VICTORIA NORTH
INFRASTRUCTURE WORK

PRE-DEVELOPMENT
REMEDIATION STRATEGY

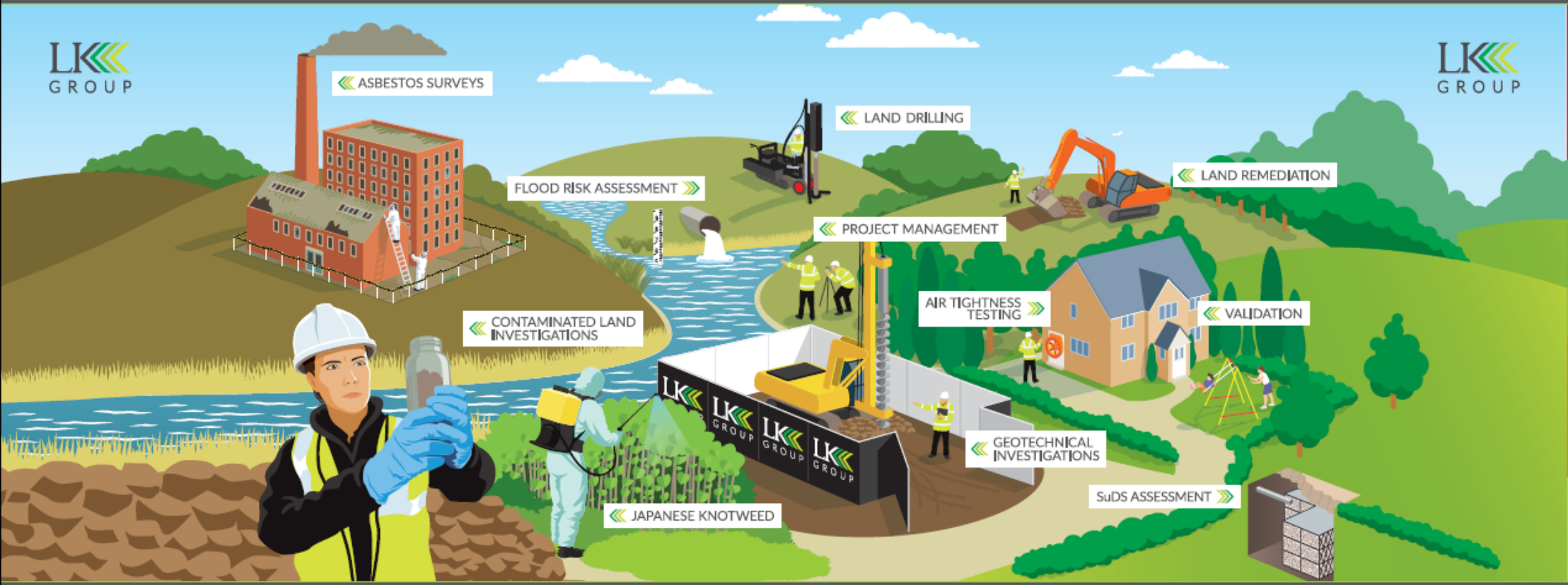
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R1	14th Nov 2022	Updated following provision of additional reports and following comments on R0 report	C Baranek
R2	18th Nov 2022	Updated following comments on R1 report	C Baranek

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Executive Summary

LK Consult Ltd (LKC) has been commissioned to produce a Pre-Development Remediation Strategy for Victoria North Infrastructure Work. The infrastructure work includes earthworks to create of development platforms, road networks, services / utilities and the creation of new and improved green infrastructure and landscaping.

Based on the review of all available investigation work and risk assessments, a Pre-Development Remediation Strategy has been produced to confirm the remediation and validation works required to ensure the site is suitable for its proposed use. The proposed end use it taken as the completion of the earthworks and infrastructure work and does not include the final development plans which will be covered as part of a separate planning application.

A summary of remediation and validation requirements is shown below.

Area / Activity	Remediation Requirements	Validation Work	Testing Schedule	Remedial Targets
Riverbank Knotweed Clearance	Vegetation Clearance including the removal of Japanese Knotweed.	TBC in Japanese Knotweed method statement.		
Creamline Dairies	Confirmation of the suitability of demolished material for re-use.	Testing of stockpiled material.	1 sample per 150m^3, min. 3no. samples. Suite 1.	Presence of ACM.
			Note: if this material is to be used as part of an environmental cover system in future development additional testing / assessment will be required in respect to suitability for use.	
All Areas and Riverbed Fly tipping	Removal of all fly tipping as part of site clearance. Watching brief for ACM pieces to be undertaken (ACM to be segregated and disposed of accordingly). Including possible removal of debris within riverbed.	Testing of stockpiled material.	Subject to waste type and disposal facility requirements.	N/A
All Areas Removal of hardstood, structures and soil turnover	Removal of hardstood ground. Relic inground structures to be removed to a depth of 2.0mbgl. Any obstructions greater than 2.0m depth will remain and be recorded. Soil turnover to approx. 0.5m across the site. Dewatering if required.	Record including photographs of work undertaken. Records to include locations of any areas of deep obstructions remaining in the ground.	N/A	N/A

Area / Activity	Remediation Requirements	Validation Work	Testing Schedule	Remedial Targets
Gasworks and Former Carriage Shed Remediation	Excavation of impacted material and relic structures under the supervision of a geo-environmental consultant.	Remaining in-situ soils to be tested to confirm impacted soils removed.	Subject to size of excavation. Samples collected from sides and base, *c.* 10m spacing. Suite 4.	1. Ensure no visual olfactory evidence of hydrocarbons / volatiles remain. 2. Compare against Gasworks Remedial Targets[1] (gasworks area). 3. Compare against Zone 1 and 2 Remedial Targets[2,3], where applicable. 4. Compare against GAC for future end use[4,5].
Gasworks and Former Carriage Shed Remediation (continued)	Impacted soils to be segregated on impermeable membrane for offsite disposal.	Testing of excavated material to confirm the waste classification.	See EA Technical Guidance on Waste Classification. Suite 2 and 3.	N/A (for offsite disposal)
	Dewatering, where required. Impacted perched groundwater to be stored for offsite disposal.	Testing of impacted groundwater to confirm the waste classification.	Subject to volume and waste facilities requirements. Suite 5.	N/A (for offsite disposal)
	Backfilling of excavation with suitable material in line with earthworks specification.	N/A	N/A	N/A
All Areas – Reuse of site-won material	To be undertaken in line with appropriate legislation and guidance (MMP with recourse to CL:AIRE Code of Practice). Material excavated on site should be stockpiled, processed and categorised to determine if the soil is suitability for re-use on site in line with the Earthworks Specification. See Screening Criteria Zones (Appendix B). Soils moved locally within the same area do not require validation testing (i.e. soils excavated and reused within Red Bank Plateau, and regrading work within St Catherine's Wood and Red Bank Terrace) with the exception of soils within Zone 1. Testing is required where soils are placed within St. Catherine's Wood or Red Bank Terrace (Zone 1 and 2).	Material placed within Zone 1 to be tested to confirm suitability.	1 sample per 150m^3 (min. 3 samples). Suite 2.	Arup derived targets for material within Zone 1[4].
		Material placed within Zone 2 to be tested to confirm suitability.	1 sample per 150m^3 (min. 3 samples). Suite 2.	Arup derived targets for material within Zone 2[5].

Area / Activity	Remediation Requirements	Validation Work	Testing Schedule	Remedial Targets
Disposal	Material required to be removed from site should be undertaken under an appropriate duty of care and the results of chemical analysis and waste classification should be provided to the relevant waste facility.	Testing of excavated material to confirm the waste classification.	See EA Technical Guidance on Waste Classification. Suite 2 and 3.	For offsite disposal, testing results to be provided to waste facility.
		Waste records such as disposal tickets and waste carrier licences should be provided.	N/A	N/A
Stockpile Management	The source of each stockpile should be recorded with associated testing (as detailed above). Material should be segregated by type and source. Quarantine areas for suspected contaminated soils to be established until use / disposal route is confirmed.	Records including photographs of work undertaken.	N/A	N/A
River Channel	Inspection during works to re-naturalise the river bank to identify: - Visual or olfactory evidence for the potential discharge of contaminants into the river through high permeability material associated with the former river meander bend, or - Visual or olfactory evidence of contamination discharging from the face of the regrading river banks. If either of these are encountered, the risk to controlled waters should be reassessed and measured to address these potential contamination linkages (for example the provision of low permeability material at appropriate locations along the river banks) should be implemented if required.	Records including photographs of inspection work undertaken. Validation of any potential remedial work to be determined once further assessment has been carried out (if required), subject to inspection work.	N/A	N/A

Area / Activity	Remediation Requirements	Validation Work	Testing Schedule	Remedial Targets
All Areas Watching Brief / Unexpected Contamination	Geo-environmental engineer to be present during groundwork to assess any unexpected contamination. Impacted material to be excavated and stockpiled in a segregated area on impermeable membrane. Delineation work to confirm lateral and vertical extent. Dewatering, where required. Potentially impacted groundwater to be stored for offsite disposal. Further assessment to confirm most appropriate action (i.e. re-use on site or disposal). Verification samples of remaining soils. Backfilling of excavation with suitable material in line with earthworks specification. Abstraction wells (if any are identified) to be appropriately decommissioned in line with EA guidance.	Remaining soils to be tested to confirm impacted soils removed.	Samples collected from sides and base, *c*. 10m spacing. Testing Suite subject to contamination identified.	Subject to location on site. 1. Ensure no visual olfactory evidence of hydrocarbons / volatiles remain. 2. Ensure no visible ACM remains. 3. Assessment criteria subject to location on site and contaminants of concern.
		Testing of excavated material to confirm if material will be re-used or disposed of.	Subject to contaminants of concern. 1 sample per 150m^3 (min. 3 samples) and in line with EA Technical Guidance on Waste Classification. (whichever is most conservative). Suite 2 and 3, possible SVOCs and VOCs.	Subject to potential re-use activity: 1. Ensure no visual olfactory evidence of hydrocarbons / volatiles remain. 2. Ensure no visible ACM remains. 3. Assessment criteria subject to location on site and contaminants of concern.
		Testing of impacted groundwater to confirm the waste classification.	Subject to volume and waste facilities requirements. Suite 5.	N/A (for offsite disposal)
Health and Safety	A Construction Management Plan and Method Statement should be produced which details appropriate Health and Safety measures to be employed during the site works.	Record to be provided of precautions undertaken during earthworks.	N/A	N/A
All Areas Asbestos Management	Asbestos Management Plan should be developed across the site.	Record to be provided of precautions undertaken during earthworks.	N/A	N/A

Area / Activity	Remediation Requirements	Validation Work	Testing Schedule	Remedial Targets
Post Earthworks Remediation	Soft landscaping areas - where soft landscaping areas are developed as part of the earthworks programme and will form long term POS areas: 300mm thick, clean cover required comprising subsoil and sufficient topsoil for a growing medium. The subsoil layer can be replaced by additional topsoil.	Measuring depth of environmental cover system using a staff and providing photographic evidence. Provision of source and volumes of imported soils (certificates and import tickets). Validation testing to confirm the soils are suitable for POS.	1 sample per 50m^3 (min. 3 samples). Suite 2.	Compare to Arup derived POS assessment criteria[4].
	Proposed development areas: 100mm thick clean cover required.	Measuring depth of environmental cover system using a staff and providing photographic evidence. Provision of source and volumes of imported soils (certificates and import tickets). Validation testing to confirm the soils are suitable for POS.	1 sample per 50m^3 (min. 3 samples). Suite 2.	Compare to Arup derived POS assessment criteria[4].
	Hardstood areas: No remediation required.	N/A	N/A	N/A
	St Catherine's Wood and Red Bank Terrace - where trees will remain as part of the proposed development scheme: Further assessment required where a cover system is not possible due to root networks.	TBC	TBC	TBC
	Potable Water Pipes: At this stage it is assumed that there is a risk to potable water pipes and barrier pipe is recommended. Further testing may allow the risk to be re-assessed.	Records of pipework installed, including photographs.	N/A	N/A

Summary of Remediation and Validation Requirements.

Testing Suites:
Suite 1 – (soils) Asbestos Screen (if present, ID and Quantification to be undertaken).
Suite 2 – (soils) Metals, cyanide, pH, sulphate, speciated PAH, SOM, TPHCWG, BTEX.
Suite 3 – (soils) WAC Stage 2.
Suite 4 – (soils) SOM, TPHCWG, BTEX, SVOCs, VOCs.
Suite 5 – (water) TPHCWG, BTEX, SVOCs, VOCs.

Remedial Targets (Provided in Appendix D):
1 - Gasworks Remedial Targets (derived by Arup – Victoria North HIF Infrastructure Works, Controlled Waters Detailed Quantitative Risk Assessment Report, produced by ARUP, ref: VNIF-ARP-ZZ-YYY-RP-CG-0011, P03, date: 7th November 2022).
2 - Targets for material within Zone 1 (derived by Arup – Victoria North HIF Infrastructure Works, Controlled Waters Detailed Quantitative Risk Assessment Report, produced by ARUP, ref: VNIF-ARP-ZZ-YYY-RP-CG-0011, P03, date: 7th November 2022).
3 - Targets for material within Zone 2 (derived by Arup – Victoria North HIF Infrastructure Works, Controlled Waters Detailed Quantitative Risk Assessment Report, produced by ARUP, ref: VNIF-ARP-ZZ-YYY-RP-CG-0011, P03, date: 7th November 2022).
4 – POS assessment criteria (derived by Arup – Victoria North Infrastructure Works, Ground Investigation Interpretive Report, produced by ARUP, ref: VNIF-ARP-XX-YYY-RP-CG-0012 P02, date: 3rd November 2022).
5 – Residential w/o plant uptake (derived by Arup – Victoria North Infrastructure Works, Ground Investigation Interpretive Report, produced by ARUP, ref: VNIF-ARP-XX-YYY-RP-CG-0012 P02, date: 3rd November 2022).

EA Technical Guidance on Waste Classification:

Population (tonnes)	Number of Samples (homogeneous waste)	Number of Samples (new/heterogeneous waste)
< 100	2	5
< 500	3	8
< 1,000	5	14
10,000	11	22
+ per additional 10,000	+5 (pro rata)	+10 (pro rata)

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APPENDICES

Appendix A: Current and Proposed Development Plans
Appendix B: Site Investigation Plans
Appendix C: JIWG Output Sheets
Appendix D: Remedial Targets

1 Introduction

1.1 Background

LK Consult Ltd (LKC) has been commissioned by BAM Nuttall Ltd (BAM) to produce a Pre-Development Remediation Strategy for Victoria North Infrastructure Work. The infrastructure work will be funded by Homes England Housing Infrastructure Fund. The infrastructure works are being carried out to support a subsequent residential led development being planned by a Joint Venture of Manchester City Council (MCC) and the Far East Consortium (FEC).

The work relates to planning reference 133143/VO/2022. Proposals are as detailed below:

'City Council Development for the creation of development platforms, including remediation and earthworks, and change in site levels, to allow delivery of future residential-led development at the Red Bank Neighbourhood, together with the construction of a new road and priority junction from Red Bank, new drainage infrastructure, utility and services connections and diversions, preparatory tree and shrub clearance, and demolition of certain existing structures, along with the creation of new and improved green infrastructure and landscaping including the improvements of St Catherine's Wood to form part of a City River Park, and other associated works.'

Future development is anticipated to include residential, public open space, school, retail and commercial. This development is outside the scope of current work.

The following reports, documents and plans have been provided for review:

- Victoria North HIF Infrastructure and Enabling Works, Geotechnical Design Report, produced by ARUP, ref: VNIF-ARP-ZZ-YYY-RP-CG-0010, date: 25th July 2022.
- Victoria North HIF Infrastructure Works, Controlled Waters Detailed Quantitative Risk Assessment Report, produced by ARUP, ref: VNIF-ARP-ZZ-YYY-RP-CG-0011, P03, date: 7th November 2022.
- Victoria North Infrastructure Works, Ground Investigation Interpretive Report, produced by ARUP, ref: VNIF-ARP-XX-YYY-RP-CG-0012 P02, date: 3rd November 2022.
- Victoria North HiF Infrastructure and Enabling Works – Phase 3 Ground Investigation Report – Factual Account, produced by BAM Richies, ref: BAX.326R, date: September 2022.
- Landscape General Arrangement HIF Delivery Plan, produced by p-ie, ref: VNIF-PLA-ZZ-YYY-DR-L-1011, date: 16th September 2022.
- Take-Off Report v5_25.05.22 (cut and fill calculations), provided by BAM Nuttall Ltd.
- Victoria North Initial Cut Fill map, produced by BAM Nuttall Ltd, ref: MCL/BAM2201/001, date: 16th February 2022.
- Victoria North Cut Fill Zones, produced by BAM Nuttall Ltd, ref: MCL/BAM2201/005, date: 8th March 2022.
- Victoria North Initial Construction Allowances, produced by BAM Nuttall Ltd, ref: MCL/BAM2201/002, date: 16th February 2022.
- Victoria North HIF Infrastructure and Enabling Works, Proposed Site Contours Plan, produced by ARUP, ref: VNIF-ARP-00-YYY-DR-CE-0001 Rev P04, date: 28th June 2022.

- Victoria North HIF Infrastructure and Enabling Works, Proposed Site Isopach Plan, produced by ARUP, ref: VNIF-ARP-00-YYY-DR-CE-0002 Rev P04, date: 28th June 2022.
- Victoria North HIF Infrastructure and Enabling Works, Site Clearance Plan, produced by ARUP, ref: VNIF-ARP-00-YYY-DR-G-0013 Rev P01, date: 1st September 2022.

This Pre-Development Remediation Strategy summarises the findings of the above and provides details of the remediation and validation works required to ensure the site is suitable for its proposed use.

The proposed end use it taken as the completion of the earthworks and infrastructure work and does not include the final development plans which will be covered as part of a separate planning application.

It is assumed that the above reports, drawings and plans have been approved by the Local Authority.

1.2 Site Details

The site comprises current industrial land, derelict land and woodland. It lies to the east of Red Bank, north of Roger Street and west of Dantzic Street and the River Irk. Manchester Victoria Railway Station is located to the southwest of the site. A site plan is provided in Appendix A.

There are 3no. parcels of land associated with the Victoria North Infrastructure Works named as Red Bank Plateau, Red Bank Terrace and St. Catherine's Wood. The site boundaries and named areas are shown on Plate 1-1 below:



Plate 1-1: Site boundary and named areas (extract from Victoria North Infrastructure Works, Ground Investigation Interpretive Report, produced by ARUP, ref: VNIF-ARP-XX-YYY-RP-CG-0012, date: 16th August 2022).

Future development within these areas will include:

- Red Bank Plateau - predominantly residential development with some local public open space.
- Red Bank Terrace - public open space.
- St Catherine's Wood – school (north) and public open space. Where possible existing vegetation will be preserved with limited areas of enhancement.

The site levels range between 45.5m AOD (former Creamline Dairies in the west) to the banks of the River Irk at 29-31m AOD. Various slopes and retaining features are present on site.

1.3 Earthworks Proposals

Based on the information provided, earthworks proposals are detailed below and associated plans are provided in Appendix A.

- Removal of relic structures including the remains of the former carriage shed and a gasworks.
- Regrading existing slopes between Plots RB02 and RB03 and the River Irk.
- Lowering ground levels in Plots RB02 and RB03.
- Filling activities across Red Bank Plateau to produce the required development platform.
- Regrading existing slopes in Red Bank Terrace to facilitate a series of new accessible footpaths.
- Regrading existing slopes in St Catherine's Wood to facilitate a series of new accessible footpath.
- Limited import of fill materials in Red Bank Terrace and St Catherine's Wood to supplement the regrading operations and achieve the required landform.

A cut and fill plan is provided in Plate 1-2 below (further detailed plans provided in Appendix A):

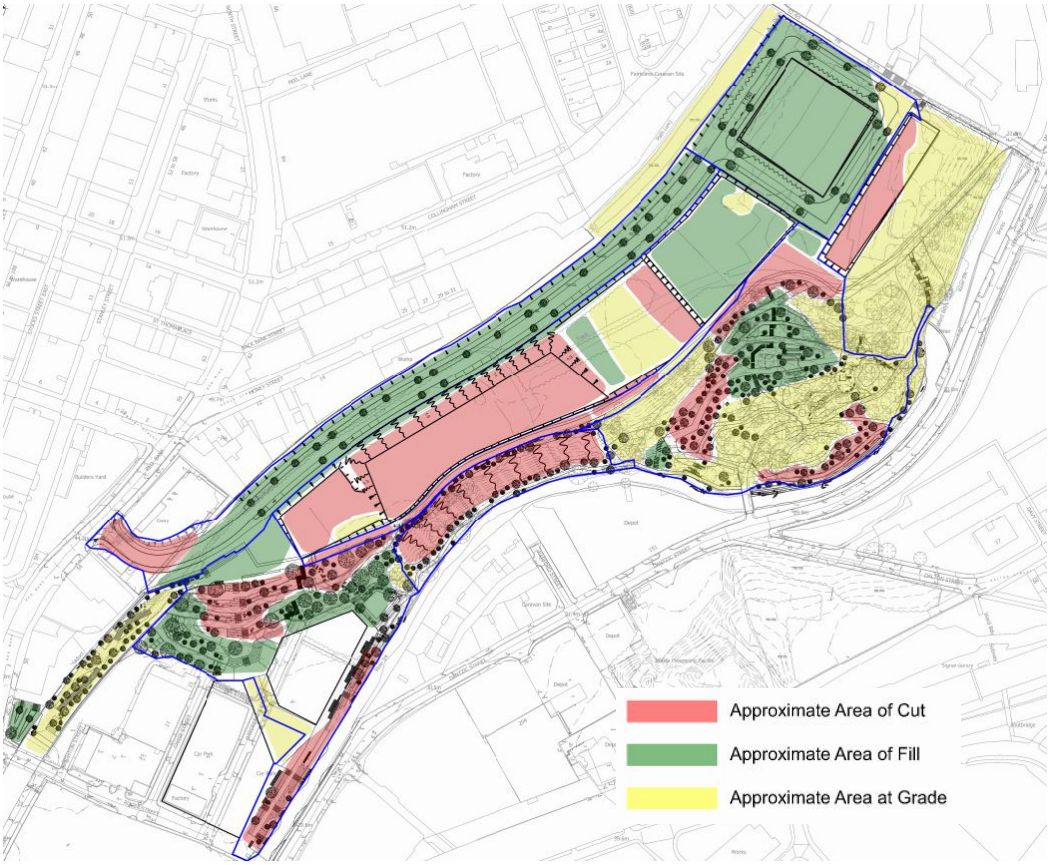


Plate 1-2: Summary of proposed cut, fill and grading (extract from Victoria North HIF Infrastructure Works, Controlled Waters Detailed Quantitative Risk Assessment Report, produced by ARUP, ref: VNIF-ARP-ZZ-YYY-RP-CG-0011, P03, date: 7th November 2022 (Cut and Fill Proposals Drawing 8)).

Details of the cut and fill are provided in Table 1-3 below:

Area	Approx. Cut (m^3)	Approx Fill (m^3)	Balance (m^3)
Active Travel Route (between Red Bank Plateau and St Catherine's Wood)	2,568.4	5.5	2,562.9
Plateau Avenue / RB05a	1,825.1	2,826.7	-1,001.6
Plateau Avenue	1,632.8	7,081.4	-5,448.6
RB01	817.1	91.8	725.3
RB02	6,014.6	158.7	5,855.9
RB03	9,467.0	129.5	9,337.5
RB04a	469.6	341.4	128.2
RB05b	853.8	36.6	817.1
RB05c	109.8	1,251.0	-1,141.1
Red Bank Terrace	9,390.5	2,006.7	7,383.8
Slope Regrading (southwestern area of St Catherine's Wood)	8,786.3	153.4	8,632.9
St Catherine's Wood	6,096.3	1,747.2	4,349.1

Table 1-3: Summary of cut and fill volumes (based on Take-Off Report v5_25.05.22, provided by BAM Nuttall Ltd).

Notes:

1 The available bank cut is the cut volume between the two subject surfaces. That material to be excavated is considered to be in its in situ bank density state (its natural state prior to excavation).

2 As the bank cut is excavated (and thereby placed in a loose state), it will occupy this increased volume, which is obtained by multiplying the available bank cut by the material's hauling bulkage factor.

3 The excess (positive) or deficit (negative) volume is obtained by subtracting the compacted fill required from the available bank cut.

Addition plans regarding the cut and fill operations and construction allowances re provided in Appendix A.

2 Review of Previous Work

2.1 Ground Investigation Interpretive Report

This is based on the following reports:

- Victoria North Infrastructure Works, Ground Investigation Interpretive Report, produced by ARUP, ref: VNIF-ARP-XX-YYY-RP-CG-0012, P02, date: 3rd November 2022.

Relevant plans from the above are provided within Appendix B.

2.1.1 Site History

Red Bank Plateau:

- The northern of two former reservoirs.
- Part of a southern former reservoir.
- NW section of a former meander bend of the River Irk.
- NW most section of a former mill race.
- All above features are buried beneath the fill used to construct the plateau, placed in the late 1800s.
- Until 1989 the area was occupied by extensive railway sidings and infrastructure (carriage sheds, turntables).

Red Bank Terrace:

- The most southerly of two former reservoirs partly in this area.
- Former millrace.
- Various buildings and industries including residential, chemical works, dye works, fireproof plate works.

St Catherine's Wood:

- Meander bend of the River Irk.
- Former Mill Race.
- Until 1970s a corn mill (later starch and size mill), dye works, church, terraced housing and school.
- Any remains of the above features will lie at the base of the made ground used to construct Red Bank Plateau. During rail operations a small gasworks was built on the top of the plateau.

2.1.2 Geology / Hydrogeology

Superficial

- None recorded in the southeast.
- Glacial Till recorded in the northwest. Secondary (undifferentiated) Aquifer.

Bedrock

- Chester Pebble Beds in the west. Principal Aquifer.
- Manchester Marls Formation in the centre. Secondary B Aquifer.
- Collyhurst Sandstone Formation in the northeast. Principal Aquifer.
- Fault (trending NNW-SSE) cuts through the centre of the site within the Manchester Marl Formation.

2.1.3 *Investigation Work Undertaken*

The following phases of investigation work have been undertaken:

- SI (Phase 1) undertaken Jan 2019.
- SI (Phase 2) undertaken Mar-Apr 2021.
- SI (Phase 3) undertaken Feb-Apr 2022.

Investigation work has included cable percussion boreholes, trial pits, trial trenches, windowless sample boreholes, rotary boreholes, observation pits (along retaining wall), cores into retaining walls, well installations, soil and water testing (contamination and geotechnical), gas and groundwater monitoring and borehole infiltration tests.

2.1.4 *Ground Conditions*

An extract of the 'summary of the stratigraphy' is provided below.

