Norwich Western Link

Environmental Statement

Chapter 13: Geology and Soils

Appendix 7: Foxburrow Stream Preliminary Contamination Assessment

Author: WSP UK Limited

Document Reference: 3.13.07

Version Number: 00

Date: March 2024

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1 Introduction

1.1 Terms of reference

1.1.1 WSP UK Limited (WSP) has been instructed by Norwich County Council (the Client) to undertake a preliminary contamination assessment of proposed enhancement works along the river bank of the Foxburrow Stream. These proposed enhancement works are located at Foxburrow Plantation, south of The Broadway, Norwich, NR9 5AU (nearest postcode), referred to herein as 'the Site', and are part of the wider Norwich Western Link (NWL) road scheme. A site plan is included in **Appendix A**.

1.1.2 The concept design (by WSP water team) for the proposed enhancement works comprise bank reprofiling and dredging (along the river banks), riparian planting and fencing with the aim of improving biodiversity on the River Wensum and Foxburrow Stream.

1.2 Aims and background

1.2.1 The aim of this preliminary contamination assessment is to provide an assessment of potential contamination within soils along the banks of Foxburrow Stream to support the proposed enhancement works. It is understood that the former sewage treatment works structures within the Foxburrow Plantation area are associated with the nearby RAF Attlebridge during WWII. The outfall of this former sewage treatment works was into the Foxburrow Stream which was periodically dredged with the dredged materials placed upon the banks.

1.2.2 The proposed enhancement works include reprofiling of the Foxburrow Stream banks and therefore an investigation of the soils along the banks was determined to be required to assess for contaminant impact as a result of the historic outfall and dredging activities.

1.3 Information sources

1.3.1 The following sources of information have been used in the production of this technical note:

- WSP (2020) – Norfolk County Council – Norwich Western Link – Interpretative Environmental Desk Study Report; Ref: NCCT41793-040-B-06-02;
- WSP (2021) – Norfolk County Council – Norwich Western Link (NWL), Generic Quantitative Risk Assessment; Ref: 70041922-GS-001;
- Ferrovial Construction (2023) – Norfolk County Council – Norwich Western Link – Ground Contamination Interpretative Report, Ref: NCCT12793-RAM-EGT-FSC-RP-NZ-0003 (appended in Appendix 2);
- Harrisons Geotechnical (2023) – Factual Ground Investigation Report – Foxburrow Plantation Contamination Campaign, Ref: NCCT41793_GI-FPCC (provided as Annex A to Ferrovial 2023 Report);
- Ferrovial Construction: Factual Ground Investigation Report – Foxburrow Plantation Contamination Campaign, Ref: NCCT41793-HAG-VGT-FSC-RP-GI-0006;
- Historic Maps Norfolk - http://www.historic-maps.norfolk.gov.uk/mapexplorer/ (accessed 19 April 2023);,
- MAGIC Maps - https://magic.defra.gov.uk/magicmap.aspx (accessed 19 April 2023).
- Ministry of Agriculture, Fisheries and Food (MAFF) Code of Good Agricultural Practice for the Protection of Soil (1998).

1.4 Limitations

1.4.1 This technical note assesses the contaminated land risks associated with the proposed enhancement works, however, does not constitute a Generic Quantitative Risk Assessment for the Site. It presents a summary and

assessment of the findings of the previous investigations along with the recent ground investigation works undertaken along the river banks of the Foxburrow Stream.

1.4.2 This report is addressed to and may be relied upon by Norwich County Council and may not be relied upon or transferred to any other parties without the express written agreement of WSP.

1.4.3 This report should be read and used in full. No responsibility will be accepted where this report is used, in its entirety or in part, by any other party. WSP cannot be held liable for third party information. Full details of the limitations are provided as **Appendix B**.

