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THE FORMER SSI STEELWORKS, REDCAR: PRIORITY AREAS WITHIN SSI LANDHOLDINGS CONTRACT 3

Contract 3 Site Condition Report

South Tees Site Company Limited

REPORT NO. Redcar Steelworks-AUK-XX-XX-RP-GE-0001-02-SSI3_GI_SCR

AUGUST 2018

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The Former SSI Steelworks, Redcar: Priority Areas within SSI Landholdings Contract

Contract 3: Site Condition Report

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1 INTRODUCTION

1.1 Project Background

The former SSI landholdings are made up of eleven discrete, sizeable land parcels situated in the Redcar, Lackenby, Grangetown and South Bank conurbations of the Borough of Redcar & Cleveland, within the industrial area generally known as 'South Tees'.

Desk study work has been ongoing since November 2016, and in two of the SSI areas at Redcar (SSI1 and part of SSI2), this work has already been augmented by an advance programme of ground investigation works, comprising close to 300 trial pit excavations (SSI1) and 67 trial pit excavations (part of SSI2), together with laboratory analysis. The desk studies and advance programme of ground investigation works was undertaken by CH2M. A package of investigations was subsequently designed for the SSI land, namely SSI1, SSI2 and SSI3.

1.2 Contract Details

Arcadis (UK) Limited (Arcadis) were appointed by South Tees Site Company Limited (STSC) to oversee and manage a ground investigation undertaken by Allied Exploration and Geotechnics Limited (AEG) and to provide consultancy advice with respect to redevelopment of the site. The work was carried out in accordance with the "Ground investigation consultancy services former Iron and Steel Works Site, South Tees" contract (Ref: STSC-JN-0007) dated 14 September 2017.

The scope of works was defined by CH2M, on behalf of STSC, and presented in:

- South Tees Site Company Limited, Ground Investigation Consultancy Services, Former Iron and Steel Works Sites, South Tees, Invitation to Tender (STSC Reference Number: STSC-JN-0007, dated July 2017).

The scope of works being undertaken by AEG was developed by CH2M and is presented in:

- STSC - SS - 0030 - Ground Investigation – Contract 3 – Invitation to Tender – The Former SSI Steelworks, Redcar – Ground investigation: Priority Areas within SSI Landholdings Contract 3. CH2M., August 2017.

1.3 Project Aims and Objectives

The overarching aim of the works was to deliver a sustainable ground remediation strategy for the contract sites which is compliant with regulatory needs and has their approval in principle. As technical consultant, our specific objectives of this phase of works were to:

- Manage and technically supervise the site works, undertaken by AEG, on behalf of STSC;
- Direct the site works to ensure compliance by the ground investigation contractors with existing site management protocols and procedures;
- Specify the requirements for laboratory analysis;
- Analyse the results of ground investigations;
- Prepare interpretative technical reports, namely
    - Site Condition Report
    - Environmental Risk Assessment Report
    - Geotechnical Risk Assessment Report
    - Remedial Options Appraisal Report
- Consult with regulators to ensure compliance with all relevant regulatory requirements; and,
- Develop cost-effective, value-engineered outline remediation strategies.

1.4 Report Aims

The aim of this site condition reports is to use the available information to develop a conceptual site model for the contract area, which will form the base of the subsequent risk assessments.

1.5 Scope of Work

This site condition report relates to the physical ground investigation works relating to the SSI3 Landholding (external to buildings), Redcar (Contract 3, Areas A and B).

Figure 1 and 2 provide details of the facility location and the site investigation areas.

The scope for the investigation (developed by CH2M) is summarised below with further details discussed in Sections 3.4 and 3.5 below.

- Site service and utilities clearance of exploratory locations by STSC operatives;

  117no trial pits excavated by a 20 tonne 360 excavator, to a target depth of 4.5m or refusal, or until natural material is encountered;
- 5no boreholes drilled by a Dando 2000 cable-percussive rig, with target depths of between 15m and 20m, or refusal on bedrock, and 1no deep borehole to a depth of 37m to investigate the bedrock. Boreholes were advanced through previously excavated trial pits.;
- UXO clearance using down-hole magnetometer at each borehole location upon encounter of natural material;
- Soil sampling for in-field assessment and submission to Derwentside Environmental Testing Services (DETS), AEG in-house Geotechnical Laboratory and Thomas Research Services (TRS) laboratories for chemical and geotechnical testing;
- Installation of 3no groundwater monitoring wells with subsequent purge development;
- Ground gas monitoring of all newly installed (shallow) monitoring wells;
- Groundwater sampling of all newly installed (shallow) monitoring wells;
- GPS elevation survey of all new exploratory locations; and,
- Groundwater elevation survey of all newly installed monitoring wells.

The legislative context and regulatory guidance for the management of potentially contaminated land is presented as Appendix A.

1.6 Reliability / Limitations of Information

A complete list of Arcadis Study Limitations is presented in Appendix B.

It should be noted that ground conditions between exploratory holes may vary from those identified during this ground investigation; any design should take this into consideration. It should also be noted that groundwater levels may be subject to diurnal, tidal, seasonal, climatic variations and those recorded in this report are solely dependent on the time the ground investigation was carried out and the weather before and during the investigation.

2 Site Conceptualisation

The following Phase I Environmental Site Assessment (ESA) for the site prepared by CH2M Hill were made available to Arcadis:

- SSI3 Redcar Works – Phase 1 Geo-environmental Desk Study, ref. 678079_SSI3_001, dated August 2017; and,
- TS3 Grangetown Prairie - Phase 1 Geo-environmental Desk Study, ref. 678079_TS1_001, dated August 2017.
- Corus UK Ltd. – Soil and Groundwater Baseline Characterisation Study Teesside Works – Interpretative Report Volume 1, 2 and 3 of 3, June 2004

This section incorporates a review of the above documents and publicly available records incorporating data collected as part of the site investigation works by AEG and reported in the Factual Report "The Former SSI Steelworks, Redcar – Ground Investigation Contract – Priority Areas Within SSI Landholdings Contract)", dated June 2018.

2.1 Site Location

The site comprises two parcels of land separated by the Tees Dock Road as summarised below.

The area identified as SSI3 (Contract 3 – Area A) 'Torpedo Ladle Repair Shop - TLRS' (is located to the south east of the Former SSI Steelworks, Redcar facility off Tees Dock Road, Middlesbrough. Site elevation ranges from 9m to 13m Above Ordnance Datum (AOD). The centre of Area A is located at National Grid Reference: 454792, 521116; and an indicative post code for the site is TS6 7BH.

The area identified as SSI3 (Contract 3 – Area B) is located in the southern part of the larger Former SSI Steelworks Facility. The former SSI Steelworks Facility extends to the north, northeast, and west, with Tees Dock Road directly southwest and the Torpedo Ladle Workshop (Contract 3 – Area A) directly southwest (separated by Tees Dock Road) and the current British Steel works situated directly northeast. The centre of the Area B is located at Ordnance Survey (OS) National Grid Reference: 455375, 521596; and an indicative postcode for the site is TS6 7HJ.

Note, no intrusive site investigation works were carried out within the buildings located in Area A or Area B.

A site location plan is presented as Figure 1 within Appendix C

2.2 Site Description

2.2.1 Area A – Torpedo Ladle Workshop

At the time of the investigtaion, the site was no longer operational. Area A was primarily occupied by the TLRS building which was used to service, re-line and repair torpedo carriages which transported molten iron from the Redcar Blast Furnace located approximatley 3 miles northeast, to the steel works within Area B located adjacent to the north-east.

The site is irregular in shape and mainly comprises the TLRS building with a number of smaller out buildings. The remainder of the site area consists of generally flat-lying ground of either concrete or unsurfaced rough ground, with a surfaced roadway running along the building directly to the south to access shuttered doors. Disused railway lines are present in the northern and southern half of the site and converge in the eastern boundary before they go off site. Sporadic areas of grassland are present surrounding the site within the rough ground. Refractory materials were noted across areas of the site.

At least two gas oil tanks which hold approximately 300 gallons are currently present on the southern side of the TLRS building according to CH2M walkover. Numerous heaps of waste material are present around the site including brick, concrete and wood waste material.

It is understood that a torpedo ladle was allowed to cool on rail sidings to the north of the TLRS building, and iron solidified within the ladle forming a large ingot. Attempts have been made to cut this into smaller, easier to transport sections without success and as such this material is still present and should be considered a development constraint for this area. The former sidings have been removed from this area.

Access to the Torpedo Ladle Workshop itself or the smaller outbuildings was limited during the time of the site investigation, and therefore the investigation was confined to easily accessible areas outside of the buildings.

The buildings on site appear to be generally in good condition, however it was noted that several metal panels of the workshop were loose. Given the age of the structures on site, it is likely that asbestos containing materials have been used in their construction. Assessment of the extent or otherwise of ACM within structures is outside of the scope of this assessment.

2.2.2 Area B – BOS Plant

At the time of operation, Area B was used for the processing of molten iron from the blast furnace into steel by the oxygen converter process or Basic Oxygen Steelmaking (BOS), and casting the steel into bloom and slab casts. The molten iron was transported to the BOS Plant in torpedo ladle cars from the Redcar Blast Furnace (located approximately 3 miles to the northeast) via a dedicated rail system. Presently Area B contains the structures and infrastructure of the BOS plant and Concast Plant. The remaining site area comprises rough ground, areas of hardstanding, relic concrete foundation slabs and some areas of grass and shrubs.

Area B comprises an area of approximately 43 hectares of industrial land. In general, the topography of the site is relatively level, with ground elevations ranging between 10-13m AOD. Photographs taken during the investigation are included in the Photo Log presented as Appendix B.

The site is roughly rectangular in shape but tapers towards the northeast. The central, and main, part of the site is occupied by the BOS Plant and Concast Plant, these comprise a large collection of multi-storeyed, elongated, metal clad structures with several tall chimney stacks along the western edge. Although these structures are redundant, the infrastructure, utilities, and services that historically supported these plants remain present. The buildings on site are in generally good condition and comprised a mixture of brick built and steel clad structures; it was noted that the metal cladding on several buildings was loose and had come away in some areas. Significant below ground structures are associated with the BOS and Concast plants.

The areas surrounding the BOS Plant comprise primarily rough ground with a large section containing stockpiles of waste materials located in the southeast (within the area of a former water treatment plant). A second large area of rough ground is located within the central, western part of the site north of the current water treatment plant clarifiers, located over former slag pits.

An area of current and former railway lines is located in the southern part of the site, with links to the Torpedo Ladle Workshop to the west (Contract 3 – Area A), and the blast furnace to the north; these lines join and run into the centre of the BOS Plant.

Several asphalt and concrete surfaced car parks and storage areas are located east of the BOS plant along with an access road running north-south along the eastern boundary. Several additional access roads and tracks bound the site to the north and south, and Tees Dock Road to the west. The areas further out surrounding the site are dominated by industrial land use, with the small residential and commercial area of Grangetown situated to the south.

Sporadic areas of grassland are present in the southern part of the site in areas of uneven rough ground or former railway lines. A line of semi-mature trees and bushes is present bounding the site to the west and running along Tees Dock Road.

2.3 Site History

Area A was predominantly agricultural land south east of the Cleveland Iron and Steel Works which extended to the north and west. A surface water feature the Knitting Wife Beck is shown running along the eastern border of the site on pre1930's mapping and subsequently appears to have then been partially and then fully culverted in the vicinity of the site.

Ordnance Survey maps from 1915-1920 show an athletics ground covering the majority of the site, with residential properties and allotment gardens in the south of the site. The current building is first shown on 1929 mapping, a building in similar position and orientation to the current TLRS and numerous rail lines is labelled as the "South Steel Plant" on drawing IX-5947 "Layout of the Cleveland Lackenby and Redcar Works" dated 1966, a series of structures with chimneys abut the structure to the south. This building is labelled as the TLRS

on Dorman Long drawing IA-30069 dated 1971 and the adjacent structures and chimneys are no longer shown. The allotments and residential properties are not shown from the early 1970 with railway lines shown in place.

Area B remained as predominantly open fields traversed approximately north to south by Kinkerdale Beck until the late 1950's however minor areas were developed prior to this. Small clay pits are shown in the north east of the site on 1895 Ordnance Survey mapping. Grangetown Power Station is shown adjacent to the clay pits from 1919 until after 1960 along with associated cooling reservoirs and transformers. Ordnance Survey mapping also indicates extensive filling / reprofiling works across the site in the 1960s.

The current structures were constructed in the mid 1970's, and are shown on historic mapping generally in its present-day arrangement. The layout includes numerous storage areas and tanks.

2.4 Geology

Historic borehole logs from Enviros and others indicate a substantial thickness of Made Ground underlies much of the site. Review of the British Geological Survey (BGS) data also suggests the presence of Made Ground at the site; the BGS maps indicate the majority of the site is then underlain by Glaciolacustrine Deposits predominantly comprising laminated clays and silt. These deposits are likely to be underlain by Glacial Till predominantly comprising slightly gravelly clay. Additionally, a thin strip of Alluvium is also indicated to be present in the northern part of Area B (BOS Plant).

Bedrock beneath the majority of both Area A and Area B is anticipated to comprise Redcar Mudstone Formation, part of the Lias Group. The north-western section of Area B (approximately 10% of Area B) is anticipated to be underlain by the Mercia Mudstone Group. The Penarth Group is indicated to be present north of the torpedo ladle workshop in Area A and between the Redcar Mudstone Formation and the Mercia Mudstone in Area B. The geological sequence of units comprises:

- **Redcar Mudstone Formation** (up to 250m thick but only basal part of unit likely to be present beneath the site) comprising grey fossiliferous, fissile mudstones and siltstones with subordinate thin beds of shelly limestone in lower part and argillaceous limestone concretions throughout;
- **Penarth Group** (approximately 15m in thickness) comprising grey to black mudstones with subordinate limestones and sandstones;
- **Mercia Mudstone Group** (approximately 200m in thickness) comprising predominantly red mudstones and subordinate siltstones with thick halite-bearing units.

The desk study suggests that bedrock is dipping approximately 14 degrees to the north-northwest. However, it is considered more likely that the bedrock is dipping to the east, possibly with a northerly component.

Exerts from the BGS mapping data are presented as Figure 2 below and in Appendix C.

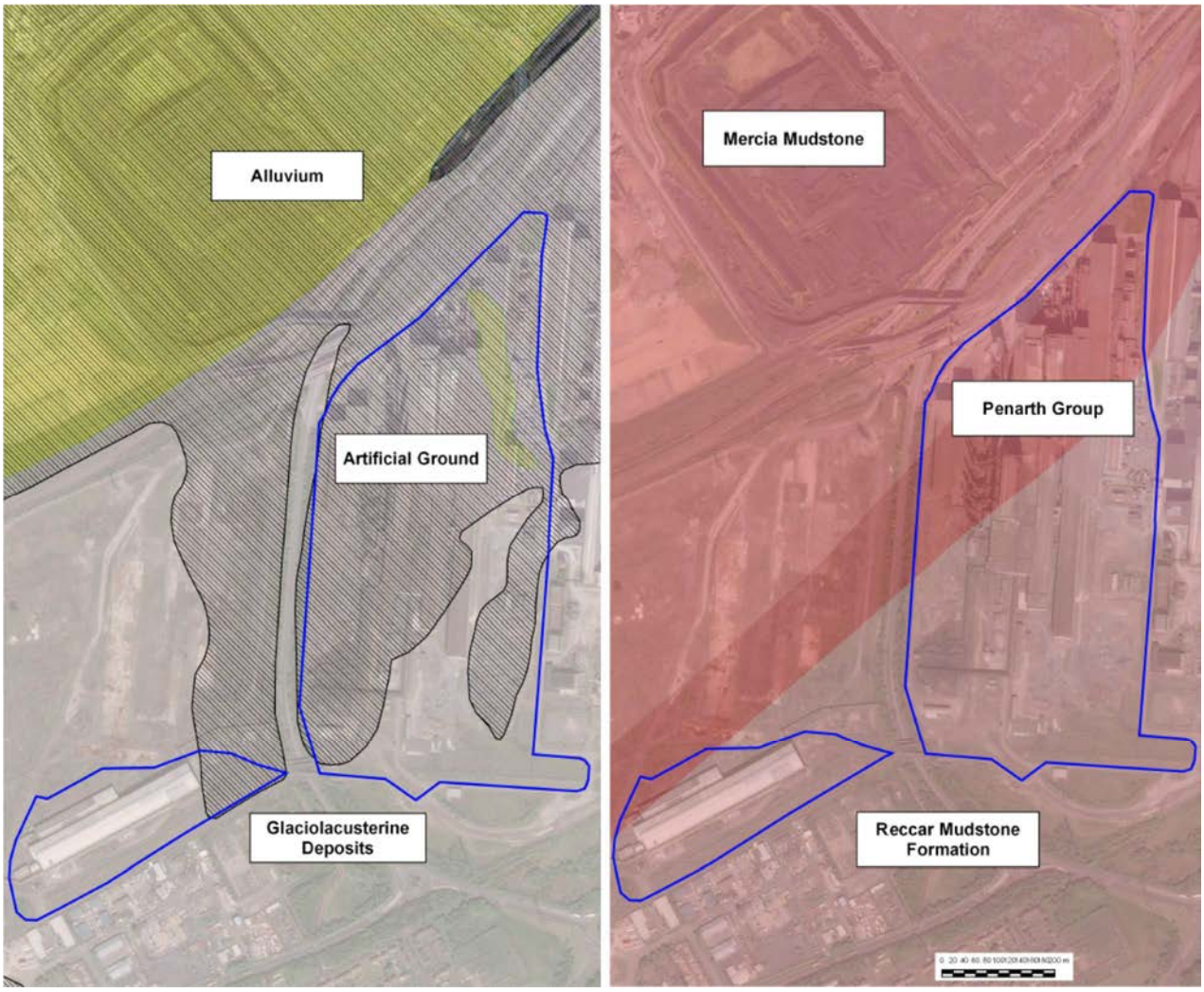


Figure 2: Extracts from BGS Geology Mapping

The following table provides an overview of the site-specific geology encountered during the investigation across the site. The full geology encountered is provided on the trial pit and borehole logs within the AEG Factual Report.

Unit	Minimum Basal Depth (m bgl)	Maximum Basal Depth (m bgl)	Comment
Made Ground	0.70 Area A 0.90 Area B	4.00 Area A 3.8 Area B	Site surfacing comprised either soft standing of gravels, slag, brick paviour, concrete, or bituminous surfacing. The Made Ground encountered during the investigation in both Area A and Area B predominantly comprised granular material with a fine-grained component and medium to high cobble/boulder content which included slag, brick, concrete and occasionally clinker, coke, coal and/or metal. Rare to frequent refractory materials were identified in a number of trial pits across the site. However, variably sandy, variably gravelly clay with low to medium cobble/boulder content was also encountered. An area of fused slag was identified at the surface in the north west of Area B (S3-TPB09 and S3-TPB11), excavation was extremely slow through this material. The extent and thickness of the deposit was not proven. The depth of made ground was noted to be generally dictated by ground elevation; made ground was encountered in greater thicknesses in areas of higher elevation. Clays within the Made Ground were noted to be of intermediate to high plasticity. In Area A three of the 42 trial pits were terminated due to obstructions or difficult progress within the Made Ground, and six due to water ingress. In Area B eight of 75 trial pits were terminated due to obstructions or slow progress, three due to collapse/instability of the pit, and 30 due to groundwater ingress. Where groundwater ingress occurred, this was typically at the base of the made ground.
Glacial Till (Upper)	1.90 Area A (1 BH only) 2.30 Area B	1.90m Area A (1 BH only) 4.60m Area B	In all boreholes and numerous trial pits, a thin layer of firm sandy gravelly clay was observed beneath the Made Ground. This material may represent an upper layer of Glacial Till. This layer is not recorded on geological maps but has been observed during several phases of investigation. Where encountered, the majority of trial pits terminated in this material, so its full thickness is only observed in a limited number of boreholes.

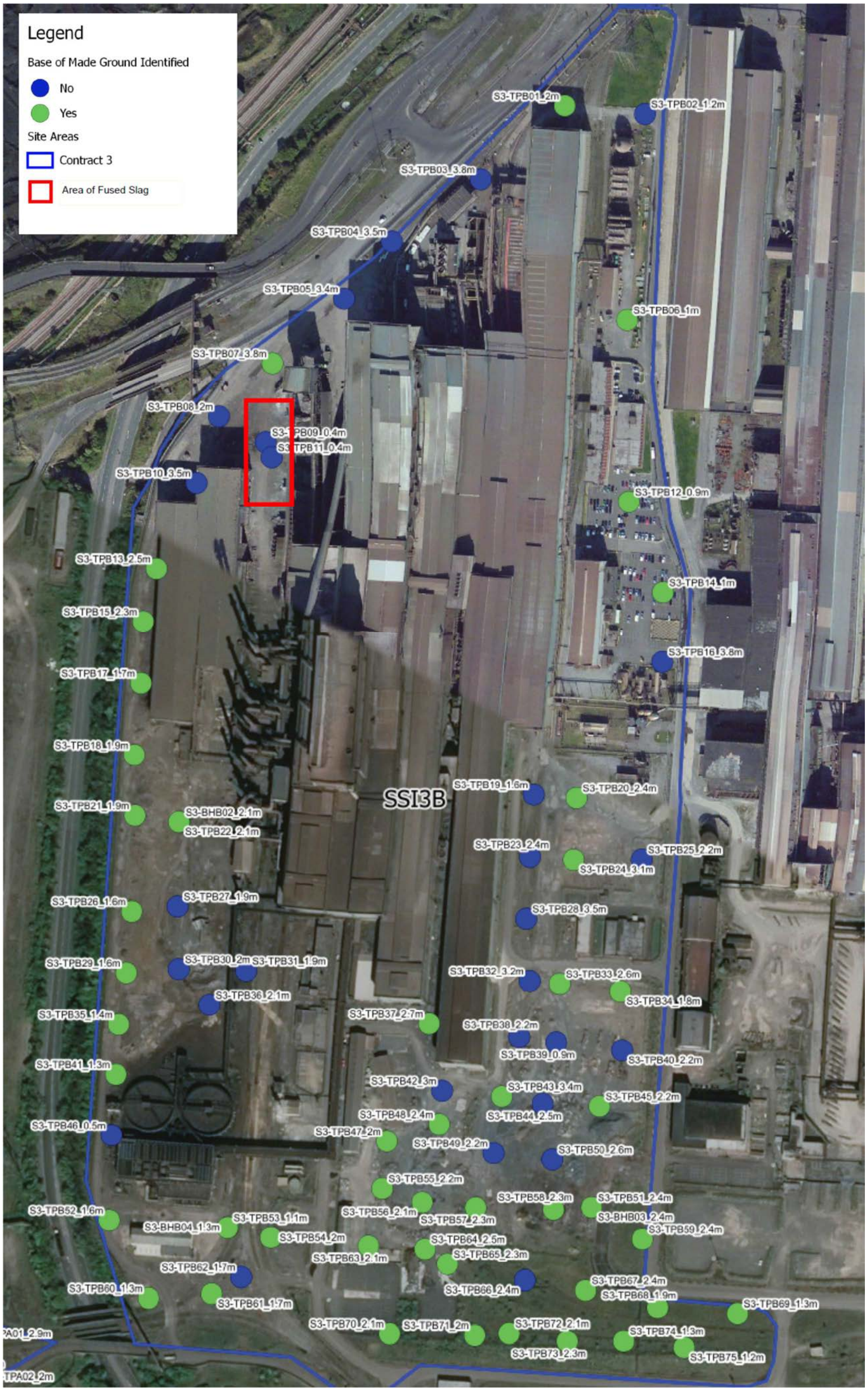
Unit	Minimum Basal Depth (m bgl)	Maximum Basal Depth (m bgl)	Comment
Glaciolacustrine Deposits (non-Aquifer)	4.9 Area A 4.1 Area B	4.9 Area A 6.1 Area B	Although indicated as present on the geological maps of the area Glaciolacustrine Deposits were only recorded in boreholes. Where identified, the Glaciolacustrine Deposits were generally noted to be interbedded with and generally between two layers of Glacial Till, although in some cases the overlying till layer was absent. The deposits were also identified to be difficult to distinguish in some cases. This finding is in line with the previous environmental investigation of the Lackenby Works conducted by Enviros. Where identified the deposits were generally described as a soft to firm brown laminated clay often with sand or silt partings along laminations. A thin band described as peat was recorded in S3-TPB26, which was similar to Tidal Flat Deposits identified elsewhere on the former SSI. The full thickness of this material was not determined; however it does appear to be a very localised feature.
Glacial Till (Lower) (non-Aquifer)	6.5 Area A 8.5 Area B	6.9 Area A 10.3 Area B	Glacial Till was below the Glaciolacustrine Deposits in boreholes described as a firm to stiff red brown slightly sandy slightly gravelly clay, with gravel composed of mixed lithologies, including sandstone, limestone and rare coal. Glacial till is distributed widely across the site and was noted to sandwich a layer of Glaciolacustrine deposits in some boreholes. This finding is in line with the previous environmental investigation of the Lackenby Works conducted by Enviros. Boulders were identified within at the base of the Glacial Till in S3-BHA01 and S3-BHB01.
Redcar Mudstone Formation (Secondary (Undifferentiated) Aquifer)	7.3 Area A 8.5 Area B	7.3 Area A 10.3 Area B	The surface of the Redcar Mudstone Formation was identified to be as an extremely weak highly weathered grey mudstone recovered as a clayey gravel or gravelly clay. Not identified within the bedrock sequence within S3-BHB01, consistent with the geological map for the site.
Penarth Group (Secondary (Undifferentiated) Aquifer)	10.2 Area B	11.7 Area B	Recovered as a brown mudstone or grey limestone gravel, recorded in one borehole only.
Mercia Mudstone (Secondary B Aquifer)	11.7 Area B	37.2 Area B	A weak to extremely weak red green sandy marl partially weathered with numerous gypsum veins and inclusions. Recorded in one borehole only.

Clays within the Glacial Till were noted to be primarily firm to stiff of intermediate plasticity, while those of the Glaciolacustrine Deposits were soft or firm, and of intermediate to very high plasticity. Typically the Glacial Till was noted to be of lower plasticity than the laminated Glaciolacustrine Deposits. SPT N values also varied between the two lithologies with uncorrected N values ranging from 6 to 8 in the Glaciolacustrine Deposits, and typically 12 to 22 in the Glacial Till (note both higher and lower outliers recorded in the glacial till due to local weathering, boulders etc.).

Trial pits were not advanced to natural deposits in all cases, reasons for shallow termination included encountering groundwater, hard strata, or the pit stability; a summary of the trial pit investigation is presented in Appendix D.

Within Areas A and B Made Ground was encountered in all intrusive locations and proven to a thickness of at least 4m and 3.8m bgl respectively. The base of the Made Ground was not proven in 21 locations on Area A and 27 locations on Area B, therefore, greater thickness of material may exist across the site. Made Ground was generally thicker in the east of SSI3A and far north of SSI3B. Figures showing the distribution of the thickness of Made Ground is presented as SSI3A_Figure 3 and SSI3B Figure 3 below and in Appendix C.

SSI3A Figure 3 – Depth of Made Ground Encountered



SSI3B Figure 3 – Depth of Made Ground Encountered

The data collected during the site investigation was in line with that of the 2004 Enviros investigation.

Four types of Made Ground were noted:

- **Slag-dominant material:** Generally ranging from gravel to boulder size fragments and intermixed with other types of manmade fragments including brick, concrete, coal, sandstone, and clinker. The slag material generally ranged from light grey to dark grey/black in colour, but a wide range of other colours were also noted including grey brown, red brown and orange brown. Discolouration of the slag surface was also noted with white crystallisation/discolouration often noted on the outer surface. Slag is estimated to comprise >50% of the soil matrix.
- **Granular Made Ground:** Noted within Area A and Area B. Generally described as a sandy gravel with varying amounts of clay, cobbles and gravel. Gravel and cobbles include brick, concrete and other demolition materials, slag was not the dominant constituent although often still present within the soil matrix. and,
- **Cohesive Made Ground:** Generally described as soft to very stiff containing minor constituents of sand, gravel and cobbles. Gravel and cobbles include brick, concrete and other demolition materials, slag was not the dominant constituent although often still present within the soil matrix.
- **Waste:** Comprised significant amounts waste materials including metal, wood, and plastic in addition to the made ground deposits.

2.5 Obstructions

In addition to the large boulders of slag and demolition rubble which presented issues with progression of a number of the exploratory holes further buried obstructions were identified during the course of the investigation. Locally areas of slag appeared to be partially fused and trial pits had to eb abandoned where fused slag could not be penetrated. The following is a summary of the non-slag or utility related obstructions.

Area A

Location	Depth (m bgl)	Obstruction Type
S3-TPA01	0.7	Metal plate on north west face
S3-TPA03	1.0 – 1.3	Concrete slab
S3-TPA06	1.0-1.3 2.8	Concrete slab Concrete slab
S3-TPA07	1.4	Foundations
S3-TPA09	0.3-0.6	Concrete on north face
S3-TPA12	1.6-2.5	Concrete foundations northwest and south east
S3-TPA14	0.5	Concrete slab and service
S3-TPA22	1.5-2.1	Potential foundation on north face
S3-TPA25	0.0-2.50 0.8-2.5 2.5	Concrete face on south wall Concrete face on north wall Concrete slab
S3-TPA28	0.0-4	Foundation on north face

Location	Depth (m bgl)	Obstruction Type
S3-TPA29	0.8-1.6	Concrete with metal base on west side of pit
S3-TPA33	0.8-1.2	Concrete on south west side of pit

It should be noted that further obstructions may be encountered in areas not investigated.

Area B

In addition to the large boulders of slag and demolition rubble which presented issues with progression of a number of the exploratory holes further buried obstructions were identified during the course of the investigation. Within the slag pits extents of slag were present which could not be excavated through. The following is a summary of the non-slag or utility related obstructions.

Location	Depth (m bgl)	Obstruction Type
S3-TPB10	1.7	Cast iron pipe and potential foundation
S3-TPB39	0.9	Concrete obstruction
S3-TPB44	1.00	Reinforced concrete structure
S3-TPB46	0.5	Concrete slab
S3-TPB54	0.3-0.5	Bituminous Macadam surface
S3-TPB66	0.2-1.8	Concrete wall down face of trial pit

It should be noted that further obstructions may be encountered in areas not investigated.

