1 INTRODUCTION

1.1 Background

This Remediation Statement has been prepared in order to satisfy Condition 9 of the planning consent (Ref. 2016/62/92055/W).

The site is located off Crosland Road, approximately 4km northwest of Huddersfield town centre; see Drawing 1823/1 in Appendix A to this letter report. Site details are summarised in the table below.

Detail	Remarks
NGR	SE 108 188
Areas	3.9 ha
Access	Off Crosland Road
Description	Grassed fields used for grazing sloping down to the southeast. A spring is present in the northeast with boggy ground also present in the northwest. Overhead powerlines cross the centre of the site orientated approximately north-south.

No significant contamination was reported across the wider site, and this Remediation Statement is therefore concerned with the northwest corner only. However, there are other issues (associated with coal etc) that affect the wider site, and these are also considered.

1.2 The proposed development

A site layout showing 109 no. 2 & 3 storey domestic dwellings has been provided by Persimmon Homes - Drawing Ref. CRO-2016-001 Rev. R dated 10th September 2018, which is reproduced as Drawing 1823/5 in Appendix A.

1.3 Ground investigation

Persimmon has made the following report available to Lithos:

- Phase 2 Geoenvironmental Assessment V2, Crosland Road, Lindley Moor (Ref. H15190 V2) issued by Patrick Parsons in dated July 2016.

In addition to the above, Lithos have previously issued a letter report (Ref. 021/1823/GLM/REG, dated 20th April 2018) detailing the findings of a supplementary investigation.

Patrick Parsons' site investigation included 36 trial pits, including soakaway testing in 4 pits, and 16 rotary percussive boreholes. Lithos' supplementary investigation comprised 10 trial pits and 13 rotary open probeholes.

Shallow ground in the northwest comprised:

Made ground topsoil: typically 300mm thick.

Made ground: encountered in Patrick Parsons' TPs 30 & 32 only and comprised gravelly clay/clayey gravel of mixed lithologies including brick, sandstone and mudstone to between 0.2m and 1.6m depth.

Natural Ground: encountered across the area comprising residual soils (gravelly clay/sandy gravel) underlain by Coal Measures bedrock.

1.4 Summary of contamination

No visual or olfactory evidence of organic contamination was noted during site work. However, a single sample of made ground recovered by Patrick Parsons (TP30), tested for a range of potential contaminants (including pH, metals, asbestos, speciated PAH & banded TPH), yielded elevated concentrations of TPH and PAH.

2 REMEDIATION STRATEGY

2.1 Aims

Remediation aims are to:

- Resolve contamination issues in order to protect environmental receptors, and render the site suitable for the proposed development
- Satisfy requirements of the Local Planning Authority

2.2 Decommissioning of boreholes

Monitoring wells in the Patrick Parsons boreholes (see Drawing1823/6A) should be decommissioned in order to prevent the possibility of gas migration into sub-floor voids. Decommissioning could be achieved by filling the well with gravel and then bentonite pellets (uppermost 2m; to be wetted after placement). The headworks should then be removed and the surface made good.

Ideally the upper length of HDPE well pipe should be back-screwed and removed from the borehole, with the resultant 'hole' to be filled with bentonite pellets (to be wetted after placement)..

2.3 Site clearance

Any trees currently under a preservation order should be identified and agreed with relevant authorities prior to the commencement of the works. All trees subject to a TPO should be clearly identified and protected by fencing in accordance with BS5837: 2012.

The site should then be cleared of all residual debris, any vegetation, shrubs, bushes and unprotected trees as instructed by Persimmon.

2.4 Supplementary Investigation

The lateral extent of residual made ground (identified by Patrick Parsons in the northwest) should be confirmed during the site preparatory works.

2.5 Shallow coal in gardens

Some excavations for foundations (most likely Plots 44 to 66) may also come into contact with coal. Care should be taken not to unnecessarily overdeepen foundations, in order to minimise the chance of encountering coal. Where foundation excavations do come into contact with coal, the foundation should be taken through the coal seam, into underlying natural in-situ strata of adequate bearing. The full thickness of coal should then be sealed with concrete to create a trench fill foundation. To prevent the ingress of air, the mass concrete fill should be placed as soon as possible after exposing the seam

By virtue of the provisions of the Coal Industry Act 1994 interests in unworked coal and coal mines previously vested in the British Coal Corporation are now vested in the Coal Authority. The developer will need to contact the Coal Authority to dig or carry away such coal as they encounter in connection with redevelopment of the site (this is often referred to as incidental coal).

