Final Remediation Verification Report

Former Sunninghill Gas Works
Bridge Road, Ascot

Berkeley Homes Ltd

M41977-JNP-XX-XX-G-R-007 P05

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[redacted]

Prepared by……
Hilary Ilsley BSc (Jnt Hons) MSc CBiol MSB SQP SiLC QP
Associate (Geo-environmental)

[redacted]

Checked by……
Sarah Longstaff
Associate (Hydrogeologist)

[redacted]

Approved by……
Daniel Sykes BSc
Director (Geo-environmental)

FOR AND ON BEHALF OF JNP GROUP

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P05	30/01/24	Updated to include capping layer and gas protection verification with associated Appendices and drawings.	HI	SLL	DRS

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1 INTRODUCTION

1.1 Site Background Summary

1.1.1 The site is located off Bridge Road, Sunninghill, Ascot, Berkshire approximately 150 m east of Sunninghill High Street (see Figure 1 Key Plan). The site covers an area of approximately 2.36 hectares.

1.1.2 Historically, the site was an operational gas works from at least 1899 to 1963. Following this the structures associated with the gas works were slowly demolished circa 2013. The most recent reported use of site was as a vehicle depot/garage for the sale and repair of commercial vehicles.

1.1.3 The site has been subject to numerous ground investigations and some preliminary remediation work (2005 – tar tank and tar/liquor separator excavation; 2014 passive removal of free product in the north of the site; 2015 – removal of contaminated soils from six main areas and removal of oily water.). Replacement fill was bought to site. The remediation was to satisfy the site's continued use as open space.

1.1.4 Further post remediation ground investigations in 2017, 2018 and 2019, along with site conceptualisation and detailed controlled waters risk assessment, were undertaken by JNP Group to confirm the recent site conditions, assess the risks to receptors for a residential development at the site and develop a remediation strategy for the site. The requirements for the post remediation ground investigation were discussed with both the Environment Agency (EA) and the Royal Borough of Windsor and Maidenhead Council (RBWMC).

1.1.5 The resulting remediation strategy (RE004 Rev G Options Appraisal and Remediation Strategy) was agreed with both the EA and RBWC, following several meetings and discussions. Section two of this report summaries the agreed remediation requirements.

1.1.6 In addition, as a result of the existing differing ground levels across the site, cut and fill earthworks were required to achieve a level platform for development.

1.1.7 The re-use of suitable site won materials was managed following the Definition of Wate Code of Practice (DoWCoP) and a materials management plan was developed for the site and officially submitted to CL:AIRE.

1.1.8 The ground investigations and remediation work were instructed by St William Homes division of the Berkeley Group, however, following some delays resulting from land ownership and the effects of the COVID-19 pandemic the site was transferred to the Berkeley Homes Ltd division of the Berkeley Group.

1.2 Scope and Objectives

1.2.1 The site is to be re-developed for a residential use comprising fifty-three residential houses, twenty-four residential apartments and four residential coach houses (Class C3) including the provision of new pedestrian and vehicular accesses and routes, car parking, landscaping, open space, remediation and associated works. The agreed redevelopment is shown on the CHBC Architecture Site Plans, references W404-CHBC-SW-XX-DR-A-0001 Rev C4 and W404-CHBC-SW-XX-DR-A-0002 Rev C3, both dated April 2019.

1.2.2 JNP Group was instructed by Berkeley Homes Ltd to verify the remediation work undertaken to date at a site known as former Sunninghill Gas Works (hereinafter referred to as 'the site').

1.2.3 This report details all the verification work undertaken between May 2021 to January 2024.

1.2.4 This report is subject to the limitations presented in Appendix A.

1.2.5 The purpose of this report is to demonstrate that the remediation work has been undertaken and verified in accordance with the agreed Remediation Strategy (noting the exclusions above), and that the site is now suitable for residential use

1.3 Methodology

1.3.1 This report has been compiled in accordance with the on-line Land Contamination: Risk Management (LCRM) guidance produced by the Environment Agency (June 2019). This can be found on the UK government website: https://www.gov.uk/guidance/land-contamination-how-to-manage-the-risks.

1.3.2 In addition, guidance has also been sought from the following publications:

Verification of Remediation of Land Contamination (Environment Agency 2010).

1.3.3 This report should be read in conjunction with the following JNP Group reports:

M41977 RE003 Rev G Options Appraisal and Remediation Strategy. 14 October 2019;

M41977 RE005 Rev B Combined Ground Investigations Report. 18 July 2019;

M49177 RE006 Rev A Foundation Works Risk Assessment, July 2019;

Bridge Road Materials Management Plan, officially submitted on 27 November 2019;

M41977 TN004 Post Remediation Off-site Gas Risk Assessment. 23 February 2022.

1.4 Parties Involved

1.4.1 The following parties were involved with the implementation of the remediation work:

JNP Group provided advice and attended site on an 'as and when required' basis to undertake further investigation, installation of monitoring boreholes, groundwater sampling and inspection of the resulting excavations. In addition, JNP Group also provided general comments and guidance on results and unexpected contamination;

The remediation contractor for the works was Dunton Environmental; Dunton was responsible for the soils remediation and validation thereof, groundwater treatment and validation thereof; and materials management in accordance with the submitted materials management plan.

The demolition of the existing cottages was undertaken by Wooldridge Demolition Ltd.

All contaminated soils designated for off-site removal were hauled by S Walsh and Son Ltd. Their registered address is East Hordon Hall Business Park, Tilbury Road, Brentwood Essex. CM13 3LR [Registered Waste Carriers and Brokers Licence CBDU93666].

Hazardous waste was taken to the waste facility operated by Mick George Ltd at their Mepal Soil and Waste Treatment Centre, at Witcham Meadland Landfill Site, Block Fen Drove, Mepal, Chatteris, Cambridgeshire CB6 2AY [Environmental Permit reference EPR/EP3492SP].

Non-hazardous waste was taken to the waste facility operated by DB Cargo Ltdat Barking Eurohub, Box Lane, Barking IG11 0SQ [Environment Permit reference: EPR/CGB3003GR].

Scrap plastic was taken by Moulding Solutions Ltd to their facility at Wharf Road, Kilnhhurst, South Yorkshire S64 5SY [Waste License Ref WEX001814 Exemption Codes: S2, T1, T4, U9. Waste Carried Registration No. CB/SM36838NK.R003].

Surplus concrete and inert arisings (from the piling) were taken to the Thames Materials' Ltd facility at Skip Lane, Harefield, Uxbridge, Middlesex UB9 6RP. [Environmental Permit EPR/BB3 709TU/A001 and Waste carriers licence CB/DU113556].

Piling works were undertaken by Sheppard Piling;

Dunton acted as Principal Contractor until the end of September 2021, when this role was taken over by Berkeley Homes Ltd.

All soil and groundwater chemical validation samples taken by Dunton were analysed by DETS Ltd, which is a UKAS and MCerts qualified laboratory.

All soil and groundwater chemical validation samples taken by JNP Group were analysed by i2 Analytical, which is a UKAS and Mcerts qualified laboratory.

Additional soil testing was done by ELAB, which is a UKAS and MCerts qualified laboratory or Chemtest Eurofins, also UKAS and MCerts qualified.

Gas protection membranes were installed by UK Membranes and were verified by MEC Environmental Ltd.

The Environmental Protection Officer (EPO) from Royal Borough of Windsor and Maidenhead Council (RBWMC) were involved dealing with any complaints received and agreeing any changes to the agreed remediation strategy.

2 SUMMARY OF REMEDIATION REQUIREMENTS (EXTRACTS TAKEN FROM OPTIONS APPRIALS AND REMEIDATION STRATEGY REPORT R004 REV G)

2.1 Site Updates and Preferred Remediation Option

2.1.1 All trees and the majority of vegetation in the south-west of the site had been removed by others prior to the commencement of main remediation works, hence, reference to this as part of the initial site works has been removed.

2.1.2 The agreed remediation strategy gave two options for soils treatment, either ex-situ bioremediation or stabilisation. Dunton selected the former and therefore any reference to solidification /stabilisation has been removed.

2.1.3 This revised Remediation (Enabling Works) Verification Report excludes gas protection measures verification, capping layer verification, and extended piling groundwater monitoring results (although an initial comment on the results recorded thus far has been included).

2.2 Remediation Areas, Proposed Methodology and RTV

2.2.1 The text below in italics is taken from M41977 RE003 Rev G Options Appraisal and Remediation Strategy.

Remediation Areas

2.2.2 From a consideration of the ground investigation findings and from the proposed Omega Partnerships site layout plan (Drawing 2765-C-1005-G Site Layout), a total of eleven localised areas requiring soil remediation are proposed that contain the worst-case areas (highest gas concentrations, highest soil and groundwater contamination, and areas of visual contamination). These are shown on jnpgroup drawing M41977 D322 Rev C. The table that follows indicates the areas and depths requiring remediation, as well as justification for the remediation.

Table 2.2: Soil Remediation (including validation) Requirements.

Remediation Area	***Justification***	***Anticipated Area (m^2)***	***Anticipated Depth (m)***	***Validation Requirements***
Area 1 (including 1A)	*Significant hydrocarbon impacted soil, including evidence of visual oils. Hazardous waste concentrations of hydrocarbons. Located in plots 51-53 including garden areas. Significant hydrocarbon and ammonium contamination within shallow and deep groundwater.*	*623*	*2.8*	*Visual assessment of oils.* *Naphthalene soil and groundwater testing*
Area 2	*Significant hydrocarbon impacted soil, including evidence of visual oils. Hazardous waste concentrations of hydrocarbons. To reduce contaminant loading on groundwater. Significant hydrocarbon and ammonium contamination within shallow groundwater.*	*5*	*2.0*	*Visual assessment of oils.* *Naphthalene soil and groundwater testing*
Area 3	*Elevated lead, arsenic and hydrocarbon contamination.*	*25*	*0.3*	

Remediation Area	Justification	Anticipated Area (m^2)	Anticipated Depth (m)	Validation Requirements
	Hazardous waste concentrations of hydrocarbons. Location in soft landscaping area.			*Soil testing for lead, arsenic and naphthalene.*
Area 4	*Hazardous waste concentrations of hydrocarbons, elevated lead and asbestos, elevated carbon dioxide Located under buildings, hardstanding and garden areas. Significant hydrocarbon and ammonium contamination within shallow and deep groundwater.*	*425*	*0.6*	*Naphthalene soil and groundwater testing.* *Benzo[a]pyrene, lead and asbestos soil testing.*
Area 5	*Visible spent oxide throughout strata. Hydrocarbon impacted material sitting on concrete slab, with some hazardous waste. Located under buildings, soft landscaping and hardstanding.*	*565*	*1.3*	*Visual assessment of oils and spent oxide.*
Area 6	*Visible spent oxide throughout strata. Partly located in plots 95-96.*	*245*	*1.3*	*Visual assessment of spent oxide.*
Area 7	*Spent oxide in natural ground. Located in garden plot 41.*	*25*	*0.6*	*Visual assessment of spent oxide.*
Area 8	*Localised hazardous waste within Made Ground at 1.4 m. Visible hydrocarbons and odours at depth – 1.3 m plus. Location is within a proposed garden area plot 36. To reduce contaminant loading on groundwater.*	*25*	*2.0*	*Visual assessment of oils.* *Naphthalene soil testing*
Area 9	*Visual spent oxide and hazardous waste concentrations of hydrocarbons. Located under buildings and garden plots 67-68*	*245*	*0.5*	*Visual assessment of spent oxide. Soil testing for benzo[a]pyrene.*
Area 10	*Localised hydrocarbons (hazardous waste) and lead, elevated carbon dioxide. Located within plot 74 and to reduce contaminant loading for groundwater.*	*255*	*0.8*	*Soil testing for lead and naphthalene.*
Area 11	*Elevated hydrocarbons and asbestos. Located in plot 69-70*	*25*	*0.6*	*Soil testing for asbestos and dibenzo[a,h]anthracene*

2.2.3 In addition, to the above there will be a surface scrape across to the site to an anticipated depth of 200 – 300 mm that will encounter surface and subsurface visual spent oxide, particularly in the south-eastern part of the site. This material will require remediation.

2.2.4 Three areas, Areas 1 and 4, also require shallow and deep groundwater treatment as agreed with the Environment Agency on 8 July 2019. This has been further expanded to include Area 2 at the request of the Environment Agency in their letter dated 29 July 2019.

Proposed Methodology

2.2.5 The combined treatment of soil and groundwater, irrespective of the method use, is likely to reduce gas generation at the site, although boundary risks require confirmation following the remediation and earthworks.

2.2.6 Therefore, given the identified remediation areas and the design requirements the following remediation options are proposed:

Physical separation of materials into separate potential waste streams from general surface scrape and cut exercise. This will include separating out hardcore materials from soil, as well as separating out visually impacted soil;
Chemical testing of site-won material for screening against RTV;
Localised ex-situ bioremediation;
Localised shallow groundwater treatment in Areas 1, 2 and 4 using in-situ treatment to meet the naphthalene RTV;
Localised deep groundwater treatment in Areas 1 and 4 using in-situ treatment to improve groundwater quality (i.e. consistent reduction in hydrocarbon and ammonium concentrations);
Provision of gas protection measures in all buildings (including garages) for a CS2 determination including the provision of hydrocarbon resistant membrane;
Provision of clean, engineered capping layer (including the provision of a geotextile membrane) in gardens, public open space, soft landscaping and root zone;
Post remediation / earthworks gas monitoring to confirm boundary gas conditions;
All soils unsuitable for on-site remediation or re-use shall be transferred to a soil treatment facility or a suitable waste disposal site.

2.2.7 The concentrations of petroleum hydrocarbons and some PAH species are considered to be hazardous. The results from the ground investigation indicated a maximum concertation of asbestos of 0.02%, which would not be classified as hazardous waste.

2.2.8 The preferred remediation option is to place a suitable, engineered capping layer in garden, open space and landscaped areas; hence, the remaining soils beneath the capping layer following the cut and fill earthworks can contain some elevated concentration of contaminants. This strategy was accepted by the Environmental Protection Officer (EPO) from RBWMC during the meeting of 29 June 2019. During that same meeting, the EPO agreed that the concentrations of asbestos recorded on site can remain under the capping layer.

2.2.9 However, the concentrations of contaminants remaining under the capping layer, under buildings and areas of hard standing, should be acceptable to controlled waters in order to reduce soil contaminant loading and assist with the betterment of the overall groundwater quality. Therefore, based on Detailed Quantitative Risk Assessment (DQRA) work and discussions with the Environment Agency where naphthalene was found to be the most significant contaminant of concern at the site, a soil remediation target value (RTV) for naphthalene has been derived to ensure site-won soils are suitable for placement under the capping layer.

2.2.10 As discussed, and agreed, with the Environment Agency on 8th July 2019, a naphthalene RTV for shallow groundwater has been set. No RTV have been set for the deeper groundwater as the Environment Agency want to see a betterment in the water quality such as a consistent reduction in the hydrocarbon and ammonium concentrations.

2.2.11 The RTV for the shallow groundwater has been calculated using the Level 3 Groundwater Assessment in the DQRA as 686 μg/l (Appendix B).

Table 2.1: Naphthalene RTV Summary

Naphthalene	***RTV***
Soil (for placement under capping, hardstanding and buildings)	*221 mg/kg*
Groundwater	*686 µg/l*

2.2.12 In addition, concentrations of asbestos remaining under the capping layer should be less than 0.1%.

2.3 Implementation Plan

2.3.1 The main works will be undertaken with St William Homes (SWH) acting as the Principal Contractor, with subcontractors employed to undertake certain activities.

2.3.2 The remediation and earthworks will be supervised by jnpgroup on an "as and when" required basis; jnpgroup shall provide a watching brief throughout the earthworks and remediation to ensure that the works are undertaken in accordance with this strategy and assist SWH with any contamination issues.

2.3.3 Subcontractors will be required to undertake; demolition; site strip; tree clearance; soil remediation; tree clearance; earthworks; piling; localised groundwater remediation; general groundwater dewatering; environmental monitoring; and the installation of gas protection measures.

2.3.4 As there is asbestos present within the soils / within buildings, all works undertaken must be in accordance with the guidance given in the CIRIA C733 (CIRIA 2014) and CL:AIRE Industry Guidance on Interpretation for Managing & Working with Asbestos in Soil and Construction and Demolition Materials (CL:AIRE 2016).