2 Site Setting

2.1 Site description and history

2.1.1 The Site is irregular in shape and comprises a single track road (The Broadway), an additional single track road in the centre, an area of woodland in the central south and marshland in the south western and south eastern portions of the Site. A number of circular and rectangular brick structures are present in the central western portion of the Site which are associated with a former sewage works structure. The Foxburrow Stream runs in a north west-south east orientation across the length of the Site. The banks of Foxburrow Stream are gently sloping and vegetated with bracken, reeds and occasional trees.

2.1.2 The surrounding area comprises agricultural land in all directions with the upstream section of the Foxburrow Stream located to the west.

2.1.3 A Site plan is presented in **Appendix A**.

2.1.4 From a review of the historical maps within the WSP Desk Study (WSP, 2020) for the wider NWL road scheme and online sources (Historic Maps Norfolk), the earliest historical maps from 1882 indicate that the Site is predominantly undeveloped woodland in the north, centre, central west, central east and

presumed agricultural land to the south. Additionally, a stream is noted to run in a north west-south east orientation across the length of the Site (Foxburrow Stream). A track is noted running west to east along the northern portion. An 'old clay pit' is present on the central southern boundary of the Site. From 1906 map edition, the Site is labelled as Foxburrow Plantation in the central south and Robins Nursery in the south western corner. A search of the Norfolk Historic Map explorer website indicates that during the period 1946-1960, a road is established in the north with several rectangular buildings noted to the immediate north and south of this road. A single-track lane lined with rectangular structures are noted along the centre and a number of circular and rectangular brick structures were noted in the central west portion which appears to be associated with a sewage works. Mapping from 1971 map indicates that the Site comprised non-coniferous woodland in the southern portion. The 'old clay pit' is no longer present on Site and is assumed to have been infilled. From 1975, the road in the north was labelled as 'The Broadway'. There were no significant changes on the mapping from 2006. From 2019, the Site comprises marshland across the southern portion. Aerial imagery from Google Earth shows an off-road track and small bridge feature which bisects the site from north to south in the south west portion of the Site.

2.1.5 A review of historical uses within the surrounding area of the Site indicates several potentially contaminative land uses including roads, agricultural land and former buildings along the road to the north (The Broadway). Anecdotal evidence has suggested that the former sewage works structures and former buildings (noted to the north and south of the Broadway) are infrastructure relating to RAF Attlebridge located approximately 830m to the north.

2.2 Geology

2.2.1 Made Ground is anticipated to be present associated with the former sewage works to the north west and the sites former use as agricultural land.

2.2.2 The British Geological Survey (BGS) maps indicate the Site is underlain by superficial deposits of Alluvium (to the north and south of the Foxburrow Stream) along the centre of the Site while the northern and southern portions of the Site comprise the Sheringham Cliffs Formation (sand and gravel). The bedrock geology underlying the Site comprises the Chalk group.

2.3 Hydrology and Hydrogeology

2.3.1 The nearest surface water feature is the Foxburrow Stream which was noted to be running from north west-south east through the Site. The superficial Alluvium deposits and Sheringham Cliffs Formation are classified as Secondary A Aquifers by the Environment Agency (EA). The underlying Chalk Group is classified as a Principal Aquifer, with intermediate groundwater vulnerability.

2.3.2 The Site is located within a Source Protection Zone (SPZ) with the Groundwater Protection Zone III – total catchment designation, for public water supply.

2.3.3 Two groundwater abstractions were identified within 500m of the Site. The first groundwater abstraction was for general farming and domestic extracted from the Chalk (located 392m to the south) and the second abstraction was for general agriculture (located 447m to the south west) and extracted from glacial sand and gravel aquifer.

2.4 Preliminary Hydrogeological Model

2.4.1 Made Ground is likely to be present in the area of the former sewage works and surrounding area due to historical development, however the thickness and composition are likely to be highly variable. Groundwater may be present as perched water within the Made Ground, associated with lenses of permeable material which are recharged by surface water infiltration. Groundwater present within the Made Ground deposits is not considered likely to constitute a continuous groundwater body. Perched water that is potentially present within any Made Ground deposits is considered likely to be

in continuity with the underlying superficial deposits (Alluvium and Sheringham Cliffs Formation).