Whilst there is no explicit guidance in NHBC Standards, liaison with NHBC suggests their stance is essentially the same as that they would apply to potentially combustible fills (such as Ash & Clinker). So where significant coal is present at very shallow depth in garden areas (uppermost 1m), it should either be removed, or covered with inert subsoil/topsoil so that it lies at greater than 1m depth.

The most pragmatic way of dealing with shallow coal in gardens (most likely Plots 44 to 66) will be to inspect foundation excavations, and where coal is recorded within the uppermost 1m or so then excavate an inspection pit in the rear garden. Further advice should be sought from Lithos during the construction phase.

2.6 Grouting

Lithos' supplementary mining investigation concluded that only a surface water attenuation structure (Carlow tank), proposed in the southern spur, might at risk from possible workings in the Soft Bed coal.

There is only about 7.5h bedrock cover beneath the southern half of the Carlow tank, and whilst probably not essential, it would be prudent to consider grouting of the seam. Indeed, there will be significantly less than 7.5h cover if the workings are closer to the maximum height of 2.5m encountered beneath the adjacent Miller development.

Excavation required for the northern half of the Carlow tank is likely to result in complete removal of the shallow Middle Band coal, but the excavation should be deepened if necessary, through this seam if any residual coal is exposed at formation level.

2.7 Geological fault

Plots in the far south might be underlain by a fault (see Drawing 1823/6A), and it would be prudent to inspect foundation excavations prior to casting of footings. Building can take place over the fault, without the need to search for the fault, and without the need to adopt special precautions in the footings of those plots suspected to lie in the vicinity of the fault.

However, NHBC like to see reinforcement of footings with one layer of B385 mesh placed 75mm above the base of the footing. Given the uncertainty regarding the precise line of the fault, it would be prudent to reinforce the footings of all plots within 25m of its assumed line; i.e. Plots 1, 2, 34 to 49, 53 & 54.

Further advice should be sought if a significant weak zone is encountered (e.g. ground comprising loose, broken or soft 'gouge' material) during the excavation of footings. If associated with a fault, the weak zone is likely to form a fairly continuous "linear belt", rather than a localised "pocket", and be anything from a few centimetres to a few metres in width.

2.8 Boundary issues

Persimmon's Designer should ensure that proposed levels tie in with the surrounding infrastructure, and ground levels of adjacent properties (after allowance for the placement of any required soil cover).

Advice should be sought from the Engineer if mobile contamination or redundant drains/utilities are encountered close to the site's boundaries.

2.9 Gas protection measures

In accordance with the gas risk assessment (Patrick Parsons letter ref. JR:le:H15190GRA dated 23rd March 2016), protection measures in accordance with Characteristic Situation 2 / Amber 1 were recommended for all new dwellings.

This classification appears to be conservative. The Amber 1 classification is based on the carbon dioxide concentration exceeding 5% (6%) in one of the six monitoring wells on only one occasion. Even the Characteristic Situation 2 classification is dependent on taking the highest carbon dioxide concentration from one monitoring well and the highest flow rate from another, to derive a gas screening value that exceeds the CS1 threshold (0.11 l/CO_2/hr cf threshold value of 0.07 l/CO_2/hr).

