.37 m bgl.

Structure	Aquifer Designations[1]	Groundwater Vulnerability[2]	In groundwater SPZ and abstractions within 250 m?	Groundwater Levels Recorded During Post GI Monitoring and Commentary Relating to Abstractions/SPZs

Notes:

1. Aquifer designations are as shown on DEFRA's Multi-Agency Geographic Information for the Countryside (MAGIC) viewer. [3]. Where the ground investigation has recorded the presence of a stratum not recorded on the BGS' 1:50,000 scale maps (typically this relates to limited thicknesses of superficial deposits), and therefore not included on the aquifer designation maps, the aquifer designation given for that stratum is an assumption based on that stratum's designation in other areas.
2. Groundwater vulnerability designations are as shown on DEFRA's MAGIC viewer. [3]. Where the ground investigation has recorded the presence of a stratum not recorded on the BGS' 1:50,000 scale maps (typically this relates to limited thicknesses of superficial deposits), and therefore not included on the groundwater vulnerability maps, the vulnerability given for that stratum is an assumption based on the geological setting and that stratum's designation (where present) in other nearby areas.

3.5 Geo-environmental conditions

3.5.1 A summary of the geo-environmental conditions encountered at each of the AGP or trenchless crossing locations is provided in Table 3-4. Further detail is provided in the GIRs for each route section contained within ES Appendix 11.2 Geotechnical and Geo-environmental reports, Volume II (Document reference 6.2, DCO Volume 6), which should be read in conjunction with this report.

3.5.2 Table 3-4 only includes discussion of soils leachability results where on-Site PSCs have been identified within the area of the proposed shafts, noting that PSCs located in the land above the trenchless crossing are not considered to be on-Site.

3.5.3 Geo-environmental laboratory analysis of soils recovered from exploratory holes in the area of AGP and shafts indicate that concentrations of Potential Contaminants of Concern (PCOC) are all below the adopted threshold criteria for protection of human health in a commercial / industrial end-use. The adopted threshold criteria for the protection of human health in a commercial / industrial end use are (in order of use) the Suitable 4 Use Levels (Nathanial, P., et. al., 2015 The LQM/CIEH S4ULs for Human Health Risk Assessment, Land Quality Press, Nottingham) [4], the Category 4 Screening Levels (CL:AIRE, 2014 to 2024, C4SL Phase 1 and 2 Reports), the CL:AIRE/EIC/AGS Generic Assessment Criteria (CL:AIRE, 2010, Soil Generic Assessment Criteria for Human Health Risk Assessment) [5] and the Environment Agency's Soil Guideline Values (EA, 2009, Soil Guideline Values for contaminants in soil. Science Reports SC050021/various) [6].

3.5.4 Chrysotile asbestos (quantification of 0.15%) was encountered within only one sample of Made Ground (2K5500SR at 0.5 m bgl) at the reception shaft for the trenchless crossing beneath Botley Road (B3035) and the River Hamble.

Table 3-4 Summary of geo-environmental conditions (groundwater)

Structure	Geo-environmental Conditions (Groundwater)[1]
BPT-K	Groundwater samples recovered from the BPT-K boreholes did not record exceedances of the Annual Average Environmental Quality Standards (EQS-AA). Exceedances of the Drinking Water Standards (DWS) were limited to ammonium only.
IPS-G	Groundwater samples were not recovered from the IPS-G boreholes.
IPS-F	Groundwater samples were not recovered from the IPS-F boreholes as water was not encountered.
BPT/IPS-E	Groundwater samples were not recovered from the BPT/IPS boreholes.
Trenchless crossing beneath the River Wallington	Groundwater samples were recovered from 2F3502SA and 2F3503SA. Exceedances of the EQS-AA were limited to $EQS_{bioavailable}$ (i.e., a conservative assessment) exceedances of zinc only. Exceedances of the DWS were limited to a marginal exceedance of nitrite only.
Trenchless crossing beneath Winchester Road (A334), south of	The results of analysis undertaken on three groundwater samples recovered from 3G4102SA and 3H4600SA were generally below the EQS-AA with the exception of exceedances of the $EQS_{bioavailable}$ for copper, lead, nickel and zinc as well as an exceedance of the EQS for cadmium (0.38 µg/l vs. EQS of 0.08 µg/l) and one exceedance of fluoranthene (0.03 µg/l vs.

Structure	Geo-environmental Conditions (Groundwater)[1]
junction with Titchfield Lane and Blind Lane	EQS of 0.0063 µg/l). A trace concentration of petroleum hydrocarbons (C6 – C40) of 190 µg/l was recorded. Exceedances of the DWS were limited to lead and (the above described trace concentration of) petroleum hydrocarbons.
Trenchless crossing beneath public footpath and High St. at Shirrell Heath	Four groundwater samples were recovered from the Whitecliff Sand Member in boreholes 2H4500DR and 2H4501DR. Exceedances of the EQS-AA were limited to $EQS_{bioavailable}$ exceedances of nickel and zinc and one marginal exceedance of the EQS for cadmium (0.1 µg/l vs. EQS of 0.08 µg/l). Trace concentrations of petroleum hydrocarbons (C6 – C40) of up to 160 µg/l were recorded. Exceedances of the DWS were limited to the above described trace concentration of petroleum hydrocarbons only.
Trenchless crossing beneath woodland, Winchester Road (B2177) and St. Anne's Lane, north of Shedfield	The results of analysis undertaken on three groundwater samples recovered from 3J5002SA were below the EQS-AA with the exception of marginal exceedances of the $EQS_{bioavailable}$ for copper and zinc, one exceedance of cadmium (0.1 µg/l vs. EQS of 0.08 µg/l) and one exceedance of mercury (0.17 µg/l vs. EQS of 0.07 µg/l). Trace concentrations of petroleum hydrocarbons (C6 – C40) of up to 380 µg/l were recorded. Exceedances of the DWS were limited to the above described trace concentrations of petroleum hydrocarbons only.
Trenchless crossing beneath Botley Road (B3035) and the River Hamble.	Leachable soils concentrations within the Made Ground were below the EQS-AA. Groundwater samples from 2K5500SR and 2K5501SR recorded exceedances of the EQS-AA for PAHs (fluoranthene and benzo(g,h,i)perylene), mercury and phenols and the $EQS_{bioavailable}$ for nickel and zinc. Leachable petroleum hydrocarbons (C6 – C40) concentrations in the River Terrace Deposits and London Clay Formation were below the laboratory method detection limit. Petroleum hydrocarbons (C6 – C40) concentrations in the three groundwater samples recovered from the Head Deposits were highly variable, between below the laboratory method detection limit, up to 42,200 µg/l. These elevated concentrations are unexpected, given this area's long-standing history of agricultural use and the absence of any visual or olfactory evidence of contamination within these exploratory holes. Exceedances of the DWS included occasional heavy metals (arsenic, boron and nickel), ammonium, chloride, sodium and sulphate.
Trenchless crossing beneath Winchester Road (B3354)	Groundwater samples from 2L6007DR and 2L6008DR recorded exceedances of the EQS-AA for total ammonia as nitrogen (TAN) as well as marginal exceedances of the $EQS_{bioavailable}$ for copper, lead, nickel and zinc. Trace concentrations of petroleum hydrocarbons (C6 – C40) of up to 170 µg/l were recorded. Exceedances of the DWS were limited to ammonium and sulphate only.
Trenchless crossing beneath Bow Lake (stream)	Groundwater samples from 2L6010DR and 2L6009DR recorded exceedances of the EQS-AA for TAN as well as marginal exceedances of the $EQS_{bioavailable}$ for copper and lead. Petroleum hydrocarbons (C6 – C40) concentrations in the River Terrace Deposits were typically below the laboratory method detection limit with a maximum concentration of 110 µg/l. Petroleum hydrocarbons (C6 – C40) concentrations in the five groundwater samples recovered from the London Clay Formation were variable, between below the laboratory method detection limit, up to 1,840 µg/l. Exceedances of the DWS were limited to boron, ammonium and sulphate only.
Trenchless crossing beneath agricultural land to the south-west of Batsford Lane, and un-named tributary of the River Itchen	Groundwater samples from 2M6507SA and 2M6508SA recorded exceedances of the EQS-AA for hexavalent chromium and PAHs (anthracene, fluoranthene, benzo(g,h,i)perylene – noting that these were trace quantities only, and only slightly in excess of the laboratory's method detection limit), and the $EQS_{bioavailable}$ for zinc. Petroleum hydrocarbons (C6 – C40) concentrations were typically below the laboratory method detection limit with only two samples (one from the Lambeth Group and one from the Chalk) recording trace concentrations up to 130 µg/l. Exceedances of the DWS were not recorded.
Trenchless crossing beneath Winters Hill (road) and agricultural land	Groundwater samples from 3K5606SA only exceeded the EQS-AA for fluoranthene (0.02 µg/l and 0.25 µg/l vs EQS of 0.01 µg/l). Petroleum hydrocarbons (C6 – C40) concentrations in the three groundwater samples recovered from the London Clay Formation were variable, between below the laboratory method detection limit, up to 7,210 µg/l. Exceedances of the DWS were limited to ammonium, sulphate and petroleum hydrocarbons only.

Structure	Geo-environmental Conditions (Groundwater)[1]
Trenchless crossing beneath the River Meon	Groundwater samples from the Head Deposits and Wittering Formation in boreholes 3W8535SA and 3W8536SA recorded concentrations generally below the EQS-AA for the determinands analysed with the exception of slightly elevated concentrations of manganese and a slightly elevated concentration of iron. Petroleum hydrocarbon concentrations in excess of the laboratory method detection limit were not recorded. Exceedances of the DWS were limited to iron, manganese and petroleum hydrocarbons only.
Trenchless crossing beneath agricultural land, woodland, River Itchen and Bournemouth (Waterloo to Weymouth) Main Line railway.	Groundwater samples from boreholes 2L6011SR and BH501 recorded concentrations generally below the EQS-AA for most determinands analysed with the exception of slightly elevated concentrations of cadmium, copper, lead, nickel, zinc and manganese and ammonia. Petroleum hydrocarbon concentrations in excess of the laboratory method detection limit were not recorded. Exceedances of the DWS included occasional heavy metals (arsenic, boron and nickel), ammonium, chloride, sodium and sulphate and a marginally elevated concentration of indeno(1,2,3-c,d)pyrene.
Trenchless crossing beneath Hoad's Hill (A32) south of Wickham	Groundwater samples recovered from the Wittering Formation in boreholes 3W8529SA and 3W8530SA recorded only exceedances of the EQS-AA for fluoranthene and anthracene (0.18 µg/l and 0.14 µg/l vs EQS of 0.0063 µg/l and 0.1 µg/l respectively) and exceedances of the $EQS_{bioavailable}$ for nickel and zinc. Of the six samples, concentrations of petroleum hydrocarbons (C6 – C40) were below the laboratory method detection limit in five samples, with a trace concentration of 350 µg/l recorded in one sample. Exceedances of the DWS were limited to nickel and petroleum hydrocarbons only.
1. Whilst exceedances of the DWS are included within this table, the assessment of potential hazards to human health within the groundwater is presented within the accompanying GIRs which should be read alongside this assessment (ES Appendix 11.2 Geotechnical and Geo-environmental reports, Volume II (Document reference 6.2, DCO Volume 6)).	

Potential hazards to human health

3.5.5 Potential hazards to human health within the on-Site soils have not been identified with the exception of a single positive detection of asbestos in the Made Ground at the launch shaft for the trenchless crossing beneath Botley Road (B3035) and the River Hamble. Mitigation measures would be required to manage the potential risk from asbestos at this location.

3.5.6 Potential sources of ground gases within 50 m of the AGP sites or the trenchless crossing launch and reception shafts are limited to:

- IPS-F:
  - PSC 5 "infilled land". A review of this PSC indicates that it comprises an historical chalk pit. The EA record the pit as a landfill named "Albany Farm", with a licence issued to accept inert waste in May 1977 – no further landfill information is available. Historical aerial photography shows the pit to have remained as woodland until at least 1946. Following completion of landfilling, if any occurred (noting that the old pit remains visible on contemporary LiDAR imagery) the pit was returned to woodland.

- Trenchless crossing beneath Winchester Road (A334), south of junction with Titchfield Lane and Blind Lane:

- PSC 45 (Old Gravel Pit) is located approximately 35 m south of the reception shaft for this trenchless crossing, corresponding with an area of woodland, labelled “Gravel pit Copse”.

- Trenchless crossing beneath woodland, Winchester Road (B2177) and St. Anne’s Lane, north of Shedfield:
  - PSCs 102 and 103 (former sand pits) are located within 50 m of the launch shaft. Modern-day LiDAR imagery shows the former pits have not been infilled, noting that localised, small-scale, non-commercial filling, e.g. with residential waste may still have taken place.

3.5.7 Bugle Farm Landfill, located within the land above the trenchless crossing beneath agricultural land, woodland, River Itchen and Bournemouth (Waterloo to Weymouth) Main Line railway, has not been included as a PSC on the basis that the landfilled areas are indicated to be approximately 410 m from the launch shaft, and approximately 300 m from the reception shaft. The crossing between the shafts would be constructed within the natural Lambeth Group at between approximately 14 m and 17 m bgl, i.e., at a significant depth beneath the landfill (and other areas of smaller potentially infilled land).

3.5.8 Further details of these PSCs are provided in the following text.

PSC 5: Former (potentially infilled) Chalk Pit Adjacent to IPS-F

3.5.9 Ground gas monitoring undertaken within the footprint of IPS-F recorded negligible ground gas flow rates, and did not record concentrations of methane in excess of the instrument limit of detection (0.1 %v/v for bulk gases and 0.1 l/hr for flow). Concentrations of carbon dioxide up to 4.7 % v/v were recorded – this is unsurprising as the response zones for these boreholes were constructed within chalk (a carbonate rock), which readily and naturally dissolves and produces carbon dioxide. In absence of significant ground gas flow (more than ±3 l/hr), or methane concentrations in excess of 0.1 %v/v it is considered that ground gases are not migrating beneath IPS-F from the adjacent former infilled chalk pit and a hazard to human health is not present.

3.5.10 It should be further noted that, as per CL:AIRE Research Bulletin 17 [5] “Examples where ground gas is present and does not generally pose a risk include soils or rocks with low gas production, such as Carbonate soils (e.g. chalk or limestone)”, “where there is no credible source of gas below a site or a pathway for gas to migrate from external sources gas monitoring is not considered to be necessary … sites where only Chalk is present that will give rise to small volumes of carbon dioxide would also fall into this classification” and “carbon dioxide in natural soils such as Glacial Deposits and Chalk can often be recorded at up to 15% in monitoring wells, but that this does not pose a risk to development”.

PSC 45: Old Gravel Pit Approximately 35 m south of Reception Shaft for Trenchless Crossing Beneath Winchester Road (A334), south of junction with Titchfield Lane and Blind Lane

3.5.11 Ground gas monitoring was undertaken within borehole 3H4600SA (reception shaft) on six occasions between 29th July 2024 and 30th September 2024. During all rounds of monitoring the groundwater level within the borehole was above the top of the response zone, i.e., the response zone was fully flooded. BS 8485:2015 +A1:2019 states "*the response zone of the gas monitoring standpipe should be wholly or partly above groundwater level to provide valid data"* and "*if water is present above the top of the slotted section of the gas standpipe, any peak flow recorded is likely to be due to a build-up of pressure caused by rising water trapping the gas within the solid section of pipe; in this case, the initial peak flow is not representative of the rate of gas generation within the ground*". Similarly, a negative peak flow can be caused by water levels falling within a sealed standpipe. On this basis, the results of the ground gas monitoring undertaken in 3H4600SA are not considered to be representative of the gas regime.

3.5.12 A review of historical mapping shows that this parcel of land has been woodland since at least the 1860s, and it is therefore considered that either:

a. gravel extraction and infilling of the pit/s occurred at least 165 years ago, or

b. extraction was very small scale within the woodland.

3.5.13 In both cases, it is considered that the potential for limited infilling of the historical gravel pit (if any occurred at all) to still be generating landfill gases is negligible and this PSC is therefore not considered to present a credible ground gas hazard to human health.

PSCs 102 and 103: Old Sand Pits Approximately 15 m east of Launch Shaft for Trenchless Crossing Beneath Woodland, Winchester Road (B2177) and St. Anne's Lane, north of Shedfield

3.5.14 Ground gas monitoring was undertaken within borehole 3J5002SA (launch shaft) on six occasions between 2nd May 2024 and 17th July 2024 at atmospheric pressures between 1000 mb and 1016 mb. The groundwater level was above the base of the response zone during each visit however the response zone was not wholly flooded during the visits. The monitoring undertaken recorded a gas mix typical of atmospheric air, with methane concentrations less than 0.1 % v/v, carbon dioxide between less than 0.1 %v/v and 0.3 %v/v and oxygen levels between 18.7 %v/v and 20.8 %v/v. Gas flow in excess of the instrument limit of detection (0.1 l/hr) was not recorded. On this basis it is considered that ground gases are not migrating to the area of the launch shaft, and a hazard to human health is not present.

Potential hazards to controlled waters (including aquatic ecology)

3.5.15 The concentrations of PCOC within the various groundwater bodies beneath the AGP and trenchless crossings were typically below the EQS.

3.5.16 Isolated and sporadic marginally elevated concentrations of PAHs, TPHs, total ammoniacal nitrogen, cadmium, mercury have been recorded.

3.5.17 Credible on-Site potential sources of these PCOC have not been identified, given the long-standing history of agricultural use of the land at the trenchless crossing shaft locations and AGP locations. On this basis, the identified elevated concentrations are considered to relate either to:

- Identified credible off-Site sources, such as the Bugle Farm Landfill, which would be the responsibilities of the respective land-owners to manage. Or,
- As yet unidentified off-Site sources, noting that none of the concentrations recorded appear to be indicative of substantial contamination, and therefore the off-Site source may be located at distance within the wider area. Or,
- Naturally derived concentrations within the groundwater.

Metals bioavailability

3.5.18 Bioavailable EQS have been developed for UK specific pollutants copper, zinc and manganese and the EU priority substances lead and nickel.

3.5.19 The bioavailability of a metal depends on a number of physico-chemical factors, which govern both metal behaviour and the interactions of the toxic forms of the metals with a biological receptor.

3.5.20 The $EQS_{bioavailable}$ corresponds to the bioavailable fraction (BioF) of dissolved metal in a sample, as determined by the physico-chemical characteristics of the water and can be calculated using a biotic ligand model (BLM) or other calculation method. To assess compliance, the bioavailable fraction of dissolved metal can be compared to the $EQS_{bioavailable}$. However, bioavailable metal is not the same metric as dissolved metal as only a fraction of the dissolved metal would usually be bioavailable.

3.5.21 It is very difficult to measure the bioavailable concentration of a metal directly. BLMs are a predictive tool that can take account of water quality parameters such as pH, and calcium to determine the amount of bioavailable metal present. However, the complexity of the models, the runtime per sample, input data requirements and level of operator skill needed to interpret the model outputs mean that few regulatory organisations have adopted the full BLMs. The UK has developed simplified Metal Bioavailability Assessment Tools (M-BAT) for copper, zinc, lead, nickel, and manganese, which can be used to calculate Predicted No-Effect Concentrations (PNEC) for specific watercourses (the watercourses being the receptor for elevated metals concentrations in the groundwater), using the results of analysis undertaken on water samples recovered from the watercourse.

3.5.22 Surface water sampling was not carried out as part of the recent ground investigations, and therefore the concentrations of copper, lead, nickel, manganese and zinc have been directly compared against the $EQS_{bioavailable}$ without any adjustment for bioavailability. This results in an over-estimate of the risk.

3.5.23 For example, surface water sampling data from the EA's sampling point on the River Wallington at Prior's Hold Farm[1] [7] recorded the following dissolved concentrations, and the EA calculated bioavailable concentrations during sampling between 2006 and 2022.

Table 3-5 Summary of dissolved and bioavailable metals concentrations (as calculated by the EA, using their BLM) at EA sampling point SO-G0006098 on river Wallington

Determinand	$EQS_{bioavailable}$	Dissolved Concentration (µg/l)	*Bioavailable Concentration
Copper	1.0	less than 0.1 to 5.0	0.05 to 0.29
Lead	1.2	less than 0.1 to 1.1	0.01 to 0.23
Manganese	123	14.0 to 93.0	11.0 to 29.0
Nickel	4.0	less than 0.5 to 5.3	0.74 to 1.21
Zinc	10.9	less than 0.5 to 15.0	0.49 to 3.2
*as calculated by the EA, using their BLM) at EA sampling point SO-G0006098 on river Wallington			

3.5.24 Table 3-5 shows the dissolved concentrations of metals are typically substantially higher than the BLM bioavailable concentrations. It is also notable that dissolved concentrations of these metals in the River Wallington have often exceeded the $EQS_{bioavailable}$ in the EA's own sampling.

3.5.25 Given the above, is considered likely that were further analysis to be undertaken to calculate PNEC for each of the rivers beneath which a trenchless crossing passes, the dissolved concentrations would be below the PNEC.

3.6 Ecologically sensitive sites

3.6.1 A review of the Groundsure Reports for the Project indicates that the following ecologically sensitive sites including nationally and internationally designated sites such as Sites of Special Scientific Interest (SSSI), Special Protection Areas (SPA), Special Areas of Conservation (SAC), Local and National Nature Reserves, wetlands of international importance as designated by the Ramsar convention and ancient woodlands are located within 250 m of the Project:

- Portsdown Site of Special Scientific Interest (SSSI), located approximately 180 m to the south-west of BPT/IPS-E.
- Kimber's Copse designated ancient woodland, located approximately 190 m to the east of BPT-K.
- An unnamed area of designated ancient woodland located approximately 210 m to the north-west of IPS-G.
- An unnamed area of designated ancient woodland located approximately 90 m to the south-west of the trenchless crossing beneath the public footpath and High St. at Shirrell Heath.
- An unnamed area of designated ancient woodland located approximately 60 m to the south-west of the trenchless crossing beneath Winchester Road (B3354).
- River Itchen SSSI and River Itchen Special Area of Conservation (SAC) located within the land overlying the trenchless crossing beneath agricultural land, woodland, River Itchen and Bournemouth Main Line (Waterloo to Weymouth) Main Line railway.

4 Conceptual site model

4.1.1 The conceptual site model for the AGP and trenchless crossings is summarised in Table 4-1.

Table 4-1 Summary of conceptual site models for AGP and trenchless crossings

Structure	Potential Sources of Contamination[1]	Potential Pathways	Potential Receptors	Credible Contaminant Linkage Present?
BPT/IPS-E	None on or within 50 m of AGP Site.	Human Health • Ingestion and inhalation of soil/dust/particles indoors e.g. in site cabins or in completed structures at BPT/IPS. • Ingestion and inhalation of soil/dust/particles outdoors. • Inhalation of vapours indoors, e.g. in site cabins or in completed structures at BPT/IPS. • Inhalation of vapours outdoors. • Dermal absorption via contact with soil. Groundwater • Groundwater within permeable natural strata as a pathway allowing migration of mobile contamination leached from contaminated soils. • Groundwater migrating via anthropogenic routes e.g. boreholes, landfill waste mass etc. Surface Water • Recharge of surface water in watercourses via contaminated groundwater within a shallow unconfined aquifer (where present) • Deposition of wind-blown dust	Human health (construction workers, users of neighbouring land, end-users operating the BPT/IPS site). Groundwater within underlying Chalk (no overlying deposits). Portsdown Site of Special Scientific Interest (SSSI) approximately 180 m to the south-west.	No – As no credible PSCs have been identified.
BPT-K	None on or within 50 m of AGP Site.		Human health (construction workers, users of neighbouring land, end-users operating the BPT Site). Groundwater within Chalk at depth (beneath more than 25m of London Clay Formation). Kimber's Copse designated ancient woodland approximately 190 m to the east.	No – As no credible PSCs have been identified.
IPS-F	None within AGP Site. Immediately to the south-west – potential limited infilling of former chalk pit with 'inert' waste. Noted that ground gas monitoring within the Site did not record gases indicative of landfill gas migration.		Human health (construction workers, users of neighbouring land, end-users operating the IPS Site). Groundwater within underlying Chalk (beneath approximately 6.0 m of Head Deposits).	No. Whilst an off-Site PSC has been identified, the ground conditions encountered did not indicate that migration onto Site of contamination from this PSC is occurring.

Structure	Potential Sources of Contamination[1]	Potential Pathways	Potential Receptors	Credible Contaminant Linkage Present?
		• Overland flow or surface run-off Buildings • Direct contact e.g. sulphate attack on concrete, hydrocarbon corrosion / permeation of plastic pipes. • Migration of gases/vapours through permeable natural strata, fissures or fractures etc. • Migration of gases / vapours through permeable backfill materials, buried service corridors, cracks in floor. Ecologically Sensitive Sites (SSSI, SPA, SAC, Local and National Nature Reserves, wetlands of international importance, designated ancient woodlands etc.) • Runoff or discharges to surface water via existing drainage network, e.g. historical land drains, highway drainage and uptake by flora and fauna either by roots, ingestion or inhalation. • Deposition of wind-blown dust and uptake by flora and fauna either by roots, ingestion or inhalation. • Recharge of surface water via contaminated groundwater and		It is considered unlikely that dewatering would be required to facilitate construction of the IPS, and therefore mobilisation of off-Site contamination into the Site is not anticipated.
IPS-G	None on or within 50 m of AGP Site		Human health (construction workers, users of neighbouring land, end-users operating the IPS Site). Groundwater within underlying River Terrace Deposits and Earnley Sand Formation (no overlying deposits). Designated ancient woodland approximately 210 m to the north-west.	No – As no credible PSCs have been identified.
Trenchless crossing beneath the River Wallington	None at or within 50 m of launch and reception shafts.		Human health (construction workers, users of neighbouring land). River Wallington. Groundwater within Chalk at depth (beneath limited thickness of Alluvium and Head Deposits).	No – As no credible PSCs have been identified.
Trenchless crossing beneath Winchester Road (A334), south of junction with Titchfield Lane and Blind Lane	No credible PSCs at or within 50 m of launch and reception shafts (see note 2).		Human health (construction workers, users of neighbouring land). Groundwater within underlying River Terrace Deposits (no overlying deposits)	No – As no credible PSCs have been identified.

