REPORT

Castlefield Viaduct Land Quality Phase 1 Pilot Verification Report

Client: National Trust

Reference: PC2387-RHD-ZZ-XX-RP-Z-0019

Status: S0/P01.02

Date: 26 September 2022

Royal HaskoningDHV

Enhancing Society Together

HASKONINGDHV UK LTD.

Honeycomb
Edmund Street
Liverpool
L3 9NG
United Kingdom
Industry & Buildings
VAT registration number: 792428892

+44 151 2362944 **T**
+44 151 2272561 **F**
info.liv@gb.rhdhv.com **E**
royalhaskoningdhv.com **W**

Document title: Castlefield Viaduct Land Quality Phase 1 Pilot Verification Report

Document short title: Land Quality Verification Report
Reference: PC2387-RHD-ZZ-XX-RP-Z-0019
Status: P01.02/S0
Date: 26 September 2022
Project name: Castlefield Viaduct
Project number: PC2387

Classification
Project related

Unless otherwise agreed with the Client, no part of this document may be reproduced or made public or used for any purpose other than that for which the document was produced. HaskoningDHV UK Ltd. accepts no responsibility or liability whatsoever for this document other than towards the Client.

Please note: this document contains personal data of employees of HaskoningDHV UK Ltd.. Before publication or any other way of disclosing, consent needs to be obtained or this document needs to be anonymised, unless anonymisation of this document is prohibited by legislation.

Royal HaskoningDHV

Revision history

Revision	Date	Description	Prepared	Checked	Approved
00	26/09/2022	Draft Issue	D. Freeman	E. Harris	C. Martin
01	10/10/2022	Final Issue	D. Freeman	E. Harris	C. Martin

1 Introduction 5
1.1 Phase 1 Pilot Scheme Development 5
1.2 Legislative Context 5
1.2.1 Relevant Planning Conditions 5

2 Remediation Requirements 7
2.1 Cover System 7
2.1.1 Amendments to the Remediation Strategy 7
2.2 Installation of Barriers 8
2.3 Installation of Drain Guards 8
2.4 Installation of Water Pipes and WC Facilities 8
2.5 Import Criteria 8

3 Verification Works 9
3.1 Verification of Cover System 9
3.2 Verification of Installed Barriers 9
3.3 Verification of Drain Guard Installation 9
3.4 Verification of Water Pipe and WC Facilities Installation 9
3.5 Verification of Imported Material 11
3.6 Unforeseen Contamination 11
3.7 Removal of Waste from Site 11

4 Environmental Monitoring 12
4.1 Downspout Water Sampling 12

5 Conclusion 14

6 References 16

Table of Tables

Table 4-1 Downspout DP1 Water Data EQS Assessment pre-construction 12
Table 4-2 Downspout Water Data EQS Assessment during construction 12
Table 4-3 Lead and Zinc Concentration Analysis 13
Table 5-1 CSM Post Enabling Works (with mitigation) 14
Table 5-2 Response to MCC's Environmental Health Consultation Comments 14

Table of Figures

Figure 3-1 Excerpt from Arup Drawing CVI-ARUP-ZZ-ZZ-DR-S-3003, Viaduct Path Details 9

Figure 3-2 Excerpt from Arup Drawing CVI-ARUP-ZZ-GF-DR-P-001502, Public Health Services Domestic Water Services Layout Ground Level 10

Figure 3-3 Excerpt from Arup Drawing CVI-ARUP-ZZ-GF-DR-P-001501, Public Health Services Domestic Water Services Layout Viaduct Level 11

Figure 4-1 Downspout Monitoring Location Points 12

Appendices

Appendix A - Limitations

Appendix B - Photographic Records

Appendix C - Import Criteria and Soil Screening Results

Appendix D – Downspout Water Sample Screening Results

1 Introduction

Royal HaskoningDHV has been commissioned by the National Trust (the Trust) to prepare a Verification Report for the Phase 1 Pilot Scheme redevelopment of Castlefield Viaduct, Manchester, centred at Ordnance Survey (OS) Grid Reference 383005 Easting 397626 Northing (herein referred to as the 'site').

Following the completion of an intrusive ground investigation, requirements for remediation of the site were set out in Castlefield Viaduct Land Quality Remediation Strategy, Ref. PC2387-RHD-ZZ-XX-RP-Z-0013 dated 9th December 2021 produced by Royal HaskoningDHV. Details of the remediation requirements are provided in Section 2 below.

Construction and remediation works were completed between May and July 2022. Information relating to the works completed pertinent to verification have been provided by the Contractor, Manchester and Cheshire Construction (MCC). Royal HaskoningDHV did not have a presence on the site during the works.

This report has been prepared by Royal HaskoningDHV for the sole benefit of the Trust.

1.1 Phase 1 Pilot Scheme Development

Castlefield Viaduct is an unused, 330 metres (m) long, historic structure in the centre of Manchester. The Trust wishes to bring the viaduct back into use by repurposing the structure into an elevated urban park and integrated active travel hub.

1.2 Legislative Context

The Remediation Strategy is undertaken in the legislative context of:

- Part 2A of The Environmental Protection Act (1990); and
- The National Planning Policy Framework (NPPF) (2021).

1.2.1 Planning Conditions Relating to Contaminated Land

The planning application (reference 131621/FO/2021 Temporary change of use to an urban park (F2(c)) for a period of 20 months) was approved on 23rd November 2021. Planning conditions related to contaminated land are:

6) a) Before the development hereby approved commences, a report (the Preliminary Risk Assessment) to identify and evaluate all potential sources and impacts of any ground contamination, groundwater contamination and/or ground gas relevant to the site shall be submitted to and approved in writing by the City Council as local planning authority. The Preliminary Risk Assessment shall conform to City Council's current guidance document (Planning Guidance in Relation to Ground Contamination).

In the event of the Preliminary Risk Assessment identifying risks which in the written opinion of the Local Planning Authority require further investigation, the development shall not commence until a scheme for the investigation of the site and the identification of remediation measures (the Site Investigation Proposal) has been submitted to and approved in writing by the City Council as local planning authority.

The measures for investigating the site identified in the Site Investigation Proposal shall be carried out, before development commences and a report prepared outlining what measures, if any, are required to remediate the land (the Site Investigation Report and/or Remediation Strategy) which shall be submitted to and approved in writing by the City Council as local planning authority.

b) When the development within each phase 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 in each phase 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 Core Strategy.

The above condition (parts 6a) and 6b) was discharged by Manchester City Council on 9th June 2022 on the provision that the development continued to be carried out in accordance with the requirements of the condition. This Verification Report has been completed in support of Planning Condition 6b.

2 Remediation Strategy Requirements

The requirements for remediation of the site were set out in Castlefield Viaduct Land Quality Remediation Strategy Ref. PC2387-ZZ-XX-RP-Z-0013 dated 9th December 2019 produced by Royal HaskoningDHV. The primary aim of the strategy was to repurpose the viaduct for use as a public open space. The strategy highlighted a risk from non-volatile contaminants predominately benzo(a)pyrene, lead and zinc and outlined the following requirements necessary in order to achieve suitable remediation for the desired site use:

- Cover system via a footpath, bedding plants (grown in imported soils above membrane) and retention of existing vegetation cover in areas fenced off from site users;
- Installation of barriers, temporary building structures and planters;
- Installation of drain guards during construction works; and,
- Importation criteria for soils proposed to be imported to site.

