Borough Council of
King's Lynn &
West Norfolk

DETAILED RISK ASSESSMENT OF A FORMER COUNTRY HOUSE GAS WORKS

GAS HOUSE
SANDY LANE,
HILGAY,
NORFOLK

MAY 2013

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DETAILED RISK ASSESSMENT

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1.0 INTRODUCTION

1.1 Terms of Reference

In April 2000, the government issued guidance and legislation known as Part 2A of the Environmental Protection Act 1990 or the Contaminated Land Regime. This regime requires local authorities in England to inspect their area for contaminated land and to ensure these areas are suitable for use.

The Borough Council produced a Contaminated Land Inspection Strategy setting out how inspections will be carried out. (Borough Contaminated Land Inspection Strategy)

The Borough's final strategy document, which incorporated the changes suggested by various consultees, was formally adopted in 2001. The strategy has been reviewed and amended twice. The most recent document is dated September 2006 and was adopted in January 2007 but is undergoing a review at this time.

1.2 Background

The Borough Council carried out an exercise to prioritise sites for detailed inspection as set out in the Contaminated Land Strategy, within the context and framework detailed in Part 2A EPA 1990, and associated Statutory Guidance. Sites have been prioritised to identify those sites where it is possible that pollutant linkages exist.

This report covers the former County House Gas Works located in the garden of a property on Sandy Lane, Hilgay. The site's location is presented in Figure 1. The site consists of a small area of land which is being used as a residential property with a domestic garden.

The prioritisation identified the possibility of pollutant linkages involving potential harm to humans, controlled water and property. It was judged that pathways to sensitive receptors could exist due to the former and present site use.

The extent and boundaries of the site were derived from GIS mapping of the Landmark historic land use dataset derived from historical Ordnance Survey Data.

1.3 Aims and Objectives

The aim of this Detailed Risk Assessment is to establish the current Part 2A status of the site.

In order to achieve this aim, the objectives are

- To review available relevant data and develop an initial conceptual model of the site to establish whether there are potentially unacceptable risks to sensitive receptors from land contamination.

- Consider whether there is a reasonable possibility that pollutant linkages exist and if there is sufficient information to determine whether or not the land is Contaminated Land as defined in S78A(2) of the Environmental Protection Act 1990.

- Recommend the scope of further work if it is considered necessary to be more confident about the condition of the land.

1.4 Scope

This preliminary risk assessment includes a review of the following data:

- Geology, hydrogeology and hydrology;
- Material relating to the former activities of the site;
- Location of landfill and other waste management sites;
- Records of abstraction and discharge licences relating to groundwater and surface water;
- Records of pollution incidents;
- Local authority Environmental Health and Planning files;
- Historical map extracts;
- Current site and surrounding land use;
- A site walkover survey, to assess for visual evidence of contamination on site.

1.5 Study Limitations

The findings and opinions conveyed in this report are based on information obtained from a variety of sources which the Borough Council believes are

reliable. Nevertheless, the Borough Council cannot and does not guarantee the authenticity or reliability of the information it has relied upon.

2.0 SITE SETTING

2.1 Location

The site is situated at National Grid Reference (NGR) 562764, 297620. The site is situated to the Southeast of Hilgay, at about an altitude of approximately 12m above Ordnance Datum (maOD) approximately 20km south of King's Lynn. The site occupies approximately 0.041ha. Figure 1 indicates the location of the site and surrounding area. Figure 2 shows the boundary of the site and the structures within its boundary.

2.2 Current Use

The site consists of a rectilinear residential plot containing a one and two storey brick built residential property with a slate roof in the north of the site and single storey brick outbuilding in the south-eastern corner. The property has a domestic garden to the south and west of the residential building.

2.3 Surrounding Land Use

Land surrounding the site is agricultural to the northwest with woods with domestic buildings to the north, east and south. A paddock is situated to the west, beyond which is another residential property, Keepers Cottage, which is surrounded by agricultural fields. To the north east in the woods is Gardeners Cottage and to the east is Wood Hall and some associated outbuildings and residential dwellings. Figure 2 shows the site's surroundings.

One commercial premises and associated buildings are located within 0.25km radius of the site (Source: BC KL & WN Local Land and Property Gazetteer, Oct 2012). This is W.B Charlesworth of Woodhall Farm, Wood Hall, who is registered as being a farmer and the owner of the property.

There is no Integrated Pollution Prevention and Control permitted installations recorded for the site or within 5km of the site.

2.4 Site History

The site has had a building on it in the same form as far back as can be traced using historic maps. As the main building is in the same configuration now as on the first map, it is considered likely that the building has always been a residential property. The building and former gas works is considered to have been associated with Wood Hall to the southeast.

2.4.1 1843 - 1893 (source map scale 2,500) Epoch 1 (Figure 3)

Reference to the earliest available OS map shows the site as being a Gas Works, with two connected buildings in the north of the site and another in the south eastern corner. A circular structure was noted in the south of the site adjacent to the southern building. Field's were noted to the north and west of the site with woods being shown to the east and south. Beyond the woods to the southeast were a series of buildings indicated as being part of Wood Hall. A depression or pit is depicted to the northeast of the site beyond a wooded area.

2.4.2 1891 - 1912 (source map scale 2,500) Epoch 2 (Figure 4)

This map is as depicted in Epoch 1, with the exception that a building had been developed to the west of the site (Keepers Cottage). This appears to be a residential building with a domestic garden.

2.4.3 1904 - 1939 (source map scale 2,500) Epoch 3

Not Available.

2.4.4 1945 – 1970 (source map scale 2,500) Epoch 5 (Figure 5)

The site was shown with two buildings in the north and one in the south eastern corner as in Epoch 1, but the circular feature is no longer present. The garden area appears to have been extended to the west incorporating part of a field/paddock. The pit to the northeast is no longer shown.

2.4.5 1940's Aerial Photograph (MOD flyover) (Figure 6)

The aerial photograph was taken early in the morning and as such the trees to the east are shadowing the majority of the site. What is visible is that a building exists in the north of the site and that the site and surrounding area appear to be generally as depicted on the Epoch 2 map.

2.4.6 1999 Colour aerial photography (Figure 7)

The site is now visible as a residential building as two chimneys can be identified on the roof. The two buildings depicted in the north are clearly shown as being connected. Something is shown in the southern part of the site but it is unclear as to what this is due to the quality of the picture. The garden extension is shown and something can be seen there but this cannot be identified.

The surrounding area appears to be as depicted on the 1945 - 1970 map with the site surrounded by fields and woods and Wood Hall positioned to the south east.

2.4.7 2006-09 Colour aerial photography (Figure 8)

The building in the north of the site is much more defined and it can be seen that the main building is a two storey building placed north to south of the site and the connected section is a single storey going west to east from the northern end of the main residential building. Nothing can be seen of the south side of the property due to tree cover. Two things can be seen in the garden extension to the west. One appears to be a parasol and the other is a light blue object which could potentially be a paddling pool or a children's play pit.

The surrounding area is as descried above.

2.5 Environmental Setting

2.5.1 Geology, Hydrogeology and Hydrology

Geology

The expected geological sequence for the whole site is:

- Superficial (drift) deposits are Lowestoft Formation - Diamicton. Superficial Deposits formed up to 2 million years ago in the Quaternary Period. Local environment previously dominated by ice age conditions.
- Solid deposits: The site is underlain by the Roxham Member and Runcton Member (Undifferentiated) - Sand. Sedimentary Bedrock formed approximately 142 to 146 million years ago in the Jurassic Period. Local

environment previously dominated by shallow seas. (BGS Website http://mapapps.bgs.ac.uk/geologyofbritain/home.html).

The site is within an area where less than 1% of homes are above the action level for Radon. The Radon advice given by the Health Protection Agency (HPA) for properties in this area is 'The property is not in a radon affected area as less that 1% of the houses are above the action level'.

Hydrogeology

The site is not in a source protection zone as defined by the Environment Agency.

The site is underlain by bedrock classified as a Principal Aquifer which has a High Vulnerability.

Hydrology

The nearest water feature is a pond within the estate of Wood Hall approximately 200m east southeast of the site. The nearest major water body is the River Wissey approximately 1.2km northeast of the site.

There are no groundwater abstraction points within 1km of the site either, Environment Agency Licensed or Private.

2.5.2 Conservation Designations

There are no conservation designations as reported by English Nature for the site.

The woods are on the National Inventory of Woodland and Trees (England) and there is a Traditional Orchard within the grounds of Wood Hall.

2.6 Review of Documentary Information

2.6.1 Recorded Pollution Incidents

There are no Environment Agency reports of pollution incidents within the site or within 500m of the site.

The only potential source of pollution on site or in the vicinity is the former Country House Gas Works site.

No information is held by the Borough Council of King's Lynn and West Norfolk about the site and no previous investigations are reported to have been carried out.

2.6.2 Planning and Building Control History

There are no planning permissions for the site. (Data taken from BCKLWN CAPS planning system, Oct 2012)

3.0 VISUAL INSPECTION - SITE WALKOVER SURVEY

3.1 Introduction

A site walkover survey was carried out on 17th December 2012 by a Senior Environmental Quality Officer of the Borough Council of King's Lynn and West Norfolk. The purpose of the site walkover survey was:

- To confirm existing site conditions and land use – in particular the presence of soft landscape and vegetative ground cover, the amount (if any) of exposed soil, and the potential for direct exposure of on-site receptors (humans);
- To establish, with reference to site features and available drawings, the location and direction of flow of site drainage – in particular the presence or absence of surface water drainage including discharges to surface waters or soakaways;
- To determine what constraints if any might apply to further detailed inspection of the land via intrusive investigation if such inspection is required. This involved observation of such features as site access, including height and width restrictions, the layout of the site including the location of buildings and extent of hard standing.
- To visually observe the nature and condition of the site boundary and the nature of the adjacent, surrounding land use including the presence of additional Part IIA receptors and migration pathways;
- To check for evidence of the presence of historical contaminants. To check for visual evidence of recent contamination such as spillages or waste deposit. This included inspection/recognition of the presence of any artificial grading and in-filling, residual surface staining and spillage, exposure of unnatural material at the surface, odours, presence/absence of vegetation, diversity of vegetation, presence and maturity of trees and distressed vegetation;
- To verify site occupancy of buildings and to establish frequency and numbers using the domestic garden;
- To check for surface evidence of underlying geology, hydrogeology and hydrology.

Site walkover photographs are included in Appendix 2.

3.2 Site Location (See Figure 1)

The site is located in a rural setting with fields and woods surrounding the site on all sides approximately 1km southeast of the centre of the village of Hilgay. The site was/is a part of the estate of Wood Hall which was originally built in 1579. The Country House Gas Works is first known to have been on the site from the first OS map dated 1879-1886.

3.3 Site Description

Permission was gained from Mr Charlesworth (the owner) to carry out a walkover survey. The site was entered via a private grass road from Woodhall Road. The private road initially bears westwards from Woodhall Road to circle 'The Lodge'. Once the private road extends past The Lodge it bears southwards and Gardeners Cottage is visible at the far end. As you progress southwards along the private road another residential property was noted to the east, called Gardeners Cottage.

As you near the site it becomes clear that the site is a residential property and that the property was occupied as smoke was issuing from the chimney. The main building on the site is a two storey brick built residential property which had been painted white and had a slate roof. A smaller single storey building is attached at right angles to the main building and is also painted white with a corrugated roof constructed from potentially asbestos containing materials. These occupy the centre and northeast corner of the site. A small brick building which is starting to collapse is located in the south-eastern corner of the site. The use of this building is unknown, but as a large stack of firewood is located adjacent to the building it is considered that this would be used as a tool shed. The remainder of the site has been laid to lawn and there was no evidence that the occupants were growing their own vegetable. Some evidence did exist which would indicate that a child was living or had lived on the site.

An area of the lawn was noted to have a depression in it which generally coincided with the location of the circular building which was noted on the historic maps. A metal frame which encloses an area just off site was noted. The use for this is unknown at this time, but it is considered that it is potentially associated with the former Country House Gas Works.

3.4 Current Site Surfacing

The site is covered with a residential property and grass.

3.5 Site Drainage

Drainage plans were not available for the purposes of this report.

No surface water drains were noted during the site walk over and the site and surrounding area was generally flat.

3.6 Site Access and Boundaries

There is only one point of access onto the site, through the main gate on the eastern side of the site. This comprises a brick wall with a capping stone and a cast iron gatepost with pivots to hold a gate which is no longer present. The northern part of the site is edged with the building, while the remainder of the site is encompassed by a two bar wooden fence.

3.7 Current Land Use

The site has been confirmed as being used as a residential dwelling with a domestic garden.

3.8 Historical Land Use (See Figures 3 to 6)

The site is historically assumed to have been a residential dwelling with a domestic garden which had also been used as a Country House Gas Works with its associated infrastructure.

At some time the gas works was dismantled, with the gasometer being removed. It is considered that the outbuilding remaining on site may have housed part of the infrastructure of the gas production system.

3.9 Site Occupancy

The site is occupied by a residential dwelling. The residential property is occupied by a family comprising an adult male and his two teenage sons.

3.10 Environmental Setting

3.10.1 Geology, Hydrogeology and Hydrology

Geology

No obvious geological features were noted on site which would disagree with the predicted geological formations.

Hydrogeology

No further observations of the local groundwater regime were made during the site walkover survey.

Hydrology

No additional surface water features were noted on the site.

4.0 CONTAMINANTS, PATHWAYS AND RECEPTORS

4.1 Contaminants

The following employs information where available to reflect local circumstances and also uses published Industry Profile 'Gas Works, Coke Works and other Carbonisation Plants' (DoE, 1996) and CLR8 Priority Contaminants for the Assessment of Land (Environment Agency, 2002).

4.1.1 Current on-site and off-site

The current site uses and surrounding land uses are:

On-site

- A residential dwelling with a domestic garden

Off-site

- Agricultural fields
- Woods
- Residential dwellings with domestic gardens and
- A working farm.

There is no information concerning the hydraulic gradient for the site.

4.1.2 Historical on-site

The site has historically been a Country House Gas Works.

Table 1 indicates the contaminants that may be associated with the historic on-site sources identified.

Source	Contaminants
Gas Works	Oil/fuel hydrocarbons, Polycyclic Aromatic Hydrocarbons (PAHs), Tar, Creosote, Coal Dust, metals, metalloids and other inorganic materials, VOC's, asbestos , pH

Table 1. Sources of Contaminants

4.1.3 Historical off-site

There is one potential off site source of contamination. This is a pit which was identified on the early historic maps but which is not shown on later ones. There is a possibility that this has been backfilled and that waste materials could have originated from the former gas works.

4.2 Receptors

4.2.1 Human Beings

On Site

Human receptors are present as residents of the residential dwelling. Residents are known to be both adults and teenagers. Construction, utility and highways workers are also considered possible adult receptors.

Off Site

Human receptors are present in the nearby residential properties and workers on the adjacent farm.

4.2.2 Controlled Water

Groundwater

Both the Roxham Member and Runcton Member are classified as groundwater receptors. The site is on a Principal Aquifer, with an overlying drift deposit of Diamicton to protect the aquifer. However, given the variable nature of Diamicton it is considered that groundwater could still represent a receptor.

Surface Water

No surface water was noted on or adjacent to the site.