Structure	Potential Sources of Contamination[1]	Potential Pathways	Potential Receptors	Credible Contaminant Linkage Present?
		uptake by flora and fauna either by roots, ingestion or inhalation.		
Trenchless crossing beneath public footpath and High St. at Shirrell Heath	None at or within 50 m of launch and reception shafts.		Human health (construction workers, users of neighbouring land). Groundwater within underlying Whitecliff Sand Member (beneath approximately 5.5 m of the London Clay Formation). Designated ancient woodland approximately 90 m to the south-west.	No – As no credible PSCs have been identified.
Trenchless crossing beneath woodland, Winchester Road (B2177) and St. Anne's Lane, north of Shedfield	No credible PSCs at location of launch and reception shafts. PSCs 102 and 103 (former sand pits) present approximately 15 m east of the launch shaft. The land above the trenchless crossing appears to have been used in the 1800s for mineral (sand) extraction, with the historical maps recording sand pits. The pits subsequently became disused and slowly became overgrown with woodland. Modern day LIDAR imagery indicates that the pits were not infilled and extend to a wider extent than shown on the historical mapping.		Human health (construction workers, users of neighbouring land). Groundwater within underlying Whitecliff Sand Member (no overlying deposits).	None identified. 6No. rounds of ground gas monitoring undertaken at the launch shaft borehole recorded a gas mix typical of atmospheric air, with methane concentrations less than 0.1 % v/v, carbon dioxide between less than 0.1 %v/v and 0.3 %v/v and oxygen levels between 18.7 %v/v and 20.8 %v/v. Gas flow in excess of the instrument limit of detection (0.1 l/hr) was not recorded. On this basis it is considered that ground gases are not migrating to the area of the launch shaft, and a hazard to human health is not present.

Structure	Potential Sources of Contamination[1]	Potential Pathways	Potential Receptors	Credible Contaminant Linkage Present?
Trenchless crossing beneath Botley Road (B3035) and the River Hamble.	None at or within 50m of launch and reception shafts. Chrysotile asbestos was encountered at 0.5 m bgl at the reception shaft.		Human health (construction workers, users of neighbouring land). River Hamble Groundwater within underlying River Terrace Deposits (beneath limited thickness of Made Ground [where present]).	Yes – Linkage is present during construction phase when construction workers would disturb asbestos contaminated soils. Potential for construction workers and neighbours to inhale dust/particles/fibres.
Trenchless crossing beneath Winchester Road (B3354)	None at or within 50 m of launch and reception shafts.		Human health (construction workers, users of neighbouring land). Groundwater within underlying Alluvium and Head Deposits (no overlying deposits) Designated ancient woodland approximately 60 m to the south-west.	No – As no credible PSCs have been identified.
Trenchless crossing beneath Bow Lake (stream)	None at or within 50 m of launch and reception shafts.		Human health (construction workers, users of neighbouring land). Bow Lake (stream). Groundwater within underlying Alluvium (no overlying deposits). Designated ancient woodland approximately 90 m to the south.	No – As no credible PSCs have been identified.

Structure	Potential Sources of Contamination[1]	Potential Pathways	Potential Receptors	Credible Contaminant Linkage Present?
Trenchless crossing beneath agricultural land to the south-west of Batsford Lane, and un-named tributary of the River Itchen	None at or within 5 0m of launch and reception shafts.		Human health (construction workers, users of neighbouring land). Tributary of the River Itchen. Groundwater within underlying River Terrace Deposits (beneath approximately 2.5 m of Alluvium).	No – As no credible PSCs have been identified.
Trenchless crossing beneath Winters Hill (road) and agricultural land	None at or within 50 m of launch and reception shafts.		Human health (construction workers, users of neighbouring land). Groundwater within Alluvium (no overlying deposits).	No – As no credible PSCs have been identified.
Trenchless crossing beneath the River Meon	None at location of launch and reception shafts. Immediately north - Wickham WTW.		Human health (construction workers, users of neighbouring land). River Meon. Groundwater within underlying River Terrace Deposits, Head Deposits, Wittering Formation and Whitecliff Sand Member.	Yes – potential for dewatering to be required at shafts, with accompanying potential for mobilisation of mobile contamination originating within the WTW, via drawdown of the groundwater.
Trenchless crossing beneath agricultural land, woodland, River Itchen and Bournemouth Main Line (Waterloo to	None at location of launch and reception shafts. A railway crosses the land above the trenchless crossing. Historical landfill (Bugle Farm, reference EA HLD20430)		Human health (construction workers, users of neighbouring land). River Itchen. Groundwater within underlying River Terrace Deposits, Alluvium	Yes – potential for dewatering to be required at shafts, with accompanying potential for mobilisation of mobile contamination originating within the landfill, via drawdown of the groundwater.

Structure	Potential Sources of Contamination[1]	Potential Pathways	Potential Receptors	Credible Contaminant Linkage Present?
Weymouth) Main Line railway.	present within the land above the eastern half of the trenchless crossing. Operational dates and waste types received are unknown. Landfill is now heavily forested.		and Chalk at depth beneath London Clay Formation and Lambeth Group. Groundwater abstractions for potable supply at Otterbourne PS. River Itchen SSSI and River Itchen Special Area of Conservation (SAC).	
Trenchless crossing beneath Hoad's Hill (A32) south of Wickham	None on-Site or within 50 m off-Site.		Human health (construction workers, users of neighbouring land). Groundwater within underlying Wittering Formation and Whitecliff Sand Member (no overlying deposits)	No – As no credible PSCs have been identified.

Notes:

1. PSCs located above the proposed trenchless crossings and further than 50 m from either the launch or reception shafts are not included in the table above. The proposed trenchless crossings would not interact with these PSCs, i.e., contamination present would not be mobilised by the construction works.
2. PSC 45 (Old Gravel Pit) is located approximately 25 m to the south. A review of historical mapping shows that the old gravel pit has been woodland since at least the 1860s, and it is therefore considered that either a) any gravel extraction and infilling of the pit/s occurred at least 170 years ago, or b) that any extraction was very small scale within the woodland. In both cases, it is considered that the potential for any limited infilling of the historical gravel pit (if any occurred at all) to still be generating landfill gases is negligible. No further PSCs have been identified within 50 m of the trenchless crossing.

5 Outline foundation works risk assessment

5.1 Purpose

5.1.1 The purpose of this Outline FWRA is to ensure that the construction of the AGP Sites and Trenchless Crossings do not have an adverse impact on the environment by creating new pathways for the migration of contamination, considering the protection of both water resources and human health. The need for an Outline FWRA is set out in ES Chapter 11 Land quality and ground conditions, Volume I (Document reference 6.1, DCO Volume 6) as a risk reduction measure.

5.2 Relevant project elements

AGP Sites

5.2.1 The proposed AGP comprise buildings, which may require piled foundations, and tanks that would be cast in-situ within the ground (with variable levels of cut into the hillside required). A piled retaining wall will be required at BPT/IPS E.

Selection of piling methodology

5.2.2 Detailed design of the proposed foundations has not been undertaken at this time. Accordingly, the following assumptions have been made regarding the likely piling methodologies to be utilised.

BPT/IPS-E piled retaining wall

5.2.3 It has been assumed that bored, cast in-situ piles (replacement) would be used for the piled retaining wall at BPT/IPS E.

5.2.4 It is assumed that a secant pile wall would be adopted and that Continuous Flight Auger (CFA) piles would be utilised, and that these piles would extend approximately 12 m below the reduced ground level (i.e., approximately 1.5 x the retained height). The reduced ground level is anticipated to be approximately 8 m below the existing ground level.

5.2.5 The use of cast in-situ CFA piles allows ‘intimate contact’ between the pile and the surrounding soil, minimising the risk of creating pathways for contamination (were it to be present) to migrate into the underlying strata.

As described in [1]:

> *“this method uses a hollow stemmed CFA to excavate the pile bore and fill the bore with cement or grout. The auger is introduced into the ground by rotary methods at a speed and pitch that minimises soil displacement. The soil retained on the auger flights supports the sides of the pile shaft during drilling.*
>
> *On achieving the required depth, cementitious grout or concrete is introduced under pressure via the hollow stem into the base of the borehole. The auger is*

withdrawn at a controlled rate whilst maintaining the concrete or grout at a positive pressure. Spoil is withdrawn from the hole on the auger flights and the concrete fills the hole under the auger head, the positive pressure forcing it into contact with the surrounding soil.

Once the auger is fully withdrawn, the positive hydrostatic pressure from the concrete supports the hole during the time taken for the concrete to cure. Once the complete auger string has been removed from the hole, the spoil arisings are cleared away, a reinforcing cage can, if required, be introduced into the concrete in the pile, assisted by vibration."

[1] also states "*the concrete that is placed in the pile forms a close contact with the surrounding soil. The irregular interface between the pile and the soil improves load transfer and the difference in skin friction between the two types is small. It will also minimise the risk of contaminant or ground gas migration down or up the pile/soil interface*".

5.2.6 The contractor will use the framework provided by this Outline FWRA to develop their own FWRA following the development of the piling design for BPT/IPS-E piled retaining wall at the detailed design stage.

BPT and IPS structures

5.2.7 It is assumed that pre-cast driven piles would be utilised to support the structures within the BPT and IPS Sites, where piled foundations are found to be required. These are assumed to extend to a maximum of 14 m below either the final or reduced ground level.

5.2.8 This assessment should be updated following the development of the piling design for the BPT and IPS Sites.

Trenchless crossings

5.2.9 Each of the trenchless crossings comprises a launch shaft and a reception shaft, between which a 1,200 mm diameter trenchless crossing 'tunnel' would be installed by pipe jacking.

5.2.10 At the time of writing, the launch and reception shaft construction methodology is unknown. It is similarly unknown if the shafts are to be temporary (i.e., retained by sheet piles, excavated, then backfilled and the piles withdrawn) or whether they would be permanent and remain in place following the completion of the pipe-jacking (i.e., retained by a cast-in situ diaphragm wall, or a retaining wall formed from secant or contiguous piles).

5.2.11 The contractor will use the framework provided by this Outline FWRA to develop their own detailed FWRA at the detailed design stage.

5.2.12 This assessment should be updated following the development of the shaft design.

5.3 Hazard identification: potential adverse environmental impacts and risk assessment

5.3.1 Discussion of the potential adverse environmental impacts that could occur as a result of construction of the Project and a Generic Quantitative Risk Assessment of the pipeline route are provided within the GIRs for each of the route sections contained within ES Appendix 11.2 Geotechnical and Geo-environmental reports, Volume II (Document reference 6.2, DCO Volume 6).

Initial risk screening

5.3.2 [1] presents a risk assessment matrix (reproduced as Table 5-1) for groundwater that can be used at the outset of a project to provide a high-level initial screening of risk to groundwater. The outcome from this matrix can then be used to guide the assessment and design processes. It is recognised that the Project has progressed well beyond the initial stages where this matrix would be used, however it has been completed to provide a 'baseline' assessment of risk.

Table 5-1 Outline foundation works risk assessment matrix for groundwater – Initial risk ranking matrix

Factor	Risk Ranking			
	Negligible Risk	Low Risk	Moderate Risk	High Risk
Aquifer designation	Unproductive strata	Groundwater resource	Secondary	Principal
Receptor	No credible receptor	Groundwater outside SPZs (that contamination could credibly reach)	SPZ 3/total catchment zone Surface watercourse	SPZ 1 and 2 Site of Special Scientific Interest (SSSI)
Flow regime		Matrix intergranular flow		Fracture flow
Permeability	Very low permeability	Low permeability	High permeability	Very high permeability
Contamination	No significant contamination present	Low leachability (compared to suitable standards, EQS or Drinking Water Standards, DWS)	Dissolved phase in perched water	Dissolved phase in perched water Non-aqueous phase liquids (NAPL)
Piling/ground improvement depth	Pile to more than 10 m above bottom of aquiclude	Pile to between 5 m and 10 m from bottom of aquiclude	Pile to less than 5 m above bottom of aquiclude	Pile extends into aquifer

5.3.3 Table 5-2 presents the assessed risk ranking at each of the AGP Sites and trenchless crossings.

Table 5-2 Outline Foundation works risk assessment matrix for groundwater – initial screening

Factor	AGP/Trenchless Crossing Location							
	BPT/IPS-E	BPT-K	IPS-F	IPS-G	Trenchless crossing beneath the River Wallington	Trenchless crossing beneath Winchester Road (A334), south of junction with Titchfield Lane and Blind Lane	Trenchless crossing beneath public footpath and High St. at Shirrell Heath	Trenchless crossing beneath woodland, Winchester Road (B2177) and St. Anne's Lane, north of Shedfield
Aquifer designation	High	Moderate	High	Moderate	High	Moderate	Moderate	Moderate
Receptor	High	Negligible	High	Low	High	Low	Low	Low
Flow regime	High	Moderate	High	Moderate	High	Moderate	Moderate	Moderate
Permeability	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate
Contamination	Negligible	Negligible	Negligible	Negligible	Negligible	Negligible	Negligible	Negligible
Piling/ground improvement depth	High	Low	High	High	High	High	High	High
Overall assessed risk*	High	Moderate	High	Moderate	High	Moderate	Moderate	Moderate

Notes:

* The overall assessed risk has been assigned on a 'reasonable worst-case' – typically assigned as the most common risk ranking in each column.

Factor	AGP/Trenchless Crossing Location							
	Trenchless crossing beneath Botley Road (B3035) and the River Hamble.	Trenchless crossing beneath Winchester Road (B3354)	Trenchless crossing beneath Bow Lake (stream)	Trenchless crossing beneath agricultural land to the south-west of Batsford Lane, and un-named tributary of the River Itchen	Trenchless crossing beneath Winters Hill (road) and agricultural land	Trenchless crossing beneath the River Meon	Trenchless crossing beneath agricultural land, woodland, River Itchen and Bournemouth (Waterloo to Weymouth) Main Line railway.	Trenchless crossing beneath Hoad's Hill (A32) south of Wickham
Aquifer designation	Moderate	Moderate	Moderate	High	Moderate	Moderate	Moderate	Moderate
Receptor	Low	Low	Low	High	Low	Low	High	Low
Flow regime	Moderate	Moderate	Moderate	High	Moderate	Moderate	Moderate	Moderate
Permeability	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate
Contamination	Negligible	Negligible	Negligible	Negligible	Negligible	Negligible*	Low	Negligible

Piling/ground improvement depth	High	Low	Low	High	Low	High	High**	High
Overall assessed risk* **	Moderate	Moderate	Moderate	High	Moderate	Moderate	Moderate	Moderate

Notes:

* Whilst asbestos was encountered, this is not considered to present a potential hazard to groundwater and has therefore not been considered in the table above.

** The high here refers only to the superficial Secondary A Aquifer, the underlying Chalk Principal aquifer was overlain by almost 10 m thickness of London Clay and/or Lambeth Group.

*** The overall assessed risk has been assigned on a 'reasonable worst-case' – typically assigned as the most common risk ranking in each column.

5.3.4 The overall risk to groundwater, on the basis of the initial screening, is assessed to be either Moderate or High, depending on the AGP/Trenchless Crossing Location identified in Table 5-2.

5.3.5 For a site assessed as High groundwater risk, [1] states:

> *"FWRA required possibly with remedial targets assessment to determine if piling is acceptable at all and if so what mitigation and monitoring is required. Specific FWRA report required. This should be started at the desk study stage (RIBA Stage 1) and should then be developed as further site investigation is completed and the design progressed."*

5.3.6 For a site assessed as Moderate groundwater risk, [1] states:

> *"FWRA required – risk needs to be considered in more detail using generic methods. This does not mean a site is high risk or that mitigation is required. This will be determined from the risk assessment. Specific FWRA report required. This should be started at the desk study stage (RIBA Stage 1) and should then be developed as further site investigation is completed and the design progressed*."

5.3.7 In relation to ground gas and vapour hazards [1] states:

> *"In most cases the use of piled foundations or ground improvement will not increase risk posed by ground gas and neither bored pile, driven precast concrete or open tube (with infill) piles or vibro concrete columns will form preferential pathways unless through a thin layer of stiff clay that is confining a gas source that is under pressure or of large volume in an open void* [8]*. Therefore most scenarios are low risk and do not need assessment."*
>
> *"The only high risk scenarios are:*
>
> - *Thin or engineered capping layer over high pressure source (e.g. recent landfill sites) or large volume gas source in an open void (mine workings); and*
> - *Driven steel H or I section piles that are driven through a confining layer and link a gas source under pressure or of large volume to the surface*."

5.3.8 It is considered highly unlikely that any of the landfills (as indicated by the EA) in the vicinity of the trenchless crossings and AGP sites benefit from a low permeability capping layer and none are considered to be 'recent' landfills.

5.3.9 CFA piles and driven pre-cast piles are therefore not considered to increase the risks posed by landfill gas and will not form preferential pathways for gas migration.

5.4 Climate change

5.4.1 The EA's Land Contamination Risk Management guidance [9] recommends the incorporation of climate change considerations into land contamination risk

assessment and the options appraisal process so that any works are sustainably robust and endure future climate change events.

5.4.2 Climate change requires the design and implementation of land contamination risk management reduction measures to account for Extreme Weather Events (EWE). EWE considers not just the general increase in magnitude such as temperature but also the intensity such as increasingly intense precipitation causing run-off or short-term groundwater level rise or surface flooding.

5.4.3 In relation to this Outline FWRA, the baseline hydrogeological conditions identified in the ground investigation could evolve through changes to long term groundwater levels and increased seasonal variations of groundwater levels potentially affecting structures and other elements of the Project that interact with the ground. EWEs leading to more frequent and higher intensity precipitation, or hotter drier conditions could lead to increased erosion/deterioration of unprotected natural surfaces.

5.5 Assessment methodology

5.5.1 Table 5-3 presents the methodology for assessment of **source significance**. A value between 1 (Very Low) and 5 (Very High) is assigned, based upon professional judgement taking into account factors such as historical land use, gas generation potential, and the results of the ground investigation.

Table 5-3 Criteria for classifying source significance

Classification/Score	Potential for generating contamination/gas based on land use
Very Low 1	Land use: Residential, retail or office use, agriculture Contamination: Limited Gas generation potential: Soils with low organic content
Low 2	Land use: Recent small scale industrial and light industry Contamination: locally slightly elevated concentrations Gas generation potential: Soils with high organic content (limited thickness)
Moderate 3	Land use: Railway yards, collieries, scrap yards, engineering works. Contamination: Possible widespread slightly elevated concentrations and locally elevated concentrations Gas generation potential: Dock silt and substantial thickness of organic Alluvium/peat
High 4	Land use: Heavy industry, non-hazardous landfills Contamination: Possible widespread elevated concentrations Gas generation potential: Shallow mine workings Pre 1960s landfill
Very High 5	Land use: Hazardous waste landfills, gas works, chemical works Contamination: Likely widespread elevated concentrations Gas generation potential: Landfill post 1960

5.5.2 Table 5-4 presents the criteria for assessment of **receptor sensitivity**, showing how for various receptors, a sensitivity value between 1 (Very Low) to 5 (Very High) is assigned using professional judgement.

Table 5-4 Criteria for classifying receptor sensitivity

Classification	Definition
Very Low 1	Receptor of limited importance • Groundwater: Unproductive strata (strata with negligible significance for water supply or river baseflow) (previously non-aquifer), Secondary B (water-bearing parts of non-aquifers), Secondary undifferentiated (previously minor or non-aquifer, but information insufficient to classify as Secondary A or B) • Surface water: WFD Surface Water status Bad • Ecology: No local designation • Buildings: Replaceable • Human health: Unoccupied/limited access
Low 2	Receptor of local or county importance with potential for replacement • Groundwater: Secondary A aquifer • Surface water: WFD Surface Water status Poor • Ecology: Local habitat resources • Buildings: Local value • Human health: Minimum score 4 where human health identified as potential receptor
Moderate 3	Receptor of local or county importance with potential for replacement • Groundwater: Principal aquifer • Surface water: WFD Surface Water status Moderate • Ecology: County wildlife sites, Areas of Outstanding Natural Beauty (AONB) • Buildings: Area of Historic Character • Human health: Minimum score 4 where human health identified as potential receptor
High 4	Receptor of county or regional importance with limited potential for replacement • Groundwater: Source Protection Zone (SPZ) 2 or 3 • Surface water: WFD Surface Water status Good • Ecology: SSSI, National or Marine Nature Reserve (NNR or MNR) • Buildings: Conservation Area • Human health: Minimum score 4 where human health identified as potential receptor
Very High 5	• Receptor of national or international importance • Groundwater: SPZ 1 • Surface water: WFD Surface Water status High • Ecology: Special Areas of Conservation (SAC and candidates), Special Protection Areas (SPA and potentials) or wetlands of international importance (Ramsar) • Buildings: World Heritage site • Human health: Residential, open spaces and uses where children are present

5.5.3 The assigned numerical values for source significance and receptor sensitivity are multiplied together to give a classification of **consequence**, as summarised below:

- Severe – 17 to 25
- Medium – 10 to 16
- Mild – 5 to 9
- Minor – 1 to 4

5.5.4 Probability is assigned a value between Unlikely and High Likelihood. Definitions of likelihood are provided in [10].

5.5.5 The matrix presented below as Table 5-5 is then used to combine the assessed values for probability and consequence.

Table 5-5 Matrix for classifying risk (combination of probability and consequence)

	Consequence			
Probability	***Severe***	***Medium***	***Mild***	***Minor***
High likelihood	Very high	High	Moderate	Moderate/Low
Likely	High	Moderate	Moderate/Low	Low
Low likelihood	Moderate	Moderate/Low	Low	Very low
Unlikely	Moderate/Low	Low	Very low	Very low
Note: Where a classification of Moderate/Low is given, professional judgement may be used to assign either a Moderate or Low classification				

5.5.6 Tables 6-7, 6-9, 6-13 and 6-14 describe the pollution linkages relevant to the assessed pollution scenarios. Each linkage comprises a source, a pathway and a receptor. The sensitivity of the source, and the significance of the receptor are assigned as per the tables above. The pathway element of the linkage is described in the table, with factors relating to the pathway then used to inform the likelihood. For example if a pathway were a clayey, functionally impermeable soil, then the likelihood of contamination migrating via that pathway would be unlikely. Similarly, the length of the pathway will inform the likelihood, if the pathway between the source and the receptor is short, the likelihood of harm being realised via that pathway is higher than if the pathway were very long. Professional judgement will be used to evaluate these factors and determine an appropriate likelihood.

5.5.7 The Outline FWRA has been conducted for the AGP and trenchless crossings described in Section 2.

5.6 Pollution scenarios

5.6.1 The guidance [1] considers the following pollution scenarios with respect to piling and penetrative ground improvement methods:

1. Creation of preferential pathways, through a low permeability layer, to cause contamination of groundwater in an aquifer.
2. The driving of solid contaminants down into an aquifer during pile driving.
3. Contamination of groundwater and subsequently surface waters by turbidity, support fluids, concrete, cement paste or grout.
4. Direct contact with contaminated soil or leachate causing degradation of pile materials.
5. Creation of preferential pathways to allow migration of landfill gas or contaminant vapours to surface.
6. Causing off-Site migration of ground gas or increased vertical emissions as a result of vibration or other effects from the pile installation process.
7. Direct contact with contaminated soil arisings that have been bought to the surface.

5.6.2 The potential risks associated with each pollution scenario have been assessed utilising a Conceptual Site Model to identify 'source-pathway-receptor' linkages and are presented in the following sections.

Pollution scenario 1

5.6.3 Pollution Scenario 1 considers the creation of preferential pathways, through a low permeability layer to cause contamination of groundwater in an aquifer.

5.6.4 Assessment of this pollution scenario has been provided when the following conditions are met:

- The proposed structure will encounter groundwater, and the construction of the structure involves elements that will extend through a low permeability layer between a shallow and a deep aquifer. And,
- The ground investigation has identified contamination that could migrate to a deeper aquifer if an aquiclude were punctured. Or,
- A credible PSC has been identified but was not investigated during the recent ground investigations.

5.6.5 Table 5-6 summarises which of the proposed structures are anticipated to encounter groundwater.

Table 5-6 Summary of proposed structures to be assessed under pollution scenario 1

Structure	Structure will encounter groundwater and extend through an aquitard to a lower aquifer	Contamination has been identified that could migrate to a deeper aquifer if an aquiclude were punctured?	A credible PSC has been identified but was not investigated during the recent ground investigations.	Carry forward to assessment?
BPT/IPS-E	No – Groundwater was not encountered during monitoring of boreholes located in area of BPT/IPS-E (response zones between 6.0 and 30.5 m bgl)			**No**
BPT-K	No – Alluvium overlies London Clay which is present to more than 25m bgl. (Does not puncture aquitard)			**No**
IPS-F	Unknown – Assumed potential for piled foundations to extend to approximately 14.0 m bgl. Groundwater was not encountered during monitoring of boreholes located in area of IPS-F (response zones between 1.5 and 10. m bgl)	No - contamination has not been identified within the strata overlying the aquifer.		**No**

Structure	Structure will encounter groundwater and extend through an aquitard to a lower aquifer	Contamination has been identified that could migrate to a deeper aquifer if an aquiclude were punctured?	A credible PSC has been identified but was not investigated during the recent ground investigations.	Carry forward to assessment?
IPS-G	No – River Terrace Deposits overlie Earnley Sand Formation (no aquitard)			**No**
Trenchless crossing beneath the River Wallington	No – Superficial deposits overlie Chalk (no aquitard)			**No**
Trenchless crossing beneath Winchester Road (A334), south of junction with Titchfield Lane and Blind Lane	No – River Terrace Deposits overlie Wittering Formation, which is present to 20 m bgl (no aquitard)			**No**
Trenchless crossing beneath public footpath and High St. at Shirrell Heath	Yes – Launch shaft extends through London Clay Formation to Whitecliff Sand Member (Secondary A aquifer) (saturated and confined).	No - contamination has not been identified within the strata overlying the aquifer.		**No**
Trenchless crossing beneath woodland, Winchester Road (B2177) and St. Anne's Lane, north of Shedfield	No – Whitecliff Sand Member overlies the London Clay Formation, which is present to 20 m bgl. (Does not puncture aquitard)			**No**
Trenchless crossing beneath Botley Road (B3035) and the River Hamble.	No – River Terrace Deposits overlie London Clay Formation, which is present to 20 m bgl. (Does not puncture aquitard)			**No**
Trenchless crossing beneath Winchester Road (B3354)	No – Alluvium overlies London Clay Formation, which is present to between 17.5 m bgl and 18.5 m bgl. (Does not puncture aquitard)			**No**
Trenchless crossing beneath Bow Lake (stream)	No – Alluvium overlies London Clay Formation, which is present to between 17.8 m bgl and 20.0 m bgl. (Does not puncture aquitard)			**No**
Trenchless crossing beneath agricultural land to the south-west of Batsford Lane, and un-named tributary of the River Itchen	No – Alluvium and River Terrace Deposits overlie Chalk, which is present to 20 m bgl. (no aquitard)			**No**
Trenchless crossing beneath Winters Hill (road) and agricultural land	No – Alluvium overlies London Clay Formation, which is present to 20.0 m bgl. (Does not puncture aquitard)			**No**

Structure	Structure will encounter groundwater and extend through an aquitard to a lower aquifer	Contamination has been identified that could migrate to a deeper aquifer if an aquiclude were punctured?	A credible PSC has been identified but was not investigated during the recent ground investigations.	Carry forward to assessment?
Trenchless crossing beneath the River Meon	Yes – At reception shaft, Head Deposits overlie Wittering Formation (Secondary A aquifer) (saturated and confined)	No – contamination has not been identified within the natural Head Deposits.		**No**
Trenchless crossing beneath agricultural land, woodland, River Itchen and Bournemouth (Waterloo to Weymouth) Main Line railway.	Yes – River Terrace Deposits overlie London Clay Formation, which is present to between 12.4 m and 15.4 m bgl. Harwich Formation and Lambeth Group (Secondary A aquifers) present beneath London Clay. Chalk (Principal Aquifer) present at depth. Groundwater appears to be confined by the London Clay Formation and Lambeth Group.	Yes – Slightly elevated concentrations of ammonia, cadmium, copper, lead, manganese, nickel and zinc were recorded in the groundwater within the River Terrace Deposits at the launch and reception shafts (noting no adjustment for bioavailability was undertaken)	n/a	**Yes**
Trenchless crossing beneath Hoad's Hill (A32) south of Wickham	No – Wittering Formation overlies Whitecliff Sand Member (no aquitard)			**No**

5.6.6 On the basis of the Table 5-6, only the trenchless crossing beneath agricultural land, woodland, River Itchen and Bournemouth (Waterloo to Weymouth) Main Line railway is conservatively taken forward for assessment under Pollution Scenario 1.

