



CALA Homes (South Homes Counties) Limited

Former West End Nursery, Roundstone Lane, Angmering, BN16 4AX

Post Remediation Validation Report – Phase 1B

27621-R09 (00)

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RSK GENERAL NOTES

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1 INTRODUCTION

RSK Environment Limited (RSK) was commissioned by CALA Homes (South Home Counties) Limited, hereafter known as the client, to produce a post remediation validation report for Phase 1B (Plots 65 to 121) of the land at the former West End Nursery, Angmering, BN16 4AX.

This report is subject to the RSK service constraints given in **Appendix A**.

1.1 Background

This report details remedial and validation works carried out within the Phase 1B development area, as well as across the wider site.

Validation of the soft landscaping and garden areas within Phase 1B (Plots 65 to 121) is still ongoing, the results of which will be reported to the National House Building Council (NHBC) and the Local Authority as plots are completed.

Several preceding phases of site investigation and associated risk assessments have been completed for the site by RSK. These are outlined in the following reports:

- RSK, 2015a. Geo-environmental Site Investigation, report ref: 27621 R01 (02), dated September 2015;
- RSK, 2015b. Additional Geo-environmental Site Investigation and Remediation, report ref: 27621 R02 (00), dated June 2015;
- RSK, 2016a. Remedial Strategy, report ref: 27621 R03 (01), dated January 2016;
- RSK, 2016b. Supplementary Geo-environmental Site Assessment, report ref: 27621 R04 (01), dated June 2016;
- RSK 2016c. Tank Validation, report ref: 27621 L01/ad, dated August 2016;
- RSK 2016d. Bund Validation Works, report ref: 27621 L02, dated October 2016;
- RSK 2016e. Asbestos Delineation Works Phase 1A – Plots 1 to 19, report ref: 27621 L04, dated October 2016;
- RSK, 2017a. Asbestos Delineation Works Phase 1A – Plots 18 and 20 to 64, report ref: 27621 L05, dated February 2017;
- RSK 2017b. Phase 1B Asbestos Delineation Works (Plots 65 to 121) and Historic Boiler House Validation Works, report ref: 27621-L08-eh, July 2017;
- RSK 2017c. Downgrading of ground gas regime, report ref: 27621-L19-dbj, November 2017;
- RSK 2017d. Post-remediation validation report – Phase 1A, report ref: 27621 R06 (00), May 2017. and
- RSK 2018a. Supplementary site investigation and remedial strategy – south east landscaped areas, report ref: 27621-R08 (00), January 2018.

It is noted that the remedial strategy report (RSK 2016a) was updated and reissued to the client in August 2017 under reference 27621-R03 (02), to reflect changes in the

topsoil to subsoil ratio agreed verbally with the Local Authority since issue of this report in January 2016, following conveyance queries on this matter.

Further to the above, Keltbray Remediation, carried out the first phase of remedial works at the site in accordance with recommendations contained within the RSK Remedial Strategy (report ref: 27621-R03 (01), January 2016). RSK attended site on an ad hoc basis during Keltbray's first phase of works to provide advice on delineation, waste disposal and to carry out validation when required. The remedial works undertaken by Keltbray were documented in a Completion Report, (report ref: 6033.CR.LH.08072016V3, dated August 2016). It is understood that this report has been submitted to the Local Authority and therefore has not been appended to this report.

The salient findings of the aforementioned works relevant to Phase 1B are included within the following report. However, the report should be read in conjunction with the previous reports listed above, some of those that have direct relevance to Phase 1B are included in **Appendix B** for ease of reference.

1.2 Objectives

The objective of the remediation is to produce a site that is suitable for its intended purposes (residential end use with private gardens and communal soft landscaping) whilst providing a safe working environment with respect to site workers and adjacent users. This will involve the following measures:

- The placement of a suitable clean cover layer within any private gardens and proposed communal soft landscaped areas, locally deepened (to the requirements of the Landscape Architect) in the proximity of any proposed deep root-balled shrubs and/or trees in order to break potential contamination pathways with respect to the underlying made ground;
- Following decommissioning and demolition of the CHP building, nitric acid store, substations and above ground storage tanks (ASTs), in the event that any visually impacted materials are observed, an Environmental Engineer be contacted so that appropriate sampling can be implemented to determine any additional remedial and validation requirements;
- Regrading of bund materials (where required) to form site levels, in accordance with the approved development plan; and to facilitate placement of a 'clean' cover layer across the remaining bund materials. Where possible material won as part of the re-grading exercise will be re-used on site in accordance with a materials management plan following the CL:AIRE Code of Practice;
- Incorporation of gas protection measures within the proposed buildings: structural barrier comprising suspended or ground bearing floor slab with appropriate ventilation and a gas resistant membrane, sealed at all joints and penetrations (please note following further assessment as detailed in **Section 1.5.2.2** gas protection measures are no longer required across the site); and
- Compliance with CAR 2012, through the adoption of safe working procedures with respect to the potential presence of asbestos containing materials (ACM) and notification to the HSE.

The objective of this report is to demonstrate that the remedial objectives listed above have been achieved for Phase 1B and that this area of the site is suitable for its intended purposes by:

- Providing a record of validation sampling undertaken post demolition/site clearance, confirming suitability of remaining materials in Phase 1B for the proposed end use (residential); and
- Production of a post-remediation validation report recording all actions taken to implement the remedial works carried out to date: To confirm that remediation goals set out in the remedial strategy report (RSK ref: 27621 R03 (01), January 2016) have been achieved in Phase 1B and identify further works, if necessary.

1.3 Existing Conditions

The site is situated off Roundstone Lane, Angmering, BN16 4AX. The National Grid reference for the site is 507640, 103520 as shown on **Figure 1**. The site covers approximately 11 ha at an elevation of approximately 11 m above Ordnance Datum (AOD) with the exception that along the eastern and western boundaries, there are bunds that rise up above general site level.

The site is currently an active construction site, with the area known as Phase 1B containing Plots 65 to 121. All of the aforementioned plots have been founded and are currently being constructed. A capping layer of subsoil underlain by geo marker membrane acting as a physical break layer has been placed throughout the entire area of Phase 1B. Topsoil has not yet been placed and as a result validation testing has not yet been undertaken.

Historically the site was arable land up until the construction of West End Nursery circa 1943. The nursery was extended during the 1970's towards the eastern part of the site with the construction of greenhouses.

Redevelopment of the site occurred from the 1990's, with the addition of smaller greenhouse's to the south. Also present from the 1990's were ASTs, a gas governor and laboratory in the south west of the site and a drainage pond in the south east. The laboratory was no longer present on mapping data between 2012 and 2014.

It is understood that the site as a whole is being redeveloped with 244 residential plots comprising a mixture of housing and flats, with private and communal gardens and some areas of communal soft landscaping. The phased development plan for the entire site and Phase 1B are shown within **Figures 2** and **3** respectively.

1.4 Regulatory Correspondence

As part of regulatory consultation process, the client forwarded all reports pertaining to the site to the relevant regulators for review and comment.

Subsequently the remedial strategy for the site was agreed with the Pollution Officer at Arun District Council.

Since agreement of the remedial strategy the following items, which deviate from the agreed remedial strategy or, are additional to the remedial strategy have been discussed and agreed as specified with the Council:

- A cover layer validation sampling frequency of one sample per 250 m³ in public open space areas has been agreed rather than one sample per 50 m³;

- Topsoil thickness of 150 mm has been agreed as acceptable rather than 300 mm, subject to the overall capping layer thickness of subsoil and topsoil remaining 600 mm in higher risk areas and 450 mm in lower risk areas;
- Prevention of public access to the south west bund by fencing and planting of prickly vegetation to deter trespassers has been agreed. Photographic evidence confirming these measures have been incorporated shall be included in the verification report for this area of the site;
- A hotspot of ACM of similar composition to materials encountered in other areas of the site was identified in Phase 1B. In accordance with the remedial strategy the client informed Keltbray and RSK of the discovery. Keltbray subsequently removed the impacted materials in accordance with their previously agreed method statements and existing Health and Safety Executive (HSE) licence. The materials were temporarily stored in their designated treatment area (at the time of reporting) in the centre of the site. RSK discussed the discovery with the Pollution Officer at Arun District Council 12th April 2017. Following verbal agreement from the Local Authority, RSK attended site on the 12th April 2017 to screen the removed materials for volatiles using a photo-ionisation detector (PID) prior to placement in the central public open space (POS) area. These works were reported in the Phase 1A post-remediation validation report (RSK 2017d), issued to and approved by Arun District Council and as such are not discussed further in this report;
- Following queries raised by the NHBC regarding the gas membrane design submitted for the site, further gas assessment has been undertaken, as detailed in **Section 1.5.2.2**. Based on the results of the further assessment, subject to no new sources of ground gas generating material being identified during the remaining works, it has been agreed with the Local Authority and NHBC that gas protection measures are no longer required.