2.4.2 Groundwater is likely to be present within the superficial deposits and was encountered at 0.95m bgl (superficial Sheringham Cliffs Formation) and at 10.50 m bgl just above the Chalk group in BHR35 (located in the centre of the Site and in the south of the wider NWL scheme) during drilling. Groundwater was encountered sitting within the standpipe between 0.55 m and 0.65 m above ground level within BHR35 across four groundwater monitoring rounds.

2.4.3 Based on information from previous investigations within the vicinity of the Site, groundwater is likely to be present within the superficial deposits and the shallow groundwater has the potential to be in continuity with the Foxburrow Stream. Groundwater is likely to flow towards and drain into Foxburrow Stream.

2.5 Preliminary Conceptual Site Model

2.5.1 The preliminary Conceptual Site Model (CSM) below is based upon the environmental conditions of the Site as described in the previous sections and was developed in the context of the proposed development.

2.5.2 The assessment followed a risk-based approach; with the potential environmental risk assessed qualitatively using the ‘source-pathway-receptor’ contaminant linkage concept introduced in the guidance documents (principally the EA’s Land Contamination Risk Management (LCRM)) on the practical implementation of the Environmental Protection Act 1990.

2.5.3 Environmental risk can be defined as the combination of the consequence of a harmful effect and the probability of its occurrence. The existence of a contaminant linkage is primarily dependant on Site usage and environmental conditions.

2.5.4 The environmental risk assessment has been carried out by identifying and evaluating the significance of the following:

- Potential sources of contamination: these include any actual or potentially contaminating materials and activities, located either on or in the vicinity of the Site.
- Potential Receptors of Contamination: these include future land users, activities or persons at the Site; and
- Potential pathways for contamination migration: these are the routes or mechanisms by which contaminants may migrate from the source to the receptor.

2.6 Potential Contaminant Sources

2.6.1 On-site contamination sources include the Made Ground associated with the former sewage works, single track roads and historical agricultural uses. Offsite sources include the Made Ground associated with the former rectangular structures (north and south of The Broadway) and agricultural land.

2.7 Potential Receptors

2.7.1 In the context of the future proposed development, the following potential receptors were identified:

- Human Health
  - Future site visitors;
  - Construction workers and future maintenance workers; and,
  - Third Party / Adjacent Site Users
- Controlled Waters
  - Surface Water (Foxburrow Stream)
  - Superficial Aquifer (Alluvium and Sheringham Cliffs Formation)
  - Principal Aquifer (Chalk Group)

- Plant Life
  - Plant life in proposed enhancement works area

2.8 Potential Pathways

2.8.1 In the context of the future proposed development, the following potential pathways were identified

- Human Health
  - Inhalation of fibres on Site (on site sources)
  - Inhalation of soil and groundwater derived vapours (on site sources)
  - Dermal Contact (on site sources)
  - Ingestion of impacted soil particles on-Site, and windblown to adjacent properties (on and off site sources)
  - Lateral migration through the unsaturated zone (ground gas on and off site)
- Controlled Waters
  - Vertical leaching from impacted soil and lateral migration of impacted groundwater derived from on-Site and off-Site sources.
  - Surface water run-off (on site)
  - Lateral migration Site within groundwater (off-site)
- Plant Life
  - Root uptake of contaminants that may affect plant life

2.8.2 **Table 2-1 and Table 2-2** below provides a summary of the identified potential sources of contamination, pathways and receptors in the context of this proposed development.

