REMEDIATION STRATEGY
NORTH LITTLEHAMPTON
WEST SUSSEX
PERSIMMON HOMES
RMS-18426C-14-288
OCTOBER 2014

idom merebrook

AN idom GROUP COMPANY

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Current Document Details

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Rev	Date	Author	Checked	Approved

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SECTION 1 INTRODUCTION

1.1 Persimmon Homes (Persimmon) has commissioned Idom Merebrook (Merebrook) to act as their consultant with respect to the contamination aspects of the development of an area located to the north of Wick, Littlehampton for residential and mixed-use purposes.

1.2 Desk-based and intrusive geo-environmental investigations have been undertaken in relation to the subject site by Merebrook to establish ground conditions and the groundwater regime at the site. The site investigation data and qualitative risk assessment have been reported in the following documents:

i. Geo environmental assessment, report reference GEA-18426-14-69, dated February 2014; and,

ii. Gas risk assessment, letter report reference L-18426-2.4.2-14-S326-MSG dated 4 July 2014.

1.3 The key findings of the above reports and recommendations are summarised in the following sections. However, the above-referenced reports should be read in conjunction with this document. Merebrook has also undertaken an asbestos management survey, details of which are provided in report reference AS-18426b-14-62 dated February 2014.

1.4 The site limits and proposed development zones are shown in drawing CB-60-012-A102A, in Appendix 1.

1.5 This document has been prepared to support the discharge of parts iii and iv of Condition 33 of planning permission LU/47/11 issued by Arun District Council as follows;

iii. The results of the site investigation and detailed risk assessment referred to in (ii) and, based on these, an options appraisal and remediation strategy giving full details of the remediation measures required and how they are to be undertaken.

iv. A verification plan providing details of the data that will be collected in order to demonstrate that the works set out in the remediation strategy in (iii) are complete and identifying any requirements for longer-term monitoring of pollutant linkages, maintenance and arrangements for contingency action.

1.6 This report has been prepared for Persimmon for the purposes detailed above. No duty of care to any third parties is implied or offered. Third parties making reference to this report do so at their own risk and should consult Merebrook and Persimmon as to the extent to which the findings may be suitable for their use.

SECTION 2 BACKGROUND

2.1 GENERAL

2.1.1 The history and setting of the site have been fully described in the aforementioned geoenvironmental assessment report.

2.1.2 In summary, historic plans show that the majority of the site was historically undeveloped prior to 1974 when three nurseries and a farm were constructed on the site. These nurseries have remained, with a depot also developed in the central portion of the site prior to 1981.

2.1.3 From the historic maps, the nurseries located on the site are a potentially contaminative land use due to kerosene storage, the use and storage of pesticides and herbicides and associated heating system for the glasshouses. These were commonly oil-powered and supported by asbestos-lagged pipes.

2.1.4 Several potentially significant contaminative land uses are located within a 250 m radius of the site. These include the railway track adjacent to the southern boundary, another nursery and farm adjacent to the southern boundary and two poultry farms 150 m and 200 m to the south of the site.

2.1.5 The site walkover and asbestos management survey identified asbestos containing materials (ACM) both across the surface of the site and within building fabric.

2.1.6 Japanese knotweed was also identified in the western portion of the site and eradication measures will be required, possibly including chemical treatment or physical removal.

2.2 PROPOSED DEVELOPMENT

2.2.1 The proposed development comprises approximately 1,260 residential dwellings employment floorspace, local facilities, a hotel, a care home, a primary school, a community centre, youth and leisure facilities, an extension to an existing household recycling centre, landscaping, replacement and additional allotments, multi-functional green infrastructure including sports pitches, informal open space and children's play areas.

2.3 LIMITATIONS

2.3.1 Remedial works proposals are made on the basis of the assessment in relation to wider land use zones provided by the client. It is recognised that individual residential plot layouts, buildings and open space areas in relation to existing sampling points and areas of known contamination may require further definition and additional sampling and assessment.

SECTION 3 SUMMARY OF INTRUSIVE INVESTIGATION

3.1 An intrusive investigation was carried out by Merebrook from 27th January to 4th February 2014 and comprised the following scope of work:

i. Six cable percussion borehole (MBH1 to MBH6) to 15 metres below ground level (m bgl);

ii. Thirty-five shallow window sample boreholes (MWS01 to MWS35) to a depth of 3 m bgl;

iii. Eleven shallow hand window sample probe holes (HWS1 to WWS11) to a depth of 2 m bgl;

iv. Twenty-five machine-dug trial pits (MTP1 to MTP25) to a depth of 3 m bgl;

v. Three hand dug trial pits (HDTP1 to HDTP3) to a maximum depth of 1.3 m bgl; and

vi. Eight machine-dug soakage test pits (SP1 to SP8) to a maximum depth of 3 m bgl.

3.2 Exploratory hole locations are indicated on drawing MER18426-304-001 in Appendix 1.

3.3 Intrusive sampling locations were chosen on the basis of providing broad spatial coverage of the site and to target contaminative land uses on the site. This includes current and historical above-ground storage tanks (ASTs) and boiler houses, electrical substations, vehicle maintenance units and areas of suspected infilling identified during the site walkover and Phase 1 desk study.

3.1.1 Made ground was encountered across the site, typically in areas which had been developed, to depths of between 0.2 m to 0.8 m bgl. However, thicker deposits of made ground were encountered at several locations to the north of the site in close proximity to low-lying floodplain, where in-filling was inferred to have taken place to achieve current levels. A significant amount of made ground was also encountered in the northeastern portion of the site ranging from 2.5 m – 3.5 m.