Site area	Stratum	Top of stratum mbgl (mOD)	Thickness range (m)
Red Bank Plateau	Made ground	Ground level (39.3 to 46.2)	0.8 to 15.7
	Glacial till	0.8 to 13.2 (42.4 to 27.5)	1.1 to 12.4 (in Creamline Dairies)
	Bedrock	4.0 to 16.8 (29.4 to 37.6)	Unproven
Red Bank Terrace	Made ground	Ground level (30.0 to 44.0)	1.8 (at toe of slope area) to 9.3
	Glacial till	3.2 to 9.3 (27.5 to 31.2)	1.4 to 3.9
	Bedrock	1.8 to 10.8 (41.4 to 29.9)	Unproven
St Catherine's Wood	Made ground	Ground level (30.2 to 43.4)	3.0 (at toe of slope area) to 16.5
	Alluvium	3.0 to 10.5 (29.2 to 28.8)	Unproven
	Bedrock	1.9 to 16.4 (28.3 to 25.5)	Unproven

<u>Red Bank Plateau General Ground Conditions</u>

In the northwest, the made ground is generally 1-4m thick comprising sandy gravel (of concrete, brick, tarmac, plastic, glass, clinker, sandstone, ceramic, rubber) with a localised cohesive zone.

The depth of the made ground increases to 16mbgl at the crest of the plateau, generally comprising granular strata (loose granular ash fill).

Glacial Till was limited to the north and northwest and comprised soft to firm, becoming stiff at depth slightly sandy gravelly clay with granular lenses.

Bedrock comprised weathered sandstone, weathered mudstone and sandstone with lenses of red marl.

Red Bank Terrace General Ground Conditions

Made ground was up to 10m thick and comprised sandy gravel and gravelly sand with gravels (of brick, concrete, sandstone and clinker) and low to moderate cobble content. Cohesive made ground was also observed, generally not laterally extensive. Strong hydrocarbon odours were observed at the base of the made ground in BH211A and BH314 (located in the southern reservoir).

Glacial deposits are thickest in the north and west, becoming absent towards the river in the south and east, comprising medium dense slightly clayey gravelly sand.

Bedrock comprised weathered sandstone, recovered as sand and gravel.

St Catherine's Wood General Ground Conditions

Predominantly granular made ground was recorded (including roadstone, slag, ash, brick, concrete, clinker, coal, mudstone, sandstone, limestone and cinder) with cohesive made ground in the northeast (including concrete, brick, mudstone, cinder, macadam, slag, sandstone and coal). Made ground was recorded to a maximum depth of 16.5m (BH204) within the infilled former meander bend; however, it was suggested that some of the deeper material may be alluvium with brick penetrated through from above.

Limited alluvium deposits were encountered comprising soft very sandy clay and loose slightly clayey sand. A strong hydrocarbon odour was noted in BH320.

Bedrock comprised weathered sandstone, weathered mudstone and sandstone (recovered as sand).

Former Gasworks Area Observations

- Hydrocarbon odours and an oily sheen were noted in BH203, TP204-TP206A.
- Deposits of metallic blue sand observed in TP204-TP206A.
- Obstruction identified in TP106.
- Masonry footing and concrete slabs identified in trial trenches.
- Metal vessel partly filled with oil in TT302.

Infilled Meander Bend

Targeted boreholes found no clear evidence of the meander; however, alluvium was encountered. Possible alluvium was observed in BH320 noted to have a strong hydrocarbon odour.

Infilled Former Reservoirs

BH211A and BH314 in the southern reservoir observed what is interpreted as an accumulation of sediment in the base of the reservoir with strong hydrocarbon odours noted. BH210 in the northern reservoir found no evidence for accumulation of sediments.

Visual / Olfactory Evidence of Contamination

Location ID*	Site area	Evidence of contamination	Sample taken for laboratory analysis (Y/N)
Site wide			
TP101	Red Bank Plateau	Slight hydrocarbon odour at 0.8 – 0.9mbgl	N
TP120	Red Bank Terrace	Strong hydrocarbon odour at 0.7 – 1.8mbgl	Y
BH203	St Catherine's Wood	Moderate hydrocarbon odour at 5.5 – 7.5mbgl	Y
BH207	Red Bank Plateau	Moderate hydrocarbon odour at 13 – 15.7mbgl	Y
TP216	Red Bank Plateau	Mild hydrocarbon odour at 1.1 – 1.2mbgl	N
BH306	Red Bank Terrace	Strong hydrocarbon odour at 1.8 – 3.9mbgl	Y
BH310	St Catherine's Wood	Weak hydrocarbon odour at 3.9 – 5.55mbgl	Y
BH321	St Catherine's Wood	Strong hydrocarbon odour at 4.4 – 5.6mbgl. Weak putrid odour at 4.85 – 5.6mbgl	Y
BH322	St Catherine's Wood	Weak hydrocarbon odour at 0.9 – 3.25mbgl	Y
BH327	Red Bank Plateau	Weak hydrocarbon odour at 7.4 – 8.0mbgl	Y
Former gasworks area			
BH103	Red Bank Plateau	Hydrocarbon odour at 0.1 – 1.3mbgl	Y
BH203	St Catherine's Wood	Moderate hydrocarbon odour at 5.5 – 7.5mbgl	Y
TP204	St Catherine's Wood	Metallic dark blue sand with strong hydrocarbon odour at 2.4 - 4.5mbgl, sheen on groundwater	Y
TP205	St Catherine's Wood	Metallic dark blue sand and gravel with strong hydrocarbon odour at 1.9 – 4.2mbgl, sheen on groundwater	Y
TP206A	St Catherine's Wood	Metallic dark blue sand with strong hydrocarbon odour at 1.7 – 4.5mbgl, sheen on groundwater	Tested for asbestos presence only
TP213	Red Bank Plateau	Strong hydrocarbon odour at 1.2 – 4.5mbgl	Y
TT302	St Catherine's Wood	Oils and hydrocarbons at 0.7 – 1.1mbgl	N
Former meander bend			
BH320	St Catherine's Wood	Weak hydrocarbon odour at 0.3 – 3.0mbgl. Strong hydrocarbon odour at 3 – 6.7mbgl	Y
Former reservoirs			
BH211A	Red Bank Plateau	Strong hydrocarbon odour at 10.1 – 10.5mbgl	Y
BH314	Red Bank Terrace	Strong hydrocarbon odour at 8.2 – 9.3mbgl	N
Former carriage shed			
TP202B	Red Bank Plateau	Oily groundwater within foundations at 0.1 – 0.6mbgl	Y
TP202C	Red Bank Plateau	Oily groundwater within foundations at 0.5 – 1.2mbgl	Y

Evidence of Volatiles

Location ID*	Date	Depth (m bgl)	PID reading (ppm)
Generally across the site			
BH310	04/04/2022	5.2	137.9
BH310	04/04/2022	4.2	132.4
BH322	10/04/2022	3.0	27.9
Former gasworks area			
TT301	21/02/2022	2.45	35.7
TT302	17/02/2022	0.3	938.6
TT302	17/02/2022	0.8	246.0
BH301C	10/04/2022	3.8	10.6
Former meander bend			
No elevated PID readings			
Former mill race			
BH303	15/02/2022	2.0	11.7
BH306	25/03/2022	0.5	17.2
BH306	25/03/2022	1.0	16.9
Former reservoirs			
No elevated PID readings			

Evidence of Obstructions

Location ID*	Site area	Evidence of below ground obstructions
Generally across the site		
BH308	Red Bank Terrace	Terminated due to void (brick lined chamber) from 1.6 –7.4mbgl
WS103	St Catherine's Wood	Terminated due to concrete obstruction at 3.9mbgl
Former gasworks area		
TP206	St Catherine's Wood	Terminated due to concrete foundations at 0.9mbgl
TT301	St Catherine's Wood	Exposed brick wall at 1.4 – 2.7mbgl
TT302	St Catherine's Wood	Steel vessel and concrete slab at 0.7 – 1.1mbgl
TT303	St Catherine's Wood	Steel pipe at 0.3mbgl
TT303A	St Catherine's Wood	Terminated due to concrete slab at 1.1mbgl
Former carriage shed		
TP102	Red Bank Plateau	Terminated due to cobble obstruction at 4.1mbgl
TP202	Red Bank Plateau	Terminated due to brick foundations at 1.4mbgl
TP202A	Red Bank Plateau	Terminated due to brick foundations at 1.2mbgl
TP202B	Red Bank Plateau	Terminated due to brick foundations at 0.6mbgl
TP202C	Red Bank Plateau	Terminated due to brick foundations at 1.2mbgl

Voids

A void was recovered in BH308, determined to be a small diameter brick lined shaft, approximately 7.4m deep penetrating the Chester Pebble Bed Formation.

Distribution of Made Ground

Based on the soil descriptions, the made ground was categorised as:

- Red Bank Plateau – 75% predominantly granular.
- Red Bank Terrace – 84% predominantly granular.
- St Catherine's Wood – 69% predominantly granular.

It was noted that the predominantly gravel still contains fine which may impact the behaviour and is for general purposes only.

Distribution of Natural Material

Based on the soil descriptions, the natual ground was categorised as:

- Red Bank Plateau – approx. half the glacial till deposits were predominantly granular. No alluvium encountered.
- Red Bank Terrace – approx. 70% glacial till deposits were predominantly granular. Glacial till is limited.
- St Catherine's Wood – Band of alluvium encountered, 78% were predominantly granular. Glacial till not encountered.

Groundwater

Groundwater strikes during investigation work varied between 0.4mbgl and 13.0mbgl and between 24.8mAOD and 42.4mAOD.

Monitoring of wells recorded groundwater at 0.27-12.78mbgl and 26.63-47.70mAOD (note: some boreholes were noted to be dry).

2.1.5 Soil Contamination Assessment

Data from all investigations have been included in the assessment.

Red Bank Plateau

Soil results were compared to GACs derived by Arup for a residential end use without plant uptake.

A total of 154 soil samples were screened, exceedances include:

- Arsenic – 17 of 132 samples above GAC (max. 89mg/kg).
- Beryllium – 25 of 129 samples above GAC (max. 3.9mg/kg).
- Lead – 19 of 132 samples above GAC (max. 1400mg/kg).
- Cyanide – 2 of 132 samples above GAC (max. 68mg/kg).
- Aromatics C21-35 – 1 of 90 samples above GAC (max. 3710mg/kg).
- Dibenzo-a-h-anthracene – 7 of 97 samples above GAC (max. 5.51mg/kg).
- Benzo(a)anthracene – 1 of 97 samples above GAC (max. 39.6mg/kg).
- Benzo(a)pyrene – 7 of 97 samples above GAC (max. 39.6mg/kg).
- Benzo(b)fluoranthene – 5 of 97 samples above GAC (max. 35.8mg/kg).
- Chrysene – 1 of 97 samples above GAC (max. 60mg/kg).

Red Bank Terrace and St Catherine's Wood

Soil results were compared to GACs derived by Arup for public open space end use (parks).

A total of 81 soil samples were screened, exceedances include:

- Arsenic – 1 of 57 samples above GAC (max. 180mg/kg).
- Lead – 4 of 57 samples above GAC (max. 2,250mg/kg).
- Aromatics C16-21 – 1 of 47 samples above GAC (max. 10,900mg/kg).
- Aromatics C21-35 – 1 of 47 samples above GAC (max. 27,800mg/kg).
- Dibenzo-a-h-anthracene – 4 of 49 samples above GAC (max. 19.2mg/kg).
- Benzo(a)anthracene – 1 of 49 samples above GAC (max. 205mg/kg).
- Benzo(a)pyrene – 4 of 49 samples above GAC (max. 123mg/kg).
- Benzo(b)fluoranthene – 3 of 49 samples above GAC (max. 111mg/kg).
- Chrysene – 1 of 49 samples above GAC (max. 409mg/kg).
- PCB BZ 114 – 1 of 10 samples above GAC (max. 0.023mg/kg).
- PCB BZ 157 – 2 of 10 samples above GAC (max. 0.039mg/kg).
- PCB BZ 77 – 1 of 10 samples above GAC (max. 0.031mg/kg).

Asbestos

Asbestos has been identified in all areas, as detailed below:

No. of samples	% range	Exceedances				
		No.	Location ID	Depth (mbgl)	Type and %	Area
113	<0.001 to 0.012	15	BH110	0.3m	Amosite fibres – <0.001	RB Terrace
			BH112	0.3m	Amosite fibres – <0.001	RB Terrace
			TP105	0.3m	Chrysotile – microscopic board fragments – 0.006	St Catherine's Wood
			TP120	1.0m	Chrysotile – microscopic ACM fragments – 0.002	RB Terrace
			WS103	1.0m	Amosite fibres – <0.001	St Catherine's Wood
			BH212A	0.6m	Chrysotile fibres – 0.005	RB Terrace
			TP206	0.3m	Chrysotile fibres – 0.007	St Catherine's Wood (RB05b school)
			TP210	1.0m	Chrysotile fibres – 0.011	RB Plateau
			WS207	1.0m	Chrysotile fibres – 0.012	RB Plateau
			BH301	1.0m	Loose fibres – 0.006	St Catherine's Wood
			BH315	0.5m	Loose fibres – <0.001	St Catherine's Wood
			BH323	0.5m	Loose insulation – 0.004	St Catherine's Wood
			TT302	0.3m	Cement – 1.539	St Catherine's Wood (RB05b school)
			OP01	0.1m	Loose insulation – <0.001	RB Plateau
			SoilSamp07	0.0m	Loose fibres – 0.011	RB Plateau

Stockpile Samples

Samples were taken from stockpile and tested. When compared to residential GAC, 2no. samples contained elevated lead and 1no. sample contained elevated arsenic. When compared to POS GAC, no elevated contaminants were identified. Asbestos (loose fibres) were noted in 1no. sample.

2.1.6 Controlled Waters Assessment

A total of 54 groundwater samples and 5 surface water samples (River Irk) were undertaken and assessed against relevant screening values.

Bedrock

Groundwater within the sandstone bedrock has a general flow direction towards the River Irk and levels suggest the groundwater is discharging into the river.

Exceedances of manganese, zinc, cadmium, lead, nickel and ammoniacal nitrogen were identified with localised exceedances of chromium, copper, cyanides, TPH and PAHs.

Made Ground

Exceedances of antimony, cadmium, chromium, manganese, zinc, lead, nickel, selenium, cyanide, thiocyanate, ammoniacal nitrogen, TPH and PAHs.

Glacial Till

Exceedances of antimony, arsenic, cadmium, chromium, copper, iron, manganese, zinc, lead, nickel, selenium, vanadium, cyanide, thiocyanate, chloride, ammoniacal nitrogen and PAHs.

Alluvium

Exceedances of arsenic, beryllium, cadmium, chromium, copper, iron, manganese, zinc, lead, nickel, selenium, vanadium, cyanide, thiocyanate, chloride, ammoniacal nitrogen, TPH and PAHs.

Surface Water

Exceedances of iron, lead and zinc. Concentrations did not significantly worsen as the river passes through the site.

Soil Leachate

Exceedances of cadmium, chromium, copper, manganese, zinc, sulphate.

The detailed controlled water risk assessment by Arup is summarised in Section 2.2.

2.1.7 Potable Water Pipes

Concentrations of contaminants along the proposed pipe route did not exceed PE threshold values (based on 3 samples). However, there were exceedances across the wider area. It is suggested that it would be appropriate that barrier pipe is used to safeguard potable supplies.

2.1.8 Waste Assessment

HazWasteOnline

Of 194 samples tested, 19 samples were classified as hazardous (associated with TPH, lead, copper and benzene) and 175 were classified as non-hazardous. All samples analysed from the glacial till, alluvium and bedrock (total of 21) were classified as non-hazardous.

In addition, if waste contains more than 0.1% asbestos fibres, it will be classified as hazardous waste. If visible identifiable asbestos is present, then these need to be assessed separately.

Asbestos containing material (ACM) was identified in 15 of 113 samples (approx. 13% of the site). Only 1 sample contained asbestos above the threshold value of 0.1%.

WAC Testing

Of 63 samples tested for WAC, 3% of the samples would be accepted by landfill operators to be placed in a hazardous waste cell, 29% of the samples as inert waste cell and 68% of the samples as non-hazardous waste cell.

TT302 has a TOC of over 6% (36.2%) and may need to be separated and treated before going to landfill.

In summary, hazardous material has been identified in the area of the former gasworks. Across the remainder of the site, samples shown as hazardous appear to represent a series of discrete areas of soil contamination.

2.1.9 Gas Risk Assessment

2021 Monitoring (6 visits undertaken in 20no. monitoring wells), recorded the following:

- Highest methane 0.4%v/v.
- Highest CO_2 11%v/v.
- Highest Flow 1.5l/hr.

In 19 of 20 locations, Characteristic Situation (CS)1 was calculated, in 1 location CS2 was calculated. As all monitoring was undertaken during atmospheric pressure greater than 1000mb, it was considered that worst-case conditions may not be reflected and further gas monitoring was recommended.

2022 Monitoring (26no. monitoring wells), recorded the following:

- Highest methane 58.9%v/v (BH314).
- Highest methane excluding BH314 1.2%v/v (BH202).
- Highest CO_2 41.9%v/v.
- Highest CO_2 excluding BH314 13.6%v/v (BH323).
- Flow -8.9l/hr to 1.5l/hr.

11 locations were classified as CS1, 14 locations were classified as CS2 and 1 location was classified as CS3 (BH314). There was no evident distribution for the CS1 and CS2 conditions.

BH314 (CS3) located in former southern reservoir. The borehole log notes a strong hydrocarbon odour. A gas sample was collected and analysis, the results shown 37.85% methane and 24.67% carbon dioxide. Considered to be relatively localised and likely to be a pocket of ground gas that has been generated slowly over prolonged timescales.

CS2 is assumed for the development site.

Although BH314 suggests local CS3 conditions, this location does not lie within a proposed development plot therefore is considered necessary to adopt CS3. This may need to be revised should development plans change.

Further gas monitoring was recommended as detailed below:

- Creamline Dairies (BH311B and BH312A) to ensure 6 gas monitoring visits are undertaken.
- Infilled Former Reservoirs (BH210, BH211A and BH314) to further assess the gas risk.
- BH320 to further assess the risks associated with hydrogen sulphide and carbon monoxide.

It was also considered that additional gas monitoring across the site may allow the gas risk assessment to be refined.

2.1.10 Engineering Considerations

Variable ground has been identified across the site including made ground and soft ground (made ground and natural).

Variable groundwater levels have been recorded including perched groundwater which may require dewatering or other forms of groundwater management.

Some buried features have been identified and other features may potentially be present.

Cut and fill will form part of the proposed earthworks to create level development plots and to construct roads. Regrading will also be required to mitigate slope stability risks.

It is anticipated that the majority of material excavated as part of the cut and fill will be made ground which is likely to be highly variable. Based on the site investigation work, 75% of the made ground could be classified as predominantly granular. There are however zones of cohesive material.

Different types of material have been classified in accordance with the Specification for Highway Works (SHW), subject to additional testing, assessment and sorting.

Consideration needs to be given to the earthworks scheme and phasing the development. Carrying out the scheme in a phased approach may reduce the amount of material to be re-used.

Consideration should be given to the settlement of material associated with old fill material (with additional loading) and newly placed fill.

2.1.11 Revised Conceptual Site Model

The revised conceptual site model has been split into the construction phase of the HIF IW (earthworks) and post completion of the HIF IW (how the site will be left after construction phase, but before the build phase):

Revised Conceptual Site Model for the **HIF IW Construction Phase** (earthworks):

Source		Pathway		Receptor	Linkage?
Made Ground (containing solid contaminants, asbestos fibres and hydrocarbons)	→	Dermal contact	→	Construction worker Assuming appropriate health and safety procedures are adopted (including the use of appropriate PPE)	No
		Ingestion of soil/ soil dust	→		No
		Inhalation of soil vapour	→		No
		Inhalation of soil and soil dust	→	Construction worker Assuming appropriate health and safety procedures are adopted (including the use of appropriate PPE)	No
			→	Site users and neighbours Assuming appropriate health and safety measures are adopted i.e. dust suppression	No
Temporary stockpiles of excavated arisings Accidental leaks and spills during construction	→	Leaching and runoff	→	Surface water drainage Assuming appropriate site management procedures are adopted	No
			→	River Irk Assuming appropriate health and safety procedures are adopted	No
		Leaching and infiltration	→	Secondary A aquifers in superficial deposits Principal aquifers in bedrock River Irk Assuming appropriate site management procedures are adopted	No
Impacted shallow groundwater, including groundwater entering the site from landfill to the north	→	Dermal contact	→	Construction worker Assuming appropriate health and safety procedures are adopted	No
		Ingestion	→	Construction worker Assuming appropriate health and safety procedures are adopted	No
		Lateral migration	→	River Irk	Yes
Ground gases/landfill gases	→	Ingress and accumulation of toxic, asphyxiating or explosive concentrations within excavations	→	Construction worker in deep trenches and chambers	No

Revised Conceptual Site Model **post completion of HIF IW** (how the site will be left after construction phase, but before the build phase):

Source		Pathway		Receptor	Linkage?
Made Ground (containing solid contaminants, asbestos fibres and hydrocarbons)	→	Dermal contact	→	Future site user in soft landscaping areas only	Yes
		Ingestion of soil/ soil dust	→	Interim users of plots where no hardstanding exists prior to follow-on development	Yes
		Inhalation of soil vapour	→		No
		Inhalation of soil and soil dust	→	Pathways broken where hard surfacing and buildings present but exposure possible in landscaped areas/gardens	Yes
		Leaching and infiltration	→	Secondary A aquifers in superficial deposits Principal aquifers in bedrock River Irk	Yes
		Direct contact	→	Buried structural concrete	No – assuming the recommendations of Section 0 are observed.
			→	Potable water supply pipes	No – assuming the recommendations of Section 6.3 and subsequent assessments are observed.
			→	New planting in public open space areas	Yes
Impacted shallow groundwater (including groundwater if entering site from landfill to north)	→	Dermal contact	→	Future site resident	No
		Ingestion	→	Future site resident	No
		Lateral migration	→	Secondary A aquifers in superficial deposits Principal aquifers in bedrock River Irk	Yes
Ground gases/landfill gases	→	Ingress and accumulation to toxic, asphyxiating or explosive concentrations within buildings	→	Future site user Building structures	Yes - plot-specific assessment recommended

2.2 Review of Controlled Waters Detailed Quantitative Risk Assessment Report

This is based on review of the following reports:

- Victoria North HIF Infrastructure Works, Controlled Waters Detailed Quantitative Risk Assessment Report, produced by ARUP, ref: VNIF-ARP-ZZ-YYY-RP-CG-0011, P03, date: 7th November 2022.

The report was undertaken to supplement the GIR (summarised in Section 2-1).

2.2.1 Hydrogeological Conceptual Model

Investigation work has confirmed that contamination in the soil and groundwater is widespread. Three areas of particular focus were identified: the gasworks, carriage shed and infilled reservoirs.

Groundwater receptors are identified as:

- Secondary A aquifer – Alluvium
- Secondary (Undifferentiated) aquifer – Glacial Till
- Secondary B aquifer – Manchester Marl
- Principal aquifers – Collyhurst Sandstone and Chester Pebble Beds

The shallow aquifer (made ground and alluvium) and glacial till are not considered as a receptor for the purposes of the DQRA. The glacial till is considered to act as a aquitard, separating the shallow aquifer from the deep groundwater.

The Collyhurst Sandstone and Chester Pebble Beds are classified as Principal Aquifers and are considered to be receptors for the purposes of the DQRA.

The Manchester Marl Formation is considered to be an aquiclude and not a receptor for the purposes of the DQRA.

The River Irk is considered to be the primary surface water receptors.

Pathways: The DQRA focuses on the evaluation of the soil leaching pathway and the lateral migration of existing dissolved phase contamination to the River Irk.

Pollutant Linkages:

- Gasworks – this area overlies the former river channel, Alluvium and Collyhurst Sandstone and there is considered to be a pathway to the Principal Aquifer and River Irk. Contamination consistent with coal gas waste has been identified in the groundwater. This linkage will be considered further in the DQRA.
- Carriage Shed – although hydrocarbon contamination was identified, this area overlies the Manchester Marl which is not considered to be a significant receptor. Glacial Till is also present which will limit migration. As there is not considered to be a viable pathway to the River Irk or Principal pathway, this source is not considered further in the DQRA. However, remedial recommendations to remove gross contamination in this area will be included.
- Infilled reservoirs – the northern reservoir is not considered to be contaminated. The southern reservoir (hydrocarbon detected in basal material) is not considered to be causing significant groundwater contamination. It is assumed that cohesive material may be helping to isolate the basal material from the surrounding groundwater. This linkage will be considered further in the DQRA.

- Made ground to be re-used – soils that are to be excavated from one area of the site and used as fill within St Catherine's Wood or Red Bank Terrace are to be considered further in the DQRA.

An extract from the report showing the summary of pollutant linkage to be considered in the DQRA is provided below:

PCL	Description	Highest risks (without mitigation)	Further assessment / risk management
1	Risk of pollution to the River Irk, during and after development, from existing made ground	Moderate to high risk	Evaluation of groundwater flow characteristics and relative groundwater and surface water levels confirms that groundwater in both the shallow and deep aquifers are likely to discharge into the River Irk. The quality of the River Irk does not appear to be affected by the current groundwater conditions, but in cases where soils are excavated from one part of the site (e.g. Red Bank Plateau) to be re-used in either St. Catherine's Wood or Red Bank Terrace (which are the areas closest to the River Irk), the re-used material has been subject to DQRA to generate re-use criteria that are protective of the river.
2	Risk of pollution to shallow (Secondary A) aquifer - Alluvium	Negligible risk	As discussed in **Section 4.2.1** the alluvium is not considered a receptor in the DQRA due to its very limited extent and predominantly cohesive characteristics.
3	Risk of pollution to Secondary (undifferentiated) aquifer – Glacial Till	Negligible risk	As discussed in **Section 4.2.1** the Glacial Till is not considered a receptor for the purposes of DQRA due to its predominantly low permeability, aquitard characteristics. No continuous groundwater body is present within the Till and it is not considered to provide significant base flow to the River Irk.
4	Risk of pollution to Secondary B aquifer – Manchester Marl	Negligible risk	As discussed in **Section 4.2.1** the Manchester Marl is not considered a receptor for the purposes of DQRA. It is not considered to provide significant base flow to the River Irk, is of no resource potential and in the vicinity of the site forms an aquiclude.
5	Risk of pollution to deep aquifer - Chester Pebble Beds, Collyhurst Sandstone	Moderate to high risk	DQRA has been undertaken to assess risks presented by existing soil contamination within the former gasworks area to the Principal Aquifer.

2.2.2 Controlled Waters Risk Assessment

Shallow groundwater – contaminants of concern are cadmium, chromium, copper, iron, manganese, nickel, zinc, cyanide, ammoniacal nitrogen, TPH and PAH.

Deep groundwater – contaminants of concern are cadmium, chromium, copper, lead, manganese, zinc, cyanide, ammoniacal nitrogen, TPH, PAH and bis(2-ethylbexyl)phthalate.

Given the similarity between the shallow and deep contaminants of concern, it is assumed that the water bodies are in continuity with each other where glacial till is absent close to the River Irk.

The concentration of contaminants within the River Irk do not vary greatly from upstream to downstream which suggests the quality of the River Irk does not deteriorate as it passes the site.

