

St EDWARD HOMES

Green Park Phase 3 - Green Park Village

**Synopsis Geoenvironmental Report
on Ground Conditions**

Project Ref: 11321/3003

Doc Ref: 11321 / 3003 Rev 01

02 July 2010

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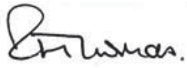
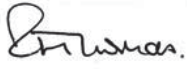
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Date: 02 July 2010

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Revision	Date	Description	Prepared	Reviewed	Approved
01	01.06.10	Final for Issue	CC	RHT	RHT

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1 Introduction

1.1 Background

Peter Brett Associates LLP (PBA) has been retained by St Edward Homes, the Client, to provide consultancy services in relation to a development proposed as part of Green Park Phase 3 referred to as Green Park Village (GPV).

PBA have prepared a number of ground condition reports (refer to Section 1.5 for details) to support a hybrid planning application where the majority of the application is outline with detailed development proposed for Phase 1. This report presents a synopsis of the findings presented in the other reports and therefore should not be considered in isolation.

Attention is drawn to Section 8 which provides guidance to assist the reader in using this report.

1.2 Site Location and General Description

The centre of the application land is located at approximate National Grid reference SU 703 705 approximately 1.5km south of Reading Town Centre and 0.5km north of the M4 Motorway.

The application land is approximately 24.65ha in area and predominantly flat and low lying. At the time of writing, the majority of the application land was unoccupied, further information on land use is presented in Chapter 2.

1.3 Proposed Development

The main elements of the proposed development comprise GPV is a residential led development supported by a range of commercial, community and education uses. Specifically the proposals will deliver:

- About 730-750 new homes including;
- An 80 unit Continuing Care Retirement Community (CCRC) scheme with extra care ancillary community facilities;
- 8 family homes for disabled persons designed in accordance with Housing Corporation guidelines;
- 16,000 sq m of Use Class B1 floorspace;
- A One Form Entry Primary School with sports pitches for dual use with the local community;
- Support facilities and recreation comprising a village hall, childcare facilities, local retail (including Class A1, A2, A3, A4 and A5); health surgery and recreation facilities;
- A network of dedicated pedestrian and cycle routes; and,
- The provision of more than 8 hectares of open space including approximately 4 ha of a high quality landscaped environment, open space, fully equipped children's play facilities (LEAPs) and sports pitches, in addition to a 4 ha lake.

These are largely the same elements and represent a similar quantum of development to the Approved Scheme. The main changes in the revised masterplan relate to the manner in which the proposed masterplan has been organised to retain much of the existing lake profile and relocate the

proposed office accommodation from adjacent to Longwater Avenue to land adjacent to the new Station. The vacated area adjacent to Longwater Avenue is replaced with residential development.

In addition, as a consequence of largely retaining the existing lake profile, the approved permanent access road to the Station and Transport Interchange and associated car parking arrangements, are required to be amended. The revised masterplan proposals utilise the temporary access road alignment, approved by the Council under a temporary Planning Permission ref. 09/00347/FUL. Proposals to upgrade the temporary access route to a permanent access route will form part of the new application.

Appendix 1 contains drawings showing the layouts of the 2010 application and also the previous application layout. The revised masterplan is not considered to alter the sources, pathways or receptors previously identified for the Approved Scheme.

1.4 Methodology Adopted for Ground Condition Assessment

The methodology adopted by PBA and used in this assessment is presented in Appendix 2. This methodology has been prepared with reference to various technical guidance including CLR11 (DEFRA 2002).

1.5 Information Sources

PBA have prepared and utilised data from the following previous ground condition reports:

- **PBA 1998:** This scoping study comprised a desk based investigation which gathered geoenvironmental and geotechnical information on the site and other land owned by Bucknell Holdings nearby. An intrusive investigation was not undertaken as part of this study.
- **PBA 2001:** This report presents the findings of ground investigation along the route of a proposed electric cable on land adjacent to the railway line. The investigation involved the excavation of nine trial pits, two boreholes and five window sample boreholes. Soil and groundwater testing was carried out on a number of samples.
- **PBA 2002:** This investigation involved the excavation of 18 trial pits and the drilling of 19 boreholes and seven window sample locations. The investigation targeted the wider Phase III area of Green Park and included soil and groundwater chemical testing along with ground gas monitoring. A geoenvironmental risk assessment and geotechnical assessment was also carried out.
- **PBA 2007A:** This report presents the findings of a gas and groundwater/surface water quality monitoring programme to assess whether lateral migration of potential pollutants from Smallmead landfill is taking place.
- **PBA 2007B:** This investigation involved the excavation of twelve trial pits and the drilling of six boreholes and eight window sample locations. The investigation targeted the wider Clembins Waste Transfer Station site and included soil and groundwater chemical testing along with ground gas monitoring.
- **PBA 2008A:** This report presents a hydrogeological risk assessment associated with the proposed dewatering of the Trout Lakes.
- **PBA 2008B:** This supplementary investigation comprised seven shallow boreholes with installations in the Pingemend Estate undertaken to support the original Green Park Village application.
- **PBA 2009A:** This investigation involved the excavation of twelve trial pits along the course of a proposed temporary access road and car park to be developed as part of the Green Park Station but the subject of a separate planning application.

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- **PBA 2009B:** This supplementary investigation comprised the excavation of fourteen trial pits and the drilling of seven boreholes in conjunction with groundwater and ground gas monitoring. This investigation targeted potential data gaps around the proposed Green Park Station development.
- **PBA 2009C:** This investigation comprised the excavation of 11 trial pits and groundwater monitoring undertaken to assess two potential hoptspots (WS8 and BHC) in order to finalise the outline remedial strategy for the proposed Green Park Station development.

2 Land Use

2.1 Introduction

The information on land use is based on historical maps presented in PBA 2002 and 2009B a selection of which are reproduced in Appendix 3 together with an aerial photograph of the application land. A walkover has been undertaken in order to up date any land use changes since the original application.

Figure 1 presents a layout plan of the application land annotated to show the features discussed below.

2.2 Land Use On Site

The application land has been sub divided into the zones shown on Figure 1 based on current/recent land use:-

2.2.1 Zone 1 - Former Clembins waste transfer site and Trout Lakes

Zone 1 is adjacent to the western boundary of the application land. Zone 1 is not currently occupied. A summary of the land use information is presented below.

- The earliest available OS map (1883) indicates that the zone consists of undeveloped common land surrounded by marshland.
- Small areas of ground workings, possibly representing borrow pits, are located adjacent to the western boundary. The borrow pits are no longer marked on the 1900 map, possibly indicating infilling.
- A waste management licence for a waste transfer and treatment facility (54/12/4/361) was issued to Mr A L Clements on the 12th June 1995. The facility is believed to have been operated by Clembins Ltd and the site vacated and operations ceased in 2007. Figure 2 shows the footprint of the land under licence and the Green Park Station development.
- The Trout Lakes are marked on the 1972 map and are shown as four lakes. Further mineral extraction within the Trout Lakes took place in 1996/1997, when material from the Lambeth Group was locally won for use as engineered fill over the Phase 1 Green Park development area. The 2008 map indicates that the Trout Lakes have been re-profiled, and are shown to be of similar layout to present day (two open water bodies (a large and a small lake)). The northeastern, southeastern and southwestern most lakes are shown to have been merged, and now form one continuous water body. The northwestern lake is shown to have been infilled over the northern half.

The Environment Agency web site shows this land to be part of an active landfill referred to as Burghfield landfill (see below) and also a historic landfill referred to as Burghfield Area D under licence reference 86253.

2.2.2 Zone 2 - Pingemead Estate

Zone 2 is located adjacent to the eastern boundary of the Trout lakes. Pingemead Estate comprises residential properties (Pingemead House and Pynings Bungalow), three single storey semi derelict buildings (two timber and one portacabin) and five industrial units.

The semi derelict buildings were previously used by a builders merchant for storage of wood and metal.

The industrial units are built on concrete raft foundations. The units are surrounded by road and hard standing for access and parking with small areas of landscaping comprising dense vegetation of trees and shrubs. The layout of industrial estate buildings is shown on Figure 3. Operations within the industrial estate have included the following:

- Steel fabricators
- Aluminium fabricators
- Car servicing and body workshop
- Mini specialists
- Oil distributors
- Photocopier sales

The northern part of Zone 2 is currently unoccupied but has historically been used as a vehicle storage area.

A small contractors (AMEC) compound is located approximately 20m to the west of Pynings Bungalow.

2.2.3 Zone 3 – Eastern Triangle

This is predominately open ground with a small training centre belonging to Thames Valley University accessed off Longwater Avenue.

- Whilst the majority of this area is open ground there is evidence of reprofiling of the ground and stockpiling.
- The earliest historical maps show this land as “Smallmead Common”.
- The outline of the training centre is first shown on the historical map dated 2008. The centre comprises two portacabin type structures, car parking and an open area at the rear.

2.3 Boundaries and Land Use Off Site

2.3.1 West

A railway line (Reading to Basingstoke) runs north south adjacent to the western boundary. The land beyond is open ground (grass/shrub). This land is shown on the Environment Agency web site as previously being two historic landfills known as Cottage Lane No1 and No2. Cottage Lane No1 was unlicensed and filled with inert and industrial wastes between 1977 and 1981. Cottage Lane No2 (approximately 5Ha) was filled with inert waste between 1977 and 1989 under licence 54/12/4/17 which is recorded as “returned”. Three exploratory holes are located in this area and the logs are presented in Appendix 4, together with a print out of the EA web page. A large electricity substation is present approximately 150m from the north western corner of the application land. The open water bodies of Kirtons Farm Hotel are adjacent to the railway to the south west. The lakes were formed following gravel extraction in the 1970’s.

2.3.2 South

The southern boundary to the western half of the application land is formed by Smallmead Road beyond which there is open ground used for agriculture. The southern boundary to the eastern half is formed by Longwater Avenue beyond which is the recently constructed Green Park development that

predominately comprises offices. The former Courage Brewery is located approximately 1km to the south east.

2.3.3 North

A surface water ditch forms the northern boundary. The Environment Agency web site shows the land beyond the ditch to have been landfill. From the west (adjacent to the railway) is Burghfield landfill is present which is operated by Biffa/RMC, and believed to be in the process of restoration, under licence (86028) and received Hazardous waste. Adjacent to this there is Smallmead Farm, another Hazardous waste landfill, which is closed site operated by RMC under license (86029).

2.3.4 East

A large sewage works (digesters) and Reading Stadium are located on Longwater Avenue approximately 100m to the north east of the nearest development building. The stadium and sewage works were constructed in the 1990's. The Environment Agency web site shows the land to be landfills referred to as Island Road Tip, Sludge Beds and Smallmead Stadium. Remedial measures carried out as part of the redevelopment included the removal of sludge and the construction of a bentonite cut off wall into the Lambeth Group around the new works. As such, it is considered that the new Sewage Treatment Works are unlikely to represent a source that will impact the proposed development.

3 Geoenvironmental Setting

3.1 Geology

3.1.1 Published Geology

The 1:50 000 scale geological map sheet of the area (BGS, 2000) indicates the natural geology in the vicinity of the site comprises the following sequence:

Pleistocene Deposits (Superficial Deposits)	Alluvium
	Second River Terrace Deposits (sand and gravel)
Solid Deposits	Lambeth Group (stiff clay overlaying silty fine to medium sands)
	Upper Chalk Formation

The geological map indicates that the western section of the application land (Zone 1) lies within a zone designated as 'worked ground'.

3.1.2 Geology – Previous Ground Investigations

The results of the previous intrusive investigations generally confirmed the sequence of strata given in Section 3.1.1 with the addition that Made Ground is present locally and generally underlain by Alluvium or River Terrace Deposits.

The ground conditions for Zone 1 former Clembins site excluding Trout Lakes are summarised below:

Table 3.1 Summary of Strata Profile for Zone 1

Strata	Depth to Top (m bgl)	Elevation to Top (m AOD)	Thickness (m)
Made Ground (locally absent)	Ground Level	Ground Level	0.20 to 4.7
Alluvium (locally absent)	0.1 to 1.1	37.55 to 38.85	0.2 to 1.5
River Terrace Deposits	0.2 to 2.1	36.3 to 38.9	1.1 to 3.55
Lambeth Group	2.7 to 4.5	34.0 to 35.9	13.45 to 15.55
Chalk Formation	17.7 to 19.0	19.4 to 20.55	Not Proven

The ground conditions for Zone 2 Pingemead Estate are summarised below:

Table 3.2 Summary of Strata Profile for Zone 2

Strata	Depth to Top (m bgl)	Elevation to Top (m AOD)	Thickness (m)
Made Ground (locally absent)	Ground Level	Ground Level	0.0 to 1.1
Alluvium (locally absent)	0.2 to 1.1	37.90 to 38.45	0.5 to 2.6
River Terrace Deposits	1.5 to 3.0	37.25 to 35.85	0.8 to 2.5
Lambeth Group	3.7 to 4.1	34.95 to 35.40	Not Proven
Chalk Formation			

The ground conditions for Zone 3 Eastern Triangle are summarised below:

Table 3.3 Summary of Strata Profile for Zone 3

Strata	Depth to Top (m bgl)	Elevation to Top (m AOD)	Thickness (m)
Made Ground (locally absent)#	Ground Level	Ground Level	0.10 to 1.00
Alluvium (locally absent) ##	0.10 to 1.00	37.55 to 38.35	0.10 to 0.40
River Terrace Deposits	0.35 to 1.60	36.42 to 37.75	1.40 to 2.75
Lambeth Group	2.70 to 3.70	34.55 to 35.25	14.60 to 15.30
Chalk Formation	17.70 to 18.00	19.90 to 20.25	Not Proven

Made Ground was recorded in G7 and G8 (as possible Made Ground) which are located adjacent to the northern boundary and in TP 206 as land raise.

Absent in G7 and G8.

3.2 Hydrogeology and Aquifer Classification

3.2.1 Aquifer Classification

The Upper Cretaceous Chalk is classed as a Primary Aquifer, (previously classified as a Major Aquifer), and is described as layers of rock or drift deposits that have high intergranular and/or fracture permeability - meaning they usually provide a high level of water storage. They may support water supply and/or river base flow on a strategic scale.

The Superficial Drift and Bedrock (Lambeth Group) are designated as Secondary A Aquifers described as permeable layers capable of supporting water supplies at a local rather than strategic scale, and in some cases forming an important source of base flow to rivers. These were formerly classified as minor aquifers.

3.2.2 Flow Direction

The groundwater flow in the superficial deposits is to the north.

The groundwater flow in the Lambeth Group is to the south/southeast.

The regional hydrogeological map (Sheet 7) indicates that the groundwater flow within the Upper Chalk Aquifer is likely to flow towards the southeast and the potentiometric groundwater surface within the Chalk was around 35m AOD in 1976.

3.2.3 Source Protection Zones

According to the Environment Agency (EA) web site the development area is located within an Outer Groundwater Source Protection Zone (SPZ). An Inner SPZ is located adjacent to the southeast of the development boundary which relates to the abstraction located at the Scottish and Newcastle Brewery approximately 1200m to the southeast. The brewery is not operational

Two groundwater abstraction licences have been identified within a 1km radius and are summarised in Table 3.4.

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Table 3.4 Summary of Groundwater Abstraction Licenses

Licence Holder	Approximate Distance and Direction From Site (m)	Purpose of Abstraction	Licensed volume (m ³ /yr)
Kennet Valley Park Ltd	70m North	Agriculture and private water supply	6819
Reading Football Club Plc	600m Southeast	Environmental Treatment	119734

3.3 Hydrology and Surface Water

Foudry Brook is located approximately 400m from the eastern boundary, flowing in a north easterly direction.

An un-named drainage ditch is present adjacent to the northern boundary, flowing in a easterly direction to join the Foudry Brook.

A further un-named drainage ditch is located adjacent to the eastern boundary of the Pingemead Estate, believed to be flowing in a southerly direction.

A number of water bodies representing flooded former gravel pits are present within and in the immediate vicinity of the site boundary. The Trout Lakes are present within the application boundary.

The River Kennet is approximately 1.3km to the north, orientated in an east - west direction and flowing towards the east.

A Flood Relief Channel is present adjoining the extreme north eastern boundary of the Green Park Village development boundary, flowing in a northerly direction. The channel was lined with clay along the reach to the north of the site due to the presence of the landfill and sludge beds associated with a former sewage works located to the north east off the present day A33.

4 Tier 1 Hazard Identification

4.1 Introduction

UK policy and legislation promote the use of a staged risk based approach to the assessment of ground quality/conditions. The underlying principle is the evaluation of *pollutant linkages* in order to assess whether the presence of a source of contamination could potentially lead to harmful consequences. More details on the PBA approach to ground condition assessment are presented in Appendix 2.

4.2 Potential to Generate Contamination Based on Land Use

A Tier 1 hazard identification identifies the importance of a potential source of contamination based on a consideration of the previous or ongoing activities on or near to the site in general accordance with the criteria presented in the following table. In addition, consideration is given to the potential for 'point source' pollutants to be present, such as local spillages of hydrocarbons.

The classification based on landuse are identified as follows:-

- Zone 1 (former Clembins operations) - Moderate
- Zone 2 (Pingemead Estate) - Low
- Zone 3 (Eastern Triangle) - Very Low for the majority of the land and Low for the Training Centre
- Offsite North (Smallmead Landfill) – Very High
- Offsite East – Moderate and High
- Offsite South – Low and Very Low for the majority of the land and Moderate for the land adjacent to the south western boundary where the former Clembins operation was sited
- Offsite West (railway and historic landfill) – Moderate

A Conceptual Site Model is presented as Figure 4.

5 Tier 2 Hazard Identification

5.1 Intrusive Investigation

The design and procedures adopted were in general accordance with current technical guidance including BSI 1999, BS 2001 and CIRIA 2007. The analytical testing was based on possible contaminants identified in technical guidance (CRL 2 and DOE 1995).

In total there are 72 exploratory holes across the application land, of which 29 are in Zone 1, 23 in Zone 2 and 20 in Zone 3.

The early PBA intrusive investigations were designed to provide sufficient information to allow a general characterisation of the ground conditions across the application land. The locations of the exploratory holes were selected on a predominately non targeted or randomly sited basis to reflect that development end use which is varied across the application land.

Subsequent investigations focussed on Zones 1 (former Clembins site) and Zone 2 (Pingemead Estate) as the nature of the land use presented a greater potential for contamination to be present.

5.2 Selection of Assessment Criteria

The PBA rationale for selection of generic assessment criteria is presented in Appendix 5. The following text describes the report specific generic criteria adopted for the Tier 2 screening.

5.2.1 For assessing the potential to impact human health

- The soil results have been compared to the Contaminated Land Exposure Assessment (CLEA) Soil Guideline Values (SGVs), where available. For contaminants where a CLEA SGV is not available the concentrations have been compared to the criteria published by Land Quality Management (LQM).
- The groundwater, surface water and leachate results have been compared to drinking water standards and surface water abstraction standards
- The gas results have been assessed using a published methodology (CIRIA, 2007).

5.2.2 To assess the potential to impact Controlled Waters

- The groundwater, surface water and leachate results have been compared to the Environmental Quality Standards (DOE circular 7/89) as the primary receptor of concern is the environment (groundwater is not abstracted for human consumption).
- For parameters where the criterion is hardness dependant the upper value has been used as the groundwater in this area is classed as "Very Hard" which is confirmed by the alkalinity results which gives averages of 2,771mg/l, 300mg/l and 300mg/l for the superficial, Lambeth Group and Chalk respectively.
- There are no published criteria for comparison of soil results.

5.3 Gas Data

A new gas data assessment has been undertaken using the methodology presented in CIRIA C665 (CIRIA, 2007) and is presented below.

5.3.1 Gas Generation Sources

Gas generating sources have been identified as

- (1) degradable materials in the Made Ground on site (including hydrocarbons) (localised predominately Zones 1 and 2)
- (2) organic content of natural Alluvium (site wide)
- (3) landfill gas from Smallmead Landfill (off site, lined landfill receiving domestic waste)

Using the guidance the gas generation potential for the three sources are assessed as Very Low for Made Ground, Low for natural Alluvium and Very High for the off site landfill.

The recommended number of monitoring rounds and frequency depends on development and gas generation potential. The guidance is summarised below:-

Zone 1 where the development is for Commercial/Industrial end use and the worst case gas generation potential is Low the guidance recommends six rounds over two months.

Zone 2 and 3 where the development is for Residential end use and the worst case gas generation potential is Low the guidance recommends nine rounds over six months.

5.3.2 Monitoring Results – Northern Boundary (Off Site Source)

Along the northern boundary of the application land a total of 13 monitoring wells have been installed (G2 to G8 inclusive in 2002 and G9 to G14 inclusive in 2005) to allow identification of any gas migration from the adjacent landfill.

- PBA have undertaken up to six rounds of monitoring in 2002 and 14 rounds in the period May 2005 to May 2006.
- At least three of the visits were during low atmospheric pressure (less than 1000mbar). Information on atmospheric trend in the 48hours before and after each round was not recorded.
- Methane concentrations (as flammable gas) were all below the instrument limit of detection (less than 0.1%v/v).
- The maximum carbon dioxide concentration recorded was 12%v/v in G2. Elevated concentrations (of 9% and above) were recorded at this location on four of the six rounds undertaken in 2002. In the later monitoring period the maximum was 6.1%v/v. Concentrations of 1.5%v/v and above were recorded in G2, G4, G5, G9 and G10. It should be noted that Made Ground was recorded during drilling of G2, G9 and G10 peat was recorded during drilling of G4 and G5.
- The maximum flow rate was 1.2l/hr recorded in G3 on the 7th June 2002 when atmospheric pressure was 996mBar.
- Exposed slot length was good (more than 0.5m) in G2 and G8, poor (less than 0.5m) in G3, G4, G7, G9, G10, G13 and G14 and insufficient (flooded) in G5, G6, G11 and G12.