3.1.2 No evidence of contamination was encountered in the majority of the exploratory locations. However, notable occurrences of visual and olfactory evidence of contamination in the form of staining and hydrocarbon odours (three occurrences), hydrocarbon sheen coating soil confined to made ground (one occurrence, MWS12) ashy deposits (one occurrence) and asbestos containing materials (one occurrence) were reported.

3.1.3 Made ground was underlain by raised marine, raised beach and river terrace deposits comprising soft, dark grey, slightly clayey silt, fine to coarse slightly gravelly sand and silty clay respectively.

3.1.4 The superficial geology was underlain by Chalk, which was identified at depths ranging from 0.9 m – 5.0 m bgl.

3.1.5 Groundwater strikes were observed during drilling of boreholes at 4.0 and 7.50 m bgl in MBH4. Groundwater ingress within trial pits varied between 1.20 m bgl and 3.10 m bgl.

3.1.6 A total of 114 soil samples were submitted to the laboratory which included 94 samples submitted for a broad suite of analysis (TPH CWG, speciated PAHs and heavy metals) and 20 samples submitted for an extended suite of analysis (VOCs, SVOCs, cyanide, asbestos, metalloids). Selected samples were also analysed for a pesticide suite of analysis, PCBs and asbestos screening. This included 52 samples from natural ground and 62 samples from made ground / topsoil.

3.1.7 Results of chemical soil analysis are presented in the geoenvironmental assessment. A summary of contamination levels compared to residential land use screening criteria is presented below as Table 1.

Table 1: Summary of Soils Chemical Analysis Results

CONTAMINANT	UNITS	MAX	MEAN	No of Tests	SCREENING LEVEL (SL)	No > SL*
HUMAN HEALTH RISK ASSESSMENT						
Asbestos in soil	-	-	-	36	Detected	3
pH	-	9.4	7.40	114	5	0
Cyanide	$mg.kg^{-1}$	<1	<1	114	-	-
Arsenic	$mg.kg^{-1}$	35	12.25	114	**32**	1
Cadmium	$mg.kg^{-1}$	1.1	0.426	114	**10**	0
Chromium (total)	$mg.kg^{-1}$	45	25.46	114	*627*	0
Hexavalent Chromium	$mg.kg^{-1}$	<4.0	<4.0	114	*4.3*	0
Lead	$mg.kg^{-1}$	370	26.9	114	200	2
Mercury	$mg.kg^{-1}$	<0.3	<0.3	114	**170**	0
Nickel	$mg.kg^{-1}$	54	19.54	114	**130**	0
Selenium	$mg.kg^{-1}$	1	1	114	**350**	0
TPH Aliphatic >EC_5 - EC_6	$mg.kg^{-1}$	0.1	0.1	114	*30*	0
TPH Aliphatic >EC_6 - EC_8	$mg.kg^{-1}$	0.1	0.1	114	*73*	0
TPH Aliphatic >EC_8 - EC_{10}	$mg.kg^{-1}$	3.2	0.127193	114	*19*	0
TPH Aliphatic >EC_{10} - EC_{12}	$mg.kg^{-1}$	5	1.484211	114	*93*	0
TPH Aliphatic >EC_{12} - EC_{16}	$mg.kg^{-1}$	450	9.570175	114	*740*	0
TPH Aliphatic >EC_{16} - EC_{21}	$mg.kg^{-1}$	1100	24.87632	114	*45000*	0
TPH Aliphatic >EC_{21} - EC_{35}	$mg.kg^{-1}$	2200	37.7614	114	*45000*	0
TPH Aromatic >EC_5 - EC_7	$mg.kg^{-1}$	0.1	0.1	114	*65*	0
TPH Aromatic >EC_7 - EC_8	$mg.kg^{-1}$	0.1	0.1	114	*120*	0
TPH Aromatic >EC_8 - EC_{10}	$mg.kg^{-1}$	0.2	0.100877	114	*27*	0
TPH Aromatic >EC_{10} - EC_{12}	$mg.kg^{-1}$	5.6	1.040351	114	*69*	0
TPH Aromatic >EC_{12} - EC_{16}	$mg.kg^{-1}$	350	6.039474	114	*140*	1

CONTAMINANT	UNITS	MAX	MEAN	No of Tests	SCREENING LEVEL (SL)	No > SL*
HUMAN HEALTH RISK ASSESSMENT						
TPH Aromatic >EC_{16} - EC_{21}	$mg.kg^{-1}$	560	19.66667	114	*250*	2
TPH Aromatic >EC_{21} - EC_{35}	$mg.kg^{-1}$	2800	44.69298	114	*890*	1
Naphthalene	$mg.kg^{-1}$	0.41	0.053158	114	*1.5*	0
Acenaphthylene	$mg.kg^{-1}$	0.31	0.200965	114	*170*	0
Acenaphthene	$mg.kg^{-1}$	2.6	0.145702	114	*210*	0
Fluorene	$mg.kg^{-1}$	3.1	0.238947	114	*160*	0
Phenanthrene	$mg.kg^{-1}$	16	0.535789	114	*92*	0
Anthracene	$mg.kg^{-1}$	4	0.174474	114	*2300*	0
Fluoranthene	$mg.kg^{-1}$	25	0.888509	114	*260*	0
Pyrene	$mg.kg^{-1}$	19	0.780789	114	*560*	0
Benzo(a)anthracene	$mg.kg^{-1}$	11	0.489386	114	*3.10*	3
Chrysene	$mg.kg^{-1}$	9.1	0.383509	114	*6*	2
Benzo(b)fluoranthene	$mg.kg^{-1}$	16	0.573333	114	*5.6*	2
Benzo(k)fluoranthene	$mg.kg^{-1}$	4.7	0.364123	114	*8.5*	0
Benzo(a)pyrene	$mg.kg^{-1}$	12	0.44386	114	*0.83*	7
Indeno(1,2,3-cd)pyrene	$mg.kg^{-1}$	9.1	0.387281	114	*3.2*	2
Dibenz(a,h)anthracene	$mg.kg^{-1}$	1.5	0.22614	114	*0.76*	2
Benzo(ghi)perylene	$mg.kg^{-1}$	11	0.30807	114	*44*	0
PHYTOTOXICITY RISK ASSESSMENT						
	Units	**Max**	**Mean**	**No of Test**	**Screening Level (SL)**	**No > SL**
Copper	$mg.kg^{-1}$	340	24.51	114	200	3
Nickel	$mg.kg^{-1}$	54	19.54	114	110	0
Zinc	$mg.kg^{-1}$	530	78.4552	114	300	5