2.2.3 Remedial Targets

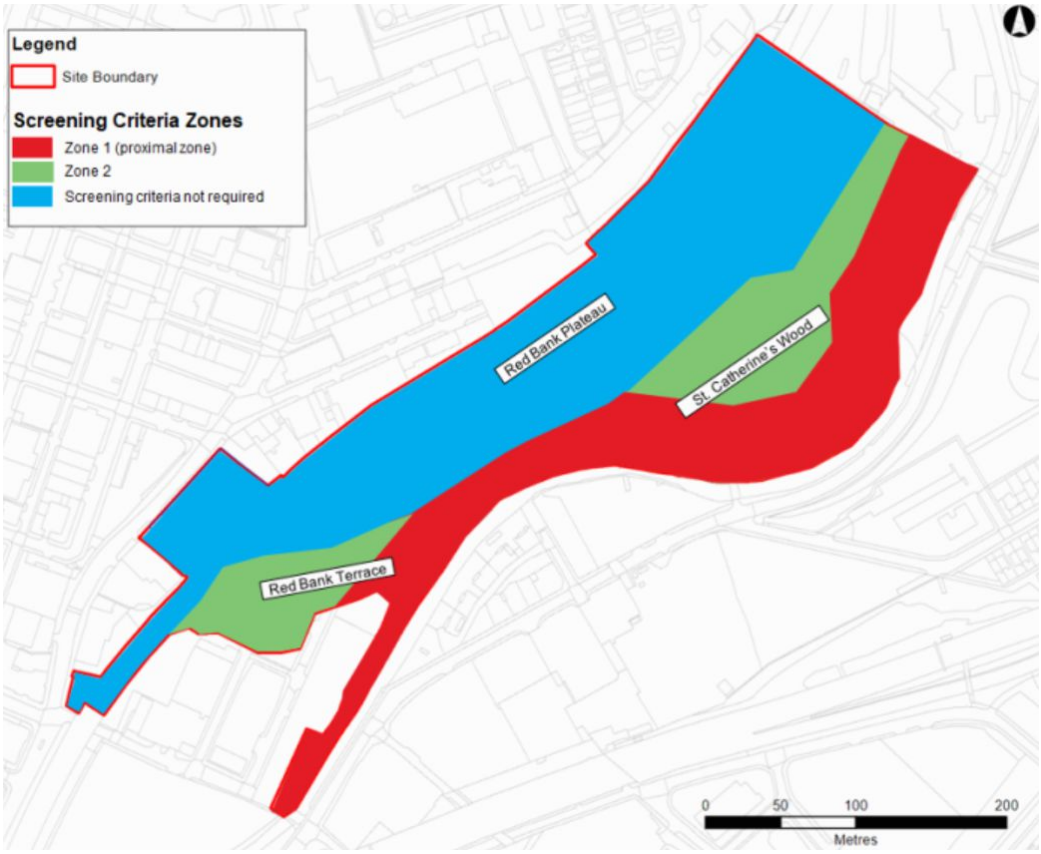
Remedial targets have been calculated for the gasworks area for selected TPH fractions, PAH and ammoniacal nitrogen as N.

Remedial targets have also been calculated for re-use activities, where soils are placed within St. Catherine's Wood or Red Bank Terrace. These include metals, TPH and PAH fractions.

Two set of criteria have been generated (Zones 1 and 2) and are dependent on the distance from the River Irk.

The remedial targets have not been derived for soils excavated from Red Bank Plateau and to be re-used within Red Bank Plateau. In addition, re-use criteria will not be derived for material excavated from St Catherine's Wood and Red Bank Terrace and to be locally distributed during regrading works. However, if material from any source within the site is to be places within Zone 1, in will be screened against the relevant set of criteria.

A plan showing the Zones is provided in Appendix B and below:



Any visible hydrocarbon contamination is anticipated to be removed as part of the remediation strategy.

It notes the values do not account for NAPLs and measures to removal NAPL will be addressed in the remediation strategy.

Gasworks Remedial Targets

The gasworks remedial targets are provided below.

Contaminant	RTM-calculated soil remediation target (mg/kg)	95th %ile of soil concentration in gasworks (mg/kg)	95th %ile of soil concentration on plateau (mg/kg)	RTM-calculated leachate target (mg/l)
Ammoniacal nitrogen	4.5	Not tested in soil	Not tested in soil	8.7
Benzo(a)Pyrene	3.6	32.8	2.5	0.0005
Fluoranthene	0.3	49.2	7	0.0003
Anthracene	0.9	16	1.8	0.003
TPH – Aliphatic C8-C10	4860	27.4	9.9	2.6
TPH – Aliphatic C10-C12	37900	52.3	9.9	2.6
TPH – Aliphatic C12-C16	758000	211	17.9	2.6
TPH – Aromatic C8-C10	1340	88	7.9	14.4
TPH – Aromatic C10-C12	772	85.4	31.2	5.3
TPH – Aromatic C12-C16	3860	546	60.4	13.3
TPH – Aromatic C16-C21	1120	1242	85	1.2
TPH – Aromatic C21-C35	8100	2989	200	1.1
TPH – C8-C35	2500	-	-	-

The report advises that the remedial targets for the PAH fractions are unrealistic and the 95%ile of soil concentrations on the plateau should be used as an alternative.

Re-Use Remedial Targets

The remedial targets for the re-use of materials within St Catherine's Wood and Red Bank Terrace are provided below.

Zone 1:

Contaminant	RTM-calculated soil remediation target (mg/kg)	95th %ile of soil concentration within site (mg/kg)	RTM-calculated leachate target (mg/l)
Chromium	93.5	38	0.02
Copper	48	300	0.1
Lead	12.9	868	0.01
Nickel	26.5	48.9	0.05
Zinc	191	646	0.4
Benzo(a)Pyrene	0.4	5	0.00006
Fluoranthene	0.04	12	0.00003
Anthracene	0.15	3.2	0.0005
TPH – Aliphatic C8-C10	1910	11	1.03
TPH – Aliphatic C10-C12	14900	17	1.03
TPH – Aliphatic C12-C16	297000	39	1.03
TPH – Aromatic C8-C10	153	10	1.64
TPH – Aromatic C10-C12	76	29	0.53
TPH – Aromatic C12-C16	208	92	0.72
TPH – Aromatic C16-C21	323	68	0.35
TPH – Aromatic C21-C35	2450	233	0.34
TPH C8-C35	2500		

Zone 2:

Contaminant	RTM-calculated soil remediation target (mg/kg)	95th %ile of soil concentration within site (mg/kg)	RTM-calculated leachate target (mg/l)
Chromium	94	38	0.02
Copper	51	300	0.1
Lead	14	868	0.014
Nickel	28	48.9	0.06
Zinc	191	646	0.4
Benzo(a)Pyrene	1.4	5	0.0002
Fluoranthene	0.11	12	0.0001
Anthracene	0.34	3.2	0.001
TPH – Aliphatic C8-C10	2010	11	1.1
TPH – Aliphatic C10-C12	14900	17	1
TPH – Aliphatic C12-C16	313000	39	1.1
TPH – Aromatic C8-C10	470	10	5.1
TPH – Aromatic C10-C12	265	29	1.8
TPH – Aromatic C12-C16	1260	92	4.3
TPH – Aromatic C16-C21	449	68	0.5
TPH – Aromatic C21-C35	3280	233	0.4
TOH – C8-C35	2500		

The report advises that the remedial targets for the PAH fractions and some metals are unrealistic and the 95%ile of soil concentrations within site should be used as an alternative where these are higher. In addition, the re-use for anthracene and

fluoranthene will match the 95%ile soil concentrations for made ground within the Red Bank Plateau.

3 Pre-Development Remediation Strategy

3.1 Introduction

The recommended remedial works and validation works are outlined in the following Sections. The Pre-Development Remediation Strategy is based on the investigation work undertaken and the Outline Remediation Strategy produced by Arup.

In order to achieve the aims of the Pre-Development Remediation Strategy, the following objectives will be set:

- Maximise sustainability through the use re-use of existing site-won materials during ground works and development.
- Ensure that the design meets with current environmental and waste legislation.
- Use of appropriate environmental controls during the remediation and development programme.
- Segregate and stockpile differing materials for validation testing for re-use or offsite disposal.
- Ensure the site is suitable for its proposed end use once all pre-development remediation and validation has been completed (on completion of earthworks and infrastructure work, prior to development).

It should be noted that the Pre-Development Remediation Strategy does not include the remediation and validation requirements of the future development work (building phase). This will be addressed separately as part of new planning applications.

3.2 Summary of Remediation Requirements

The following work has been identified and is detailed in the following sections:

- Site Clearance Work.
- Removal of Hardstanding / Inground Structure and Soil Turning.
- Gasworks Remediation.
- Former Carriage Works Remediation.
- Re-Use of Site Material.
- Stockpile Management.
- Disposal.
- River Channel.
- Watching Brief / Unexpected Contamination.
- Health and Safety Measures.
- Asbestos in Soils.
- Post Earthworks Remediation.

3.3 Testing Schedules

Testing schedules for the validation testing is based on Manchester City Council (MCC) 'Technical Guidelines to Developers' (2021) [1] and EA Technical Guidance on Waste Classification[2].

The MCC 'Technical Guidelines to Developers' (2021) is summarised below:

[1] YALPAG (2021). "Verification Requirements for Cover Systems: Technical Guidance for Developers, Landowners and Consultants." Yorkshire and Lincolnshire Pollution Avisory Group. V. 4.1-June 2021.
[2] Environment Agency. Waste Classification - Guidance of the Classification and Assessment of Waste (1st Edition v1.2.GB). Technical Guidance WM3.

Material Type	Source	Suite of Analysis	Sampling Rate (min. 3 per source) *		
			Garden	Landscape	Other **
Topsoil Subsoil Fill material	Greenfield	Suite A	200m^3	200m^3	200m^3
	Remediated	Suite A / B dependent upon original SI	100m^3	150m^3	200m^3
	Brownfield / Unknown	Suite B	50m^3	150m^3	200m^3
Quarried Fill	First Generation i.e. quarried sand (subsoil) or stone (break layer)	No testing is required. Certification of material provenance is required.			

Sampling requirements for imported soils.

Notes:

Suite A - Heavy metals, pH, water soluble sulphate, speciated PAH, soil organic matter and asbestos screen.

Suite B - Heavy metals, pH, water soluble sulphate, speciated PAH, phenol, total and free cyanide, soil organic matter, asbestos screen, banded petroleum hydrocarbons (TPH CWG), BTEX, MTBE.

** Other assumed to be stone / 6F2 / mass fill etc.

The EA Technical Guidance is summarised below:

Table 1: Number of Samples Required for Waste Characterisation (from Environment Agency guidance *Waste Sampling and Testing for Disposal to Landfill*).

Population (tonnes)	Number of Samples (homogeneous waste)	Number of Samples (new/heterogeneous waste)
< 100	2	5
< 500	3	8
< 1,000	5	14
10,000	11	22
+ per additional 10,000	+5 (pro rata)	+10 (pro rata)

3.4 Site Clearance Work

Vegetation clearance will be required prior to earthworks.

Any invasive species need to be appropriately managed. It is understood that a method statement for the treatment of Japanese Knotweed is being produced and this will need to be followed during the clearance work.

Any soils impacted with Japanese Knotweed will need to be appropriately disposed and will not be suitable for use within the soils selected for re-use onsite.

Asbestos screening should be undertaken on the demolished material from the Creamline Dairies site to ensure it is suitable for re-use on site. A visual inspection should be initially undertaken and sampling on a rate of at least 1 sample per 150m^3 material with a minimum of 3no. samples screened for asbestos (see Table 3-1).

Fly tipping within the site will need to be removed from site and accumulated material within the River Irk may also need to be cleared and removed from site. Testing of the waste material may be required to confirm the most appropriate disposal route (subject to the type of material and waste facility testing requirements). A watching brief for ACM pieces will be maintained during this process. ACM waste will be hand-picked by a suitably qualified and experienced person, sealed in bags (double bagged) and segregated for suitable off-site disposal.

3.5 Removal of Hardstanding / Inground Structures and Soil Turning

Areas of surface hardstanding across the site will be removed including the former rail infrastructure. Inground structures will be removed including the structures associated with the former gasworks and railway carriage shed.

Areas to remain at grade and areas of proposed filling within the Red Bank Plateau and Red Bank Terrace are to be turned to an average depth of 0.5m. Any relic structures and obstructions should be removed to a depth of 2.0m below existing ground level. Any obstructions greater than 2.0m depth will remain and be recorded. Material disturbed will need to be recompacted in accordance with the Earthworks Specifications.

Dewatering of excavations may be required subject to groundwater levels during excavations.

Most excavations will be limited to above the groundwater level. However, where deeper excavations are required, some localised excavation below the groundwater table may be required. Where relict structures are found to retain fluid contaminants, they should be drained first.

Arrangements should be made to prevent ponding in shallow excavations; the Contractor should ensure that ground levels are of sufficient gradient to enable the collection of surface water run-off in sumps or grips. Pumping from over-excavated sumps may be required to maintain satisfactory working conditions.

Contingency arrangements to remove groundwater (including contaminated groundwater if encountered) from excavations / relict structures should be allowed. Small volumes of pumped fluids / groundwater should be stored in appropriate, sealed tanks / containers and analysed for a range of determinants prior to disposal to suitable facility. Alternatively, a temporary discharge licence, including their requirements for treatment / testing, should be agreed with local utility providers prior to start on site.

A site clearance plan has been produced by Arup (ref: VNIF-ARP-00-YYY-DR-G-0013) has been produced showing where structures, services and obstructions are present.

A void was noted in BH308 (small diameter brick lined shaft, approximately 7.4m deep penetrating the Chester Pebble Bed Formation). It is understood that this area is not within the current scope of works and remediation associated with this feature is not included.

3.6 Gasworks Remediation

Excavation and removal of hydrocarbon impacted soils should be undertaken in the gasworks area.

Impacted soils should be excavated under the supervision of an appropriate geo-environmental engineer. The impacted soils will be determined based on visual / olfactory evidence on site and the use of a photo ionising detector (PID).

Excavation should extend to include removal of any in-ground relict structures (brick structure identified to at least 2.6mbgl).

All impacted soils should be stockpiled in segregated areas on impermeable membrane ready for offsite disposal. Testing of the excavated material should be

completed to undertake waste classification and to confirm the most appropriate disposal route. It is recommended that sampling is undertaken in line with EA Technical Guidance on Waste Classification[3] (subject to disposal facility requirements).

Validation samples of the remaining in-situ ground should be undertaken to confirm appropriate impacted soils have been removed. This should be undertaken at the base and sides of the excavation. The number of samples should be appropriate to the size of the excavation at *c.* 10m spacing.

The excavation should be reinstated with suitable engineered fill placed and compacted in accordance with the earthworks specification.

Dewatering of the excavation should be undertaken and abstracted water should be removed from site to an appropriate facility. It is assumed that groundwater from this area will be impacted with hydrocarbons.

Excavation, where possible should extend until all impacted soils and relict structures have been removed. However, existing trees may prevent full excavation and removal (subject to the extent of the impacted soils). If the trees are to remain (as part of the development plan), the excavation work should cease where tree roots are encountered and samples collected from the remaining soils. The extent of the remaining impacted soils should be confirmed and further assessment may be required if the remaining soils are above the defined remedial targets.

3.7 Former Carriage Works Remediation

In the former carriage works areas, the following remediation is required:

Excavation and removal of hydrocarbon impacted soils.

Impacted soils should be excavated under the supervision of an appropriate geo-environmental engineer. The impacted soils will be determined based on visual / olfactory evidence on site and the use of a photo ionising detector (PID).

Excavation should extend to include removal of any in-ground relict structures (brick structure identified to at least 1.4mbgl).

All impacted soils should be stockpiled in segregated areas on impermeable membrane ready for offsite disposal. It is recommended that sampling is undertaken in line with EA Technical Guidance on Waste Classification (subject to disposal facility requirements).

Validation samples of the remaining in-situ ground should be undertaken to confirm appropriate impacted soils have been removed. This should be undertaken at the base and sides of the excavation. The number of samples should be appropriate to the size of the excavation at *c.* 10m spacing.

The excavation should be reinstated with suitable engineered fill placed and compacted in accordance with the earthworks specification.

[3] Environment Agency. Waste Classification - Guidance of the Classification and Assessment of Waste (1st Edition v1.2.GB). Technical Guidance WM3.

Dewatering of the excavation should be undertaken and abstracted water should be removed from site to an appropriate facility. It is assumed that groundwater from this area will be impacted with hydrocarbons.

3.8 Re-Use of Site Won Material

The proposed earthworks involves cut and fill and slope regrading. The scheme has been developed to re-use and retain materials onsite to ensure a sustainable development.

Plans are provided in Appendix B showing the details of the cut and fill and the movement of soils.

To ensure material is compliant with appropriate waste regulations, any site won material re-used onsite should be in recourse to appropriate exemptions.

A Materials Management Plan (MMP) with recourse to the CL:AIRE Code of Practice may be required if volumes exceed exemption limits. This must be registered before material movement starts onsite.

If an MMP is required, this needs to be registered by a Qualified Person (QP) and there must be 'certainty of use' for any material re-used onsite or exported to site to ensure there is no 'sham recovery'.

Material excavated on site should be stockpiled, processed and categorised to determine if the soil is suitability for re-use on site in line with the Earthworks Specification. Additional testing may be required to determine the engineering properties.

Remedial targets have been calculated for re-use activities, where soils are placed within St. Catherine's Wood or Red Bank Terrace. Two set of criteria have been generated (Zones 1 and 2) and are dependent on the distance from the River Irk.

The remedial targets have not been derived for soils excavated from Red Bank Plateau and to be re-used within Red Bank Plateau. In addition, re-use criteria will not be derived for material excavated from St Catherine's Wood and Red Bank Terrace and to be locally distributed during regrading works. However, if material from any source within the site is to be places within Zone 1, in will be screened against the relevant set of criteria.

Soils should be compared against remedial targets provided by Arup. It is recommended that at least 1 sample per 150m^3 material is tested with a minimum of 3no. samples tested (see Table 3-1 for further details).

Once confirmed to be suitable for re-use (where testing is required), material can be placed and compacted in accordance with the earthworks specification.

Any soils considered not suitable for re-use will need to be removed from site to an appropriate facility.

Impacted soils removed from the gasworks, former carriage shed, Japanese Knotweed area and any other impacted soils identified during earthworks should not be re-used on site.

3.9 Stockpile Management

Stockpiled material should be suitably managed. The source of each stockpile should be recorded and appropriate validation testing for the proposed re-use or potential offsite disposal should be undertaken as required. Depending on the nature of the material the potential for dust generation will be mitigated by dampening down and covering as required.

Material should be segregated by type and source. For example, construction / demolition arisings, site won subsoil, etc.

A quarantine area for suspect contaminated soils should established on site. This should comprise an impermeable lined area with a small bund to prevent run off and to minimise the risk of contaminating other areas of the site. The material should also be covered to minimise the generation of vapours, fibres, dust and possible nuisance to adjacent receptors, and to prevent rainwater ingress which may mobilise soluble contaminants as required.

3.10 Disposal

Material required to be removed from site should be carried out under an appropriate duty of care and the results of chemical analysis and waste classification should be provided to the relevant waste facility.

Waste records such as disposal tickets and waste carrier licences should be provided in the Site Completion Report. Photographic evidence of removal and waste removal tickets should be retained and included in the validation report.

3.11 River Channel

The controlled water DQRA has identified risks to the river channel in areas where the existing river wall is to be removed. During works to re-naturalise the river banks through St Catherine's Wood, inspection should be undertaken to identify:

- Visual or olfactory evidence for the potential discharge of contaminants into the river through high permeability material associated with the former river meander bend, or
- Visual or olfactory evidence of contamination discharging from the face of the regrading river banks.

If either of these are encountered, the risk to controlled waters should be reassessed and measured to address these potential contamination linkages (for example the provision of low permeability material at appropriate locations along the river banks) should be implemented if required.

3.12 Watching Brief / Unexpected Contamination

It is recommended that a geo-environmental engineer is present on site during the earthworks to assess any unexpected contamination or ground conditions.

This could include visual / olfactory evidence of hydrocarbons, other unusual odours or colours within the soil, suspected asbestos material, voids etc.

Should any unexpected contamination or ground conditions be identified, work should cease until an assessment of the ground is undertaken to determine the risk and possible remedial requirements.

Material will be excavated and stockpiled in a segregated area on impermeable membrane. Testing will be carried out to confirm if the material should be removed offsite to a licensed treatment facility or an assessment made of its potential for treatment and / or retention on site.

Delineation works will be undertaken to confirm the lateral and vertical extent.

Validation samples of the remaining in-situ ground should be undertaken to confirm appropriate impacted soils have been removed. This should be undertaken at the base and sides of the excavation. The number of samples should be appropriate to the size of the excavation at *c.* 10m spacing.

The excavation should be reinstated with suitable engineered fill placed and compacted in accordance with the earthworks specification.

Dewatering of the excavation should be undertaken and abstracted water should be removed from site to an appropriate facility. It is assumed that groundwater from this area will be impacted with hydrocarbons.

Any abstraction wells identified during earthworks will need to be appropriately decommissioned in line with EA guidance[4].

3.13 Health and Safety Measures

A Construction Management Plan and Method Statement should be produced which details appropriate Health and Safety measures to be employed during the site works.

Risks to site workers and adjacent receptors from contamination present in the site soils can be easily mitigated by good environmental management of the site during site works. Standard health and safety precautions (as per HSE guidance) should be adopted by all workers involved with site enabling and construction works.

3.14 Asbestos In Soils

Due to the presence of asbestos containing material, it is recommended that additional precautions are taken during site clearance, earthworks and construction. The presence of asbestos in the made ground at the site presents a potential risk of generation of airborne fibres if this material is disturbed, such as for excavations to construct new foundations.

This risk can be managed by careful procedures and site monitoring to reduce the risk of airborne fibres, and it is recommended that an appropriate 'Asbestos Management Plan' is developed and adopted for all intrusive ground works which disturb the made ground in the area of concern. This should be carried out in line with CIRIA C733[5].

The locations where asbestos was identified are shown in Appendix B (plan produced by Arup, 'Identification of Asbestos in Soil Samples'. Drawing 15 P1). Across the majority of the site, the locations where asbestos was identified is very low density. However, there is a cluster in the northeast (gasworks area) where asbestos appears more abundant.

[4] Environment Agency. Science Report SC020093. Guidance on the Design and Installation of Groundwater Quality Monitoring Points.
[5] CIRIA (2014). "Asbestos in Soil and Made Ground: A Guide to Understanding and Managing Risks". C733.

JIWG assessments have been undertaken for work categories and output sheets are provided in Appendix C. The assessments were carried out for the following scenarios:

- NE Area (gasworks area) - excluding TT302:
  A higher density of asbestos was identified in this area and samples included within the assessment were generally loose fibres with a maximum of 0.011% asbestos within the soil sample.
- NE Area - TT302 only:
  This sample was treated separately as it was the only sample to comprise cement asbestos (significantly reduced risk of asbestos becoming airbourne); however, the percentage of asbestos within the material was higher at 1.539%.
- Remainder of the site (excluding gasworks area):
  Only sporadic asbestos was identified across the remainder of the site. Asbestos within the samples was recorded at <0.001 to 0.012%.

A JIWG assessments identified the following:

- NE Area (gasworks area) - excluding TT302: Medium Risk.
- NE Area - TT302 only: Low Risk.
- Remainder of the site (excluding gasworks area): Medium Risk.

The following outputs were produced (all areas):

Risk Assessment Outputs

Probable Licensing Status	Non-Licensed Work
RPE*	EN149 type FFP3 disposable
Dust Suppression**	Manual/localised dust suppression
Hygiene/Decontamination***	Localised and basic personal decontamination facilities

*Where RPE has to be worn continuously for long periods (e.g. more than 1-hour), then powered RPE may be necessary.
**Reduction in control measures possible if natural mitigation factors are present (e.g. raining, wet ground)
***Guide only; suitability of selected personal hygiene measures may be reviewed on a site/contamination-specific basis

The above outcomes should be used as an aid to determine the requirements of the Asbestos Management Plan.

This is expected to include precautions to limit dust generation, air monitoring and appropriate PPE for site workers.

If evidence of additional asbestos is identified during earthworks (i.e. visible asbestos), further assessment will be required and the Asbestos Management Plan updated.

3.15 Post Earthworks Remediation

The Landscape General Arrangement HIF Delivery Plan, produced by p-ie, ref: VNIF-PLA-ZZ-YYY-DR-L-1011, date: 16th September 2022 (Appendix A) shows how the site will be left ready for future development. An extract of the plan is provided below:



A road will be constructed along the northwest boundary of the site. Plots will be left ready for development adjacent to the road in the northwest and at reduced levels to accommodate a future clean environmental cover system. The land nearest to the River Irk will be finished as soft landscaping / POS areas.

This Pre-Development Remediation Strategy does not include for the build-phase remediation requirements associated with the plots (i.e. garden environmental cover systems, gas protection measures) as this will be dealt with in subsequent planning applications. However, prior to future development, the site must be left in a condition to ensure there is no unacceptable risk to potential site users.

Proposed areas of soft landscaping developed as part of the Earthworks will need remediation to ensure it is suitable for its proposed end use (POS). This includes the areas of Red Bank Terraces and St Catherine's Wood as shown on the Landscape General Arrangement HIF Delivery Plan, produced by p-ie, ref: VNIF-PLA-ZZ-YYY-DR-L-1011, date: 16th September 2022. It is assumed that further groundworks / landscaping works may not be undertaken in the future. As such, remediation should be undertaken to ensure the soft landscaped areas are suitable for the long term use as POS.

The following remediation is recommended:

<u>Soft Landscaping Areas (POS)</u>

This includes where soft landscaping areas are developed as part of the earthworks programme and will form long term POS areas. This proposal has been finalised and therefore remediation will need to be undertaken.

A 300mm thick clean environmental cover required at the site surface.

The clean cover should comprise clean validated subsoil and sufficient topsoil for a growing medium. Alternatively, subsoil can be replaced by topsoil. Validation testing should be undertaken to confirm the material is suitable for use (POS). Validation testing frequencies are provided in Table 3-1.

Confirmation of the depth of cover should also be undertaken.

Proposed Development Area

This includes all future development areas where made ground will remain exposed following completion of earthworks. There will be a potential risk associated with contaminants within the shallow made ground exposed to possible site users prior to the future development work commencing.

A 100mm thick clean cover is required in these areas of the site as a temporary cover, prior to a full environmental cover system once the proposed development is finalised for the site.

The 100mm thick clean cover should comprise clean validation soil (hydroseeded material). Validation testing should be undertaken to confirm the material is suitable for use (POS). Validation testing frequencies are provided in Table 3-1.

Confirmation of the depth of cover should also be undertaken.

Proposed Hardstood Areas

Where hardstood ground is present post earthworks, there will be no pollutant linkage and no further remediation will be required.

St Catherine's Wood and Red Bank Terrace

There are vegetated / wooded areas within St Catherine's Wood and Red Bank Terrace area where a cover system will not be possible due to the presence of root systems (where trees will remain as part of the proposed development scheme).

Where a cover system is not possible, further assessment will be required. This could include additional testing of the shallow soils and statistical methods to allow a more refined risk assessment to be undertaken and allow for remedial options to be developed where required.

Potable Water Pipes

Only limited data was used in the potable pipeline risk assessment. At this stage, it is assumed that barrier pipe will be required. If potable water pipes are to be installed as part of the Earthworks, it is recommended that additional testing is carried out along the pipeline route (post remediation and earthworks) at pipeline depth to confirm the appropriate pipeline material. If no further testing is undertaken, barrier pipe should be used.