Consequently, it is considered that a classification of Green\CS2 will be more than adequate here and the following protective measures should be incorporated in all new dwellings:

Traffic light classificn and "score" req'd by BS8485#	**Floor slab (BS8485 "score")**	**Protective measures**	
		Sub-floor ventilation (BS8485 "score")	**Membrane**
			Type (BS8485 "score")
Green & **CS2** (Wilson & Card) **2.5**	*Select one from:* i. Block & Beam – **(0)**. ii. Reinforced ground bearing slab – **(0.5)**. iii. Reinforced, cast in-situ suspended slab (with minimal and suitably sealed service penetrations & joints) – **(1.5)**. iv. Reinforced ground bearing raft (with limited service penetrations cast into slab). Note: the venting area through any downstand beam should be 3 times greater than that provided by the side ventilation (air bricks) – **(1.5)**.	*Select one from:* Passive sub-floor ventilation; venting layer could be: i. A min. 150mm clear void **(2.5)**, or ii. A proprietary void former providing an equivalent clear void depth of 60mm; see Section B7 in BS8485:2015 **(2.5)**, or iii. Min. 300mm thick blanket of min. 20mm single size gravel **(1.0)**. Min. ventilation = 1,500 mm²/m run of external wall (via air bricks on each of 2 opposite sides), with 100mm pipes at 1.75m centres or honeycombing of any sub-floor sleeper walls.	Waterproof DPM (2000 gauge polyethylene). Lapped & sealed in accordance with BR 414. **(0)** *Or* Gas resistant membrane meeting all of the following criteria: • sufficiently impervious to gases with a methane gas transmission rate <40.0 ml/day/m²/atm (average) for sheet and joints (tested in accordance with BS ISO 15105-1 manometric method); • sufficiently durable to remain serviceable for the anticipated life of the building and duration of gas emissions; • sufficiently strong to withstand in-service stresses (e.g. settlement if placed below a floor slab); • sufficiently strong to withstand the installation process and following trades until covered (e.g. penetration from steel fibres in fibre reinforced concrete, penetration of reinforcement ties, tearing due to working above it, dropping tools, etc); • capable, after installation, of providing a complete barrier to the entry of the relevant gas; and • a minimum 0.4 mm thickness (1600g polyethylene) reinforced membrane (virgin polymer) • first plot and 1 in 20 plots thereafter: membrane to be visually inspected for possible damage by an independent third party (e.g. Lithos) **(2.0)**

Footnotes:

\# Score is broadly based on those outlined in BS8485:2015 (for Characteristic Situation 2, and Building Type A), but modified by Lithos to reflect the fact that this gas regime would be classed as Green in accordance with the NHBC (traffic light) methodology, and is at the lower end of the range for Characteristic Situation 2 when monitoring data is reviewed using Wilson & Card methodology.

1. A combination of two or more of the three types of protection measures (slab, ventilation & membrane) should be used to achieve the score of 2.5.
2. The membrane should always be lapped and sealed in accordance with BRE\Environment Agency Report BR 414 (2001) – "*Protective Measures for housing on gas-contaminated land*". The membrane should be **continuous** across internal walls & the cavity, and there should be a **cavity tray** in external walls.
3. In all cases there should be minimum penetration of floor slab by **services**; any penetrations should be suitably sealed.
4. Integral **garages** with occupied rooms above, or direct access through a doorway from the garage to the house, should be provided with the same protective measures as the rest of the dwelling. Buildings with basement car parks (with ventilation in accordance with Building Regulations) may not require gas resistant membranes.

Lithos' classification as Green\CS2 precludes the need for membrane validation of every plot. However, we recommend inspection of the membrane of the first plot, before it is covered, and thereafter 1 in 20 plots.

2.10 Placement of soil in garden areas

A minimum 600mm thickness of clean inert soil (comprising 450mm subsoil and 150mm topsoil) should be placed over the made ground in proposed garden and landscaped areas (but not beneath hardstanding) in the northwest; see Drawing 1823/8.

Alternatively, given the apparently isolated nature of the made ground, prior to commencement of construction it could be 'chased out', excavated and subsequently isolated beneath hardstanding.

Subsoil suitable for use as cover material could be sourced on site, subject to the Engineer's approval. The Engineer will assess accessibility, suitability, the conceptual site model (most notably the creation of new pathways by which mobile contaminants could impact controlled waters), and engineering implications (for example, increased foundation depth) before allowing any excavation of in-situ natural soils for re-use as clean cover

Any material imported for use as cover should be validated in accordance with Lithos' Protocol for Soil Importation, copied in Appendix B. This Protocol includes chemical assessment criteria which should not be exceeded.