2.3.5 All works on site will be undertaken following the guidance given in C762 Environmental Good Practice on-site (CIRIA C762) and Construction Site Safety GE700E/18 (CITB 2018).

Site Set Up

2.3.6 The site shall be set up to include the provision of site portacabins, welfare facilities, car parking areas, storage and security fencing.

Surface Strip, Breaking Out Surface and Subsurface Structures

2.3.7 The first stage of the works will comprise fly tipped waste clearance, vegetation clearance, surface stripping of topsoil and some of the shallow remediation of visually contamination with spent oxide areas under the direction of jnpgroup.

2.3.8 Remaining surface and subsurface concrete slabs will be broken out. Deeper underground structures shall also require breaking out, typically to 2 m below ground level or to accommodate final ground levels.

2.3.9 The material generated from the above will be stockpiled accordingly to await physical segregation, crushing, re-use screening, removal off-site for disposal or removal off-site. This should be undertaken in accordance with the Materials Management Plan.

Demolition of Cottages

2.3.10 Two redundant cottages require demolition. An asbestos inspection was undertaken on no.29 Bridge Road and the property was found to contain chrysotile as corrugated roof sheets,

within the boiler flue and within floor tiles in various parts of the building (reference Thames Laboratories. Asbestos Inspection Report @ 29 Bridge Road, Sunninghill. 010145/B606a. November 2004.).

2.3.11 This work will be undertaken by a specialist demolition subcontractor suitably experienced and licensed to work with asbestos containing materials within buildings.

2.3.12 A method statement will be provided for approval prior to any demolition work commencing, which should also include use of the JIWG Decision Support Tool to categorise the work activities involving asbestos.

2.3.13 Upon removal of the floor slab, jnpgroup will undertake verification sampling and chemical testing would be required to assess the quality of the underlying ground and ensure gross contamination is not present.

Installation of Boundary Monitoring Boreholes and additional treatment boreholes

2.3.14 As requested by the Environment Agency, shallow and deep monitoring boreholes are to be placed along the site boundary for use during the remediation and piling works. The locations of these boreholes and their depths are shown on jnpgroup drawing M41977 D323 Rev E.

2.3.15 BH301 is to be placed in the central part of the site to assist with shallow groundwater treatment. This borehole is to be drilled to a depth of 10 m. jnpgroup will advise on the installation depth during the work.

Decommissioning of Existing Boreholes

2.3.16 As a result of the numerous phases of ground investigation that have been undertaken at the site, there is the potential for numerous boreholes from previous investigations to remain in-situ, having not been decommissioned. This also includes the two abstraction boreholes (BGS reference SU96NW39 in north-western part of the site (NGR 496740 167600) and SU96NW38 in the south-central part of the site (NGR 493700 167500)). The only exception to this shall be boreholes required to assist with the in-situ groundwater remediation work.

2.3.17 A surface search supervised by jnpgroup will be undertaken following the surface strip to identify any such locations. These shall be marked with orange wooden pegs to await decommissioning, which shall be undertaken prior to any excavation work by a specialist contractor.

2.3.18 Each borehole is to be decommissioned in accordance with the EA guidance, as summarised in Appendix E, to avoid leaving possible preferential pathways. Any additional boreholes encountered during the works will be decommissioned in a similar manner.

2.3.19 Upon completion of all post earthworks and piling monitoring, all monitoring and treatment boreholes will also require decommissioning as per Appendix E. This work will not be undertaken until the Environment Agency confirm that the groundwater quality at the site is acceptable and that no more monitoring is required.

2.3.20 Records shall be kept that document the work undertaken, this will include a borehole location plan, with reference numbers, groundwater level prior to decommissioning, nature of backfill materials and any problems encountered.

Remediation and Excavation Work

2.3.21 The remediation and cut excavation works shall be undertaken in accordance with the jnpgroup drawing M41977 D322 Rev C and pta drawing reference W404-PTA-SW-NA-DR-C-9310.

2.3.22 All soils excavated will undergo physical separation prior to any remediation work. jnpgroup will supervise the hot spot excavations and will visually verify the areas and take the necessary sampling as per the requirements of Table 2.3 and section 4.2.

2.3.23 Suitable hardcore material will be crushed. Soils unsuitable for ex-situ bioremediation would require segregation to await off-site remediation options as detailed in paragraphs 4.1.34 – 4.1.37.

2.3.24 A detailed method statement for the soil remediation will be provided by the remediation Contractor to jnpgroup for approval that details site-specific methodology proposed. This will include the relevant data sheets for the any specialist treatment chemicals or additives to be used prior to work commencing on site.

Re-use of Site Won Material

2.3.25 Site-won material from the remediation excavations, cut exercise, crushing activities (including fines), surplus arisings from the excavation of foundations and service trenches shall be re-used if chemically acceptable compared to the RTV in Table 2.1 and if geotechnically suitable (to meet the foundation design requirements).

2.3.26 Stockpiled material suitable for placement under the capping layer, buildings or hardstanding will be marked with green wooden stakes.

2.3.27 Stockpiled material destined for off-site remediation will be marked with red wooden stakes.

Material Requiring Removal Off-site

2.3.28 Material designated for removal off-site should be stockpiled in a designated area to await disposal. Any stockpiled material shall be placed on tarpaulin sheets to avoid any cross contamination, or if appropriate in skips.

2.3.29 Further WAC testing may be required for any material destined for disposal at an inert or hazardous waste management facility.

2.3.30 The Principal Contractor will keep records of any material removed off-site either for treatment and re-use or as a waste destined for a waste management facility. The Waste License and Permit Register form, as given in Appendix F, detailing the waste codes and haulier and receive details will be completed by the Principal Contractor for each waste material generated requiring removal.

2.3.31 In addition, all material removed off site will be logged on the Waste Disposal Record form given in Appendix G. The completed waste management form, duty of care and consignment notes will be provided to jnpgroup for inclusion in the verification report.

Dewatering Excavations

2.3.32 It is likely that pockets of perched groundwater and shallow groundwater within the Made Ground and / or Bagshot Formation will be encountered during the excavation work. Periods

of inclement weather may also affect excavations. The following should be undertaken to assist with the control of water in excavations:

- Work on one area at a time to avoid too many deep or large excavations being open at once;
- Ensure there is on-site storage of suitable materials and equipment to construct a temporary storage tank;
- Ensure on-site storage of suitably powered pumps and sufficient lengths of hoses to enable dewatering of excavation as and when required.

2.3.33 This water will require collection and on-site treatment by the remediation Contractor prior to suitable disposal. Such water is likely to contain dissolved and suspended contamination, suspended solids and free product; therefore, the water is unsuitable for the following:

- Use as dust suppression water;
- Direct disposal to the adjacent watercourses or ground.

2.3.34 The preferred disposal option is for disposal to sewer; the quality of the water should meet with the discharge criteria provided by Thames Water and should also be discharged in accordance with their discharge rates. It will be the responsibility of the remediation Contractor to undertake the chemical testing of the output water to demonstrate compliance with Thames Waters' discharge criteria.

2.3.35 Regular site walkovers should be undertaken throughout the day to check the water level within excavations.

In-situ Shallow and Deep Groundwater Remediation

2.3.36 Boreholes PRB108, PRB110, BH203 and BH202B (Areas 1 and 2) and BH201 and BH301 (Area 4) need to be retained for use as post remediation monitoring boreholes following the propose in-situ chemical oxidation. Specialist treatment chemicals will be injected into the groundwater using an injection rig under the supervision and direction of the remediation Contractor. A detailed method statement will be provided by the remediation Contractor to jnpgroup for approval that details site-specific methodology proposed, proposed location of injection points and the relevant data sheets for the specialist treatment chemicals to be used prior to work commencing on site.

2.3.37 Validation monitoring of the shallow boreholes to assess concentrations of naphthalene and monitoring of the deep boreholes to assess concentration of hydrocarbons and ammonium will be required. Refer to Section 4.2 for chemical validation testing requirements.

2.3.38 It will be the responsibility of the remediation Contractor to undertake the chemical testing associated with the in-site groundwater treatment, in order to demonstrate compliance with the agreed naphthalene RTV and show betterment in the deeper groundwater quality.

Specifics for Capping Layer

2.3.39 A capping layer is required in all garden and public open space areas, this will comprise a suitable puncture resistant geotextile membrane (such as an Alert barrier or equivalent) at the base, then 600 mm of clean subsoil and topsoil. Within the top 600 mm, no deleterious material should be present (e.g. wire, brick, glass, plastics, treated wood or textiles). It is usual

practice for the top 150 mm to comprise topsoil with subsoil below but if required the proportion of topsoil and subsoil can change.

2.3.40 In areas of landscaping, the capping layer thickness can be reduced to 300 mm, comprising clean subsoil and topsoil, free of deleterious material and overlying a suitable geotextile membrane.

2.3.41 In areas close to trees, the capping layer thickness shall be reduced to 150 mm, comprising clean subsoil and topsoil, free of deleterious material and overlying a suitable geotextile membrane.

2.3.42 The capping layer thicknesses have been agreed and accepted by RBWMC EPO. The requirements of "Imported Fills" below and Section 4.2 also apply.

Piling Activities

2.3.43 The material used for the construction of the piling mat will be suitable material. If imported fill material is to be used, then it should comply with the chemical testing requirements of Tables 4.1 and 4.2.

2.3.44 The proposed methodology for piling is the use of CFA piles, for further details of the piling methodology and risks, reference should be made to jnpgroup R006 Rev A Foundation Works Risk Assessment. A pictorial conceptual model for the proposed piling methodology is shown in M4977 SK002. Any material brought to the surface shall be screened, stockpiled, chemically tested and validated as site won material.

2.3.45 Groundwater monitoring before, during and after the piling work is required by the EA. Boreholes BH302-BH307 inclusive as shown on jnpgroup drawing M41977 D323 Rev E will be monitored by jnpgroup on a fortnightly basis and will provide interim results to the Environment Agency. Upon completion of the third post-piling monitoring round, the need for further monitoring and sampling will be reviewed by jnpgroup and the Environment Agency. Depending upon the outcome of this review, further post-piling monitoring and sampling may be required.

2.3.46 Refer to Section 4.2 for chemical validation testing requirements.

2.3.47 Protective, visible plastic fencing or suitable equivalent is to be placed around these boreholes to assist with retention during the works. However, if boreholes are damaged or destroyed during the works, they will need replacement by the Principal Contractor.

Post-Earthworks Gas Monitoring and Assessment

2.3.48 As a result of the earthworks and remediation activities proposed at the site, the gassing regime at the site is likely to alter and hence, additional gas monitoring will be undertaken at the site to clarify boundary post earthworks gas concentrations.

2.3.49 Gas monitoring installations will be placed along the site boundary and in strategic positions on site where they are least likely to be disturbed as a result of the on-going site activities. The proposed locations of these boreholes are shown on jnpgroup drawing M41977 D323 Rev E. These boreholes are to be drilled to 5 m below ground level with installation comprise 0.5 m plain pipe and the remainder slotted pipe. Protective, visible plastic fencing or suitable equivalent is to be placed around these boreholes to assist with retention during the works.

However, if boreholes are damaged or destroyed during the works, they will need replacement by the Principal Contractor.

2.3.50 Six weekly monitoring visits will be undertaken with at least two of these to coincide with periods of low and falling pressure, where possible.

2.3.51 Following the completion of this, the boundary gas conditions shall be re-assessed and confirmed by jnpgroup.

Imported Fill

2.3.52 Any imported fill such as subsoil or topsoil used at the site will be sourced from a suitable provider of such material, who will provide chemical testing certificates of the material destined for the site. These certificates will be issued to jnpgroup for approval prior to accepting the material and importing it to site. In addition, the imported fill should be free of any deleterious material (e.g. wire, brick, glass, plastics, treated wood or textiles) and a visual inspection should be undertaken by jnpgroup once the material arrives on site.

2.3.53 Any topsoil and subsoil imported to site shall be classified and characterised in accordance with the requirements of BS3882:2015 [Specification for topsoil and requirements for use] and BS8601:2013 (Specification for subsoil and requirements for use) respectively as well as the chemical testing criteria given in Tables 4.2 – 4.4 as appropriate.

2.3.54 Refer to Section 4.2 for chemical validation testing requirements.

2.3.55 Records on imported fill brought onto site should be documented.

Gas Membrane Specifics

2.3.56 The pre-development gas assessment undertaken, in line with BS BS8485 (2015) +A1 (2019), indicates that gas protection measures are required in all properties to a level of CS2. Referring to Table 4 of BS8485, the level of ground gas protection required should be equal or greater than 3.5 points, when one item from each of Table 5 (structural barrier), Table 6 (ventilation) and Table 7 (gas resistant membrane) within BS8485 is selected.

2.3.57 A gas membrane provides 2 points of protection providing it meets with the requirement of section 7.2.4 and Table 7 of BS8485. The remaining 1.5 points could be provided by a good performance passive floor void providing it meets with the requirements of Table 6 of BS8485.

2.3.58 The proposed gas protection measures will also have to account for the mobile hydrocarbons present at the site and hence, any membrane used will have to be hydrocarbon resistant.

2.3.59 The details of the gas protection measures to be installed within all buildings, including garages, are included as part of Appendix H.

2.3.60 The installer of the gas membrane will be suitably experienced and qualified, and they should provide a method statement for their works for approval prior to undertaking any work.

2.3.61 A photographic record of the installation work will be kept by the installer. In addition, appropriate records of all the Integrity Testing undertaken will be produced by the installer personnel.

2.3.62 Following the final integrity testing, Certificates of Conformity will be provided by the installer for each property to jnpgroup.

Dealing with Unexpected Contamination

2.3.63 Whilst investigation works has been undertaken at the site, it remains possible that unexpected soil contamination may be encountered during the process of any site demolition, clearance, excavation and / or construction.

2.3.64 There is the potential for areas of previously unidentified and unexpected contamination to be present at the site such as ashy soils, brightly coloured soil, significantly oily or odorous material, asbestos impacted soils and underground tanks, and areas of significant free product within the groundwater.

2.3.65 If during the works such material is encountered, then the Principal Contractor will inform jnpgroup directly and immediately who shall then advise on the best course of action. Photographic and written records should be kept by the Principal Contractor detailing any such material.

2.4 Validation Plan

Post Demolition Validation Chemical Testing

2.4.1 Following the removal of the floor slab to the existing cottages, trial pitting supervised by jnpgroup will be undertaken in four random locations within the footprint of the cottages to obtain a profile of the underlying ground and to obtain soil samples. These samples will be tested for a standard gas works suite of analysis.

2.4.2 Should the chemical results fail, then jnpgroup shall advise on the best course of action.

Validation Chemical Testing – Excavation Level and Site-Won Stockpile Screening

2.4.3 Should any excavations require validation then the resulting excavation bases and faces shall be sampled at random locations by jnpgroup at a frequency to suit the size of the excavation and the samples sent for chemical analysis for either a standard gas works suite of analysis or individual determinants as determined by jnpgroup.

2.4.4 jnpgroup will undertake visual assessment of the hots spot areas as detailed in Table 2.2, to ensure that visible oil and spent oxide do not remain in these areas. In accordance with Table 2.2, there will also be some further soil testing to validate the extents of the hot spot excavations, particularly when they extend into garden areas. In these instances, the following criteria shall be used:

Table 4.1: Hot Spot Validation Criteria

Contaminant of Concern	RTV (mg/kg)	Justification
Naphthalene	221	Groundwater RTV
Benzo(a)pyrene	10	Defra C4SL for residential with plant uptake scenario
Dibenzo(a,h)anthracene	10	Based on the above in the absence of specific C4SL
Arsenic	37	Defra C4SL for residential with plant uptake scenario
Lead	200	Defra C4SL for residential with plant uptake scenario
Asbestos	<0.1%	Upper Limit of JIWG medium risk band

2.4.5 Providing the chemical results are acceptable compared to the screening values given in Table 4.1, the area can then be backfilled with acceptable site won material or imported fill.

2.4.6 Following the excavation of any unexpected contamination, soil samples shall be taken by jnpgroup and tested for an appropriate testing suite. The results shall be compared to the criteria given in Table 4.1 and provided they are acceptable the area can be backfilled with

appropriate material. Should contaminants be identified on site that are not included in Table 4.1 then jnpgroup will provide further assessment and direction.