5.6.7 The pollution linkage assessed and the assessed significance of the potential source, pathway and the receptor sensitivity are summarised in Table 5-7.

Table 5-7 Pollution scenario 1 - significance of potential pollution linkage

Link	Description	Comment	Source Significance/Receptor Sensitivity
Source	Contamination within shallow groundwater.	Five PSCs are located in the land above the Site* and/or within 50 m of the trenchless crossing route but PSCs have not been identified within 50 m of the shafts. The PSCs relate to the off-Site Bugle Farm Landfill and other off-Site areas of potentially infilled land.	High (4)
Pathway	Shaft/soil interface	The launch and reception shafts will extend from the surface, through the shallow River Terrace Deposits and through the underlying London Clay Formation to the underlying Harwich Formation and Lambeth Group. There is potential for preferential flow pathways to be created at the interface between the shaft and the surrounding geology.	-
Receptor	Secondary A aquifers (Harwich Formation and Lambeth Group)	The Site is underlain by River Terrace Deposits, designated as a Secondary A aquifer and the Harwich Formation and Lambeth Group, both of which are also Secondary A aquifers.	Secondary A aquifers – Low (2)
* Trenchless crossing beneath agricultural land, woodland, River Itchen and Bournemouth (Waterloo to Weymouth) Main Line railway			

5.6.8 Penetrating the London Clay Formation that currently separates the River Terrace Deposits from the underlying Harwich Formation and Lambeth Group has the potential to create a preferential pathway, allowing contamination within groundwater in the River Terrace Deposits (considered to originate from the Bugle Farm landfill) to migrate downwards into the underlying aquifers.

5.6.9 The degree of harm, given the nature of the source (landfill – High (4)) and significance of the receptor (Secondary A aquifer – Low (2)) is currently assessed as Mild. As the shaft construction methodology is unknown at the time of writing a likelihood of 'Likely' has been assigned, as it is unknown how any mitigation against the creation of preferential pathways through low permeability layers will be provided.

5.6.10 On this basis, combining a Mild consequence and Likely probability, as per Table 5-5, the risk of pollution of groundwater with regards to the creation of preferential pathways through low permeability layers is assessed to be **Moderate/Low** and has been assigned as **Moderate** on the basis of the current unknowns in shaft design and construction methodology.

5.6.11 It is suggested that this assessment is revised following development of the shaft construction methodology and the specification of quality assurance and quality control (QA/QC) measures, as the currently assessed position is likely to be highly conservative.

Pollution scenario 2

5.6.12 Pollution Scenario 2 considers the driving of solid contaminants down into an aquifer.

5.6.13 On the basis that contamination within the on-Site soils has not been encountered, with the exception of a single piece of asbestos containing material (not considered to be a hazard to groundwater), this Pollution Scenario has not been assessed further.

Pollution scenario 3

5.6.14 Pollution Scenario 3 considers the contamination of groundwater and, subsequently, surface water by turbidity, support fluids, concrete, cement paste, or grout.

5.6.15 Assessment of this pollution scenario has been provided when the following conditions are met:

- The proposed structure will encounter groundwater; and
- A receptor that could be impacted has been identified, e.g. an aquifer that is being abstracted from, or a watercourse that is anticipated to be in hydraulic continuity with the surrounding groundwater.

5.6.16 Table 5-8 summarises which of the AGP and trenchless crossings fulfil these criteria.

Table 5-8 Summary of proposed structures to be assessed under pollution scenario 3

Structure	Structure will encounter groundwater?	Receptor has been identified that could be impacted?	Carry forward to assessment?
BPT/IPS-E	No – structure will not encounter groundwater		**No**
BPT-K	Yes – groundwater present within the possible weathered London Clay Formation/'Possible Alluvium'	No – Whilst the Contractor has described the soil at shallow depth beneath BPT-K as possible Alluvium, the BGS do not map a deposit of Alluvium and DEFRA's MAGIC Map does not record a superficial aquifer at this location.	**No**
IPS-F	Unknown – Assumed potential for piled foundations to extend to approximately 14.0 m bgl. Groundwater not encountered within 10.0 m of existing ground level	Head Deposits = Secondary Undifferentiated aquifer. Chalk = Principal aquifer. Groundwater SPZ Zone 2. There are no groundwater abstractions located within 1.0 km of this trenchless crossing. The public water supply abstraction upon which the SPZ is centred is located some 2.0 km to the south. Piled foundations utilised will rest within the Chalk, potentially below groundwater level.	**Yes**
IPS-G	No – structure will not encounter groundwater		**No**

Structure	Structure will encounter groundwater?	Receptor has been identified that could be impacted?	Carry forward to assessment?
Trenchless crossing beneath the River Wallington	Yes – groundwater present within Alluvium and Chalk. Head Deposits unlikely to be saturated or significantly water bearing.	Alluvium = Secondary A aquifers. Head Deposits = Secondary Undifferentiated aquifer. Chalk = Principal aquifer. River Wallington Groundwater SPZ Zone 2. There are no groundwater abstractions located within 1.0 km of this trenchless crossing. The public water supply abstraction upon which the SPZ is centred is located approximately 1.3 km to the south. The proposed excavation depths for the shafts mean that both the launch and reception shafts and the trenchless crossing 'tunnel' will be constructed partially within the Chalk.	**Yes**
Trenchless crossing beneath Winchester Road (A334), south of junction with Titchfield Lane and Blind Lane	Yes – groundwater present within River Terrace Deposits and Wittering Formation	River Terrace Deposits and Wittering Formation = Secondary A aquifers.	**Yes**
Trenchless crossing beneath public footpath and High St. at Shirrell Heath	Yes – groundwater present within Whitecliff Sand Member (Limited thickness of near-surface Head Deposits at 0.25 – 0.80 m bgl anticipated to not be significantly water bearing)	Whitecliff Sand = Secondary A aquifer.	**Yes**
Trenchless crossing beneath woodland, Winchester Road (B2177) and St. Anne's Lane, north of Shedfield	Yes – groundwater present within Whitecliff Sand Member	Whitecliff Sand Member = Secondary A aquifer.	**Yes**
Trenchless crossing beneath Botley Road (B3035) and the River Hamble.	Yes – groundwater present within Head Deposits, River Terrace Deposits	Head Deposits – Secondary Undifferentiated Aquifer River Terrace Deposits = Secondary A aquifers. River Hamble	**Yes**
Trenchless crossing beneath Winchester Road (B3354)	Yes – groundwater present within Alluvium	Alluvium = Secondary A aquifer. Groundwater abstraction located approximately 80 m to the north, for abstraction up to 1,091 m^3 per day of groundwater to supply a fish farm. The shaft depths at this location are between 9.0 m	**Yes**

Structure	Structure will encounter groundwater?	Receptor has been identified that could be impacted?	Carry forward to assessment?
		and 7.6 m bgl, passing through Head Deposits and Alluvium before terminating within the London Clay Formation. On the basis that none of the strata through which the shafts and trenchless crossing 'tunnel' are to be constructed are considered capable of supplying over 1,000 m^3 of water per day, groundwater is assumed to be abstracted from the Chalk at depth. As this trenchless crossing does not extend into the Chalk this abstraction is not considered further.	
Trenchless crossing beneath Bow Lake (stream)	Yes – groundwater present within Alluvium and River Terrace Deposits	Alluvium and River Terrace Deposits = Secondary A aquifers.	**Yes**
Trenchless crossing beneath agricultural land to the south-west of Batsford Lane, and un-named tributary of the River Itchen	Yes – groundwater present within Alluvium, River Terrace Deposits and Chalk Groundwater not anticipated within the Lambeth Group at this location based upon descriptions. Water strikes, rises and monitored levels indicate that the Lambeth Group appears to confine groundwater within the underlying Chalk.	Alluvium and River Terrace Deposits = Secondary A aquifers. Chalk = Principal aquifer. Unnamed tributary of the River Itchen Groundwater SPZ Zone 1. Two abstractions for public supply located within 250 m of the trenchless crossing. As per Table 4.3, water is assumed to be abstracted from the Chalk aquifer at depth. The proposed excavation depths for the shafts mean that the launch shaft will penetrate into the Chalk aquifer, the reception shaft will terminate approximately 1.0 m above the top of the Chalk, within the very stiff clay of the Lambeth Group. The trenchless crossing 'tunnel' will be constructed partially within the Chalk.	**Yes**
Trenchless crossing beneath Winters Hill (road) and agricultural land	Yes – Potential for limited shallow groundwater to be present within the Alluvium overlying the London Clay Formation.	Alluvium = Secondary A aquifer.	**Yes**
Trenchless crossing beneath the River Meon	Yes – groundwater within Alluvium, River Terrace Deposits, Wittering Formation and Whitecliff Sand Member. Groundwater not anticipated within the Head Deposits. Water strikes, rises and monitored levels indicate that the Lambeth Group appears to confine groundwater within the underlying Wittering Formation.	Alluvium and River Terrace Deposits = Secondary A aquifers. Wittering Formation and Whitecliff Sand = Secondary A aquifers. River Meon	**Yes**
Trenchless crossing beneath agricultural	Yes – groundwater within River Terrace Deposits. The Lambeth Group and the London Clay	River Terrace Deposits = Secondary A aquifers. River Itchen	**Yes**

Structure	Structure will encounter groundwater?	Receptor has been identified that could be impacted?	Carry forward to assessment?
land, woodland, River Itchen and Bournemouth (Waterloo to Weymouth) Main Line railway.	Formation are anticipated to confine groundwater within the underlying Chalk.	Groundwater SPZ Zone 1c – subsurface activity in confined aquifer. The nearest abstractions within this SPZ are located approximately 490 m north and 560 m north of the trenchless crossing, both of which are for public drinking water supply. As per Table 4.3, water is assumed to be abstracted from the Chalk. The proposed excavation depths for the shafts are approximately 33 m bgl. The ground investigation at this trenchless crossing comprised boreholes at the reception shaft only, and to a depth of 20 m (within which the Chalk was not encountered). It is therefore assumed, to provide a conservative assessment, that both shafts and the trenchless crossing 'tunnel' will be constructed partially within the Chalk.	
Trenchless crossing beneath Hoad's Hill (A32) south of Wickham	Yes – groundwater within Wittering Formation and Whitecliff Sand Member	Superficial deposits were not encountered at this trenchless crossing. Wittering Formation and Whitecliff Sand Member = Secondary A aquifers.	**Yes**

5.6.17 The pollution linkages assessed, and the assessed significance of the potential source, pathway and receptor are summarised in the Table 5-9 and the text that follows.

Table 5-9 Pollution scenario 3 - significance of potential pollution linkages

Link	Description	Comment	Source Significance/Receptor Sensitivity
Source	Increased turbidity due to drilling and casting of piles, shaft excavation and construction and trenchless crossing construction. Includes particulates from formation and concrete/grout particulates washed into groundwater.	Turbidity increases could occur as a result of physical disturbance of soils during the piling, shaft excavation and construction processes, as well as during the pipe-jacking operation.	High (4)
	Water bleeding from concrete.	Water with a high pH and chloride content may bleed from concrete into groundwater. Additives can be added to concrete to reduce the amount of water used in the mix and thereby reduce the amount of concrete loss and bleed. Mix is to be designed according to appropriate technical guidance and with the agreement of the EA.	Low (2)
	Excess dispersal of fissure grout into groundwater	Grout may be injected into the Chalk aquifer at the base of the shaft prior to dewatering to prevent ingress of groundwater through the base of the shaft. Where required, a high-density grout mix (cement, gravel and bentonite) will be utilised to prevent	High (4)

Link	Description	Comment	Source Significance/Receptor Sensitivity
		dispersal through the rock. Grout volume to be minimised, with careful preparation and methodology, including injection pressure control. The methodology for this will be agreed with the EA following detailed design.	
	Bentonite support fluid breakout from excavation into groundwater and surface water	Bentonite may be used to support shaft excavations and potentially to lubricate the pipe-jack during jacking operations.	High (4)
	Slurry/concrete/grout additives	Slurry/concrete/grout additives may be used to enhance the performance of these materials and could potentially include hazardous substances.	Moderate (3)
Pathway	Migration within the granular aquifers beneath the Site, towards receptors	The granular aquifers are typically variably clayey sand and gravel deposits. These deposits are expected to be highly permeable.	-
	Migration within the Chalk aquifer towards receptors	Chalk is a dual porosity aquifer; the majority of transport occurs within the fractures and fissures. Transport within fractures and fissures is likely to be rapid and can occur over long distances.	
Receptor	Secondary A aquifers (where no abstractions identified)	As previously described.	Low (2)
	Principal aquifer (Chalk) (where no abstractions identified)	As previously described.	Moderate (3)
	River Wallington at trenchless crossing beneath the River Wallington	The EA's Catchment Data explorer shows that the River Wallington in the "Wallington below Southwick" water body [11] received a Water Framework Directive (WFD) classification of Moderate for ecological quality in both 2019 and 2022. Shallow groundwater within the superficial Alluvium is likely to be in hydraulic continuity with the river.	Moderate(3)
	River Meon at trenchless crossing beneath the River Meon	The EA's Catchment Data explorer shows that the River Meon in the "Meon" water body [12] received a WFD classification of Good for ecological quality in 2019 and Moderate in 2022. Shallow groundwater within the superficial River Terrace Deposits and bedrock of the Whitecliff Sand Member and Wittering Formation is likely to be in hydraulic continuity with the river.	High (4)
	River Hamble at trenchless crossing beneath Botley Road (B3035) and the River Hamble.	The EA's Catchment Data explorer shows that the River Hamble in the "Main River Hamble" water body [13]received a WFD classification of Moderate for ecological quality in both 2019 and 2022.	Moderate (3)

Link	Description	Comment	Source Significance/Receptor Sensitivity
		Shallow groundwater within the superficial Alluvium and River Terrace Deposits is likely to be in hydraulic continuity with the river.	
	River Itchen at trenchless crossing beneath agricultural land, woodland, River Itchen and Bournemouth Main Line (Waterloo to Weymouth) Main Line railway.	The EA's Catchment Data explorer shows that the River Itchen in the "Itchen" water body [14] received a WFD classification of Good for ecological quality in both 2019 and 2022. Shallow groundwater within the superficial River Terrace Deposits is likely to be in hydraulic continuity with the river.	High (4)
	River Itchen at trenchless crossing beneath agricultural land to the south-west of Batsford Lane, and un-named tributary of the River Itchen	The EA's Catchment Data explorer shows that the River Itchen in the "Itchen" water body [14] received a WFD classification of Good for ecological quality in both 2019 and 2022. Shallow groundwater within the superficial Alluvium and River Terrace Deposits is likely to be in hydraulic continuity with the river.	High (4)
	SPZ2 at trenchless crossing beneath the River Wallington	Groundwater SPZ Zone 2. There are no groundwater abstractions located within 1.0 km of this trenchless crossing. The public water supply abstraction upon which the SPZ is centred is located approximately 1.3 km to the south and is assumed to abstract from the Chalk at depth. The proposed excavation depths for the shafts mean that both the launch and reception shafts and the trenchless crossing 'tunnel' will be constructed partially within the Chalk.	High (4)
	SPZ1 and public supply abstractions at trenchless crossing beneath agricultural land to the south-west of Batsford Lane, and un-named tributary of the River Itchen	Groundwater SPZ Zone 1 Abstractions for public supply located approximately 160 m to the north and 230 m to the south-east. Water is assumed to be abstracted from the Chalk. The proposed excavation depths for the shafts mean that the launch shaft will penetrate into the Chalk aquifer, the reception shaft will terminate approximately 1.0 m above the top of the Chalk, within the very stiff clay of the Lambeth Group. The trenchless crossing 'tunnel' will be constructed partially within the Chalk.	Very High (5)
	SPZ1 at trenchless crossing beneath agricultural land, woodland, River Itchen and Bournemouth Main Line (Waterloo to	Groundwater SPZ Zone 1c – subsurface activity in confined aquifer. The nearest abstractions within this SPZ are located approximately 490 m north and 560 m north of the trenchless crossing, both of which are for public drinking water supply. Water is assumed to be abstracted from the Chalk.	Very High (5)

Link	Description	Comment	Source Significance/Receptor Sensitivity
	Weymouth) Main Line railway.	The proposed excavation depths for the shafts are approximately 33 m bgl. The ground investigation at this trenchless crossing comprised boreholes at the reception shaft only, and to a depth of 20 m (within which the Chalk was not encountered). It is therefore assumed, to provide a conservative assessment, that both shafts and the trenchless crossing 'tunnel' will be constructed partially within the Chalk.	

Risk assessment - turbidity

5.6.18 The impacts of increased turbidity principally relate to potable water abstractions. As stated in [15] "*abstractors of groundwater are required by the Drinking Water Inspectorate to regularly test groundwater for turbidity. The turbidity results are used as a marker for risks from pathogens such as Cryptosporidium and E. coli, which the turbidity test does not differentiate from mineral particles. Therefore, if increased turbidity is detected the operator has to shut down the abstraction until mitigation has been implemented… Additionally, increased turbidity can compromise the disinfection process, and where the abstracted water is treated using membrane filters then the filters can become fouled by the turbidity*".

5.6.19 Fate and transport models are not suitable for assessing turbidity and no practicable methods for modelling migration of particles in fracture flow systems has been recognised by regulators. Transport of particles has thus been addressed qualitatively.

5.6.20 Turbidity could be generated from the shaft construction and pipe-jacking processes, through the mechanical mixing of soils and cement/water injection, as well as through the excavation and casting of diaphragm walls (if such approaches are adopted).

Superficial aquifers and hydraulically connected surface waters

5.6.21 The size of particles that will effectively be trapped by a sand is about 0.1 times the particle diameter D15 at which 15% of the soil by weight is finer [16] and [17].

5.6.22 The results of particle size distribution tests (as described in the GIRs for the Project contained within ES Appendix 11.2 Geotechnical and Geo-environmental reports, Volume II (Document reference 6.2, DCO Volume 6)) have been analysed and the D15 ranges for the Alluvium, River Terrace Deposits, Earnley Sand Formation, Whitecliff Sand Member and Wittering Formations are summarised as follows:

- Alluvium – D15 = less than 0.002 mm (less than 2.0 µm), i.e., predominantly clay.
- River Terrace Deposits – D15 = 0.063 mm (63 µm) to 0.002 mm (2.0 µm), i.e., predominantly fine sand, silt and clay.

- Earnley Sand Formation – D15 = less than 0.002 mm (less than 2 µm), i.e., predominantly clay.
- Whitecliff Sand Member – D15 = 0.002 mm (2 µm) to 0.063 mm (63 µm), i.e., predominantly fine sand and silt.
- Wittering Formation – D15 = less than 0.002 mm (less than 2.0 µm), i.e., predominantly clay.

5.6.23 On the basis of the above, the most permeable of the strata, i.e., the River Terrace Deposits, is expected to effectively trap all particles with a diameter greater than 6.3 µm.

Chalk principal aquifer and public water supply abstractions

5.6.24 Parts of the Site are located within groundwater SPZs, as follows:

- IPS-F – SPZ2 associated with a groundwater abstraction (ref: 11/42/33.9/20) located approximately 2.0 km to the south. This abstraction is for potable public water supply and is operated by Portsmouth Water. The groundwater is assumed to be abstracted from the Chalk. No other recorded licenced groundwater abstractions within 250 m.
- Trenchless crossing beneath the River Wallington – SPZ 2 associated with the same abstraction described above (approximately 1.45 km to the south of this trenchless crossing). No other recorded licenced groundwater abstractions within 250 m.
- Trenchless crossing beneath agricultural land to the south-west of Batsford Lane, and un-named tributary of the River Itchen – SPZ 1 associated with public water supply groundwater abstractions operated by the Applicant at Otterbourne Pumping Station (PS). 2No. abstractions are located within 250 m of the Site (Otterbourne PS Point D – approximately 160 m to the north, and Otterbourne PS Point J – approximately 230 m to the south-east).
- Trenchless crossing beneath agricultural land, woodland, River Itchen and Bournemouth Main Line (Waterloo to Weymouth) Main Line railway – SPZ1 associated with the Otterbourne PS abstractions.

5.6.25 In all the above cases, the Site appears to be located hydraulically upgradient of the public water supply abstractions.

5.6.26 Where construction of the trenchless crossings is undertaken through the superficial deposits it is considered that whilst an increase in turbidity will likely occur, it is considered unlikely that this increase in turbidity will be realised at any significant distance from the trenchless crossings, as the superficial strata will effectively trap particles mobilised during the construction.

5.6.27 The proposed IPS-F piles and the trenchless crossings beneath the River Wallington, agricultural land to the south-west of Batsford Lane, and un-named tributary of the River Itchen, will be constructed either partially or wholly within the Chalk.

5.6.28 It is noted that [1] states: Turbidity risk is lower with driven piles although they do cause remoulding of the Chalk which could pose a risk of creating turbidity.

5.6.29 Chalk generally comprises coccoliths, foraminifera and other shell debris, cemented together to lesser or greater degrees. The coccoliths are particularly small, being several micrometres across. Any construction work can result in disintegration of the Chalk mass into these fine particles which, when the work is below or close to the groundwater level, has the potential to induce turbidity in groundwater. Due to their small size these particles do not settle quickly and can rapidly migrate through fissures in the aquifer.

5.6.30 Flow through Chalk is predominantly fracture controlled, and therefore it is considered that an increase in turbidity will occur within the Chalk Principal aquifer as a result of the construction of the proposed structures. Whilst it is considered that there is a Low likelihood that this increase in turbidity would be realised at the Portsmouth Water abstraction (11/42/33.9/20) located, at most proximal, approximately 1.45 km to the south of the Site (Trenchless crossing beneath the River Wallington), the likelihood that a measurable increase in turbidity at the Otterbourne PS abstraction (around 160 m from the trenchless crossing beneath in Itchen tributary) occurring is considered to be High.

5.6.31 Table 5-10 presents an assessment of the assessed risks associated with increases in turbidity.

Table 5-10 Pollution scenario 3 - summary of assessed risks (turbidity)

Linkage	Consequence	Likelihood	Risk
Increase in turbidity within Secondary A aquifers (not abstracted from) due to construction of trenchless crossings and AGP.	S = High (4) R = Low (2) S X R = Mild	Unlikely (due to 'filtering' by aquifers as described above)	Very Low
Increase in turbidity in surface waters (Rivers Wallington, Hamble, Meon and Itchen) that are in hydraulic continuity with shallow groundwater, due to construction of trenchless crossings and AGP.	S = High (4) R = High (4) S X R = Medium	Unlikely (due to 'filtering' by aquifers as described above)	Low
Increase in turbidity within Chalk aquifer in SPZ2 associated with Portsmouth Water abstraction (11/42/33.9/20) due to construction of the trenchless crossing beneath the River Wallington and the piled foundations for IPS-F.	S = High (4) R = High (4) S X R = Medium	Low	Moderate[1]

Linkage	Consequence	Likelihood	Risk
Increase in turbidity within Chalk aquifer in SPZ1 and public supply abstractions at Otterbourne PS, due to construction of the trenchless crossing beneath agricultural land to the south-west of Batsford Lane, and un-named tributary of the River Itchen, and the trenchless crossing beneath agricultural land, woodland, River Itchen and Bournemouth Main Line (Waterloo to Weymouth) Main Line railway.	S = High (4) R = Very High (5) S X R = Severe	High	Very High
Notes: S = Source significant R = Receptor sensitivity 1. A Medium consequence and a Low likelihood results in a risk (as per Table 6.5) of Moderate/Low. This risk has been assigned as Moderate to provide a worst-case assessment. This should be reviewed following the development of the detailed design of the Project.			

5.6.32 As shown in Table 5-10, the construction activities within the Chalk aquifer present potential risks to public water supply abstractions due to increasing turbidity through rapid migration of particulates in fissures and fractures, with the works closest to the public water supply boreholes at the trenchless crossing beneath agricultural land to the south-west of Batsford Lane, and un-named tributary of the River Itchen, assessed to be the highest risk.

5.6.33 It is recommended that the Applicant as the operator of the abstraction boreholes, should ascertain if the wells within 250 m of the trenchless crossing need to be pumping during the period of the works.

5.6.34 Monitoring boreholes should be installed into the Chalk within the SPZ1, between the proposed trenchless crossing and the abstraction boreholes, noting that the drilling of these boreholes could itself cause localised and short-term increases in turbidity. Continuous monitoring of turbidity, chloride and pH should be undertaken within these boreholes for a period of one month prior to construction commencing. The data should be reviewed and used to determine appropriate compliance criteria against which the results of monitoring undertaken during and for a period of one week after construction may be is compared.

5.6.35 Should evidence of increased turbidity, pH or chloride be recorded, a stop should be immediately placed on the works until the impacts are dispersed, following which excavation rates should be reviewed.

5.6.36 This assessment should be reviewed following development of the detailed design of the Project.

Risk assessment - loss of high pH and high chloride water from concrete

5.6.37 Concrete bleeding can occur as fresh concrete is subject to high head pressures resulting in high pore-water pressures inside the fresh concrete matrix. This can

be much higher than the pore-water pressures in the surrounding soil and thus cause water to be forced out of the fresh concrete matrix, into the soil matrix (Martin D. Larisch, September 2021). In the context of the Project, the principal area of bleed is anticipated to be the bottom of the shaft.

5.6.38 The concrete mix composition has not yet been designed, however Clause 1604.7 of the Specification for Highway Works [18] requires that "*the concrete shall be designed so that segregation does not occur during the placing process, and bleeding of the concrete shall be minimised*". There are currently no specific requirements in the specification to control bleed but Clause B21.5.4 of the ICE Pile Specification allows for determination of bleed in accordance with the test recommended by the Concrete Institute of Australia (CIA). The CIA recommended practice [19] gives an acceptance criterion of 15l/m^3.

5.6.39 [20] indicates that a suitable specification of the fine/medium sand content, water/cement ratio and admixtures will effectively restrict bleeding. The suitability of any additives added to the concrete mix to promote fast-curing should be confirmed with the EA.

