Validation Report

Site: Bennett Street, Manchester
Reference: 15-974-R6-4
Date: February 2025



e3p

E3P

Taylor Road
Trafford Park
Urmston
Manchester
M41 7JQ

[redacted]
https://e3p.co.uk

Registered in England
CRN: 08725262

QUALITY ASSURANCE

Report reference	**15-974-R6**

REV REF:	DESCRIPTION	AUTHOR	CHECKED	AUTHORISED	DATE
R6-1	First issue – Phase 1	JB	MSD	MD	March 2024
R6-2	Phase 1	JB	MSD	MD	April 2024
R6-3	Draft - Full Validation of Site Wide Works	GC	MSD	MD	January 2025
R6-4	Full Validation of Site Wide Works	GC	MSD	MD	February 2025

This report has been prepared for the sole benefit, use, and information of the client. The liability of Environmental Engineering Partnership Limited T/A E3P with respect to the information contained in the report will not extend to any third party. This report has been prepared by the qualified persons as listed below.

WRITTEN BY	QUALIFICATIONS	POSITION
G. Calvert	BSc (Hons), FGS	Geo-environmental Consultant

REVIEWED BY	QUALIFICATIONS	POSITION
M. Dee	MESci (Hons), FGS, MIEnvSc	Senior Consultant

AUTHORISED BY	QUALIFICATIONS	POSITION
M. Dyer	BSc, FGS, PIEMA, MIEnvSc, Cenv	Director

TABLE OF CONTENTS

EXECUTIVE SUMMARY 3
Remediation and enabling work objectives: 3

1. INTRODUCTION 1
1.1. Background 1
1.2. Proposed Development 1
1.3. Summary of Parties Involved 2
1.4. Previous Works 3

2. SUMMARY OF REMEDIATION AND ENABLING WORKS OBJECTIVES ... ERROR! BOOKMARK NOT DEFINED.

3. SECOND PHASE MITIGATION AND MANAGEMENT – BUILD PHASE 37

4. DETAILED REMEDIATION AND ENABLING WORKS ACTIVITIES 4
RE-1 – Pre-commencement Regulatory Compliance 4
RE-2 – Environment and Nuisance Control 4
RE-3 – Risk to Infrastructure and Culverts 5
RE-4 – Identification, Isolation and Treatment of Invasive Plants 8
RE-5 – Site Clearance Operations 10
RE-6 – Delineation, Excavation and Treatment of Identified Asbestos Impact 11
RE-7 – Delineation, Excavation, Treatment and Disposal of Visual and Olfactory Semi-volatile Impacted Material, TPH, Napthalene, SVOC 14
RE-8 – Excavation, Breaking and Processing of All Above- and Below-Ground Structures 16
RE-9 – Delineation, Excavation, and Treatment of Infilled Historical Ponds 17
RE-10 – Removal of Deleterious Material 20
RE-11 – Removal of ASTs 20
RE-12 – Investigation and Removal of Historic USTs 22
RE-13 – Cut-And-Filling of MADE GROUND to Development Levels 23
RE-14 – Placement and Compaction of Upfill Material to Facilitate Ground Improvement by VSC 26
RE-15 – Construction of Temporary Working Platform 27
RE-16 – Replacement of Materials, Geotechnical Engineering Requirements 28
RE-17 – Preparation of Ground for Vibro-Stone Columns Within Tree Influence 30
RE-18 – Importation of Bulk Fill 31
RE-19 – Preparation of Garden for Cover System 31
RE-20 – Provision of Subsoil 32
RE-21 – Provision of Topsoil 33
RE-22 – Independent Validation: Watching Brief 34
RE-23 – Waste Soils Surplus to Requirements 34
RE-24 – Validation of Materials for Potable Water Supply Infrastructure 36
RE-25 – Remedial Verification Report 36

5. CONCLUSION 37

APPENDIX I LIMITATIONS 39

APPENDIX II GLOSSARY 45

APPENDIX III DRAWINGS 48

APPENDIX IV CHEMICAL TESTING RESULTS 49

APPENDIX V PHOTOGRAPHS 50

APPENDIX VI GEOTECHNICAL TESTING RESULTS 73

APPENDIX VII CONTRACTOR COMPLETION CHECK SHEET 74

APPENDIX VIII M-BAT ASSESSMENT 75

EXECUTIVE SUMMARY

REMEDIATION AND ENABLING WORK OBJECTIVES:

RE-NUMBER	OBJECTIVE	SUMMARY
RE-1	Pre-commencement Regulatory Compliance	**Complete No Further Action:** Overview provided in Section 2
RE-2	Environment and Nuisance Control	**Complete No Further Action:** Overview provided in Section 2
RE-3	Risk to Infrastructure and Culverts	**Complete No Further Action:** Overview provided in Section 2
RE-4	Identification, Isolation and Treatment of Invasive Plants	**Complete No Further Remedial Action:** Overview provided in Japanese Knotweed Solutions Report: JK23/9266 Ongoing monitoring by Nightingale Environmental Limited over 2 year period.
RE-5	Site Clearance Operations	**Complete No Further Action:** Overview provided in Section 2
RE-6	Delineation, Excavation and Treatment of Identified Asbestos Impact	**Complete No Further Action:** Overview provided in Section 2
RE-7	Delineation, Excavation, Treatment and Disposal of Visual and Olfactory Semi-volatile Impacted Material – TPH, Naphthalene, SVOC	**Complete No Further Action:** Overview provided in Section 2
RE-8	Excavation, Breaking and Processing of All Above- and Below-Ground Structures	**Complete No Further Action:** Overview provided in Section 2
RE-9	Delineation, Excavation and Treatment of Infilled Historical Ponds	**Complete No Further Action:** Overview provided in Section 2
RE-10	Removal of Deleterious Material	**Complete No Further Action:** Overview provided in Section 2
RE-11	Removal of Above Ground Storage Tanks (ASTs)	**Complete No Further Action:** Overview provided in Section 2
RE-12	Investigation and Removal of Underground Storage Tanks (USTs)	**Complete No Further Action:** Overview provided in Section 2
RE-13	Cut-And-Filling of MADE GROUND to Development Levels	**Complete No Further Action:**

RE-NUMBER	OBJECTIVE	SUMMARY
		Overview provided in Section 2
RE-14	Placement and Compaction of Upfill Material to Facilitate Ground Improvement by Vibro Stone Column (VSC)	**Complete No Further Action:** Overview provided in Section 2
RE-15	Construction of Temporary Working Platform	**Complete No Further Remedial Action:** Overview provided in Section 2. Civil contractor to undertake further CBR testing on roads for adoption – not required as part of remediation works package.
RE-16	Replacement of Materials, Geotechnical Engineering Requirements	**Complete No Further Action:** Overview provided in Section 2
RE-17	Preparation of Ground for Vibro-Stone Columns Within Tree Influence	**Complete No Further Action:** Overview provided in Section 2
RE-18	Importation of Bulk Fill	**Complete No Further Action:** No Imported Fill Required
RE-19	Preparation of Garden for Cover System	**Complete No Further Action:** Overview provided in Section 2
RE-20	Provision of Subsoil	**Build Phase Item** -Not part of remediation works package. -Compliance testing of subsoil will be included within garden validation letters for each plot as agreed with Manchester City Council. -CL:AIRE MMP will be updated for each additional subsoil donor site. -Summary of testing undertaken to date included within Section 2.
RE-21	Provision of Topsoil	**Build Phase Item** -Not part of remediation works package. -Compliance testing of topsoil will be included within garden validation letters for each plot as agreed with Manchester City Council. -CL:AIRE MMP will be updated for each additional topsoil donor site. -Summary of testing undertaken to date included within Section 2.
RE-22	Independent Validation: Watching Brief	**Complete No Further Action:** Overview provided in Section 2
RE-23	Waste Soils Surplus to Requirements	**Complete No Further Action:** Overview provided in Section 2
RE-24	Validation of Materials for Potable Water Supply Infrastructure	**Complete No Further Action:** Overview provided in Section 2

RE-NUMBER	OBJECTIVE	SUMMARY
RE-25	Remedial Verification Report	**Complete No Further Action:** Overview provided in Section 2

1. INTRODUCTION

1.1. BACKGROUND

This report details the remediation and enabling works operations that were undertaken by Total Demolition & Remediation (August 2022 – April 2024) and Urban Regen (May 2024 – October 2024) under the supervision of E3P to facilitate the preparation of the residential development on a parcel of former industrial land off Bennett Street, Manchester, M12 5NL; herein referred to as the site.

E3P was appointed by Kellen Homes as an independent Geo-Environmental Consultant for the site remediation, enabling and validation works, and the subsequent production of a suitably detailed report to ensure the satisfaction of the relevant planning conditions.

This report has been prepared to discharge planning condition 11 as part of the planning application 134504/FO/2022 with Manchester City Council. Below is the relevant text taken from the planning decision letter under condition 11:

"….. b) When the development commences, the development shall be carried out in accordance with the previously agreed Remediation Strategy and a Completion/Verification Report shall be submitted to and approved in writing by the City Council as local planning authority.

In the event that ground contamination, groundwater contamination and/or ground gas, not previously identified, are found to be present on the site at any time before the development is occupied, then development shall cease and/or the development shall not be occupied until, a report outlining what measures, if any, are required to remediate the land (the Revised Remediation Strategy) is submitted to and approved in writing by the City Council as local planning authority and the development shall be carried out in accordance with the Revised Remediation Strategy, which shall take precedence over any Remediation Strategy or earlier Revised Remediation Strategy.

Reason - To ensure that the presence of or the potential for any contaminated land and/or groundwater is detected and appropriate remedial action is taken in the interests of public safety, pursuant to policies DM1 and EN18 of the Manchester Core Strategy (2012)."

This report documents the completion of all necessary land remediation and enabling works and has been completed to record the presence of any variation in ground conditions or previously unidentified sources of potential contamination, environmental impact, or potential nuisance to the wider environ.

The proposed remediation activities were detailed within the E3P Remediation and Enabling Works Strategy (15-974-R1; dated December 2023) and supplementary supporting documents provided by E3P.

1.2. PROPOSED DEVELOPMENT

Kellen Homes will construct 272 residential homes and apartments (Class C3) with buildings between two and six storeys in height, a community centre and up to 317 sqm of flexible use Commercial Hub floorspace (Class E). Kellen will form associated open space and landscaping. Access will be gained via two altered access points off Bennett Street.

E3P has been provided with final approved planning layout detailing the proposed layout presented in Figure 1.1.

FIGURE 1.1 SNAPSHOT OF PROPOSED DEVELOPMENT



1.3. SUMMARY OF PARTIES INVOLVED

Function/interest	Name of Party
Local Planning Authority	Manchester City Council
Developer	Kellen Homes
Geoenvironmental Consultant	E3P
Main Contractor	Kellen Homes
Remediation/Enabling Works Contractor	Total Demolition & Remediation (August 2022 – April 2024) Urban Regen (May 2024 – October 2024)
Human Health Regulator	Manchester City Council
Controlled Waters and Waste Regulator	Environment Agency
Highways Adoption Authority	Manchester City Council

1.4. PREVIOUS WORKS

The following previous phases of site investigation and assessment have been completed at the subject site:

- **WYG** – *Phase II Geo-Environmental Ground Investigation Interpretative Report*. Reference E11056-1, January 2008. Prepared for Braidwater Ltd.
- **E3P** – *Phase I and II Geoenvironmental Site Assessment*. Ref: 15-974-R1-2, dated December 2022, prepared for Kellen Homes.
- **E3P** – *Ground Gas Addendum Report.* Ref: 15-974-R3-1, dated January 2023, prepared for Kellen Homes.

These documents were utilised to development the following Remediation and Enabling Works Strategy:

- **E3P** – *Remediation and Enabling Works Strategy*. Ref: 15-974-R2-2, dated January 2023, prepared for Kellen Homes.
- **E3P** – *Response to EA comments received 19th April 2023, Ref 15-974-L3-1, dated 11th May 2023;*
- **E3P** – *Response to EA comments received 9th June 2023, Ref 15-974-L4-1, dated 13th June 2023;*
- **E3P** – *Build Phase Contamination Mitigation Strategy*. Ref: 15-974-R3-6, dated November 2023, prepared for Kellen Homes.

The above documents should be read in conjunction with this Validation Report.

2. DETAILED REMEDIATION AND ENABLING WORKS ACTIVITIES

The focus of the remediation and enabling works is to address the contaminant issues previously identified within the site investigations that presented an unacceptable risk to human health following the redevelopment of the site.

No previously unknown contamination types were identified during the remediation and enabling works. All remediation technologies utilised were previously agreed and outlined within the E3P Remediation Strategy (Ref: 15-974-R2-2, dated January 2023).

For completeness, each of these activities has been discussed below within the context of the actual remediation works that were undertaken on-site.

The Remediation and Site Enabling works commenced on the 6th July 2023 and were completed in by 31st October 2024, with the exception of a final asbestos pipe removal undertaken in December 2025.

RE-1 – PRE-COMMENCEMENT REGULATORY COMPLIANCE

DATE OF WORKS UNDERTAKEN
August 2022 – April 2023

OVERVIEW OF WORKS

The site was granted planning permission under application number 134504/FO/2022, for the development of 272 residential homes and apartments (Class C3) with buildings between two and six storeys in height, a community centre and up to 317 sqm of flexible use Commercial Hub floorspace (Class E) with two altered access points off Bennett Street; vehicular access from Anthony Close; and associated open space and landscaping. A decision was issued on 9th August 2022.

Before any works on site commenced, E3P and Kellen Homes had extensive correspondence and consultation with the Environment Agency (EA) and Local Planning Authority (LPA). Full written approval of the E3P Remediation Strategy (Ref: 15-974-R2-2, Dated January 2023) was obtained from the LPA and EA.

As the proposed volume of soils to be reused (excluding crushed materials) exceeds the parameters of the Standard Rules Permit, a CL:AIRE Materials Management Plan (MMP)-qualified declaration was obtained and kept up to date throughout the works (E3P document Ref: 14-554-R4-1, April 2023).

Conclusion
No Further Action.