2.6 Hydrogeology

Previous investigations have indicated that shallow groundwater is present and was encountered between 0.8m and 5.0m bgl (Enviros, 2004 and 2008). The site is not located within a Groundwater Source Protection Zone. Groundwater levels recorded within the shallow superficial deposits during the site investigation (November 2017 and May 2018) are shown in the table below:

Borehole	Aquifer	Range in Depth to Groundwater (m bgl)	Range in Groundwater Elevation (m AOD)
Area A			
S3-BHA01	Made Ground and Glacial Till	0.65 - 1.10*	9.63 – 9.58*
S3-BHA02	Glaciolacustrine Deposits	1.30 – 1.73*	9.86 – 9.43*
Area B			
S3-BHB01	Made Ground and Glaciolacustrine Deposits	1.56 – 1.60 (1.56 – 2.20)**	8.20 – 8.16 (8.20 - 7.56)**

Borehole	Aquifer	Range in Depth to Groundwater (m bgl)	Range in Groundwater Elevation (m AOD)
S3-BHB02	Made Ground, Glaciolacustrine Deposits, and Glacial Till	1.37 - 1.65	8.47 – 8.19
S3-BHB03	Made Ground	1.80 – 3.50	8.16 – 6.46
S3-BHB04s	Made Ground	1.00 – 1.30	8.90 – 8.60
S3-BHB04d	Glacial Till	1.00 – 1.50	8.90 – 8.40
*Dry during initial visit ** Data including the initial visit			

Area A

Across the groundwater monitoring visits there was consistency in the order of the elevation data collected for the two monitoring wells. S3-BHA02 consistently recording the highest groundwater elevation and S3-BHA01 recording the lowest. Based on the number of wells installed it is not possible to infer a groundwater flow direction. It should also be noted groundwater flow will likely be influenced by the significant foundations and sub surface structures identified within Area A, and the cutting for Tees Dock Road.

Excluding the initial monitoring visit which was conducted within three days of the borehole installation when the monitoring wells were recorded to be dry and may have taken time to equilibrate, the variation in groundwater elevation was noted to be approximately 0.45m within both wells.

Groundwater was encountered in 12 out of 42 trial pits at depths of between 0.6m and 3.7m bgl, and noted to be perched within the Made Ground above the more cohesive natural soils; inflow rates ranged between slow to heavy. It is likely that this represents “perched” water, and may not be representative of the regional groundwater elevation.

Area B

Across the groundwater monitoring visits there was consistency in the order of the groundwater elevation data collected for the four monitoring wells screened across the Made Ground with S3-BHB04s consistently recording the highest groundwater elevation and S3-BHB03 recording the lowest. Based on the elevation data recorded groundwater flow within the Made Ground is inferred to be in an easterly or north easterly direction. However, it should be noted this is based on a limited dataset given the size of Area B, furthermore groundwater flow will likely be influenced by the significant foundations and sub surface structures associated with the BOS Plant and the road cutting to the west of the site, therefore a consistent flow across the site is considered unlikley.

Excluding the initial monitoring visit which was conducted within a week of the borehole installation the variation in groundwater elevation within the wells screened across the Made Ground was generally less than 0.15m.

Groundwater levels measured within both monitoring wells in the twin installation borehole S3-BHB04 were identical during four of the five monitoring events, further resting groundwater levels within S3-BHB04d screened across the Glacial Till between 4 and 5m were measured at an elevation consistent with the Made Ground. It is therefore considered that groundwater within the superficial deposits at this location is in continuity with the Made Ground.

Groundwater was encountered in 38 out of 75 trial pits at depths of between 0.7m and 3.4m bgl, and noted to be associated with the interface between made ground and natural cohesive deposits; inflow rates were described as between slow and heavy. It is likely that this represents “perched” water, and may not be representative of the regional groundwater elevation, however see note above regarding S3-BHB04.

Summary

For both Area A and B the Made Ground is considered to be of variable permeability, with groundwater perched within the more granular horizons and flow dictated by localised preferential pathways. Groundwater within the superficial deposits is likely to be laterally and vertically discontinuous due to the composition of the deposits at the site, however as with the Made Ground flow through more permeable horizons may occur. This is in line with previous findings for the Site.

2.7 Hydrology

Area A

Holme Beck is shown approximately 110m south from the southwest corner of the site, parallel with Eston Road and north of the A66, it is culverted from here to discharge at SSI's Solid and Liquid Effluent Management System (SLEMS) (Tata Steel, 2014). Knitting Wife Beck is shown immediately southeast of the site, it is also culverted to the SLEMS.

Enviros drawing CO0520017A dated June 2004 indicates a storm drain running across Area A from the vicinity of the Holm Beck Culvert before discharging into Knitting Wife Beck.

Area B

Kinkerdale Beck crosses the northern end of the site in an approximate east to west orientation with a westerly flow direction. A second culverted stream known as the Boundary Beck enters the site approximately midway along the southern boundary and flows approximately north to join the Kinkerdale Beck which after joining the Knitting Wife Beck eventually discharges into the River Tees.

A surface water pound approximately 100m long by 20m wide is located to the south of Area B just beyond the Hot Metal Route.

2.8 Historical Landfill Data

Area A

The Environment Agency website – What's in Your Backyard (accessed on 3/11/2017) contains records of landfills that are located within 500m of the site, the findings of which are summarised below:

Landfill Name	Active or Historical	Distance from Site	Dates of Operation/Types of Waste
Area adjacent to Tees Dock Road	Historical	Approximately 225m southeast	Waste received from 31st December 1982 to 31st March 1983. Types of waste received: inert and commercial.

The desk study report identified a number of potential areas of concern associated with Area A, these are presented as Appendix E and summarised below on SSI3A Figure 4.

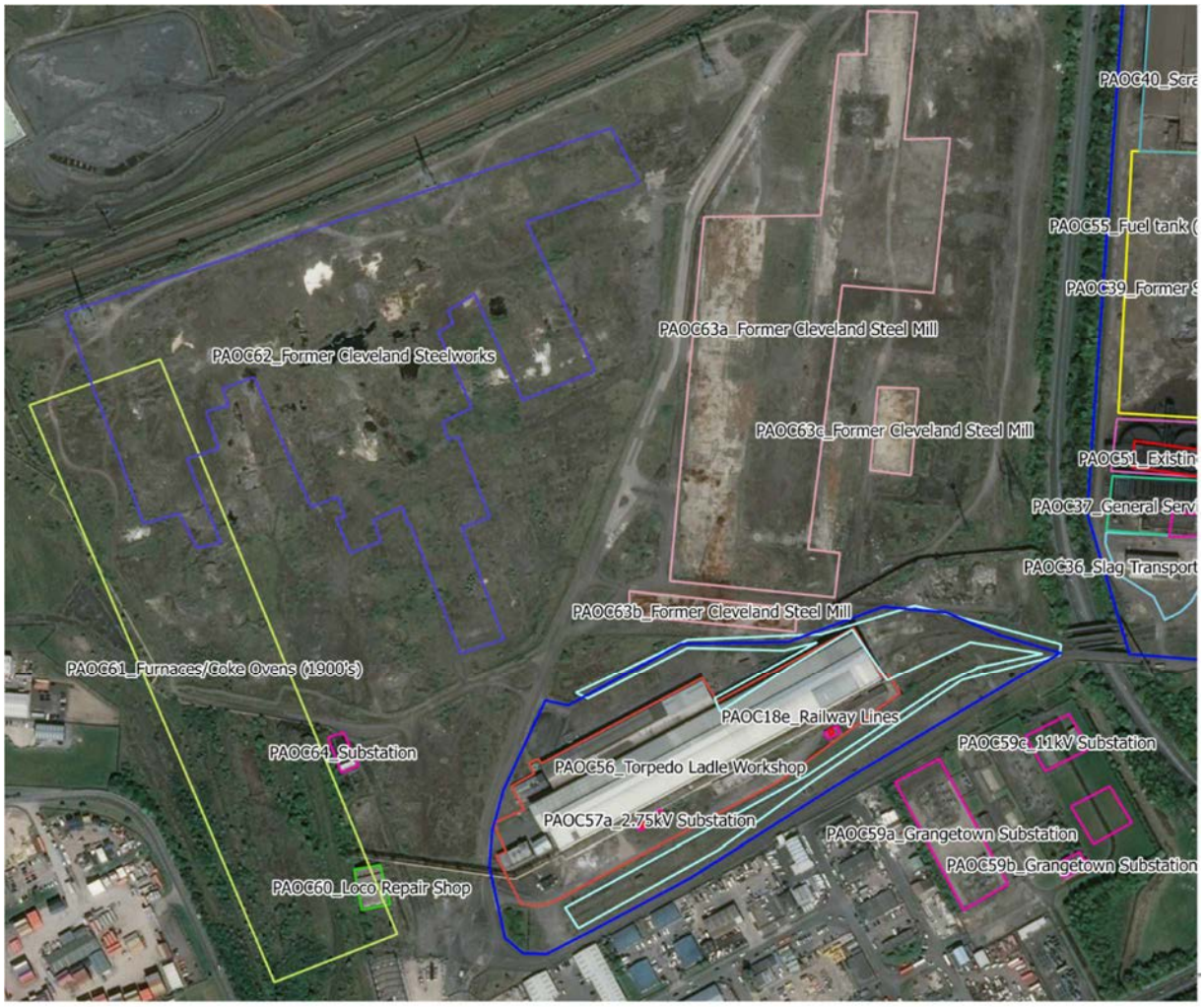


Figure SSI3A – PAOC Area A (PAOC1 – Made Ground, PAOC2 – Waste Materials, and PAOC3 Glaciolacustrine Deposits, BOS and Concast Plant, and Landfills not shown)

Area B

The Environment Agency website – What's in Your Backyard (accessed on 3/11/2017) contains records of landfills that are located within 500m of the site, the findings of which are summarised below:

Landfill Name	Active or Historical	Distance from Site	Dates of Operation/Types of Waste
Redcar Trunk Road Landscaping	Historical	Approximately 100m south-west of the site.	Received inert and industrial waste between 1977 to 1979.
Area adjacent to Tees Dock Road	Historical	Approximately 150m south west of the site.	Received inert and commercial waste between 1982 and 1983.
Bolckow Road	Historical	Approximately 230m south of the site.	Received inert waste between 1st February and 6th March 1993
Mushroom Grove Allotments	Historical	Approximately 230m south of the site.	Received inert and commercial waste between 1984 and 1985
Wilton, Perimeter Mounds	Active	Approximately 230m & 300m south of the site.	Types of waste unknown, however, it is recorded as an A07 Industrial Landfill

Landfill Name	Active or Historical	Distance from Site	Dates of Operation/Types of Waste
			(Factory Curtilage) from ICI Chemicals & Polymers Ltd. Permit reference: EAEPR\EA/EPR/UP3090ZF/A001
ICI No 2 Teesport EPR/RP3631DA	Active	Approximately 350m northwest of the site.	Types of waste unknown; however current licence allows 10 tonnes per day with a capacity for ≈25,000 tonne (excluding inert waste). Operated by Highfield Environmental Limited.

The desk study report identified a number of potential areas of concern associated with Area A, these are presented as Appendix E and summarised below on SSI3B Figure 4.

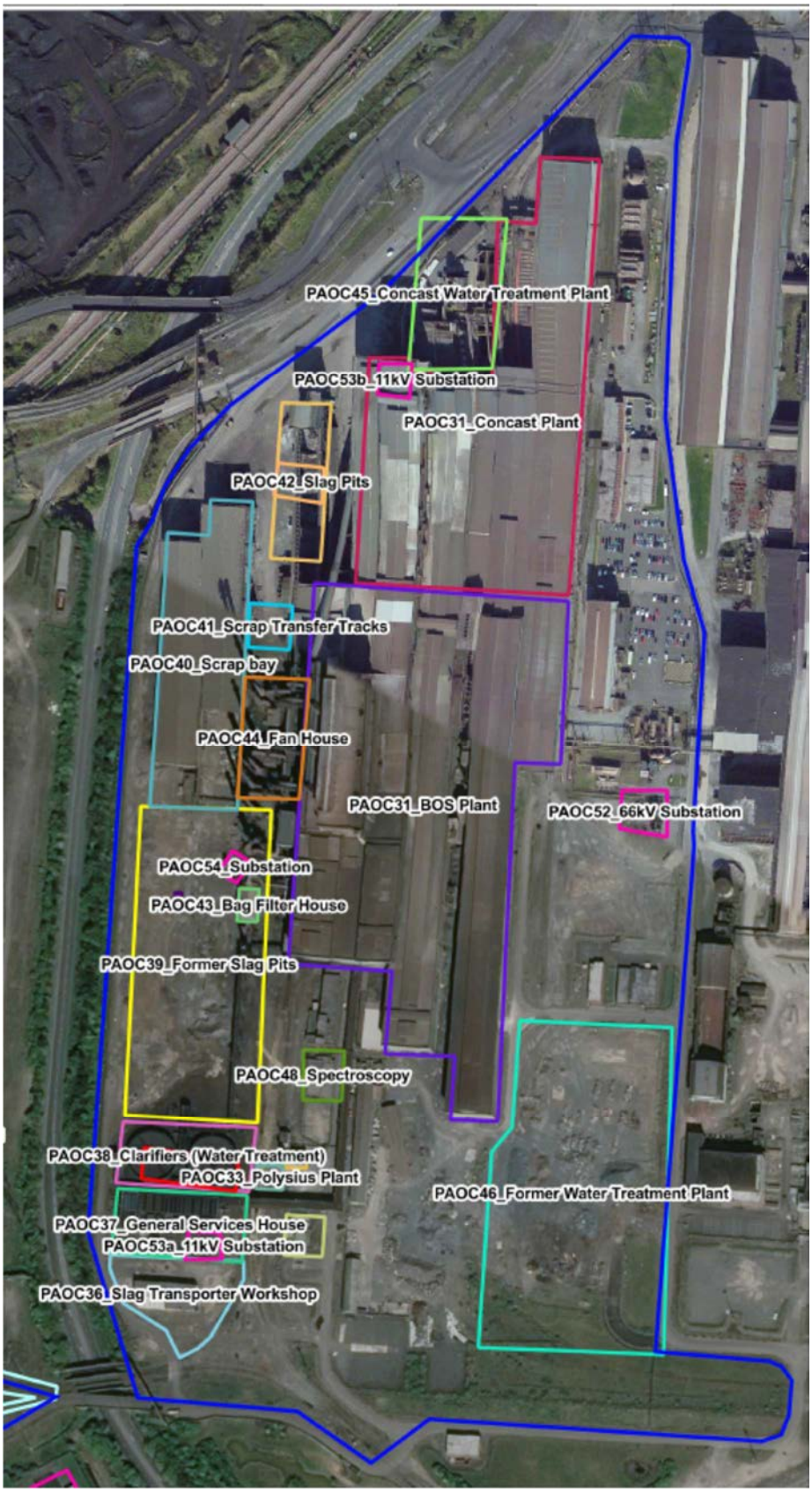


Figure 3 SSIB: PAOC Area A (PAOC1 – Made Ground and PAOC3 Glaciolacustrine Deposits, TLRS, Cleveland Steel Works, Historic ASTs, some substations, former power station, and Landfills not shown for clarity)

3 CONCEPTUAL SITE MODEL AND ENVIRONMENTAL SITE CONDITION ASSESSMENT – Area A

3.1 Introduction

This section summarises the findings of Section 2 in the form of a geo-environmental conceptual site model (CSM) which is presented as Figure 5 in Appendix C.

The CSM provides a qualitative evaluation of potentially active "pollutant linkages" at the site; these being plausible scenarios whereby a contamination source is connected to a possible receptor by one or more pathways:

- 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 pathways for contamination migration: these comprise the routes or mechanisms by which contaminants may migrate from the source to the receptor including environmental migration pathways and human health exposure pathways; and
- Potential receptors of contamination: these include present and/or future land users, ecological systems, water resources and property.

The significance of these source-pathway-receptor linkages will be assessed in the Environmental Risk Assessment Report.

3.2 Contamination Sources

Based on the information reviewed in this report the following potential contamination sources have been identified:

3.2.1 On-Site

On-site sources have been identified associated with Made Ground and potential contaminants of concern (CoC) associated with former site uses. The table below summarises the potential on-site sources and the primary contaminants associated with these sources which are outlined in further detail in the Desk Study report and Appendix E.

Potential On-Site sources	Primary Contaminants
Made Ground including slag deposits	Metals (including heavy metals), refractory materials polyaromatic hydrocarbons (PAHs), cyanide, thiocyanate, sulphate, sulphide, carbonates, pH, ammonia, and asbestos. Potential source of ground gas if found to be have a high organic content.
Sub Stations	Asbestos, total petroleum hydrocarbons (TPH), polychlorinated biphenyls (PCB),
Railway lines and sidings	Metals, asbestos, TPH, PAH, sulphate, sulphide, and pH
Torpedo Ladle Repair Shop	Metals including refractory materials, (including heavy metals), asbestos, PAHs, volatile organic compounds (VOC), semi volatile organic compounds (SVOC), pH, and asbestos.
Above Ground Storage tanks (various)	TPH, PAH, including metals, hydrocarbons, pH.

Potential On-Site sources	Primary Contaminants
South Steel Plant	Metals (including heavy metals), polyaromatic hydrocarbons (PAHs), cyanide, thiocyanate, sulphate, sulphide, carbonates, pH, ammonia, and asbestos.

3.2.2 Off-Site

Potentially contaminative land uses have been identified in the vicinity of the site, the most pertinent of which are presented in the table with potentially associated contaminants:

Potential Off-Site sources	Primary Contaminants
Surrounding landfills	Metals, asbestos, TPH, PAH, VOCs, SVOCs, chloride, ammonia, sulphate, pH
Steel works (BOS and Concast Plants) – part of SSI3 Area B but considered off site for this review. Former Steelworks – Cleveland Iron and Steel Works and Mill	Metals, asbestos, TPH, PAH, cyanides, thiocyanate, VOCs, SVOCs, chloride, ammonia, sulphates, sulphides, pH
Sub Station	Asbestos, total petroleum hydrocarbons (TPH), polychlorinated biphenyls (PCB),
Locomotive Repair Shop	Metals, asbestos, PAHs, VOC, SVOC, and pH
Furnaces / Coke Ovens (1900s)	Metals, asbestos, TPH, PAH, VOC, SVOC, cyanides, thiocyanate, phenols, VOCs, SVOCs, chloride, ammonia, sulphate, pH

Contaminants of concern in green are of low mobility and have therefore been discounted for some sources in question based on the distance from the site, for others they have been retained due to the unknown composition of surface Made Ground adjacent to the site and the consequential potential for dust generation.

3.3 Contamination Sources Assessment

The contamination assessment will be undertaken in two ways – contaminants that are dependent upon the material composition (e.g. metals, inorganics, asbestos and PAHs) will be assessed separately for each material type and contaminants that are associated with a particular point source (e.g. hydrocarbons) will be assessed based on the likely source.

A summary of the analytical data and statistical analysis is presented as Appendix F.

3.3.1 Made Ground

Asbestos

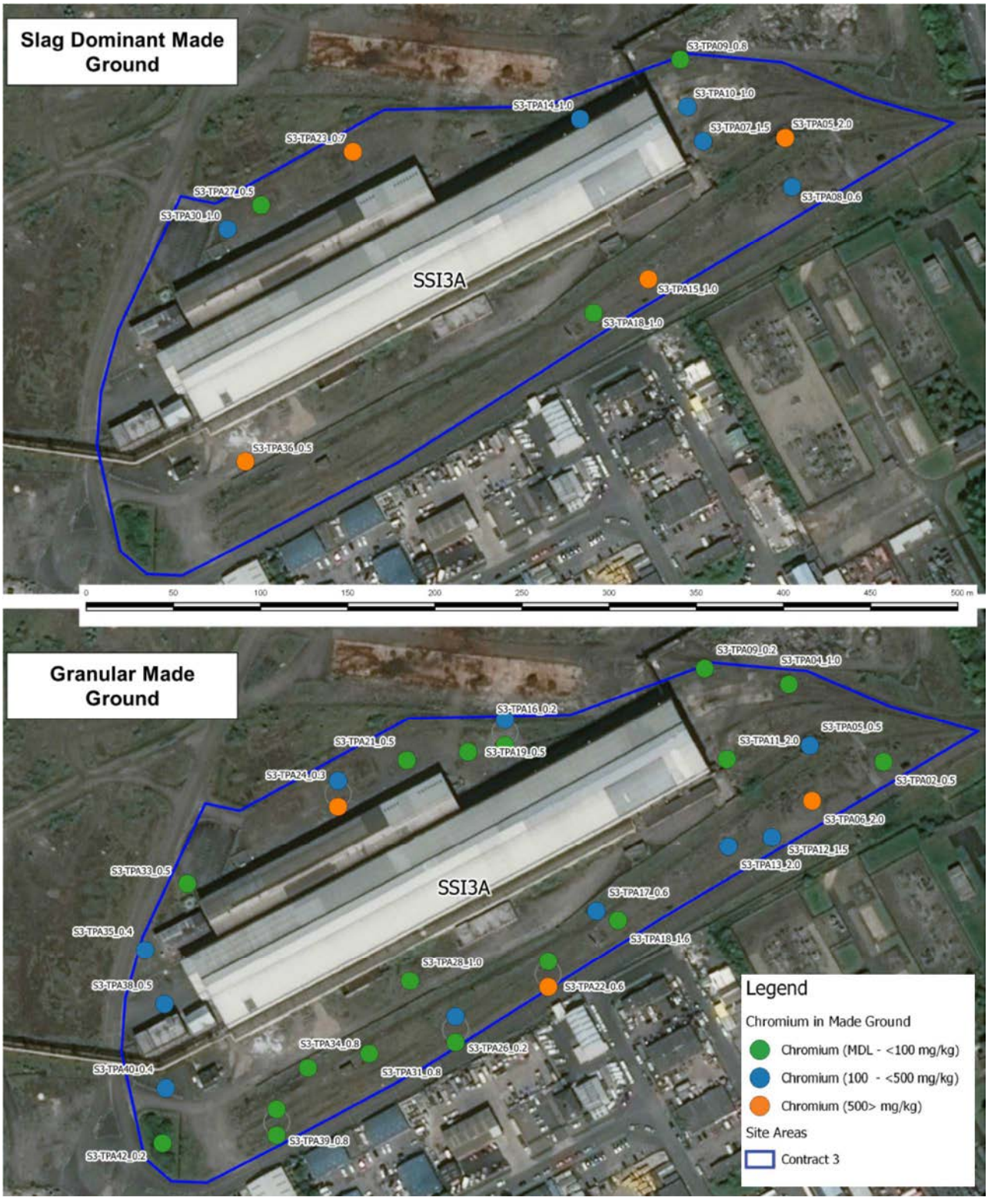
Asbestos fibres were identified in the following locations associated with the Made Ground, the distribution was noted to be primarily across the southern half of the site south to the TLRS; the distribution and quantification of asbestos across Area A is presented on Figure 6 below and in Appendix C.

SSI3A Figure 6: Summary of Asbestos Testing

No asbestos testing was conducted within or associated with the structures.

Metals and Inorganics

With the exception of hexavalent chromium which was not measured above the method detection limit (MDL) the metals analysed were detected in the majority of the soil samples taken from the Made Ground. Statistical analysis indicates that the metal and inorganic ion distribution across the site within the three types of Made Ground deposit (slag dominant deposits, granular and cohesive Made Ground) are relatively consistent within the same order of magnitude. The highest metal concentrations were identified in the slag dominant Made Ground. Concentrations of copper, lead, and vanadium were notably higher in slag dominant deposits, aluminium in granular Made Ground, and cadmium in cohesive Made Ground. A distribution plot for chromium is presented as SSI3A Figure 7 below and in Appendix C; further plots for lead, and vanadium as SSI3A Figures 8 and 10 in Appendix C.



SSI3A Figure 7: Chromium in Made Ground

Levels of cyanide and thiocyanate were generally low across the site, but notably higher based on a limited number of samples from the cohesive Made Ground; where identified cyanide was found to be primarily complexed rather than free. Soluble sulphate concentrations were elevated and generally consistent between Made Ground types. Soil samples were on average strongly alkaline with mean pH values of 11.2, 10.7, and 10.5 for slag dominant, granular, and cohesive Made Ground respectively.

The sample from S3-TPA25 which came from a location where a range of waste materials including wood, chains, rods, and wire had been identified in the trial pit, showed levels of metals and inorganic ions comparable to the other Made Ground Deposits.

Metals were noted to leach from all three types of Made Ground with leached concentrations noted in all eleven samples tested with arsenic, copper, lead, and selenium leaching in ten samples, and barium and manganese leaching in eight samples. The pH of leachate samples was noted to be generally lower than the corresponding soil samples and in the majority of the samples close to neutral.

A summary of the analytical data and statistical analysis is presented as Appendix F.

Polyaromatic Hydrocarbons

Concentrations of PAH were measured in all the samples of slag dominant material, all but one of the granular Made Ground samples and two of the three cohesive Made Ground samples tested. Statistical analysis indicates that average concentrations in slag dominant material was twice that measured in granular made ground and four times that in cohesive Made Ground deposits, however this finding is influenced by an elevated concentration in S3-TPA10.

The sample from S3-TPA25 which came from a location where a range of waste materials including wood, chains, rods, and wire had been identified in the trial pit, showed levels of PAH comparable to the other Made Ground Deposits.

Leached concentrations of PAH were measured in all three samples analysed, leached concentrations ranged between 0.22µg/l and 85µg/l, the latter sample comprising predominantly heavy end compounds.

Elevated concentrations of PAH (330mg/kg and 100mg/kg) and similar levels of TPH were measured in S3-TPA10 (0.8m bgl) and S3-TPA16 (0.7m bgl) respectively, the analysis indicated the contamination was heavy end hydrocarbons of limited volatility and solubility, this is corroborated by field screening where no olfactory evidence of contamination was noted.

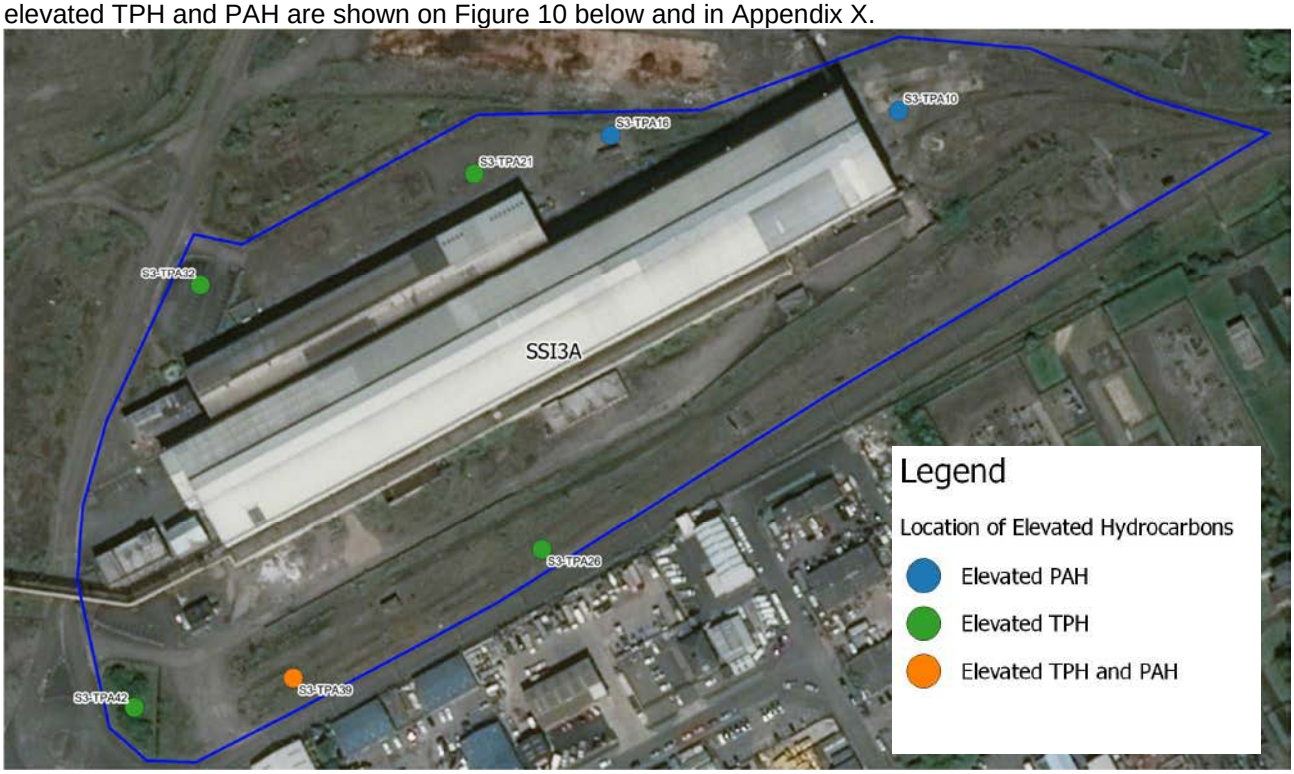
Total Petroleum Hydrocarbons

Concentrations of TPH were detected above the MDL in approximately two thirds of soil samples, the following samples reported concentrations of above 500mg/kg:

- An elevated concentration of TPH (560mg/kg) was measured in S3-TPA21 (0.5m bgl), PAH levels measured in the same sample were low. The analysis indicated the contamination was medium to heavy end hydrocarbons in the C16 to C35 range which are of lower volatility, this is corroborated as no elevated reading was measured by photo ionisation detector (PID) during field screening. The low solubility of the identified hydrocarbons indicates the mobility of the contamination is limited;
- An elevated concentration of TPH (640mg/kg) was measured in S3-TPA26 (0.2m bgl), PAH levels measured in the same sample were low. The analysis indicated the contamination was heavy end hydrocarbons in the C21 to C35 range which are of limited volatility, this is corroborated as no elevated reading was measured by PID during field screening. No TPH was measured above the MDL following leaching tests on the sample, low levels of PAH were noted to leach. The low leachability and solubility of the identified hydrocarbons indicates the mobility of the contamination is limited;
- An elevated concentration of TPH (1,800mg/kg) was measured in S3-TPA32 (1m bgl), PAH levels measured in the same sample were low. The analysis indicated the contamination was primarily a mixture of middle to heavy end hydrocarbons in the C10 to C35 range a bitumen odour had been noted during the excavation of the trial pit and a PID of 12ppm recorded at the approximate depth of the sample.
- An elevated concentration of TPH (640mg/kg) was measured in S3-TPA39 (0.3m bgl), elevated PAH levels were also measured in the same sample. The analysis indicated the contamination was primarily medium to heavy end hydrocarbons in the C16 to C35 range which are of lower volatility, this is corroborated as no elevated reading was measured by photo ionisation detector (PID) during field screening. A concentration of 58µg/l TPH and 58µg/l PAH was measured following leaching tests on the sample, the results suggest a leaching potential for the soil impact.
- An elevated concentration of TPH (900mg/kg) was measured in S3-TPA42 (0.2m bgl), PAH levels measured in the same sample were low. The analysis indicated the contamination was primarily

medium to heavy end hydrocarbons in the C16 to C35 range which are of lower volatility, this is corroborated as no elevated reading was measured by photo ionisation detector (PID) during field screening. No TPH was measured above the MDL following leaching tests on the sample, low levels of PAH were measured in leachate but these were only marginally above the MDL. The low leachability of the identified hydrocarbons indicates the mobility of the contamination is limited;

The TPH was noted to be associated with rail sidings at the former TLRS and is considered likely to result from historic placement of Made Ground material prior to the construction of the current structure. The locations of elevated TPH and PAH are shown on Figure 10 below and in Appendix X.