Email correspondence between RSK and Arun District Council in regards to bullet points 1, 3 and 5 above are presented in **Appendix C**.

1.5 Method Statement for Remediation of Contaminated Ground

The strategies proposed for the remedial works was based upon previous site investigations findings. Previous investigations found evidence for ACM in trial pits TP1 to TP9 (all excavated through the bund materials) and within boreholes BH1, BH4, BH12 and BH15 during the initial ground investigation. Elevated concentrations of hydrocarbons and metals were also identified within bund materials. On this basis, a potentially complete pollutant linkage was identified to human health (construction workers and future residents) from asbestos in soil and elevated concentrations of hydrocarbons and metals.

1.5.1 Implementation

The overall remediation strategy for the site as a whole (RSK report ref: 27621 R03 (02) was divided into the enabling and demolition phase, i.e. those works required to produce a suitable development platform, and the subsequent construction phase.

The sequence of works required under both phases is outlined in the following sections relating to the proposed demolition sequence and the subsequent construction works.

- Before commencing demolition works of the remaining buildings, an asbestos survey suitable for demolition purposes should be undertaken to confirm the presence or absence of ACM within all structures. Where ACM is encountered removal by an appropriately licensed contractor should undertake works before commencing demolition works. The demolition works were the responsibility of the vendor prior to handover of the site to our client. As such, no further details are available in regards to whether or not this was completed prior to demolition of the buildings.
- With regards to the removal of the ASTs and substations, live services to these features would need to be isolated/disconnected before removal. In addition the contents of any ASTs and associated pipework should be purged of their liquid contents. The liquid shall be tankered off-site for appropriate disposal by a licensed waste disposal contractor.
- The existing ASTs, substations and associated pipework, underlying concrete and brick, should be removed under the supervision of a suitably qualified geo-environmental engineer and disposed off-site. Validation of the soils underlying these features, in relation to potential contamination, should be completed at the discretion of the geo-environmental engineer. Validation of the underlying soils is likely to include some or all of the following:
 - Logging of the underlying materials to BS5930 (2015);
 - In-situ screening by a photo-ionisation device;
 - Any materials suspected to be contaminated based on visual/olfactory observations and/or in-situ screening should be stockpiled in areas of impermeable surfacing (hard-standing/on impermeable geo-membrane material. Soil sample(s) should be collected from the stockpiled material and submitted for laboratory analysis to verify its suitability for re-use on-site or off-site disposal; and
 - Any remaining drains or service ducts associated with these features, which have the potential to provide a pathway for contaminant migration should be removed or sealed.
- In accordance with the proposed development plan, sections of the bunds were proposed to be regraded with the removal of the top 1.3 m (approximately). Following agreement from the Local Authority, the excavated materials were to be re-used beneath a clean capping layer in the central POS area. A capping layer to a minimum depth of 600 mm was subsequently required across the re-graded bunds and POS area. The capping materials were proposed to be sourced from natural subsoil won from the central POS area and imported topsoil, underlain by a geo-marker layer.
- It was recommended that material movements across the site be controlled through the implementation of a CL:AIRE Code of Practice Material Management Plan (MMP) to demonstrate compliance of the four factors set out therein.

Additional / specific requirements identified within 27621 R08 (00) Remediation Strategy Report in relation to Phase 1B are as follows:

- In accordance with development levels and requirements for clean capping materials across the site it is anticipated that the majority of the made ground

present in the bunds surrounding the pond and the made ground in the cleared wooded area, with a total approximate volume of 6390 m³ shall need to be removed/regraded. The made ground will need to be capped with 450 mm of clean site won subsoil and 150 mm of imported topsoil below any soft landscaping. A geo-marker layer is also required to be placed between the material won from the bunds surrounding the pond, cleared wooded area and any other suitable made ground used at depth and the 'clean' topsoil/subsoil layer to provide a visual guide showing the limit of the depth of the cover layer.

1.5.2 Construction Phase

1.5.2.1 Placement of clean cover soils

In order to break the identified pollutant linkages in **Section 1.5**, within the proposed areas of private gardens and communal soft landscaping areas within Phase 1B the placement of a suitable clean cover layer will be required. To address potential risks posed from the impacts identified in a sustainable manner, the minimum thickness of the clean cover layer is required to be 600 mm in higher risk areas. The 600 mm cover layer should comprise 150 mm of topsoil and 450 mm of subsoil with a geo-membrane marker layer at the base. These higher risk areas have been identified as:

- Areas of identified impact, pesticide hotspot, made ground containing asbestos, un-investigated areas considered to potentially impacted (i.e. made ground extending to the south of the sites buildings considered to potentially contain asbestos and soils in the vicinity of the fuel tanks and nitric acid store).
- Soils are to be placed over a geomarker in high risk garden and soft landscaped areas as indicated in **Figure 4**.

The minimum thickness of the clean cover layer in lower risk areas is required to be 450 mm. The 450 mm cover layer should comprised 150 mm topsoil and 300 mm subsoil. These lower risk areas have been identified as:

- Areas where no impacts have been identified during the previous phases of works, no significant un-investigated potential sources identified and distribution of exploratory locations considered appropriate for 'low risk' to be concluded. This zone primarily relates to the footprint of the green house.

1.5.2.2 Installation of gas protection membranes

It was recommended in the remedial strategy for the site (RSK, 2016a) that a detailed gas membrane installation design and implementation plan be completed in accordance with the recent updates in UK guidance (BS8485:2015).

Following queries raised by the NHBC regarding the gas membrane design submitted for the site, further validation gas assessment in the form of void monitoring was undertaken at the site. RSK initially completed void monitoring for Plots 10, 20, 28, 30, 44, 48 and 50. These plots were chosen due to their proximity to the principal borehole of concern (BH1), other observed sources of potential ground gas generation from the site investigation and to provide suitable coverage of the Phase 1A development area.

Additional void monitoring in Plots 53, 63 and, to a lesser extent, Plot 51 took place to provide an added level of comfort for plots that were due to be occupied as Plots 44, 48

and 50 located in the southern half of Phase 1A were not yet ready for the void monitoring to take place at that time.

The original classification of Amber 1/CS2 was also a belt and braces precautionary approach due to the site history and encountered ground conditions. Whilst not the original purpose of the void monitoring, it quickly became clear that the collection of primary data from beneath existing properties on site was demonstrating that the ground gas regime on the site was presenting itself as a Green/CS1.

Based on the new lines of evidence of significant void monitoring data with further widespread excavation of the development site not encountering significant organic material, RSK considered there was sufficient data to downgrade the site from Amber 1/CS2 to Green/CS1. This has been subsequently agreed by the Local Authority and the NHBC and therefore ground gas protective measures are not required at the site unless any new sources of ground gas generation are discovered during the remaining stages of the development, which is considered to be very low.

1.5.3 Verification

1.5.3.1 *Validation of clean cover soils*

In accordance with the remedial strategy reports, validation is required in regards to the thickness and chemical quality of the clean capping layer placed in gardens and areas of communal soft landscaping.

To verify the thickness of the cover layer, it will be necessary to dig through the cover layer at selected locations to verify the required thickness of topsoil, subsoil and presence of the marker layer where required.

In addition, validation samples are to be collected on a 1 in 50 m³ frequency for garden areas and a 1 in 250 m³ frequency in areas of communal soft landscaping as agreed with the Local Authority. All chemical testing for validation purposes is required to be carried out by an MCERTS and UKAS accredited laboratory and the results compared to the relevant validation assessment criteria as set out in the remedial strategy reports (RSK report ref: 27621 R03 (01), January 2016 and 27621 R08 (00), January 2018) and **Table 1**. Should lower SOM be present, the RSK GAC within **Appendix D** provides alternative criteria for 1% and 2% SOM.