In addition the National Trust proposed the following six mitigation measures to further reduce the risk posed by contaminants on the site:

1 The Pilot is a temporary 12 month scheme and visitors will book onto a timed, guided tour in order to access the site. They will be supervised and escorted on site by trained National Trust staff members at a ratio no greater than 1:20 visitors for a period of less than 1 hour (managed by a booking in advance system). Additional events with a maximum capacity of 50 people are also proposed. The staff to visitor ratio of 1:20 will still be maintained during these events;

2 There will be a low level fence to restrict access to areas of existing vegetation and bare track ballast/soils;

3 Staff will be trained to provide safety briefings which clearly acknowledge the risk associated with in ground contamination and the reasoning why visitors are not to step over the low level fence;

4 Safety briefings will be given to visitors via pre-visit information confirmed with their booking, and upon arrival to the viaduct, which clearly state they expect no attempt to access the areas of existing vegetation;

5 Clear signage will deter access to these areas;

6 Vegetation (mainly buddleia plants) will inhibit and deter access to these areas. It is envisaged that the plants (which will be in leaf/flower) will create a natural barrier preventing anyone from walking through;

Remediation and construction works were completed by MCC between May and July 2022. Statements verifying the completed works have been provided by MCC and are detailed in Section 3 of this report.

2.1 Cover System

The cover system in the form of the footpath design shall comprise a membrane capillary break layer at its base above the existing soils/track ballast. This shall be overlain by Type 1 MOT subbase gravel, which shall be in turn overlain by a 50 mm gravel retention system and a solid resin bound finishing layer.

2.1.1 Amendments to the Remediation Strategy

A letter was sent by Royal HaskoningDHV to the Environmental Health Officer (EHO) at Manchester City Council (dated 23rd May 2022, ref: PC2387-RHD-ZZ-XX-CO-Z-0020) detailing a proposed amendment to the remediation strategy. It stated that rather than retain existing vegetation in fenced off areas to the north and south of the footpath ‘plug plants’ were to be planted into the bare ballast instead. This amendment was proposed as it was not possible to retain the original vegetation during the construction of the site, ‘plug

plants' were considered a suitable means to replicate the vegetation in these areas. It was proposed that the plants would provide sufficient coverage to discourage pedestrian access to these areas.

Due to severe hot weather during the construction period the proposed planting within areas of bare ballast was not able to take place. As such the areas of ballast to the north and south of the footpath have been left bare, with management systems including fencing, appropriate signage and staff supervision still being included to reduce the risk of contact be made with the identified contamination associated with ballast.

Following these amendments five of the six mitigation measures outlined in Section 2 are still to be adhered to during the operation of the site with point six no longer being relevant as vegetation will not be present.

2.2 Installation of Barriers

As elevated levels of lead and zinc were recorded in the flaking paint of the metalwork located on the viaduct it was stated that barriers were to be installed to prevent members of the public from accessing these areas. The barriers combined with the designated footpath reduce the risk posed by these contaminants to site users.

2.3 Installation of Drain Guards

It was stated that drain guards were to be installed, this is to reduce contaminants and debris from entering the drains and thus improve the rainfall infiltration. The design of the drain guards has been specified by Arup with advice given from Royal HaskoningDHV and has been proposed to consist of 'Hytex' drain guards first being installed to prevent potentially contaminated dirt or debris from entering the drainage system with iron hinged grate covers being installed over the top.

2.4 Installation of Water Pipes and WC Facilities

It has been stated that all water pipes being installed along the viaduct structure will be installed within channels isolated from existing soils or ballast. WC Facilities are to be installed as a closed system with wastewater generated being stored on site for removal by a waste management company.

2.5 Import Criteria

The import criteria were derived to prevent new contaminants or elevated levels of contaminants being brought on to the site. Due to the nature of the proposed development, the generic assessment criteria for allotments were considered to be appropriate to screen any samples against. It was also required that any imported soils were to be sourced from a site free from Japanese Knotweed or other invasive species. Samples of imported topsoil were required to be taken at a minimum frequency of 1:150 m^3. The import criteria are included as Appendix C.

3 Verification Works

3.1 Verification of Cover System

MCC have confirmed that the cover system has been installed as per proposed design drawings. Photographs showing the installation of the footpath are shown in Appendix B. A resin path has been constructed running down the centre of the viaduct with the resin being a minimum of 155 mm thick. Underlying the path is a layer of ballast with a minimum thickness of 95 mm. As per confirmation of amendments to the Remediation Strategy with the EHO, MCC have stated that areas of ballast between 250 mm and 350 mm thick have been left exposed to the north and south of the footpath, these areas have been segregated from the footpath using low hook fencing. In total an area of the viaduct comprising 532 m^2 has been left with bare ballast exposed. The proposed design of the footpath is shown on Figure 3-1.

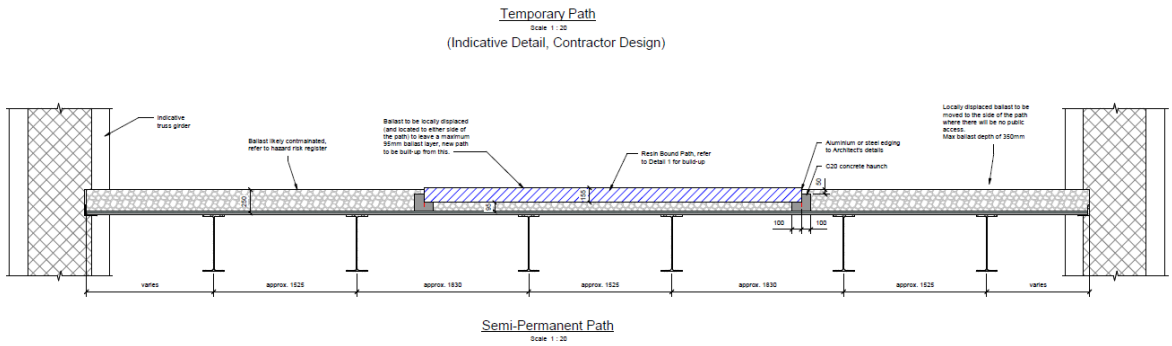


Figure 3-1 Excerpt from Arup Drawing CVI-ARUP-ZZ-ZZ-DR-S-3003, Viaduct Path Details

3.2 Verification of Installed Barriers

MCC have confirmed that barriers have been installed along the inside of the viaduct to deter access to areas where the viaducts metalwork is exposed. Photographs showing the installation of the barriers are included in Appendix B.

It has also been confirmed that edible plants have not be planted during the Phase 1 Pilot Scheme so there will not be a risk of uptake of contaminants from the paintwork into edible plants.

3.3 Verification of Drain Guard Installation

MCC have confirmed that the drain guards have been installed in line with their design specification with 'Hytex' drain guards being placed in the drains and iron hinged grate covers being installed on top. Photographs showing the installation of the drain guards are included in Appendix B.

3.4 Verification of Water Pipe and WC Facilities Installation

MCC have confirmed that water pipelines and WC Facilities (two toilets and sinks) have been installed as per the proposed design. The domestic water supply for the site is connected to water mains at street level before being pumped up the viaduct wall terminating in a standpipe on top of the viaduct. The route of the installed pipework is shown on Figure 3-2 and Figure 3-3. It has been stated that no potable water pipework has been installed further along the viaduct meaning pipework does not come into contact with existing soils or ballast.