Gas screening values of 0.144l/hr (calculated using the worst case data from G2) and 0.0732l/hr (calculated using the 2005 maximum gas concentration) equate to Characteristic Situations CS2 and CS1 respectively for any residential building that is not low rise with a ventilated underfloor void (minimum 150mm).

Using guidance specific to low rise housing with a ventilated underfloor void (NHBC 2007) generates gas screening values for carbon dioxide that would characterise the situation as Green in all instances.

5.3.3 Monitoring Results – Zone 1 (Former Clembins Area)

In Zone 1 (the former Clembins area) a total of 8 wells have been installed; BH112, G1, BHA, BHB, BHC, WS1, WS2 and WS3 and a further six located in the vicinity which have been utilised in this review.

- The locations have been monitored on up to nine occasions over a two year period.
- Monitoring rounds were conducted during rising and falling atmospheric pressure conditions, with pressures at the time of monitoring between 998mb and 1027mb.
- The highest recorded methane concentration is 54.0%v/v in WS7 recorded on the 18/07/07 (the reason for this particularly high concentration in this location is not certain but the log details the presence of wood and tarmacadam). Nine of the facilities monitored recorded a concentration of 1% or more on at least one occasion and six of these recorded a concentration of 10% or more.
- The maximum carbon dioxide concentration recorded was 27.0%v/v in WS5 recorded on the 18/07/07. Seven of the facilities monitored recorded a concentration of 1.5% or more on at least one occasion and six of these recorded a concentration of 5% or more.
- The maximum flow was recorded as 6.8l/hr in BHC on the 13/01/09. It should be noted that on this occasion the slotted section was below the water level and that subsequently the well could not be monitored as the area was flooded. During the earlier rounds there was one occasion when the well was not flooded and the steady state reading was 2.1l/hr. The maximum reading from other wells was 1.0l/hr in BHE, WS3 and WS4.

The worst case flow reading of 6.8l/hr would give a maximum Gas Screening Value (GSV) of 3.6l/hr for methane. Using the flow reading from when this location was not flooded (2.1l/hr) gives a GSV of 1.13l/hr and using the more typical and widespread flow of 1.0l/hr gives a GSV of 0.54l/hr.

Using Table 8.6 from the guidance the GSVs would give the following Characteristic Situations for industrial or commercial developments:-

CS4 (GSV <15l/hr)

CS3 (GSV <3.5l/hr)

CS2 (GSV <0.7l/hr)

It is considered that CS4 is inappropriate as the GSV is only marginally above the CS3 threshold and the maximum flow is suspect due to high water levels in the monitoring well. CS3 is typical for old landfills (pre 1960's) and is considered appropriate for the widespread Made Ground at this site. This characteristic situation has been agreed in principle with both Local Authorities for the adjacent Green Park Station development.

5.3.4 Monitoring Results – Zone 2 (Pingemead Estate)

In Zone 2 a total of 11 wells have been installed; BH102, WS1, WS4, WS5, WS6, WS08/01, WS08/03, WS08/04, WS08/05, WS08/06 and WS08/08.

- PBA have undertaken up to 14 monitoring rounds in the older wells and one round in the recent WS08 wells.
- The maximum recorded methane concentration (as flammable gas) was 8.8%v/v in WS08/06. Concentrations of 1% and above were recorded in WS08/08 and WS5.

- The maximum carbon dioxide concentration recorded was 14%v/v in WS5. Elevated concentrations (of 5% and above) were recorded at this location on five of the six rounds undertaken and also in WS08/06. Concentrations of 1.5%v/v and above were recorded in WS08/01, WS4 and WS6.
- The maximum flow rate was 0.2l/hr recorded in WS5 when atmospheric pressure was low.

A gas screening value of 0.028 is calculated which equates to Characteristic Situation CS1 for any residential building that is not low rise with ventilated underfloor void (minimum 150mm).

Using guidance specific to low rise housing with ventilated underfloor void (NHBC 2007) gives a gas screening value for carbon dioxide that would characterise the Zone as "Green".

Special gas protection measures are not required for either development scenario for the majority of this zone, however, the two wells (WS5 and WS08/06) recording the highest gas concentrations are in the same vicinity and therefore further investigation has been recommended (PBA 2008B) to ascertain the source and extent and also determine if additional protection is warranted in this area.

5.3.5 Monitoring Results – Zone 3 (Triangle)

In Zone 3 a total of three wells have been installed BH 103, 104, 105.

- PBA have undertaken up to 14 monitoring rounds.
- The maximum recorded methane concentration (as flammable gas) was 2.3%v/v in BH105.
- The maximum carbon dioxide concentration recorded was 3.9%v/v in BH105.
- The maximum flow rate was 0.1l/hr recorded in BH103.

A gas screening value of 0.0039 l/hr is calculated which equates to Characteristic Situation CS1 for any residential building that is not low rise with ventilated underfloor void (minimum 150mm).

Using guidance specific to low rise housing with ventilated underfloor void the gas screening value for carbon dioxide would characterise the zone as Green.

Special gas protection measures are not required for either development scenario based on the assessment of data from within the zone. However, depending on development type to be constructed adjacent to the northern boundary further investigation of local ground gas regime might be necessary if the worst case scenario (which generated a classification of CS2) is applied. It should be noted that rather than gas migration from the adjacent landfill the gases might be generated by on site sources (alluvium/peat probably associated with the northern ditch and localised Made Ground).

If the stockpiled materials are to be used as engineered fill the materials will be screened to remove degradable matter. Suitability for re-use will require regulator approval.

5.4 Soil Data

The ground condition data has been re-assessed using current best practise and published criteria. Published criteria are only available for assessing the potential to impact human health. A highlighted table is presented in Appendix 6 and summarised below:-

- Zone 1 – none of the results exceed the published screening criteria for commercial/industrial end use.

- Zone 2 – four of the 16 samples recorded benzo(a)pyrene above the screening criterion for residential with plant up take (two are from WS08/03 and two from WS7). The two samples from WS7 also recorded nickel concentration above the screening criterion.
- Zone 3 - none of the results obtained exceed the published screening criteria for residential with plant up take.

5.5 Leachability Testing and Groundwater Data

The groundwater data has been up dated with the additional investigation data. Highlighted tables are presented in Appendix 7 and summarised below:-

5.5.1 Zone 1

- One result (BH101 in Lambeth Group) exceeded the screening criterion for copper. This result is suspect as it is unusually high and even if correct does not indicate the site as the source as the concentrations in the superficial deposits are two orders of magnitude lower.
- Four results exceed the selected screening criterion for iron, two from BHC screened in the Made Ground and two from BH112 screened in the Lambeth Group, which is situated in a hydraulically up gradient location.
- All the results exceed the selected screening criterion for ammonical nitrogen. The results from BHC stand out as particularly elevated and were the subject of further investigation and assessment in PBA 2009C. The summary assessment in this report (which has been agreed with in principle was that as (1) the contaminant is probably natural in origin, (2) that the ground conditions only seem to be adversely impacting the quality of a perched water body and (3) the wider water quality on site is similar to that regionally it is considered that remediation would not generate a betterment and is therefore not appropriate. Ammonical nitrogen has not been taken forward as a potential contaminant of concern.
- A number of parameters recorded one or more results above the secondary screening criteria (for protection of human health) – arsenic, iron, manganese, nickel, selenium, chloride, Extractable Petroleum Hydrocarbons and Polycyclic Aromatic Hydrocarbons. If the results from BHC are removed (this well is screened solely in Made Ground and all superficial deposits have been removed) then the only parameters to exceed secondary criteria were iron, manganese and PAH.
- The leachability testing on seven samples of Made Ground in Zone 1 and the land to the south (also part of the former Clembins operations) indicate that zinc, copper, vanadium, sulphate and EPH are present in a form(s) that can be mobilised (leached).

5.5.2 Zone 2

- Three of the ten results for EPH exceed the criterion and five also exceed the criterion for PAH.
- Three results exceed the selected screening criterion for iron.
- A number of parameters recorded one or more results above the secondary screening criteria (for protection of human health) – antimony, arsenic, copper, iron.
- The leachability testing on five samples of Made Ground in Zone 2 indicate that the majority of parameters are not present in a form(s) that can be mobilised (leached).

5.5.3 Zone 3

- The four samples from Zone 3 all recorded EPH and PAH below the instrument limit of detection.

- All the results exceed the selected screening criterion for ammonical nitrogen.
- A number of parameters recorded one or more results above the secondary screening criteria (for protection of human health) – copper, manganese and nickel.

6 Risk Assessment

6.1 Introduction

The ground investigation data allows the refinement of the CSM to incorporate the Hazard Identification based on actual ground conditions. The refined model is presented in tabular format in Appendix 8 as Risk Estimation Tables showing hazards and pathways for each potential receptor. It should be noted that Tables have been prepared for Zones 1 and 2 but not Zone 3 as potential hazards were not identified for Zone 3 (if there are no hazards (contaminant sources) there can be no pollutant linkages and no associated risk).

6.2 Hazards Identified for the Protection of Human Health

6.2.1 Ground gases

Ground gases have been identified as potential hazards and gas protection measure commensurate with commercial/industrial development on land assessed as having a characteristic situation of CS3 are considered appropriate for Zone 1.

Ground gases have not been identified as potential hazards however, further investigation of local ground gas regime is considered necessary to confirm that gas protection measures are not necessary for Zone 2.

Ground gases have not been identified as potential hazards for Zone 3 however, depending on development type to be constructed adjacent to the northern boundary further investigation of local ground gas regime will be considered should the worst case scenario (which generated a classification of CS2) be applied.

6.2.2 Soil Hazards

The soil chemistry has not been identified as a potential human health hazard for Zone 1.

The soil chemistry indicates that there might be localised soil hazards (nickel and benzo(a)pyrene) present in Zone 2. Due to access restrictions presented by the operations undertaken there is also the potential for unidentified ground conditions to be present (for example under buildings) which include hydrocarbons and volatile contaminants. Although the potential for unidentified ground conditions is noted the extent of any contamination is considered likely to be small scale and very localised in the context of the proposed development.

The revised CSM includes the placement of a 1m thick cover for flood alleviation purposes. The risk to human health has been estimated as Moderate/Low and further characterisation comprising delineation and possibly generation of site specific assessment criteria is proposed.

The soil chemistry has not been identified as a potential human health hazard for Zone 3. However, the presence of stockpiled materials is noted within this zone and investigation of the soil chemistry would be required to confirm suitability for re-use onsite should this be an option for this material.

6.2.3 Water Hazards

Controlled waters have been eliminated as potential sources of human health hazards on the basis that neither groundwater nor surface water is abstracted for public use within a 1km radius of the site.

The potential for hazards to ingress into water supply pipes has been retained for Zones 1 and 2 subject to discussions with the water authority. The risks associated with this pathway are estimated as very low and low. The risk can be eliminated through adoption of protected pipework if discussions indicate a need.

6.3 Hazards Identified for the Protection of Controlled Waters

6.3.1 Zone 1

The composition of the Made Ground has the potential to impact water quality and there is evidence of localised poor water quality in wells screened in the Made Ground (considered to be at least partially perched based on recharge rates during purging). The Made Ground in the northern part of the Zone is thicker than elsewhere, reflecting the re-profiling of the Trout Lakes, but there is no evidence to suggest the composition of the fill is substantially different. There are no hydraulically down gradient wells located within the site boundary screened in either the Lambeth Group or the Chalk and therefore the potential impact of the application land can not be assessed with total confidence.

However, the site Made Ground on Zone 1 is part of a wider area of Made Ground (extending south where the Green Park Station development is to be constructed) and also the application land is located in an area of landfilling. It is considered that the development reduces the risk of controlled water quality being impacted due to the placement of imported soil and hardstanding across the majority of the site which reduces leaching from the Made Ground. It is therefore considered that remediation is not required but that mitigation measures similar to those for the Green Park Station would be appropriate. The mitigation measures comprise lined drainage system, a protocol detailing management of unforeseen ground conditions and measures to ensure no uncontrolled discharges including run off, adoption of an appropriate piling technique to minimise creation of preferential pathways. The measures are considered viable both technically and commercially.

6.3.2 Zone 2

Hydrocarbons (EPH and PAH) have been identified as potential hazards to Controlled Waters. Widespread soil and/or groundwater remediation is not considered necessary but there is the potential for contaminated ground in areas not accessible such as under buildings or near services but these areas are relatively small and it is considered that there are technically and commercially available management options.

Whilst the ground investigation data does not indicate gross and/or widespread impacted ground chemistry further investigation is proposed post demolition to reduce the uncertainty associated with the potential presence of localised impacted ground.

6.3.3 Zone 3

Potential hazards have not been identified.

6.4 Confidence and Uncertainty

CLR 11 requires appropriate range and level of information to be collected. The information quality criteria given in CLR 11 are:-

- Relevant – to the context of the assessment
- Sufficient – for the required level of confidence
- Reliable – reflect the true or likely conditions
- Transparent – in meaning and origin

Green Park Phase 3 - Green Park Village

Synopsis Geoenvironmental Report on Ground Conditions

The investigation techniques adopted, sample locations and suite of potential contaminants selected provide *indicative* information on ground conditions. Whilst the data used in this assessment is considered robust and suitable for purpose, there will always be some degree of uncertainty regarding ground and gas conditions due to the potential for unforeseen ground conditions, however, these are not anticipated to result in making the development unviable as the scale of any unforeseen ground is small relative to whole site.

7 Conclusions

7.1 Introduction

The application land has been sub divided based on land use and the potential for contaminated ground to be present. The Tier 1 Hazard Identification is presented below:-

- Zone 1 (former Clembins operations) - Moderate
- Zone 2 (Pingemead Estate) - Low
- Zone 3 (Eastern Triangle) - Very Low for the majority of the land and Low for the Training Centre
- Offsite North (Smallmead Landfill) – Very High
- Offsite East – Moderate and High
- Offsite South – Low and Very Low for the majority of the land and Moderate for the land adjacent to the south western boundary where the former Clembins operation was sited
- Offsite West (railway and historic landfill) - Moderate

7.2 Protection of Human Health

Soil remediation for the protection of human health is not considered necessary in any Zone. The raising of ground levels by 1m for flood alleviation using clean inert fill will eliminate a number of potential pathways and therefore only those remaining are considered for mitigation

Gas mitigation measures are considered necessary in Zone 1. Whilst gas mitigation measures are not considered necessary across Zone 2 and 3 further investigation of the localised gas regime should be considered once the construction design is confirmed.

The adoption of protected water supply pipes in Zones 1 and 2 should be considered subject to discussions with the water utility provider.

Further investigation to determine ground conditions in areas of restricted access are considered prudent in Zone 2.

7.3 Protection of Controlled Waters

It is considered that remediation is not required in Zone 1 but that mitigation measures similar to those for the Green Park Station would be appropriate.

The ground investigation data does not indicate gross and/or widespread impacted ground chemistry in Zone 2 however further investigation is proposed post demolition of the structures that restricted access in the past, in order to reduce the uncertainty associated with the potential presence of localised impacted ground.

It is considered that neither remediation nor mitigation is required in Zone 3. The suitability for re-use of stockpiled material in this Zone will require regulator confirmation prior to placement.

8 Essential Guidance for Report Readers

This report has been prepared within an agreed timeframe and to an agreed budget that will necessarily apply some constraints on its content and usage. The remarks below are presented to assist the reader in understanding the context of this report and any general limitations or constraints. If there are any specific limitations and constraints they are described in the report text.

The opinions and recommendations expressed in this report are based on statute, guidance, and best practice current at the time of its publication. Peter Brett Associates LLP (PBA) does not accept any liability whatsoever for the consequences of any future legislative changes or the release of subsequent guidance documentation, etc. Such changes may render some of the opinions and advice in this report inappropriate or incorrect and the report should be returned to us and reassessed if required for re-use after one year from date of publication. Following delivery of the report PBA has no obligation to advise the Client or any other party of such changes or their repercussions.

Some of the conclusions in this report may be based on third party data. No guarantee can be given for the accuracy or completeness of any of the third party data used. Historical maps and aerial photographs provide a “snap shot” in time about conditions or activities at the site and cannot be relied upon as indicators of any events or activities that may have taken place at other times.

The conclusions and recommendations made in this report and the opinions expressed are based on the information reviewed and/or the ground conditions encountered in exploratory holes and the results of any field or laboratory testing undertaken. There may be ground conditions at the site that have not been disclosed by the information reviewed or by the investigative work undertaken. Such undisclosed conditions cannot be taken into account in any analysis and reporting.

It should be noted that groundwater levels, groundwater chemistry, surface water levels, surface water chemistry, soil gas concentrations and soil gas flow rates can vary due to seasonal, climatic, tidal and man made effects.

This report has been written for the sole use of the Client stated at the front of the report in relation to a specific development or scheme. The conclusions and recommendations presented herein are only relevant to the scheme or the phase of project under consideration. This report shall not be relied upon or transferred to any other party without the express written authorisation of PBA. Any such party relies upon the report at its own risk.

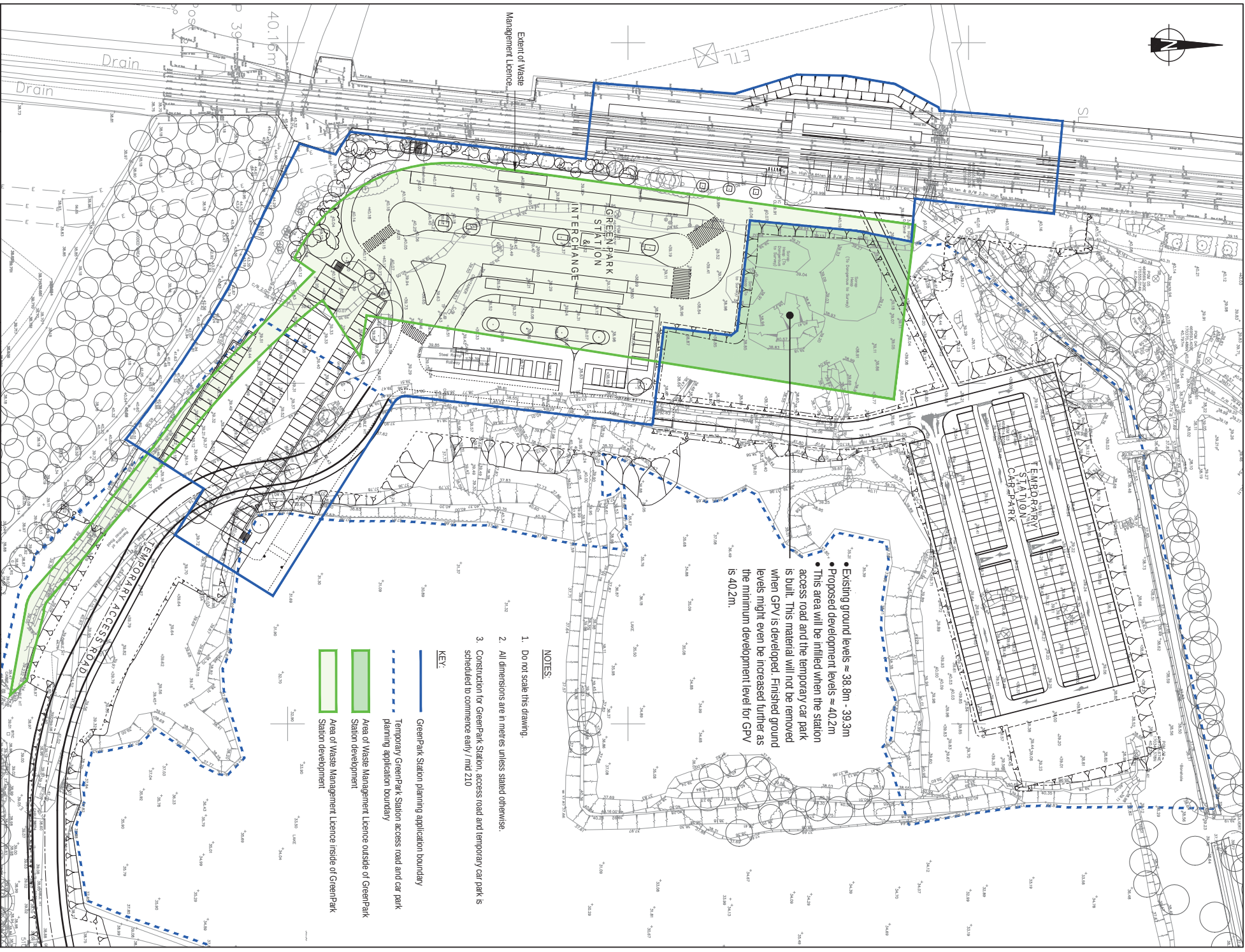
The interpretation carried out in this report is based on scientific and engineering appraisal carried out by suitably experienced and qualified technical consultants based on the scope of our engagement. We have not taken into account the perceptions of, for example, banks, insurers, other funders, lay people, etc, unless the report has been prepared specifically for that purpose. Advice from other specialists may be required such as the legal, planning and architecture professions, whether specifically recommended in our report or not.

Public or legal consultations or enquiries, or consultation with any Regulatory Bodies (such as the Environment Agency, Natural England or Local Authority) have taken place only as part of this work where specifically stated.

