

Ref: C8510A

SOILS

4

Sample No:	Depth	Sample Description	pH	SO ₃	S ²⁻	Total Cu	Free Cu	Phenol	Cl ⁻	NO ₃ ⁻	Fol X	Avail Zn	Zn	Total Cd	Pb	As	Organic Content %	Total Tar	H ₂ O Sol. SO ₃ g/litre
U1/1	0.3	Grey/black/grey/gravelly soil.	7.60	580	<1	<1	<1	<1	<10	<50	5,000	35	92	2.0	115	15	13.3	1190	-
/2	1.6	Orange/brown sand.	7.35	70	<1	<1	<1	<1	<10	<50	1,300	2	27	0.7	15	2	10.0	-	-
/3	2.8	Orange sand.	7.23	40	<1	<1	<1	<1	<10	<50	1,700	<1	11	0.7	15	1	10.0	-	-
U2/1	0.7	Brown/grey clay soil & gravel.	7.17	350	<1	1	<1	<1	<10	<50	3,100	-	-	-	-	-	14.5	-	-
/2	1.8	Orange/brown clay/sand	6.76	250	<1	<1	<1	<1	<10	<50	1,500	-	-	-	-	-	13.3	-	-
/3	2.4	Orange sand.	6.96	280	<1	<1	<1	<1	<10	<50	1,200	-	-	-	-	-	3.7	-	-
X1/1	1.5	Brown/orange sand. Some clay.	7.91	420	<1	<1	<1	<1	<10	<50	2,900	-	-	-	-	-	3.3	-	-
/2	2.7	Dark brown stoney sand.	7.98	1,120	<1	<1	<1	<1	<10	<50	2,100	-	-	-	-	-	15.3	-	-
X3/1	0.6	Black grey gravelly soil. Coke.	7.46	2,050	<1	<1	<1	<1	<10	<50	5,700	-	-	-	-	-	25.8	600	-
X4/1	0.5	Black grey gravelly soil.	7.82	1,870	<1	<1	<1	<1	<10	<50	2,300	76	430	3.2	890	51	14.6	-	-
/2	2.0	Dark brown clay/sandy soil.	7.43	560	<1	<1	<1	<1	<10	<50	1,700	20	35	1.6	90	14	3.4	-	-
/3	2.0	Purple greeney soil.	7.5	25	<1	1	<1	<1	<10	<50	1,600	21	125	2.7	90	46	14.3	-	-
/4	3.2	Orange sand.	7.25	295	<1	<1	<1	<1	<10	<50	1,400	1	32	1.1	20	1	5.9	-	-
X5/1	0.25	Grey/black soil/gravel.	3.9 ^B	1,575	<1	29	20	<1	<10	<50	8,900	-	-	-	-	-	13.4	2200	-
/2	1.9	Purple/ brown gravelly soil.	7.26	4,850	<1	9	4	<1	<10	<50	2,400	-	-	-	-	-	18.3	-	-
/3	3.4	Brown/ orange gravelly soil.	4.76	560	<1	12	5	<1	<10	<50	2,000	-	-	-	-	-	12.9	-	-

/continued.....

Ref: C8501A

SOILS

.5

Sample No:	Depth	Sample Description	pH	SO ₃	S ²⁻	Total Cn	Free Cn	Phenol	Cl ⁻	El. S	Col X	Avail Zn	Zn	Total Cd	Pb	As	Moisture Content (% wt)	Coal Tar	H ₂ O Sol SO ₃ g/litre
X7/1	0.2	Lt. Brown gravel in sandy soil.	7.10	350	<1	<1	<1	<1	<10	<50	14,100	-	-	-	-	-	10.5	2100	-
/2	1.8	Orange sand.	7.43	290	<1	<1	<1	<1	<10	<50	1,000	-	-	-	-	-	10.0	-	-
/3	0.9	Brown/yellow slightly clayey sand.	7.29	380	<1	<1	<1	<1	<10	<50	9,100	-	-	-	-	-	11.1	1400	-
/4	2.6	Brown/orange slightly clayey sand.	7.04	110	<1	<1	<1	<1	<10	<50	7,700	-	-	-	-	-	12.0	1200	-



**DETAILED ASSESSMENT
REPORT**

**SEVENOAKS HOLDER STATION,
CRAMPTONS ROAD, SEVENOAKS, KENT**

Reference No. 910547

Mentor No. 11090

July 2001

**DETAILED ASSESSMENT
REPORT**

**SEVENOAKS HOLDER STATION,
CRAMPTONS ROAD, SEVENOAKS, KENT**

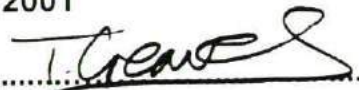
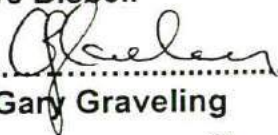
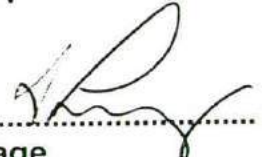
Reference No. 910547

Mentor No. 11090

July 2001

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Report Title	:	Detailed Assessment Report: Sevenoaks Holder Station, Cramptons Road, Sevenoaks, Kent
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Date	:	July 2001
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CONTENTS

Page

EXECUTIVE SUMMARY

SECTION 1

INTRODUCTION

1	Introduction	4
1.1	General	4
1.2	Report Format	4

SECTION 2

SITE AREA

2	Site area	6
2.1	Site Location and Description	6
2.2	Site Walkover	7

SECTION 3

SITE INVESTIGATION

3	Site investigation	
3.1	On Site Activities	9
3.2	Ground Conditions	9
3.3	Scheduled Chemical Analyses	10
3.4	Scheduled Geotechnical Analyses	11

SECTION 4

ENVIRONMENTAL ASSESSMENT

4	Environmental Assessment	
4.1	Assessment Criteria	14
4.2	Quality Control	14
4.3	Findings	15
4.4	Risks from Off-site Sources	22

SECTION 5

REMEDIATION

5	Remediation	
5.1	Remedial Measures with Respect to Statutory Liability (Tadco Environmental Issue)	24
5.2	Remedial Measures in Respect to Non-Statutory (Development) Issues (Transco/Spectrasite JV Issue)	24
5.3	Geotechnical Considerations	24

SECTION 6

CONCLUSIONS AND RECOMMENDATIONS

6	Conclusions and Recommendations	
6.1	Conclusions	26
6.2	Recommendations	26

FIGURES

- Figure 1 Site Location Plan
- Figure 2 Site Layout and Exploratory Hole Location Plan

APPENDICES

- Appendix A Photographs
- Appendix B Site Investigation Logs and Site Monitoring Reports
- Appendix C Analytical Results & Further Laboratory Information
- Appendix D Geotechnical Results
- Appendix E Desk Top Assessment & Original Greenline Plan
- Appendix F Historical Information



EXECUTIVE SUMMARY

EXECUTIVE SUMMARY

SpectraSite Transco Communications Limited (SST) has commissioned Parsons Brinckerhoff Ltd (PB) to undertake an intrusive ground investigation of the Greenline Area at Sevenoaks Holder Station, Cramptons Road, Sevenoaks, Kent, TN14 5DY. This report describes the investigation undertaken and provides a detailed assessment of the environmental conditions and associated potential risks, on behalf of SST, and documents what remedial action or other measures, and associated costs of such action, are recommended to practically and appropriately minimise potential liabilities to Tadco in relation to contaminated land, soil and water which would otherwise be present prior to transfer of the site to the SST joint venture company.

Current Site Status	Gas storage and distribution, proposed Greenline area disused.
Site Investigation Details	The investigation comprised the excavation of 2 No. trial pits and 1 No. borehole with associated soil and groundwater sampling. Trial pits and boreholes were excavated to investigate ground and groundwater conditions, together with any historical structures present.
Environmental Assessment	<p>Following analysis of soil samples obtained during the investigation and comparison of the results with relevant screening criteria it is considered that concentrations of cyanide identified in the shallow Made Ground on site potentially pose a significant risk to human health and the environment. It is, therefore, concluded that there is a moderate statutory risk arising from the site to the SpectraSite-Transco joint venture. However, associated risks could be mitigated as recommended below.</p> <p>The former tanks at the southern boundary of the greenline area were not encountered during the investigation and are not thought to pose a significant risk to the proposed development of the site. However, it would be considered prudent to bear in mind that the tank foundations may remain (as shown in trial pit TP1), and these should be removed as part of the construction phase.</p> <p>Following the analysis of soil samples from the Natural Ground and the analysis of a groundwater sample obtained during the investigation, it is considered that identified contamination in the groundwater and sand and gravel aquifer derives from a combination of off and on site sources. The potential risk of a liability to Tadco with regard to statutory risks from contamination encountered in the Natural Ground and groundwater is, therefore, considered to be moderate. Additional constraints to the development of the site might be posed by aggressive ground conditions encountered during the site investigation. It is recommended that this be taken into consideration during the design of future foundation structures.</p>
Geotechnical Assessment	<p>The presence of surface Made Ground to some 1.8m to 2.2m depth, together with the presence of old footings extending to 1.35m depth and the underlying presence locally of topsoil / subsoil extending to some 2.8m depth, makes prevailing ground conditions unsuitable at this particular location for the proposed raft slab to be simply placed in the near surface soils. As such there are essentially two options at this location, as follows:</p> <p>(a). construct the raft slab on a granular (or stone) mattress; or (b). resort to a piled foundation</p>
Recommendations and development issues/costs*	<p>In order to mitigate the site from statutory liabilities associated with significant cyanide concentrations in the shallow Made Ground, it is recommended that areas of cyanide contamination in the soil are removed and replaced with inert material to a depth of 0.5m below ground level. In addition it is recommended that a layer of gravel be placed in accessible areas to minimise human contact with elevated PAH concentrations in the Made Ground.</p> <p>Budget costs for the recommended remedial works are estimated at approximately £4,500. Construction costs (removal of soils and instatement of a layer of gravel) would be in the region of £3,000-4,000. The above costs do not include for contractors set up, overhead and profit and can only be regarded as provisional estimates based on currently available data obtained from the ground investigation.</p> <p>Following completion of ground water monitoring, it is recommended that borehole BH1 is decommissioned in accordance with the Project Mayflower Guidance Document (August 2000 V6). The estimated cost for this work is £1,500.</p> <p>*Budget costs are given in Table 5.1</p>

This sheet is intended as a summary only of the assessment of the site in relation to ground contamination. It does not provide a definitive engineering analysis.

1 INTRODUCTION

1.1 General

1.1.1 SpectraSite Transco Communications Limited (SST) has commissioned Parsons Brinckerhoff Ltd (PB) to undertake an intrusive ground investigation of the Greenline Area at Sevenoaks Holder Station, Cramptons Road, Sevenoaks, Kent, TN14 5DY, currently owned by Tadco Limited (Tadco).

1.1.2 All work has been undertaken in accordance with the Project Mayflower Guidance Document, unless otherwise stated.

1.1.3 The principal objectives of the investigation were; to identify the nature and extent of potential soil and groundwater contamination; to provide an assessment of environmental risk; to provide preliminary remediation design and cost estimates; and to provide preliminary recommendations for foundation design.

1.1.4 This report describes the investigation undertaken and provides a detailed assessment of the environmental conditions and associated potential risks, on behalf of SST, and documents what remedial action or other measures, and associated costs of such action, are recommended to practically and appropriately minimise potential liabilities to Tadco in relation to contaminated land, soil and water which would otherwise be present prior to transfer of the site to the SST joint venture company on a 99 year lease.

1.2 Report Format

1.2.1 This report includes the following information:

- current site status – including the location and description of on-site and neighbouring development;
- site geology, hydrogeology and hydrology;
- site history including a review of available historic information;
- site investigation summary including logs, field and laboratory data;
- an environmental assessment of the soils and water encountered;
- comment on potential liabilities;
- proposal for site remediation and mast foundation.