3.16 Summary of Remediation and Validation Requirements

Area / Activity	Remediation Requirements	Validation Work	Testing Schedule	Remedial Targets
Riverbank Knotweed Clearance	Vegetation Clearance including the removal of Japanese Knotweed.	TBC in Japanese Knotweed method statement.		
Creamline Dairies	Confirmation of the suitability of demolished material for re-use.	Testing of stockpiled material.	1 sample per 150m^3, min. 3no. samples. Suite 1.	Presence of ACM.
			Note: if this material is to be used as part of an environmental cover system in future development additional testing / assessment will be required in respect to suitability for use.	
All Areas and Riverbed Fly tipping	Removal of all fly tipping as part of site clearance. Watching brief for ACM pieces to be undertaken (ACM to be segregated and disposed of accordingly). Including possible removal of debris within riverbed.	Testing of stockpiled material.	Subject to waste type and disposal facility requirements.	N/A
All Areas Removal of hardstood, structures and soil turnover	Removal of hardstood ground. Relic inground structures to be removed to a depth of 2.0mbgl. Any obstructions greater than 2.0m will remain and be recorded. Soil turnover to approx. 0.5m across the site. Dewatering if required.	Record including photographs of work undertaken. Records to include any areas of deep obstructions remaining in the ground.	N/A	N/A
Gasworks and Former Carriage Works Remediation	Excavation of impacted material and relic structures under the supervision of a geo-environmental consultant.	Remaining in-situ soils to be tested to confirm impacted soils removed.	Subject to size of excavation. Samples collected from sides and base, *c*. 10m spacing. Suite 4.	1. Ensure no visual olfactory evidence of hydrocarbons / volatiles remain. 2. Compare against Gasworks Remedial Targets[1] (gasworks area). 3. Compare against Zone 1 and 2 Remedial Targets[2,3], where applicable. 4. Compare against GAC for future end use[4,5].
Gasworks and Former Carriage Works	Impacted soils to be segregated on impermeable membrane for offsite disposal.	Testing of excavated material to confirm the waste classification.	See EA Technical Guidance on Waste Classification. Suite 2 and 3.	N/A (for offsite disposal)

Area / Activity	Remediation Requirements	Validation Work	Testing Schedule	Remedial Targets
Remediation (continued)	Dewatering, where required. Impacted groundwater to be stored for offsite disposal.	Testing of impacted groundwater to confirm the waste classification.	Subject to volume and waste facilities requirements. Suite 5.	N/A (for offsite disposal)
	Backfilling of excavation with suitable material in line with earthworks specification.	N/A	N/A	N/A
All Areas – Reuse of site-won material	To be undertaken in line with appropriate legislation and guidance (MMP with recourse to CL:AIRE Code of Practice). Material excavated on site should be stockpiled, processed and categorised to determine if the soil is suitability for re-use on site in line with the Earthworks Specification. See Screening Criteria Zones (Appendix B). Soils moved locally within the same area do not require validation testing (i.e. soils excavated and reused within Red Bank Plateau, and regrading work within St Catherine's Wood and Red Bank Terrace) with the exception of soils within Zone 1. Testing is required where soils are placed within St. Catherine's Wood or Red Bank Terrace (Zone 1 & 2).	Material placed within Zone 1 to be tested to confirm suitability.	1 sample per 150m^3 (min. 3 samples). Suite 2.	Arup derived targets for material within Zone 1[4].
		Material placed within Zone 2 to be tested to confirm suitability	1 sample per 150m^3 (min. 3 samples). Suite 2.	Arup derived targets for material within Zone 2[5].
Disposal	Material required to be removed from site should be undertaken under an appropriate duty of care and the results of chemical analysis and waste classification should be provided to the relevant waste facility.	Testing of excavated material to confirm the waste classification.	See EA Technical Guidance on Waste Classification. Suite 2 and 3.	For offsite disposal, testing results to be provided to waste facility.
		Waste records such as disposal tickets and waste carrier licences should be provided.	N/A	N/A
Stockpile Management	The source of each stockpile should be recorded with associated testing (as detailed above). Material should be segregated by type and source. Quarantine areas for suspected contaminated soils to be established until use / disposal route is confirmed.	Records including photographs of work undertaken.	N/A	N/A

Area / Activity	Remediation Requirements	Validation Work	Testing Schedule	Remedial Targets
River Channel	Inspection during works to re-naturalise the river bank to identify: - Visual or olfactory evidence for the potential discharge of contaminants into the river through high permeability material associated with the former river meander bend, or - Visual or olfactory evidence of contamination discharging from the face of the regrading river banks. If either of these are encountered, the risk to controlled waters should be reassessed and measured to address these potential contamination linkages (for example the provision of low permeability material at appropriate locations along the river banks) should be implemented if required.	Records including photographs of inspection work undertaken. Validation of any potential remedial work to be determined once further assessment has been carried out (if required), subject to inspection work.	N/A	N/A
All Areas Watching Brief / Unexpected Contamination	Geo-environmental engineer to be present during groundwork to assess any unexpected contamination. Impacted material to be excavated and stockpiled in a segregated areas on impermeable membrane. Delineation work to confirm lateral and vertical extent. Dewatering, where required. Potentially impacted groundwater to be stored for offsite disposal. Further assessment to confirm most appropriate action (i.e. re-use on site or disposal). Verification samples of remaining soils. Backfilling of excavation with suitable material in line with earthworks specification. Abstraction wells (if any are identified) to be appropriately decommissioned in line with EA requirements.	Remaining soils to be tested to confirm impacted soils removed.	Samples collected from sides and base, *c.* 10m spacing. Testing Suite subject to contamination identified.	Subject to location on site. 1. Ensure no visual olfactory evidence of hydrocarbons / volatiles remain. 2. Ensure no visible ACM remains. 3. Assessment criteria subject to location on site and contaminants of concern.
		Testing of excavated material to confirm if material will be re-used or disposed of.	Subject to contaminants of concern. 1 sample per 150m^3 (min. 3 samples) and in line with EA Technical Guidance on Waste Classification (whichever is most conservative). Suite 2 and 3, possible SVOCs and VOCs.	Subject to potential re-use activity: 1. Ensure no visual olfactory evidence of hydrocarbons / volatiles remain. 2. Ensure no visible ACM remains. 3. Assessment criteria subject to location on site and contaminants of concern.
		Testing of impacted groundwater to confirm the waste classification.	Subject to volume and waste facilities requirements. Suite 5.	N/A (for offsite disposal)

Area / Activity	Remediation Requirements	Validation Work	Testing Schedule	Remedial Targets
Health and Safety	A Construction Management Plan and Method Statement should be produced which details appropriate Health and Safety measures to be employed during the site works.	Record to be provided of precautions undertaken during earthworks.	N/A	N/A
All Areas Asbestos Management	Asbestos Management Plan should be developed across the site.	Record to be provided of precautions undertaken during earthworks.	N/A	N/A
Post Earthworks Remediation	Soft landscaping areas - where soft landscaping areas are developed as part of the earthworks programme and will form long term POS areas: 300mm thick, clean cover required comprising subsoil and sufficient topsoil for a growing medium. The subsoil layer can be replaced by additional topsoil.	Measuring depth of environmental cover system using a staff and providing photographic evidence. Provision of source and volumes of imported soils (certificates and import tickets). Validation testing to confirm the soils are suitable for POS.	1 sample per 50m^3 (min. 3 samples). Suite 2.	Compare to Arup derived POS assessment criteria[4].
	Proposed development areas: 100mm thick clean cover required.	Measuring depth of environmental cover system using a staff and providing photographic evidence. Provision of source and volumes of imported soils (certificates and import tickets). Validation testing to confirm the soils are suitable for POS.	1 sample per 50m^3 (min. 3 samples). Suite 2.	Compare to Arup derived POS assessment criteria[4].
	Hardstood areas: No remediation required.	N/A	N/A	N/A
	St Catherine's Wood and Red Bank Terrace - where trees will remain as part of the proposed development scheme: Further assessment required where a cover system is not possible due to root networks.	TBC	TBC	TBC

Area / Activity	Remediation Requirements	Validation Work	Testing Schedule	Remedial Targets
	Potable Water Pipes: At this stage it is assumed that there is a risk to potable water pipes and barrier pipe is recommended. Further tested may allow the risk to be re-assessed.	Records of pipework installed, including photographs.	N/A	N/A

Table 3-1: Summary of Remediation and Validation Requirements.

Testing Suites:
Suite 1 – (soils) Asbestos Screen (if present, ID and Quantification to be undertaken).
Suite 2 – (soils) Metals, cyanide, pH, sulphate, speciated PAH, SOM, TPHCWG, BTEX.
Suite 3 – (soils) WAC Stage 2.
Suite 4 – (soils) SOM, TPHCWG, BTEX, SVOCs, VOCs.
Suite 5 – (water) TPHCWG, BTEX, SVOCs, VOCs.

Remedial Targets (Provided in Appendix D):
1 - Gasworks Remedial Targets (derived by Arup – Victoria North HIF Infrastructure Works, Controlled Waters Detailed Quantitative Risk Assessment Report, produced by ARUP, ref: VNIF-ARP-ZZ-YYY-RP-CG-0011, P03, date: 7th November 2022).
2 - Targets for material within Zone 1 (derived by Arup – Victoria North HIF Infrastructure Works, Controlled Waters Detailed Quantitative Risk Assessment Report, produced by ARUP, ref: VNIF-ARP-ZZ-YYY-RP-CG-0011, P03, date: 7th November 2022).
3 - Targets for material within Zone 2 (derived by Arup – Victoria North HIF Infrastructure Works, Controlled Waters Detailed Quantitative Risk Assessment Report, produced by ARUP, ref: VNIF-ARP-ZZ-YYY-RP-CG-0011, P03, date: 7th November 2022).
4 – POS assessment criteria (derived by Arup – Victoria North Infrastructure Works, Ground Investigation Interpretive Report, produced by ARUP, ref: VNIF-ARP-XX-YYY-RP-CG-0012 P02, date: 3rd November 2022).
5 – Residential w/o plant uptake (derived by Arup – Victoria North Infrastructure Works, Ground Investigation Interpretive Report, produced by ARUP, ref: VNIF-ARP-XX-YYY-RP-CG-0012 P02, date: 3rd November 2022).

EA Technical Guidance on Waste Classification:

Population (tonnes)	Number of Samples (homogeneous waste)	Number of Samples (new/heterogeneous waste)
< 100	2	5
< 500	3	8
< 1,000	5	14
10,000	11	22
+ per additional 10,000	+5 (pro rata)	+10 (pro rata)

4 Conclusions

Based on information available in reports provided to LKC, a detailed Pre-Development Remediation Strategy has been produced for the earthworks and infrastructure proposed at Victoria North.

LKC should stress that no works should take place until Regulatory approval of the Pre-Development Remediation Strategy has been obtained.

The pre-development remediation and validation work addresses the pollutant linkage identified for the site and will ensure the site is suitable for its proposed use. It is understood that future planning applications will be submitted for the build-phase of works.

All remediation and validation work undertaken should be documented in a Site Completion Report once all earthworks and infrastructure work have been completed.

The aim of the completion reports will be to demonstrate to the Local Authority that the site has been suitably remediated to the extent that construction works may commence and, in accordance with the National Planning Policy Framework (NPPF)[6]:

Once the above is satisfied the Local Authority should be able to discharge all the relevant contaminated land conditions.

A separate Remediation Strategy will be developed for build phase remediation. This is anticipated to include:

- Gas protection measures within all proposed buildings.
- Environmental cover system in all gardens / soft landscaping.
- Barrier pipe for all potable water pipes.

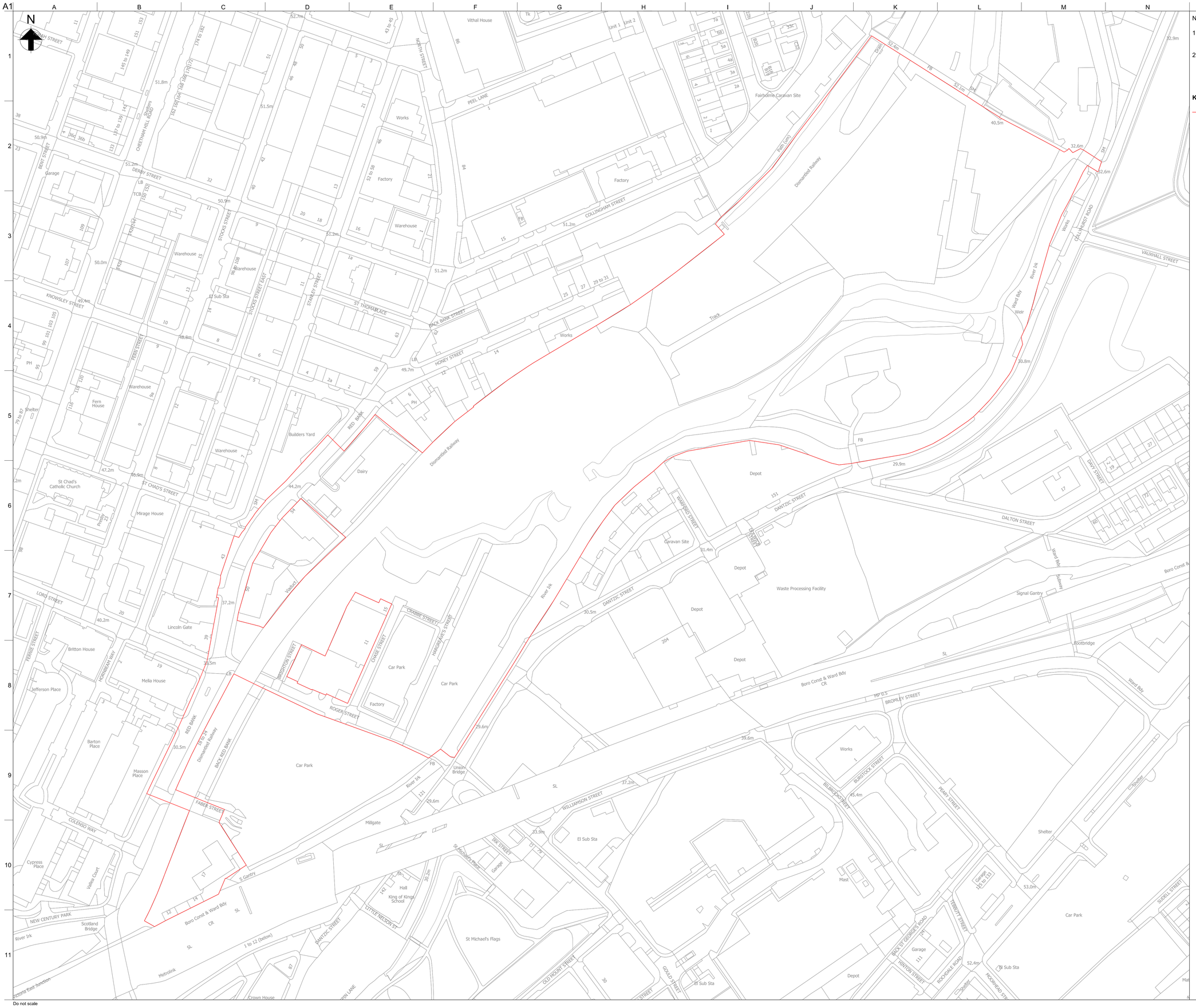
Additional investigation work may allow the above build phase remediation to be re-assessed.

[6] DCL (2021). “National Planning Policy Framework.” Department of Communities and Local Government.

Appendix A

Development Plans

A1



Rev	Date	Description	By	Chkd	Appd	Auth
P01	09/11/21		EC	EC	ME	—
P02	09/11/21	For Enabling Works Application	EC	EC	ME	—
P03	16/11/21	Updated redline boundary	EC	EC	ME	—
P04	10/12/21		RG	RG	RG	—
P05	04/02/22	For Information	RG	RG	RG	—
P06	11/03/22		EC	EC	RG	—

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Client

MANCHESTER CITY COUNCIL

bam nuttall

Project Title

Victoria North HIF Infrastructure & Enabling Works

Drawing Title

Location Plan

Scale at A1	1:1250	Arup Job No	282022-00
Role	GIS & Land Surveyors		
Suitability	S3 - Issued for Review and Comment		

Rev	By	Chkd	Appd	
P06	EC	EC	RG	—
	Date 11/03/22	Date 11/03/22	Date 11/03/22	—

Name

VNIF	- ARP -	00	- YYY -	DR	- G	- 0009
Project	Originator	Volume	Location	Type	Role	Number

Do not scale

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A1

KEY

SITE BOUNDARY

PROPOSED HARDWORKS
Refer to detail drawings VNIF-PLA-ZZ-YYY-DR-L-5000-5002 for more information.

S1 CLAY PAVING - Pedestrian grade
Product: Neland Clay Paving by Hardscape (OSA)
Colour /Finish: 50% Bronx Waterstruck
50% Sienna (sanded)
Size: 200mm(l) x 50mm(w) x 85mm(d)
Laid: stretcher/herringbone bond as shown (TBC)

S1.1 CLAY PAVING - Vehicular grade
Product: Neland Clay Paving by Hardscape (OSA)
Colour /Finish: 50% Bronx Waterstruck
50% Sienna (sanded)
Size: 200mm(l) x 50mm(w) x 85mm(d)
Laid: stretcher/herringbone bond (TBC)

HRA SURFACING (Vehicular)
Location: to vehicular carriageway on Plateau Avenue
Material: HRA to Arup details and specification. Refer to Arup drawings

HRA SURFACING (Temporary Carriageway)
Location: to vehicular carriageway on Plateau Avenue
Material: HRA to Arup details and specification,. Surface Course not to be installed for temporary carriageway. Refer to Arup drawings

PERMEABLE SURFACING (Parking/Loading Bays)
Location: to parking and loading bays on Plateau Avenue
Material: Permeable block paving, Surface Course not to be installed for temporary carriageway. Refer to Arup drawings

ASPHALT SURFACE (Pedestrian)
Location: to pedestrian routes on Plateau Avenue
Material: Asphalt Surfacing, Surface Course not to be installed for temporary footway. Refer to Arup drawings

S3 GRANITE SETTS
Location: to St Catherine's Wood entrance area, Union Waterfront & Red Bank Terrace
Material: European granite natural stone setts
Colour/finish: 40% Rose Santa Eulalia (fine picked), 30% Amarelo montemuro (flamed), 30% Rosa Forte (flamed)
Cropped sides, sawn bottoms.
Laid: stretcher bond, with single course of setts to perimeter edges.

S3.1 GRANITE SETTS
Location: to St Catherine's Wood entrance area, Union Waterfront & Red Bank Terrace
Material: European granite natural stone setts
Colour/finish: 40% Rose Santa Eulalia (fine picked), 30% Amarelo montemuro (flamed), 30% Rosa Forte (flamed)
Cropped sides, sawn bottoms.
Laid: Rigid, Stretcher Bond. 14mm Jointing

S4 RESIN BOUND GRAVEL SURFACING
Location: Site wide
Product: Sureset Resin Bound Surfacing System (permeable)
Finish/Colour: 6mm Winter Bronze or similar and approved
40mm thick open graded asphalt concrete binder course (50mm depth) to Arup details and specification. Refer to detail drawing VNIF-PLA-ZZ-YYY-DR-L-5000 for more information.

S5 GREEN GAP PAVING
Product: Neland Clay Pavers by Hardscape (OSA)
Grass infill to joints
Colour /Finish: 50% Bronx Waterstruck
50% Sienna (sanded)
Size: 200 (l) x 50 (w) x 85 (d)mm
Laid: linear bands with 30mm gaps for planting/grass

S6 STEEL GRATING DECKS
Location: Red Bank Terraces, St Catherine's Wood
Material: Galvanised steel structural frame with galvanised steel deck infill.
System to be developed with Weland AB (OSA)
To meet required slip resistance standards
Finish: Corten frame, galvanised steel deck/grating

S7 STEEL GRATING STEPS
Location: to Red Bank Terraces, St Catherine's Wood
Material: Galvanised steel structural frame with galvanised steel deck infill.
System to be developed with Weland AB (OSA)
To meet required slip resistance standards
Finish: Corten frame, galvanised steel deck/grating

TACTILE HAZARD WARNING STRIPS
Location: Red Bank Terraces and St Catherine's Wood wherever there are steel grating steps
Material: Tactile strips mechanically fixed to metal decking or root fixed into groundplane

S7 COMPOSITE TIMBER DECKING
Location: to elevated walkway/cycle route in St. Catherine's Wood and Union Waterfront deck
Corten steel structural frame with composite deck surfacing
Supplier/Product: Lasta-Grip composite decking by Millboard (OSA)
Colour: Coppered Oak
Finish: to meet required slip resistance

S8 PRE-CAST CONCRETE STEPS
Location: to Union Bridge Waterfront and Red Bank Terraces
Material: Pre cast concrete with stone aggregate
Product: Mix design ref BLSC135
Supplier: Evans Concrete Products Ltd (OSA)
Colour: buff/natural tone
Finish: combination of light/medium/heavy acid etched finishes with contrasting nosings

S8.1 PRE-CAST CONCRETE SEATING STEPS
Location: to Union Bridge Waterfront and lower Red Bank Terraces
Material: Pre cast concrete with stone aggregate
Product: Mix design ref BLSC135
Supplier: Evans Concrete Products Ltd (OSA)
Colour: buff/natural tone
Finish: combination of light/medium/heavy acid etched finishes

S8.2 TACTILE CORDUROY HAZARD PAVING
Location: Red Bank Terraces and Union Waterfront wherever there are steps
Material: Granite
Colour: Dark Grey
Size: 400mm (l) x 400mm (w) x 50mm (d)
Finish: flamed
Laid: Rigid, stack bond

S8.3 IN-SITU CONCRETE STEPS
Location: Eastern run of steps
Material: Concrete, fair faced finish
Colour: Natural/grey
Notes: To have contrasting aluminium nosings mechanically fixed

S9 TACTILE BLISTER HAZARD PAVING
Location: road crossings
Material: pre-cast concrete
Colour: Natural
Size: 400mm (l) x 400mm (w) x 50mm (d)
Finish: as cast
Laid: Rigid, stack bond

S11 BARK CHIPPINGS
Location: to secondary pedestrian paths in St. Catherine's Wood
Material: Bark chippings, opportunity to use chipped site won timber from tree clearance

S11.1 TIMBER SLEEPER STEPS ALONG BARK PATH
Location: to informal tertiary routes within St Catherine's Wood
Material: Larch FSC timber sleepers
Colour: natural
To have GRP Anti-Slip flat plate strips by GripClad (OSA) to be mecahnically fixed to the sleeper tops.

S12 RUBBER BARK LOOK CHIPPINGS
Location: to St. Catherine's Wood Play Area
Material: Tiger Bark or similar and approved
Colour: Earth Tone 1

STEPPING STONE PATH
Location: to St Catherine's Wood tertiary routes
Material: European granite natural stone slabs
Colour: buff/natural tones TBC
Size: 800mm(L) x 400mm(W) x 75mm(D)
Finish: Picked surface, cropped sides
Laid: on concrete haunchings

S14 TEMPORARY TARMACADAM SURFACING
Location: to provide link between Union Waterfront and Red Bank Terraces
Material: Asphalt to engineers details and specification.
Note: to be replaced by future landscaping

S15 COLOURED ASPHALT SURFACING
Location: to ridge promenade at Plateau level and cyclist loop on Red Bank Terraces
Material: Buff Ulticolour by Tarmac or similar and approved.

S16 TIMBER SLEEPERS IN SELF BINDING GRAVEL
Location: to Red Bank Viaduct
Self Binding: Breedon Golden Amber Gravel or similar and approved.

PROPOSED SUBSTATION

PLOT FOOTPRINT
Plot groundworks prepared but no construction work as part of HIF infrastructure.

EXISTING CONDITION
No groundworks or preparation as part of HIF infrastructure work.