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- Existing ground levels $\approx 38.8\text{m} - 39.3\text{m}$
- Proposed development levels $\approx 40.2\text{m}$
- This area will be infilled when the station access road and the temporary car park is built. This material will not be removed when GPV is developed. Finished ground levels might even be increased further as the minimum development level for GPV is 40.2m .

NOTES.

1. Do not scale this drawing.
2. All dimensions are in metres unless stated otherwise.
3. Construction for GreenPark Station access road and temporary car park is scheduled to commence early / mid 210

KEY:

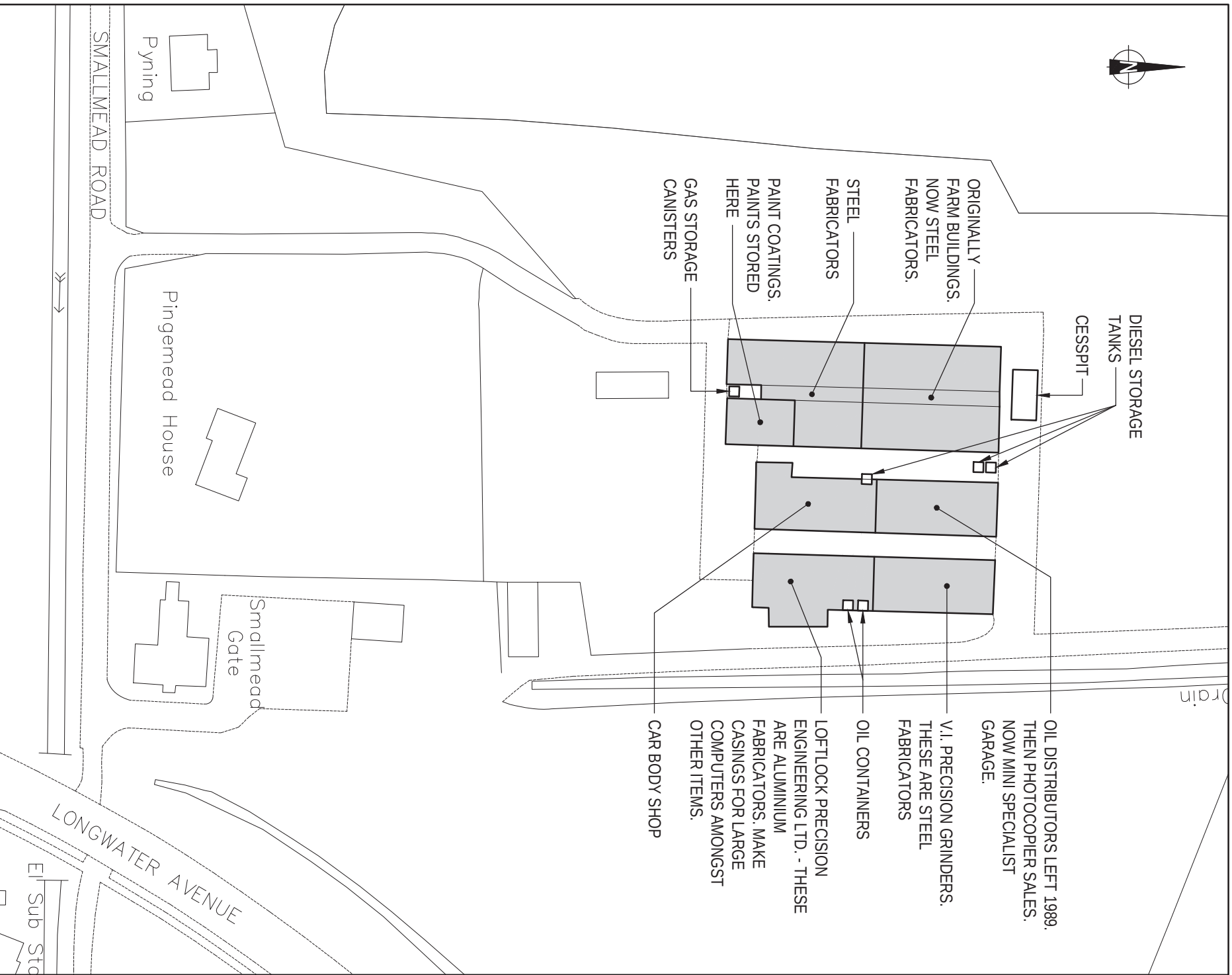
- GreenPark Station planning application boundary
- Temporary GreenPark Station access road and car park planning application boundary
- Area of Waste Management Licence outside of GreenPark Station development
- Area of Waste Management Licence inside of GreenPark Station development

Client
ST. EDWARD HOMES

GREEN PARK VILLAGE FOOTPRINT OF WASTE MANAGEMENT LICENCE IN RELATION TO GREENPARK STATION

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Mark	Revision	Drawn	Date	Chd
Drawing Status				
Date of 1st Issue	18.02.2010	Drawing Number		Revision
A3 Scale	1:1000	Figure 2		
Drawn by	WJP			
Checked by	JS			





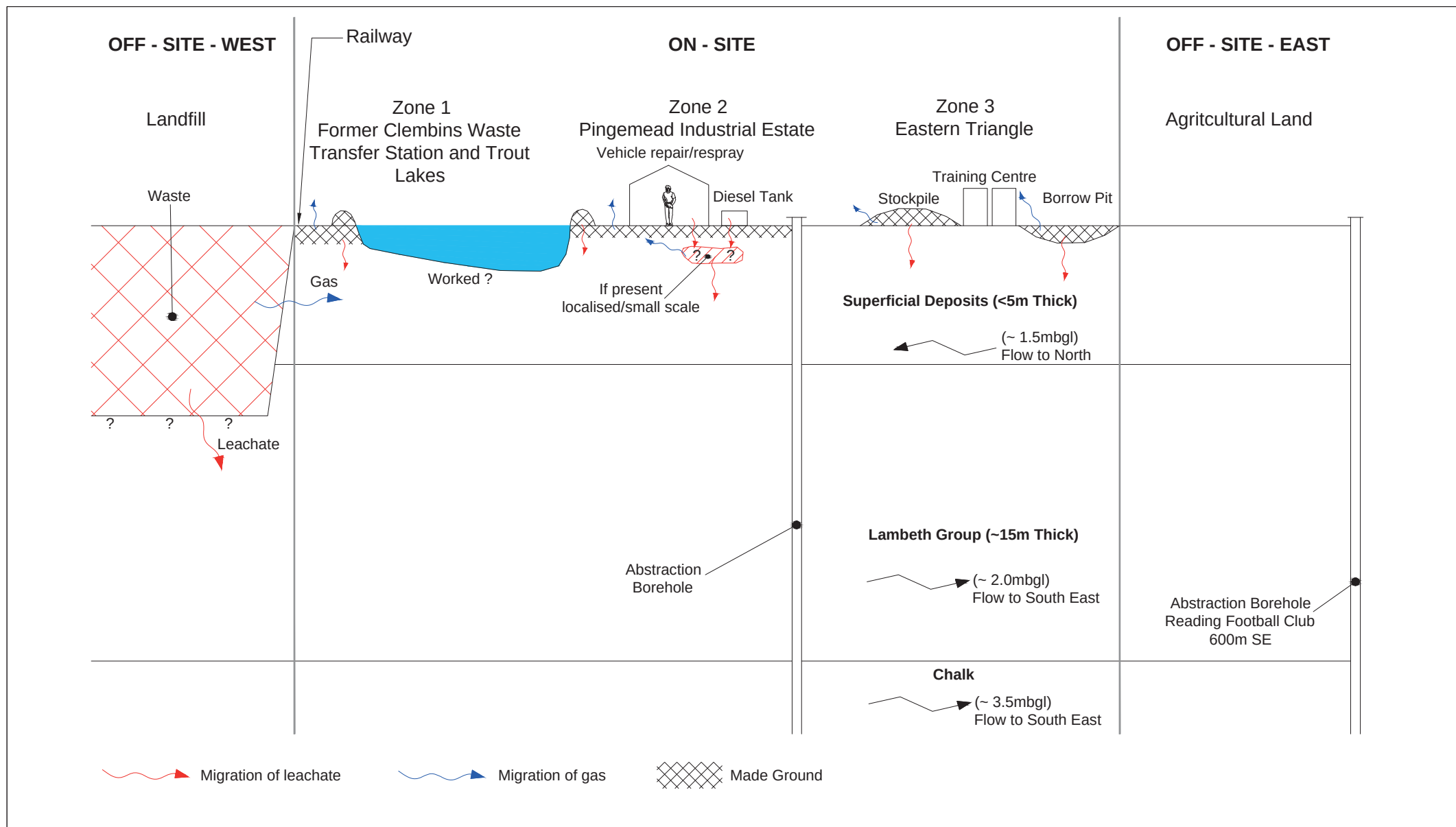
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GREEN PARK VILLAGE
CURRENT USAGE OF
PINGMEAD INDUSTRIAL
ESTATE BUILDINGS

Date	18.05.2010
A4 Scale	1:1,000
Drawn by	LJJ
Checked by	CC
Figure Number	3



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GREEN PARK VILLAGE, READING

CONCEPTUAL SITE MODEL

Date 01/05/08
A4 Scale NTS
Drawn by AG
Checked by CC

Figure Number

4



Dashed red-line indicates extent of
Detailed application

Approx gardens across site
 Garden range = 0.0-19.9m
 No. garden Appl = 15,7m
 Number of gardens less than 10m = 26 (21%)
 Number of gardens 10m to 15m = 130 (27%)
 Number of gardens 15m or more = 182 (39%)
Approx garden area
 (Total garden area)
 Garden area = 1.1m
 No. garden Appl = 15,7m
 Number of gardens less than 10m = 26 (21%)
 Number of gardens 10m to 15m = 130 (27%)
 Number of gardens 15m or more = 182 (39%)
 Approx garden area = 1.1m

Contractors are not to be held responsible for the
 accuracy of the drawing

Contractors are not to be held responsible for the
 accuracy of the drawing

The survey information shown on this
 drawing is based on a long-term survey
 prepared by a third party and Broadway
 Design Limited accepts no responsibility for
 the accuracy or completeness of the survey



Item	Area	Volume	Weight	Value	Notes
1. GreenPark Village	1.1m	1.1m	1.1m	1.1m	
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St. Edwards House

GreenPark Village

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Previous Application

Introduction

The aim of the PBA methodology is to define our approach and ensure that (i) it is systematic and objective, (ii) it provides for the assessment of uncertainty, (iii) it provides a rational, consistent, transparent framework and (iv) it provides a defensible basis for the assessment. To this end, technical documentation has been reviewed and the essential features assimilated to generate the PBA methodology for ground condition assessment.

Legislation

The Environment Act 1995 introduced Part IIA into the Environmental Protection Act 1990. Part IIA, its accompanying regulations and Statutory Guidance contained in DETR Circular 02/2000 came into force in England in April 2000. Part IIA defines contaminated land as "land which appears to the Local Authority in whose area it is situated to be in such a condition that, by reason of substances in, on or under the land that significant harm is being caused, or there is a significant possibility that such harm could be caused, or pollution of controlled waters is being, or likely to be, caused". It should be noted that the definition does not include all land that has been impacted by contamination even though such contamination may be relevant in the context of other legislation or redevelopment works. The legislation was extended in August 2006 to include radiological hazards (now referred to as Part 2A). For the purposes of Part 2A assessments, situations where harm is to be regarded as significant are (i) chronic or acute toxic effect, serious injury or death to humans, (ii) irreversible or other adverse harm to the ecological system, (iii) substantial damage to, or failure of buildings, (iv) disease, other physical damage or death of livestock or crops, and (v) pollution of controlled waters.

Ground condition/contamination is a material planning consideration and guidance (PPS 23 2004) has been considered during the preparation of this methodology. The principle planning objective is to ensure that any unacceptable risks to human health, buildings and other property and the natural and historical environment from the contaminated condition of the land are identified so that appropriate action can be considered and taken to address those risks. The Local Planning Authority (LPA) has to be satisfied that there is sufficient information about the condition of the land, its impacts and the availability of viable remedial options.

Approach

The CLR11 promotes a staged approach to the assessment of ground quality/conditions and details three tiers of risk assessment:-

- Tier 1 - preliminary – a qualitative assessment forming part of a Phase 1 report,
- Tier 2 - generic - a quantitative assessment using published criteria to screen site specific ground condition data forming part of a Phase 2 report
- Tier 3 - detailed – a quantitative assessment involving the generation of site specific assessment criteria

Each tier of risk assessment comprises the following four stages:-

1. Hazard Identification – identifying potential contaminant sources on and off site;
2. Hazard Assessment – assessing the potential for unacceptable risks by identifying what pathways and receptors could be present, and what pollutant linkages could result (forming the Conceptual Site Model (CSM));
3. Risk Estimation – estimating the magnitude and probability of the possible consequences (what degree of harm might result to a defined receptor and how likely); and
4. Risk Evaluation – evaluating whether the risk needs to be, and can be, managed.

The PBA approach to risk estimation involves identifying the magnitude of the potential consequence (taking into account both the potential severity of the hazard and the sensitivity of the receptor) and the magnitude of the likelihood i.e. the probability (taking into account the presence of the hazard and the receptor and the integrity of the pathway). This approach is promoted in current guidance such as R&D 66 (NHBC 2008).

The PBA approach is that if a pollution linkage is identified then it represent a potential risk which requires further consideration and either (1) remediation / direct risk management or (2) further tiers of assessment. Subsequent tiers require additional information and the refinement of the CSM.

PBA Methodology for Ground Condition Assessment

The PBA methodology provides an estimate of the level of risk, it does not identify a risk level at which the risk is considered "significant" and/or "unacceptable" as this is dependant on the view of the individual / stakeholder. For example; to a risk adverse stakeholder even a risk level of "very low" may be considered unacceptable and as such this stakeholder may require risk management options to be implemented.

Identification of Pollutant Linkages

The underlying principle to ground condition assessment is the identification of *pollutant linkages* in order to evaluate whether the presence of a source of contamination could potentially lead to harmful consequences. A pollutant linkage consists of the following three elements:-

- A source/hazard – a substance or situation which has the potential to cause harm or pollution;
- A pathway – a means by which the hazard moves along / generates exposure; and
- A receptor/target – an entity which is vulnerable to the potential adverse effects of the hazard.

The *Conceptual Site Model* identifies the types and locations of potential contaminant sources/hazards and potential receptors and potential migration/transportation pathway(s).

Hazard Identification

A hazard is a substance or situation that has the potential to cause harm. Hazards may be chemical, biological or physical (e.g. explosive gases). The potential for hazards to be present is determined from consideration of the previous or ongoing activities on or near to the site in accordance with the criteria presented in the **Table 1**.

Table 1: Criteria for Classifying Hazards

Classification/Score	Definition (potential for generating contamination/gas based on Land Use)
Very Low 1	Land Use: greenfield Contamination: None. Gas generation potential : Inert Made Ground
Low 2	Land Use: residential, retail or office use, recent small scale industrial. Contamination: None or locally slightly elevated concentrations. Gas generation potential : Alluvium or dock silt
Moderate 3	Land Use: railways, collieries, scrap yards, light industry, engineering works. Contamination: Locally elevated concentrations. Gas generation potential : Pre 1960's landfill
High 4	Land Use: gas works, chemical works, heavy industry, non-hazardous landfills. Contamination: Possible widespread elevated concentrations. Gas generation potential : Shallow mine workings
Very High 5	Land Use: hazardous waste landfills. Contamination: Likely widespread elevated concentrations. Gas generation potential : Domestic landfill post 1960

NOTE the classification for gas generation potential is based on CIRIA C665

Receptor Identification

The potential receptors (for both on site and adjoining land) that will be considered are:

- Human Health – including current and future occupiers, construction and future maintenance workers, and neighbouring properties/third parties;
- Ecological systems; ^{*1}
- Controlled waters ^{*2} – including surface water and groundwater;
- Property, Animal or Crop (existing or proposed) - including buildings, service lines and pipes, crops, livestock, pets, woodland; and
- Archaeological sites and ancient monuments.

^{*1} internationally or nationally designated sites (as defined in the statutory guidance (Draft Circular on Contaminated Land, DETR, 2000)) "in the local area" will be identified as potential ecological receptors. A search radius of 1, 2 or 5km will be utilised depending on the site specific circumstances (see also pathway identification). The Environment Agency has published an ecological risk assessment framework (EA 2008) which promotes (as opposed to statutorily enforces) consideration of additional receptors to include locally protected sites and protected or notable species. These additional potential receptors will only be considered if a Phase 1 habitat survey, undertaken in accordance with guidance (JNCC 1993), is commissioned and the data

PBA Methodology for Ground Condition Assessment

provided to PBA. It should be noted that without such a survey the Tier 1 risk assessment may conclude that the identification of potential ecological receptors is inconclusive (see Specification).

*² the definition of "pollution of controlled water" has been amended by the introduction of Section 86 of the Water Act 2003. For the purposes of Part 2A groundwater does not include waters above the saturated zone and our assessment does not therefore address perched water other than where development causes a pathway to develop.

If a receptor is taken forward for further assessment it will be classified in terms of its sensitivity, the criteria for which are detailed in Table 2. Table 2 has been generated using descriptions of environmental receptor importance/value given in various guidance documents including R&D 66 (NHBC 2008) and Transport Analysis Guidance (based on DETR 2000). Human health and buildings classifications have been generated by PBA using the attribute description for each class.

Table 2: Criteria for Classifying Receptor Sensitivity/Value

Classification/Score	Definition
Very Low 1	Receptor of limited importance Groundwater: Non aquifer Surface water: GQA Grade F Ecology: No local designation Buildings: Replaceable Human health: Unoccupied/limited access
Low 2	Receptor of local or county importance with potential for replacement Groundwater: Minor aquifer Surface water: GQA Grade D/E Ecology: local habitat resources Buildings: Local value Human health: Industrial
Moderate 3	Receptor of local or county importance with potential for replacement Groundwater: Major aquifer Surface water: GQA Grade B/C Ecology: County wildlife sites, Areas of Outstanding Natural Beauty (AONB) Buildings: Area of Historic Character Human health: Commercial
High 4	Receptor of county or regional importance with limited potential for replacement Groundwater: Source protection zone 2 Surface water: GQA Grade A Ecology: SSSI, National or Marine Nature Reserve (NNR or MNR) Buildings: Conservation Area Human health: Open spaces and uses where children are present
Very High 5	Receptor of national or international importance Groundwater: Source protection zone 1 Surface water: GQA Grade A Ecology: Special Areas of Conservation (SAC and candidates), Special Protection Areas (SPA and potentials) or wetlands of international importance (RAMSAR) Buildings: World Heritage site Human health: Residential

Pathway Identification

The exposure pathway and modes of transport that will be considered are presented in the **Table 3**.

For ecological systems the Tier 1 will assess the viability of the mode of transport given the site specific circumstances not specific pathways. As with receptor identification it should be noted that without a habitat survey the Tier 1 risk assessment may conclude that the risk to potential ecological receptors is inconclusive (see Specification).

Table 3: Exposure Pathway and Modes of Transport

Receptor	Pathway	Mode of transport
Human health	Ingestion	Fruit or vegetable leaf or roots
		Contaminated water
		Soil/dust indoors
		Soil/dust outdoors
	Inhalation	Particles (dust / soil) – outdoor
		Particles (dust / soil) - indoor
		Vapours – outdoor - migration via natural or anthropogenic pathways
		Vapours - indoor - migration via natural or anthropogenic pathways
	Dermal absorption	Direct contact with soil
		Direct contact with waters (swimming / showering)
		Irradiation
Groundwater	Leaching	Gravity / permeation
	Migration	Natural – groundwater as pathway Anthropogenic (e.g. boreholes, culverts, pipelines etc.)
Surface Water	Direct	Runoff or discharges from pipes
	Indirect	Recharge from groundwater
	Indirect	Deposition of wind blown dust
Buildings	Direct contact	Sulphate attack on concrete, hydrocarbon corrosion of plastics
	Gas ingress	Migration via natural or anthropogenic paths
Ecological systems	See Notes	Runoff/discharge to surface water body
	See Notes	Windblown dust
	See Notes	Groundwater migration
	See Notes	At point of contaminant source
Animal and crop	Direct	Wind blown or flood deposited particles / dust / sediments
	Indirect	Plants via root up take or irrigation. Animals through watering
	Inhalation	By livestock / fish - gas / vapour / particulates / dust
	Ingestion	Consumption of vegetation / water / soil by animals

Risk Estimation

Risk estimation classifies what degree of harm might result to a receptor (defined as consequence) and how likely it is that such harm might arise (probability). The consequence classification is generated by multiplying the hazard classification score and the receptor sensitivity score. This approach follows that presented in the republished R&D 66 (NHBC 2008). The classifications detailed in Table 4 have been adapted from Table 6.3 presented in CIRIA C552 and A4.3 in R&D 66.

The resulting risk is estimated for each receptor using the matrix given in Table 6 which is taken directly from CIRIA C552 (Table 6.5).

Table 6: Classification of Risk (Combination of Consequence and Probability)

Probability	Consequence			
	Severe	Medium	Mild	Minor
High likelihood	Very high	High	Moderate	Low
Likely	High	Moderate	Moderate/low	Low
Low likelihood	Moderate	Moderate/low	Low	Very low
Unlikely	Moderate/low	Low	Very low	Very low

Risk Evaluation

In order to put the risk classification into context the likely actions are detailed in Table 7 which is taken directly from CIRIA C552 (Table 6.6).