2.4.7 Should the chemical results fail then further material shall be excavated (it is suggested by 200 mm if practicable, deeper depths may be required to suit ground conditions) and the new excavation level sampled and tested as above.

2.4.8 Stockpiled site-won material acceptable to the RTV given in Table 2.1 can be re-used on site under the capping layer, under buildings or under areas of hardstanding, and in accordance with the Materials Management Plan. All chemical testing shall be undertaken by a UKAS and MCERTS accredited testing laboratory using standard turnaround times.

Validation Chemical Testing – On-site Remediation

2.4.9 The soils shall be screened against the naphthalene RTV of 221 mg/kg to assess their status for re-use.

Validation Chemical Testing – Imported Fill

2.4.10 Chemical testing certificates will be available for any imported fill including subsoil or topsoil, however, in line with the requirements of the NHBC guidance, as the number of plots scheduled for development is above forty, each source of imported material used must have a minimum of ten tests with a nominal sampling frequency of one test per four plots. This sampling will be undertaken by jnpgroup.

2.4.11 Imported fill for use in residential gardens and landscaping areas must chemically comply with the screening values given in Table 4.2. These have been derived using BRE guidance on provision of a capping layer and published UK screening values for a residential with plant uptake end use.

2.4.12 Imported fill for use in public open space areas will chemically comply with the screening values given in Table 4.3. These have been derived using BRE guidance on provision of a capping layer and published UK screening values for a public open space in a residential area end use.

2.4.13 In addition, as copper, nickel and zinc are considered phytotoxic in nature the criteria given in Table 4.4 will be used (these values are less than the published UK screening values and hence are considered protective of human health).

Table 4.2: Imported Fill Screening Values for Capping Layer in Residential Gardens

Determinant	Screening Criteria (mg/kg)	Source		Determinant	Screening Criteria (mg/kg)	Source
TPH Aliphatic $C_5 - C_6$	42	LQM S4UL		Acenaphthylene	25	Professional Judgement[1]
TPH Aliphatic $C_6 - C_8$	100	LQM S4UL		Acenaphthene		
TPH Aliphatic $C_8 - C_{10}$	27	LQM S4UL		Anthracene		
TPH Aliphatic $C_{10} - C_{12}$	130	LQM S4UL		Benzo(a)anthracene	7.2	LQM S4UL
TPH Aliphatic $C_{12} - C_{16}$	250	Professional judgement[1]		Benzo(a)pyrene	5	DEFRA C4SL
TPH Aliphatic $C_{16} - C_{21}$				Benzo(b)fluoranthene	2.6	LQM S4UL
TPH Aliphatic $C_{21} - C_{35}$				Benzo(k)fluoranthene	25	Professional Judgement[1]
TPH Aromatic $C_5 - C_7$	0.87	Taken as benzene C4SL		Benzo(g,h,i)perylene		
TPH Aromatic $C_7 - C_8$	130	LQM S4UL		Chrysene	15	LQM S4UL
TPH Aromatic $C_8 - C_{10}$	34	LQM S4UL		Dibenzo(a,h)anthracene	5	Taken as BaP DEFRA C4SL
TPH Aromatic $C_{10} - C_{12}$	74	LQM S4UL		Fluoranthene	25	Professional Judgement[1]
TPH Aromatic $C_{12} - C_{16}$	140	LQM S4UL		Fluorene		
TPH Aromatic $C_{16} - C_{21}$	250	Professional judgement[1]		Indeno(1,2,3,c-d)pyrene		
TPH Aromatic $C_{21} - C_{35}$				Naphthalene	2.3	LQM S4UL
				Pyrene	25	Professional Judgement[1]
Arsenic	37	DEFRA C4SL		Phenanthrene		
Cadmium	26	DEFRA C4SL				
Chromium	910[2]	LQM S4UL		Nickel	pH dependent	Refer to Table 4.2
Mercury	40[3]	LQM S4UL		Selenium	250	LQM S4UL
Lead	200	DEFRA C4SL		Benzene	0.87	DEFRAC4SL
Copper	pH dependent	Refer to Table 4.2		Toluene	130	LQM S4UL
Zinc	pH dependent	Refer to Table 4.22		Ethyl benzene	47	LQM S4UL
asbestos	None present	Professional Judgement		Xylene	56	LQM S4UL

1. Based on professional judgement to ensure the capping layer is clean
2. Based on LQM S4UL for chromium III, assumes no chromium VI is likely to be present
3. Based on LQM S4UL for inorganic mercury, assumes that no elemental or methyl mercury is likely to be present
4. Note all LQM S4UL for organics are based on a 1% SOM

Table 4.3: Imported Fill Screening Values for Capping Layer in Public Open Space within Residential Area

Determinant	Screening Criteria (mg/kg)	Source		Determinant	Screening Criteria (mg/kg)	Source
TPH Aliphatic $C_5 - C_6$	350	Professional Judgement[1]		Acenaphthylene	35	Professional Judgement[1]
TPH Aliphatic $C_6 - C_8$				Acenaphthene		
TPH Aliphatic $C_8 - C_{10}$				Anthracene		
TPH Aliphatic $C_{10} - C_{12}$				Benzo(a)anthracene	29	LQM S4UL
TPH Aliphatic $C_{12} - C_{16}$				Benzo(a)pyrene	10	DEFRA C4SL
TPH Aliphatic $C_{16} - C_{21}$				Benzo(b)fluoranthene	7.1	LQM S4UL
TPH Aliphatic $C_{21} - C_{35}$				Benzo(k)fluoranthene	35	Professional Judgement[1]
TPH Aromatic $C_5 - C_7$	140	Taken as benzene C4SL		Benzo(g,h,i)perylene		
TPH Aromatic $C_7 - C_8$	350	Professional Judgement[1]		Chrysene		
TPH Aromatic $C_8 - C_{10}$				Dibenzo(a,h)anthracene	10	DEFRA C4SL
TPH Aromatic $C_{10} - C_{12}$				Fluoranthene	50	Professional Judgement[1]
TPH Aromatic $C_{12} - C_{16}$				Fluorene		
TPH Aromatic $C_{16} - C_{21}$				Indeno(1,2,3,c-d)pyrene		
TPH Aromatic $C_{21} - C_{35}$				Naphthalene		
				Pyrene		
Arsenic	79	DEFRA C4SL		Phenanthrene		
Cadmium	220	DEFRA C4SL				
Chromium	1500[2]	LQM S4UL		Nickel	pH dependent	Refer to Table 4.2
Mercury	40[3]	LQM S4UL		Selenium	1100	LQM S4UL
Lead	630	DEFRA C4SL		Benzene	140	DEFRA C4SL
Copper	pH dependent	Refer to Table 4.2		Toluene	140	Taken as benzene for conservatism.
Zinc	pH dependent	Refer to Table 4.22		Ethyl benzene		
asbestos	None present	Professional Judgement[1]		Xylene		

1.Based on professional judgement to ensure the capping layer is clean
2. Based on LQM S4UL for chromium III, assumes no chromium VI is likely to be present
3. Based on LQM S4UL for inorganic mercury, assumes that no elemental or methyl mercury is likely to be present
4. Note all LQM S4UL for organics are based on a 1% SOM

Table 4.4: Imported Fill Screening Values- phytotoxic metals

Determinant	Screening Criteria (mg/kg)			Source
	pH <6	pH 6-7	pH >7	
Copper (nitric acid extractable)	<100	<135	<200	BS 3882:2015 and BS 8601:2013
Nickel (nitric acid extractable)	<60	<75	<110	BS 3882:2015 and BS 8601:2013
Zinc (nitric acid extractable)	<200	<200	<300	BS 3882:2015 and BS 8601:2013

Groundwater Monitoring

2.4.14 During and following the completion of the localised shallow groundwater remediation, sampling and chemical analysis for dissolved naphthalene will be undertaken by the remediation Contractor to assess compliance with the RTV.

2.4.15 During and following the completion of the deep groundwater remediation, monitoring for aliphatic and aromatic petroleum hydrocarbon fractions, speciated PAH and ammonium will be undertaken by the remediation Contractor to demonstrate betterment of the groundwater.

2.4.16 The above chemical validation results will be passed to jnpgroup in pdf and excel format upon receipt of each chemical testing report.

2.4.17 Groundwater monitoring and sampling before, during and after the piling will be undertaken by jnpgroup on a fortnightly basis. The groundwater samples will be analysed for aliphatic and aromatic petroleum hydrocarbon fractions, speciated PAH, total phenols (monohydric) and ammonium.

Gas Membrane Verification

2.4.18 All testing and verification of the membrane will be in accordance with the good practice guide Table A3 given in CIRIA C735. Following the completion of all the installation work and integrity testing, all records of work undertaken, photographs, integrity testing records, Certificates of Conformity, and copies of the CSWIP Approval Certificates for all relevant installation welders, will be provided to jnpgroup for inclusion in the Verification Plan.

2.4.19 All work will be verified in accordance with the requirements of the Gas Verification Report as given in in Appendix I. In addition, the Verification Proforma, also given in Appendix J will be completed by the installer.

2.4.20 A photographic record of the installation work will be kept by the installer. In addition, appropriate records of all the Integrity Testing undertaken will be produced by the installer.

2.4.21 Independent verification of the gas membranes in all properties will be undertaken by an appropriate third party. Following completion of the validation, copies of the validation report / certificates will be submitted to jnpgroup for inclusion in the Verification Report.

Verification Reporting

2.4.22 Following the completion of the remediation / earthworks works all records of works undertaken (including drawings and photographs), chemical validation results, environmental monitoring results, gas membrane certificates of conformity, duty of care

certificates and imported soil chemical testing certificates will be provided to jnpgroup by the Principal Contractor.

2.4.23 Following the completion of the remediation works, a verification report will be produced by jnpgroup that details the remediation work undertaken, the validation testing undertaken, and the details of any material removed from or brought to the site.

Environmental Monitoring

2.4.24 Environmental monitoring requirements were covered by a Construction Environment Management Plan as produced by St William Homes / Berkely Homes. That should cover as a minimum the following items: Nuisance Dust, Airborne Release of Asbestos Fibres; odours; noise; air quality (VOC).

3 REMEDIATION WORKS UNDERTAKEN

3.1 Remediation / Earthworks Works

3.1.1 The main remediation and earthworks commenced in April 2021 and were largely completed by early November 2021; the piling works commenced at the end of September 2021 and are currently ongoing. This report details all remediation and earthworks undertaken up to 30 November 2021.

3.1.2 In accordance with the agreed remediation strategy, Dunton provided JNP Group with method statements for the soil remediation methodology and groundwater remediation methodology. Copies of these are given in Appendix B.

3.1.3 Prior to the start of the main works, several meetings were held between JNP Group, Berkeley Homes and Dunton to discuss the remediation requirements. An initial onsite meeting was held on site on 6th May 2021 to discuss the remediation and other works required at the site.

3.1.4 Dunton were present on site from April to early November 2021 overseeing the remediation / earthworks activities, once the remediation work was completed, Berkey Homes took over management of the remaining site works. All the works undertaken by Dunton have been provided in a Summary Remediation Letter (included as Appendix C to this report).

3.1.5 JNP Group were not required by the client to provide full time supervision, hence JNP Group representatives attended the site throughout the works on a regular basis to verify that the work was being undertaken in accordance with the agreed remediation strategy, to oversee the installation of the additional monitoring boreholes (and any subsequent redrills), to undertake groundwater monitoring and sampling, to undertake post remediation gas monitoring, validate the ground following the demolition of the cottages, and verify the capping layer.

3.1.6 A total of 27 visits were undertaken in 2021: May 6th and 19th; June 2nd, 14-18th, 29th; July 2nd, 5th, 7-9th, 21st; August 11th and 27th; September 14-16th, 17th, 27th; October 13th and 22nd; November 9th and 24th, and December 9th. Two visits were undertaken in January 2022 on 14th and 23rd. Due to the loss of all the monitoring boreholes, no further monitoring has been undertaken since this time.

3.1.7 A further six visits were undertaken between 5th May 2022 and 27th July 2022 to sample groundwater from the redrilled borehole BH305B, at the request of the Environment Agency.

3.1.8 Thirteen capping layer validation visits were undertaken between 10th October 2022 and 11th December 2023 in order to validate the quality of the imported topsoil and subsoil, and record the presence of the geotextile membrane and thickness of the capping layer.

3.1.9 The site visit records (which include photographs that were taken during the visits) completed by JNP Group are included in Appendix D. Additional photographs taken throughout the course of the works are included in Appendix E.

3.1.10 Any soil or groundwater samples taken for chemical analysis by JNP Group were sent to i2 Analytical on the day of collection. I2 Analytical is a UKAS and MCerts accredited laboratory.

Surface Soils Strip, Breaking out of Surface and Subsurface Structures

3.1.11 Dunton undertook a surface strip across the site, any visible spent oxide was scraped and placed in a stockpile in the north-west of the site to await off-site disposal. The average depth of this scrape was 175 mm but was deeper in places mainly due to the presence of spent oxide. In addition, some visible asbestos containing material (ACM) was found in the south-west of the site, prior to the treatment area being set out. Any visible ACM was bagged, the remainder of the scraped material from this area was stockpiled with the spent oxide. The stockpile was covered with a polythene sheet to prevent dust generation.

3.1.12 Any areas of hardstanding were broken out; in the central part of the site, an existing foundation located close to hot spot 4 extended further than anticipated. In addition, a former gasholder basin close to hot spot 5 was uncovered; the brick walls were broken out. Broken concrete and bricks were stockpiled in the north and centre to the site to await further assessment and crushing. The crushed (to 6F2) material was re-used on site to form the haul roads and the piling mat road. Dunton took validation samples of the crushed material to demonstrate it suitability for re-use. The results of these are discussed in Section 4.

3.1.13 A former drainage tank structure was broken out in the north of the site.

3.1.14 A surface strip was undertaken in mid-November 2021 along the south-eastern boundary to reduce the ground level compared to the adjacent area.

Borehole Decommissioning

3.1.15 During initial site visits, JNP did survey the site to locate any remaining boreholes and the abstraction wells. The following boreholes were located by JNP Group PRB104, PRB117 and MAW1 and these were used for monitoring.

3.1.16 Dunton confirm in their Summary Remediation Letter (included as Appendix C to this report) that many of the previous boreholes had already been destroyed when they arrived on site. Dunton confirmed that boreholes they had to remove due to the utility diversion works were decommissioned by removal of the pipe, where possible, and replacement with like for like material.

3.1.17 No evidence of the two abstraction wells (BGS reference SU96NW39 in north-western part of the site (NGR 496740 167600) and SU96NW38 in the south-central part of the site (NGR 493700 167500) were found during the works.

Additional Monitoring Installations and Monitoring Thereof by JNP Group

3.1.18 The drilling of additional groundwater installations was undertaken between July – August 2021. The majority of these were drilled by cable tool methods to either shallow or deep depths as indicated in Table 3.1. Copies of the logs for these additional boreholes are included in Appendix F.

3.1.19 Two boreholes BH303A and BH305A were re-drilled by Dunton using rotary techniques. Due to constraints from underground utilities, the adjacent railway and location of proposed building footprints, these had to redrilled in slightly different locations. Some were relocated again due to the necessary sewer and electricity diversion work, that later occurred.