PROPOSED SOFTWORKS

PROPOSED TREE PLANTING
Subject to further detailed design

EXISTING TREES RETAINED
Subject to further detailed design

EX1 EXISTING WOODLAND RETAINED
To St. Catherine's Wood

EXISTING WOODLAND ENHANCED

M1 To St. Catherine's Wood
Refer to drawing for notes
Approx area: 12215m²

M2 WOODLAND MATRIX MIX
To St. Catherine's Wood
Refer to drawing for notes
Approx area: 5900m²

M3 WOODLAND EDGE MIX
To St. Catherine's Wood
Refer to drawing for notes
Approx area: 1265m²

M4 ORNAMENTAL PLANTING
To Red Bank Terraces
Refer to drawing for notes
Approx area: 3155m²

M5 ORNAMENTAL PLANTING
To Viaduct Linear Park
Refer to drawing for notes
Approx area: 1412m²

M6 AQUATIC MARGINAL VEGETATION
To Rivers Edge
Refer to drawing for notes
Approx area: 2690m²

HEDGE PLANTING
Mixed native species hedgerow mix to northern boundary
Approx area: 73m², Approx length: 50m

RB01 RB02 RB03 RB04 RB05a RB05b RB05c RB06 RB07 RB08 RB09 RB11 RB12a RB12b RB16 RB17 NT01 NT02 NT03 NT04

HAZ-SW-005 HAZ-SE-001 HAZ-ST-005 HAZ-ST-006 HAZ-ST-012 HAZ-ST-013 HAZ-SW-001 HAZ-SW-002 HAZ-SW-003 HAZ-SW-004 HAZ-SW-005 HAZ-SW-006 HAZ-SW-011 HAZ-SW-012 HAZ-SW-013 HAZ-GE-001 HAZ-GE-004 HAZ-LA-007

Works to river and river banks in abeyance - subject to further review and coordination with Arup rivers team

Scale bar (m) 0 10 20 50 100

Do not scale

NOTE: Future Plot Extents are Indicative Only

Rev	Date	Description	By	Chkd	Appd	Auth
P07	16.09.22	Stage 4 issue - drawing pack amends	BM	MS	GB	GB
P06	04.08.22	Stage 4 issue - refer to revision notes	BM	MS	GB	GB
P05	19.07.22	Stage 4 issue - PF to review	BM	MS	GB	GB
P04	13.06.22	Stage 4 Issue	BM/SR	MS	GB	GB
P03.03	25.05.22	Interim GA Issue - for coordination	BM/SR	MS	GB	GB
P03.02	03.05.22	Interim GA Issue for costing	BM/SR	MS	GB	GB
P03.01	22.04.22	Interim GA Issue - for coordination/costing	BM/SR	MS	GB	GB
P03	07.03.22	Costing	BM	MS	GB	GB
P02.08	02.03.22	Final Draft Planning	CL	MS	GB	GB
P02.07	14.02.22	Draft Planning	CL	MS	GB	GB
P02.06	14.02.22	Draft Planning	BM	MS	GB	GB
P02	11.02.22	Draft Planning	BM	MS	GB	GB
P02.05	04.02.22	Draft Planning	BM	MS	GB	GB
P02.04	31.01.22	Draft Planning	SR	MS	GB	GB
P02.03	27.01.22	Draft Planning	BM	MS	GB	GB
P02.02	27.01.22	Draft Planning	BM	MS	GB	GB
P02.01	25.01.22	Draft Planning Issue	BM	MS	GB	GB
P01	17.12.21	Stage 3 Issue	SR	MS	GB	GB
P01.02	10.12.21	For Information	SR	MS	GB	GB
P01.01	07.12.21	For Information	SR	MS	GB	GB

Safety, Health and Environmental Information

Notes below are additional to hazards/risks normally associated with this type of work. Numbers correspond to Risk Register references (document reference VNIF-ARP-ZZ-YYY-RE-WD-0002)

Construction

- HAZ-GE-001 Excavation near slopes
- HAZ-GE-004 Ground contamination
- HAZ-LA-007 Condition of existing trees
- HAZ-SE-001 Slips, trips, falls down embankment
- HAZ-ST-005 Potential instability of Creamline Dairies retaining wall
- HAZ-ST-006 Working near existing structures
- HAZ-ST-012 Buried Structures
- HAZ-ST-013 Lifting of heavy elements
- HAZ-SW-001 Working adjacent to live traffic
- HAZ-SW-002 Buried existing services
- HAZ-SW-003 Working adjacent to live water course
- HAZ-SW-004 Deep excavations
- HAZ-SW-005 Working on or adjacent to historic structures
- HAZ-SW-006 Asbestos - operatives in contact with asbestos materials
- HAZ-SW-011 Contact with hazardous plants / vegetation
- HAZ-SW-012 Risk of water borne diseases
- HAZ-SW-013 Human debris / drug paraphernalia

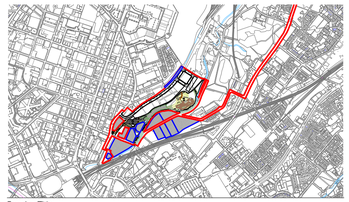
p·ie

Client

Project Title

Victoria North HIF Infrastructure

Key Plan



Drawing Title

Landscape General Arrangement
HIF Delivery Plan

Scale at A1	Planit-IE Job No
1:1000	2700

Role: Landscape Architect

Suitability: S3

Rev	By	Chkd	Appd
P07	SR	MS	MS
	Date	Date	Date
	16.09.22	16.09.22	16.09.22

Name

Project	Originator	Volume	Location	Type	Role	Number
VNIF	PLA	ZZ	YYY	DR	L	1011

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Notes:

Rev:	Date:	Revisions
C	25/5/22	Model Updated over steps / Ramps. Soil Depth Revised
B	12/4/22	Initial length of road increased to deeper construction as remainder
A	8/3/22	Updated to reflect revised arrangement and construction details

Scale : 1:1000

Date : 16/02/2022

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BAM Nuttall
Victoria North
Initial Construction Allowances

Rev: A B C

Drawing No: MCL/BAM2201/002

Original Drawing Size: 841x1189 (A0)



Notes:

Depths of Cut / Fill indicated are calculated from a commencement surface of OGL, to the formation model (refer to dwg MCL/BAM2201/002 Rev C)

Mass Earthworks Analysis

Volumes per Area of Interest (m³)

Area of Interest	Available Bank Cut (1)	Compacted Fill Required (2)	Excess/Deficit (3)
Active Travel Route	2,568.4	5.5	2,562.9
Plateau Ave / RB05a	1,825.1	2,826.7	-1,001.6
Plateau Avenue	1,632.8	7,081.4	-5,448.6
RB01	817.1	91.8	725.3
RB02	6,014.6	158.7	5,855.9
RB03	9,467.0	129.5	9,337.5
RB04a	469.6	341.4	128.2
RB05b	853.8	36.6	817.1
RB05c	109.8	1,251.0	-1,141.1
Red Bank Terrace	9,390.5	2,006.7	7,383.8
Slope Regrade	8,786.3	153.4	8,632.9
St Catherine's Wood	6,096.3	1,747.2	4,349.1

1 The available bank cut is the cut volume between the two subject surfaces. That material to be excavated is considered to be in its in situ bank density state (its natural state prior to excavation).
2 As the bank cut is excavated (and thereby placed in a loose state), it will occupy this increased volume, which is obtained by multiplying the available bank cut by the material's hauling bulkage factor.
3 The excess (positive) or deficit (negative) volume is obtained by subtracting the compacted fill required from the available bank cut.

Rev:	Date:	Revisions
C	25/5/22	Model updated over steps/ramps. Soil depths revised
B	8/3/22	Updated to reflect revised arrangement & construction details
A	5/3/22	Updated survey & design data used (ARUP Mar22)

Scale : 1:1000 Date : 16/02/2022

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BAM Nuttall
Victoria North
Initial Cut Fill Map

Rev: A B C

Drawing No: MCL/BAM2201/001

Original Drawing Size: 841x1189 (A0)



Notes:

Rev:	Date:	Revisions

Scale : 1:1000 | Date : 08/03/2022

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BAM Nuttall
Victoria North
Cut / Fill Zones

Rev:

Drawing No: MCL/BAM2201/005 | Original Drawing Size: 841x1189 (A0)

Earthworks Programme Strategy

2678.9m3
Cut & Fill

RB05

RB05a

1221.5m3
Cut & Fill

RB04

7407.1m3
RB02 & RB03
Stockpile

129.5m3
Cut & Fill

2572.5m3
Disposal

376.4m3
RB04 & RB05c

4400.9m3
RB02 & RB03
Stockpile

153.4m3
Cut & Fill

7489m3
Disposal

4232m3
Invasive
Species

RB01

1632.8m3
Cut & Fill

250.5m3
Cut & Fill

RB17

1750.8m3
Disposal

4232m3
Invasive
Species
Disposal

RB16

184.4m3
RB05a&b

RB12a

5448.6m3
Plateau Rd

2006.7m3
Cut & Fill

HAZ-DR-002

HAZ-SW-002

HAZ-DR-002

RB11

RB06

HAZ-DR-002

NT03

HAZ-DR-002

NT02

RB08

RB07

Legend

- Historic Carriage Shed
- Historic Gas Slab
- Invasive Species Disposal
- Proposed Material Stockpile for Disposal
- Disposal Haul Route



Do not scale

Notes:

1. Topograhical data based on Paragon Surveys Drawing No. PS-2158-TS Issue P.
2. All levels are in metres above Ordnance Datum.
3. Refer to Landscape Architect drawings for details of soft and hard landscaping in the development site.
4. Development masterplan based on Planit drawing VNIF-PLA-ZZ-YYY-DR-L-1011 Rev P04.
5. Plot boundaries are indicative based on FEC masterplan.
6. Plot levels represent the proposed ground level for the interim state following HIF Infrastructure Works and do not represent building Finished Floor Levels.

Key:

- Red Line Boundary
- Development Plot Boundaries
- Proposed Major Contour (0.5m interval)
- Proposed Minor Contour (0.1m interval)

Rev	Date	Description	By	Chkd	Appd	Auth
P01	26/11/21		RS	RG	RG	---
P02	17/12/21		RS	RS	RG	---
P03	02/03/22	Draft for Client Comment	OM	RS	RG	---
P04	28/06/22	Stage 4 Draft	ID	RS	LS	---

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Client

MANCHESTER CITY COUNCIL

bam nuttall

Project Title

Victoria North HIF Infrastructure & Enabling Works

Drawing Title

Proposed Site Contours

Scale at A1	1:1000	Arup Job No	282022-00
Role	Civil - Earth works and Geotechnics		
Suitability	S2 - Issued for Information		

Rev	By	Chkd	Appd	
P04	ID	RS	LS	---
	Date 28/06/22	Date 28/06/22	Date 28/06/22	---

Name

Project	Originator	Volume	Location	Type	Role	Number
VNIF	ARP	00	YYY	DR	CE	0001

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A1



Notes:

1. Topograhical data based on Paragon Surveys Drawing No. PS-2158-TS Issue P.
2. All levels are in metres above Ordnance Datum.
3. Refer to Landscape Architect drawings for details of soft and hard landscaping in the development site.
4. Development masterplan based on Planit drawing VNIF-PLA-ZZ-YYY-DR-L-1011 Rev P04.
5. Plot boundaries are indicative based on FEC masterplan.
6. Plot levels represent the proposed ground level for the interim state following HIF Enabling Works and do not represent building Finished Floor Levels.

Key:

- Red Line Boundary
- Development Plot Boundaries
- C 0.00m Proposed Cut
- C 0.00m Proposed Fill

Rev	Date	Description	By	Chkd	Appd	Auth
P01	26/11/21		RS	RG	RG	—
P02	17/12/21		RS	RS	RG	—
P03	02/03/22	Draft for Client Comment	OM	RS	RG	—
P04	28/06/22	Stage 4 Draft	ID	RS	LS	—

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Client

MANCHESTER CITY COUNCIL

bam nuttall

Project Title

Victoria North HIF Infrastructure & Enabling Works

Drawing Title

Proposed Site Isopach

Scale at A1	1:1000	Arup Job No	282022-00
Role	Civil - Earth works and Geotechnics		
Suitability	S2 - Issued for Information		

Rev	By	Chkd	Appd	
P04	ID	RS	LS	—
	Date 28/06/22	Date 28/06/22	Date 28/06/22	—

Name

VNIF - ARP - 00 - YYY - DR - CE - 0002

Project | Originator | Volume | Location | Type | Role | Number

Do not scale

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A1

Tall floodlight

Concrete slabs from former buildings

Existing earth bund

Collapsed pipe discharging water. Testing confirms water has a high nitrogen content

Existing hut with pumping equipment to be retained

Electric cables to be removed

Approximate location of demolition waste

Turntable, location determined from historical drawings

Existing toilet block and slabs

12m deep drainage manhole, suspected connection to manhole by river (assumed location)

Debris from human occupation distributed throughout area

Demolition of Creamline Dairies site will result in services left in situ which are to be abandoned

Viaduct wall under surface

Two trees which obstruct access

Extent of works and site clearance within the public highway will be subject to a S278 agreement.

Electric cables to be removed

Large fallen tree blocking access from car park area

Below ground oil interceptor, size to be confirmed on site

Concrete Surface (5445 sqm) at Vaulkers Yard to be removed

Combined water sewer manhole and live connecting pipe

Electric cables to be removed

Location of below ground tank confirmed via BH308. Size to be confirmed on site

Timing of abandonment of exisiting utility assets in Hargreaves Street dependent on FEC demolition phasing. These works may be undertaken by FEC in the future if existing land uses are retained beyond the HIF timeframe.

RB01 RB02 RB03 RB04 RB05a RB05b RB05c RB06 RB07 RB08 RB09 RB10 RB11 RB12a RB12b RB16 RB17

NT02 NT03 NT04

HAZ-GE-002 HAZ-GE-003

Notes

1. All dimensions are in mm, all levels in mAOD, unless specified otherwise.
2. This map is reproduced from Ordnance Survey Material with the permission of the Ordnance Survey on behalf of the Controller of Her Majesty's Stationery Office (c) Crown Copyright. License Number 100019568 (2021).
3. Layout is based on:
   - Plot boundaries developed in conversation with FEC Winter 2021/22 boundaries between adjacent plots are indicative only and are subject to change as the FEC masterplan is developed.
   - Topographical Survey drawing PS-2158-TS by Paragon Surveys dated September 2021.
4. Existing Utilities and Drainage layout based on the following information:
   - Utility Search Map drawing 97079 by Atkins dated 24/06/2021.
   - GPR Survey drawing PUM-11943-U-DR-0001 Rev 02 undertaken by Precison Utility Mapping dated 18/01/2022.
   - Site walkover observations.
5. Due to the previous industrial land uses and buildings which occupied the site, it is anticipated that there are private services present on the site. These are to be abandoned within the site clearance process.
6. Works within public highway will be subject to a Section 278 agreement.

Key

- HIF Site Boundary
- Plot Boundary

Existing features to be removed

- Hardstanding and Below Ground Features
- Large Areas of Hardstanding or Surfacing
- Above Ground Features
- Surface debris
- Fencing
- Private / other drainage features
- Drainage Combined Sewer
- Private / other services features
- Electricity 6-6.6kV
- Electricity Low Voltage
- Water Distribution Main
- Removal to be Confirmed

FND Foundation
DP Draw Pit
LP Lighting Post
RW Retaining Wall

Rev	Date	Description	By	Chkd	Appd	Auth
P01	01/09/22	WS4 Issue for BAM Review	AS	AL	LS	—

Safety, Health and Environmental Information

Notes below are additional to hazards/risks normally associated with this type of work. Numbers correspond to Risk Register references (document reference VNIF-ARP-ZZ-YYY-RE-WD-0002)

Construction (Location Specific)

- HAZ-GE-002 - Steep slopes (potential instability)
- HAZ-GE-003 - Induced slope instability due to inappropriate siting of stockpiles during earthworks

Construction (Site Wide)

- HAZ-SW-002 - Buried Existing Services
- HAZ-SW-006 - Asbestos
- HAZ-SW-007 - Unexploded Ordnance (UXO)
- HAZ-SW-011 - Hazardous plants

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Client: MANCHESTER CITY COUNCIL / bam nuttall

Project Title: Victoria North HIF Infrastructure & Enabling Works

Drawing Title: Site Clearance

Scale at A1	1:1250	Arup Job No	282022-00
Role	GIS & Land Surveyors		
Suitability	S3 - Issued for Review and Comment		

Rev	By	Chkd	Appd	
P01	AS	AL	LS	—
	Date 01/09/22	Date 01/09/22	Date 01/09/22	—

Name: VNIF - ARP - 00 - YYY - DR - G - 0013
(Project - Originator - Volume - Location - Type - Role - Number)

Do not scale

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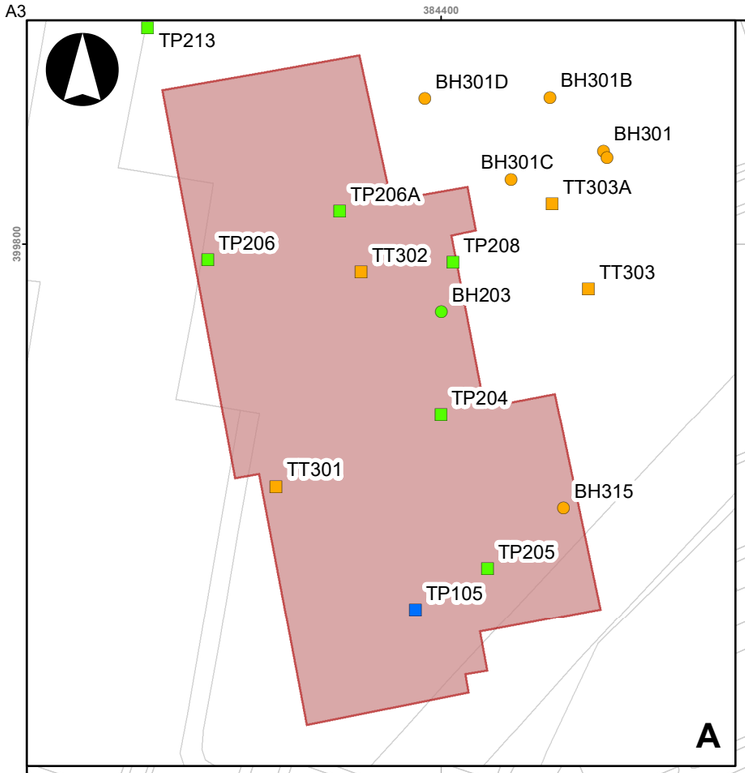
Appendix B

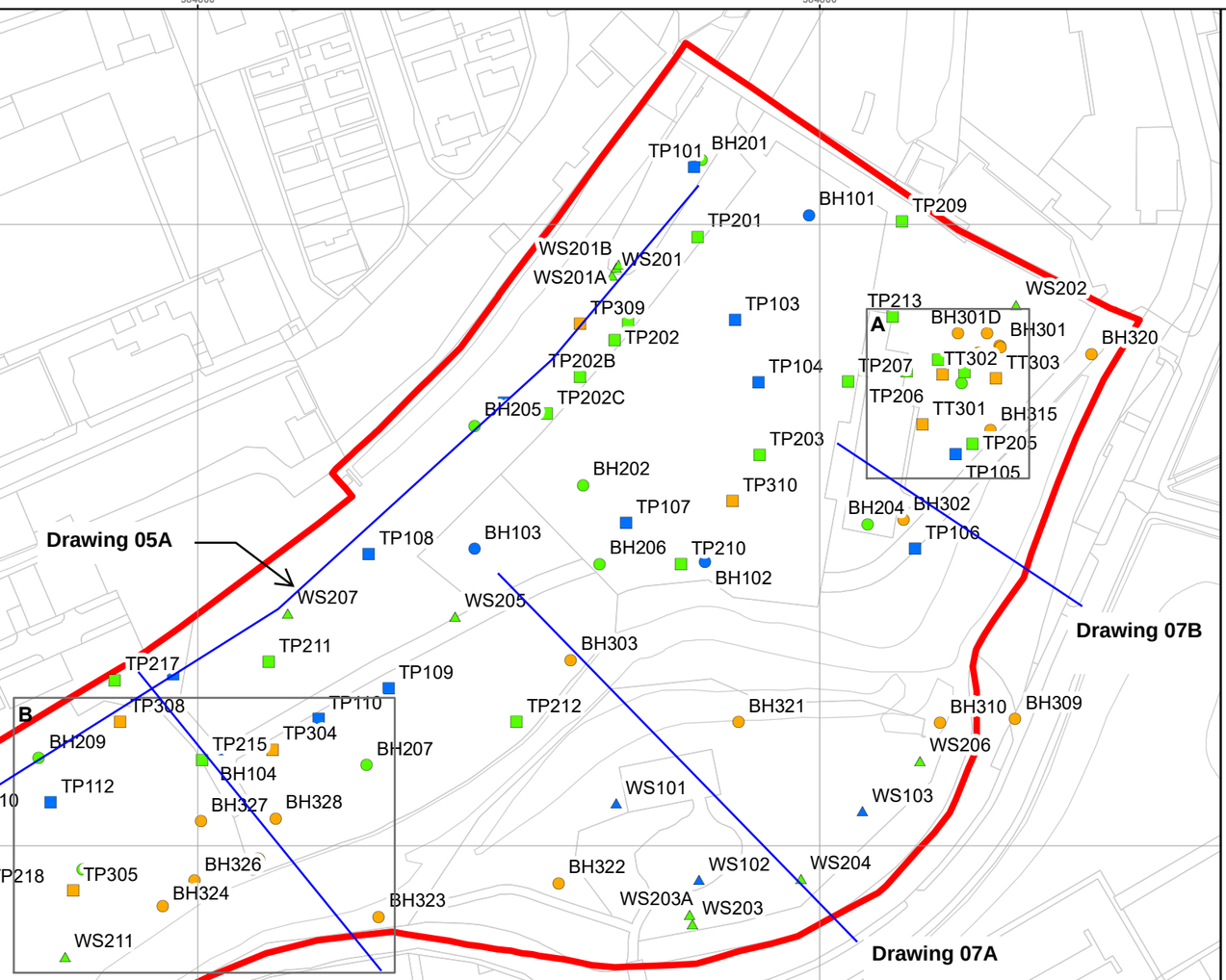
Site Investigation Plans

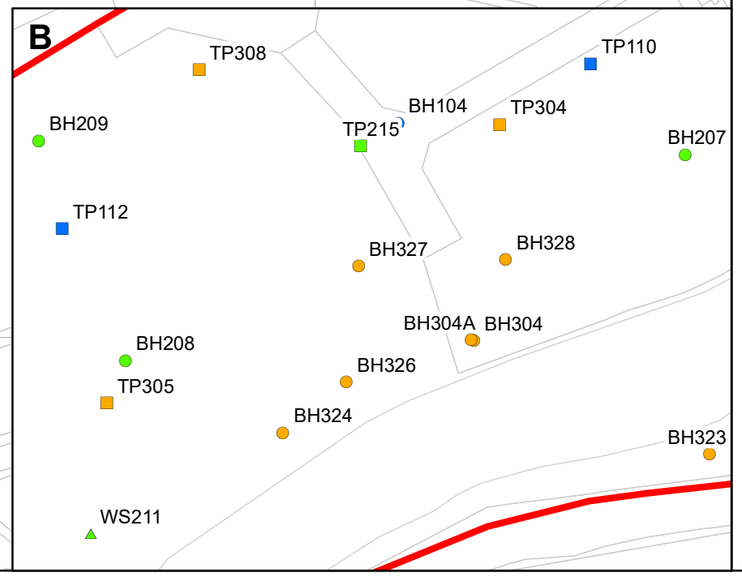
A3

384400 384600 384800

3398800 3399600 3399400







Legend

- Site Boundary

Phase 1 GI
- Borehole
- Trial pit
- Window sample

Phase 2 GI
- Borehole
- Trial pit
- Window sample

Phase 3 GI
- Borehole
- Trial pit
- Window sample

River Engineering Works GI
- Borehole
- Gasworks footprint

Cross section lines and associated drawings

Issue	Date	By	Chkd	Appd
P0	2022-06-23	LH	LH	LH

Metres: 0 25 50 100

ARUP

6th Floor, 3 Piccadilly Place
Manchester M1 3BN
Tel+44(0161) 228 2331 Fax+44(0161)228 6879
www.arup.com

Client
BAM Nuttall Limited

Project Title
Victoria North

This drawing relates to
Ground Investigation Interpretive Report
VNIF-ARP-ZZ-YYY-RP-CG-0012

Drawing Title
Ground Investigation Locations

Scale at A3
1:1,900

Arup Job No
282022

Suitability
Issue

Name
Drawing 01

Rev
P1

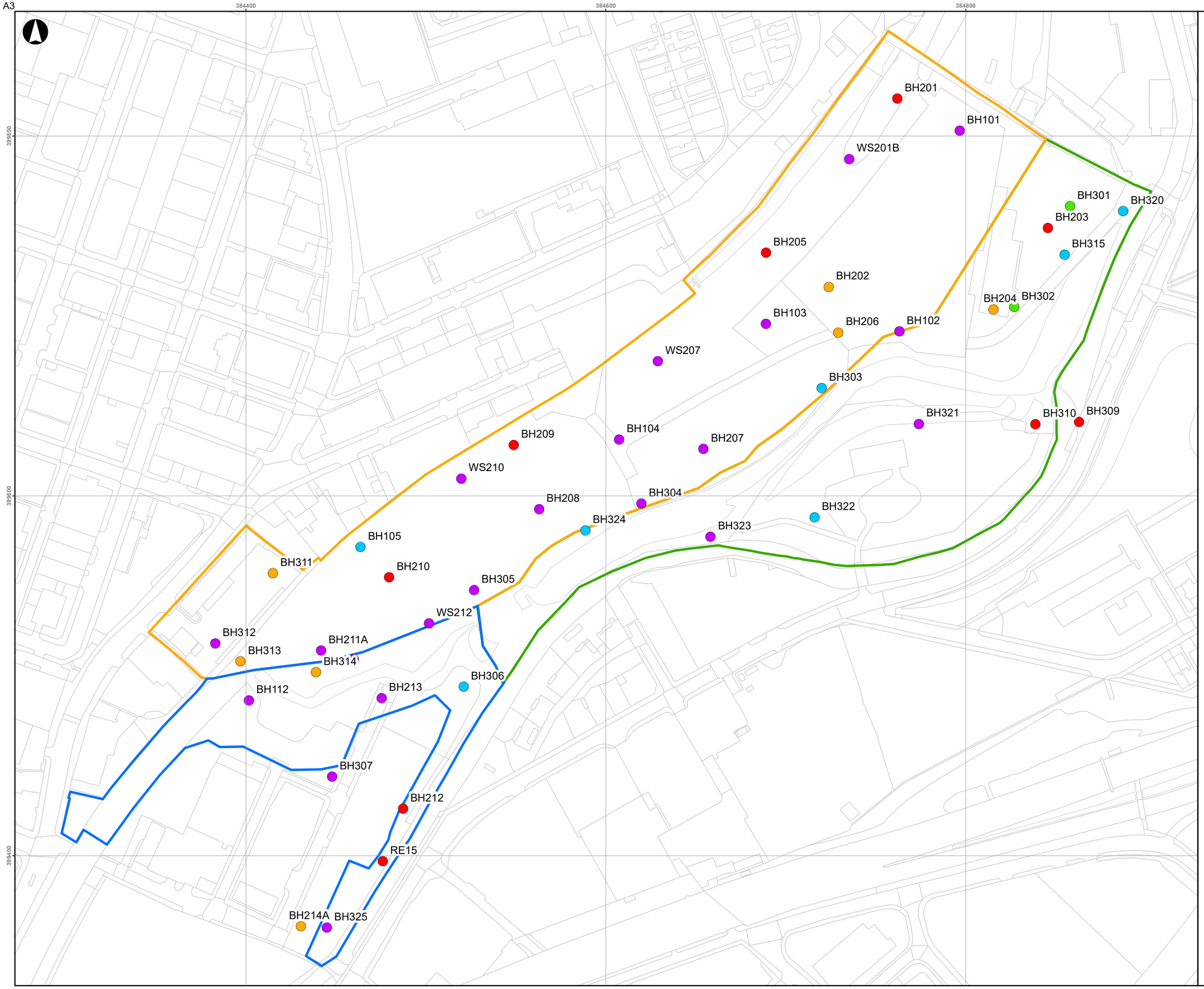
\\global\gis\UK\282000\282022-00 Vic North\Workspaces\VN Phase 3 GIR.mxd

© Arup

A3

384400 384600 384800

399800 399600 399400



Legend

Site Area

- Red Bank Plateau
- Red Bank Terrace
- St Catherine's Wood

Monitoring Installations

Response strata

- Made ground
- Alluvium
- Glacial till
- Bedrock
- Inclinometer

Issue	Date	By	Chkd	Appd
P1	2022-08-01	LH	LH	LH

Metres
0 25 50 100

ARUP

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Manchester , M1 3BN
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Client
BAM Nuttall Limited

Project Title
Victoria North
This drawing relates to
Ground Investigation Interpretive Report
VNIF-ARP-ZZ-YYY-RP-CG-0012

Drawing Title
Monitoring Installations

Scale at A3
1:1,900

Arup Job No
282022-00

Suitability
Issue

Name
Drawing 02

Rev
P1

\\globalgis\UK\280000\282022-00 Vic North\Workspaces\VN Phase 3 GIR - Drawing 02 onwards.mxd

© Arup

A3

384400 384600 384800

399800 399600 399400

TP101 (0.8-0.9m)
TP213 (1.2-4.5m)
TP206A (1.7-4.5m)
BH320 (3-6.7m)
TT302 (0.7-1.1m)
TP202B (0.1-0.6m)
TP202C (0.5-1.2m)
BH203 (5.5-7.5m)
TP204 (2.4-4.5m)
TP205 (1.9-4.2m)
BH103 (0.1-1.3m)
BH102 (3m)
BH321 (4.4-5.6m)
BH310 (3.9-5.6m)
BH207 (13-15.7m)
TP216 (1.1-1.2m)
BH327 (7.4-8.0m)
BH322 (0.9-3.3m)
BH211A (10.1-10.5m)
BH314 (8.2-9.3m)
BH306 (1.8-3.9m)
TP120 (0.7-1.8m)

Legend

Site Area

- Red Bank Plateau
- Red Bank Terrace
- St Catherine's Wood

Contamination observed during fieldwork

- Hydrocarbon odour
- Metallic blue sand
- Oily groundwater

Key features

- Bridge
- Carriage Shed
- Infilled Channel
- Infilled Water Body
- Railway Turntable
- River Irk
- Gasworks footprint

Contamination in BH102 was noted during subsequent groundwater sampling

Issue	Date	By	Chkd	Appd
P1	2022-08-05	LH	LH	LH

Metres
0 25 50 100

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Client
BAM Nuttall Limited

Project Title
Victoria North
This drawing relates to
Ground Investigation Interpretive Report
VNIF-ARP-ZZ-YYY-RP-CG-0012

Drawing Title
Visual and Olfactory Evidence of Contamination

Scale at A3
1:1,900

Arup Job No
282022-00

Suitability
Issue

Name
Drawing 03

Rev
P1

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A3

384400 384600 384800

399800 399600 399400

TP202A (1.2m)
TP202 (1.4m)
TP202B (0.6m)
TP102 (4.1m)
TP202C (1.2m)
TP206 (0.9m)
TT303A (1.1m)
TT303 (0.3m)
TT302 (0.7-1.1m)
TT301 (1.4-2.7m)
WS103 (3.9m)
OP04 (0.18m)
OP03 (0.2m)
OP02 (0.4m)
OP01 (0.15m)
Zone of surface obstructions including turntables and concrete slab
Buried retaining wall
BH308 (1.6-7.4m)

Legend

Site Area

- Red Bank Plateau
- Red Bank Terrace
- St Catherine's Wood
- Obstructions encountered during formation of exploratory holes

Key features

- Carriage Shed
- Railway Turntable
- River Irk
- Gasworks footprint

A number of surface obstructions were observed during the fieldworks which were not recorded in exploratory holes. These included two rail turntables, a number of drainage chambers, and shallow concrete slabs located in the North Western side of Red Bank Plateau. Please refer to the site clearance drawing (VNIF-ARP-00-YYY-DR-G-0013) which shows obstructions needed to be removed during pre-construction works.