RE-2 – ENVIRONMENT AND NUISANCE CONTROL

DATE OF WORKS UNDERTAKEN
August 2022 – October 2024

OVERVIEW OF WORKS

Background
Management of all works to ensure that no environmental nuisance is created through dust emissions, noise or vibration levels and to ensure no disturbance to water courses present below the site (RE-3).

Works Undertaken
During remediation, it was a requirement for works to be restricted to between 8.00am and 5.30pm, however, E3P do not have information to confirm this.

A road sweeper was present to keep the access and Bennett Street clean and clear of debris during the importation of materials to site.

Heras fencing was erected around the site boundary with appropriate health and safety signage. An out of hours site security team was in place to ensure site security and prevent injury to the public.

During prolonged periods of dry weather, a mist sprayer and bowser were utilised to dampen down materials to limit dust generation. Additionally, materials were damped down during the excavation and delineation of asbestos hotspots.

During piling activities Roger Bullivant undertook vibration monitoring to ensure no structural risk to the culverts, adjacent highways and rail infrastructure.

Vibration reports are available upon request to Kellen Homes.

Throughout the works scrap metal, timber/wood and waste streams were segregated and placed into allotted stockpiles and skips for removal off-site.

Monthly water sampling of Blackbrook and Cornbrook Culvert was undertaken and is discussed in RE-3.

Conclusion
Completed in line with the remediation strategy, **no further action.**

RE-3 – RISK TO INFRASTRUCTURE AND CULVERTS

DATE OF WORKS UNDERTAKEN
May 2023 – October 2024

CHEMICAL TESTING
I2 Analytical Report ref: 23-43785 (May 2023; baseline)
I2 Analytical Report ref: 23-47897 (July 2023)
I2 Analytical Report ref: 23-50842 (August 2023)
I2 Analytical Report ref: 23-59942 (September 2023)
I2 Analytical Report ref: 23-66926 (October 2023)
I2 Analytical Report ref: 23-72754 (November 2023)
I2 Analytical Report ref: 23-76129 (December 2023)
I2 Analytical Report ref: 24-81005 (January 2024)
I2 Analytical Report ref: 24-006553 and 24-008820 (February 2024)
I2 Analytical Report ref: 24-09948 (March 2024)
Eurofins Report ref: 24-13863 (April 2024)
Eurofins Report ref: 24-17365 (May 2024)
Eurofins Report ref: 24-17365 (June 2024)
Eurofins Report ref: 24-24980 (July 2024)
Eurofins Report ref: 24-27697 (August 2024)
Eurofins Report ref: 24-32045 (September 2024)
Eurofins Report ref: 24-35026 (October 2024)
I2 Analytical Report ref: 23-59931 (SW Leachate Samples)
Eurofins Report Ref: 24-16336 (NW Leachate Samples)
Eurofins Report Ref: 24-27345-(NE Leachate Samples)

OVERVIEW OF WORKS

Background

Site works were to be completed in a manner that ensures no risk of disturbance to the adjacent infrastructure.

A new Blackbrook Culvert was installed and diverted by WPI working outside of the E3P validation scope.

It was proposed that monthly sampling of the underground culverts at upstream and downstream points should be undertaken to ensure no detrimental effect to the surface waters is taking place during enabling works.

Works Undertaken

Due to the shallow depth to Cornbrook Culvert in the east of the site, no turnover works were undertaken above the culvert to ensure no disturbance.

A set of baseline samples were collected in May 2023 to indicate background contaminant levels within the culverts prior to works commencing on site. Baseline samples indicate elevated heavy metals (copper, zinc and cyanide), toluene and benzene upstream of the site compared to Environmental Quality Standards (EQS), which can be attributed to the wider industrial history and current activities in this area of Manchester.

Throughout the works monthly water sampling of Blackbrook and Cornbrook culverts was undertaken to ensure no detrimental effect to the surface waters is taking place during enabling works. Upstream, midstream and downstream sampling was undertaken at agreed locations along both the Blackbrook and Cornbrook culverts. Sample locations are given in Figure 4.1 and Drawing 15-974-027 in APPENDIX III.

Samples were scheduled for a full suite of analysis, including heavy metals, suspended solids, polycyclic aromatic hydrocarbons (PAH) and total petroleum hydrocarbons (TPH).

FIGURE 4.1 – CULVERT WATER SAMPLE LOCATIONS



Cornbrook Culvert
Results of monthly sampling within the Cornbrook culvert show consistent elevations of heavy metals copper, zinc, cyanide, and nickel within upstream, on site and downstream samples compared to the EQS. No obvious or consistent increase between upstream and downstream values has been recorded, indicating this was background concentrations in the watercourse or the source was located upstream.

Due to programmed build phase works throughout May 2024 no access to on-site sample locations (CB Mid or CB Downstream) were accessible. As such, no samples for Cornbrook were obtained within May 2024 with sampling re-commencing upon completion of build phase works in this area in June 2024.

No elevations of benzene, toluene, ethylbenzene and xylene (BTEX) or TPH compounds have been identified within any of the Cornbrook samples. Additionally, no suspended soils were visually observed within water samples obtained.

Given the above, no detrimental impact to Cornbrook Culvert has been recorded during the remediation and enabling work activities, as such, **no further action is required.**

Blackbrook Culvert
Results of monthly water sampling within Blackbrook culvert show consistent elevations of heavy metals copper, zinc and cyanide within upstream, on site and downstream samples compared to the EQS values. No obvious or consistent increase in between upstream and downstream values has been recorded, indicating this was background concentrations in the watercourse or the source was located upstream.

Results from the July sampling of the downstream location within Blackbrook culvert indicate elevated TPH compounds C12-16, C16-21 and C21-35 when compared to the EQS values. This is attributed to the high suspended solids within the sample (470 ppm). Silt removal works were undertaken in the culvert undertaken throughout July and early August, resulting in increased sediment within samples. Following the completion of the culvert works in early August 2023, no further TPH impact was recorded; additionally, suspended solids within the watercourse returned to normal lower volumes and were not visually observed in samples obtained.

Given the above, no detrimental impact to Blackbrook Culvert has been recorded during the remediation and enabling work activities, as such, **no further action is required.**

Chemical certificates of water sampling undertaken to date are included within APPENDIX IV.

Perched Groundwater in Southwest
Perched groundwater was encountered within Made Ground deposits beneath the former bus depot in the south west of the site. As per Action 1, agreed with the Environment agency within E3P letter report 15-974-L4, impacted perched or shallow groundwater associated with the shallow made ground was pumped into IBC's and removed from site.

E3P can confirm all impacted shallow groundwater was removed to a suitably licensed waste management facility by Oil Salvage Ltd on 21st September 2023. Waste Transfer Notes, inclusive of impacted groundwater removal, are available on request from Total Demolition & Remediation and Kellen Homes.

Leachates of the Made Ground soils (I2 Ref: 23-59931) remaining within this area did not record any elevations when compared to remediation target concentrations. As such, these soils were utilised in the bulk earthworks.

Perched Groundwater in Northwest
Perched groundwater was encountered within Made Ground deposits beneath proposed plots 118-120 in the north west. As per Action 1, agreed with the Environment agency within E3P letter report 15-974-L4, impacted perched or shallow groundwater associated with the shallow made ground was pumped into IBC's and removed from site.

E3P can confirm all impacted shallow groundwater was removed to a suitably licensed waste management facility by Oil Salvage Ltd on 17th April 2024. Waste Transfer Notes, inclusive of impacted groundwater removal, are available on request from Total Demolition & Remediation and Kellen Homes.

Leachates of the Made Ground soils (Eurofins Ref: 24-16336) remaining within this area did not record any elevations when compared to remediation target concentrations. As such, these soils were utilised in the bulk earthworks.

Perched Groundwater in North East
Perched groundwater was encountered within Made Ground deposits beneath the former vehicle repair garage in the north east. As per Action 1, agreed with the Environment agency within E3P letter report 15-974-L4, impacted perched or shallow groundwater associated with the shallow made ground was pumped into IBC's and removed from site.

E3P can confirm all impacted shallow groundwater was removed to a suitably licensed waste management facility by Oil Salvage Ltd. Waste Transfer Notes, inclusive of impacted groundwater removal, are available on request from Urban Regen and Kellen Homes.

Leachates of the Made Ground soils (SW-MG-014-018) remaining within this area did not record any elevations when compared to remediation target concentrations. As such, these soils were utilised in the bulk earthworks.

Conclusion
Completed in line with the remediation strategy, **no further action.**

RE-4 – IDENTIFICATION, ISOLATION AND TREATMENT OF INVASIVE PLANTS

DATE OF WORKS UNDERTAKEN
July 2023– February 2024

SUPPORTING DOCUMENTS
Japanese Knotweed Solutions Report: JK23/9266

CHEMICAL TESTING
I2 Reports: 23-52624-1, 23-52626-1

PHOTOGRAPHS
Plate 1

OVERVIEW OF WORKS

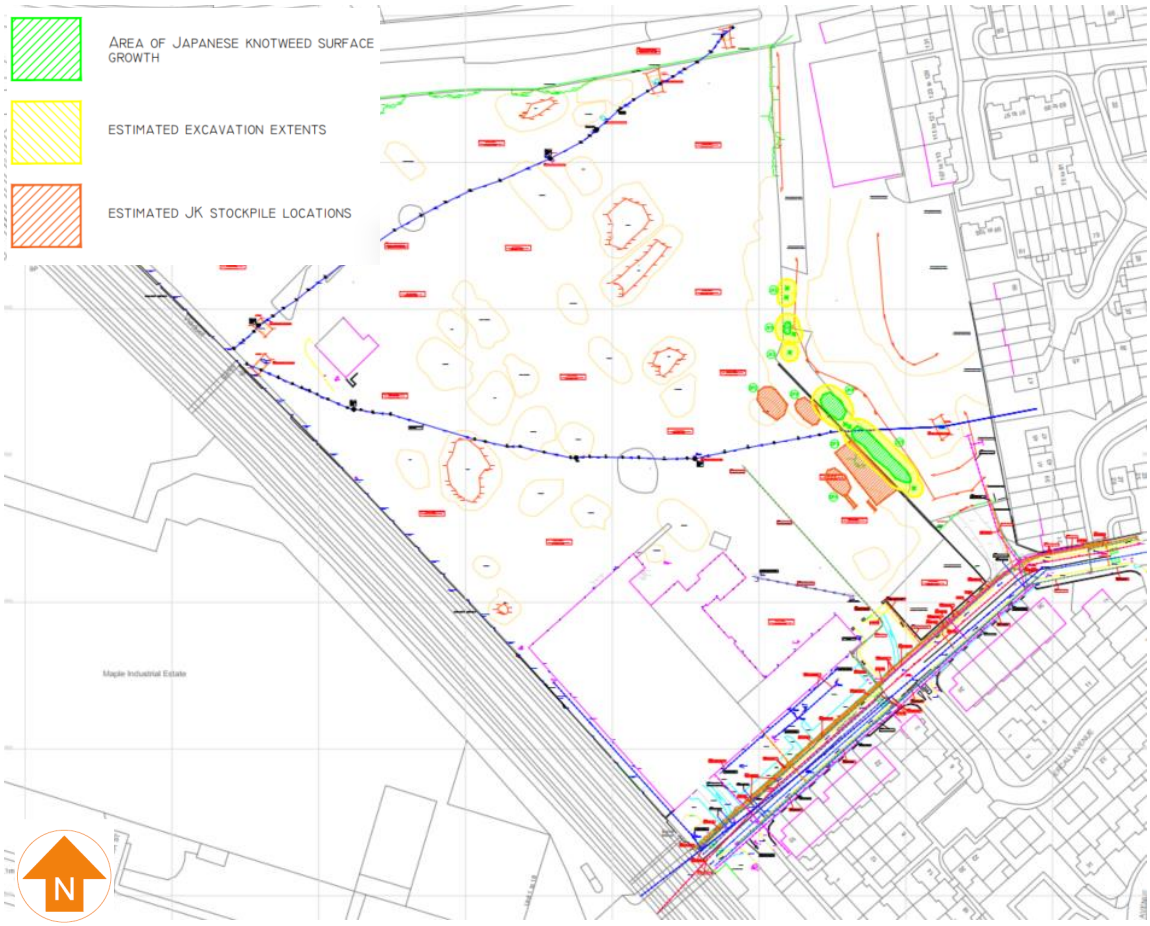
Background
Invasive plant species were identified within the east of the site. The remediation contractor was to satisfy themselves with respect to the extent of all species deemed invasive prior to the commencement of works on site.

Works Undertaken

Kellen Homes employed Japanese Knotweed Solutions (JKS), a qualified invasive species expert, to investigate the presence of invasive plant species on or adjacent to the site. JKS undertook a site inspection in July 2023 and identified areas of Japanese knotweed impact within the site boundary. Areas were fenced off with appropriate signage erected to ensure no disturbance.

The location of Japanese knotweed impact is shown as areas of green, orange and yellow in the east of the site on Figure 4.2 below and within Japanese Knotweed Solutions report (ref: JK23/9266).

FIGURE 4.2 – JAPANESE KNOTWEED LOCATION



Japanese Knotweed impacted materials were excavated under the supervision of JKS in January 2024 with works completed by 2nd February 2024. Material excavated was placed in a temporary stockpile area on visqueen sheeting, tested by E3P, and subsequently removed from site.

A validation report was prepared by Japanese Knotweed Solutions (report ref: JK23/9266) that is available upon request to Kellen Homes.

It is understood that Nightingale Environmental Limited are undertaking a program of monitoring for the next two years to inspect for any regrowth.

Conclusion

Completed in line with the remediation strategy, **no further remedial action** – ongoing monitoring by Nightingale Environmental Limited.

RE-5 – SITE CLEARANCE OPERATIONS

DATE OF WORKS UNDERTAKEN
June 2024 – September 2024

PHOTOGRAPHS
Plate 2-10

OVERVIEW OF WORKS

Background
Post-demolition general site clearance and provision of welfare, offices and site security were to be determined as per the contract requirements.

Works Undertaken
Provision of welfare, offices and site security by Total Demolition and Remediation (TDR), Urban Regen (UR) and Kellen Homes throughout the works. An out of hours site security team was in place to ensure site security and prevent injury to the public.

Prior to the commencement of remediation and enabling works, all building on site were demolished between July 2022 and May 2023.

Trees and vegetation were removed by a specialist contractor, shredded and subsequently removed off-site.