Table 7: Description of Risks and Likely Action Required

Risk Classification	Description
Very high risk	There is a high probability that severe harm could arise to a designated receptor from an identified hazard, OR, there is evidence that severe harm to a designated receptor is currently happening. This risk, if realised, is likely to result in a substantial liability. Urgent investigation (if not undertaken already) and remediation are likely to be required.
High risk	Harm is likely to arise to a designated receptor from an identified hazard. Realisation of the risk is likely to present a substantial liability. Urgent investigation (if not undertaken already) is required and remedial works may be necessary in the short-term and are likely over the longer-term.
Moderate risk	It is possible that harm could arise to a designated receptor from an identified hazard. However, it is either relatively unlikely that any such harm would be severe, or if any harm were to occur it is more likely that the harm would be relatively mild. Investigation (if not already undertaken) is normally required to clarify the risk and to determine the potential liability. Some remedial works may be required in the longer-term.
Low risk	It is possible that harm could arise to a designated receptor from an identified hazard, but it is likely that this harm, if realised, would at worst normally be mild.
Very low risk	There is a low possibility that harm could arise to a receptor. In the event of such harm being realised it is not likely to be severe.

References

- NHBC & CIEH, 2008 R&D Publication 66 Guidance for the safe development of housing on land affected by contamination.
- CIRIA 2001 C552 Contaminated land risk assessment – a guide to good practice.
- CIRIA 2008 C655 Assessing risks posed by hazardous ground gases to buildings.
- EA 2004 CRL 11 Model Procedures for the Management of Land Contamination.
- ODPM 2004 Planning Policy Statement 23 (PPS 23):Planning and Pollution Control.
- DETR 2000 Methodology for Multi Modal Studies. Volume 2 Section 4 The Environmental Objective.
- EA 2008 Ecological Risk Assessment Science Report Series SC070009 published by the Environment Agency (EA).
- JNCC 1993 Handbook for Phase 1 Habitat Survey – A Technique for Environmental Audit prepared by the Joint Nature Conservancy Council (JNCC)

Table 4: Classification of Consequence (score = magnitude of hazard and sensitivity of receptor)

Classification Score	Examples
Severe 20-25	Human health effect - exposure likely to result in "significant harm". Significant harm to humans is defined in circular 01/2006 as death, disease, serious injury, genetic mutation, birth defects or impairment of reproductive function. Controlled water effect - short-term risk of pollution (note: Water Resources Act contains no scope for considering significance of pollution) of sensitive water resource. Equivalent to EA Category 1 incident (persistent and/or extensive effects on water quality leading to closure of potable abstraction point or loss of amenity, agriculture or commercial value. Major fish kill. Ecological effect - short-term exposure likely to result in a substantial adverse effect. Catastrophic damage to crops, buildings or property
Medium 10-16	Human health effect - exposure could result in "significant harm". Significant harm to humans is defined in circular 01/2006 as death, disease, serious injury, genetic mutation, birth defects or impairment of reproductive function. Controlled water effect - equivalent to EA Category 2 incident requiring notification of abstractor Ecological effect - short-term exposure may result in a substantial adverse effect. Damage to crops, buildings or property
Mild 6-9	Human health effect - exposure may result in "significant harm". Significant harm to humans is defined in circular 01/2006 as death, disease, serious injury, genetic mutation, birth defects or impairment of reproductive function. Controlled water effect - equivalent to EA Category 3 incident (short lived and/or minimal effects on water quality). Ecological effect - unlikely to result in a substantial adverse effect. Minor damage to crops, buildings or property. Damage to building rendering it unsafe to occupy (for example foundation damage resulting in instability).
Minor 1-5	No measurable effect on humans. Protective equipment is not required during site works. Equivalent to insubstantial pollution incident with no observed effect on water quality or ecosystems. Repairable effects to crops, buildings or property. The loss of plants in a landscaping scheme. Discolouration of concrete.

The criteria for classifying probability are set out in Table 5 which is taken directly from CIRIA C552 (Table 6.4). Probability considers the integrity of the exposure pathway.

Table 5: Classification of Probability

Classification	Definition
High likelihood	There is a pollution linkage and an event that either appears very likely in the short-term and almost inevitable over the long-term, or there is already evidence at the receptor of harm / pollution.
Likely	There is a pollution linkage and all the elements are present and in the right place, which means that it is probable that an event will occur. Circumstances are such that an event is not inevitable, but possible in the short-term and likely over the long-term.
Low likelihood	There is a pollution linkage and circumstances are possible under which an event could occur. However, it is by no means certain that even over a longer period such event would take place, and is less likely in the shorter-term.
Unlikely	There is a pollution linkage but circumstances are such that it is improbable that an event would occur even in the very long-term.



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Client

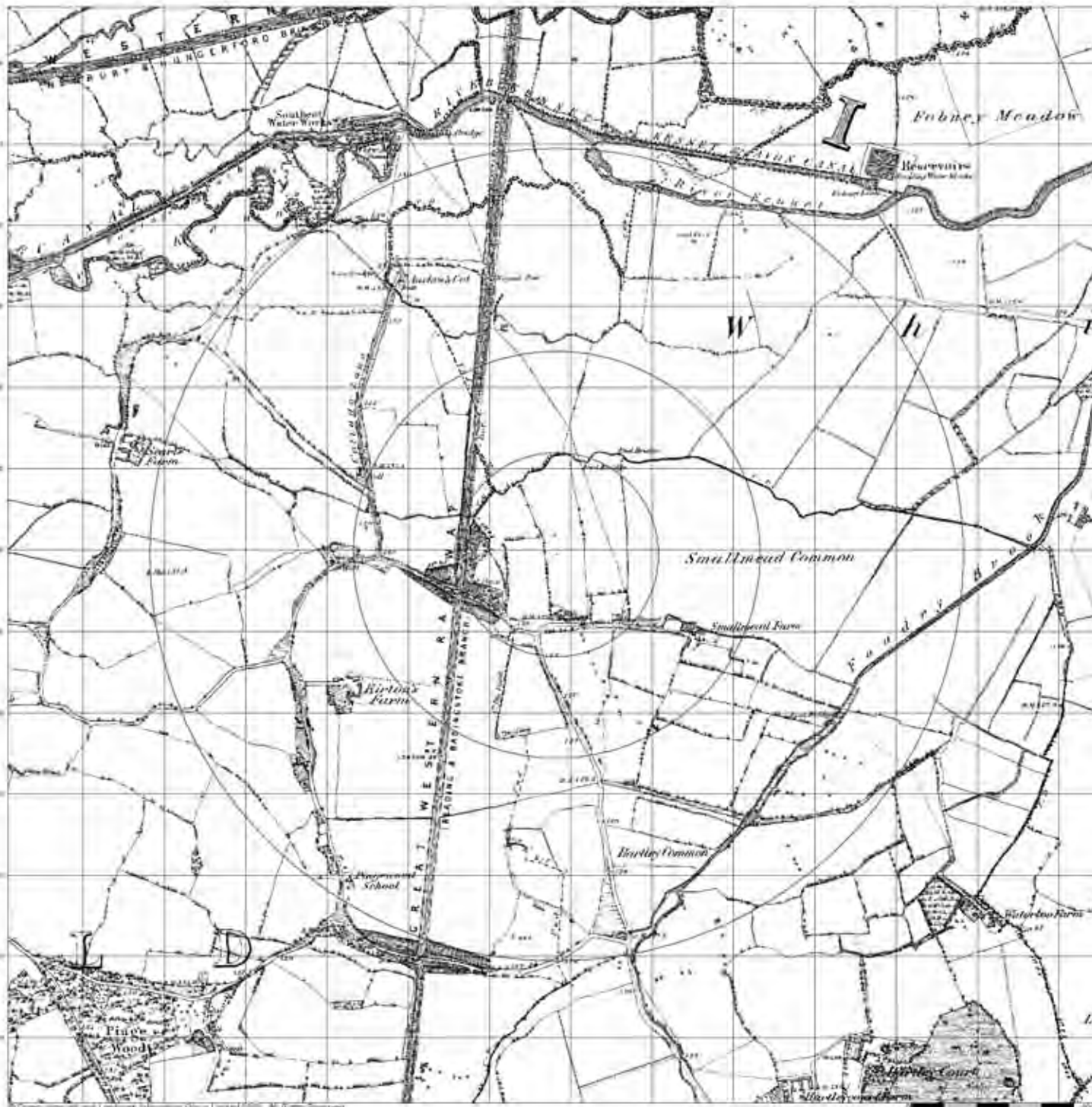
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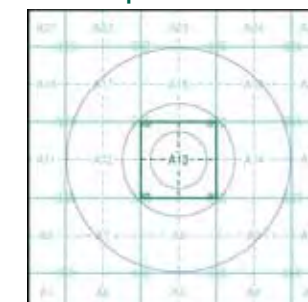
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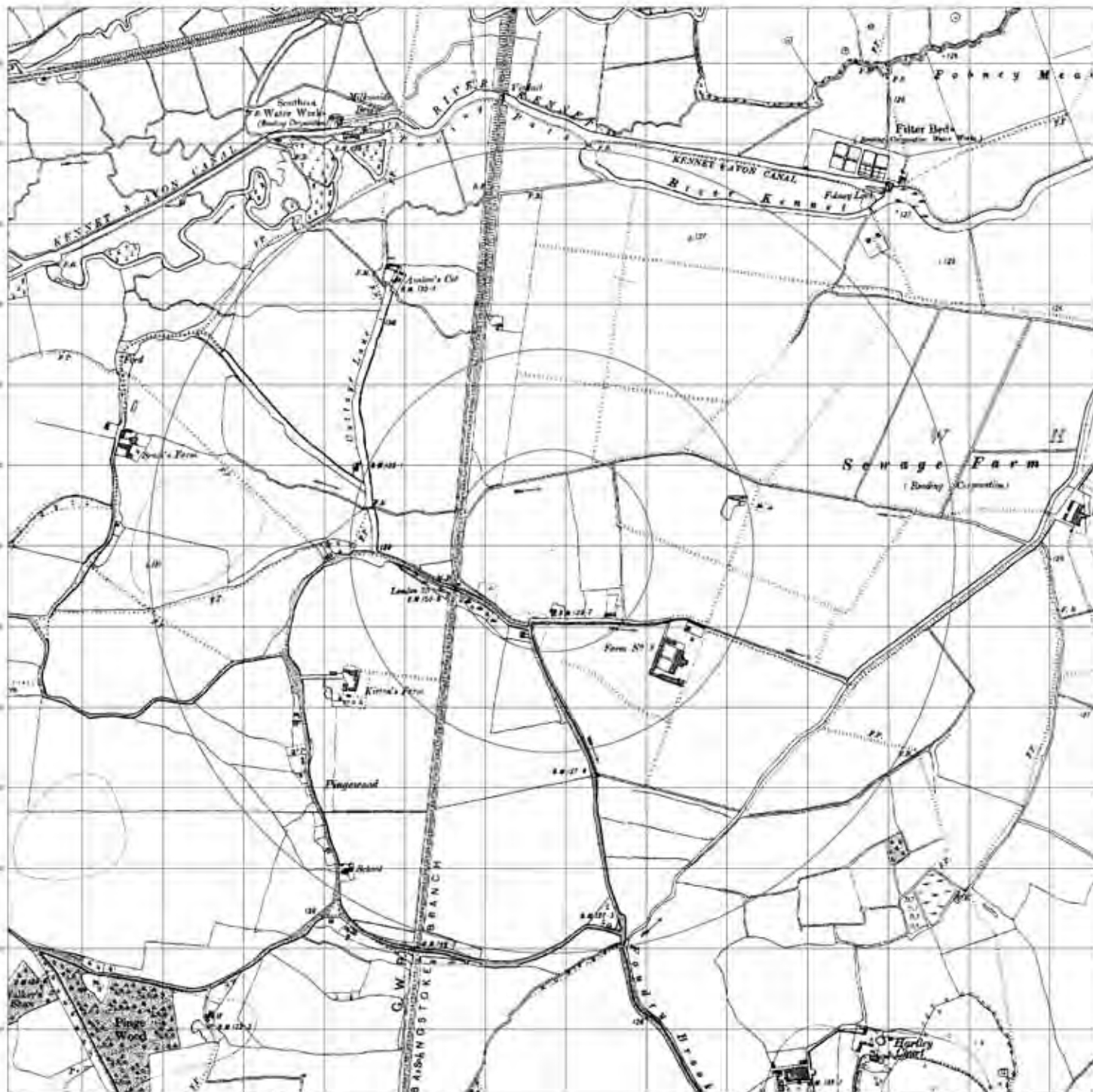
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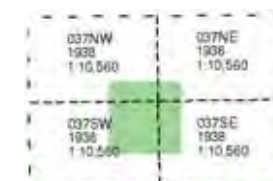


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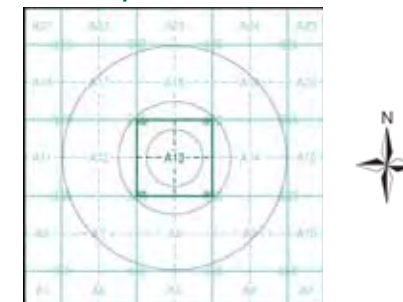


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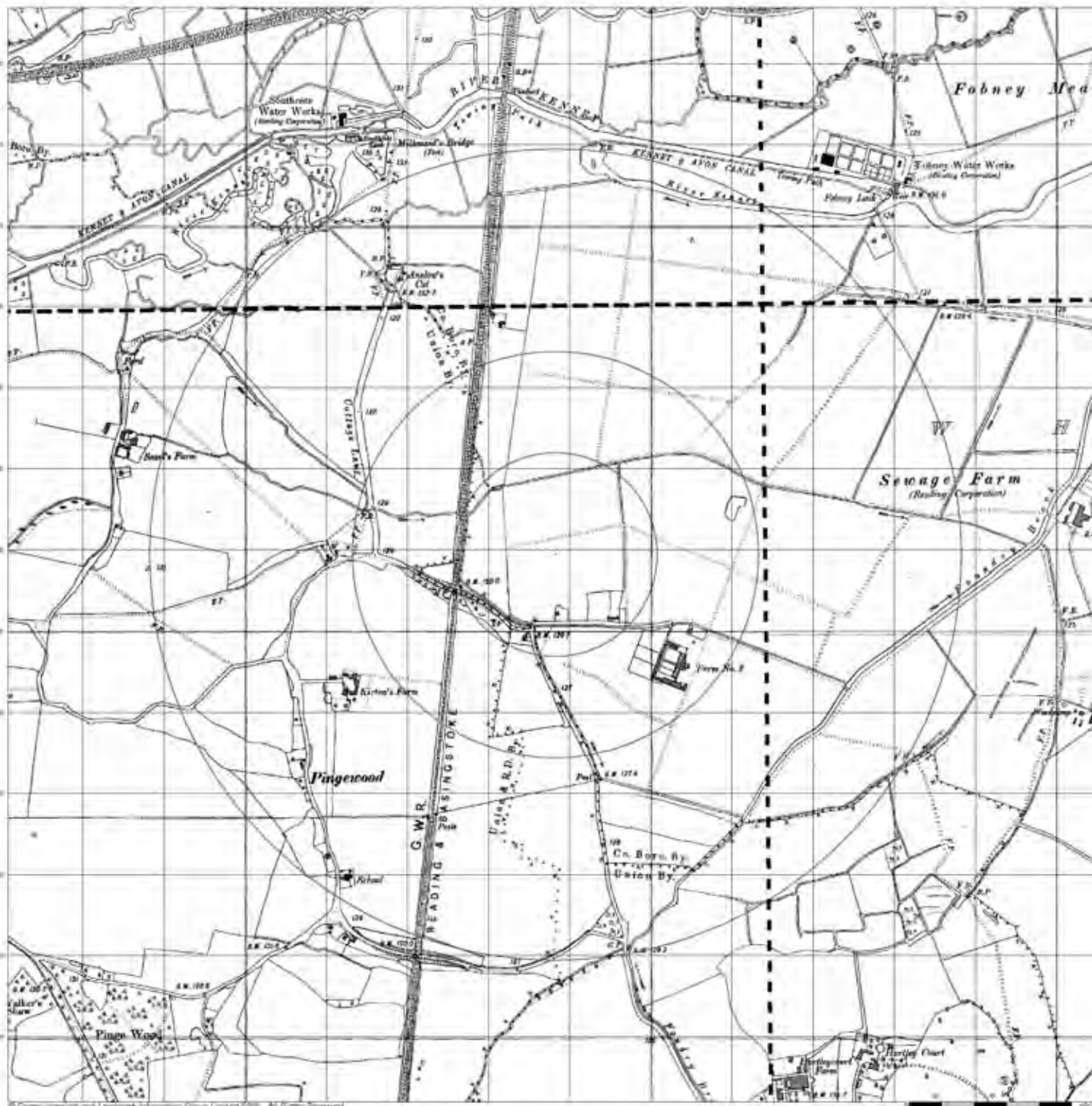


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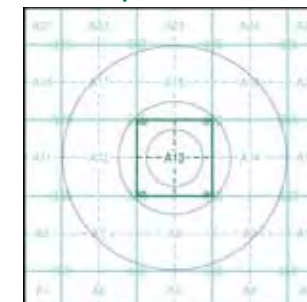
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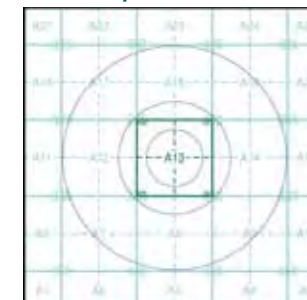
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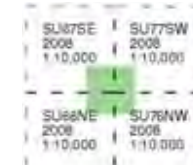
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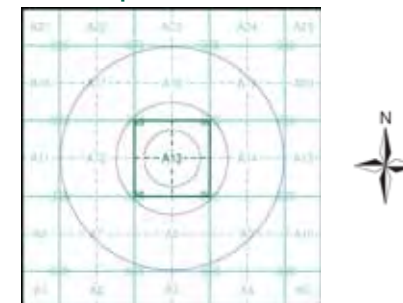
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The historical maps shown were produced from the Ordnance Survey's 1:10,000 colour raster mapping. These maps are derived from Landplan which replaced the old 1:10,000 maps originally published in 1970. The data is highly detailed showing buildings, fences and field boundaries as well as all roads, tracks and paths. Road names are also included together with the relevant road number and classification. Boundary information depiction includes county, unitary authority, district, civil parish and constituency.

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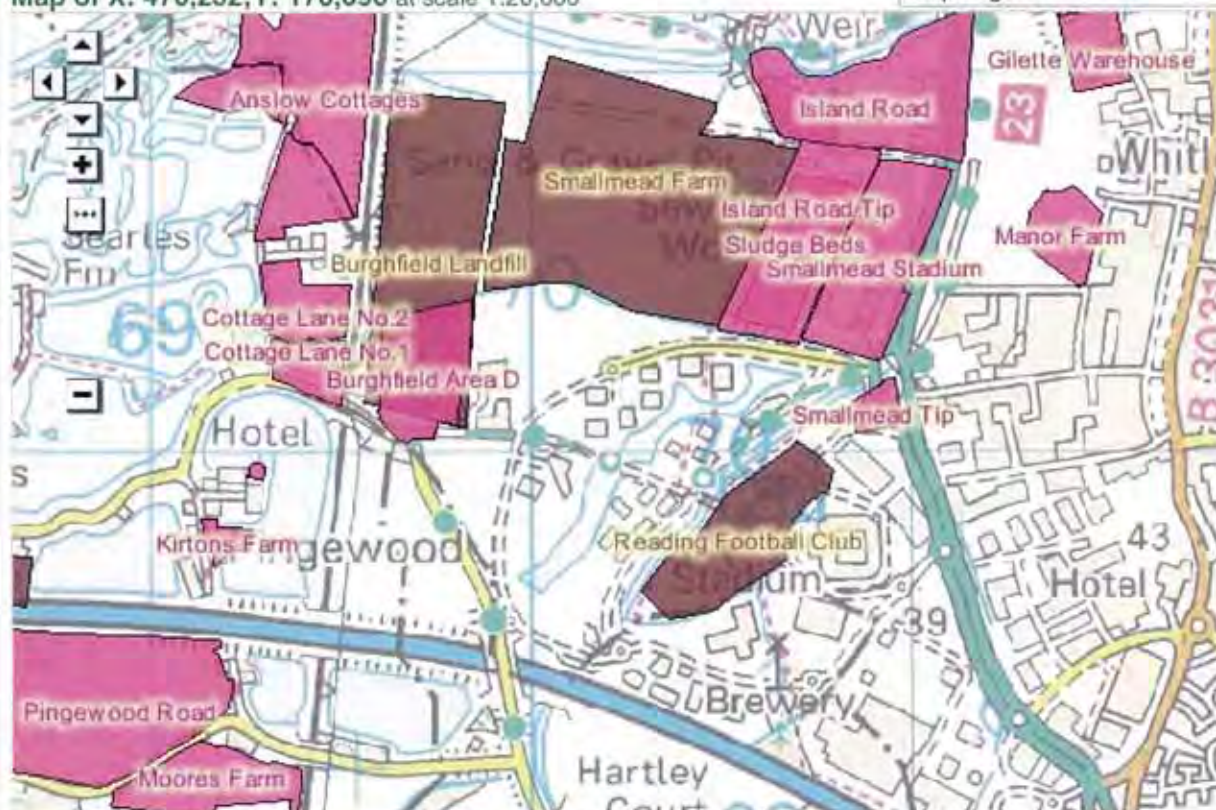
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Map of X: 470,232;Y: 170,096 at scale 1:20,000

Map Legend



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Tell me more about waste and landfill:

Active landfills are sites with a current licence that are still accepting waste, or are no longer accepting waste but still being actively managed.