4.2.3 Property - Buildings

On Site

The site is the location of a residential dwelling and an outbuilding.

Off Site

The nearest offsite buildings are residential buildings and farm buildings associated with Wood Hall Farm.

4.2.4 Property – Crops, Livestock and Game

On site

No vegetables were noted to be growing in the garden of the site and no vegetative stress was noted in the vegetation which was present.

Off site

Agricultural field, paddocks and woods surround the site. No vegetative stress was noted in any of the groups described above.

Housing in the vicinity of the site particularly on the rest of the estate may have domestic produce. Agricultural crops in the form of cereal and root crops in the surrounding fields. No evidence of fishing, but given the remote locality of the site game bird shooting is a potential activity.

4.3 Exposure Pathways

4.3.1 Pathways Associated with Human Beings

Pathways by which humans may be exposed to contaminants include:

- Dermal exposure by direct contact with soil and household dust
- Ingestion of soil and household dust
- Ingestion of contaminated vegetables and soil attached to vegetables
- Inhalation of fugitive soil dust and household dust
- Inhalation of vapours outside and inside

4.3.2 Pathways Associated with Controlled Water

Groundwater

Contaminants present in the soil in location of the gasometer and its associated infrastructure could pose a risk to groundwater due to the soluble components in the gas works waste material, and the potential for a below ground tar tank to be on site. The surface geology is highly variable including clays/silts and sands and gravels but generally is of a clay /silt matrix, decreasing its permeability.

Surface Water

Contaminants could enter surface water by direct surface run off into channels and dykes. Soluble contaminants may also leach from soil and migrate via shallow ground or perched water into surface water features.

4.3.3 Pathways Associated with Buildings

It is possible that the residential building will be affected by direct contact with aggressive or corrosive contaminants.

4.3.4 Pathways Associated with Produce and Property in the form of crops

Domestic produce and farm animals may be affected by contamination in the soil, vegetation and surface waters.

4.4 Potential Contaminant Linkages

There is a reasonable possibility that pollutant linkages may exist on the site and these are set out in Table 2 below.

No	Contaminant	Pathway	Receptor	Notes
			Humans	
1	Oil/fuel hydrocarbons Aromatic hydrocarbons PAH, Tar, Coal Dust	Dermal exposure Ingestion of soil and dust Inhalation of dust Inhalation of vapours	On-site residents	The contaminant has been identified as possibly present on gas works sites and within their waste. Dermal contact, ingestion and inhalation pathways are likely to be present. All pathways may be present outdoors and indoors. There is a strong possibility that this pollutant linkage exists and the likelihood is high as the property is occupied.
2	Oil/fuel hydrocarbons Aromatic hydrocarbons PAH	Dermal exposure Ingestion of soil and dust Inhalation of dust Inhalation of vapours	On-site workers	The contaminant has been identified as possibly present on gas works sites and within their waste. Dermal contact, ingestion and inhalation pathways are likely to be present. All pathways may be present outdoors and indoors. There is a reasonable possibility that this pollutant linkage exists although the likelihood is low as it is a residential property.
3	Oil/fuel hydrocarbons Aromatic hydrocarbons PAH	Dermal exposure Ingestion of soil and dust Inhalation of dust Inhalation of vapours	Off site residents	The contaminant has been identified as possibly present on gas works sites and within their waste. Some pathways may be present outdoors and indoors. There is a slight possibility that this pollutant linkage exists.
4	Metals including chromium complex cyanide and copper	Dermal exposure Ingestion of soil and dust Inhalation of dust	On-site residents	The contaminant has been identified as possibly present on gas works sites and within their waste. Dermal contact, ingestion and inhalation pathways are likely to be present. All pathways may be present outdoors and indoors There is a strong possibility that this pollutant linkage exists and there is a high likelihood that it will occur as the property is occupied.

5	Metals including chromium complex cyanide and copper	Dermal exposure Ingestion of soil and dust Inhalation of dust	On-site workers	The contaminant has been identified as possibly present on gas works sites and within their waste. Dermal contact, ingestion and inhalation pathways are likely to be present. All pathways may be present outdoors and indoors There is a reasonable possibility that this pollutant linkage exists, although there is a low likelihood.
6	Metals including chromium complex cyanide and copper	Dermal exposure Ingestion of soil and dust Inhalation of dust	Off-site residents	The contaminant has been identified as possibly present on gas works sites and within their waste. Dermal contact, ingestion and inhalation pathways are likely to be present. Some pathways may be present outdoors and indoors There is a slight possibility that this pollutant linkage exists although it is considered that there is a very low likelihood.
7	Asbestos	Inhalation of fibres	On-site residents	The contaminant has been identified as possibly present on gas works sites. Inhalation pathways are likely to be present. All pathways may be present outdoors and indoors There is a reasonable possibility that this pollutant linkage exists as potential asbestos containing materials were noted on site (roofing materials).

8	Asbestos	Inhalation of fibres	On-site workers	The contaminant has been identified as possibly present on gas works sites. Inhalation pathways are likely to be present. All pathways may be present outdoors There is a reasonable possibility that this pollutant linkage exists although the likelihood is considered to be significantly lower then for on site receptors.
			Property - Buildings	
9	Oil/fuel hydrocarbons Aromatic hydrocarbons	Direct contact	On-site buildings	The contaminant has been identified as possibly present on gas works sites and within their waste. The contaminant may be present in local hotspots. There is a reasonable possibility that this pollutant linkage exists.
10	Inorganic Chemicals (e.g. Sulphates)	Direct contact	On-site buildings	The contaminant has been identified as possibly present on gas works sites and within their waste. The contaminant may be present in local hotspots. There is a reasonable possibility that this pollutant linkage exists.
			Property – Produce Crops and Livestock	
11	Oil/fuel hydrocarbons Aromatic hydrocarbons PAH, Tar, Coal Dust	Dermal exposure Ingestion of soil and dust Inhalation of dust Inhalation of vapours	On-site domestic produce Crops	The contaminant has been identified as possibly present on gas works sites and within their waste. Dermal contact, ingestion and inhalation pathways are likely to be present. All pathways may be present outdoors and indoors. There is a slight possibility that this pollutant linkage exists although no livestock was noted on site during the site walkover.

12	Metals including Arsenic, Cadmium, Chromium, Lead, Nickel,	Plant uptake	On-site domestic produce Crops	The contaminant has been identified as possibly present on gas works sites and within their waste. The plant uptake pathway may be present in agricultural fields and private gardens. There is a reasonable possibility that this pollutant linkage exists or will exist in the future.
			Controlled waters	
13	Leachable metals	Ground or perched water	Surface water channels & Principal Aquifer	The contaminant has been identified as possibly present on gas works sites and within their waste.
14	Oil/fuel hydrocarbons Aromatic hydrocarbons	Ground or perched water	Surface water channels & Principal Aquifer	The contaminant has been identified as possibly present on gas works sites and within their waste.

Table 2: Potential Contamination Linkages

5.0 CONCLUSIONS AND RECOMMENDATIONS

5.1 Site Summary

The site is located on the Sandy Lane just outside the village of Hilgay. It covers an area of approximately 0.0041ha.

5.2 Site Description and Environmental Setting

The site is a former gas works, which was located in the garden of a residential dwelling. The gas works is no longer in operation and the gasometer has been removed and this area has now been incorporated into the garden of the residential property. The site is still being used as a residential dwelling with a domestic garden.

The site is situated on a Principal Aquifer, but has the potential to have a low permeability drift deposit decreasing the overall risk to the groundwater. No surface water receptor was noted on site.

5.3 Conceptual Model

A number of potential pollutant linkages have been identified. There is a possibility that some of the linkages are present, however further data are required to establish if the pollutant linkages exist and if the risk is significant.

The potential pollutant linkages relate to both organic and inorganic contaminants. The receptors identified are humans, controlled waters and property (in the form of buildings and produce).

The conceptual model is based on the following assumptions:

- The former use of the site as a gas works
- The present use of the site as a residential property with a domestic garden.
- The site is situated on a Principal aquifer.

5.5 Preliminary Risk Assessment Findings

The Preliminary Risk Assessment for human health, controlled waters and property was based on a conceptual model of potential pollutant linkages that took into account:

- The former use of the sites as a gas works;
- Its current use as a residential property.
- The condition of land based on a site walkover survey;
- The characteristics and likely behaviour of site occupants and off-site users of adjacent land taking into account the current residential use;
- The geological, hydrological and hydrogeological characteristics of the site as determined from the desk study information and the site walkover survey;

The Preliminary Risk Assessment was based on the following assumptions:

- No remediation was undertaken when the gas works was decommissioned.
- The residents of the site don't grow their own vegetables.
- The superficial deposits of diamicton are generally impermeable.

5.6 Part 2A Status

Paragraph 5.6 of the statutory guidance states that 'there are four possible grounds for the determination of land as Contaminated Land, namely that:

(a) Significant harm is being caused to a human, or relevant non-human, receptor.

(b) There is a significant possibility of significant harm being caused to a human, or relevant non-human, receptor.

(c) Significant pollution of controlled waters is being caused.

(d) There is a significant possibility of significant pollution of controlled waters being caused. '

Paragraph 5.7 states that 'Before making any determination, the local authority should have identified one or more significant contaminant linkage(s), and carried out a robust, appropriate, scientific and technical assessment of all the relevant and available evidence.'

At the present time, there is insufficient information to confidently assess the Part 2A status of the site.

5.7 Recommendations for Further Work

Given the findings of this report it is considered necessary to undertake Detailed Inspection, as described in 2.9 of the statutory guidance, to assess the site for potential risks to human health or the environment under Part 2A of the Environmental Protection Act 1990.

The investigation should include soil sampling and analysis with the potential for the installation of monitoring positions. Dependant on the discussions with the Environment Agency groundwater sampling and analysis may be required should any surface, perched or groundwater be encountered.

During the site investigation, an assessment should be undertaken as to whether the pit shown to the north east has been back filled and if it has than additional site investigation should be undertaken in this location to assess whether the pit was backfilled with gas works waste.

6.0 Site Investigation

As a result of the information presented above a limited site investigation was considered necessary to be undertaken immediately to provide an initial assessment of the site and its potential impact on human health.

The field works to be undertaken at the site were to comprise boreholes excavated by the use of a hand auger. A hand auger comprises a series of steel rods with a cutting tool on one rod and a handle on another. It is used to carry out manual augering and sampling in a wide range of different soils and is particularly suitable for general soil investigation (descriptions of composition, geology, mineralogy) and environmental research. It can carry out excavations to a depth of 5 metres, depending on the depth of the groundwater, the build-up of the soil and the nature of the material to be drilled into.

With the limited nature of the intended site investigation and the potential shallow depth of made ground anticipated. It was decided that the borehole depths would be limited to 1m or where sufficient depth of natural material has been confirmed.

A limited number of soil samples are to be collected from the boreholes. These were proposed to be from the near surface material in all boreholes, in the made ground at depth (where encountered) and in the natural material if any staining or olfactory evidence indicates that there is potential contamination.

6.1 Field works

The site was attended on 27/02/2013 where the position of the proposed boreholes was agreed with the land owner. The borehole positions were scanned with a Cable Avoidance Tool (CAT) prior to the excavation and where the position was in an area covered with turf, a section of turf was removed so that the site could be restored to it previous condition once the site works had been completed.

A total of four boreholes were excavated on the residential site, one in the centre of what was assumed to be the position of the gasometer, and three around its perimeter. A fifth position was proposed, through the base of the shed in the south eastern corner of the site. However, on inspection of the base of the shed it was discovered that the floor comprised a double layer of brick. It was decided that breaking out the floor to examine for potential contamination was beyond the scope to the field works at this time. If contamination was encountered in the

other boreholes then the removal of the floor and subsequent intrusive site investigation would comprise part of the follow up fieldworks.

As an additional part of the site investigation a depression to the northeast was assessed by excavating a borehole to ascertain if any deleterious material from the former gas works had been placed into it.

6.2 Ground Conditions

The residential site was found to be covered with a layer of made ground comprising a brown sandy slightly gravely CLAY with the gravel generally comprising flint brick and ash/coke. No visible signs of staining were noted and no olfactory evidence of contamination was noted during the site investigation. The made ground extended to a maximum depth of 1.10m below ground level (bgl) in the centre of the former gasometer with the surrounding are extending to a maximum of 0.4mbgl.

The borehole, placed in the former pond/depression, encountered dark brown slightly sandy gravely organic CLAY. The gravel comprised flint, however some waste material was encountered (crisp packets) which after a conversation with the site owner would appear to have come from the use of the depression by the previous owner to deposit some household waste.

6.3 Chemical Analysis

Five soil samples and one water sample were dispatched for chemical analysis. The soil samples all came from the near surface material and the water from a cistern to the north of the house. The samples were tested for a variety of analytes including Speciated Polycyclic Aromatic Hydrocarbons (PAHs), Speciated Hydrocarbons, Metals and Volatile Organic Compounds (VOCs).

As an initial screening assessment the results of the chemical analysis were compared against the soil guideline values (SGV) produced by the Environment Agency or the generic assessment criteria (GAC) produced by LQM and Chartered Institute of Environmental Health. These generic values are considered to define minimal risk and are used widely within the development industry as an indication of the suitability of a site for its intended use. The only analytes which were higher than the SGV or GAC were Arsenic, Lead and some species of PAHs as presented in Table 3 and 4 below.

Analyte	SGV mg/kg	Min/Max recorded	No of exceedances
Arsenic	32	13/47	2/5
Lead	450[1]	270/1,700	4/5
1) This soil guideline value has been withdrawn and no nationally agreed limit has been produced and as such it has been used in this context as a generic benchmark.			

Table 3 Metal Exceedances

Analyte	GAC mg/kg	Min/Max recorded	No of exceedances
Benzo(a)anthracene	3.1	0.45/11	1/5
Benzo(b)fluoranthene	5.6	0.85/8.8	1/5
Benzo(a)pyrene	0.83	0.87/8.2	5/5
Chrysene	6.0	0.59/12	1/5
Dibenzo(a, h)anthrocene	0.76	<0.1/1.6	2/5

Table 4 Polycyclic Aromatic Hydrocarbon Exceedances

6.4 Metals

Two analytes were noted as being elevated, these were Arsenic and Lead. Further assessment of these analytes was undertaken to determine if the reported concentrations represented a significant risk.

6.4.1 Arsenic

Arsenic is a chemical element with symbol As and atomic number 33. Arsenic occurs in many minerals, usually in conjunction with sulphur and metals, and also as a pure elemental crystal. Arsenic and its compounds, especially the trioxide, are used in the production of pesticides, treated wood products, herbicides, and insecticides. It is also a waste product of many historic industrial processes including gas works.

Symptoms of arsenic poisoning begin with headaches, confusion, severe diarrhea, and drowsiness. As the poisoning develops, convulsions and changes in fingernail pigmentation called leukonychia (The occurrence of white spots or patches under the nails) may occur. When the poisoning becomes acute, symptoms may include diarrhea, vomiting, blood in the urine, cramping muscles, hair loss, stomach pain, and more convulsions. The organs of the body that are usually affected by arsenic poisoning are the lungs, skin, kidneys, and liver. The acute minimal lethal dose of arsenic in adults is estimated to be 70 to 200mg or 1mg/kg/day. The majority of arsenic absorbed around the world comes from drinking water. The amount of arsenic absorbed through the skin or ingested is considered to be insignificant in comparison.