3.1.20 The table below documents the resulting changes in the groundwater monitoring network.

Table 3.1: Changes to Groundwater Monitoring Boreholes

Borehole		Purpose	Location	Status, reason for Change and outcome
Shallow	BH301	Remediation and piling monitoring	Near DS04, Central part of the site.	Destroyed during works.
	BH301A	Remediation and Piling Monitoring-	Central part of the site.	To replace BH301. Position was constrained by concrete stockpile, so was positioned as close as reasonably practicable to DS04 area. Destroyed due to site works early December 2021.
	BH302	Remediation and piling monitoring	North-east corner	Cancelled due to space / utilities constraints. Alternative borehole to use: BH203.
	BH305A	Piling monitoring	South-east	Initial BH305 required redrilling due to being silted up. Redrilled by Dunton via rotary techniques as BH305A. Destroyed due to site works early January 2022.
	BH305B	Piling Monitoring	South-east	Replacement for BH305A.
	BH306	Piling monitoring	North-west	Position slightly altered to avoid building constraints. Destroyed due to site works early December 2021.
	BH203	Remediation treatment and monitoring.	North-east corner	Due to cancellation of BH302, this was used as both a treatment boreholes and monitoring borehole. Destroyed due to site works mid January 2022.
	PRB104	Remediation monitoring	Central part of the site.	This was used as a monitoring boreholes to supplement BH301 and BH201A. Destroyed due to site works early December 2021.
	PRB108	Remediation treatment & monitoring	North-east corner	Initially monitored but got destroyed during utilities diversion work.
	PRB110			
	PRB 117	Remediation monitoring	North-east corner	Used in place of PRB108 and PRB110. Destroyed due to site works mid January 2022.
	MWA1	Piling monitoring	North-west corner	Standby boreholes in case adjacent ones are unavailable / lost. Destroyed due to site works early December 2021.
Deep	BH303A	Remediation & piling monitoring	North-east corner	Initial BH303 required drilling due to utilities diversion work. Replaced by Dunton via rotary techniques as BH303A. Destroyed due to site works mid January 2022.
	BH304	Piling monitoring	South-east	Position slightly altered to avoid building constraints. Destroyed due to site works early December 2022.
	BH307A	Piling monitoring	North-west	Initial BH307 required redrilling due to constraints by development. Redrilled as BH307A. Destroyed due to site works early January 2022.
	BH201	Remediation monitoring	Central area	Destroyed during works.
	BH201A			To replace BH201. Position was constrained by concrete stockpile, so was positioned as close as reasonably practicable to DS04 area. Destroyed due to site works early December 2021.
	BH202B	Remediation monitoring	North-east	Destroyed during the second period of utilities diversion works.

Note – Boreholes denoted in red have been destroyed.

3.1.21 JNP drawings M41977-JNP-ZZ-DR-G-0328 P05 Location Plan – Monitoring points (North) and M41977-JNP-ZZ-DR-G-0329 P04 Location Plan – Monitoring points (South) show the final positions of the boreholes.

3.1.22 Pre-piling and pre-treatment groundwater quality sampling was undertaken by JNP Group in August 2021– September 2021. Post groundwater treatment and pre-piling works monitoring occurred during September 2021. Post groundwater treatment and during piling works monitoring occurred from October 2021 to January 2022.

3.1.23 The piling works commenced in the south of the site in October 2021 and moved up into the central area by the end of October / early November 2021, continuing into the north-east of the site in November 2021 and finishing in early December 2021. During the JNP Group monitoring visit of 9th December 2021, there was no piling activities as this had temporarily ceased. Piling works in the final area (north central) of the site commenced mid-January 2022.

3.1.24 Groundwater quality monitoring had not been undertaken since mid-January 2022 due the destruction of all the boreholes. Following liaison with the EA (refer to Appendix G) further monitoring of the groundwater in the south-east corner of the site was continued for three months on a fortnightly basis (refer to section 4.5.17).

3.1.25 During the groundwater monitoring, the boreholes were dipped, where possible the water was purged, but on occasions there was an insufficient water column to do this. A combination of dedicated waterra tubing and bailers were used to extract the water. The water was decanted into the appropriate glass sampling jars, which were suitably labelled and then placed in a cool box ready for transfer to i2. The water samples were scheduled for testing of speciated PAH, aliphatic-aromatic split petroleum hydrocarbons, total phenols (monohydric) and ammoniacal nitrogen as N / ammoniacal nitrogen as NH_4.

Demolition of Cottages and Validation of Underlying Ground

3.1.26 The cottages were demolished at the end of May / early June 2021 by Wooldridge Demolition Ltd under direct instruction and supervision from Berkeley Homes. Once the area was clear, Dunton used it as a storage area.

3.1.27 Once Dunton had vacated the area, JNP Group attended site on 11 August 2021 to visually inspect the underlying ground and excavated four shallow trial pits, denoted TP201-TP204 inclusive, excavated to 0.6 m depth, terminating in the natural ground. Two soils samples were taken from the shallow made ground (TP201@ 0.2m and TP203 @ 0.4 m) and two samples were taken from the deeper natural ground in both TP202 and TP204 at 0.6m . The sampled soils were placed in appropriate glass jars, the jars labelled and placed in a cool box ready for transfer to i2.

Earthworks and Hot Spot Removal

3.1.28 Excavation work of the thirteen identified hot spot areas were started in the south of the site and moved towards the north. The hot spots were excavated, with some additional chasing of extended visibly contaminated soils. Where hot spots were located in close proximity to each other and as a result of the chasing out of contaminated soils, the hot spot areas became merged into one. This included areas 1 (a1) and 2, areas 6 and 9, and areas 7 and 8.

3.1.29 Further spent oxide contaminated material was uncovered during hot spot 5 excavation, and the utilities division work in the vicinity of hot spot 5. The arisings from these areas were predominantly spent oxide and consequently, this material was stockpiled to await off-site disposal.

3.1.30 Upon completion of the excavation and subsequent validation work undertook by Dunton, an Inspection Testing Plan (ITP) was produced that detailed the area and depth of excavation, the location that the validation soils samples were taken from and the results of the chemical analysis. Copies of the ITP are included in Dunton Remediation Summary Letter as Appendix A.

3.1.31 During the excavation works undertaken in May, the remains of two former gasholder basins were uncovered near hot spots 4 and 5 (east central area of the site) . The gasholders contained a mix of demolition rubble, wood, tyres, made ground and natural soils. This material has been removed as it was unsuitable for supporting a piling rig; the material was screened and either moved to the treatment area, crushed or removed off site as a waste.

3.1.32 Material requiring on-site treatment was transferred to the south-east corner of the site and placed in windrows. The material was placed on an impermeable polythene sheet. This material was covered and turned using an excavator on a regular basis. Dunton tested each material batch prior to treated as a "T0" samples. The frequency of the treatment testing was dependent on the volumes of material removed and its heterogeneity. No additional chemicals were added to the material to enhance the remediation as the windrow monitoring samples undertaken by Dunton indicated that the concentrations of hydrocarbons were decreasing. Once the treatment was deemed complete the materials were resampled (T1) by Dunton, compared to the re-use criteria (Table 4.1 of JNP Group OARS Report) and returned to their site of origin if proven acceptable. All of the material placed in windrows was successfully treated.

3.1.33 Some of the excavated materials were wet, these were subject to lime treatment for moisture conditioning to allow the correct compaction upon backfilling.

3.1.34 A total volume of 6,790 m^3 contaminated soils were excavated from the hot spot areas, the table below shows the volumes of soil treated from each hot spot area.

Table 3.2: Volume of Excavated Material

Hot Spot Area	Volume (m^3) of Excavated Soils
Area 1 and 2	1,270
Area 3	75
Area 4	1,730
Area 5	1,375
Areas 6 and 9	1,015
Areas 7 and 8	800

Hot Spot Area	Volume (m^3) of Excavated Soils
Area 10	525
Area 11	65

3.1.35 Of the excavated materials approximately 4,200 m^3 were bioremediated and placed back in the areas from which they arose.

3.1.36 In addition, approximately 4,200 m^3 of crushed 6F2 material arising from site won brick and concrete was re-used across the site predominantly as part of the piling mats.

Off-site Disposal

3.1.37 During the main works, two stockpiles of contaminated arisings (predominantly spent oxide and hydrocarbons) from the surface scrape, hot spot 5 excavation and the arisings from the utilities diversion work, were removed from site.

3.1.38 The stockpile in the north-west of the site was removed as hazardous waste between 13th-20th May 2021. A total of 56 tipper lorry loads of hazardous soils was hauled by S Walsh and Son Ltd and taken to Mepal Soil and Waste Treatment Centre, operated by Mick George. Copies of the hazardous waste consignment notes are included in Dunton's Remediation Summary Letter as Appendix C.

3.1.39 A second stockpile containing contaminated arisings was removed as non-hazardous waste on 10th November 2021. Ten tipper lorry loads this material was hauled by S Walsh and Son Ltd and taken to the Barking Eurohub Facility, operated by DB Cargo Ltd. Copies of the duty of care certificates are included in Dunton's Remediation Summary Letter as Appendix C.

3.1.40 Additional contaminated material uncovered following the excavation for the storm water tank, was removed as non-hazardous waste and transferred to the Barking Eurohub Facility by S Walsh and Son Ltd in November 2021 along with the TPO (Area 11) area excavation arisings. Copies of the duty of care certificates are included in Dunton's Remediation Summary Letter as Appendix C.

3.1.41 Scrap plastic was removed on 5th May 2021 by Moulding Solutions Ltd for recycling at their facility in Kilnhurst, South Yorkshire. The correct duty of care procedures were followed and a copy of the Controlled Waste Transfer Note is included in Dunton's Remediation Summary Letter as Appendix C.

3.1.42 Concrete that was excavated after the crusher had demobilised from site were recycled at Thames Materials' facility in Uxbridge. A total of 14 loads of concrete (as dug) were removed, copies of the Controlled Waste Transfer Note is included in Dunton's Remediation Summary Letter as Appendix C.

3.1.43 There was also 450 m^3 of arisings from the piling works that were removed from site as this was surplus to requirements. This material was transferred as inert waste to the Thames Materials' facility in Uxbridge, copies of the Waste Transfer Notes are included in Dunton's Remediation Summary Letter as Appendix C.

Groundwater Remediation

3.1.44 Groundwater treatment was undertaken by Subadra supervised by Dunton between 15th and 16th September 2021.

3.1.45 A total of 27 locations in the north-east and central area of the site (hot spot areas 1 and 4) were injected with Regenox ORC Advanced, mixed as a slurry, using a direct injection rig. The injection points were constrained by the presence of the underground utilities in the area of hot spot 1, the locations are shown on the injection plan included in Dunton's Remediation Summary Letter as Appendix D.

3.1.46 The rig drives hollow rods into the ground to the required depth, then withdraws them at 1m increments combined with the high-pressure injection of the reagent. The injection depth ranged between 3 m -1 3m below ground level in order to target the shallow groundwater.

3.1.47 Due to the presence of the underground utilities in the hot spot 1 area, an additional reagent, Petrofix, was injected alongside the ORC Advanced. Petrofix comprises an activated carbon suspension that helps to promote the action of the ORC.

3.1.48 During the following groundwater monitoring visits, the treatment slurry did remain in some of the nearby monitoring boreholes, subsequently these boreholes (BH306 and BH307A) were not sampled by JNP Group during the monitoring visits undertaken on 27th September and 13th October 2021.

3.1.49 Dunton used low flow sampling techniques to take groundwater samples from the designated monitoring boreholes. The groundwater samples were sent to DETS and in accordance with the agreed remediation strategy were analysed for naphthalene only. Copies of the groundwater testing results undertaken by Dunton are included in Dunton's Remediation Summary Letter as Appendix D.

Post Remediation Gas Monitoring Borehole Installations (Summary)

3.1.50 Five shallow perimeter boreholes were drilled to between 3-4 m below ground level using a dynamic sampling rig at locations around the south-eastern, southern and western boundaries (adjacent to residential properties). The locations of these boreholes are shown on drawings JNP drawings M41977-JNP-ZZ-DR-G-0328 P05 Location Plan – Monitoring points (North) and M41977-JNP-ZZ-DR-G-0328 P03 Location Plan – Monitoring points (South).

3.1.51 Gas monitoring for carbon dioxide and methane was undertaken during November and December 2021, and January 2022. Further details are provided in the JNP Group Technical Note given in Appendix H to this report.

3.2 Deviations to the Agreed Remediation Strategy

3.2.1 There were three main deviations to the agreed earthworks / remediation strategy as detailed below.

3.2.2 The first was that, at the client's request, Dunton, not JNP Group, were to undertake the validation visual assessment and soil sampling of the excavated hot spots as Dunton were undertaking the remediation works.

3.2.3 The second concerned the extension of the gardens to plots 64- 72 inclusive, this area was previously open space. As remediation could not be undertaken in the tree root areas to the required depth of 0.6 m, it was agreed with Michael McNaughton (EPO from RBWM) that

remediation would occur to 'as deep as possible' in the root zone and then be completed by placement of a geotextile marker layer. There will be a covenant written into the deeds of these properties to notify the residents of the remaining contamination. A record of the agreement received from RBWM is given in Appendix G to this report.

3.2.4 The third was due to a short fall of material available for re-use due to the client raising the formation ground level and more contaminated material being removed off site than originally envisaged. A total of 14 loads of 6F5, inert material was imported to site and used to form a stable layer for the piling mat. Approximately 8,500 m^3 of suitable material was placed to at least 300 mm across the entire site, but in some areas such as the deeper hot spots and areas of utilities diversion work it was between 500mm and 1000 mm. The source of this material was another Berkeley site at Sunningdale Park, off Larch Avenue, Ascot, with PJ Murphy acting as the contractor. Chemical testing certificate results were provided by the PJ Murphy, copies of the testing results (Elab Report 21-36607-01) are included in Appendix H to this Report, the material was also sampled and tested by Dunton once it arrived on site and deemed suitable for use. Copies of these testing certificates area included in Dunton's Remediation Summary Letter as Appendix F and are discussed further in Section 4.3 to this report.

3.3 Additional or Unexpected Contamination

3.3.1 Due to presence of more contaminated materials within several of the hot spots as detailed herein, several of them became merged (areas 1 and 2, areas 6 and 9, and areas 7 and 8) and extended due to contamination chasing by Dunton. The additional material was transferred to the treatment area for bioremediation. The treated material was then replaced in its original location.

3.3.2 During the excavation of the new storm water tank in the north of the site, further black, oily soils were encountered. These were excavated out and temporally stored in the central part of the site to await off-site disposal. This material was removed along with the Area 11 (TPO) material as non-hazardous waste and transferred to the Barking Eurohub Facility by S Walsh and Son Ltd in November 2021. Copies of the duty of care certificates are included in Dunton's Remediation Summary Letter as Appendix C.

3.4 Environmental Monitoring and Mitigation Measures

3.4.1 Routine environment monitoring was undertaken by Dunton for airborne particulates, nuisance dust, noise, odours, temperature, volatiles, vibration and wind speed as detailed in their Remediation Summary Letter (Appendix B to this report). Lucien Environmental were employed by Dunton to undertake random asbestos air monitoring. Mitigation measures were also employed to suit the monitoring results, site activities as well as the weather conditions. Dunton used a qualitative approach with the daily monitoring and assigned levels 1-4 for severity of the monitored parameter. If either a 3 (moderate) or 4 (severe) was assigned, then works were halted and a change in work practice was implemented. In the case of the PID monitoring, similar levels 1-4 were assigned – 1 (<1 ppm), 2 (1 - <5 ppm), 3 (5- <10ppm) and 4 (>10 ppm). If a level 2 or 3 was assigned, then PIRA dispersal units and or foam odour suppressant were utilised. If a level 4 was assigned, then works were halted and a change in work practice was implemented.

3.4.2 The monitoring and mitigation are summarised in Table 3.3 given on the following page.

Table 3.3: Monitoring and Mitigation Measures Summary

Monitoring Frequency	Monitoring	Monitoring Method	No of Monitoring Points	Mitigation
Daily	Dust	Visual	Four perimeter locations: north, east, south and west	Traditional dust suppression PIRA dispersal unit
	Noise (dB(A))			As per Dunton's rating scheme
	Odour	Qualitative		Foam chief odour suppressant & PIRA dispersal unit
	Vibration	Underfoot		As per Dunton's rating scheme
	Volatiles	Photo-ionisation meter		PIRA dispersal unit
Monthly	Dust (mg/m^2/day)	Frisbee deposition		Traditional dust suppression
	Volatiles: benzene and naphthalene	Tenax adsorption tubes		Foam chief odour suppressant & PIRA dispersal unit
Continuous	Airborne particulates (µg/m3)	Mabey Units	South-east corner, south-west corner and western permitter (closest to adjacent residential receptors)	Traditional dust suppression
	Noise (dB(B))			As per Dunton's rating scheme
	Vibration (ppv mm/s)			As per Dunton's rating scheme
	Volatiles (ppm)			PIRA dispersal unit
Random	Asbestos (fibres/cm^3) Six visits taken between 10th May and 3rd August 2021	Air flow meter	5-6 locations were chosen to suit the site works being undertaken	None required
	Volatiles (to suit excavation locations)	Photo-ionisation meter		PIRA dispersal unit upwind of bio-treatment area and excavations

3.4.3 The locations of the perimeter monitoring points are shown on the monitoring plan included in Dunton's Remediation Summary Letter as Appendix E.