3.1.8 Investigations have demonstrated the former uses of the site have resulted in contamination of the made ground with:

i. Isolated zootoxic metals and metalloids (lead and arsenic in two and one samples respectively).

ii. Phytotoxic metal associated with the made ground in the northern portion of the site;

iii. Occasional marginally PAH as benzo(a)pyrene in made ground in the north of the site and also from made ground in the south;

iv. Localised PAH and TPH soil contamination associated with the former AST in the central Fargro area;

v. Localised PAH contamination associated with staining and odours near the current AST in the eastern portion of the site;

vi. Localised PAH contamination associated with staining and odours near the mechanics workshop in the southeastern portion of the site and

vii. Asbestos fragments detected in the MTP10 and in the western portion of the site. Asbestos fibres were also detected in two soil samples.

SECTION 4 SUMMARY OF CONTAMINATION RISK ASSESSMENT

4.1 CONTROLLED WATERS

4.1.1 The Phase 1 assessment identified that the site is underlain by a Secondary A aquifer associated with superficial deposits and a Principal aquifer associated with the bedrock geology. The site is therefore considered a sensitive hydrogeological setting. However, no significant site-based impact has been identified.

4.1.2 Localised PAH and TPH groundwater contamination associated with the former AST in the central Fargro area was identified in conjunction with hydrocarbon odours and sheen but no discrete layer of free product was observed.

4.1.3 Monitoring suggests that groundwater beneath the site is not laterally continuous and instead comprises a series of groundwater pockets. The hydrocarbon contamination identified is located one known pocket where perched water has been impacted. However, a significant risk to wider controlled waters is considered to be unlikely.

4.1.4 Subject to remedial actions proposed below, remnant contamination would not appear to impact proposed piling or surface water disposal schemes.

4.2 HUMAN HEALTH (FUTURE USERS)

4.2.1 With the exception of benzo(a)pyrene at MWS4 which reached 12 $mg.kg^{-1}$, the marginal levels of PAH found elsewhere are not considered to pose a significant risk to human health from chronic or acute exposure. Similarly, sporadic elevated lead and arsenic are unlikely to pose a risk.

4.2.2 Localised hydrocarbon staining and odours coincide with the highest PAH occurrence as mentioned above and two of these containing aromatic petroleum hydrocarbons may pose a risk to health via ingestion of soil and inhalation of soil-derived dust.

4.2.3 Asbestos cement sheet identified in made ground in MTP10 would only pose a risk via inhalation of fibres if such materials become exposed and subject to deterioration during construction and subsequent occupation. Two occurrences of fibres in the soil matrix do not appear to be indicative of specific zones of asbestos contamination. The screening of 36 samples of screening of soils typical of the shallow ground does not reveal widespread impact by loose fibres in soil. One occurrence (MTP17), is shown to be located at the boundary of a floodplain area and residential zone. The other occurrence (MWS26) is shown to be located in a proposed education development zone. The likely fibre content in soil that would exist within averaging areas corresponding to the proposed development zones is likely to be low. A low risk is considered to exist.

4.2.4 Six rounds of gas monitoring were undertaken over a four month period and completed in June 2014.as reported in Merebrook letter report L-18426-2.4.2-S326-MSG. A gas risk assessment has been undertaken using guidance in CIRIA report C665: *Assessing risks posed by hazardous ground gas to buildings* which indicates that the site is classified as GREEN (no significant risk) using the NHBC traffic light system (for low rise housing with a ventilated sub-floor void) with the exception of Amber 1 (low to moderate risk) conditions which exist in MWS01 and Amber 2 (moderate risk) condition in MWS12. The latter is the location of hydrocarbon impacted made ground close to an aboveground fuel storage tank. However it is also shown to be within an area of proposed floodplain where no structures are proposed.

4.3 CONSTRUCTION WORKERS

4.3.1 Site workers employed in development of the site are potentially in the highest risk category with regard to soil contamination due to the likelihood of exposure to contaminants in excavations and during materials handling. With regards soil and groundwater contamination, the sporadic and marginal level of chemical contamination indicates that the risks are low. A low risk may exist from asbestos cement sheet in MTP10 should such material become exposed and deteriorate for example, due to crushing by moving plant. The two occurrences of trace fibres, would in our experience, be likely to result in fibre counts in air well below statutory control limits (applicable in this case to exposure durations in the construction phase) and a significant risk to groundworkers is unlikely.

4.4 INFRASTRUCTURE

4.4.1 The presence of hydrocarbon stained and malodorous soils would locally pose a risk of permeation and degradation of plastic pipe materials.