As the levels of contamination encountered exceeded the generic screening levels as detailed above, a site specific risk assessment was undertaken to generate a Site Specific Assessment Criteria (SSAC). Initially the risk assessment tool chosen was the CLEA 1.06 risk assessment package developed by the Environment Agency. This was chosen as an initial screening tool, despite it being developed technically for use within the planning regime, due to its ability to be varied to take into consideration the differences in soil type, house type and the occupancy type.

The input parameters chosen for the site were that the soil type was a clayey loam. The house type chosen was a detached house with the occupants being male with a full age category range from 1 to 75. This returned a value of 406mg/kg which was above the levels of arsenic detected in the soils analysed.

6.4.2 Lead

Lead interferes with a variety of body processes and is toxic to many organs and tissues including the heart, bones, intestines, kidneys, and reproductive and nervous systems. It interferes with the development of the nervous system and is therefore particularly toxic to children, causing potentially permanent learning and behaviour disorders. Symptoms include abdominal pain, confusion, headache, anaemia, irritability, and in severe cases seizures, coma, and death.

Lead and its compounds can be absorbed into the body by inhalation of dust, aerosol, fume and vapour, with the degree of absorption dependent on particle size and solubility. There is relatively little absorption from the gastrointestinal tract following ingestion and absorption through the skin is likely to be negligible. Once absorbed, lead binds strongly to red blood cells, and is then deposited in bone, where it accumulates.

The Health and Safety Executive (HSE) has produced a document (Control of Lead at Work 3rd Ed. Based on the Control of Lead at Work Regulation 2002), which gives action levels at which work should be suspended due to the risk to human health. This falls into three categories, based on age and gender, women of reproductive age, young persons (aged16 and 17) and any other employee. Women of reproductive age are considered to be the most susceptible to the affect of lead because of the chance of them carrying a child.

Within the wider environment it is generally considered that children are the most susceptible. This is due to the adverse effects that lead has on IQ, particularly during the formative years of a child's life. The most formative time that a child will have is considered to be when the

foetus is in the womb of its mother. Here the foetus has the potential to be affected by higher levels of lead then it will once it is born. This is due to the fact that the foetus is in direct blood contact with its mother, and the mother can be exposed to high levels of lead, which would not damage the mother but could cause significant mental damage to the unborn child.

The HSE have placed the action level for women of reproductive age at 25ug/dl indicating a point when work should be suspended, due to the risk from lead. Therefore, it has been decided that if the soil concentration level is sufficiently elevated such that it has the potential to raise the blood-lead level of either a woman of reproductive age or her unborn child to that action level, then that is considered to represent the point at which the level of lead in the soil represents a significant possibility of significant harm (SPOSH) as defined with the EPA1990.

Therefore, in calculating the most appropriate value for soil lead levels the risk assessment model the Integrated Exposure Uptake Biokinetic Model for Lead in Children (IEUBK) was used. The IEUBK was produced by the United States Environmental Protection Agency (USEPA) and was chosen as it provides a robust, repeatable risk assessment which has been designed such that it does not include work place exposure. It also gives the ability to calculate to find the blood-lead level which would result from a particular soil-lead level. This can then be compared to the action levels presented in the HSE document and a decision can be made as to whether SPOSH exists.

The risk assessment model was used using the site specific data gained from the site investigation. The model produced a theoretical maximum blood-lead level of 16.4ug/dl. The action level for women of reproductive age is 24ug/dl which is higher then the calculated blood-lead level for the site. Additionally the action levels are considered to represent workplace exposure levels, where the person affected is exposed to the contaminant continually over an 8hr period whereas the exposure time at this site is considered to be transient and erratic. The level of exposure is also considered to be lower as the surface of the site is grassed, which will reduce dust emissions, limiting inhalation of dust particles.

Therefore, although the levels of lead encountered in the soils at the site are considered to be elevated they are not considered to represent SPOSH at this time.

6.5 Polycyclic Aromatic Hydrocarbons

For Polycyclic Aromatic Hydrocarbons (PAH) the CLEA 1.06 risk assessment tool was used to create a SSAC.

Analyte	CLEA 1.06 mg/kg	Min/Max recorded	No of exceedances
Benzo(a)anthracene	128	0.45/11	0/5
Benzo(b)fluoranthene	131	0.85/8.8	0/5
Benzo(a)pyrene	18.5	0.87/8.2	0/5
Chrysene	185	0.59/12	0/5
Dibenzo(a,h)anthrocene	16.7	<0.1/1.6	0/5

Table 5 PAH Risk Assessment

As can be seen the values recorded from the site investigation are well below those calculated using the CLEA 0.6 risk assessment package. As such polycyclic Aromatic Hydrocarbons are not considered to represent a significant risk to the occupants at this time.

6.6 Water

The water analysis was compared to the levels produced by the Drinking Water Inspectorate and none were found to be elevated.

6.7 Conclusion

From the Detailed Quantitative Risk Assessments discussed above the Council has concluded that the site known as Gas House, Sandy Lane, Hilgay does not represent contaminated land at this time. If the circumstances surrounding the house change than the risk assessment should be reviewed. Such changes would be considered to include, a change of occupants, usage or any physical change to the building or its surroundings. The review should take into consideration the above data and assumptions used in the risk assessment.

If the land use changes or it is redeveloped, this land may still require further investigation. The National Planning Policy Framework (NPPF) states that responsibility for securing a safe development rests with the developer and/or landowner. The Borough Council will require that adequate site investigation information, prepared by a competent person is presented to ensure that the site is suitable for its new use.