3.4.4 The EPO (Michael McNaughton) from RBW&MC visited the site on 20th May 2021 and was shown around the site by Dunton's site representative. Dunton reported to JNP Group that the EPO was satisfied with the work being undertaken and the provision of the environmental mitigation measures employed at the site.

4 VALIDATION RESULTS

4.1 Post Cottage Demolition Validation

4.1.1 Following the completion of the demolition of the cottages, JNP Group attended site and visually inspected the remaining ground. No visible contamination was observed in the area or during the excavation of the trial pits.

4.1.2 The four soil samples taken were scheduled for testing for a full gas works suite comprising: pH, soil organic matter, ammoniacal nitrogen (as NH_4), asbestos screen, total, complex and free cyanide, heavy metals, speciated PAH, total phenols (monohydric) and aliphatic-aromatic petroleum hydrocarbon fractions.

4.1.3 Upon receipt and review of the results, the following determinants were recorded at concentrations less than the limit of laboratory detection (LOD): mercury, selenium, free cyanide; total phenols (monohydric), acenaphthene, petroleum hydrocarbon fractions aliphatic C_5-C_{12} and aromatic C_5-C_{10}. Asbestos fibres were not detected in any of the samples.

4.1.4 The concentrations of the remaining determinants were compared to the RTV given in Table 4.1 or Table 4.3 (as appropriate) of the agreed Remediation Strategy and were found to be acceptable. Whilst no RTV was set for complex cyanide, the highest result of 34 mg/kg is not considered of significant concern by JNP Group as no visible spent oxide (source of complex cyanide) was seen in the area and this result is at least one order of magnitude lower than concentrations recorded in areas with visible spent oxide.

4.1.5 A copy of the Chemical Testing Results (i2 Report 21-92807) is given in Appendix I.

4.2 Review of Dunton Soil Validation Soils Work

4.2.1 JNP Group consider that the bioremediation work undertaken by Dunton was generally in accordance with their proposed method statement. The only additions to the treatment stockpile was of lime to correct the moisture condition of the material.

4.2.2 The treatment monitoring testing results provided by Dunton have been reviewed by JNP Group. The T1 results show that the naphthalene concentrations were all acceptable to the agreed RTV of 221mg/kg. In addition, although not a requirement of the Remediation Validation Plan, arsenic and lead were also tested with their results being below the hot spot validation criteria of 37 mg/kg and 200 mg/kg respectively. Asbestos screening was also undertaken; in two samples chrysotile asbestos was identified, however, the T0 stockpile had acceptable asbestos quantification results that were less than 0.1 %. The results ranged between 0.002 % – 0.037 %, similar to those recorded during the previous JNP Group ground investigation. They are therefore suitable for re-placement at their original location below the capping layer. Copies of the treatment testing results are included in Dunton's Remediation Summary Letter as Appendix B.

4.2.3 JNP Group consider that the hot spots were excavated in accordance with the requirements of the remediation strategy. The resulting excavations were often larger and deeper as a result of the chasing out of the contamination. When the resulting excavations were viewed by JNP Group, no visible contamination remained. The majority of the excavations were into the underlying natural ground.

4.2.4 The table below summarises the validation soils sampling and subsequent validation testing results, that was undertaken and provided by Dunton in their ITPs.

Table 4.1: Hot Spot Validation Summary

Area	No. of excavation face samples	No. of excavation base samples	Testing Suite	Comparison to Hot Spot criteria (Table 4.1 of remediation Strategy)
Area 1 (including 1A)	Three	Two	Asbestos, arsenic, lead, speciated PAH.	All acceptable.
Area 2	Three	Two	Full gas works testing suite.	All acceptable.
Area 3	Four	One	Asbestos, arsenic, lead, speciated PAH.	All acceptable except face sample VAL-W. This had a marginal BaP exceedance (10.60 mg/kg) compared to the RTV of 10 mg/kg. When considering the final layout, depth of sample, and absence of any visible contamination, JNP Group consider that this concentration is not likely to pose a significant risk to receptors.
Areas 4	Four	One	Asbestos, arsenic, lead, speciated PAH.	All acceptable except face sample VAL-W. This had a marginal BaP exceedance (10.30mg/kg) compared to the RTV of 10 mg/kg. When considering the final layout, depth of sample, and absence of any visible contamination, JNP Group consider that this concentration is not likely to pose a significant risk to receptors.
Areas 5	Four	One	Asbestos, arsenic, lead, speciated PAH.	All acceptable.
Area 6	Six	Two	Asbestos, arsenic, lead, speciated PAH.	All acceptable.
Area 7	Four	One	Asbestos, arsenic, lead, speciated PAH.	All acceptable.
Area 8	Four	One	Asbestos, arsenic, lead, speciated PAH. Plus asbestos quantification.	All acceptable, except asbestos was detected in four samples (VAL-N, VAL-E, VAL-W, VAL-Base). The quantification results (<0.001% - 0.005%) are acceptable to RTV.
Area 9	Six	Three	Asbestos, arsenic, lead, speciated PAH.	All acceptable.
Area 10	Five	Three	Asbestos, arsenic, lead, speciated PAH.	All acceptable.

4.2.5 Following the surface scrape from area 11 (TPO area) validation testing was not undertaken as no further excavation could be undertaken in this area due to it being in the tree root protection zone and a geotextile is to be placed in this area.

4.2.6 Based on the ITP provided by Dunton and reviewed by JNP Group, JNP Group consider that the validation work has been undertaken in accordance with the remediation strategy.

4.2.7 Copies of the ITP produced by Dunton are included in Dunton's Remediation Summary Letter as Appendix A.

4.3 Imported Soil Validation

4.3.1 Berkely Homes provided a chemical testing certificate (Elab 21-36607) for the subsoil to be imported to the site, two soil samples were scheduled for a full gasworks suite of chemical

analysis (including asbestos, heavy metals, inorganics, total phenols (monohydric), speciated PAH, and aliphatic and aromatic petroleum hydrocarbons.

4.3.2 Whilst imported fill criteria had been set for subsoil and topsoil for placement in the capping layer, none had been set for below the capping layer. Therefore, for conservatism, JNP Group advised Dunton to screen against those set for a caping layer in public open space (i.e. Table 4.3 of the Remediation Strategy Report). All the results were acceptable when compared to these screening values. A copy of the chemical testing certificate is given in Appendix H to this report.

4.3.3 Dunton sampled the imported material placed across the site at 16 locations as well as from five stockpiles of imported material. The material brought to site comprised predominantly a brown sandy clay and with brown sand.

4.3.4 All the samples were scheduled for a full gasworks suite of chemical analysis (including asbestos, heavy metals, inorganics, total phenols (monohydric), speciated PAH, and aliphatic and aromatic petroleum hydrocarbons. The samples were sent to DETS for analysis.

4.3.5 Whilst imported fill criteria had been set for subsoil and topsoil for placement in the capping layer, none had been set for below the capping layer. Therefore, for conservatism, JNP Group advised Dunton to screen against those set for a caping layer in public open space (i.e. Table 4.3 of the Remediation Strategy Report). Upon receipt of the results, all the results were acceptable when compared to these screening values with the exception of four positive asbestos identifications (grids B3, B5, B6 and H2).

4.3.6 Follow on quantification was undertaken on these four samples with the results ranged from <0.00 1% to 0.003 %, which JNP Group do not consider to be of concern for the following reasons:

- The JIWG DST risk bands are considered to be very low;
- The results are an order of magnitude lower than the maximum recorded on site during the recent ground investigations (0.02 %);
- The EPO agreed that asbestos concentrations as above, could be left under the capping (refer to section 2.2.7).

4.4 Groundwater Treatment Validation

4.4.1 JNP Group consider that the groundwater treatment undertaken at the site was in accordance with the method statement provided by Dunton, albeit with the additional use of Petrofix.

4.4.2 Dunton provided the following conclusions following their post remediation groundwater analysis:

4.4.3 The first round of post-remediation analyses was undertaken by Dunton by a low-flow method two weeks after the completion of the injection works. This round found slight visual evidence of ORC-A slurry (and Petrofix) within some groundwater monitoring boreholes, suggesting some direct linkage between the injection point and borehole response zones (although the injection points were at least 3m from the nearest borehole). Most boreholes also exhibited increases in DO, ORP and EC, all suggesting a direct impact upon the aquifer in

that area. The second round of samples also revealed increases in DO and EC, although less visual evidence of ORC-A slurry and Petrofix.

4.4.4 Both rounds of analyses revealed significant decreases in aqueous concentrations of naphthalene in both the shallow and deep aquifers.

4.4.5 Copies of the groundwater testing results undertaken by Dunton are given in Dunton's Remediation Summary Letter as Appendix D.

4.4.6 It should be noted that some boreholes have been destroyed part way through the monitoring, mainly in the north-east corner, so nearby boreholes still present in the north-east were selected for use.

4.4.7 The aims of the groundwater treatment were to reduce naphthalene concentrations in the shallow groundwater to less than 686 µg/l, and to show a betterment in the quality of the deeper groundwater.

4.4.8 The naphthalene results from the Dunton groundwater monitoring from the treatment / monitoring boreholes in the north-east and central areas of the site are summarised in the following table.

Table 4.2: Dunton Results-Naphthalene Concentrations in Monitoring / Treatment Boreholes

Borehole		Location	Pre-treatment Results (µg/l)		Post-treatment Results (µg/l)	
			9/3/21	12/8/21	24/9/21	7/10/21
Shallow	BH301A	Central area			0.57	0.18
	PRB104				0.03	7.94
Deep	BH201A		372.8	19.79	1.65	1.32
Shallow	BH203	North -east corner	386.5*	29.58	0.06	0.41
	PRB108		1.8	61.6		
	PRB109		587.6			
	PRB110		1028	2637		
	PRB 117				50.01	0.02
Deep	BH303A				0.09	0.19
	BH202B			61.16		

Notes:
Those boreholes in red later destroyed; * wrongly labelled as BH202A

4.4.9 JNP Group also undertook additional groundwater monitoring in the north-east and central areas of the site, the naphthalene results from the JNP Group monitoring are summarised in the following tables. A full set of chemical results are included as Appendix J to this report.

Table 4.3: JNP Group Results-Naphthalene Concentrations in Monitoring / Treatment Boreholes

Borehole		Location	Pre-treatment Results (µg/l)				Post-treatment Results (µg/l)				
			18/6/21	2/7/21	5/7/21 & 9/7/21	21/7/21	27/9/21	13/10/21	22/10/22	9/11/21	24/11/21
Shallow	BH801	Central area	390								
	BH801A				5.34	1.18			0.67		
	PRB104			335		30.9			8.79		
Deep	BH201A				18.2	0.88			1.86		
Shallow	BH203	North -east corner		30.2		125	<0.01	4.77	5.86	2.66	<0.01
	PRB108		249	1.01		0.5					
	PRB110		376	8.08							

Borehole		Location	Pre-treatment Results (µg/l)				Post-treatment Results (µg/l)				
			18/6/21	2/7/21	5/7/21 & 9/7/21	21/7/21	27/9/21	13/10/21	22/10/22	9/11/21	24/11/21
	PRB 117			390			<0.01	1.80	1.09	<0.01	<0.01
Deep	BH303				37.4	3.22					
	BH303A						25.5	3.22	3.01		<0.01
	BH202B			99.9		193					

Notes:
Those boreholes in red later destroyed.

4.4.10 From the above tables (4.2 and 4.3), it can be seen, that despite the borehole changes, both JNP Group and Dunton results for the central area and north-eastern corner show a reduction in naphthalene concentrations in both the shallow and deep groundwater, and are all below the agreed RTV of 686 µg/l.

4.4.11 The aliphatic fraction C_{12}-C_{16}, and aromatic fractions C_{10}-C_{12} and C_{16}-C_{21} have been selected by JNP Group to show additional deep groundwater hydrocarbon quality, these, along with the ammonia / ammoniacal nitrogen concentrations are summarised in the following tables.

Table 4.4: Dunton Chemical Results for Deep Groundwater

Deep boreholes		Location	Pre-treatment Results (µg/l)		Post-treatment Results (µg/l)	
			9/3/21	12/8/21	24/9/21	7/10/21
BH201 & BH201A	Ammonia as NH_4 (mg/l)	Central area	2.37		10.1	10.4
	Aliphatic C_{12}-C_{16}		697		<10	<10
	Aromatic C_{10}-C_{12}		287		<10	<10
	Aromatic C_{16}-C_{21}	North -east corner	261		<10	<10
BH303 & BH303A	Ammonia as NH_4 (mg/l)				51.4	49.5
	Aliphatic C_{12}-C_{16}				<10	<10
	Aromatic C_{10}-C_{12}				<10	<10
	Aromatic C_{16}-C_{21}				<10	<10
BH202B	Ammonia as NH_4 (mg/l)		NT	3.73		
	Aliphatic C_{12}-C_{16}		<10	<10		
	Aromatic C_{10}-C_{12}		266	177		
	Aromatic C_{16}-C_{21}		29	16		

Notes:
Those boreholes in red later destroyed. NT- not tested.

Table 4.5: JNP Group Chemical Results for Deep Groundwater

Deep Borehole		Location	Pre-treatment Results (µg/l)			Post-treatment Results (µg/l)				
			18/6/21	2/7/21, 5/7/21 & 9/7/21	21/7/21	27/9/21	13/10/21	22/10/22	9/11/21	24/11/21
BH201 & BH201A	Ammoniacal nitrogen as NH_4 (mg/l)	Central area	3.3	62	NT					
	Aliphatic C_{12}-C_{16}		<10	<10	<10					
	Aromatic C_{10}-C_{12}		330	20	<10					
	Aromatic C_{16}-C_{21}		120	<10	<10					
BH303 & BH303A	Ammoniacal nitrogen as NH_4 (mg/l)	North-east corner		NT	NT	52 (as N)	50	35 (as N)	59	39 (as N)
	Aliphatic C_{12}-C_{16}			<10	<10	<10	<10	<10	<10	<10
	Aromatic C_{10}-C_{12}			50	71	26	<10	<10	<10	<10
	Aromatic C_{16}-C_{21}			100	<10	<10	<10	<10	<10	<10
BH202B	Ammoniacal nitrogen as NH_4 (mg/l)			3.2	NT					
	Aliphatic C_{12}-C_{16}			<10	<10					
	Aromatic C_{10}-C_{12}			100	850					
	Aromatic C_{16}-C_{21}			27	260					

Notes:
Those boreholes in red later destroyed. NT- not tested.

4.4.12 From the above tables 4.4 and 4.53 it can be seen that in the central area and north-east corner, the hydrocarbons concentrations have decreased to <10 mg/l in deep groundwater, showing a betterment in quality following the groundwater treatment.

4.4.13 With regard to the ammonia / ammoniacal nitrogen concentrations, these have not been affected by the treatment and appear to have increased. This could be for number of reasons: the effects of the extensive earthworks, the effects of the piling work, and the periods of seasonal heavy rain that could all have flushed dissolved ammonia / ammoniacal nitrogen into and through the groundwater.

4.5 Piling Groundwater Quality Monitoring

4.5.1 Pre-piling, during and post piling groundwater monitoring was undertaken across the site, in both the shallow and deep groundwater, in up and down gradient boreholes. However, due to site works, many of these boreholes were destroyed and due to operational constraints could not be replaced. Therefore, the discussion on water quality that follows focuses on the boundary boreholes (north-east, north-west and south-east) where there is the most data available.

4.5.2 The tables that follow show the range in concentrations of selected contaminants including ammoniacal nitrogen, total phenol, benzene, naphthalene, aliphatic fraction C_{12}-C_{16}, and aromatic fractions C_{10}-C_{12} and C_{12}-C_{16}. In addition, trend graphs showing the changes in all concentrations for these contaminants in both the shallow and deep groundwater have been included in Appendix I to this report and, where relevant, have been reproduced below.

4.5.3 The shallow and deep groundwater results from the monitoring undertaken until the end of December 2021 were discussed with the EA in March 2022, as by January 2022 many of monitoring boreholes had been destroyed and could not be sampled; whilst the EA accepted that the groundwater treatment had achieved its objective (with a reduction in naphthalene concentrations) in the north of the site, and that the groundwater quality in the north-east and north-west had not been impacted by the piling works, the elevated lighter hydrocarbon fractions remaining in the south-east corner required further monitoring. It was agreed that a single replacement borehole be installed in this area, to a depth of 10 m and that the shallow groundwater be monitored and sampled for a further three months at fortnightly intervals. The groundwater samples were chemically tested for aliphatic and aromatic hydrocarbons and naphthalene only. A copy of this correspondence is included in Appendix G to this report.