SSI3A Figure 10: Locations of Elevated TPH

Other Contaminants

No elevated concentrations of VOC, SVOC, or PCBs were measured in any of the soil samples.

Additional sources were identified by Environ in 2004, these are detailed in the relevant report and will be considered as part of the risk assessment.

3.3.2 Glaciolacustrine Deposits and Glacial Till

Concentrations of metals within the natural Glaciolacustrine Deposits and Glacial Till were consistent and generally lower that those measured in Made Ground deposits; particularly for arsenic, chromium, copper, lead and Zinc. Metals levels in one of the six samples, Glacial Till from S3-TPA27 showed metals concentrations notably elevated compared to other samples. Concentrations of two PAHs were measured just above the MDL in one of the samples from the natural deposits.

3.3.3 Groundwater

Metals and Inorganics

Metals were measured in groundwater samples from both monitoring wells, concentrations were broadly similar within the same order of magnitude both between monitoring wells and over the two groundwater monitoring visits. Boron, magnesium, and manganese, were measured at the highest concentrations. Elevated levels of sulphate were measured in both monitoring wells. The pH of groundwater samples ranged between 7.6 and 8.6.

Organics

Low levels (9.1µg/l) of TPH were in groundwater sampled from S3-BHA01 during the first monitoring visit only; TPH was measured during both monitoring visits in groundwater from S3-BH02, again at low levels (69-90µg/l). Levels of PAH were also measured in groundwater sampled from both monitoring wells, concentrations were generally low and did not show good reproducibility between the two visits. No VOC, SVOC, or PCBs were measured in either of the samples.

3.4 Pathways

Potential migration pathways based on a proposed commercial / industrial end use are discussed below.

3.4.1 Airborne Migration Pathways

- The majority of the site is currently covered in soft landscaping, as such, particulate inhalation due to dust generation is a potentially active pathway.
- Vapour inhalation pathways in relation to soil are potentially active, vapour inhalation pathways in relation to groundwater are considered potentially active due to the identified depth of groundwater (approximately <2m bgl).
- During potential re-development works, sub-surface soils could be exposed at the surface due to trenching and or re-profiling requirements and therefore dust has the potential to be generated. Notwithstanding this, it is suggested typical dust suppression techniques should be employed so that exposures would be minimised.
- Migration and accumulation of permanent ground gases originating from the Made Ground on site in confined spaces leading to asphyxiation and/or explosion is considered potentially active.

3.4.2 Direct Contact Exposure Pathways

- The proposed site surfacing under any potential re-development scenario is unknown, should a significant portion of the site area be covered in some form soft landscaping direct contact pathways and ingestion in relation to soil would be considered active. Given the identified depth to groundwater, direct contact pathways in relation to groundwater are not considered active.
- Direct contact pathways would be active throughout a potential redevelopment; typical mitigation measures such as personal protective equipment (PPE; overalls, gloves etc.) would be used to mitigate this risk. If significant levels of contamination (such as NAPL) are present additional PPE may be required as mitigation.

3.4.3 Aqueous Migration Pathways

- Leaching of contaminants in the shallow soils to groundwater within the Superficial Deposits is considered potentially active.
- Based the thickness of the Made Ground and the limited thickness of Glacial Till and Glaciolacustrine Deposits identified in on-site boreholes overlying the Redcar Mudstone Formation, Penarth Group and Mercia Mudstone the potential for vertical migration of contaminants to the underlying Secondary (undifferentiated)
- Given the thickness and granular nature of the identified Made Ground and the identified resting groundwater levels the migration of off-site impacts on to the site from nearby PAOC is considered potentially active. The most likely sources would be the former Cleveland Steelworks and Mill to the north. Under the same logic the migration of on site contaminants off site is considered potentially active. Migration is also considered possible within the Superficial Deposits.
- Lateral migration of on-site impacts towards the off-site culverted surface water streams and subsequently the River Tees is considered potentially active given the likely thickness and nature of the Made Ground. The construction details and condition of the culverts is unknown.
- Migration of groundwater into the on site storm drain and subsequently the off-site culverted surface water streams and subsequently the River Tees is considered potentially active
- Migration of contaminants of concern in surface water runoff from the Made Ground is considered potentially active.
- The vertical migration of impacts down piled structures is considered potentially active.

3.5 Ground Gas Assessment

Ground gas monitoring was conducted on 3 occasions across a range of weather and atmospheric conditions. In monitoring well S3-BHA02 groundwater was resting above the top of the well slotted section indicating the data recorded is not representative if the sub surface ground gas condition, this is expected as the monitoring well was designed to assess groundwater conditions within the Glaciolacustrine Deposits.

In S3-BHA01 which is screened across the Made Ground and Glacial Till methane levels were below the detection limit of the instrument and carbon dioxide levels were below 0.5% across all the visits. Flow rates were observed to be below the detection limit of the instrument.

3.6 Receptors

With reference to Part 2a of the Environmental Protection Act (1990), the potential receptors to be considered in any contaminated land scenario can be summarised as follows:

3.6.1 Human Health

For the purposes of this assessment it is assumed that the proposed development will comprise a commercial or industrial end use, and as such commercial and industrial workers are the primary receptor of concern for any contamination risk. The risk would be influenced by the duration and location of the staff work regimes.

Construction workers/contractors could also be exposed to contaminants during any construction processes (i.e. during any ground reprofiling or utility/foundation trenching).

Users of the adjacent buildings could also be at risk. However, for exposure to occur, active cross-boundary migration pathways would be required.

3.6.2 Property (buildings, etc.)

The proposed development will include new structures and associated infrastructure, which could be subject to potential sulphate attack in relation to buried concrete. Given the presence of slag deposits within the Made Ground the potential for expansive slag to impact structures is considered active.

3.6.3 Controlled Water

Groundwater is a Controlled Water; therefore, the groundwater beneath the site requires consideration and protection. At this site, the underlying geology comprises Glacial Till and Glaciolacustrine Deposits which are not classified as an Aquifer but have been identified to contain water, and the Mercia Mudstone Formation classified as a Secondary (Undifferentiated) Aquifer. At this CSM stage both the superficial and bedrock water bearing units are considered groundwater receptors at the site. Surface water courses including those culverted adjacent to the site are also considered Controlled Water receptors, the storm drain below the site is also considered a receptor.

3.7 Slag Testing Data

A total of 6 samples of slag recovered from trial pits were submitted for examination, the results are presented in Appendix G and summarised below.

- The majority of the samples contained mixed blast furnace and basic steel slag deposits. In three samples blast furnace slags predominated, in one sample basic steel slag predominated and in the remaining samples the two slags were present in equal amounts.
- Small amounts of basic refractory materials were noted in one slag sample, these materials are particularly susceptible to expansion.
- Samples containing medium or higher proportions of basic steel slag were tested for free calcium and magnesium oxides. Free calcium oxide compositions ranged from 0.8% to 1.3% and free magnesium oxides ranged between 0.1% and 0.2%.
- Three samples were subject to 14 day expansion tests, samples showed expansions between 0.04% and 0.78%.

- Three samples were subject to 28 day accelerated expansion tests. The results showed expansion in all samples ranging between 0.04 and 1.16%.
- The samples tested did not contain Ettringite, which if present is an indicator expansion has occurred in the past.

3.8 Geotechnical Analysis Summary

- Triaxial cell measurements are awaited.
- Hand shear vane (HSV) test results ranged between:
    - Made Ground – 80kPa to 110kPa indicating high strength soils.
    - Glacial Till –116kP indicating a high strength soil.
- Standard penetration test (SPT) results ranged between:
    - Glacial Till – N15 to >N50, boulders were observed within the glacial till.
    - Glaciolacustrine Deposits – N6 to N8.
    - Redcar Mudstone Formation – N19 to >N50, SPTs at the rockhead may be influenced by boulders at the base of the Glacial Till.
- Loss on ignition ranged between 3.1% and 13%

3.9 Conceptual Site Model

The above data has been used to produce a geo-environmental CSM for the site, this is presented as SSI3A Figure 5 below and in Appendix C.

Potential Human Health SPR Linkages

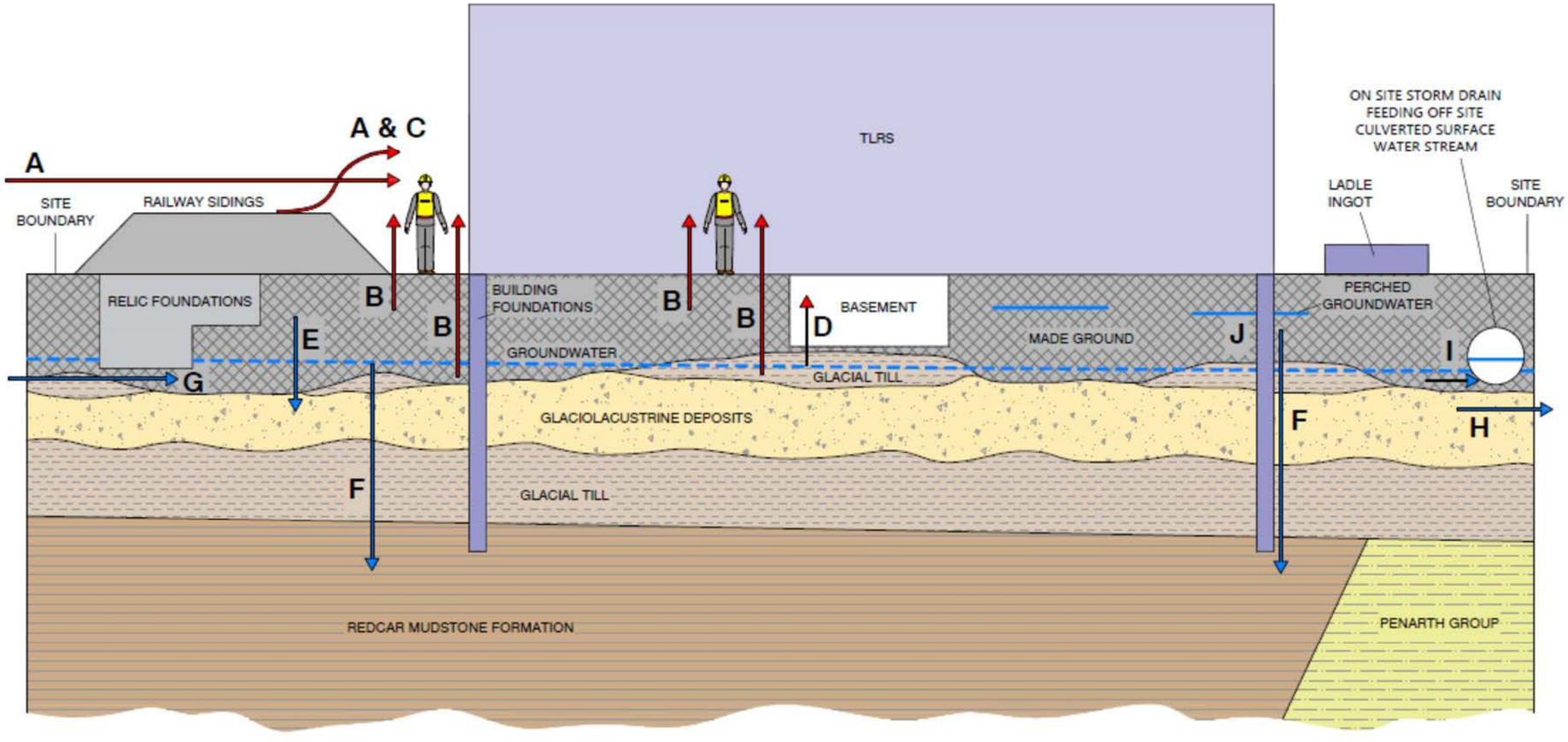
A = Dust inhalation from Made Ground from site and adjacent land
B = Vapour inhalation of indoor or outdoor air from contaminated soil and or groundwater
C = Direct contact and ingestion
D = Accumulation of ground gas in confined spaces
SPR linkages for construction workers during redevelopment not shown

Potential Water Resource SPR Linkages

E = Leaching of contaminants from Made Ground and point sources to groundwater in superficial deposits
F = Migration of contaminated groundwater to (Secondary (Undifferentiated) Aquifer) in bedrock
G = Migration of contaminated groundwater onto site in Made Ground and Superficial Deposits
H = Migration of contaminated groundwater off site in Made Ground and Superficial Deposits
I = Migration of contaminated groundwater into culverted surface water stream (Holme Beck Knitting Wife Beck) either directly or via storm drain.

Other SRP Linkages

J = Attack by contaminants of concern on foundations



SSI3A Figure 5: CSM

4 CONCEPTUAL SITE MODEL AND ENVIRONMENTAL SITE CONDITION ASSESSMENT – AREA B

4.1 Introduction

This section summarises the findings of Section 2 in the form of a geo-environmental conceptual site model (CSM) which is presented as SSI3B Figure 5.

The CSM provides a qualitative evaluation of potentially active "pollutant linkages" at the site; these being plausible scenarios whereby a contamination source is connected to a possible receptor by one or more pathways:

- 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 pathways for contamination migration: these comprise the routes or mechanisms by which contaminants may migrate from the source to the receptor including environmental migration pathways and human health exposure pathways; and
- Potential receptors of contamination: these include present and/or future land users, ecological systems, water resources and property.

The significance of these source-pathway-receptor linkages will be assessed in the Environmental Risk Assessment Report.

4.2 Contamination Sources

Based on the information reviewed in this report the following potential contamination sources have been identified:

4.2.1 On-Site

On-site sources have been identified associated with Made Ground and potential contaminants of concern associated with former site uses. The table below summarises the main potential on-site sources and the primary contaminants associated with these sources which are outlined in further detail in the Desk Study report.

Potential On-Site sources	Primary Contaminants
Made Ground including slag deposits	Metals (including heavy metals), polyaromatic hydrocarbons (PAHs), cyanide, thiocyanate, sulphate, sulphide, carbonates, pH, ammonia, and asbestos. Potential source of ground gas if found to be have a high organic content.
Sub Stations	Asbestos, total petroleum hydrocarbons (TPH), polychlorinated biphenyls (PCB),
BOS and Concast Plant including: • Steelmaking areas • Storage areas and tanks • Garages and workshops • Water treatment plant	Metals, asbestos, PAH, VOC, SVOC, cyanide, thiocyanate, sulphate, sulphide, carbonates, pH, ammonia
Railway lines and sidings	Metals, asbestos, TPH, PAH, sulphate, sulphide, and pH
Grangetown Power Station	Metals, asbestos, TPH, PAH, PCBs, sulphate
Clay Pits	Backfill material, included in Made Ground above

4.2.2 Off-Site

Potentially contaminative land uses have been identified in the vicinity of the site, the most pertinent of which are presented in the table with potentially associated contaminants:

Potential Off-Site sources	Primary Contaminants
Surrounding landfills	Metals, asbestos, TPH, PAH, VOCs, SVOCs, chloride, ammonia, sulphate, pH, ground gas
Current British Steel Facility and Former Cleveland Iron and Steelworks and Mill	Metals, asbestos, TPH, PAH, cyanides, thiocyanate, VOCs, SVOCs, chloride, ammonia, sulphates, sulphides, pH
Sub Station	Asbestos, total petroleum hydrocarbons (TPH), polychlorinated biphenyls (PCB),
Torpedo Ladle Repair Shop – Part of SSI3 Area A but considered off site for this review.	Metals, asbestos, PAHs, volatile organic compounds VOC, SVOC, pH, and asbestos.
Locomotive Repair Shop	Metals, asbestos, PAHs, VOC, SVOC, and pH
Furnaces / Coke Ovens (1900s)	Metals, asbestos, TPH, PAH, VOC, SVOC, cyanides, thiocyanate, chloride, ammonia, sulphate, pH

Contaminants of concern in green are of low mobility and have therefore been discounted for some sources in question based on the distance from the site, for others they have been retained due to the unknown composition of surface Made Ground adjacent to the site and the consequential potential for dust generation. Ground gas from off site landfills can be discounted based on the distance from the site.

4.3 Contamination Sources Assessment

The contamination assessment will be undertaken in two ways – contaminants that are dependent upon the material composition (e.g. metals, inorganics, asbestos and PAHs) will be assessed separately for each material type and contaminants that are associated with a particular point source (e.g. hydrocarbons) will be assessed based on the likely source.

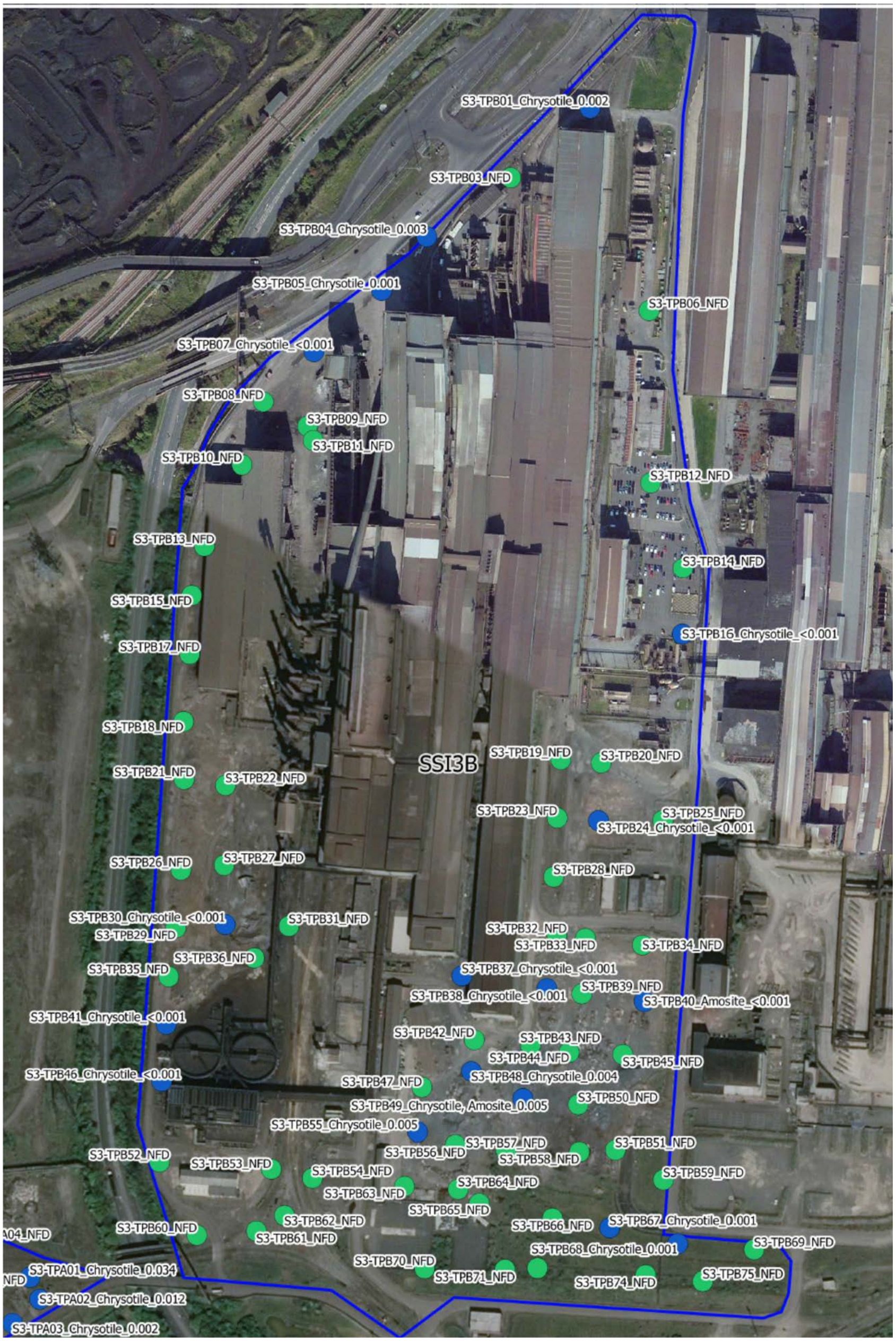
A summary of the analytical data and statistical analysis is presented as Appendix F.

4.3.1 Made Ground

Asbestos

Asbestos fibres were identified in the following locations associated with the Made Ground, the distribution was noted to be primarily across the south eastern third of the site and northern boundary. The distribution and quantification of asbestos presented on SSI3B Figure 6 below and in Appendix C.

Note, giver the age of the structures on site, it is likely that asbestos containing materials (ACM) have been used in the building construction., Assessment of the presence of ACM in buildings is outside of the scope of this report, and further surveys should eb carried out ahead of any refurbishment or demolition works.

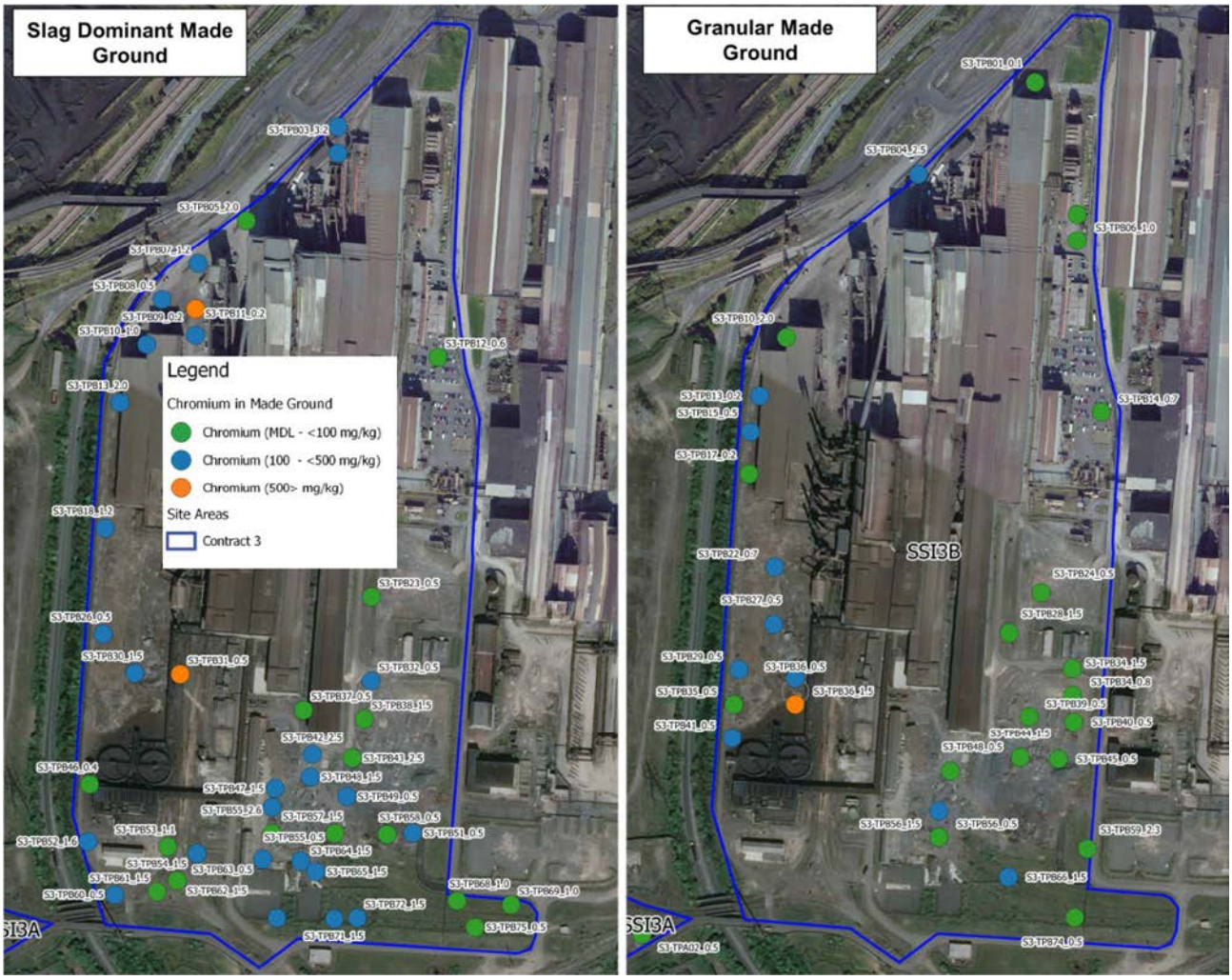


SSI3B Figure 6: Summary of Asbestos Testing

No asbestos testing was conducted within or associated with the structures.

Metals and Inorganics

With the exception of hexavalent chromium which was not measured above the method MDL and mercury the metals analysed were detected in the majority of the soil samples taken from the Made Ground. Statistical analysis indicates that the metal and inorganic ion distribution across the site within slag dominant deposits, granular and cohesive Made Ground are relatively consistent within the same order of magnitude. The highest metal concentrations were identified in the slag dominant and granular Made Ground. Concentrations of manganese, mercury and vanadium were notably higher in slag dominant deposits, and lead in granular Made Ground. A distribution plot for chromium is presented as SSI3B Figure 7 below and in Appendix C; further plots for lead, and vanadium as SSI3B Figures 8 and 10 in Appendix C.



Levels of cyanide and thiocyanate were generally low across the site, more variation was noted in soluble sulphate concentrations with higher levels noted in slag dominant and cohesive Made Ground. The pH of the Made Ground samples was noted to be strongly alkaline with mean values of 11.4 and 11 noted for slag dominant and granular Made Ground respectively.

The sample from S3-TPB19 came from a location where a range of waste materials including metal, plastic and wood had been identified in the trial pit, showed levels of metals and inorganic ions comparable to the other Made Ground Deposits.

Leachability testing was conducted on all types of Made Ground and showed the majority of metals were present in the leachate, with beryllium, cadmium and nickel the only metals not measured above the MDL. Leached concentrations of metals were noted in all 10 samples tested with arsenic, barium, and manganese.

Concentrations of arsenic, iron, and manganese were noted to be lower in leachate from slag samples, whereas barium concentrations were noted to be higher. The concentration of vanadium in leachate from S3-TPB28 (1.5m bgl) was noted to be an order of magnitude higher than measured in the other samples, this sample was classed a granular Made Ground. The pH of leachate was generally lower than the corresponding soil sample and in 8 of 10 cases alkaline (pH 6.4 – 10.6).

A summary of the analytical data is presented as Appendix F.

Polyaromatic Hydrocarbons

Concentrations of PAH were measured in almost all the samples of slag dominant material and granular made ground tested as well as the majority of samples of cohesive Made Ground. Statistical analysis indicates that average concentrations in slag dominant material was twice that measured in granular Made Ground and an order of magnitude higher than that measured in cohesive Made Ground.

The sample from S3-TPB19 taken from a location where a range of waste materials including metal, plastic and wood had been identified in the trial pit, showed levels of PAH comparable to the other Made Ground Deposits.

Leached concentrations of PAH were measured all six samples and comprised a broad range of light to heavy end compounds. Total leached concentrations were higher from samples of slag dominant material than cohesive or granular Made Ground but all detections were only marginally above the MDL at less than 1µg/l.

Total Petroleum Hydrocarbons

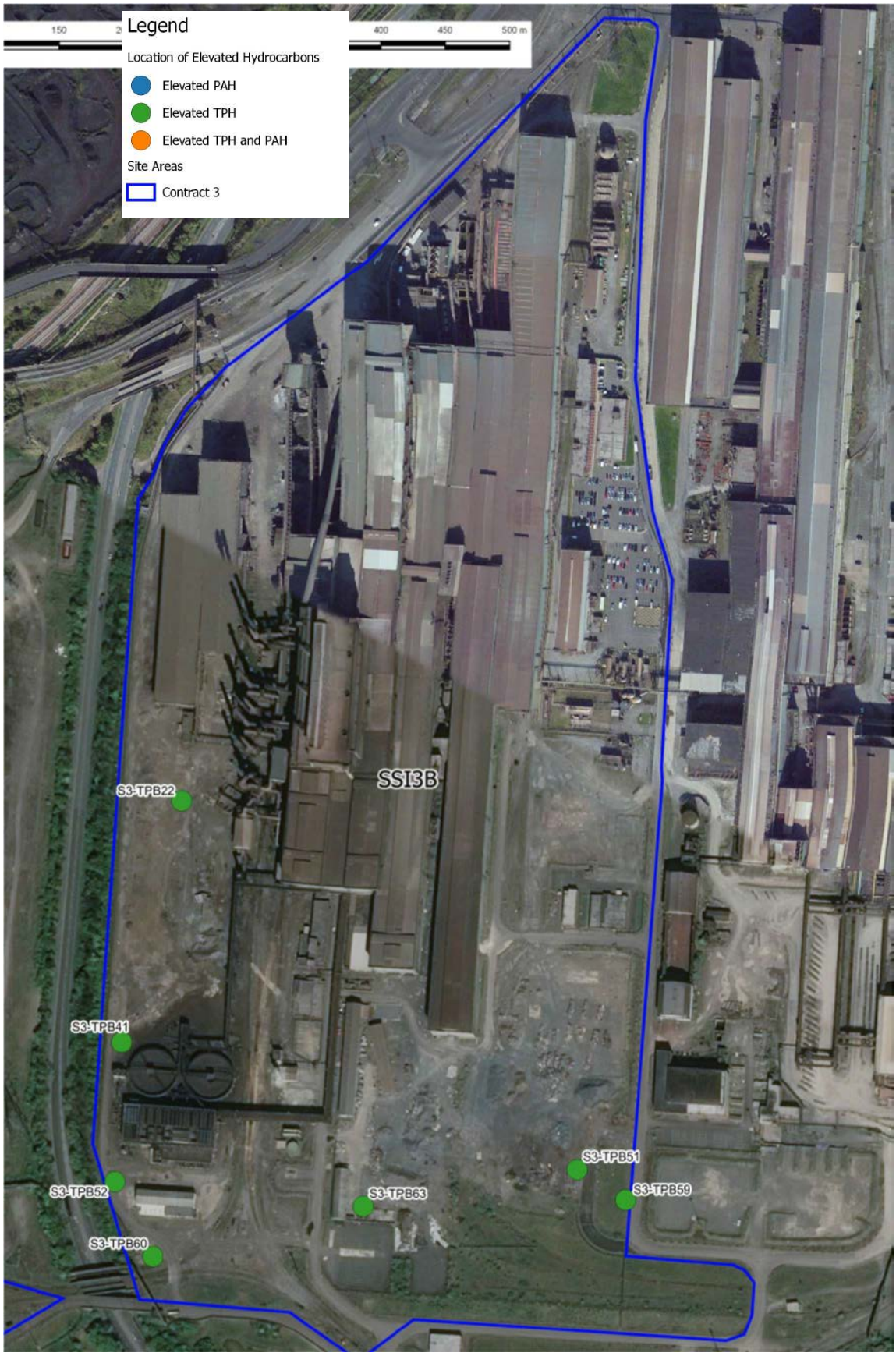
Concentrations of TPH were detected above the MDL in the majority of soil samples, the following samples reported concentrations of above 500mg/kg:

- An elevated concentration of TPH (810-990mg/kg) was measured in two samples from S3-TPB22 (0.7 - 1.9m bgl) located within the area of former slag pits, concentrations of PAH within the same samples were low. A hydrocarbon odour, sheen, and staining were noted between 1.7 and 2.1m bgl in the trial pit. Analysis indicated the contamination was mid-range to heavy end hydrocarbons. A concentration of 76µg/l TPH was measured following leaching tests on the sample, the results suggest a leaching potential for the soil impact.
- An elevated concentration of TPH (760mg/kg) was measured in S3-TPB41 (0.5m bgl), located close to the clarifiers, concentrations of PAH in the same sample were 26mg/kg. No visual or olfactory evidence of contamination had been noted during field screening. Analysis indicated the contamination was primarily mid to heavy end hydrocarbons.
- An elevated concentration of TPH (960mg/kg) was measured in S3-TPB51 (0.5m bgl) located within the storage area south east of the BOS building, concentrations of PAH within the same sample was 71mg/kg. No visual or olfactory evidence of contamination had been noted during field screening. Analysis indicated the contamination was primarily heavy end hydrocarbons. A concentration of 1.7µg/l TPH and 0.3µg/l PAH was measured following leaching tests on the sample, the results suggest a low leaching potential for the soil impact.
- An elevated concentration of TPH (1,900mg/kg) was measured in S3-TPB52 (1.55m bgl) located close to water treatment plant, concentrations of PAH within the same sample was 27mg/kg. A tar like substance had been noted on the Made Ground during excavation of the trial pit. Analysis indicated the contamination was mid-range to heavy end hydrocarbons. A concentration 0.61µg/l PAH was measured following leaching tests on the sample, no TPH was measured above the MDL in the leachate, the results suggest a low leaching potential for the soil impact.
- An elevated concentration of TPH (3,400mg/kg) was measured in S3-TPB60 (0.5m bgl) located south west of the water treatment plan and slag transporter workshop, concentrations of PAH within the same samples were low. No visual or olfactory evidence of contamination had been noted during field screening. Analysis indicated the contamination was primarily heavy end hydrocarbons. A

concentration of 2.7µg/l TPH and 0.44µg/l PAH was measured following leaching tests on the sample, the results suggest a low leaching potential for the soil impact.