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Appendices

Appendix 1 - Figures

Figure 1. Site Location

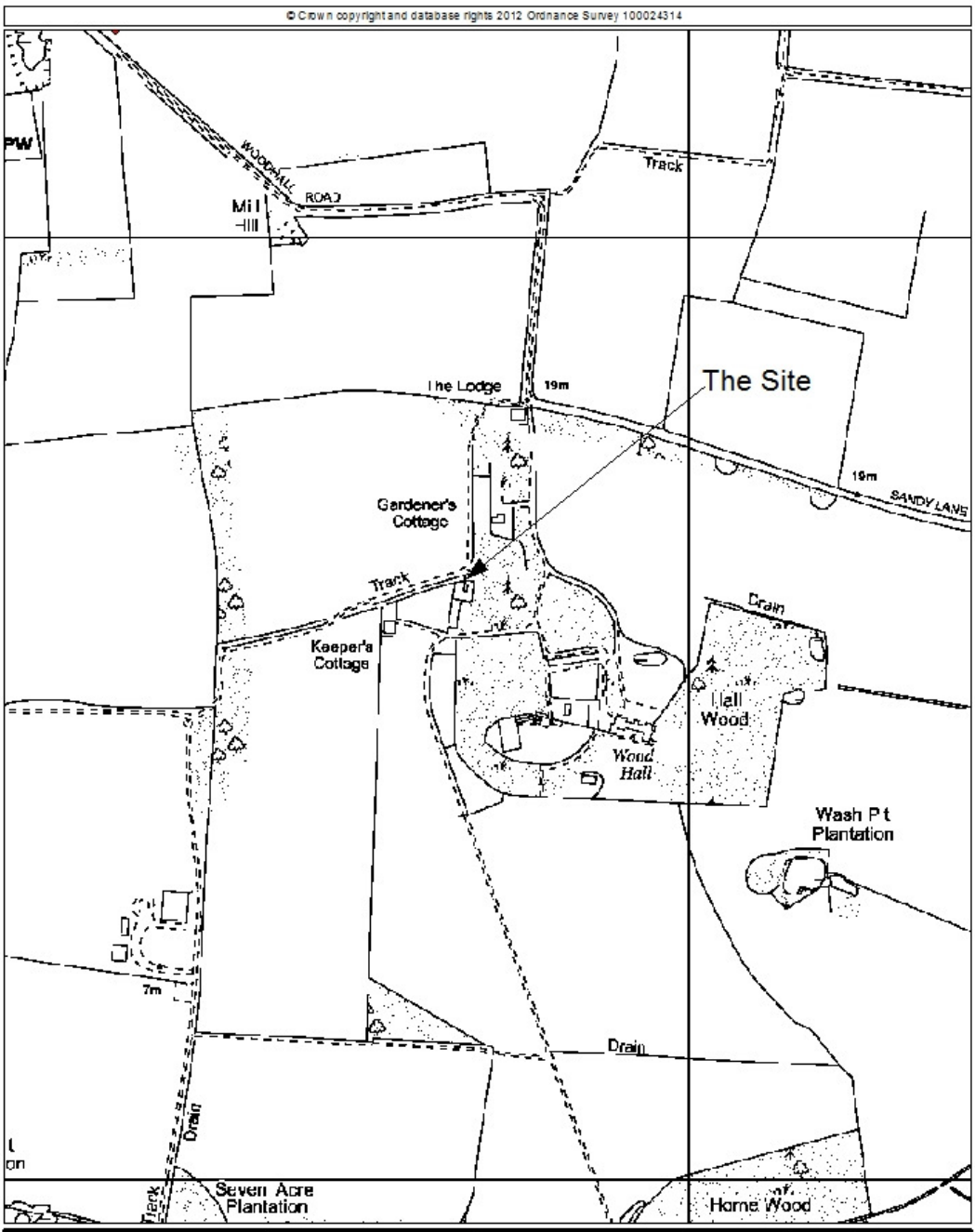


Figure 2. Site Plan

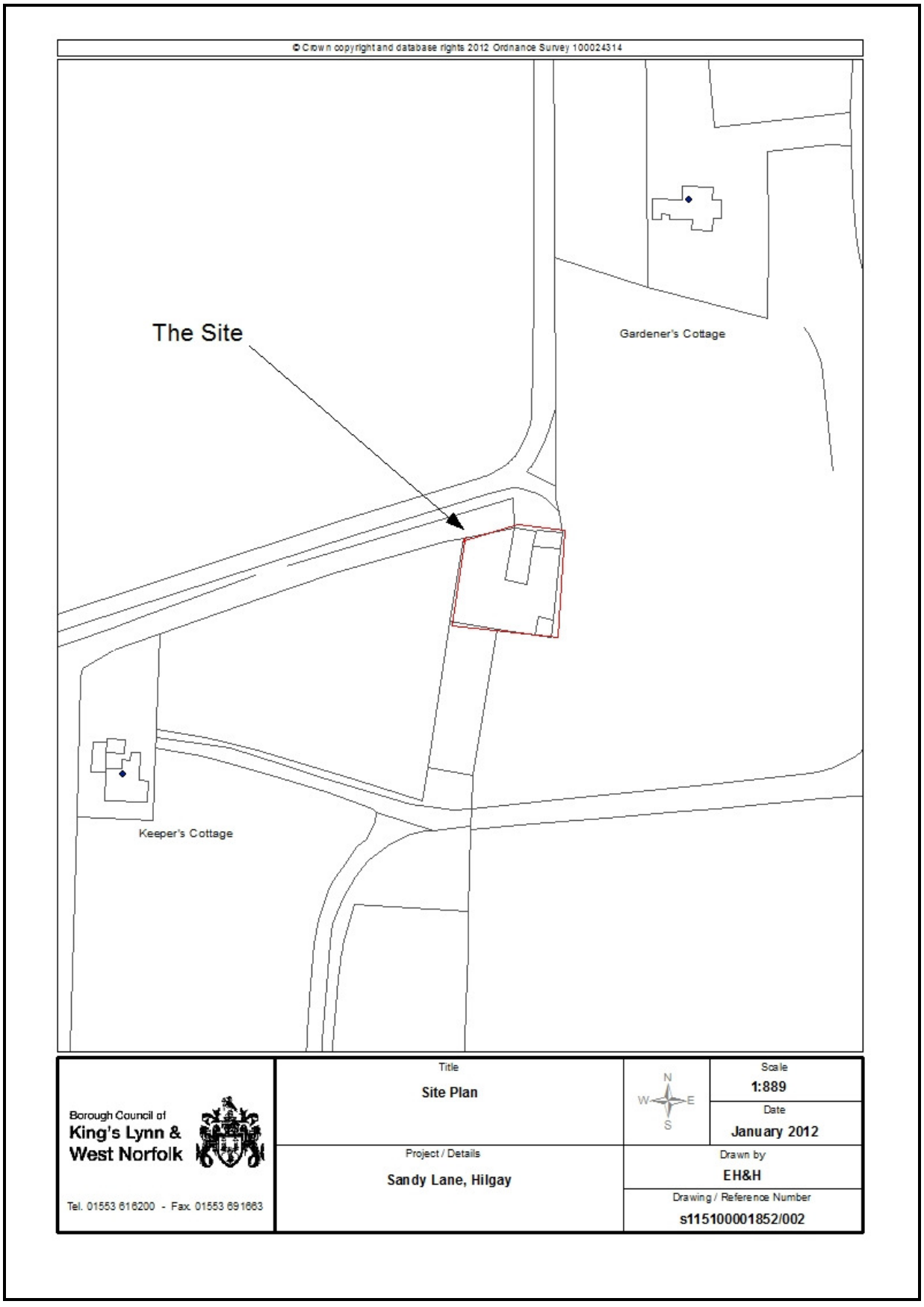


Figure 3. Historic Site Map 1843-1893

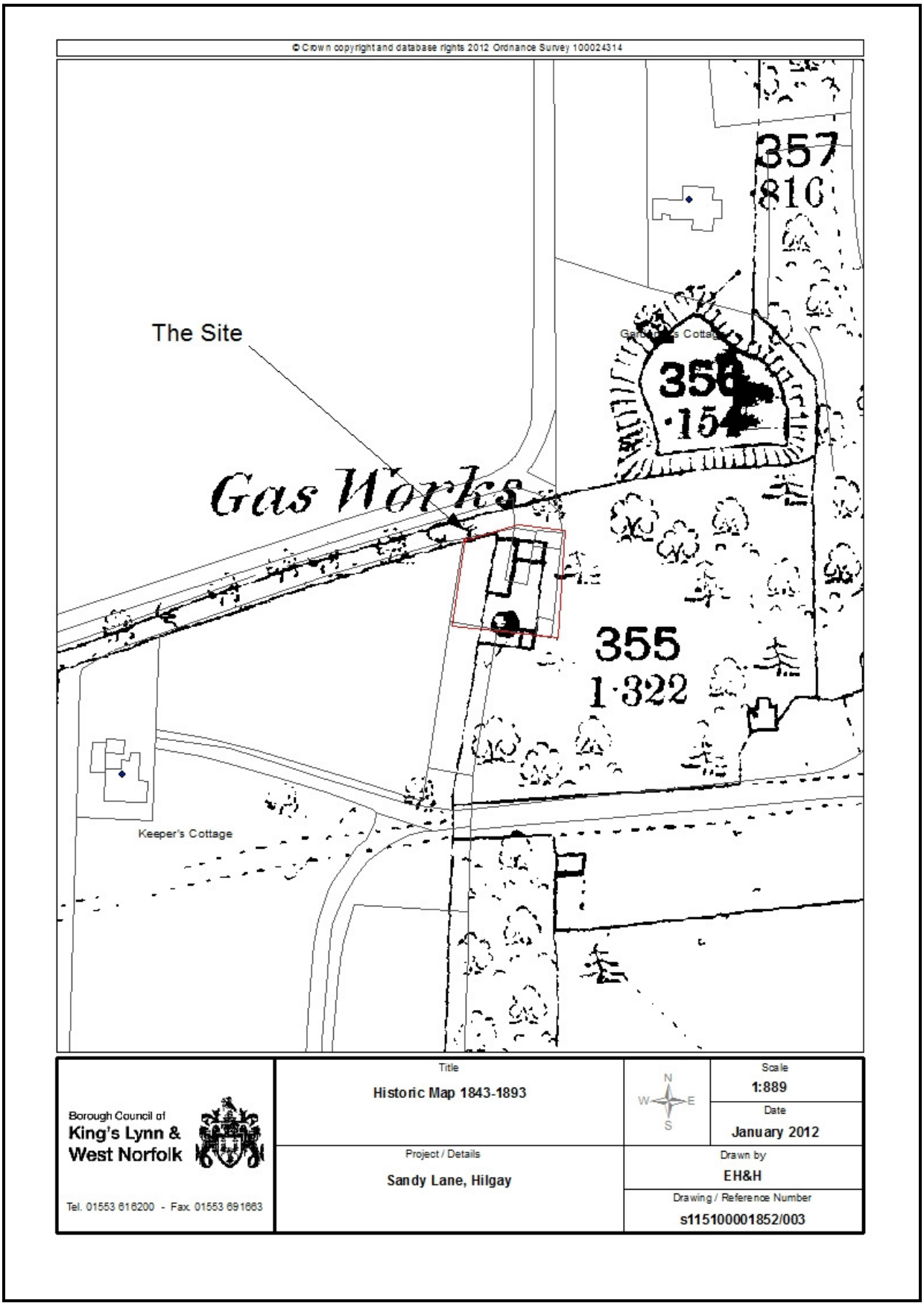


Figure 4. Historic Site Map 1891-1912

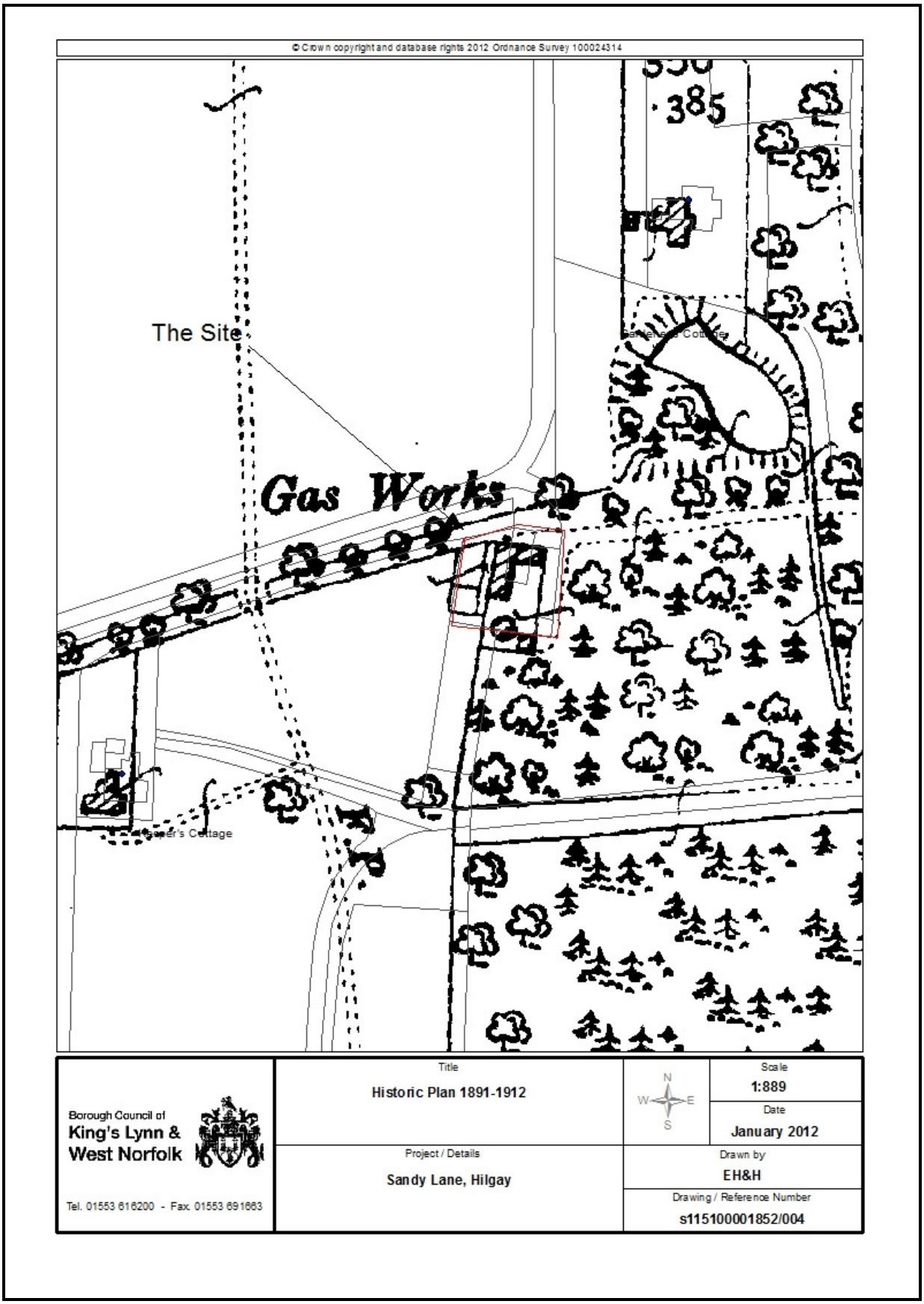


Figure 5. Historic Site Map 1945-1970

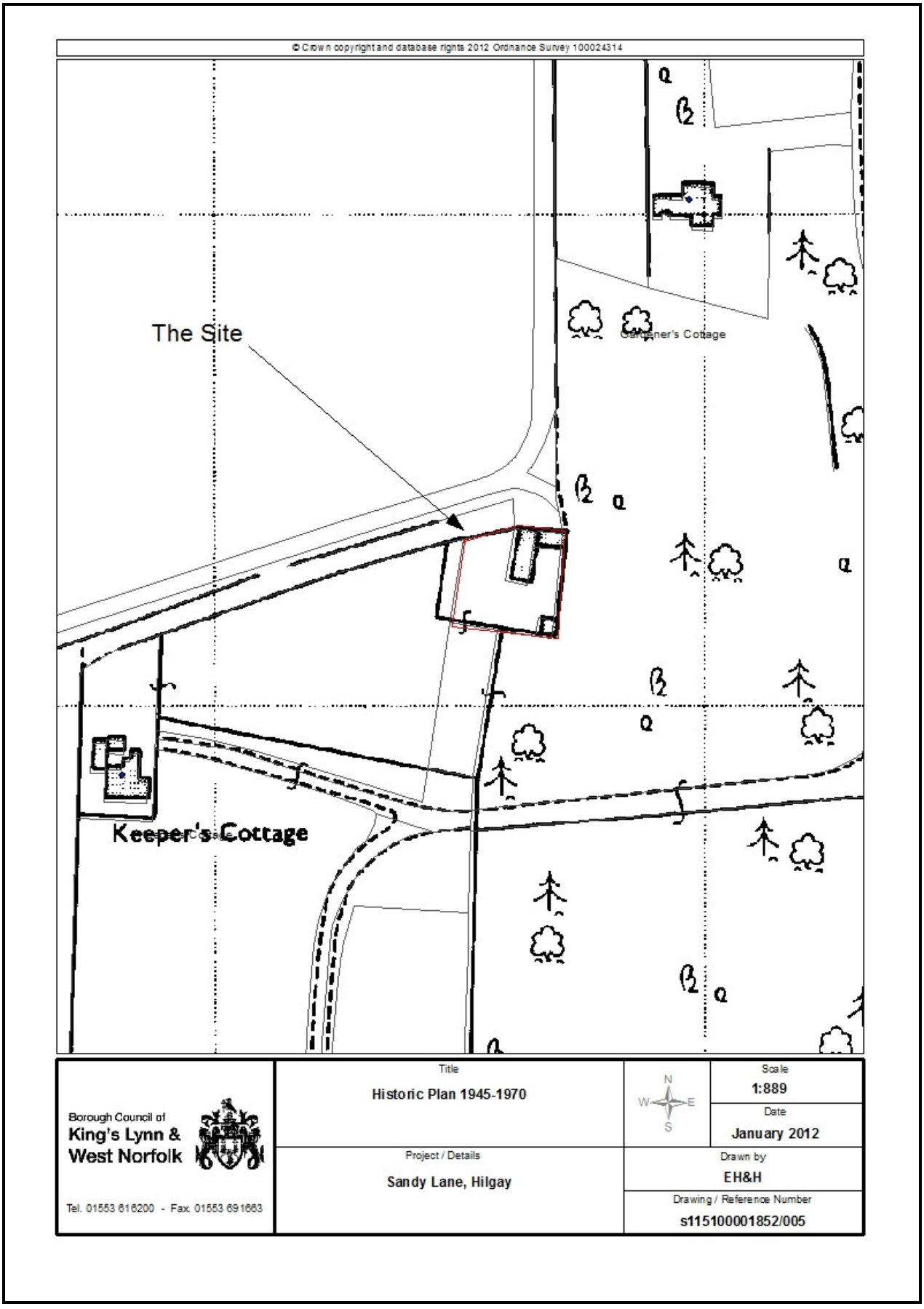


Figure 6. 1940s Aerial Photograph (MOD flyover)

Figure 7. 1999 Aerial Photograph

Borough Council of King's Lynn & West Norfolk Tel. 01553 616200 - Fax. 01553 691663	Title: Aerial Photograph 1999	N W E S	Scale: 1:889 Date: January 2012
	Project / Details: Sandy Lane, Hilgay		Drawn by: EH&H Drawing / Reference Number: s115100001852/007

Figure 8. 2006-2009 Aerial Photograph

Borough Council of King's Lynn & West Norfolk Tel. 01553 616200 - Fax. 01553 691663	Title: Aerial Photograph 2006-2009	N W E S	Scale: 1:889 Date: January 2012
	Project / Details: Sandy Lane, Hilgay		Drawn by: EH&H Drawing / Reference Number: s115100001852/008