4.5.4 The full set of groundwater results for the pre-piling, during piling and post piling are also included in Appendix I to this report.

South-east (upgradient boreholes)

Table 4.6: BH305/A and BH304 Concentration Range Summary

South-east Corner (up gradient)		Pre-Piling Concentrations Range (µg/l)	During-Piling Concentrations Range (µg/l)	Post piling Concentrations Range (µg/l)
BH305/A/B (Shallow)	Ammoniacal Nitrogen as N (mg/l)	0.85-65	73-110	NA
	Total Phenols (monohydric)	<10 – 600	340-1200	NA
	Naphthalene	<0.01 – 499	497-908	395-495 (4710*)
	Benzene	<1 – 777	497 – 1070	< 1 – 78
	Aliphatic C_{12}-C_{16}	<10	<10	<10
	Aromatic C_{10}-C_{12}	<10 – 550	16-2700	400-520 (4710*)
	Aromatic C_{16}-C_{21}	<10 – 570	<10 – 1800	250-580
BH304 (deep)	Ammoniacal Nitrogen as N (mg/l)	0.27 – 75	0.23 – 68	NR
	Total Phenols (monohydric)	<10 – 240	150 – 240	
	Naphthalene	<0.01 – 639	86.9 – 281	
	Benzene	<1 – 572	280 – 423	
	Aliphatic C_{12}-C_{16}	<10	<10	
	Aromatic C_{10}-C_{12}	<10 – 70 640	87 <10 – 840	
	Aromatic C_{16}-C_{21}	<10 -230	<10 – 35 440	

Notes:

NR – not required as analyte did not require further testing.

* outlier result.

4.5.5 From the above table and graphs, the shallow groundwater shows increased concentrations of most hydrocarbon contaminants during piling compared to pre-piling, but with the majority of contaminants generally reducing in concentration towards the end of the piling. Benzene and naphthalene concentrations remain elevated.

4.5.6 The deeper groundwater contamination concentrations pre and during piling, were similar orders of magnitude. Benzene and naphthalene concentrations spike during piling but as the piling progressed the concentrations generally decreased.

Figure 4.1 Benzene Concentrations

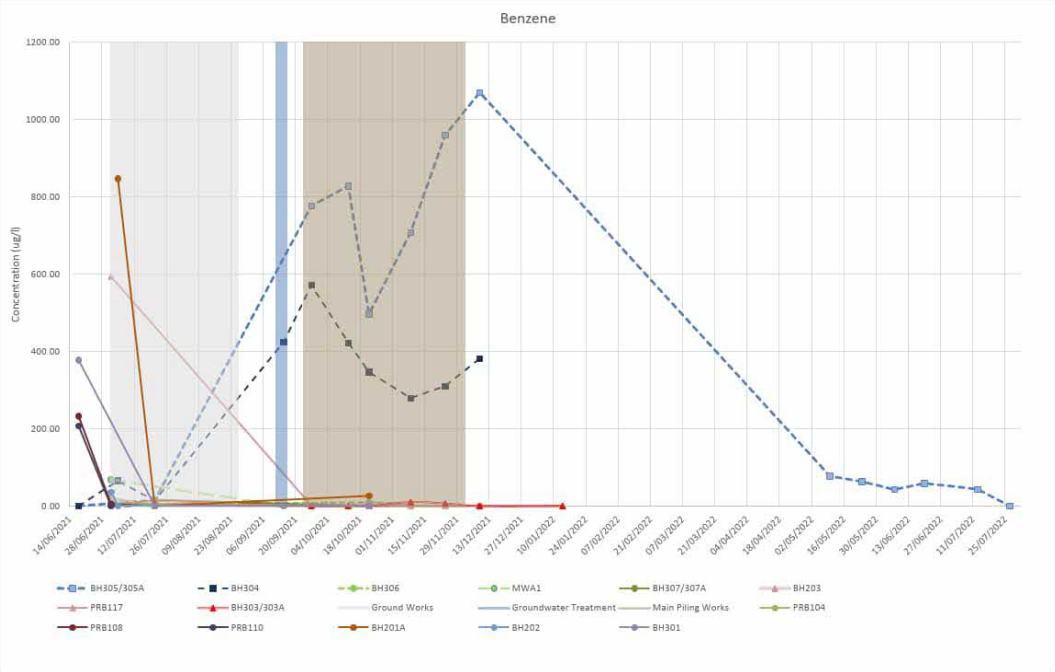
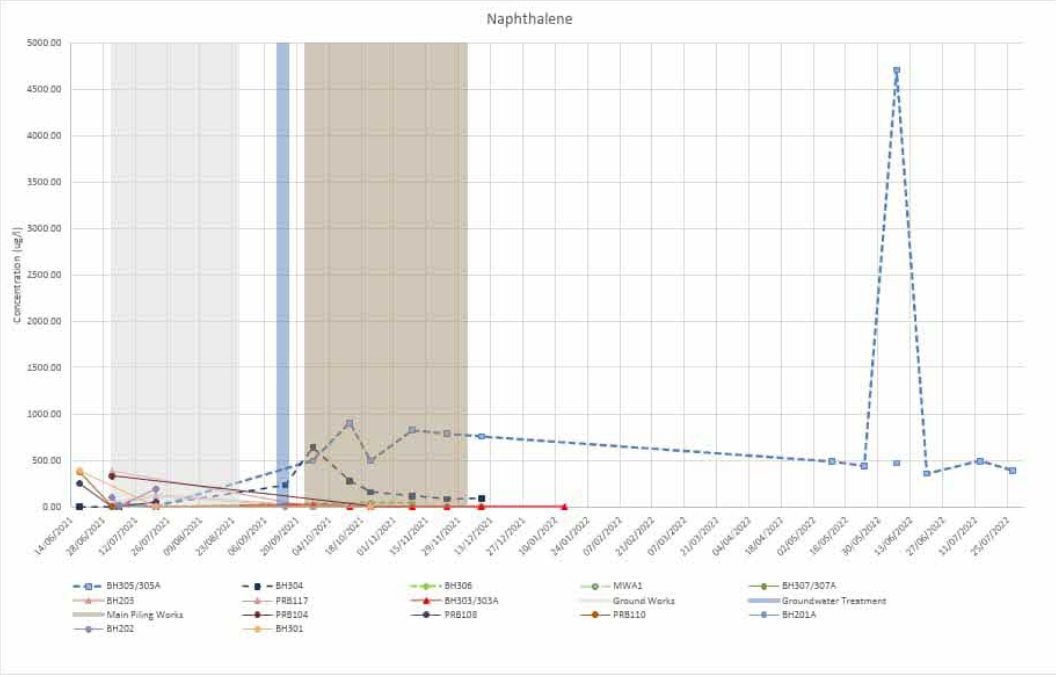


Figure 4.2 Naphthalene Concentrations



4.5.7 Ammoniacal nitrogen concentrations remain generally similar throughout the works in this part of the site.

4.5.8 In this area of the site, the piling works may have had a negative impact on groundwater quality, however, JNP Group consider that the increase in hydrocarbon contamination seen in the shallow groundwater is the result of the works being undertaken in winter, when some heavy infiltration events were recorded, and that this has flushed some residual hydrocarbon contamination through the shallow soils with possibly the more mobile benzene and naphthalene reaching the deep groundwater.

4.5.9 During the extended monitoring, the concentrations of naphthalene (and aromatic petroleum hydrocarbon fraction C_{10}-C_{12}) reduced to less than the agreed RTV of 686 µg/l. There was one exception to this, the sampling undertaken on 7th June 2022 recorded excessively high results for these two analytes, which compared to the other results were possible outliers. This is shown in the updated naphthalene graph given in Figure 4.2. During the monitoring no obvious odours or discolouration of the sample water was noted. Therefore, this result was not considered to be representative of the groundwater quality. Benzene concentrations also reduced during the extended monitoring, as did the other aromatic hydrocarbon fraction concentrations.

4.5.10 Following the completion of the extended groundwater monitoring, the results were submitted to the Environment Agency with the recommendation that groundwater concentrations were all acceptable and no further monitoring was required. The Environment Agency agreed with this conclusion. A copy of the relevant correspondence is included in Appendix G to this report.

North-west (down gradient boreholes)

Table 4.7: BH306/MWA1 and BH307/A Concentration Range Summary

North-west Corner (possible down gradient)		Pre-Piling Concentrations Range (µg/l)	During-Piling Concentrations Range (µg/l)
BH306 / MWA1 (Shallow)	Ammoniacal Nitrogen as N (mg/l)	0.18 -17	0.16 -3.3
	Total Phenols (monohydric)	<10-36	<10 – 11
	Naphthalene	0.46 – 2.48	<0.01 – 45.4
	Benzene	<1-22.569	<1 – 10
	Aliphatic C_{12}-C_{16}	<10 – 160	<10
	Aromatic C_{10}-C_{12}	<10-100	<10 – 130
	Aromatic C_{16}-C_{21}	<10-30 140	<10 – 160
BH307/A (Deep)	Ammoniacal Nitrogen as N (mg/l)	1.4	0.29 – 0.63
	Total Phenols (monohydric)	18-41	10-16
	Naphthalene	1.11 – 5.87	4.2<0.01 – 4.78
	Benzene	5 – 17.1	<1.0
	Aliphatic C_{12}-C_{16}	<10	<10
	Aromatic C_{10}-C_{12}	10 – 310	<10 – 10
	Aromatic C_{16}-C_{21}	<10 – 20	11 0– 45

4.5.11 From the above table and the trend graphs, the pre and during piling concentrations are generally a similar order of magnitude; the shallow groundwater showed a slight

improvement in some of the hydrocarbons, which could be linked to the treatment that was undertaken in the north-east area of the site. There is a slight increase seen in the aromatic fractions and naphthalene concentrations during piling; the naphthalene results are below the RTV of 686 µg/l. The ammoniacal nitrogen concentrations remain relatively similar throughout.

4.5.12 The deep groundwater results show no overall impact on groundwater quality as a result of piling.

4.5.13 Therefore, in this area, JNP Group do not consider that the piling works have adversely affected the underlying groundwater.

North-east (upgradient boreholes)

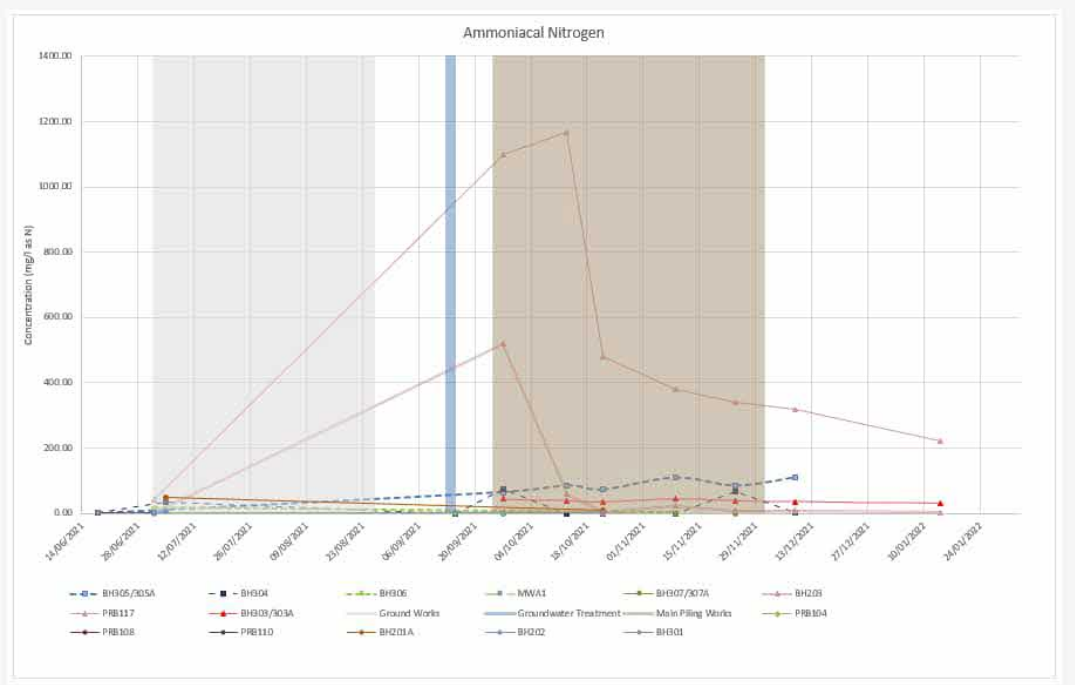
Table 4.8: BH203/PRB117 and BH303/A Concentration Range Summary

North-east Corner (down gradient)		Pre-Piling Concentrations Range (µg/l)	During-Piling Concentrations Range (µg/l)
BH203/ PRB117 (Shallow)	Ammoniacal Nitrogen as N (mg/l)	1.9 – 1100	3.1 -1167
	Total Phenols (monohydric)	<10 – 710	<10-13
	Naphthalene	<0.01 – 390	<0.01-5.86
	Benzene	<1 – 594	<1 – 10
	Aliphatic C_{12}-C_{16}	<10 – 3800	<10 – 680
	Aromatic C_{10}-C_{12}	<10 -1100	<10 -80
	Aromatic C_{16}-C_{21}	<10 – 430	<10
BH303/A (deep)	Ammoniacal Nitrogen as N (mg/l)	44	30- 45.8
	Total Phenols (monohydric)	<10 – 130	<10 – 12
	Naphthalene	3.22 – 37.4	<0.01 – 3.22
	Benzene	<1 – 14.2	<1 – 7.711
	Aliphatic C_{12}-C_{16}	<10	<10
	Aromatic C_{10}-C_{12}	26 -71	<10
	Aromatic C_{16}-C_{21}	<10-100	<10

4.5.14 From the above table and the trend graphs, the hydrocarbon concentrations within the shallow groundwater and deep groundwater have decreased during piling, compared to the pre-piling concentrations, most likely as a result of the treatment undertaken in this area.

4.5.15 The ammoniacal nitrogen concentrations spike at the beginning of the piling works and then reduce significantly and continue to reduce. The concentrations in the shallow groundwater remain elevated compared to drinking water standards of 0.39 mg/l (as N). The ammoniacal nitrogen concentrations are an order of magnitude better in the deep groundwater compared to the south of the site. The objective of the groundwater treatment was to treat hydrocarbons and was unlikely to reduce ammoniacal nitrogen. In addition, as there was a lot of open excavation and disturbance of ground in this area, it is considered likely that this along heavy periods of rainfall flushed the ammoniacal nitrogen through the soil and into the surrounding groundwater.

Figure 4.4 Ammoniacal Nitrogen Concentrations



4.5.16 Therefore, in this area of the site, JNP Group consider that the piling works have not resulted in any significant deterioration in groundwater quality across the site.

4.5.17 By way of comparison, and to demonstrate an overall improvement to the groundwater quality at the site, the groundwater results from 2019 JNP Group Ground Investigation (as reported M41977 RE005 Rev B Combined Ground Investigations Report, dated 18 July 2019) for the same contaminants are summarised below.

Table 4.9: JNP Group Ground Investigation 2019 Groundwater Summary Maximum Results

Contaminant	Shallow Groundwater (µg/l)	Deep Groundwater (µg/l)
Ammoniacal Nitrogen as N mg/l	150	130
Total Phenols (monohydric)	4700	4500
Naphthalene	9110	2360
Benzene	3290	2720
Aliphatic C_{12}-C_{16}	1900	<10
Aromatic C_{10}-C_{12}	1900	11000
Aromatic C_{16}-C_{21}	6400	4000

4.5.18 The hydrocarbon concentrations during piling and post treatment, and post piling show a considerable reduction across the site. Compared to the results given above. Ammoniacal nitrogen concentrations are reduced in the deeper groundwater and are generally similar in the shallow groundwater.

4.5.19 Therefore, taking all the above results into consideration, JNP Group's overall conclusion is that the piling works have not significantly impacted on groundwater quality, and that the remediation works undertaken at the site, via source removal, soil treatment and

groundwater treatment have combined to significantly improve the underlying groundwater quality at the site.