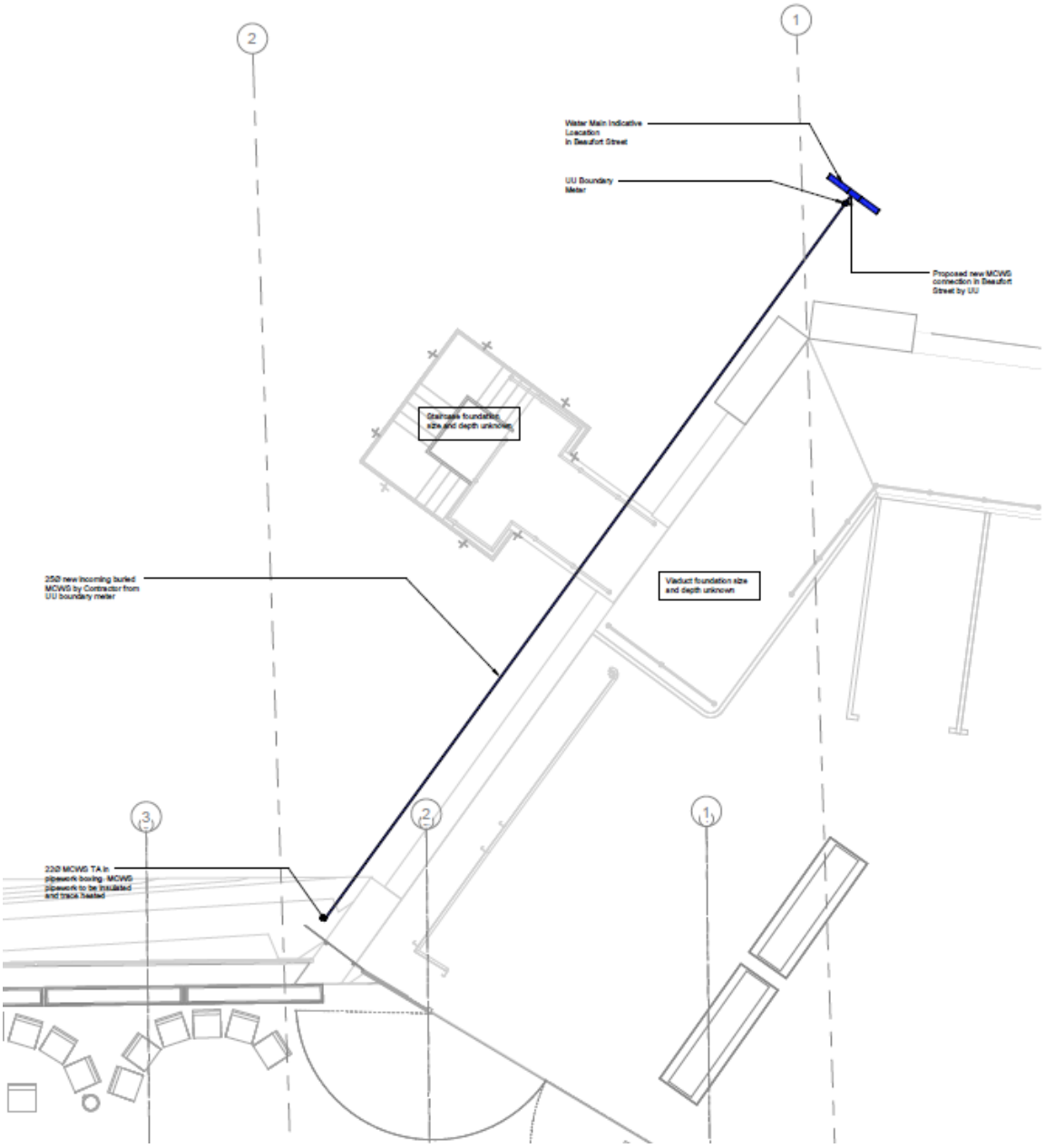


Figure 3-2 Excerpt from Arup Drawing CVI-ARUP-ZZ-GF-DR-P-001502, Public Health Services Domestic Water Services Layout Ground Level

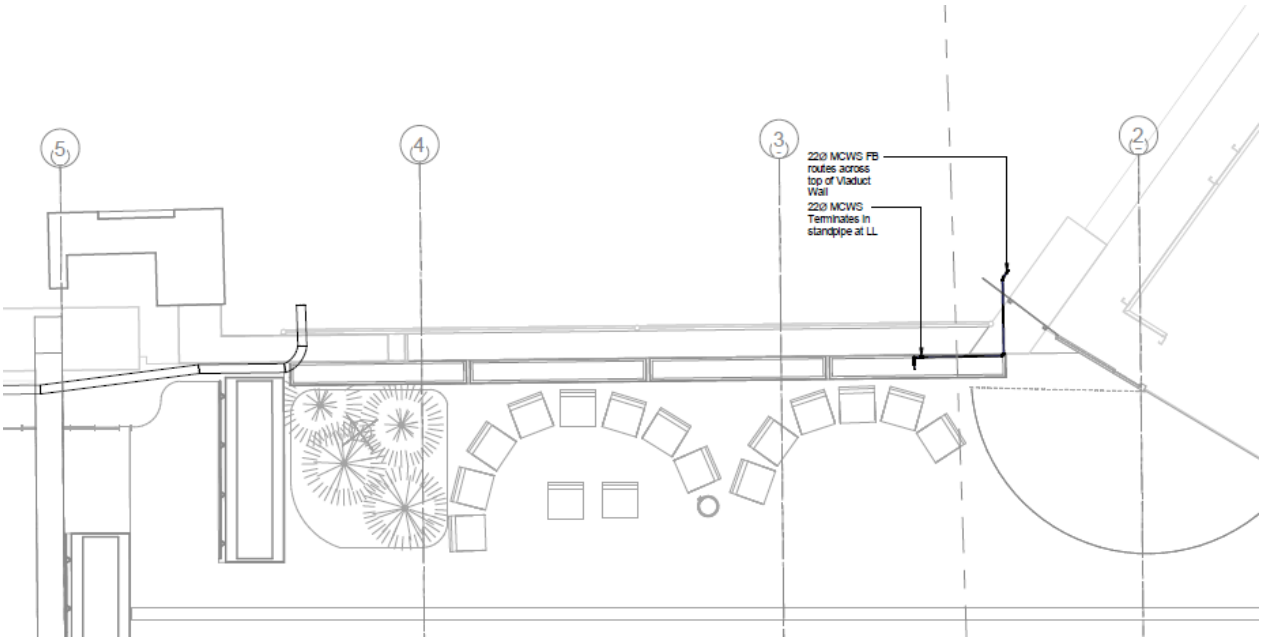


Figure 3-3 Excerpt from Arup Drawing CVI-ARUP-ZZ-GF-DR-P-001501, Public Health Services Domestic Water Services Layout Viaduct Level

3.5 Verification of Imported Material

Approximately 157 m^3 of topsoil was imported from Petersfield Growing Mediums to be used as a growing medium within the installed planters. Based on the volume of topsoil imported, it was deemed appropriate that a total of four samples were taken to be tested against the import criteria. No exceedances of the import criteria were noted in any of the samples tested. The soil testing results and screening sheets are included as Appendix C.