Table 1: Validation assessment criteria

Compound	Generic Assessment Criteria (GAC) 6% SOM (mg/kg)
Metals	
Arsenic	37
Cadmium	30
Chromium (III) - oxide	910
Chromium (VI)	21
Copper	2,500
Lead	200
Elemental Mercury (Hg0)	1.2
Inorganic Mercury (Hg2+)	39
Methyl Mercury (Hg4+)	10
Nickel	180
Selenium	258
Zinc	3,900
BTEX Compounds	
Benzene	0.87
Toluene	680
Ethylbenzene	260
Xylene - m	327
Xylene - o	332
Xylene - p	310
Total xylene	310
Polycyclic Aromatic Hydrocarbons (PAHs)	
Acenaphthene	1,170
Acenaphthylene	970
Anthracene	10,900
Benzo(a)anthracene	13
Benzo(b)fluoranthene	3.7
Benzo(g,h,i)perylene	350
Benzo(k)fluoranthene	100
Chrysene	27
Dibenzo(a,h)anthracene	0.30
Fluoranthene	900
Fluorene	880
Indeno(1,2,3-cd)pyrene	41
Phenanthrene	440
Pyrene	2,040
Benzo(a)pyrene	5
Naphthalene	71

Compound	Generic Assessment Criteria (GAC) 6% SOM (mg/kg)
Total Petroleum Hydrocarbons	
Aliphatic hydrocarbons EC ₅ –EC ₆	160
Aliphatic hydrocarbons >EC ₆ –EC ₈	530
Aliphatic hydrocarbons >EC ₈ –EC ₁₀	154
Aliphatic hydrocarbons >EC ₁₀ –EC ₁₂	7,50
Aliphatic hydrocarbons >EC ₁₂ –EC ₁₆	3,500
Aliphatic hydrocarbons >EC ₁₆ –EC ₃₅	79,000
Aromatic hydrocarbons >EC ₈ –EC ₉	56
Aromatic hydrocarbons >EC ₉ –EC ₁₀	189
Aromatic hydrocarbons >EC ₁₀ –EC ₁₂	367
Aromatic hydrocarbons >EC ₁₂ –EC ₁₆	600
Aromatic hydrocarbons >EC ₁₆ –EC ₂₁	800
Aromatic hydrocarbons >EC ₂₁ –EC ₃₅	1,200
Other	
Asbestos	Not observed in asbestos in soil with ID analysis
Note: if heavy PAH compounds exceed the GAC, benzo(a)pyrene will be used as a surrogate depending upon the heavy PAH compound composition	

2 REMEDIAL WORKS WITHIN PHASE 1B

The remedial works have been carried out in a phased approach as development has progressed at the site.

The following validation and verification requirements were identified (outstanding requirements are shaded in blue within **Figure 5**) as needing to be completed across Phase 1B report (RSK, 2016d), prior to this area being deemed suitable for the proposed residential end use:

- Validation sampling in the vicinity of the historic boiler house;
- Garden and soft landscaping validation sampling and reporting; and
- Post remediation validation reporting for all of the above.

2.1 Verification Works

Throughout the remedial works RSK has been attending site on an ad hoc basis to verify the works carried out. During ground works undertaken in Phase 1B RSK has maintained a site presence (on a nearly full time basis), to undertake a watching brief and conduct validation works as and when required.

2.1.1 Asbestos Delineation Works Phase 1B – Plots 65 to 121 (18th to 25th April 2017)

To delineate asbestos impacts observed within Phase 1B, RSK carried out intrusive investigation works across Plots 64 to 121 between 18th to 25th April 2017. The works undertaken are detailed in RSK letter report ref: RSK 27621 L08, dated July 2017 (presented in **Appendix B**) and summarised below.

The objective of the works was to characterise made ground and identify the potential presence of ACM and/or asbestos fibres in soil at each plot, to inform cover layer thickness requirements.

In the vicinity of each plot, a single trial pit was excavated to target the footprint of the proposed garden areas. The locations of the exploratory holes are shown on **Figure 6**.

A soil sample was collected from each accessible plot, with a total of 56 representative soil samples collected.

The exploratory holes revealed that the majority of Phase 1B is underlain by a variable thickness of made ground, with some topsoil in the less-disturbed south east corner of Plots 111 to 121. Both of these overlie River Terrace Deposits. For the purpose of discussion, the ground conditions are summarised in **Table 2**.

Table 2: Ground conditions encountered during asbestos delineation works - Plots 65 to 121

Strata	Exploratory holes encountered	Depth to top of stratum (mbgl)	Thickness (m)
Made Ground	All locations except Plots 111, 114, 115	Ground level	0.15 to 1.00
Topsoil	Plots 111, 114, 115	Ground level	0.10 to 0.20
River Terrace Deposits	All locations except Plots 65 to 73, 82, 84, and 113.	0.10 to 1.00	0.03 to 0.95

Fragments of suspected cement-bonded asbestos were noted within made ground deposits encountered in Plots 66, 73, 80, 98, 99, 104, 105, 107, 113 and 121.

Fragments of suspected cement-bonded asbestos were also noted on the ground surface on /or adjacent to Plots 66, 80, 84, 93 to 95, 98, 99, 109 and 113.

The majority of the samples submitted for analysis returned negative asbestos screens with the exception of those detailed below in **Table 3**.

Table 3: Summary of asbestos analysis results

Samples of soil where asbestos was identified					
Exploratory Hole	Depth Range	Stratum	Asbestos Type	Presenting As	Quantification Result
Plot 66	0.75	Made ground	Chrysotile	Loose Fibres	<0.001 %
Plot 68	0.50	Made ground	Crocidolite and Chrysotile	Loose Fibres	<0.001 %
Plot 80	0.50 to 0.60	Made ground	Chrysotile	Loose Fibres	0.001 %
Plot 84	0.60	Made ground	Chrysotile	Loose Fibres	0.009 %
Plot 93	0.10	Made ground	Chrysotile	Loose Fibres	<0.001 %
Plot 94	0.20	Made ground	Chrysotile	Loose Fibres	0.006 %
Plot 98	0.20	Made ground	Amosite	Loose Fibres	0.001 %
Plot 105	0.30	Made ground	Amosite	Loose Fibres	0.050 %
Plot 106	0.10	Made ground	Chrysotile	Loose Fibres	<0.001 %
Plot 107	0.10	Made ground	Chrysotile	Loose Fibres	<0.001 %
Suspected asbestos cement sample results					
Exploratory Hole	Depth Range	Stratum	Asbestos Type	Presenting As	Quantification Result
Plot 93	0.10	Made ground	Chrysotile	Cement	15 %
Plot 99	0.10 to 0.30	Made ground	Chrysotile	Cement	15 %

A total of 15 plots were found to contain suspected asbestos cement fragments or asbestos fibres in made ground beneath the surface, as shown on **Figure 7** and in photos 4 and 6 of the photographic log (**Appendix B**) of RSK report 27621 L08. Red shading denotes the plots in which fragments of suspected asbestos cement were observed below the ground surface on-site, or where asbestos fibres were identified by later laboratory analysis.

All 10 soil samples returning positive results for asbestos fibres were submitted for asbestos quantification analysis. Previous results across Phase 1A and Phase 1B ranged from <0.001 to 0.050%, as detailed in RSK report refs: 27621 L04 Plots 1 to 19, October 2016; 27621 L05 Plots 18, 20 to 64, February 2017; 27621 L08 Plots 65 to 121, July 2017.

Plots 95 and 109 were the only plots whereby suspected ACM were observed at the ground surface, but not within the underlying soils, and the subsequent soil samples analysed were not found to contain asbestos fibres or ACM.

The representative suspected asbestos cement samples collected from Plots 93 and 99 tested positive for chrysotile cement, with a percentage asbestos within the material at 15 %.

It was recommended that handpicking for ACM at the ground surface also be completed across Plots 95 and 109 followed by removal of the upper 200 mm of the existing ground profile through these plots.

On the basis of the results discussed above, it was recommended that 600 mm of clean cover, underlain by a geo-marker membrane should be placed in the front and back gardens of Plots 66, 68, 73, 80, 84, 93 to 94, 98, 99, 104, 105, 107, 113 and 121, where suspected ACM or asbestos fibres have been found to be present. 600 mm of clean cover underlain by a geo-marker membrane should also be placed in the front and back gardens of Plots 69 to 71, 97 and 100, as these plots were inaccessible at the time of the delineation works. A 450 mm clean cover layer is required across the front and back gardens of all other plots in Phase 1B. The cover layer requirements for Plots 65 to 121 are presented on **Figure 4**.