APPENDIX A
DRAWINGS

LITHOS CONSULTING
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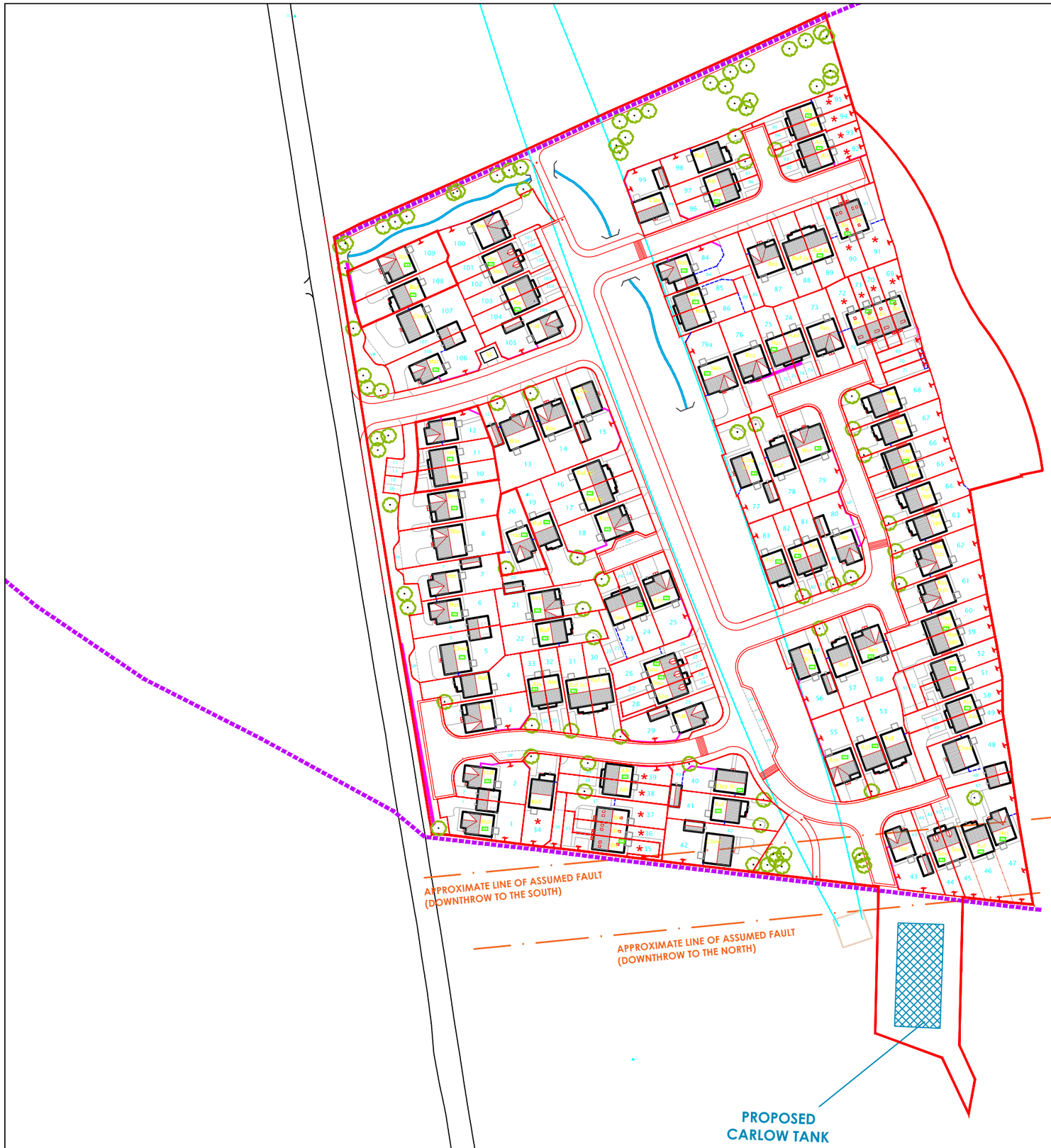
Tel 01937 545330