3.6 Unforeseen Contamination

No records of unforeseen contamination were reported by the contractor during the remediation or constructions works on the site.

3.7 Removal of Waste from Site

No waste soils have been removed from the site during the Phase 1 Pilot Scheme remediation works.

4 Environmental Monitoring

4.1 Downspout Water Sampling

Water sampling of a single sampling location, downspout 1 (DP1), prior to the commencement of works on the viaduct found elevated levels of zinc and lead when screened against Water Framework Directive (WFD) Environmental Quality Standards (EQS) for inland surface waters. Further water sampling was undertaken on two occasions during the remediation and construction works on 31st May and 8th June 2022. The sampling location is shown on Figure 4-1. A summary of the testing completed is provided in Table 4-1 and Table 4-2 with the complete screening data included in Appendix D.

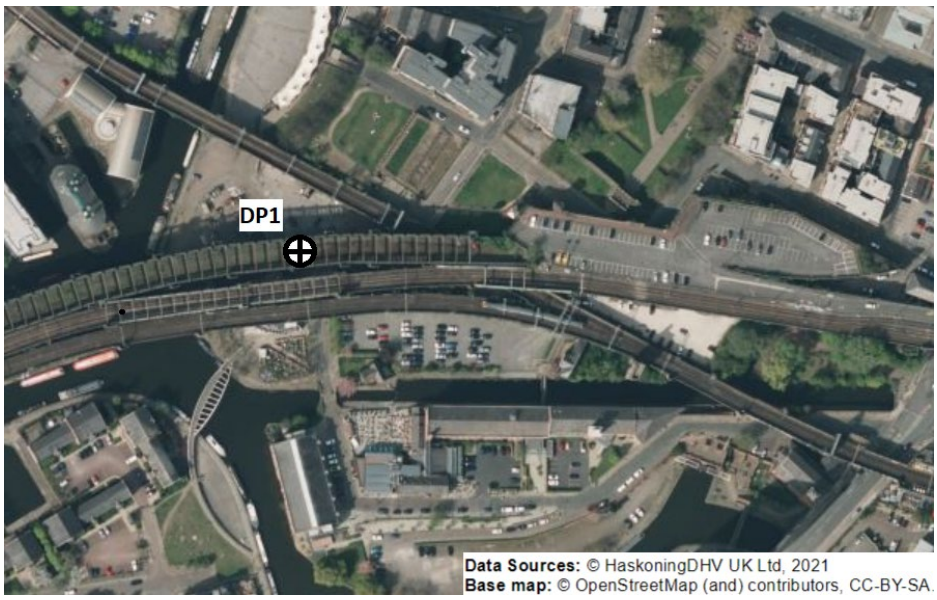


Figure 4-1 Downspout Monitoring Location Points

Table 4-1 Downspout DP1 Water Data EQS Assessment pre-construction

Determinand	Total Number of Samples	EQS (µg/l)	Data Range min to max (µg/l)	Number of Results above EQS
Lead	6	4.99	8.5 to 14.0	6
Zinc	6	24.66	100 to 590	6

Table 4-2 Downspout Water Data EQS Assessment during construction

Determinand	Total Number of Samples	EQS (µg/l)	Data Range min to max (µg/l)	Number of Results above EQS
Lead	3	4.99	4.1 to 15.0	1
Zinc	3	24.66	1.4 to 19	0

Levels of lead and zinc identified in the water samples collected during construction works were found to be lower than those identified prior to works commencing with the exception of one sample.

Prior to construction all samples collected from location DP1 were found to exceed EQS assessment criteria for both lead and zinc. Following the installation of the drain covers, only one exceedance was noted for lead and none for zinc.

Levels of the contaminants are compared in Table 4-3 below.

Table 4-3 Lead and Zinc Concentration Analysis

Determinand	Average concentration recorded in October and November 2021	Average concentration recorded in May and June 2022 DP1	Maximum concentration recorded in October and November 2021	Maximum concentration recorded in May and June 2022 DP1
Lead	10.5	7.8	14	15
Zinc	250	9.2	590	19

Based on the reduced average levels of contaminants recorded at location DP1 after the installation of the drain guard system during May and June 2022, it appears that the drain guards have been successful in reducing the amount of contaminants entering the drainage system.

Downspout water samples were also collected from a second monitoring location during the construction phase of works. As this location is outside of the Phase 1 Pilot Area the results have not been included at this stage. Results from the second sampling area will be used to support future stages of the development.

5 Conclusion

Following verification of the construction and remediation works, an updated version of the refined Conceptual Site Model is provided in Table 5-1.

Table 5-1 CSM Post Enabling Works (with mitigation)

Source	Receptor	Pathway	Comment
PAHs and lead originating from soils/track ballast across the viaduct	Future site users	dermal contact, ingestion or inhalation	Pathway interruption due to installation of cover system comprising: subbase, footpath, building and planters. Site inductions and the presence of a low level hook fence reduced the risk of creating a pathway.
Metals (lead and zinc) within paint dust or flaking paintwork off the viaduct	Future site users	dermal contact, ingestion or inhalation	Potential pathway interrupted due to management via barriers and site infrastructure to avoid contact with or disturbance of the paintwork on viaduct structure.
PAHs and lead originating from soils/track ballast across the viaduct	Development workers during construction and maintenance workers	dermal contact, ingestion or inhalation	Pathway reduced by avoidance and management where contact is unavoidable via appropriate working methods and usage of PPE.
Metals (lead and zinc) within paint dust or flaking paintwork off the viaduct	Development workers during construction and maintenance workers	dermal contact, ingestion or inhalation	Pathway reduced by avoidance and management where contact is unavoidable via appropriate working methods and usage of PPE.
Metals (lead and zinc) originating from soils/track ballast across the viaduct and possibly viaduct structure	Surface waters	leaching and run-off	Pathway reduced due to installation of drain guards during enabling works and due to a reduction in rainfall infiltration.

Remediation techniques employed have aimed to reduce the risks as far as is reasonable practicable whilst considering the temporary nature of the scheme as well as the sustainability goals set by the National Trust. The verification demonstrates that environmental risk reduction measures have been incorporated to reduce the impact on receptors through the reduction of Pollutant Contamination Linkages (PCLs).

During the consultation phase, a number of comments were made by the EHO with respect to the Phase 1 Pilot scheme. Following completion of the remediation works, these have been addressed with responses summarised in Table 5-2.

Table 5-2 Response to MCC's Environmental Health Consultation Comments

Environmental Health Comment	Our Response
1. A footpath is being created so we will need details of how any potentially contaminated arisings will be stored and disposed of and the contractor will need to retain and submit waste transfer notes for any removed ground	As confirmed in Section 3.7. No waste soils have been removed from the site.
2. We will need details of what material will be imported for the footpath and how contractor safety will be maintained during its creation	Materials used in the construction of the footpath were manufactured such as quarried sub-base. For all imported soils, robust sample to volume ratio has been undertaken which confirms no exceedances of the import criteria.