4.5.20 All monitoring boreholes have since been decommissioned by the Principal Contractor; the boreholes were removed and replaced with appropriate fill.

4.6 Gas Assessment Verification

4.6.1 Following the completion of the gas monitoring, an updated gas assessment was undertaken. In summary, there was no flow or methane recorded at the site. Maximum carbon dioxide concentrations ranged between 5.8-7.7 % v/v. The calculated maximum gas volumes were two orders of magnitude lower than the cut off value of 0.7 l/hr for a very low risk of off-site gas generation (as given in BS84850), hence, JNP Group concluded that, whilst the CS2 protection requirements on site remain, a gas vent trench is not required to be installed along the residential site boundaries. Further details of the gas assessment undertaken are given in the JNP Group Technical Note included in Appendix K to this report.

4.6.2 The JNP Group Technical Note was issued to Michael McNaughton, the EPO for RBWMC, on 23rd February 2022 and he responded on 14th March 2022 with agreement that a gas vent trench was not required. A copy of this correspondence is included in Appendix G to this report.

4.7 Duty of Care (Off-site Removal)

4.7.1 Dunton kept a record of all material exported from site, a copy of this is included in Dunton's Remediation Summary Letter as Appendix C.

4.7.2 All contaminated soils designated for off-site removal were hauled by S Walsh and Son Ltd. Their registered address is East Hordon Hall Business Park, Tilbury Road, Brentwood Essex. CM13 3LR [Registered Waste Carriers and Brokers Licence CBDU93666].

4.7.3 Hazardous waste was taken to the waste facility operated by Mick George Ltd at their Mepal Soil and Waste Treatment Centre, at Witcham Meadland Landfill Site, Block Fen Drove, Mepal, Chatteris, Cambridgeshire CB6 2AY [Environmental Permit reference EPR/EP3492SP].

4.7.4 Copies of the consignment notes (hazardous waste), waste transfer notes (non-hazardous wastes) and the weighbridge tickets are included in Dunton's Remediation Summary Letter as Appendix C.

4.7.5 Non-hazardous waste was taken to the waste facility operated by DB Cargo Ltd at Barking Eurohub, Box Lane, Barking IG11 0SQ [Environment Permit reference: EPR/CGB3003GR].

4.7.6 Scrap plastic was taken by Moulding Solutions Ltd to their facility at Wharf Road, Kilnhhurst, South Yorkshire S64 5SY [Waste License Ref WEX001814 Exemption Codes: S2, T1, T4, U9. Waste Carried Registration No. CB/SM36838NK.R003]. A copy of the waste transfer note is included in Dunton's Remediation Summary Letter as Appendix C.

4.7.7 Surplus concrete and inert arisings (from the piling) were taken to the Thames Materials' Ltd facility at Skip Lane, Harefield, Uxbridge, Middlesex UB9 6RP. [Environmental Permit EPR/BB3 709TU/A001 and Waste carriers licence CB/DU113556]. Copies of the waste transfer notes and weighbridge tickets are included in Dunton's Remediation Summary Letter as Appendix C.

4.7.8 Copies of the Environmental Permits for Mick George Ltd, DB Cargo, S Walsh, Thames Material and Moulding Solutions Ltd are included in Appendix J to this report.

4.7.9 JNP Group consider that the correct duty of care procedures undertaken by Dunton complied with the general requirements as outlined in the Validation Plan within the JNP Group OARS Report (M41977 RE003 Rev G Options Appraisal and Remediation Strategy).

4.8 Environmental Monitoring

4.8.1 The results from all the environmental monitoring undertaken are included in Dunton's Remediation Summary Letter as Appendix E. Where the monitoring results were obtained instantly, Dunton reacted to the results and adjusted the mitigation measures to suit. Of note;: the asbestos results were all recorded at <0.001 f/cm^3 , which is below clearance indicator (0.01 f/cm^3); the dust deposition results were generally below 200 mg/m^2/day (industry accepted nuisance trigger value), except for two dates (October and December 2021) when the southern boundary monitor recorded results that exceeded this; the results from the Tenax tubes were generally recorded at less than the limit of detection (<0.0001 mg/m^3) with occasional naphthalene recorded. A maximum of 0.6 mg/m^3, the PID results for, the daily monitoring recorded a level 1 (i.e. <1 ppm), however, throughout the works until November 2021, monitoring point 3 (located along the southern boundary) recorded a level 2 throughout, hence mitigation measures were employed.

4.8.2 In addition, the EPO from RBWM had visited the site and was satisfied with the work being undertaken at the site.

4.8.3 JNP Group consider that the environmental monitoring undertaken by Dunton complied with the general requirements as outlined in the Validation Plan within the JNP Group OARS Report (M41977 RE003 Rev G Options Appraisal and Remediation Strategy). Daily monitoring was undertaken and the necessary mitigation measures such as damping down and odour suppressions system were utilised on site, as seen by JNP Group during their site visits.

4.9 Capping Layer Verification

4.9.1 The capping layer placed in all gardens, open space and landscaped areas comprised topsoil and subsoil sourced from another Berkeley Homes operated site (Warfield) following DoWCoP. In all locations, the subsoil was placed onto an orange geotextile membrane (Alert).

4.9.2 During the validation visits, JNP Group excavated shallow hand excavated pits to view the geotextile, measure the depth of topsoil and subsoil and take the necessary soil samples. JNP Group drawing M41977-JNP-XX-XX-DR-G-0508 P01 shows the locations of all the hand excavated pits and highlights those where soil samples were taken across the whole site.

4.9.3 Generally, the topsoil comprised dark brown slightly gravelly sandy clay and the subsoil comprised orangish brown slightly gravelly, and in some cases slightly silty, fine and medium SAND subsoil. Both the topsoil and subsoil were free from the presence of deleterious materials.

4.9.4 Due to a short fall in material from Warfield, Plots 75 and 75 in Block L received clean, imported topsoil supplied from Potters Bar. Testing certificates were issued to JNP Group demonstrating that this material was suitable for placement. Copies of these testing certificates are included in Appendix D.

4.9.5 The topsoil sourced from Potters Bar comprised brown to grey topsoil that was free of deleterious materials.

4.9.6 A total of fifty soil samples were taken from randomly selected front and back gardens, either from topsoil or subsoil and were scheduled for a testing suite comprising asbestos, heavy metals, polycyclic aromatic hydrocarbons, aliphatic-aromatic petroleum hydrocarbons, pH and soil organic matter.

4.9.7 Samples were collected in appropriate jars and were either transferred on the day of testing to the i2 testing laboratory (UKAS and MCERTS accredited) in Watford or collected the next day. Due to unexpected logistical reasons, the four samples taken from Block E on 6th June 2023, were submitted to Chemtest Eurofins (UKAS and MCERTS accredited) for testing.

4.9.8 The table that follows summarises the verification undertaken and the findings.

Table 4.10: Capping Layer Verification

Location	Date(s) Verified	Source	Samples taken	Capping Layer Thickness	Geotextile Membrane Present
Public Open Space Area	10/11/22	Warfield	1 topsoil 1 subsoil	0.7 m	Yes
Block A	10/10/22 & 10/11/22		Front: 1 topsoil & 1 subsoil Rear: 1 topsoil & 1 subsoil	Front: 0.8 m Rear: 0.5-0.9 m	Yes
Block B	20/02/23 & 09/03/23		Rear: 2 topsoil & 2 subsoil	Front: 0.6 – 0.7 m Rear: 0.6 m	Yes
Block C (Apartments)	11/12/23		Landscaping: 1 topsoil	0.3 m	Yes
Block D	09/03/23 & 12/04/23		Front: 2 topsoil & 2 subsoil Rear: 2 topsoil & 2 subsoil	Front: 0.6 m Rear: 0.6-0.7 m	Yes
Block E	02/06/23 & 07/07/23		Front: 1 topsoil & 2 subsoil Rear: 1 topsoil & 1 subsoil	Front: 0.6 – 0.65 m Rear: 0.6 – 0.65 m	Yes
Block F	07/07/23 & 27/10/23		Front: 1 topsoil & 2 subsoil Rear: 1 topsoil & 1 subsoil	Front: 0.55 – 0.6 m Rear: 0.55 m	Yes
Block G	29/11/23		Front: 1 topsoil & 1 subsoil Rear:1 topsoil & 1 subsoil	Front: 0.45 – 0.55 m Rear: 0.65 – 0.7 m	Yes
Block H (Apartments)	29/11/23		Landscaping: 1 topsoil	0.4 m	Yes
Block I	29/11/23		Front: 1 topsoil Rear: 1 topsoil & 1 subsoil	Front: 0.45 - 0.6 m Rear: 0.65 – 0.8 m	Yes
Block J	07/07/23		Front: 4 topsoil & 1 subsoil Rear: 1 topsoil & 4 subsoil	Front: 0.45 – 0.6 m Rear: 0.65 – 0.8 m Root Protection Zone: 0.4 m	Yes
Block K					
Block L	20/01/23	Potters Bar and Warfield	Front: 1 topsoil & 1 subsoil	Front: 0.45 – 0.65 m Rear: 0.6 – 0.7 m	Yes

4.9.9 From the above table it can be seen that in general the capping layer thickness meets with the requirements of the agreed Remediation Strategy (M41977 RE003 Rev G Options Appraisal and Remediation Strategy): 0.6 m in areas of public open space, 0.6 m in front and rear gardens, 0.3 m in landscaping areas and 0.15 m in root protection zone. Where shortfalls were encountered, the following should be noted:

The root protection zone extended into the rear gardens of Block K affecting the full depth of capping layer in the rear garden. As the full depth of 0.6 m could not be achieved, it was agreed with the EHO (refer to section 3.2.3) for the capping thickness to be as deep as possible in this area.

Shortfall in depth is likely to be as a result of some settlement and slight variations in ground levels. Measurements do not take into account placement of bark chippings or turf.

4.9.10 The chemical testing results confirmed there were no elevated concentrations of any of the analytes when compared to the imported fill criteria given in the Remediation Strategy. Copies of the chemical testing certificates are given in Appendix I to this report.

4.9.11 Therefore, JNP Group consider that the soil quality and make up (thickness and geotextile) of the capping layer is suitable in all locations and complies with the general requirements of the agreed Remediation Strategy (M41977 RE003 Rev G Options Appraisal and Remediation Strategy).

4.10 Gas Protection Measures Verification

4.10.1 A 150 mm beam and block void was used in the construction of the dwellings, which is sufficient as a good performance floor void.

4.10.2 Visqueen HC Block gas membranes, which are hydrocarbon resistant, were installed in all dwellings and garages by UK Membranes. The installation work was verified by MEC Environmental Ltd on a plot by plot basis and was found to be in order: the membranes were installed by qualified installers, photographs of the installation were taken and integrity testing was undertaken. This is detailed in their Verification Report, a copy of which is included in Appendix L to this report.

4.10.3 Therefore, based on the above, JNP Group consider that the gas protection measures have been installed in accordance with the requirements of agreed Remediation Strategy (M41977 RE003 Rev G Options Appraisal and Remediation Strategy).

5 FINAL SITE CONDITIONS

5.1 Work Undertaken

5.1.1 Based upon the remediation work undertaken, as seen by JNP Group during the site visits and the results of the chemical validation testing, JNP Group consider that the site has been remediated in accordance with the requirements of the agreed JNP Group Remediation Strategy (as detailed in JNP Group Report M41977 RE003 Rev G Options Appraisal and Remediation Strategy).

5.1.2 The three deviations to the agreed Remediation Strategy were managed appropriately and have been suitably validated and verified in this report.

5.1.3 The following work has been undertaken by Dunton and validated by Dunton and / or JNP Group:

- Surface scrape;
- Installation of groundwater and gas monitoring boreholes;
- Demolition of former cottages and validation of the underlying ground;
- Excavation of hot spot excavations;
- Successful bioremediation of contaminated soils arising from hot spot excavations and unexpected contamination;
- Re-placement of treated contaminated soils in their area of origin;
- Removal of hazardous and non-hazardous waste following the correct duty of care procedures;
- In-situ groundwater remediation and validation to show acceptable concentrations of naphthalene in the shallow aquifer and a betterment in the underlying deep groundwater;
- The imported 6F5 material imported on to site was suitably validated and deemed as acceptable for use the under the capping layer;
- Decommissioning of groundwater boreholes;
- Pre, during and post piling works groundwater monitoring and assessment;
- Post works gas monitoring and off-site gas migration risk assessment;
- Provision of environmental monitoring and mitigation measures were employed on site.

5.1.4 The following works were undertaken by Berkeley Homes and validated by MEC Environmental or JNP Group:

- Verification of the gas protection measures;
- Capping layer validation (including provision of geotextile and subsoil / topsoil chemical testing).

5.1.5 The site is therefore considered to be suitably remediated and validated and suitable for its' residential end use.

5.2 Recommendations

5.2.1 JNP Group recommend that a copy of this report be submitted to the RBWMC and EA to ensure that they satisfied with the remediation works undertaken and the subsequent validation work undertaken.

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Figures / Drawings

Figure 1

Site Location Plan

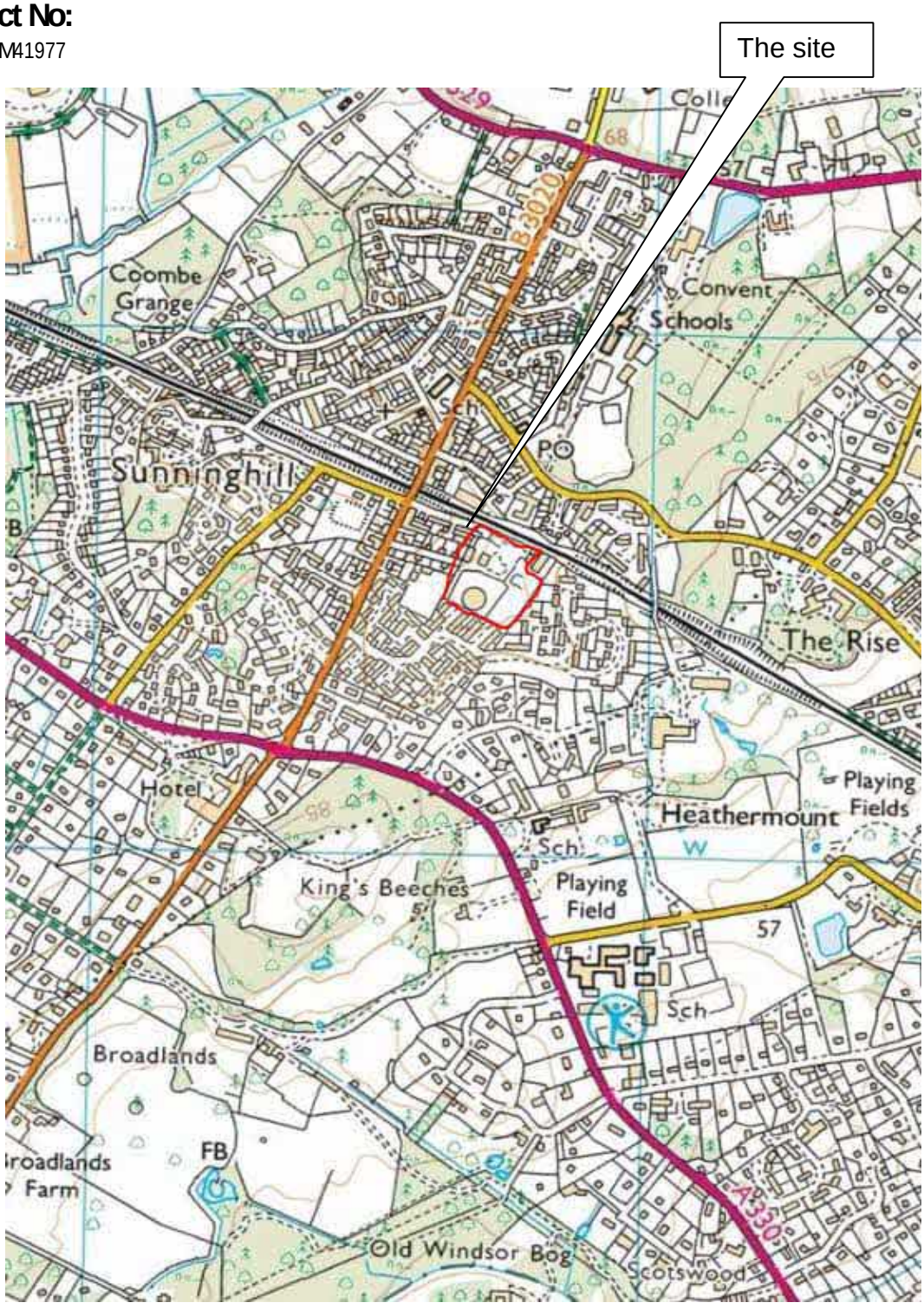
john newton & partners
jnpgroup
Consulting Engineers