A 450 mm thick clean cover layer is also required in all communal soft landscaped areas in Phase 1B (excluding the south west bund A, which required a 600 mm thick clean cover layer underlain by geo-marker membrane and south west bund B, which is proposed to be securely fenced off and planted with prickly vegetation).

A watching brief was undertaken between August 2017 to present day during groundworks in Phase 1B, as the possibility of further asbestos could not be discounted. Although no further groundworks are required for Phase 1B, RSK was asked by the client to continue and expand the watching brief in Phase 1B and Phase 2.

The capping layer thickness requirements for the entirety of Phase 1B is summarised on **Figure 4**.

2.1.2 Validation works in the vicinity of the historic boiler house

Weak to moderate hydrocarbon odours were noted in the area around Plots 66, 68, 76, 77, 83 and 84 with PID readings of VOCs for Plots 66, 68, 76 and 77 ranging from 0.2 to 2.5 ppmV. Readings for Plots 83 and 84 ranged from 22.8 to 140.0 ppmV together with

visual evidence of hydrocarbon impact on the made ground, as shown in RSK letter report ref: RSK 27621 L08, dated July 2017.

Seven soil samples were collected within the vicinity of Plots 83 and 84, as part of the historic boiler house delineation works. Of these, six samples were submitted for TPHCWG and PAH laboratory analysis. The analysis results were compared to RSK generic assessment criteria (GAC) for a residential end-use with home grown produce.

Predominately heavy end TPH and PAHs were detected in the soil samples collected from TPBOILER 2 to 5, TPP84 and TPP66, with a maximum total TPH concentration of 384 mg/kg observed in TPP84. Measured concentrations of benzo(b)fluoranthene (maximum concentration 2.65 mg/kg) and dibenzo(ah)anthracene (maximum concentration 0.31 mg/kg) in TPP84 and TPP66 were marginally (in the same order of magnitude) in excess of the RSK GAC in relation to direct contact pathways.

Provision of the 600 mm capping layer underlain by a geo-marker membrane layer within the front and back gardens at these two locations, as required in relation to asbestos impacts, shall break the identified direct contact pathways. Therefore, no further validation or remediation works are deemed necessary in the vicinity of the former boiler house.

All other determinants were below the RSK GAC.

On the 15th August 2017 a small old oil drum in poor repair was excavated in the northern portion of Phase 1B near Plots 67 to 69. This feature and surrounding impacted materials were removed, placed on and covered by impermeable membranes, labelled as TPS03. A total of two samples (PIB/TV and PIB/TVB1) were collected, of these PIB/TV was scheduled for WAC testing and PIB/TV and PIB/TVB1 were scheduled for asbestos screening, PAHs, TPH CWG and BTEX.

The validation sample (PIB/TV) collected from soils surrounding the feature was found to exceed the human health GAC for private gardens for the following determinants: naphthalene (591 mg/kg); phenanthrene (102 mg/kg); aliphatic C10 – C12 (454 mg/kg); aliphatic C12 – C16 (1240 mg/kg); aromatic C10 – C12 (376 mg/kg); aromatic C12 – C16 (2090 mg/kg) and aromatic C16 – C21 (1160 mg/kg). However given the implementation of a 600mm capping layer and the depth of the material the human health GAC for private gardens was not considered appropriate. Results were further compared to the inhalation GAC for residential end use which found aliphatic C10 – C12 (454 mg/kg); aliphatic C12 – C16 (1240 mg/kg) and aromatic C10 – C12 (376 mg/kg) to exceeded the relevant GAC therefore the material was removed and stockpiled within TPS03. The results of the WAC test indicated the material surrounding the feature should be sent to a stable non reactive hazardous waste landfill. To RSKs knowledge the material is still stockpiled on site.

The validation sample (PIB/TVB1) collected from soils beneath this feature and following removal of all visually affected materials, is below the RSK GAC for residential end use and therefore remaining soils in this area are suitable to be left in-situ below the cover layer.

Laboratory certificates presenting the validation sampling results conducted to date are presented in **Appendix E**.

Trial pit logs and photographic logs for works carried out in **Sections 2.1.1 and 2.1.2** are presented in **Appendix F and G**.

2.1.3 Geo-marker layer and subsoil placement

Following completion of the groundworks within Phase 1B, RSK have observed the placement of geo marker membrane and clean sub-soil across the entirety of Phase 1B to form part of the “clean designation site areas” as recommended within the remedial strategy for areas with a 600 mm clean capping layer and as a physical break barrier underlying areas with a 450 mm clean capping layer. Clean subsoil was taken from the clean stockpile resulting from the Keltbray POS works. To date topsoil has not been placed within Phase 1B, formal validation works to confirm suitable chemical status and thickness in accordance with the remedial strategy and delineation letter report will be completed upon the placement of Topsoil at individual plots.

2.1.4 Health and Safety regarding asbestos within Phase 1B

In accordance with the RSK remedial strategy report ref. 27621 R03 (00) the principal contractor (Blaze) prepared health and safety method statement documentation (presented in **Appendix I**) pertaining to how potential risks from asbestos in accordance with the control of asbestos regulations (2012).

The health and safety method statement ensured the following actions were employed onsite to reduce associated health risks:

- All operative to be inducted in the health and safety method statement;
- All operatives to have received asbestos awareness training;
- Operatives to wear P3 filtering face masks when breaking ground;
- Exposed stockpiles to be dampened down to prevent asbestos fibres becoming airborne;
- Stockpiles to be covered in terram and weighted down with blocks;
- Clean and dirty access routes to Phase 1B for plant. Plant not to be removed from designated dirty area unless jet washed;
- Presence of a decontamination unit to define clean and dirty areas for operatives. All operatives to have clean boots and remove potentially contaminated PPE and store in the decontamination unit upon leaving the work area; and
- Operatives to have specific PPE such as non laced boots and overalls.

As a result of the above actions cross contamination between Phase 1B and the remainder of the site did not occur.

3 VALIDATION RESULTS SUMMARY WITHIN PHASE 1B

The remedial works are being carried out in a phased approach as the proposed development progresses. The following is applicable to the Phase 1B part of the site as shown within **Figure 2** and **3**.

3.1 Validation within Phase 1B

Investigation works prior to remediation of the site identified asbestos across Phase 1B (as detailed within **Sections 2.1.1** and **2.1.3**) and elevated hydrocarbons in the vicinity of the historic boiler house and historic oil drum (as detailed within **Sections 2.1.2**). Additionally asbestos fibres and ACM were identified primarily within the bund materials but also locally across Phase 1A in made ground.

The following delineation works have been undertaken within Phase 1B

- asbestos delineation works conducted across Plots 65 to 121 (as detailed in **Sections 2.1.1** and **2.1.3**);
- hydrocarbon delineation works conducted within the vicinity of the historic boiler house in the area around Plots 66, 68, 76, 77, 83, 84 (as detailed in **Sections 2.1.2**); and
- hydrocarbon delineation works surrounding the historic oil drum in the vicinity of Plots 67 to 69 (as detailed in **Sections 2.1.2**)

the information obtained from the above works has been used to refine the garden capping layer thickness requirements across Phase 1B on a plot by plot basis. The capping layer thickness required in each plots garden is presented on **Figure 4**.

On the basis of the results discussed above, it was recommended that 600 mm of clean cover, underlain by a geo-marker membrane should be placed in the front and back gardens of Plots 66, 68, 73, 80, 84, 93 to 94, 98, 99, 104, 105, 107, 113 and 121, where suspected ACM or asbestos fibres have been found to be present. 600 mm of clean cover underlain by a geo-marker membrane should also be placed in the front and back gardens of Plots 69 to 71, 97 and 100, as these plots were inaccessible at the time of the delineation works. A 450 mm clean cover layer is required across the front and back gardens of all other plots in Phase 1B. The cover layer requirements for Plots 65 to 121 are presented on **Figure 4**.

A 450 mm thick clean cover layer is also required in all communal soft landscaped areas in Phase 1B.

No further delineation works or remediation is deemed necessary in this area in relation to asbestos or hydrocarbons, other than the application of the capping layer requirements detailed above.

All garden validation testing data will then be submitted to the NHBC for approval prior to release of any CML's.

4 CONCLUSIONS AND RECOMMENDATIONS FOR PHASE 1B

4.1 Conclusions - Phase 1B

Based upon the remedial works carried out to date within the Phase 1B, it is considered that the area is suitable for the proposed residential end use, subject to the results of the garden/soft landscaping validation works.