SECTION 5 REMEDIAL OPTIONS APPRAISAL

5.1 Significant pollutant linkages identified to human receptors include the following:

i. Localised exposure primarily by ingestion of and dermal contact with soil and inhalation of soil-derived dust where hydrocarbon stained and malodorous soils contain PAH and TPH fractions significantly in excess of screening levels. However, general low-level impact by organic contaminants and inorganic and metallic contaminants is unlikely to prove significant over averaging areas corresponding to the development zones.

ii. Asbestos cement sheet may pose a localised risk if such material is exposed in gardens and deteriorates to release fibres over the long term. The two occurrences of fibres in soil may pose a low risk of inhalation but would be subject to confirmation by quantitative risk assessment.

iii. Hydrocarbon in shallow impacted soils may permeate potable water pipes and taint water supplies. Exposure to hydrocarbons may occur via ingestion of water and dermal contact.

5.2 With regards to protection of human health during the occupational phase of the development, it is considered that remedial options required to remove these linkages will comprise a combination of a physical barrier to prevent exposure and localised removal of the source. For potable water supplies, a combination of localised source removal and use of resistant pipe materials is considered appropriate.

5.3 No pollutant linkages have been identified to wider controlled waters receptors, but locally perched water has been impacted by hydrocarbons. For groundwater contaminated by hydrocarbons, the remedial options are dependent upon the scale of the occurrence, which in this case is shallow and of small areal extent. Where significant impact of exploitable aquifers exists, large scale abstraction and ex situ treatment or in situ methods to attenuate and degrade contamination may be appropriate. However, in this case, the shallow and areally confined zone of impact would allow removal of impacted soil and perched water for treatment and replacement or disposal.

SECTION 6 REMEDIATION STRATEGY

6.1 CHEMICAL CONTAMINATION – SOIL AND GROUNDWATER

6.1.1 The site is understood will be developed in phases and it is expected that each area of the site will be subject to initial site strip where hardstandings, slabs and buried obstructions will be removed and any topsoil materials will be stripped and stockpiled. It is also understood that areas of the wider site will be raised to meet minimum ground levels for flood protection (500 mm above flood level).

6.1.2 Given the sporadic nature of the contamination and the overall concentrations, it is considered that - with the exception of localised zones of hydrocarbon stained soil and asbestos – the site clearance, incidental homogenisation of topsoil and usable subsoil and routine need for provision of soil cover for amenity purposes in gardens and landscaped areas, will remove the need for specific remedial works to remove or isolate contamination. This will however, be subject to a programme of careful soil segregation, management and confirmatory testing. The following sections set out the overall methodology to ensure the upper soil profile is chemically acceptable in areas where future users' exposure to soil may occur.

6.2 HYDROCARBON IMPACTED SOIL AND PERCHED GROUNDWATER

6.2.1 For contamination in MWS12 and MWS04, their positions should be recorded before site clearance to ensure relocation once oversite/buildings have been removed. Made ground containing visible staining and odours should be removed entirely to the interface with underlying chalk formation (2.5 m bgl in MWS12 and 0.90 m in MWS04) with the excavation centred upon each position and extended

outwards until no visible evidence of contamination remains. Excavations should be supervised by an environmental specialist and samples of the bases and sides screened by photoionisation detector to identify the absence of volatile hydrocarbons. One soil sample per 10 m^2 of the base and sides of the excavation will be analysed for speciated petroleum hydrocarbons. Where these meet the chemical criteria for hydrocarbon fractions in Appendix 2, the extent of excavation will be deemed sufficient, otherwise excavation will be extended.

6.2.2 In MWS12, the sides should be battered back to enable the excavation to be left open for collection of perched water. The excavation will be fenced off. Water ingress will be sampled to determine suitable treatment options. It is proposed that waters are collected for disposal to sewer or tanker removal until further water ingress demonstrates absence of free phase fuel as films or sheens and dissolved phase hydrocarbons do not exceed a screening level of 0.01 mg/l TPH. The hole will be then backfilled with suitable graded granular fill compacted to an approved specification.

6.2.3 Excavated soils are to be placed on an impermeable surface for either disposal or treatment. Disposal will take place subject to the requirements of Section 7.2 below. Arisings may be suitable for treatment and re-use subject to assessment of volumes recovered and remedial costs. Any treatment activities designed to enable re-use of previously contaminated soils will be undertaken in accordance with a specific method statement. Again, re-use will be permissible below clean cover or hardstanding if hydrocarbon fractions meet the criteria in Appendix 2 and soils are free from staining and odours.

6.3 **ASBESTOS**

6.3.1 Cement asbestos as whole sheets and fragments were identified on the ground surface in the derelict site in the western portion of the site and in the Tulley Nursery area. The Merebrook Asbestos Management Survey has also identified cement and other ACMs in the fabric of buildings. To prevent further deterioration and mixing with soils, ACMs on the surface and in buildings should be removed prior to demolition and site clearance. The works should be undertaken in accordance with the Control of Asbestos Regulations 2012 by a suitability experienced specialist and all relevant notifications to the Health and Safety Executive be made. These works and any asbestos removal which requires a licence under the regulations will require their own method statement and risk assessment, which is beyond the scope of this document. However, it is likely that work areas will require adequate signage and be excluded to personnel not engaged in the removal works and a programme of reassurance and personnel monitoring for fibres be in place for their duration.

6.3.2 ACMs in MTP10. This location is shown to be in an area where foundations will be piled and is understood to be subject to uplift to meet minimum flood risk levels. As such exposure to cement sheet may be limited to drainage or other service trench excavations. As no fibres were detected in the soil matrix at this location, it is

proposed that a watching brief be undertaken during groundworks in this northern zone where made ground containing brick fragments has been identified. Where construction excavations result in asbestos cement fragments being exposed in trench sides, bases or in arisings, such materials should be handpicked by trained staff and placed in approved containers (plastic sacks with approved warning signs, double bagged and sealed). Clean arising may then be backfilled.