Across the site concrete slabs were present and required removal. E3P observed the hardstanding being broken out and inspected soils beneath the slabs. No visual or olfactory evidence was identified directly underlying the historic slabs across the site. The hardcore arisings from historic slab removal were crushed and screened on site for re-use as 6F2 for haul roads and temporary works mats.

Across the site former roads were lined with sandstone cobble setts. The cobble setts had historically been set within a coal tar. E3P observed the setts being broken out and inspected soils beneath the slabs. Visible coal tar was identified, where encountered coal tar impacted soil was stockpiled on visqueen and subsequently removed to a licenced waste facility (RE-7 provides further detail). Sandstone setts were bagged and removed from site for re-use by an external contractor. No cobble setts were re-used on site within the crushed aggregate.

Across the site areas of vegetation were present. Where previous self-seeded vegetation was present the material was excavated to the base of shallow root beds, stockpiled separately as per the MMP and subsequently removed from the site.

Throughout the enabling works, scrap metal, vegetation and other waste streams were separated from demolition materials and placed into allocated skips for subsequent disposal off-site. Suitable hardcore from demolition of former structures was stockpiled and crushed for use as 6F5 on site.

Conclusion
Completed in line with the remediation strategy, **no further action**.

RE-6 – DELINEATION, EXCAVATION AND TREATMENT OF IDENTIFIED ASBESTOS IMPACT

DATE OF WORKS UNDERTAKEN

Throughout works

SUPPORTING DOCUMENTS

Lucion Air Monitoring : Certificate 101965 and Report 609650
Scopus : Inspection and Re-Occupation Certificates RC-20241219083055 and HF-20241219140305
North Star Environmental: Certificates J114063/FX01, J114063/FX02, J114063/FX03, J114063/FX04, J114063/FZ01, J114063/GL01, J114063/GL02

PHOTOGRAPHS

Plate 11-16

CHEMICAL TESTING

Site Won Made Ground (in-situ)
I2 Analytical Report Ref: 23-41464 (SW-MG-001-002)
Eurofins Report Ref: 24-24013 (SW-MG-014-017)
Eurofins Report Ref: 24-35015 (SW-MG-019-021)

Stockpiled Made Ground
I2 Analytical Report Ref: 23-38011 (SP1-01 – SP11-01 and SP13-01)
I2 Analytical Report Ref: 23-38003 (SP5-01 – SP8-01 and SP12-01)
I2 Analytical Report Ref: 23-41067 (Bund 1-5)
I2 Analytical Report Ref: 23-54584 (Bund 6-8)
I2 Analytical Report Ref: 23-61056 (Bund 9-11)
Eurofins Report Ref: 23-35498 (Bund 12-14)
I2 Analytical Report Ref: 24-75932 (Bund 15-17)
Eurofins Report Ref: 24-12813 (SP07 and SP12A)

Visual Asbestos Stockpile
I2 Analytical Report Ref: 23-74533 (ASB-001)
I2 Analytical Report Ref: 24-77955 (ASB Bund)

Made Ground Soils in Area of WS125
Eurofins Report Ref:24-12813 (SW-MG-014(A)-SW-MG-017(A)

Material from "burial pits" in north and south of the Site
Eurofins Report Ref:24-27684 (ASB A and ASB B)
Eurofins Report Ref: 24-35015 (SW-MG-019-021)

OVERVIEW OF WORKS

Background
During the Phase II Geo-Environmental Assessment completed in December 2022 asbestos containing soils were encountered within WS125 at 0.5 m bgl. The Phase II report detailed that the asbestos impacted material must be buried in line with the E3P Conceptual Site Model, with material placed below 1.0m below final finished levels beneath plots, gardens or POS.

Due to the nature and age of the filled material, it must be assumed that trace fibres are present throughout the Made Ground.

Works Undertaken

Site Won Made Ground

Areas of the site were known to be impacted by asbestos. As such, Made Ground soils were tested for asbestos identification and quantification at a frequency 1 per 5000m3 across the site (turnover of c.105,000 m3) in line with the E3P Remediation Strategy (Ref: 15-974-R2-2, Dated January 2023). Generally, Made Ground was excavated, stockpiled, sampled and screened prior to placement, additional in-situ Made Ground testing was undertaken on soils utilised in the bulk earthworks to be appropriately conservative.

In June 2023 18no. stockpiles of site won Made Ground, generated from enabling works, were tested prior to placement (SP1-01 to SP13-01 and Bund 1 - 5) and a further two samples of in-situ Made Ground obtained (SW-MG-101 and SW-MG-102). Only trace asbestos fibres were detected in stockpiled Made Ground, within SP1-01 (0.013%); SP2-01, SP7-01, SP8-01, SP9-01 (<0.001%) and Bund 2 (0.011%). In all instances stockpiled soils recorded asbestos <0.1% w/w, as such, this material was utilised as bulk upfill with placement >1.0 m bgl, as per the agreed asbestos in soils conceptual site model, a copy of this model is provided as Drawing 15-974-035 in APPENDIX III.

In September and October 2023, 14.no. stockpiles of site won Made Ground, generated from enabling works, were tested prior to placement (Bund 1 - 14). Only trace asbestos fibres were detected in Stockpile 11 (Bund-11 <0.001%), as such, these soils were re-used as bulk upfill placed at depths >1.00 m bgl as discussed above.

Within Stockpile 7 (Bund 7) visible asbestos cement was noted, testing confirmed the presence of 0.172% chrysotile loose fibrous debris and cement. Stockpile 7 was fenced off with appropriate warning signs erected. A Joint Industry Working Group (JIWG) assessment was undertaken that recorded the receptor pathway was low with the overall ranking ''negligible''. Using the JIWG the works were determined to be non-licensed work with the following precautions being suitable - EN149 type FFP3 disposable masks as RPE, manual localised dust suppression and localised basic decontamination facilities. Due to wet weather during the works further dust suppression was not required, visual asbestos was handpicked, double bagged and removed from site in December 2023. Following the removal of visual asbestos, E3P obtained samples of the remaining soils and recorded trace chrysotile 0.021% (ASB-Bund) and 0.036 (ASB-001). Due to only trace fibres remaining within the processed Made Ground in Stockpile 7, this material was deemed suitable for placement >1.0 m bgl and utilised as bulk upfill across the development.

During the mechanical movement of these soils asbestos air monitoring was undertaken by Lucion Services in the works area and excavators cabin the reported concentrations were <0.100 f/ml within the cab and <0.010 f/ml within the works area. Lucion Air Monitoring Certificate 101965 and Report 609650 are available upon request to Kellen Homes.

From January 2024 to July 2024 8no. stockpiles of site won Made Ground were tested prior to placement (Bund 15 – 17, SP16-A and SP16-B, SP07, SP12A) with a further four samples of in-situ Made Ground obtained (SW-MG-014-017). Only trace asbestos fibres were detected in stockpiled Made Ground, within Bund 15 (0.004%); Bund 16 (0.002), Bund 17 and SP07 (<0.001%). Due to trace fibres present within the stockpiled Made Ground this material was utilised as bulk fill, placed at dpeths >1.0 m bgl.

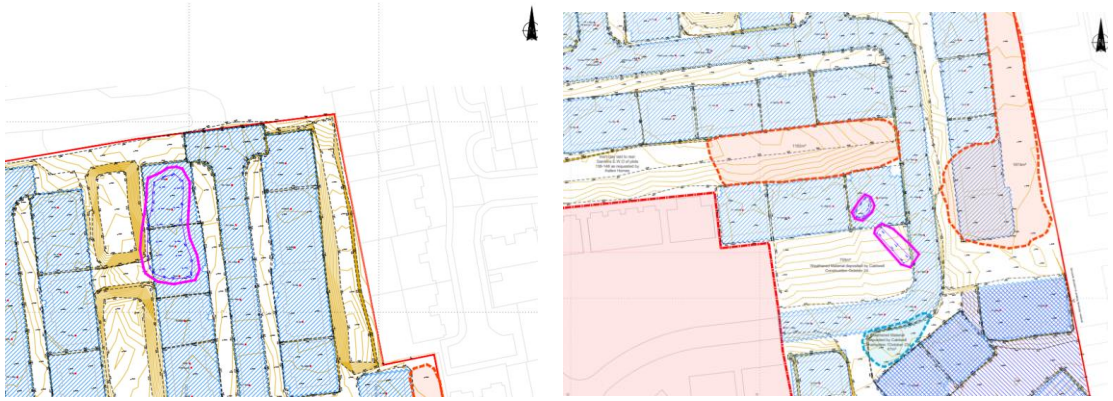
Historic 'Asbestos Burial Pits'

During turnover works on 1st July 2024 an area with visible asbestos containing materials (predominantly asbestos cement sheeting) was identified in the south of the site below plots 155-156 – referred to as 'southern asbestos burial pit'. The asbestos burial pit was not known about; however, asbestos as a contaminant was known to be presence within the Made Ground soils. As such, remedial technologies for the delineation and treatment of asbestos had already been outlined and agreed within the E3P Remediation Strategy (Ref: 15-974-R2-2, Dated January 2023). The location of

this ACM infill is shown as a purple outline on UR AsBuilt Sheet 4, UR drawing ref 395-004 in Appendix III and Figure 4.3. The location was identified as two small pits adjacent to each other, due to the limited soils between the pits and likely asbestos impact of these soils, the two locations were treated as one large ''hotspot''. Fencing with appropriate health and safety signage was erected around the area, with soils remaining undisturbed until updated RAMS were produced by the appointed contractor.

Additionally, during turnover on 19th August 2024, an area containing a layers of clearly visible asbestos cement sheeting was identified in the north of the site, referred to as 'northern asbestos burial pit' was identified below the proposed location of plots 60-63. The location of this ACM infill is shown as a purple outline on UR AsBuilt Sheet 2, UR drawing ref 395-002 in Appendix III and Figure 4.3. Fencing with appropriate health and safety signage was erected around the area, with soils remaining undisturbed until updated RAMS were produced by the appointed contractor.

FIGURE 4.3 LOCATION OF ASBESTOS BURIAL PITS (NORTH – LEFT & SOUTH – RIGHT)



E3P obtained a sample of the fine soil matrix for both the northern (ASB-B) and southern (ASB-A) asbestos pits. Sample of soils obtained from the southern asbestos area (ASB-A) recorded 3.6% w/w of chrysotile cement. No asbestos fibres were recorded within the soil matrix in the northern asbestos area (ASB-B).

In both instances work was ceased and a JIWG undertaken. The JIWG assessment concluded that the works were determined to be non-licensed work with the following precautions being suitable - EN149 type FFP3 disposable masks as RPE, manual localised dust suppression and localised basic decontamination facilities.

Visually impacted soils were load loaded directly into wagons and removed from site to a licenced waste facility by Braidwood. A total of 13no. loads (circa 90 m3) of impacted soils were removed from the southern asbestos area between 14th to 16th August 2024. A total of 46no. loads (circa 320 m3) of impacted soils were removed from the northern asbestos area between 11th and 9th September 2024. Waste consignment notes and tracking notes were made available to E3P and are available held by to Kellen Homes and UR.

Personal and boundary asbestos air monitoring was undertaken by North Star Environmental during the mechanical movement of the soils within the northern and southern asbestos impacted areas. In all locations the concentrations were <0.010 f/cm3. Asbestos air monitoring results are provided on North Star Environmental Certificates J114063/FX01, J114063/FX02, J114063/FX03, J114063/FX04, J114063/FZ01, J114063/GL01 and J114063/GL02, held by Kellen Homes.

Following the removal of impacted soils, remaining soils were tested in-situ in the north (SW-MG-019 and SW-MG-020) and south (SW-MG-021), no asbestos was identified within the soils.

Soils in Vicinity of WS125
Trace fibres of chrysolite were identified during the initial site investigation quantified at just above laboratory LOD at <0.001% within the area of WS125 and suitable for use in areas of upfill outside of gardens. E3P undertook a watching brief of the turnover works within this area, where no further impacted material was identified. Further Made Ground samples were taken from this area SW-MG-014-017 and chemical analysis confirmed no asbestos present within the samples. Therefore, the soils were utilised as bulk upfill in line with the Asbestos CSM (E3P Drawing: 15-974-035 in APPENDIX III).

Asbestos Lagged Pipe
During turnover in the south of the site in October 2024, a historic underground brick lined pipe chamber was identified, likely associated with the historic bus depot. A pipe was present within the chamber with asbestos lagged insulation present. Given the loose and friable nature of the asbestos containing material, removal works were undertaken by Scopus, an ISO accredited asbestos contractor in December 2024. Asbestos air monitoring, removal and de-contamination procedures undertaken are provided in Scopus Inspection and Re-Occupation Certificates RC-20241219083055 and HF-20241219140305, held by Kellen Homes.

Conclusion
Completed in line with the remediation strategy, **no further action**.

RE-7 – DELINEATION, EXCAVATION, TREATMENT AND DISPOSAL OF VISUAL AND OLFACTORY SEMI-VOLATILE IMPACTED MATERIAL, TPH, NAPTHALENE, SVOC

DATE OF WORKS UNDERTAKEN
Throughout works and during build phase

PHOTOGRAPHS
Plate 17-20

CHEMICAL TESTING
Coal Tar
I2 Analytical Report ref: 23-69190 and 23-69196 (CT-001)

Historic Infilled Chimney Base
I2 Analytical Report ref: 23-53713 (CB-001)

Northwest Hotspot
Eurofins Analytical Report ref: 24-005764 (SP16-LA,LB,LC,A,B)
Eurofins Analytical Report ref: 24-16336 (NWHS A-E)

OVERVIEW OF WORKS
Background
Semi-volatile contamination has been identified within the shallow Made Ground soils across the site; this was attributed to a residue from the coal tar sealant used within the former cobble sets across the site. The cobble sets and layer of coal tar sealant has been removed during the site demolition works.

The remediation works include the full depth turnover of all Made Ground under the part time supervision of E3P. During turnover works, frequent monitoring utilising a PID was to be undertaken with turnover soils chemically validated in line with section 3.8 of the E3P Remediation Strategy (Ref: 15-974-R2-2, Dated January 2023).