Table 2-1 Preliminary Conceptual Site Model – On-site

Potential Sources of Contamination	Pathways	Receptor	Comments
Asbestos in Made Ground	Inhalation of fibres on Site	Construction Workers Future Site Visitors / Maintenance workers Third Party / Adjacent Site users	It is considered that Made Ground soils may potentially be present at the Site associated with the former sewage works, which may contain asbestos. The proposed enhancement works comprises bank reprofiling along Foxburrow Stream which would remove topsoil and is not anticipated to contain Made Ground soils as it is outside of the area of the former sewage works. If any further development is likely to involve the disturbance of areas of Made Ground (i.e. former sewage works, existing roads), the risk is considered to be **Low** to **Moderate**. In areas of bank reprofiling, the risk is considered to be **Low**.
Non-volatile contaminants in Made Ground, soils and groundwater (excluding asbestos)	Dermal contact, ingestion of impacted soil particles on-Site, and windblown to adjacent properties.	Construction workers Future Site Users / Maintenance workers Third Party / Adjacent Site users	The proposed enhancement works is related to bank reprofiling which aims to promote the formation of wetlands. In the area where works are proposed, the development is not likely to involve the disturbance of widespread areas of Made Ground. The risk to future and adjacent Site users is considered to be **Low.**

Potential Sources of Contamination	Pathways	Receptor	Comments
Non-volatile contaminants in Made Ground, soils and groundwater (excluding asbestos)	Vertical leaching from impacted soil and lateral migration of impacted groundwater derived from on-Site and off-Site sources. Surface water run-off.	Superficial Aquifer (Alluvium and Sheringham Cliffs Formation) Principal Aquifer (Chalk Group) Surface water (Foxburrow Stream)	Risk of vertical migration of contaminants from potentially impacted shallow soils to the underlying aquifers cannot be discounted. There is the potential for contaminants within shallow groundwater (if present) to migrate laterally and impact the Foxburrow Stream. The risk to surface waters/ groundwater is considered to be **Low to Moderate**. The proposed development would involve dredging activities along the river banks that would involve reprofiling the existing ground and could potentially mobilise contamination to the watercourse, if present.
Non-volatile contaminants in Made Ground, soils and groundwater (excluding asbestos)	Root uptake of contaminants that may affect plant life	Plant life	Contaminants may be present within any Made Ground present on Site which could be mobilised and made bioavailable to plant life through leaching of rainwater. However, no observations of existing plant life along the Foxburrow Stream banks were not observed to be distressed therefore the risk is anticipated to be **Low**.

Potential Sources of Contamination	Pathways	Receptor	Comments
Volatile compounds derived from on-Site sources, and soil gases generated from Made Ground (methane / carbon dioxide)	Inhalation of soil and groundwater-derived vapours.	Future Site Users / Maintenance workers Third Party / Adjacent Site users	The presence of Made Ground and the potential for pockets of areas of infilled land (old clay pit) related to the historical agricultural land use could produce a potential source for ground gas. There is also the potential for volatile organic compounds to be present associated with former land uses. The risk of the accumulation of hazardous gases and vapours in confined spaces is low considering the proposed development includes no buildings or enclosed spaces. In addition, no significant ground gas source has been identified within the Site (other than the potential for Made Ground and pockets of organic matter). The risk is considered to be **Low** and is not deemed to require further assessment.

Table 2-2 Preliminary Conceptual Site Model – Off-site

Potential Sources of Contamination	Pathways	Receptor	Comments
Off-Site sources (i.e., ground gas and VOCs)	Lateral migration through the unsaturated zone.	Future Site Users / Maintenance workers	The potential presence of off-Site Made Ground is a potential source of lateral ground gas migration into future infrastructure on the Site. There is also potential for migration of vapours from off-Site sources. However due to the nature of the proposed development and lack of enclosed spaces within structures, the risk is considered to be **Low** and is not considered to require further assessment.
Off-Site sources (i.e., ground gas and VOCs)	Lateral migration Site within groundwater	Superficial Aquifer (Alluvium and Sheringham Cliffs Formation) Principal Aquifer (Chalk Group) Surface water (Foxburrow Stream)	Given the potentially contaminative historical land uses identified within the surrounding area, there is the potential for contaminants within groundwater to migrate on to the Site an impact groundwater underlying the Site, and the Foxburrow Stream. The risk is considered **Low** to **Moderate**

3 Summary of Ground Investigation

3.1 Site works

3.1.1 Ground Investigation (GI) works were undertaken in a single phase of works by Harrison Group Environmental Ltd between the 16 and 17 March 2023.