- An elevated concentration of TPH (3,300mg/kg) was measured in S3-TPB59 (2.3m bgl) located in the south-east of the site, concentration of PAH within the same sample was 4.2mg/kg. A tar like substance had been noted on the Made Ground during excavation of the trial pit, the contamination did not give an elevated reading on the PID indicating it was of low volatility. Chemical analysis indicated the contamination was primarily heavy end hydrocarbons which are generally less volatile. A concentration 0.01µg/l PAH was measured following leaching tests on the sample, no TPH was measured above the MDL in the leachate, the results suggest a low leaching potential for the soil impact. Based on discussions with site personnel and review of historical Ordnance Survey mapping the impact identified in S3-TPB59 is understood to be in the vicinity of a former hydrocarbon storage tank.
- An elevated concentration of TPH (970mg/kg) was measured in S3-TPB63 (0.5m bgl) located in the south of the site close to a small stores building, concentrations of PAH within the same sample was 15mg/kg. No visual or olfactory evidence of contamination had been noted during field screening. Analysis indicated the contamination was primarily heavy end hydrocarbons.

Based on the type of TPH fractions identified and the position of the trial pits the hydrocarbons identified in S3-TPB52 and S3-TPB60 are likely to relate to the same source, potentially associated with the slag transporter workshop. The locations of elevated TPH are shown on Figure 10 below and in Appendix C.



SSI Figure 10: Location of Elevated Hydrocarbon Detections

Other Contaminants

No elevated concentrations of VOC, SVOC, or PCBs were measured in any of the soil samples analysed.

Additional sources were identified by Environ in 2004, these are detailed in the relevant report and will be considered as part of the risk assessment.

4.3.2 Glaciolacustrine Deposits and Glacial Till

Concentrations of metals within the natural Glaciolacustrine Deposits and Glacial Till were consistent. Statistical analysis indicates metals concentrations were generally lower than those observed in Made Ground particularly for chromium, lead, and zinc. Concentrations of PAHs were measured marginally above the MDL in one of the six samples from the natural deposits.

4.3.3 Groundwater

Metals and Inorganic Ions

Metals and inorganic ions were measured in groundwater samples from all five monitoring wells, concentrations were broadly similar within the same order of magnitude both between monitoring wells and over the two groundwater monitoring visits, although levels in S3-BHB03 were generally higher than in the other wells. An elevated concentration of manganese was noted in groundwater from S3-BHB03 and an elevated level of vanadium was noted in S3-BHB02 during the initial monitoring visit.

Levels of sulphate were noted to be an order of magnitude higher in S3-BHB01 than in the other monitoring wells. The pH of the groundwater was alkaline and ranged between pH8 and pH9.5

Organics

Concentrations of PAH were generally low <5µg/l with the exception of S3-BHB04s/d during the first sampling visit, concentrations were noted to significantly reduce during the second monitoring visit after the sample from S3-BHB04d was filtered at the well head to remove sediment entrainment; no sample was collected from S3-BHB04s during the second monitoring visit.

Concentrations of TPH were measured in groundwater from all wells with the exception of S3-BHB01; concentrations within S3-BHB02 and S3-BHB04d were noted to reduce to below the MDL during the second monitoring visit after the samples were filtered at the well head to reduce sediment entrainment. Concentrations in S3-BHB03 (120-300µg/l) remained consistent within the same order of magnitude between the two visits. Concentrations of TPH in soil in the trial pit (S3-TPB53) where the monitoring well had been installed were 160mg/kg.

No significant sources of VOC, SVOC, or phenols were detected.

4.4 Pathways

Potential migration pathways based on a proposed commercial / industrial end use are discussed below.

4.4.1 Airborne Migration Pathways

- The majority of the external areas of the site is currently covered in soft landscaping, as such, particulate inhalation due to dust generation is a potentially active pathway.
- Vapour inhalation pathways in relation to soil are potentially active, vapour inhalation pathways in relation to groundwater are considered potentially active due to the identified depth of groundwater (approximately >1m bgl).
- During potential re-development works, sub-surface soils could be exposed at the surface due to trenching and or re-profiling requirements and therefore dust has the potential to be generated. Notwithstanding this, typical dust suppression techniques should be employed so that exposures would be minimised.
- Migration and accumulation of permanent ground gases originating from the Made Ground on site in confined spaces leading to asphyxiation and/or explosion is considered potentially active.

4.4.2 Direct Contact Exposure Pathways

- The proposed site surfacing under any potential re-development scenario is unknown, should a significant portion of the site area be covered in some form soft landscaping direct contact and ingestion pathways in relation to soil would be considered active. Given the identified depth to groundwater, direct contact pathways in relation to groundwater are not considered active.
- Direct contact pathways would be active throughout a potential redevelopment; typical mitigation measures such as personal protective equipment (PPE; overalls, gloves etc.) would be used to mitigate this risk. If significant levels of contamination (such as non-aqueous phase liquids (NAPL)) are present additional PPE may be required as mitigation.

4.4.3 Aqueous Migration Pathways

- Leaching of contaminants in the Made Ground to groundwater within the Superficial Deposits is considered potentially active
- Based the thickness of the Made Ground and the limited thickness of Glacial Till and Glaciolacustrine Deposits identified in on-site boreholes overlying the bedrock the potential for vertical migration of contaminants to the underlying Aquifers is considered potentially active, however the composition of these deposits may limit the potential for vertical migration.
- Given the thickness and granular nature of the identified Made Ground and the identified resting groundwater levels the migration of off-site impacts on to the site from nearby PAOC is considered potentially active. The most likely sources would be the British Steel facility to the east. Under the same logic the migration of on site contaminants off site is considered potentially active. Migration is also considered possible within the Superficial Deposits however the composition of these materials may limit the potential for lateral migration.
- Lateral migration of on-site impacts towards the off-site culverted surface water streams and subsequently the River Tees is considered potentially active given the likely thickness and nature of the Made Ground. The construction details and condition of the culverts is unknown.
- Migration of contaminants of concern in surface water runoff from the Made Ground is considered potentially active
- The vertical migration of impacts down piled foundations is considered potentially active.

4.5 Ground Gas Assessment

Ground gas monitoring was conducted on 3 occasions across a range of weather and atmospheric conditions. In monitoring well S3-BHB04d groundwater was resting above the top of the well slotted section indicating the data recorded is not representative if the sub surface ground gas condition, this is expected as the monitoring well was designed to assess groundwater conditions within the Glacial Till.

In the remaining wells which are wholly or partially screened across the Made Ground, Glaciolacustrine Deposits, and Glacial Till methane levels were below the detection limit of the instrument during the first two visits and 0.2% during the third visit; carbon dioxide levels were below 1% across all the visits. Flow rates were observed to be below the detection limit of the instrument.

These results suggest there is minimal build up and movement of ground gas below the site, the significance of the results will be assessed as part of the environmental risk assessment. However it is noted that this is based on a limited number of sampling points given the size of the site.

4.6 Receptors

With reference to Part 2a of the Environmental Protection Act (1990), the potential receptors to be considered in any contaminated land scenario can be summarised as follows:

4.6.1 Human Health

For the purposes of this assessment it is assumed that the proposed development will comprise a commercial or industrial end use, and as such commercial and industrial workers are the primary receptor of concern for any contamination risk. The risk would be influenced by the duration and location of the staff work regimes.

Construction workers/contractors could also be exposed to contaminants during any construction processes (i.e. during any ground reprofiling or utility/foundation trenching).

Users of the adjacent buildings could also be at risk. However, for exposure to occur, active cross-boundary migration pathways would be required.

4.6.2 Property (buildings, etc.)

The proposed development may include new structures and associated infrastructure, which could be subject to potential sulphate attack in relation to buried concrete. Given the presence of slag deposits within the Made Ground the potential for expansive slag to impact structures is considered active.

The Mercia Mudstone present in the north of the site contains gypsum a source of sulphate, this has the potential to attack concrete within foundation piles.

4.6.3 Controlled Water

Groundwater is a Controlled Water; therefore, the groundwater beneath the site requires consideration and protection. At this site, the underlying geology comprises Glacial Till and Glaciolacustrine Deposits which are not classified as an Aquifer but have been identified to contain water; and three bedrock units, the Redcar Mudstone Formation and Penarth Group which are both classified as a Secondary (Undifferentiated) Aquifers, and the Mercia Mudstone a Secondary A Aquifer. At this CSM stage all the above water baring bodies are considered groundwater receptors at the site.

The pond to the south of the site and surface water courses including those culverted within the site are also considered Controlled Water receptors.

4.7 Slag Testing Data

A total of 15 samples of slag recovered from trial pits were submitted for examination, the results are presented in Appendix G and summarised below.

- The majority of the samples contained mixed slag deposits with blast furnace slags predominating in all but 1 samples which was comprised of basic steel slag only.
- Small amounts of basic refractory materials were noted in 8 slag samples, these materials are particularly susceptible to expansion.
- Three samples containing medium or higher proportions of basic steel slag were tested for free calcium and magnesium oxides. Free calcium oxide compositions ranged from 0.6% to 4.4% and free magnesium oxides ranged between 0.2% and 1.3%.
- Fourteen samples were subject to 14 day expansion tests, samples showed expansions between 0.03% and 2.78%, the highest expansion was within the sample wholly comprised of basic steel slag.
- Fourteen samples were subject to 28 day accelerated expansion tests. The results showed expansion in all samples ranging between 0.65 and 3.19%, the highest expansion was within the sample wholly comprised of basic steel slag.
- Three samples tested contained Ettringite indicating expansion has occurred in the past.

4.8 Geotechnical Analysis Summary

- Undrained shear strengths in triaxial cell measurements are awaited.
- Hand shear vane (HSV) test results ranged between:
    - Cohesive Made Ground - 33kPa and 101kPa indicating low to high strength soils.
    - Glacial Till – 43kPa to 111kPa indicating medium to high strength soils.
    - Glaciolacustrine Deposits – 35kPa to 95kPa indicating low to high strength soils (Note High strength sample may be associated with desiccation).
- Standard penetration test (SPT) results ranged between:

  - Glacial Till – N6 to >N50, with higher values generally noted towards the base of the deposit; boulders were observed within the Glacial Till.
  - Glaciolacustrine Deposits – N6 and N11 with a slight increase in value with depth noted.
  - Redcar Mudstone Formation – N19 to >N50, SPTs at the rockhead may be influenced by boulders at the base of the Glacial Till.
  - Penarth Group - >N50
  - An SPT was conducted in the Made Ground and returned an N value of 11 however the depth at which the test was conducted was within a previously excavated trial pit and may not be representative.
- Loss on ignition ranged between 2.9% and 6.1%

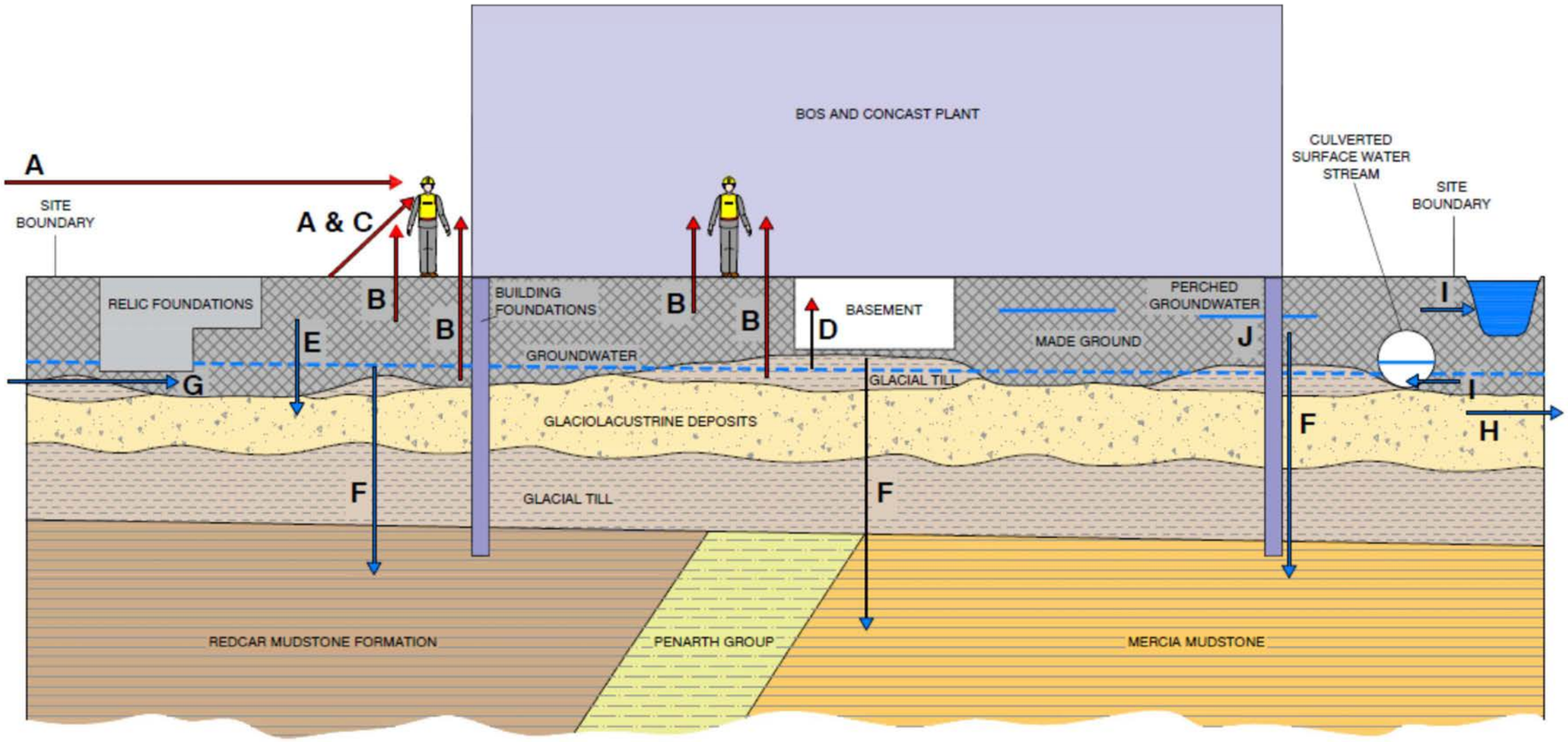
4.9 Conceptual Site Model

The above data has been used to produce a geo-environmental CSM for the site, this is presented as Figure 6 below and in Appendix C.

Potential Human Health SPR Linkages
A = Dust inhalation from Made Ground from site and adjacent land
B = Vapour inhalation of indoor or outdoor air from contaminated soil and or groundwater
C = Direct contact and ingestion
D = Accumulation of ground gas in confined spaces
SPR linkages for construction workers during redevelopment not shown

Potential Water Resource SPR Linkages
E = Leaching of contaminants from Made Ground and point sources to groundwater in superficial deposits
F = Migration of contaminated groundwater to Secondary Aquifers in bedrock
G = Migration of contaminated groundwater onto site in Made Ground and Superficial Deposits
H = Migration of contaminated groundwater off site in Made Ground and Superficial Deposits
I = Migration of contaminated groundwater into culverted surface water streams (Kinkerdale Beck, Boundary Beck), and off site pond

Other SRP Linkages
J = Attack by contaminants of concern on foundations



SSI3B Figure 5: CSM

5 SUMMARY OF RESULTS

Based on a review of historic documentation and the results of the intrusive investigation CSM's have been developed for Area A and Area B of Contract SSI3. The main findings of the investigation were:

- Made Ground was encountered across both sites sands and gravel with varying amounts of slag, concrete, and brick and other materials; slag deposits ranged from gravel to boulder sized. The maximum thickness of Made Ground in both areas was approximately 4 m however the base of the Made Ground was not identified in all locations and greater thickness of material may exist elsewhere.
- Within Area A the majority of the deposits were classed as granular Made Ground with a lesser amount of slag dominant deposits, across Area B the majority of deposits were classified as slag dominant, although a significant amount of granular Made Ground was also present. A small quantity of cohesive Made Ground deposits were also identified.
- Obstructions including slag and relic foundations were identified in Area A and Area B, these are likely to impact and redevelopment of the site and will be further considered in the Geotechnical Risk Assessment.
- Asbestos fibres have been identified in Made Ground in both Area A and Area B. These were principally in the form of lose fibres.
- The Made Ground deposits were noted to be highly alkaline with a pH of between 10 and 12.5, the pH of leachate from the Made Ground was mildly alkaline to neutral as was groundwater.
- Elevated sulphate levels were noted in Made Ground and groundwater;
- Based on a statistical analysis the highest concentrations of metals and PAH were generally identified in slag dominant Made Ground, concentrations in cohesive Made Ground were generally lower.
- A number of point sources of petroleum hydrocarbon have been identified associated with the Made Ground deposits in both Area A and Area B;
- Tests identified that metals readily leached from Made Ground deposits, TPH and PAH were also noted to leach in some samples. Metals, TPH and PAH were also detected in groundwater at both sites.
- Based on the slag testing conducted the majority of the slag deposits are of mixed blast furnace and basic steel slag, with the latter comprising the minor fraction in most cases. The testing indicated only three of the slags tested showed signs of past expansion and that there is the potential for further expansion in the future.

The significance of the identified ground conditions will be assessed in the Environmental and Geotechnical Risk Assessment Reports.

APPENDIX A

Legislative Context and Regulatory Guidance

Land contamination is generally dealt with by the following types of regulation:

- Acts of Parliament to investigate and remedy harm caused by land contamination;
- Conditions placed upon Planning Permissions for the redevelopment of land; and,
- Acts of Parliament and Regulations for the control of waste.

In England land contamination is identified and dealt with through Acts / Regulations including:

- The Contaminated Land (England) (Amended) Regulations (2012);
- Part IIA of the Environmental Protection Act (1990);
- The Environment Act 1995;
- The Town and Country Planning Act (1990);
- The Environmental Permitting (England and Wales) (Amended) Regulations (2011);
- The Water Resources Act (1991);
- The Water Act (2003); and
- The Environmental Damage (Prevention and Remediation) Regulations 2009.

Part IIA of the Environmental Protection Act 1990

Part IIA of the Environmental Protection Act 1990 (which was inserted by Section 57 of the Environment Act 1995) created a regime for the identification and remediation of contaminated land. Section 78A (2) of the Environmental Protection Act 1990 defines contaminated land for the purposes of Part IIA as:

'*any land which appears to the local authority in whose area it is situated to be in such a condition, by reason of substances in, on or under the land, that;*
(a) Significant harm is being caused or there is a significant possibility of such harm being caused; or
(b) significant pollution of controlled waters is being caused or there is a significant possibility of such pollution being caused.'[1]

Harm is defined under section 78A of the Environmental Protection Act as meaning 'harm to the health of living organisms or other interference with the ecological systems of which they form part and, in the case of man, includes harm to his property'. Types of harm are related to specific receptors in order to determine whether they can be regarded as "significant", as defined in the DEFRA (2012)[2] statutory guidance.

Part IIA sets the definition of contaminated land within the context of the 'suitable for use' approach. The 'suitable for use' approach underlies these objectives, and is based on the principles of risk assessment, including the concept of the 'pollutant linkage'.

In the event that there are unacceptable levels of risk posed by a site, a remediation notice can be served under the contaminated land regime introduced under Part IIA of the Environmental Protection Act 1990.

Regulation of Development on Land Affected by Contamination

Management of risks from contamination in development of land is also regulated in the England under the Town and Country Planning Act 1990. Land contamination is a material planning consideration within this planning regime.

The Local Planning Authority may impose conditions on the development during planning that include preliminary risk assessment, site investigation, risk assessment and remediation. The Environment Agency may use its role as a statutory consultee to provide the Local Planning Authority with advice.

[1] Definition amended by the Water Act 2003, and came into force on 6th April 2012
[2] Contaminated Land Statutory Guidance. DEFRA 2012, which came into force on 6th April 2012

Assessment of risk is again based on the pollutant linkage concept. The aim of risk management in the development should be to render the land suitable for the proposed use and, therefore, to prevent consideration of the site under Part IIA.

The National Planning Policy Framework (NPPF) (2012) provides high level guidance on the relationship between development and the management of risks from land contamination caused by historical use. The interpretation of the NPPF is left to local decision-makers, but with the expectation that good practice developed using the pre-existing Planning Policy Statements will be maintained. The Building Regulations 2000, made under the Building Act 1984, also require measures to be taken to protect new buildings and their occupants from the effects of contamination. Guidance on the requirements is provided in Approved Document C - Site preparation and resistance to contaminants and moisture, published by ODPM in 2004.

Voluntary Remediation Action

Voluntary remediation action on contamination resulting from historical activities can often anticipate future remediation requirements, such as through the Planning regime, and is encouraged, especially where the site is not being assessed under Part IIA.

Environmental Damage

The Environmental Damage (Prevention and Remediation) Regulations 2009 came into force on 1st March 2009 to implement EC Directive 2004/35 on environmental liability with regard to the prevention and remedying of environmental damage.

These Regulations do not apply retrospectively; environmental damage that took place before the Regulations came into force (1st March 2009), or damage that takes place (or is likely to take place) after that date but is caused by an incident, event or emission that occurred before that date are exempt from the requirements of the Regulations.

The Regulation is concerned with preventing environmental damage. It requires that all operators of activities that cause an imminent threat of environmental damage to take all reasonably practical steps to prevent the damage. Where damage has already been caused, the operator must take all reasonably practical steps to prevent further damage from occurring.

Non-Statutory Regulatory Technical Guidance Documents

The non-statutory regulatory technical guidance for England on the assessment of land contamination, primarily released as part of the Contaminated Land Exposure Assessment (CLEA) methodology (DEFRA and EA) has recently been updated. The following documents currently present guiding principles in investigating and assessing potentially contaminated land, which are generally adopted in considering sites within any of the legal frameworks discussed above, or when considering voluntary remediation action:

- Investigation of potentially contaminated sites – Code of Practice (British Standard 10175: 2011).
- Contaminated Land Report CLR11 Model Procedures for the Management of Land Contamination. (DEFRA and EA, 2004).
- Human health toxicological assessment of contaminants in soil Environment Agency Science Report SC050021/SR2 (EA, 2009).
- Updated technical background to the CLEA model Environment Agency Science Report SC050021/SR3 (EA, 2009).
- Compilation of Data for Priority Organic Pollutants for Derivation of Soil Guideline Values Environment Agency Science Report SC050021/SR7 (EA, 2008).
- An ecological risk assessment framework for contaminants in soil. Environment Agency Science Report SC070009/SR1 and related reports S2a-e.
- Groundwater Protection: Policy and Practice, Environment Agency GP3 Parts 1-4.

- Remedial Targets Methodology: Hydrogeological Risk Assessment for Land Contamination (EA of England and Wales, 2006) developed in consultation with the Scottish Environment Protection Agency (SEPA) and the Northern Ireland Heritage and Environment Service.
- Assessing risks posed by hazardous ground gases to buildings Report C665 (CIRIA, 2007).
- BS 8485:2007 Code of practice for the characterization and remediation from ground gas in affected developments (British Standards Institution, 2007).
- Risk Based Corrective Action (RBCA) Methodology (ASTM designation E1739-95, E2081-00).
- DoE Industry Profiles.

APPENDIX B

Study Limitations

IMPORTANT: This section should be read before reliance is placed on any of the information, opinions, advice, recommendations or conclusions contained in this report.

1. This report has been prepared by Arcadis UK Ltd (Arcadis), with all reasonable skill, care and diligence within the terms of the Appointment and with the resources and manpower agreed with **STSC** (the 'Client'). Arcadis does not accept responsibility for any matters outside the agreed scope.

2. This report has been prepared for the sole benefit of the Client unless agreed otherwise in writing.

3. Unless stated otherwise, no consultations with authorities or funders or other interested third parties have been carried out. Arcadis are unable to give categorical assurance that the findings will be accepted by these third parties as such bodies may have unpublished, more stringent objectives. Further work may be required by these parties.

4. All work carried out in preparing this report has used, and is based on, Arcadis' professional knowledge and understanding of current relevant legislation. Changes in legislation or regulatory guidance may cause the opinion or advice contained in this report to become inappropriate or incorrect. In giving opinions and advice, pending changes in legislation, of which Arcadis is aware, have been considered. Following delivery of the report, Arcadis have no obligation to advise the Client or any other party of such changes or their repercussions.

5. This report is only valid when used in its entirety. Any information or advice included in the report should not be relied upon until considered in the context of the whole report.

6. Whilst this report and the opinions made are correct to the best of Arcadis' belief, Arcadis cannot guarantee the accuracy or completeness of any information provided by third parties.

7. This report has been prepared based on the information reasonably available during the project programme. All information relevant to the scope may not have been received.

8. This report refers, within the limitations stated, to the condition of the Site at the time of the inspections. No warranty is given as to the possibility of changes in the condition of the Site since the time of the investigation.

9. The content of this report represents the professional opinion of experienced environmental consultants. Arcadis does not provide specialist legal or other professional advice. The advice of other professionals may be required.

10. Where intrusive investigation techniques have been employed they have been designed to provide a reasonable level of assurance on the conditions. Given the discrete nature of sampling, no investigation technique is capable of identifying all conditions present in all areas. In some cases the investigation is further limited by site operations, underground obstructions and above ground structures. Unless otherwise stated, areas beyond the boundary of the site have not been investigated.

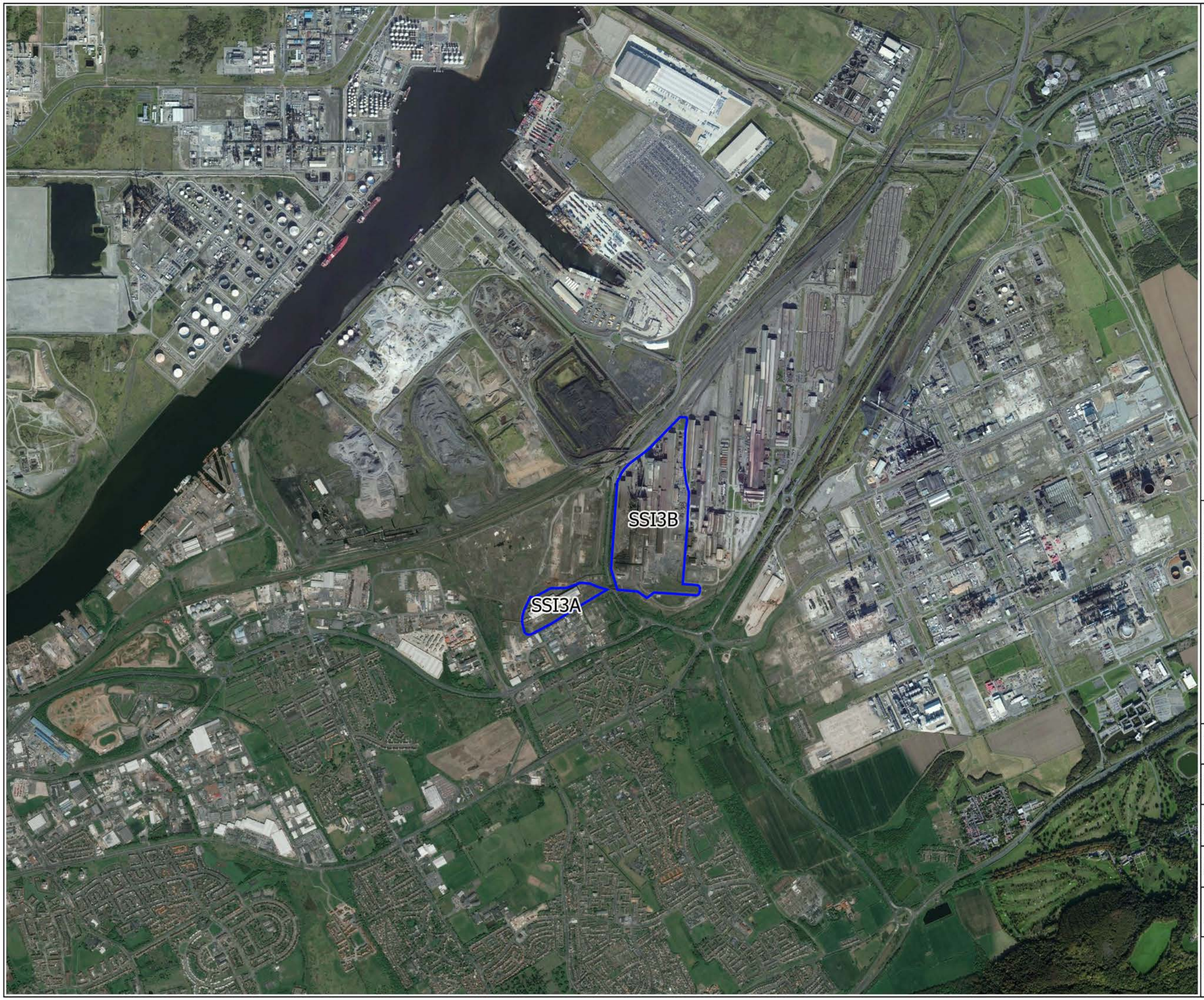
11. If below ground intrusive investigations have been conducted as part of the scope, service tracing for safe location of exploratory holes has been carried out. The location of underground services shown on any drawing in this report has been determined by visual observations and electromagnetic techniques. No guarantee can be given that all services have been identified. Additional services, structures or other below ground obstructions, not indicated on the drawing, may be present on Site.