The impact of semi-volatile contamination is site wide and so hotspot removals were not required unless a point source was identified. As such, at build phase, a provision for the installation of vapour resistant membranes has been made for all dwellings.

Material deemed to be impacted through either visual or olfactory observations or because of notable PID readings (> 50 ppm) were to be excavated and stockpiled on an impermeable membrane. Detailed laboratory analysis of the soils was to be undertaken to determine the level of semi-volatile contamination present and establish whether it is suitable for reuse or requires off-site disposal.

Works Undertaken
Historically the site was lined with sandstone setts placed within a coal tar binding. During the demolition phase E3P observed the setts being broken out and inspected soils beneath the slabs. Where visible coal tar was encountered this was segregated and stockpiled on an impermeable membrane and subsequently removed to a licenced waste facility by TDR.

A circa 0.15 m thick layer of residual coal tar was encountered below the sandstone setts in the northwest of the site circa 5 m by 5 m in size. The extent of the coal tar was delineated by visual and PID inspection, prior to excavation and placement on an impermeable membrane. The material underwent WAC testing and a WM3 assessment prior to removal from site to a hazardous waste facility by Kenny Waste Managements. Waste consignment notes relating to the removal of coal tar are held by the client.

E3P maintained part time supervision during the full depth turnover of Made Ground. Made ground soils were visually inspected by an E3P engineer with frequent PID monitoring undertaken throughout the excavation of Made Ground. Generally, throughout the turnover of made ground soils elevated PID readings (>50 ppm) were not recorded. However, within a former chimney base in the west of the site and an area of historically infilled anthropogenic materials in the northwest of the site, elevated PID readings were recorded, as discussed below.

Chimney Base
During turnover works a suspected historically infilled chimney base was noted below the proposed parking area, north of apartment block 3. This feature was excavated in its entirety (5 m bgl) under the supervision of E3P. The soil arisings were deemed visually impacted by the on-site E3P engineer due to the presence of a hydrocarbon sheen. Additionally, elevated PID readings of 75-145 ppm were recorded, above the target threshold of 50ppm. The arisings were segregated and stockpiled on an impermeable membrane as per the remediation strategy. Once excavated E3P undertook chemical sampling (CB-001) that recorded elevated PAH's (including naphthalene of 77 mg/kg), TPH C12-C16 (260 mg/kg), TPH C16-21 (1200 mg/kg) and TPH C21-C35 (1900 mg/kg). Given the human health and controlled waters risk associated with the elevated volatile and non-volatile PAH's the soils were removed from site to a licenced waste facility. Waste consignment notes are held by the client and TDR.

Northwest Hotspot
During turnover works in the northwest, a volatile hotspot containing black ash, tar deposits and anthropogenic materials was encountered in the vicinity of proposed plots 118–121. Soils were noted to have a hydrocarbon sheen and recorded elevated PID readings of 62-185 ppm, above the target threshold of 50ppm. The extent of the impacted soils was delineated using the PID and visual inspection and excavated in its entirety to a depth of circa 2.50 m bgl. Arisings were stockpiled on an impermeable membrane as per the remediation strategy.

E3P undertook an initial phase of sampling (24-005764), with results recording exceedances of remediation targets for non-volatile and volatile PAH compounds in leachate samples (SP16-LA and SP16-LB). Following this, E3P completed a hotspot validation, with samples obtained from the base and side walls of the excavation (24-16336) to confirm the removal of impact. Samples obtained from the side walls and base recorded no exceedances in leachate samples against site specific remediation thresholds. It is therefore considered the source of contamination has been removed.

Soil arisings were sampled by E3P with completion of WAC prior to the removal from site (23-69190 and 23-69196).

Conclusion.
All works completed as per the Remediation Strategy.
Vapour membranes will be installed on all plots as part of the build phase requirements, as per the Remediation Strategy.

RE-8 – EXCAVATION, BREAKING AND PROCESSING OF ALL ABOVE- AND BELOW-GROUND STRUCTURES

DATE OF WORKS UNDERTAKEN

Throughout works

PHOTOGRAPHS

Plate 21-26

CHEMICAL TESTING

I2 Analytical Report ref: 23-44843 (SW-CRUSH-001-003)
I2 Analytical Report ref: 23-47263 (SW-CRUSH-004-006)
I2 Analytical Report ref: 23-51589 (SW-CRUSH-007-008)
Eurofins Report ref: 24-27347 (SW-CRUSH-007-011)

GEOTECHNICAL TESTING

Murray Rix Report ref: 4588/90 (SW-CRUSH)
Murray Rix Report ref: 4588/91 (CRUSH-002)
Murray Rix Report ref: MRN 24005-219 (Crush 005-006)

OVERVIEW OF WORKS

Background
Obstructions, relict foundations and infrastructure (apart from live services) were to be removed in their entirety, inclusive of below proposed plot footprints, rear gardens, private driveways, adopted highway and utilities infrastructure (road box).

Works Undertaken
TDR was contracted by Kellen Homes to undertake the controlled demolition of previous structures on site. Following demolition, the removal of concrete slabs and oversized material started within the southeast and progressed north before moving west. All sub-structures were excavated using controlled mechanical techniques under the strict control of the TDR site manager and under part time supervision of E3P.

The site was subject to a turnover to the top of the natural stratum to ensure the full removal and excavation of all below ground obstructions and relict foundations. This process allowed for the removal of any oversize materials and the identification of any previously unidentified areas of contamination. Areas of visual or olfactory contamination that were identified are discussed in RE-6

and RE-7. E3P undertook PID sampling of soils beneath slabs with no elevated PID readings recorded, areas of elevated PID readings are discussed in RE-7.

A new Blackbrook Culvert was installed and diverted by Westfields working outside of the E3P validation scope. Once diverted the historic Blackbrook culvert was grubbed out in its entirety by TDR under the part time supervision of E3P. Soils from within areas of reduced level excavation (inclusive of the grubbed-out culvert) underwent careful selection prior to placement in a manner that accords with the geotechnical engineering specification & contamination compliance criteria in areas of upfill (RE-16).

Any steel re-enforcements present within the concrete hardstanding, or waste in the form of wood, scrap metal and plastic was removed prior to the crushing of demolition material stockpiles. Waste streams were segregated and placed within allocated skips for subsequent disposal.

Suitable oversized hardcore materials were stockpiled prior to crushing/processing to nominal 6F5 grading with chemical validation in accordance with the validation sampling protocol (11 samples obtained at a frequency of 1 per 1000m3). Chemical testing results are included in Appendix IV.

Chemical analysis of site won crush used across the site identified elevated non-volatile PAHs including Benzo(a)anthracene, chrysene, benzo(b)fluoranthene, benzo(a)pyrene and dibenzo(a,h)anthracene, volatile PAH (naphthalene) and heavy metals (lead and mercury). With the exception of naphthalene, identified elevated concentrations have primary exposure pathways related to dermal contact and ingestion. Crush was placed beneath areas of future hardstanding (roads and plots) which will serve to cut the contamination pathway. Naphthalene has a primary exposure pathway through vapour inhalation, to mitigate the residual risk from SVOCs across the site, vapour membranes are to be installed on all proposed plots. This will remove the pathway and mitigate the risk to the end-user against indoor vapour inhalation. Therefore, no human health risk will be present, and the crush is suitable for use.

Elevated mercury concentrations have been identified within Crush 008 at 5.1 mg/kg. Crush was placed beneath areas of future hardstanding (roads and plots) which will serve to cut the contamination pathway. Mercury has a primary exposure pathway through vapour inhalation, to mitigate the residual risk from SVOCs across the site, vapour membranes are to be installed on all proposed plots. This will remove the pathway and mitigate the risk to the end-user against indoor vapour inhalation. Therefore, no human health risk will be present, and the crush is suitable for use.

Given the placement of crush beneath hardstanding, construction of surface water drainage and the lack of a high groundwater table, no surface or groundwater interaction will occur with these soils and as such, no leaching of potentially mobile contaminant will occur. Therefore, no controlled waters risk will be present from the use of crush on site.

Particle size distribution testing showed the crushed material complied with 6F2 grading (Murray Rix Report: MRN 4588/90, 4588/91and 24005-219).

Conclusion
Completed in line with the remediation strategy, **no further action**.

RE-9 – DELINEATION, EXCAVATION, AND TREATMENT OF INFILLED HISTORICAL PONDS

DATE OF WORKS UNDERTAKEN
Throughout works

PHOTOGRAPHS

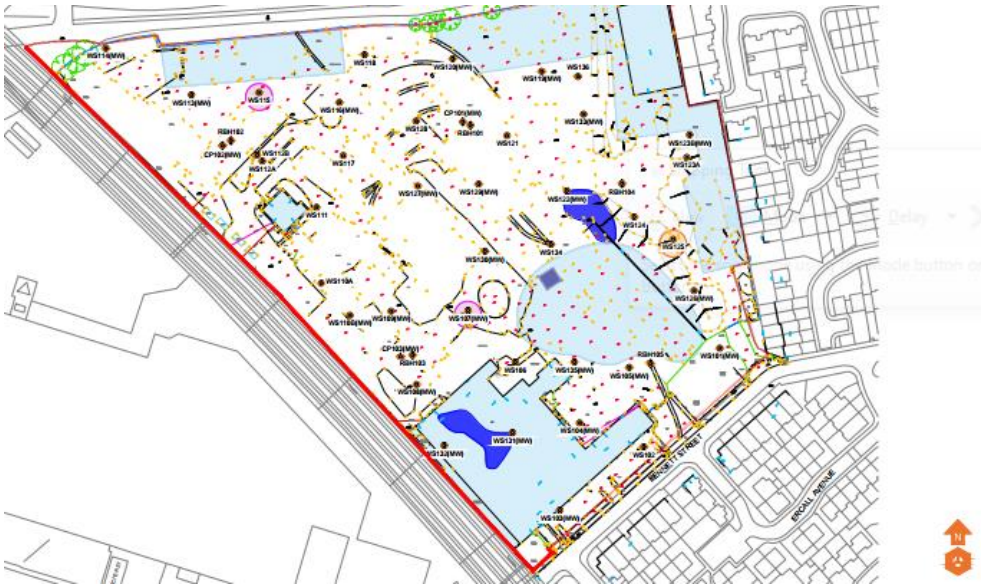
Plates 42-43

OVERVIEW OF WORKS

Background

Two historic infilled ponds were identified on site during the previous phases of investigation. All known former infilled ponds were to be delineated and investigated to assess the nature of materials and the extent of any deleterious elements. The location of historic ponds is shown as areas of dark blue in Figure 4.4.

FIGURE 4.4 – HISTORICAL FEATURES PLAN (HISTORICAL PONDS SHOWN IN DARK BLUE)



Works Undertaken

E3P maintained part time supervision during the excavation and turnover of materials across the site.

Pond 1 – Southwest

During turnover works, the former pond feature in the southwest (Pond 1) was identified through a change in the colour of clay soils beneath apartment blocks one and two. E3P maintained full time supervision during the removal of soft grey CLAY backfill and undertook hand shear vane testing (HSV) on the base of the excavation(s) to confirm competent natural stratum (>50 cu).

The base of Pond 1 was noted to be 1.50 m below the wider natural level.

No organic pond base was identified, it is likely this was historically grubbed out and nominally backfilled during construction of the historical structures. The resulting excavation was backfilled with geotechnically suitable site won Made Ground in line with the agreed specification for a piled foundation (RE-16).

Pond 2 – Northeast

During turnover works, the former pond feature in the northeast (POND 2) was identified through a change in the colour of clay soils beneath Plots 68-71. Pond 2 was recorded slightly north of the mapped location. E3P maintained full time supervision during the removal of soft greyish brown CLAY backfill and undertook hand shear vane testing (HSV) on the base of the excavation(s) to confirm competent natural stratum (>50 cu).

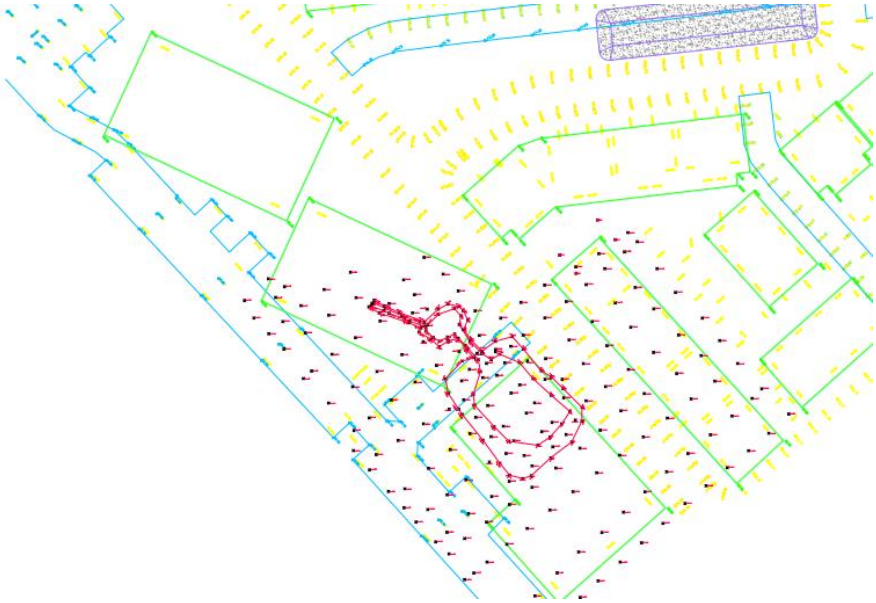
The base of Pond 2 was noted to be 1.75 m below the wider natural level.

No organic pond base was identified, it is likely this was historically grubbed out and nominally backfilled during construction of the historical structures. The resulting excavation was backfilled with geotechnically suitable site won Made Ground in line with the agreed specification for a vibrio stone column foundation with in situ density testing conducting to confirm compliance with the specification (RE-16 & RE-17).

The location and depth of Pond 1 excavation is provided in red on the left of Figure 4.4 (below Apartment Blocks 1 and 2) and within Drawing 15-974-032 in Appendix III. The location and depth of the northeast pond excavation is provided in red on the right of Figure 4.5 (below plots 68-71) and within Drawing 15-974-032 and 15-974-036 in Appendix III.