6.3.3 Asbestos fibres in MTP17 and MWS26. Prior to any ground or demolition works which may result in ground disturbance, these sampling locations are to be located on the ground. The upper 1 m or full depth of made ground, whichever is the lesser, will then be sampled at four equidistant spaced locations at 3 m from the original sampling point and again at 6 m from the original sampling point. Disturbed soil samples (eight in total at each of MTP17 and MWS26) will be screened for asbestos fibres by polarised light microscopy and then quantified by weight where detected. Where no additional asbestos is detected no soil removal is proposed. Where additional soil samples are found to contain asbestos, the risk will be assessed in accordance with guidance in CIRIA 733. Additional delineation of the affected area will then be undertaken to cover the extent of a specific exposure assessment area (such as a garden or group of gardens or school playing field). Where fibre levels indicate cumulative risk leads to significant incidence of excess lifetime cancer or mesothelioma per 100 000 population, affected made ground will be removed for placement under a suitable thickness of clean cover (minimum 1 m). If site levels allow for levels to be raised sufficiently and limited disturbance of soil during construction can be ensured, affected material may be left in situ beneath clean cover or hardstandings.

6.3.4 Any soil remedial works for asbestos, in this case removal and placement beneath areas to built up, will be subject to reassurance and personnel air fibre monitoring within the area of soil handling and at its boundaries. The monitoring will be conducted daily for up to the first five days and the frequency and number of sampling points reviewed thereafter. Measures to control dust will be in place during the works (damping down by combination of misting, water hoses and bowsers).

6.4 HAZARDOUS GAS/VAPOURS

6.4.1 With regard to the exceedance of methane exhibited within MWS01, ground gas protection measures consistent with Amber 1 are required locally. A zone where gas protection to dwellings is proposed is shown on Figure 1 in Appendix 1, which is estimated on the basis of half the distance to the next nearest monitoring point where NHBC GREEN conditions exist and eastwards of MWS01 to the edge of the residential development.

6.4.2 Measures incorporated into dwellings in this zone comprise a methane resistant membrane and ventilated sub floor void. The membrane should be installed as prescribed in BRE 414 and fitted by a specialist contractor and each plot should be independently validated by a competent specialist. Ventilation of the sub-floor void

should be designed to provide a minimum of one complete volume change per 24 hours and may comprise a suspended beam and block floor construction or void former - subject to the geotechnical requirements for foundations and floor slab design.

6.4.3 Final plot numbers affected will depend upon detailed arrangement of individual dwellings. It should include plots which straddle the indicative boundary of areas where an AMBER gas regime has been identified. This remediation methodology allows for the developer to re-assess the number of plots requiring gas protection by undertaking further investigation/zonation of the gas regime in this area. This would be by means of an increased density of gas monitoring points (at a recommended 25 m interval) targeted to proposed dwelling locations and with a further six monitoring rounds undertaken over two months including at least one measurement during falling atmospheric pressure. This option will be subject to assessment of the cost of the further investigation against the savings made by excluding gas protection.

6.5 JAPANESE KNOTWEED

6.5.1 Remediation of the Japanese knotweed identified in the western portion of the site will be required through a programme of spraying or physical removal. This will be undertaken by a specialist knotweed eradication contractor. The solution will depend upon development timescales and sensitivity of the final land use in the affected zones, for example, managed open space or residential gardens. All knotweed eradication will be undertaken in accordance with *The Knotweed Code of Practice*, Environment Agency 2006 (updated 2013). A separate method statement will be provided by the chosen contractor.

6.6 INFRASTRUCTURE

6.6.1 In view of the identified hydrocarbon contamination it is recommended that use of potable water pipes is implemented following the completion of a pipeline risk assessment. The final pipe and backfill materials used will be subject to the requirements of the local utility provider and only general recommendations can be presented in this report. These include the removal of stained and malodorous soils where encountered within the depths at which pipes are to be laid. This should include an allowance for removal beyond the pipe trench to ensure no recontamination of trench backfill and validatory testing of the base and sides of the excavation.

6.7 PROTOCOLS FOR DEALING WITH UNEXPECTED CONTAMINATION

6.7.1 Any observations of ground conditions potentially atypical of those described above shall be reported to Merebrook for assessment. This includes staining, odours, suspected asbestos cement and fibrous materials. Where, upon initial inspection, it is confirmed that potential new contamination has been encountered then the works in that area will cease and Merebrook will prepare and submit a

Method Statement for assessing and dealing with the suspected contamination. This may include additional risk assessment and/or removal of contaminated material if this is deemed necessary.

SECTION 7 GENERAL SITE PRACTICES

7.1 CONSTRUCTION WORKERS

7.1.1 Management of risks during construction phase will comprise a combination of dust control, locally vapour assessment, and control and minimisation of personal exposure to soil as dust or by dermal contact and inadvertent ingestion.

7.1.2 Potential risks to construction workers have been identified and the adoption of appropriate Health and Safety procedures will ensure that risks to operatives from hazardous materials at the site are minimised. Operatives should not be allowed to eat, drink or smoke on site except in designated areas and should be required to wash all exposed skin at the end of each shift. Operatives should be informed of the potential hazards at the site and should be required to report any observations of suspect material.

7.2 WASTE MANAGEMENT

7.2.1 It is understood the works will re-use soil arisings within the Scheme in less sensitive areas where exposure to soils will be precluded. Due to a materials deficit, direct transfer of clean soils is also proposed from a Persimmon development at Yapton This will be carried out under the principles of the CL:AIRE *The Definition of Waste: Development Industry Code of Practice* (CoP). In this way re-used site-generated arisings will not be considered as waste.