12. Unless otherwise stated the report provides no comment on the nature of building materials,

operational integrity of the facility or on any regulatory compliance issue

APPENDIX C

Figures



Legend

Contract 3

Notes:

CONTACT ARCADIS IN CASE OF ANY QUERIES.

N

Title:
SSI3 Site Location Plan

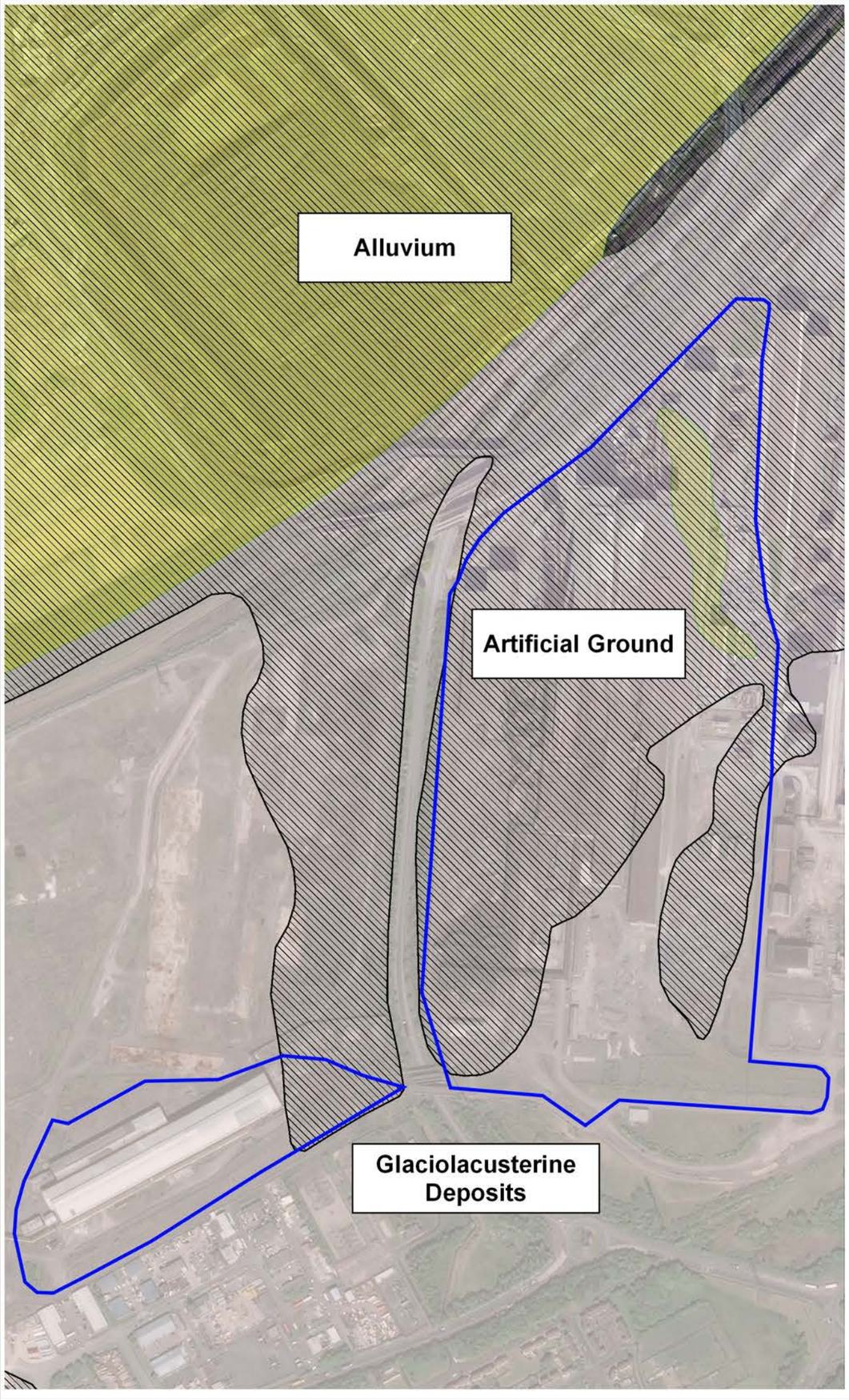
Site:
Redcar Steelworks

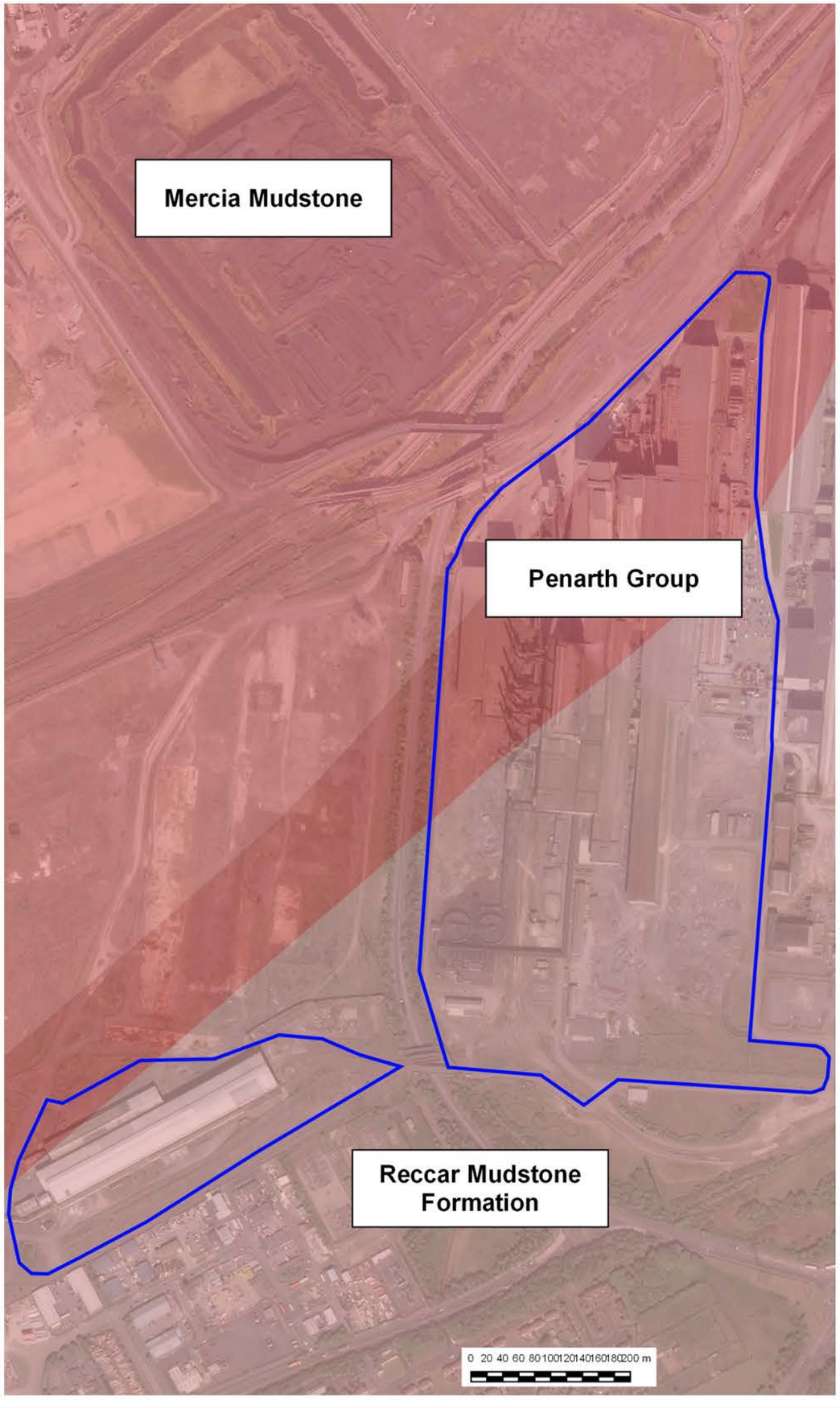
Client:
South Tees Site Company

Project: 37774100	**Figure 1**

Date: 24/04/2018
Drawn By: JALM
DRG No: 37774100_01_SSI2b_Figure_1

ARCADIS Design & Consultancy for natural and built assets





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Site Areas

Contract 3

Notes:

CONTACT ARCADIS IN CASE OF ANY QUERIES.

N

Title:
Extracts From BGS Mapping SSI3

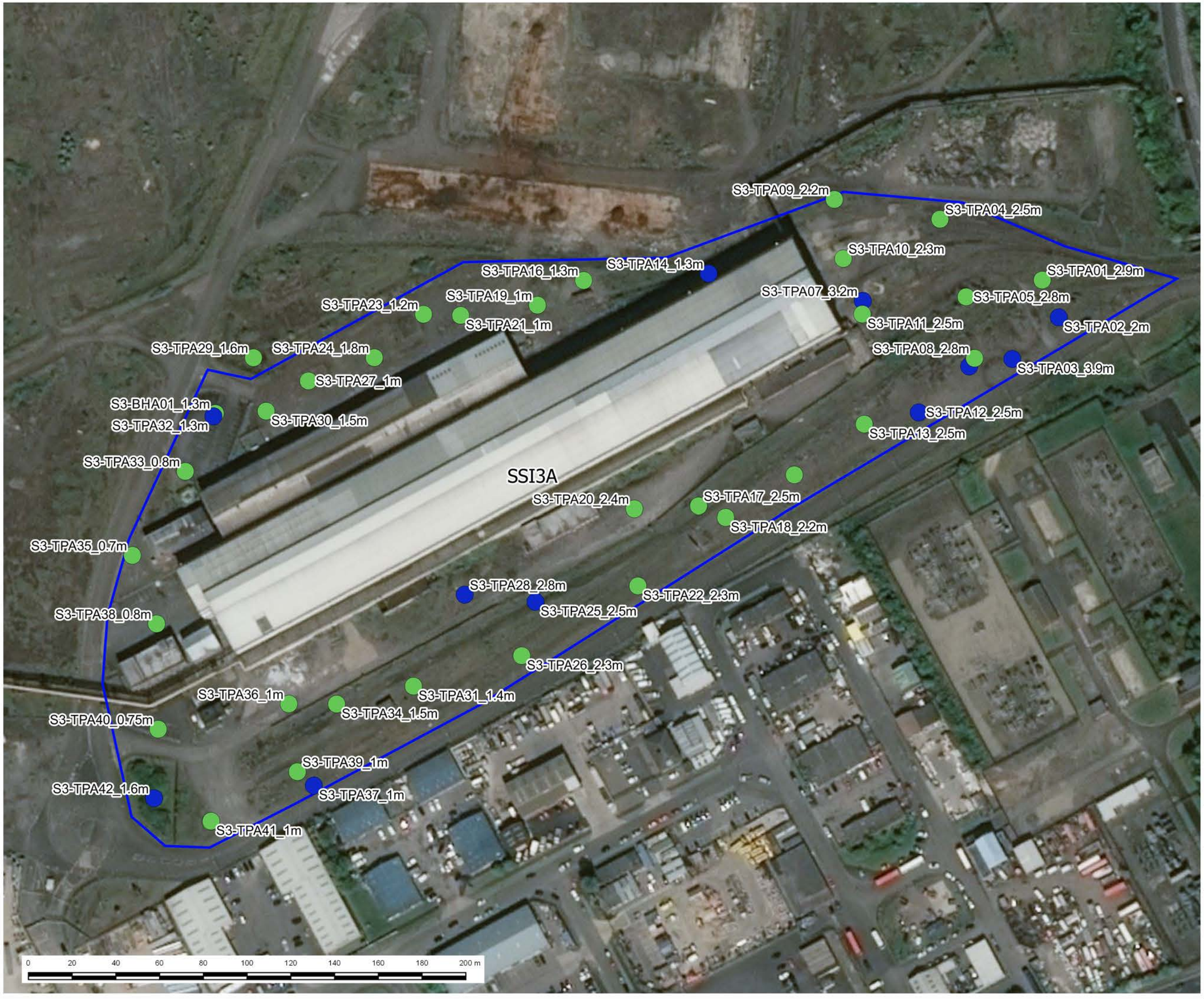
Site:
Redcar Steelworks

Client:
South Tees Site Company

Project: 37774100	**Figure 2**

Date: 18/04/2018
Drawn By: JM
DRG No: 3777410031_01_SSI3_Figure_2

ARCADIS Design & Consultancy for natural and built assets



Legend

Base of Made Ground Identified

- No
- Yes

Site Areas

- Contract 3

Notes:

CONTACT ARCADIS IN CASE OF ANY QUERIES.

Note: Where boreholes have been installed through trial pits the top of the natural deposits (if identified) is taken from the trial pit log.

Format: Location ID_Depth(m bgl)

N

Title:
SSI3A Made Ground Thickness Encountered

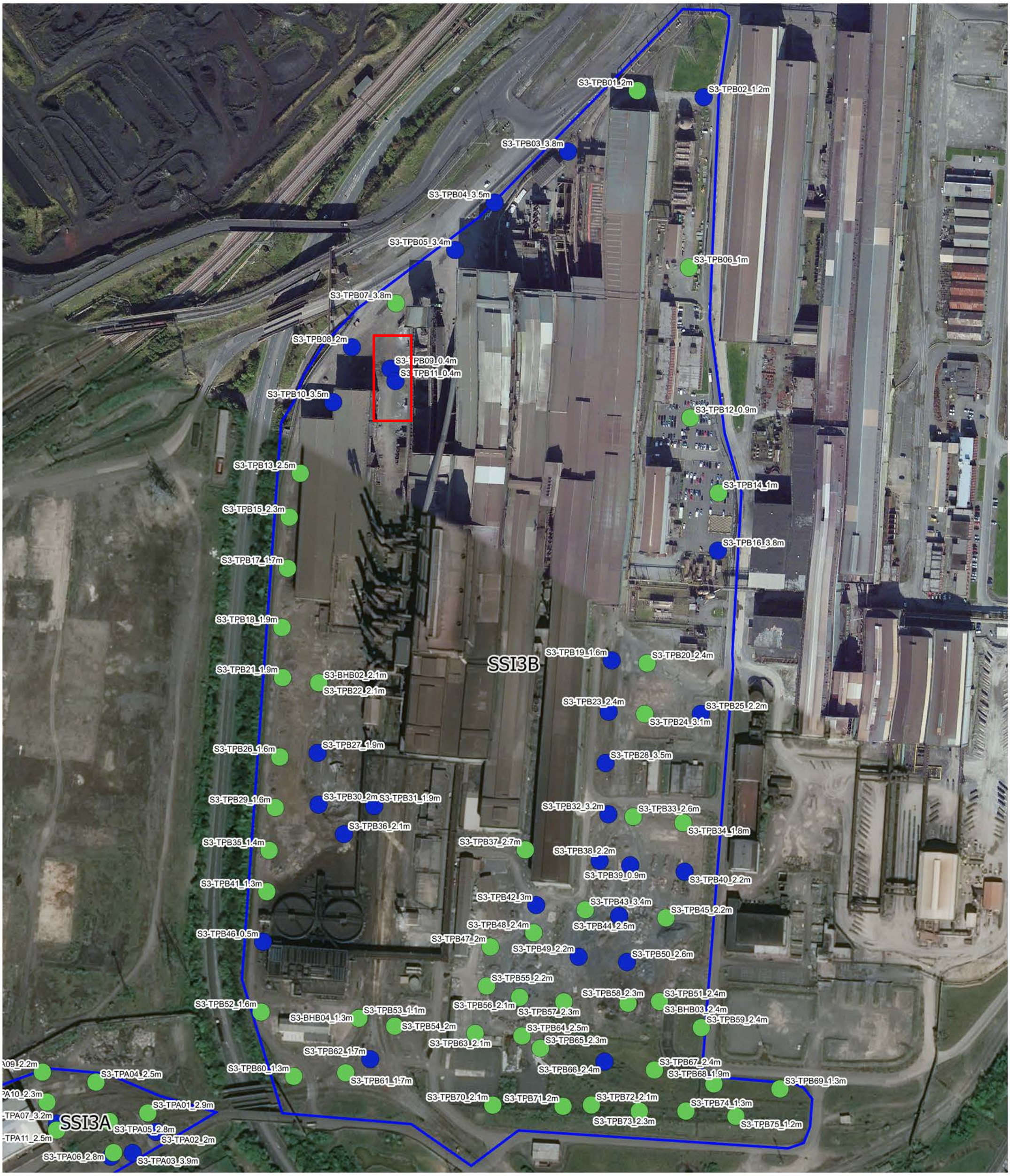
Site:
Redcar Steelworks

Client:
South Tees Site Company

Project: 37774100	**SSI3A Figure 3**

Date: 19/04/2018
Drawn By: JM
DRG No: 37774100_01_SSI3A_Figure_3

ARCADIS Design & Consultancy for natural and built assets



Legend

Base of Made Ground Identified

- No
- Yes

Site Areas

- Contract 3
- Area of Fused Slag

Notes:

CONTACT ARCADIS IN CASE OF ANY QUERIES.

Note: Where boreholes have been installed through trial pits the top of the natural deposits (if identified) is taken from the trial pit log.

Format: Location ID_Depth(m bgl)

N

Title: SSI3B Made Ground Thickness Encountered

Site: Redcar Steelworks

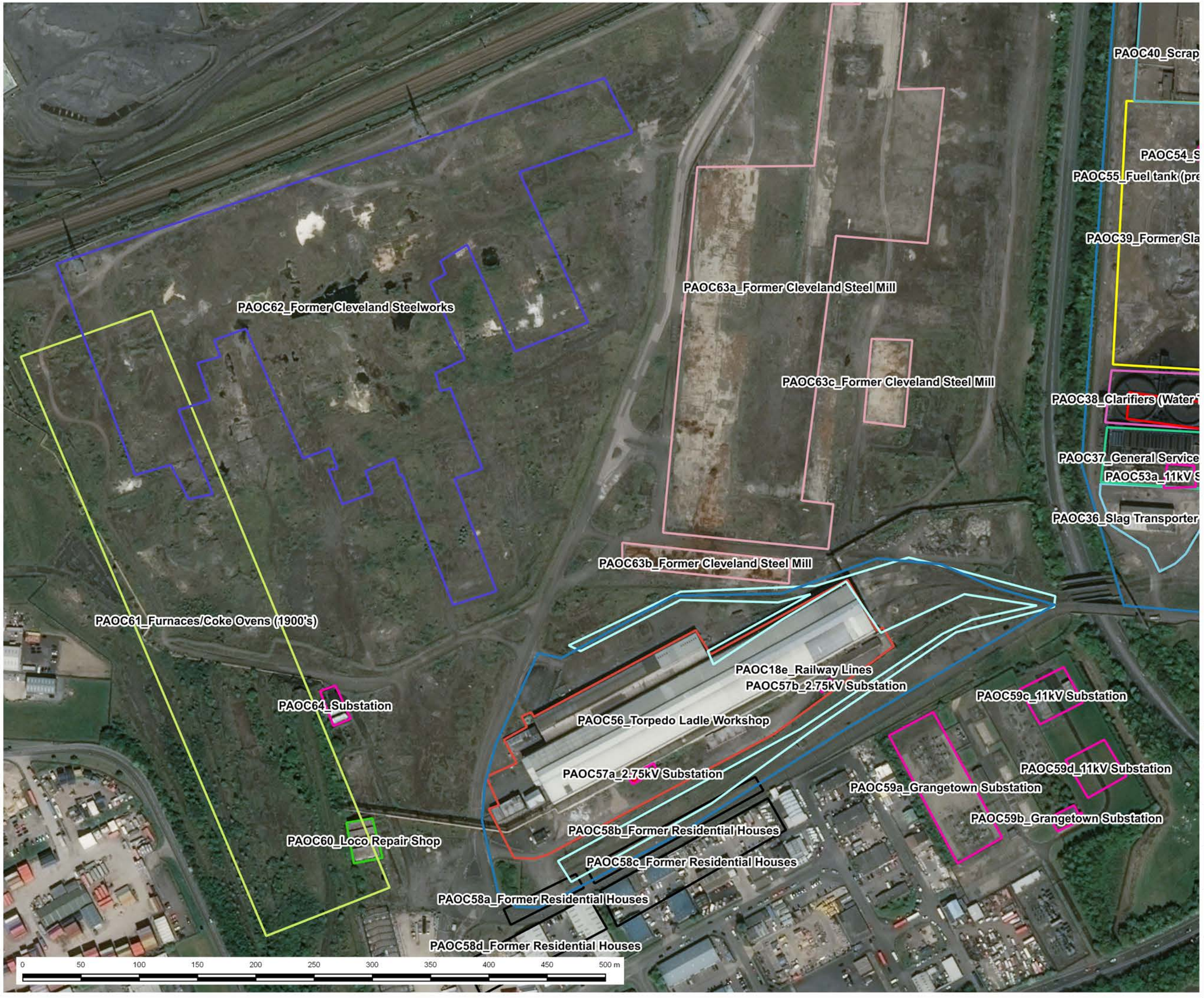
Client: South Tees Site Company

Project: 37774100

SSI3B_Figure 3

Date: 20/04/2018
Drawn By: JALM
DRG No: 37774100_01_SSI3B_Figure_3

ARCADIS Design & Consultancy for natural and built assets



Legend

Site Areas

Contract 3

Notes:

CONTACT ARCADIS IN CASE OF ANY QUERIES.

Not Shown:
PAOC1 - Made Ground
PAOC3 - Ground gas from Glaciolacusterine Deposits
Adjacent BOS and Concast Plant, and Landfills

N

Title:
SSI3A Potential Areas of Concern

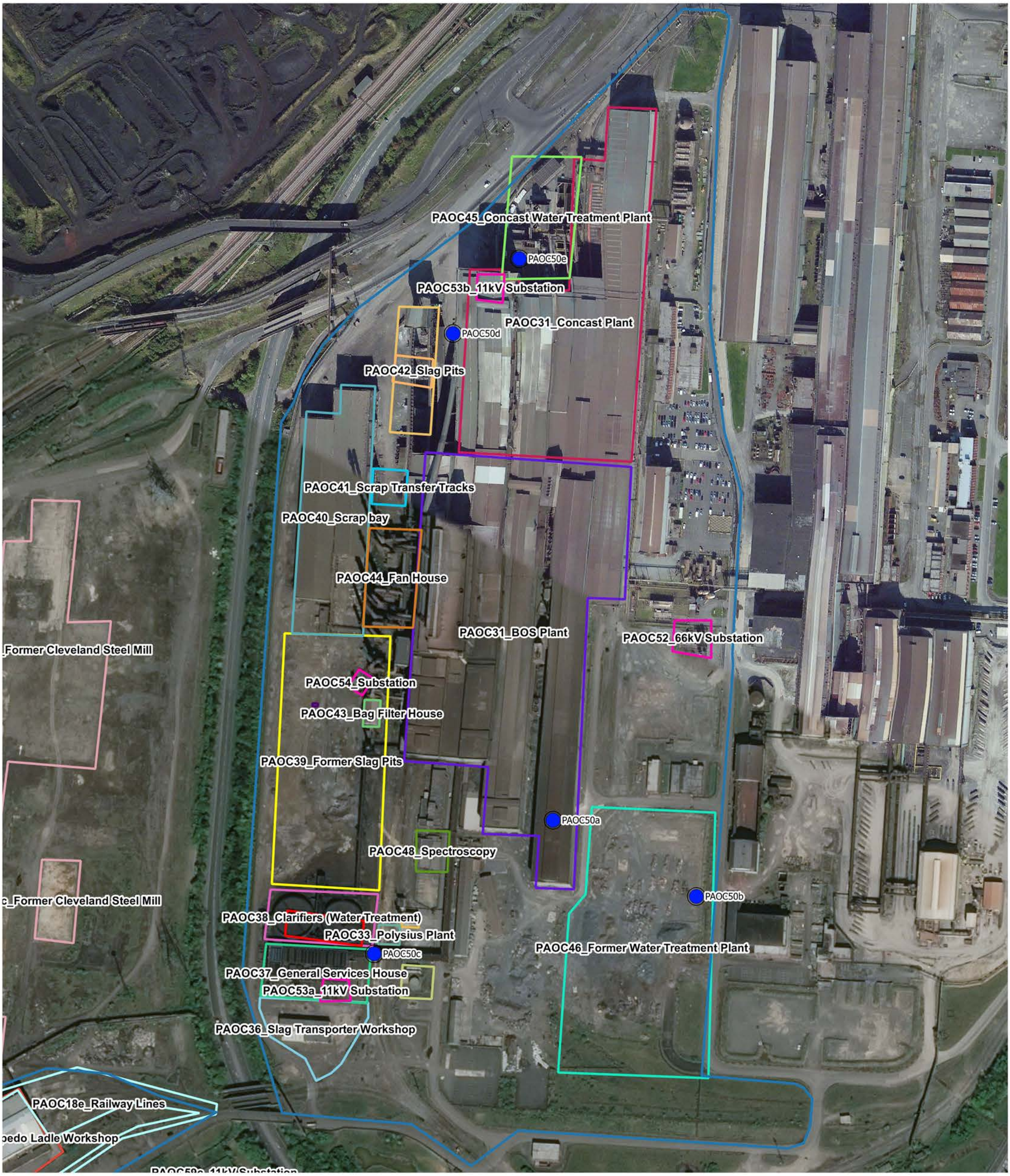
Site:
Redcar Steelworks

Client:
South Tees Site Company

Project:	
37774100	SSI3A Figure 4

Date: 20/04/2018
Drawn By: JALM
DRG No: 37774100_01_SSI3A_Figure_4

ARCADIS Design & Consultancy for natural and built assets



Legend

Site Areas

Contract 3

Notes:

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CONTACT ARCADIS IN CASE OF ANY QUERIES.

Not Shown:
PAOC1 - Made Ground
PAOC3 - Ground gas from Glaciolacusterine Deposits Adjacent TLRS and former Cleveland Works, and Landfills

N

Title: SSI3B Potential Areas of Concern

Site: Redcar Steelworks

Client: South Tees Site Company

Project: 37774100

SSI3B Figure 4

Date: 20/04/2018
Drawn By: JALM
DRG No: 37774100_01_SSI3B_Figure_4

ARCADIS Design & Consultancy for natural and built assets

Potential Human Health SPR Linkages

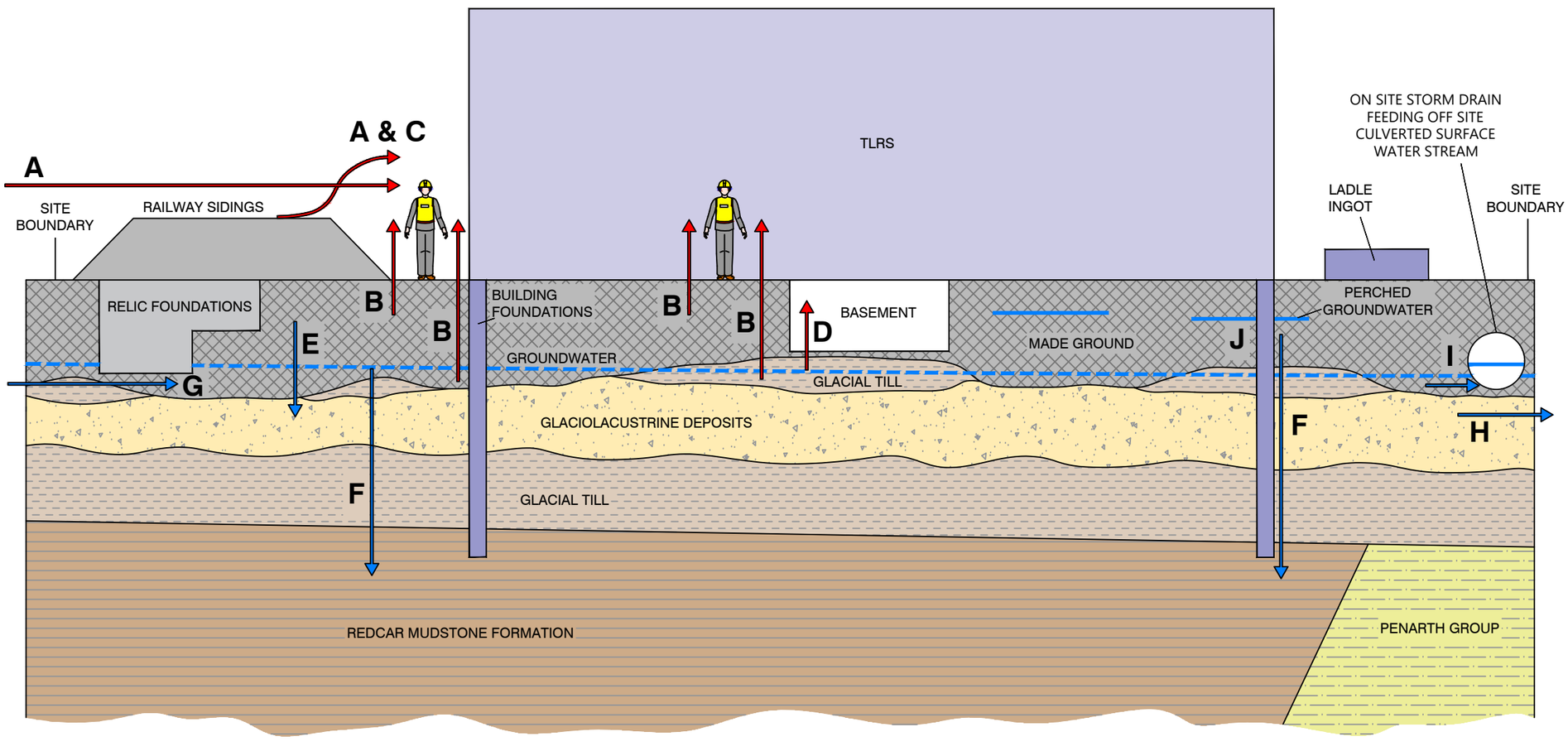
A = Dust inhalation from Made Ground from site and adjacent land
B = Vapour inhalation of indoor or outdoor air from contaminated soil and or groundwater
C = Direct contact and ingestion
D = Accumulation of ground gas in confined spaces
SPR linkages for construction workers during redevelopment not shown

Potential Water Resource SPR Linkages

E = Leaching of contaminants from Made Ground and point sources to groundwater in superficial deposits
F = Migration of contaminated groundwater to (Secondary (Undifferentiated) Aquifer) in bedrock
G = Migration of contaminated groundwater onto site in Made Ground and Superficial Deposits
H = Migration of contaminated groundwater off site in Made Ground and Superficial Deposits
I = Migration of contaminated groundwater into culverted surface water stream (Holme Beck Knitting Wife Beck) either directly or via storm drain.