3.1.2 The exploratory hole locations and scope of works relevant to the Foxburrow Stream site boundary include the following:

- Twelve hand excavated inspected pits (HD1 to HD12) up to a maximum depth of 1.20 meters below ground level (m bgl); and,
- Collection of soil and surface water samples for environmental laboratory testing.

3.1.3 Exploratory hole logs from the ground investigation and laboratory certificates have been included within the Factual Report (**Appendix C)**.

3.1.4 Geotechnical assessment of soils has not been included within this assessment as it was excluded from the scope of works.

3.2 Ground Conditions Summary

3.2.1 The ground conditions section below has been compiled using all of the available historical ground investigation data and more recent Ferrovial ground investigation data. In total, there are thirteen exploratory hole locations on the Site. A summary of the encountered ground conditions during the ground investigations are presented in **Table 3-1** below.

Table 3-1 Summary of Encountered Ground Conditions

STRATUM	ELEVATION OF UPPER SURFACE (M AOD)	TYPICAL THICKNESS (M)
Topsoil	32.99 to 39.32	0.10 to 0.50
Alluvium	32.84 to 39.17	0.20 to 3.60
Sheringham Cliffs Formation	32.49 to 37.14	1.00 to 10.05 (Note 1)
Chalk Group (Note 2)	25.28	Proven to be 19.55 m at BHR35 only

Note 1 - Maximum thickness encountered in BHR35

Note 2 - Not encountered during 2023 investigation

3.2.2 Relevant borehole data from exploratory hole BHR35 (within the vicinity of the Site) from the 2021 Ferrovial investigation has been included within this section.

3.2.3 A rotary borehole was excavated during the 2021 ground investigation works within the centre of the Site area (BHR35). During the 2023 ground investigation, Topsoil was encountered to depths between 0.10 m bgl (HD10) and 0.50 m bgl (HD5) across all locations. The topsoil mainly comprised grass over soft dark brown silty gravelly sandy clay / clayey sand. Gravel comprised sub angular to sub rounded fine to coarse flint. Plastic dark brown slightly gravelly clayey fibrous peat with strong organic odours were noted in HD6 and HD7. No Made Ground was encountered at any of the hand pit locations.

3.2.4 Alluvium was encountered in seven locations to depths between 0.5 m bgl (HD12) and 1.20 m bgl (HD7) with thicknesses ranging from 0.20 m (HD11) to 1.05m (HD3) across the Site comprising dark brownish grey gravelly silty fine to coarse sand / very soft to soft organic clay with occasional rootlets. Gravel comprised subrounded to rounded fine to coarse flint. Plastic dark orangish

brown clayey fibrous peat was identified between 0.45m and 0.65m bgl in HD7. Strong organic odours were noted in HD3 and HD7 within the Alluvium. Alluvium was underlain by the Sheringham Cliffs Formation in three hand pit locations (HD9, HD11 and HD12) located on the south bank of the stream and in the centre and south east of the Site

3.2.5 The Sheringham Cliffs Formation was encountered in eight locations to depths between 0.30 m bgl (HD9) and 5.85 m bgl (BHR35). Sheringham Cliffs Formation comprised light to dark brown / orangish brown very gravelly fine to coarse sand / sandy gravel. Gravel is sub rounded to rounded flint. The base of this formation was not proven in any of the exploratory hole locations with the exception of BHR35.

3.2.6 Groundwater strikes within the Alluvium were encountered between 0.50 m bgl to 0.90 m bgl and strikes were noted within the Sheringham Cliffs Formation between 0.90 m bgl and 1.10m bgl. A water seepage was noted in HD7 within the Sheringham Cliffs Formation. Perched water was encountered within HD7 at 0.25 m bgl within the Topsoil. Full details of groundwater strikes are shown on the exploratory hole logs included within the factual reports for the ground investigation works undertaken across the Site.