2 SITE AREA

2.1 Site Location and Description

Table 2.1: Site Information	
Site Address	Sevenoaks Holder Station, Cramptons Road, Sevenoaks, Kent, TN14 5DY.
Telephone Number	-
National Grid Reference	TQ 547168
Reference Number	910547
Mentor Number	11090
Greenline Plan Number	V1. 02/08/00
General Environment	<p>The Greenline area is situated in the south eastern corner of a Transco gas holder and distribution compound. (See figure 1 & Greenline plan in Appendix E). The surrounding land uses comprises:</p> <ul style="list-style-type: none"> • North – Open ground and gravel pit beyond Otford Road; • North East – Residential housing and Vestry industrial estate beyond gas holder station; • South – Commercial / industrial estate and residential housing, • West – Open ground of Sevenoaks Wildfowl Reserve and East Lake beyond Otford Road, • East – Residential housing beyond gas holder station.
Current Site Use	Gas storage and distribution, proposed Greenline area disused.
Proposed Site Use	The erection of a third generation mobile telephone telecommunication radio tower is proposed within the Greenline area.
Site Access	Access to the gas holder station is gained via locked gates in the car park of the industrial estate (DIY centre at time of writing) off Otford Road.
Site Topography	The gas holder compound is generally level, with the gas holder base, north of the Greenline area, lying approximately 2.0m below the rest of the site.
Ground Cover	The cover within the Greenline area comprises mainly concrete hardstanding with patchy grass, scrub, and loose chippings on the eastern margin. The rest of the gas holder station is covered by a mixture of hardstanding, gravel and grass, some areas of tipped rubble are also present.
Plant and Equipment	An above ground gas holder with valve pit lies directly to the north of the Greenline area. An above road pedestrian gantry links the site to a second gas storage and distribution compound to the east.
Site History	Limited historical plans suggest that the current gas distribution compound and Greenline area formed part of a Gasworks since before 1909 and until 1960-64 when the gasworks was decommissioned. The historical Gasworks site extended beyond the current gas holder compound site

	<p>boundary, to the south and south east.</p> <p>In 1909, three gas holders were present within the old gasworks boundary located to the west and south west of the Greenline area. Historical information from 1936 shows that the southerly most holder has been removed and a new, larger third holder built in the northern corner of the site immediately north of the Greenline area. The gasworks to the south of the current gas holder compound shows expansion at this time, with 6 undesignated tanks and other structures associated with increasing gas production. Immediately to the south of the Greenline area are shown two miscellaneous tanks and a rectangular structure. Plans from 1959 show numerous changes in the overall gasworks layout together with the removal of the tanks mentioned above. The three gas holders are still present.</p> <p>Currently, the gas holder immediately north of the Greenline area is present together with a more recent gas holder and development to the east and north east.</p> <p>The DTA states that a 1997 site survey shows the Greenline to be in an area used as "gas purifying, with several tanks at the southern boundary". these tanks are marked as above ground structures on historic plans and were not encountered during the investigation.</p>
Geology	<p>Made Ground over the Folkestone Beds Formations (sands and gravels) over the Tunbridge Wells Sands (part of the Cretaceous Wealden, Hastings Beds described as yellowish sands with beds of sandstone thickening westwards to 55 to 122m).</p>
Hydrogeology	<p>The Folkestone Beds consist of sands and gravels, with groundwater flow being controlled by intergranular flow. The Folkestone Beds are classified as a Major Aquifer by the Environment Agency and are considered of local importance for public water supply. The deeper Tunbridge Wells Sands are classified as a Minor Aquifer by the Environment Agency and possess an intergranular and fracture flow mechanism.</p>
Hydrology	<p>Drainage within the gas distribution compound is to surface water sewers with oil interceptors.</p> <p>East Lake, part of the Sevenoaks Wildfowl Reserve, lies 100m to the south west of the gas holder compound boundary. Various small drainage features operate within the nature reserve, draining into the lake. The Moors Wood, a local wood and lakeland area lies approximately 250m to the north east of the gas holder compound boundary. The River Darent, a quality D (fair) river lies approximately 600m to the north west of the gas holder compound boundary. A covered reservoir is located approximately 100m to the east of the gas holder site boundary, the hydraulic nature and continuity with local groundwater of this reservoir is unknown.</p>
Services	<p>Service plans provided by Transco are provided in Appendix E.</p>
Environmentally Sensitive Areas in the Vicinity of the Site	<p>Two groundwater abstraction wells lie 500m north of the site. East Lake and the Sevenoaks Wildfowl Reserve are both environmentally sensitive areas in the vicinity of the site. The Moors Wood and lakeland area along with the River Darent are both further possible environmentally sensitive areas, near the site. With the exception of local residential housing and the covered reservoir, there are considered to be no further major environmentally sensitive areas in the vicinity of the site.</p>
Potential Sources of off Boundary Contamination	<p>The completeness of the decommissioning of the gasholder on the western boundary of the Greenline is unknown. No underground tank structures were encountered during investigations within the Greenline area. It is, therefore, possible that the purifying tanks are located just south of the Greenline boundary – thus being a possible source for cross</p>

	boundary migration of contaminants. The historical nature of the Vestry Industrial Estate, located to the of the Greenline area has not been verified, but the possibility of historical contamination associated with past industrial processes exists.
--	--

Table 2.2: Previous Work	
Previous Reports	<p>Stanger (1997), Report - 8440/BGAAT7/jz</p> <p>Harrison (1992), Boundary Survey, Report – C1935/22</p> <p>Alfred McAlpine Homes South Limited (1985), Report on Ground Contamination With Proposed Remedial Measures – Residential Development, Cramptons Road, Sevenoaks.</p>
Summary of DTA	<p>DTA used ref: EO844/SummarySheets/Cons Final/910547FV1.Sevenoaks</p> <p>Exploratory investigations were previously conducted within the Greenline area. Significant levels of contamination (Total Cyanides 900 – 10,000 mg/kg, Phenols at 1200 mg/kg and PAH at 1,000 – 5,000 mg/kg) were identified from below ground tanks and purifier boxes. Remediation, with elevated disposal costs was considered necessary. Spread foundations likely solution.</p> <p>The Risk Rating assigned to Land Ownership within the DTA was MEDIUM.</p> <p>The Risk Rating assigned to Construction/Operation within the DTA was MEDIUM to HIGH.</p>
Information Sources	<p>1:63 360 Geological Survey Sheet 287 Sevenoaks (Solid and Drift Edition)</p> <p>NRA Regional Appendix for the Southern Region.</p> <p>Lattice Property Record Library.</p> <p>Previous Desk top assessment (DTA)</p>

2.2 Site Walkover

Summary of Site Walkover

2.2.1 A site walkover was undertaken prior to investigative work. The inspection was undertaken to identify the present status of the site and identity any issues that might hinder the smooth running of the programme of works, such as vegetation and/or access etc. No such issues were identified at the time of the visit. Site photographs are presented in Appendix A of this report.

2.2.2 During the site visit, no visual contamination was identified at the site.

3 SITE INVESTIGATION

3.1 On Site Activities

- 3.1.1 The investigation comprised the excavation of a total of 2 No. trial pits (TP1 and TP2) using a JCB 3CX excavator and 1 No. borehole (BH1) using a water flush rotary coring drill rig (Pioneer) on 12 March 2001. In addition a piezometer was installed within the borehole to sample groundwater and one trial pit to sample perched water (if any) and land gas. Trial pits were extended until proof of Natural Ground, where possible. The borehole was extended to a maximum of 10m below ground level (bgl). Representative soil samples were collected and submitted for laboratory analyses. Sample collection, storage and analyses were undertaken in accordance with the Project Mayflower Guidance Document.
- 3.1.2 Trial pits and the associated piezometer were located to prove historical structures and to investigate the nature of the Made Ground/Natural Ground and possible water and gas within the Made Ground at the site. The borehole was positioned to monitor the depth and quality of possible groundwater and to assess the geotechnical parameters of sub-surface strata. Trial pit and borehole locations are shown on Figure 2.
- 3.1.3 The location of trial pits along the southern boundary of the site to investigate possible cross boundary underground tanks was not possible due to the suspected presence of extensive underground services in this area.
- 3.1.4 Groundwater and gas monitoring within borehole BH1 and the piezometer (BH2) in trial pit TP2 was undertaken on 12 March 2001. Levels of carbon dioxide, methane and oxygen in both the piezometer and borehole BH1 were recorded. Following purging, groundwater was sampled for laboratory analysis. Measurements of conductivity, dissolved oxygen, pH, and temperature were recorded on site.

3.2 Ground Conditions

- 3.2.1 All ground conditions encountered were logged by an engineer from PB in accordance with the requirements of BS5930 (1999). Photographs of the trial pits and arisings and detailed logs are provided in Appendices A and B respectively. A summary of encountered ground conditions is given below.

Made Ground

- 3.2.2 Made Ground was found to be variable across the site, with concrete hardstanding overlying a brown silt and gravel layer in trial pit TP1 and TP2 and BH1. The thickness of the silt and gravel was found to vary in thickness from around 0.4m in TP1 and BH1 to only 0.1m thick in TP2.
- 3.2.3 A layer of spent oxide, clinker and coke gravel was found to be underlying the silt and gravel to a maximum thickness of 0.9m bgl in TP1 and BH1 and to a shallower depth of 0.4m in TP2. Below this horizon, in BH1 the possible base of an old structure was encountered. In trial pit TP2 dark

sands and gravels were encountered below the layer of spent oxide, clinker and coke, while the same sands and gravel were encountered below the historic foundation structure in borehole BH1. The base of the Made Ground was encountered at 1.8m bgl in TP2 and borehole BH1, with natural sands underlying the sands and gravel.

3.2.4 In trial pit TP1 a gravely sand was found to be underlying the spent oxide, clinker and coke horizon. The base of the Made Ground was not encountered due to the presence of unmarked buried pipework.

3.2.5 Olfactory and visual evidence of contamination within the Made Ground was identified at the following locations:

- Within BH1 broken roofing material and brick fragments were encountered at 0.45m – 0.7m bgl. In addition, a bituminous odour was detected within this material.
- Within all excavations, characteristic blue colouration associated with spent oxide was noted, and a related odour was noted in BH1 and TP1.
- Within TP2, between 0.65m and 1.1m bgl, a strong tar/bituminous odour was noted.

Natural Ground

3.2.4 Natural Ground was identified at a depth of 1.8m bgl in borehole BH1 and trial pit TP2. Directly below the Made Ground, a 0.8m thick band of buried topsoil marked the top of the Natural Ground in TP2, in BH1 the buried topsoil was not encountered. Natural Ground in BH1 and TP2 comprised the slightly gravelly occasionally silty sands (possible Folkestone Beds).

3.2.5 No olfactory or visual evidence of contamination was identified within the Natural Ground.

Groundwater

3.2.6 Groundwater within the Made Ground was not encountered during the site investigation. Groundwater in the Natural Ground was identified during the site investigation and subsequent groundwater monitoring in borehole BH1 at a depth of 3.3m bgl.

3.2.7 Olfactory evidence of contamination in the groundwater sample from borehole BH1 was identified in the form of a weak tarry odour.

Buried Structures

3.2.8 With the exception of a demolished brick structure encountered in the shallow Made Ground of BH1, no other buried structures were encountered.

3.2.9 Previous investigations in the general area of the Greenline identified the presence of significant concentrations of cyanides, phenols and PAH

within "below ground tanks and purifiers". However, no such structures were identified in this investigation.

3.3 Scheduled Chemical Analyses

3.3.1 A total of 7 soil samples were taken during the excavation of the trial pits, together with 9 samples from the borehole excavation. A selected number of samples were scheduled for analysis comprising the following range of determinants:

- BG Suite; comprising contaminants commonly found on former gasworks and coal carbonisation sites, including – total, complex and easily liberatable cyanides, phenolic compounds, metals (arsenic, boron, cadmium, chromium, copper, lead, mercury, nickel, selenium, zinc), polycyclic aromatic hydrocarbons (PAH's), ammonia, sulphate and sulphur.
- Total Petroleum Hydrocarbons (TPH); hydrocarbon compounds in the gasoline and/or diesel range – measured where appropriate.
- Volatile Organic Compounds (VOC's) – common organic solvents including BTEX (Benzene, Toluene, Ethylbenzene, and Xylene) compounds associated with petroleum hydrocarbon contamination – measured where appropriate.