5.6.40 The contractor will also be required to specify the concrete mix to prevent bleed as far as is reasonably practicable. It is anticipated that this would be done by default as the contractor would (for cost reasons) wish to minimise concrete loss.

5.6.41 Assuming the use of an appropriate concrete design with additives to reduce amount of water used in the mix and thereby reduce the amount of concrete loss and bleed it is considered that there is a low likelihood that an increase in pH and chloride concentrations within the groundwater beneath the Site would occur. Table 5-11 presents the estimated risks associated with concrete bleed.

Table 5-11 Pollution scenario 3 - summary of assessed risks (concrete bleed)

Linkage	Consequence*	Likelihood	Risk
Loss of high pH and high chloride water from concrete to Secondary A aquifers (not abstracted from) due to construction of trenchless crossings and AGP.	S = Low (2) R = Low (2) S X R = Mild	Low	Low
Loss of high pH and high chloride water from concrete to groundwater that is in hydraulic continuity with surface water, due to construction of trenchless crossings and AGP.	S = Low (2) R = High (4) S X R = Mild	Low	Low
Loss of high pH and high chloride water from concrete to groundwater within Chalk aquifer in SPZ2 at trenchless crossing beneath the River Wallington, due to construction of trenchless crossings and AGP.	S = Low (2) R = High (4) S X R = Mild	Low	Low
Loss of high pH and high chloride water from concrete to groundwater within SPZ1 and public supply abstractions at trenchless crossing beneath agricultural land to the south-west of Batsford Lane,	S = Low (2) R = Very High (5) S X R = Medium	Low	Moderate[1]

Linkage	Consequence*	Likelihood	Risk
and un-named tributary of the River Itchen, due to construction of trenchless crossings and AGP.			
Loss of high pH and high chloride water from concrete to groundwater within SPZ1, River Itchen SSSI and River Itchen SAC at trenchless crossing beneath agricultural land, woodland, River Itchen and Bournemouth Main Line (Waterloo to Weymouth) Main Line railway, due to construction of trenchless crossings and AGP.	S = Low (2) R = Very High (5) S X R = Medium	Low	Moderate[1]
Notes: S = Source significance R = Receptor sensitivity 1. A Medium consequence and a Low likelihood results in a risk (as per Table 6.5) of Moderate/Low. This risk has been assigned as Moderate to provide a worst-case assessment. This should be reviewed following the development of the detailed design of the Project.			

Risk assessment - bentonite support fluid break out

5.6.42 Bentonite is a dense and viscous, thixotropic material, which is used as a support fluid to stabilise excavations, and lines the excavations with a low permeability layer (or 'filter cake'). These properties prevent it from dispersing widely beyond the excavation walls.

5.6.43 Bentonite mud is formed from inert, non-toxic clays, that are not damaging to land surfaces and quickly break down in salt water. Break out of bentonite mud occurs when the mud pressure in the trench exceeds the strength of the overlying/surrounding ground resulting in mud being forced out into the surrounding formation.

5.6.44 The contractor should, during detailed design, consider developing their construction methodology to mitigate and remediate break outs during excavation and should consider the mitigation and responses outlined in the following points:

- **Limiting the volume of the break out**. The contractor will be monitoring fluid pressure and the volume of fluid returns to allow losses to be quickly identified if they occur. When fluid losses are identified the contractor will cease excavation and investigate if the losses are visible at surface and, if so, the location of the break out. During the excavation a watching brief will be maintained for any signs of break out.
- **Containing the break out**. When a surface break out has been identified, it will be contained with appropriate methods. The most appropriate methods will depend on the location of the break out. Sandbags arranged to form a bund around the break out are the most common method.
- **Removing the break out fluid.** Typically, hand carried pumps and hoses are used to pump the fluid from the break out location to either the entry or exit pits, or a holding tank or bowser for transfer back to the excavation.

- **Sealing the break out.** Most break outs seal themselves after either a period of time to allow the bentonite mud to gel in the fracture, or when the excavation advances, reducing the pressure of the fluid passing the fracture. In some cases, environmentally friendly additives, termed Lost Circulation Materials (LCM) are added to the drilling fluid to assist in sealing the fracture.
- **Remediating the break out.** When the break out is deemed to have been sealed, remaining bentonite mud will be removed as far as possible, with the proviso that the cleaning process does not cause more harm or damage to the environment than leaving the fluid to dissipate and break down naturally.

5.6.45 As an additional precaution, the contractor undertaking the excavation works should prepare an Outline Water Monitoring Plan. The aim of this plan would be to identify significant changes to groundwater/contamination levels in key locations during construction and establish the Contingency Plan (CP) to be enacted if adverse impacts are identified. An Outline Water Monitoring Plan should include the following:

- Groundwater level and quality should be monitored prior to construction to establish baseline conditions, including turbidity.
- Groundwater level and quality should be monitored during and post construction, including turbidity measurements.
- Alert and trigger levels should be identified.
- A CP should be presented, establishing the actions that will be taken to mitigate adverse impacts. This approach should be agreed with the EA.

5.6.46 With the adoption of the measures described above is considered that there is a Low likelihood of either a break-out of bentonite support fluid occurring, or harm occurring to a receptor in the event of a break-out occurring. Table 5-12 presents an assessment of the estimated risks.

Table 5-12 Pollution scenario 3 - summary of assessed risks (bentonite support fluid breakout)

Linkage	Consequence*	Likelihood	Risk
Bentonite support fluid breakout within Secondary A aquifers (not abstracted from) due to construction of trenchless crossings and AGP.	S = High (4) R = Low (2) S X R = Mild	Low	Low
Bentonite support fluid breakout within surface water, due to construction of trenchless crossings and AGP.	S = High (4) R = High (4) S X R = Medium	Low	Moderate*
Bentonite support fluid breakout within SPZ2 at trenchless crossing beneath the River Wallington, due to construction of trenchless crossings and AGP.	S = High (4) R = High (4) S X R = Medium	Low	Moderate*
Bentonite support fluid breakout within SPZ1 at trenchless crossing beneath agricultural land to the	S = High (4) R = Very High (5)	Low	Moderate

Linkage	Consequence*	Likelihood	Risk
south-west of Batsford Lane, and un-named tributary of the River Itchen, due to construction of trenchless crossings and AGP.	S X R = Severe		
Bentonite support fluid breakout within SPZ1, River Itchen SSSI and River Itchen SAC at trenchless crossing beneath agricultural land, woodland, River Itchen and Bournemouth Main Line (Waterloo to Weymouth) Main Line railway, due to construction of trenchless crossings and AGP.	S = High (4) R = Very High (5) S X R = Severe	Low	Moderate
Notes: S = Source significance R = Receptor sensitivity *Assessed as Moderate/Low and conservatively assigned as Moderate due to unknowns relating to trenchless crossing design at the time of writing.			

Risk assessment - fissure grout dispersal

5.6.47 Fissure grouting may be required around the base of the shafts within the Chalk, in order to reduce transmissivity rates and control required dewatering processes. Grout is injected into the ground at relatively high pressure, which can cause it to disperse widely, especially in areas of open fissures or particularly weak rock. Grout injection should be kept to a minimum by avoiding wide dispersal beyond the target area.

5.6.48 Dispersal of grout can be minimised in a number of ways, for instance by altering its consistency with additives that make it more resistant to washout. A thixotropic grout can be selected, i.e. one that is fluidised upon action by vibration and pumping, and becomes stiff as pressure releases, and would prevent wide dispersal of grout into the surrounding Chalk. Grout should be properly mixed and injection pressures can be carefully administered and monitored, to ensure suitability for the ground conditions.

5.6.49 Assuming the adoption of the above, it is considered that the risk of significant dispersal of fissure grout (if required) is **Low**.

Risk assessment – contamination of groundwater by additives in slurry/concrete/grout

5.6.50 Additives may be used to enhance the performance of the bentonite slurry, concrete or grout and may include polymers, clay, cement, foaming agents, thickening agents, etc. These substances may have potential to leach into groundwater.

5.6.51 Additives and conditioning agents should be appropriately selected with the exclusion of substances that could be hazardous to the environment. The EA should be consulted by the contractor should any potentially hazardous additives be proposed for use.

5.6.52 On this basis, it is considered that the risk of contamination of groundwater by additives is **Very Low**.

Pollution scenario 4

5.6.53 Pollution Scenario 4 considers the direct contact between engineered structures and contaminated soil or leachate causing degradation of structural materials (where the secondary effects are to increase the potential for contaminant migration).

5.6.54 The contaminant linkage assessed, and the assessed significance of the potential source, pathway and receptor are summarised in Table 5-13.

Table 5-13 Pollution scenario 4 - significance of potential pollution linkage

Link	Description	Comment	Source Significance / Receptor Sensitivity
Source	Sulphate in soils and groundwater	The results of the pH and sulphate tests (SO_4) undertaken on the Alluvium and River Terrace Deposits indicate that worst case design sulphate class is DS-1 and the worst case aggressive chemical environment for concrete (ACEC) class AC-1. For the Head Deposits and Chalk the worst-case design sulphate class is DS-2 and the worst case ACEC is AC-2. For the Made Ground, Wittering Formation, Whitecliff Sand Member, Harwich Formation, London Clay Formation and the Lambeth Group, the worst-case design sulphate class is DS-4 and the worst case ACEC is AC-4. Soil contamination with the potential to impact structures has not been identified. Free phase hydrocarbons were not encountered.	High (4)
Pathway	Structure/soil interface	Direct contact with surrounding soils and groundwater.	-
Receptor	In-ground structural elements	To be designed using an appropriate concrete class as per the GIRs for each Section of the Project (ES Appendix 11.2 Geotechnical and Geo-environmental reports, Volume II (Document reference 6.2, DCO Volume 6)).	High (4)

Inhibition of concrete curing

5.6.55 Organic compounds, notably phenols, can affect the setting of concrete through an inhibition or medication of the hydration of the cement [21] [22]. BRE report BR 255 [23] states that: "*hydrocarbons such as petrol, petroleum distillates in general, and lubricating oils that are entirely of mineral origin, do not attack concrete*." In relation to phenols [22] states the main effect of phenol upon concrete may be "*inhibition or modification of the hydration process*" rather than chemical attack on the hardened cement paste.

5.6.56 [22] further notes that: "*it is difficult to say what the relationship might be between a concentration in soil and the concentration in groundwater in contact with the soil, but it should be noted that phenol is soluble and, in general, a given soil-concentration implies a higher concentration in the liquid phase. Concentrations of up to 250 mg/l have been reported in groundwater from gasworks*".

5.6.57 Potential sources of phenol on or in the vicinity of the site have not been identified. Leachable or groundwater concentrations of phenols were not determined during the recent ground investigations. On this basis, inhibition of concrete curing or loss of strength due to phenols is considered to be highly unlikely and the associated risk is assessed as **Very Low**.

Degradation of pile materials

5.6.58 Concrete in contact with contaminated soils or groundwater may be subject to chemical attack, resulting in degradation of the concrete. Such degradation could reduce the effectiveness of the seal between the structure and surrounding ground resulting in pathways to open along the soil/structure interface, increasing the risk of pollution scenarios 1 and 5. In particularly aggressive scenarios, degradation of concrete can cause structural weakness leading to long term settlement or eventual collapse of structures.

5.6.59 An assessment of measured concentrations of naturally occurring sulphates and acids is presented in the GIRs for each Section of the Project contained within ES Appendix 11.2 Geotechnical and Geo-environmental reports, Volume II (Document reference 6.2, DCO Volume 6), providing appropriate Design Sulphate Classes and ACEC that are appropriate for the buried concrete throughout each Section of the Project, noting that the recommendations of [24] should be followed in the design of mixes for buried concrete for the classifications given.

5.6.60 Other potentially aggressive conditions include attack by chloride and hydrocarbons. On the basis of the ground investigations undertaken, these conditions are not considered to be present at the Site. Nonetheless, the design of the Project should be undertaken in accordance with the design recommendations given in Table F.1 of BS EN 206:2013 + A2:2021.

5.6.61 The degree of harm, given the nature of the source (High - 4) and significance of the receptor (High - 4) is assessed as Medium. Assuming the use of an appropriate concrete mix, the probability of degradation of in-ground concrete due to attack by aggressive chemicals or naturally occurring sulphates and acids is assessed to be Unlikely.

5.6.62 By combining a Medium consequence and Unlikely probability, as per Table 5-5, the associated risk of degradation of concrete and the associated creation of new pathways is assessed to be **Low**.

Pollution scenario 5

5.6.63 Pollution Scenario 5 considers the potential for creation of preferential pathways to allow upward migration of landfill gas or contaminant vapours to the surface.

5.6.64 As stated in [1]:

> *"The only situation where gas migration may potentially be enhanced by piles other than H or I piles is where driven or bored piles penetrate a stiff over consolidated clay layer that is very thin (thickness less than two pile diameters) at shallow depth and that covers a gas source under pressure*.
>
> *In most sites in the UK where diffusive flow of gas through the ground will be dominant (i.e. the gas source is not recent landfill or mine workings), large displacement-driven piles or replacement piles will not cause preferential pathways for ground gas migration. This assumes the piles are constructed with reasonable standards of workmanship and quality assurance in appropriate ground conditions (e.g. obstructions will not damage driven tube piles).* [8] *advised that there is no reason to increase the category of risk associated with ground gas, or the characteristic situation (CS) in BS 8485 because piled foundations are being used."*

5.6.65 The proposed piled foundations are therefore not considered to increase the risks posed by landfill gases that may be present and will not form preferential pathways for gas migration.

5.6.66 It is considered highly unlikely that the landfills (as indicated by the EA) in the vicinity of the trenchless crossings and AGP Sites benefit from a low permeability capping layer and none are recent landfills. Credible ground gas hazards to human health have not been identified during the work undertaken to date, and therefore this pollution scenario will not be considered further.

Pollution scenario 6

5.6.67 Pollution Scenario 6 considers causing of off-Site migration of ground gas or increased vertical emissions as a result of vibration or other effects from the pile installation process.

5.6.68 As stated above, credible on-Site ground gas hazards to human health have not been identified during the work undertaken to date, and therefore this pollution scenario will not be considered further.

Pollution scenario 7

5.6.69 Pollution Scenario 7 considers direct contact of site workers and others with contaminated soil arisings, which have been brought to the surface.

5.6.70 Potential hazards to human health within the on-Site soils have not been identified with the exception of a single positive detection of asbestos in the Made Ground at the reception shaft for the trenchless crossing beneath Botley Road (B3035) and the River Hamble.

5.6.71 The contaminant linkage assessed, and the assessed significance of the potential source, pathway and receptor are summarised in Table 5-14.

Table 5-14 Pollution scenario 7 - significance of potential pollution linkage

Link	Description	Comment	Source Significance / Receptor Sensitivity
Source	Asbestos within Made Ground	A single piece of chrysotile asbestos containing cement board (quantification result of 0.147 %) was identified within the Made Ground at the reception shaft for the trenchless crossing beneath Botley Road (B3035) and the River Hamble.	High (4)
Pathway	Contact with excavated arisings	Construction workers undertaking the shaft construction works will excavate the Made Ground to construct the shaft. Asbestos could be mobilised to the air in dust and particles, which could then be inhaled or ingested by construction workers and users of the neighbouring land.	-
Receptor	Construction workers and users of neighbouring land	The critical receptor is construction workers undertaking the shaft construction works and users of the neighbouring land who could inhale dust containing asbestos fibres.	High (4)

5.6.72 The identified hazards to human health are limited to a single detection of asbestos within shallow Made Ground at a single exploratory hole.

5.6.73 The degree of harm, given the nature of the source (Made Ground containing asbestos - High (4)) and significance of the receptor (construction workers – High (4)) is assessed as Medium, with a likelihood of realising this linkage (in absence of mitigation) assessed as 'Likely'. By combining a Medium consequence and Likely probability, as per Table 5-5, the associated risk is assessed to be **Moderate**.

5.6.74 It is noted that this risk is assessed in absence of any mitigation measures. It will be the responsibility of the Principal Contractor undertaking the construction works to prepare suitable Risk Assessments and Method Statements (RAMS) for excavating soil containing asbestos and to discharge their duties under the Control of Asbestos Regulations 2012, to prevent harm occurring to their staff.

5.6.75 In addition, in line with prevailing regulations (such as the Construction (Design and Management) Regulations, 2015) and prevailing good practice, appropriate protective clothing and equipment will be worn by site workers; and good standards of hygiene adopted to prevent prolonged skin contact, inhalation and ingestion of soils during construction, whilst appropriate methods of working will be selected to limit the potential for air-borne dust to arise associated with the excavation and disturbance of soils.

5.6.76 The inclusion of mitigation measures does not alter the sensitivity of the receptor or the magnitude of the hazard (i.e., the consequence), which remains as Medium but does reduce the likelihood of the risk being realised to Unlikely. By combining a Medium consequence and an Unlikely (including mitigation) probability, as per Table 5-5, the associated risk is assessed to be **Low**.

6 Mitigation measures

6.1 General

6.1.1 Remediation measures to mitigate potential risks to the groundwater are not deemed necessary. However, the following general mitigation measures are assumed as part of this assessment:

- Outline Construction Environmental Management Plan (CEMP) presenting construction and operational good practice measures (prevention of the creation of new pollution, personal protective equipment, safe methods of work).
- Assurance of a high standard of work by selecting a competent contractor(s) to carry out the piling, shaft construction and trenchless crossing construction works, ideally with prior experience in similar conditions.
- Appropriate risk assessment and method statements (RAMS) as required by the Construction (Design and Management) Regulations 2015.
- Cleaning down equipment if any obvious smearing or contaminated materials is observed to be adhering to the piling machinery, with any contaminated water resulting from this contained and disposed of appropriately as per the piling method statement.
- Appropriate personal protection and dust control measures during site works to minimise exposure for construction workers and users of the neighbouring land.
- Collection and appropriate disposal of waste concrete and other arisings at the surface.
- Protocol for dealing with unexpected contamination.
- Appropriate concrete mix/metal selection and appropriate design life of the development.
- A watching brief should be put in place to identify any visual indication of increased turbidity within watercourses during trenchless crossing construction and should this occur a stop placed on the works, until visual impact dispersed and piling method and rates reviewed.

6.1.2 In addition to the above, the storage of materials e.g., cement, grout, additives, diesel, cleaning chemicals etc. will all require control. Controls for materials storage will be provided within the CEMP.

6.2 CFA piles

6.2.1 Mitigation measures specifically relating to CFA piles (or other bored cast in-situ piles) are as follows:

- Design of piles to try to minimise penetration into the Chalk e.g. by considering larger pile groups with shorter piles.
- Placement of concrete at a rate consistent with the withdrawal of the auger to ensure support of the soil during CFA piling.

- A risk assessment in accordance with BRE Special Digest 1:2005 conducted at detailed design stage in order to verify the concrete class. This will result in the risks of pile degradation being negligible.
- Design of the concrete mix for the piles to limit bleeding into pore spaces.

6.3 Trenchless crossings

6.3.1 In addition to the general mitigation measures, the mitigation measures specifically relating to shaft and trenchless crossing construction are as follows:

- Design of shafts to try to minimise penetration into the Chalk by tailoring to local ground conditions.
- Cut off walls to be designed to optimise stability of the diaphragm wall trench by tailoring to local ground conditions.
- Design of the concrete mix for the diaphragm walls and piles to limit bleeding into pore spaces.
- Design of grout and fissure grouting methodology to limit excess dispersal through the Chalk.
- Additives and conditioning agents should be appropriately selected with the exclusion of substances that could be hazardous to the environment. The EA should be consulted by the contractor should any potentially hazardous additives be proposed for use.
- A risk assessment in accordance with BRE Special Digest 1:2005 conducted at detailed design state in order to verify the concrete class. This will result in the risks of pile degradation being negligible.
- An Outline Water Monitoring Plan to identify significant changes in groundwater levels/ contamination levels in key locations during construction, and a CP established.
- Appropriate construction methodology developed by the contractor to mitigate and remediate bentonite break outs that could occur during the works.
- Appropriate storage/ treatment of potentially contaminated water pumped out during dewatering to inhibit contamination of ground or surface water bodies.

6.3.2 For the trenchless crossing beneath the agricultural land to the south-west of Batsford Lane and un-named tributary of the River Itchen, and the trenchless crossing trenchless crossing beneath agricultural land, woodland, River Itchen and Bournemouth (Waterloo to Weymouth) Main Line railway, construction-driven increases in turbidity present a potential hazard to the potable supply abstractions at Otterbourne PS. For these trenchless crossings, the following additional mitigation measures are recommended (and should be reviewed following development of the detailed design):

- The Applicant as the operator of the abstraction boreholes, should ascertain if the wells within 250 m of the trenchless crossing need to be pumping during the period of the works.

- Sentinel monitoring boreholes may need to be installed into the Chalk within the SPZ1, between the proposed trenchless crossing and the abstraction boreholes. These boreholes would have instruments installed to provide turbidity data that would give an 'early warning' of turbidity 'spikes' before these are recorded at the abstraction boreholes. Note that the drilling of these boreholes could itself cause localised and short-term increases in turbidity. Baseline conditions should be defined from continuous monitoring of turbidity, chloride and pH within these boreholes for a period of one month prior to construction commencing.
- The data should be reviewed and used to determine appropriate compliance criteria against which the results of monitoring undertaken during and for a period of one month after construction may be is compared. Should evidence of increased turbidity, pH or chloride be recorded a stop should be immediately placed on the works until the impacts are dispersed, following which excavation rates should be reviewed.

6.4 Considerations

6.4.1 Following completion of the detailed design a detailed FWRA will be prepared, replacing this outline FWRA. The detailed FWRA, prepared following completion of the detailed design process, will specify quality assurance and quality control (QA/QC) procedures suitable for the adopted methods of construction.

6.4.2 Engagement and consultation with the EA, Havant Borough Council, Portsmouth Water and other relevant consultees will be continued in order to address relevant concerns and clarify regulatory requirements for the works as above including any required licences, permits and consents, e.g., for dewatering.

7 Conclusion

7.1.1 This Outline FWRA has followed the approach recommended in the guidance [1], which considers the pollution scenarios shown below with respect to piling and penetrative ground improvement methods. These scenarios have been assessed (where necessary) and the associated risks are summarised below.

7.1.2 Pollution scenario 1 - Creation of preferential pathways, through a low permeability layer to cause contamination of groundwater in an aquifer:

- Relevant only for the trenchless crossing beneath agricultural land, woodland, River Itchen and Bournemouth (Waterloo to Weymouth) Main Line railway. Risk assessed as **Moderate** in absence of any mitigation. To be reviewed following development of shaft construction methodology.

7.1.3 Pollution scenario 2 - The driving of solid contaminants down into an aquifer during construction:

- On the basis that contamination within the on-Site soils has not been encountered, with the exception of a single piece of asbestos containing material (not considered to be a hazard to groundwater), this Pollution Scenario does not require assessment.

7.1.4 Pollution scenario 3 - Contamination of groundwater and, subsequently, surface waters by turbidity, support fluids, concrete, cement paste or grout:

- Increased turbidity – In absence of mitigation, risks are assessed as **Very Low** within the Secondary A aquifer, and **Moderate to Very High** in the Chalk Principal aquifer.
- Loss of high pH and high chloride water from concrete – Assuming the use of an appropriate concrete design with additives to reduce amount of water used in the mix and thereby reduce the amount of concrete loss and bleed the risks are assessed as **Low to Moderate**.
- Bentonite support fluid break-out – Assuming the contractor will develop their construction methodology to mitigate and remediate breakout during excavation and an Outline Water Monitoring Plan, the risks are assessed as **Moderate**.
- Fissure grout dispersal – Assuming the use of a thixotropic grout mix, properly mixed, with suitably selected dispersal additives that make it more resistant to washout, injected in-line with industry good practice at selected injection pressures that are carefully administered and monitored, it is considered that the risk of significant dispersal of fissure grout (if required) is **Low**.
- Contamination of groundwater by additives in slurry/concrete/grout – Assuming the selection of additives and conditioning agents excludes of substances that could be hazardous to the environment, and that the EA is consulted on any additives proposed, it is considered that the risk of contamination of groundwater by additives is **Very Low**.

7.1.5 Pollution scenario 4 - Direct contact of engineered structures with contaminated soil or leachate causing degradation of structural materials:

- Assuming the use of an appropriate concrete mix, the potential risk of degradation of in-ground concrete due to attack by aggressive chemicals or naturally occurring sulphates and acids is assessed to be **Very Low to Low**.

7.1.6 Pollution scenario 5 - Creation of preferential pathways to allow upward migration of landfill gas or contaminant vapours to the surface:

- Credible ground gas hazards to human health have not been identified during the work undertaken to date. No assessment required.

7.1.7 Pollution scenario 6 - Causing off site migration of ground gas or increased vertical emissions as a result of vibration or other effects from the pile installation process:

- Credible on-Site ground gas hazards have not been identified during the work undertaken to date. No assessment required.

7.1.8 Pollution scenario 7 - Direct contact of site workers and others with contaminated soil arisings which have been brought to the surface:

- Potential hazards to human health within the on-Site soils have not been identified with the exception of a single positive detection of asbestos in the Made Ground at the reception shaft for the trenchless crossing beneath Botley Road (B3035) and the River Hamble. Assuming the inclusion of the mitigation measures described in section 6 above, the associated risk is assessed to be **Low**.

7.1.9 The Outline FWRA demonstrates that technical solutions are feasible with mitigation measures that are protective of land quality and ground conditions receptors. The development of the Outline FWRA follows an iterative process, which is dependent on detailed design and therefore the mitigation measures discussed in this Outline FWRA are subject to change.

Glossary

Term	Definition
Above Ground Plant (AGP)	This collectively refers to the Intermediate Pumping Stations and Break Pressure Tanks.
As Low As Reasonably Practicable (ALARP)	Involves weighing a risk against the trouble, time and money needed to control it. Thus, ALARP describes the level to which we expect to see risks controlled.
Amenity	Refers to the qualities of a place that make it enjoyable and attractive to users of an area.
Ancient woodland	Woodland that has existed continuously since 1600 in England, Wales and Northern Ireland and is defined as an irreplaceable habitat.
Anthropogenic	Caused by humans or their activities.
Applicant	Southern Water Services Limited.
Aquitard	Geological formations that have low permeability and restrict the flow of water. They are often made up of clay, shale, or other fine-grained materials, and can act as barriers that prevent or restrict the movement of water between aquifers or between groundwater and surface water.
Baseline	The current environmental and social conditions within the Order Limits or within a study area. This provides a benchmark against which changes arising from the Proposed Development are assessed for each relevant assessment.
Break Pressure Tank (BPT)	BPT are anticipated to be required at high points along the pipeline route. Water is pumped to BPTs, where it then flows onwards using gravity from the tank. This reduces the amount of energy required to transfer water. BPTs reduce the overall maximum pressure in the pipeline system associated with changes in flow rate as a result of topography.
Budds Farm pumping station	A pumping station located at Budds Farm Wastewater Treatment Works to support the transfer of treated wastewater to the Water Recycling Plant site.
Budds Farm Wastewater Treatment Works (WTW)	An existing Southern Water site that treats wastewater from the Applicant's customers prior to release into the Solent from the Eastney Long Sea Outfall. The Proposed Development would utilise highly treated wastewater from the Budds Farm WTW to produce recycled water at the Water Recycling Plant site. Reject water would be transferred from the Water Recycling Plant back to Budds Farm WTW where a connection would be made for onwards transfer to the existing Eastney Transfer Tunnel, Eastney Pumping Station and Eastney Long Sea Outfall for discharge into the Solent.