FIGURE 4.5 – POND 1 (TOP) AND POND 2 (BOTTOM)

Pond 1 Location :



Pond 2 Location:



Conclusion
Completed in line with the remediation strategy, **no further action**.

RE-10 – REMOVAL OF DELETERIOUS MATERIAL

DATE OF WORKS UNDERTAKEN
Throughout works

PHOTOGRAPHS
Plate 27-29

OVERVIEW OF WORKS

Background
All potentially deleterious materials were to be delineated, stockpiled and removed from the site by the contractor to a licensed waste facility.

Works Undertaken
Following the demolition of structures across the site, demolition materials were segregated with waste materials removed from site.

E3P maintained part-time supervision during excavation and turnover works, E3P witnessed the separation of deleterious materials with materials segregated and placed in appropriate skips or stockpiles.

E3P witnessed the removal of coal tar (RE-5 and RE-7), Japanese Knotweed impacted soils (RE-4), asbestos containing materials (RE-6) and anthropogenic wastes across the site (RE-7).

The majority of Made Ground soils were screened on two-way screeners prior to re-use on site. Where oversized materials were segregated, inert hardcore was separated for use on site. Remaining anthropogenic oversized materials including wood, roots, metal, plastic and building waste was delineated, stockpiled and removed from the site by the contractor to a licensed waste facility. Where the materials could not be recycled (such as building wastes) bulk waste wagons were utilised to remove the anthropogenic soils to landfill sites.

Where applicable, E3P undertook WM3 or WAC testing prior to removal of wastes from site (RE-23).

Copies of waste transfer notes are held by TDR, UR and Kellen Homes.

E3P undertook visual inspections and analysis of Made Ground soils utilised in the earthworks across the site to confirm the suitability for use.

Conclusion
Completed in line with the remediation strategy, **no further action**.

RE-11 – REMOVAL OF ASTS

DATE OF WORKS UNDERTAKEN
June 2024

CHEMICAL TESTING
Eurofins Report ref: 24-20643-1

PHOTOGRAPHS
Plate 30

OVERVIEW OF WORKS

Background

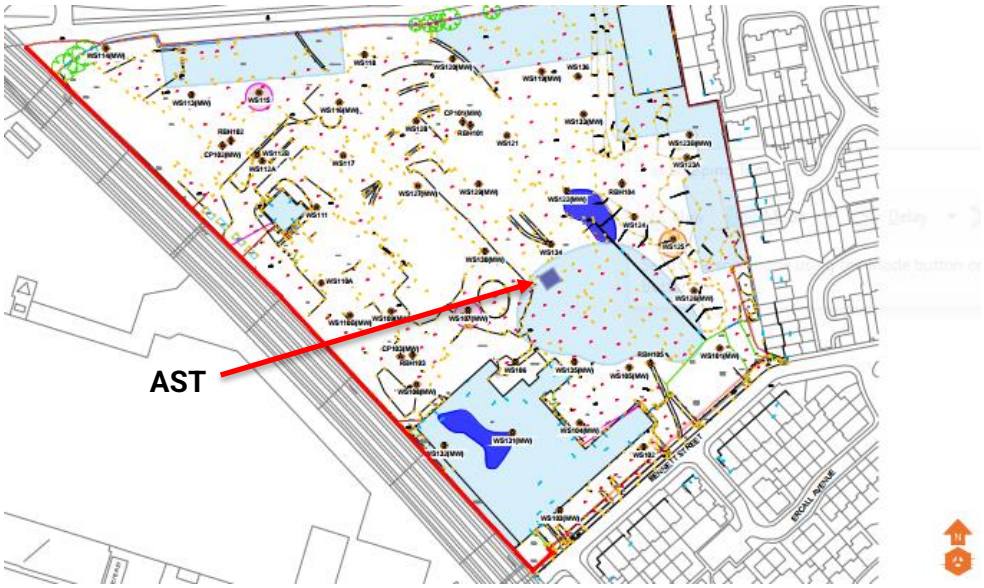
The remediation strategy required that any redundant above-ground storage tanks (ASTs) require emptying, decommissioning and removal from the site. Should the tanks contain any residual liquids, this should then be uplifted by the vacuum tanker or a surface-mounted pump (peristaltic or double-diaphragm).

Any soils with visual or olfactory evidence of hydrocarbon impact will be excavated, delineated and placed on impermeable MDPE for subsequent chemical validation. Any soils that exceed these site-specific screening values will be disposed of off-site in accordance with UK waste management legislation.

Overview of work

One redundant above-ground storage tanks (ASTs) was present in the central/eastern area of site, the location of which is shown as a purple square on E3P Drawing 15-974-004 and Figure 4.6.

FIGURE 4.6 – HISTORICAL FEATURES PLAN (AST SHOWN IN PURPLE)



The tank was noted to be empty with no residual fluids present. PID monitoring of tank openings and surrounding area did not record elevated readings (all readings <50 ppm).

E3P undertook a watching brief during the breaking out of the concrete base in June 2024. No visual or olfactory evidence of contamination was noted within Made Ground soils below the concrete subbase. Additionally, all PID readings were recorded <50ppm.

E3P obtained three validation samples of underlying soils and submitted the samples for a full suite of soil and leachate analysis inclusive of heavy metal, PAH, TPH, SVOC and VOC analysis to ensure no residual contamination from the historic tank remained. Elevated naphthalene was identified within AST102 at 5.4mg/kg. However, due to the soil organic matter (SOM) content being recorded above 2.5%, the chemical results were compared to modified naphthalene screening values for 2.5% SOM (5.6mg/kg), using the modified naphthalene value, no exceedance of human health screening criteria was recorded, and no further works were required.

Leachate analysis recorded no exceedances when compared to site specific remedial targets.

Given the above, no contamination associated with the AST was deemed to have occurred. The tank was removed from site, with the concrete sub-based processed and re-used as crush (aggregate) within the development.

Conclusion
Completed in line with the remediation strategy, **no further action**.

RE-12 – INVESTIGATION AND REMOVAL OF HISTORIC USTS

DATE OF WORKS UNDERTAKEN

June 2023 – July 2023

PHOTOGRAPHS

Plate 31

CHEMICAL TESTING

Tank Soil Validation
I2 Analytical Report Ref: 23-41682 (Tank-B1,B2,N,S,E,W)

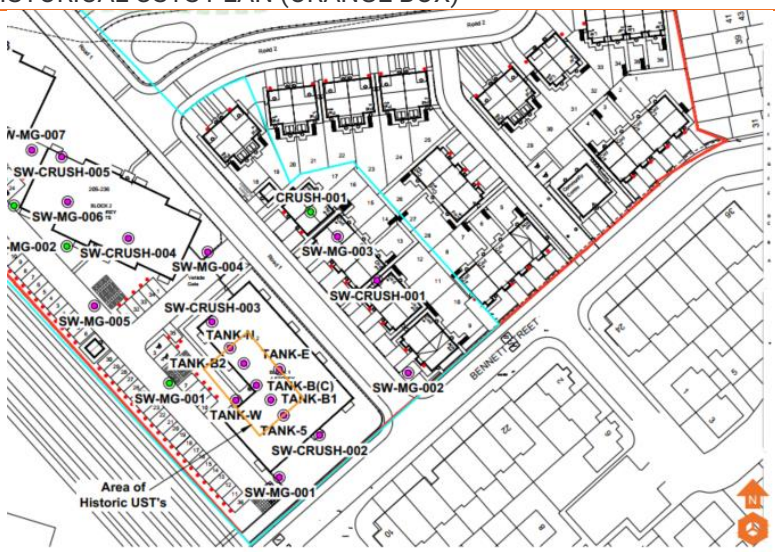
Tank Leachate Validation
I2 Analytical Report Ref: 23-43859 (Tank (L)-B1,B2,N,S,E,W)

OVERVIEW OF WORKS

Background
The remediation strategy required that during remediation and enabling works, any tanks identified were to be investigated. Prior to works starting the contents of any USTs were unknown and no evidence was provided to suggest decommissioning. The sides and bases of excavations required chemical validation to ensure that soils are below the site-specific remedial validation criteria for the protection of human health and controlled waters.

Works Undertaken
Following the demolition of the former bus depot in the south east, two adjacent underground storage tanks (UST) were encountered beneath/recessed within the floor slab. The location of the tanks is shown on Figure 4.7.

FIGURE 4.7 – HISTORICAL USTS PLAN (ORANGE BOX)



Tanks were noted to be empty with no residual fluids present. PID monitoring of tank openings and surrounding area did not record elevated readings (all readings <50 ppm).

Following the removal of the tanks, E3P undertook a visual and olfactory inspection with no visual, olfactory or PID readings above 50ppm noted. Concrete tank bases were broken out and added to the oversize stockpile for crushing and re-use on site (RE-8).

Following removal of tank bases E3P undertook further inspection of the underlying soils, no evidence of visual or olfactory evidence was recorded. E3P obtained soil and leachate samples from the base, north, south, east and west walls of the excavation in the area of the historic tank(s). Results show no elevated contaminants when compared to soil remediation targets with respect to human health. Additionally, leachate analysis did not record any exceedances of remedial values agreed within E3P Letter Report 15-974-L4, Table 1.4 (15m compliance) and Table 1.5 (50m compliance). As such, no residual effect on the surrounding soils from the historic USTs has been recorded. The soils are considered suitable for use as upfill for the creation of the development platform.

Conclusion
Completed in line with the remediation strategy, **no further action**.

RE-13 – CUT-AND-FILLING OF MADE GROUND TO DEVELOPMENT LEVELS

DATE OF WORKS UNDERTAKEN
Throughout works

PHOTOGRAPHS
Plate 32-35

CHEMICAL TESTING

Site investigation soil testing
I2 Analytical Report Ref: 21-30518 (WS107, WS109, WS110)
I2 Analytical Report Ref: 22-31069 (WS104, WS131, WS135)

Site Won Made Ground (in-situ)
I2 Analytical Report Ref: 23-41464 (SW-MG-001-002)
Eurofins Report Ref: 24-24013 (SW-MG-014-017)
Eurofins Report Ref: 24-35015 (SW-MG-019-021)

Stockpiled Made Ground
I2 Analytical Report Ref: 23-38011 (SP1-01 – SP11-01 and SP13-01)
I2 Analytical Report Ref: 23-38003 (SP5-01 – SP8-01 and SP12-01)
I2 Analytical Report Ref: 23-41067 (Bund 1-5)
I2 Analytical Report Ref: 23-54584 (Bund 6-8)
I2 Analytical Report Ref: 23-61056 (Bund 9-11)
Eurofins Report Ref: 23-35498 (Bund 12-14)
I2 Analytical Report Ref: 24-75932 (Bund 15-17)
Eurofins Report Ref: 24-12813 (SP07 and SP12A)

Leachate testing
I2 Analytical Report Ref: 23-44732 (SW-MG-001-002)
I2 Analytical Report Ref: 23-49287 (SW-MG-003-007)
I2 Analytical Report Ref: 23-59931 (SW-MG-008-009)
I2 Analytical Report Ref: 23-70619 (SW-MG-010)
Eurofins Analytical Report Ref: 24-18029 (SW-MG-011 – SW-MG-013)
Eurofins Analytical Report Ref: 24-27345 (SW-MG-014 – SW-MG-018)
Eurofins Analytical Report Ref: 24-29961 (SW-MG-019 – SW-MG-021)

GEOTECHNICAL TESTING

Murray Rix Report Ref: MRN 24005/29 (Clay Upfill)
Murray Rix Report Ref: MRN 4588-87 (SW-MG-001-002)
Murray Rix Report Ref: MRN 4588-97 (SW-MG-003)
Murray Rix Report Ref: MRN 4588-146 (SW-MG-004)
Murray Rix Report Ref: MRN 24005-77 (SW-MG-005-006)
Murray Rix Report Ref: MRN 24005-78 (SP07)
Murray Rix Report Ref: MRN 24005/211 (SW-MG-007-016)

OVERVIEW OF WORKS

Background

As part of the remediation and enabling works, a full depth turnover of Made Ground to the top of natural stratum was required in order to cut and fill the site to the required development levels.

The overarching aim of the remediation and enabling earthworks was the construction of a development platform that will ensure suitability for vibro stone columns (VSC) across the majority of the site and a piled foundation for apartment blocks 1-3 and plots 87-91 and 130-135 (controlled flight auger piled).

Where the development levels require material to be filled, site derived Made Ground were to be sorted in a controlled manner prior to replacement, in accordance with the requirements of the remediation and enabling works geotechnical specification.

Works Undertaken

The area was subject to a process of enabling earthworks completed by the appointed contractors, TDR August 2022 – April 2024) and UR (May 2024 – October 2024), under the supervision of E3P.

The ground levels for the subject site were subject to cut (blue) and fill (red) as shown on Figure 4.5 (Kellen Drawing: KH006-003 in Appendix III).

In order to provide the final development platforms there was a requirement to undertake a significant cut and filling process of Made Ground across the site. Excavated materials and imported materials were used to build final development levels.

The ground levels for the subject site were subject to cut and fill with circa 105,000 m3 of Made Ground material turned over across the site. Generally, Made Ground was excavated, stockpiled, sampled and screened prior to placement, additional in-situ Made Ground testing was undertaken on soils utilised in the bulk earthworks.

All unsuitable materials were removed in their entirety to ensure the removal of relict hardstanding, foundations and infrastructure. A new Blackbrook Culvert was installed and diverted by Westfields working outside of the E3P validation scope. Once diverted the historic Blackbrook culvert was grubbed out in its entirety by TDR under the part time supervision of E3P. Soils from within areas of reduced level excavation (inclusive of the grubbed out culvert) underwent careful selection prior to placement in a manner that accords with the geotechnical engineering specification & contamination compliance criteria in areas of upfill.

Where the proposed enabling works levels required the current landform to be cut, extreme care was taken so as not to disturb the underlying stratum prior to the placement of the appropriate platform, in compliance with the E3P Geotechnical Specification.

Where the development levels required material to be filled, site derived Made Ground and natural clays were utilised. Upfill materials were sorted in a controlled manner prior to replacement, in accordance with the requirements of the specification for the intended land use.