3.3.2 From the soil samples collected during the site investigation 7 were scheduled for analysis of the BG suite, with 1 sample analysed for TPH and VOC due to the presence of hydrocarbon contamination within the soil sample.

3.3.3 One soil sample with moderate contaminant concentrations was subjected to leachability tests, with the leachate being tested for the BG suite and total cyanide to a low detection limit of 1 µg/l (to allow comparison to EQS')

3.3.4 Groundwater was sampled from borehole BH1 on 12 March 2001 and analysed for determinants specified in the BG suite. Additional parameters included total hardness, TPH, VOC and nitrate, with free and complex cyanides being analysed to a detection limit of 1 µg/l.

3.3.5 Monitoring of the piezometer installed in trial pit TP2 did not reveal the presence of groundwater within the Made Ground.

3.3.6 All samples were analysed by Environmental Analysis Limited of Hastings, East Sussex. The laboratory appears on the Lattice Property Holdings approved laboratories list.

3.4 Scheduled Geotechnical Analyses

3.4.1 A total of 8 soil samples were taken for geotechnical purposes during the excavation of the borehole, with a selected number of samples being scheduled for testing comprising the following range of properties:

- Moisture Content, Particle Size Distribution; and
- <425 μ m (silt) fraction.

3.4.2 From the soil samples collected during the site investigation, 1 sample was scheduled for Moisture Content, Particle Size Distribution and <425 μ m (silt) fraction. Due to the ground conditions encountered within the borehole, none of the samples were scheduled for consolidation or triaxial testing (see Section 3.2.9).

4 ENVIRONMENTAL ASSESSMENT

4.1 Assessment Criteria

Soils

4.1.1 Soil contamination levels are assessed in a two tiered Risk Assessment approach in accordance with statutory guidance. The first tier comprises comparison of measured concentrations to screening criteria produced by the DETR (CLEA). Where such standards are not available, reference is made to alternative criteria such as those produced by the Scottish and Northern Ireland Forum For Environmental Research (SNIFFER) or those produced by RIVM (Dutch Intervention Values). Where relevant to the assessment, assumptions made in any alternate criteria are detailed herein.

4.1.2 The second tier comprises the further characterisation of the aforementioned criteria using site-specific factors followed by comparison with Dutch Human Toxicological values, where available (see Table 4.1 and discussion below). This is undertaken in order to assess the risk (non-statutory) to site workers and future site users.

Leachate Tests

4.1.3 Leachability studies were undertaken to assess the leaching potential of contaminants. The advantage of the method is that in combination with measured total contaminant concentrations in the soil they give an indication about the concentrations readily available to the infiltrating soil water, thus quantifying the mobile and immobile contaminant fraction.

Groundwater

4.1.4 Groundwater assessment is undertaken in a tiered approach in accordance with Environment Agency R&D Publication 20 ("Methodology for the Derivation of Remedial Targets for Soil and Groundwater to Protect Water Resources"), with results given in section 4.3. Contaminant concentrations found in the groundwater are compared to a set of screening criteria in each of the assessment tiers.

4.1.5 The hydrogeological and geological properties of the site indicate that both groundwater and surface water are environmentally sensitive receptors of ground and groundwater contamination potentially present on site. With the surface water environment of the East Lake and Moor Wood located in close proximity to the site and the underlying Folkestone Beds classified as a Major Aquifer, both Environmental Quality Standards (EQS) and Drinking Water Standards (DWS) were adopted in this report as the relevant screening criteria for groundwater contamination.

4.2 Quality Control

4.2.1 The data collection, storage and preparation of this report has been undertaken in accordance with PB's Quality Management System which operates within the standards outlined in ISO 9001 (BSI Certificate No. Q06143).

4.2.2 All sample analyses have been undertaken by Environmental Analysis Ltd in accordance with quality control procedures specified in Project Mayflower Guidance Document (August 2000/V6).

4.3 Findings

Soil Contamination

4.3.1 Concentrations of a number of determinands analysed in the soil samples on the site are compared to Dutch Intervention Values (DIV) and Dutch Human Toxicological Values (DHTV) in Table 4.1. The comparison is intended as a screening process to identify areas of possible contamination.

Table 4.1: Summary of Analytical Results for Soils

Determinand	No. of Tests	Max. Concentration (mg/kg)		Dutch Intervention Value		Dutch Human Tox. Value	
		Made Ground ^A		Natural Ground ^B		Made Ground ^A	
		Min	Max.	Value (mg/kg)	No > Value	Value (mg/kg)	No > Value
pH	7	4.0 ^A	7.3 ^A	-	-	-	-
Arsenic	7	8.5 ^A	19.5 ^B	39 ^A 33 ^B	0 0	483 ^A 408 ^B	0 0
Cadmium	7	<0.5 ^{A/B}	<0.5 ^{A/B}	8 ^A 7 ^B	0 0	23 ^A 20 ^B	0 0
Chromium	7	9 ^A	30 ^B	281 ^A 228 ^B	0 0	1665 ^A 1350 ^B	0 0
Copper	7	5 ^B	27 ^A	124 ^A 98 ^B	0 0	10400 ^A 8267 ^B	0 0
Nickel	7	14 ^A	24 ^B	132 ^A 90 ^B	0 0	4149 ^A 2829 ^B	0 0
Lead	7	4 ^B	101 ^A	399 ^A 349 ^B	0 0	226 ^A 198 ^B	0 0
Mercury	7	<0.2 ^{A/B}	0.3 ^A	8 ^A 7 ^B	0 0	162 ^A 145 ^B	0 0
Zinc	7	24 ^A	41 ^B	342 ^A 458 ^B	0 0	35600 ^A 26600 ^B	0 0
Total PAH ^C	7	<0.5 ^B	1864 ^B	8 ^A 8 ^B	2 2	- -	- -
Cresols	7	<0.1 ^{A/B}	<0.1 ^{A/B}	1 ^A 1 ^B	0 0	10 ^A 10 ^B	0 0
Phenol	7	<0.5 ^{A/B}	<0.5 ^{A/B}	8 ^A 8 ^B	0 0	12 ^A 12 ^B	0 0
Easily Liberated Cyanide	7	<1 ^{A/B}	32.4 ^A	20 ^A 20 ^B	1 0	- -	- -
Complex Cyanide	7	<1 ^B	418.1 ^A	50 ^A 50 ^B	2 0	- -	- -

^A Dutch Values for Made Ground calculated for a 12 % clay and 2 % organic matter content, with a pH of 5.75.
^B Dutch Values for Natural Ground calculated for a 5 % clay and 1 % organic matter content, with a pH of 5.03.
^C For 10 priority PAHs.
^D Checked against individual Dutch Human Toxicological Values for 10 PAH.

4.3.2 Dutch Intervention Values and Dutch Human Toxicological values have been adjusted for two different soil types identified during the site investigation: Made Ground comprising a variety of soil types and Natural Ground consisting of clays and sands. Clay and organic carbon

percentages used in the adjustment of the Dutch Values for different soil types are given in the subscript to Table 4.1.

4.3.3 It can be seen in Table 4.1 that the concentrations of most determinands were below the relevant Dutch Intervention Value or the detection limit of the method of analysis. Exceedences of Dutch Intervention Values were, however, found for PAH and free and complex cyanide.

4.3.4 Concentrations of PAH in exceedence of Intervention Values were found in soil samples from the Made Ground in borehole BH1 and trial pit TP2. Concentrations in borehole BH1 were associated with fragments of clinker, while PAH concentrations in the Made Ground in trial pit TP2 were associated with a tarry odour.

4.3.5 Concentrations of cyanide in exceedence of Dutch Intervention Values were identified in borehole BH1 and trial pit TP2 and were associated with the occurrence of spent oxide and clinker. Visual observations made during the site investigation suggest that spent oxide contamination is likely to be relatively continuous across the site. Therefore, there exists the potential for higher concentrations of cyanides than those identified above. There is also the potential that underground tanks containing significant concentrations of cyanides, phenols and PAHs (as identified in a previous investigation) extend across the southern boundary of the site. Investigation of this area was prohibited as described in Section 3.1.3

4.3.6 Concentrations of PAH in exceedence of Intervention Values in the Natural Ground were encountered in borehole BH1 and trial pit TP2 within the sand and gravel (possible Folkestone Beds Formation). The concentrations were not associated with the occurrence of olfactory or visual evidence of contamination in the soil sample and are not considered to be associated with PAH concentrations in the shallow Made Ground.

Leachability Tests

4.3.7 A soil sample considered representative of contamination encountered in the Made Ground (visual/olfactory) was subjected to a leachability test, using standard Mayflower protocol.

4.3.8 The results of these analyses are compared to relevant guidelines in Table 4.2 below.

Table 4.2: Summary of Analytical Results for Leachability Test.

Determinand	Measured Concentration (µg/l)	DWS (µg/l)	No > DWS	EQS (µg/l)	No > EQS
	TP2 0.9m				
pH	7.0	-	-	6.0 – 9.0 ^{BC}	0
Arsenic	<10	50 ^A	0	50 ^B	0
Cadmium	<1.0	5 ^A	0	5.0 ^B	0
Chromium	<10	50 ^A	0	50 ^B	0
Copper	<10	3000 ^A	0	28 ^B	0
Nickel	<10	50 ^A	0	200 ^B	0
Lead	<10	50 ^A	0	20 ^B	0
Mercury	<0.2	1 ^A	0	1 ^B	0

Determinand	Measured Concentration (µg/l)	DWS (µg/l)	No > DWS	EQS (µg/l)	No > EQS
	TP2 0.9m				
Zinc	173.0	5000 ^A	0	125 ^B	1
Benzene	<1	10	0	30	0
Toluene	<1	10	0	50	0
Ethyl Benzene	<1	10	0	30 ^F	0
Xylene	<1	10	0	30	0
Cresols	2.6	0.5 ^{A, D}	1	30 ^{B, D}	0
Phenol	<0.1	0.5 ^A	0	30 ^B	0
Total PAH ^G (Naphthalene)	<1	0.2 -	1 ^E -	- (10 ^B)	- 0
Easily Liberated (free) Cyanide	3200	-	-	1 ^B	1
Complex Cyanide	2200	-	-	-	-
Total Cyanide	5400	50 ^A	1	-	-
Sulphate	437,000	250,000 ^A	1	-	-
Total Ammonium	<100	500 ^A	0	-	-

^A Drinking Water standard taken from the EC Drinking Water Standards (80/778/EEC)

^B DoE Circular 7/89 EQS value for the protection of (salmonid) aquatic life; some values adjusted to take account of total hardness. Total Hardness taken as 50 – 100 mg/L

^C Dimensionless.

^D For comparison purposes the EQS for cresols were assumed to be equal to the EQS for phenol

^E Number of exceedences not known as detection limit is higher than the EQS value

^F For comparison purposes the EQS values for ethyl benzene and complex cyanide were assumed to be equal to the EQS for benzene and free cyanide, respectively.

^G For 10 priority PAHs.

- 4.3.9 Table 4.2 shows that total cyanide, cresol and sulphate were present in the leachate at concentrations exceeding DWS. In addition, concentrations of free cyanide and zinc were noted to be in exceedence of EQS.
- 4.3.10 The occurrence of cyanide indicates that concentrations encountered in the soil potentially pose a risk to underlying water resources. Concentrations of sulphate in the leachate indicate the presence of aggressive ground conditions and are recommended to be taken into account for the development of future foundation structures.
- 4.3.11 The leachability tests also showed that elevated concentrations of PAH in the Made Ground were found to be relatively immobile, with the most mobile fraction, naphthalene, not identified in the leachate above the detection limits.
- 4.3.12 It should be emphasised that leachability tests usually overestimate actual concentrations mobilised by the infiltrating soil water under field conditions due to the rigorous nature of the test. The test, therefore, reveals more about the inability of contaminants to leach from the soil rather than quantifying those contaminants that do leach to some extent. For this reason the actual leaching behaviour of contaminants under field conditions is better assessed by analysing contaminant concentrations in the groundwater beneath the site.