Term	Definition
	Chemical filter washing at the Water Recycling Plant site would generate process waste that would be discharged via the foul sewer network to Budds Farm WTW for treatment.
Carbon dioxide (CO_2)	A naturally occurring gas, also a by-product of burning fossil fuels from fossil carbon deposits, such as oil, gas and coal, of burning biomass, of land use changes and of industrial processes (e.g. cement production). It is the principal anthropogenic greenhouse gas that affects the earth's radiative balance.
Climate	The general weather conditions prevailing over a long period of time. Climate change will see trends in the climate conditions changing (seasonal averages and extremes).
The Contractor	The Applicant or a person appointed by the Applicant or by anyone else having the benefit of part or all of the Development Consent Order to carry out any construction element of the Proposed Development or to operate the Proposed Development.
Development Consent Order (DCO)	A statutory order which provides consent for a project and means that a range of other consents, such as planning permission and listed building consent, will not be required. A DCO can also include powers authorising the compulsory acquisition and temporary possession of land and rights over land which is the subject of an application. A draft DCO (Document reference 3.1, DCO Volume 3) is submitted by the applicant as part of its application [25].
Drinking water	Water that has been treated to strict regulatory standards, ready for supply to domestic and non-domestic customers as drinking water.
Drought conditions	Droughts are naturally occurring events and are typically characterised by a prolonged period of abnormally low rainfall, leading to a shortage of water.
Eastney Long Sea Outfall (LSO)	An existing Southern Water infrastructure component used to release treated wastewater from Budds Farm Wastewater Treatment Works. No works to the Eastney LSO are proposed as part of the Proposed Development; however, reject water produced from the Water Recycling Plant will be released from the Eastney LSO using the Eastney Transfer Tunnel and Eastney Pumping Station.
Environmental Permit	A legal requirement under the Environmental Permitting (England and Wales) Regulations 2016 [26] that allows certain activities which could impact the environment or human health to be carried out, subject to conditions that control and reduce those impacts.
Environmental Statement (ES) (DCO Volume 7.4)	A document reporting the findings of the Environmental Impact Assessment which describes the likely significant effects arising from the Proposed Development on the

Term	Definition
	environment and measures proposed to mitigate likely significant effects.
Extreme drought	A drought event that occurs every 1-in-500 years, or a 0.2% chance of occurring in any given year .
Flood Risk Assessment (FRA) (Environmental Statement Appendix 19.1 Flood Risk Assessment, Volume II (Document reference 6.2, DCO Volume 6))	A technical report that evaluates the potential for flooding from all sources (e.g. fluvial, coastal, surface water, groundwater, reservoir and sewers) on a development site and proposes measures to manage and mitigate those risks. It is a crucial part of the planning process, ensuring that new developments are located and designed in a way that minimises the potential for flood damage and protects people and property both on the site and in the wider area. A FRA (Environmental Statement Appendix 19.1 Flood Risk Assessment, Volume II (Document reference 6.2, DCO Volume 6)) is submitted by the Applicant as part of the Development Consent Order application.
Flood Zone 1	Land having a less than 0.1% annual probability of river or sea flooding.
Flood Zone 2	Land having between a 1% and 0.1% annual probability of river flooding; or land having between a 0.5% and 0.1% annual probability of sea flooding.
Flood Zone 3a	Land having a 1% or greater annual probability of river flooding; or land having a 0.5% or greater annual probability of sea flooding.
Flood Zone 3b	Comprises land where water from rivers or sea has to flow or be stored in times of flood. Functional floodplain will normally compromise: Normally land having a 3.3% or greater annual probability of flooding, with any existing flood risk management infrastructure operating effectively, or Land that is designed to flood, even I it would only food in more extreme events (such as 0.1% annual probability of flooding).
Geophysical survey	The means of non-intrusive survey by systematic collection of measurements of physical properties of the earth to provide spatial information allowing interpretation of site formation processes and/or the potential presence of archaeologically significant remains.
Hampshire Water Transfer and Water Recycling Project	This is the name of the Proposed Development, that is the Strategic Resource Option being delivered as part of the Water For Life Hampshire programme. A water supply scheme comprising a combination of both water transfer and water recycling technology that would play a major role in making up the shortfall in water supply across the Hampshire supply area, especially in a drought.

Term	Definition
Havant Thicket Reservoir	The Havant Thicket Reservoir is a development under construction by Portsmouth Water that has planning permission granted by the relevant local planning authorities. Following the transfer of recycled water from the Water Recycling Plant site, the recycled water would be combined with water contained within the Havant Thicket Reservoir. The Proposed Development would use the Havant Thicket Reservoir for the storage of recycled water, before transfer to Otterbourne Water Supply Works.
Hazardous waste	Waste, or the material or substances it contains, which is harmful to humans or the environment, and is classified as hazardous in The Hazardous Waste (England and Wales) Regulations 2005 (SI 2005/894) .
Inert Waste	According to Directive 2008/98/EC [27] which is Retained European Union Legislation under the European Union (Withdrawal) Act 2018, inert waste is waste that: • Will not undergo any significant physical, chemical or biological transformations. • Will not dissolve. • Will not burn. • Will not physically or chemically react. • Will not biodegrade. • Will not adversely affect other matter with which it comes into contact in a way likely to give rise to environmental pollution or harm to human health. • Has insignificant total leachability and pollutant content. • Produces a leachate with an ecotoxicity that is insignificant (if it produces leachate).
Light Detection and Ranging (LiDAR)	A survey detection system based on radar principles using light. It makes 3-dimensional representations of areas of the Earth's surface.
Made Ground	Areas where natural deposits have been replaced or altered by the introduction of artificial deposits and/or imported natural materials.
Main River	Watercourses designated under the Water Resources Act 1991 [28] as ‘main’ are usually larger rivers and streams that are shown on the Environment Agency’s Statutory Main River map. The Environment Agency has permissive powers, but not a duty, to carry out maintenance, improvement or construction work on designated Main Rivers to manage flood risk.
Mitigation	Measures intended to avoid, prevent, reduce and, where possible, offset likely significant adverse environmental effects. Measures follow the mitigation hierarchy as described in section 5.3 of Environmental Statement

Term	Definition
	Chapter 5 EIA approach and methodology, Volume I (Document reference 6.1, DCO Volume 6).
Monitoring	Measures to ensure the systematic and ongoing collection, analysis and evaluation of data related to the implementation and performance of a development. Monitoring can be undertaken to monitor conditions in the future to verify any environmental effects identified by the Environmental Impact Assessment, the effectiveness of mitigation or enhancement measures or ensure remedial action are taken should adverse effects above a set threshold occur. All monitoring measures adopted by the Proposed Development are reflected in Environmental Statement Appendix 5.5 Commitments Register, Volume II (Document reference 6.2, DCO Volume 6).
Otterbourne Water Supply Works (WSW)	An existing Southern Water site which abstracts water from river Itchen and ground sources and will continue to do in certain circumstances after the Proposed Development. The Proposed Development would transfer source water from Havant Thicket Reservoir to Otterbourne WSW. The source water would be treated to strict regulatory standards at Otterbourne WSW prior to being supplied to customers.
Outline Construction Environmental Management Plan (CEMP) (Document reference 7.1, DCO Volume 7)	Contains identified topic specific mitigation measures to be adopted during construction and specifies plans and method statements to be produced by the Contractor to avoid and reduce environmental effects. Mitigation measures are generally tertiary mitigation, although some secondary mitigation measures are also included. The measures contained in the Outline CEMP are secured by a requirement in Schedule 2 to the Development Consent Order. Detailed CEMP(s) will be produced and submitted for approval in accordance with the corresponding requirement in Schedule 2 to the draft Development Consent Order (Document reference 3.1, DCO Volume 3).
Outline Foundation Works Risk Assessment (FWRA) (Document reference 7.4, DCO Volume 7)	A preliminary assessment prepared during the design phase that identifies potential risks associated with foundation works, such as piling or ground improvement, particularly in areas of contamination or sensitive ground conditions. It sets out initial mitigation measures and informs the development of detailed risk assessments post-consent.
Pipeline between the Water Recycling Plant site and Otterbourne Water Supply Works	An underground pipeline approximately 35 kilometres long would transfer up to approximately 90 megalitres per day of source water at maximum operation, from the Water Recycling Plant site to Otterbourne Water Supply Works. Above Ground Plant would support the transfer of water from the Water Recycling Plant site to Otterbourne Water Supply Works.

Term	Definition
	Due to the length of the pipeline, it has been divided into sections: Section D: The Water Recycling Plant site to Portsdown Hill Section E: Portsdown Hill to Boarhunt Section F: Boarhunt to Crockerhill Section G: Crockerhill to Wickham Section H: Wickham to Shedfield Section J: Shedfield to the River Hamble Section K: The River Hamble to Lower Upham Section L: Lower Upham to Brambridge Section M: Brambridge to Otterbourne Water Supply Works
Pipelines between Budds Farm Wastewater Treatment Works and the Water Recycling Plant site	Two pipelines between Budds Farm Wastewater Treatment Works and the Water Recycling Plant site: one to transfer treated wastewater from Budds Farm Wastewater Treatment Works to the Water Recycling Plant site and the other to transfer reject water from the Water Recycling Plant site to Budds Farm Wastewater Treatment Works. The Pipelines would connect to the existing treated wastewater release infrastructure and the reject water would be released via the existing Eastney Long Sea Outfall using the existing Eastney Transfer Tunnel and Eastney Pumping Station. The development required to connect into the existing treated wastewater infrastructure would form part of this component of the Proposed Development. The Pipelines between Budds Farm Wastewater Treatment works and the Water Recycling Plant site would be installed on the same route under the Hermitage Stream and Harts Farm Way and would be approximately 700m in length. The Pipelines between Budds Farm Wastewater Treatment works and the Water Recycling Plant site would transfer a maximum flow of approximately 82 Mega litres per day (Ml/d) of treated wastewater to the Water Recycling Plant site. The pipeline from the Water Recycling Plant site to Budds Farm Wastewater Treatment Works would be sized for the same transfer capacity of approximately 82Ml/d as it may be necessary to return the maximum volume of water being treated back to Budds Farm Wastewater Treatment Works.
Pipelines between the Water Recycling Plant site and Bedhampton Springs	The Pipelines would transfer recycled water from the Water Recycling Plant site to Bedhampton Springs, and source water from Bedhampton Springs back to the Water Recycling Plant site (before transfer to Otterbourne Water Supply Works). The Pipelines, connecting to pipelines being delivered by Portsmouth Water between Bedhampton Springs and Havant Thicket Reservoir, would enable the transfer at

Term	Definition
	maximum operation of approximately 60 megalitres per day (Ml/d) of recycled water from the Water Recycling Plant site to Havant Thicket Reservoir and approximately 90Ml/d of source water from Havant Thicket Reservoir to the Water Recycling Plant site, for onward transfer to Otterbourne Water Supply Works.
Preliminary Environmental Information (PEI) Report	The PEI Report sets out the information that "*is reasonably required for the consultation bodies to develop an informed view of the likely significant environmental effects of the development*" (Regulation 12(2)(b) of the Environmental Impact Assessment Regulations 2017 [29] as set out in Planning Inspectorate (2025) Nationally Significant Infrastructure Projects - Advice Note Seven: Environmental Impact Assessment: process, preliminary environmental information and environmental statements, Section 8.3 [30]). The PEI Report was consulted on at the Summer 2024 Consultation.
Principal Aquifer	Rocks or soils that provide significant quantities of water and can support water supply and/or baseflow to rivers, lakes and wetlands on a strategic scale. They typically have a high intergranular and/or fracture permeability, meaning they usually provide a high level of water storage.
Project	This refers to the Hampshire Water Transfer and Water Recycling Project, as described in Environmental Statement Chapter 3 Description of the Proposed Development, Volume I (Document reference 6.1, DCO Volume 6).
Ramsar site	A Ramsar site is the land listed as a Wetland of International Importance under The Convention on Wetlands of International Importance Especially as Waterfowl Habitat (the Ramsar Convention) established in 1971 and came into force in 1975.
Receptor	An individual, group or asset that receives an impact of effect.
Recycled water	Purified water that has been produced by taking treated wastewater and removing remaining impurities using advanced treatment techniques.
Reject water	During the water recycling process, reject water is produced. Reject water is water containing impurities removed from the treated wastewater and released using the existing Eastney Transfer Tunnel and Eastney Long Sea Outfall.
Release from the Eastney Long Sea Outfall (LSO)	The existing Eastney LSO releases treated wastewater from Budds Farm Wastewater Treatment Works via the existing Eastney Transfer Tunnel and Eastney Pumping Station. The Proposed Development would utilise the Eastney LSO for the release of reject water produced by the Water Recycling Plant site. During maximum operation approximately 22

Term	Definition
	Mega litres per day (Ml/d) of reject water would be released from the Eastney LSO. During minimum flow operation approximately 4Ml/d of reject water would be released from the Eastney LSO.
Remediation	An action taken to break or modify the source-pathway-receptor (contaminant) linkage so that the risks are removed or reduced to an acceptable level for the land use under consideration [31].
Secondary A aquifer	These are permeable layers capable of supporting water supplies at a local rather than strategic scale, and in some cases forming an important source of base flow to rivers. These are generally aquifers formerly classified as minor aquifers.
Secondary B aquifer	These are mainly lower permeability layers that may store and yield limited amounts of groundwater through characteristics like thin cracks (called fissures) and openings or eroded layers.
Secondary undifferentiated aquifer	This has been assigned in cases where it has not been possible to attribute either a Secondary A or B aquifer to the soil type due to the variable characteristics. In most cases, this means that the layer in question has previously been designated as both minor and non-aquifer in different locations due to the variable characteristics of the rock type.
Site of Special Scientific Interest (SSSI)	A nationally site designated by Natural England as an area of special interest by reason of any of its flora, fauna, geological or physiographical features. SSSI are legally protected under the Wildlife and Countryside Act 1981 (as amended) [32].
Source Protection Zone 1 (SPZ1)	Inner protection zone - defined as the 50-day travel time from any point below the water table to the abstraction source. This zone has a minimum radius of 50m radius from the source, whichever is larger.
Source Protection Zone 1c (SPZ1c)	Inner protection zone - defined as the 50-day travel time from any point below the water table to the abstraction source. This zone has a minimum radius of 50m and is where there is protective geology cover, such as clay.
Source Protection Zone 2 (SPZ2)	Outer protection zone - defined by a 400-day travel time. The zone will default to a minimum radius of 250m or 500m, depending on the size of the abstraction, if the 400-day travel time zone is smaller.
Source Protection Zone 2c (SPZ2c)	Outer protection zone – defined by a 400-day travel time. The zone will default to a minimum radius of 250m or 500m, depending on the size of the abstraction, if the 400-day travel time zone is smaller, and is where there is a protective geology cover of low permeability sat above a unit of high permeability.

Term	Definition
Source Protection Zone 3 (SPZ3)	Source catchment protection zone - defined as the area around an abstraction source within which all groundwater recharge is presumed to be discharged at the abstraction source.
Source water	Water that is used as a source for drinking water. For the Proposed Development, this water is treated to strict regulatory standards at the Otterbourne Water Supply Works before being supplied to customers.
Source-pathway-receptor linkage	For a risk to arise there must be hazard that consists of a 'source' (e.g. high rainfall); a 'receptor' (e.g. people, environment); and a pathway between the source and the receptor (e.g. flooding).
Special Area of Conservation (SAC)	Area(s) of protected habitat(s) and species as defined in the European Union Habitats Directive (92/43/EEC) [33].
Special Protection Area (SPA)	A designated area for birds under the European Union Directive on the Conservation of Wild Birds (2009/147/EC) [34].
Summer 2024 Consultation	The statutory consultation held in 2024 which consulted on the Proposed Development, including the draft Order Limits, the proposed pipeline routes, proposed sites for the Above Ground Plant and Water Recycling Plant, temporary construction compounds and any temporary or permanent access routes.
Trenchless crossings	Crossings where trenchless installation techniques will be used during construction of the Proposed Development.
Unproductive strata	These are predominantly rock layers or drift deposits with low permeability that have negligible significance for water supply or river base flow.
Waste	Any substance or object which the holder discards or intends to or is required to discard – unusable or unwanted.
Wastewater	A combination of water from kitchens, bathrooms, sinks and taps (in domestic and non-domestic properties) and rainwater from roads and roofs, that is transported to, and cleaned at, a wastewater treatment works.
Water for Life Hampshire	This is the programme being progressed by the Applicant to address the sustainability objectives of to meet demand following a reduction in abstractions on Hampshire's two main rivers - The Test and Itchen - and ensuring a resilient water supply for the Applicant's customers, especially during times of drought.
Water Recycling Plant (WRP)	The WRP would receive a total maximum volume of approximately 82 Mega litres per day (Ml/d) of treated wastewater from Budds Farm Wastewater Treatment Works. This would provide a maximum output of approximately 60Ml/d of recycled water. Approximately 22Ml/d of reject water is produced from the water recycling

Term	Definition
	process and would be combined with the existing Budds Farm Wastewater Treatment Works treated wastewater flows (that are generated by the existing operation of Budds Farm Wastewater Treatment Works), and released via the existing Eastney Transfer Tunnel, Eastney Pumping Station, and Eastney Long Sea Outfall operated by the Applicant.
Water Recycling Plant (WRP) site	The site containing the WRP, three pumping stations, a main process building, kiosks, administrative buildings and parking facilities. Located at a site north-west of Budds Farm Wastewater Treatment Works.
The Water Environment (Water Framework Directive) (England and Wales) Regulations 2017 (WER)	The WER [35] transpose the European Water Framework Directive 2000/60/EC into law in England and Wales.
The Water Framework Directive (Standards and Classification) Directions (England and Wales) 2015 (WFD Direction)	The WFD Direction [36] establish a series of thresholds that are used in the classification of water body status under the Water Environment (Water Framework Directive) England and Wales) Regulation 2017.

Abbreviations

Term	Definition
AA	Annual Average
ACM	Asbestos Containing Material
AGP	Above Ground Plant
AOD	Above Ordnance Datum
AONB	Area of Outstanding Natural Beauty
APFP	Application Form for Development Consent
AQS	Air Quality Standards
BaP	Benzo(a)pyrene
BGS	British Geological Survey
BLM	Biotic Ligand Model
BPT	Break Pressure Tank
BS	British Standards
BSI	British Standards Institution
BTEX	Benzene, Toluene, Ethylbenzene, and Xylene
bgl	Below Ground Level
CEMP	Construction Environmental Management Plan
CH_4	Methane
CFA	Continuous Flight Auger
CL:AIRE	Contaminated Land: Applications in Real Environments
CO_2	Carbon dioxide
CO_2e	Carbon dioxide equivalent
COD	Chemical Oxygen Demand
CSM	Conceptual Site Model
DCO	Development Consent Order
DEFRA	Department for Environment, Food and Rural Affairs
DWS	Drinking Water Standards
EA	Environment Agency
EPS	European Protected Species
EQS	Environmental Quality Standards
EQS-AA	Environmental Quality Standard – Annual Average
ES	Environmental Statement
FGL	Finished Ground Level
FWRA	Foundation Works Risk Assessment
GAC	Generic Assessment Criteria
GI	Ground Investigation

GIR	Geo-Environmental Interpretative Report
GL	Ground Level
GWDTE	Groundwater Dependent Terrestrial Ecosystem
HBC	Havant Borough Council
IPS	Intermediate Pumping Station
LiDAR	Light Detection and Ranging
km	Kilometre
LSO	Long Sea Outfall
MAGIC	Multi-Agency Geographic Information for the Countryside
mbgl	Metres Below Ground Level
mAOD	Metres Above Ordnance Datum
Ml/d	Megalitres per Day
NVZ	Nitrate Vulnerable Zone
NH_3	Ammonia
NH_4	Ammonium
NO_2	Nitrogen dioxide
NO_3	Nitrate
PCOC	Potential Contaminant of Concern
OD	Ordnance Datum
OS	Ordnance Survey
PAH	Polycyclic aromatic hydrocarbons
PFAS	Poly- and per-fluoroalkyl substances
PPE	Personal Protective Equipment
PSC	Potential Source of Contamination
SAC	Special Area of Conservation
SPA	Special Protection Area
SPZ	Source Protection Zone
SSSI	Site of Special Scientific Interest
SVOCs	Semi-volatile organic compounds
TBM	Tunnel Boring Machine
TPH	Total petroleum hydrocarbons
UK	United Kingdom
WFD	Water Framework Directive
WMP	Water Monitoring Plan
WRP	Water Recycling Plant
WSW	Water Supply Works
WTW	Wastewater Treatment Works

References

[1] CL:AIRE, “Piling and Penetrative Ground Improvement Methods and Land Affected by Contamination: Guidance on Pollution Prevention,” Contaminated Land: Applications in Real Environments, Reading, 2025.

[2] SOCOTEC, “Ground Investigation Report (Factual Account of Fieldwork Monitoring and Laboratory Testing), ref: G2034-22,” 2023.

[3] DEFRA, “Multi-Agency Geographic Information for the Countryside,” 2025. [Online]. Available: https://magic.defra.gov.uk/MagiCMap.aspx.

[4] P. e. a. Nathanial, The LQM/CIEH S4ULs for Human Health Risk Assessment, Nottingham: Land Quality Press, 2015.

[5] CL:AIRE, “Research Bulletin 17 - A pragmatic approach to ground gas risk assessment,” 2012.

[6] EA, Review of the Fate and Transport of Selected Contaminants in the Soil Environment - Draft Technical Report P5-079/TR1, 2003.

[7] EA, “Water Quality Sampling Point SO-G0006098,” 2025. [Online]. Available: https://environment.data.gov.uk/water-quality/view/sampling-point/SO-G0006098?_all=true .

[8] S. a. M. S. Wilson, “Piled foundations and pathways for ground gas migration in the UK.,” *Environmental Geotechnics ,* pp. 8(8):1-39, 2017.

[9] EA, “Land Contamination Risk Management,” 2025. [Online]. Available: https://www.gov.uk/government/publications/land-contamination-risk-management-lcrm.

[10] CIRIA, “C552- Contaminated land risk assessment. A guide to good practice,” CIRIA, 2001.

[11] Environment Agency, “Wallington below Southwick Water Body,” 2025. [Online]. Available: https://environment.data.gov.uk/catchment-planning/WaterBody/GB107042016360.

[12] Environment Agency 2, “Meon Water Body,” 2025. [Online]. Available: https://environment.data.gov.uk/catchment-planning/WaterBody/GB107042016640.

[13] Environment Agency 3, “Main River Hamble Water Body,” 2025. [Online]. Available: https://environment.data.gov.uk/catchment-planning/WaterBody/GB107042016250.

[14] Environment Agency 4, “Itchen Water Body Data Catchment Explorer,” 2025. [Online]. Available: https://environment.data.gov.uk/catchment-planning/WaterBody/GB107042022580.

[15] AGS, “Assessment and Mitigation of Turbidity Risks from Piling,” 2023.

[16] J. L. Sherard, “Basic Properties of Sand and Gravel Filters,” *Journal of the ASCE,* pp. Vol 110(GT6), pp 684 to 700, 1984a.

[17] J. L. Sherard, “Filters for Silts and Clays,” *Journal of the ASCE,* pp. Vol 110(GT6), pp 701 to 718, 1984b.

[18] National Highways, “Specification for Highway Works - Series 1600, Piling and Embedded Retaining Walls,” 2005.

[19] CIA, “Z17 - Tremie Concrete for Deep Foundations,” Concrete Institute of Australia, 2012.

[20] M. Larisch, “Fundemental Mechanisms of Concrete Bleeding in Bored Piles,” 2019.

[21] BRE, “Special Digest 1 Concrete in aggressive ground. 3rd edition (Includes February 2017 amendments),” Buildings Research Establishment - Construction Division, 2005.

[22] M. A. Smith, “The Effect of Phenol Upon Concrete,” *Magazine of Concrete Research,* pp. Volume 37, Issue 133, 1985.

[23] BRE, “Report BR 255 - Performance of Building Materials In Contaminated Land,” Buildings Research Establishment, 1994.

[24] BRE, “Special Digest 1 Concrete in aggressive ground. 3rd edition (Includes February 2017 amendments),” IHS BRE Press, Bracknell, 2017.

[25] Planning Inspectorate, “Nationally Significant Infrastructure Projects: Terms commonly used in the process,” 2025. [Online]. Available: https://www.gov.uk/guidance/nationally-significant-infrastructure-projects-terms-commonly-used-in-the-process?utm_medium=email&utm_campaign=govuk-notifications-topic&utm_source=0f8aa6eb-cfc8-41a1-af95-a3404f6622b5&utm_content=daily#development-consent-ord.

[26] UK Parliment, “The Environmental Permitting (England and Wales) Regulations 2016,” 2025. [Online]. Available: https://www.legislation.gov.uk/uksi/2016/1154/contents.

[27] European Union, *Directive 2008/98/EC of the European Parliament and of the Council of 19 November 2008 on waste and repealing certain Directives (Text with EEA relevance),* 2025.

[28] UK Parliament, “Water Resources Act 1991,” 2020. [Online]. Available: https://www.legislation.gov.uk/ukpga/1991/57/introduction.

[29] UK Parliament, “The Infrastructure Planning (Environmental Impact Assessment) Regulations 2017,” 2023. [Online]. Available: https://www.legislation.gov.uk/uksi/2017/572/introduction.

[30] Planning Inspectorate, “Nationally Significant Infrastructure Projects - Advice Note Seven: Environmental Impact Assessment: process, preliminary environmental information and environmental statements,” 2025. [Online]. Available: https://www.gov.uk/government/publications/nationally-significant-infrastructure-projects-advice-note-seven-environmental-impact-assessment-process-preliminary-environmental-information-an/nationally-significant-infrastructure-projects-advice-note-seven-e.

[31] CIRIA, “Remediation of contaminated soils,” No date. [Online]. Available: https://www.ciria.org/SOILCOP/SOILCOP/Knowledgebase/Remediation_of_contaminated_soils.aspx.

[32] UK Parliament, “Wildlife and Countryside Act 1981,” 2025. [Online]. Available: https://www.legislation.gov.uk/ukpga/1981/69.

[33] European Union, *Council Directive 92/43/EEC of 21 May 1992 on the on the conservation of natural habitats and of wild fauna and flora,* 2025.

[34] European Union, *Directive 2009/147/EC of the European Parliament and of the Council of 30 November 2009 on the conservation of wild birds (Codified version),* 2019.