Issue	Date	By	Chkd	Appd
P1	2022-08-05	LH	LH	LH

Metres
0 25 50 100

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Client
BAM Nuttall Limited

Project Title
Victoria North

This drawing relates to
Ground Investigation Interpretive Report
VNIF-ARP-ZZ-YYY-RP-CG-0012

Drawing Title
Historic Features and Potential Development Constraints

Scale at A3
1:1,900

Arup Job No
282022-00

Suitability
Issue

Name
Drawing 04

Rev
P1

\\globalgis\UK\280000\282022-00 Vic North\Workspaces\VN Phase 3 GIR - Drawing 02 onwards.mxd

© Arup

Distance along baseline (m)

Elevation (mOD)

Creamline Dairies location

Honey Street retaining wall

Shallow cohesive made ground layer

Buried carriage shed location

Made Ground

Made Ground

Glacial Till

Manchester Marl

Chester Pebble Bed formation

BH312 (7.4)

BH311 (-6.8)

01_BH105 (7.6)

OP04 (9.1)

GEO_TP216 (-8.8)

GEO_WS210 (-0.1)

GEO_BH209 (-1.6)

TP308 (1.0)

01_TP111 (-3.1)

GEO_TP211 (8.8)

GEO_WS207 (-1.4)

01_TP108 (1.9)

GEO_BH205 (-3.2)

01_TP102 (-1.8)

GEO_TP202B (0.6)

TP309 (8.1)

GEO_TP202 (7.3)

GEO_TP201 (5.4)

Ground level from EA LiDAR data

SCALE 1:133V 1:1528H @ A3-L

LEGEND

Hole offset is +ve to the RIGHT of the baseline

HoleID (Offset) N20*

SPT N value, * denotes N extrapolated by gINT: * from main blows ** from seating blows

PLAN



COLOUR LEGEND

- Made Ground - Granular [MG-G]
- Made Ground - Cohesive [MG-CO]
- Made Ground - Concrete [MG-Conc]
- Glacial Till Deposits - Cohesive [GTD - CO]
- Glacial Till Deposits - Granular [GTD - G]
- Chester Formation [CHES]
- Manchester Marls Formation [MM]
- Assumed ground water profile in Glacial Till

MATERIALS

- Fill (MADE GROUND)
- Silty gravelly SAND
- SAND
- Gravelly SAND
- Silty SAND
- SANDSTONE
- Gravelly CLAY
- Sandy gravelly CLAY
- Silty sandy CLAY
- Sandy cobbly GRAVEL
- Clayey gravelly SAND
- Silty gravelly CLAY
- SAND and GRAVEL
- MUDSTONE
- Sandy CLAY
- Silty sandy gravelly CLAY

Refer to Drawing 01 For cross section locations

This drawing relates to
Ground Investigation Interpretive Report

VNIF-ARP-ZZ-YYY-RP-CG-0012

ARUP

Job Title
Victoria North

Figure Title
Geological Long section
Red Bank Plateau

Job No
282022

Drawing 05A

ARUP_gINT v10.00.01.07. Made by Jonny Tyrer on 17-May-22

Library: arup_gIntb_4-a-002. Report: 2.1.01 SECTION WITH WATER & SPT (A3)
Database: c:\gints\bra northallerton + rw.gpj\01.22 - 282022_victoria_north_stage 3 data_inc_rivenworks.gpj RevP1.1 (SO - Work in progress)

Distance along baseline (m)

Elevation (mOD)

01_BH105 (27.3)
GEO_WS210 (-39.7)
GEO_BH210 (26.8)
GEO_WS212
BH305 (27.6)

Made Ground
Granular

Glacial Till

Chester Pebble Bed formation

High SPT - may be bedrock

?

Ground level from EA LiDAR data

SCALE 1:133V 1:361H @ A3-L

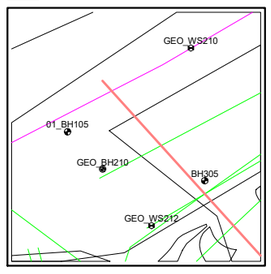
LEGEND

Hole offset is +ve to the RIGHT of the baseline

HoleID (Offset) N20*

SPT N value, * denotes N extrapolated by gINT:
* from main blows
** from seating blows

PLAN



COLOUR LEGEND

- Made Ground - Granular [MG-G]
- Made Ground - Cohesive [MG-CO]
- Glacial Till Deposits - Granular [GTD - G]
- Chester Formation [CHES]
- Assumed ground water profile based on glacial till

MATERIALS

- Fill (MADE GROUND)
- Silty gravelly SAND
- SAND
- Gravelly SAND
- Silty SAND
- SANDSTONE
- Clayey SAND
- Clayey gravelly SAND
- Clayey sandy GRAVEL

Refer to Drawing 01 For cross section locations

This drawing relates to
Ground Investigation Interpretive Report

VNIF-ARP-ZZ-YYY-RP-CG-0012

ARUP

Job Title
Victoria North

Figure Title
Geological cross section

Red Bank Plateau

Job No
282022

Drawing 05B

ARUP_gINT v10.00.01.07. Made by Jonny Tyrer on 8-Jul-22

Library: arup_uklib_4-s-002; Report: 2.1.01 SECTION WITH WATER & SPT (A3)
Database: C:\gINT\Victoria North\Vic + N v gINT282022 - 282022_victoria_north_stage 3 data_inc_riverworks.gpj RevP1.1 (SO - Work in progress)

Distance along baseline (m)

Elevation (mOD)

GEO_BH209 (36.4)
GEO_WS207 (-55.3)
01_BH104 (-11.2)
BH327 (8.6)
BH328 (-10.6)
BH304 (-0.1)
BH304A (2.1)
BH323 (-15.8)
52_WS4 (-0.4)

Made Ground
Granular

Cohesive pockets

Glacial Till

Cohesive pockets

BH323 is upstream to the east.
Bedrock drops in elevation to the west

Original rail viaduct present to the left and rail sidings expanded to the right of this line

Transition from higher density MG behind plateau and loose material forming plateau slope

Bedrock

Assumed relic surface soil material containing tree remnants associated with the historical mill race

Honey street retaining wall

Ground level from EA LiDAR data

SCALE 1:133V 1:389H @ A3-L

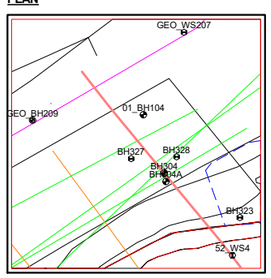
LEGEND

Hole offset is +ve to the RIGHT of the baseline

HoleID (Offset) N20*

SPT N value, * denotes N extrapolated by gINT: * from main blows ** from seating blows

PLAN



COLOUR LEGEND

- Made Ground [MG]
- Made Ground - Granular [MG-G]
- Made Ground - Cohesive [MG-CO]
- Alluvium granular [ALV-G]
- Glacial Till Deposits - Cohesive [GTD - CO]
- Glacial Till Deposits - Granular [GTD - G]
- Manchester Marls Formation [MM]
- Assumed ground water profile in made ground

MATERIALS

- Fill (MADE GROUND)
- Sandy gravelly CLAY
- SAND
- CLAY
- SANDSTONE
- TOPSOIL
- Silty gravelly SAND
- MUDSTONE
- Gravelly SAND
- Clayey gravelly SAND

Refer to Drawing 01 For cross section locations

This drawing relates to
Ground Investigation Interpretive Report

VNIF-ARP-ZZ-YYY-RP-CG-0012

ARUP

Job Title
Victoria North

Figure Title
Geological cross section
Red Bank Plateau

Job No
282022

Drawing 05C

ARUP. gINT v10.00.01.07. Made by Jonny Tyrer on 8-Jul-22

Library: arup_uk6b_4-a-002. Report 2.1 01 SECTION WITH WATER & SPT (A3)
Database: c:\gintx\bra northlinfra + rw gint2016.22 - 282022_victoria_north_stage 3 data_inc_riverworks.gpj

Distance along baseline (m)

Elevation (mOD)

GEO_BH215 (-5.8)

BH312 (2.9)

BH313 (7.2)

GEO_BH211A (-26.6)

BH314 (-9.1)

Made Ground

Glacial Till deposits

Chester Pebble Bed formation

Honey street wall

approximate location of the viaduct wall

BH211A and BH314 are part of the Redbank Terrace ground model (refer to drawing 06)

Base of walls not proven

Ground level from EA LiDAR data

SCALE 1:111V 1:250H @ A3-L

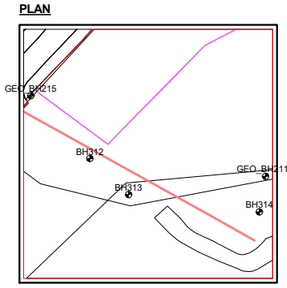
LEGEND

Hole offset is +ve to the RIGHT of the baseline

HoleID (Offset) N20*

SPT N value, * denotes N extrapolated by gINT: * from main blows ** from seating blows

PLAN



COLOUR LEGEND

- Made Ground - Granular [MG-G]
- Made Ground - Cohesive [MG-CO]
- Made Ground - Concrete [MG-Conc]
- Glacial Till Deposits - Cohesive [GTD - CO]
- Glacial Till Deposits - Granular [GTD - G]
- Chester Formation [CHES]
- Assumed ground water profile in Glacial TIll

MATERIALS

- Fill (MADE GROUND)
- Gravelly CLAY
- Clayey gravelly SAND
- Silty gravelly CLAY
- SAND and GRAVEL
- SAND
- SANDSTONE
- Sandy CLAY
- Sandy gravelly CLAY

Refer to Drawing 01 For cross section locations

This drawing relates to
Ground Investigation Interpretive Report

VNIF-ARP-ZZ-YYY-RP-CG-0012

ARUP

Job Title
Victoria North

Figure Title
Geological cross section

Red Bank Plateau

Job No
282022

Drawing 05D

ARUP gINT v10.00.01.07. Made by Jonny Tyrer on 27-May-22

Library: arup_ukltb_4-a-002; Report: 2.1.01 SECTION WITH WATER & SPT (A3)
Database: c:\gint\ezbra northallia - i've gint\123.22 - 282022_victoria_north_stage 3 data_inc_riverworks.gpj; RevP1.1; (SO - Work in progress)

Distance along baseline (m)

0 10 20 30 40 50 60 70 80 90

Elevation (mOD)

48 46 44 42 40 38 36 34 32 30 28

BH311 (-1.3)

N10 N12 N22 N75* N33 N25 N25 N40 N42 N67 N375* N1500*

GEO_TP214 (-4.4)

GEO_WS213 (-4.9)

GEO_WS213A (-6.9)

N2 N7 N14

01_TP115 (-3.4)

01_BH106 (8.7)

N N9 N N15 N N8 N N7 N N11 N N12 N N15 N405* N938*

Made Ground

Glacial Till

Chester Pebble Bed formation

?

Ground level from EA LiDAR data

SCALE 1:111V 1:250H @ A3-L

Library: arup_uklib_4-x-002: Report 2.1.07 SECTION WITH WATER & SPT (A3)
Database: c:\gint\victoria north\arup v 10 gint\db8.22 - 282062_victoria_north_stage 3 data_inc_rivenworks.gpj RevP1.1 (SO - Work in progress)

ARUP_gINT v10.00.01.07. Made by Jonny Tyrer on 20-Jun-22

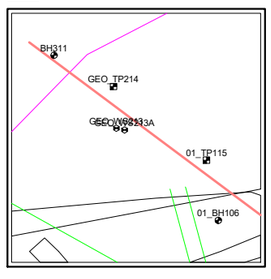
LEGEND

Hole offset is +ve to the RIGHT of the baseline

HoleID (Offset) N20*

SPT N value, * denotes N extrapolated by gINT: * from main blows ** from seating blows

PLAN



COLOUR LEGEND

- Made Ground - Granular [MG-G]
- Made Ground - Cohesive [MG-CO]
- Made Ground - Concrete [MG-Conc]
- Glacial Till Deposits [GTD]
- Glacial Till Deposits - Cohesive [GTD - CO]
- Glacial Till Deposits - Granular [GTD - G]
- Chester Formation [CHES]
- Assumed ground water profile in Glacial Till

MATERIALS

- Fill (MADE GROUND)
- Sandy gravelly CLAY
- SANDSTONE
- Gravelly CLAY
- Gravelly SAND
- Silty sandy CLAY
- Sandy cobbly GRAVEL

Refer to Drawing 01 For cross section locations

This drawing relates to
Ground Investigation Interpretive Report

VNIF-ARP-ZZ-YYY-RP-CG-0012

ARUP

Job Title
Victoria North

Figure Title
Geological cross section

Red Bank Plateau

Job No
282022

Drawing 05E

Distance along baseline (m)

0 10 20 30 40 50 60 70 80 90 100

Elevation (mOD)

42 40 38 36 34 32 30 28 26 24 22 20

GEO_BH211A (5.0)

01_BH106 (-11.3)

BH314 (10.1)

GEO_BH213 (-20.6)

01_TP119 (-25.2)

01_TP120 (9.3)

BH307 (8.3)

Made Ground Granular

Glacial Till

Chester Pebble Bed formation

Historical reservoir has been infilled during the expansion of the rail sidings which has caused variation in the Glacial till profile.

Ground level from EA LiDAR data

SCALE 1:122V 1:278H @ A3-L

Library: arup_ukllb_4-s-002; Report: 2.1.01 SECTION WITH WATER & SPT (A3)
Database: C:\gINT\Victoria North\Victoria North.GPJ; Template: 3 data_inc_riverworks.gpj; RevP1.1 (SO - Work in progress)

ARUP gINT v10.00.01.07. Made by Jonny Tyrer on 14-Jun-22

LEGEND

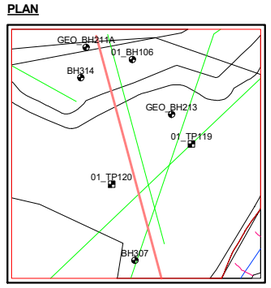
Hole offset is +ve to the RIGHT of the baseline

HoleID (Offset)

SPT N value, * denotes N extrapolated by gINT:
* from main blows
** from seating blows

N20*

PLAN



COLOUR LEGEND

- Made Ground - Granular [MG-G]
- Made Ground - Cohesive [MG-CO]
- Glacial Till Deposits [GTD]
- Glacial Till Deposits - Granular [GTD - G]
- Chester Formation [CHES]
- Assumed ground water profile in made ground

MATERIALS

- Fill (MADE GROUND)
- Sandy gravelly CLAY
- SANDSTONE
- SAND and GRAVEL
- Clayey gravelly SAND
- Gravelly SAND
- CLAY
- SAND

Refer to Drawing 01 For cross section locations

This drawing relates to
Ground Investigation Interpretive Report

VNIF-ARP-ZZ-YYY-RP-CG-0012

ARUP

Job Title
Victoria North

Figure Title
Geological cross section

Red Bank Terrace

Job No
282022

Drawing 06

Distance along baseline (m)

Elevation (mOD)

GEO_WS205 (6.6)

BH303 (-8.9)

01_WS101 (11.9)

BH322 (47.4)

01_WS102 (11.5)

GEO_WS204 (-3.2)

Made ground

Possible historical mill race sediments/alluvium

Base of made ground

Manchester Marl

Alluvium

Water strike.

20min Moderate inflow.

?

Ground level from EA LiDAR data

SCALE 1:133V 1:500H @ A3-L

LEGEND

Hole offset is +ve to the RIGHT of the baseline

HoleID (Offset) N20*

SPT N value, * denotes N extrapolated by gINT: * from main blows ** from seating blows

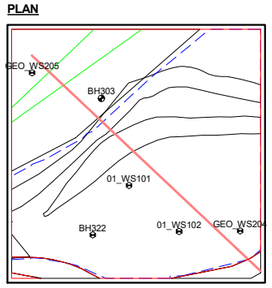
Water strikes during boring / excavation

Time for reported water rise and flow rate remarks

Level that water rose to

Level of water strike

PLAN



COLOUR LEGEND

- Made Ground - Granular [MG-G]
- Alluvium Cohesive [ALV-CO]
- Alluvium granular [ALV-G]
- Glacial Till Deposits - Cohesive [GTD - CO]
- Manchester Marls Formation [MM]
- Assumed ground water profile in made ground / alluvium

MATERIALS

- Fill (MADE GROUND)
- Silty Clay
- MUDSTONE
- Clayey sandy GRAVEL
- Sandy CLAY
- Clayey SAND
- SAND
- SAND and GRAVEL
- Sandy gravelly CLAY

Refer to Drawing 01 For cross section locations

This drawing relates to
Ground Investigation Interpretive Report

VNIF-ARP-ZZ-YYY-RP-CG-0012

ARUP

Job Title
Victoria North

Figure Title
Geological cross section

St Catherine's Wood

Job No
282022

Drawing 07A

ARUP, gINT v10.00.01.07. Made by Jonny Tyrer on 24-Jun-22

Library: arup_uk\lb_4-a-002_Report 2_1 01 SECTION WITH WATER & SPT (A3)
Database: c:\gint\victoria northern\vn ++ngint\282022_victoria_north_stage 3 data_inc_riverworks.gpj RevP1.1 (SO - Work in progress)

Distance along baseline (m)

Elevation (mOD)

Made Ground Granular

Made Ground Cohesive

Collyhurst formation

Alluvium Granular

Made Ground Granular

Made Ground Cohesive

Possible former course of River

BH310 Is further down stream below Collyhurst weir, but ground water profile is based on borehole piezometric data rather than surface topography

Ground level from EA LiDAR data

SCALE 1:156V 1:278H @ A3-L

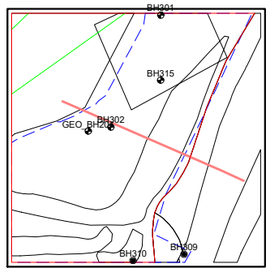
LEGEND

Hole offset is +ve to the RIGHT of the baseline

HoleID (Offset) N20*

SPT N value, * denotes N extrapolated by gINT:
* from main blows
** from seating blows

PLAN



COLOUR LEGEND

- Made Ground - Granular [MG-G]
- Made Ground - Cohesive [MG-CO]
- Made Ground - Concrete [MG-Conc]
- Alluvium granular [ALV-G]
- Manchester Marls Formation [MM]
- Collyhurst Sandstone Formation [CS]
- Assumed ground water profile in made ground / bedrock

MATERIALS

- Fill (MADE GROUND)
- SANDSTONE
- TOPSOIL
- Sandy CLAY
- Silty sandy CLAY
- Silty SAND
- Sandy gravelly CLAY
- Clayey sandy GRAVEL
- Gravelly SAND
- SAND and GRAVEL

Refer to Drawing 01 For cross section locations

This drawing relates to
Ground Investigation Interpretive Report

VNIF-ARP-ZZ-YYY-RP-CG-0012

ARUP

Job Title
Victoria North

Figure Title
Geological cross section

North East of St Catherine's Wood

Job No
282022

Drawing 07B

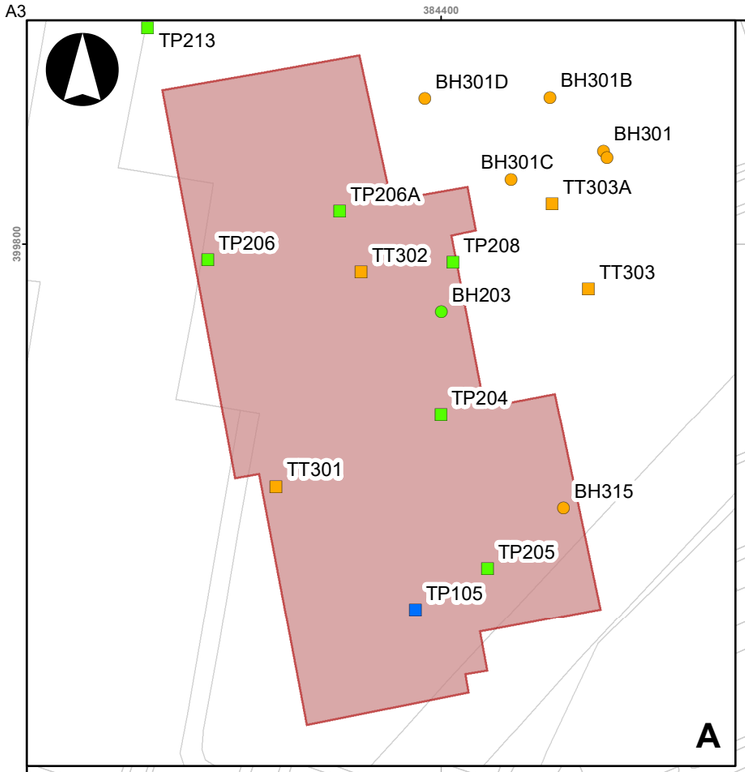
ARUP, gINT v10.00.01.07. Made by Jonny Tyrer on 10-Aug-22

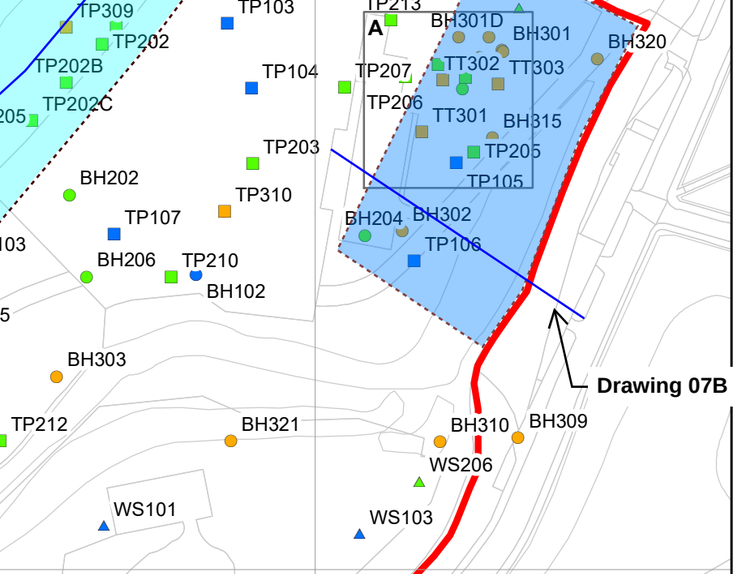
Library: arup_uklib_4-a-002, Report 2.1.01 SECTION WITH WATER & SPT (A3)
Database: c:\gint\victoria north\fire + rs gint\27.07.22 - 282022_victoria_north_stage 3 data_inc_riverworks.gpj RevP1.1 (50 - Work in progress)

A3

384400 384600 384800

3398600 3396600 3394600





Drawing 05A

Drawing 05B

Drawing 05C

Drawing 07B

Legend

Site Boundary

Phase 1 GI
- Borehole
- Trial pit
- Window sample

Phase 2 GI
- Borehole
- Trial pit
- Window sample

Phase 3 GI
- Borehole
- Trial pit
- Window sample

River Engineering Works GI
- Borehole
- Gasworks footprint

Approximate extent of cohesive zones in made ground

Approximate extent of glacial till

Geological cross section locations (with drawing reference)

P0	2022-06-23	LH	LH	LH

Issue	Date	By	Chkd	Appd

Metres: 0 25 50 100

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Tel+44(0161) 228 2331 Fax+44(0161)228 6879
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Client
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Project Title
Victoria North

This drawing relates to
Ground Investigation Interpretive Report
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Drawing Title
Approximate extent of cohesive made ground and glacial till

Scale at A3
1:1,900

Arup Job No
282022

Suitability
Issue

Name
Drawing 08

Rev
P1

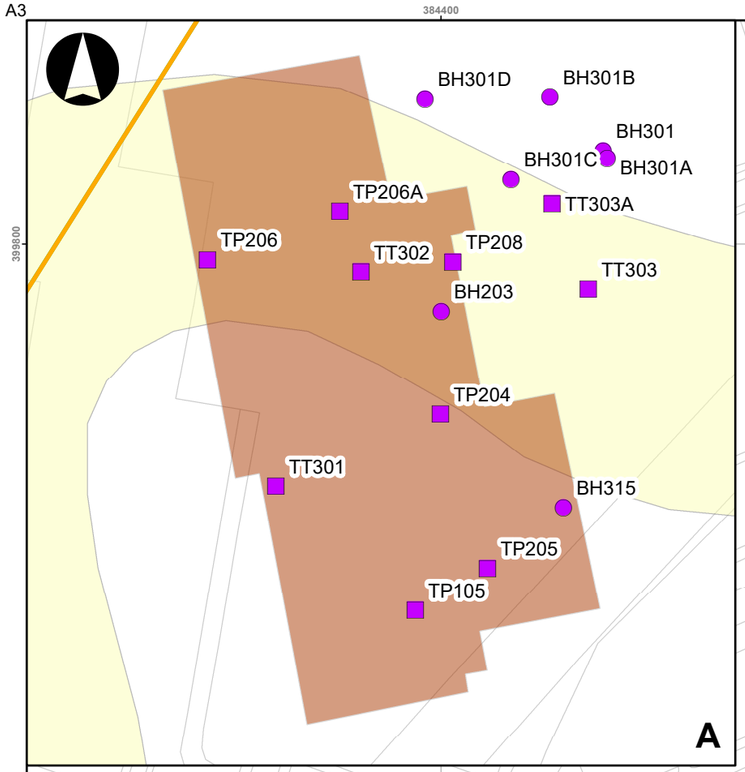
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A3

384400 384600 384800

399800 399600 399400



BH201
TP201
TP202A
TP202
TP202B
TP202C
BH202
BH103
BH303
BH207
BH304
BH210
BH211A
BH314
BH306
BH320
BH302
BH315
TP105
TP205
TT301