FIGURE 4.5 KELLEN HOMES CUT AND FILL SITE MODEL



Chemical soil testing

Validation sampling of site won Made Ground was completed in line with the testing frequency (1 sample per 5000 m^3) outlined in the remediation and enabling works strategy. A total of 41 samples were obtained from stockpiled and placed Made Ground soils. Samples were scheduled for a full suite of analysis, including heavy metals, asbestos quantification, polycyclic aromatic hydrocarbons (PAH) and total petroleum hydrocarbons (TPH).

Results confirmed the initial site model, with site wide minor elevations of non-volatile PAH (Benzo(b)fluoranthene, Dibenz(a,h)anthracene, Benzo(a)anthracene and Benzo(a)pyrene) and heavy metals (lead). Minor elevations of volatile contaminants (naphthalene and mercury) were recorded associated with the historical industrial use and coal tar leaching.

Exceedances of non-volatile PAH and heavy metals have primary exposure pathways related to dermal contact and ingestion. Soils were used as upfill and therefore any risk to human health is mitigated by the installation of a chemically suitable cover systems within all proposed garden areas and areas of soft standing, additionally, where hardstanding is present (plots, driveways and roads) the pathway is cut.

Volatile contaminants have a primary exposure pathway related to vapour inhalation. All dwellings are to be installed with an appropriate vapour membrane to ensure no vapour ingress into dwellings, preventing harmful vapour build up and removing the risk to end users.

Trace asbestos was encountered within Made Ground soils, where encountered, was asbestos quantified and re-used/removed as per RE-5 to ensure no future risk.

Chemical leachate testing

Leachate analysis has been undertaken at a frequency of 1 sample per 5000 m^3 in order to ensure site won Made Ground is not likely to have a detrimental effect to the on-site surface water courses.

A total of 21no. Made Ground leachate samples were obtained from stockpiled and placed soils, results of leachate testing are presented in the analytical reports referenced above.

Results were compared to Environmental Quality Standards (EQS) and site-specific remedial targets agreed within E3P Letter Report 15-974-L4, Table 1.4 (15m compliance) and Table 1.5 (50m compliance). Within 20no. of the 21no. samples (with the exception of SW-MG-020), minor copper exceedances above EQS and 15m compliance were recorded. Eleven of 21no samples (SW-MG-001 to 004, 008-009, 011 and 019-020) recorded copper values below the 50m compliance threshold for copper. Two minor exceedances above the 15m compliance threshold for lead were recorded within SW-MG-005 and SW-MG-006, as such, these soils were placed over 15 m from the culvert in the south west of the site below Apartment Block 1. Given the lack of point source for heavy metals and low solubility of the determinants, the risk associated with relatively low-level metalloid impact on the Cornbrook Culvert(s) is considered to be insignificant and representative of urbanised watercourses due to the industrial legacy of the immediate area and not specifically attributed to the subject site, as agreed with the EA letter dated 9th June 2023.

Results show no elevations of PAH or TPH compounds compared to the EQS values.

Where potential point sources were identified (USTs, coal tar and TPH impacted soils), the point sources were removed and subsequent leachate analysis undertaken as detailed in RE-12 and RE-7 to ensure no risk to controlled waters. Additionally, as per RE-3, no detrimental impact to Cornbrook or Blackbrook Culvert has been recorded during the remediation and enabling work activities.

Geotechnical testing
E3P undertook laboratory geotechnical sampling involving particle size distribution (PSD), moisture content and dry density/water content relationship. PSD testing confirms the Made Ground material generally complies as class 2C cohesive fill. Dry density/moisture content relationship results indicated the natural moisture content of the material to be outside the 2% (+/-) requirement in relation to the optimum moisture content. As such, during dry weather periods the soils were stockpiled, dried and subsequently placed as detailed in RE-14 and RE-16. During wetter months, ordinary Portland cement (OPC) and pelletised lime were added to Made Ground soils to control the moisture content.

In-situ HSV testing was undertaken at the top of natural stratum to ensure a shear strength >45 Cu. As discussed in RE-9, material with a shear strength <45 Cu encountered within the former pond area(s) was removed and backfilled with suitable site won Made Ground.

E3P maintained part time supervision of the works to ensure materials were engineered in line with the E3P Geotechnical Engineering Specification as detailed within Section 6 of the Remediation Strategy (Ref: 15-974-R2-2, Dated January 2023).

Where site-won Class 2 materials have been used as fill beneath proposed VSC plots, externals driveways and rear gardens, NNDG testing of upfill was undertaken, detailed in RE-16.

Conclusion
Completed in line with the remediation strategy and EA correspondence letters, **no further action**.

RE-14 – PLACEMENT AND COMPACTION OF UPFILL MATERIAL TO FACILITATE GROUND IMPROVEMENT BY VSC

DATE OF WORKS UNDERTAKEN
Throughout works

PHOTOGRAPHS
Plate 32-36

Geotechnical TESTING
Murray Rix Report Ref: MRN 24005/29 (Clay Upfill) Murray Rix Report Ref: MRN 4588-87 (SW-MG-001-002) Murray Rix Report Ref: MRN 4588-97 (SW-MG-003) Murray Rix Report Ref: MRN 4588-146 (SW-MG-004) Murray Rix Report Ref: MRN 24005-77 (SW-MG-005-006) Murray Rix Report Ref: MRN 24005-78 (SP07) Murray Rix Report Ref: MRN 24005/211 (SW-MG-007-016)

OVERVIEW OF WORKS
Background Where plots were to be prepared in a manner that would facilitate ground improvement by vibro-stone column, materials must be either compliant with the specified grading requirements for a nominally placed and tracked granular aggregate, or alternatively, they should be engineered to a defined geotechnical standard to achieve 95% compaction of the laboratory determined maximum dry density (DD). **Works Undertaken** Where the proposed enabling works levels required the current landform to be cut, extreme care was taken so as not to disturb the underlying stratum prior to the placement of the appropriate platform, in compliance with the E3P Geotechnical Specification. E3P maintained part time supervision of throughout turnover works. Where the natural formation was exposed, E3P undertook in-situ HSV testing was undertaken to ensure competent strata (shear strength >45 Cu). As discussed in RE-9, material with a shear strength <45 Cu encountered within the former pond area was removed and backfilled with geotechnically suitable site won Made Ground. Dry density/moisture content relationship results indicated the natural moisture content of the material to be outside the 2% (+/-) requirement in relation to the optimum moisture content. As such, during dry weather periods the soils were stockpiled, dried and subsequently placed and engineered in line with MCHW as detailed in RE-16. During wetter months, OPC and pelletised lime were added to Made Ground soils to control the moisture content prior to placement and engineering. PSD testing of site won Made Ground confirms the material complies as class 2C cohesive fill. Given the backfill material has more than 10% fines, soils were engineered in line the E3P Geotechnical Engineering Specification as detailed within Section 5 of the Remediation Strategy (Ref: 15-974-R2-2, Dated January 2023) to achieve >95% compaction of the laboratory determined maximum dry density (DD). To confirm engineering compliance, where site-won Class 2 materials have been utilised as fill beneath proposed VSC plots, external driveways and rear gardens NNDG testing of was undertaken every 750mm of upfill. NNDG testing confirms that the soils have been engineered and achieved compaction >95% of the maximum dry density, determined from lab derived OMC/DD testing. Plans showing the locations of NNDG testing across layers is given as E3P Drawings 15-974-038 to 041 in Appendix III. Results from NNDG testing are included within Appendix V. **Conclusion** Completed in line with the remediation strategy, **no further action**.

RE-15 – CONSTRUCTION OF TEMPORARY WORKING PLATFORM

DATE OF WORKS UNDERTAKEN
Throughout works

PHOTOGRAPHS
Plate 37-41

CHEMICAL ANALYSIS
I2 Analytical Report ref: 23-44843 (SW-CRUSH-001-003) I2 Analytical Report ref: 23-47263 (SW-CRUSH-004-006) I2 Analytical Report ref: 23-51589 (SW-CRUSH-007-008)

GEOTECHNICAL TESTING
Murray Rix Reports: 4588/90 & 4588/91 Murray Rix Report: MRN 24005-219 & 24005-301 (CRUSH 005-007) E3P CBR testing certificates included in Appendix V CBR Test Results – E3P Drawings 15-974-037 and 042

OVERVIEW OF WORKS

Background

Where plots were to be prepared in a manner that will facilitate ground improvement by vibro-stone column, and those utilising piled foundations, a temporary working platform was to be constructed.

Works Undertaken

A temporary working platform was constructed comprising 300mm of 6F5 from site won crush material. 6F5 was tested to confirm chemical suitability (RE-8).

Particle size distribution testing showed the crushed material complied with 6F5 grading (Murray Rix Report: MRN 4588/90 and 4588/91).

TDR (August 2022 – April 2024) and UR (May 2024 – October 2024) had full-time supervision with E3P providing part-time supervision of the following:

- CBR plate load tests to be completed on roads and piling mats to ensure compaction of 5%.
- Geotechnical testing of the site won material was undertaken for PSD.

The results of the CBR tests confirm that all piling locations mats met the compaction specification and are given in Appendix III and IV, except for the mat in the area of Plot 115/116, however, given the deformation recorded during the test, the VSC contractor was happy to proceed. The location and result of CBR testing on piling mats is provided on E3P Drawing 15-974-042 in APPENDIX III.

CBR testing was undertaken on the formation of highways to be adopted, generally CBRs on road/highways achieved the required 5% CBR. However, Road 1 CBRs 103 (3%) and 104 (2%), Road 3 CBR Pl134E (4%) and Road 4 +40m (0.7%), +60m (3%) and + 70m (2%) failed to meet the required 5%. Where less than 5% CBR was achieved, capping thickness was increased in line with highways guidance. Caldwell's construction (build phase civil contractor) will excavate the current temporary road box, install infrastructure and complete validation CBR testing on the `final highways formation, sub-grade and capping for future highways adoption. The location and result of CBR testing on piling mats is provided on E3P Drawing 15-974-037 in APPENDIX III.

Conclusion

Completed in line with the remediation strategy, **no further action**.

RE-16 – REPLACEMENT OF MATERIALS, GEOTECHNICAL ENGINEERING REQUIREMENTS

DATE OF WORKS UNDERTAKEN
Throughout works

PHOTOGRAPHS

Plates 32-36

GEOTECHNICAL TESTING

E3P CBR & NNDG testing certificates included in Appendix V
Murray Rix Report Ref: MRN 4588-87 (SW-MG-001-002)
Murray Rix Report Ref: MRN 4588-97 (SW-MG-003)
Murray Rix Report Ref: MRN 4588-146 (SW-MG-004)
Murray Rix Report Ref: MRN 24005-77 (SW-MG-005-006)
Murray Rix Report Ref: MRN 24005-78 (SP07)
Murray Rix Report Ref: MRN 24005/211 (SW-MG-007-016)

OVERVIEW OF WORKS

Background

Material was to be backfilled in strict compliance with the E3P Geotechnical Engineering Specification as presented in detail within Section 6 of the E3P Remediation Strategy (Ref: 15-974-R2-2, Dated January 2023).

Works Undertaken

Site won general fill was placed and compacted in 225 mm layers in accordance with the E3P geotechnical engineering specification.

To achieve the proposed Enabling Works Levels (EWLs), TDR and UR undertook a process of cut/fill works including the careful selection of materials from within areas of reduced level excavation (cut) prior to placement in a manner that accords with the geotechnical engineering specification & contamination compliance criteria. Arisings from the foundations were re-used on site to build up levels.

TDR August 2022 – April 2024) and UR (May 2024 – October 2024), had full supervision with E3P providing part time supervision of the following:

- General cut and fill of natural and anthropogenic soils in accordance with the E3P geotechnical & contamination performance criteria to create a development platform for a combination of piled foundations (apartment blocks) and VSC foundations (low rise plots).
- Management of all materials to maximise the retention of soils on site to ensure suitable development.
- Turnover of any Made Ground soils to remove slabs, historic culvert, obstructions and historic foundations.
- CBR plate load tests completed on all roads and piling mats.
- NNDG testing on upfill to confirm compaction.
- Geotechnical testing of the site won material was undertaken for PSD and OMC/DD.

E3P undertook laboratory geotechnical sampling involving particle size distribution (PSD), moisture content and dry density/water content relationship. PSD testing confirms the Made Ground material generally complies as class 2C cohesive fill. Dry density/moisture content relationship results indicated the natural moisture content of the material to be outside the 2% (+/-) requirement in relation to the optimum moisture content. As such, during dry weather periods the soils were stockpiled, dried and subsequently placed as detailed in RE-14 and RE-16. During wetter months, OPC and pelletised lime were added to Made Ground soils to control the moisture content.

In-situ HSV testing was undertaken at the top of natural stratum to ensure a shear strength >45 Cu. As discussed in RE-9, material with a shear strength <45 Cu encountered within the former pond area(s) was removed and backfilled with suitable site won Made Ground.

E3P maintained part time supervision of the works to ensure materials were engineered in line with the E3P Geotechnical Engineering Specification as detailed within Section 6 of the Remediation Strategy (Ref: 15-974-R2-2, Dated January 2023).

To confirm engineering compliance, where site-won Class 2 materials have been utilised as fill beneath proposed VSC plots, external driveways and rear gardens NNDG testing of was undertaken every 750mm of upfill (RE-14). NNDG testing confirms that the soils have been engineered and achieved compaction >95% of the maximum dry density, determined from lab derived OMC/DD testing. Plans showing the locations of NNDG testing across layers is given as E3P Drawings 15-974-038 to 041 in Appendix III. Results from NNDG testing are included within Appendix V.

The results of the CBR and NNDG tests confirm that all locations met the compaction specification and are given in Appendix III and IV.

Conclusion
Completed in line with the remediation strategy, **no further action**.

RE-17 – PREPARATION OF GROUND FOR VIBRO-STONE COLUMNS WITHIN TREE INFLUENCE

DATE OF WORKS UNDERTAKEN
June 2024 – October 2024

PHOTOGRAPHS
Plates 32-36

OVERVIEW OF WORKS

Background
Where trees were present, or within their total zone of influence, the contractor was to ensure that all cohesive soils are removed to the required depth with the subsequent replacement with a granular blanket to fully mitigate the potential for volumetric instability in the clay soils.

AJP Consulting Engineers completed the FZP for the site (Drawing ref: BEN-AJP-XX-00-DR-S-2000), this should be read in conjunction with this validation report. The AJP Consulting Engineers FZP denotes plots affected by tree influence across the site.