3.3 Visual / Olfactory Evidence of Contamination

3.3.1 There was no visual / olfactory evidence of contamination noted during the Site works and no Made Ground was reported to have been encountered within the area of investigation. However, it should be noted that a piece of suspected asbestos containing material (ACM) and pieces of clinker were identified at surface within the former sewage works area (central west of site). It should be noted that this was not in the area of investigation but was noted to the north of the proposed area of works. The suspected ACM was not tested.

4 Contamination Assessment

4.1 Human Health

Rationale

4.1.1 WSP has derived a set of Generic Assessment Criteria (GAC) for the CLEA generic land use scenarios using the CLEA Workbook v1.071 Excel modelling tool.

4.1.2 Based on the proposed enhancement works, generic assessment criteria (GAC) assuming a Parks Public Open Space land use were utilised for the soil assessment. Soil organic matter content (SOM) within soil samples analysed ranged from 0.5 mg/kg to 26mg/kg. Given the large variability in SOM encountered within samples, an SOM value of 1 % was utilised to generate conservative screening criteria.

4.1.3 Should the enhancement plans change or be altered, an update of the assessments undertaken within this report are likely be required.

Soil Assessment

4.1.4 Contamination testing was undertaken on sixteen soil samples from depths between 0.20 m bgl to 0.80m bgl across twelve hand pit locations which were located along the riverbanks of the Foxburrow Stream. Soils were tested for a suite of contaminants including asbestos identification, metals, pH, phenol, cyanide, polycyclic aromatic hydrocarbons (PAH), total petroleum hydrocarbons (TPH), polychlorinated bi-phenyls (PCBs), benzene, toluene, ethylbenzene, xylenes (BTEX), semi-volatile organic compounds (SVOCs) and volatile organic compounds (VOCs). The testing results were screened against Generic Assessment Criteria (GACs) which assume a Parks Public Open Space land use. Results are presented within the laboratory certificates presented in the Factual Report for the Site **(Appendix C)** and screening tables presented in **Appendix D**.

4.1.5 There were no soil exceedances of the Parks Open Space Generic Assessment Criteria (GAC).

Human Health Risk Assessment Summary

4.1.6 The proposed enhancement works is related to bank reprofiling which aims to promote the formation of wetlands. In the area where works are proposed, the development is not likely to involve the disturbance of widespread areas of Made Ground. Based on the results of the ground investigation and proposed works, the risk to future and adjacent Site users is considered to be **Low.**

4.1.7 No Made Ground was reported to have been encountered in any of the hand pits and no asbestos fibres were detected within any soil samples tested. In areas of bank reprofiling, the risk from asbestos is considered to be **Low**.

4.2 Controlled Waters

Rationale

4.2.1 The generic controlled waters risk assessment was conducted in accordance with the principles of the EA 'Remedial Targets Methodology: Hydrogeological Risk Assessment for Land Contamination' 2006 and the 'prevent and limit' approach of the Water Framework Directive (2000/60/EC). Generic Controlled Waters risk assessments compare directly measured concentrations with standard assessment criteria.

4.2.2 Water Quality Standards (WQS) are selected based on both a hierarchy of relevance to England and the receptor. In this case, Controlled Waters receptors identified in the CSM were;

- **Aquifers:** Groundwater underlying the Site within the superficial deposits of Alluvium and Sheringham Cliffs Formation (Secondary A Aquifers) and within the Chalk Group (Principal Aquifer).
- **Surface water:** Foxburrow Stream, crossing the Site.

4.2.3 The following hierarchies of WQS were considered to be appropriate:

Aquifers

- UK Drinking Water Quality Standards (DWS) from The Water Supply (Water Quality) Regulations 2000 (amended 2004);

- World Health Organisation Guidelines for Drinking Water Quality, Fourth Edition, Volume 1, (2017); and,
- World Health Organisation Petroleum Products in Drinking Water (2008).

Surface Water

- Environmental Quality Standards (EQS) from The Water Framework Directive (Standards and Classification) Directions (England and Wales) 2015.