Legend

Site Area
- Red Bank Plateau
- Red Bank Terrace
- St Catherine's Wood

Exploratory hole
- Borehole
- Trial pit

Key features
- Bridge
- Carriage Shed
- Infilled Channel
- Infilled Water Body
- River Irk
- Gasworks footprint

Issue	Date	By	Chkd	Appd
P1	2022-08-05	LH	LH	LH

Metres
0 25 50 100

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Project Title
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Drawing Title
Exploratory Holes Targetting Historical Features

Scale at A3
1:1,900

Arup Job No
282022

Suitability
Issue

Name
Drawing 09

Rev
P1

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A3

384400 384600 384800

399800 399600 399400

Manchester Marl

Collyhurst Sandstone

Chester Pebble Beds

38.8 36.38 37.78 34.16 38.57 36.59 36.13 34.02 30.9 30.56 28.6 28.89 33.01 25.94 26.46 25.58 26.2 28.31 31.87 29.4 26.85 28.57 29.6 29.14 29.75 29.87 29.31 28.64 25.85 28.25 26.91 24.86 24.68 24.41 25.93 26.05 25.47 28.37 25.49 26.6 26.6

38mOD 36mOD 34mOD 32mOD 30mOD 28mOD 28mOD 28mOD 28mOD 28mOD 28mOD 28mOD

Legend

Bedrock encountered (moD)

- Chester Pebble Beds
- Collyhurst Sandstone
- Manchester Marl
- Inferred rockhead contours (mOD)
- Inferred bedrock boundaries

The coloured background displays the BGS 1:50,000 bedrock map

Issue	Date	By	Chkd	Appd
P1	2022-08-05	LH	LH	LH

Metres
0 25 50 100

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Client
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Project Title
Victoria North

This drawing relates to
Ground Investigation Interpretive Report
VNIF-ARP-ZZ-YYY-RP-CG-0012

Drawing Title
Bedrock Elevation

Scale at A3
1:1,900

Arup Job No
282022-00

Suitability
Issue

Name
Drawing 10

Rev
P1

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A3

384400 384600 384800

399800 399600 399400

38.5
42.8
Dry
29.5
37.4
40.5
40.1
39.6
39.7
41.6
34.3
30.2
33.1
28.9
35 mOD
38.6
Dry
28.7
29.2
28.8
Dry
37
37.7
30 mOD
Dry
Dry
41.8
36.1
32.9
Dry
30.6
28 mOD
Dry
28.9
27.5
28.6
Dry
27 mOD
27.2
26.6
26.7

Legend

Site Area

- Red Bank Plateau
- Red Bank Terrace
- St Catherine's Wood
- Groundwater levels in made ground (mOD)
- Groundwater levels in alluvium (mOD)
- Groundwater levels in glacial till (mOD)
- Inferred shallow groundwater contour (mOD)

Shallow groundwater contours have been interpreted from made ground and alluvium data only

Issue	Date	By	Chkd	Appd
P1	2022-08-05	LH	LH	LH

Metres
0 25 50 100

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Client
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Project Title
Victoria North

This drawing relates to
Ground Investigation Interpretive Report
VNIF-ARP-ZZ-YYY-RP-CG-0012

Drawing Title
Groundwater Elevation in Shallow Aquifer

Scale at A3
1:1,900

Arup Job No
282022-00

Suitability
Issue

Name
Drawing 11

Rev
P1

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A3

384400 384600 384800

399800 399600 399400

38
Collyhurst Sandstone
29.7
36.4
Manchester Marl
28.4
27.7
28.9
32.1
Chester Pebble Beds
30.6
Dry
27
27.2

Legend

Site Area

- Red Bank Plateau
- Red Bank Terrace
- St Catherine's Wood
- Groundwater levels in bedrock (mOD)
- Inferred bedrock boundaries

Issue	Date	By	Chkd	Appd
P1	2022-08-05	LH	LH	LH

Metres
0 25 50 100

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Client
BAM Nuttall Limited

Project Title
Victoria North

This drawing relates to
Ground Investigation Interpretive Report
VNIF-ARP-ZZ-YYY-RP-CG-0012

Drawing Title
Groundwater Elevation in Bedrock

Scale at A3
1:1,900

Arup Job No
282022-00

Suitability
Issue

Name
Drawing 12

Rev
P1

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A3

384400 384600 384800

399800 399600 399400

WS201
TP202
SoilSamp05
TP213
BH301D
TT302
PAH
TP206
TP210
BH102
WS205
BH303
TP109
TP110
TP212
BH209
BH104
SoilSamp10
BH207
TP112
BH327
BH304
BH328
BH208
BH326
TP305
BH324
TP306
BH305
TP115
WS212
OP01
BH211A

Legend

Site Area

- Red Bank Plateau
- Red Bank Terrace
- St Catherine's Wood

GAC Exceedances

- No contaminants tested exceed GAC
- >1 contaminant exceeds GAC
- >1 contaminant significantly exceeds GAC

Issue	Date	By	Chkd	Appd
P1	2022-08-05	LH	LH	LH

Metres
0 25 50 100

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Client
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Project Title
Victoria North

This drawing relates to
Ground Investigation Interpretive Report
VNIF-ARP-ZZ-YYY-RP-CG-0012

Drawing Title
Human Health Risk Assessment for Residential without Plant Uptake

Scale at A3
1:1,900

Arup Job No
282022-00

Suitability
Issue

Name
Drawing 13

Rev
P1

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A3

384400

384600

384800

399800

399600

399400

BH301

TT303
PAH

BH323

BH314

BH306

BH213

TP120

TP219

BH307

BH110

BH308

Legend

Site Area

- Red Bank Plateau
- Red Bank Terrace
- St Catherine's Wood

GAC Exceedances

- No contaminants tested exceed GAC
- >1 contaminant exceeds GAC
- >1 contaminant significantly exceeds GAC

Issue	Date	By	Chkd	Appd
P1	2022-08-05	LH	LH	LH

Metres

0 25 50 100

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Client

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Project Title

Victoria North

This drawing relates to
Ground Investigation Interpretive Report

VNIF-ARP-ZZ-YYY-RP-CG-0012

Drawing Title

Human Health Risk Assessment for Public Open Space

Scale at A3

1:1,900

Arup Job No	Suitability
282022-00	**Issue**

Name

Drawing 14

Rev

P1

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A3

384400

384600

384800

399800

399600

399400

SoilSamp07

BH301

TP206

TT302

BH315

TP105

TP210

WS207

WS103

BH323

OP01

BH112

TP120

BH110

BH212A

Legend

Site Area

- Red Bank Plateau
- Red Bank Terrace
- St Catherine's Wood

Asbestos identification

- Asbestos detected
- Asbestos not detected

Issue	Date	By	Chkd	Appd
P1	2022-08-05	LH	LH	LH

Metres

0 25 50 100

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Project Title

Victoria North

This drawing relates to
Ground Investigation Interpretive Report

VNIF-ARP-ZZ-YYY-RP-CG-0012

Drawing Title

Identification of Asbestos in Soil Samples

Scale at A3

1:1,900

Arup Job No

282022-00

Suitability

Issue

Name

Drawing 15

Rev

P1

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A3

384400 384600 384800

399800 399600 399400

WS201B
NH4

2022 U/S

TP202B
PAH

TP202C
PAH

BH205

BH315
Mn, cyanide, PAH, NH4

BH202
Cd, Zn, Mn

BH204
Cd, Zn

BH103
Mn, cyanide

BH206

BH102
Pb, TPH, PAH

WS207
NH4

BH303
PAH

BH209

BH207

WS210

BH208

BH105
Cd, Mn

BH210
NH4

2022 Central

BH211A
Cyanide

BH314
Pb, Mn, cyanide, NH4

BH306
Cd, Cr, Pb, cyanide, NH4

BH212
Cd, Pb, cyanide

RE15

BH214A

2022 D/S
Hg

Legend

Site Area

- Red Bank Plateau
- Red Bank Terrace
- St Catherine's Wood

GAC Exceedances

- No contaminants tested exceed GAC
- >1 contaminant exceeds GAC
- >1 contaminant significantly exceeds GAC

Issue	Date	By	Chkd	Appd
P1	2022-08-08	LH	LH	LH

Metres
0 25 50 100

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Client
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Project Title
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This drawing relates to
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Drawing Title
Controlled Waters Risk Assessment

Scale at A3
1:1,900

Arup Job No
282022-00

Suitability
Issue

Name
Drawing 16

Rev
P1

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A3

384400 384600 384800

399800 399600 399400

BH101 (0.8m)
BH203 (11.7m)
TT303 (0.35m)
TT302 (0.3m, 0.8m)
TT301 (2.45m)
BH103 (1m)
BH102 (3.5m)
WS205 (2m)
TP109 (0.3m)
BH327 (7.4m)
BH323 (0.5m)
BH314 (7.5m)
BH306 (0.5m, 1m)
BH213 (1.2m)
TP120 (0.3m)
BH110 (3m)
BH308 (1m)

Legend

Site Area

- Red Bank Plateau
- Red Bank Terrace
- St Catherine's Wood

HazWasteOnline classification

- Hazardous
- Non Hazardous

Issue	Date	By	Chkd	Appd
P1	2022-08-04	LH	LH	LH

Metres
0 25 50 100

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Project Title
Victoria North

This drawing relates to
Ground Investigation Interpretive Report

VNIF-ARP-ZZ-YYY-RP-CG-0012

Drawing Title
Hazardous Waste Classification

Scale at A3
1:1,900

Arup Job No
282022-00

Suitability
Issue

Name
Drawing 17

Rev
P1

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A3

384400 384600 384800

399800 399600 399400

SoilSamp05 TP102 WS202 BH301D TT303A TT302 BH203 TT301 SoilSamp09 BH103 WS207 WS205 SoilSamp04 BH303 TP109 TP212 BH310 TP215 TP304 SoilSamp10 BH207 TP112 WS210 BH327 BH328 TP305 BH326 BH304 BH324 BH322 BH323 TP306 WS211 BH210 BH305 TP115 WS212 BH211A BH106 BH306 BH212 BH308

Legend

Site Area

- Red Bank Plateau
- Red Bank Terrace
- St Catherine's Wood

Landfill type

- Inert
- Non-Hazardous
- Hazardous
- Hazardous – requires TOC treatment

Issue	Date	By	Chkd	Appd
P1	2022-08-04	LH	LH	LH

Metres

0 25 50 100

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Project Title
Victoria North

This drawing relates to
Ground Investigation Interpretive Report

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Drawing Title
Waste Acceptance Criteria Classification

Scale at A3
1:1,900

Arup Job No	Suitability
282022-00	**Issue**

Name	Rev
Drawing 18	**P1**

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A3

384400 384600 384800

399800 399600 399400

BH201
BH101
WS201B
BH320
BH205
BH315
BH202
BH204
BH206
BH102
BH209
BH207
BH321
BH208
BH304
BH323
BH311
BH305
BH312
BH313
BH314
BH306
BH112
BH213
BH307
BH325

Legend

Site Area

- Red Bank Plateau
- Red Bank Terrace
- St Catherine's Wood

Characteristic Situation

- CS1
- CS2
- CS3

Key features

- Infilled Channel
- Infilled Water Body
- Bridge

Issue	Date	By	Chkd	Appd
P1	2022-08-05	LH	LH	LH

Metres
0 25 50 100

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Project Title
Victoria North

This drawing relates to
Ground Investigation Interpretive Report
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Drawing Title
Gas Risk Assessment

Scale at A3
1:1,900

Arup Job No
282022-00

Suitability
Issue

Name
Drawing 19

Rev
P1

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A3

384400 384600 384800

399800 399600 399400

BH101 (0.8m)
TP202 (0.3m)
TP104 (0.3m)
TT302 (2.45m)
TT303 (0.35m)
TT301 (0.3m)
BH103 (0.3m)
BH102 (0.3m, 3.5m)
TP210 (0.3m)
BH305 (1.0m)
OP02 (0.1m)
BH211A (10.5m)
OP01 (0.1m)

Legend

Site Area

- Red Bank Plateau
- Red Bank Terrace
- St Catherine's Wood
- Samples exceeding TPH saturation limit

Key features

- Bridge
- Carriage Shed
- Infilled Channel
- Infilled Water Body
- Railway Turntable
- River Irk
- Gasworks footprint
- Approximate Extent of Regrading & Reduced Level Dig

Issue	Date	By	Chkd	Appd
P1	2022-08-12	LH	LH	LH

Metres
0 25 50 100

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Project Title
Victoria North

This drawing relates to
Ground Investigation Interpretive Report

VNIF-ARP-ZZ-YYY-RP-CG-0012

Drawing Title
Samples Exceeding TPH Saturation Limit

Scale at A3
1:1,900

Arup Job No
282022-00

Suitability
Issue

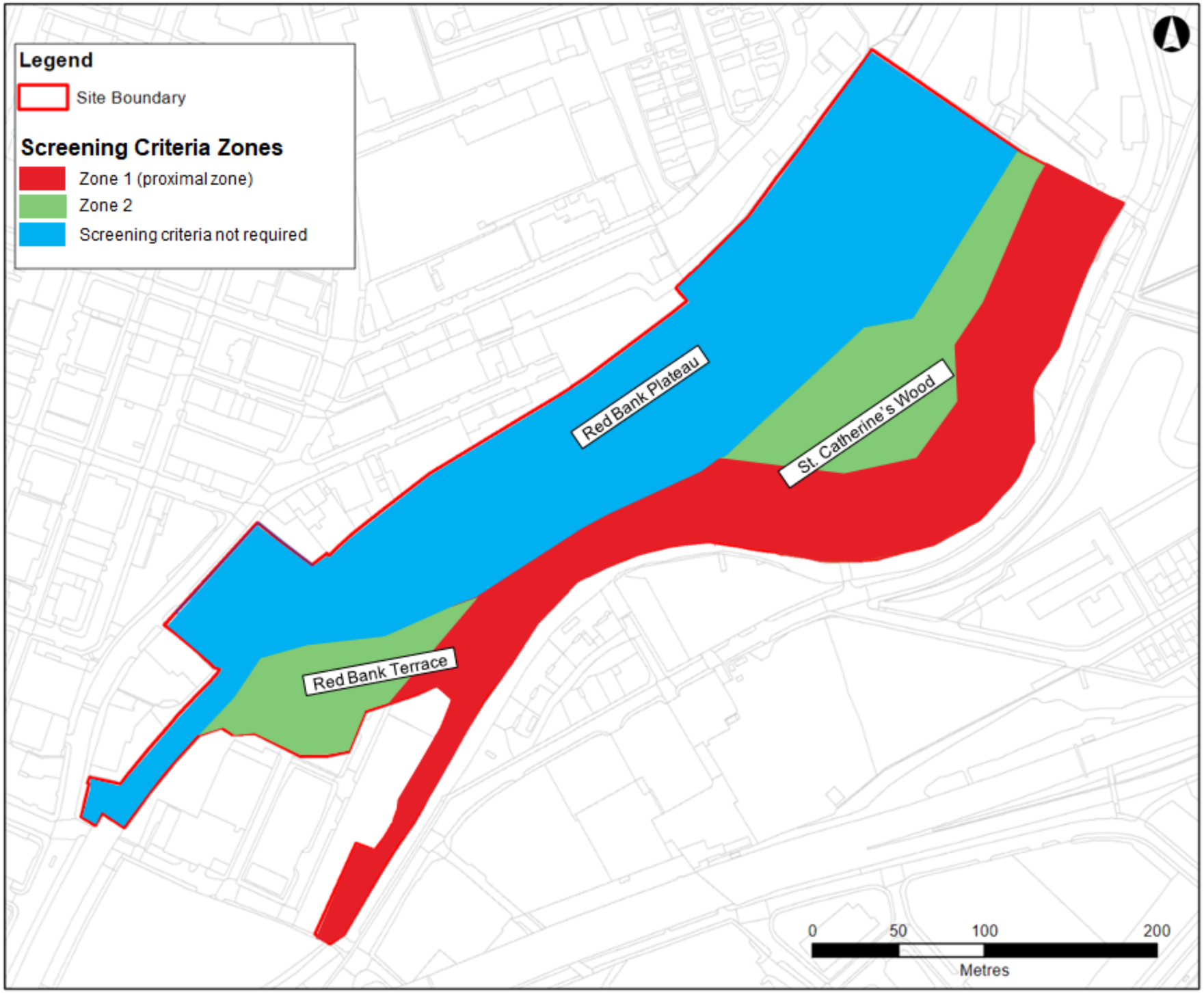
Name
Drawing 20

Rev
P1

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A3



Issue	Date	By	Chkd	Appd
P0	2022-08-04	LH	DH	DH

Metres
0 25 50 100

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Client
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Project Title
Victoria North

Drawing Title
Screening Criteria Zones

Scale at A3
1:2,000

Arup Job No
282022-00

Suitability
Preliminary

Name
Drawing 9

Rev
P0

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Appendix C

JIWG Output Sheets

JIWG

Joint Industry Working Group

Asbestos in Soil and Construction & Demolition Materials

Project Reference	LKC 22 1587
Site Name	Victoria North Infrastructure
Client	BAM
Run by	CB
Date	21-Oct-22
Scenario details	Earthworks - TT302 only

Decision Support Tool for CAR2012 Work Categories

Stage 1

Hazard Factors

		Score
Select ACM type (run model for each type to generate 'Worst Case' output)	Bonded ACMs: cement, vinyl, composites, textured decorative coatings, bitumen products	1
Extent of degradation of ACMs at outset of work	Weathered (Slight degradation in ACM; material still retains its basic integrity)	2
Friability and degree of bonding by matrix (ACM matrix, not ground materials)	Non-friable ACM or ACM with fibres firmly linked in a matrix	0
Distribution of Visible Asbestos Across Affected Area	No visible ACMs/fibre bundles	0
Amount of asbestos fibre in selected ACM/fibre type as % of host material	Large quantities - >0.1 %wt/wt	4
Sub-total		**7**

Note: the asbestos licensing regime is unaffected by the type of asbestos fibre present in ACMs

Hazard ranking Low

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It is contingent on users to satisfy themselves that the output from the tool is relevant and appropriate to the assessment being made.

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Stage 2

Exposure Factors

		Score
Anticipated airborne fibre concentration - Control Limit or SALI?	<0.01 fibres/ml	1
Anticipated duration of exposure to asbestos	> 2 hours in a 7 day period and Up to 10 hours in a day (e.g. full time occupational exposure)	4
Activity type and effect on deterioration of ACMs during work	Not low intensity, significant deterioration expected	4
Best description of primary host material matrix (soil/made ground)	Coarse to Fine Sand	2
Respirable fibre index for ACM - RIVM report 711701034 (2003)	Very low	1
Sub-total		**12**
Exposure ranking		Medium
Combined hazard and exposure ranking	**19**	Low

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Stage 3

Risk Assessment Outputs

Probable Licensing Status	Non-Licensed Work
RPE*	EN149 type FFP3 disposable
Dust Suppression**	Manual/localised dust suppression
Hygiene/Decontamination***	Localised and basic personal decontamination facilities

*Where RPE has to be worn continuously for long periods (e.g. more than 1-hour), then powered RPE may be necessary.
**Reduction in control measures possible if natural mitigation factors are present (e.g. raining, wet ground)
***Guide only; suitability of selected personal hygiene measures may be reviewed on a site/contamination-specific basis

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JIWG

Joint Industry Working Group

Asbestos in Soil and Construction & Demolition Materials

Project Reference	LKC 22 1587
Site Name	Victoria North Infrastructure
Client	BAM
Run by	CB
Date	21-Oct-22
Scenario details	Earthworks - NE Area (excluding TT302)

Decision Support Tool for CAR2012 Work Categories

Stage 1

Hazard Factors

		Score
Select ACM type (run model for each type to generate 'Worst Case' output)	Loose fibrous asbestos debris	3
Extent of degradation of ACMs at outset of work	Disaggregated (dominated by loose fibrous material; extreme degradation in ACM and/or free asbestos fibres/fibre bundles)	4
Friability and degree of bonding by matrix (ACM matrix, not ground materials)	Friable ACM or ACM with fibres not linked in any matrix (free dispersed fibres/fibre bundles)	4
Distribution of Visible Asbestos Across Affected Area	No visible ACMs/fibre bundles	0
Amount of asbestos fibre in selected ACM/fibre type as % of host material	Low quantities - >0.01 to <0.05 %wt/wt	2
Sub-total		**13**

Note: the asbestos licensing regime is unaffected by the type of asbestos fibre present in ACMs

Hazard ranking **Medium**

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Version 2, July 2016

Stage 2

Exposure Factors

			Score
Anticipated airborne fibre concentration - Control Limit or SALI?	<0.01 fibres/ml		1
Anticipated duration of exposure to asbestos	> 2 hours in a 7 day period and Up to 10 hours in a day (e.g. full time occupational exposure)		4
Activity type and effect on deterioration of ACMs during work	Not low intensity, significant deterioration expected		4
Best description of primary host material matrix (soil/made ground)	Coarse to Fine Sand		2
Respirable fibre index for ACM - RIVM report 711701034 (2003)	Medium		3
Sub-total			**14**
Exposure ranking			Medium
Combined hazard and exposure ranking		**27**	Medium

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Stage 3

Risk Assessment Outputs

Probable Licensing Status	Non-Licensed Work
RPE*	EN149 type FFP3 disposable
Dust Suppression**	Manual/localised dust suppression
Hygiene/Decontamination***	Localised and basic personal decontamination facilities

*Where RPE has to be worn continuously for long periods (e.g. more than 1-hour), then powered RPE may be necessary.
**Reduction in control measures possible if natural mitigation factors are present (e.g. raining, wet ground)
***Guide only; suitability of selected personal hygiene measures may be reviewed on a site/contamination-specific basis

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JIWG

Joint Industry Working Group

Asbestos in Soil and Construction & Demolition Materials

Project Reference	LKC 22 1587
Site Name	Victoria North Infrastructure
Client	BAM
Run by	CB
Date	21-Oct-22
Scenario details	Earthworks - Remainder of the site

Decision Support Tool for CAR2012 Work Categories

Stage 1

Hazard Factors

		Score
Select ACM type (run model for each type to generate 'Worst Case' output)	Loose fibrous asbestos debris	3
Extent of degradation of ACMs at outset of work	Disaggregated (dominated by loose fibrous material; extreme degradation in ACM and/or free asbestos fibres/fibre bundles)	4
Friability and degree of bonding by matrix (ACM matrix, not ground materials)	Friable ACM or ACM with fibres not linked in any matrix (free dispersed fibres/fibre bundles)	4
Distribution of Visible Asbestos Across Affected Area	No visible ACMs/fibre bundles	0
Amount of asbestos fibre in selected ACM/fibre type as % of host material	Very Low quantities - <0.001 to 0.01 %wt/wt	1
Sub-total		**12**

Note: the asbestos licensing regime is unaffected by the type of asbestos fibre present in ACMs

Hazard ranking **Medium**

No warranty, expressed or implied, or reliance, is provided in relation to the use of this tool.
It is contingent on users to satisfy themselves that the output from the tool is relevant and appropriate to the assessment being made.

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Version 2, July 2016

Stage 2

Exposure Factors

			Score
Anticipated airborne fibre concentration - Control Limit or SALI?	<0.01 fibres/ml		1
Anticipated duration of exposure to asbestos	> 2 hours in a 7 day period and Up to 10 hours in a day (e.g. full time occupational exposure)		4
Activity type and effect on deterioration of ACMs during work	Not low intensity, significant deterioration expected		4
Best description of primary host material matrix (soil/made ground)	Coarse to Fine Sand		2
Respirable fibre index for ACM - RIVM report 711701034 (2003)	Medium		3
Sub-total			**14**
Exposure ranking			Medium
Combined hazard and exposure ranking		**26**	Medium

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Stage 3

Risk Assessment Outputs

Probable Licensing Status	Non-Licensed Work
RPE*	EN149 type FFP3 disposable
Dust Suppression**	Manual/localised dust suppression
Hygiene/Decontamination***	Localised and basic personal decontamination facilities

*Where RPE has to be worn continuously for long periods (e.g. more than 1-hour), then powered RPE may be necessary.
**Reduction in control measures possible if natural mitigation factors are present (e.g. raining, wet ground)
***Guide only; suitability of selected personal hygiene measures may be reviewed on a site/contamination-specific basis

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Appendix D

Remedial Targets

Gasworks Remedial Targets

(derived by Arup – Victoria North HIF Infrastructure Works, Controlled Waters Detailed Quantitative Risk Assessment Report, produced by ARUP, ref: VNIF-ARP-ZZ-YYY-RP-CG-0011, P03, date: 7th November 2022).

Contaminant	RTM-calculated soil remediation target (mg/kg)	95th %ile of soil concentration in gasworks (mg/kg)	95th %ile of soil concentration on plateau (mg/kg)	RTM-calculated leachate target (mg/l)
Ammoniacal nitrogen	4.5	Not tested in soil	Not tested in soil	8.7
Benzo(a)Pyrene	3.6	32.8	2.5	0.0005
Fluoranthene	0.3	49.2	7	0.0003
Anthracene	0.9	16	1.8	0.003
TPH – Aliphatic C8-C10	4860	27.4	9.9	2.6
TPH – Aliphatic C10-C12	37900	52.3	9.9	2.6
TPH – Aliphatic C12-C16	758000	211	17.9	2.6
TPH – Aromatic C8-C10	1340	88	7.9	14.4
TPH – Aromatic C10-C12	772	85.4	31.2	5.3
TPH – Aromatic C12-C16	3860	546	60.4	13.3
TPH – Aromatic C16-C21	1120	1242	85	1.2
TPH – Aromatic C21-C35	8100	2989	200	1.1
TPH – C8-C35	2500	-	-	-

Targets for material within Zone 1

(derived by Arup – Victoria North HIF Infrastructure Works, Controlled Waters Detailed Quantitative Risk Assessment Report, produced by ARUP, ref: VNIF-ARP-ZZ-YYY-RP-CG-0011, P03, date: 7th November 2022).

Contaminant	RTM-calculated soil remediation target (mg/kg)	95th %ile of soil concentration within site (mg/kg)	RTM-calculated leachate target (mg/l)
Chromium	93.5	38	0.02
Copper	48	300	0.1
Lead	12.9	868	0.01
Nickel	26.5	48.9	0.05
Zinc	191	646	0.4
Benzo(a)Pyrene	0.4	5	0.00006
Fluoranthene	0.04	12	0.00003
Anthracene	0.15	3.2	0.0005
TPH – Aliphatic C8-C10	1910	11	1.03
TPH – Aliphatic C10-C12	14900	17	1.03
TPH – Aliphatic C12-C16	297000	39	1.03
TPH – Aromatic C8-C10	153	10	1.64
TPH – Aromatic C10-C12	76	29	0.53
TPH – Aromatic C12-C16	208	92	0.72
TPH – Aromatic C16-C21	323	68	0.35
TPH – Aromatic C21-C35	2450	233	0.34
TPH C8-C35	2500		

Targets for material within Zone 2

(derived by Arup – Victoria North HIF Infrastructure Works, Controlled Waters Detailed Quantitative Risk Assessment Report, produced by ARUP, ref: VNIF-ARP-ZZ-YYY-RP-CG-0011, P03, date: 7th November 2022).