Groundwater Quality

4.3.13 One groundwater sample was recovered from borehole BH1 during monitoring on 12 of March 2001. The sample was analysed according to quality standards described above, with detailed analytical results being provided in Appendix C.

Table 4.3: Summary of Analytical Results for Groundwater

Determinand	Measured Concentration (µg/l)	DWS (µg/l)	No > DWS	EQS (µg/l)	No > EQS
	BH1				
pH	5.8	-	-	6.0 – 9.0 ^{BC}	1
Arsenic	<10	50 ^A	0	50 ^B	0
Cadmium	<1.0	5 ^A	0	5.0 ^B	0
Chromium	<10	50 ^A	0	175 ^B	0
Copper	<10	3000 ^A	0	6 ^B	1 ^E
Nickel	<10	50 ^A	0	100 ^B	0
Lead	<10	50 ^A	0	125 ^B	0
Mercury	<0.2	1 ^A	0	1.0 ^B	0
Zinc	2039	5000 ^A	0	175 ^B	1
TPH	<100	10	1 ^{E,E}	-	-
Benzene	<1	10	0	30	0
Toluene	<1	10	0	50	0
Ethyl Benzene	<1	10	0	30 ^F	0
Xylene	0.5	10	0	30	0
Cresols	<0.1	0.5 ^{A,D}	0	30 ^{B,D}	0
Phenol	<0.1	0.5 ^A	0	30 ^B	0
Total PAH ^G (Naphthalene)	57 (<1)	- -	- -	- (10 ^B)	0 0
Easily Liberated (free) Cyanide	<500	-	-	1 ^B	1 ^E
Complex Cyanide	1400	-	-	-	-
Total Cyanide	1400	50 ^A	1	-	-
Ammonium	4200	500 ^A	1	-	-

^A Drinking Water standard taken from the EC Drinking Water Standards (80/778/EEC)

^B DoE Circular 7/89 EQS value for the protection of aquatic life; some values adjusted to take account of total hardness. Total Hardness taken as +250 mg/L

^C Dimensionless.

^D For comparison purposes the EQS for cresols were assumed to be equal to the EQS for phenol

^E Number of exceedences not known as detection limit is higher than the EQS value

^F For comparison purposes the EQS values for ethyl benzene and complex cyanide were assumed to be equal to the EQS for benzene and free cyanide, respectively.

^G For 10 priority PAHs.

- 4.3.14 Results from groundwater analyses are compared in Table 4.3 against EQS for a freshwater environment and DWS in order to assess the risk (statutory) to the environment.
- 4.3.15 Results from the analysis of groundwater given in Table 4.3 show that concentrations of contaminants in the groundwater exceeding DWS and EQS were identified for free and total cyanide, total ammonium and zinc.
- 4.3.16 Concentrations of cyanide identified in the groundwater are considered to reflect the results from the leachability tests, showing that cyanide concentrations in the Made Ground were potentially leaching at concentrations exceeding relevant quality standards.
- 4.3.17 Concentrations of PAH identified in the groundwater are considered to be associated with elevated PAH concentrations analysed in soil samples from the sands and gravel (possibly of the Folkestone Beds Formation). As no significant source of PAH contamination was identified within the Made Ground on site, it is considered likely that contaminant concentrations in soil samples from the Natural Ground and groundwater on site derive from cross boundary migration of contaminants from the adjacent part of the gasworks site, most notably from possible underground purifier tanks immediately to the south of the study site.
- 4.3.18 It should be noted, however, that there remains the possibility that the underground tanks (with associated contamination) to the south of the site (assuming that they have not been remediated) extend beyond the southern boundary of the site. Therefore, identified groundwater contamination could result, in part, from the presence of these structures within the site boundary.

Gas Emissions

- 4.3.19 The results of land gas monitoring are attached in Appendix B. The measured concentrations of carbon dioxide and methane are not considered to pose a significant risk to the development of the site.

Contamination Sources

- 4.3.20 The following contaminant Sources have been identified in the previous sections and are referred to as follows:

- **Source 1:** General Shallow Made Ground – elevated concentrations of PAH and cyanide.

Source, Pathway, Receptor Assessment

- 4.3.21 The following table lists all potential receptors and assesses likely risks according to a "Source-Pathway-Receptor" approach. Risks are classified as low, moderate or high, with the individual risk categories defined as follows:

- **Low risk** – it is considered unlikely those issues within the category will arise as a liability/cost for the owner of the site.
- **Moderate risk** – it is possible but not certain that issues within the category will arise as a liability/cost for the owner of the site.
- **High risk** – there is a high potential that issues within the category will arise as a liability/cost for the owner of the site.

-
- 4.3.22 Pollutant linkages (i.e. the relationships between source, pathway and receptor) are also placed in a priority order with a score of 1 representing the most significance. For each pollutant linkage, where a source, pathway or receptor does not exist, then there is considered to be no unacceptable risk.
- 4.3.23 Within the following table comment is also made on whether each pollutant linkage is a statutory or non-statutory (development) issue.



SECTION 4
ENVIRONMENTAL ASSESSMENT

DETAILED ASSESSMENT REPORT
SEVENOAKS HOLDER STATION

Table 4.4: Contamination Related Risks

Priority of Linkage	Source	Receptor	Pathway	Current Risk Assessment	Proposed Remedial Action	Residual Risk
1	Source 1 General Made Ground	Groundwater and surface water (Statutory)	Potential for migration of aqueous phase contamination into the underlying groundwater and surface water.	<p>Moderate</p> <p>Identified concentrations of PAH and cyanide within the Made Ground can potentially pose a risk to the underlying groundwater through leaching in the dissolved phase.</p> <p>Leachability studies have shown that total PAH is immobile and is unlikely to leach from the Made Ground in concentrations exceeding DWS and EQS.</p> <p>Cyanides were identified within the Made Ground at the site and there exists the potential for significant concentrations of cyanides, phenols and PAHs within underground structures that may extend under the southern boundary of the site.</p> <p>Cyanide was shown to leach at levels in excess of DWS and EQS. In addition free and total cyanide were found to be in exceedence of DWS and EQS in the groundwater indicating the potential mobilisation of cyanide form the Made Ground on site.</p>	Removal of Made Ground with elevated cyanide concentrations together with removal of underground tanks if encountered during development works.	Low
2	Source 1 General Made Ground	Construction Workers (Non-Statutory)	Ingestion, inhalation or direct contact with contaminated soil	<p>Low to Moderate</p> <p>Possibility of ingestion or inhalation of soils contaminated with PAH and cyanide during construction.</p>	<p>Use of appropriate PPE and good housekeeping during site works will mitigate the risk to site workers during the construction phase.</p> <p>Soil excavated during the construction phase should be stockpiled (sheeted and banded) and tested pending disposal to a suitably licensed landfill.</p>	Low



SECTION 4
ENVIRONMENTAL ASSESSMENT

DETAILED ASSESSMENT REPORT
SEVENOAKS HOLDER STATION

Priority of Linkage	Source	Receptor	Pathway	Current Risk Assessment	Proposed Remedial Action	Residual Risk
2	Source 1 General Made Ground	Future Site Users Commercial End Use (Non-Statutory)	Ingestion, inhalation or direct contact with contaminated soil	Low Possibility of ingestion or inhalation of soils contaminated with PAH and cyanide for site users.	Removal of Made Ground and any encountered underground structures with elevated cyanide concentrations will mitigate potential liabilities associated with cyanide contamination. To mitigate residual risk deriving from PAH concentrations in the Made Ground the installation of hardstanding or a layer of gravel is recommended in accessible areas.	Low
3	Source 1 General Made Ground	Concrete Foundations	Direct contact of structures with soils and/or possible pore water	Moderate to High The analysis of soil samples and results from the leachability study have indicated aggressive ground conditions and high levels of sulphate.	Depending on the development design the use of up to Class 5 concrete might be required during later development stages (see BRE Digest 363).	Low

4.4. Risks from Off-Site Sources

- 4.4.1 The review of historical information has identified several storage and purifier tanks, gas holders and other production facilities in the immediate vicinity of the site. It is likely that grossly contaminated material is still present on the adjacent site and potentially leaching into sand and gravel aquifer.
- 4.4.2 It is, therefore, considered likely that contamination identified in the sand and gravel aquifer and associated groundwater is derived, in part, from cross boundary migration of contaminants from the adjacent part of the gasworks.
- 4.4.3 The former tanks at the southern boundary of the greenline area were not encountered during the investigation and are not thought to pose a significant risk to the proposed development of the site. However, it would be considered prudent to bear in mind that the tank foundations may remain (as shown in trial pit TP1), and these should be removed as part of the construction phase.

5 REMEDIATION

5.1 Remedial Measures with Respect to Statutory Liability (Tadco Environmental Issue)

5.1.1 Concentrations of cyanide identified in the shallow Made Ground on site are considered to potentially pose a significant risk to the environment and human health. It is, therefore, recommended that areas of soil contamination with elevated cyanide concentrations are removed and exchanged for clean material.

5.1.2 In addition, there is the potential that underground structures contaminated with cyanides, phenols and PAHs, extend underneath the southern boundary of the site. If encountered during development excavation works, underground structures will likely need to be removed in order to mitigate possible statutory risks.

5.1.3 Due to the limited number of trial pits excavated during the investigation it is difficult at this stage of the investigation to give accurate estimates of the total volume of soils contaminated with cyanide. However, based on the findings of this investigation soil volumes for remediation of contaminated soils are as follows:-

- Assuming a soil strip of $0.5 \times 12 \times 12 = 72 \text{m}^3$;
- Minus the soil to be removed due to the foundation $0.5 \times 6 \times 6 = 18 \text{m}^3$; and
- Total to be removed and replaced = 54m^3

5.1.4 During development of the site and the duration of remedial works it is recommended that site workers use appropriate PPE for the level of contamination and that good house-keeping practices are observed. The excavated soil material shall be disposed off to a suitable landfill facility. It is also recommended that the site be covered with hardstanding in accessible areas following the remediation to reduce the risks associated with elevated PAH concentrations in the Made Ground. This will also to reduce rainwater infiltration and the potential for mobilisation of soluble contamination.

Estimated Costs

5.1.5 The costs for remediation of the soils not to be removed as part of the construction of the mast foundation are as follows:-

- | | |
|--|---------------|
| • Volume of soil to be remediated = $54 \text{m}^3 @ £50/\text{m}^3$ | £2,700 |
| • Replacement with inert fill = $54 \text{m}^3 @ £30/\text{m}^3$ | £1,800 |
| • Total | £4,500 |

5.1.6 These costs do not include landfill tax duty, contractors set up, supervision, and validation, overhead and profit and they can only be regarded as provisional estimates based on currently available data obtained from the ground investigation.

5.1.7 It is important to note that remedial costs may vary if underground structures (tank foundations) are identified during the development phase.

5.2 Remedial Measures in Respect to Non-Statutory (Development) Issues (Transco/Spectrasite JV Issue)

5.2.1 Remedial measures with regard to statutory issues are considered to automatically mitigate the site from non-statutory liabilities associated with the site. Special care should be taken to the construction and location of future foundations due to the aggressive ground conditions encountered on site.

5.2.2 In order to reduce residual risks associated with elevated PAH concentrations in the Made Ground it is recommended that hardstanding is installed in accessible areas on the site to reduce human contact with contaminated soil.

Estimated Costs

5.2.3 Budget costs for future development of the site are as follows:-

Table 5.1: Budget Development Costs for Statutory and Non-Statutory Development.

	Cost £	Item
Remediation (see Section 5.1.5)	4,500	Removal and Disposal of Made Ground with Elevated Cyanide Concentrations
Construction	3,000-4,000	Removal of contaminated soils and instatement of gravel cover
Borehole Decommissioning	1,500	Decommissioning and Closure

5.2.4 Again, the above costs are not inclusive of contractors set up, supervision, overhead and profit and they can only be regarded as provisional estimates based on currently available data obtained from the ground investigation.