4.2.4 Calcium, pH and dissolved organic carbon within the Foxburrow Stream can affect the bioavailability of copper, manganese, lead, nickel and zinc. Site specific EQS may be derived using the WFD-UKTAG metal bioavailability tool (m-BAT **Ref 13.13.1**). Water samples were collected from Foxburrow Stream; however, calcium and dissolved oxygen were not calculated therefore Site specific EQS values were unable to be derived. In this case, 100% bioavailability was assumed in order to maintain conservatism.

4.2.5 Further details on the assumptions and methodologies adopted by WSP are presented in **Appendix E.**

Soil Leachate Assessment

4.2.6 Soil leachate testing was carried out as part of the ground investigation works in order to determine the potential of contaminants leaching from soils within the unsaturated zone into underlying groundwater and ultimately Foxburrow Stream.

4.2.7 Selected soil samples were scheduled for leachate analysis and the results were compared to Environmental Quality Standard (EQS) and Drinking Water Standard (DWS) criteria. **Table 4-1 and Table 4-2** below summarise the exceedances of EQS and DWS, respectively. Screening Tables are presented in **Appendix D**.

Table 4-1 Summary of Leachate Exceedances (EQS)

Analyte	EQS (µg/l)	#EQS Exceeds	Maximum Concentration (µg/l)	Location of Maximum Concentration
Cadmium	0.08	1	0.19	HD4 at 0.20 m bgl
Chromium	3.4	1	5.1	HD3 at 0.20 m bgl
Copper	1.0	8	100	HD1 at 0.40 m bgl
Lead	1.2	8	14.0	HD11 at 0.20 m bgl
Nickel	4.0	4	7.90	HD3 at 0.20 m bgl
Zinc	11.9	6	31.0	HD2 at 0.20 m bgl
Naphthalene	2.0	2	9.9	HD3 at 0.20 m bgl
Anthracene	0.1	2	0.21	HD6 at 0.20 m bgl
Fluoranthene	0.0063	2	0.70	HD6 at 0.20 m bgl

Table 4-2 Summary of Leachate Exceedances (DWS)

Analyte	DWS (µg/l)	#DWS Exceeds	Maximum Concentration (µg/l)	Location of Maximum Concentration
Lead	10	2	14	HD11 at 0.20 m bgl
Ammoniacal Nitrogen as NH4	500	1	720	HD5 at 0.20 m bgl

4.2.8 Concentrations of metals and PAHs within soil leachates were found to exceed EQS criteria in several locations. Exceedances of heavy metals, in particular against EQS protective of surface waters, are not considered to be significant and are likely reflective of natural background soil geochemistry. PAHs (naphthalene, anthracene and fluoranthene) were found to exceed EQS criteria at two locations (HD02 and HD06) which are not proximal to each other. No Made Ground or other anthropogenic inclusions were reported at these locations and there is no known source of these contaminants. However, the magnitude of exceedance is generally minor and not considered to be significant.

4.2.9 The exceedance of ammoniacal nitrogen against DWS at one location is likely to be associated with the decomposing organic matter within the alluvium.

Surface Water Assessment

4.2.10 One round of surface water sampling was undertaken during the 2023 ground investigation from three separate locations along the Foxburrow Stream. The three locations were positioned to account for potential leachable contamination from the former sewage works with samples taken upstream of the former sewage works (SW1), adjacent to (SW2) and downstream of the former sewage works (SW3). Surface water sample locations are shown in the Factual Report for the Site (**Appendix C**). Screening Tables can be found in **Appendix D**.

4.2.11 Selected surface water sample results were compared to the Environmental Quality Standard (EQS). There were no exceedances of the EQS criteria.

Controlled Waters Risk Assessment Summary

4.2.12 Overall, the soil leachate results did not report contaminant concentrations indicative of contaminant impact from the former sewage works, or other sources of contamination. It should be noted that leachate analysis is an aggressive method and not necessarily reflective of natural leaching conditions. Any leachable contaminants are also likely to undergo attenuation within groundwater and upon entering the stream. Additionally, no exceedances of EQS criteria were identified within the three surface water samples, or evidence of contaminant impact to Foxburrow Stream from soils along the banks.