Environmental Health Comment	Our Response
3. We will also need to ensure any new plants or shrubs are embedded in planters rather than dug in to the soil for the temporary phase so further comment and confirmation will be required to address this	No plants have been intentionally planted within the bare ballast areas. With all new plants being located in planters filled with imported topsoil. Photographs indicate naturally seeding has taken place in these areas in recent months.
4. The full scheme is likely to require more intrusive ground work and proposals so a full remediation strategy will be required for the scheme beyond the trial proposal	This remediation strategy is likely to be revised substantially for the proposed Phase 2 'permanent urban park and travel hub scheme' and will incorporate any lessons learnt from this temporary Phase 1 Pilot scheme.

The above sections detail the completed construction and remediation works comprising the Phase 1 Pilot Scheme.

Remediation requirements for the proposed subsequent Phase 2 Permanent Scheme are to be addressed under a separate Remediation Strategy.

6 References

British Standards Institution (BSI) BS ISO 18504:2017 Soil Quality - Sustainable Remediation, ISBN 978 0 580 81455 6, 2017

British Standards Institution (BSI) BS 5228-1:2009 Code of practice for noise and vibration control on construction and open sites, 2009

CIRIA 2001, Contaminated Land Risk Assessment – A Guide to Good Practice, C552, 2001

CIRIA 2015, Environmental Good Practice on Site Guide (fourth edition), C741, 2015

CL:AIRE, 2010, EIC/AGS/CL:AIRE – Soil Generic Assessment Criteria for Human Health Risk Assessment, 2010

CL:AIRE, 2014 SP1010 – Development of Category 4 Screening Levels for Assessment of Land Affected by Contamination Final Project Report (Revision 2), Appendix H. Contaminated Land: Applications in Real Environments, 2014.

Department of Environment Food and Rural Affairs (Defra), Environmental Protection Act 1990: Part 2A Contaminated Land Statutory Guidance, Ref. PB13735, 2012

EIC, 2010 Environmental Industries Commission (EIC) Soil Generic Assessment Criteria for Human Health Risk Assessment. The Association of Geotechnical and Geoenvironmental Specialists (AGS) and Contaminated Land: Applications in Real environments (CL:AIRE), 20101.

Environment Agency, 2007, Review of Odour Character and Thresholds, Science Report: SC030170/SR2, ISBN: 978-1-84432-719-5, March 2007

Environment Agency, 2011, H4 Odour Management – how to comply with your environmental permit, ref. LIT 5419, 4 April 2011

Environment Agency, 2021, Land Contamination: Risk Management Framework, https://www.gov.uk/government/publications/land-contamination-risk-management-lcrm updated 19 April 2021

Historic England National Heritage List for England. Available at URL: https://historicengland.org.uk/listing/the-list/list-entry/1292315

LQM 2014 Land Quality Management and the Chartered Institute for Environmental Health, Suitable for Use Levels (S4UL), “Copyright Land Quality Management Limited reproduced with permission; Publication Number S4UL3534. All rights reserved”

Manchester City Council ‘Planning Guidance in Relation to Ground Contamination: Guidance Note for Applicants, Developers, Land Owners and Consultants, Environmental Protection Group Contaminated Land Section, February 2021

Ministry of Housing, Communities & Local Government, National Planning Policy Framework (NPPF), revised 20 July 2021

Natural England, Department for Environment, Food & Rural Affairs, and Environment Agency, 2019, Stop invasive non-native plants from spreading guidance, dated 20 May 2019

National Trust, 2021, Castlefield Viaduct Appendix A, National Trust, February 2021

SoBRA, 2020, Society of Brownfield Risk Assessment, Development of Acute Generic Assessment Criteria for Assessing Risks to Human Health from Contaminants in Soil, version 2.0, July 2020;

Twelve Architects, 2021, Stage 4 Masterplan, drawing ref. 122019 (GA)001_C, 22 September 2021

Twelve Architects Castlefield Viaduct Phase Two Temporary Scheme Specification v1.0

Urban Green, 2021, Preliminary Ecological Appraisal, Castlefield Viaduct Urban Park, project ref. UG922, April 2021

Water Framework Directive (Standards and Classification) Directions (England and Wales) 2015
The revised Water Framework Directive (rWFD) (2008/98/EC)

Wildlife and Countryside Act 1981 (as amended)

Appendix

Appendix A - Limitations

Royal HaskoningDHV

Limitations

This report has been prepared by Royal HaskoningDHV with reasonable skill and care, within the terms of the contract with the Client. The direct assessments and judgements given in this report are limited by both the finite data on which they are based and the proposed works to which they are addressed. The report has utilised a variety of publicly available data sources therefore the study is limited by the age and limitations inherent in the data. The acquisition of data is also constrained by both physical and economic factors and by definition is subject to the limitations imposed by the methods of investigations employed. In this instance the data has been obtained from samples and tests from mechanically excavated trial pits which by their nature only provide information about small discrete volumes of soil. They cannot provide data on every section of the ground beneath the site but the data are taken to be spatially representative of the zones of material between exploratory hole locations.

Conditions at the site will change over time due to natural variations and may be affected by human activities. In particular, groundwater, surface water and soil gas conditions should be anticipated to change with diurnal, seasonal and meteorological variations. Soil and water chemistry may change due to the actions of groundwater flows and microbiological activity etc. The likely variations in the data with time can be assessed following extended periods of measurement and statistical analyses. Unless specifically discussed in the text such extended measurement and analysis have not been carried out and the data collected are taken to be representative.

This document has been prepared for the titled project and should not be relied upon or used for any other project. This document is confidential and has been prepared for the sole benefit of the Client. Royal HaskoningDHV accepts no responsibility or liability for the consequences of this document being used for a purpose other than that purpose for which it was commissioned. The assessments and judgements contained herein should not be relied upon as legal opinion.

The findings and opinions are relevant to the dates of the site work and should not be relied upon to represent conditions at substantially later dates. The opinions included herein are based on the information obtained from the published information, investigations undertaken at the site and from our experience. If additional information becomes available which might impact our conclusions, we request the opportunity to review the information reassess the potential concerns and modify our opinion if warranted.

Appendix

Appendix B - Photographic Records

Royal HaskoningDHV



Photographic Plate No. 01: Membrane and sub-base during the construction of the footpath.



Photographic Plate No. 02: Installed sub-base along footpath route.

Royal HaskoningDHV
Enhancing Society Together

Project : Castlefield Viaduct

Client: National Trust

Photographic Plates

Project No.: PC2387

Date: 26 September 2022



Photographic Plate No. 03: Installation of the resin footpath.



Photographic Plate No. 04: Installed low hook fencing.

Royal HaskoningDHV
Enhancing Society Together

Project : Castlefield Viaduct

Client: National Trust

Photographic Plates

Project No.: PC2387

Date: 26 September 2022



Photographic Plate No. 05: Fencing deterring access to the exposed metalwork along the viaduct.



Photographic Plate No. 06: Installed drain guards with membrane covers to prevent ballast entering during constriction works.

Royal HaskoningDHV
Enhancing Society Together

Project : Castlefield Viaduct

Client: National Trust

Photographic Plates

Project No.: PC2387

Date: 26 September 2022

Appendix

Appendix C - Import Criteria and Soil Screening Results

Royal HaskoningDHV

Royal HaskoningDHV

Appendix C

Soils to be imported for use as a plant growing medium shall be chemically verified prior to placement ensure they meet the generic assessment criteria set out in the table below. This is to ensure the soils do not present a risk to future users of the site. These are based upon generic screening criteria suitable for allotment use in the scenario of gardeners tending to the plant beds. Any soils which do not meet the criteria will not be used in the site.