5.3 Geotechnical Considerations

Natural and Artificial Cavities Database Search

5.2.5 A search of the natural cavities database compiled by Parsons Brinckerhoff Ltd's predecessor's (Applied Geology Limited) for the Department of the Environment has identified 1 No record within a 2km radius of the site centre. These recorded a feature - at NGR TQ 521 566, approximately 750m south-west of the site - is made up of an unknown number of fissures encountered during excavation works in a former quarry within the Folkestone Beds. A search of an artificial cavities database also compiled at that time by Parsons Brinckerhoff Ltd's predecessors has identified nil records for the 2km search radius.

Strata Encountered

- 5.3.1 Borehole BH1 has confirmed the general anticipated geology with Made Ground proven to 1.8m depth overlying the Lower Cretaceous aged Folkestone Beds. The Made Ground sequence comprised an upper sequence of brown gravelly sandy silt with a thin layer of broken slates overlying buried brickwork and concrete which was present from 0.92m to 1.35m depth. Beneath this old foundation dark coloured gravelly sand fill was present to 1.85m depth.
- 5.3.2 Natural ground was encountered in BH1 at 1.85m depth and comprised a sequence of brown slightly silty fine and fine to medium sands consistent with the Folkestone Beds. These sands were proven to 7.3m depth. The sands were assessed as moderately compact to compact.
- 5.3.3 Trial pit TP1 proved Made Ground to 1.6m depth where the presence of a buried pipe resulted in the abandonment of the test pit. TP2 again proved Made Ground to 1.8m depth overlying a buried dark fine sand topsoil / subsoil horizon of some 800mm total thickness. Beneath the topsoil/ subsoil horizon, at 2.6m depth, light brown very silty fine sand was present. The logging engineer again assessed these sands to be moderately compact.
- 5.3.4 Earlier trial pits by others (circa 1992) in this area had indicated slightly greater depths of Made Ground with up to 2.2m depth of fill locally identified
- 5.3.5 Both of the trial pits were dry during excavation and no discernible groundwater strikes was noted during the sinking of BH1. The use of water flush to assist casing installation and advancement of the bore below 5.7m will, however, have masked any such strikes. Limited subsequent groundwater monitoring of the standpipe installed in BH1 has shown groundwater standing at 3.345m depth on completion of the installation of the standpipe.

Foundation Considerations

- 5.3.6 The presence of surface Made Ground to some 1.8m to 2.2m depth, together with the presence of old footings extending to 1.35m depth and the underlying presence locally of topsoil / subsoil extending to some 2.8m depth, makes prevailing ground conditions unsuitable at this particular location for the proposed raft slab to be simply placed in the near surface soils. As such there are essentially two options at this location, as follows:
- (a). construct the raft slab on a granular (or stone) mattress; or
 - (b). Resort to a piled foundation

5.3.7 (a). Use of a Granular (Stone) Mattress

This option will entail:

- Excavation of the existing Made Ground and underlying topsoil / subsoil to expose the underlying Folkestone Beds over an extended footprint of the mast foundation (i.e. excavation to a depth in the order of 2.8m)
- Inspection of the exposed Folkestone Beds surface by an experienced geotechnical specialist to confirm suitability of the foundation stratum and to check for the possible presence of natural solution related fissuring.
- Placement then of suitable, imported, granular fill placed and compacted in a controlled exercise to required formation level.
- Construction of the raft foundation slab directly onto the compacted stone.

For design purposes, it is recommended that the allowable bearing pressure assigned to the upper weathered horizons of the Folkestone Beds be limited to 100 kPa. Based on this loading, resultant total and differential settlements should be small (i.e. less than 25mm).

With this option, disposal of excavated arisings will be required. Also, borehole BH1 has identified the presence of old foundations relating to some former gas works building / structure. Available historical information from circa 1959 indicates a possible former building extending into the southeastern corner of the site. In the same location, an earlier plan of circa 1936 indicates the presence of above ground tanks.

The likely requirement to excavate and remove materials to 2.6m depth may well render this option impractical. Consequently, resort to the alternate piled foundation scheme option may be required.

5.3.8 (b). Piled Foundation option

This alternate foundation option would entail sinking piles into the Folkestone Beds. Further investigation would be required to confirm design parameters if this option was to be considered further. The close proximity of residential properties may preclude the use of a driven form of pile on environmental considerations. Consequently, resort to a bored form of pile construction may be required. Consideration could be given to the suitability of the chd (continuous helical displacement) [or screw pile] technique from which essentially 'no spoil arisings occur.

However, irrespective of the piling technique utilised, the presence of buried foundations will likely necessitate advance excavation at proposed pile positions to check for and remove these potential obstructions.

During pile construction, a careful watch should be maintained for any anomalous conditions which may potentially be indicative of the presence of dissolution related fissuring (e.g. Increased concrete takes where bored piles

are used or increased pile lengths required in the case of driven piles). If encountered, specialist geotechnical advice should be sought.

5.4 **Borehole Closure**

- 5.4.1 Following completion of ground water monitoring, it is recommended that borehole BH1 is decommissioned in accordance with the Project Mayflower Guidance Document (August 2000 V6). The estimated cost for this work is £1,500.

6 CONCLUSIONS AND RECOMMENDATIONS

6.1 Conclusions

- 6.1.1 An intrusive ground investigation was undertaken on part of the former gas works site at Sevenoaks Holder Station, Cramptons Road, Sevenoaks, Kent. The investigation comprised the excavation of 2 No. trial pits and 1 No. borehole with associated soil and groundwater sampling.
- 6.1.2 Following analysis of soil samples obtained during the investigation and comparison of the results with relevant screening criteria it is considered that concentrations of cyanide identified in the shallow Made Ground on site potentially pose a significant risk to human health and the environment. It is, therefore, concluded that there is a moderate statutory risk arising from the site to the SpectraSite-Transco joint venture. However, associated risks could be mitigated as recommended below.
- 6.1.3 The former tanks at the southern boundary of the greenline area were not encountered during the investigation and are not thought to pose a significant risk to the proposed development of the site. However, it would be considered prudent to bear in mind that the tank foundations may remain (as shown in trial pit TP1), and this should be taken into account during the construction of the mast.
- 6.1.4 Following the analysis of soil samples from the Natural Ground and the analysis of a groundwater sample obtained during the investigation, it is considered that identified contamination in the groundwater and sand and gravel aquifer derives from a combination of off and on site sources. The potential risk of a liability to Tadco with regard to statutory risks from contamination encountered in the Natural Ground and groundwater is, therefore, considered to be moderate.
- 6.1.5 Additional constraints to the development of the site might be posed by aggressive ground conditions encountered during the site investigation. It is recommended that this be taken into consideration during the design of future foundation structures.

6.2 Recommendations

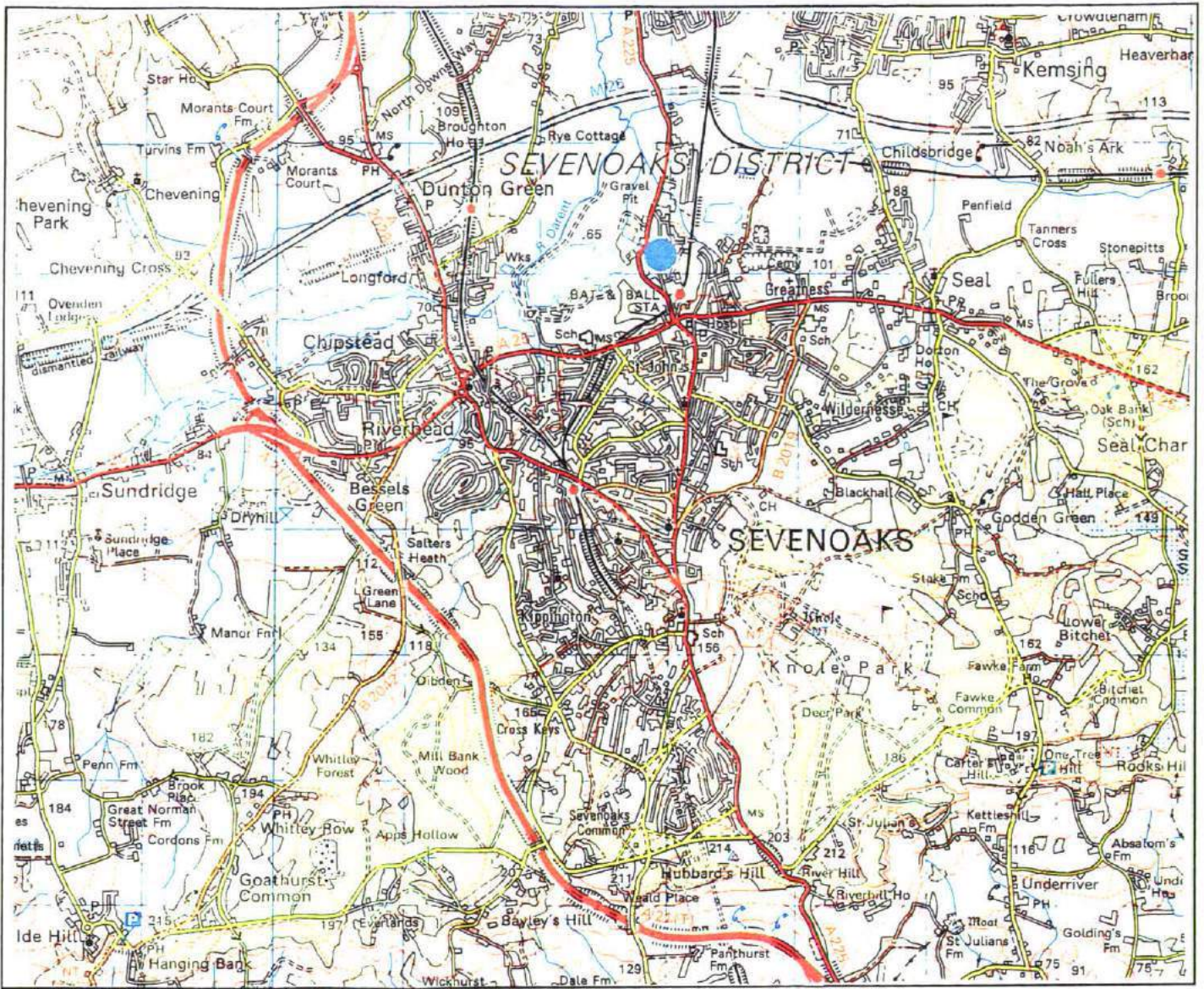
- 6.2.1 In order to mitigate the site from statutory liabilities associated with significant cyanide concentrations in the shallow Made Ground, it is recommended that areas of cyanide contamination in the soil are removed and replaced with inert material to a depth of 0.5m below ground level. In addition it is recommended that a layer of gravel be placed in accessible areas to minimise human contact with elevated PAH concentrations in the Made Ground.
- 6.2.2 Budget costs for the recommended remedial works are estimated at approximately £4,500. Construction costs (removal of soils and instatement of a layer of gravel) would be in the region of £3,000-4,000. The above costs do not include for contractors set up, overhead and profit and can only be

regarded as provisional estimates based on currently available data obtained from the ground investigation.


6.2.3

Following completion of ground water monitoring, it is recommended that borehole BH1 is decommissioned in accordance with the Project Mayflower Guidance Document (August 2000 V6). The estimated cost for this work is £1,500.