Historic landfills are sites that are now closed and may date back to early records.

Waste regulation

We regulate waste management through a system of licences. Find out how to get the correct licence here, get data on waste and find out if there are any rules applying to household waste.

Waste facts and figures

The UK produces about 220 million tonnes of controlled wastes per year. Find out about waste incineration, hazardous waste, recycling and landfill.

TRIAL PIT RECORD

Project KENNET VALLEY PARK PROJECT

Engineer PETER BRETT ASSOCIATES

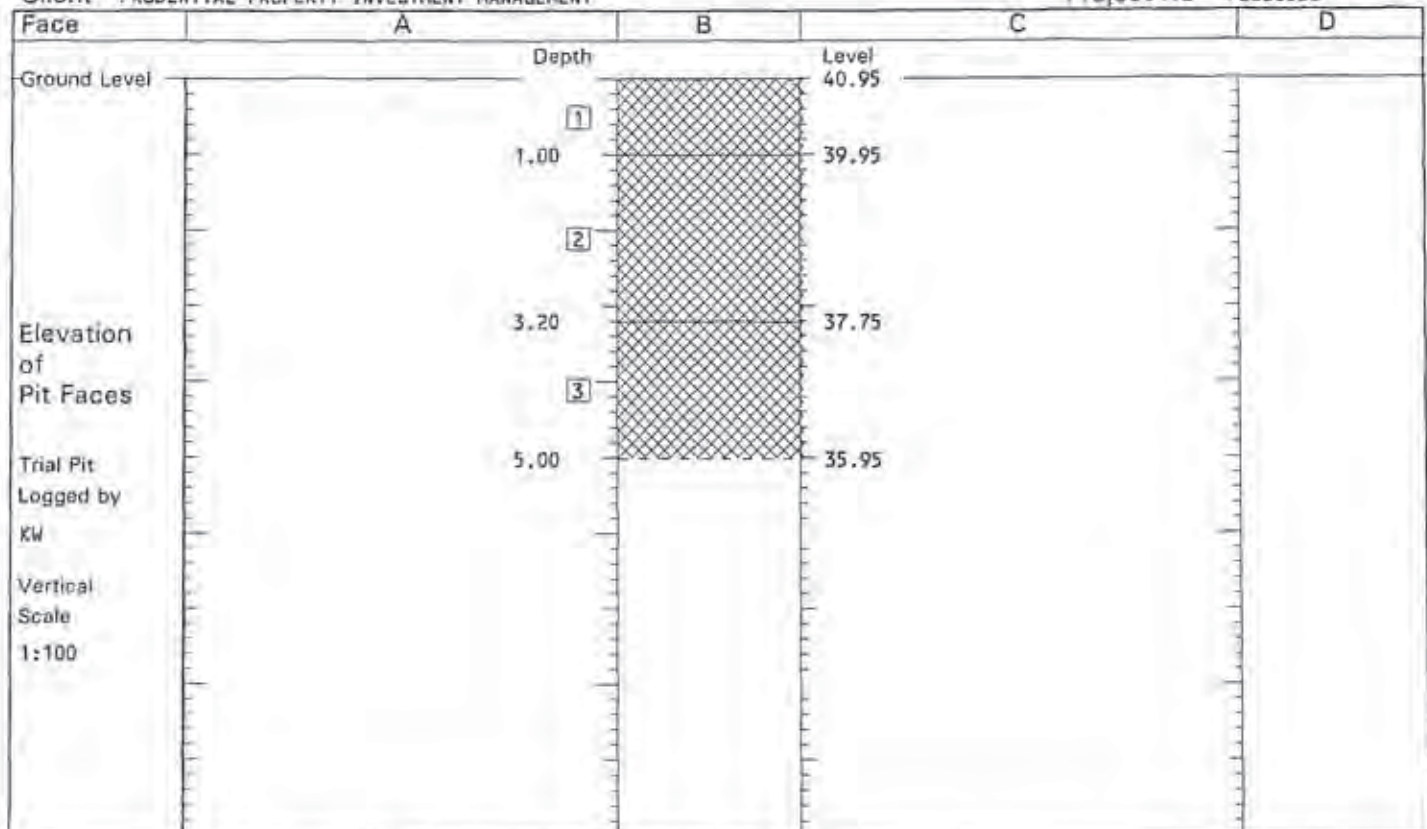
Trial Pit TP1047

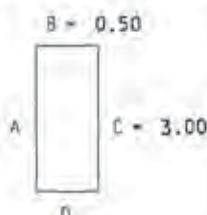
Coordinates 469371.3E 170239.1N

Client PRUDENTIAL PROPERTY INVESTMENT MANAGEMENT

National Grid

Project No PC030538



Samples and Tests			Strata			
Depth	Type	Strength kN/m ²	Face B Depth	Stratum Number	Description	Geological Classification
0.30	J		1.00	1	Dark brown sandy gravelly clay. Gravel is angular to subrounded fine to coarse flint, brick cobbles, metal and concrete.	MADE GROUND.
1.20 2.10	B J		3.20	2	Grey green brown mottled black sandy very gravelly clay. Gravel is angular to subrounded fine to coarse of flint, limestone, chalk, brick, concrete, metal, a roll of carpet and timbers. Between 2.00-2.20m, pocket of grey green sandy gravelly clay with bricks. At 2.60m, tarmac. At 3.20m, concrete.	MADE GROUND.
3.60 4.20 4.90	J J B		5.00	3	Grey white mottled black sandy gravelly clay. Gravel is angular to subrounded fine to coarse chalk, flint, brick, concrete and tarmac. Between 4.10-4.40m, pocket of soft brown grey sandy slightly gravelly clay. Gravel is angular to subrounded fine to coarse brick, flint and chalk with timber fragments. At 4.70m, concrete blocks and metal sheeting. Below 4.70m, becoming grey clay.	MADE GROUND.
Excavation				Dimensions		Groundwater
Date Excavated	08/09/03	Date Backfilled	08/09/03			Below 3.50m, slight seepage.
Plant	JCB 3CX					
Shoring	None					
Stability	Slight caving in chalky clay.					

geotechnics

Symbols and abbreviations are explained on the accompanying key. All linear dimensions are in metres.

TRIAL PIT RECORD

Project KENNET VALLEY PARK PROJECT

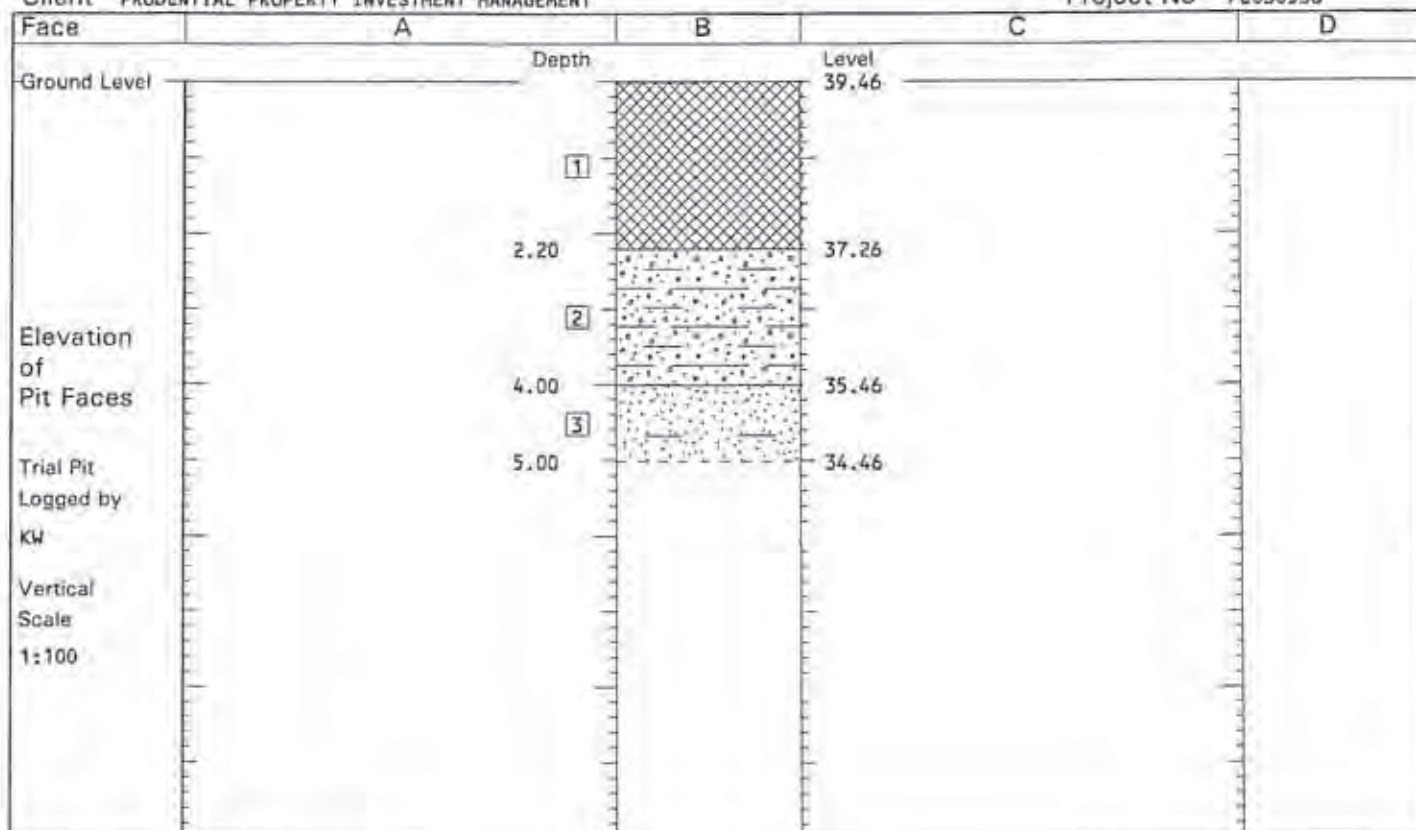
Engineer PETER BRETT ASSOCIATES

Trial Pit TP1048

Coordinates 469482.4E 170203.3N

Client PRUDENTIAL PROPERTY INVESTMENT MANAGEMENT

Project No PC030538



Samples and Tests			Strata			
Depth	Type	Strength kN/m ²	Face B Depth	Stratum Number	Description	Geological Classification
0.40 1.40	J B				Brown mottled orange brown and black sandy slightly gravelly clay/silt. Gravel is angular to subrounded fine to coarse flint, brick, glass, metal and chalk with occasional pockets of light brown sand and blocks of concrete.	MADE GROUND.
			2.20	1	At 1.80m, pocket of black clay with tarmac and burnt timber.	
2.30 2.80 3.90	J J J				Soft green grey mottled brown sandy gravelly CLAY. Gravel is angular to subrounded fine to coarse flint.	
					At 2.70m, becomes very gravelly.	
			4.00	2	At 3.90m, becomes brown grey and very gravelly.	
4.10 5.00	B J		5.00	3	Grey mottled brown clayey SAND.	

Excavation				Dimensions	Groundwater
Date Excavated	08/09/03	Date Backfilled	08/09/03		At 2.80m, seepage.
Plant	JCB 3CX				
Shoring	None				
Stability	Collapse in gravel at 3.00m.				

Remarks



Symbols and abbreviations are explained on the accompanying key. All linear dimensions are in metres.

BOREHOLE RECORD - Cable Percussion

Sheet 1 of 2

Project KENNET VALLEY PARK PROJECT

Engineer PETER BRETT ASSOCIATES

Borehole BH1016

Coordinates 469406.7E 170165.1N

National Grid

Project No PC030538

Client PRUDENTIAL PROPERTY INVESTMENT MANAGEMENT

Sampling				Properties			Strata			
Depth	Sample Type	Depth Cased	Depth to Water	Strength kN/m ²	W %	SPT N	Description	Depth	Legend	Level
0.00 - 0.95	B						Dark brown clayey sand and gravel. Gravel is subangular fine to coarse brick, flint, chalk and clinker with occasional cobbles of brick. MADE GROUND.	G.L.		39.96
1.00	J							0.95		39.01
1.20 - 1.65	J									
1.20 - 1.65	S					11	Dark grey and black silty/clayey gravelly sand. Gravel is subangular to subrounded fine to coarse flint, quartzite and brick. MADE GROUND.			
1.20 - 1.65	B									
1.80	J						Below 1.80m, soft dark grey clay pockets.			
2.20 - 2.65	B									
2.20 - 2.65	S	2.15				46	Dense brown, grey and white slightly silty very sandy GRAVEL. Gravel is angular to subrounded fine to coarse flint.	2.30		37.66
3.00	J									
3.20 - 3.65	B						Between 3.20-4.80m, becoming medium dense.			
3.20 - 3.65	C	3.15	2.45			30				
4.00	J									
4.20 - 4.65	B									
4.20 - 4.65	C	4.15	3.30			18				
5.00	J						Stiff green grey oxidising to brown CLAY.	4.80		35.16
5.55 - 6.00	U38	5.50	3.50	127	21.0			5.60		34.36
							Stiff red brown and grey sandy CLAY.			
6.00 - 6.15	J							6.00		33.96
							Grey and brown fine SAND.			
6.50	J						Below 6.50m, becomes clayey/silty.			
								6.80		33.16
							Stiff brown and grey CLAY. Becomes very stiff with depth.			
7.05 - 7.50	J									
7.05 - 7.50	S	7.00	3.80			20				
7.05 - 7.50	B									
8.00	J							8.00		31.96

Boring				Progress				Groundwater				Remarks on Groundwater
Depth	Dia	Technique	Crew	Depth of Hole	Depth Cased	Depth to Water	an (A) Date pm (P)	Depth Struck	Depth Cased	Depth after 20 mins	Depth Sealed	
1.20		Inspection Pit.	CR	Start			10/09/03	2.30	2.15	2.28		
3.00	200mm	Cable Percussion.	CR	8.30	7.00	3.80	P10/09/03					
12.00	150mm	Cable Percussion.	CR	8.30	7.00	3.80	P11/09/03					
				12.00	11.50	5.30	P11/09/03					
				End			11/09/03					

Remarks Inspection pit hand excavated to 1.20m. 50mm standpipe installed, risings 12.00-5.60m, seal 5.60-4.80m, slotted pipe and filter 4.80-2.30m, seal 2.30-1.30m, concrete and cover 0.50m-G.L. ** Drillers Description.



Logged by: EA Symbols and abbreviations are explained on the accompanying key. All linear dimensions are in metres.

Scale: 1:50

BOREHOLE RECORD - Cable Percussion

Sheet 2 of 2

Project KENNET VALLEY PARK PROJECT

Engineer PETER BRETT ASSOCIATES

Borehole BH1016

Coordinates 469406.7E 170165.1N

Client PRUDENTIAL PROPERTY INVESTMENT MANAGEMENT

National Grid

Project No PC030538

Sampling				Properties			Strata			
Depth	Sample Type	Depth Cased	Depth to Water	Strength kN/m ²	V %	SPT N	Description	Depth	Legend	Level
8.55 - 9.00 8.55 - 9.00 8.55 - 9.00	J S B	8.50	4.50			29	As on preceding sheet Below 8.50m, red brown and grey mottled.	8.00		31.96
9.50	J									
10.05- 10.50	U41	10.00	4.30	99	27.0					
10.50- 10.65	J									
11.00	J									
11.55- 12.00 11.55- 12.00	J S	11.50	5.30			38		12.00		27.96

Boring				Progress				Groundwater				
Depth	Dia	Technique	Crew	Depth of Hole	Depth Cased	Depth to Water	as (A) Date pe (P)	Depth Struck	Depth Cased	Depth after 20 mins	Depth Sealed	Remarks on Groundwater
1.20 3.00 12.00	200mm 150mm	Inspection Pit. Cable Percussion. Cable Percussion.	CR CR CR	Start 8.30 8.30 12.00 End	7.00 7.00 11.50	3.80 3.80 5.30	10/09/03 P10/09/03 P11/09/03 P11/09/03 11/09/03	2.30	2.15	2.28		

Remarks Inspection pit hand excavated to 1.20m.
50mm standpipe installed, risings 12.00-5.60m, seal 5.60-4.80m,
slotted pipe and filter 4.80-2.30m, seal 2.30-1.30m,
concrete and cover 0.50m-G.L.
** Drillers Description.

geotechnics

Logged by: EA Symbols and abbreviations are explained on the accompanying key. All linear dimensions are in metres. Scale: 1:50

pba
peterbrett

Rationale for the Selection of Generic Assessment Criteria

to collect site-specific data before an application can be made.

4 Tier 2 Generic Assessment Criteria

The Tier 2 risk assessment involves the use of published generic criteria to "screen" the site-specific contamination testing data and identify potential hazards to specific receptors. Guidance on available generic assessment criteria (GAC) is given in CRL 11 (EA, 2004). The following text identifies the criteria routinely adopted by PBA for screening the risk to specific receptors. Where this general approach is not appropriate for any one site, alternative assessment criteria will be presented in the report text.

4.1 General Notes

It should be noted that in general, GAC have been developed using highly conservative assumptions to screen out sites that definitely would not present a problem. Where sites fail the criteria this may not necessarily mean that the site represents an unacceptable risk for the particular management context in which decisions have been made.

It is stressed that the exceedance of a Tier 2 GAC does not necessarily indicate that a site is statutorily contaminated or unsuitable for use (CLAN2-05) and that whilst GAC provide an aid to decision-making, they do not replace the need for sound professional judgement in risk assessment (EA, 2006b).

It should be noted that any PBA interpretation of contamination test results is based on a scientific and engineering appraisal. The perceptions of, for example, banks, insurers, lay people etc are not taken into account.

Any summary tables included in this Appendix are produced for ease of reference to the criteria, they do not in any way replace the documents of origin (which are fully referenced) and which should be read to ensure appropriate use and interpretation of the data.

4.2 Tier 2 Screening Values for Assessing Soils

Potential Harm to Human Health The criteria which are routinely used by PBA as Tier 2 soil screening values are presented in Table 1.

Cautionary Note The production of authoritative contaminated land guidance in the UK is currently incomplete. DEFRA has yet to produce a comprehensive list of assessment criteria that on its own, would be sufficient to enable the assessment of the potential risks posed by soil contaminants (to human health). A number of industry-driven initiatives have developed in recent months in order to increase the amount of contaminated land guidance available to

practitioners. This has led to the publication of a series of non-statutory non-Governmental contaminated land assessment criteria. (It should be noted that the published DEFRA guidance is also non-statutory).

PBA has reviewed these publications and has taken a pragmatic view to the use of various criteria in the assessment of human health risk from contaminated land. Where we consider that non-Governmental criteria are authoritative and robust, we will refer to such criteria in our assessment of soil contamination. Because such criteria are not published by the UK Government, they are not beyond scrutiny and may be subject to challenge by a regulatory body or their representative. If the use of selected generic assessment criteria is challenged, it may be necessary to carry out detailed modelling to generate site-specific assessment criteria.

Former Soil Guideline Values (2002) Technical guidance with respect to the human health element of the assessment of contamination in soils was released by the Environment Agency (EA) in March 2002 via the 'contaminated land exposure assessment' (CLEA) regime (EA, 2002).

The CLEA regime provided generic Soil Guideline Values (SGVs) for a limited number of contaminants for a variety of different land use classes. The regime was incomplete in terms of the range of contaminants listed in CLR8 (EA, 2002) and prior to July 2008, SGVs had only been published for 10 substances (arsenic, cadmium, chromium, lead, mercury, nickel, selenium, ethylbenzene, toluene and phenol).

On 22 July 2008 DEFRA announced the withdrawal of the existing SGVs to coincide with the release of a revised and updated version of the CLEA model (the original version of which was used to devise the original SGVs). The Environment Agency (EA) is currently in the process of deriving new SGVs using the updated CLEA model. The first tranche of this work was published in March 2009.

New (2009) SGVs that have been published are generally similar to the withdrawn SGVs (i.e. they still represent conservative threshold numbers below which no significant risk of harm to human health is likely to be present). Consequently, in the absence of replacement SGVs, there is no reason whatsoever to suggest that the former SGVs should be considered technically unsound and since both practitioners and regulators require a framework to continue working within, the former SGVs will still be used to assist in the interpretation of relevant geoenvironmental testing results until such time that they have been formally replaced by DEFRA.

An exceedance of a 2002 SGV indicates that further assessment via a site specific risk

Rationale for the Selection of Generic Assessment Criteria

Mercury is most commonly found in its inorganic state and it is very rare to find significant concentrations of elemental and organic mercury unless there is a process related source of one of these other forms relevant to the site in question. PBA undertake routine analytical testing to determine total mercury content. Total mercury includes both inorganic and elemental forms of the metal.

The hazard identification stage of the risk assessment process is used to assess whether further speciation of mercury into its elemental and organic forms is necessary and these additional tests are not routinely specified.

Situations where it is desirable to determine the proportions of different forms of mercury might include sites where potential industrial sources of mercury have been identified, or where initial screening tests have revealed unusually high concentrations of total mercury.

In these cases, concentrations of inorganic, elemental and organic mercury can be assessed against specific Soil Guideline Values published by the Environment Agency.

4.3 Tier 2 Screening Values for Assessing Controlled Waters

Potential Harm to Human Health The criteria which are routinely used by PBA as Tier 2 water screening values are given in Table 2. PBA use the following primary guidance to assess the significance of water chemistry with respect to its potential to harm human health where appropriate.