7.2.2 Soils to be re-used must fulfil the following requirements in order to be considered suitable:

i. Will not cause pollution;

ii. Suitable for use (geotechnically and chemically);

iii. Certain to be used;

iv. Only the volume of material used which is need for that purpose.

7.2.3 Any soils imported from other sites for the formation of clean cover to landscaping will be either topsoil or clean subsoil as permitted by the CoP. A record will be maintained of all imported soils including quantity, visual inspection records and chemical analyses.

7.2.4 Materials, including clean waste soils, (including those from excavations for services and foundations) which are not to be retained or re-used should be removed and disposed of in accordance with all relevant statutes including the Environmental Protection Act 1990, The Controlled Waste Regulations 2012 as

amended, The Waste Regulations 2011 as amended, The List of Wastes Regulations 2005 as amended, The Hazardous Waste Regulations 2005 as amended, The Waste Management Regulations 2006 and The Environmental Permitting Regulations 2010 as amended.

7.2.5 Contaminated soil arisings will be stored in a suitable surfaced area, to be treated as a quarantine area for storage prior to disposal or treatment to enable re-use. This will be marked on a site plan to be displayed within the main site office during development. Soil storage areas will have adequate signage and have safeguards in place to prevent generation of contaminated run-off, dust and odour nuisance.

7.3 CONTROL OF EMISSIONS

7.3.1 Working hours will be restricted to those imposed by the local Planning Department to minimise the nuisance to local residents.

7.3.2 Every precaution deemed sensible and practical to prevent nuisance to neighbouring properties due to noise will be undertaken. Such precautions shall include the fitting of efficient silencers suitable for residential areas to the exhausts of the engines of all mechanical plant employed on the site.

7.3.3 During the works, all reasonable measures will be taken to suppress dust arising from the works, in order to prevent a nuisance to neighbouring properties.

7.3.4 Vehicle fuel and other potentially polluting substances shall be stored in suitable bunded secure storage areas.

7.3.5 Measures to minimise risk of fibre release and dust generation should be in place and may include the following:

i. Limiting plant movements as far as possible to defined routes which are formed from clean granular cover.

ii. Formation of highways and pavements at an early stage for use by plant.

iii. Damping down of *in situ* made ground which, if unavoidable, remains exposed at the surface during the construction phase.

7.3.6 All vehicles leaving site shall be clear of any potentially contaminated debris other than that specifically being removed. A wheel wash may be required for the duration of the works where adverse weather conditions are encountered. A mechanical sweeper will be employed as necessary to maintain clean highways in the area of the site.

7.3.7 No machinery used on site during the execution of the works shall be operated outside the limits of the site other than when travelling on public roads.

7.3.8 All vehicles carrying materials from site shall be fully sheeted before leaving the site and shall be loaded in such a way that no loose material can fall onto any highway.

7.3.9 Public highways shall not be used for the storage of materials or plant.

SECTION 8 VERIFICATION PLAN

8.1 VALIDATION OF IMPORTED MATERIALS

8.1.1 Subject to the completion of remedial actions in Section 6, no clean cover for risk mitigation is required. In relation to the provision of clean imported materials used to finish soft areas, these materials should be validated prior to placement in order to ensure suitability. Topsoil brought to site for landscaping and planting purposes shall, as a minimum, conform to the nutrient and textural classifications for multipurpose topsoil as defined in BS3882:2007 *Specification for topsoil and requirements for use*. Topsoil shall be free from weeds, propagules of weeds and invasive plant species and be free from debris such as glass, wire, plastic, coarse brick and concrete fragments. The supplier shall provide data in accordance with Annex E of the British Standard, including an assessment of both the provenance of the material supported by chemical data. Chemical data should include both organic and inorganic contaminants listed in Appendix 2.

8.1.2 Independent validation of the chemical quality of imported soils for use in clean cover shall be obtained at a nominal rate of approximately one sample per 250 m^3. For materials used as general fill under CoP direct transfer, suitability of use will be determined by a desk based and intrusive ground investigation of the donor site.