CLIENT	PERSIMMON HOMES WEST YORKSHIRE
JOB TITLE	CROSLAND ROAD, LINDLEY MOOR
DRAWING TITLE	LOCATION PLAN
DRAWN	LEW
DATE	13 12 2018
CHECKED	REG
DATE	13 12 2018
STATUS	FOR COMMENT ☐ DRAFT ☐ FOR APPROVAL ☐ FINAL ☑
SCALE	1:25,000
SHEET	A4
DRAWING NO.	1823/1
REVISION	A



NOTES

REPRODUCED FROM PERSIMMON HOMES' DRAWING 'CROSLAND ROAD, LINDLEY MOOR - PROPOSED PLANNING LAYOUT' DATED SEPTEMBER 2018 Ref. CRO-2016-001F

APPROXIMATE SITE BOUNDARY

CONJECTURED LINE OF FAULT

REV.	DESCRIPTION	DATE
A	Faults added	20/04/2017
B	Updated layout added	13/12/2018

LITHOS CONSULTING

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CLIENT

PERSIMMON HOMES WEST YORKSHIRE

JOB TITLE

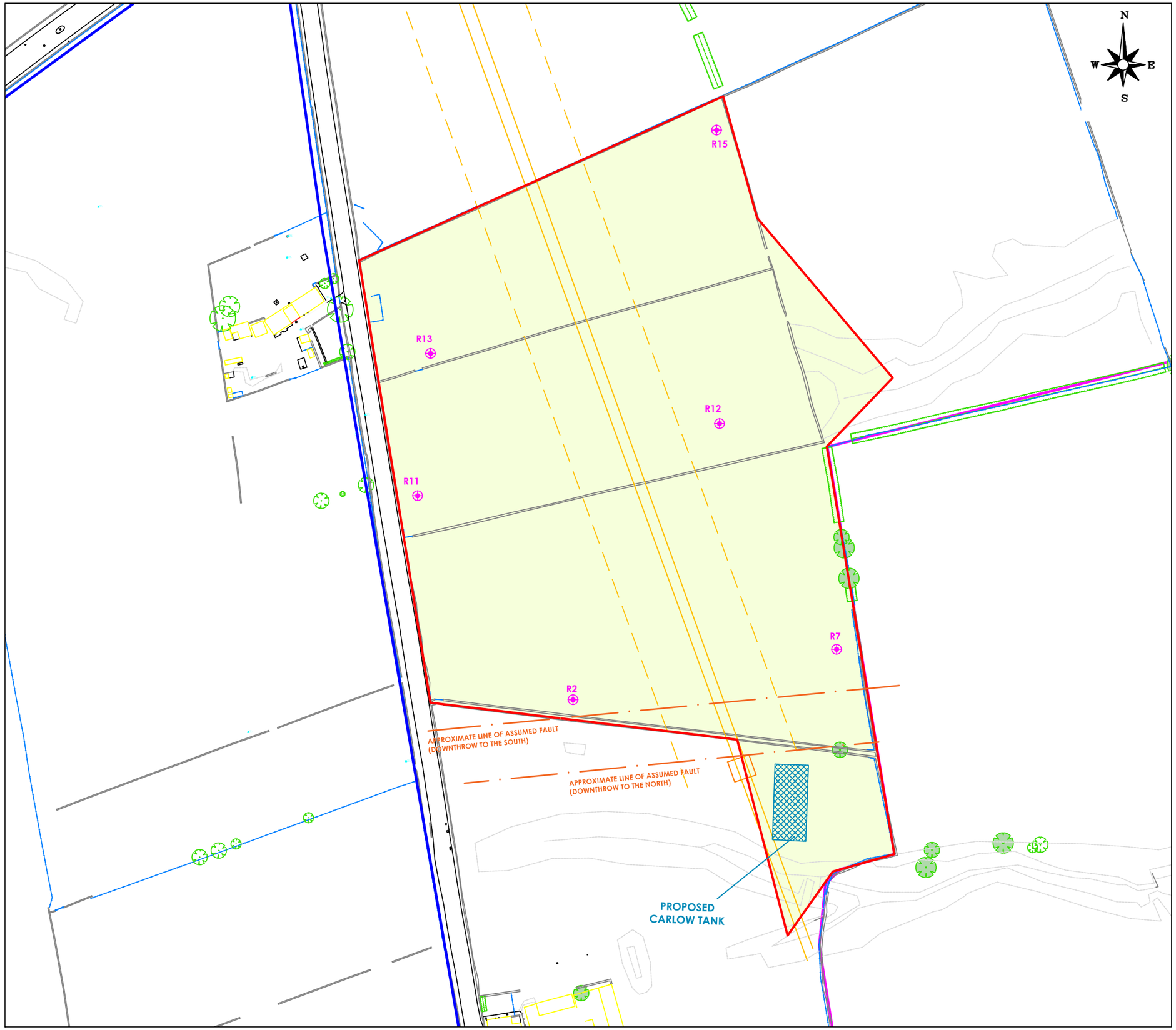
CROSLAND ROAD, LINDLEY MOOR

DRAWING TITLE

PROPOSED SITE LAYOUT

DRAWN	DATE	STATUS
LEW	23/03/2017	FOR COMMENT ☐
CHECKED	DATE	FOR APPROVAL ☐
REG	23/03/2017	DRAFT ☐
		FINAL ☑

SCALE	SHEET	DRAWING NO.	REVISION
1:1,500	A3	1823/5	B



NOTES

APPROXIMATE SITE BOUNDARY

APPROXIMATE LINE OF ASSUMED FAULT

PP WELL LOCATION

REV.	DESCRIPTION	DATE
A	PHs 10 to 13 added	20/04/2017

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CLIENT

PERSIMMON HOMES WEST YORKSHIRE

JOB TITLE

CROSLAND ROAD, LINDLEY MOOR

DRAWING TITLE

MONITORING WELL LOCATIONS

DRAWN	DATE	STATUS
LEW	07/04/2017	FOR COMMENT ☐
CHECKED	DATE	FOR APPROVAL ☐
REG	07/04/2017	DRAFT ☐
		FINAL ☑

SCALE	SHEET	DRAWING NO.	REVISION
1:1500	A3	1823/6A	

NOTES

APPROXIMATE SITE BOUNDARY

450mm SUBSOIL + 150mm TOPSOIL

AREA UNDERLAIN BY MADE GROUND

REV.	DESCRIPTION	DATE

LITHOS CONSULTING

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www.lithos.co.uk

Tel 01937 545330

CLIENT

PERSIMMON HOMES WEST YORKSHIRE

JOB TITLE

CROSLAND ROAD, LINDLEY MOOR