- i) The Water Supply (Water Quality) Regulations 2000 (DETR (2000b);
- ii) Guidelines for drinking-water quality, World Health Organisation (WHO, 1993); and
- iii) The Surface Water (Abstraction for Drinking Water) (Classification) Regulations (DoE, 1996); and subsequent amendments.

Although not specific to the UK the WHO guidelines for drinking water quality are utilised as they incorporate more organic parameters than listed in the Water Supply (Water Quality) Regulations. The WHO system provides a guideline value for substances that are considered to be carcinogenic based on a concentration in drinking water associated with an excess lifetime cancer risk of 10^{-5} (one additional cancer per 100,000 of the population ingesting drinking water containing the substance at or above the guideline value for 70 years).

A number of the prescribed concentrations listed in the Water Supply Regulations have been set for reasons other than their potential to cause harm to human health. The concentrations of some elements are controlled because they may taint potable water with an undesirable taste, odour or colour or may potentially deposit precipitates in

water supply pipes.

Potential to Harm Controlled Waters Controlled Waters are namely rivers, estuaries, coastal waters, lakes and groundwaters, but not perched waters. There are no official or statutory limits on acceptable concentrations of contaminants in groundwater in the UK.

There are statutory limits on acceptable concentrations of contaminants in surface water in the UK. Limits have been published in the form of Environmental Quality Standards (EQSs) which are available for fresh, estuarine and marine waters. EQSs have been derived under the requirements of the EC Dangerous Substances Directive (EC, 1976) that classifies substances as List I and List II. Standards for List I substances have been defined in 'daughter' Directives to the EC Dangerous Substances Directive. The Dangerous Substances Directive requires that standards for List II substances are derived by the member states. The UK has set EQSs for List II substances (derived by WRc plc, Swindon) and these are published on the Environment Agency website (EA, 2004). The Environment Agency has a legal obligation to ensure that statutory EQSs are met.

The criteria which are routinely used by PBA as Tier 2 screening values are given in Table 2. PBA use the following primary guidance to assess the significance of water chemistry with respect to its potential to harm Controlled Waters.

- i) the Water Supply (Water Quality) Regulations (DETR, 2000); and
- ii) Environmental Quality Standards (EQSs).

The results from any eluted liquids will be compared to appropriate assessment criteria depending on the receptor of concern.

4.4 Tier 2 Screening Guidance for Assessing Soil Gases

Risk Assessment Approach Guidance on the assessment of risks specifically for sites located adjacent to Landfill Sites has been published by the Environment Agency (EA, 2004d). A tiered approach to assessing risk is advocated by the guidance. This allows the level of detail in a risk assessment to be proportionate to the nature and complexity of the risk.

The Tier 1 Risk Screening methodology advocated by the Environment Agency (EA) guidance document (EA, 2004d) should:

- i) Identify complete source-pathway-receptor linkages;
- ii) Screen out insignificant risks;
- iii) Prioritise the risks and receptors; and
- iv) Provide an initial assessment of the potential impacts at a receptor.

A Tier 2 assessment comprises the quantitative

analysis of risk following the collection and analysis of soil gas monitoring data.

Guidance on suitable methodologies for the collection of gas monitoring data is provided in CIRIA Report C665 (CIRIA, 2007).

Guidance Available PBA use the following primary guidance to assess the significance of soil gas chemistry with respect to its potential to harm human health.

- i) Assessing risks posed by hazardous gases to buildings C665 (CIRIA 2007);
- ii) Guidance on evaluation of development proposals on sites where methane and carbon dioxide are present. (NHBC 2007);
- iii) Code of practice for the characterization and remediation from ground gas is affected developments (BSI, 2007); and
- iv) Waste Management Paper No. 27 (DoE, 1991).

Waste Management Paper No. 27 (DoE, 1991) defines what constitutes a "significant quantity" of gas. WMP27 advises that a site producing (i) Methane concentrations in excess of 1% by volume and with a flow rate of greater than 15 litres per hour; or (ii) Carbon dioxide in excess of 1.5% by volume in air and with a flow rate of greater than 22 litres per hour would be considered as a significant source of soil gas.

Guidance on quantifying the risks from hazardous soil gases to properties and their occupiers is provided in CIRIA, 2007 (commercial developments), NHBC, 2007 (low rise residential developments) and British Standard BS 8485:2007. These documents provide guidance on gas monitoring methods and strategy, the assessment of risk posed by soil gases and mitigating the risks posed by soil gases during site development.

PBA use gas concentrations and borehole flow data in order to obtain the gas screening value (GSV) for methane and carbon dioxide at the site. The GSV can be used to establish the characteristic situation of the site as detailed in CIRIA C665 and in order to make recommendations for gas protection measures for buildings if required.

Radon In addition to the guidance listed above, PBA use the following primary guidance to assess the significance of the radon content of soil gas.

- i) Radon: guidance on protective measures for new dwellings. Report BR211 (BRE, 1999); and
- ii) Radon Atlas of England, R290 (NRPB, 1996).

5 References

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Rationale for the Selection of Generic Assessment Criteria

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Rationale for the Selection of Generic Assessment Criteria

Table 1: Tier 2 Screening Criteria for the Assessment of the Significance of Potential Contaminant Concentrations in Soil – Protection of Human Health

Concentrations in Soil – Protection of Human Health				
Determinand	Allotments mg/kg	Residential with plant uptake mg/kg	Residential without plant uptake mg/kg	Commercial/ Industrial mg/kg
Metals/Metalloids				
Arsenic	43 ^a	32 ^a	35 ¹	640 ^a
Beryllium	55 ^c	51 ^c	-	420 ^c
Boron	45 ^c	291 ^c	-	192,000 ^c
Cadmium	1.8 ^a	10 ^a	117 ¹	230 ^a
Chromium (trivalent)	34,600 ^c	3000 ^c	-	30,400 ^c
Chromium (hexavalent)	2.1 ^a	4.3 ^c	-	35 ^c
Copper	524 ^c	2330 ^c	-	71,700 ^c
Lead	-	450 ^b	450 ^b	750 ^b
Mercury (elemental)	1 ^a	26 ^a	-	26 ^a
Mercury (inorganic)	80 ^a	170 ^a	235 ¹	3600 ^a
Methyl Mercury	8 ^a	11 ^a	-	410 ^a
Nickel	230 ^a	130 ^a	130 ¹	1800 ^a
Selenium	120 ^a	350 ^a	595 ¹	13000 ^a
Vanadium	18 ^c	75 ^c	-	3160 ^c
Zinc	618 ^c	3750 ^c	-	665,000 ^c
BTEX Compounds (1%, 3% and 6% SOM)^d				
Benzene	0.02 ¹ / 0.04 ¹ / 0.07 ^a	0.08 ¹ / 0.18 ¹ / 0.33 ^a	0.27 ¹ / 0.56 ¹ / 1.0 ¹	28 ¹ / 57 ¹ / 95 ^a
Toluene	22 ¹ / 60 ¹ / 120 ^a	120 ¹ / 320 ¹ / 610 ^a	600 ¹ / 1500 ¹ / 2700 ¹	870 ¹ / 2200 ¹ / 4400 ^a
Ethylbenzene	16 ¹ / 45 ¹ / 90 ^a	65 ¹ / 180 ¹ / 350 ^a	165 ¹ / 450 ¹ / 840 ¹	520 ¹ / 1400 ¹ / 2800 ^a
Xylenes (m-xylene)	28 ¹ / 80 ¹ / 160 ^a	42 ¹ / 120 ¹ / 230 ^a	53 ¹ / 145 ¹ / 285 ¹	475 ¹ / 1300 ¹ / 2600 ^a
Polycyclic Aromatic Hydrocarbons (1%, 2.5% and 6% SOM)^d				
Acenaphthene	34 ^c / 85 ^c / 200 ^c	210 ^c / 480 ^c / 1000 ^c	-	85000 ^c / 98000 ^c / 100000 ^c
Acenaphthylene	28 ^c / 69 ^c / 160 ^c	170 ^c / 400 ^c / 850 ^c	-	84000 ^c / 97000 ^c / 100000 ^c
Anthracene	380 ^c / 950 ^c / 2200 ^c	2300 ^c / 4900 ^c / 9200 ^c	-	530000 ^c / 540000 ^c / 540000 ^c
Benzo(a)anthracene	2.5 ^c / 5.5 ^c / 10 ^c	3.1 ^c / 4.7 ^c / 5.9 ^c	-	90 ^c / 95 ^c / 97 ^c
Benzo(a)pyrene	0.60 ^c / 1.2 ^c / 2.1 ^c	0.83 ^c / 0.94 ^c / 1.0 ^c	-	14 ^c / 14 ^c / 14 ^c
benzo(b)fluoranthene	3.5 ^c / 7.4 ^c / 13 ^c	5.6 ^c / 6.5 ^c / 7.0 ^c	-	100 ^c / 100 ^c / 100 ^c
benzo(g,h,i)perylene	70 ^c / 120 ^c / 160 ^c	44 ^c / 46 ^c / 47 ^c	-	650 ^c / 660 ^c / 680 ^c
benzo(k)fluoranthene	6.8 ^c / 14 ^c / 23 ^c	8.5 ^c / 9.6 ^c / 10 ^c	-	140 ^c / 140 ^c / 140 ^c
Chrysene	2.6 ^c / 5.8 ^c / 12 ^c	6.0 ^c / 8.0 ^c / 9.3 ^c	-	140 ^c / 140 ^c / 140 ^c
Dibenzo(a,h) anthracene	0.76 ^c / 1.5 ^c / 2.3 ^c	0.76 ^c / 0.86 ^c / 0.90 ^c	-	13 ^c / 13 ^c / 13 ^c
Fluoranthene	52 ^c / 130 ^c / 290 ^c	280 ^c / 460 ^c / 670 ^c	-	23000 ^c / 23000 ^c / 23000 ^c
Fluorene	27 ^c / 67 ^c / 160 ^c	160 ^c / 380 ^c / 780 ^c	-	64000 ^c / 69000 ^c / 71000 ^c
Indeno(1,2,3-cd)pyrene	1.8 ^c / 3.8 ^c / 7.1 ^c	3.2 ^c / 3.9 ^c / 4.2 ^c	-	60 ^c / 61 ^c / 61 ^c
Naphthalene	4.1 ^c / 9.9 ^c / 23 ^c	1.5 ^c / 3.7 ^c / 8.7 ^c	-	200 ^c / 480 ^c / 1100 ^c
Phenanthrene	16 ^c / 38 ^c / 90 ^c	92 ^c / 200 ^c / 380 ^c	-	22000 ^c / 22000 ^c / 23000 ^c
Pyrene	110 ^c / 270 ^c / 620 ^c	560 ^c / 1000 ^c / 1600 ^c	-	54000 ^c / 54000 ^c / 54000 ^c
Aliphatic/Aromatic Hydrocarbons (1%, 2.5%				

Rationale for the Selection of Generic Assessment Criteria

Determinand	Allotments mg/kg	Residential with plant uptake mg/kg	Residential without plant uptake mg/kg	Commercial/ Industrial mg/kg
TPH Aliphatic >C16-35	260000 ^e / 270000 ^e / 270000 ^e	45000 ^e / 64000 ^e / 76000 ^e	-	1600000 ^e / 1800000 ^e / 1800000 ^e
TPH Aliphatic >C35-44	260000 ^e / 270000 ^e / 270000 ^e	45000 ^e / 64000 ^e / 76000 ^e	-	1600000 ^e / 1800000 ^e / 1800000 ^e
TPH Aromatic >C5-7 (benzene)	13 ^e / 27 ^e / 57 ^e	65 ^e / 130 ^e / 280 ^e	-	28000 ^e / 49000 ^e / 90000 ^e
TPH Aromatic >C7-8 (toluene)	22 ^e / 51 ^e / 120 ^e	120 ^e / 270 ^e / 611 ^e	-	59000 ^e / 110000 ^e / 190000 ^e
TPH Aromatic >C8-10	8.6 ^e / 21 ^e / 51 ^e	27 ^e / 65 ^e / 151 ^e	-	3700 ^e / 8600 ^e / 18000 ^e
TPH Aromatic >C10-12	13 ^e / 31 ^e / 74 ^e	69 ^e / 160 ^e / 346 ^e	-	17000 ^e / 29000 ^e / 34500 ^e
TPH Aromatic >C12-16	23 ^e / 57 ^e / 130 ^e	140 ^e / 310 ^e / 593 ^e	-	36000 ^e / 37000 ^e / 37800 ^e
TPH Aromatic >C16-21	46 ^e / 110 ^e / 260 ^e	250 ^e / 480 ^e / 770 ^e	-	28000 ^e / 28000 ^e / 28000 ^e
TPH Aromatic >C21-35	370 ^e / 820 ^e / 1600 ^e	890 ^e / 1100 ^e / 1230 ^e	-	28000 ^e / 28000 ^e / 28000 ^e
TPH Aromatic >C35-44	370 ^e / 820 ^e / 1600 ^e	890 ^e / 1100 ^e / 1230 ^e	-	28000 ^e / 28000 ^e / 28000 ^e
TPH Aliphatic + Aromatic >C44-70	1200 ^e / 2100 ^e / 3000 ^e	1200 ^e / 1300 ^e / 1300 ^e	-	28000 ^e / 28000 ^e / 28000 ^e
Chlorinated Hydrocarbons (1%, 2.5% and 6% SOM) ^d				
1,2-dichloroethane	0.0046 ^e / 0.0083 ^e / 0.016 ^e	0.0054 ^e / 0.0080 ^e / 0.014 ^e	-	0.71 ^e / 1.0 ^e / 1.8 ^e
1,1,1 Trichloroethane (TCA)	48 ^e / 110 ^e / 240 ^e	6.2 ^e / 13 ^e / 28 ^e	-	700 ^e / 1400 ^e / 3100 ^e
1,1,1,2 Tetrachloroethane	0.79 ^e / 1.9 ^e / 4.4 ^e	0.90 ^e / 2.1 ^e / 4.8 ^e	-	120 ^e / 260 ^e / 590 ^e
1,1,2,2 Tetrachloroethane	0.41 ^e / 0.89 ^e / 2.0 ^e	1.4 ^e / 2.9 ^e / 6.3 ^e	-	290 ^e / 580 ^e / 1200 ^e
Tetrachloroethane (PCE)	1.6 ^e / 3.7 ^e / 8.7 ^e	0.94 ^e / 2.1 ^e / 4.8 ^e	-	130 ^e / 290 / 660 ^e
Tetrachloromethane (Carbon tetrachloride)	0.16 ^e / 0.37 ^e / 0.85 ^e	0.018 ^e / 0.039 ^e / 0.089 ^e	-	3.0 ^e / 6.6 / 15 ^e
Trichloroethene (TCE)	0.43 ^e / 0.95 ^e / 2.2 ^e	0.11 ^e / 0.22 ^e / 0.49 ^e	-	12 ^e / 25 ^e / 55 ^e
Trichloromethane (chloroform)	0.36 ^e / 0.70 ^e / 1.5 ^e	0.75 ^e / 1.3 ^e / 2.7 ^e	-	110 ^e / 190 ^e / 370 ^e
Vinyl Chloride (Chloroethene)	0.00055 ^e / 0.0010 ^e / 0.0018 ^e	0.00047 ^e / 0.00064 ^e / 0.00099 ^e	-	0.063 ^e / 0.081 ^e / 0.12 ^e
Pesticides and Other Organic Compounds (1%, 2.5% and 6% SOM) ^d				
Aldrin	1.3 ^e / 2.6 ^e / 4.0 ^e	1.7 ^e / 2.0 ^e / 2.1 ^e	-	54 ^e / 54 ^e / 54 ^e
Atrazine	0.037 ^e / 0.085 ^e / 0.2 ^e	0.24 ^e / 0.56 ^e / 1.3 ^e	-	870 ^e / 880 ^e / 880 ^e
Dichlorvos	0.044 ^e / 0.091 ^e / 0.20 ^e	0.29 ^e / 0.6 ^e / 1.3 ^e	-	842 ^e / 872 ^e / 893 ^e
Dieldrin	0.13 ^e / 0.32 ^e / 0.73 ^e	0.69 ^e / 1.4 ^e / 2.2 ^e	-	90 ^e / 91 ^e / 92 ^e
Endosulfan	0.47 ^e / 1.2 ^e / 2.7 ^e	2.9 ^e / 7.0 ^e / 16 ^e	-	2310 ^e / 2990 ^e / 3390 ^e
Carbon Disulphide	4.8 ^e / 10 ^e / 23 ^e	0.10 ^e / 0.20 ^e / 0.44 ^e	-	12 ^e / 23 ^e / 50 ^e
Chlorobenzene	5.9 ^e / 14 ^e / 32 ^e	0.33 ^e / 0.73 ^e / 1.7 ^e	-	59 ^e / 130 ^e / 310 ^e
Hexachloro-1,3-butadiene	0.25 ^e / 0.61 ^e / 1.4 ^e	0.21 ^e / 0.51 ^e / 1.2 ^e	-	32 ^e / 69 ^e / 120 ^e
Hexachlorobenzene	0.18 ^e / 0.42 ^e / 0.92 ^e	0.59 ^e / 1.0 ^e / 1.4 ^e	-	48 ^e / 53 ^e / 55 ^e
Pentachlorobenzene	1.2 ^e / 3.1 ^e / 7.1 ^e	5.2 ^e / 10 ^e / 17 ^e	-	650 ^e / 770 ^e / 830 ^e
Pentachlorophenol	0.084 ^e / 0.21 ^e / 0.49 ^e	0.55 ^e / 1.3 ^e / 2.96 ^e	-	1200 ^e / 1300 ^e / 1400 ^e
Phenol (1, 3, 6% SOM)	66 ^f / 158 ^f / 280 ^a	184 ^f / 316 ^f / 420 ^a	310 ^f / 441 ^f / 519 ^f	3200 ^a

Notes

- a Soil Guideline Value (2009)
b Soil Guideline Value (2002)
c Generic Assessment Criteria (LQM & CIEH 2009)
d Where three values are presented, SGV/GAC for soils with SOM of 1%, 2.5% and 6% or 1%, 3% and 6% are given as detailed in the table. SOM denotes Soil Organic Matter.
f Generic Assessment Criteria generated using CLEA v 1.04 by an independent contaminated land working group and independently verified by PBA (CLSD, 2009)

Rationale for the Selection of Generic Assessment Criteria

Table 2: Tier 2 Screening Criteria for the Assessment of the Significance of Potential Contaminant Concentrations in Groundwater and Surface Water

Parameter	Water abstracted for potable use	Water not abstracted for potable use
	Water Supply (Water Quality) Regulations 2000	Environmental Quality Standards (EQSs)
Arsenic ($\mu\text{g/l}$)	10	50
Cadmium ($\mu\text{g/l}$)	5	5
Chromium ($\mu\text{g/l}$)	50	5 to 250
Lead ($\mu\text{g/l}$)	25 (10 from 25/12/13)	4 to 250
Mercury ($\mu\text{g/l}$)	1	1
Selenium ($\mu\text{g/l}$)	10	-
Nickel ($\mu\text{g/l}$)	20	50 to 200
Zinc ($\mu\text{g/l}$)	-	8 to 500
Antimony ($\mu\text{g/l}$)	5	-
Boron ($\mu\text{g/l}$)	1000	2000
Copper ($\mu\text{g/l}$)	2000	1 to 28
Iron ($\mu\text{g/l}$)	200	1000
Manganese ($\mu\text{g/l}$)	50	-
Vanadium ($\mu\text{g/l}$)	-	20 to 60
pH (pH units)	6.5 to 10	6.0 to 9.0
Electrical Conductivity ($\mu\text{S/cm}$)	2500	-
Ammoniacal nitrogen (mg/l)	0.5	0.015
Sulphate (mg/l)	250	400
Chloride (mg/l)	250	250
Total Phenol (mg/l)	0.5	30 (300)
Nitrate (mg/l)	50	-
Cyanide (mg/l)	50	-
PAHs (EPA 16) ($\mu\text{g/l}$)	0.1	-
Benzo(a)pyrene ($\mu\text{g/l}$)	0.01	-
SVOCs:		
Hexachlorobenzene ($\mu\text{g/l}$)	-	0.03
Hexachlorobutadiene ($\mu\text{g/l}$)	-	0.1
Phenol ($\mu\text{g/l}$)	-	30 (300)
VOCs:		
Chloroform ($\mu\text{g/l}$)	-	12
1,2-Dichloroethane ($\mu\text{g/l}$)	3	10
1,1,1-Trichloroethane ($\mu\text{g/l}$)	-	100 (1000)
Trichloroethene ($\mu\text{g/l}$)	10	10
1,1,2-Trichloroethane ($\mu\text{g/l}$)	-	400 (4000)
Tetrachloroethene ($\mu\text{g/l}$)	10	10
Styrene ($\mu\text{g/l}$)	-	50 (500)
Benzene ($\mu\text{g/l}$)	1	30 (300)
Toluene ($\mu\text{g/l}$)	-	50 (500)
Vinyl Chloride ($\mu\text{g/l}$)	0.5	-
Xylene ($\mu\text{g/l}$)	-	30

Notes

- Some organic contaminants are given two EQS values. These values relate to an acceptable annual average concentration followed in brackets by a maximum admissible peak concentration.
- Where a range is presented e.g. for vanadium, different EQSs relate to different alkalinity (hardness) values for the water sample being tested.