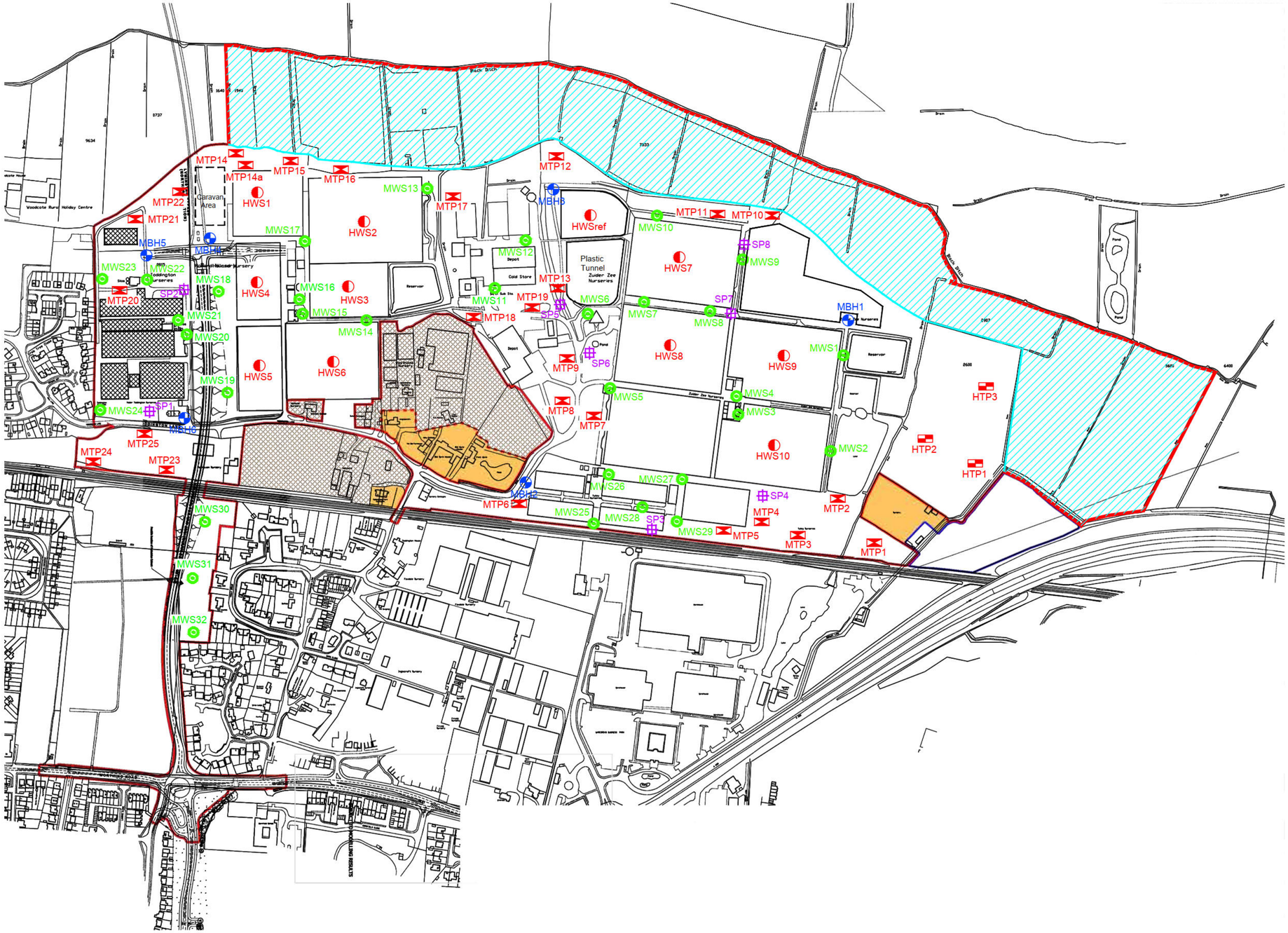
8.1.3 Topsoil shall be stockpiled and placed in accordance with the British Standard.

8.1.4 A validation report will present the above data for any imported soils, including provenance, chemical quality and depths placed. The report will also document implementation of the remedial measures detailed in Section 6 above. The validation report will be provided to Arun District Council upon completion of the development.

8.1.5 As proposed in Section 6.4 all habitable structures within areas calculated as NHBC Amber 1 or high gas regime will be inspected to ensure adequate installation of gas membranes and ventilation measures. This will include a photographic record of the installation, completed check list of installation watchpoints (taping, corner seals, pipe seals, lapping) to be signed by the inspecting specialist when satisfactory.

APPENDIX 1

- Drawings:
- CB-60-012-A102A
- Drawing 304-001
- Figure 1 – indicative Amber gas regime zone



Legend

- Red Line Boundary 78.81ha (75.59ha + 3.22ha - north & south of railway)
- Other Land controlled by Greencore Group
- Land for development not controlled by Greencore Group 5.46ha
- Land under ownership by others
- Flood plain/area not to be developed
- Inaccessible area during SI
- MWSref — Approximate Merebrook window sample location with reference
- MTPref — Approximate Merebrook trial pit location with reference
- MBHref — Approximate Merebrook borehole location with reference
- HWSref — Approximate Merebrook hand window sample location with reference
- HTPref — Approximate Merebrook hand trial pit location with reference
- SP — Approximate Merebrook soakaway location with reference

Base Drg	DATE 19/02/2014	REV -
	D.M.S.	G.O.B.	R.G.
Revision Details	Dwn	Chd	App'd

Client: Permission House South Coast

Project: North Littlehampton

Dwg Title: Site Investigation Locations

Job No.	Dwg No.	Revision
18426	18426-304-001	-
Scale: NTS	Date: 19/02/2014	Frame Dimensions mm: (A2) 544 x 370
Drawn: D.M.S.	Checked: G.O.B.	Approved: R.G.