Works Undertaken
Shallow natural CLAY was identified in the east of the site within the area of tree influence identified by AJP. The natural CLAY soils were excavated as per the UR cut and fill drawing 15-974-036, stockpiled and subsequently re-used as subsoils within the cover systems at the development (RE-20).

The resulting void was infilled with suitable site won Made Ground and engineered in accordance with the E3P Geotechnical Engineering Specification as detailed within Section 6 of the Remediation Strategy (Ref: 15-974-R2-2, Dated January 2023). Where site-won Class 2 Made Ground materials have been used as fill beneath proposed VSC plots, NNDG testing of upfill was undertaken (RE-14 & RE-16). NNDG testing confirms that the soils have been engineered and achieved compaction >95% of the maximum dry density, determined from lab derived OMC/DD testing.

Plans showing the locations of NNDG testing across different layers is given as E3P Drawings 15-974-030 in Appendix III.

Conclusion
Completed in line with the remediation strategy, **no further action**.

RE-18 – IMPORTATION OF BULK FILL

OVERVIEW OF WORKS

There was no requirement for the importation of bulk fill to the site throughout the remediation works.

RE-19 – PREPARATION OF GARDEN FOR COVER SYSTEM

DATE OF WORKS UNDERTAKEN

Throughout works

OVERVIEW OF WORKS

Background
As part of the land remediation works, garden areas were to be prepared in a manner that will facilitate the placement of the clean cover system during the development phase of the works.

Works Undertaken
All proposed rear gardens have been prepared in a manner that will facilitate the placement of a minimum 600 mm clean cover system over the geotextile membrane / no dig barrier during the development phase of the works.

Front garden areas have been left 450 mm below finished level to allow the placement of clean cover systems over a geotextile membrane.

POS areas have been left 450 mm below finished level to allow the placement of clean cover systems, no geotextile membranes is required below cover systems in POS areas as per the agreed Build Phase Mitigation Strategy (Ref: 15-974-R3-6, dated November 2023).

The agreed location and depth requirements for cover systems is provided on Kellen Homes Drawings KH006-SA1 and KHE-006-CSS01 in Appendix III.

The placement of certified subsoil and topsoil will be completed as part of the developer works/build-phase mitigation plan. All garden areas where a cover system is required will be subject to plot-specific independent validation.

Conclusion
No further remedial works.
Placement and validation of certified topsoil and subsoil above a geotextile membrane across the soft landscaped areas of site will be covered within build phase works package.

RE-20 – PROVISION OF SUBSOIL

DATE OF WORKS UNDERTAKEN
March 2024 - October2024

CHEMICAL ANALYSIS
I2 Analytical Report ref: 24-008736 (Mere Golf Club IMP-SS001-004)
I2 Analytical Report ref: 24-010773 (Mere Golf Club IMP-SS005)
I2 Analytical Report ref: 24-77927-1(Roman Way SS-001-003)
Eurofins Report ref: 24-25212(SW-CLAY 001-005)
Eurofins Report ref: 24-25843(SW-CLAY 006-010)
Eurofins Report ref: 24-27346(SW-CLAY 011-015)
Eurofins Report ref: 24-29407 (SW-CLAY 016-018)

OVERVIEW OF WORKS

Background

Underlying natural clay soils are suitable for use as subsoil, however, it is anticipated there will be a shortfall of suitable subsoils on-site, as such, there is likely to be a requirement to import additional suitable material for use within cover systems at the proposed development.

Overview of Works

Imported subsoils

Subsoils were imported to site from donor sites Roman Way, Preston and the Mere Golf Club. Prior to import both donor sites were added to the MMP with acceptance granted by CL:AIRE. To date circa 150m3 of subsoil from Roman Way and circa 200m3 of subsoil from the Mere Golf Club have been imported. A total of eight subsoil samples have been submitted for analysis, at a brownfield frequency of 1 per 50 m3 in line with the E3P remediation strategy, covering 400 m3 of imported subsoil.

The chemical analysis suite comprises heavy metals, sulphates, phenols, speciated Polycyclic Aromatic Hydrocarbons (PAHs), speciated and total Petroleum Hydrocarbons (TPH) and asbestos. No exceedances of human health screening values were recorded within the five samples, confirming the soils suitability for use within private garden cover systems.

Site won subsoils

Natural soils generated from road and sewer arisings as well as the clay removed from areas of tree influence were stockpiled in the east of the site.

To date, E3P have obtained 18no. samples of site won natural clay subsoils, won from civil excavations, cut/fill works and tree influence areas across the development site.

The chemical analysis suite comprises heavy metals, sulphates, phenols, speciated Polycyclic Aromatic Hydrocarbons (PAHs), speciated and total Petroleum Hydrocarbons (TPH) and asbestos.

Minor exceedance of non-volatile PAH thresholds were recorded within SW-CLAY-001- 002 and SW-CLAY-01, likely associated with the interface of the natural soils and Made Ground. Therefore, these soils were segregated and placed in areas of upfill and not gardens with additional subsoil tests confirming suitability for use of remaining soils. Remaining soils confirmed suitability for use in private garden cover systems. To date, a total of 16no. suitable subsoil samples have been submitted for analysis, at a site won subsoil frequency of 1 per 250 m3 in line with the E3P remediation strategy, covering 4,000 m3 of site won subsoil

Conclusion

No further remedial works.

As part of the build phase works, the MMP will be updated to include any future import of clean naturally occurring soils with validation testing of imported subsoils undertaken at agreed frequencies. All garden areas where a cover system is required will be subject to plot specific independent validation. The subsoil source and associated chemical testing for soils used within plots will be issued as part of the garden validation letters for these plots. Garden validation letters are to be submitted in batches as agreed with Manchester City Council.

RE-21 – PROVISION OF TOPSOIL

DATE OF WORKS UNDERTAKEN

April 2024 – October 2024

CHEMICAL ANALYSIS

Eurofins Report ref: 24-77927 (Roman Way TS001-003)
Eurofins Report ref: 24-12322 (Roman Way TS101-103)
Eurofins Report ref: 24-13816 (Roman Way TS104-113)
Eurofins Report ref: 24-29418 (Halewood IMP-TS-101-105)
Eurofins Report ref: 24-36526 (Viking Way CONG-TS-101-105)

OVERVIEW OF WORKS

Background
No material that would be deemed suitable for use as topsoil is present on-site and as such there will be a requirement to import suitable material for use within the proposed development.

Overview of Works
E3P have obtained imported topsoil deposits from Donor Site 'Roman Way, Preston', 'Halewood Consortium' and 'Viking Way, Congleton' which were analysed in line with the E3P Remediation Strategy.

To date, a total of 16no. topsoil samples have been submitted for analysis from Roman Way, at a brownfield frequency of 1 per 50 m3. Five topsoil samples have been submitted for analysis from Halewood Consortium at a greenfield frequency of 1 per 200m3. Five topsoil samples have been submitted for analysis from Viking Way, Congleton at a greenfield frequency of 1 per 200m3 in line with the E3P remediation strategy. Total samples obtained cover 2,800 m3 of imported topsoil.

Analysis for subsoil undertaken by I2 Analytical Laboratories and Eurofins Laboratories using UKAS accredited methods where applicable.

The chemical analysis suite comprises heavy metals, sulphates, phenols, speciated Polycyclic Aromatic Hydrocarbons (PAHs), speciated and total Petroleum Hydrocarbons (TPH) and asbestos. The sampling frequency follows the agreed Remediation Strategy. Laboratory analysis certificates are attached to this validation certificate.

Chemical analysis confirmed that these topsoil deposits were chemically suitable for use within the proposed garden areas.

Conclusion
No further remedial works.
As part of the build phase works, the MMP will be updated to include any future import of clean naturally occurring soils with validation testing of imported topsoils undertaken at agreed frequencies. All garden areas where a cover system is required will be subject to plot specific independent validation. The topsoil source and associated chemical testing for soils used within plots will be issued as part of the garden validation letters for these plots. Garden validation letters are to be submitted in batches as agreed with Manchester City Council

RE-22 – INDEPENDENT VALIDATION: WATCHING BRIEF

DATE OF WORKS UNDERTAKEN
Throughout works

OVERVIEW OF WORKS

Background
Given the site history and potential contamination sources identified within the ICSM, a degree of uncertainty remained with regard to the potential unidentified contamination impact within the near-surface soils and groundwater.

It will therefore be necessary to instigate the site-wide remediation and enabling works under the supervision of a suitably qualified and independent specialist.

Works Undertaken
E3P maintained a part-time watching brief throughout the duration of remediation and enabling works to monitor works, record ground conditions and fully investigate all potential sources of yet unidentified contamination. E3P's records and findings are summarised throughout this report.

E3P engineer site diaries are available upon request,

Conclusion
Completed in line with the remediation strategy, **no further action**.

RE-23 – WASTE SOILS SURPLUS TO REQUIREMENTS

DATE OF WORKS UNDERTAKEN
Throughout works

CHEMICAL ANALYSIS

Coal Tar
I2 Analytical Report ref: 23-69190
I2 Analytical Report ref: 23-69196
RJT Report Ref: 24-Nov-23

Knotweed
I2 Analytical Report ref: 23-52624
I2 Analytical Report ref: 23-52626
RJT Report Ref: 31-Aug-23

Historic Infilled Chimney Base
I2 Analytical Report ref: 23-53713

Visual Asbestos Stockpile
I2 Analytical Report Ref: 23-74533 (ASB-001)
I2 Analytical Report Ref: 24-77955 (ASB Bund)

Material from "burial pits" in north and south of the Site
Eurofins Report Ref:24-27684 (ASB A and ASB B)
Eurofins Report Ref: 24-35015 (SW-MG-019-021)

OVERVIEW OF WORKS

Background

In the event that a surplus of excavation material was present on-site, this, in most cases, was to be deemed a waste in accordance with the Waste Framework Directive (Article 3(1) Waste Framework Directive 2008/98/EE). The waste producer – but ultimately, the landowner – is responsible for the compliant disposal of such materials.

A formal waste classification assessment was required, irrespective of any future options or considerations for those materials that were to be removed from the site.

Works Undertaken

Across the development the earthworks have been designed to be in balance, as such, soils generated from excavation activities (cut) have been re-used on site within the earthworks balance in areas requiring upfill, as such, surplus soil generation was limited to contaminated soil sources.

In line with the above, where potential contamination sources have been identified and where bulk waste was extracted from Made Ground soils these materials were removed from site. Contamination sources identified on site included visible coal tar, TPH / SVOC impacted soils within historic chimney base infill and northwest hotspot (RE-7) knotweed impacted soils (RE-4) and asbestos impacted soils (RE-6).

Across the site former roads were lined with sandstone setts. The setts had historically been set within a coal tar. E3P observed the setts being broken out and inspected soils beneath the slabs. Visible coal tar was identified, where encountered coal tar impacted soil was stockpiled on visqueen and subsequently removed to a licenced waste facility (RE-7 provides further detail). Sandstone setts were bagged and removed from site for re-use by an external contractor. No cobble setts were re-used on site within the crushed aggregate.

Historic chimney base arisings were visually impacted with a hydrocarbon sheen. Additionally, PID elevated readings of 75-145 ppm were recorded. The arisings were segregated and stockpiled on an impermeable membrane. E3P undertook chemical sampling (CB-001) that recorded elevated PAH's (including naphthalene of 77 mg/kg), TPH C12-C16 (260 mg/kg), TPH C16-21 (1200 mg/kg) and TPH C21-C35 (1900 mg/kg). Circa 8m3 of backfill material from within the chimney base was removed from site.

Where soils were impacted with knotweed E3P undertook chemical (i2 report 23-52624), WAC (i2 report 23-52626) and WM3 sampling (RJT Report 31-Aug-23) in August 2023 prior to removal of knotweed impacted soils from site by TDR and UR.

Asbestos impacted soils were encountered within two "burial pits" as discussed in RE-6. Visually impacted soils were load loaded directly into wagons and removed from site to a licenced waste facility. A total of 13no. loads (circa 90 m3) of impacted soils were removed from the southern asbestos area between 14th to 16th August 2024. A total of 46no. loads (circa 320 m3) of impacted soils were removed from the northern asbestos area between 11th and 9th September 2024. Waste consignment notes and tracking notes are held by Kellen Homes and UR.

Deleterious materials (inclusive of tyres), unsuitable demolition material, metals, timber and vegetation were removed from site by TDR and UR.

Waste consignment notes and tracking notes are held by TDR and UR.

Conclusion

Completed in line with the remediation strategy, **no further action**.

RE-24 – VALIDATION OF MATERIALS FOR POTABLE WATER SUPPLY INFRASTRUCTURE

DATE OF WORKS UNDERTAKEN
July 2023

SUPPORTING DOCUMENT
15-974 - UURA – Bennett Street – July 2023

OVERVIEW OF WORKS

Background
A contaminant risk assessment, completed during pervious works in accordance with the UKWIR assessment framework identified elevated concentrations of potentially volatile/soluble hydrocarbon compounds that necessitate the use of protected water supply pipe-work.

Works Undertaken
The site has been turned over and upfilled with site won made ground soils to create a development platform. A UKWIR assessment (15-974 - UURA – Bennett Street – July 2023) of Made Ground samples was undertaken by E3P, this assessment recommended barrier pipe was installed across the development due to the presence of site wide elevated SVOC, TPH EC10-16 & TPH EC16-40, Phenols and VOC have been recorded against PE Thresholds.

Conclusion
Assessment completed in line with the remediation strategy and confirms that the installation of barrier pipe is required across development.

RE-25 – REMEDIAL VERIFICATION REPORT

DATE OF WORKS UNDERTAKEN
July 2023 – October 2024

OVERVIEW OF WORKS

This report outlines works undertaken relating to site clearance, chemical testing, remedial works, remedial verification and waste transfer.

This report should be submitted to the local authority for approval following completion.

Conclusion
No further action.

3. SECOND PHASE MITIGATION AND MANAGEMENT – BUILD PHASE

A second post remediation phase of works will be required to ensure the proposed development is constructed in a manner that incorporates the required mitigation measures to ensure the development is compliant with UK Building Regulations and the Local Authority Planning requirements.