Other SRP Linkages

J = Attack by contaminants of concern on foundations



KEY

NOTES

SCHEMATIC DRAWING ONLY - NOT TO SCALE

REV	DATE	COMMENT	CAD

TITLE: CONCEPTUAL SITE MODEL - SSI3 AREA A TLRS

SITE: REDCAR

CLIENT: STSC

PROJECT: 10013655 | FIGURE 5

DATE: 19/04/18 | DRAWN: BNB | REV: -

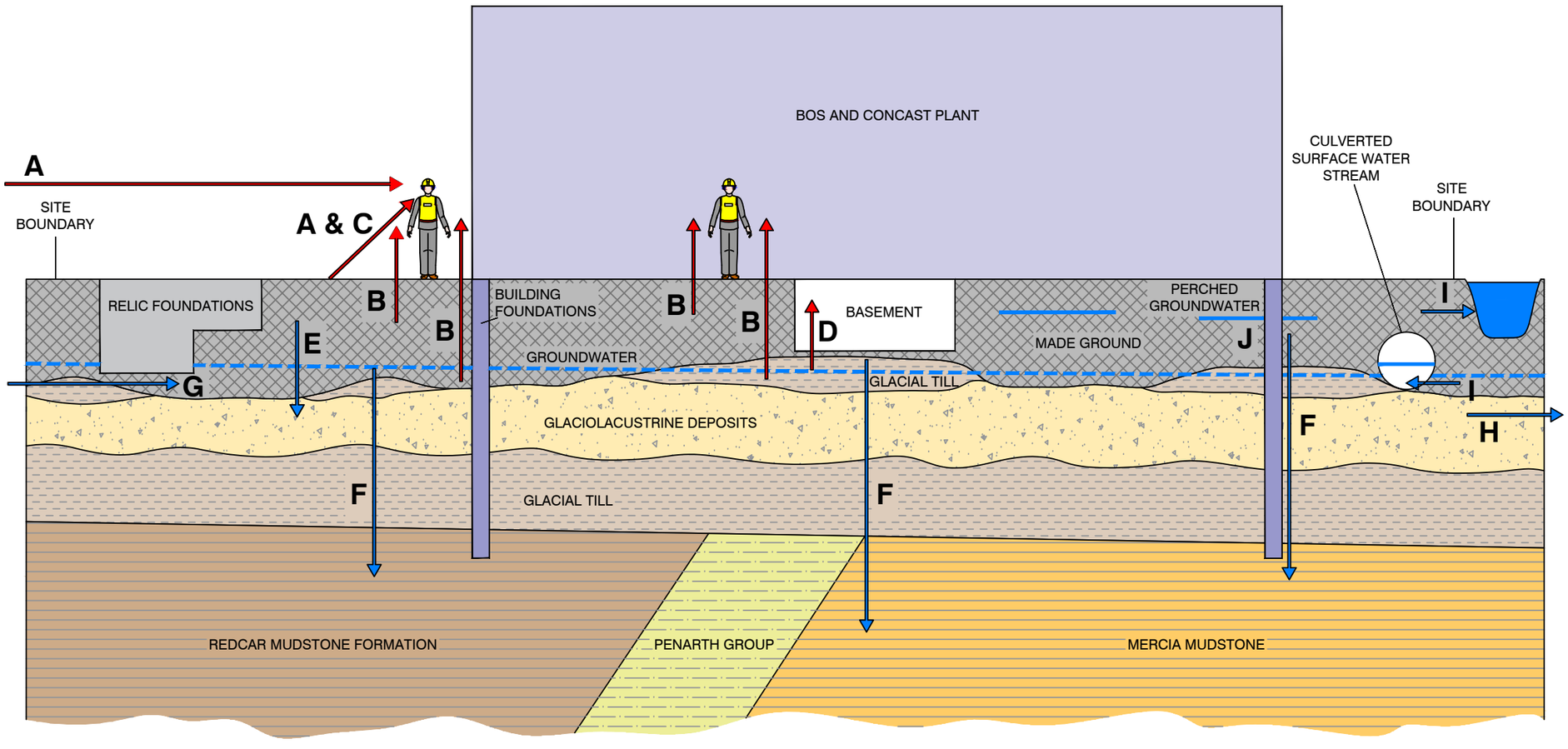
DRG.No.: 10013655_CSM_1 | PRINT: A3

ARCADIS Design & Consultancy for natural and built assets

Potential Human Health SPR Linkages
A = Dust inhalation from Made Ground from site and adjacent land
B = Vapour inhalation of indoor or outdoor air from contaminated soil and or groundwater
C = Direct contact and ingestion
D = Accumulation of ground gas in confined spaces
SPR linkages for construction workers during redevelopment not shown

Potential Water Resource SPR Linkages
E = Leaching of contaminants from Made Ground and point sources to groundwater in superficial deposits
F = Migration of contaminated groundwater to Secondary Aquifers in bedrock
G = Migration of contaminated groundwater onto site in Made Ground and Superficial Deposits
H = Migration of contaminated groundwater off site in Made Ground and Superficial Deposits
I = Migration of contaminated groundwater into culverted surface water streams (Kinkerdale Beck, Boundary Beck), and off site pond

Other SRP Linkages
J = Attack by contaminants of concern on foundations



KEY

NOTES

SCHEMATIC DRAWING ONLY - NOT TO SCALE

REV	DATE	COMMENT	CAD

TITLE: CONCEPTUAL SITE MODEL - SSI3 AREA B BOS AND CONCAST PLANT

SITE: REDCAR

CLIENT: STSC

PROJECT: 10013655 | FIGURE 5

DATE: 19/04/18 | DRAWN: BNB | REV: -

DRG.No.: 10013655_CSM_2 | PRINT: A3

ARCADIS Design & Consultancy for natural and built assets

Legend

Asbestos Plots

- Asbestos Detected (%)
- No Asbestos Detected

Site Areas

- Contract 3

Notes:

CONTACT ARCADIS IN CASE OF ANY QUERIES.

Format: LocationID_Result_% composition

N

Title:
SSI3A Summary of Asbestos Testing

Site:
Redcar Steelworks

Client:
South Tees Site Company

Project:
37774100

SSI3A Figure 6

Date: 20/04/2018
Drawn By: JALM
DRG No: 37774100_01_SSI3A_Figure_6

ARCADIS Design & Consultancy for natural and built assets

S3-TPB01_Chrysotile_0.002
S3-TPB03_NFD
S3-TPB04_Chrysotile_0.003
S3-TPB05_Chrysotile_0.001
S3-TPB06_NFD
S3-TPB07_Chrysotile_<0.001
S3-TPB08_NFD
S3-TPB09_NFD
S3-TPB11_NFD
S3-TPB10_NFD
S3-TPB12_NFD
S3-TPB13_NFD
S3-TPB14_NFD
S3-TPB15_NFD
S3-TPB16_Chrysotile_<0.001
S3-TPB17_NFD
S3-TPB18_NFD
SSI3B
S3-TPB19_NFD
S3-TPB20_NFD
S3-TPB21_NFD
S3-TPB22_NFD
S3-TPB23_NFD
S3-TPB25_NFD
S3-TPB24_Chrysotile_<0.001
S3-TPB26_NFD
S3-TPB27_NFD
S3-TPB28_NFD
S3-TPB30_Chrysotile_<0.001
S3-TPB31_NFD
S3-TPB29_NFD
S3-TPB32_NFD
S3-TPB33_NFD
S3-TPB34_NFD
S3-TPB36_NFD
S3-TPB35_NFD
S3-TPB37_Chrysotile_<0.001
S3-TPB38_Chrysotile_<0.001
S3-TPB39_NFD
S3-TPB40_Amosite_<0.001
S3-TPB41_Chrysotile_<0.001
S3-TPB42_NFD
S3-TPB43_NFD
S3-TPB44_NFD
S3-TPB45_NFD
S3-TPB46_Chrysotile_<0.001
S3-TPB48_Chrysotile_0.004
S3-TPB47_NFD
S3-TPB49_Chrysotile, Amosite_0.005
S3-TPB50_NFD
S3-TPB55_Chrysotile_0.005
S3-TPB57_NFD
S3-TPB51_NFD
S3-TPB56_NFD
S3-TPB58_NFD
S3-TPB52_NFD
S3-TPB53_NFD
S3-TPB54_NFD
S3-TPB59_NFD
S3-TPB64_NFD
S3-TPB63_NFD
S3-TPB65_NFD
S3-TPB62_NFD
S3-TPB66_NFD
S3-TPB67_Chrysotile_0.001
S3-TPB60_NFD
S3-TPB61_NFD
S3-TPB68_Chrysotile_0.001
S3-TPB69_NFD
S3-TPB70_NFD
S3-TPB71_NFD
S3-TPB74_NFD
S3-TPB75_NFD
S3-TPA04_NFD
S3-TPA01_Chrysotile_0.034
S3-TPA05_NFD
S3-TPA02_Chrysotile_0.012
S3-TPA08_NFD
S3-TPA03_Chrysotile_0.002

Legend

Asbestos Plots

- Asbestos Detected (%)
- No Asbestos Detected

Site Areas

- Contract 3

Notes:

CONTACT ARCADIS IN CASE OF ANY QUERIES.

Format: Location ID_Result_% composition

N

Title: SSI3B Summary of Asbestos Testing

Site: Redcar Steelworks

Client: South Tees Site Company

Project: 37774100

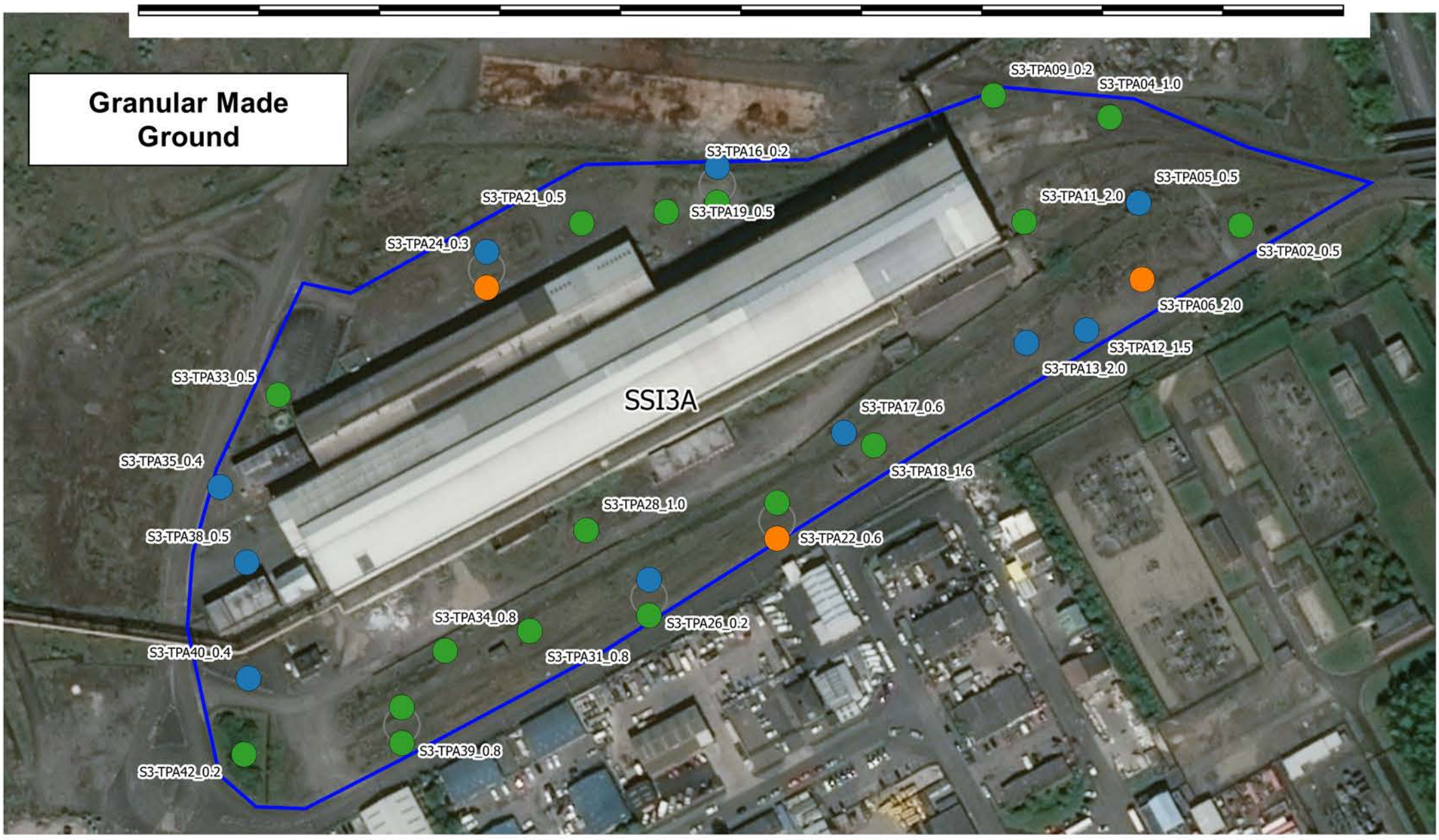
SSI3B Figure 6

Date: 20/04/2018
Drawn By: JALM
DRG No: 37774100_01_SSI3B_Figure_6

ARCADIS Design & Consultancy for natural and built assets

Slag Dominant Made Ground

Granular Made Ground



Legend

Chromium in Made Ground

- Chromium (MDL - <100 mg/kg)
- Chromium (100 - <500 mg/kg)
- Chromium (500> mg/kg)

Site Areas

- Contract 3

Notes:

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CONTACT ARCADIS IN CASE OF ANY QUERIES.

Format: LocationID_Depth(m bgl)

N

Title: Chromium Levels in Made Ground Soils SSI3A

Site: Redcar Steelworks

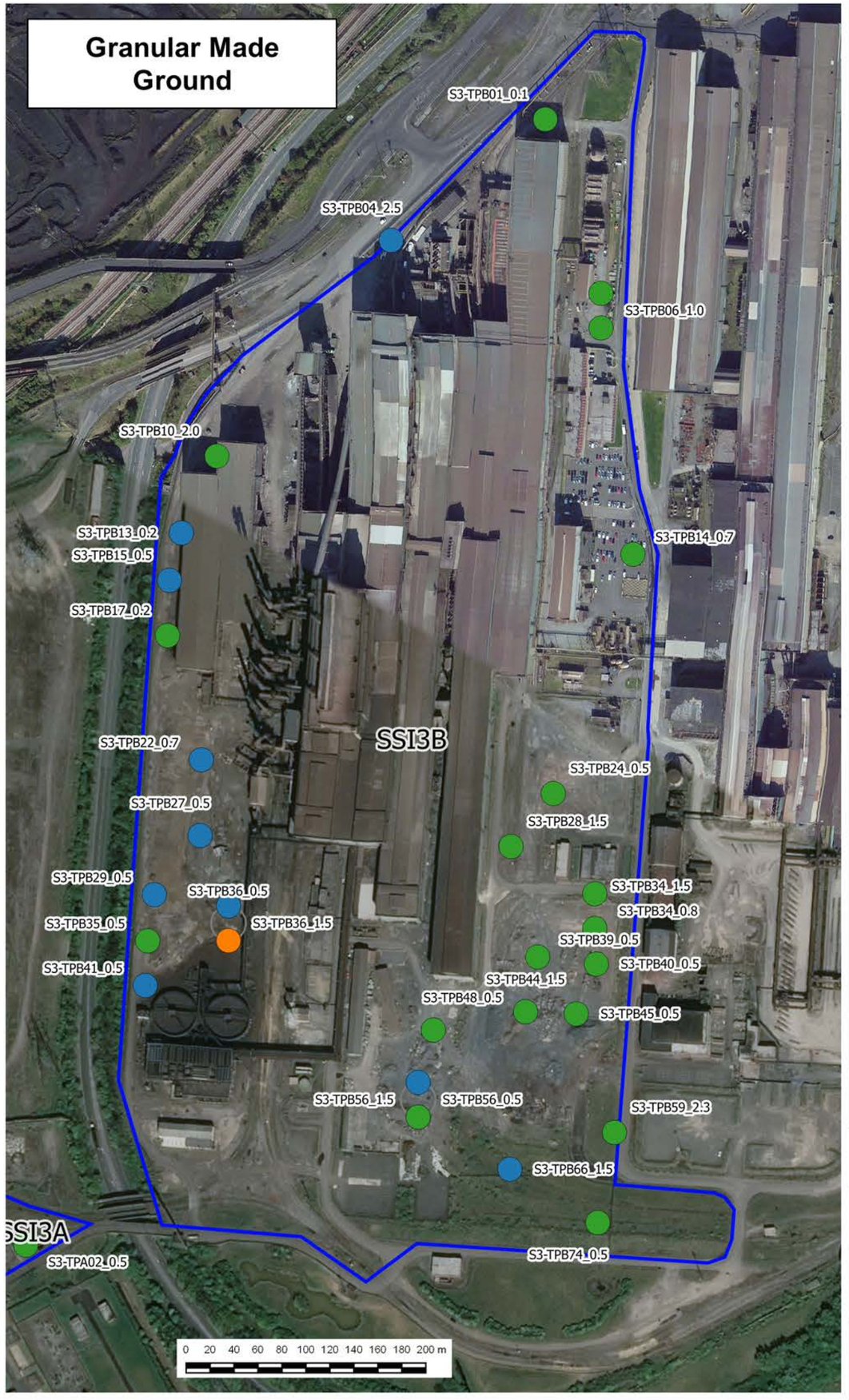
Client: South Tees Site Company

Project: 37774100

SSI3A Figure 7

Date: 20/04/2018
Drawn By: JALM
DRG No: 37774100_01_SSI3A_Figure_7

ARCADIS Design & Consultancy for natural and built assets



Legend

Chromium in Made Ground

Site Areas

Contract 3

Notes:

CONTACT ARCADIS IN CASE OF ANY QUERIES.

Format: LocationID_Depth(m bgl)

N

Title:
Chromium Levels in Made Ground Soils SSI3B

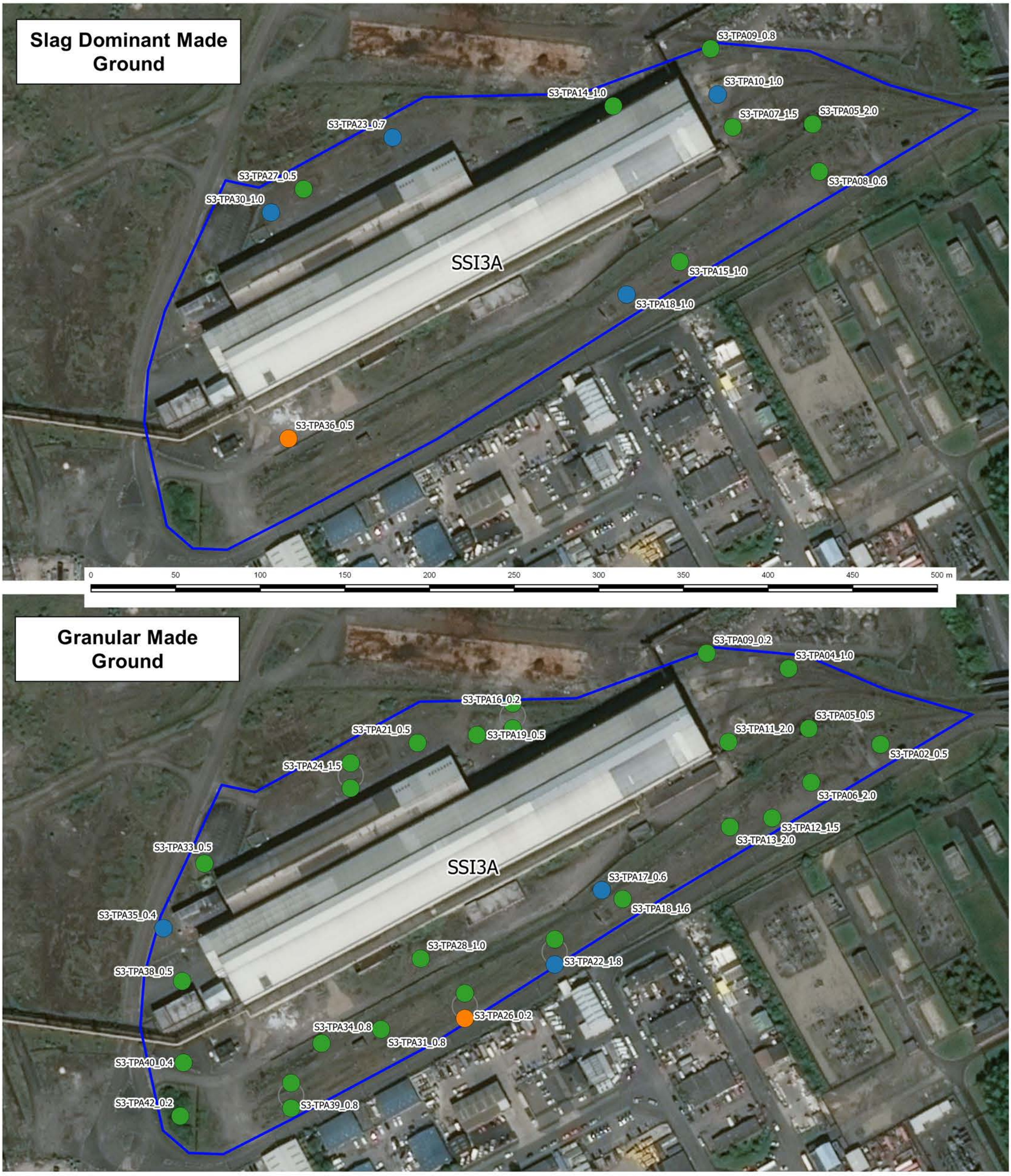
Site:
Redcar Steelworks

Client:
South Tees Site Company

Project: 37774100	**SSI3B Figure 7**

Date: 18/04/2018
Drawn By: JALM
DRG No: 37774100_01_SSI3B_Figure_7

ARCADIS Design & Consultancy for natural and built assets



Legend

Lead in Made Ground

- Lead (MDL - <100 mg/kg)
- Lead (100 - <500 mg/kg)
- Lead (500> mg/kg)

Site Areas

- Contract 3

Notes:

CONTACT ARCADIS IN CASE OF ANY QUERIES.

Format: Location ID_Depth(m bgl)

N

Title: Lead Levels in Made Ground Soils SSIA3

Site: Redcar Steelworks

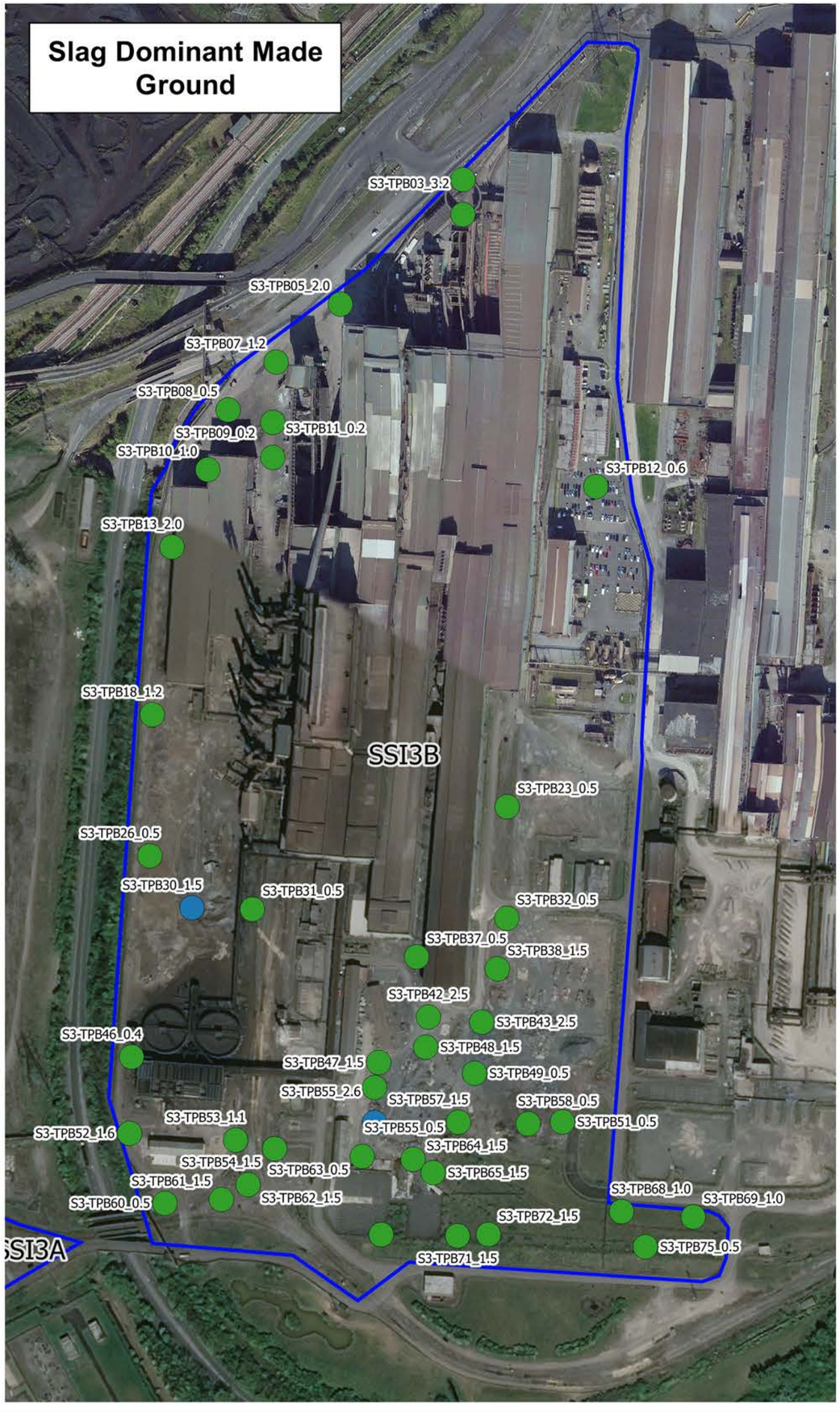
Client: South Tees Site Company

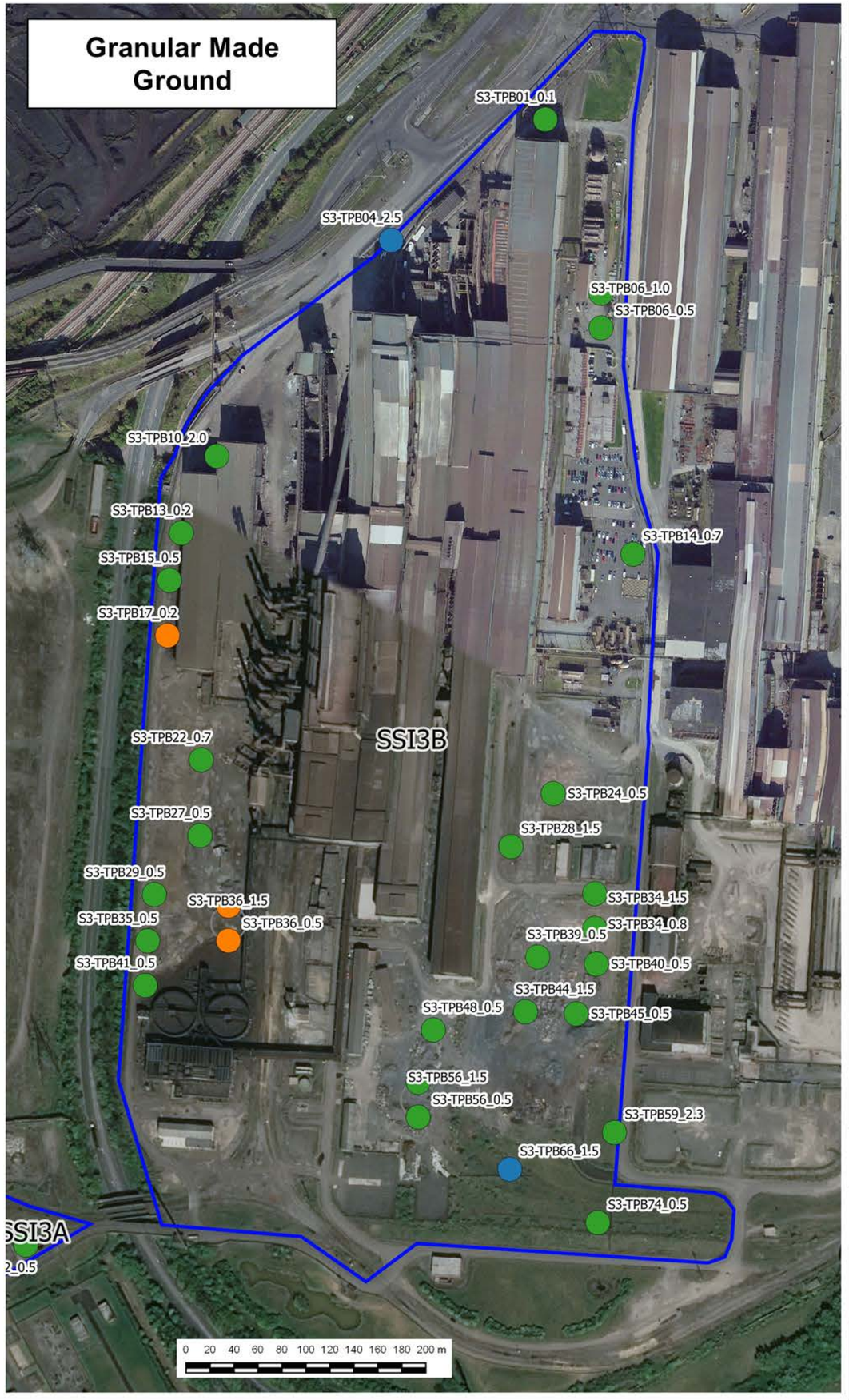
Project: 37774100

SSI3A Figure 8

Date: 23/04/2018
Drawn By: JALM
DRG No: 37774100_01_SSI3A_Figure_8

ARCADIS Design & Consultancy for natural and built assets





Legend

Lead in Made Ground

- Lead (MDL - <100 mg/kg)
- Lead (100 - <500 mg/kg)
- Lead (500> mg/kg)

Site Areas

- Contract 3

Notes:

CONTACT ARCADIS IN CASE OF ANY QUERIES.