FIGURES



Key:-

Site Location 



Parsons Brinckerhoff

Spectrasite Transco Communications Ltd
Former Gasworks
Cramptons Road
Sevenoaks
Kent

Figure 1: Site Location Plan

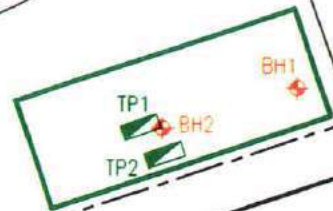
Project No: BEN45066

Scale: 1:50 000




Drawn By: EB

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OTFORD ROAD



KEY

-  GREEN LINE AREA (GLA)
-  BOREHOLE
-  TRIAL PIT

NOTES

1. BASED ON APPROXIMATE FIELD MEASUREMENTS
2. DO NOT SCALE FROM THIS DRAWING



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CLIENT/PROJECT

SPECTRASITE TRANSCO
COMMUNICATIONS LTD
107 CRAMPTONS ROAD,
SEVENOAKS, KENT

TITLE

SITE PLAN SHOWING
EXPLORATORY HOLE LOCATIONS

DATE 17/01/01

SCALE 1:500

CAD REF \BEN\450\66\Z\1
\SEVENOAKS-F02

DRAWN BY BRG

PRODUCED BY BRG

CHECKED

APPROVED

DRAWING NUMBER

FIGURE 2

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APPENDIX A
PHOTOGRAPHS



Photo 1a

Sevenoaks Holder Station – Trial Pit TP1 – View West



Photo 1b

Sevenoaks Holder Station – Arisings Trial Pit TP1 – View South East



Photo 2a

Sevenoaks Holder Station – Trial Pit TP2 – View South



Photo 2b

Sevenoaks Holder Station – Trial Pit TP2 – View ENE of trial pit



Photo 3a

Sevenoaks Holder Station – Bore Hole BH1 – Borehole Arisings

APPENDIX B



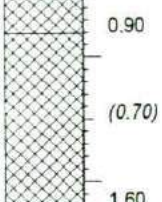
SITE INVESTIGATION LOGS

SITE MONITORING REPORTS

Job No. : **BEN45066**
 Site Name : **Cramptons Road, Sevenoaks**
 Client : **EnvirosAspinwall**

Easting		Start date	12/03/2001
Northing		End date	12/03/2001
Ground level		Backfill date	12/03/2001
Final depth	1.60m	Page	1 of 1

Parsons Brinckerhoff Ltd, Queen Victoria House, Redland Hill, Redland, Bristol BS6 6US Tel. 0117-973-9090 Fax. 0117-923-7479

Samples & Testing					Strata			
Average Vane Strength	Water	Depths		Type	Legend	Depth (Thickness)	Level m AOD	Strata Descriptions
		From	To					
						(0.10)		Concrete hard standing
		0.35	0.35	D		0.10 (0.35)		MADE GROUND comprising (loose) brown gravelly very silty sand. Gravel sub-rounded and medium to coarse. Thin parting of sand at 0.3m
		0.70	0.70	D		0.45 (0.05) 0.50 (0.40)		MADE GROUND comprising (loose) purple black clinker gravel MADE GROUND comprising (loose) yellow brown locally, streaked blue (sand) with occasional broken & intact bricks. Spent oxide odour noted.
		1.40	1.40	D		0.90 (0.70)		MADE GROUND comprising (loose) yellow brown sand becoming slightly gravelly. Pit abandoned at 1.6m bgl due to presence of unknown pipe.
						1.60		

General remarks

- Concrete broken out using pneumatic tools then starter pit hand dug to 1.2m bgl.
- No groundwater encountered.
- Pit abandoned at 1.6m bgl due to presence of buried pipe. 2cm diameter.
- Pit backfilled with materials arising. 50mm HDPE slotted standpipe incorporated. Gas valve and surface cover installed (referenced BH2)

 Plant:
JCB 3CX

 Shoring:
NONE

 Stability:
GOOD

Pit dimensions:


 Width: 0.7m
 Length: 2.5m

Groundwater:

Orientation: 90deg.

Notes:

- Relative densities by visual assessment only
- All dimensions in metres unless otherwise stated

 Checked by: 

Logged by: TG

Job No. : BEN45066
 Site Name : Cramptons Road, Sevenoaks
 Client : EnviroAspinwall

Easting		Start date	12/03/2001
Northing		End date	12/03/2001
Ground level		Backfill date	12/03/2001
Final depth	3.60m	Page	1 of 1

Samples & Testing				Strata				
Average Vane Strength	Water	Depths		Type	Legend	Depth (Thickness)	Level m AOD	Strata Descriptions
		From	To					
						(0.10)		Concrete hard standing
		0.35	0.35	D		0.10 (0.10) 0.20 (0.22) 0.42 (0.23) 0.65		MADE GROUND comprising (loose) brown gravelly very silty sand
						(0.45)		MADE GROUND comprising (moderately compact) blue-black very gravelly coarse sand with broken & whole bricks. Gravel composed of purple-black clinker
		0.90	0.90	D		(0.70)		MADE GROUND comprising (moderate compact) brown-black slightly silty very gravelly sand.
						1.80		MADE GROUND comprising black & brown very gravelly sand. Tar/bituminous odour noted
		1.60	1.60	D		(1.00)		MADE GROUND comprising (loose to moderately compact) brown black gravelly very silty sand
						2.60		(loose) dark brown very silty fine SAND with many fine rootlets (buried topsoil/subsoil).
		2.80	2.80	D		(1.00)		(loose to moderately compact) light brown very silty fine SAND
						3.60		

General remarks

- Concrete broken out using pneumatic tools then starter pit hand dug to 1.2m bgl.
- No groundwater encountered.
- Pit backfilled with materials arising.

Notes:

- Relative densities by visual assessment only
- All dimensions in metres unless otherwise stated


 Plant:
JCB 3CX

 Shoring:
NONE

 Stability:
GOOD

Pit dimensions:

 Width: 0.7m
 Length: 1.9m

 Checked by: 

Groundwater:

Orientation: 90deg.

Logged by: TG

Job No. : BEN45066
 Site Name : Cramptons Road, Sevenoaks
 Client : EnviroAspinwall

Easting		Start date	12/03/2001
Northing		End date	12/03/2001
Ground level		Backfill date	12/03/2001
Final depth	7.50m	Page	1 of 2

Progress				Samples & Testing				Strata				Standpipe
Date	Hole	Casing	Water	Depths		Type	Field Record	Legend	Depth (Thickness)	Level m AOD	Strata Descriptions	
				From	To							
									(0.45)		MADE GROUND comprising (loose moderate dense) brown sandy, gravelly silt. Gravel is medium large sub-rounded to angular.	
									0.45		Bricks appearing at 0.25mbgl	
				0.75	0.75	D			(0.25)		MADE GROUND comprising (loose) purple black broken slates with iron nails. Old roofing material.	
									(0.70)		Bituminous odour	
									(0.22)		MADE GROUND comprising (loose) black occasionally gravelly sandy silt. Moderate gas works odour (spent oxide)	
									0.92		MADE GROUND comprising concrete and brick base	
				1.35	1.55	D			(0.43)		MADE GROUND comprising (moderate dense) black-grey very coarse sand.	
									1.35			
				1.60	1.80	D			(0.30)		MADE GROUND comprising (moderate dense) brown - with black pockets silty sand. No strong odour	
									1.65		MADE GROUND comprising (moderate dense), dark brown slightly gravelly sand. Gravel is small sub angular	
									(0.20)		clinker	
									1.85		(moderate dense) brown slightly silty fine SAND	
									(0.15)			
									2.00			
				2.20	2.40	D						
									(0.80)			
				2.40	2.50	B						
				2.80	3.20	B						
									2.80		(dense) brown silty very fine SAND	
									(0.30)			
									3.10		(dense to very dense) brown slightly silty fine to medium SAND	
				3.34					(0.60)			
				3.3								
				3.50	3.70	D						
									3.70		Bands of lighter grey brown SAND at 3.5m & 4.05m	
									(0.45)			
				4.00	4.20	D						
									4.15		(Dense to very dense) brown slightly gravelly silty SAND	
									(0.15)		(Moderate dense) brown to orange slightly silty fine to medium SAND	
									4.30			
									(0.40)			
									4.70		(moderate dense) brown fine to medium SAND.	

Parsons Brinckerhoff Ltd, Queen Victoria House, Redland Hill, Redland, Bristol BS6 6US Tel. 0117-973-9090 Fax. 0117-923-7479

<table border="1"> <thead> <tr> <th colspan="3">Diameters</th> </tr> <tr> <th>Depth (m)</th> <th>Hole (mm)</th> <th>Casing (mm)</th> </tr> </thead> <tbody> <tr> <td></td> <td></td> <td></td> </tr> </tbody> </table>			Diameters			Depth (m)	Hole (mm)	Casing (mm)				<p>General remarks</p> <ol style="list-style-type: none"> Hand dug starter pit to 0.92m bgl then advanced by dynamic sampling Concrete and brick base at 0.92m CORED with drill rig. No recovery from 5.7m to 7.5m bgl due to use of water flush to assist drilling. Installation Details Gravel annulus from 7.5m to 2.5m bgl. Bentonite seal from 2.5m to 0.0m bgl. 50mm "slotted" HDPE pipe with geotextile sock from 7.5m to 3.0m bgl. 50mm "plain" HDPE pipe from 3.0m to 0.0m bgl. Gas monitoring well head installed. <p>Notes: All dimensions in metres unless otherwise stated</p>	<p>Equipment and Methods</p> <p>PIONEER</p>
Diameters													
Depth (m)	Hole (mm)	Casing (mm)											
<table border="1"> <thead> <tr> <th colspan="3">Groundwater</th> </tr> <tr> <th>Depth struck</th> <th>After 20 mins</th> <th>Depth sealed</th> </tr> </thead> <tbody> <tr> <td>3.34</td> <td>3.34</td> <td></td> </tr> </tbody> </table>			Groundwater			Depth struck	After 20 mins	Depth sealed	3.34	3.34			
Groundwater													
Depth struck	After 20 mins	Depth sealed											
3.34	3.34												
<p>Checked by: <i>[Signature]</i></p>			<p>Drilled by: GEOTECH</p> <p>Logged by: TG</p>										

Job No. : BEN45066
Site Name : Cramptons Road, Sevenoaks
Client : EnvirosAspinwall

Easting		Start date	12/03/2001
Northing		End date	12/03/2001
Ground level		Backfill date	12/03/2001
Final depth	7.50m	Page	2 of 2

Progress				Samples & Testing				Strata				Standpipe
Date	Hole	Casing	Water	Depths		Type	Field Record	Legend	Depth (Thickness)	Level m AOD	Strata Descriptions	
				From	To							
				5.10	5.30	D					Hole terminated at 7.5m	
									(2.80)			
									7.50			

Diameters Depth (m) Hole (mm) Casing (mm)			General remarks Notes: All dimensions in metres unless otherwise stated	Equipment and Methods PIONEER
Groundwater Depth struck After 20 mins Depth sealed				
(Empty table for groundwater data)				
			Checked by: <i>CB</i>	Drilled by: GEOTECH Logged by: TG

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Site Name:	Sevenoaks
Date of visit:	12/03/01
Pressure (mb):	988

BH	Flow Rate (l/m)	Gas monitoring (%)			H ₂ O Monitoring (m)			Purge Vol (x3) (l)	Recovery Time (mins)	pH	Temp (°C)	Dissolved O ₂ (%)	Conductivity (µs)	Comments
		CH ₄	O ₂	CO ₂	Surface	Base	Product							
BH 2	0.01	0.0	19.5	0.0										DRY
BH 1	0.0	0.0	19.5	0.0	3.345	7.75	-			5.8	6.4	68.6	176	Very weak tarry odour ???

Samples Taken BH1

Meters Calibrated -Y

Notes:

- ¹ A trip blank must be taken for each site visit. (This should be provided by the laboratory carrying out the analysis)
- ² A duplicate of ONE borehole is needed for each site visit.
- ³ Testing- BG suite, TPH, VOCs, Nitrate, Total Hardness as CaCO₃.