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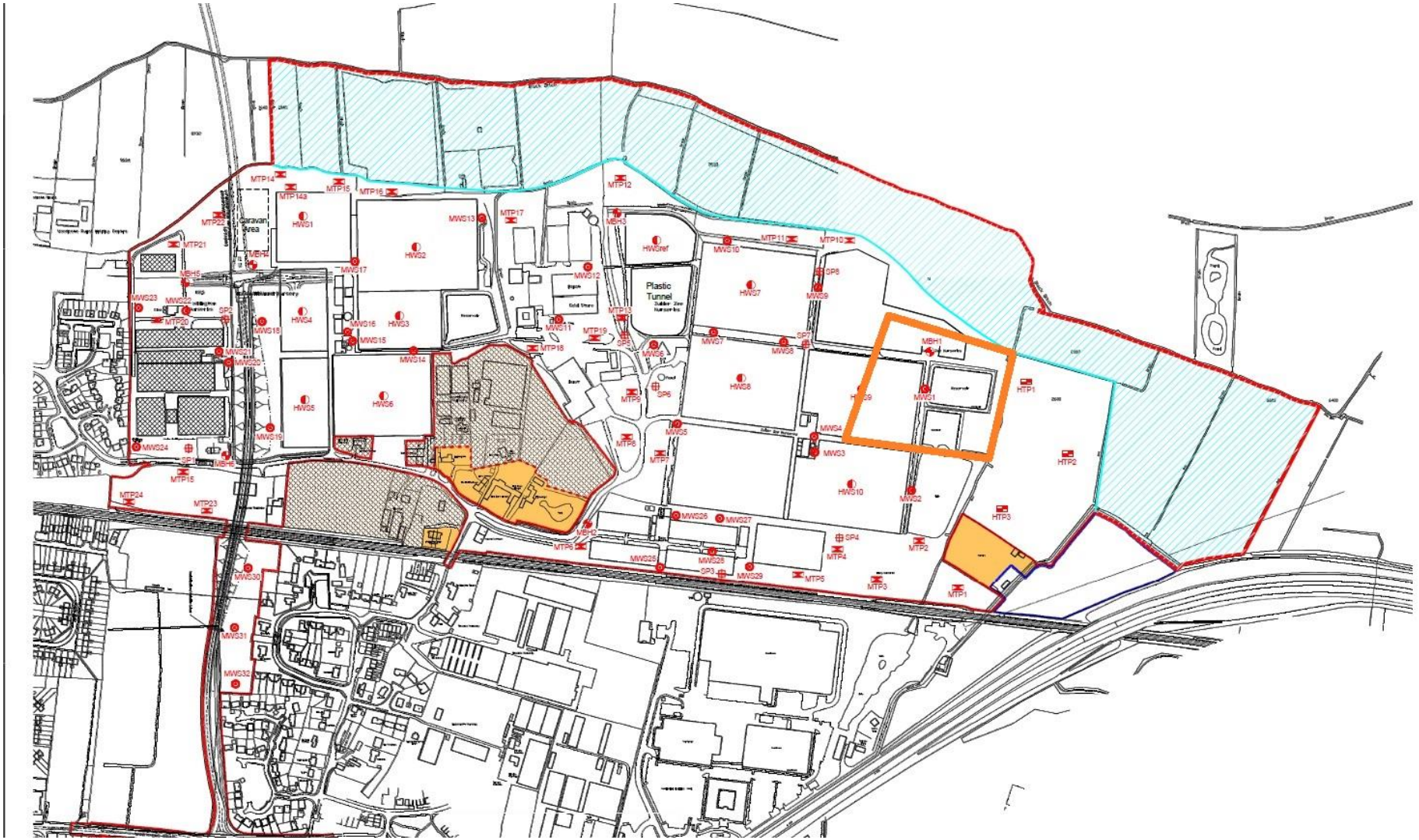

Figure 1.

Key: Area requiring ground gas protection measures.

Key

- Residential Area
- Commercial Use
- Enterprise Area
- Education
- Youth Facility
- Community Centre
- Leisure
- Hotel
- Recycling Area
- Care Home
- Further Residential
- Owned by Others

0 20 40 60 80 100m
Scale 1:2500

Drawn by : MBC Checked by : SJC

Date: MAY 2014

Revisions

Rev	Date	Drawn	Checked

INFORMATION PURPOSES ONLY

Project:

TODDINGTON LANE,
NORTH LITTLEHAMPTON

Drawing Title:

LAND USE
PLAN

Client:

PERSIMMON
Building Britain's homes for 40 years

COOPERBAILLIE
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Drg No: CB_60_012_PL002

Scale @ A1: 1:2500 Rev:

APPENDIX 2

- Soil chemical criteria – imported soil and site-won soils for placement in the upper 1 m of gardens

Determinand	Units	Screen Level (SL)
pH**	-	5-11
Arsenic	$mg.kg^{-1}$	**32.4**
Cadmium	$mg.kg^{-1}$	**10**
Chromium (total)	$mg.kg^{-1}$	*627*
Hexavalent chromium	$mg.kg^{-1}$	*4.3*
Lead	$mg.kg^{-1}$	200
Mercury (inorganic)	$mg.kg^{-1}$	**170**
Nickel	$mg.kg^{-1}$	**130**
Selenium	$mg.kg^{-1}$	**350**
Cyanide (total complex)	$mg.kg^{-1}$	16200
Aliphatic (C_5-C_6)	$mg.kg^{-1}$	*30*
Aliphatic (C_6-C_8)	$mg.kg^{-1}$	*73*
Aliphatic (C_8-C_{10})	$mg.kg^{-1}$	*19*
Aliphatic (C_{10}-C_{12})	$mg.kg^{-1}$	*93*
Aliphatic (C_{12}-C_{16})	$mg.kg^{-1}$	*740*
Aliphatic (C_{16}-C_{21})	$mg.kg^{-1}$	*45000*
Aliphatic (C_{21}-C_{35})	$mg.kg^{-1}$	*45000*
Aromatic (C_5-C_7)	$mg.kg^{-1}$	*65*
Aromatic (C_7-C_8)	$mg.kg^{-1}$	*120*
Aromatic (C_8-C_{10})	$mg.kg^{-1}$	*27*
Aromatic (C_{10}-C_{12})	$mg.kg^{-1}$	*69*
Aromatic (C_{12}-C_{16})	$mg.kg^{-1}$	*140*
Aromatic (C_{16}-C_{21})	$mg.kg^{-1}$	*250*
Aromatic (C_{21}-C_{35})	$mg.kg^{-1}$	*890*
Naphthalene	$mg.kg^{-1}$	*3.7*
Benzo (a) pyrene	$mg.kg^{-1}$	*0.94*
Phenol (as phenol)	$mg.kg^{-1}$	5
Asbestos	%	none
Staining/odours	$mg.kg^{-1}$	none

Determinand	Units	No. Tests	Screen Level (SL)
Boron	$mg.kg^{-1}$	44	3
Copper	$mg.kg^{-1}$	44	200
Nickel	$mg.kg^{-1}$	44	110
Zinc	$mg.kg^{-1}$	44	300

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