4.2.13 Based on these results the risk to Controlled Waters from soils is considered to be **Low**.

4.3 Plant Life – Phytotoxicity Assessment

4.3.1 Guidance on the effects of metal contamination on plant growth is provided within the Ministry of Agriculture, Fisheries and Food (MAFF) Code of Good Agricultural Practice for the Protection of Soil. Soil samples were screened against phytotoxic screening criteria to assess risk to plant life. Screening tables are presented in **Appendix 3**.

4.3.2 A summary of the test results versus the recommended phytotoxic screening criteria is provided in **Table 4-3.**

Table 4-3 Summary of Soil Results Screened Against Phytotoxicity Criteria

Analyte	Screening Value (mg/kg)	Concentration Range (mg/kg)	Average Concentration (mg/kg)	Average Concentration above Screening Value
Zinc	200	8.2 to 43.0	17.7	No
Copper	100	4.6 to 13.0	6.84	No
Nickel	300	4.0 to 14.0	7.26	No

4.3.3 Based on the average of results from samples obtained during the initial investigation, there were no average concentration exceedances of the MAFF values noted. As such, an overall phytotoxic risk to plants is considered to be **Low**.

4.3.4 Based on the nature of the proposed development, any materials generated (within the area of investigation) is considered likely to be suitable for re-use in proposed landscaping areas.

5 Conclusions and Recommendations

5.1 Conclusions

5.1.1 Based on the findings of the preliminary contamination assessment, the following conclusions have been made:

- No Made Ground was identified within any of the twelve exploratory hand pit locations.
- Available soil analytical data was screened against a Parks Public Open Space GAC; no exceedances of the criteria were noted. Therefore, the risk to future land users and adjacent Site users from soil contamination is considered to be **Low**.

- The risk to construction/maintenance workers is considered to be **Low to Moderate** during the construction phases of the enhancement works.
- No asbestos containing materials and/or fibres were identified within the soil samples tested during the ground investigation. However, during a walkover of the former sewage works area (central west of Site), a piece of suspected asbestos containing material (ACM) was identified within the former sewage works area on the surface of the infilled filter beds.
- A number of exceedances metals, PAHs and ammoniacal nitrogen as NH4 against EQS and DWS criteria were identified within soil leachate samples. However, contaminant concentrations are not considered to be significant or to be indicative of contaminant impact as a result of historic dredging materials or the former sewage works associated with RAF Attlebridge. Therefore, the risk to Controlled Waters from soils along the banks is considered to be **Low.**
- Phytotoxic risk to plants is considered to be **Low**.

5.1.2 Should development plans change or be altered, an update of the assessments undertaken within this technical note are likely to be required.

5.2 Recommendations

5.2.1 Based on the findings of the preliminary contamination assessment, the following recommendations are provided:

- Further detailed assessment in accordance with LCRM may be required to include groundwater monitoring and testing. This should be determined in consultation with regulatory authorities.
- A methodology for activities including reprofiling the river banks and dredging should be incorporated within a Construction Environmental

Management Plan (CEMP) to prevent mobilisation of sediments into the watercourse during construction.

- Risks from asbestos to maintenance workers and groundworkers during the construction phases of the scheme (including materials movement) should be managed by health and safety controls in line with the current Control of Asbestos Regulations (CAR) 2012.
- If the re-use of material is proposed within the Site or wider Norwich Western Link scheme, this material would need to be managed under a wider Materials Management Plan (MMP) to ensure it is suitable for re-use.

6 References

Ref 13.13.1 Water Framework Directive – United Kingdom Technical Advisory Group (WFD-UKTAG) 'UKTAG River & Lake Assessment Method, Specific Pollutants (Metals): Metal Bioavailability Assessment Tool (M-BAT)' ISBN: 978-1-906934-57-6 (July 2014)