SAMPLES MUST BE KEPT COOL AND DISPATCHED ON DAY OF SAMPLING WITH SCHEDULING
 NB do not forget to take field meters

DRILLER'S DAILY REPORT

CRAMPTON RD. SEVENOAKS

CLIENT PARSONS BRINCKERHOFF

DATE 12th March 01

CONTRACT No. 12220

SITE SEVENOAKS RD - ST MARY CHURCH, KENT

SHEET 1 of 1

BOREHOLE 1

TIME AND PRODUCTION RECORD

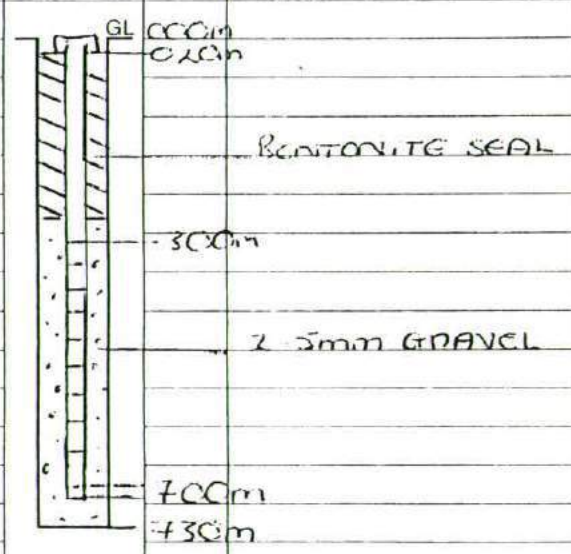
from	0500	rig move	no	hr	dynamic sampling	m	hr
to	1900	rig up	no	hr	core drilling	m	hr
hrs	14	rig down	no	hr	CFA	m	hr
transport to and from site				hr	HSFA	m	hr
awaiting access/instructions				hr	penetration testing	no	hr
TRAVEL TO NEXT SITE				hr	undisturbed sampling	no	hr
				hr	installing	m	hr

PIEZOMETER / STANDPIPE RECORD

TYPE	SCREEN (m)			CASING (m)			RESPONSE ZONE/SEAL	No. USED	COVER TYPE	WELL HEAD			
	1.0	1.5	3.0	1.0	1.5	3.0				push on cap	no		
							washed sand	25kg bags	helmet		push on cap	no	
HDPE	3		1			1	gravel	25kg bags	stopcock		gas valve	no	
UPVC							bentonite pellets	25kg bags	traffic rated			no	
Triloc							bentonite powder	25kg bags	manhole		WATER LEVELS		
19mm							cement	25kg bags	padlocks		before	am/pm	m
							ballast	25kg bags			after	am/pm	m

DRILLING AND SAMPLING RECORD

sample no.	type	depth (m bgl)		drilled (m)	recov'd (m)	casing		water depth (m bgl)	penetration test				strata description	installation / backfilling	depth (m bgl)	installation description	
		from	to			size (mm)	depth (m bgl)		seating	test drive							
		INSPECTION PIT TO 1.00m															
1x	116	1.00	1.35	0.35	0.35								0.00m TO 1.00m				
-	SPT	1.35	1.80	0.45	0.00			dry	4	5	1	1	1	CLAY GRAVEL FILL + CONCRETE			
		ream 113mm casing to 1.35m															
2x	98	1.35	2.80	1.45	1.45								1.00m TO 1.35m			BENTONITE SEAL	
		FLUSH 113mm casing to 2.80m															
30	SPT	2.80	3.25	0.45	0.35	113	280	050	2	3	6	7	10	10	1.35m TO 1.50m		
4x	98	2.80	4.10	1.30	1.30								SANDY CLAY FILL				
		FLUSH 113mm casing to 4.10m															
50	SPT	4.10	4.55	0.45	0.35	113	2.80	230	4	4	6	9	9	10	1.50m TO 7.30m		
		FLUSH 113mm casing to 4.10m															
6x	98	4.10	5.20	1.10	1.10								DENSE LIGHT BROWN SAND				
70	SPT	5.20	5.65	0.45	0.35	113	4.10	320	7	9	10	10	12	14			
8x	98	5.20	5.70	0.50	0.50												
90	SPT	5.70	6.15	0.45	0.35	113	5.20	360	9	16	16	17	17	20			
-	101	5.70	7.30	1.60	N/A												



WATER DEPTHS (m bgl)

a.m.	p.m.		struck at		settled at
	5	10	15	20	
after striking					
sample taken at	before water flush				
before pulling casing	after pulling casing				

REMARKS

S.P.T / 7.30m TO 7.49m 110/15/50 for 4cm (19cm TOTAL)
 * 2m LENGTH OF SLOTTED PIPE INSTALL IN TRIAL PIT DOG BY J.C.B

weather Overcast

driller M STEVENS
 assistant driller O SAVORY

landrover WISLITAE
 rig COMACALIO

APPENDIX C

ANALYTICAL RESULTS

**NEW PROFORMA FOR REPORTING
ANALYTICAL RESULTS (SOIL)**

All analytical results to be reported as mg/kg ONLY
R54976

Site Name: Sevenoaks
Date: 12/04/01

Laboratory: Environmental Analysis Laboratories

Date Sampled:	12/03/01	12/03/01	12/03/01	12/03/01	12/03/01	12/03/01	12/03/01
Laboratory Sample Reference	94285	94288	94289	94292	94293	94294	94296
Trial Pit/Borehole No.	BH1	BH1	BH1	TP1	TP2	TP2	TP2
Sampling Depth (m)	1.60-1.80	4.00-4.20	5.10-5.30	1.40	0.35	0.90	2.80
Hardstanding at Surface (Y/N)							
pH	4.5	4.3	4.3	4.0	7.3	7.2	6.5
% Loss on Ignition	5.31	1.20	1.08	1.56	3.86	5.95	1.88
% Moisture	13.26	8.09	8.44	7.00	7.72	7.68	9.91
% Stones	4	0	0	0	41	46	0
Cresols	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Xylenols & Ethylphenols	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Naphthols	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Phenol	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Trimethylphenol	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Total Phenols	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Naphthalene	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	4.8
Acenaphthylene	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	11.7
Acenaphthene	1.1	<0.5	<0.5	<0.5	<0.5	<0.5	10.8
Fluorene	0.7	<0.5	<0.5	<0.5	<0.5	<0.5	50.9
Phenanthrene	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	386.7
Anthracene	1.8	<0.5	4.2	<0.5	<0.5	203.7	375.4
Fluoranthene	2.9	<0.5	17.7	<0.5	<0.5	95.8	404.8
Pyrene	3.8	<0.5	15.7	<0.5	<0.5	91.2	326.1
Benzo(a)anthracene	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	18.1
Chrysene	2.0	<0.5	15.1	<0.5	<0.5	61.9	219.1
Benzo(b)fluoranthene & Benzo(k)fluoranthene	1.5	<0.5	11.5	<0.5	<0.5	59.6	170.3
Benzo(a)pyrene	2.7	<0.5	10.1	<0.5	<0.5	38.0	116.7
Indeno(1,2,3-cd)pyrene & Di-benzo(a,h.)anthracene	1.7	<0.5	6.2	<0.5	<0.5	19.9	94.3
Benzo(g,h,i.) Perylene	1.6	<0.5	4.4	<0.5	<0.5	11.8	74.5
Total PAH	21.1	<0.5	96.3	<0.5	<0.5	604.5	2398.8
Easily Liberatable Cyanide	6.9	<1	<1	<1	32.4	2.7	6.9
Complex Cyanide	182.6	<1	1.6	1.8	418.1	4.5	9.1
Total Cyanide	189.5	<1	1.6	1.8	450.4	7.2	16.0
Elemental Sulphur	49	<10	<10	80	939	655	<10
Water Soluble Sulphate	4431	480	520	4169	4263	2275	1180
Water Soluble Chloride	25	28	334	23	19	13	27
Exchangeable Ammonium	16.1	18.7	6.9	12.4	5.2	<5	24.7
Arsenic	14.7	16.4	19.5	10.4	18.6	8.5	13.5
Cadmium	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Chromium	19	15	23	17	11	9	30
Lead	86	7	4	35	101	22	8
Mercury	0.3	<0.2	<0.2	<0.2	0.3	<0.2	<0.2
Selenium	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Copper	25	5	5	7	27	14	5
Nickel	14	17	24	14	16	14	22
Zinc	36	29	41	33	34	24	37
Boron	1.5	2.4	1.3	1.5	2.2	2.4	1.5

**ANALYTES TO BE DETERMINED ONLY IF
THEIR PRESENCE IS SUSPECTED**

Cobalt
Vanadium
Molybdenum
Germanium
Hexavalent Chromium

Benzene
Toluene
Ethylbenzene
Xylene

Mineral Oil (%)
Asbestos (%)

ADDITIONAL ANALYTES

Anthanthrene	1.2	<0.5	6.1	<0.5	<0.5	<0.5	41.7
Benzo(e)pyrene	<0.5	<0.5	5.3	<0.5	<0.5	22.6	92.9
Catechol	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Resorcinol	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Total Petroleum Hydrocarbons						<5	

ENVIRONMENTAL ANALYSIS LABORATORIES

15 Burgess Road, Ivyhouse Lane Industrial Estate, Hastings, East Sussex. TN35 4NR
 Fax: 01424 442299 Tel: 01424 444433 info@environmentalanalysis.com

ANALYTICAL REPORT No. R54976

Location: Sevenoaks

CLIENT: Parsons Brinckerhoff Ltd

Queen Victoria House, Redland Hill
 Redhill, Bristol BS6 6US

F.A.O: Tim Graves

Your Job No: BEN45066
 Sampling Date: 12/03/01
 Reporting Date: 12/04/01

<u>Soil (VOC suite)</u>	TP/BH		TP2
	Depth (m)	Our ref	0.90 94294
1,1-Dichloroethylene (mg/kg)	N		<0.02
Dichloromethane (mg/kg)	N		<0.02
Hexane (mg/kg)	N		<0.02
trans-1,2-Dichloroethylene (mg/kg)	N		<0.02
1,1-Dichloroethane (mg/kg)	N		<0.02
2,2-Dichloropropane (mg/kg)	N		<0.02
cis-1,2-Dichloroethylene (mg/kg)	N		<0.02
Chloroform (mg/kg)	N		<0.02
Bromochloromethane (mg/kg)	N		<0.02
1,1,1-Trichloroethane (mg/kg)	N		<0.02
1,2-Dichloropropene (mg/kg)	N		<0.02
Carbon Tetrachloride (mg/kg)	N		<0.02
1,2-Dichloroethane (mg/kg)	N		<0.02
Benzene (mg/kg)	N		<0.02
Trichloroethylene (mg/kg)	N		<0.02
1,2-Dichloropropane (mg/kg)	N		<0.02
Bromodichloromethane (mg/kg)	N		<0.02
Dibromomethane (mg/kg)	N		<0.02
cis-1,3-Dichloropropene (mg/kg)	N		<0.02
Toluene (mg/kg)	N		<0.02
trans-1,3-Dichloropropene (mg/kg)	N		<0.02
1,1,2-Trichloroethane (mg/kg)	N		<0.02
1,3-Dichloropropane (mg/kg)	N		<0.02
Tetrachloroethylene (mg/kg)	N		<0.02
Chlorodibromomethane (mg/kg)	N		<0.02
Dibromoethane (mg/kg)	N		<0.02
Chlorobenzene (mg/kg)	N		<0.02
Ethylbenzene (mg/kg)	N		<0.02
meta & para Xylene (mg/kg)	N		<0.02
ortho Xylene (mg/kg)	N		<0.02
Styrene (mg/kg)	N		0.08
1,2,3-Trimethylbenzene (mg/kg)	N		<0.02
Bromoform (mg/kg)	N		<0.02
1,1,2,2-Tetrachloroethane (mg/kg)	N		<0.02
1,2,3-Trichloropropane (mg/kg)	N		<0.02
n Propylbenzene (mg/kg)	N		<0.02
Bromobenzene (mg/kg)	N		<0.02
1,2,4-Trimethylbenzene (mg/kg)	N		<0.02
1-Chlorotoluene (mg/kg)	N		<0.02
2-Chlorotoluene (mg/kg)	N		<0.02
tert Butylbenzene (mg/kg)	N		<0.02
1,3,5-Trimethylbenzene (mg/kg)	N		<0.02
1-Methylpropylbenzene (mg/kg)	N		<0.02
Methyl-isopropylbenzene (mg/kg)	N		<0.02
1,4-Dichlorobenzene (mg/kg)	N		<0.02
1,3-Dichlorobenzene (mg/kg)	N		<0.02
n Butylbenzene (mg/kg)	N		<0.02
1,2-Dichlorobenzene (mg/kg)	N		<0.02
1,2-Dibromo-3-Chloropropane (mg/kg)	N		<0.02
1,3,5-Trichlorobenzene (mg/kg)	N		<0.02
Hexachlorobutadiene (mg/kg)	N		<0.02
Naphthalene (mg/kg)	N		<0.02
1,2,4-Trichlorobenzene (mg/kg)	N		<0.02

Descriptions of methods & performance data available on request.