Rationale for the Selection of Generic Assessment Criteria

Table 3 Tier 2 Screening Criteria for the Assessment of the Significance of Potential Contaminant Concentrations in Soil – Protection of Ecological Systems

Parameter	ICRCL 70/90 ^a			Proposed SSVs ^b	The Soil Code ^c
	Threshold ^d	Maximum			
		Livestock	Crop Growth		
	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
Benzo(a)pyrene				0.15	
Arsenic	50	500	1000		50
Cadmium	3	30	50	1.15	3
Chromium				21.1	400
Copper	250	500	250	88.4	80/ 100/ 135/ 200*
Fluoride	500	1000			500
Lead	300	1000		167.9	300
Mercury				0.06	1
Molybdenum					4
Nickel				25.1	50/ 60/ 75/ 110*
Pentachlorobenzene				0.029	
Pentachlorophenol				0.6	
Selenium					3
Tetrachloroethene				0.01	
Toluene				0.3	
Zinc	1000	3000	1000	90.1	200/ 200/ 200/ 300*

Notes

- a Interdepartmental Committee on the Redevelopment of Contaminated Land (ICRCL) 70/90 Restoration and Aftercare of Metalliferous Mining Sites for Pasture and Grazing 1st edition 1990.
- b Proposed Soil Screening Values (SSVs) – Consultation, Environment Agency 2008. Threshold which if exceeded prompts further assessment.
- c Maximum permissible concentration of potentially toxic elements from The Soil Code revised 1998 – Code of Practice for the Protection of Soil MAFF October 1998.
- d Concentrations are for contamination derived from mine spoil. In other situations the speciation may be more available. Factors include total concentration, speciation, particle size, pH, species of plant, type of animal/grazing habit.
- e Where four values are presented, concentrations are for soils with pH values 5.0-5.5/ 5.5-6.0/ 6.0-7.0/ >7.0

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Assessment Criteria

- A - Soil Guideline Value (SGV) for Allotments
- B - SGV for Residential with Plant Uptake
- C - SGV for Commercial/Industrial
- D - LQM Generic Assessment Criteria (GAC) for Allotments
- E - LQM GAC for Residential with Plant Uptake
- F - LQM GAC for Commercial/Industrial
- G - Contaminated Land Working Group (CLWG) GAC for Allotments
- H - CLWG GAC for Residential with Plant Uptake
- I - CLWG GAC for Commercial/Industrial
- J - PBA Internal Screening Value

*Lead - Soil Guideline Value 2002

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		Assesse t Criteria								WS	WS	WS	WS	WS	WS	WS	WS	WS	T	1	WS5	WS	WS	T A1	T A	T A5	T A	
		A	C	D	E	F	G	I		1								5	5	5	5	5	-	-	-	-		
A l te	its																											
Stones BG 2.6/3.0	%									23	46	100			11	35	0.1	21						32	13	19	9.9	3.0
Moisture content at 30 C	%									21	18	16			20	18	14	16						20	32	20	32	23
Arsenic as As, dry weight	mg/kg	43	32	640						4	5	7			3	5	3	7	6	5	1	1		7	3	11	6	
Beryllium as Be, dry weight	mg/kg									0.4	0.5	0.4			0.6			0.4							0.6	0.5		
Boron as B, hot water sol d	mg/kg				55	51	420																					
Cadmium as Cd, dry weight	mg/kg	1.9	10	230						0.4	0.3	0.3			0.3	0.3	0.3	0.3	0.5	0.6	0.6	0.7	0.8	0.7	0.3	0.4	0.4	
Chromium as Cr, dry weight	mg/kg	34600	3000	30400						37	29	31			36	28	17	18	27	51	26	22	30.0	20	20	20	32	
Copper as Cu, dry weight	mg/kg				524	2330	71700			28	27	19			20			24	14	45	24	44	43		14	14		
Lead as Pb, dry weight	mg/kg	450*	450*	750*						54	65	360			32	36	19	210	26	83	36	168	145	210	41	61	59	
Mercury as Hg, dry weight	mg/kg	80	170	3600						0.6	0.7	0.6			0.6	0.6	0.6	0.6	1.5	0.6	0.8	1.1	0.4	0.4	0.4	0.4		
Nickel as Ni, dry weight	mg/kg	230	120	1800						20	14	12			18	19	16	17	12	24	36	368	145.0	16	15	18	25	
Selenium as Se, dry weight	mg/kg	120	350	13000						3	3	3			3	3	3	1.3	0.5	0.5	0.5	0.5	3	3	3	3		
Vanadium as Vn, dry weight	mg/kg				18	75	3180			30	27	23			32			28							26	34		
Zinc as Zn, dry weight	mg/kg				618	3750	665000			110	110	180			85			82	47	126	65	189	151		75	100		
Cyanide (Total)	mg/kg																											
Organic matter	%									3.2	4.4	1.6			2.6			0.94	2.5	2.5	2.5	4.7	2.5		6.7	4.4		
Phenol, Total	mg/kg			3200				66	184	0.15	0.15	0.15			0.15			0.15	0.01	0.01	0.01	0.01	0.01		0.15	0.15		
Sulphate (Total) as SO4	%									0.003	0.003	0.053			0.032			0.14	0.003	0.196	0.06	0.3	0.815					
pH	pH Units							0.02	0.08	7.73	7.5	8.23			7.73			8.49	6.49	7.69	8.02	8.80	7.9		6.99	7.70		
Benzene								0.01	0.01	0.01	0.01	0.01			0.01													
Toluene								22	120	0.01	0.01	0.01	0.01		0.01													
Ethylbenzene								16	65	0.01	0.01	0.01	0.01		0.01													
Xylene								28	42	0.01	0.01	0.01	0.01		0.01													
>C5 to C6 Aliphatic	mg/kg			740	30	2400				0.01	0.01	0.01	0.01		0.01													
>C6 to C8 Aliphatic	mg/kg			2300	73	8300				0.01	0.01	0.01	0.01		0.01													
>C8 to C10 Aliphatic	mg/kg			320	19	2100				0.01	0.01	0.01	0.01		0.01													
>C10 to C12 Aliphatic	mg/kg			2200	93	10000				0.01	0.01	0.01	0.01		0.01													
>C12 to C16 Aliphatic	mg/kg			11000	740	61000				0.1	0.1	3.6	0.1		0.1													
>C16 to C35 Aliphatic	mg/kg			260000	45000	1600000				37	31	49	12		0.1													
>C35 to C44 Aliphatic	mg/kg			260000	45000	1600000				7.1	0.1	26	0.1		0.1													
Total Aliphatic	mg/kg									44	31	78	12		0.1													
>C5 to C7 Aromatic	mg/kg			13	65	28000				0.01	0.01	0.01	0.01		0.01													
>C7 to C8 Aromatic	mg/kg			22	120	59000				0.01	0.01	0.01	0.01		0.01													
>C8 to C10 Aromatic	mg/kg			8.6	27	3700				0.01	0.01	0.01	0.01		0.01													
>C10 to C12 Aromatic	mg/kg			13	69	17000				0.01	0.01	0.01	0.01		0.01													
>C12 to C16 Aromatic	mg/kg			23	140	36000				0.1	0.1	0.1	0.1		0.1													
>C16 to C21 Aromatic	mg/kg			46	250	28000				3.6	0.1	5.7	0.1		0.1													
>C21 to C35 Aromatic	mg/kg			370	890	28000				62	48	46	20		4.1													
>C35 to C44 Aromatic	mg/kg			370	890	28000				15	15	49	5.3		7.5													
Total Aromatic	mg/kg									81	63	100	26		12													
Total EPH Aliphatic/Aromatic	mg/kg							1000		130	93	180	38		12			370	338	445	383			130		110		
TPH by GC (>C6-C10)	mg/kg																											
TPH by GC (>C10 - C20)	mg/kg																											
TPH by GC (>C20-C40)	mg/kg																											
TPH by GC (>C6 - C40)	mg/kg											290	95		310													
TPH (Chromatogram)	TEXT																											
naphthalene	mg/kg			4.1	1.5	200				0.049	0.058	0.037	0.034		0.049	0.03	1	0.092		0.287	0.339	0.159	0.394		0.017		0.016	
acenaphthylene	mg/kg			28	170	84000				0.39	0.21	0.076	0.025		0.011	0.015	0.005	0.041		0.034	0.031	0.165	0.136		0.032		0.017	
acenaphthene	mg/kg			34	210	85000				0.099	0.045	0.014	0.014		0.014	0.014	0.057		0.045	0.066	0.294	0.2		0.008		0.008		
fluorene	mg/kg			27	160	64000				0.22	0.065	0.039	0.012		0.012	0.012	0.082		0.073	0.06	0.276	0.293		0.01		0.01		
phenanthrene	mg/kg			16	92	22000				3.2	0.91	0.59	0.059		0.053	0.037	0.064	0.37		0.263	0.464	3.139	2.585		0.18		0.13	
anthracene	mg/kg			380	2300	536000				0.71	0.25	0.18	0.019		0.018	0.015	0.009	0.1		0.053	0.141	0.96	0.689		0.054		0.026	
fluoranthene	mg/kg			52	260	23000				4.4	2.2	1	0.14		0.083	0.088	0.029	0.74		0.312	0.777	4.522	3.18		0.52		0.2	
pyrene	mg/kg			110	560	54000				3.6	1.8	0.83	0.13		0.076	0.09	0.026	0.67		0.283	0.657	3.687	2.662		0.48		0.17	
benzo(a)anthracene	mg/kg			2.5	3.1	90				2.1	1.2	0.83	0.11		0.077	0.074	0.038	0.44		0.129	0.577	4.509	1.798		0.25		0.085	
chrysene	mg/kg			2.6	6	140				1.4	0.95	0.43	0.091		0.067	0.061	0.032	0.33		0.164	0.327	1.474	1.054		0.24		0.12	
benzo(b)fluoranthene	mg/kg			3.5	5.6	100				1.7	1.4	0.83	0.17		0.1	0.095	0.018	0.53		0.486	1.172	5.531	3.39		0.28		0.12	
benzo(k)fluoranthene	mg/kg			6.8	8.5	140				1.3	0.91	0.38	0.11		0.048	0.056	0.025	0.24		0.054	0.129	0.516	0.452		0.14		0.056	
benzo(a)pyrene	mg/kg			0.6	0.83	14				1.9	1.4	0.64	0.12		0.068	0.056	0.013	0.43		0.149	0.272	1.811	1.175		0.29		0.082	
indeno(1,2,3cd)pyrene	mg/kg			1.8	3.2	60				1.1	0.85	0.39	0.079		0.046	0.047	0.011	0.25		0.102	0.218	1.303	0.79		0.17		0.059	
benzo(a)anthracene	mg/kg			0.76	0.76	13				0.24	0.19	0.11	0.021		0.011	0.01	0.008	0.048		0.037	0.064	0.375	0.255		0.053		0.023	
benzo(g)h)pyrene	mg/kg			70	44	650				1.5	1.1	0.5	0.12		0.079	0.083	0.017	0.41		0.124	0.267	1.429	0.848		0.24		0.065	
PAH (Total)	mg/kg									24	13	6.9	1.2		0.8	0.76	1.3	4.8	62	2.596	5.562	30.152	19.902		2.9		1.2	
PCB (as Aroclors)	mg/kg																											
1,2-dichloroethane	mg/kg			0.0046	0.0054	0.71				0.005					0.005	0.005	0.005	0.005										
1,1,1 Trichloroethane (TCA)	mg/kg			48	6.2	760				0.007					0.007	0.007	0.007	0.007										
1,1,1,2 Tetrachloroethane	mg/kg			0.79	0.9	120				0.01					0.01	0.01	0.01	0.01										

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				Assessment Criteria		oe 1		oe 2		oe 3		oe 4		oe 5		oe 6		oe 7		oe 8		oe 9		oe 10		oe 11		oe 12		oe 13		oe 14		oe 15		oe 16		oe 17		oe 18		oe 19		oe 20		oe 21		oe 22		oe 23		oe 24		oe 25		oe 26		oe 27		oe 28		oe 29		oe 30		oe 31		oe 32		oe 33		oe 34		oe 35		oe 36		oe 37		oe 38		oe 39		oe 40		oe 41		oe 42		oe 43		oe 44		oe 45		oe 46		oe 47		oe 48		oe 49		oe 50		oe 51		oe 52		oe 53		oe 54		oe 55		oe 56		oe 57		oe 58		oe 59		oe 60		oe 61		oe 62		oe 63		oe 64		oe 65		oe 66		oe 67		oe 68		oe 69		oe 70		oe 71		oe 72		oe 73		oe 74		oe 75		oe 76		oe 77		oe 78		oe 79		oe 80		oe 81		oe 82		oe 83		oe 84		oe 85		oe 86		oe 87		oe 88		oe 89		oe 90		oe 91		oe 92		oe 93		oe 94		oe 95		oe 96		oe 97		oe 98		oe 99		oe 100		oe 101		oe 102		oe 103		oe 104		oe 105		oe 106		oe 107		oe 108		oe 109		oe 110		oe 111		oe 112		oe 113		oe 114		oe 115		oe 116		oe 117		oe 118		oe 119		oe 120		oe 121		oe 122		oe 123		oe 124		oe 125		oe 126		oe 127		oe 128		oe 129		oe 130		oe 131		oe 132		oe 133		oe 134		oe 135		oe 136		oe 137		oe 138		oe 139		oe 140		oe 141		oe 142		oe 143		oe 144		oe 145		oe 146		oe 147		oe 148		oe 149		oe 150		oe 151		oe 152		oe 153		oe 154		oe 155		oe 156		oe 157		oe 158		oe 159		oe 160		oe 161		oe 162		oe 163		oe 164		oe 165		oe 166		oe 167		oe 168		oe 169		oe 170		oe 171		oe 172		oe 173		oe 174		oe 175		oe 176		oe 177		oe 178		oe 179		oe 180		oe 181		oe 182		oe 183		oe 184		oe 185		oe 186		oe 187		oe 188		oe 189		oe 190		oe 191		oe 192		oe 193		oe 194		oe 195		oe 196		oe 197		oe 198		oe 199		oe 200		oe 201		oe 202		oe 203		oe 204		oe 205		oe 206		oe 207		oe 208		oe 209		oe 210		oe 211		oe 212		oe 213		oe 214		oe 215		oe 216		oe 217		oe 218		oe 219		oe 220		oe 221		oe 222		oe 223		oe 224		oe 225		oe 226		oe 227		oe 228		oe 229		oe 230		oe 231		oe 232		oe 233		oe 234		oe 235		oe 236		oe 237		oe 238		oe 239		oe 240		oe 241		oe 242		oe 243		oe 244		oe 245		oe 246		oe 247		oe 248		oe 249		oe 250		oe 251		oe 252		oe 253		oe 254		oe 255		oe 256		oe 257		oe 258		oe 259		oe 260		oe 261		oe 262		oe 263		oe 264		oe 265		oe 266		oe 267		oe 268		oe 269		oe 270		oe 271		oe 272		oe 273		oe 274		oe 275		oe 276		oe 277		oe 278		oe 279		oe 280		oe 281		oe 282		oe 283		oe 284		oe 285		oe 286		oe 287		oe 288		oe 289		oe 290		oe 291		oe 292		oe 293		oe 294		oe 295		oe 296		oe 297		oe 298		oe 299		oe 300		oe 301		oe 302		oe 303		oe 304		oe 305		oe 306		oe 307		oe 308		oe 309		oe 310		oe 311		oe 312		oe 313		oe 314		oe 315		oe 316		oe 317		oe 318		oe 319		oe 320		oe 321		oe 322		oe 323		oe 324		oe 325		oe 326		oe 327		oe 328		oe 329		oe 330		oe 331		oe 332		oe 333		oe 334		oe 335		oe 336		oe 337		oe 338		oe 339		oe 340		oe 341		oe 342		oe 343		oe 344		oe 345		oe 346		oe 347		oe 348		oe 349		oe 350		oe 351		oe 352		oe 353		oe 354		oe 355		oe 356		oe 357		oe 358		oe 359		oe 360		oe 361		oe 362		oe 363		oe 364		oe 365		oe 366		oe 367		oe 368		oe 369		oe 370		oe 371		oe 372		oe 373		oe 374		oe 375		oe 376		oe 377		oe 378		oe 379		oe 380		oe 381		oe 382		oe 383		oe 384		oe 385		oe 386		oe 387		oe 388		oe 389		oe 390		oe 391		oe 392		oe 393		oe 394		oe 395		oe 396		oe 397		oe 398		oe 399		oe 400		oe 401		oe 402		oe 403		oe 404		oe 405		oe 406		oe 407		oe 408		oe 409		oe 410		oe 411		oe 412		oe 413		oe 414		oe 415		oe 416		oe 417		oe 418		oe 419		oe 420		oe 421		oe 422		oe 423		oe 424		oe 425		oe 426		oe 427		oe 428		oe 429		oe 430		oe 431		oe 432		oe 433		oe 434		oe 435		oe 436		oe 437		oe 438		oe 439		oe 440		oe 441		oe 442		oe 443		oe 444		oe 445		oe 446		oe 447		oe 448		oe 449		oe 450		oe 451		oe 452		oe 453		oe 454		oe 455		oe 456		oe 457		oe 458		oe 459		oe 460		oe 461		oe 462		oe 463		oe 464		oe 465		oe 466		oe 467		oe 468		oe 469		oe 470		oe 471		oe 472		oe 473		oe 474		oe 475		oe 476		oe 477		oe 478		oe 479		oe 480		oe 481		oe 482		oe 483		oe 484		oe 485		oe 486		oe 487		oe 488		oe 489		oe 490		oe 491		oe 492		oe 493		oe 494		oe 495		oe 496		oe 497		oe 498		oe 499		oe 500		oe 501		oe 502		oe 503		oe 504		oe 505		oe 506		oe 507		oe 508		oe 509		oe 510		oe 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636		oe 637		oe 638		oe 639		oe 640		oe 641		oe 642		oe 643		oe 644		oe 645		oe 646		oe 647		oe 648		oe 649		oe 650		oe 651		oe 652		oe 653		oe 654		oe 655		oe 656		oe 657		oe 658		oe 659		oe 660		oe 661		oe 662		oe 663		oe 664		oe 665		oe 666		oe 667		oe 668		oe 669		oe 670		oe 671		oe 672		oe 673		oe 674		oe 675		oe 676		oe 677		oe 678		oe 679		oe 680		oe 681		oe 682		oe 683		oe 684		oe 685		oe 686		oe 687		oe 688		oe 689		oe 690		oe 691		oe 692		oe 693		oe 694		oe 695		oe 696		oe 697		oe 698		oe 699		oe 700		oe 701		oe 702		oe 703		oe 704		oe 705		oe 706		oe 707		oe 708		oe 709		oe 710		oe 711		oe 712		oe 713		oe 714		oe 715		oe 716		oe 717		oe 718		oe 719		oe 720		oe 721		oe 722		oe 723		oe 724		oe 725		oe 726		oe 727		oe 728		oe 729		oe 730		oe 731		oe 732		oe 733		oe 734		oe 735		oe 736		oe 737		oe 738		oe 739		oe 740		oe 741		oe 742		oe 743		oe 744		oe 745		oe 746		oe 747		oe 748		oe 749		oe 750		oe 751		oe 752		oe 753		oe 754		oe 755		oe 756		oe 757		oe 758		oe 759		oe 760		oe 761		oe 762		oe 763		oe 764		oe 765		oe 766		oe 767		oe 768		oe 769		oe 770		oe 771		oe 772		oe 773		oe 774		oe 775		oe 776		oe 777		oe 778		oe 779		oe 780		oe 781		oe 782		oe 783		oe 784		oe 785		oe 786		oe 787		oe 788		oe 789		oe 790		oe 791		oe 792		oe 793		oe 794		oe 795		oe 796		oe 797		oe 798		oe 799		oe 800		oe 801		oe 802		oe 803		oe 804		oe 805		oe 806		oe 807		oe 808		oe 809		oe 810		oe 811		oe 812		oe 813		oe 814		oe 815		oe 816		oe 817		oe 818		oe 819		oe 820		oe 821		oe 822		oe 823		oe 824		oe 825		oe 826		oe 827		oe 828		oe 829		oe 830		oe 831		oe 832		oe 833		oe 834		oe 835		oe 836		oe 837		oe 838		oe 839		oe 840		oe 841		oe 842		oe 843		oe 844		oe 845		oe 846		oe 847		oe 848		oe 849		oe 850		oe 851		oe 852		oe 853		oe 854		oe 855		oe 856		oe 857		oe 858		oe 859		oe 860		oe 861		oe 862		oe 863		oe 864		oe 865		oe 866		oe 867		oe 868		oe 869		oe 870		oe 871		oe 872		oe 873		oe 874		oe 875		oe 876		oe 877		oe 878		oe 879		oe 880		oe 881		oe 882		oe 883		oe 884		oe 885		oe 886		oe 887		oe 888		oe 889		oe 890		oe 891		oe 892		oe 893		oe 894		oe 895		oe 896		oe 897		oe 898		oe 899		oe 900		oe 901		oe 902		oe 903		oe 904		oe 905		oe 906		oe 907		oe 908		oe 909		oe 910		oe 911		oe 912		oe 913		oe 914		oe 915		oe 916		oe 917		oe 918		oe 919		oe 920		oe 921		oe 922		oe 923		oe 924		oe 925		oe 926		oe 927		oe 928		oe 929		oe 930		oe 931		oe 932		oe 933		oe 934		oe 935		oe 936		oe 937		oe 938		oe 939		oe 940		oe 941		oe 942		oe 943		oe 944		oe 945		oe 946		oe 947		oe 948		oe 949		oe 950		oe 951		oe 952		oe 953		oe 954		oe 955		oe 956		oe 957		oe 9	
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Assesse t	Criteria	DWS	E S	27/06/2007 MG/RTD	11/07/2007 MG/RTD	27/06/2007 MG	11/07/2007 MG	13/01/09 MG	28/01/09 MG	27/03/2009 RTD	07/04/2009 RTD	05/05/09 RTD	18/08/09 RTD	2002 Superf	2002 Superf (U)	2002 LAM (D)	13/01/09 LMB	28/01/09 LMB	27/03/09 CHK	07/04/09 CHK	05/05/09 CHK	27/03/09 CHK (DG)	07/04/09 CHK (DG)	05/05/09 CHK (DG)
A al te	its																							
Antimony	ug/l	5		1	1			0.75	1	2.2	0.75	0.75	0.75	5	5	5	1.5	1	8.2	0.75	0.75	1.4	5.3	0.8
Arsenic	ug/l	10	50	3	5.8	7.4	11	13	16	1.5	2.5	3.1	1.7	2	2	2	2.5	5	2.6	0.75	0.75	3.1	0.75	0.75
Barium	ug/l	1000																						
Beryllium	ug/l																							
Boron	ug/l	1000	2000	110	77			110	87	20	20	20		80	90	530	120	120	93	20	24	130	140	150
Cadmium	ug/l	5	5	0.5	0.5	0.5	0.5	0.22	1	0.22	0.22	0.22	0.22	0.4	0.4	0.4	0.22	1	0.25	0.22	0.22	0.22	0.22	0.22
Chromium	ug/l	50	5-250	6	2	10	10	9	6	2	1	2	1	1	1	1	3	<5	3	1	2	2	1	1
Copper	ug/l	2000	1 to 28	5	5			7.9	5	2.7	1.6	1.6	1.6	15	6	182	7.9	5	6.4	1.7	1.6	3.3	1.6	1.6
Iron	ug/l	200	1000	620	760			23000	21000	76	74	50	50	32	2	12	2700	1200	50	260	50	50	50	50
Lead	ug/l	25+ / 10**	4-250	3.1	1	3.1	1	2.7	5	0.8	0.4	0.4	0.4	5	5	5	2.6	5	0.7	0.4	0.4	0.8	0.4	0.4
Manganese	ug/l	50		220	130			3000	2600	200	200	240	180	312	12	419	610	600	35	71	74	34	28	40
Molybdenum	ug/l																							
Nickel	ug/l	20	50-200	10	3	21	13	8.2	25	3	2.2	2.4	1.5	10	10	10	4	5	6.4	1.8	1.5	4.8	1.8	1.5
Selenium	ug/l	10		1.5	1.1	2	19	5	5	1	1	1	1	5	5	5	2	5	17	1	1	22	1	1
Vanadium	ug/l		20-60	10	10			2	5	1	1	2	1				1	5	8	1	1	2	3	1
Zinc	ug/l	5000	8-500	5	5	26	10	10	6	12	9	5	5	25	5	105	5	5	25	6	5	10	5	5
Mercury	ug/l	1	1	0.2	0.2	0.2	0.2	0.01	0.05	0.01	0.01	0.01	0.01	0.05	0.05	0.05	0.01	0.05	0.01	0.01	0.01	0.01	0.01	0.01
Alkalinity as CaCO3	mg/l	30 (min)																						
Conductivity	mS/cm	2.5		0.47	0.38	2.2	2.2	1.9	1.95	0.46	0.46	0.45	0.43	0.649	0.639	0.885	0.68	0.795	1.5	0.64	0.65	1.7	0.72	0.71
Sulphate (soluble)	mg/l	250	400	47	24	360	270	71	50	42	30	14	3	86	12	139	24	77	300	47	48	350	77	58
Chloride	mg/l	250	250	40	34	310	210	82	70	30	32	35	35	46	94	71	39	41	210	46	44	270	60	54
Ammoniacal Nitrogen	mg/l	0.5	0.015	0.52	0.51	15	14	15	16	0.9	0.7	0.9	0.8	0.7	0.2	1.3	1.3	1.1	1	0.3	0.5	1	0.6	0.6
Phenols Monohydric	mg/l	0.5	30/300	0.0083	0.0034	0.0019	0.0013	0.01	0.01	0.01	0.01	0.01	<0.5	<0.5	<0.5	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
pH Value	pH Units	6.5 - 8.5		7.1	6.9	6.7	6.7	6.86	6.8	8.47	8.34	8.09	8.59	8.55	8.38	8.35	7.17	7.3	8.21	8.43	8.1	8.26	8.58	8.02
BOD	mg/l			7.4	2			6	3	2	1	1	1				1	3	140	4	3	88	13	12
EPH (DRO) (C10-C40)	ug/l	10		<10	<10	<10	<10	470	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
EPH C10-16	ug/l																							
EPH >C16-24	ug/l																							
EPH >C24-40	ug/l																							
A b GC S																								
Naphthalene	ng/l		30				55	<100	<100	<100	<100	<100	<100				<100	<100	<100	<100	<100	190	<100	<100
Acenaphthylene	ng/l		35				<10	<11	<100	<11	<11	<11	<11				<11	<100	<11	<11	<11	<11	<11	<11
Acenaphthene	ng/l		<10				<10	<15	<100	<15	<15	<15	<15				<15	<100	<15	<15	<15	18	<15	<15
Fluorene	ng/l		23				<10	<14	<100	<14	<14	<14	<14				<14	<100	<14	<14	<14	18	<14	<14
Phenanthrene	ng/l		54				17	<22	<100	<22	<22	<22	<22				<22	<100	<22	<22	<22	<22	<22	<22
Anthracene	ng/l		14				<10	<15	<100	<15	<15	<15	<15				<15	<100	<15	<15	<15	<15	<15	<15
Fluoranthene	ng/l		23				<10	<17	<100	<17	<17	<17	<17				<17	<100	<17	<17	<17	<17	<17	<17
Pyrene	ng/l		17				<10	<15	<100	31	<15	<15	<15				<15	<100	21	<15	<15	<15	<15	<15
Benz(a)anthracene	ng/l		<10				<10	<17	<100	<17	<17	<17	<17				<17	<100	<17	<17	<17	<17	<17	<17
Chrysene	ng/l		<10				<10	<13	<100	<13	<13	<13	<13				<13	<100	<13	<13	<13	<13	<13	<13
Benzo(b)fluoranthene	ng/l		<10				<10	<23	<100	<23	<23	<23	<23				<23	<100	<23	<23	<23	<23	<23	<23
Benzo(k)fluoranthene	ng/l		<10				<10	<27	<100	<27	<27	<27	<27				<27	<100	<27	<27	<27	<27	<27	<27
Benzo(a)pyrene	ng/l	10	<10				<10	<9	<100	<9	<9	<9	<10	<10	<10	<10	<9	<100	<9	<9	<9	<9	<9	<9
Indeno(123cd)pyrene	ng/l		<10				<10	<14	<100	<14	<14	<14	<14				<14	<100	<14	<14	<14	<14	<14	<14
Dibenzo(ah)anthracene	ng/l		<10				<10	<16	<100	<16	<16	<16	<16				<16	<100	<16	<16	<16	<16	<16	<16
Benzo(ghi)perylene	ng/l		<10				<10	<16	<100	<16	<16	<16	<16				<16	<100	<16	<16	<16	<16	<16	<16
PAH 16 Total	ng/l	100	200	<100	<100	<10	<100	ND	<100	<100	<100	340	820	743	95	<100	ND	<100	<100	<100	<100	220	<100	<100