These obligations, inclusive of vapour gas protective measures, are specified in more detail within the E3P Build Phase Contamination Risk Mitigation Strategy (15-974-R3-6, November 2023) that should be read as a precursor to this report.

4. CONCLUSION

The remediation elements identified within the approved Remediation and Enabling Works Strategy have been completed across the site, with validation testing confirming that the works have been completed to the required standard.

As part of the on-going construction works the developer will be required to construct and validate the items listed below in strict accordance with the requirements of the regulatory authorities as documented in detail within this report. Build phase validation certification will be issued to Manchester City Council in batches, as agreed with Sue Wills for Condition 11B.

- Installation and validation of specialist mitigation measures that will facilitate the dispersal of vapour accumulation within the sub-floor void with specialist membranes and construction design works to inhibit the ingress of hazardous volatile chemicals and ground gasses into the dwellings;
- Laboratory testing and chemical validation of imported or site-derived topsoil and subsoil;
- Placement of a 600 mm cover system using certified material and geotextile break layer with appropriate validation within all private rear garden areas;
- Placement of a 450 mm cover system using certified material and geotextile break layer with appropriate validation within all private front garden areas;
- Placement of 450 mm cover system within POS and landscaped areas; and,
- Installation of appropriate potable water supply pipework (barrier pipe – see United Utilities Risk Assessment for further detail).

END OF REPORT

APPENDIX I
LIMITATIONS

GENERAL

1. This report and any associated works (together comprising the "Services") were compiled and carried out by E3P for the client (as present in Section 1) under the E3P “Terms of Business” or with those parties with whom a warranty agreement has been executed, or with whom an assignment has been agreed and outlined in the body of the report.

2. Unless explicitly agreed otherwise, in writing, this report has been prepared under E3P Standard Terms and Business as included within our proposal to the Client.

3. Project-specific appointment documents may be agreed upon at our discretion and a charge may be levied for both the time to review and finalise appointment documents and also for associated changes to the appointment terms. E3P reserves the right to amend the fee should any changes to the appointment terms create an increased risk to E3P.

4. The report needs to be considered in light of the proposal and associated limitations of scope. The report needs to be read in full and isolated sections cannot be used without full reference to other elements of the report and any previous works referenced within the report.

PHASE 1 GEOENVIRONMENTAL AND PRELIMINARY RISK ASSESSMENTS

5. Coverage: This section covers reports with the following titles or combination of titles: Phase 1; Desktop Study; Geoenvironmental Assessment; Development Appraisal; Preliminary Environmental Risk Assessment; Constraints Report; Due Diligence Report; Geotechnical Development Review; Environmental Statement; Environmental Chapter; Baseline Environmental Assessment; Project Scope Summary Report (PSSR), Program Environmental Impact Report (PEIR), Geotechnical Development Risk Register; Agricultural Land Assessment; Mineral Safeguarding Assessment; Desk Top Coal Mining Risk Assessment; Hydrogeological Appraisal; Construction Environmental Management Plan; and Site Water Management Plan.

6. The works undertaken to prepare this report comprised a study of available and easily documented information from a variety of sources (including the Client), together with (where appropriate) a brief walkover inspection of the Site and correspondence with relevant authorities and other interested parties. Due to the short timescales associated with these projects responses may not have been received from all parties. E3P cannot be held responsible for any disclosures that are provided post-production of our report and will not automatically update our report.

7. The opinions given in this report have been dictated by the finite data on which they are based and are relevant only for the purpose for which the report was commissioned. The information reviewed should not be considered exhaustive and has been accepted in good faith as providing true and representative data pertaining to site conditions. Should additional information become available which may affect the opinions expressed in this report, E3P reserves the right to review such information and, if warranted, to modify the opinions accordingly.

8. It should be noted that any risks identified in this report are perceived risks based on the information reviewed. Actual risks can only be assessed following intrusive investigations of the site.

9. Where mention has been made to the identification of Japanese Knotweed and other invasive plant species and asbestos or asbestos-containing materials, this is for indicative purposes only and does not constitute or replace full and proper surveys completed by suitably qualified and experienced specialists in these fields.

10. E3P does not warrant work/data undertaken/provided by others.

INTRUSIVE INVESTIGATION REPORTS

11. Coverage: The following report titles (or combination) may cover this category of work: Geoenvironmental Site Investigation; Geotechnical Assessment; GIR (Ground Investigation Reports); Preliminary Environmental And Geotechnical Risk Assessment; Preliminary Summary; Coal Mining Risk Assessment, Ground Gas Addendum; and, Geotechnical Risk Register.

12. The investigation has been undertaken to provide information concerning either:

    I. The type and degree of contamination present at the site in order to allow a generic quantitative risk assessment to be undertaken; or

    II. Information on the soil properties present at the site to allow for geotechnical development constraints to be considered.

13. The scope of the investigation was selected on the basis of the specific development and land use scenario proposed by the Client and may be inappropriate to another form of development or scheme. If the development layout was not known at the time of the investigation the report findings may need revisiting once the development layout is confirmed.

14. Unless otherwise specified in the scope of works, any site drawing(s) provided in this report is (are) not meant to be an accurate base plan but is (are) used to present the general relative locations of features on, and surrounding, the site. Features (intrusive and sample locations etc) annotated on site plans are not drawn to scale but are centred over the approximate location. Such features should not be used for setting out and should be considered indicative only.

15. For contamination purposes, the objectives of the investigation are limited to establishing the risks associated with potential contamination sources with the potential to cause harm to human health, building materials, the environment (including adjacent land), or controlled waters.

16. For geotechnical investigations, the purpose is to broadly consider potential development constraints associated with the physical property of the soils underlying the site within the context of the proposed future or continued use of the site, as stated within the report.

17. The amount of exploratory work, soil property testing and chemical testing undertaken has necessarily been restricted by various factors which may include accessibility, the presence of services; existing buildings; current site usage or short timescales. The exploratory holes completed assess only a small percentage of the area in relation to the overall size of the Site, and as such can only provide a general indication of conditions.

18. The number of sampling points and the methods of sampling and testing do not preclude the possible existence of contamination where concentrations may be significantly higher than those actually encountered or ground conditions that vary from those identified. In addition, there may be exceptional ground conditions elsewhere on the site which have not been disclosed by this investigation and which have therefore not been taken into account in this report.

19. The inspection, testing and monitoring records relate specifically to the investigation points and the timeframe that the works were undertaken. They will also be limited by the techniques employed. As part of this assessment, E3P has used reasonable skill and care to extrapolate conditions between these points based on assumptions to develop our interpretation and conclusions.

20. The assumption made in forming our conclusions is that the ground and groundwater conditions (both chemically and physically) are the same as have been encountered during the works undertaken at the specific points of investigation and at the time of the investigation.

21. Conditions can change between investigation points both spatially and over time and these interpretations should therefore be considered indicative. The assessment of extreme weather events and their impact on ground conditions is not within the scope of E3P's work.

22. The risk assessment and opinions provided are based on currently available guidance relating to acceptable contamination concentrations; no liability can be accepted for the retrospective effects of any future changes or amendments to these values. Specific assumptions associated with the risk assessment process have been outlined within the body or associated appendix of the report.

23. Additional investigations may be required in order to satisfy relevant planning conditions or to resolve any engineering and environmental issues.

24. Where soil contamination concentrations recorded as part of this investigation are used for commentary on the potential waste classification of soils for disposal purposes, these should be classed as indicative only. Due consideration should be given to the variability of contaminant concentrations taken from targeted samples versus bulk excavated soils and the potential variability of contaminant concentrations between sampling locations. Where major waste disposal operations are considered, targeted waste classification investigations should be designed and the waste classification and any subsequent disposal option agreed upon with licenced subcontractors and/or the relevant regulators.

25. The results of the asbestos testing are factually reported and interpretation is given as to how this relates to the previous use of the site, the types of ground encountered and site conceptualisation. This does not however constitute a formal asbestos assessment. These results should be treated cautiously and should not be relied upon to provide detailed and representative information on the delineation, type and extent of bulk ACMs and/or trace loose asbestos fibres within the soil matrix at the site.

26. If costs have been included in relation to additional site works, and/or site remediation works these must be considered as indicative only and must be confirmed by a qualified quantity surveyor.

EUROCODE 7: GEOTECHNICAL DESIGN

27. On 1st April 2010, BS EN 1997-1:2004 (Eurocode 7: Geotechnical Design – Part 1) became the mandatory baseline standard for geotechnical ground investigations.

28. In terms of geotechnical design for foundations, slopes, retaining walls and earthworks, EC7 sets guidance on design procedures including specific guidance on the numbers and spacings of boreholes for geotechnical design, there are limits to methods of ground investigation and the quality of data obtained and there are also prescriptive methods of assessing soil strengths and methods of design. Unless otherwise explicitly stated, the work has not been undertaken in accordance with EC7. A standard geotechnical interpretative report will not meet the requirements of the Geotechnical Design Report (GDR) under Eurocode 7. The GDR can only be prepared following confirmation of all structural loads and serviceability requirements. The report is likely to represent a Ground Investigation Report (GIR) under the Eurocode 7 guidance.

DETAILED QUANTITATIVE RISK ASSESSMENTS AND REMEDIATION AND ENABLING WORK STRATEGY REPORTS

29. These reports build upon previous report versions and associated notes. The scope of the investigation, further testing and monitoring and associated risk assessments were selected based on the specific development and land use scenario proposed by the Client and may not be appropriate to another form of development or scheme layout. The risk assessment and opinions provided are based on currently available approaches in the generation of Site Specific Assessment Criteria relating to contamination concentrations and are not considered to represent a risk in a specific land use scenario to a specific receptor. No liability can be accepted for the retrospective effects of any future changes or amendments to these values, associated models or associated guidance.

30. The outputs of the Detailed Quantitative Risk Assessments are based upon the manipulation of standard risk assessment models. These are our interpretation of the risk assessment criteria.

31. Before adoption on-site, assessment criteria will need to be discussed and agreed upon with the Regulatory Authorities prior to adoption on site. The regulatory discussion and engagement process may result in an alternative interpretation being determined and agreed. The process and timescales associated with the Regulatoy Authority engagement are not within the control of E3P. All costs and programmes presented as a result of this process should be validated by a quantity surveyor and should be presumed to be indicative.

32. E3P does not accept liability for any subcontract work that has not been completed in strict accordance with an approved E3P Remediation and Enabling Works Strategy.

GEOTECHNICAL DESIGN REPORT (GDR)

33. The GDR can only be prepared following confirmation of all structural loads and serviceability requirements. All the relevant information needs to be provided to allow for a GDR to be produced.

MONITORING (INCLUDING REMEDIATION MONITORING REPORTS AND BUILD PHASE MITIGATION)

34. These reports are factual and comprise monitoring, normally groundwater and ground gas and data provided by contractors as part of earthworks or remedial works.

35. The data is presented and will be compared with assessment criteria.

APPENDIX II
GLOSSARY

TERMS

ACM	Asbestos-containing material	**MMP**	Materials management plan
ADS	Acoustic design statement	**ND**	Not detected
AST	Above-ground storage tank	**NDP**	Nuclear density probe
BGS	British Geological Survey	**NMP**	Noise management plan
BSI	British Standards Institute	**NPSE**	Noise policy statement for England
BTEX	Benzene, toluene, ethylbenzene, xylenes	**NR**	Not recorded
CA	Coal Authority	**PAH**	Polycyclic aromatic hydrocarbon
CBR	California bearing ratio	**PCB**	Polychlorinated biphenyl
CIEH	Chartered Institute of Environmental Health	**PI**	Plasticity index
CIRIA	Construction Industry Research Association	**PID**	Photo ionisation detector
CLEA	Contaminated land exposure assessment	**POS**	Public open space
CML	Council of Mortgage Lenders	**PPE**	Personnel protective equipment
CoC	Contaminants of concern	**ProPG**	Professional practice guidance
CSM	Conceptual site model	**QA**	Quality assurance
DNAPL	Dense non-aqueous phase liquid (chlorinated solvents, PCB)	**SGV**	Soil guideline value
DWS	Drinking water standard	**SPH**	Separate-phase hydrocarbon
EA	Environment Agency	**SPT**	Standard penetration test
EQS	Environmental quality standard	**SVOC**	Semi-volatile organic compound
FFL	Finished floor level	**TPH**	Total and speciated petroleum hydrocarbon
GAC	General assessment criteria	**TPH CWG**	Total Petroleum Hydrocarbon (Criteria Working Group)
GL	Ground level	**UKWIR**	United Kingdom Water Infrastructure Risk
GSV	Gas screening value	**UST**	Underground storage tank
HCV	Health criteria value	**VCC**	Vibro-concrete column
ICSM	Initial conceptual site model	**VOC**	Volatile organic compound
LEL	Lower explosive limit	**VRSC**	Vibro-replacement stone columns
LMRL	Lower method reporting limit	**VSC**	Vibro-stone columns
LNAPL	Light non-aqueous phase liquid (petrol, diesel, kerosene)	**WHO**	World Health Organisation
MCV	Moisture condition value	**WRAP**	Waste and Resources Action Programme
MIBK	Methyl isobutyl ketone	**WTE**	Water table elevation

m	Metres	**ppm**	Parts per million
km	Kilometres	**mg/m^3**	Milligram per metre cubed
% v/v	Percent volume in air	**m bgl bgl**	Metres below ground level
mb	Millibars (atmospheric pressure)	**m bcl**	Metre below cover level
l/hr	Litres per hour	**mAOD**	Metres above ordnance datum (sea level)
µg/l	Micrograms per litre (parts per billion)	**kN/m^2**	Kilonewtons per metre squared
ppb	Parts per billion	**µm**	Micrometre
mg/kg	Milligrams per kilogram (parts per million)	**SSRT**	Site Specific Remediation Target
PSD	Particle Size Distribution	**DD**	Dry Density
CL:AIRE	Contaminated Land: Applications in Real Environments	**Mc**	Moisture Content
ρ	Bulk Density	**GPR**	Ground Penetrating Radar
NDP	Nuclear Density Probe	**FFL**	Finished Floor Level
LEL	Lower Explosive Limit	**UKWIR**	UK Water Industry Research
CIRIA	Construction Industry Research and Information Association	**LOD**	Limit of Detection