DRAWING TITLE

PROPOSED SITE LAYOUT & SOIL COVER IN PROPOSED GARDEN AREAS

DRAWN	DATE	STATUS
LEW	13 12 2018	FOR COMMENT ☐
CHECKED	DATE	FOR APPROVAL ☐
REG	13 12 2018	DRAFT ☐
		FINAL ☑

SCALE	SHEET	DRAWING NO.	REVISION
1:500	A3	1823/8	

APPENDIX B

LITHOS PROTOCOL FOR IMPORTATION & USE OF SOIL COVER (CAPPING)

1 INTRODUCTION

1.1 Isolation of made ground in garden and landscaped areas beneath a cover of "clean" subsoil, and topsoil is often recommended on residential developments; most notably when the made ground contains inorganic (and non-volatile organic) contaminants at concentrations above guidance threshold values. A cover solution is not appropriate for volatile or semi-volatile organic contaminants (fuels, solvents etc); removal or treatment will usually be required.

1.2 The thickness of cover is dependent on the nature and degree of contamination (and sometimes the Local Authority whose area the site lies within), but typically between 600mm and 1,000mm is required. Where contamination is more significant a granular hard-dig layer or geotextile marker membrane may also be required at the base of the cover.

1.3 If the made ground is essentially "clean", but contains materials generally considered undesirable as near-surface material in garden areas (e.g. oversize materials such as construction/demolition rubble) then, in accordance with NHBC Standards Chapter 9.2, a 300mm thick soil cover should be adequate. If the made ground is essentially "clean" and comprises reworked natural soil, the only cover likely to be required is topsoil.

1.4 The "clean" soil cover blocks potential linkages between the contaminated made ground and future residents. Soil cover is not required beneath drives, garages or houses.