RSK are satisfied that the remedial works carried out to date in other areas of the site by CALA Homes and Keltbray, have been carried out in accordance with the agreed remedial strategy.

4.2 Recommendations - Phase 1B

The following validation and verification requirements need to be completed across Phases 1B. prior to this area of the site being deemed suitable for the proposed residential end use:

- Garden (Plots 65 to 121) and soft landscaping validation sampling and reporting.

5 REMEDIAL WORKS FOR REMAINING AREAS OF THE SITE

5.1 Background for remaining areas of the site

Key background information observed in areas of the site other than Phase 1B since submission of the Phase 1A verification report is summarised in the subsequent subsection.

During tree clearance work in the base of the pond and the surrounding bunds within the south eastern portion of the site, a portion of the western bund was removed to create an access route for plant, within which potential ACM were observed. Prior to tree clearance access to investigate the south eastern portion of the site was limited. Previous investigations undertaken in this area included a hand pit (HP1) and two trial pits (SA3 and SA4) in the base of the pond area. No visual or olfactory signs of contamination (including suspected ACMs) were observed in these locations.

An additional investigation was undertaken by RSK in 2017 (27621-R08 (00)) within the pond area and the surrounding bund in which suspected cement bound ACM were encountered in all the investigation locations undertaken during the additional site investigation works. Investigation locations were undertaken on the bund materials (except for TP7) and within BH1, BH4, BH12 and BH15 during the initial phase of works. Charcoal and ash fragments were encountered in 16 of the initial exploratory investigation locations, but was only detected in TP6 during the additional intrusive works. During the supplementary site assessment works ash and clinker was encountered in BHA to BHE and, moderate chemical and ash odours in BHE and ash odours in BHD, which correspond with concentrations of PAHs and pesticide compounds above laboratory levels of detection (LOD). No other visual/olfactory evidence for soil or groundwater contamination was encountered during either phase of intrusive works.

In accordance with the findings a remedial strategy was prepared for these areas of the site, a report has been submitted (by RSK in 2017 27621-R03 (02)) and approved by the Local Authority and as such has not been appended to this report. It should be noted that the pond and associated bund areas within the above report are not within the boundary of Phase 1B.

5.2 Method Statement for remediation of Contaminated ground relating areas other than Phase 1B

The below section details the method statement for remedial action in areas of the site other than Phase 1B since submission of the Phase 1A verification report.

The made ground materials encountered within the bund surrounding the pond and the cleared wooded area to the west of the pond bund appear to be generally of similar composition to those found in the bunds investigated during previous phases of works based on visual inspection and in-situ volatiles screening. However, anthropogenic

material including ACM were observed to be less frequent than those observed in the bunds previously investigated. Therefore, these materials are anticipated to pose a risk to human health via direct contact and dust/fibre inhalation pathways unless remediated, (i.e. capped in-situ, re-used at depth or removed and disposed off site). The made ground encountered is not however anticipated to pose a risk to controlled waters via leaching through the unsaturated zone into the dissolved phase.

The ground conditions (natural soils) encountered in the base of the pond concurred with previous exploratory holes in this area.

The following potential linkages require further assessment in relation to the south east landscaped area:

- Future end-uses coming into direct contact with contaminants of potential concern in made ground;
- Potential exposure to future end-users and neighbouring residents from the presence of asbestos fibres and ACM within made ground;
- Potential exposure to construction workers from asbestos fibres associated with the potential disturbance of the ACM and soils containing asbestos fibres within made ground;
- Risks to controlled waters via leaching of contaminants within the made ground;
- Phytotoxic effects from potential metal contaminants in made ground; and
- The permeation of future water supply pipes.

5.3 Verification Works for Remaining Areas

The remedial works have been carried out in a phased approach as development has progressed at the site.

The following validation and verification requirements were identified (within RSK, 2016d) as needing to be completed across the remainder of the site (detailed in **Figure 5**), prior to these areas being deemed suitable for the proposed residential end use:

- Additional validation of the south west bund A following the placement of topsoil and in the vicinity of the formerly inaccessible area outside of the hoarding;
- Further delineation and removal of oily impacts observed in the vicinity of tank validation sampling location V2;
- Validation that secure fencing and prickly vegetation has been implemented in regards to the south west bund B;
- Validation sampling in the vicinity of the south east bund following capping of this feature;
- Re-validation of north east bund following re-grading works in accordance with design layout changes; and
- Re-validation of the central POS area capping materials following placement of surplus asbestos impacted materials beneath this area.

Further to the above in accordance with the impacted materials identified in the south eastern bund proposed for soft landscaping, the following remediation validation and verification requirements are outstanding:

- Regrading/removal of the made ground in the bunds surrounding the pond and cleared wooded area to the west (where required) to form site levels, in accordance with the approved development plan; and to facilitate placement of a 'clean' cover layer across the remaining bund materials. Where possible material won as part of the re-grading/removal exercise will be re-used on site in accordance with a materials management plan (yet to be revised) following the CL:AIRE Code of Practice. For example material may be placed beneath 'clean' cover in the south eastern soft landscaped area;
- The placement of a suitable clean cover layer in any areas of the bunds surrounding the pond or cleared wooded area that can remain in-situ (if feasible), as well as across the south eastern landscaped area; and
- Compliance with CAR 2012, through the adoption of safe working procedures with respect to the potential presence of ACM and notification to the HSE.

The remedial and validation/verification works conducted since submission of the Phase 1A verification report are summarised in the subsequent subsections. Laboratory certificates presenting the validation sampling results conducted to date are presented in **Appendix E**.

Please note the development phase boundaries have evolved as the development has progressed the phasing proposed at the time of writing this report are shown on **Figure 2**.

5.3.1 Central POS Validation Works (April 2017)

5.3.1.1 Validation of POS and bund capping layers

RSK attended site on 9th and 23rd June 2016, 7th and 25th July 2016 and 24th April 2017 to undertake validation works of the capping layer placed on the re-graded bunds and central POS area.

In these areas, a series of hand excavated validation trial pits were undertaken to allow inspection of the capping layer and recovery of representative soils for laboratory testing in accordance with the testing suite outlined in the remedial strategy report (RSK report ref: 27621 R03 (01), January 2016). Trial pits were excavated to the base of the capping layer (i.e. when the bright orange 'geo-marker' geotextile was encountered) or up to a maximum of 600 mm depth whereby the geo-marker layer was observed being placed during construction. Validation locations were targeted to give a good spread across the areas subject to remedial works, whilst working to a sampling ratio of 1 in 250 m³ for communal soft landscaping, as agreed with Local Authority.

The following validation pits were carried out:

- NWB V1-8 - 9th June 2016;
- SWB V1-4 - 23rd June 2016;
- POS V1-12 - 7th July 2016;
- NEB V1-4 - 25th July 2016;
- Additional inspection pits POS V13-16, POS V2A-D, POS V12-A-D - 22nd August 2016; and
- Central V-POS1-4 24th April 2017.

The locations of the above are presented on **Figure 8**.

Following the initial validation, ACM were found at surface level in selected areas of the north west bund, north east bund, south west bund A and central POS area. Laboratory testing confirmed presence of chrysotile cement from surface samples obtained from the north west bund and POS. Asbestos was also identified in soil samples obtained from POSV2 and POSV12.

A recommendation for hand picking of visible fragments of asbestos from the surface of the bunds was made by RSK and completed by Keltbray, as summarised in the Keltbray Completion Report. Additional delineation and soil sampling works were recommended in the vicinity of POSV2 and POSV12.

Following the identification of ACM in several areas across the site (as detailed above) on the surface of bunds and within two soil samples (POSV2 and POSV12), Keltbray carried out a series of hand-picking exercises across these areas. RSK re-inspected these areas after Keltbray had completed the hand-picking exercise and were satisfied that visually identifiable asbestos fragments had been removed for the surface across these areas.

Additional validation trial pits were excavated by RSK on 2nd August 2016 to confirm the extent of asbestos materials in the vicinity of POSV2 and POSV12. Representative soils samples were obtained from the validation pits (refer to as POSV12A-D and POSV2A-D) and submitted for laboratory testing to screen for the presence of asbestos fibres. None of the additional soil samples were found to contain asbestos fibres.

It is noted that topsoil had not been placed across the bunds or POS area prior to the validation sampling visits detailed above. It was therefore recommended that additional validation works be completed following placement of topsoil with respect to the north west bund and south west bund A, whereby the subsoil capping layer thickness was observed to be less than 600 mm thick.