Table G-1 Imported Material Criteria – Soils

Determinand	Screening Value – Allotments (mg/kg)	Origin of Generic Assessment Criteria	Limits of detection required (mg/kg) unless stated otherwise
Fraction of organic carbon (FoC)			<0.001%
General Inorganics			
Asbestos	No visible ACM <0.001%		<0.001%
Metals			
Arsenic	43	C4SL (allotment)	3.0
Cadmium	3.9	C4SL (allotment)	0.3
Chromium (III)	18000	LQM/CIEH S4UL (allotment)	3.0
Chromium (VI)	170	C4SL (allotment)	3.0
Copper	520	LQM/CIEH S4UL (allotment)	6.0
Lead	80	C4SL (allotment)	2.0
Nickel	53	LQM/CIEH S4UL (allotment)	2.0
Selenium	88	LQM/CIEH S4UL (allotment)	1.0
Zinc	620	LQM/CIEH S4UL (allotment)	2.5
Inorganic Mercury	19	LQM/CIEH S4UL (allotment)	0.6
Organic Compounds			
BTEX	**SOM 1%**		
Benzene***	0.017	LQM/CIEH S4UL (allotment)	0.1
Toluene	22	LQM/CIEH S4UL (allotment)	0.1
Ethylbenzene	16	LQM/CIEH S4UL (allotment)	0.1
m-xylene	31	LQM/CIEH S4UL (allotment)	0.1
o-xylene	28	LQM/CIEH S4UL (allotment)	0.1

Determinand	Screening Value – Allotments (mg/kg)	Origin of Generic Assessment Criteria	Limits of detection required (mg/kg) unless stated otherwise
p-xylene	29	LQM/CIEH S4UL (allotment)	0.1
PAH	SOM 1%		
Benzo[a]pyrene	5.7	C4SL (allotment)	0.015
Naphthalene	4.1	LQM/CIEH S4UL (allotment)	0.01
TPH	**SOM 1%**		
Aliphatic TPH > C5 to C6	730	LQM/CIEH S4UL (allotment)	0.1
Aliphatic TPH > C6 to C8	2300	LQM/CIEH S4UL (allotment)	0.1
Aliphatic TPH > C8-10	320	LQM/CIEH S4UL (allotment)	0.1
Aliphatic TPH > C10-12	2200	LQM/CIEH S4UL (allotment)	0.1
Aliphatic TPH > C12-16	11000	LQM/CIEH S4UL (allotment)	0.1
Aliphatic TPH > C16-35	260000	LQM/CIEH S4UL (allotment)	0.1
Aliphatic TPH > C35-44	260000	LQM/CIEH S4UL (allotment)	0.1
Aromatic TPH > C5-7	13	LQM/CIEH S4UL (allotment)	0.1
Aromatic TPH > C7-8	22	LQM/CIEH S4UL (allotment)	0.1
Aromatic TPH > C8-10	8.6	LQM/CIEH S4UL (allotment)	0.1
Aromatic TPH > C10-12	13	LQM/CIEH S4UL (allotment)	0.1
Aromatic TPH > C12-16	23	LQM/CIEH S4UL (allotment)	0.1
Aromatic TPH > C16-21	46	LQM/CIEH S4UL (allotment)	0.1
Aromatic TPH > C21-35	370	LQM/CIEH S4UL (allotment)	0.1
Aromatic TPH > C35-44	370	LQM/CIEH S4UL (allotment)	0.1
Aliphatic and Aromatic TPH > C44-70	1200	LQM/CIEH S4UL (allotment)	0.1
Other determinands may be required specific to the origin of the soils, for example:			
VOCs			0.001

Determinand	Screening Value – Allotments (mg/kg)	Origin of Generic Assessment Criteria	Limits of detection required (mg/kg) unless stated otherwise
SVOCs			0.1
Free cyanide			1.0

Downspout Water Screening Criteria

Table G-2 Downspout Water Quality Screening Criteria

Determinand	Average concentration recorded in October and November 2021	Maximum concentration recorded in October and November 2021	Laboratory limit of detection (µg/l)
pH	8.3	8.4	0.1 pH units
Lead (dissolved)	10.5	14.0	0.2
Zinc (dissolved)	250	590	0.5

Data Summary Statistics

Site:	Castlefield Viaduct	**Project No:**	PC2387
Data Description:	Topsoil	**SOM (%):**	1.0%
Land Use:	POS_Park	**Completed By:**	PP
Receptor:	Human Health	**Checked By:**	DF