Gree ark hase
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i hli hte Table of Grou ater esults - o e

		Assessme t	Assessme t	WS 1	WS	WS	WS 5	WS	WS	WS	WS	1	1	11	W1 C	W1 C	W1 C
		Criteria	Criteria	13/05/2008	13/05/2008	13/05/2008	13/05/2008	13/05/2008	13/05/2008	13/05/2008	13/05/2008	2002	2002	2002	11/09/2006	06/09/2007	14/12/2007
		DWS	E S	RTD	RTD	RTD	RTD	RTD	RTD	RTD	RTD	RTD	LAM (D)	CHK (D)	CHK (U)	CHK (U)	CHK (U)
SVOC by GCMS																	
he ols																	
2-Chlorophenol	ug/l			<1	<1	<1	<1	<1	<1	<1	<1						
2-Methylphenol	ug/l			<1	<1	<1	<1	<1	<1	<1	<1						
2-Nitrophenol	ug/l			<1	<1	<1	<1	<1	<1	<1	<1						
2,4-Dichlorophenol	ug/l			<1	<1	<1	<1	<1	<1	<1	<1						
2,4-Dimethylphenol	ug/l			<1	<1	<1	<1	<1	<1	<1	<1						
2,4,5-Trichlorophenol	ug/l			<1	<1	<1	<1	<1	<1	<1	<1						
2,4,6-Trichlorophenol	ug/l			<1	<1	<1	<1	<1	<1	<1	<1						
4-Chloro-3-methylpheno	ug/l			<1	<1	<1	<1	<1	<1	<1	<1						
4-Methylphenol	ug/l			<1	<1	<1	<1	<1	<1	<1	<1						
4-Nitrophenol	ug/l			<1	<1	<1	<1	<1	<1	<1	<1						
Pentachlorophenol	ug/l			<1	<1	<1	<1	<1	<1	<1	<1						
Phenol	ug/l			<1	<1	<1	<1	<1	<1	<1	<1						
A s																	
2-Chloronaphthalene	ug/l			<1	<1	<1	<1	<1	<1	<1	<1						
2-Methylnaphthalene	ug/l			<1	<1	<1	<1	<1	<1	<1	<1						
Acenaphthene	ug/l			<1	<1	<1	<1	<1	<1	<1	<1						
Acenaphthylene	ug/l			<1	<1	<1	<1	<1	<1	<1	<1						
Anthracene	ug/l			<1	<1	<1	<1	<1	<1	<1	<1						
Benzo(a)anthracene	ug/l			<1	<1	<1	<1	<1	<1	<1	<1						
Benzo(a)pyrene	ug/l			<1	<1	<1	<1	<1	<1	<1	<1						
Benzo(b)fluoranthene	ug/l			<1	<1	<1	<1	<1	<1	<1	<1						
Benzo(ghi)perylene	ug/l			<1	<1	<1	<1	<1	<1	<1	<1						
Benzo(k)fluoranthene	ug/l			<1	<1	<1	<1	<1	<1	<1	<1						
Chrysene	ug/l			<1	<1	<1	<1	<1	<1	<1	<1						
Dibenzo(a,h)anthracene	ug/l			<1	<1	<1	<1	<1	<1	<1	<1						
Fluoranthene	ug/l			<1	<1	<1	<1	<1	<1	<1	<1						
Fluorene	ug/l			<1	<1	<1	<1	<1	<1	<1	<1						
Indeno(1,2,3-cd)pyrene	ug/l			<1	<1	<1	<1	<1	<1	<1	<1						
Naphthalene	ug/l			<1	<1	<1	<1	<1	<1	<1	<1						
Phenanthrene	ug/l			<1	<1	<1	<1	<1	<1	<1	<1						
Pyrene	ug/l			<1	<1	<1	<1	<1	<1	<1	<1						

Gree ark hase
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 i hli hte Table of Grou ater esults - o e

		Assessme t	Assessme t	WS 1	WS	WS	WS 5	WS	WS	WS	WS	1	1	11	W1 C	W1 C	W1 C
		Criteria	Criteria	13/05/2008	13/05/2008	13/05/2008	13/05/2008	13/05/2008	13/05/2008	13/05/2008	13/05/2008	2002	2002	2002	11/09/2006	06/09/2007	14/12/2007
		DWS	E S	RTD	RTD	RTD	RTD	RTD	RTD	RTD	RTD	RTD	LAM (D)	CHK (D)	CHK (U)	CHK (U)	CHK (U)
hthalates																	
Bis(2-ethylhexyl) phthala	ug/l			<2	<2	<2	<2	<2	<2	<2	<2						
Butylbenzyl phthalate	ug/l			<1	<1	<1	<1	<1	<1	<1	<1						
Di-n-butyl phthalate	ug/l			<1	<1	<1	<1	<1	<1	1	<1						
Di-n-Octyl phthalate	ug/l			<5	<5	<5	<5	<5	<5	<5	<5						
Diethyl phthalate	ug/l			<1	<1	<1	<1	<1	<1	<1	<1						
Dimethyl phthalate	ug/l			<1	<1	<1	<1	<1	<1	<1	<1						
Other Semi- olatiles																	
1,2-Dichlorobenzene	ug/l			<1	<1	<1	<1	<1	<1	<1	<1						
1,2,4-Trichlorobenzene	ug/l		0.4	<1	<1	<1	<1	<1	<1	<1	<1						
1,3-Dichlorobenzene	ug/l			<1	<1	<1	<1	<1	<1	<1	<1						
1,4-Dichlorobenzene	ug/l			<1	<1	<1	<1	<1	<1	<1	<1						
2-Nitroaniline	ug/l			<1	<1	<1	<1	<1	<1	<1	<1						
2,4-Dinitrotoluene	ug/l			<1	<1	<1	<1	<1	<1	<1	<1						
2,6-Dinitrotoluene	ug/l			<1	<1	<1	<1	<1	<1	<1	<1						
3-Nitroaniline	ug/l			<1	<1	<1	<1	<1	<1	<1	<1						
4-Bromophenylphenylet	ug/l			<1	<1	<1	<1	<1	<1	<1	<1						
4-Chloroaniline	ug/l			<1	<1	<1	<1	<1	<1	<1	<1						
4-Chlorophenylphenylet	ug/l			<1	<1	<1	<1	<1	<1	<1	<1						
4-Nitroaniline	ug/l			<1	<1	<1	<1	<1	<1	<1	<1						
Azobenzene	ug/l			<1	<1	<1	<1	<1	<1	<1	<1						
Bis(2-chloroethoxy)meth	ug/l			<1	<1	<1	<1	<1	<1	<1	<1						
Bis(2-chloroethyl)ether	ug/l			<1	<1	<1	<1	<1	<1	<1	<1						
Carbazole	ug/l			<1	<1	<1	<1	<1	<1	<1	<1						
Dibenzofuran	ug/l			<1	<1	<1	<1	<1	<1	<1	<1						
Hexachlorobenzene	ug/l		0.03	<1	<1	<1	<1	<1	<1	<1	<1						
Hexachlorobutadiene	ug/l		0.1	<1	<1	<1	<1	<1	<1	<1	<1						
Hexachlorocyclopentadi	ug/l			<1	<1	<1	<1	<1	<1	<1	<1						
Hexachloroethane	ug/l			<1	<1	<1	<1	<1	<1	<1	<1						
Isophorone	ug/l			<1	<1	<1	<1	<1	<1	<1	<1						
N-nitrosodi-n-propylamin	ug/l			<1	<1	<1	<1	<1	<1	<1	<1						
Nitrobenzene	ug/l			<1	<1	<1	<1	<1	<1	<1	<1						

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i hli hte Table of Grou ater results - a e Grou i er Terrace Deposits - o e

		Assessme t	Assessme t	WS 1	WS	WS	WS 5	WS	WS	WS
		Criteria	Criteria	13/05/2008	13/05/2008	13/05/2008	13/05/2008	13/05/2008	13/05/2008	13/05/2008
		DWS	E S	RTD	RTD	RTD	RTD	RTD	RTD	RTD
olatile Or a ic Compou s										
Dichlorodifluoromethane	ug/l			<1	<1	<1	<1	<1	<1	<1
Chloromethane	ug/l	100*		<1	<1	<1	<1	<1	<1	<1
Vinyl Chloride	ug/l	0.5		<1	<1	<1	<1	<1	<1	<1
Bromomethane	ug/l			<2	<2	<2	<2	<2	<2	<2
Chloroethane	ug/l			<2	<2	<2	<2	<2	<2	<2
Trichlorofluoromethane	ug/l			<2	<2	<2	<2	<2	<2	<2
trans-1-2-Dichloroethen	ug/l			<2	<2	<2	<2	<2	<2	<2
Dichloromethane	ug/l			<3	<3	<3	<3	<3	<3	<3
Carbon Disulphide	ug/l			<2	<2	<2	7	<2	<2	<2
1.1-Dichloroethene	ug/l			<1	<1	<1	<1	<1	<1	<1
1.1-Dichloroethane	ug/l			11	<1	<1	6	<1	<1	<1
Methyl Tertiary Butyl Eth	ug/l			<2	<2	<2	<2	<2	<2	<2
cis-1-2-Dichloroethene	ug/l			<2	<2	<2	3	<2	<2	<2
Bromochloromethane	ug/l			<2	<2	<2	<2	<2	<2	<2
Chloroform	ug/l		12	<2	<2	<2	<2	<2	<2	<2
2.2-Dichloropropane	ug/l			<1	<1	<1	<1	<1	<1	<1
1.2-Dichloroethane	ug/l	3	10	<4	<4	<4	<4	<4	<4	<4
1.1.1-Trichloroethane	ug/l		100	<1	<1	<1	<1	<1	<1	<1
1.1-Dichloropropene	ug/l			<1	<1	<1	<1	<1	<1	<1
Benzene	ug/l	1	30 (300)	<1	<1	<1	<1	<1	<1	<1
Carbon tetrachloride	ug/l			<1	<1	<1	<1	<1	<1	<1
Dibromomethane	ug/l			<3	<3	<3	<3	<3	<3	<3
1.2-Dichloropropane	ug/l			<3	<3	<3	<3	<3	<3	<3
Bromodichloromethane	ug/l			<1	<1	<1	<1	<1	<1	<1
Trichloroethene	ug/l	10	400	<2	<2	<2	<2	<2	<2	<2
cis-1-3-Dichloropropene	ug/l			<2	<2	<2	<2	<2	<2	<2
trans-1-3-Dichloropropene	ug/l			<3	<3	<3	<3	<3	<3	<3
1.1.2-Trichloroethane	ug/l			<2	<2	<2	<2	<2	<2	<2
Toluene	ug/l		50(500)	<1	<1	<1	<1	<1	<1	<1
1.3-Dichloropropane	ug/l			<2	<2	<2	<2	<2	<2	<2
Dibromochloromethane	ug/l			<2	<2	<2	<2	<2	<2	<2
1.2-Dibromoethane	ug/l			<2	<2	<2	<2	<2	<2	<2
Tetrachloroethene	ug/l	10	10	<2	<2	<2	<2	<2	<2	<2
1.1.1.2-Tetrachloroethane	ug/l			<1	<1	<1	<1	<1	<1	<1
Chlorobenzene	ug/l			<4	<4	<4	<4	<4	<4	<4
Ethylbenzene	ug/l			<2	<2	<2	<2	<2	8	8
p/m-Xylene	ug/l		30	<2	<2	<2	<2	<2	15	15
Bromoform	ug/l			<3	<3	<3	<3	<3	<3	<3
Styrene	ug/l		50(500)	<1	<1	<1	<1	<1	<1	<1
1.1.2.2-Tetrachloroethane	ug/l			<5	<5	<5	<5	<5	<5	<5
o-Xylene	ug/l		30	<1	<1	<1	<1	<1	<1	<1
1.2.3-Trichloropropane	ug/l			<9	<9	<9	<9	<9	<9	<9
Isopropylbenzene	ug/l			<2	<2	<2	<2	<2	<2	<2
Bromobenzene	ug/l			<1	<1	<1	<1	<1	<1	<1
2-Chlorotoluene	ug/l			<2	<2	<2	<2	<2	<2	<2
Propylbenzene	ug/l			<3	<3	<3	<3	<3	<3	<3
4-Chlorotoluene	ug/l			<2	<2	<2	<2	<2	<2	<2
1.2.4-Trimethylbenzene	ug/l			<1	<1	<1	<1	<1	<1	<1
4-Isopropyltoluene	ug/l			<3	<3	<3	<3	<3	<3	<3
1.3.5-Trimethylbenzene	ug/l			<1	<1	<1	<1	<1	<1	<1
1.2-Dichlorobenzene	ug/l			<3	<3	<3	<3	<3	<3	<3
1.4-Dichlorobenzene	ug/l			<1	<1	<1	<1	<1	<1	<1
sec-Butylbenzene	ug/l			<1	<1	<1	<1	<1	<1	<1
tert-Butylbenzene	ug/l			<2	<2	<2	<2	<2	<2	<2
1.3-Dichlorobenzene	ug/l			<2	<2	<2	<2	<2	<2	<2
n-Butylbenzene	ug/l			<2	<2	<2	<2	<2	<2	<2
1.2-Dibromo-3-chloropropane	ug/l			<10	<10	<10	<10	<10	<10	<10
1.2.4-Trichlorobenzene	ug/l			<2	<2	<2	<2	<2	<2	<2
Naphthalene	ug/l			<4	<4	<4	<4	<4	<4	<4
1.2.3-Trichlorobenzene	ug/l			<3	<3	<3	<3	<3	<3	<3
Hexachlorobutadiene	ug/l			<3	<3	<3	<3	<3	<3	<3

* from 25th December 2003 until immediately before 25th December 2013

** on and after 25th December 2013

Protection of Human Health Criteria taken from The Water Supply (Water Quality) Regulations 2000
Protection of Controlled Water are Environmental Quality Standards

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Green text highlights one or more elements of the Pollutant Linkage are missing and therefore eliminated

Overall Classification (Note assumes 1m floor allocation)

Green text highlights one or more elements of the Pollutant Linkage are missing and therefore eliminated