Figure 9. Borehole Location Plan 1

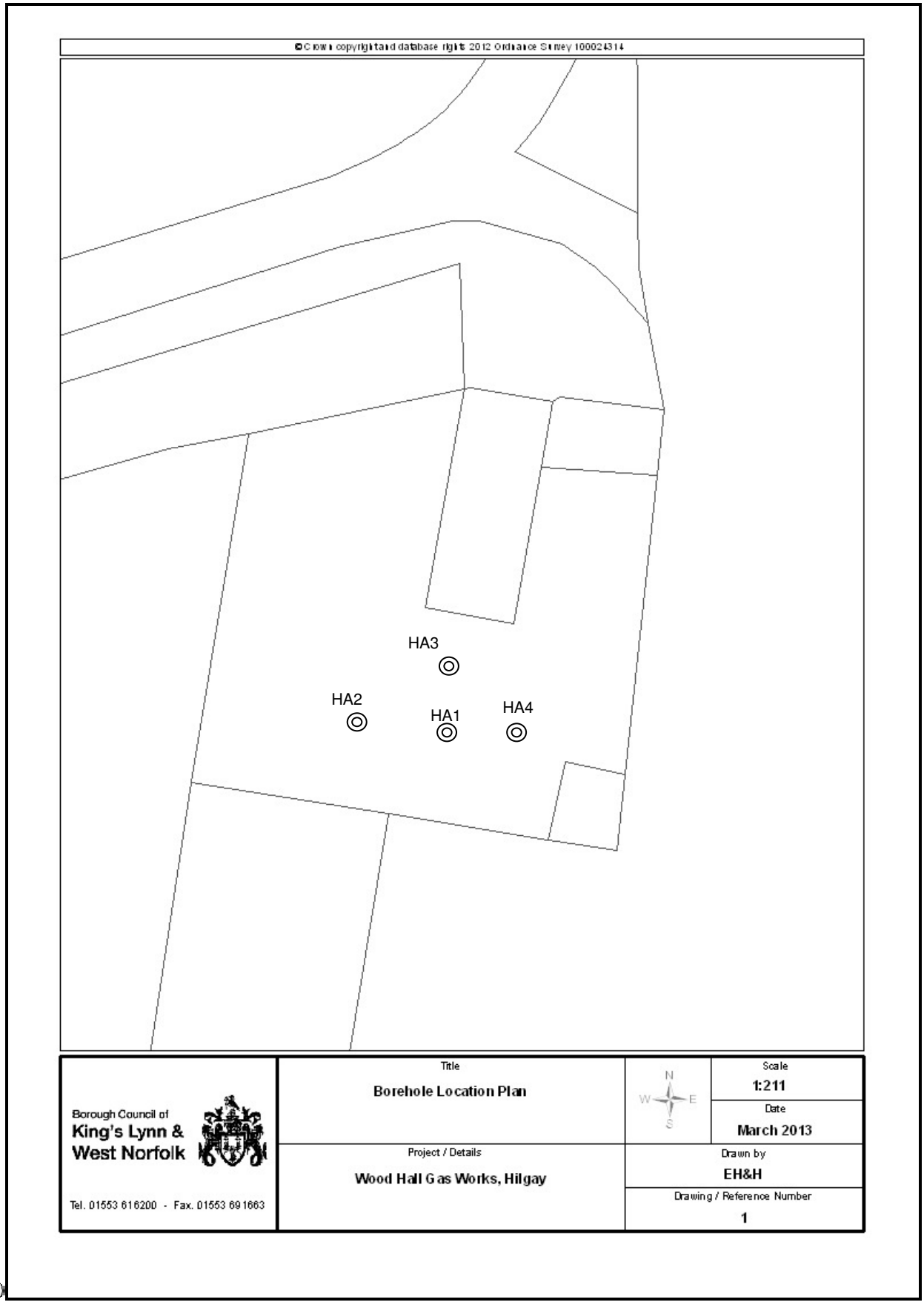
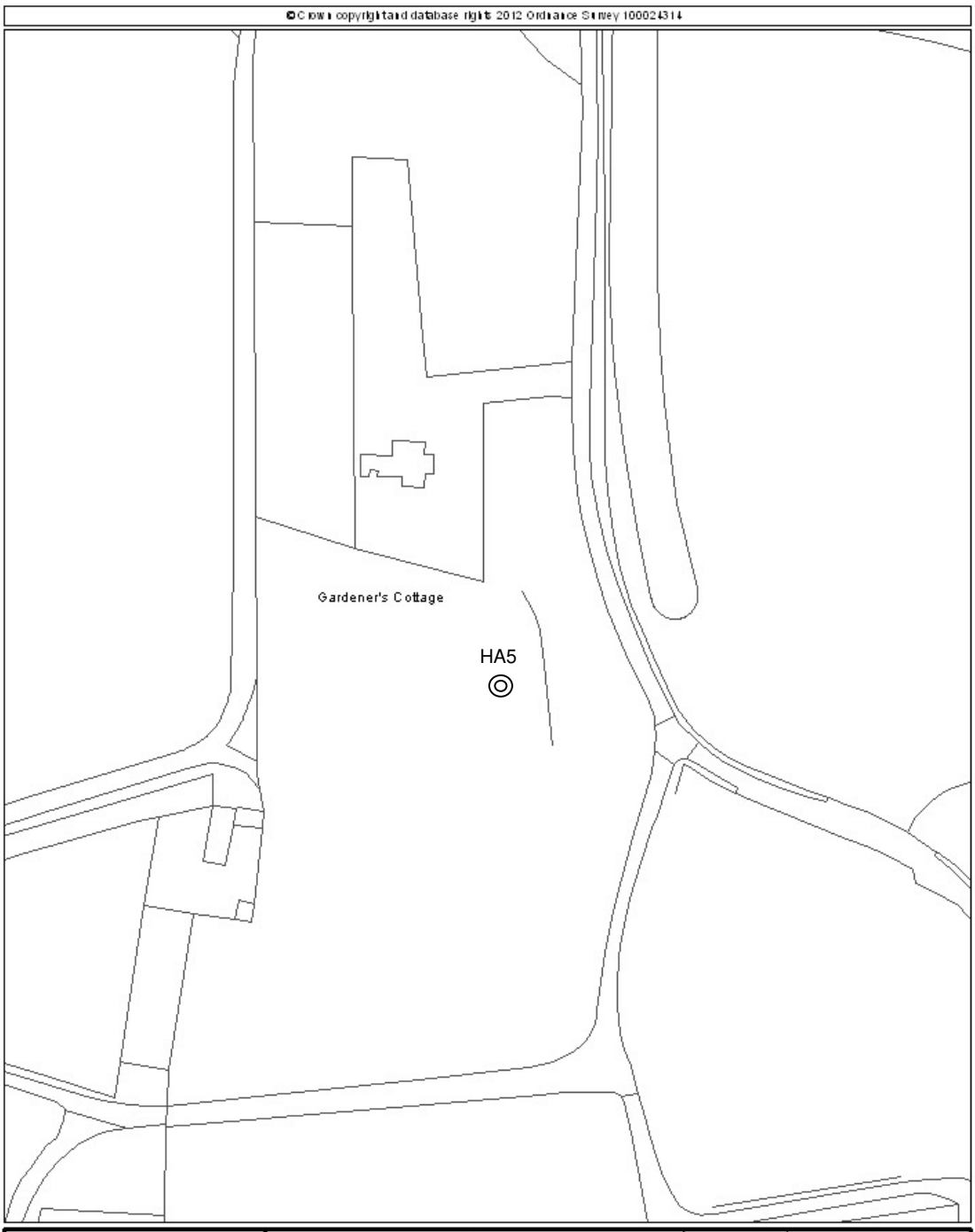
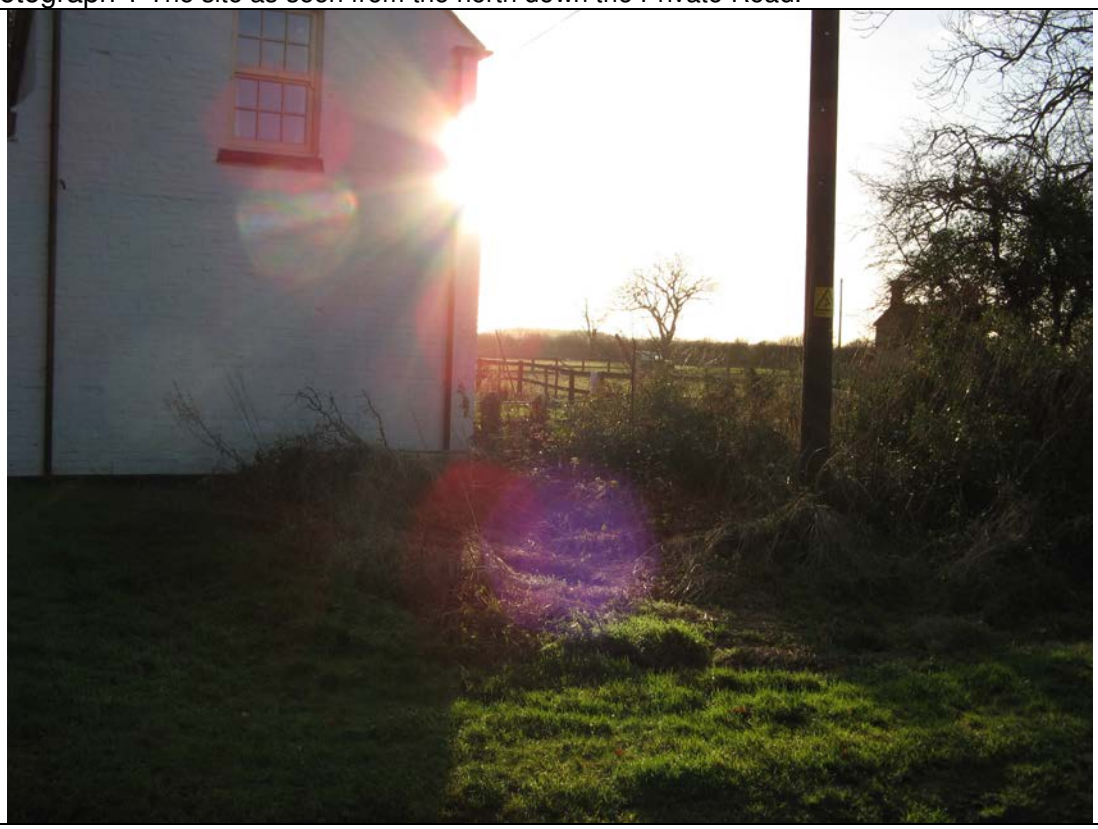


Figure 10. Borehole Location Plan 2



Appendix 2 - Site Photographs

Photograph 1 The site as seen from the north down the Private Road.



Photograph 2. The northern end of the site showing part of the rear garden.

Photograph 3. The eastern side of the site showing the boundary wall, brick outhouse and metal frame outside the property boundary.

Photograph 4. The eastern boundary of the site showing wood stockpile and state of the garden.

Photograph 5. The eastern side of the site showing the boundary wall, cast iron gate post, framed area outside the site and a depression within the site.

Appendix 3. Chemical Analysis

Chemtest
The right chemistry to deliver results
Depot Road
Newmarket
CB8 0AL
Tel: 01638 606070

Borough Council of King's Lynn & Wesk Norfolk
Kings Court
Chapel Street
King's Lynn, Norfolk
PE30 1EX

FAO Alex Grimmer
08 March 2013

Dear Alex Grimmer

Test Report Number **224867**
Your Project Reference **Gas House Hilgay**

Please find enclosed the results of analysis for the samples received 1 March 2013.

All soil samples will be retained for a period of one month and all water samples will be retained for 7 days following the date of the test report. Should you require an extended retention period then please detail your requirements in an email to customerservices@chemtest.co.uk. Please be aware that charges may be applicable for extended sample storage.

If you require any further assistance, please do not hesitate to contact the Customer Services team.

Yours sincerely

Keith Jones, Technical Manager

UKAS TESTING
2183

MCERTS

ISO 14001
sira
UKAS ENVIRONMENTAL MANAGEMENT

Notes to accompany report:

- *The sign < means 'less than'*
- *Tests marked 'U' hold UKAS accreditation*
- *Tests marked 'M' hold MCertS (and UKAS) accreditation*
- *Tests marked 'N' do not currently hold UKAS accreditation*
- *Tests marked 'S' were subcontracted to an approved laboratory*
- *n/e means 'not evaluated'*
- *i/s means 'insufficient sample'*
- *u/s means 'unsuitable sample'*
- *Comments or interpretations are outside of the scope of UKAS accreditation*
- *The results relate only to the items tested*
- *Stones represent the quantity of material removed prior to analysis*
- *All results are expressed on a dry weight basis*
- *The following tests were analysed on samples as received and the results subsequently corrected to a dry weight basis TPH, BTEX, VOCs, SVOCs, PCBs, phenols*
- *For all other tests the samples were dried at < 37°C prior to analysis*
- *Uncertainties of measurement for the determinands tested are available upon request*
- *Soil descriptions, including colour and texture, are beyond the scope of MCertS accreditation*
- *None of the test results included in this report have been recovery corrected*

Newmarket • Coventry • Dublin
Registered in England & Wales - Registration Number 6511736 - Registered Office: 11 Depot Road Newmarket Suffolk CB8 0AL

Borough Council of King's Lynn & Wesk Norfolk
Kings Court
Chapel Street
King's Lynn, Norfolk
PE30 1EX

FAO Alex Grimmer

LABORATORY TEST REPORT

Results of analysis of 5 samples received 28 February 2013

Gas House Hilgay

Chemtest
The right chemistry to deliver results

Report Date
08 March 2013

Login Batch No						224867				
Chemtest LIMS ID					AI37030	AI37031	AI37032	AI37033	AI37034
Sample ID					HA1	HA2	HA3	HA4	HA5
Sample No					ES1	ES1	ES1	ES1	ES1
Sampling Date					27/2/2013	27/2/2013	27/2/2013	27/2/2013	27/2/2013
Depth					0.3m - 0.5m	0.1m	0.1m	0.1m	0.1m - 0.3m
Matrix					*SOIL*	*SOIL*	*SOIL*	*SOIL*	*SOIL*
SOP↓	Determinand↓	CAS No↓	Units↓	*					
2030	Moisture		%	n/a	22.1	19.5	18.6	21.8	25
	Stones content (>50mm)		%	n/a	<0.02	<0.02	<0.02	<0.02	<0.02
2040	Soil colour			M	brown	brown	brown	brown	brown
	Soil texture			M	sand	sand	sand	sand	sand
	Other material			M	stones	stones	stones	stones	stones
2010	pH			M	7.5	7.4	7.6	7.4	6.9
2300	Cyanide (complex)	57125	mg kg^{-1}	M	<0.5	<0.5	<0.5	<0.5	<0.5
	Cyanide (free)	57125	mg kg^{-1}	M	<0.5	<0.5	<0.5	<0.5	<0.5
	Cyanide (total)	57125	mg kg^{-1}	M	<0.5	<0.5	<0.5	<0.5	<0.5
2450	Arsenic	7440382	mg kg^{-1}	M	37	25	19	13	47
	Cadmium	7440439	mg kg^{-1}	M	0.35	0.53	0.47	0.54	0.48
	Chromium	7440473	mg kg^{-1}	M	26	45	39	24	27
	Copper	7440508	mg kg^{-1}	M	41	34	21	21	24
	Mercury	7439976	mg kg^{-1}	M	0.44	0.38	0.34	0.22	0.41
	Nickel	7440020	mg kg^{-1}	M	27	48	39	20	25
	Lead	7439921	mg kg^{-1}	M	1700	670	520	270	470
	Selenium	7782492	mg kg^{-1}	M	0.78	0.71	0.47	0.98	0.87
	Zinc	7440666	mg kg^{-1}	M	180	210	160	150	210
2675	TPH aliphatic >C5-C6		mg kg^{-1}	N	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
	TPH aliphatic >C6-C8		mg kg^{-1}	N	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
	TPH aliphatic >C8-C10		mg kg^{-1}	N	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
	TPH aliphatic >C10-C12		mg kg^{-1}	M	< 1	< 1	< 1	< 1	< 1
	TPH aliphatic >C12-C16		mg kg^{-1}	M	< 1	< 1	< 1	< 1	< 1
	TPH aliphatic >C16-C21		mg kg^{-1}	M	< 1	< 1	< 1	< 1	< 1

All tests undertaken between 01/03/2013 and 08/03/2013

* Accreditation status

This report should be interpreted in conjuction with the notes on the accompanying cover page.

Borough Council of King's Lynn & Wesk Norfolk
Kings Court
Chapel Street
King's Lynn, Norfolk
PE30 1EX

FAO Alex Grimmer

LABORATORY TEST REPORT

Results of analysis of 5 samples received 28 February 2013

Gas House Hilgay

Chemtest
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Report Date
08 March 2013

					224867				
					AI37030	AI37031	AI37032	AI37033	AI37034
					HA1	HA2	HA3	HA4	HA5
					ES1	ES1	ES1	ES1	ES1
					27/2/2013	27/2/2013	27/2/2013	27/2/2013	27/2/2013
					0.3m - 0.5m	0.1m	0.1m	0.1m	0.1m - 0.3m
					SOIL	*SOIL*	*SOIL*	*SOIL*	*SOIL*
2675	TPH aliphatic >C21-C35		mg kg-1	M	< 1	< 1	< 1	< 1	< 1
	TPH aliphatic >C35-C44		mg kg-1	N	< 1	< 1	< 1	< 1	< 1
	TPH aromatic >C5-C7		mg kg-1	N	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
	TPH aromatic >C7-C8		mg kg-1	N	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
	TPH aromatic >C8-C10		mg kg-1	N	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
	TPH aromatic >C10-C12		mg kg-1	M	< 1	< 1	< 1	< 1	< 1
	TPH aromatic >C12-C16		mg kg-1	M	1.7	1.2	2.7	1.8	1.6
	TPH aromatic >C16-C21		mg kg-1	M	8.3	5.3	13	4.0	3.1
	TPH aromatic >C21-C35		mg kg-1	M	18	12	28	11	12
	TPH aromatic >C35-C44		mg kg-1	N	1.6	1.1	1.3	< 1	< 1
	Total Petroleum Hydrocarbons		mg kg-1	N	30	20	46	17	18
2700	Naphthalene	91203	mg kg-1	M	0.48	0.1	0.37	< 0.1	0.15
	Acenaphthylene	208968	mg kg-1	M	< 0.1	0.12	0.77	< 0.1	< 0.1
	Acenaphthene	83329	mg kg-1	M	< 0.1	< 0.1	0.4	< 0.1	< 0.1
	Fluorene	86737	mg kg-1	M	0.31	< 0.1	1	0.17	< 0.1
	Phenanthrene	85018	mg kg-1	M	0.59	0.7	9.5	0.64	0.4
	Anthracene	120127	mg kg-1	M	0.13	0.2	2.6	0.13	< 0.1
	Fluoranthene	206440	mg kg-1	M	1.5	3	13	1.5	0.76
	Pyrene	129000	mg kg-1	M	1.4	2.3	11	1.3	0.74
	Benzo[a]anthracene	56553	mg kg-1	M	1.6	3	11	1.5	0.45
	Chrysene	218019	mg kg-1	M	1.9	4.3	12	1.6	0.59
	Benzo[b]fluoranthene	205992	mg kg-1	M	1.9	3.5	8.8	1.8	0.85
	Benzo[k]fluoranthene	207089	mg kg-1	M	1	2.7	7.2	1	0.49
	Benzo[a]pyrene	50328	mg kg-1	M	1.7	3.6	8.2	1.9	0.87
	Dibenzo[a,h]anthracene	53703	mg kg-1	M	0.51	0.91	1.6	0.18	< 0.1

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Column page 1
Report page 2 of 14
LIMS sample ID range AI37030 to AI37035

Borough Council of King's Lynn & Wesk Norfolk
Kings Court
Chapel Street
King's Lynn, Norfolk
PE30 1EX