1.5 The **CML initiative**, which came into force on 1st April 2003, requires housebuilders to submit to NHBC (or other warranty provider) a validation report confirming the thickness and quality (i.e. contaminant-free) of the placed soil cover. Validation reports should normally be prepared by independent geoenvironmental consultants.

1.6 Failure to submit cover validation reports promptly will delay issue of the cover note by the warranty provider, which will subsequently delay the release of mortgage funds and hence legal completion; i.e. the financial implications are significant. Consequently, it is essential that cover validation is requested at least 2 weeks prior to the anticipated finalling date.

1.7 Soil cover is usually placed many weeks after completion of the preparatory/remediation works, and issue of the associated Verification Report, typically at a relatively late stage in the construction programme.

1.8 Prior to placement of soil cover, the appointed remediation contractor and/or groundworker should ensure that ground levels are low enough to accommodate the required cover thickness, taking account of any boundary issues, and without compromising the DPC and any sub-floor ventilation.

1.9 Ideally soil **quality** should be determined by sampling of the **source** at least 7 working days before importation to the development site. Samples could be obtained from stockpiles on site, which may on occasion comprise surplus natural ground development arisings. Soil samples could be obtained from gardens after placement, but this is not recommended.

1.10 Clearly, if soil cover is imported and placed before confirmation of its suitability, no guarantee can be given that validation work will yield the desired results. It may therefore be necessary to excavate and export the placed soil cover and/or import further "clean" soil.

1.11 Where soils have been tested at source and temporarily stockpiled on site, stockpiles should be fenced-off and marked as containing certified topsoil/subsoil. The soil should be inspected prior to placement to confirm that it is the same material as previously tested, and that it has not been cross-contaminated with miscellaneous arisings generated during the construction works.

1.12 Soil **thickness** can only be checked after placement; this should be done before turfing / landscaping, but ideally after scaffolding has been dismantled.

1.13 ***Sampling Frequency (to check Soil Quality):*** The number of samples tested will be dependent on the nature of the source, and the quantity of material to be imported. However, in accordance with current YAHPAC (Yorkshire & Humberside Pollution Advisory Council) guidance (Verification Requirements for Cover Systems: Technical Guidance for Developers, Landowners & Consultants; Version 3.2, October 2014), the testing frequency should be as follows:

Nature of source	Number of samples (from any single source material)	
	Up to 1,000m³	Per additional 1,000m³
Greenfield	At least 3, with at least 1 sample per 250m³	2
Brownfield	At least 6, with at least 1 sample per 100m³	2
Crushed product	At least 3, with at least 1 sample per 500m³	2

1.14 On a typical development with gardens comprising a total area of 100m² (front and rear), and a soil cover thickness of 600mm including 100mm topsoil, for a brownfield source this testing frequency equates to approximately one topsoil sample per ten plots and one subsoil sample per two plots. Given the requirement to test a minimum number of samples from any one source, the testing frequency effectively increases for sites with only a small number of plots.

1.15 **Inspection Frequency (to check Soil Thickness):** The number of inspection pits excavated to check cover thickness (and collect samples, if testing at source has not been undertaken), should be dependent on the number of plots associated with the given development. The following frequencies are recommended:

No. plots within development	Frequency of inspection pits	Remarks
1 to 5	1 pit per plot	e.g. for 3 plots, dig 3 inspection pits
6 to 20	1 pit per 2 plots	e.g. for 9 plots, dig 5 inspection pits
21 to 30	1 pit per 3 plots	e.g. for 23 plots, dig 8 inspection pits
≥ 30	1 pit per 4 plots	e.g. for 39 plots, dig 10 inspection pits

1.16 Photographs should be taken of each inspection pit to show:

- The thickness of cover material present
- The presence of any geotextile marker or granular hard-dig layer (if required)
- The position of each inspection pit in relation to the plot

1.17 **Soil Material Suitability**: Inspection pits should be excavated through the entire thickness of any proposed in-situ source material, or cover material (if inspection is post-placement). Stockpiles should be assessed from both the surface and by digging into the "core", to ensure the material is reasonably homogenous.