Format: LocationID_Depth(m bgl)

N

Title:
Lead Levels in Made Ground Soils SSI3B

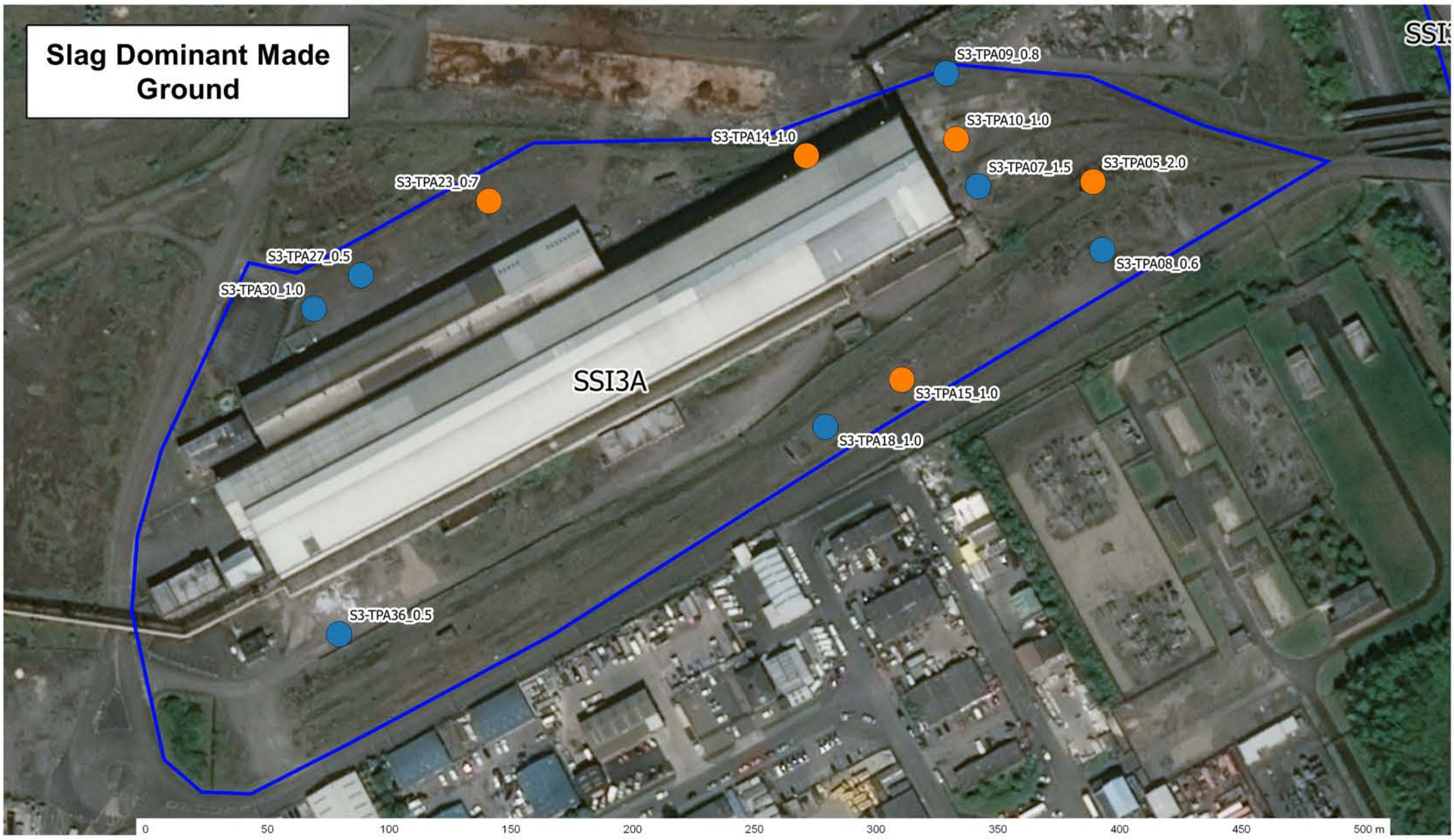
Site:
Redcar Steelworks

Client:
South Tees Site Company

Project: 37774100	**SSI3B Figure 8**

Date: 23/04/2018
Drawn By: JALM
DRG No: 37774100_01_SSI3B_Figure_8

ARCADIS Design & Consultancy for natural and built assets



Legend

Vanadium in Made Ground

- Vanadium (MDL - <100 mg/kg)
- Vanadium (100 - <500 mg/kg)
- Vanadium (500> mg/kg)

Site Areas

- Contract 3

Notes:

CONTACT ARCADIS IN CASE OF ANY QUERIES.

Format: Location ID_Depth(m bgl)_Concentration(mg/kg)

N

Title: Vanadium Levels in Made Ground Soils SSI3A

Site: Redcar Steelworks

Client: South Tees Site Company

Project: 37774100

SSI3A Figure 9

Date: 20/04/2018
Drawn By: JALM
DRG No: 37774100_01_SSI3A_Figure_9

ARCADIS Design & Consultancy for natural and built assets

Slag Dominant Made Ground

S3-TPB03_0.7
S3-TPB05_2.0
S3-TPB07_1.2
S3-TPB08_0.5
S3-TPB09_0.2
S3-TPB11_0.2
S3-TPB10_1.0
S3-TPB12_0.6
S3-TPB13_2.0
S3-TPB18_1.2
SSI3B
S3-TPB23_0.5
S3-TPB26_0.5
S3-TPB30_1.5
S3-TPB31_0.5
S3-TPB32_0.5
S3-TPB37_0.5
S3-TPB38_1.5
S3-TPB42_2.5
S3-TPB43_2.5
S3-TPB46_0.4
S3-TPB48_1.5
S3-TPB47_1.5
S3-TPB49_0.5
S3-TPB55_0.5
S3-TPB57_1.5
S3-TPB58_0.5
S3-TPB53_1.1
S3-TPB52_1.6
S3-TPB55_2.6
S3-TPB51_0.5
S3-TPB64_1.5
S3-TPB54_1.5
S3-TPB65_1.5
S3-TPB61_1.5
S3-TPB63_0.5
S3-TPB60_0.5
S3-TPB62_1.5
S3-TPB68_1.0
S3-TPB69_1.0
S3-TPB72_1.5
S3-TPB75_0.5
S3-TPB71_1.5
SSI3A

Granular Made Ground

S3-TPB01_0.1
S3-TPB04_2.5
S3-TPB06_0.5
S3-TPB14_0.7
S3-TPB17_0.2
SSI3B
S3-TPB27_0.5
S3-TPB28_1.5
S3-TPB29_0.5
S3-TPB36_0.5
S3-TPB35_0.5
S3-TPB34_1.5
S3-TPB39_0.5
S3-TPB40_0.5
S3-TPB41_0.5
S3-TPB44_1.5
S3-TPB45_0.5
S3-TPB56_1.5
S3-TPB59_2.3
S3-TPB66_1.5
S3-TPB74_0.5

0 20 40 60 80 100 120 140 160 180 200 m

Legend

Vanadium in Made Ground

- Vanadium (MDL - <100 mg/kg)
- Vanadium (100 - <500 mg/kg)
- Vanadium (500> mg/kg)

Site Areas

- Contract 3

Notes:

CONTACT ARCADIS IN CASE OF ANY QUERIES.

Format: LocationID_Depth(m bgl)

N

Title:
Vanadium Levels in Made Ground Soils SSI3B

Site:
Redcar Steelworks

Client:
South Tees Site Company

Project: 37774100	**SSI3B Figure 9**

Date: 23/04/2018
Drawn By: JALM
DRG No: 37774100_01_SSI3B_Figure_9

ARCADIS Design & Consultancy for natural and built assets

Legend

Location of Elevated Hydrocarbons

- Elevated PAH
- Elevated TPH
- Elevated TPH and PAH

Notes:

CONTACT ARCADIS IN CASE OF ANY QUERIES.

N

Title:
SSI3A Areas of Elevated Total Petrroleum Hydrocarbons (TPH) and Polyaromatic Hydrocarbons (PAH)

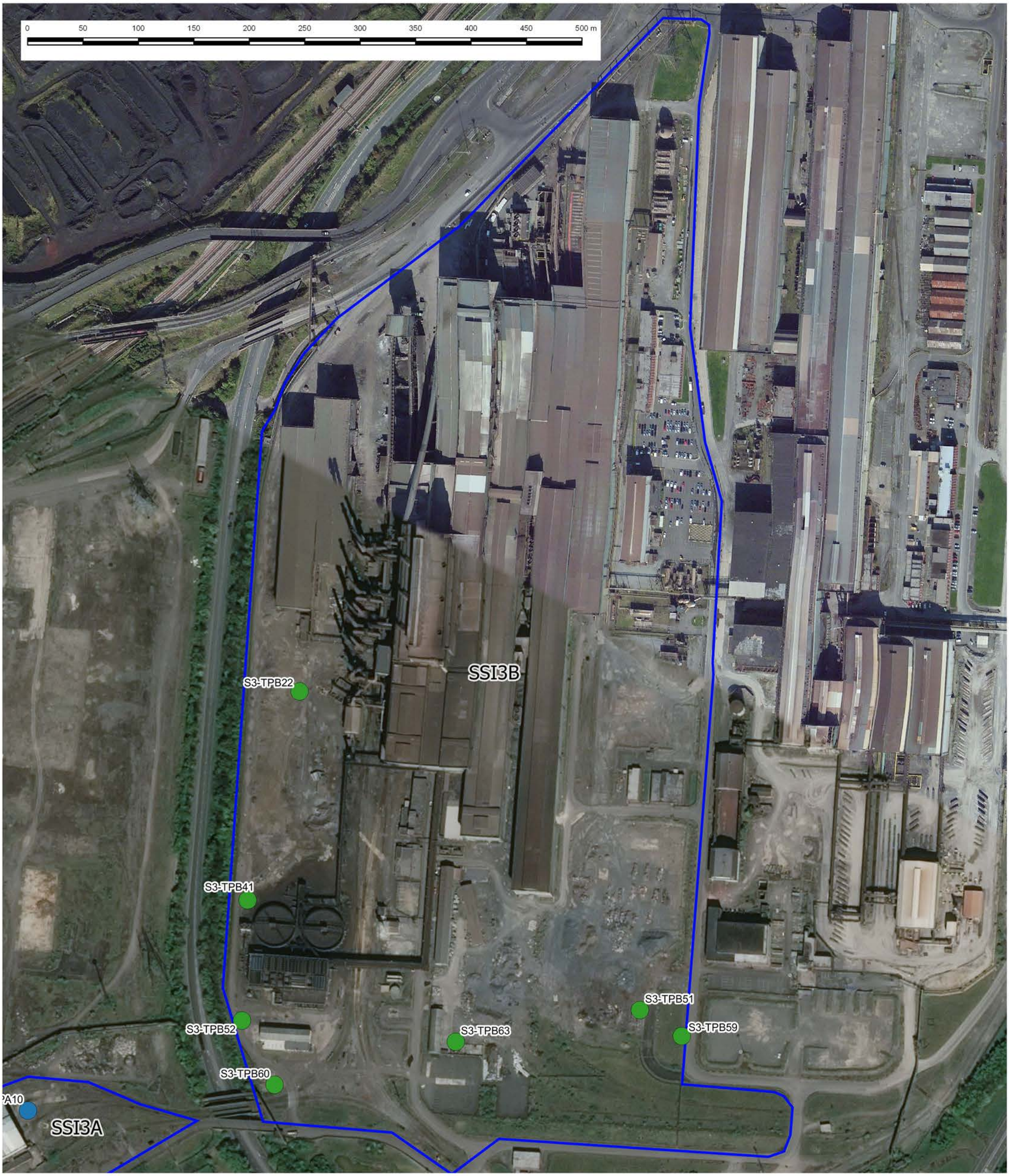
Site:
Redcar Steelworks

Client:
South Tees Site Company

Project:	
37774100	SSI3A Figure 10

Date: 20/04/2018
Drawn By: JALM
DRG No: 37774100_01_SSI3A_Figure_10

ARCADIS Design & Consultancy for natural and built assets



Legend

Location of Elevated Hydrocarbons

- Elevated PAH
- Elevated TPH
- Elevated TPH and PAH

Site Areas

- Contract 3

Notes:

CONTACT ARCADIS IN CASE OF ANY QUERIES.

Format: Location ID_Depth(m bgl)_Concentration(mg/kg)

N

Title:
SSI3B Areas of Elevated Total Petrroleum Hydrocarbons (TPH) and Polyaromatic Hydrocarbons (PAH)

Site:
Redcar Steelworks

Client:
South Tees Site Company

Project:
37774100

SSI3B Figure 10

Date: 23/04/2018
Drawn By: JALM
DRG No: 37774100_01_SSI2B_Figure_10

ARCADIS Design & Consultancy for natural and built assets

APPENDIX D

Trial Pit Investigation Summary

Excavation Summary - Taken from the AEG Factual report

Exploratory Hole Number	Excavation Method	Completion Depth (m BGL)	Remarks
S3-TPA01	Machine Excavated	3.90	Advanced to required depth.
S3-TPA02	Machine Excavated	2.00	Terminated due to encountering service.
S3-TPA03	Machine Excavated	3.90	Terminated – excavator unable to progress.
S3-TPA04	Machine Excavated	3.20	Advanced to required depth.
S3-TPA05	Machine Excavated	3.20	Terminated due to groundwater ingress.
S3-TPA06	Machine Excavated	2.80	Terminated – unable to progress.
S3-TPA07	Machine Excavated	3.20	Terminated due encountering groundwater.
S3-TPA08	Machine Excavated	3.20	Advanced to required depth.
S3-TPA09	Machine Excavated	4.20	Advanced to required depth.
S3-TPA10	Machine Excavated	3.60	Advanced to required depth.
S3-TPA11	Machine Excavated	3.00	Advanced to required depth.
S3-TPA12	Machine Excavated	2.50	Terminated due to obstruction.
S3-TPA13	Machine Excavated	3.50	Advanced to required depth.
S3-TPA14	Machine Excavated	1.30	Advanced to required depth.
S3-TPA15	Machine Excavated	2.90	Advanced to required depth.
S3-TPA16	Machine Excavated	1.70	Terminated due to groundwater ingress.
S3-TPA17	Machine Excavated	3.50	Advanced to required depth.
S3-TPA18	Machine Excavated	3.50	Advanced to required depth.
S3-TPA19	Machine Excavated	1.80	Advanced to required depth.
S3-TPA20	Machine Excavated	3.60	Advanced to required depth.
S3-TPA21	Machine Excavated	1.70	Terminated due to groundwater ingress.
S3-TPA22	Machine Excavated	3.30	Advanced to required depth.
S3-TPA23	Machine Excavated	1.80	Advanced to required depth.
S3-TPA24	Machine Excavated	1.80	Terminated due to groundwater ingress.
S3-TPA25	Machine Excavated	2.50	Terminated due to concrete obstruction.
S3-TPA26	Machine Excavated	3.70	Advanced to required depth.
S3-TPA27	Machine Excavated	1.50	Advanced to required depth.
S3-TPA28	Machine Excavated	4.00	Advanced to required depth.
S3-TPA29	Machine Excavated	3.60	Advanced to required depth.
S3-TPA30	Machine Excavated	2.20	Advanced to required depth.
S3-TPA31	Machine Excavated	2.80	Advanced to required depth.
S3-TPA32	Machine Excavated	3.20	Advanced to required depth.
S3-TPA33	Machine Excavated	2.80	Advanced to required depth.
S3-TPA34	Machine Excavated	3.30	Advanced to required depth.
S3-TPA35	Machine Excavated	2.60	Advanced to required depth.
S3-TPA36	Machine Excavated	2.60	Advanced to required depth.
S3-TPA37	Machine Excavated	1.05	Terminated due to anticipating encountering service.
S3-TPA38	Machine Excavated	2.10	Terminated due to groundwater ingress.

S3-TPA39	Machine Excavated	2.40	Advanced to required depth.
S3-TPA40	Machine Excavated	2.00	Advanced to required depth.
S3-TPA41	Machine Excavated	1.40	Terminated due to services.
S3-TPA42	Machine Excavated	1.60	Terminated due to anticipating encountering service.
S3-TPB01	Machine Excavated	2.80	Advanced to required depth.
S3-TPB02	Machine Excavated	1.20	Terminated due to groundwater ingress.
S3-TPB03	Machine Excavated	3.80	Terminated due to collapse back to 3.40m BGL.
S3-TPB04	Machine Excavated	3.50	Terminated due to collapsed pit sides.
S3-TPB05	Machine Excavated	3.40	Terminated – unable to advance.
S3-TPB06	Machine Excavated	2.00	Advanced to required depth.
S3-TPB07	Machine Excavated	3.80	Terminated – unable to advance.
S3-TPB08	Machine Excavated	2.00	Terminated – unable to advance.
S3-TPB09	Machine Excavated	0.40	Terminated due to slow progress.
S3-TPB10	Machine Excavated	3.50	Terminated – unable to progress.
S3-TPB11	Machine Excavated	0.40	Terminated due to slow progress.
S3-TPB12	Machine Excavated	1.90	Advanced to required depth.
S3-TPB13	Machine Excavated	2.80	Terminated due to groundwater ingress.
S3-TPB14	Machine Excavated	2.40	Advanced to required depth.
S3-TPB15	Machine Excavated	2.50	Advanced to required depth.
S3-TPB16	Machine Excavated	3.80	Terminated due to groundwater ingress and pit side collapse.
S3-TPB17	Machine Excavated	1.80	Terminated due to groundwater ingress.
S3-TPB18	Machine Excavated	2.50	Terminated due to groundwater ingress.
S3-TPB19	Machine Excavated	1.60	Terminated due to groundwater ingress.
S3-TPB20	Machine Excavated	3.20	Advanced to required depth.
S3-TPB21	Machine Excavated	2.40	Terminated due to groundwater ingress.
S3-TPB22	Machine Excavated	2.30	Terminated due to groundwater ingress.
S3-TPB23	Machine Excavated	2.40	Terminated due to groundwater ingress.
S3-TPB24	Machine Excavated	3.50	Terminated due to groundwater ingress.
S3-TPB25	Machine Excavated	2.60	Advanced to required depth.
S3-TPB26	Machine Excavated	1.70	Terminated due to groundwater ingress.
S3-TPB27	Machine Excavated	1.90	Terminated due to groundwater ingress.
S3-TPB28	Machine Excavated	3.50	Terminated due to groundwater ingress.
S3-TPB29	Machine Excavated	1.90	Advanced to required depth.
S3-TPB30	Machine Excavated	2.00	Advanced to required depth.
S3-TPB31	Machine Excavated	1.90	Terminated due to groundwater ingress.
S3-TPB32	Machine Excavated	3.30	Advanced to required depth.
S3-TPB33	Machine Excavated	3.00	Advanced to required depth.
S3-TPB34	Machine Excavated	2.70	Advanced to required depth.
S3-TPB35	Machine Excavated	1.70	Advanced to required depth.
S3-TPB36	Machine Excavated	2.10	Terminated due to groundwater ingress.
S3-TPB37	Machine Excavated	2.90	Advanced to required depth.
S3-TPB38	Machine Excavated	2.20	Terminated due to groundwater ingress.

S3-TPB39	Machine Excavated	0.90	Terminated due to possible asbestos/concrete obstruction.
S3-TPB40	Machine Excavated	2.20	Terminated due to groundwater ingress.
S3-TPB41	Machine Excavated	1.50	Advanced to required depth.
S3-TPB42	Machine Excavated	3.00	Advanced to required depth.
S3-TPB43	Machine Excavated	3.70	Advanced to required depth.
S3-TPB44	Machine Excavated	2.50	Terminated due to groundwater ingress.
S3-TPB45	Machine Excavated	2.80	Advanced to required depth.
S3-TPB46	Machine Excavated	0.50	Terminated due to encountering concrete (possible foundation).
S3-TPB47	Machine Excavated	2.70	Advanced to required depth.
S3-TPB48	Machine Excavated	2.70	Advanced to required depth.
S3-TPB49	Machine Excavated	2.20	Terminated due to groundwater ingress.
S3-TPB50	Machine Excavated	2.60	Terminated due to groundwater ingress.
S3-TPB51	Machine Excavated	2.70	Advanced to required depth.
S3-TPB52	Machine Excavated	2.10	Advanced to required depth.
S3-TPB53	Machine Excavated	1.30	Terminated due to groundwater ingress.
S3-TPB54	Machine Excavated	2.20	Advanced to required depth.
S3-TPB55	Machine Excavated	1.30	Advanced to required depth.
S3-TPB56	Machine Excavated	1.30	Advanced to required depth.
S3-TPB57	Machine Excavated	2.40	Terminated due to groundwater ingress.
S3-TPB58	Machine Excavated	2.40	Terminated due to groundwater ingress.
S3-TPB59	Machine Excavated	2.80	Terminated due to groundwater ingress.
S3-TPB60	Machine Excavated	1.60	Advanced to required depth.
S3-TPB61	Machine Excavated	2.00	Advanced to required depth.
S3-TPB62	Machine Excavated	1.70	Terminated due to groundwater ingress.
S3-TPB63	Machine Excavated	2.40	Advanced to required depth.
S3-TPB64	Machine Excavated	2.80	Advanced to required depth.
S3-TPB65	Machine Excavated	2.60	Advanced to required depth.
S3-TPB66	Machine Excavated	2.40	Advanced to required depth.
S3-TPB67	Machine Excavated	2.80	Terminated due to groundwater ingress.
S3-TPB68	Machine Excavated	2.30	Terminated due to groundwater ingress.
S3-TPB69	Machine Excavated	1.90	Advanced to required depth.
S3-TPB70	Machine Excavated	2.30	Terminated due to groundwater ingress.
S3-TPB71	Machine Excavated	2.20	Advanced to required depth.
S3-TPB72	Machine Excavated	2.50	Advanced to required depth.
S3-TPB73	Machine Excavated	2.50	Terminated due to groundwater ingress.
S3-TPB74	Machine Excavated	1.60	Terminated due to groundwater ingress.
S3-TPB75	Machine Excavated	1.60	Terminated due to groundwater ingress.

Field Screening Summary - Taken from the AEG Factual Report

Exploratory Hole Number	Occurrence (*in-situ*/surface/ laboratory sample)	Visual / Olfactory / Laboratory Testing	Depth (m BGL)	Occurrence Type	Additional Remarks
S3-BHB02	*In-situ*	Olfactory	0.00-2.00	Slight hydrocarbon odour	None
S3-TPA03	*In-situ*	Olfactory	0.00-1.00	Sulphurous odour	None

Exploratory Hole Number	Occurrence (*in-situ*/surface/ laboratory sample)	Visual / Olfactory / Laboratory Testing	Depth (m BGL)	Occurrence Type	Additional Remarks
S3-TPA06	*In-situ*	Olfactory	0.00-1.00	Sulphurous odour	None
S3-TPA29	*In-situ*	Olfactory	0.00-0.80	Engineer notes bitumen odour	None
S3-TPA32	*In-situ*	Olfactory	0.70-1.30	Engineer notes bitumen odour	None
S3-TPB13	*In-situ*	Olfactory	0.00-1.00	Hydrocarbon odour	None
S3-TPB22	*In-situ*	Olfactory and Visual	1.70-2.10	Bitumen and strong hydrocarbon odour and staining/sheen	None
S3-TPB52	*In-situ*	Visual	1.50-1.60	Engineer notes tar like substance.	None
S3-TPB53	*In-situ*	Visual	1.10	Hydrocarbon film on water surface and at clay surface	None
S3-TPB59	*In-situ*	Visual	2.20-2.40	Engineer notes tar like substance.	None

Services Encountered– Reproduced from AEG Factual Report

Exploratory Hole Number	Type of Service	Orientation & Depth (size where indicated)	Status (Damaged/Undamaged)	Additional Remarks
S3-TPA02	Redundant electric cable	095° at 2.00m BGL (20mm diameter)	Damaged	Cable made safe prior to backfilling pit.
S3-TPA37	Possible service	1.05m BGL	Not uncovered	Trial pit terminated due to anticipating service.
S3-TPA41	Clay field drain	1.40m BGL	Undamaged	Trial pit terminated
S3-TPA42	Possible service	1.60m BGL	Not uncovered	Trial pit terminated due to anticipating service.
S3-TPB10	Redundant cast iron pipe	255° at 1.70m BGL	Damaged	None
S3-TPB20	Disused cable	015° at 1.00m BGL	Damaged	None
S3-TPB22	Aluminium cable	220° at 0.20m BGL (20mm diameter)	Undamaged	None
S3-TPB55	Disused plastic water pipe	140° at 0.50m BGL (25mm diameter)	Damaged	None
S3-TPB60	Disused clay drain (silted up)	078° at 0.50m BGL	Damaged	None

Groundwater Summary – Reproduced from AEG borehole logs

Location	Depth (m bgl)	Remarks
S3-BHB01	11.00	Water strike (Slow inflow).
S3-BHB03	2.70	Water seepage.
S3-TPA05	2.50	Water seepage (Moderate inflow).
S3-TPA07	3.00	Water strike (Moderate inflow).
S3-TPA09	2.00	Water seepage (slight inflow).
S3-TPA10	2.00	Water seepage (slight inflow).
S3-TPA16	1.20	Water seepage (slow inflow).
S3-TPA21	0.70	Water strike (Moderate inflow).
S3-TPA23	1.70	Water strike (Slow to moderate inflow).
S3-TPA24	1.60	Water strike (Moderate inflow).

Location	Depth (m bgl)	Remarks
S3-TPA28	3.70	Water strike (Moderate inflow).
S3-TPA29	0.60	Water seepage (Slight inflow).
S3-TPA32	1.20	Water seepage (Slight inflow).
S3-TPA33	0.80	Water seepage (Slight inflow).
S3-TPA33	1.80	Water strike (Moderate inflow).
S3-TPB01	2.00	Water seepage (Slight inflow).
S3-TPB02	1.20	Water strike (Heavy inflow).
S3-TPB06	0.70	Water seepage (Slow inflow).
S3-TPB12	0.70	Water seepage (Slow inflow).
S3-TPB13	2.50	Water strike (Heavy inflow).
S3-TPB15	2.30	Water seepage (Slow inflow).
S3-TPB16	1.50	Water seepage (Slow inflow).
S3-TPB17	1.70	Water strike (Heavy inflow).
S3-TPB18	1.70	Water strike (Moderate inflow).
S3-TPB19	1.50	Water strike (Moderate inflow).
S3-TPB21	1.70	Water seepage (Slow inflow).
S3-TPB22	1.70	Water strike (Heavy inflow).
S3-TPB23	2.30	Water strike (Moderate inflow).
S3-TPB24	3.10	Water strike (Slight inflow).
S3-TPB25	2.20	Water seepage (Slight inflow).
S3-TPB26	1.60	Water strike (Moderate inflow).
S3-TPB27	1.70	Water strike (Moderate inflow).
S3-TPB28	2.70	Water seepage (Slight inflow).
S3-TPB28	3.40	Water strike (Slight inflow).
S3-TPB29	1.60	Water seepage (Slight inflow).
S3-TPB30	1.70	Water strike (Heavy inflow).
S3-TPB31	1.60	Water strike (Heavy inflow).

Location	Depth (m bgl)	Remarks
S3-TPB32	3.20	Water strike (Moderate inflow).
S3-TPB36	1.90	Water strike (Heavy inflow).
S3-TPB37	2.70	Water seepage (Slight inflow).
S3-TPB38	2.10	Water strike (Heavy inflow).
S3-TPB40	2.00	Water strike (Heavy inflow).
S3-TPB42	2.80	Water strike (Moderate inflow).
S3-TPB44	2.40	Water strike (Moderate inflow).
S3-TPB45	2.20	Water seepage (Slight inflow).
S3-TPB49	2.10	Water strike (Moderate inflow).
S3-TPB50	2.50	Water strike (Heavy inflow).
S3-TPB52	1.60	Water seepage (Slight inflow).
S3-TPB53	1.10	Water strike (Moderate inflow).
S3-TPB55	2.20	Water seepage (Moderate inflow).
S3-TPB57	2.20	Water strike (Heavy inflow).
S3-TPB58	2.10	Water strike (Heavy inflow).
S3-TPB59	2.40	Water strike (Slight inflow).
S3-TPB61	1.70	Water strike (Moderate inflow).
S3-TPB62	1.50	Water strike (Heavy inflow).
S3-TPB64	2.50	Water seepage (Moderate inflow).
S3-TPB67	2.40	Water strike (Slight inflow).
S3-TPB68	1.90	Water strike (Slight inflow).
S3-TPB70	2.00	Water strike (Heavy inflow).
S3-TPB73	2.30	Water strike (Moderate inflow).
S3-TPB74	1.20	Water strike (Moderate inflow).
S3-TPB75	1.20	Water strike (Slight inflow).