[35] UK Parliament, "The Water Environment (Water Framework Directive) (England and Wales) Regulations 2017," 2022. [Online]. Available: https://www.legislation.gov.uk/uksi/2017/407/introduction/made.

[36] UK Parliament, *The Water Framework Directive (Standards and Classification) Directions (England and Wales) 2015.*

[37] Historic England, "Aerial Photo Explorer," 2023. [Online]. Available: https://historicengland.org.uk/images-books/archive/collections/aerial-photos/.

[38] e. a. Burris, "Tunnelling, Chalk and turbidity: conceptual model of risk to groundwater public water supplies. Quaterly Journal of Engineering Geology and Hydrogeology," 2020.

[39] McDonald, "A geophysical investigation of saline intrusion and geological structure beneath areas of tidal coastal wetland at Langstone Harbour, Hampshire, UK - Robert J. McDonald, Nicholas R.W. Russill, Marios Miliorizos and Jonathan W. Thomas," *Geological Sociery, London, Special Publications, ed. 130,* pp. 77 - 94, 1998.

[40] Hanson Cement, "Material Safety Data Sheet - Common Cements. Version 5," Maidenhead, 2015.

[41] EA, " Piling and penetrative ground improvement methods on land affected by contamination: Guidance on pollution prevention," Environment Agency National Groundwater & Contaminated Land Centre., 2001.

[42] Allen and Crane, The Chalk Aquifer of the Wessex Basin. Research Report RR/11/02., British Geological Society. Keyworth. Nottingham, 2019.

[43] Allen, et. al., The physical properties of major aquifers in England and Wales. British Geological Survey Technical Report WD/97/34, 1997.

[44] Hydrogeological Impact Assessment , "Preliminary Environmental Information Report - Appendix 19.4 Hydrogeological Impact Assessment, ref: 710166-ARU-EWE-XX-RP-L-00002," 2024.

[45] Section H Geotechnical and Geo-environmental Interpretive Report, 6.2 Vol2 ES Appendix 11.2, "Geotechnical and Geo-environmental Interpretative Report for Ground Investigation in Section H (Phase 2 and Phase 3B/3C). Ref: 710166-SWS-XX-XX-RP-GE-0104," Stantec, 2025d.

[46] Section J Geotechnical and Geo-environmental Interpretive Report, 6.2 Vol2 ES Appendix 11.2, "Geotechnical and Geo-environmental Interpretative Report for Ground Investigation in Section J (Phase 2 and Phase 3B/3C). Ref: 710166-SWS-XX-XX-RP-GE-0109," Stantec, 2025e.

[47] Section K Geotechnical and Geo-environmental Interpretive Report, 6.2 Vol2 ES Appendix 11.2, "Geotechnical and Geo-environmental Interpretative Report for Ground Investigation in Section K (Phase 2 and Phase 3B/3C). Ref: 710166-SWS-XX-XX-RP-GE-0105," Stantec, 2025f.

[48] Section L Geotechnical and Geo-environmental Interpretive Report, 6.2 Vol2 ES Appendix 11.2, “Geotechnical and Geo-environmental Interpretative Report for Ground Investigation in Section L (Phase 2 and Phase 3B/3C). Ref: 710166-SWS-XX-XX-RP-GE-0108,” Stantec, 2025g.

[49] Section M Geotechnical and Geo-environmental Interpretive Report, 6.2 Vol2 ES Appendix 11.2, “Geotechnical and Geo-environmental Interpretative Report for Ground Investigation in Section M (Phase 2 and Phase 3B/3C). Ref: 710166-SWS-XX-XX-RP-GE-00107,” Stantec, 2025h.

[50] Section E Geotechnical and Geo-environmental Interpretive Report, 6.2 Vol2 ES Appendix 11.2, “Hampshire Water Transfer and Water Recycling Project - Geotechnical and Geo-Environmental Interpretative Report for Ground Investigation in Section E (Phase 2 and Phase 3B/3C) - Ref: 710166-SWS-XX-XX-RP-GE-00101,” Stantec, 2025a.

[51] Section F Geotechnical and Geo-environmental Interpretive Report, 6.2 Vol2 ES Appendix 11.2, “Hampshire Water Transfer and Water Recycling Project - Geotechnical and Geo-Environmental Interpretative Report for Ground Investigation in Section F (Phase 2 and Phase 3B/3C) - Ref: 710166-SWS-XX-XX-RP-GE-00102,” Stantec, 2025b.

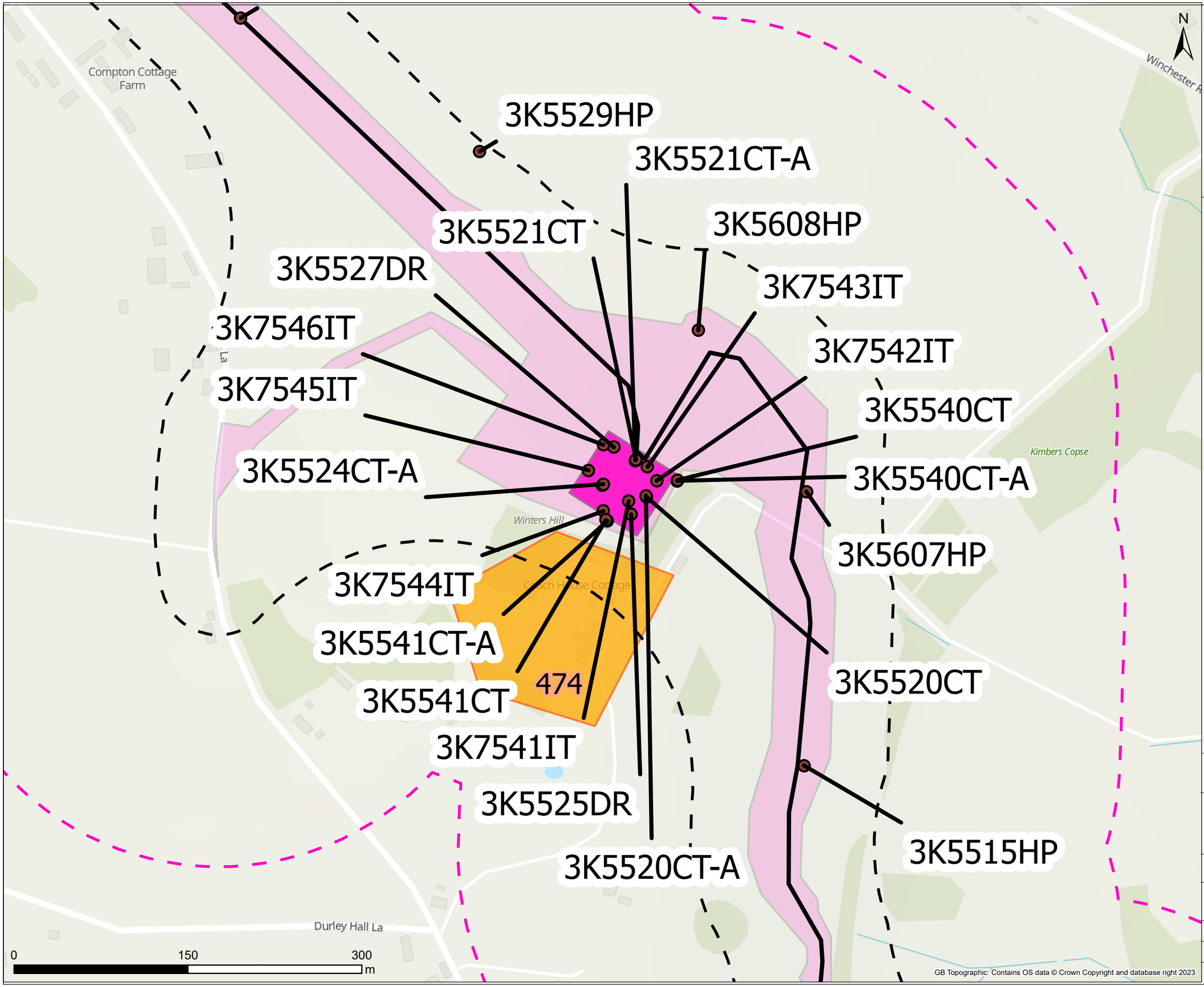
[52] Section G Geotechnical and Geo-environmental Interpretive Report, 6.2 Vol2 ES Appendix 11.2, “Hampshire Water Transfer and Water Recycling Project - Geotechnical and Geo-Environmental Interpretative Report for Ground Investigation in Section G (Phase 2 and Phase 3B/3C) - Ref: 710166-SWS-XX-XX-RP-GE-00103,” Stantec, 2025c.

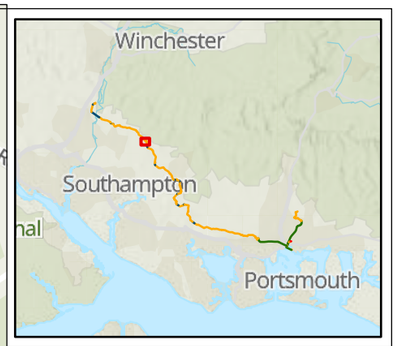
[53] WRP GIR, 6.2 Vol2 ES Appendix 11.2, “Havant Water Recycling Plant - Land Parcel 72, Geo-Environmental Interpretative Report, Version 3, ref: 331101000-RP-GEO-100.00948-710060-002,” Stantec, 2024.

[54] Pipelines Geotechnical and Geo-environmental Summary Report, 6.2 Vol2 ES Appendix 11.2, “Geotechnical and Geo-environmental Interpretative Ground Investigation Summary Report (Phase 2 and Phase 3B/3C) Ref 710166-SWS-XX-XX-RP-GE- 00100 Version P01.2”.

[55] Geotechnical and Geo-environmental Desk Study, 6.2 Vol2 ES Appendix 11.2, “Hampshire Water Transfer and Water Recycling Project - Geotechnical and Geo-environmental Desk Study - Version 4. Ref: 710166-SWS-XX-XX-RP-GE-00004,” Stantec.

Appendix A Figures Showing Locations of Trenchless Crossings and Above Ground Plant Sites





Legend

- Ground Investigation
- Draft Order Limits 50m buffer
- Draft Order Limits 250m buffer

GI Scoping Route

- Open cut

Draft Order Limits Sections

- A
- B
- C
- D
- E
- F
- G
- H
- J
- K
- L
- M

Above Ground Plant

- BPT K
- Potential Sources of Contamination

Contains Southern Water preliminary data - All site locations and routes shown are preliminary only and subject to further site selection assessment and stakeholder consultation.

GB Topographic: Contains OS data © Crown Copyright and database right 2023

Stantec

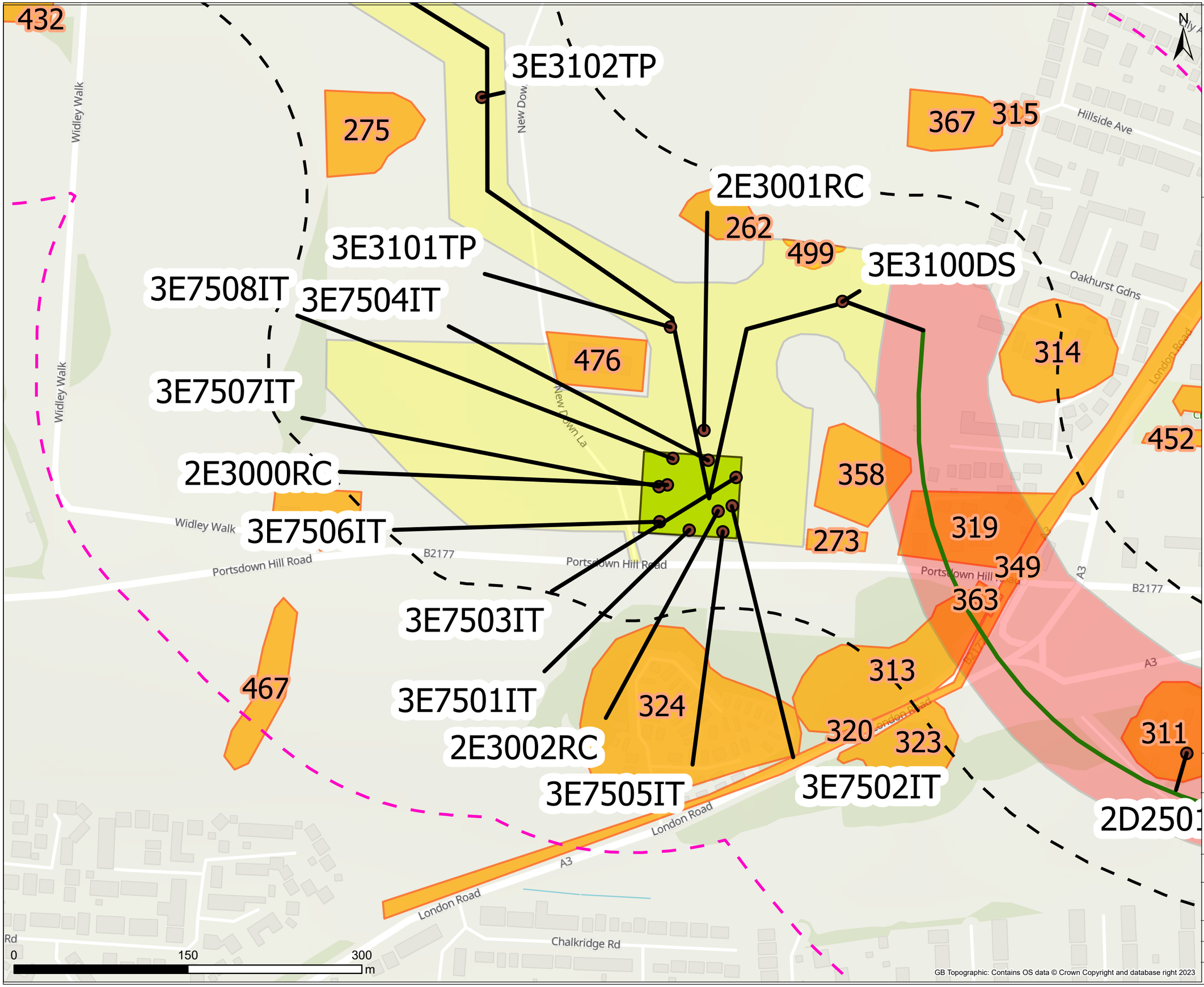
Southern Water
Southern House
Lewes Road
Falmer, Brighton
BN1 9PY

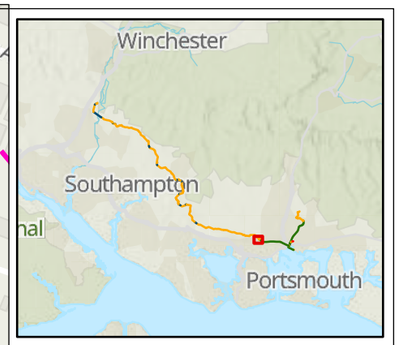
Southern Water

Project Title	Water For Life Hampshire
Drawing Title	Section BPT K (Detail) Ground Investigation Locations with PSCs

Scale	Date Drawn	Page	Sheet Size
1:3,000	27/11/2024	1.1	A3
Originator	Checker	Reviewer	Approver
SB	GS	AC	JH
Project No.			Revision
710166-SWS-XX-XX-SK-GE-00001			A

Document Path: C:\Southern Water\Hampshire Water for Life\Geo_MapSeries\GI_Scoping\GI_Scoping.aprx





Legend

- Ground Investigation
- Draft Order Limits 50m buffer
- Draft Order Limits 250m buffer

GI Scoping Route

- Open cut
- Tunnel

Draft Order Limits Sections

- A
- B
- C
- D
- E
- F
- G
- H
- J
- K
- L
- M

Above Ground Plant

- BPT-E /IPS-E
- Potential Sources of Contamination

Contains Southern Water preliminary data - All site locations and routes shown are preliminary only and subject to further site selection assessment and stakeholder consultation.

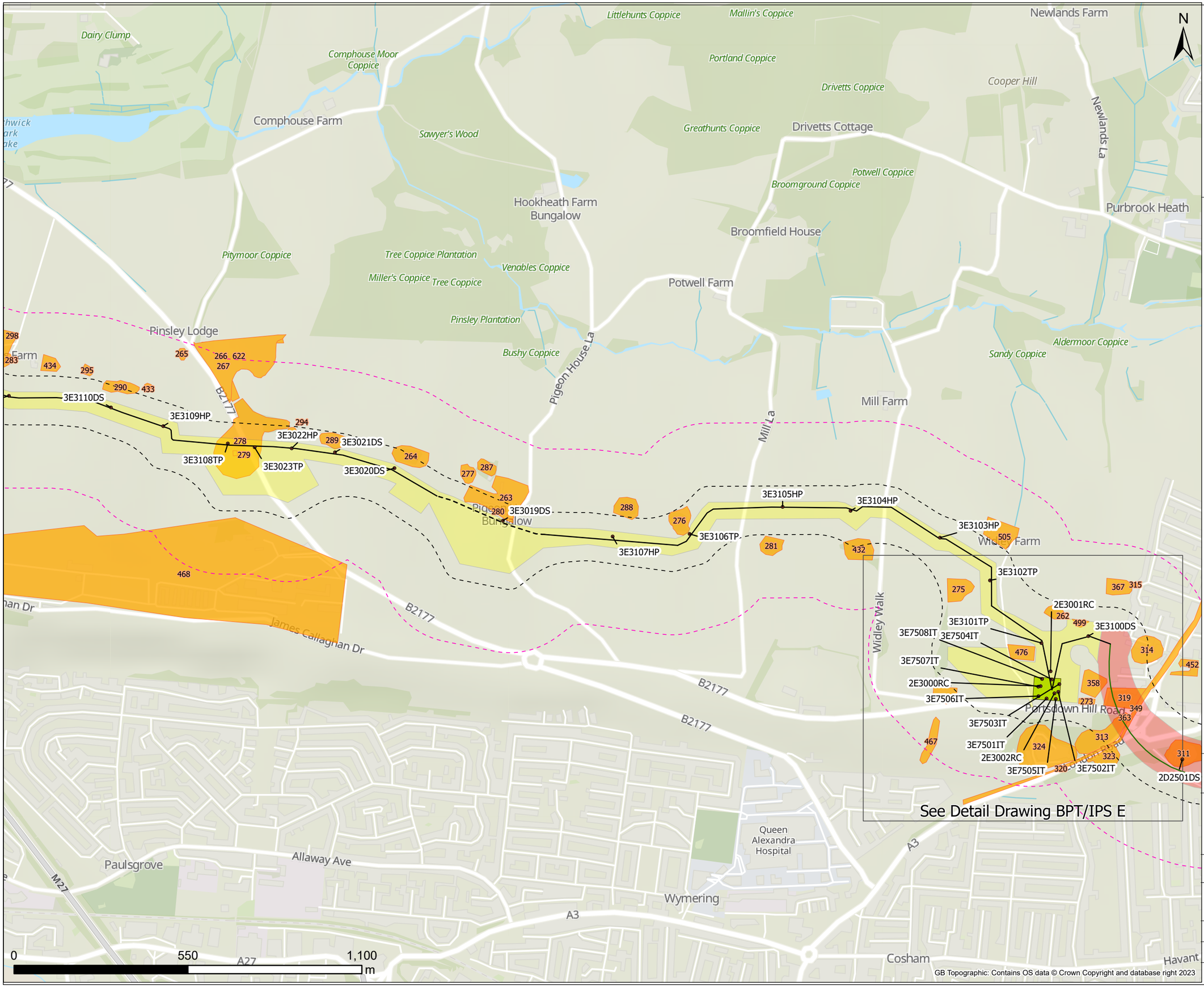
Stantec

Southern Water
Southern House
Lewes Road
Falmer, Brighton
BN1 9PY

Southern Water

Project Title	Water For Life Hampshire
Drawing Title	Section BPT/IPS E (Detail) Ground Investigation Locations with PSCs

Scale	Date Drawn	Page	Sheet Size
1:3,000	27/11/2024	1.1	A3
Originator	Checker	Reviewer	Approver
SB	GS	AC	JH
Project No.			Revision
710166-SWS-XX-XX-SK-GE-00001			A



Legend

- Ground Investigation
- Draft Order Limits 50m buffer
- Draft Order Limits 250m buffer

GI Scoping Route

- Open cut
- Open cut - Subject to Change
- Tunnel

Draft Order Limits Sections

- A
- B
- C
- D
- E
- F
- G
- H
- J
- K
- L
- M

Above Ground Plant

- BPT-E /IPS-E
- Potential Sources of Contamination

Contains Southern Water preliminary data - All site locations and routes shown are preliminary only and subject to further site selection assessment and stakeholder consultation.

GB Topographic: Contains OS data © Crown Copyright and database right 2023

Stantec

Southern Water
Southern House
Lewes Road
Falmer, Brighton
BN1 9PY

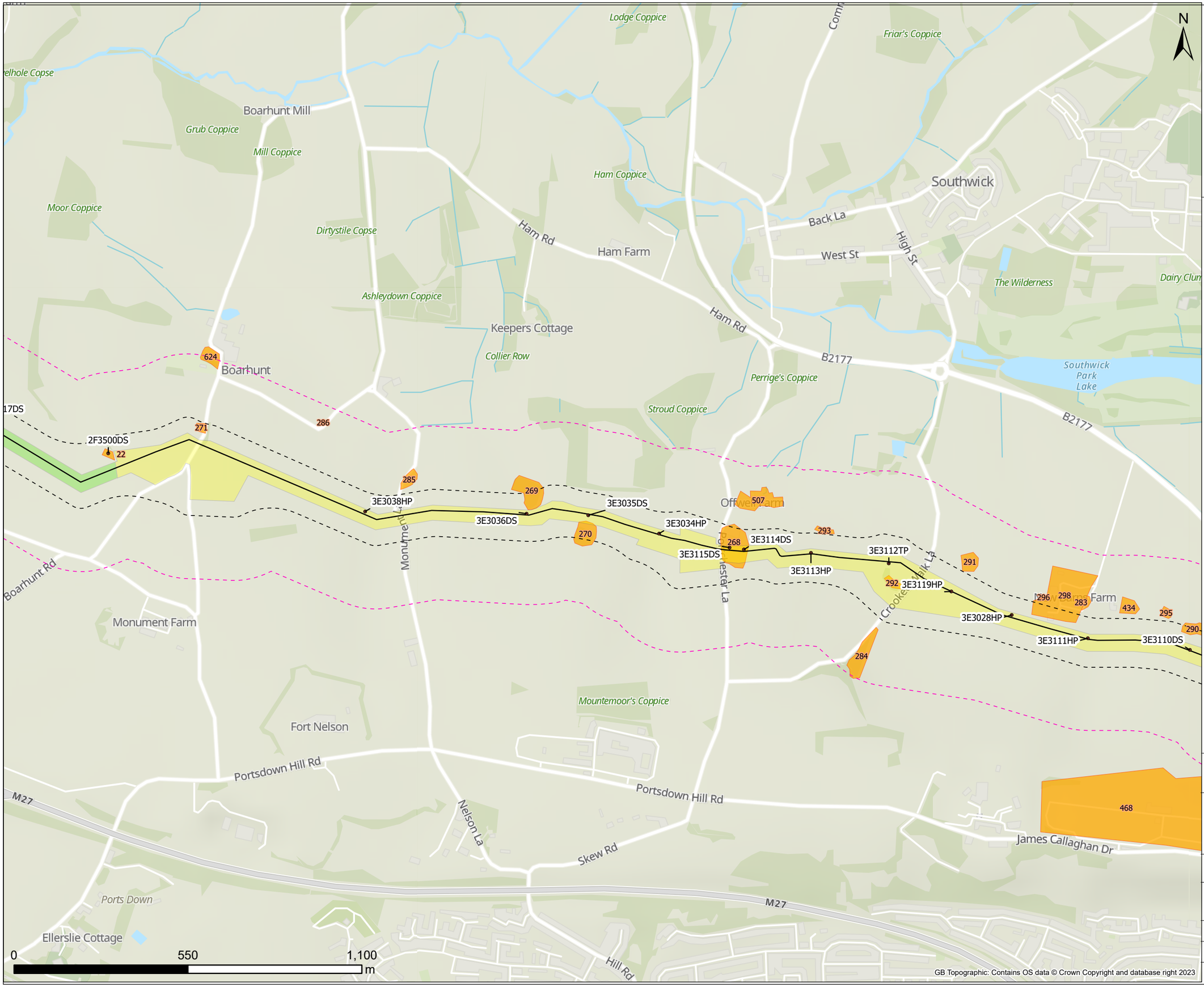
Southern Water

Project Title: Water For Life Hampshire

Drawing Title: Section E (East)
Ground Investigation Locations with PSCs

Scale	Date Drawn	Page	Sheet Size
1:11,000	27/11/2024	1.1	A3
Originator	Checker	Reviewer	Approver
SB	GS	AC	JH
Project No.			Revision
710166-SWS-XX-XX-SK-GE-00001			A

Document Path: C:\Southern Water\Hampshire Water for Life\Geo_MapSeries\GI_Scoping\GI_Scoping.aprx



Legend

- Ground Investigation
- Draft Order Limits 50m buffer
- Draft Order Limits 250m buffer

GI Scoping Route

- Open cut

Draft Order Limits Sections

- A
- B
- C
- D
- E
- F
- G
- H
- J
- K
- L
- M
- Potential Sources of Contamination

Contains Southern Water preliminary data - All site locations and routes shown are preliminary only and subject to further site selection assessment and stakeholder consultation.