The north west bund has subsequently been re-validated as detailed in **Section 5.3.2**.

In accordance re-profiling of the north western bund and additional works in Phase 1B and 2, a 2nd phase of remedial works has been completed by Keltbray at the site. A completion report for this phase of works is in progress by Keltbray, as well as supplementary validation works by RSK including revalidation of the central POS area.

Further validation trial pits were excavated by RSK on the 24th April 2017 to confirm the extent of asbestos materials in the vicinity of the POS area. Representative soils samples were obtained from the validation pits (refer to as V-POS1 – V-POS4) and submitted for laboratory testing to screen for the presence of asbestos fibres. None of the additional soil samples were found to contain asbestos fibres.

Trial pit logs and photographic logs for works carried are presented in **Appendix F and G**.

5.3.2 North West Bund Supplementary Validation Phase 1A – (February 2017)

Following re-profiling works by Keltbray in the southern portion of the north west bund, RSK undertook supplementary validation works in this area on the 28th February 2017.

Five trial pits were hand excavated to depths of up to 0.80 m bgl designated TP101A to TP105A (as presented on **Figure 6**), in order to obtain representative soil samples to validate that the capping material had not been cross contaminated during re-profiling works and to determine the thickness of the capping layer.

The stratum observed within the trial pits was identified as a brown sandy gravelly clay with occasional cobbles of flint to a depth of 0.8 m. No made ground was identified in any of the trial pits. The trial pit logs and photographic log documenting the works are presented in **Appendix E** of RSK report 27621 R06.

Topsoil was being placed at the time of sampling, therefore the capping layer will exceed the required 600 mm thickness. No geo-textile marker layer was observed during the validation visit. However, RSK observed the geo-textile marker layer being replaced following the re-profiling works prior to application of the subsoil and topsoil.

Validation samples collected from the natural site 'won' subsoil's within the capping were submitted for laboratory testing, at a range of depths between 0.50 m and 0.70 m bgl. None of the determinants tested were found to exceed the validation assessment criteria.

Information pertaining to the imported topsoil is provided in **Appendix H**.

Validation works conducted on the north west bund in June 2016 and February 2017 in regards the capping layer, have demonstrated that the capping layer thickness and chemical quality outlined in the agreed remedial strategy for the site has been achieved and that this area is suitable for use as communal soft landscaping. Therefore, no further validation is required with regards to the north west bund.

5.3.3 Conclusions and Recommendations for Remaining areas of the site

5.3.3.1 Conclusions for Remaining areas of the site

RSK are satisfied that the remedial works carried out to date in areas other than Phase 1B by Cala Homes and Keltbray, have been carried out in accordance with the agreed remedial strategy.

5.3.3.2 Recommendations for Remaining areas of the site

The following validation and verification requirements need to be completed across areas other than Phase 1B, prior to these areas of the site being deemed suitable for the proposed residential end use:

- Additional validation of the south west bund A following the placement of topsoil and in the vicinity of the formerly inaccessible area outside of the hoarding;
- Validation that secure fencing and prickly vegetation has been implemented in regards to south west bund B;
- Validation sampling in the vicinity of the south east bund following capping of this feature (Phase 2);
- Re-validation of north east bund following re-grading works in accordance with design layout changes (Phase 2);

- Re-validation of the central POS area capping materials following placement of surplus asbestos impacted materials beneath this area;
- Garden and soft landscaping validation sampling and reporting; and
- Post remediation validation reporting for all of the above.

BIBLIOGRAPHY

Baker, K., Hayward, H., Potter, L., Bradley, D. and McLeod, C. (2009), *CIRIA Report C682. The VOCs Handbook. Investigating, assessing and managing risks from inhalation of VOCs at land affected by contamination* (London: CIRIA).

Boyle, R. A. and Witherington, P. J. (2007), 'Guidance on Evaluation of Development Proposals on Sites where Methane and Carbon Dioxide are Present', National House-Building Council and RSK Group.

British Geological Survey (2017), www.bgs.ac.uk.

British Standards Institution (BSI) (1990), 'BS 1377:1990. Methods of test for soils for civil engineering purposes'.

British Standards Institution (2015), 'BS 5930:2015. Code of practice for ground investigations'.

British Standards Institution (2011), 'BS 10175:2011. Investigation of potentially contaminated sites: Code of practice'.

Building Research Establishment (BRE) (2001), *BRE Report 414. Protective measures for housing on gas-contaminated land* (London: BRE).

Building Research Establishment (2005), *BRE Special Digest 1: Concrete in aggressive ground* (London: BRE).

Building Research Establishment (2007) *BRE Digest 365. Soakaway design* (London: BRE).

Card, G. B. (1995), *CIRIA Report 149. Protecting development from methane* (London: CIRIA).

Chartered Institute for Environmental Health and Land Quality Management (2009), 'The LQM/CIEH Generic Assessment Criteria for Human Health', second edition.

Chartered Institute of Environmental Health (CIEH) and CL:AIRE (2008), *Guidance on Comparing Soil Contamination Data with a Critical Concentration* (London: CIEH).

CL:AIRE (2009), *Soil Generic Assessment Criteria for Human Health Risk Assessment* (London: CL:AIRE).

CL:AIRE (2011), *CL:AIRE Code of Practice. The Definition of Waste: Development Industry Code of Practice, Version 2* (London: CL:AIRE).

Dangerous Substances Directive (76/464.EEC).

Department for Environment, Food and Rural Affairs (2010), *The River Basin Districts Typology, Standards and Groundwater Threshold Values (Water Framework Directive) (England and Wales) Directions 2010* (London: HMSO).

Department of the Environment (1996), *Code of Practice for Agricultural Use of Sewage Sludge* (London: HMSO).

Environment Agency (2003), 'Technical Guidance WM3. Interpretation of the definition and classification of hazardous waste'.

Environment Agency (2004a), *Model Procedures for the Management of Contaminated Land. Contaminated Land Report Number 11 (CLR11)*, September (Bristol: Environment Agency).

Environment Agency (2004b), 'Policy Number 199_04, dated 9 March 2004, Part IIA – Detailed Quantitative Assessment of Chronic Risks to Human Health from Contaminated Soils'.

Environment Agency (2006a), 'Remedial Targets Methodology: Hydrogeological Risk Assessment for Land Contamination'.

Environment Agency (2006b), 'The Knotweed Code of Practice – managing Japanese Knotweed on development sites'.

Environment Agency (2008), *Science Report SC050021/SR7. Compilation of Data for Priority Organic Pollutants for Derivation of Soil Guideline Values* (Bristol: Environment Agency).

Environment Agency (2009a), Contaminated Land Exposure Assessment (CLEA) software, version 1.06.

Environment Agency (2009b), *Human health toxicological assessment of contaminants in soil. Science Report – Final SC050021/SR2*, January (Bristol: Environment Agency).

Environment Agency (2009c), 'Science Report SC050021/benzene SGV, toluene SGV, ethylbenzene SGV, xylene SGV, mercury SGV, selenium SGV, nickel SGV, arsenic SGV, cadmium SGV, phenol SGV, dioxins, furans and dioxin like PCBs SGVs', 'Supplementary information for the derivation of SGV for: benzene, toluene, ethylbenzene, xylene, mercury, selenium, nickel, arsenic, cadmium, phenol, dioxins, furans and dioxin- like PCBs', and 'Contaminants in soil: updated collation of toxicological data and intake values for humans: benzene, toluene, ethylbenzene, xylene, mercury, selenium, nickel, arsenic, cadmium, phenol, dioxins, furans and dioxin- like PCBs', March 2009, May 2009 and September 2009.

Environment Agency (2009d), *Science Report – SC050021/SR3. Updated technical background to the CLEA model* (Bristol: Environment Agency).

Environment Agency (2010a), 'GPLC1 – Guiding Principles of Land Contamination', 'GPLC2 – Frequency Asked Questions, Technical Information, Detailed Advice and References', and 'GPLC3 – Reporting Checklists', all March.

Environment Agency (2010b), 'Horizontal Guidance Note H1 - Environmental risk assessment for permits'.

Environment Agency (2010c), 'Status Report: Management of the London Basin Chalk Aquifer'.

Environment Agency (2011) Chemical Standards Database.

Environment Agency (no date) Freshwater environmental quality standards.

Environment Agency www.environment-agency.gov.uk/.