1.18 The soil material should comply with the following requirements:

- Be clean and free of foreign debris, building waste materials, glass sharps, and contaminants
- Topsoil should not have a gravel content of greater than 30% by dry weight and should generally have a maximum stone size of 50mm in any one direction
- Subsoil should generally have a maximum stone size of 150mm in any one direction
- Not have been sourced from an area within 7m laterally, or 3m vertically, of Japanese Knotweed plants, and not contain any Japanese Knotweed fragments (rhizomes, leaves, stems etc)

1.19 **Laboratory Analysis:** Whether samples are taken at source, from stockpiles on site, or from gardens after placement, they should be forwarded to an analytical laboratory for testing in accordance with one of the Schedules detailed in Table 1.

1.20 Imported topsoil should be subject to such testing, unless it is being sourced from a reputable commercial supplier able to provide robust certification (certificate date less than 2 months prior to import date). In addition, some analysis in accordance with BS3882 may occasionally be appropriate.

Table 1 – Test schedule

Source	Test schedule
Greenfield & Manufactured topsoil	pH, total metals (Cu, Ni, Zn, Cr III, Cr VI, As, Hg, Se, Cd & Pb), water soluble boron. TOC & speciated PAH Asbestos ID
Brownfield & Soil transfer stations	pH, total metals (Cu, Ni, Zn, Cr III, Cr VI, As, Hg, Se, Cd & Pb), water soluble boron. TOC, Speciated PAH & banded TPH* Asbestos ID
Crushed product	pH, total metals (Cu, Ni, Zn, Cr III, Cr VI, As, Hg, Se, Cd & Pb), water soluble boron. TOC & Speciated PAH Asbestos ID

Note: The schedules detailed above have been prepared in accordance with the Secondary Model Procedures. This document states that analysis should be relevant to potential sources and not merely a set list of parameters applied to each site.

* The YAHPAC guidance recommends speciated TPH (TPH CWG) analysis for brownfield sources, but this should not be necessary unless the banded TPH analysis fails the assessment criteria detailed in Table 2 below.

Where crushed product is used at least 600mm below finished garden level, only asbestos analysis will be required.

1.21 Additional determinands may be scheduled dependent on the history of the source site, although if this is considered necessary it may suggest the material is unlikely to be suitable for use as clean cover in gardens.

1.22 Chemical assessment (Tier 1) criteria for imported soils are provided in Table 2, these reflect exposure and toxicological amendments proposed within the C4SL report. Where no revised toxicological value has been published the former CLEA value has been adopted.

Table 2 - Chemical assessment criteria for imported soils

Contaminant	Source	Tier 1 assessment criteria (mg/kg)	Comments/notes
pH	CLEA		
As	C4SL	37	
Cd	C4SL	26	
Cr (III)	C4SL	3,000	
Cr (VI)	C4SL	21	
Pb	C4SL	200	
Ni	C4SL	127	Assessment of human health risk only.
Se	C4SL	434	
Hg	C4SL	199	Assumes mercury present as an inorganic compound (cf elemental metal or within organic compound). See Science Report SC050021/Mercury SGV.
B	Lithos	5	Based on phytotoxic risks as plants are the more sensitive receptor (Cu is pH dependent).
Cu	DoE	80 to 200	
Zn	DoE	200	
Benzo(a)pyrene	C4SL	5	
Naphthalene	C4SL	12	
GRO	C4SL	45	Conservative value based on value for aromatic fraction C7 to C8 range, but assuming indoor inhalation pathway still relevant (it shouldn't be).
DRO	C4SL	219	Conservative value based on value for aliphatic fraction C10 to C12 range, but assuming indoor inhalation pathway still relevant (it shouldn't be).
LRO	C4SL	1,000	Calculated value above hazardous waste screen in WM3, there 1,000mg/kg adopted. This may be reviewed on a site specific basis depending on the source and nature of transfer.

2 VALIDATION REPORTS

2.1 The analytical testing will usually be undertaken on a 3 or 5-day turnaround and the Client/Contractor will be notified of the soil's suitability (or otherwise) immediately after receipt of the results.

2.2 Interim plot validation certificates should be issued to warranty providers on a plot by plot (or block by block) basis as development proceeds. Once the full development has been completed these should be pulled together into a final verification report, for submission to the Local Authority to satisfy planning conditions.