Assessment Criteria Key

a) Import Criteria

Contaminant	Units	Method Detection Limit	Assess-ment Criteria (AC)	Source (see key)	Summary Statistics							Sample Identifiers and Analytical Data			
					Total Number of Samples	Results Above Detection Limit	Minimum	Maximum	Arithmetic Mean	Standard Deviation	Number of results >AC	SP1 ES1 08/06/2022	SP1 ES2 08/06/2022	SP1 ES3 08/06/2022	SP1 ES4 08/06/2022
Asbestos in Soil	Type	N/A	-		0	0			-	-	-	Not-detected	Not-detected	Not-detected	Not-detected
Naphthalene	mg/kg	0.05	4.1	a	4	1	0.05	0.4	0.14	-	0	< 0.05	0.40	< 0.05	< 0.05
Benzo(a)pyrene	mg/kg	0.05	5.7	a	4	3	0.05	0.88	0.45	0.35	0	0.32	0.88	0.53	< 0.05
			-												
Arsenic (aqua regia extractable)	mg/kg	1	43	a	4	4	6.9	9.9	8.68	1.44	0	8.10	6.90	9.80	9.90
Cadmium (aqua regia extractable)	mg/kg	0.2	3.9	a	4	0	0.2	0.2	-	-	0	< 0.2	< 0.2	< 0.2	< 0.2
Chromium (hexavalent)	mg/kg	1.2	170	a	4	0	1.2	1.2	-	-	0	< 1.2	< 1.2	< 1.2	< 1.2
Chromium (III)	mg/kg	1	18000	a	4	4	12	15	13.50	1.29	0	13.00	12.00	14.00	15.00
Copper (aqua regia extractable)	mg/kg	1	520	a	4	4	25	31	27.25	2.63	0	27.00	31.00	26.00	25.00
Lead (aqua regia extractable)	mg/kg	1	80	a	4	4	24	33	27.5	3.87	0	33.00	27.00	26.00	24.00
Mercury (aqua regia extractable)	mg/kg	0.3	19	a	4	0	0.3	0.3	-	-	0	< 0.3	< 0.3	< 0.3	< 0.3
Nickel (aqua regia extractable)	mg/kg	1	53	a	4	4	10	12	11	0.82	0	11.00	10.00	11.00	12.00
Selenium (aqua regia extractable)	mg/kg	1	88	a	4	0	1	1	-	-	0	< 1.0	< 1.0	< 1.0	< 1.0
Zinc (aqua regia extractable)	mg/kg	1	620	a	4	4	60	62	61	0.82	0	60.00	61.00	61.00	62.00
			-												
Benzene	µg/kg	1	17	a	4	0	1	1	-	-	0	< 1.0	< 1.0	< 1.0	< 1.0
Toluene	µg/kg	1	22000	a	4	0	1	1	-	-	0	< 1.0	< 1.0	< 1.0	< 1.0
Ethylbenzene	µg/kg	1	16000	a	4	0	1	1	-	-	0	< 1.0	< 1.0	< 1.0	< 1.0
p & m-xylene	µg/kg	1	29000	a	4	0	1	1	-	-	0	< 1.0	< 1.0	< 1.0	< 1.0
o-xylene	µg/kg	1	28000	a	4	0	1	1	-	-	0	< 1.0	< 1.0	< 1.0	< 1.0
			-												
TPH-CWG - Aliphatic >EC5 - EC6 HS_1D_AL	mg/kg	0.001	730	a	4	0	0.001	0.001	-	-	0	< 0.001	< 0.001	< 0.001	< 0.001
TPH-CWG - Aliphatic >EC6 - EC8 HS_1D_AL	mg/kg	0.001	2300	a	4	0	0.001	0.001	-	-	0	< 0.001	< 0.001	< 0.001	< 0.001
TPH-CWG - Aliphatic >EC8 - EC10 HS_1D_AL	mg/kg	0.001	320	a	4	0	0.001	0.001	-	-	0	< 0.001	< 0.001	< 0.001	< 0.001
TPH-CWG - Aliphatic >EC10 - EC12 EH_CU_1D_AL	mg/kg	1	2200	a	4	0	1	1	-	-	0	< 1.0	< 1.0	< 1.0	< 1.0
TPH-CWG - Aliphatic >EC12 - EC16 EH_CU_1D_AL	mg/kg	2	11000	a	4	0	2	2	-	-	0	< 2.0	< 2.0	< 2.0	< 2.0
TPH-CWG - Aliphatic >EC16 - EC21 EH_CU_1D_AL	mg/kg	8	2600000	a	4	0	8	8	-	-	0	< 8.0	< 8.0	< 8.0	< 8.0
TPH-CWG - Aliphatic >EC21 - EC35 EH_CU_1D_AL	mg/kg	8	2600000	a	4	0	8	8	-	-	0	< 8.0	< 8.0	< 8.0	< 8.0
			-												
TPH-CWG - Aromatic >EC5 - EC7 HS_1D_AR	mg/kg	0.001	13	a	4	0	0.001	0.001	-	-	0	< 0.001	< 0.001	< 0.001	< 0.001
TPH-CWG - Aromatic >EC7 - EC8 HS_1D_AR	mg/kg	0.001	22	a	4	0	0.001	0.001	-	-	0	< 0.001	< 0.001	< 0.001	< 0.001
TPH-CWG - Aromatic >EC8 - EC10 HS_1D_AR	mg/kg	0.001	8.6	a	4	0	0.001	0.001	-	-	0	< 0.001	< 0.001	< 0.001	< 0.001
TPH-CWG - Aromatic >EC10 - EC12 EH_CU_1D_AR	mg/kg	1	13	a	4	0	1	1	-	-	0	< 1.0	< 1.0	< 1.0	< 1.0
TPH-CWG - Aromatic >EC12 - EC16 EH_CU_1D_AR	mg/kg	2	23	a	4	1	2	4.2	2.55	-	0	< 2.0	4.20	< 2.0	< 2.0
TPH-CWG - Aromatic >EC16 - EC21 EH_CU_1D_AR	mg/kg	10	46	a	4	1	10	12	10.5	-	0	< 10	12.00	< 10	< 10
TPH-CWG - Aromatic >EC21 - EC35 EH_CU_1D_AR	mg/kg	10	370	a	4	1	10	20	12.5	-	0	< 10	20.00	< 10	< 10

Sample Identity	SP1 ES1	SP1 ES2	SP1 ES3	SP1 ES4
Strata	TS	TS	TS	TS
Depth (m bgl)				
Benzo(a)anthracene	0.36	1	0.51	0.05
Chrysene	0.24	0.8	0.5	0.05
Benzo(b)fluoranthene	0.32	1.1	0.48	0.05
Benzo(k)fluoranthene	0.16	0.49	0.25	0.05
Di-benzo(a,h)anthracene	0.05	0.05	0.05	0.05
Indeno(1,2,3-cd)pyrene	0.05	0.49	0.05	0.05
Benzo(g,h,i)perylene	0.05	0.56	0.05	0.05
Benzo(a)pyrene	0.32	0.88	0.53	0.05

Ratio to BaP					Min	Max	Culp study limits	
Benzo(a)anthracene	1.13	1.14	0.96	1.00	0.96	1.14	0.12	12.43
Chrysene	0.75	0.91	0.94	1.00	0.75	1.00	0.12	11.61
Benzo(b)fluoranthene	1.00	1.25	0.91	1.00	0.91	1.25	0.11	10.85
Benzo(k)fluoranthene	0.50	0.56	0.47	1.00	0.47	1.00	0.04	3.72
Dibenzo(ah)anthracene	0.16	0.06	0.09	1.00	0.06	1.00	0.01	1.38
Indeno(123cd)pyrene	0.16	0.56	0.09	1.00	0.09	1.00	0.07	7.27
Benzo(ghi)perylene	0.16	0.64	0.09	1.00	0.09	1.00	0.08	8.22

Appendix

Appendix D – Downspout Water Sample Screening Results

Data Summary Statistics

Site:	Castlefield Viaduct	**Project No:**	PC2387
Data Description:	Downspout Water		
Land Use:	Future Public Open Space	**Completed By:**	KD
Receptor:	Controlled Waters - EQS	**Checked By:**	EH

Assessment Criteria Key

a) WFD EQS inland surface waters 2015

b) M-BAT Tool

Contaminant	Units	Method Detection Limit	Assess-ment Criteria (AC)	Source (see key)	Summary Statistics							Sample Identifiers and Analytical Data									
					Total Number of Samples	Results Above Detection Limit	Minimum	Maximum	Arithmetic Mean	Standard Deviation	Number of results >AC	DP1	DP1	DP1	DP1	DP1	DP1	TB	TB	TB	FB
												20/10/2021	21/10/2021	01/11/2021	20/10/2021	21/10/2021	01/11/2021	20/10/2021	21/10/2021	01/11/2021	01/11/2021
												Round 1	Round 2	Round 3	Round 1	Round 2	Round 3	Round 1	Round 2	Round 3	Round 3
												Sample 1	Sample 1	Sample 1	Sample 2	Sample 2	Sample 2	Trip Blank	Trip Blank	Trip Blank	Field Blank
pH	pH Units	N/A	6 to 9	a	10	10	6.8	8.4	7.83	0.64644326	0	8.3	8.3	8.3	8.4	8.3	8.3	7.2	7.4	6.8	7
			-																		
Naphthalene	µg/l	0.01	2	a	10	0	0.002	0.002	-	-	0	< 0.0020	< 0.0020	< 0.0020	< 0.0020	< 0.0020	< 0.0020	< 0.0020	< 0.0020	< 0.0020	< 0.0020
Anthracene	µg/l	0.01	0.1	a	10	0	0.002	0.002	-	-	0	< 0.0020	< 0.0020	< 0.0020	< 0.0020	< 0.0020	< 0.0020	< 0.0020	< 0.0020	< 0.0020	< 0.0020
Fluoranthene	µg/l	0.01	0.0063	a	10	2	0.002	0.08	0.0116	0.02469008	2	< 0.002	< 0.002	0.08	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	0.02	< 0.002
Benzo(a)pyrene	µg/l	0.01	0.00017	a	10	0	0.002	0.002	-	-	10	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002
			-																		
Chromium (hexavalent)	µg/l	5	3.4	a	10	0	5	5	-	-	10	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0
Chromium (III)	µg/l	1	4.7	a	10	6	1	2	1.36	0.38064273	0	2	1.7	1.1	1.5	1.6	1.7	< 1.0	< 1.0	< 1.0	< 1.0
			-																		
Copper (dissolved)	µg/l	0.5	17.1	b	10	10	0.8	8.3	5.08	3.12651741	0	8	7.4	6.8	8.3	7.1	7.2	1.7	0.8	1.4	2.1
Lead (dissolved)	µg/l	0.2	4.99	b	10	6	0.2	14	6.37	5.53394575	6	14	9.7	9.2	12	8.5	9.5	< 0.2	< 0.2	< 0.2	< 0.2
Zinc (dissolved)	µg/l	0.5	24.66	b	10	10	1.9	590	151.33	197.439527	6	120	590	140	140	410	100	1.9	4.9	2.9	3.6
			-																		