Environmental Permitting (England and Wales) Regulations 2010 (London: HMSO).

Hartless, R. (1991), 'BRE Report 212: Construction of new buildings on gas-contaminated land', Building Research Establishment.

Hazardous Waste Regulations 2005 (London: HMSO).

Knipp, C. V., Lloyd, J. W., Lerner, D. N. and Greswell, R. (1993), *CIRIA Special Publication 92. Rising groundwater levels in Birmingham, and their engineering significance* (London: CIRIA).

Lord, J. A., Clayton, C. R. I. and Mortimore, R. N. (2002), *CIRIA Report C574 Engineering in chalk* (London: CIRIA).

National House-Building Council (1999), 'Chapter 5.2: Suspended Ground Floors' in *NHBC Standards*, revised September 1999, effective January 2000.

Norbury, D. (2010), *Soil and Rock Description in Engineering Practice* (Caithness: Whittles).

Office of the Deputy Prime Minister (2004), *Planning Policy Statement 23: Planning and Pollution Control* (London: The Stationery Office).

Part IIA of the Environmental Protection Act (Contaminated Land Regulations (England) 2002 (London: HMSO).

Rudland, D. J., Lancefield, R. M. and Mayell, P. N. (2001), *CIRIA C552. Contaminated Land Risk Assessment: A Guide to Good Practice* (London: CIRIA).

Simpson, G., Blower, T., Craig, R. N. and Wilkinson, W. B. (1989), *CIRIA Special Publication 69. The engineering implications of rising groundwater levels in the deep aquifer beneath London* (London: CIRIA).

Stone, K., Murray, A., Cooke, S., Foran, J., Gooderham, L., (2009) CIRIA C681, Unexploded Ordnance (UXO). A guide for the construction industry.

The Building Regulations (revised December 2004) 'Approved Document C. Department of the Environment and The Welsh Office'.

The Surface Waters (Abstraction for Drinking Water) (Classification) Regulations 1996 (London: HMSO).

The Surface Waters (Dangerous Substances) (Classification) Regulations 1998 (London: HMSO).

The Water Supply (Water Quality) Regulations 1989, 2000 and 2001 (London: HMSO).

Transport and Road Research Laboratory (1970), 'TRRL Road Note 29 (Appendix 1). Road pavement design'.

Transport and Road Research Laboratory (1984), 'TRRL Report LR1132 (Table C1)'.

UK Water Industry Research (2010) *UKWIR Report 10/WM/03/21. Guidance for the Selection of Water Supply Pipes to be used in Brownfield Sites* (London: UKWIR).

Water Framework Directive (2000/60/EC).

Wilson, S. A. and Card, G. B. (1999), 'Reliability and risk in gas protection design', *Ground Engineering*, February: 33–6.

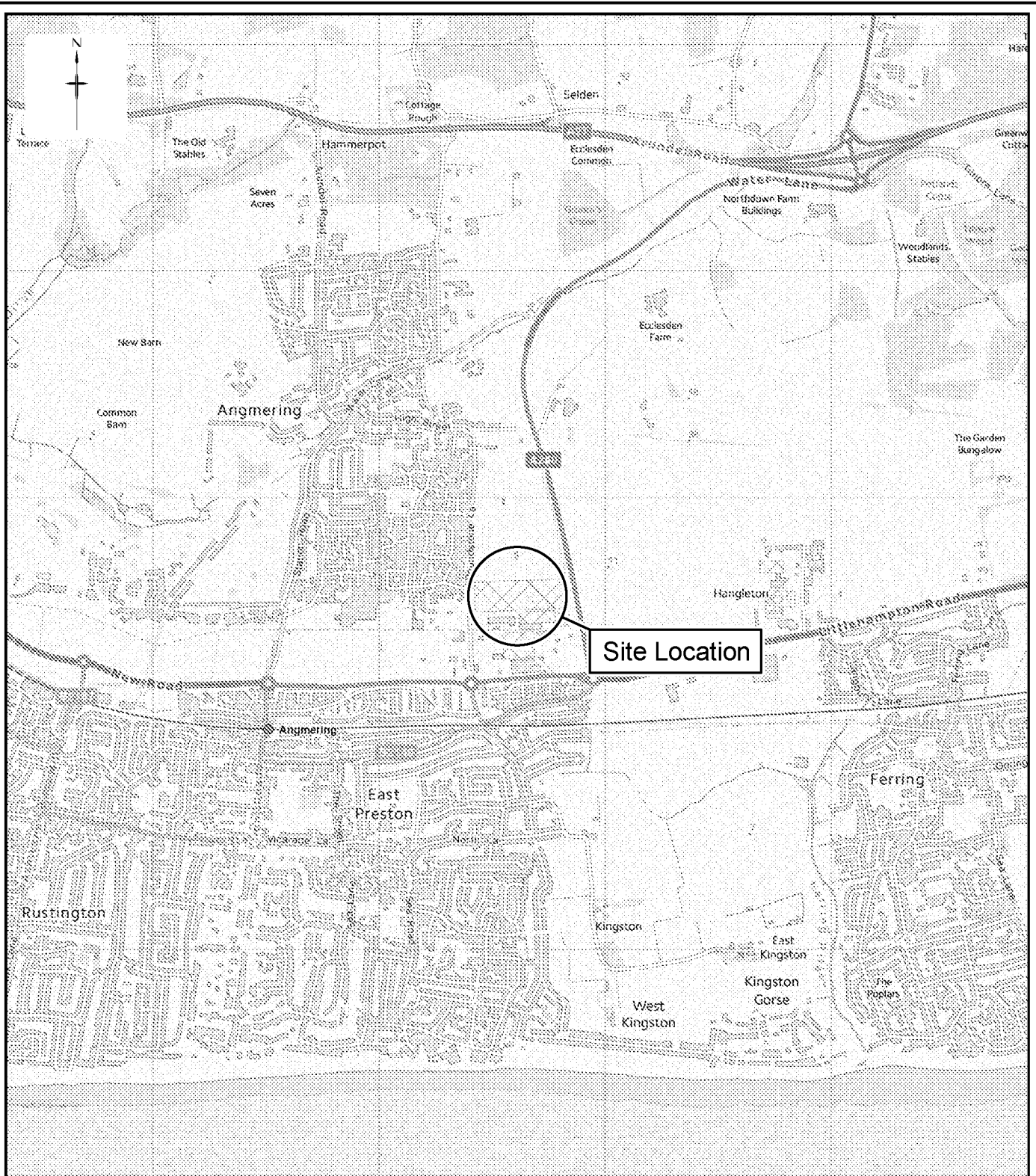
Wilson, S., Oliver, S., Mallet, H., Hutchings, H. and Card, G. (2007), *CIRIA Report C665: Assessing risks posed by hazardous ground gases to buildings* (London: CIRIA).

World Health Organization (2004), *Guidelines for drinking-water quality*, 3rd edn (Geneva: WHO).

WRc plc (2002), 'Polycyclic Aromatic Hydrocarbons (PAH): Priorities for Environmental Quality Standard Development, R&D Technical Report P45'.

USEPA (2015), Regional Screening Levels.