APPENDIX E

Summary of PAOC

PAOC ID	Source ID	Site	Type	Location	General Description	Specific Details	Data Source / Dates	Risk Level	Point or Material Source	On- / off-site	CoC
PAOC1		All areas	Made Ground	Site Wide	Likely to be several metres thick due to land raising and to comprise variety of materials including slag waste.				Material	On-site	Various metals, PAHs, asbestos, sulphates, pH.
PAOC2		All Areas	Made Ground	Site Wide	Waste including wood, metal, plastic etc. buried alongside Made Ground		CH2M borehole Logs	Low	Material	On-site	Various metals, asbestos, PAH, ground gas
PAOC3		Most areas	Tidal Flat / Glaciolacustrine Deposits	Site Wide	Potential source of permanent ground gas				Material	On-site	Carbon dioxide, methane and hydrogen sulphide
PAOC14	n/a	All	Site roads / car parks	Site wide	These routes represent a potential source of contamination as a result of spillages.		n/a	Low	Point	on-site	metals, asbestos, hydrocarbons, inorganics
PAOC18	18a	n/a	Railway lines	Site wide	Various rail/tramways cross or crossed the site. These could be a potential source of contamination as a result of spillages / loss of materials. Asbestos also CoC.	The Hot Metal Route railway line links to the site via the TS2 site area. This line was used to transport the liquid metal in the Torpedo ladles to the Basic Oxygen Steelmaking plant located approximately 7km to the south within the SSI3 site. In addition to this route numerous other rail lines link the various processes on site.		Moderate	Point/material	on-site	Hydrocarbons, metals, phenols, sulphates and PAHs.
	18e	SSI3A				Surrounding Torpedo Ladle Workshop					
PAOC31		SSI3	BOS Plant and Concast Works	Takes up most of SSI3 area			CH2M SSI3 Desk Study	High	Point	On-site	Sulphates, phosphates, hydrocarbons, elevated pH, heavy metals.
PAOC32		SSI3	Desulphurisation Plant	Desulphurisation plant located to the south of the charging bay	The molten iron underwent desulphursation before being added to the furnace.		CH2M SSI3 Desk Study	High	Point	On-site	Elevated pH, organic and inorganic compounds, hydrocarbons.
PAOC33		SSI3	Polysius Plant	Located adjacent to the east of the clarifier tanks	Associated with the desulphurisation process	Roller mill	CH2M SSI3 Desk Study	High	Point	On-site	Elevated pH, organic and inorganic compounds, hydrocarbons.
PAOC34		SSI3	Clarifier Tanks	Southwest area of SSI3			CH2M SSI3 Desk Study	High	Point	On-site	Asbestos, elevated pH, heavy metals and mettaloids, hydrocarbons (PAH), inorganic compounds (fluoride, sulphates phosphates), organic solvents (chlorofluorocarbons), transformer oils (PCBs)

PAOC ID	Source ID	Site	Type	Location	General Description	Specific Details	Data Source / Dates	Risk Level	Point or Material Source	On- / off-site	CoC
PAOC35		SSI3	Charging Bay	Centre of BOS Plant	Where the vessel is charged?		CH2M SSI3 Desk Study	High	Material	On-site	Asbestos, elevated pH, heavy metals and metalloids, sulphates, phosphates, PAH
PAOC36		SSI3	Slag Transporter Workshop	Loacted between the Scrap Bay and Slag Pits on western side of SSI3	Possible that contaminatio may remain in these areas due to accidental spillage and leaks of fuel.		CH2M SSI3 Desk Study	High	Material	On-site	Asbestos, elevated pH, heavy metals and metalloids, sulphates, phosphates
PAOC37		SSI3	General Services House				CH2M SSI3 Desk Study			On-site	Asbestos, PAH, TPH (diesel), lead
PAOC38		SSI3	Clarifiers (Water Treatment)	Two large circular tanks within the southwestern area of SSI3	Connected to the BOS plant via a series of overhead pipes and they removed solids from waste water used within the plant.		CH2M SSI3 Desk Study	High	Point	On-site	Asbestos, elevated pH, heavy metals and mettaloids, hydrocarbons (PAH), inorganic compounds (fluoride, sulphates phosphates), organic solvents (chlorofluorocarbons), transformer oils (PCBs)
PAOC39		SSI3	Former Slag Pits	Western area of SSI3	The use of saltwater in the former Slag Pits will have created hypersaline conditions, which may persist.		CH2M SSI3 Desk Study	High	Material	On-site	Asbestos, elevated pH, heavy metals and metalloids, sulphates, phosphates
PAOC40		SSI3	Scrap Bay	North western area of SSI3	Scrap metal was stored here before being transferred to the Vessel in the Charging Bay of the BOS plant		CH2M SSI3 Desk Study	High	Material	On-site	Heavy metals, PAH, TPH
PAOC41		SSI3	Scrap Transfer Tracks				CH2M SSI3 Desk Study			On-site	Heavy metals, PAH, TPH, phenols and sulphates
PAOC42		SSI3	Slag Pits	South of Scrap Bay	The molten steel was tapped from the furnace, leaving the slag. This was transported, cooled and stored within Slag Pits. Later converted to scrap maetal storage		CH2M SSI3 Desk Study	High	Material	On-site	Asbestos, elevated pH, heavy metals and metalloids, sulphates, phosphates
PAOC43		SSI3	Bag Filter House	West of Desulphurisation plant	Gases generated by the conversion process were filtered via the Bag Filter and particulate matter filtered out. Likely to be contaminated with heavy metals.		CH2M SSI3 Desk Study	High	Point	On-site	Heavy metals, hydrocarbons
PAOC44		SSI3	Fan House	Located between the BOS Plant and Scrap Bay	Collected gases produced by the steel making processes and sent them to be filtered		CH2M SSI3 Desk Study	High	Point	On-site	Heavy metals, hydrocarbons
PAOC48		SSI3	Spectroscopy	South of BOS offices	Laboratory		CH2M SSI3 Desk Study			On-site	

PAOC ID	Source ID	Site	Type	Location	General Description	Specific Details	Data Source / Dates	Risk Level	Point or Material Source	On- / off-site	CoC
PAOC45		SSI3	Concast Water Treatment plant	North of main BOS plant close to site boundary	Water treatment separates suspended solids from the waste water with the waste material recycled or sent to landfill. The remaining water is then treated using a variety of different filters to capture different contaminants.	Four tanks present: Tank 22 - Water treatment Tank 23 - Corrosion inhibitor Tank 24 - Corrosion inhibitor Tank 25 - Sodium Hypochlorite	CH2M SSI3 Desk Study	High	Point	On-site	Asbestos, elevated pH, heavy metals and mettaloids, hydrocarbons (PAH), inorganic compounds (fluoride, sulphates phosphates), organic solvents (chlorofluorocarbons), transformer oils (PCBs)
PAOC46		SSI3	Fomer Water Treatment Plant	South eastern area of Contract 3 Area B	Area of former water treatment works (description as above)		CH2M SSI3 Desk Study	High	Point	On-site	Asbestos, elevated pH, heavy metals and mettaloids, hydrocarbons (PAH), inorganic compounds (fluoride, sulphates phosphates), organic solvents (chlorofluorocarbons), transformer oils (PCBs)
PAOC47		SSI3	Compressor	Directly south of BOS plant	Compressor house hase a basement level and tunnels		CH2M SSI3 Desk Study		Point	On-site	Hydrocarbons
PAOC49		SSI3	Pump Houses	Within location of slag pits	Associated with the concast water cooling plant		CH2M SSI3 Desk Study	High	Point	On-site	Hydrocarbons
PAOC50	50a	SSI3	Historical Tanks	Southern part of BOS plant.	Various historical tanks		CH2M SSI3 Desk Study	Moderate-High	Point	On-site	Asbestos, hydrocarbons, heavy metals, inorganic and organic compounds
	50b	SSI3	Historical Tanks	Eastern boundary of former water treatment plant.	Various historical tanks		CH2M SSI3 Desk Study	Moderate-High	Point	On-site	
	50c	SSI3	Historical Tanks	South east of current large tanks in south western area of Contract 3.	Various historical tanks		CH2M SSI3 Desk Study	Moderate-High	Point	On-site	
	50d	SSI3	Historical Tanks	Northern central area, close to slag pits.	Various historical tanks		CH2M SSI3 Desk Study	Moderate-High	Point	On-site	
	50e	SSI3	Historical Tanks	Within the location of the concast water treatment plant.	Various historical tanks		CH2M SSI3 Desk Study	Moderate-High	Point	On-site	
PAOC51		SSI3	Present Tanks	South western corner of Contract 3.	Clarifiers that remove solids from waste water		CH2M SSI3 Desk Study	High	Point	On-site	Asbestos, hydrocarbons, heavy metals, inorganic and organic compounds
PAOC52		SSI3	66kv substation	Southern area of SSI3, south of the Red Main access road	Stepdown transformer from 275kV to 66kV		CH2M SSI3 Desk Study	Moderate-High	Point	On-site	Asbestos, elevated pH, heavy metals, hydrocarbons, PCBs

PAOC ID	Source ID	Site	Type	Location	General Description	Specific Details	Data Source / Dates	Risk Level	Point or Material Source	On- / off-site	CoC
PAOC53	53a	SSI3	11kv substation	South of current clarifiers and tanks in south western corner of site.	Stepdown transformer from 66kV to 11kV		CH2M SSI3 Desk Study	Moderate-High	Point	On-site	
	53b	SSI3		Central northern area of Contract 3 - Area B, close to concast water treatment plant.	Stepdown transformer from 66kV to 11kV		CH2M SSI3 Desk Study	Moderate-High	Point	On-site	
PAOC54		SSI3	Substation	Inside PAOC39				Moderate-High	Point	On-site	
PAOC55		SSI3	Fuel Tank (assumed)	Inside PAOC39				Moderate-High	Point	On-site	Asbestos, hydrocarbons, heavy metals, inorganic and organic compounds
PAOC56		SSI3A	Torpedo + Ladle Workshop	Encompasses the central part of Contract 3 - Area A	Torpedo ladles were routinely used on site to transport molten iron from the blast furnace to the BOS Plant for processing. They were lined with a double skin of refractory bricks which were replaced every few months – this re-lining was carried out in the TLRS.	The TLRS is approximately 320m long from east to west, and 45m north to south. The TLRS was operational until the shut-down in the winter of 2015.	CH2M SSI3 (TS3) Desk Study	Moderate-High	Point	On-site	Asbestos, hydrocarbons (TPH & PAH), metals & metalloids
PAOC58a, PAOC58b, c & d		SSI3A	Former residential houses	Along southern western boundary	Residential housing (terraced) located along southern boundary around 1895		CH2M SSI3 (TS3) Desk Study	Low	Point	On-site/off-site	Asbestos, metals, soil gases, hydrocarbons
PAOC62 PAOC63		SSI3A	Former Cleveland Steelworks	Various structures were constructed over the years operational - all located north and northwest of the current site.	The footprint of the former Cleveland Iron Works partially occupied the land towards the north and northwest corner of the site. The site was repeatedly developed and redeveloped during the 20th century, finally being demolished at some point after 1988.	Historical mapping shows traveling cranes operated within this area. With tanks and chimneys also recorded. Except for railway embankments associated with the former tracks which serviced the works, there is little evidence of the Iron Works remaining on site.	CH2M SSI3 (TS3) Desk Study	High	Point	Off-site	Asbestos, metals, sulphates, sulphides and carbonates
PAOC61		SSI3A	Former Furnaces & Coke Ovens	Northwest-west of site.	The former Cleveland Coke Ovens were located within the western are of the site, south of the former Blast Furnace. The ovens are believed to have become derelict during the 1970's, and were demolished by the late 1980's. Except for some occasional foundations, no sign of the coke ovens, or the adjacent Gas Holder and Cooling Plant remains.		CH2M SSI3 (TS3) Desk Study	High	Point	Off-site	Asbestos, elevated pH, metals, hydrocarbons (TPH & PAH), sulphates, sulphides, carbonates, organic compounds
PAOC60		SSI3A	Loco Repair Shop	Directly west of current workshop.	Lone structure directly west of current site - formerly used as a locomotive repair shop.		CH2M SSI3 (TS3) Desk Study	Moderate-High	Point	Off-site	Asbestos, hydrocarbons (TPH & PAH), metals & metalloids
PAOC59a, c, b and d		SSI3A	Grangetown 11kV substations	Southeast of site.	11kV stepdown transformer and substation		CH2M SSI3 (TS3) Desk Study	High	Point	Off-site	Asbestos, hydrocarbons, heavy metals, metalloids, PCB's, elevated pH
PAOC57b		SSI3A	2.75kV substation	South of workshop located in small structure in eastern part of the site.	2.75kV stepdown transformer and substation		CH2M SSI3 (TS3) Desk Study	High	Point	On-site	Asbestos, hydrocarbons, heavy metals, metalloids, PCB's, elevated pH

PAOC ID	Source ID	Site	Type	Location	General Description	Specific Details	Data Source / Dates	Risk Level	Point or Material Source	On- / off-site	CoC
PAOC57a		SSI3A	2.75kV substation	South of workshop located in small structure attached to the main workshop building	2.75kV stepdown transformer and substation		CH2M SSI3 (TS3) Desk Study	High	Point	On-site	Asbestos, hydrocarbons, heavy metals, metalloids, PCB's, elevated pH
PAOC64		SSI3A	Substation	Off site							
PAOC65a and b		SSI3A	Tanks	Located adjacent to 2.75kV substations	Unknown tanks marked as being in vicinity of 2.75kV substations		CH2M SSI3 (TS3) Desk Study	High	Point	On-site	Asbestos, hydrocarbons, heavy metals, metalloids, PCB's, elevated pH

APPENDIX F

Statistical Analysis Results

Area A - Granular Made Ground Analysis Summary					
Analyte	**Number of Detections**	**Maximum Concentration (mg/kg)**	**Minimum Concentration (mg/kg)**	**Mean Concentration (mg/kg)**	**Standard Deviation**
Aluminium	7/7	46,000	11,000	25,857	13,109
Antimony	21/25	14	1.1	3.97	3.52
Arsenic	36/36	35	2.4	12.01	6.76
Barium	25/25	1100	41	398	243
Beryllium	25/25	4.9	1	2.48	1.09
Boron, Water Soluble	36/36	35	1.1	4.90	5.87
Cadmium	30/36	5.7	0.1	0.950	1.305
Chromium	36/36	1300	8.4	178	244
Chromium, Hexavalent	0/25	NA	NA	NA	NA
Copper	36/36	280	6.7	58.8	56.4
Iron	7/7	150,000	11,000	81,714	42,436
Lead	36/36	790	4.8	74.3	130.9
Magnesium	7/7	27,000	8,200	20,314	6,054
Manganese	7/7	21,000	4,300	10,743	5,416
Mercury	19/36	5.6	0.025	0.326	0.928
Molybdenum	25/25	18	0.7	2.78	3.32
Nickel	36/36	100	2.3	20.4	17.9
Silicon	7/7	110,000	22,000	56,000	25,529
Vanadium	25/25	3,000	25	430	606
Zinc	36/36	1,500	14	193	277
pH	36/36	12.3	8.9	10.7	0.747
Cyanide, Total	31/36	36	0.05	2.424	6.993
Cyanide, Free	4/11	1.1	0	0.221	0.314
Cyanide, Complex	7/11	35	0	5.858	10.798
Thiocyanate	5/11	2.3	0	0.717	0.697
Sulphate Aqueous Extract as SO4	36/36	1600	20	528.639	416.434
Naphthalene	13/36	0.15	0.03	0.037	0.037
Acenaphthylene	20/36	0.64	0.03	0.091	0.144
Acenaphthene	14/36	0.66	0.04	0.069	0.122
Fluorene	15/36	0.45	0.03	0.062	0.088
Phenanthrene	34/36	6.9	0.06	0.917	1.363
Anthracene	31/36	3.2	0.04	0.337	0.600
Fluoranthene	35/36	53	0.2	4.545	9.772
Pyrene	35/36	50	0.18	4.237	9.244
Benzo(a)anthracene	35/36	22	0.1	2.209	4.480
Chrysene	35/36	19	0.1	2.018	3.948
Benzo(b)fluoranthene	35/36	25	0.09	2.957	5.751
Benzo(k)fluoranthene	35/36	9.5	0.04	1.145	2.224
Benzo(a)pyrene	35/36	18	0.06	1.942	3.967
Indeno(1,2,3-c,d)pyrene	35/36	9.7	0.04	1.026	2.080
Dibenzo(a,h)anthracene	24/36	3.1	0.03	0.311	0.661

Area A - Granular Made Ground Analysis Summary					
Analyte	Number of Detections	Maximum Concentration (mg/kg)	Minimum Concentration (mg/kg)	Mean Concentration (mg/kg)	Standard Deviation
Benzo(g,h,i)perylene	34/36	11	0.06	1.148	2.354
PAH - USEPA 16, Total	36/36	150	1	19.481	33.162

Area A - Slag Dominant Materials Analysis Summary					
Analyte	Number of Detections	Maximum Concentration (mg/kg)	Minimum Concentration (mg/kg)	Mean Concentration (mg/kg)	Standard Deviation
Aluminium	6/6	23000	7600	12,983	5,298
Antimony	8/9	18	1.6	7.46	5.21
Arsenic	9//	20	7.7	14.32	4.59
Barium	9/9	790	180	450	240
Beryllium	9/9	3.2	0.6	1.50	0.94
Boron, Water Soluble	9/9	5.2	1.4	3.12	1.17
Cadmium	8/9	1.5	0.3	0.906	0.498
Chromium	9/9	790	43	384	272
Chromium, Hexavalent	0/9	NA	NA	NA	NA
Copper	9/9	3200	25	422.1	984.2
Iron	6/6	160000	20000	92,833	50,426
Lead	9/6	1200	14	255.7	355.5
Magnesium	6/6	25000	4000	17,167	7,010
Manganese	6/6	30000	1300	15,083	10,396
Mercury	5/9	1.2	0.025	0.191	0.360
Molybdenum	9/9	8.3	0.9	3.89	2.90
Nickel	9/9	50	11	24.8	13.6
Silicon	6/6	200000	37000	80,667	57,273
Vanadium	9/9	2800	110	950	949
Zinc	9/9	670	40	216	189
pH	9/9	9	12.5	9.5	11.2
Cyanide, Total	7/9	7	43	0.05	5.122
Cyanide, Free	0/3	NA	NA	NA	NA
Cyanide, Complex	1/3	1	0.4	0.1	0.200
Thiocyanate	0/3	NA	NA	NA	NA
Sulphate Aqueous Extract as SO_4	9/9	9	1300	10	299
Naphthalene	3/9	0.67	0.04	0.094	0.204
Acenaphthylene	2/9	1.1	0.06	0.141	0.340
Acenaphthene	2/9	0.15	0.03	0.032	0.042
Fluorene	4/9	1.9	0.04	0.235	0.589
Phenanthrene	9/9	13	0.03	1.660	4.013
Anthracene	6/9	6.5	0.05	0.778	2.024
Fluoranthene	9/9	77	0.11	9.128	24.003
Pyrene	9/9	56	0.13	6.656	17.450
Benzo(a)anthracene	9/9	30	0.07	3.558	9.351

Area A - Slag Dominant Materials Analysis Summary					
Analyte	**Number of Detections**	**Maximum Concentration (mg/kg)**	**Minimum Concentration (mg/kg)**	**Mean Concentration (mg/kg)**	**Standard Deviation**
Chrysene	9/9	23	0.09	2.791	7.147
Benzo(b)fluoranthene	9/9	40	0.08	4.761	12.463
Benzo(k)fluoranthene	9/9	18	0.03	2.114	5.617
Benzo(a)pyrene	9/9	25	0.05	2.922	7.807
Indeno(1,2,3-c,d)pyrene	9/9	17	0.03	1.989	5.308
Dibenzo(a,h)anthracene	2/9	2.8	0.05	0.328	0.874
Benzo(g,h,i)perylene	8/9	18	0.06	2.112	5.618
Total PAH	9/9	330	0.79	39.232	102.828

Area A – Cohesive Made Ground Materials Analysis Summary					
Analyte	**Number of Detections**	**Maximum Concentration (mg/kg)**	**Minimum Concentration (mg/kg)**	**Mean Concentration (mg/kg)**	**Standard Deviation**
Antimony	2/3	5.8	5	3.77	2.33
Arsenic	3/3	19	10	16.00	4.24
Barium	3/3	480	240	340	102
Beryllium	3/3	2.4	1.5	1.90	0.37
Boron, Water Soluble	3/3	5.9	1.9	4.07	1.65
Cadmium	3/3	8.4	1.2	4.900	2.943
Chromium	3/3	220	100	143	54
Chromium, Hexavalent	0/3	NA	NA	NA	NA
Copper	3/3	130	65	89.3	28.9
Lead	3/3	700	79	343.0	261.9
Mercury	2/3	0.15	0.14	0.105	0.057
Molybdenum	3/3	2	1.2	1.67	0.34
Nickel	3/3	35	12	23.7	9.4
Vanadium	3/3	320	180	237	60
Zinc	3/3	5000	210	1,920	2,182
pH	3/3	11.3	9.2	10.5	0.910
Cyanide, Total	3/3	27	0.9	11.400	11.249
Cyanide, Free	1/3	0.6	0.05	0.233	0.259
Cyanide, Complex	3/3	26	0.9	11.033	10.802
Thiocyanate	1/3	8.7	0.3	3.100	3.960
Sulphate Aqueous Extract as SO_4	3/3	11.3	9.2	10.5	0.910
Naphthalene	1/3	0.17	0.17	0.067	0.073
Acenaphthylene	1/3	0.14	0.14	0.057	0.059
Acenaphthene	1/3	0.84	0.84	0.290	0.389
Fluorene	1/3	0.69	0.69	0.240	0.318
Phenanthrene	2/3	0.08	0.015	1.732	2.382
Anthracene	1/3	1.2	0.015	0.410	0.559
Fluoranthene	2/3	0.21	0.015	2.442	3.295
Pyrene	2/3	0.19	0.015	1.968	2.640

Area A – Cohesive Made Ground Materials Analysis Summary					
Analyte	**Number of Detections**	**Maximum Concentration (mg/kg)**	**Minimum Concentration (mg/kg)**	**Mean Concentration (mg/kg)**	**Standard Deviation**
Benzo(a)anthracene	2/3	0.11	0.015	0.708	0.914
Chrysene	2/3	0.14	0.015	0.685	0.861
Benzo(b)fluoranthene	2/3	0.14	0.015	0.752	0.955
Benzo(k)fluoranthene	2/3	0.07	0.015	0.282	0.339
Benzo(a)pyrene	2/3	0.07	0.015	0.462	0.593
Indeno(1,2,3-c,d)pyrene	2/3	0.08	0.015	0.215	0.238
Dibenzo(a,h)anthracene	1/3	0.15	0.015	0.060	0.064
Benzo(g,h,i)perylene	2/3	0.015	0.015	0.252	0.277
Total PAH	3/3	0.5	0.5	10.567	13.744

Area B - Granular Made Ground Analysis Summary					
Analyte	Number of Detections	Maximum Concentration (mg/kg)	Minimum Concentration (mg/kg)	Mean Concentration (mg/kg)	Standard Deviation
Aluminium	10/10	61000	9900	25,290	14,870
Antimony	20/24	9.3	1.2	3.00	2.60
Arsenic	30/31	25	0.1	7.85	5.40
Barium	23/24	710	0.75	296	189
Beryllium	23/24	5.7	0.4	1.83	1.32
Boron, Water Soluble	31/31	8.7	1	4.23	1.75
Cadmium	27/31	5.9	0.1	0.823	1.088
Chromium	31/31	530	0.18	131	136
Chromium, Hexavalent	0/24	NA	NA	NA	NA
Copper	30/31	130	6.7	32.7	26.9
Iron	10/10	110000	15000	49,400	29,045
Lead	30/31	1200	0.15	97.1	222.7
Magnesium	9/9	44000	2300	17,589	10,847
Manganese	10/10	14000	900	4,980	4,533
Mercury	11/31	0.74	0.06	0.080	0.135
Molybdenum	23/24	11	0.5	2.79	2.78
Nickel	30/31	90	2.2	18.8	16.4
Silicon	9/9	190000	23000	79,000	53,899
Vanadium	23/24	660	25	181	163
Zinc	30/31	1900	28	199	333
pH	31/31	12.6	8.1	11.0	1.332
Cyanide, Total	25/31	2.1	0.1	0.374	0.491
Cyanide, Free	0/8	0.05	NA	0.044	0.016
Cyanide, Complex	2/8	1	0.1	0.263	0.308
Thiocyanate	1/9	1.9	0.3	0.478	0.503
Sulphate Aqueous Extract as SO4	30/30	1200	17	370	318
Naphthalene	8/31	1.1	0.03	0.063	0.192
Acenaphthylene	5/31	0.27	0.04	0.032	0.052
Acenaphthene	4/31	3.9	0.1	0.151	0.685
Fluorene	6/31	2	0.04	0.105	0.360
Phenanthrene	25/31	5.6	0.03	0.428	1.054
Anthracene	18/31	0.77	0.03	0.090	0.158
Fluoranthene	29/31	4.3	0.04	0.508	0.820
Pyrene	29/31	3.3	0.03	0.519	0.688
Benzo(a)anthracene	24/31	1.1	0.04	0.248	0.284
Chrysene	26/31	1.2	0.03	0.297	0.340
Benzo(b)fluoranthene	25/31	2.2	0.03	0.356	0.454
Benzo(k)fluoranthene	21/31	0.8	0.03	0.151	0.182
Benzo(a)pyrene	23/31	1.7	0.03	0.207	0.321
Indeno(1,2,3-c,d)pyrene	22/31	0.93	0.03	0.141	0.184
Dibenzo(a,h)anthracene	11/31	0.21	0.03	0.041	0.047

Area B - Granular Made Ground Analysis Summary					
Analyte	Number of Detections	Maximum Concentration (mg/kg)	Minimum Concentration (mg/kg)	Mean Concentration (mg/kg)	Standard Deviation
Benzo(g,h,i)perylene	23/31	1.1	0.03	0.175	0.222
PAH - USEPA 16, Total	31/31	26	0.11	3.254	5.212

Area B - Slag Dominant Materials Analysis Summary					
Analyte	Number of Detections	Maximum Concentration (mg/kg)	Minimum Concentration (mg/kg)	Mean Concentration (mg/kg)	Standard Deviation
Aluminium	33/33	62000	8800	33,145	13,129
Antimony	40/45	10	0.5	3.18	2.28
Arsenic	45/45	33	0.5	7.02	5.29
Barium	44/45	1300	65	285	208
Beryllium	43/45	6	0.1	2.93	1.44
Boron, Water Soluble	45/45	13	1.5	5.52	3.00
Cadmium	38/45	5.6	0.05	0.597	0.884
Chromium	45/45	710	26	166	147
Chromium, Hexavalent	0/44	0.5	0.5	0.500	0.000
Copper	45/45	190	6	26.5	30.1
Iron	33/33	190000	11000	49,485	37,548
Lead	45/45	170	2.6	30.3	36.7
Magnesium	23/23	36000	2900	25,126	6,792
Manganese	33/33	86000	770	14,232	15,823
Mercury	9/45	2.6	0.025	0.126	0.392
Molybdenum	43/45	36	0.2	2.65	5.38
Nickel	45/45	220	1.2	14.6	32.7
Silicon	23/23	170000	3000	62,522	32,953
Vanadium	44/45	2000	37	344	362
Zinc	45/45	2900	8.7	134	424
pH	45/45	12.7	9.2	11.4	0.745
Cyanide, Total	33/45	21	0.05	0.689	3.071
Cyanide, Free	1/18	0.5	0.05	0.075	0.103
Cyanide, Complex	6/18	20	0.1	1.256	4.547
Thiocyanate	4/20	2.7	0.3	0.490	0.537
Sulphate Aqueous Extract as SO_4	44/45	1900	18	637	534
Naphthalene	12/45	0.54	0.03	0.040	0.082
Acenaphthylene	13/45	0.22	0.03	0.036	0.047
Acenaphthene	9/45	2.2	0.03	0.108	0.348
Fluorene	10/45	3.8	0.04	0.153	0.595
Phenanthrene	38/45	19	0.03	0.985	3.091
Anthracene	19/45	4	0.03	0.217	0.636
Fluoranthene	39/45	15	0.06	1.346	3.066
Pyrene	39/45	12637mg/kg Area B)	0.05	1.168	2.426

Area B - Slag Dominant Materials Analysis Summary					
Analyte	**Number of Detections**	**Maximum Concentration (mg/kg)**	**Minimum Concentration (mg/kg)**	**Mean Concentration (mg/kg)**	**Standard Deviation**
Benzo(a)anthracene	37/45	5.3	0.03	0.533	1.057
Chrysene	39/45	5.2	0.03	0.534	1.001
Benzo(b)fluoranthene	38/45	7.6	0.04	0.668	1.328
Benzo(k)fluoranthene	33/45	3.1	0.03	0.272	0.541
Benzo(a)pyrene	36/45	4.5	0.03	0.412	0.820
Indeno(1,2,3-c,d)pyrene	35/45	2.6	0.03	0.253	0.468
Dibenzo(a,h)anthracene	16/45	0.92	0.03	0.070	0.150
Benzo(g,h,i)perylene	37/45	3.2	0.03	0.298	0.561
Total PAH	45/45	71	0.26	6.998	15.105

Area A – Cohesive Made Ground Materials Analysis Summary					
Analyte	**Number of Detections**	**Maximum Concentration (mg/kg)**	**Minimum Concentration (mg/kg)**	**Mean Concentration (mg/kg)**	**Standard Deviation**
Aluminium	2/2	29000	11000	20,000	9,000
Antimony	8/10	3.1	1	1.83	0.99
Arsenic	12/12	24	2.3	10.38	5.63
Barium	10/12	370	100	230	89
Beryllium	10/10	3.7	0.5	1.75	1.04
Boron, Water Soluble	12/12	8	1.8	4.02	1.81
Cadmium	11/12	1.3	0.1	0.496	0.383
Chromium	12/12	350	26	81	88
Chromium, Hexavalent	0/10	NA	NA	NA	NA
Copper	12/12	56	14	30.3	12.8
Iron	2/2	120000	16000	68,000	52,000
Lead	12/12	120	11	50.6	34.6
Magnesium	1/1	14000	14000	14,000	0
Manganese	2/2	8900	2300	5,600	3,300
Mercury	6/12	0.41	0.06	0.086	0.106
Molybdenum	10/10	2.1	1	1.52	0.38
Nickel	12/12	32	8.4	20.7	7.6
Silicon	1/1	160000	160000	NA	NA
Vanadium	10/10	730	41	167	196
Zinc	12/12	250	31	103	69
pH	12/12	12.2	7.9	9.9	1.346
Cyanide, Total	8/12	1.6	0.1	0.300	0.423
Cyanide, Free	0/3	NA	NA	NA	NA
Cyanide, Complex	2/3	0.6	0.2	0.300	0.216
Thiocyanate	0/3	NA	NA	NA	NA
Sulphate Aqueous Extract as SO_4	12/12	1800	10	550	499
Naphthalene	1/12	0.04	0.015	0.017	0.007
Acenaphthylene	0/12	NA	NA	NA	NA

Area A – Cohesive Made Ground Materials Analysis Summary					
Analyte	**Number of Detections**	**Maximum Concentration (mg/kg)**	**Minimum Concentration (mg/kg)**	**Mean Concentration (mg/kg)**	**Standard Deviation**
Acenaphthene	1/12	0.06	0.015	0.019	0.012
Fluorene	1/12	0.04	0.015	0.017	0.007
Phenanthrene	8/12	0.54	0.015	0.100	0.138
Anthracene	1/12	0.15	0.015	0.026	0.037
Fluoranthene	9/12	0.93	0.015	0.158	0.239
Pyrene	9/12	0.72	0.015	0.130	0.185
Benzo(a)anthracene	7/12	0.26	0.015	0.052	0.065
Chrysene	7/12	0.26	0.015	0.056	0.065
Benzo(b)fluoranthene	7/12	0.21	0.015	0.054	0.055
Benzo(k)fluoranthene	3/12	0.09	0.015	0.025	0.022
Benzo(a)pyrene	3/12	0.11	0.015	0.032	0.033
Indeno(1,2,3-c,d)pyrene	2/12	0.07	0.015	0.022	0.016
Dibenzo(a,h)anthracene	0/12	NA	NA	NA	NA
Benzo(g,h,i)perylene	2/12	0.07	0.015	0.022	0.016
Total PAH	12/12	3.5	0.05	0.600	0.910

APPENDIX G

Slag testing Report

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