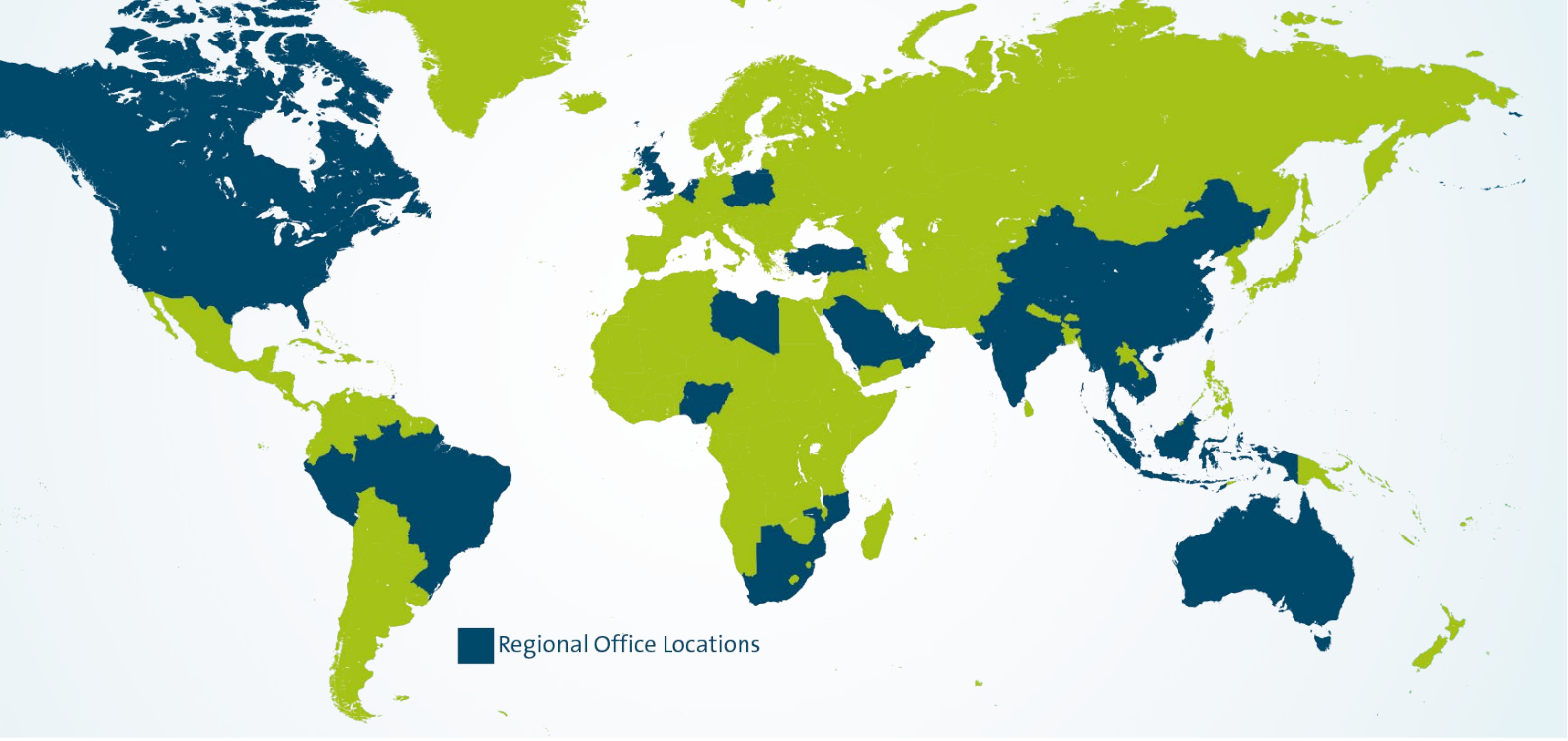
Data Summary Statistics

Site:	Castlefield Viaduct	**Project No:**	PC2387
Data Description:	Downspout Water (post remdiation)		
Land Use:	Future Public Open Space	**Completed By:**	PP
Receptor:	Controlled Waters - EQS	**Checked By:**	DF

Assessment Criteria Key

a) M-BAT Tool

Contaminant	Units	Method Detection Limit	Assess-ment Criteria (AC)	Source (see key)	Summary Statistics							Sample Identifiers and Analytical Data			
					Total Number of Samples	Results Above Detection Limit	Minimum	Maximum	Arithmetic Mean	Standard Deviation	Number of results >AC	DP1	Dup DP1	DP1	
												31/05/2022	31/05/2022	08/06/2022	
												R4	R4	R5	
pH	pH Units	N/A	-		3	3	9.2	9.3	9.23	0.06	-	9.3	9.2	9.2	
			-												
Lead (dissolved)	µg/l	0.2	4.99	a	3	3	4.1	15	7.80	6.24	1	4.3	4.1	15	
Zinc (dissolved)	µg/l	0.5	24.66	a	3	3	1.4	19	9.17	8.98	0	1.4	7.1	19	
			-												



Royal HaskoningDHV is an independent, international engineering and project management consultancy with over 138 years of experience. Our professionals deliver services in the fields of aviation, buildings, energy, industry, infrastructure, maritime, mining, transport, urban and rural development and water.

Backed by expertise and experience of 6,000 colleagues across the world, we work for public and private clients in over 140 countries. We understand the local context and deliver appropriate local solutions.

We focus on delivering added value for our clients while at the same time addressing the challenges that societies are facing. These include the growing world population and the consequences for towns and cities; the demand for clean drinking water, water security and water safety; pressures on traffic and transport; resource availability and demand for energy and waste issues facing industry.

We aim to minimise our impact on the environment by leading by example in our projects, our own business operations and by the role we see in “giving back” to society. By showing leadership in sustainable development and innovation, together with our clients, we are working to become part of the solution to a more sustainable society now and into the future.

Our head office is in the Netherlands, other principal offices are in the United Kingdom, South Africa and Indonesia. We also have established offices in Thailand, India and the Americas; and we have a long standing presence in Africa and the Middle East.

ETHIC Intelligence
CERTIFICATE ANTI-CORRUPTION COMPLIANCE SYSTEM

royalhaskoningdhv.com

Royal HaskoningDHV
Enhancing Society Together