Project:

Bridge Road, Sunninghill, Ascot

Project No:

M41977



Rev:	Date:	Amendment:	Initial:
C1	12.07.19	**CONSTRUCTION ISSUE**	KWS
C2	16.09.19	garage S5 added for boiler condensate	KWS
C3	27.02.20	coordinated with landscape drawing	RBH
C4	27.04.21	site plan updated in accordance with BHOC updated house layouts.	KWS

0 8 16m
1:200

SITE LEGEND

- Site Boundary
- 01 Plot Number
- 5BH1 Dwelling Type
- Allocated parking:
  - P01-P76 - Allocated parking (number refers to associated plot)
  - V - Visitor parking spaces
  - BRP - Bridge Road parking spaces
  - PRS - Pressure Reduction Station parking spaces
  - P01
- Timber Bin Storage Structure approx. size - 900 x 2175mm
- Bin Storage Area, consisting of:
  - 180 litre black bin - non-recyclable waste
  - 240 litre blue bin - mixed recyclable waste
  - 240 litre green bin - garden waste (subscription)
  - 23 litre brown caddy - food waste
- Bin Collection Point
- Rainwater Pipe
- Soil and Vent Pipe
- Stub Stack
- Floor Gulley
- Floor Socket
- Future shower connection (within ground floor finishes), to be sealed below F.F.L.
- Proprietary solid wall underfloor gas ventilation outlet, with associated venting pipework (Visqueen Pro Gas Vent Box, or similar approved), connected to surface water drainage system, in accordance with manufacturer's approved details
- Gas intake position, within ground mounted Unibox, with gas meter, in accordance with M&E consultant's design & specification
- Gas intake position, within recessed wall mounted box, with gas meter, in accordance with M&E consultant's design & specification
- Boiler positions
  - Houses: typically located within garages, or on upper floors where not shown.
  - Apartments: within utility cupboard.
- Lamp Post
- Bollard Lamp
- Rainwater Butt, 200 litres min.

St William
Designed for life

CONSTRUCTION

CHBC Architecture
32 High Street, Ingatestone, Essex CM4 9EE
Telephone : 01277 355007

Suite 4, Newmarket House, Fordham Rd, Snailwell, CB8 7NB. Telephone : 01638 663838

Client:
St William Homes LLP

Project:
FORMER GAS WORKS,
BRIDGE ROAD,
SUNNINGHILL, BERKSHIRE

Drawing:
EXTERNAL WORKS : SITE PLAN

SHEET ONE OF TWO

Scale:	Date:	Drawn:	Check:
1:200@A0	APRIL 2019	SLB	KWS

Drawing No: W404-CHBC-SW-XX-DR-A-0001 Rev: C4

Rev:	Date:	Amendment:	Initial:
C1	12.07.19	**CONSTRUCTION ISSUE**	KWS
C2	27.02.20	coordinated with landscape drawing	RBH
C3	27.04.21	site plan updated in accordance with BHOC updated house layouts.	KWS

0 8 16m
1:200

SITE LEGEND

- Site Boundary
- 01 — Plot Number
- 5BH1 — Dwelling Type
- P01 — Allocated parking:
  - P01-P76 -Allocated parking (number refers to associated plot)
  - V -Visitor parking spaces
  - BRP - Bridge Road parking spaces
  - PRS - Pressure Reduction Station parking space
- Timber Bin Storage Structure approx. size - 900 x 2175mm
- Bin Storage Area, consisting of:
  180 litre black bin - non-recyclable waste
  240 litre blue bin - mixed recyclable waste
  240 litre green bin - garden waste (subscription)
  23 litre brown caddy - food waste
- Bin Collection Point
- RP — Rainwater Pipe
- SP — Soil and Vent Pipe
- SS — Stub Stack
- FG — Floor Gulley
- FS — Floor Socket
- SC — Future shower connection (within ground floor finishes), to be sealed below F.F.L.
- GVB — Proprietary solid wall underfloor gas ventilation outlet, with associated venting pipework (Visqueen Pro Gas Vent Box, or similar approved), connected to surface water drainage system, in accordance with manufacturer's approved details.
- G — Gas intake position, within ground mounted Unibox, with gas meter, in accordance with M&E consultant's design & specification
- G — Gas intake position, within recessed wall mounted box, with gas meter, in accordance with M&E consultant's design & specification
- Boiler positions
  Houses: typically located within garages, or on upper floors where not shown.
  Apartments: within utility cupboard.
- LP — Lamp Post
- BL — Bollard Lamp
- W — Rainwater Butt, 200 litres min.

BRIDGE ROAD

Garden wall

P10 P06 P08 P08

06 07 09 11 12

3BH1-A 4BH8-B G07 G09 2BHOG1 08 4BH8-B 3BH1-A 3BH1-A 4BH8-B G12

garage garage garage

BRP BRP BRP BRP BRP BRP BRP BRP BRP BRP BRP

St William
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CONSTRUCTION

CHBC Architecture
32 High Street, Ingatestone, Essex CM4 9EE
Telephone : 01277 355007
Suite 4, Newmarket House, Fordham Rd, Snailwell, CB8 7NB. Telephone : 01638 663838

Client:
St William Homes LLP

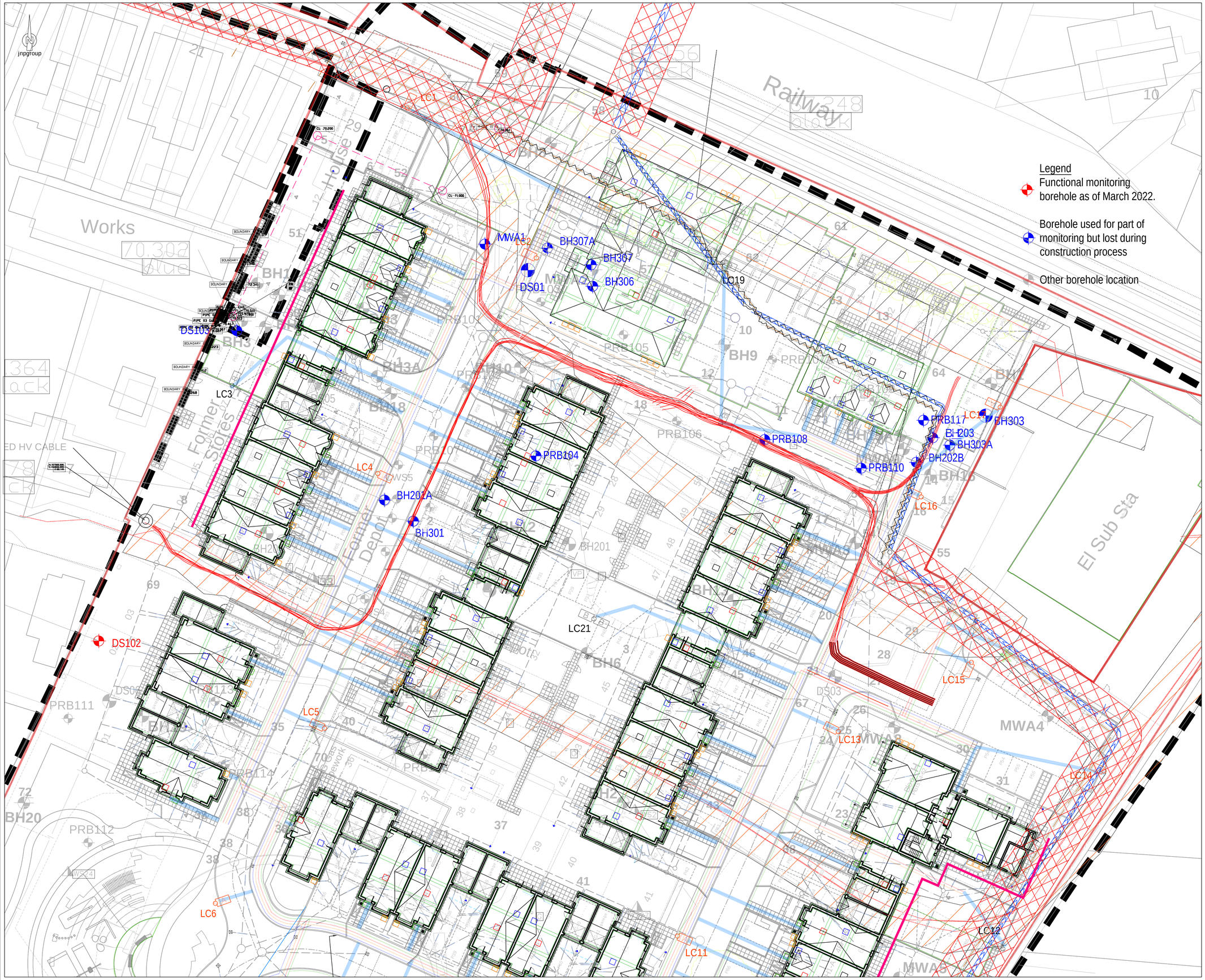
Project:
FORMER GAS WORKS,
BRIDGE ROAD,
SUNNINGHILL, BERKSHIRE

Drawing:
EXTERNAL WORKS : SITE PLAN

SHEET TWO OF TWO

Scale:	Date:	Drawn:	Check:
1:200@A1	APRIL 2019	SLB	KWS

Drawing No: W404-CHBC-SW-XX-DR-A-0002 Rev: C3



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Health & Safety Note

The details on this drawing have been prepared on the assumption that a competent contractor will be carrying out the works. If the contractor(s) considers that there is insufficient Health and Safety information on this drawing, this should immediately be brought to the attention of the designer.

HAZARD IDENTIFICATION BOX			
This table is provided to assist the Principal Contractor to fulfil their obligations under the CDM Regulations 2015			
Hazard Ref	Hazard Type (Construction/Maintenance/ Cleaning/Demolition/Adaptation)	Hazard Description	Mitigation Measures/ Residual Risk
1			

Rev.	Date	Description	Drn / Chk'd / App'd

Suitability: S2 - Suitable for Information

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Chesham ● Brighouse ● Glasgow ● Hartlepool
Leamington Spa ● Sheffield
www.jnpgroup.co.uk

Client: Berkeley Homes

Job: Sunninghill Gasworks

Title: Location plan - Monitoring points (North)

Classification: FI_60_20

Scale @ A1: 1:250

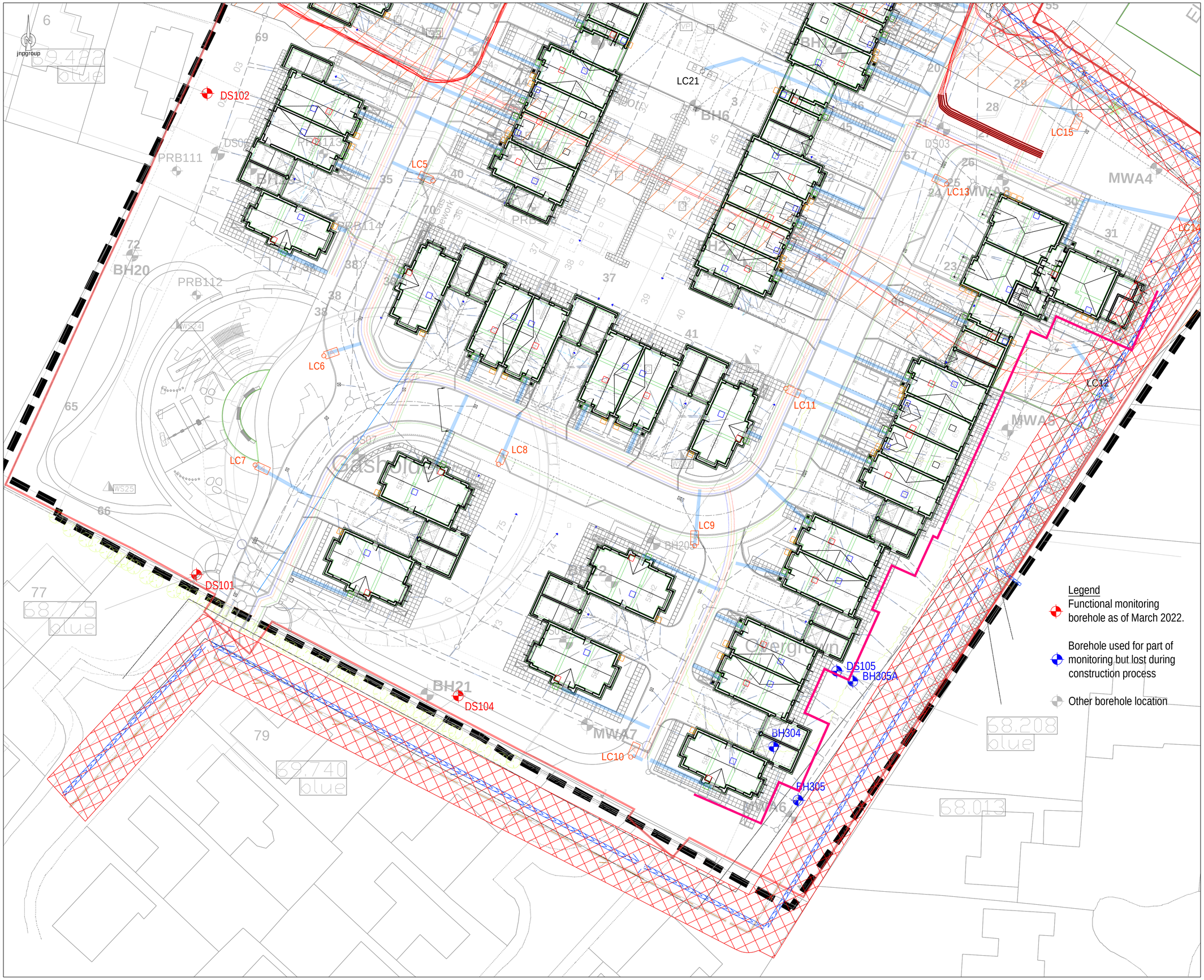
Project - Originator - Volume/System - Level/Location - Type - Discipline - Number: M41977 - JNP - XX - ZZ - DR - C - 0328

Revision: P05

Document/Drawing Number

Complies to ISO17025:2005 JNP QA Ref: QB10 Iss F

JNP Group Internal Project Number: M0977



Legend

Functional monitoring borehole as of March 2022.

Borehole used for part of monitoring but lost during construction process

Other borehole location

General Notes

1. Where this drawing has been issued in electronic .dwg format it has been done so in good faith. JNP Group do not take any responsibility for any inaccuracies in the electronic data, which should be checked against the paper (or .pdf) drawing issue. Any apparent discrepancies should be immediately reported to JNP Group. The electronic .dwg file should not be assumed to be to scale and should not be used for 'overlaying', setting out or checking of any third party information. All dimensions should be taken from the paper (or .pdf) version of the drawing. Electronic drawings may contain third party information. JNP Group take no responsibility for this information, which should be checked against the originators paper drawing(s).
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3. Do not scale from this drawing.
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HAZARD IDENTIFICATION BOX

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Hazard Ref	Hazard Type (Construction/Maintenance/ Cleaning/Demolition/Adaptation)	Hazard Description	Mitigation Measures/ Residual Risk
1			

Rev	Date	Description	Drn / Chk'd / App'd

Suitability: S2 - Suitable for Information

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Client: Berkeley Homes

Job: Sunninghill Gasworks

Title: Location plan - Monitoring points (South)

Classification: FI_60_20

Scale @ A1: 1:250

Project - Originator - Volume/System - Level/Location - Type - Discipline - Number: M41977 - JNP - XX-ZZ- DR-C-0329

Revision: P03

Document/Drawing Number

JNP Group Internal Project Number: M41977

Complies to ISO17100:2004 JNP QA Ref: QB03/Rev F