FAO Alex Grimmer

LABORATORY TEST REPORT

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					AI37030	AI37031	AI37032	AI37033	AI37034
					HA1	HA2	HA3	HA4	HA5
					ES1	ES1	ES1	ES1	ES1
					27/2/2013	27/2/2013	27/2/2013	27/2/2013	27/2/2013
					0.3m - 0.5m	0.1m	0.1m	0.1m	0.1m - 0.3m
					SOIL	*SOIL*	*SOIL*	*SOIL*	*SOIL*
2700	Indeno[1,2,3-cd]pyrene	193395	mg kg⁻¹	M	1.1	2.1	3.2	1	0.48
	Benzo[g,h,i]perylene	191242	mg kg⁻¹	M	1.3	1.9	3	1.1	0.57
	Total (of 16) PAHs		mg kg⁻¹	M	15	28	94	14	6.4
2760	Methyl tert-butylether	1634044	µg kg⁻¹	N	< 1.0				
	Dichlorodifluoromethane	75718	µg kg⁻¹	U	< 1.0				
	Chloromethane	74873	µg kg⁻¹	M	< 1.0				
	Vinyl chloride	75014	µg kg⁻¹	M	< 1.0				
	Bromomethane	74839	µg kg⁻¹	U	< 20				
	Chloroethane	75003	µg kg⁻¹	U	< 2.0				
	Trichlorofluoromethane	75694	µg kg⁻¹	U	< 1.0				
	1,1-Dichloroethene	75354	µg kg⁻¹	U	< 1.0				
	Dichloromethane	75092	µg kg⁻¹	N	ne				
	trans-1,2-Dichloroethene	156605	µg kg⁻¹	U	< 1.0				
	1,1-Dichloroethane	75343	µg kg⁻¹	M	< 1.0				
	cis-1,2-Dichloroethene	156592	µg kg⁻¹	M	< 1.0				
	Bromochloromethane	74975	µg kg⁻¹	U	< 1.0				
	Trichloromethane	67663	µg kg⁻¹	M	< 1.0				
	1,1,1-Trichloroethane	71556	µg kg⁻¹	M	< 1.0				
	Tetrachloromethane	56235	µg kg⁻¹	M	< 1.0				
	1,1-Dichloropropene	563586	µg kg⁻¹	U	< 1.0				
	Benzene	71432	µg kg⁻¹	M	< 1.0				
	1,2-Dichloroethane	107062	µg kg⁻¹	U	< 2.0				
	Trichloroethene	79016	µg kg⁻¹	U	< 1.0				
	1,2-Dichloropropane	78875	µg kg⁻¹	U	< 1.0				
	Dibromomethane	74953	µg kg⁻¹	U	< 10				

XX

All tests undertaken between 01/03/2013 and 08/03/2013

* Accreditation status

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Borough Council of King's Lynn & Wesk Norfolk
Kings Court
Chapel Street
King's Lynn, Norfolk
PE30 1EX

FAO Alex Grimmer

LABORATORY TEST REPORT

Results of analysis of 5 samples received 28 February 2013

Gas House Hilgay

Chemtest
The right chemistry to deliver results

Report Date
08 March 2013

					224867				
					AI37030	AI37031	AI37032	AI37033	AI37034
					HA1	HA2	HA3	HA4	HA5
					ES1	ES1	ES1	ES1	ES1
					27/2/2013	27/2/2013	27/2/2013	27/2/2013	27/2/2013
					0.3m - 0.5m	0.1m	0.1m	0.1m	0.1m - 0.3m
					SOIL	*SOIL*	*SOIL*	*SOIL*	*SOIL*
2760	Bromodichloromethane	75274	µg kg^{-1}	U	< 5.0				
	cis-1,3-Dichloropropene	10061015	µg kg^{-1}	N	< 10				
	Toluene	108883	µg kg^{-1}	M	< 1.0				
	trans-1,3-Dichloropropene	10061026	µg kg^{-1}	N	< 10				
	1,1,2-Trichloroethane	79005	µg kg^{-1}	U	< 10				
	Tetrachloroethene	127184	µg kg^{-1}	M	< 1.0				
	1,3-Dichloropropane	142289	µg kg^{-1}	U	< 2.0				
	Dibromochloromethane	124481	µg kg^{-1}	U	< 10				
	1,2-Dibromoethane	106934	µg kg^{-1}	U	< 5.0				
	Chlorobenzene	108907	µg kg^{-1}	M	< 1.0				
	1,1,1,2-Tetrachloroethane	630206	µg kg^{-1}	M	< 2.0				
	Ethylbenzene	100414	µg kg^{-1}	M	< 1.0				
	m- & p-Xylene	1330207	µg kg^{-1}	U	< 1.0				
	o-Xylene	95476	µg kg^{-1}	U	< 1.0				
	Styrene	100425	µg kg^{-1}	U	< 1.0				
	Tribromomethane	75252	µg kg^{-1}	U	< 10				
	Isopropylbenzene	98828	µg kg^{-1}	U	< 1.0				
	Bromobenzene	108861	µg kg^{-1}	U	< 1.0				
	1,2,3-Trichloropropane	96184	µg kg^{-1}	N	< 50				
	n-Propylbenzene	103651	µg kg^{-1}	U	< 1.0				
	2-Chlorotoluene	95498	µg kg^{-1}	M	< 1.0				
	1,2,4-Trimethylbenzene	95636	µg kg^{-1}	U	< 1.0				
	4-Chlorotoluene	106434	µg kg^{-1}	U	< 1.0				
	tert-Butylbenzene	98066	µg kg^{-1}	U	< 1.0				
	1,3,5-Trimethylbenzene	108678	µg kg^{-1}	U	< 1.0				

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All tests undertaken between 01/03/2013 and 08/03/2013

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Kings Court
Chapel Street
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PE30 1EX

FAO Alex Grimmer

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Gas House Hilgay

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					224867				
					AI37030	AI37031	AI37032	AI37033	AI37034
					HA1	HA2	HA3	HA4	HA5
					ES1	ES1	ES1	ES1	ES1
					27/2/2013	27/2/2013	27/2/2013	27/2/2013	27/2/2013
					0.3m - 0.5m	0.1m	0.1m	0.1m	0.1m - 0.3m
					SOIL	*SOIL*	*SOIL*	*SOIL*	*SOIL*
2760	sec-Butylbenzene	135988	µg kg-1	U	< 1.0				
	1,3-Dichlorobenzene	541731	µg kg-1	U	< 1.0				
	4-Isopropyltoluene	99876	µg kg-1	U	< 1.0				
	1,4-Dichlorobenzene	106467	µg kg-1	U	< 1.0				
	n-Butylbenzene	104518	µg kg-1	U	< 1.0				
	1,2-Dichlorobenzene	95501	µg kg-1	U	< 1.0				
	1,2-Dibromo-3-chloropropane	96128	µg kg-1	U	< 50				
	1,2,4-Trichlorobenzene	120821	µg kg-1	U	< 1.0				
	Hexachlorobutadiene	87683	µg kg-1	U	< 1.0				
2790	Phenol	108952	mg kg-1	N	< 0.5				
	bis(2-Chloroethyl)ether	111444	mg kg-1	N	< 0.5				
	2-Chlorophenol	95578	mg kg-1	N	< 0.5				
	1,3-Dichlorobenzene	541731	mg kg-1	N	< 0.5				
	1,4-Dichlorobenzene	106467	mg kg-1	N	< 0.5				
	1,2-Dichlorobenzene	95501	mg kg-1	N	< 0.5				
	2-Methylphenol	95487	mg kg-1	N	< 0.5				
	bis(2-Chloroisopropyl)ether	108601	mg kg-1	N	< 0.5				
	4-Methylphenol	106445	mg kg-1	N	< 0.5				
	N-Nitrosodi-n-propylamine	621647	mg kg-1	N	< 0.5				
	Hexachloroethane	67721	mg kg-1	N	< 0.5				
	Nitrobenzene	98953	mg kg-1	N	< 0.5				
	Isophorone	78591	mg kg-1	N	< 0.5				
	2-Nitrophenol	88755	mg kg-1	N	< 0.5				
	2,4-Dimethylphenol	105679	mg kg-1	N	< 0.5				
	bis(2-Chloroethoxy)methane	111911	mg kg-1	N	< 0.5				

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					224867				
					AI37030	AI37031	AI37032	AI37033	AI37034
					HA1	HA2	HA3	HA4	HA5
					ES1	ES1	ES1	ES1	ES1
					27/2/2013	27/2/2013	27/2/2013	27/2/2013	27/2/2013
					0.3m - 0.5m	0.1m	0.1m	0.1m	0.1m - 0.3m
					SOIL	*SOIL*	*SOIL*	*SOIL*	*SOIL*
2790	2,4-Dichlorophenol	120832	mg kg-1	N	< 0.5				
	1,2,4-Trichlorobenzene	120821	mg kg-1	N	< 0.5				
	Naphthalene	91203	mg kg-1	N	< 0.5				
	4-Chloroaniline	106478	mg kg-1	N	< 0.5				
	Hexachlorobutadiene	87683	mg kg-1	N	< 0.5				
	4-Chloro-3-methylphenol	59507	mg kg-1	N	< 0.5				
	2-Methylnaphthalene	91576	mg kg-1	N	< 0.5				
	Hexachlorocyclopentadiene	77474	mg kg-1	N	< 0.5				
	2,4,6-Trichlorophenol	88062	mg kg-1	N	< 0.5				
	2,4,5-Trichlorophenol	95954	mg kg-1	N	< 0.5				
	2-Chloronaphthalene	91587	mg kg-1	N	< 0.5				
	2-Nitroaniline	88744	mg kg-1	N	< 0.5				
	Dimethylphthalate	131113	mg kg-1	N	< 0.5				
	2,6-Dinitrotoluene	606202	mg kg-1	N	< 0.5				
	Acenaphthylene	208968	mg kg-1	N	< 0.5				
	3-Nitroaniline	99092	mg kg-1	N	< 0.5				
	Acenaphthene	83329	mg kg-1	N	< 0.5				
	Dibenzofuran	132649	mg kg-1	N	< 0.5				
	2,4-Dinitrotoluene	121142	mg kg-1	N	< 0.5				
	Diethylphthalate	84662	mg kg-1	N	< 0.5				
	Fluorene	86737	mg kg-1	N	< 0.5				
	4-Chlorophenylphenylether	7005723	mg kg-1	N	< 0.5				
	4-Nitroaniline	100016	mg kg-1	N	< 0.5				
	2-Methyl-4,6-dinitrophenol	534521	mg kg-1	N	< 0.5				
	Azobenzene	103333	mg kg-1	N	< 0.5				

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						AI37030	AI37031	AI37032	AI37033	AI37034
						HA1	HA2	HA3	HA4	HA5
						ES1	ES1	ES1	ES1	ES1
						27/2/2013	27/2/2013	27/2/2013	27/2/2013	27/2/2013
						0.3m - 0.5m	0.1m	0.1m	0.1m	0.1m - 0.3m
						SOIL	*SOIL*	*SOIL*	*SOIL*	*SOIL*
2790	4-Bromophenylphenylether	101553	mg kg-1	N	< 0.5					
	Hexachlorobenzene	118741	mg kg-1	N	< 0.5					
	Pentachlorophenol	87865	mg kg-1	N	< 0.5					
	Phenanthrene	85018	mg kg-1	N	< 0.5					
	Anthracene	120127	mg kg-1	N	< 0.5					
	Carbazole	86748	mg kg-1	N	< 0.5					
	Di-n-butylphthalate	84742	mg kg-1	N	< 0.5					
	Fluoranthene	206440	mg kg-1	N	0.69					
	Pyrene	129000	mg kg-1	N	0.68					
	Butylbenzylphthalate	85687	mg kg-1	N	< 0.5					
	Benzo[a]anthracene	56553	mg kg-1	N	< 0.5					
	Chrysene	218019	mg kg-1	N	< 0.5					
	bis(2-Ethylhexyl)phthalate	117817	mg kg-1	N	< 0.5					
	Di-n-octylphthalate	117840	mg kg-1	N	< 0.5					
	Benzo[b]fluoranthene	205992	mg kg-1	N	0.68					
	Benzo[k]fluoranthene	207089	mg kg-1	N	< 0.5					
	Benzo[a]pyrene	50328	mg kg-1	N	< 0.5					
	Indeno[1,2,3-cd]pyrene	193395	mg kg-1	N	< 0.5					
	Dibenzo[a,h]anthracene	53703	mg kg-1	N	< 0.5					
	Benzo[g,h,i]perylene	191242	mg kg-1	N	< 0.5					
	2,4-Dinitrophenol	51285	mg kg-1	N	< 0.5					
	4-Nitrophenol	100027	mg kg-1	N	< 0.5					

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Login Batch No					224867
Chemtest LIMS ID					AI37035
Sample ID					Well
Sample No					W1
Sampling Date					27/2/2013
Depth					0.6m
Matrix					*WATER*
SOP↓	Determinand↓	CAS No↓	Units↓	*	
1010	pH	PH		U	7.9
1300	Cyanide (total)	57125	mg l-1	U	< 0.05
	Cyanide (complex)	57125	mg l-1	U	< 0.05
	Cyanide (free)	57125	mg l-1	U	< 0.05
1450	Arsenic	7440382	µg l-1	U	1.2
	Cadmium	7440439	µg l-1	U	<0.080
	Chromium	7440473	µg l-1	U	<1.0
	Copper	7440508	µg l-1	U	3.8
	Mercury	7439976	µg l-1	U	<0.50
	Nickel	7440020	µg l-1	U	1.2
	Lead	7439921	µg l-1	U	1.0
	Selenium	7782492	µg l-1	U	<1.0
	Zinc	7440666	µg l-1	U	13
1675	TPH aliphatic >C5-C6		µg l-1	N	< 0.1
	TPH aliphatic >C6-C8		µg l-1	N	< 0.1
	TPH aliphatic >C8-C10		µg l-1	N	< 0.1
	TPH aliphatic >C10-C12		µg l-1	N	< 0.1
	TPH aliphatic >C12-C16		µg l-1	N	< 0.1
	TPH aliphatic >C16-C21		µg l-1	N	< 0.1
	TPH aliphatic >C21-C35		µg l-1	N	< 0.1
	TPH aliphatic >C35-C44		µg l-1	N	< 0.1
	TPH aromatic >C5-C7		µg l-1	N	< 0.1
	TPH aromatic >C7-C8		µg l-1	N	< 0.1
	TPH aromatic >C8-C10		µg l-1	N	< 0.1

[1]The sample container/fill level was not appropriate for the specified analysis - these results may be compromised. The accreditation for these results remains unaffected.