Stantec

Southern Water
Southern House
Lewes Road
Falmer, Brighton
BN1 9PY

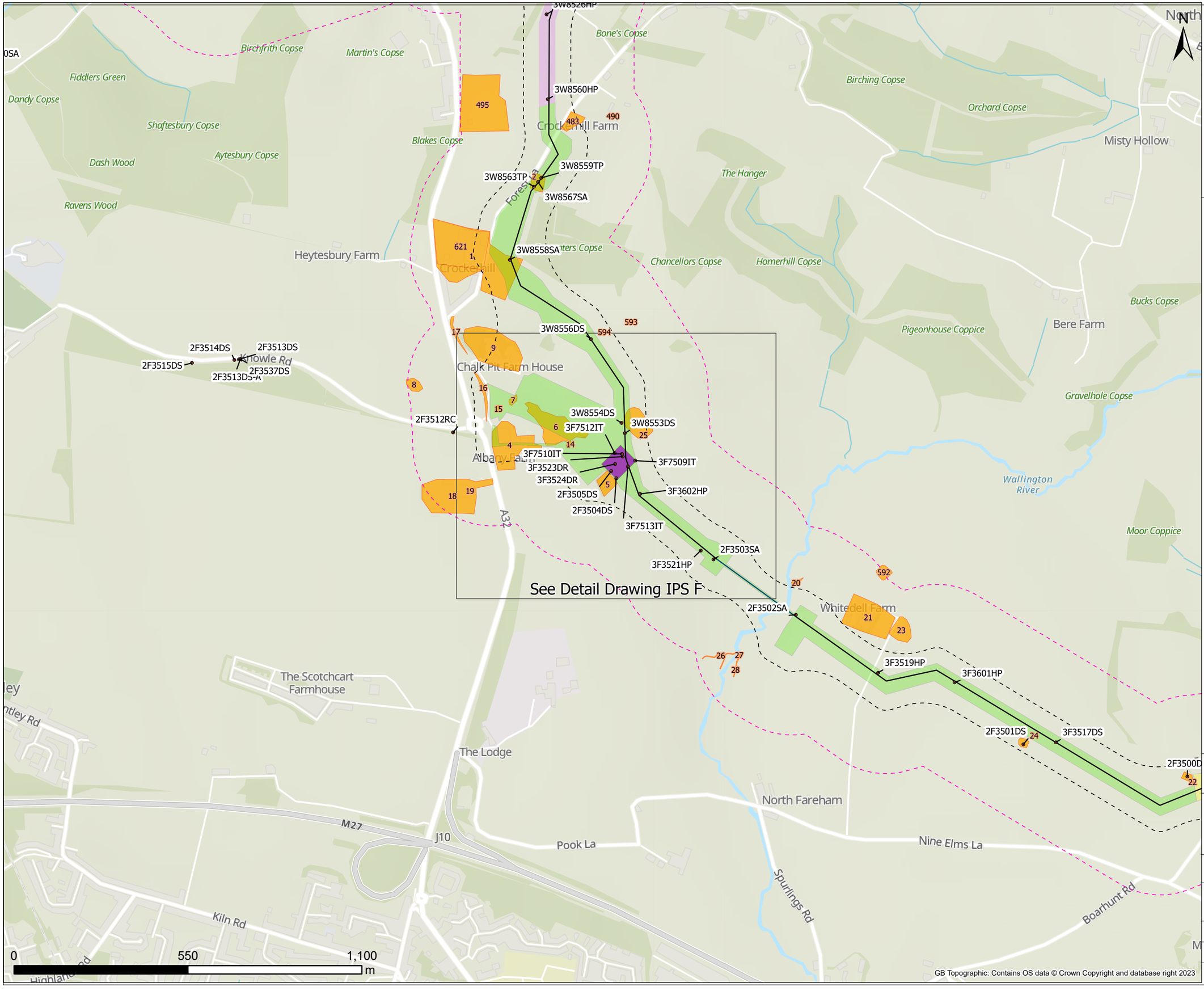
Southern Water

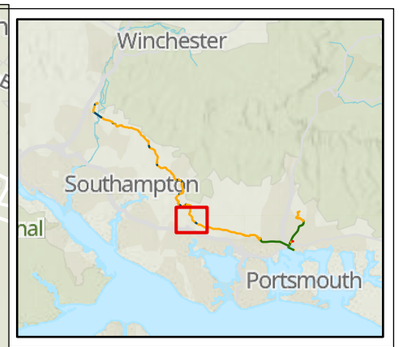
Project Title: Water For Life Hampshire

Drawing Title: Section E (West)
Ground Investigation Locations with PSCs

Scale	Date Drawn	Page	Sheet Size
1:11,000	27/11/2024	1.2	A3
Originator	Checker	Reviewer	Approver
SB	GS	AC	JH
Project No.			Revision
710166-SWS-XX-XX-SK-GE-00001			A

Document Path: C:\Southern Water\Hampshire Water for Life\Geo_MapSeries\GI_Scoping\GI_Scoping.aprx





Legend

- Ground Investigation
- Draft Order Limits 50m buffer
- Draft Order Limits 250m buffer

GI Scoping Route

- Open cut
- Trenchless

Draft Order Limits Sections

- A
- B
- C
- D
- E
- F
- G
- H
- J
- K
- L
- M

Above Ground Plant

- IPS F
- Potential Sources of Contamination

Contains Southern Water preliminary data - All site locations and routes shown are preliminary only and subject to further site selection assessment and stakeholder consultation.

Stantec

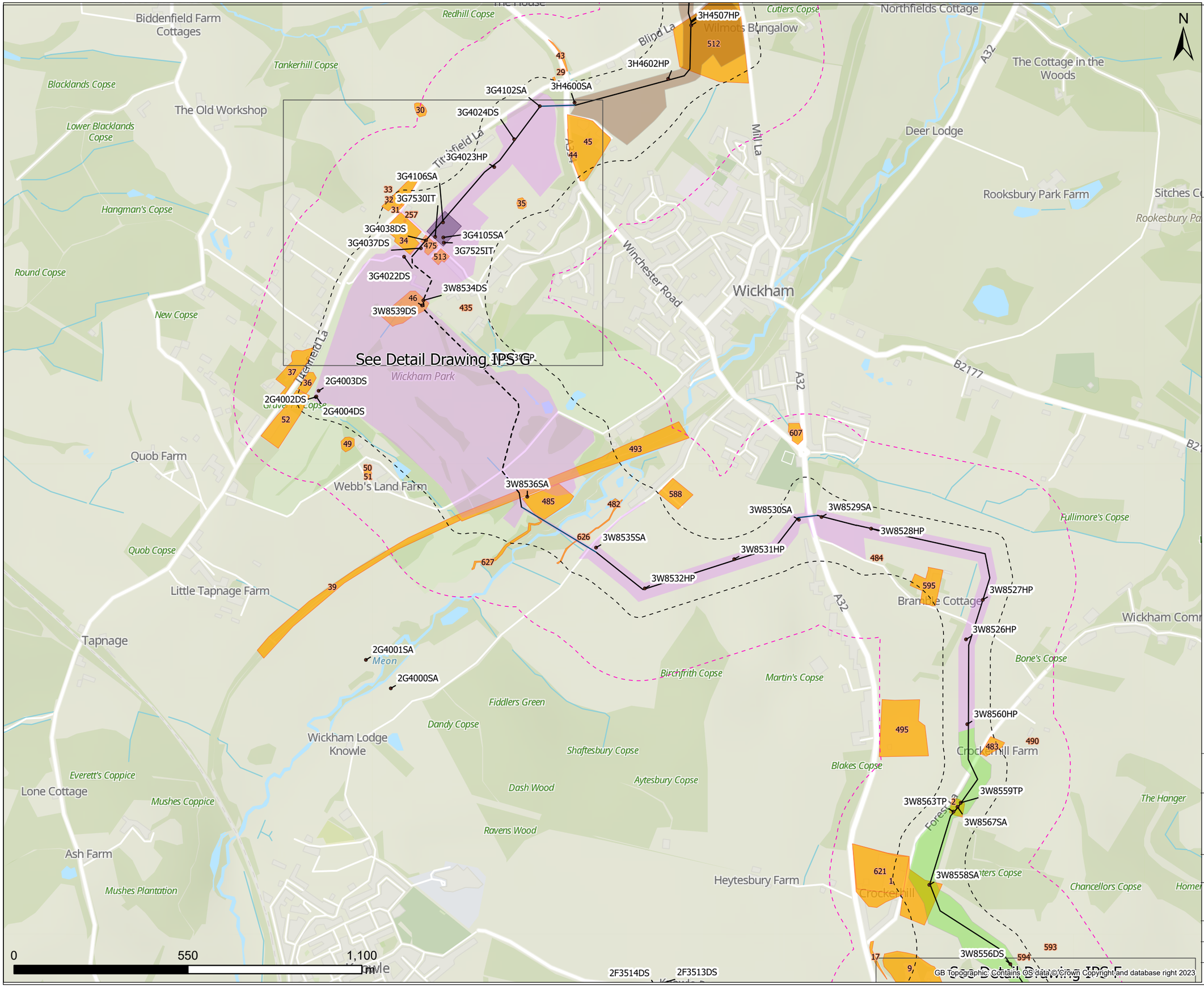
Southern Water
Southern House
Lewes Road
Falmer, Brighton
BN1 9PY

Southern Water

Project Title	Water For Life Hampshire
Drawing Title	Section F Ground Investigation Locations with PSCs

Scale	Date Drawn	Page	Sheet Size
1:11,000	27/11/2024	1.1	A3
Originator	Checker	Reviewer	Approver
SB	GS	AC	JH
Project No.			Revision
710166-SWS-XX-XX-SK-GE-00001			A

Document Path: C:\Southern Water\Hampshire Water for Life\Geo_MapSeries\GI_Scoping\GI_Scoping.aprx



Contains Southern Water preliminary data - All site locations and routes shown are preliminary only and subject to further site selection assessment and stakeholder consultation.

Stantec

Southern Water
Southern House
Lewes Road
Falmer, Brighton
BN1 9PY

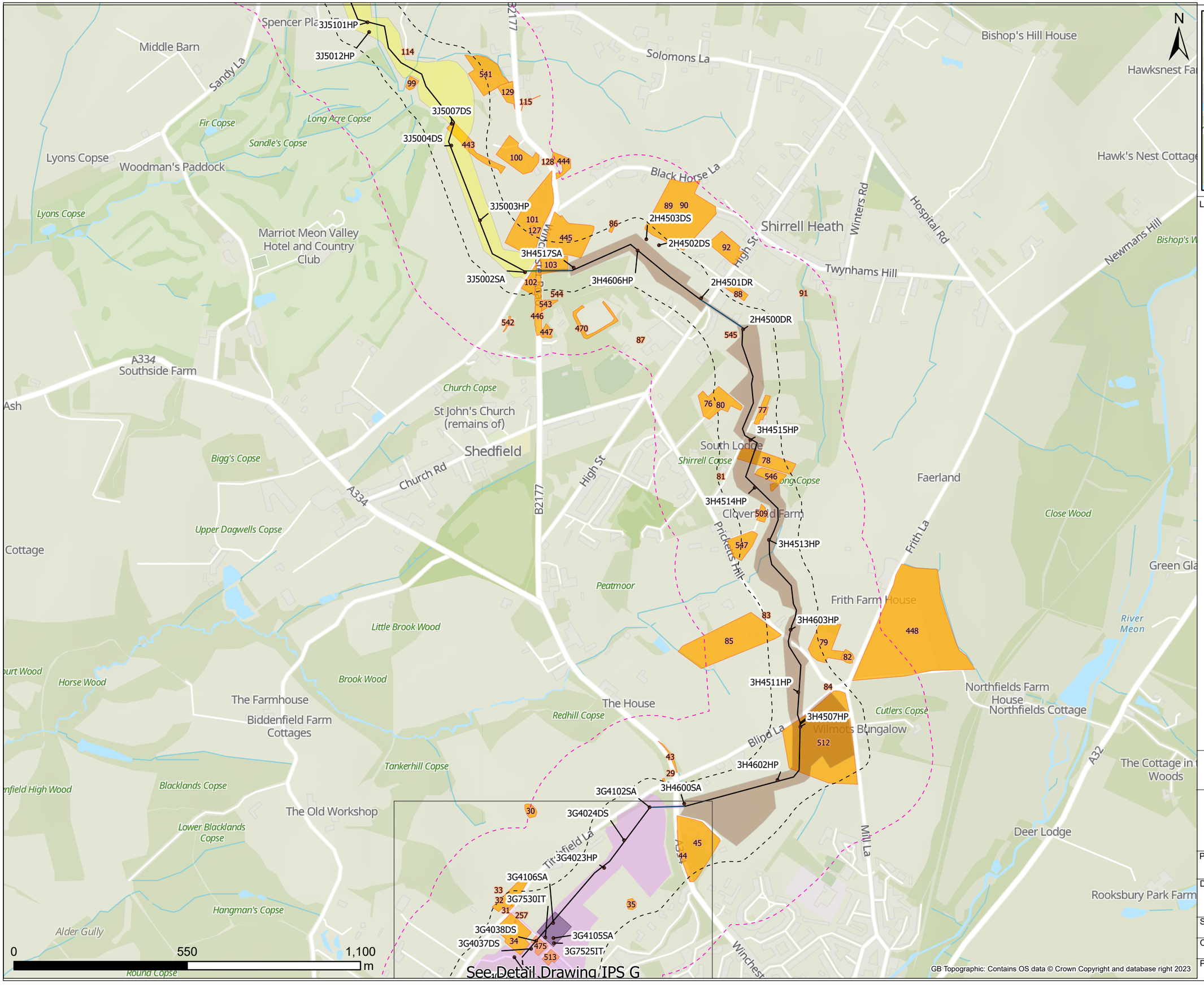
Southern Water

Project Title
Water For Life Hampshire

Drawing Title
Section G
Ground Investigation Locations with PSCs

Scale	Date Drawn	Page	Sheet Size
1:11,000	27/11/2024	1.1	A3
Originator	Checker	Reviewer	Approver
SB	GS	AC	JH
Project No.			Revision
710166-SWS-XX-XX-SK-GE-00001			A

Document Path: C:\Southern Water\Hampshire Water for Life\Geo_MapSeries\GI_Scoping\GI_Scoping.aprx



Legend

- Ground Investigation
- Draft Order Limits 50m buffer
- Draft Order Limits 250m buffer

GI Scoping Route

- Open cut
- Open cut - Subject to Change
- Trenchless

Draft Order Limits Sections

- A
- B
- C
- D
- E
- F
- G
- H
- J
- K
- L
- M

Above Ground Plant

- IPS G
- Potential Sources of Contamination

Contains Southern Water preliminary data - All site locations and routes shown are preliminary only and subject to further site selection assessment and stakeholder consultation.

Stantec

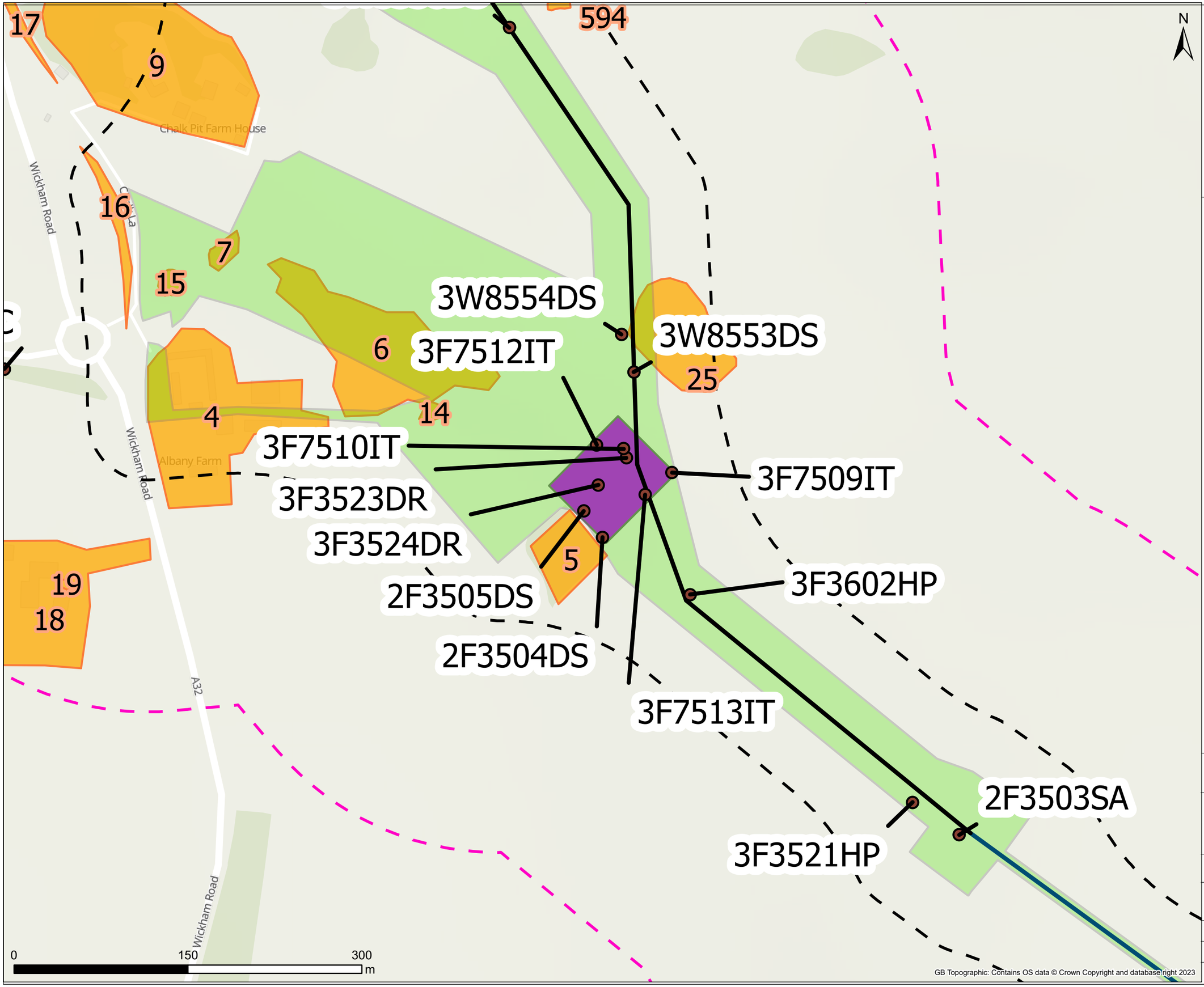
Southern Water
Southern House
Lewes Road
Falmer, Brighton
BN1 9PY

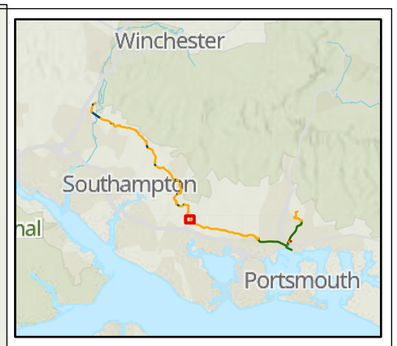
Southern Water

Project Title	Water For Life Hampshire
Drawing Title	Section H Ground Investigation Locations with PSCs

Scale	Date Drawn	Page	Sheet Size
1:11,000	27/11/2024	1.1	A3
Originator	Checker	Reviewer	Approver
SB	GS	AC	JH
Project No.			Revision
710166-SWS-XX-XX-SK-GE-00001			A

Document Path: C:\Southern Water\Hampshire Water for Life\Geo_MapSeries\GI_Scoping\GI_Scoping.aprx





Legend

- Ground Investigation
- Draft Order Limits 50m buffer
- Draft Order Limits 250m buffer

GI Scoping Route

- Open cut
- Trenchless

Draft Order Limits Sections

- A
- B
- C
- D
- E
- F
- G
- H
- J
- K
- L
- M

Above Ground Plant

- IPS F
- Potential Sources of Contamination

Contains Southern Water preliminary data - All site locations and routes shown are preliminary only and subject to further site selection assessment and stakeholder consultation.

Stantec

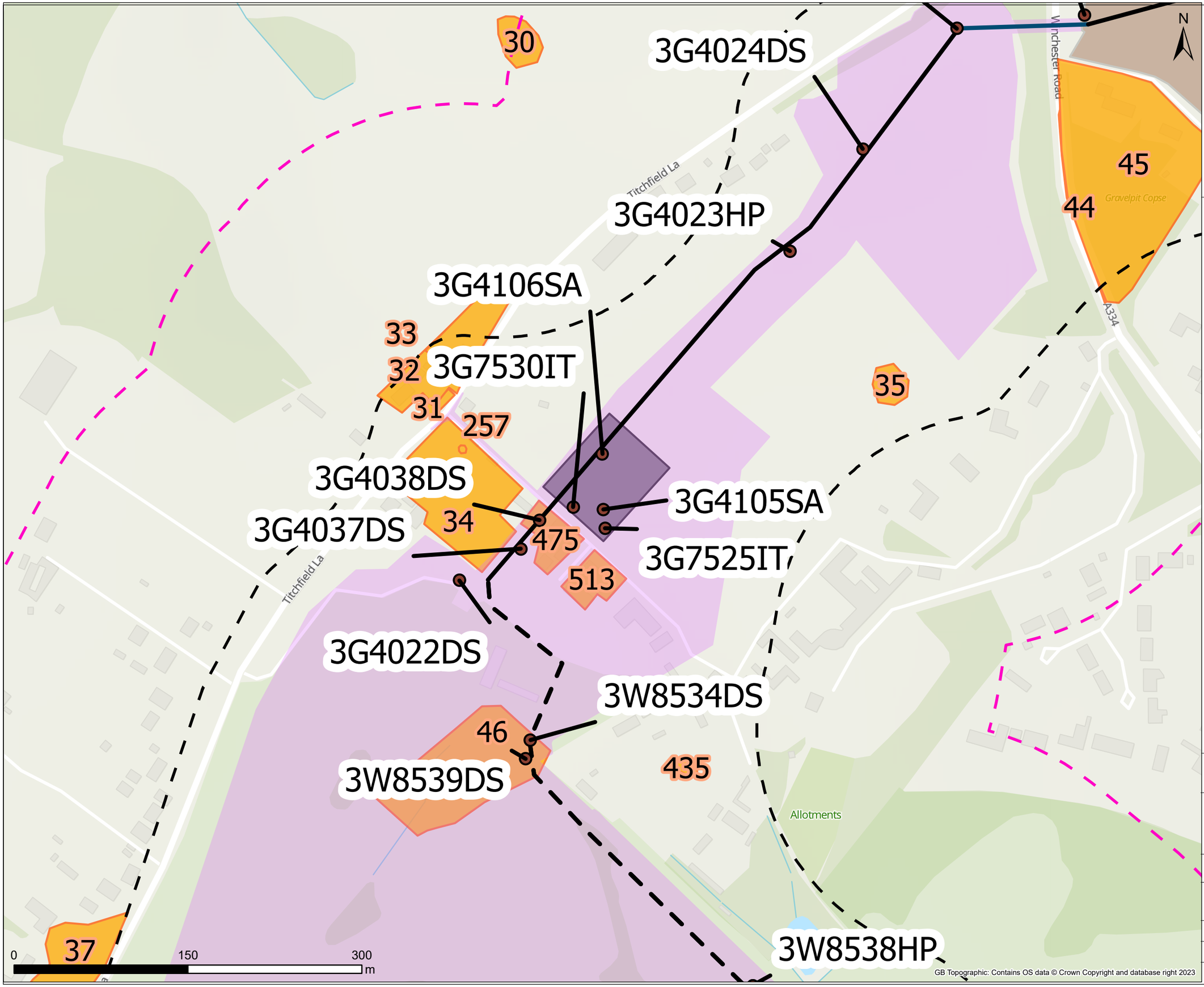
Southern Water
Southern House
Lewes Road
Falmer, Brighton
BN1 9PY

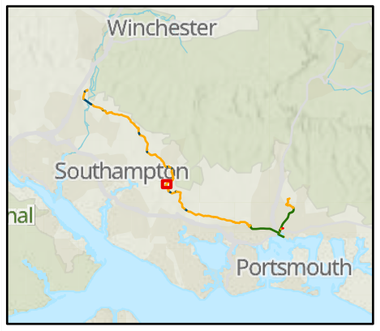
Southern Water

Project Title	Water For Life Hampshire
Drawing Title	Section IPS F (Detail) Ground Investigation Locations with PSCs

Scale	Date Drawn	Page	Sheet Size
1:3,000	27/11/2024	1.1	A3
Originator	Checker	Reviewer	Approver
SB	GS	AC	JH
Project No.			Revision
710166-SWS-XX-XX-SK-GE-00001			A

Document Path: C:\Southern Water\Hampshire Water for Life\Geo_MapSeries\GI_Scoping\GI_Scoping.aprx





Legend

- Ground Investigation
- Draft Order Limits 50m buffer
- Draft Order Limits 250m buffer

GI Scoping Route

- Open cut
- Open cut - Subject to Change
- Trenchless

Draft Order Limits Sections

- A
- B
- C
- D
- E
- F
- G
- H
- J
- K
- L
- M

Above Ground Plant

- IPS G
- Potential Sources of Contamination

Contains Southern Water preliminary data - All site locations and routes shown are preliminary only and subject to further site selection assessment and stakeholder consultation.

Stantec

Southern Water
Southern House
Lewes Road
Falmer, Brighton
BN1 9PY

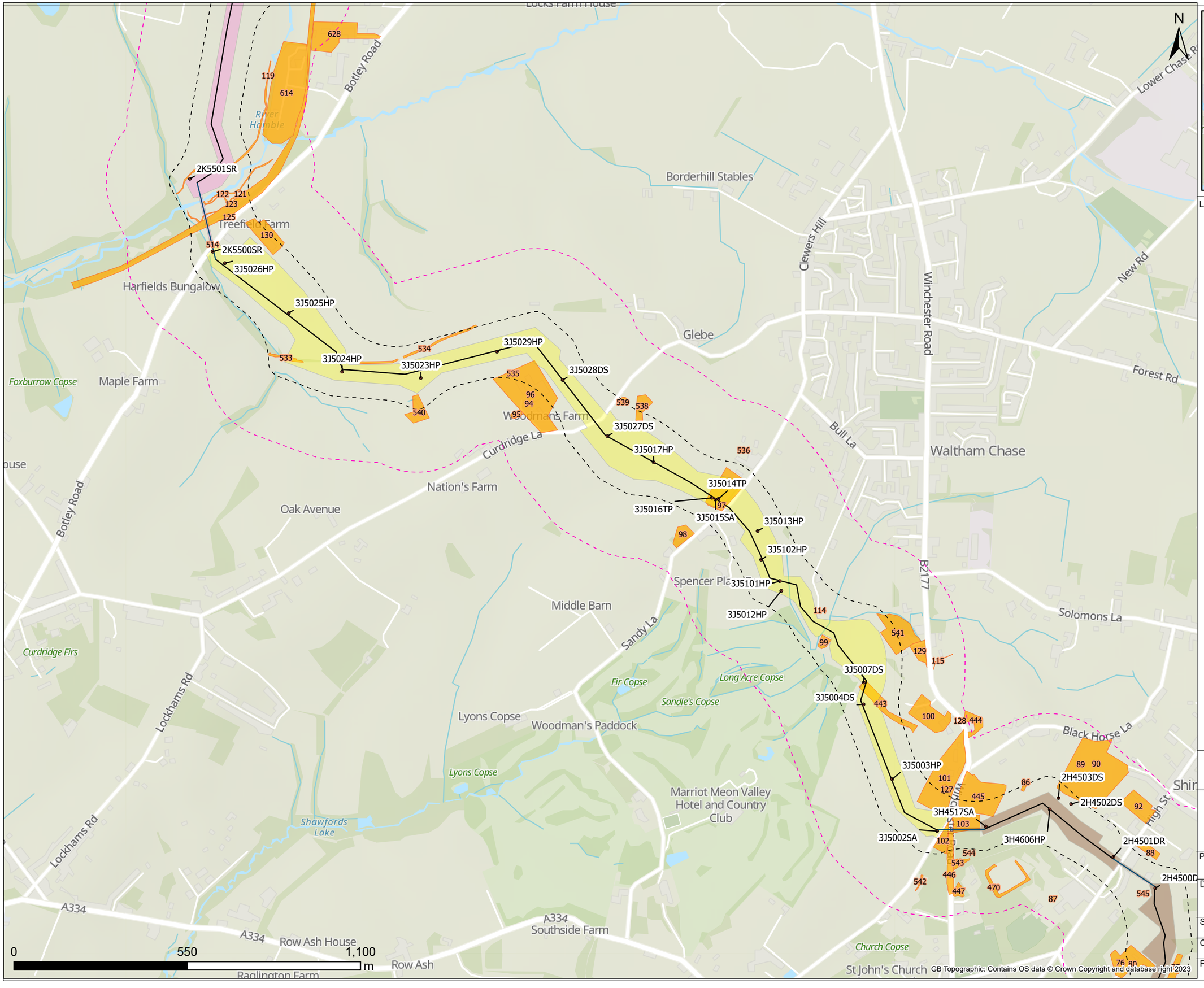
Southern Water

Project Title: Water For Life Hampshire

Drawing Title: Section IPS G (Detail)
Ground Investigation Locations with PSCs

Scale	Date Drawn	Page	Sheet Size
1:3,000	27/11/2024	1.1	A3
Originator	Checker	Reviewer	Approver
SB	GS	AC	JH
Project No.			Revision
710166-SWS-XX-XX-SK-GE-00001			A

Document Path: C:\Southern Water\Hampshire Water for Life\Geo_MapSeries\GI_Scoping\GI_Scoping.aprx



Legend

- Ground Investigation
- Draft Order Limits 50m buffer
- Draft Order Limits 250m buffer

GI Scoping Route

- Open cut
- Trenchless

Draft Order Limits Sections

- A
- B
- C
- D
- E
- F
- G
- H
- J
- K
- L
- M
- Potential Sources of Contamination

Contains Southern Water preliminary data - All site locations and routes shown are preliminary only and subject to further site selection assessment and stakeholder consultation.