FIGURES



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Client

CALA HOMES (SOUTH HOME COUNTIES) LTD

Project Title

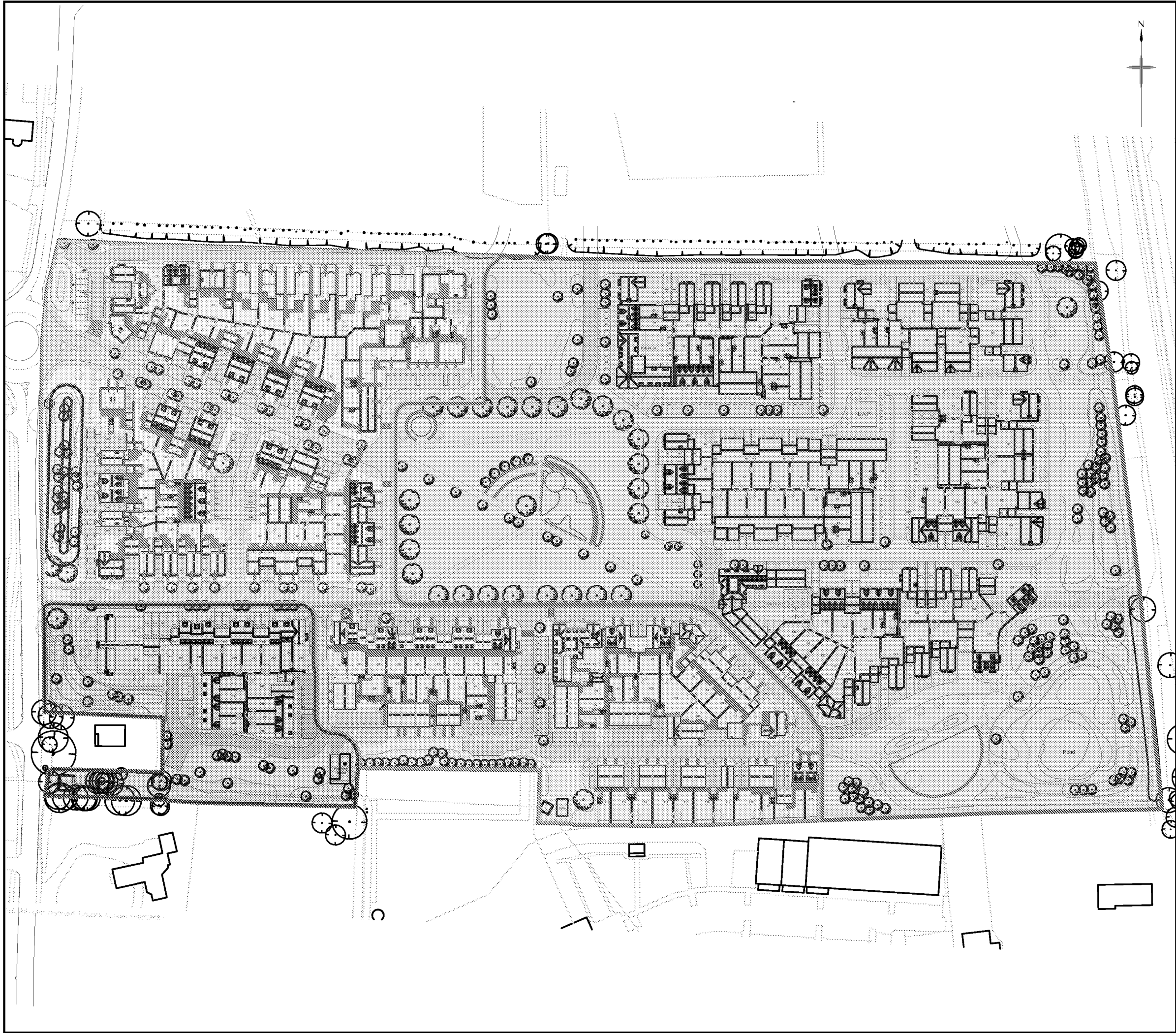
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ANGMERING**

Drawing Title

SITE LOCATION MAP

Rev	Drawn	Date	Checked	Date	Approved	Date
00	ASC	28.03.18	CL	28.03.18	CL	28.03.18
Dimensions		Scale		Original Size		
m		1:25,000		A4		

Project Number	Drawing File	Drawing Number
27621 - R09 (00)	27621 - SLP.dwg	FIGURE 1



LEGEND

- Site Boundary
- Phase 1A
- Phase 1B
- Phase 2
- Phase 3

Rev.	Date	Amendment	Drawn	Chkd.	Appd.



18 Frogmore Road
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Client	CALA HOMES (SOUTH HOME COUNTIES) LTD
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Project Title	FORMER WEST END NURSERY, ANGMERING
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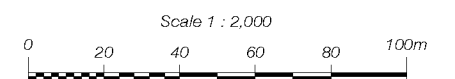
Drawing Title	PROPOSED DEVELOPMENT PLAN
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Drawn	Date	Checked	Date	Approved	Date
ASC	28.03.18	CML	28.03.18	CML	28.03.18

Scale	Orig Size	Dimensions
1:1500	A3	m

Project No.	Drawing File
27621 - R09 (00)	27621 (R09-00) Fig 2

Drawing No.	Rev.
FIGURE 2	P1





LEGEND

Phase 1B Boundary

Rev.	Date	Amendment	Drawn	Chkd.	Appd.
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18 Frogmore Road
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Client
CALA HOMES (SOUTH HOME COUNTIES) LTD

Project Title
**FORMER WEST END NURSERY,
ANGMERING**

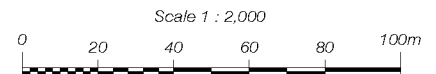
Drawing Title
**PROPOSED
DEVELOPMENT
PLAN (PHASE 1B)**

Drawn	Date	Checked	Date	Approved	Date
ASC	03.04.18	CML	03.04.18	CML	03.04.18

Scale	Orig Size	Dimensions
1:1500	A3	m

Project No.	Drawing File
27621 - R09 (00)	27621 (R09-00) Fig 3

Drawing No.	Rev.
FIGURE 3	P1





Plot Number	Front Garden		Back Garden	
	Area of Soft landscaping (m ²)	Volume of Soft landscaping (m ³)	Area of Soft landscaping (m ²)	Volume of Soft landscaping (m ³)
85	53.6294	32.17764	64.3598	38.81588
86	15.1892	8.62614	98.2552	42.21484
87	18.3277	10.99662	85.1776	48.10656
88	15.3263	9.19578	78.7855	47.2593
89	15.9895	7.195275	78.7855	35.444475
90	15.9895	7.195275	78.7855	35.444475
91	15.999	7.19965	78.7655	35.444475
92	15.9821	9.58526	85.3032	48.18192
93	21.7983	9.858335	79.8754	35.94393
94	43.6347	26.18682	47.7415	28.6449
95	10.18	6.108	84.8282	50.89572
96	8.874	5.9244	58.0355	33.8213
97	9.64	5.784	50.4051	30.24306
98	16.9883	11.99258	94.3547	58.61282
99	21.2673	12.78638	75.6612	45.36072
90	24.2808	10.92836	84.7363	38.131335
81	19.9998	11.99988	64.736	38.8416
82	20.117	12.0702	32.286	19.3596
83	9.0556	5.43336	57.7691	34.06146
84	8.5181	3.832245	95.4822	42.95799
85-92	159.7244	95.83484	177.1721	106.30326
93	17.4112	7.83504	51.9823	23.388535
94	15.9893	7.189685	80.7328	36.32976
95	16.0173	7.287786	81.0123	36.455635
96	13.5886	8.15195	58.8541	35.91246
97	32.5927	14.868715	90.1233	40.555485
98	18.9177	8.512985	79.797	35.90865
99	19.1745	9.82868	77.2342	34.75539
100	18.3612	8.23564	77.4855	34.868475
101	N/a	N/a	74.1702	44.59212
102	112.5854	67.53924	119.9713	71.98278
103	28.2905	18.9749	98.1672	57.88432
104	18.4365	7.356425	182.4404	82.09618
105	N/a	N/a	120.0562	54.02664
106	N/a	N/a	64.736	29.1312
107	N/a	N/a	34.296	15.4197
108	31.0331	18.61966	63.3774	38.02644
109	4.2494	1.91223	61.7431	27.784395
110	5.0461	3.02768	81.5398	48.92383
111	14.1517	8.49102	81.5917	48.95602
112	14.2137	8.52822	128.9318	78.15908
113	14.2136	8.39612	127.5396	57.39282
114	14.2138	8.52818	137.853	82.5918
115	15.6785	9.4071	121.8011	73.58066
116	15.6785	9.4071	126.8104	72.36824
117	15.625	9.375	121.8267	73.09602
118	14.0327	8.41982	161.424	96.8544
119	16.0459	9.62754	72.8528	43.71188
120	98.2684	57.76104	141.0161	84.60966
121	22.2324	10.09458	77.3341	34.800345

LEGEND

- Phase 1B Boundary
- 600mm Capping Layer and Geo Marker Membrane Required
- 450mm Capping Layer Required

Rev.	Date	Amendment	Drawn	Chkd.	Appd.



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Client
CALA HOMES (SOUTH HOME COUNTIES) LTD

Project Title
FORMER WEST END NURSERY, ANGMERING

Drawing Title
CAPPING THICKNESS REQUIRED (PHASE 1B)

Drawn	Date	Checked	Date	Approved	Date
ASC	28.03.18	CML	28.03.18	CML	28.03.18

Scale	Orig Size	Dimensions
1:750	A3	m

Project No.	Drawing File
27621 - R09 (00)	27621 (R09-00) Fig 4

Drawing No.	Rev.
FIGURE 4	P1