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					Well
					W1
					27/2/2013
					0.6m
					WATER
1675	TPH aromatic >C10-C12		µg l-1	N	< 0.1
	TPH aromatic >C12-C16		µg l-1	N	< 0.1
	TPH aromatic >C16-C21		µg l-1	N	< 0.1
	TPH aromatic >C21-C35		µg l-1	N	< 0.1
	TPH aromatic >C35-C44		µg l-1	N	< 0.1
	Total Petroleum Hydrocarbons		µg l-1	N	< 10
	Total Aliphatic Hydrocarbons		µg l-1	N	< 5
	Total Aromatic Hydrocarbons		µg l-1	N	< 5
1700	Naphthalene	91203	µg l-1	U	<0.1
	Acenaphthylene	208968	µg l-1	U	<0.1
	Acenaphthene	83329	µg l-1	U	<0.1
	Fluorene	86737	µg l-1	U	<0.1
	Phenanthrene	85018	µg l-1	U	<0.1
	Anthracene	120127	µg l-1	U	<0.1
	Fluoranthene	206440	µg l-1	U	<0.1
	Pyrene	129000	µg l-1	U	<0.1
	Benzo[a]anthracene	56553	µg l-1	U	<0.1
	Chrysene	218019	µg l-1	U	<0.1
	Benzo[b]fluoranthene	205992	µg l-1	U	<0.1
	Benzo[k]fluoranthene	207089	µg l-1	U	<0.1
	Benzo[a]pyrene	50328	µg l-1	U	<0.1
	Dibenzo[a,h]anthracene	53703	µg l-1	U	<0.1
	Indeno[1,2,3-cd]pyrene	193395	µg l-1	U	<0.1
	Benzo[g,h,i]perylene	191242	µg l-1	U	<0.1
	Total (of 16) PAHs		µg l-1	U	<2

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					Well
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					27/2/2013
					0.6m
					WATER
1760	Methyl tert-butylether	1634044	µg l-1	N	<1.0 [1]
	Dichlorodifluoromethane	75718	µg l-1	U	<1.0 [1]
	Chloromethane	74873	µg l-1	U	<1.0 [1]
	Vinyl chloride	75014	µg l-1	U	<1.0 [1]
	Bromomethane	74839	µg l-1	U	<20 [1]
	Chloroethane	75003	µg l-1	U	<2.0 [1]
	Trichlorofluoromethane	75694	µg l-1	U	<1.0 [1]
	1,1-Dichloroethene	75354	µg l-1	U	<1.0 [1]
	Dichloromethane	75092	µg l-1	N	ne [1]
	trans-1,2-Dichloroethene	156605	µg l-1	U	<1.0 [1]
	1,1-Dichloroethane	75343	µg l-1	U	<1.0 [1]
	cis-1,2-Dichloroethene	156592	µg l-1	U	<1.0 [1]
	Bromochloromethane	74975	µg l-1	U	<1.0 [1]
	Trichloromethane	67663	µg l-1	U	<1.0 [1]
	1,1,1-Trichloroethane	71556	µg l-1	U	<1.0 [1]
	Tetrachloromethane	56235	µg l-1	U	<1.0 [1]
	1,1-Dichloropropene	563586	µg l-1	U	<1.0 [1]
	Benzene	71432	µg l-1	U	<1.0 [1]
	1,2-Dichloroethane	107062	µg l-1	U	<2.0 [1]
	Trichloroethene	79016	µg l-1	N	<1.0 [1]
	1,2-Dichloropropane	78875	µg l-1	U	<1.0 [1]
	Dibromomethane	74953	µg l-1	U	<10 [1]
	Bromodichloromethane	75274	µg l-1	U	<5.0 [1]
	cis-1,3-Dichloropropene	10061015	µg l-1	U	<10 [1]
	Toluene	108883	µg l-1	U	<1.0 [1]

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						Well
						W1
						27/2/2013
						0.6m
						WATER
1760	trans-1,3-Dichloropropene	10061026	µg l-1	U		<10 [1]
	1,1,2-Trichloroethane	79005	µg l-1	U		<10 [1]
	Tetrachloroethene	127184	µg l-1	U		<1.0 [1]
	1,3-Dichloropropane	142289	µg l-1	U		<2.0 [1]
	Dibromochloromethane	124481	µg l-1	U		<10 [1]
	1,2-Dibromoethane	106934	µg l-1	U		<5.0 [1]
	Chlorobenzene	108907	µg l-1	U		<1.0 [1]
	1,1,1,2-Tetrachloroethane	630206	µg l-1	U		<2.0 [1]
	Ethylbenzene	100414	µg l-1	U		<1.0 [1]
	m- & p-Xylene	1330207	µg l-1	U		<1.0 [1]
	o-Xylene	95476	µg l-1	U		<1.0 [1]
	Styrene	100425	µg l-1	U		<1.0 [1]
	Tribromomethane	75252	µg l-1	U		<10 [1]
	Isopropylbenzene	98828	µg l-1	U		<1.0 [1]
	Bromobenzene	108861	µg l-1	U		<1.0 [1]
	1,2,3-Trichloropropane	96184	µg l-1	U		<50 [1]
	n-Propylbenzene	103651	µg l-1	U		<1.0 [1]
	2-Chlorotoluene	95498	µg l-1	U		<1.0 [1]
	1,2,4-Trimethylbenzene	95636	µg l-1	U		<1.0 [1]
	4-Chlorotoluene	106434	µg l-1	U		<1.0 [1]
	tert-Butylbenzene	98066	µg l-1	U		<1.0 [1]
	1,3,5-Trimethylbenzene	108678	µg l-1	U		<1.0 [1]
	sec-Butylbenzene	135988	µg l-1	U		<1.0 [1]
	1,3-Dichlorobenzene	541731	µg l-1	U		<1.0 [1]
	4-Isopropyltoluene	99876	µg l-1	U		<1.0 [1]

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					AI37035
					Well
					W1
					27/2/2013
					0.6m
					WATER
1760	1,4-Dichlorobenzene	106467	µg l-¹	U	<1.0 [1]
	n-Butylbenzene	104518	µg l-¹	U	<1.0 [1]
	1,2-Dichlorobenzene	95501	µg l-¹	U	<1.0 [1]
	1,2-Dibromo-3-chloropropane	96128	µg l-¹	U	<50 [1]
	1,2,4-Trichlorobenzene	120821	µg l-¹	U	<1.0 [1]
	Hexachlorobutadiene	87683	µg l-¹	U	<1.0 [1]
1790	Acenaphthene	83329	µg l-¹	N	<0.50
	Acenaphthylene	208968	µg l-¹	N	<0.50
	Anthracene	120127	µg l-¹	N	<0.50
	Azobenzene	103333	µg l-¹	N	<0.50
	Benzo[a]anthracene	56553	µg l-¹	N	<0.50
	Benzo[a]pyrene	50328	µg l-¹	N	<0.50
	Benzo[b]fluoranthene	205992	µg l-¹	N	<0.50
	Benzo[g,h,i]perylene	191242	µg l-¹	N	<0.50
	Benzo[k]fluoranthene	207089	µg l-¹	N	<0.50
	bis(2-Chloroethoxy)methane	111911	µg l-¹	N	<0.50
	bis(2-Chloroethyl)ether	111444	µg l-¹	N	<0.50
	bis(2-Chloroisopropyl)ether	108601	µg l-¹	N	<0.50
	bis(2-Ethylhexyl)phthalate	117817	µg l-¹	N	<0.50
	Butylbenzylphthalate	85687	µg l-¹	N	<0.50
	Carbazole	86748	µg l-¹	N	<0.50
	Chrysene	218019	µg l-¹	N	<0.50
	Di-n-butylphthalate	84742	µg l-¹	N	<0.50
	Di-n-octylphthalate	117840	µg l-¹	N	<0.50
	Dibenzo[a,h]anthracene	53703	µg l-¹	N	<0.50

[1]The sample container/fill level was not appropriate for the specified analysis - these results may be compromised. The accreditation for these results remains unaffected.

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					224867
					AI37035
					Well
					W1
					27/2/2013
					0.6m
					WATER
1790	Dibenzofuran	132649	µg l-1	N	<0.50
	Diethylphthalate	84662	µg l-1	N	<0.50
	Dimethylphthalate	131113	µg l-1	N	<0.50
	Fluoranthene	206440	µg l-1	N	<0.50
	Fluorene	86737	µg l-1	N	<0.50
	Hexachlorobenzene	118741	µg l-1	N	<0.50
	Hexachlorobutadiene	87683	µg l-1	N	<0.50
	Hexachlorocyclopentadiene	77474	µg l-1	N	<0.50
	Hexachloroethane	67721	µg l-1	N	<0.50
	Indeno[1,2,3-cd]pyrene	193395	µg l-1	N	<0.50
	Isophorone	78591	µg l-1	N	<0.50
	N-Nitrosodi-n-propylamine	621647	µg l-1	N	<0.50
	Naphthalene	91203	µg l-1	N	<0.50
	Nitrobenzene	98953	µg l-1	N	<0.50
	Pentachlorophenol	87865	µg l-1	N	<0.50
	Phenanthrene	85018	µg l-1	N	<0.50
	Phenol	108952	µg l-1	N	<0.50
	Pyrene	129000	µg l-1	N	<0.50
	1,2-Dichlorobenzene	95501	µg l-1	N	<0.50
	1,2,4-Trichlorobenzene	120821	µg l-1	N	<0.50
	1,3-Dichlorobenzene	541731	µg l-1	N	<0.50
	1,4-Dichlorobenzene	106467	µg l-1	N	<0.50
	2-Chloronaphthalene	91587	µg l-1	N	<0.50
	2-Chlorophenol	95578	µg l-1	N	<0.50
	2-Methyl-4,6-dinitrophenol	534521	µg l-1	N	<0.50

XXX

[1]The sample container/fill level was not appropriate for the specified analysis - these results may be compromised. The accreditation for these results remains unaffected.

All tests undertaken between 01/03/2013 and 08/03/2013

* Accreditation status

This report should be interpreted in conjuction with the notes on the accompanying cover page.

Borough Council of King's Lynn & Wesk Norfolk
Kings Court
Chapel Street
King's Lynn, Norfolk
PE30 1EX

FAO Alex Grimmer

LABORATORY TEST REPORT

Results of analysis of 6 samples
received 28 February 2013

Gas House Hilgay

Chemtest
The right chemistry to deliver results

Report Date
08 March 2013

					224867
					AI37035
					Well
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					27/2/2013
					0.6m
					WATER
1790	2-Methylnaphthalene	91576	µg l-1	N	<0.50
	2-Methylphenol	95487	µg l-1	N	<0.50
	2-Nitroaniline	88744	µg l-1	N	<0.50
	2-Nitrophenol	88755	µg l-1	N	<0.50
	2,4-Dichlorophenol	120832	µg l-1	N	<0.50
	2,4-Dimethylphenol	105679	µg l-1	N	<0.50
	2,4-Dinitrotoluene	121142	µg l-1	N	<0.50
	2,4,5-Trichlorophenol	95954	µg l-1	N	<0.50
	2,4,6-Trichlorophenol	88062	µg l-1	N	<0.50
	2,6-Dinitrotoluene	606202	µg l-1	N	<0.50
	3-Nitroaniline	99092	µg l-1	N	<0.50
	4-Bromophenylphenylether	101553	µg l-1	N	<0.50
	4-Chloro-3-methylphenol	59507	µg l-1	N	<0.50
	4-Chloroaniline	106478	µg l-1	N	<0.50
	4-Chlorophenylphenylether	7005723	µg l-1	N	<0.50
	4-Methylphenol	106445	µg l-1	N	<0.50
	4-Nitroaniline	100016	µg l-1	N	<0.50
	4-Nitrophenol	100027	µg l-1	N	<0.50

[1]The sample container/fill level was not appropriate for the specified analysis - these results may be compromised. The accreditation for these results remains unaffected.

All tests undertaken between 01/03/2013 and 08/03/2013
* Accreditation status
This report should be interpreted in conjuction with the notes on the accompanying cover page.

Appendix 4. CLEA v0.6 Risk Assessment

CLEA Software Version 1.06

Report generated	02-Apr-13
Report title	Gas House, Sandy Lane, Hilgary, Norfolk.
Created by	Mr A Grimmer at Borough Council of King's Lynn and West Norfolk

Environment Agency

RESULTS

Environment Agency

		Assessment Criterion (mg kg^{-1})			Ratio of ADE to HCV			Saturation Limit (mg kg^{-1})	50% rule?	
		oral	inhalation	combined	oral	inhalation	combined		Oral	Inhal
1	Arsenic	4.06E+02	9.70E+02	NR	1.00	0.42	NR	NR	No	No
2	Benz[a]anthracene	1.28E+02	1.61E+02	NR	1.00	0.79	NR	1.03E+01 (sol)	No	No
3	Benzo[a]pyrene	1.85E+01	3.32E+01	NR	1.00	0.56	NR	5.46E+00 (vap)	No	No
4	Benzo[b]fluoranthene	1.31E+02	2.35E+02	NR	1.00	0.56	NR	7.29E+00 (sol)	No	No
5	Chrysene	1.85E+02	3.12E+02	NR	1.00	0.59	NR	2.64E+00 (vap)	No	No
6	Dibenz[ah]anthracene	1.67E+01	2.93E+01	NR	1.00	0.57	NR	2.36E-02 (vap)	No	No
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Environment Agency

	Assessment Criterion (mg kg^{-1})			Ratio of ADE to HCV			Saturation Limit (mg kg^{-1})	50% rule?	
	oral	inhalation	combined	oral	inhalation	combined		Oral	Inhal
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Environment Agency

		Soil Distribution				Media Concentrations													
		Sorbed	Dissolved	Vapour	Total	Soil	Soil gas	Indoor Dust	Outdoor dust at 0.8m	Outdoor dust at 1.6m	Indoor Vapour	Outdoor vapour at 0.8m	Outdoor vapour at 1.6m	Green vegetables	Root vegetables	Tuber vegetables	Herbaceous fruit	Shrub fruit	Tree fruit
		%	%	%	%	mg kg^{-1}	mg m^{-3}	mg kg^{-1}	mg m^{-3}	mg m^{-3}	mg m^{-3}	mg m^{-3}	mg m^{-3}	mg kg^{-1} FW	mg kg^{-1} FW	mg kg^{-1} FW	mg kg^{-1} FW	mg kg^{-1} FW	mg kg^{-1} FW
1	Arsenic	99.9	0.1	0.0	100.0	4.06E+02	NR	2.03E+02	1.73E-07	0.00E+00	0.00E+00	0.00E+00	0.00E+00	NA	NA	NA	NA	NA	NA
2	Benz[a]anthracene	100.0	0.0	0.0	100.0	1.28E+02	1.49E-03	6.38E+01	5.43E-08	0.00E+00	1.44E-06	1.69E-07	0.00E+00	NA	NA	NA	NA	NA	NA
3	Benzo[a]pyrene	100.0	0.0	0.0	100.0	1.85E+01	7.26E-06	9.25E+00	7.88E-09	0.00E+00	9.58E-09	1.81E-08	0.00E+00	NA	NA	NA	NA	NA	NA
4	Benzo[b]fluoranthene	100.0	0.0	0.0	100.0	1.31E+02	7.39E-05	6.57E+01	5.59E-08	0.00E+00	9.66E-08	1.41E-07	0.00E+00	NA	NA	NA	NA	NA	NA
5	Chrysene	100.0	0.0	0.0	100.0	1.85E+02	3.08E-04	9.25E+01	7.88E-08	0.00E+00	3.96E-07	2.81E-07	0.00E+00	NA	NA	NA	NA	NA	NA
6	Dibenz[ah]anthracene	100.0	0.0	0.0	100.0	1.67E+01	1.39E-05	8.33E+00	7.09E-09	0.00E+00	1.72E-08	1.31E-08	0.00E+00	NA	NA	NA	NA	NA	NA
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Environment Agency