Contaminant	RTM-calculated soil remediation target (mg/kg)	95th %ile of soil concentration within site (mg/kg)	RTM-calculated leachate target (mg/l)
Chromium	94	38	0.02
Copper	51	300	0.1
Lead	14	868	0.014
Nickel	28	48.9	0.06
Zinc	191	646	0.4
Benzo(a)Pyrene	1.4	5	0.0002
Fluoranthene	0.11	12	0.0001
Anthracene	0.34	3.2	0.001
TPH – Aliphatic C8-C10	2010	11	1.1
TPH – Aliphatic C10-C12	14900	17	1
TPH – Aliphatic C12-C16	313000	39	1.1
TPH – Aromatic C8-C10	470	10	5.1
TPH – Aromatic C10-C12	265	29	1.8
TPH – Aromatic C12-C16	1260	92	4.3
TPH – Aromatic C16-C21	449	68	0.5
TPH – Aromatic C21-C35	3280	233	0.4
TOH – C8-C35	2500		

POS Assessment Criteria

(derived by Arup – Victoria North Infrastructure Works, Ground Investigation Interpretive Report, produced by ARUP, ref: VNIF-ARP-XX-YYY-RP-CG-0012 P02, date: 3rd November 2022).

Contaminant Name	GAC	Units
Metal		
Antimony	3290	mg/kg
Arsenic	168	mg/kg
Beryllium	63	mg/kg
Cadmium	532	mg/kg
Chromium	33000	mg/kg
Chromium (hexavalent)	220	mg/kg
Copper	44400	mg/kg
Lead	1300	mg/kg
Manganese		mg/kg
Mercury	240	mg/kg
Nickel	804	mg/kg
Selenium	1850	mg/kg
Vanadium	5000	mg/kg
Zinc	173000	mg/kg
Inorganic		
pH		pH Units
% Moisture at <40C		% w/w
% Stones >10mm		% w/w
Cyanide	24	mg/kg
Complex Cyanide		mg/kg
Cyanide (free)	24	mg/kg
Thiocyanate		mg/kg
Boron	46200	mg/kg
Total Organic Carbon		%
Sulphate (acid soluble)		mg/kg
Asbestos		
Asbestos Matrix (microscope)		-
Asbestos Matrix (visual)		-
Asbestos Quantification (Total %)		%
Asbestos (Presence of)		---
Asbestos Analysts Comments		---
Phenol and mineral oils		
Phenol	1300	mg/kg
Phenol (Monohydric)	1300	mg/kg
Phenols Total (from SVOC)		mg/kg
Phenols, Total		mg/kg
Cresols		mg/kg
Xylenols		mg/kg
TPH		
Ali >C10-C12	24300	mg/kg
Ali >C12-C16	25700	mg/kg
Ali >C16-C21	494000	mg/kg
Ali >C21-C35	494000	mg/kg
Ali >C35-C44	49400	mg/kg
Ali >C5-C6	181000	mg/kg
Ali >C6-C8	316000	mg/kg
Ali >C8-C10	21400	mg/kg
Aliphatics >C5-35		mg/kg
Total Aliphatics		mg/kg

Contaminant Name	GAC	Units
Aro >C10-C12	10000	mg/kg
Aro >C12-C16	10400	mg/kg
Aro >C16-C21	7770	mg/kg
Aro >C21-C35	7850	mg/kg
Aro >C35-C44	7850	mg/kg
Aro >C7-C8	101000	mg/kg
Aro >C8-C10	9290	mg/kg
Mineral Oil (>C10-C40)		mg/kg
TPH (Ali & Aro >C5-C35)		mg/kg
TPH (Ali & Aro >C5-C44)		mg/kg
TPH >C10-40		mg/kg
PAH		
Acenaphthene	29900	mg/kg
Dibenz-a-h-anthracene	1.36	mg/kg
Fluoranthene	6350	mg/kg
Fluorene	20100	mg/kg
Indeno(1,2,3-cd)pyrene	183	mg/kg
Phenanthrene	6270	mg/kg
Pyrene	15200	mg/kg
Naphthalene	2950	mg/kg
PAH (total 17)		mg/kg
Total PAH-16MS		mg/kg
Pah,Total		mg/kg
Acenaphthylene	29900	mg/kg
Anthracene	152000	mg/kg
Benzo(a)anthracene	62.5	mg/kg
Benzo (g,h,i) perylene	1570	mg/kg
Benzo(a)pyrene	13.2	mg/kg
Benzo(b)fluoranthene	16.3	mg/kg
Benzo(k)fluoranthene	442	mg/kg
Chrysene	121	mg/kg
BTEX		
BTEX - Benzene	113	mg/kg
BTEX - Toluene	101000	mg/kg
BTEX - Ethyl Benzene	27100	mg/kg
BTEX - m & p Xylene	31500	mg/kg
BTEX - o Xylene	32600	mg/kg
Xylene	31500	mg/kg
BTEX and MTBE Total		mg/kg
BTEX (total)		mg/kg
PCBs		
PCB BZ 105	0.000074	mg/kg
PCB BZ 114	0.000004	mg/kg
PCB BZ 118	0.000171	mg/kg
PCB BZ 123	0.000006	mg/kg
PCB BZ 126	0.000005	mg/kg
PCB BZ 156	0.000032	mg/kg
PCB BZ 157	0.000008	mg/kg
PCB BZ 167	0.000013	mg/kg
PCB BZ 169	0.000001	mg/kg
PCB BZ 189	0.000005	mg/kg
PCB BZ 77	0.000016	mg/kg
PCB BZ 81	0.000001	mg/kg

Contaminant Name	GAC	Units
Total Speciated PCB-WHO12		mg/kg
VOCs/SVOCs		
1,1,1,2-Tetrachloroethane	2070	mg/kg
1,1,1-Trichloroethane	101000	mg/kg
1,1,2,2-Tetrachloroethane	2290	mg/kg
1,1,2-Trichloroethane	1480	mg/kg
1,1-Dichloroethane	31200	mg/kg
1,1-Dichloroethene	5860	mg/kg
1,1-Dichloropropene		mg/kg
1,2,3 Trichlorobenzene	1570	mg/kg
1,2,3-Trichloropropane		mg/kg
1,2,4-Trichlorobenzene	3980	mg/kg
1,2,4-Trimethylbenzene	408	mg/kg
1,2-Dibromo-3-Chloropropane		mg/kg
1,2-Dibromoethane		mg/kg
1,2-Dichlorobenzene	50500	mg/kg
1,2-Dichloroethane	27.8	mg/kg
1,2-Dichloropropane	292	mg/kg
1,3,5-Trimethylbenzene		mg/kg
1,3-Dichlorobenzene	392	mg/kg
1,3-Dichloropropane		mg/kg
1,4-Dichlorobenzene	36000	mg/kg
2,2-Dichloropropane		mg/kg
2,3,4,6-Tetrachlorophenol	1050	mg/kg
2,4,5-Trichlorophenol	1100	mg/kg
2,4,6-Trichlorophenol	1060	mg/kg
2,4-Dichlorophenol	1040	mg/kg
2,4-Dimethylphenol	9880	mg/kg
2,4-Dinitrotoluene	990	mg/kg
2,6-Dinitrotoluene	498	mg/kg
2-Chloronaphthalene	2750	mg/kg
2-Chlorophenol	1060	mg/kg
2-Chlorotoluene		mg/kg
2-Methyl-4,6-Dinitrophenol		mg/kg
2-Methylnaphthalene		mg/kg
2-Methylphenol	49400	mg/kg
2-Nitroaniline		mg/kg
2-Nitrophenol		mg/kg
3-Nitroaniline		mg/kg
4-Bromophenyl Phenyl Ether		mg/kg
4-Chloro-3-Methylphenol		mg/kg
4-Chlorotoluene		mg/kg
4-Isopropyltoluene		mg/kg
4-Nitroaniline		mg/kg
4-Nitrophenol		mg/kg
Aniline		mg/kg
Azobenzene		mg/kg
Benzyl Alcohol		mg/kg
Bis(2-chloroethoxy)methane		mg/kg
Bis(2-chloroethyl)ether		mg/kg
Bis(2-chloroisopropyl)ether		mg/kg
Bis(2-ethylhexyl)phthalate	16800	mg/kg
Bromobenzene	3460	mg/kg

Contaminant Name	GAC	Units
Bromochloromethane		mg/kg
Bromodichloromethane	80.9	mg/kg
Bromoform	5220	mg/kg
Bromomethane		mg/kg
Butylbenzyl phthalate	259000	mg/kg
Carbazole		mg/kg
Carbon Disulphide	2700	mg/kg
Carbon Tetrachloride	396	mg/kg
Chlorobenzene	2900	mg/kg
Chloroethane	217000	mg/kg
Chloroethene	5.36	mg/kg
Chloroform	3090	mg/kg
Chloromethane	173	mg/kg
Di-N-Butyl Phthalate	2630	mg/kg
Di-N-Octyl Phthalate	20000	mg/kg
Dibenzofuran		mg/kg
Dibromochloromethane		mg/kg
Dibromomethane		mg/kg
Dichloromethane	1530	mg/kg
Diethyl phthalate	96000	mg/kg
Dimethyl phthalate		mg/kg
Diphenylamine		mg/kg
Hexachlorobenzene	29.7	mg/kg
Hexachlorobutadiene	50.8	mg/kg
Hexachlorocyclopentadiene		mg/kg
Hexachloroethane	206	mg/kg
Isophorone		mg/kg
Isopropylbenzene	33800	mg/kg
M-Dinitrobenzene		mg/kg
MTBE	117000	mg/kg
Nitrobenzene		mg/kg
O-Dinitrobenzene		mg/kg
P-Dinitrobenzene		mg/kg
PCP; (Pentachlorophenol)	117	mg/kg
Sec-Butylbenzene		mg/kg
Styrene	6120	mg/kg
Tert-Butylbenzene		mg/kg
Tetrachloroethene	1460	mg/kg
Trichloroethene	115	mg/kg
Trichlorofluoromethane		mg/kg
cis 1,2-Dichloroethene	1040	mg/kg
cis 1,3-Dichloropropene		mg/kg
cis1,3-Dichloropropene		mg/kg
n-Butylbenzene		mg/kg
n-Nitroso-n-dipropylamine		mg/kg
n-Propylbenzene	43900	mg/kg
trans 1,2-Dichloroethene	2710	mg/kg
trans 1,3-Dichloropropene		mg/kg
VOC Total (excl. BTEX)		mg/kg
Herbicides		
2,3,6-TBA		mg/kg
2,4,5-TP; (Fenoprop); (Silvex)		mg/kg
2,4-D		mg/kg

Contaminant Name	GAC	Units
2,4-DB		mg/kg
4-CPA		mg/kg
Ametryne		mg/kg
Atraton		mg/kg
Atrazine	2300	mg/kg
Benazolin		mg/kg
Bentazone		mg/kg
Bromacil		mg/kg
Bromoxynil		mg/kg
Carbetamide		mg/kg
Chlorbufam		mg/kg
Chlorpropham		mg/kg
Chlortoluron		mg/kg
Clopyralid		mg/kg
Cyfluthrin		mg/kg
Cyhalothrin		mg/kg
Cypermethrin		mg/kg
Deltamethrin		mg/kg
Dicamba		mg/kg
Diclofop		mg/kg
Diuron		mg/kg
Fenvalerate		mg/kg
Flamprop		mg/kg
Flamprop-isopropyl		mg/kg
Ioxynil		mg/kg
Isoproturon		mg/kg
Linuron		mg/kg
MCPA		mg/kg
MCPB		mg/kg
MCPP; (Mecoprop)		mg/kg
Monuron		mg/kg
Permethrin		mg/kg
Picloram		mg/kg
Pirimicarb		mg/kg
Prometon		mg/kg
Prometryn		mg/kg
Propazine		mg/kg
Propham		mg/kg
Simazine		mg/kg
Simetryn		mg/kg
Terbuthylazine		mg/kg
Triclopyr		mg/kg
Pesticides		
Aldrin	7.9	mg/kg
Azinphos-ethyl		mg/kg
Azinphos-methyl		mg/kg
Carbophenothion		mg/kg
Chlorfenvinphos		mg/kg
Chlorothalonil		mg/kg
Chlorpyrifos		mg/kg
Chlorpyrifos-methyl		mg/kg
Coumaphos		mg/kg
Diazinon (Dimpylate)		mg/kg

Contaminant Name	GAC	Units
Dichlobenil		mg/kg
Dichlorvos	27	mg/kg
Dieldrin	13	mg/kg
Dimethoate		mg/kg
Disulfoton		mg/kg
Endosulphan I (Alpha)	2450	mg/kg
Endosulphan II (Beta)	2460	mg/kg
Endosulphan Sulphate		mg/kg
Endrin		mg/kg
Ethion		mg/kg
Fenitrothion		mg/kg
Fenthion		mg/kg
Heptachlor		mg/kg
Heptachlor epoxide		mg/kg
Isodrin		mg/kg
Malathion		mg/kg
Methyl Parathion		mg/kg
Mevinphos		mg/kg
Parathion (Ethyl Parathion)		mg/kg
Pendimethalin		mg/kg
Permethrin II (trans)		mg/kg
Phorate		mg/kg
Phosalone		mg/kg
Pirimiphos-methyl		mg/kg
Propetamphos		mg/kg
Quintozene (PCNB)		mg/kg
Tecnazene		mg/kg
Triadimefon		mg/kg
Triallate		mg/kg
Triazophos		mg/kg
Trifluralin		mg/kg
alpha-Hexachlorocyclohexane (HCH)	48	mg/kg
beta-Hexachlorocyclohexane (HCH)	15	mg/kg
cis-Chlordane (Alpha)		mg/kg
delta-Hexachlorocyclohexane (HCH)		mg/kg
o,p-DDD (2,4)		mg/kg
o,p-DDE (2,4)		mg/kg
o,p-DDT (2,4)		mg/kg
o,p-Methoxychlor		mg/kg
p,p-DDE (4,4)		mg/kg
p,p-DDT (4,4)		mg/kg
trans-Chlordane (Gamma)		mg/kg
2,3,5,6-Tetrachlorophenol		mg/kg
2,4,5-T		mg/kg
2,4-DP; (Dichlorprop)		mg/kg
3+4-Methylphenol		mg/kg
4-Chlorophenyl Phenyl Ether		mg/kg
Aliphatics >C10-44		mg/kg
Aluminium		mg/kg
Ammoniacal Nitrogen as N		mg/kg
Aro >C5-C7		mg/kg
Asbestos ACM - Suitable for Water		-
Asbestos in soil		-

Residential w/o plant uptake Assessment Criteria

(derived by Arup – Victoria North Infrastructure Works, Ground Investigation Interpretive Report, produced by ARUP, ref: VNIF-ARP-XX-YYY-RP-CG-0012 P02, date: 3rd November 2022).

Contaminant Name	GAC	Units
Metal		
Antimony	617.5682	mg/kg
Arsenic	39.9	mg/kg
Beryllium	1.7	mg/kg
Cadmium	85	mg/kg
Chromium	907	mg/kg
Chromium (hexavalent)	6	mg/kg
Copper	7130	mg/kg
Lead	310	mg/kg
Manganese		mg/kg
Mercury	56	mg/kg
Nickel	181.4	mg/kg
Selenium	430	mg/kg
Vanadium	1200	mg/kg
Zinc	40400	mg/kg
Inorganic		
pH		pH Units
% Moisture at <40C		% w/w
% Stones >10mm		% w/w
Cyanide	24	mg/kg
Complex Cyanide		mg/kg
Cyanide (free)	24	mg/kg
Thiocyanate		mg/kg
Boron	10775	mg/kg
Total Organic Carbon		%
Sulphate (acid soluble)		mg/kg
Asbestos		
Asbestos Matrix (microscope)		-
Asbestos Matrix (visual)		-
Asbestos Quantification (Total %)		%
Asbestos (Presence of)		---
Asbestos Analysts Comments		---
Phenol and mineral oils		
Phenol	1200	mg/kg
Phenol (Monohydric)	1200	mg/kg
Cresols		mg/kg
Xylenols		mg/kg
TPH		
Ali >C10-C12	767	mg/kg
Ali >C12-C16	4370	mg/kg
Ali >C16-C21	48900	mg/kg
Ali >C21-C35	48900	mg/kg
Ali >C35-C44	48901	mg/kg
Ali >C5-C6	161	mg/kg
Ali >C6-C8	529	mg/kg
Ali >C8-C10	155	mg/kg

Contaminant Name	GAC	Units
Aliphatics >C5-35		mg/kg
Total Aliphatics		mg/kg
Aro >C10-C12	1240	mg/kg
Aro >C12-C16	2480	mg/kg
Aro >C16-C21	1817	mg/kg
Aro >C21-C35	1930	mg/kg
Aro >C35-C44	1930	mg/kg
Aro >C7-C8	3928	mg/kg
Aro >C8-C10	269	mg/kg
Mineral Oil (>C10-C40)		mg/kg
TPH (Ali & Aro >C5-C35)		mg/kg
TPH (Ali & Aro >C5-C44)		mg/kg
TPH >C10-40		mg/kg
PAH		
Acenaphthene	6040	mg/kg
Dibenz-a-h-anthracene	0.32	mg/kg
Fluoranthene	1580	mg/kg
Fluorene	4460	mg/kg
Indeno(1,2,3-cd)pyrene	46	mg/kg
Phenanthrene	1520	mg/kg
Pyrene	3790	mg/kg
Naphthalene	13.2	mg/kg
PAH (total 17)		mg/kg
Total PAH-16MS		mg/kg
Pah,Total		mg/kg
Acenaphthylene	5970	mg/kg
Anthracene	36600	mg/kg
Benzo(a)anthracene	15	mg/kg
Benzo (g,h,i) perylene	359	mg/kg
Benzo(a)pyrene	3.23	mg/kg
Benzo(b)fluoranthene	4.06	mg/kg
Benzo(k)fluoranthene	107	mg/kg
Chrysene	31.9	mg/kg
BTEX		
BTEX - Benzene	1.421879	mg/kg
BTEX - Toluene	3927.625	mg/kg
BTEX - Ethyl Benzene	439.718	mg/kg
BTEX - m & p Xylene	428	mg/kg
BTEX - o Xylene	475.7208	mg/kg
Xylene	428	mg/kg
BTEX and MTBE Total		mg/kg
BTEX (total)		mg/kg
PCBs		
PCB BZ 105	0.000074	mg/kg
PCB BZ 114	0.000004	mg/kg
PCB BZ 118	0.000171	mg/kg
PCB BZ 123	0.000006	mg/kg
PCB BZ 126	0.000005	mg/kg
PCB BZ 156	0.000032	mg/kg
PCB BZ 157	0.000008	mg/kg
PCB BZ 167	0.000013	mg/kg
PCB BZ 169	0.000001	mg/kg

Contaminant Name	GAC	Units
PCB BZ 189	0.000005	mg/kg
PCB BZ 77	0.000016	mg/kg
PCB BZ 81	0.000001	mg/kg
Total Speciated PCB-WHO12		mg/kg
VOCs/SVOCs		
1,1,1,2-Tetrachloroethane	8.2	mg/kg
1,1,1-Trichloroethane	40.4	mg/kg
1,1,2,2-Tetrachloroethane	17.2	mg/kg
1,1,2-Trichloroethane	5.53	mg/kg
1,1-Dichloroethane	10.9	mg/kg
1,1-Dichloroethene	1.17	mg/kg
1,1-Dichloropropene		mg/kg
1,2,3 Trichlorobenzene	8.81	mg/kg
1,2,3-Trichloropropane		mg/kg
1,2,4-Trichlorobenzene	15.3	mg/kg
1,2,4-Trimethylbenzene	3.31	mg/kg
1,2-Dibromo-3-Chloropropane		mg/kg
1,2-Dibromoethane		mg/kg
1,2-Dichlorobenzene	133	mg/kg
1,2-Dichloroethane	0.0227	mg/kg
1,2-Dichloropropane	0.121	mg/kg
1,3,5-Trimethylbenzene		mg/kg
1,3-Dichlorobenzene	2.45	mg/kg
1,3-Dichloropropane		mg/kg
1,4-Dichlorobenzene	350	mg/kg
2,2-Dichloropropane		mg/kg
2,3,4,6-Tetrachlorophenol	229	mg/kg
2,4,5-Trichlorophenol	210	mg/kg
2,4,6-Trichlorophenol	231	mg/kg
2,4-Dichlorophenol	186	mg/kg
2,4-Dimethylphenol	1040	mg/kg
2,4-Dinitrotoluene	254	mg/kg
2,6-Dinitrotoluene	125	mg/kg
2-Chloronaphthalene	31.6	mg/kg
2-Chlorophenol	207	mg/kg
2-Chlorotoluene		mg/kg
2-Methyl-4,6-Dinitrophenol		mg/kg
2-Methylnaphthalene		mg/kg
2-Methylphenol	9930	mg/kg
2-Nitroaniline		mg/kg
2-Nitrophenol		mg/kg
3-Nitroaniline		mg/kg
4-Bromophenyl Phenyl Ether		mg/kg
4-Chloro-3-Methylphenol		mg/kg
4-Chlorotoluene		mg/kg
4-Isopropyltoluene		mg/kg
4-Nitroaniline		mg/kg
4-Nitrophenol		mg/kg
Aniline		mg/kg
Azobenzene		mg/kg
Benzyl Alcohol		mg/kg
Bis(2-chloroethoxy)methane		mg/kg

Contaminant Name	GAC	Units
Bis(2-chloroethyl)ether		mg/kg
Bis(2-chloroisopropyl)ether		mg/kg
Bis(2-ethylhexyl)phthalate	4090	mg/kg
Bromobenzene	7	mg/kg
Bromochloromethane		mg/kg
Bromodichloromethane	0.096	mg/kg
Bromoform	32.4	mg/kg
Bromomethane		mg/kg
Butylbenzyl phthalate	63800	mg/kg
Carbazole		mg/kg
Carbon Disulphide	0.622	mg/kg
Carbon Tetrachloride	0.128	mg/kg
Chlorobenzene	2.41	mg/kg
Chloroethane	26	mg/kg
Chloroethene	0.00153	mg/kg
Chloroform	4.22	mg/kg
Chloromethane	0.0188	mg/kg
Di-N-Butyl Phthalate	645	mg/kg
Di-N-Octyl Phthalate	4920	mg/kg
Dibenzofuran		mg/kg
Dibromochloromethane		mg/kg
Dibromomethane		mg/kg
Dichloromethane	6.37	mg/kg
Diethyl phthalate	8970	mg/kg
Dimethyl phthalate		mg/kg
Diphenylamine		mg/kg
Hexachlorobenzene	6.38	mg/kg
Hexachlorobutadiene	1.79	mg/kg
Hexachlorocyclopentadiene		mg/kg
Hexachloroethane	1.8	mg/kg
Isophorone		mg/kg
Isopropylbenzene	95.4	mg/kg
M-Dinitrobenzene		mg/kg
MTBE	319	mg/kg
Nitrobenzene		mg/kg
O-Dinitrobenzene		mg/kg
P-Dinitrobenzene		mg/kg
PCP; (Pentachlorophenol)	30.6	mg/kg
Sec-Butylbenzene		mg/kg
Styrene	236	mg/kg
Tert-Butylbenzene		mg/kg
Tetrachloroethene	0.92	mg/kg
Trichloroethene	0.0797	mg/kg
Trichlorofluoromethane		mg/kg
cis 1,2-Dichloroethene	0.559	mg/kg
cis 1,3-Dichloropropene		mg/kg
cis1,3-Dichloropropene		mg/kg
n-Butylbenzene		mg/kg
n-Nitroso-n-dipropylamine		mg/kg
n-Propylbenzene	323	mg/kg
trans 1,2-Dichloroethene	1.02	mg/kg
trans 1,3-Dichloropropene		mg/kg

Contaminant Name	GAC	Units
VOC Total (excl. BTEX)		mg/kg
SVOC Total (excl. PAH/Phenols/Cresols and Chlorophenols)		mg/kg
SVOC Total (excl. PAH/Phenols/Cresols/Chlorophenols/Ethers/Nitrobenzene)		mg/kg
Herbicides		
2,3,6-TBA		mg/kg
2,4,5-TP; (Fenoprop); (Silvex)		mg/kg
2,4-D		mg/kg
2,4-DB		mg/kg
4-CPA		mg/kg
Ametryne		mg/kg
Atraton		mg/kg
Atrazine	620	mg/kg
Benazolin		mg/kg
Bentazone		mg/kg
Bromacil		mg/kg
Bromoxynil		mg/kg
Carbetamide		mg/kg
Chlorbufam		mg/kg
Chlorpropham		mg/kg
Chlortoluron		mg/kg
Clopyralid		mg/kg
Cyfluthrin		mg/kg
Cyhalothrin		mg/kg
Cypermethrin		mg/kg
Deltamethrin		mg/kg
Dicamba		mg/kg
Diclofop		mg/kg
Diuron		mg/kg
Fenvalerate		mg/kg
Flamprop		mg/kg
Flamprop-isopropyl		mg/kg
Ioxynil		mg/kg
Isoproturon		mg/kg
Linuron		mg/kg
MCPA		mg/kg
MCPB		mg/kg
MCPP; (Mecoprop)		mg/kg
Monuron		mg/kg
Permethrin		mg/kg
Picloram		mg/kg
Pirimicarb		mg/kg
Prometon		mg/kg
Prometryn		mg/kg
Propazine		mg/kg
Propham		mg/kg
Simazine		mg/kg
Simetryn		mg/kg
Terbuthylazine		mg/kg

Contaminant Name	GAC	Units
Triclopyr		mg/kg
Pesticides		
Aldrin	1.9	mg/kg
Azinphos-ethyl		mg/kg
Azinphos-methyl		mg/kg
Carbophenothion		mg/kg
Chlorfenvinphos		mg/kg
Chlorothalonil		mg/kg
Chlorpyrifos		mg/kg
Chlorpyrifos-methyl		mg/kg
Coumaphos		mg/kg
Diazinon (Dimpylate)		mg/kg
Dichlobenil		mg/kg
Dichlorvos	6.6	mg/kg
Dieldrin	3.2	mg/kg
Dimethoate		mg/kg
Disulfoton		mg/kg
Endosulphan I (Alpha)	404	mg/kg
Endosulphan II (Beta)	440	mg/kg
Endosulphan Sulphate		mg/kg
Endrin		mg/kg
Ethion		mg/kg
Fenitrothion		mg/kg
Fenthion		mg/kg
Heptachlor		mg/kg
Heptachlor epoxide		mg/kg
Isodrin		mg/kg
Malathion		mg/kg
Methyl Parathion		mg/kg
Mevinphos		mg/kg
Parathion (Ethyl Parathion)		mg/kg
Pendimethalin		mg/kg
Permethrin II (trans)		mg/kg
Phorate		mg/kg
Phosalone		mg/kg
Pirimiphos-methyl		mg/kg
Propetamphos		mg/kg
Quintozene (PCNB)		mg/kg
Tecnazene		mg/kg
Triadimefon		mg/kg
Trialiate		mg/kg
Triazophos		mg/kg
Trifluralin		mg/kg
alpha-Hexachlorocyclohexane (HCH)	11	mg/kg
beta-Hexachlorocyclohexane (HCH)	3.8	mg/kg
cis-Chlordane (Alpha)		mg/kg
delta-Hexachlorocyclohexane (HCH)		mg/kg
o,p-DDD (2,4)		mg/kg
o,p-DDE (2,4)		mg/kg
o,p-DDT (2,4)		mg/kg
o,p-Methoxychlor		mg/kg
p,p-DDE (4,4)		mg/kg

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