Stantec

Southern Water
Southern House
Lewes Road
Falmer, Brighton
BN1 9PY

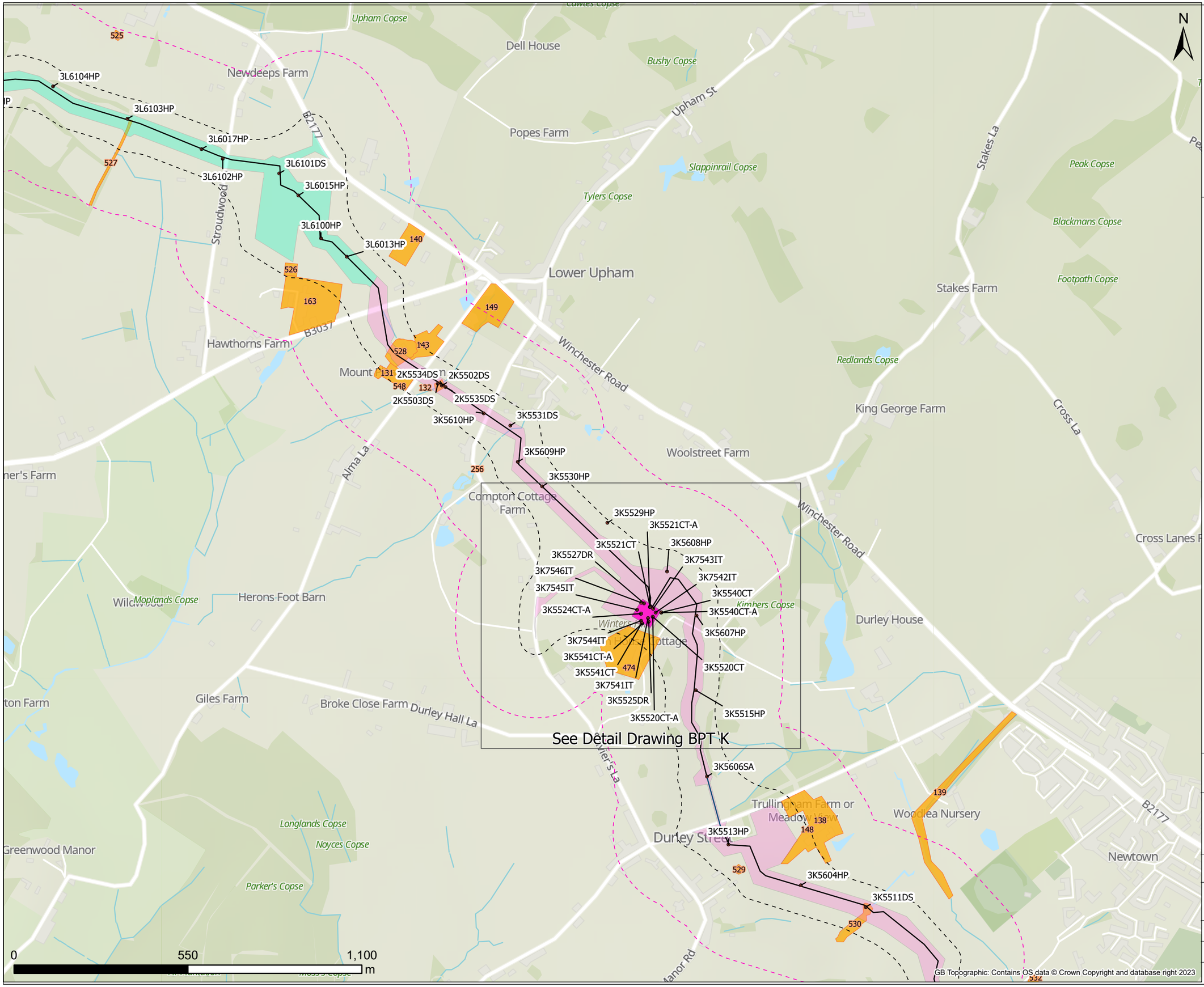
Southern Water

Project Title: Water For Life Hampshire

Drawing Title: Section J
Ground Investigation Locations with PSCs

Scale	Date Drawn	Page	Sheet Size
1:11,000	27/11/2024	1.1	A3
Originator	Checker	Reviewer	Approver
SB	GS	AC	JH
Project No.			Revision
710166-SWS-XX-XX-SK-GE-00001			A

Document Path: C:\Southern Water\Hampshire Water for Life\Geo_MapSeries\GI_Scoping\GI_Scoping.aprx



Contains Southern Water preliminary data - All site locations and routes shown are preliminary only and subject to further site selection assessment and stakeholder consultation.

Stantec

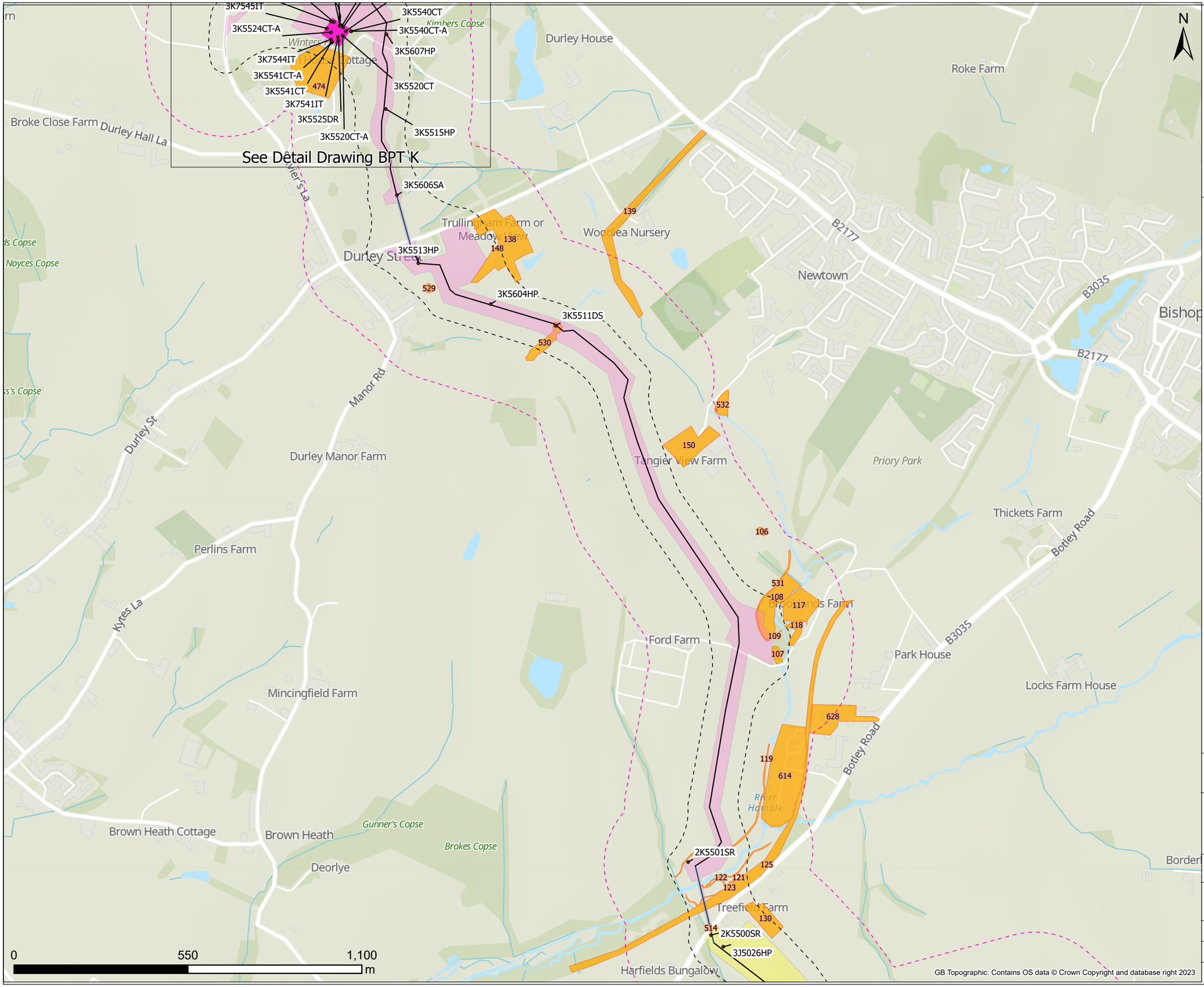
Southern Water
Southern House
Lewes Road
Falmer, Brighton
BN1 9PY

Southern Water

Project Title	Water For Life Hampshire
Drawing Title	Section K (NW) Ground Investigation Locations with PSCs

Scale	Date Drawn	Page	Sheet Size
1:11,000	27/11/2024	1.1	A3
Originator	**Checker**	**Reviewer**	**Approver**
SB	GS	AC	JH
Project No.			**Revision**
710166-SWS-XX-XX-SK-GE-00001			A

Document Path: C:\Southern Water\Hampshire Water for Life\Geo_MapSeries\GI_Scoping\GI_Scoping.aprx



Legend

- Ground Investigation
- Draft Order Limits 50m buffer
- Draft Order Limits 250m buffer

GI Scoping Route

- Open cut
- Trenchless

Draft Order Limits Sections

- A
- B
- C
- D
- E
- F
- G
- H
- J
- K
- L
- M

Above Ground Plant

- BPT K
- Potential Sources of Contamination

Contains Southern Water preliminary data - All site locations and routes shown are preliminary only and subject to further site selection assessment and stakeholder consultation.

Stantec

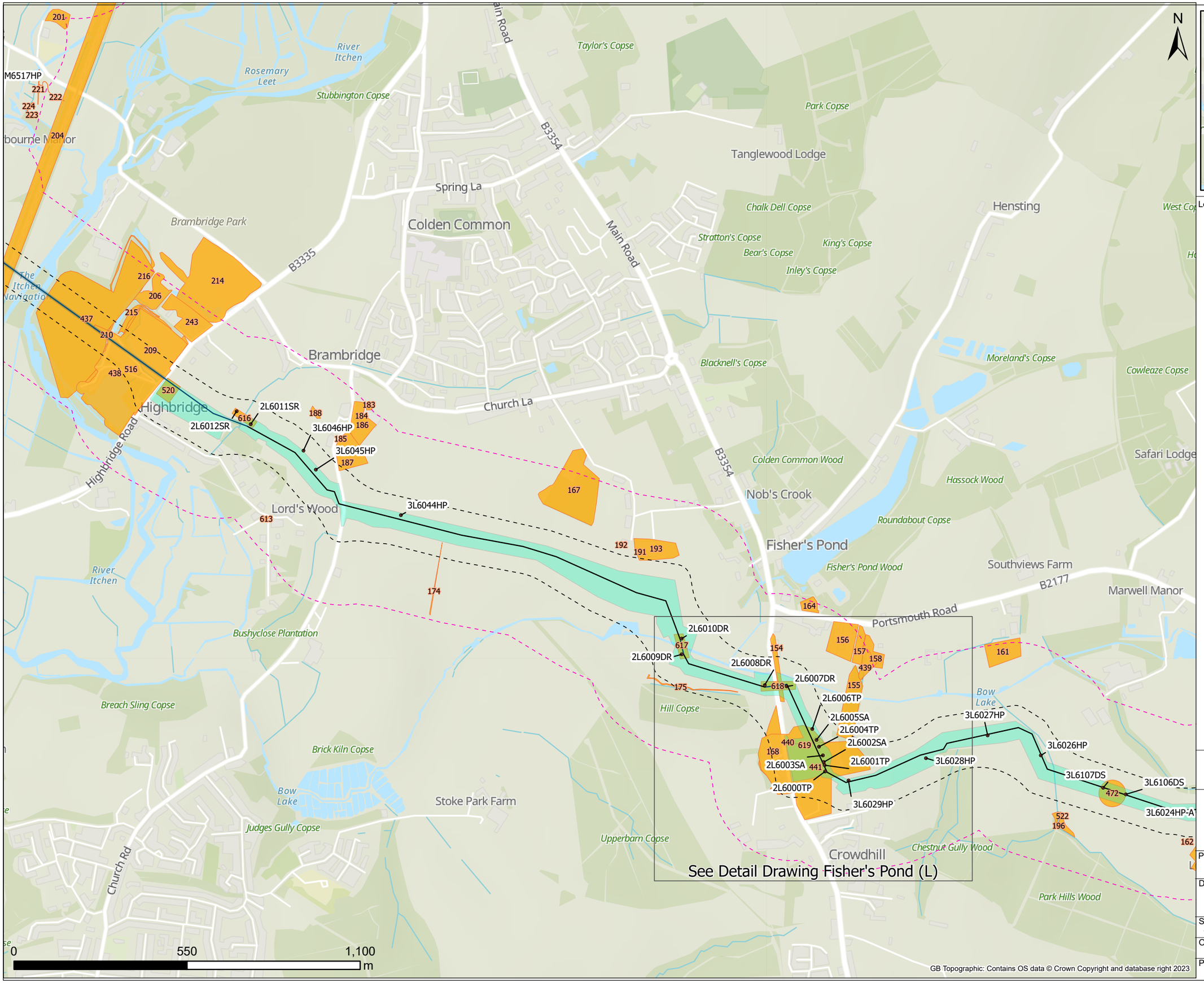
Southern Water
Southern House
Lewes Road
Falmer, Brighton
BN1 9PY

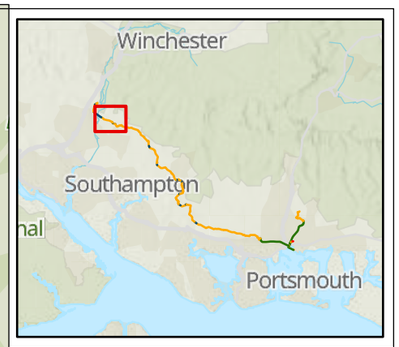
Southern Water

Project Title	Water For Life Hampshire
Drawing Title	Section K (SE) Ground Investigation Locations with PSCs

Scale	Date Drawn	Page	Sheet Size
1:11,000	27/11/2024	1.2	A3
Originator	Checker	Reviewer	Approver
SB	GS	AC	JH
Project No.			Revision
710166-SWS-XX-XX-SK-GE-00001			A

Document Path: C:\Southern Water\Hampshire Water for Life\Geo_MapSeries\GI_Scoping\GI_Scoping.aprx





Legend

- Ground Investigation
- Draft Order Limits 50m buffer
- Draft Order Limits 250m buffer

GI Scoping Route

- Open cut
- Trenchless

Draft Order Limits Sections

- A
- B
- C
- D
- E
- F
- G
- H
- J
- K
- L
- M
- Potential Sources of Contamination

Contains Southern Water preliminary data - All site locations and routes shown are preliminary only and subject to further site selection assessment and stakeholder consultation.

Stantec

Southern Water
Southern House
Lewes Road
Falmer, Brighton
BN1 9PY

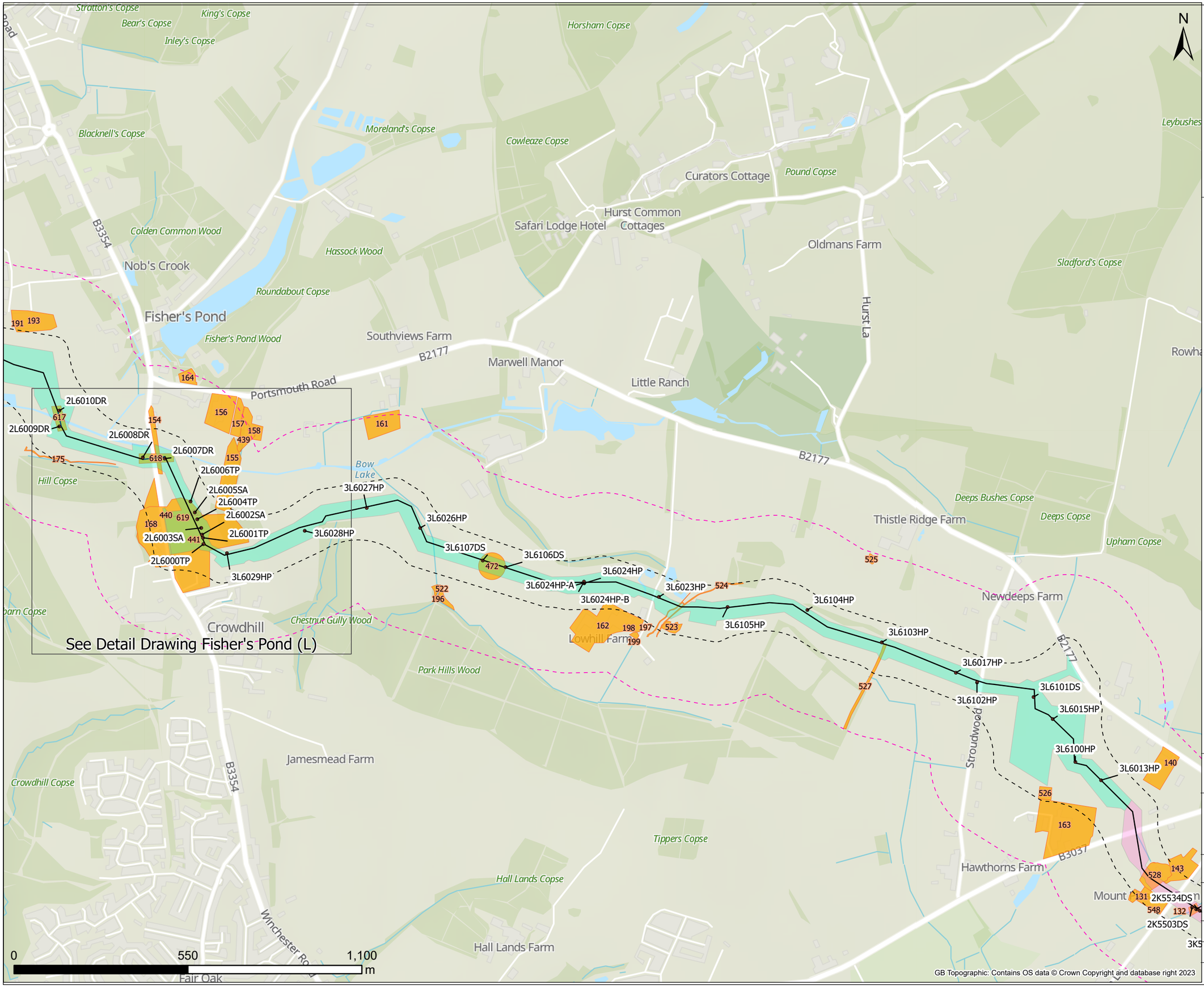
Southern Water

Project Title: Water For Life Hampshire

Drawing Title: Section L (NE)
Ground Investigation Locations with PSCs

Scale	Date Drawn	Page	Sheet Size
1:11,000	27/11/2024	1.1	A3
Originator	Checker	Reviewer	Approver
SB	GS	AC	JH
Project No.			Revision
710166-SWS-XX-XX-SK-GE-00001			A

Document Path: C:\Southern Water\Hampshire Water for Life\Geo_MapSeries\GI_Scoping\GI_Scoping.aprx



Legend

- Ground Investigation
- Draft Order Limits 50m buffer
- Draft Order Limits 250m buffer

GI Scoping Route

- Open cut
- Trenchless

Draft Order Limits Sections

- A
- B
- C
- D
- E
- F
- G
- H
- J
- K
- L
- M
- Potential Sources of Contamination

Contains Southern Water preliminary data - All site locations and routes shown are preliminary only and subject to further site selection assessment and stakeholder consultation.

Stantec

Southern Water
Southern House
Lewes Road
Falmer, Brighton
BN1 9PY

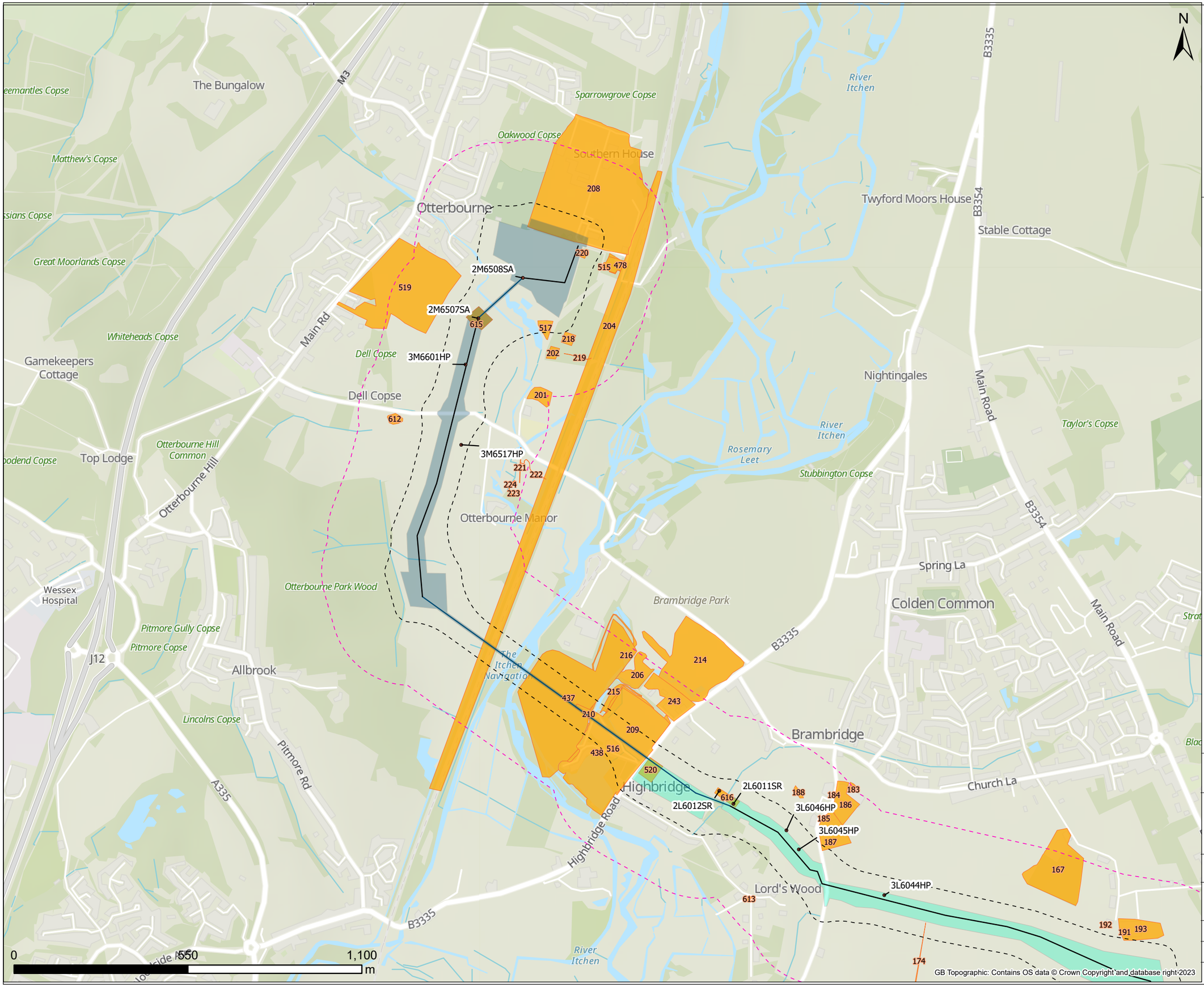
Southern Water

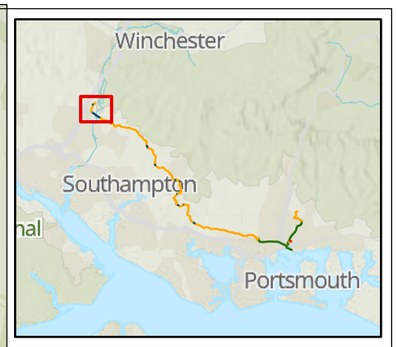
Project Title: Water For Life Hampshire

Drawing Title: Section L (SE)
Ground Investigation Locations with PSCs

Scale	Date Drawn	Page	Sheet Size
1:11,000	27/11/2024	1.2	A3
Originator	Checker	Reviewer	Approver
SB	GS	AC	JH
Project No.			Revision
710166-SWS-XX-XX-SK-GE-00001			A

Document Path: C:\Southern Water\Hampshire Water for Life\Geo_MapSeries\GI_Scoping\GI_Scoping.aprx





Legend

- Ground Investigation
- Draft Order Limits 50m buffer
- Draft Order Limits 250m buffer

GI Scoping Route

- Open cut
- Trenchless

Draft Order Limits Sections

- A
- B
- C
- D
- E
- F
- G
- H
- J
- K
- L
- M
- Potential Sources of Contamination

Contains Southern Water preliminary data - All site locations and routes shown are preliminary only and subject to further site selection assessment and stakeholder consultation.

Stantec

Southern Water
Southern House
Lewes Road
Falmer, Brighton
BN1 9PY

Southern Water

Project Title
Water For Life Hampshire

Drawing Title
Section M
Ground Investigation Locations with PSCs

Scale	Date Drawn	Page	Sheet Size
1:11,000	27/11/2024	1.1	A3
Originator	Checker	Reviewer	Approver
SB	GS	AC	JH
Project No.			Revision
710166-SWS-XX-XX-SK-GE-00001			A

Document Path: C:\Southern Water\Hampshire Water for Life\Geo_MapSeries\GI_Scoping\GI_Scoping.aprx