	Soil Distribution				Media Concentrations													
	Sorbed	Dissolved	Vapour	Total	Soil	Soil gas	Indoor Dust	Outdoor dust at 0.8m	Outdoor dust at 1.6m	Indoor Vapour	Outdoor vapour at 0.8m	Outdoor vapour at 1.6m	Green vegetables	Root vegetables	Tuber vegetables	Herbaceous fruit	Shrub fruit	Tree fruit
	%	%	%	%	mg kg^{-1}	mg m^{-3}	mg kg^{-1}	mg m^{-3}	mg m^{-3}	mg m^{-3}	mg m^{-3}	mg m^{-3}	mg kg^{-1} FW	mg kg^{-1} FW	mg kg^{-1} FW	mg kg^{-1} FW	mg kg^{-1} FW	mg kg^{-1} FW
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CLEA Software Version 1.06 Report generated 2-Apr-13 Page 6 of 11

Environment Agency

		Average Daily Exposure (mg kg^{-1} bw day^{-1})							Distribution by Pathway (%)							
		Direct soil ingestion	Consumption of homegrown produce and attached soil	Dermal contact with soil and dust	Inhalation of dust	Inhalation of vapour	Background (oral)	Background (inhalation)	Direct soil ingestion	Consumption of homegrown produce and attached soil	Dermal contact with soil and dust	Inhalation of dust	Inhalation of vapour (indoor)	Inhalation of vapour (outdoor)	Background (oral)	Background (inhalation)
1	Arsenic	2.58E-04	0.00E+00	4.16E-05	8.37E-07	0.00E+00	0.00E+00	0.00E+00	85.88	0.00	13.84	0.28	0.00	0.00	0.00	0.00
2	Benz[a]anthracene	8.13E-05	0.00E+00	5.67E-05	2.63E-07	1.17E-07	1.03E-06	1.94E-07	58.72	0.00	41.01	0.19	0.08	0.00	0.00	0.00
3	Benzo[a]pyrene	1.18E-05	0.00E+00	8.22E-06	3.82E-08	8.43E-10	1.90E-06	1.06E-07	58.76	0.00	41.04	0.19	0.00	0.00	0.00	0.00
4	Benzo[b]fluoranthene	8.36E-05	0.00E+00	5.84E-05	2.71E-07	8.35E-09	1.90E-06	2.29E-07	58.76	0.00	41.04	0.19	0.01	0.00	0.00	0.00
5	Chrysene	1.18E-04	0.00E+00	8.22E-05	3.82E-07	3.31E-08	1.90E-06	2.99E-07	58.76	0.00	41.04	0.19	0.02	0.00	0.00	0.00
6	Dibenz[ah]anthracene	1.06E-05	0.00E+00	7.40E-06	3.43E-08	1.44E-09	6.90E-07	5.81E-07	58.76	0.00	41.04	0.19	0.01	0.00	0.00	0.00
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Environment Agency

	Average Daily Exposure (mg kg^{-1} bw day^{-1})							Distribution by Pathway (%)							
	Direct soil ingestion	Consumption of homegrown procuce and attached soil	Dermal contact with soil and dust	Inhalation of dust	Inhalation of vapour	Background (oral)	Background (inhalation)	Direct soil ingestion	Consumption of homegrown produce	Dermal contact with soil and dust	Inhalation of dust	Inhalation of vapour (indoor)	Inhalation of vapour (outdoor)	Background (oral)	Background (inhalation)
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Environment Agency

		Oral Health Criteria Value (µg kg^{-1} BW day^{-1})		Inhalation Health Criteria Value (µg kg^{-1} BW day^{-1})		Oral Mean Daily Intake (µg day^{-1})	Inhalation Mean Daily Intake (µg day^{-1})	Air-water partition coefficient (K_{aw}) (cm^3 cm^{-3})	Coefficient of Diffusion in Air (m^2 s^{-1})	Coefficient of Diffusion in Water (m^2 s^{-1})	log K_{oc} (cm^3 g^{-1})	log K_{ow} (dimensionless)	Dermal Absorption Fraction (dimensionless)	Soil-to-dust transport factor (g g^{-1} DW)	Sub-surface soil to indoor air correction factor (dimensionless)	Relative bioavailability via soil ingestion (unitless)	Relative bioavailability via dust inhalation (unitless)
1	Arsenic	ID	0.3	ID	0.002	NR	NR	NR	NR	NR	NR	NR	0.03	0.5	1	1	1
2	Benz[a]anthracene	ID	0.138	ID	0.00048	0.06	0.011	3.16E-05	4.60E-06	3.80E-10	4.89	5.91	0.13	0.5	1	1	1
3	Benzo[a]pyrene	ID	0.02	ID	0.00007	0.11	0.006	1.76E-06	4.38E-06	3.67E-10	5.11	6.18	0.13	0.5	1	1	1
4	Benzo[b]fluoranthene	ID	0.142	ID	0.0005	0.11	0.013	2.05E-06	4.36E-06	3.62E-10	5.02	6.08	0.13	0.5	1	1	1
5	Chrysene	ID	0.2	ID	0.0007	0.11	0.017	3.18E-06	4.57E-06	3.77E-10	4.74	5.73	0.13	0.5	1	1	1
6	Dibenz[ah]anthracene	ID	0.018	ID	0.000063	0.04	0.033	5.40E-06	4.08E-06	3.40E-10	5.27	6.38	0.13	0.5	1	1	1
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Environment Agency

	Oral Health Criteria Value (µg kg^{-1} BW day^{-1})		Inhalation Health Criteria Value (µg kg^{-1} BW day^{-1})		Oral Mean Daily Intake (µg day^{-1})	Inhalation Mean Daily Intake (µg day^{-1})	Air-water partition coefficient (K_{aw}) (cm^3 cm^{-3})	Coefficient of Diffusion in Air (m^2 s^{-1})	Coefficient of Diffusion in Water (m^2 s^{-1})	log K_{oc} (cm^3 g^{-1})	log K_{ow} (dimensionless)	Dermal Absorption Fraction (dimensionless)	Soil-to-dust transport factor (g g^{-1} DW)	Sub-surface soil to indoor air correction factor (dimensionless)	Relative bioavailability via soil ingestion (unitless)	Relative bioavailability via dust inhalation (unitless)
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Environment Agency

		Soil-to-water partition coefficient ($cm^3 g^{-1}$)	Vapour pressure (Pa)	Water solubility ($mg L^{-1}$)	Soil-to-plant concentration factor for green vegetables (mg g^{-1} plant DW or FW basis over mg g^{-1} DW soil)	Soil-to-plant concentration factor for root vegetables (mg g^{-1} plant DW or FW basis over mg g^{-1} DW soil)	Soil-to-plant concentration factor for tuber vegetables (mg g^{-1} plant DW or FW basis over mg g^{-1} DW soil)	Soil-to-plant concentration factor for herbaceous fruit (mg g^{-1} plant DW or FW basis over mg g^{-1} DW soil)	Soil-to-plant concentration factor for shrub fruit (mg g^{-1} plant DW or FW basis over mg g^{-1} DW soil)	Soil-to-plant concentration factor for tree fruit (mg g^{-1} plant DW or FW basis over mg g^{-1} DW soil)
1	Arsenic	5.00E+02	NR	1.25E+06	0.00043 fw	0.0004 fw	0.00023 fw	0.00033 fw	0.0002 fw	0.0011 fw
2	Benz[a]anthracene	2.70E+03	1.24E-06	3.80E-03	model	model	model	model	model	model
3	Benzo[a]pyrene	4.48E+03	2.00E-08	3.80E-03	model	model	model	model	model	model
4	Benzo[b]fluoranthene	3.64E+03	6.34E-08	2.00E-03	model	model	model	model	model	model
5	Chrysene	1.91E+03	4.52E-08	2.00E-03	model	model	model	model	model	model
6	Dibenz[ah]anthracene	6.48E+03	1.66E-10	6.00E-04	model	model	model	model	model	model
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Environment Agency

	Soil-to-water partition coefficient ($cm^3 g^{-1}$)	Vapour pressure (Pa)	Water solubility ($mg L^{-1}$)	Soil-to-plant concentration factor for green vegetables (mg g^{-1} plant DW or FW basis over mg g^{-1} DW soil)	Soil-to-plant concentration factor for root vegetables (mg g^{-1} plant DW or FW basis over mg g^{-1} DW soil)	Soil-to-plant concentration factor for tuber vegetables (mg g^{-1} plant DW or FW basis over mg g^{-1} DW soil)	Soil-to-plant concentration factor for herbaceous fruit (mg g^{-1} plant DW or FW basis over mg g^{-1} DW soil)	Soil-to-plant concentration factor for shrub fruit (mg g^{-1} plant DW or FW basis over mg g^{-1} DW soil)	Soil-to-plant concentration factor for tree fruit (mg g^{-1} plant DW or FW basis over mg g^{-1} DW soil)
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Appendix 5. Integrated Exposure uptake Biokinetic Model

LEAD MODEL FOR WINDOWS Version 1.1

==========

Model Version: 1.1 Build11
User Name:
Date:
Site Name:
Operable Unit:
Run Mode: Research

==========

****** Air ******

Indoor Air Pb Concentration: 30.000 percent of outdoor.
Other Air Parameters:

Age	Time Outdoors (hours)	Ventilation Rate (m^3/day)	Lung Absorption (%)	Outdoor Air Pb Conc (µg Pb/m^3)
.5-1	1.000	2.000	32.000	0.100
1-2	2.000	3.000	32.000	0.100
2-3	3.000	5.000	32.000	0.100
3-4	4.000	5.000	32.000	0.100
4-5	4.000	5.000	32.000	0.100
5-6	4.000	7.000	32.000	0.100
6-7	4.000	7.000	32.000	0.100

****** Diet ******

Age	Diet Intake(µg/day)
.5-1	2.260
1-2	1.960
2-3	2.130
3-4	2.040
4-5	1.950
5-6	2.050
6-7	2.220

****** Drinking Water ******

Water Consumption:

Age	Water (L/day)
.5-1	0.200
1-2	0.500
2-3	0.520
3-4	0.530
4-5	0.550
5-6	0.580
6-7	0.590

Drinking Water Concentration: 4.000 µg Pb/L

****** Soil & Dust ******

Multiple Source Analysis Used
Average multiple source concentration: 1200.000 µg/g

Mass fraction of outdoor soil to indoor dust conversion factor: 0.700
Outdoor airborne lead to indoor household dust lead concentration: 100.000
Use alternate indoor dust Pb sources? No

Age	Soil (µg Pb/g)	House Dust (µg Pb/g)
.5-1	1700.000	1200.000
1-2	1700.000	1200.000
2-3	1700.000	1200.000
3-4	1700.000	1200.000
4-5	1700.000	1200.000
5-6	1700.000	1200.000
6-7	1700.000	1200.000

****** Alternate Intake ******

Age	Alternate (µg Pb/day)
.5-1	0.000
1-2	0.000
2-3	0.000
3-4	0.000
4-5	0.000
5-6	0.000
6-7	0.000

****** Maternal Contribution: Infant Model ******

Maternal Blood Concentration: 1.000 µg Pb/dL

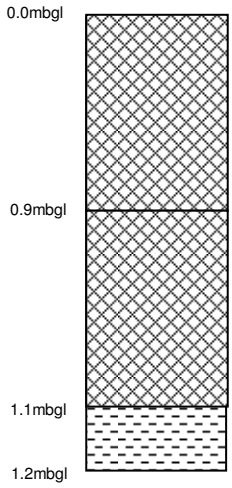
****
CALCULATED BLOOD LEAD AND LEAD UPTAKES:
****

Year	Air (µg/day)	Diet (µg/day)	Alternate (µg/day)	Water (µg/day)
.5-1	0.021	0.817	0.000	0.289
1-2	0.034	0.673	0.000	0.687
2-3	0.062	0.763	0.000	0.745
3-4	0.067	0.760	0.000	0.789
4-5	0.067	0.793	0.000	0.895
5-6	0.093	0.864	0.000	0.978
6-7	0.093	0.954	0.000	1.014

Year	Soil+Dust (µg/day)	Total (µg/day)	Blood (µg/dL)
.5-1	26.272	27.400	14.1
1-2	39.633	41.027	16.4
2-3	41.358	42.928	15.5
3-4	42.980	44.595	15.1
4-5	34.788	36.543	12.7
5-6	32.431	34.366	10.8
6-7	31.232	33.294	9.5

Appendix 5. Borehole Logs

Hand Auger 1

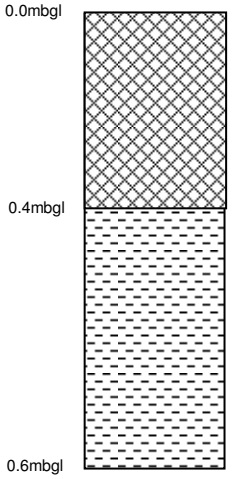


Turf over MADE GROUND. Brown slightly gravelly clayey SAND. Gravel is of occasional fine to medium sub-angular to sub-rounded flint and occasional fine brick ash coke and chalk.

MADE GROUND. Orange brown gravelly clayey SAND. Gravel is of fine to medium flint, ash and coke.

Soft orange brown sandy gravelly CLAY. Gravel is of fine flint, quartzite and chalk.

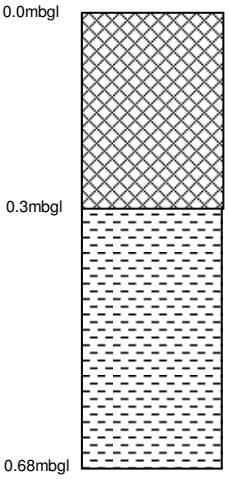
Hand Auger 2



Turf over MADE GROUND. Brown slightly gravelly clayey SAND. Gravel is of occasional fine to medium sub-angular to sub-rounded flint and occasional fine brick and ash.

Soft to firm orange brown grey slightly sandy slightly gravelly CLAY. Gravel is of fine chalk.

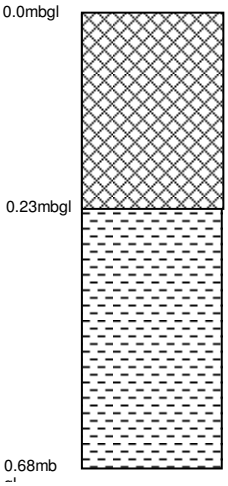
Hand Auger 3



Turf over MADE GROUND. Brown gravelly sandy CLAY. Gravel is of fine to medium, angular to sub-rounded flint and occasional fine brick and ash.

Soft to firm mottled orange brown/grey slightly sandy slightly gravelly CLAY. Gravel is of fine to medium angular to sub-rounded flint. and occasional fine to medium chalk

Hand Auger 4



Turf over MADE GROUND. Brown slightly gravelly sandy CLAY. Gravel is of fine to medium, angular to sub-rounded flint and occasional fine brick and ash.

Soft to firm mottled orange brown/grey slightly sandy slightly gravelly CLAY. Gravel is of fine to medium angular to sub-rounded flint. and occasional fine to medium chalk

Hand Auger 5

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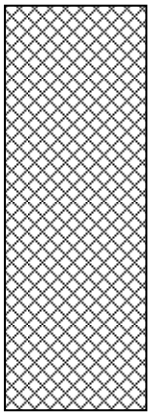

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Turf over MADE GROUND. Brown slightly sandy gravelly CLAY. Gravel is of occasional fine to medium sub-angular to sub-rounded flint and occasional waste material (crisp packets).