N = NAMAS accredited test

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Checked by:

WJV

M.J. Varley
 M.J. Varley
 Technical Manager

RECEIVED 17 APR 2001

**NEW PROFORMA FOR REPORTING
ANALYTICAL RESULTS (WATER)**

All analytical results to be reported as mg/l ONLY
R54979

Site Name: Sevenoaks

Date: 11/04/01

Laboratory: Environmental Analysis Laboratories

Date Sampled: 12/03/01
 Laboratory Sample Reference: 94306
 Trial Pit/Borehole No.: BH1
 Sampling Depth (m): ---
 Hardstanding at Surface (Y/N):

pH: 5.8
 TOC: 7.1
 Suspended Solids: 23496
 Conductivity (µS/cm): 738

Cresols: <0.0001
 Xylenols & Ethylphenols: <0.0001
 Naphthols: <0.0001
 Phenol: <0.0001
 Trimethylphenol: <0.0001
 Total Phenols: <0.0005

Naphthalene: <0.001
 Acenaphthylene: <0.001
 Acenaphthene: <0.001
 Fluorene: <0.001
 Phenanthrene: 0.003
 Anthracene: 0.004
 Fluoranthene: 0.012
 Pyrene: 0.010
 Benzo(a)anthracene: 0.010
 Chrysene: 0.010
 Benzo(b)fluoranthene: 0.006
 Benzo(k)fluoranthene: 0.006
 Benzo(a)pyrene: 0.004
 Indeno(1,2,3-cd)pyrene: 0.003
 Di-benzo(a,h.)anthracene: <0.001
 Benzo(g,h,i.) Perylene: 0.003
 Total PAH: 0.071

Easily Liberatable Cyanide: <0.5
 Complex Cyanide: 1.4
 Total Cyanide: 1.4
 Thiocyanate: 0.3
 Elemental Sulphur: <0.1
 Sulphate: 775
 Sulphide: <0.1
 Chloride: 35
 Total Ammonium: 4.2

Arsenic: <0.01
 Cadmium: <0.001
 Chromium: <0.01
 Lead: <0.01
 Mercury: <0.0002
 Selenium: <0.02
 Copper: <0.01
 Nickel: <0.01
 Zinc: 2.039
 Iron: 5.661

**ANALYTES TO BE DETERMINED ONLY IF THEIR
PRESENCE IS SUSPECTED**

Cobalt
 Vanadium
 Molybdenum
 Germanium
 Hexavalent Chromium

Benzene
 Toluene
 Ethylbenzene
 Xylene

Total Petroleum Hydrocarbons: <0.1

ADDITIONAL ANALYTES

Anthanthrene: <0.001
 Benzo(e)pyrene: <0.001
 Catechol: <0.0001
 Resorcinol: <0.0001
 Total Hardness: 937

ENVIRONMENTAL ANALYSIS LABORATORIES

15 Burgess Road, Ivyhouse Lane Industrial Estate, Hastings, East Sussex. TN35 4NR
Fax: 01424 442299 Tel: 01424 444433 info@environmentalanalyses.com

ANALYTICAL REPORT No. R54979

Location: Sevenoaks

CLIENT: Parsons Brinckerhoff Ltd

Queen Victoria House, Redland Hill
Redhill, Bristol BS6 6US

Reporting Date: 11/04/01

<u>Water (VOC suite)</u>	TP/BH	BH1
	Our ref	94306
1,1-Dichloroethylene	(mg/l) N	<0.001
Dichloromethane	(mg/l) N	<0.001
Hexane	(mg/l) N	<0.001
trans-1,2-Dichloroethylene	(mg/l) N	<0.001
1,1-Dichloroethane	(mg/l) N	<0.001
2,2-Dichloropropane	(mg/l) N	<0.001
cis-1,2-Dichloroethylene	(mg/l) N	<0.001
Chloroform	(mg/l) N	<0.001
Bromochloromethane	(mg/l) N	<0.001
1,1,1-Trichloroethane	(mg/l) N	<0.001
1,2-Dichloropropene	(mg/l) N	<0.001
Carbon Tetrachloride	(mg/l) N	<0.001
1,2-Dichloroethane	(mg/l) N	<0.001
Benzene	(mg/l) N	<0.001
Trichloroethylene	(mg/l) N	<0.001
1,2-Dichloropropane	(mg/l) N	<0.001
Bromodichloromethane	(mg/l) N	<0.001
Dibromomethane	(mg/l) N	<0.001
cis-1,3-Dichloropropene	(mg/l) N	<0.001
Toluene	(mg/l) N	<0.001
trans-1,3-Dichloropropene	(mg/l) N	<0.001
1,1,2-Trichloroethane	(mg/l) N	<0.001
1,3-Dichloropropane	(mg/l) N	<0.001
Tetrachloroethylene	(mg/l) N	<0.001
Chlorodibromomethane	(mg/l) N	<0.001
Dibromoethane	(mg/l) N	<0.001
Chlorobenzene	(mg/l) N	<0.001
Ethylbenzene	(mg/l) N	<0.001
meta & para Xylene	(mg/l) N	0.004
ortho Xylene	(mg/l) N	0.001
Styrene	(mg/l) N	<0.001
1,2,3-Trimethylbenzene	(mg/l) N	<0.001
Bromoform	(mg/l) N	<0.001
1,1,2,2-Tetrachloroethane	(mg/l) N	<0.001
1,2,3-Trichloropropane	(mg/l) N	<0.001
n Propylbenzene	(mg/l) N	<0.001
Bromobenzene	(mg/l) N	<0.001
1,2,4-Trimethylbenzene	(mg/l) N	<0.001
1-Chlorotoluene	(mg/l) N	<0.001
2-Chlorotoluene	(mg/l) N	<0.001
tert Butylbenzene	(mg/l) N	<0.001
1,3,5-Trimethylbenzene	(mg/l) N	<0.001
1-Methylpropylbenzene	(mg/l) N	<0.001
Methyl-isopropylbenzene	(mg/l) N	<0.001
1,4-Dichlorobenzene	(mg/l) N	<0.001
1,3-Dichlorobenzene	(mg/l) N	<0.001
n Butylbenzene	(mg/l) N	<0.001
1,2-Dichlorobenzene	(mg/l) N	<0.001
1,2-Dibromo-3-Chloropropane	(mg/l) N	<0.001
1,3,5-Trichlorobenzene	(mg/l) N	<0.001
Hexachlorobutadiene	(mg/l) N	<0.001
Naphthalene	(mg/l) N	<0.001
1,2,4-Trichlorobenzene	(mg/l) N	<0.001

Descriptions of methods & performance data available on request.

N = NAMAS accredited test

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Checked by:



M.J. Varley
Technical Manager

**NEW PROFORMA FOR REPORTING
ANALYTICAL RESULTS (LEACHATE)**

All analytical results to be reported as mg/l ONLY
R54976

Site Name: Sevenoaks

Date: 12/04/01

Laboratory: Environmental Analysis Laboratories

Date Sampled: 12/03/01
Laboratory Sample Reference: 94294
Trial Pit/Borehole No.: TP2
Sampling Depth (m): 0.90
Hardstanding at Surface (Y/N)

pH: 7.0
TOC: 5.9
Conductivity (μ S/cm): 879

Cresols: 0.0026
Xylenols & Ethylphenols: <0.0001
Naphthols: <0.0001
Phenol: <0.0001
Trimethylphenol: <0.0001
Total Phenols: 0.0026

Naphthalene: <0.001
Acenaphthylene: <0.001
Acenaphthene: <0.001
Fluorene: <0.001
Phenanthrene: <0.001
Anthracene: <0.001
Fluoranthene: <0.001
Pyrene: <0.001
Benzo(a)anthracene: <0.001
Chrysene: <0.001
Benzo(b)fluoranthene: <0.001
Benzo(k)fluoranthene: <0.001
Benzo(a)pyrene: <0.001
Indeno(1,2,3-cd)pyrene: <0.001
Di-benzo(a,h.)anthracene: <0.001
Benzo(g,h,i.) Perylene: <0.001
Total PAH: <0.001

Easily Liberatable Cyanide: 3.2
Complex Cyanide: 2.2
Total Cyanide: 5.4
Sulphate: 437
Ammonium: <0.1

Arsenic: <0.01
Cadmium: <0.001
Chromium: <0.01
Lead: <0.01
Mercury: <0.0002
Selenium: <0.02
Copper: <0.01
Nickel: <0.01
Zinc: 0.173
Iron: 0.977

**ANALYTES TO BE DETERMINED ONLY IF THEIR
PRESENCE IS SUSPECTED**

Cobalt
Vanadium
Molybdenum
Germanium
Uranium

Benzene
Toluene
Ethylbenzene
Xylene

Total Petroleum Hydrocarbons

ADDITIONAL ANALYTES

Anthanthrene: <0.001
Benzo(e)pyrene: <0.001
Catechol: <0.0001
Resorcinol: <0.0001

**NEW PROFORMA FOR REPORTING
ANALYTICAL RESULTS (LEACHATE)**

All analytical results to be reported as mg/kg ONLY
R54976

Site Name: Sevenoaks

Date: 12/04/01

Laboratory: Environmental Analysis Laboratories

Date Sampled: 12/03/01
Laboratory Sample Reference: 94294
Trial Pit/Borehole No.: TP2
Sampling Depth (m): 0.90
Hardstanding at Surface (Y/N):

pH: 7.0
TOC: 59
Conductivity ($\mu\text{S}/\text{cm}$): 879

Cresols: 0.026
Xylenols & Ethylphenols: <0.001
Naphthols: <0.001
Phenol: <0.001
Trimethylphenol: <0.001
Total Phenols: 0.030

Naphthalene: <0.01
Acenaphthylene: <0.01
Acenaphthene: <0.01
Fluorene: <0.01
Phenanthrene: <0.01
Anthracene: <0.01
Fluoranthene: <0.01
Pyrene: <0.01
Benzo(a)anthracene: <0.01
Chrysene: <0.01
Benzo(b)fluoranthene: <0.01
Benzo(k)fluoranthene: <0.01
Benzo(a)pyrene: <0.01
Indeno(1,2,3-cd)pyrene: <0.01
Di-benzo(a,h.)anthracene: <0.01
Benzo(g,h,i.) Perylene: <0.01
Total PAH: <0.01

Easily Liberatable Cyanide: 32
Complex Cyanide: 22
Total Cyanide: 54
Sulphate: 4369
Ammonium: <1

Arsenic: <0.1
Cadmium: <0.01
Chromium: <0.1
Lead: <0.1
Mercury: <0.002
Selenium: <0.2
Copper: <0.1
Nickel: <0.1
Zinc: 1.73
Iron: 9.77

**ANALYTES TO BE DETERMINED ONLY IF THEIR
PRESENCE IS SUSPECTED**

Cobalt
Vanadium
Molybdenum
Germanium
Uranium

Benzene
Toluene
Ethylbenzene
Xylene

Total Petroleum Hydrocarbons

ADDITIONAL ANALYTES

Anthanthrene: <0.01
Benzo(e)pyrene: <0.01
Catechol: <0.001
Resorcinol: <0.001

APPENDIX D

GEOTECHNICAL RESULTS



PARTICLE SIZE DISTRIBUTION

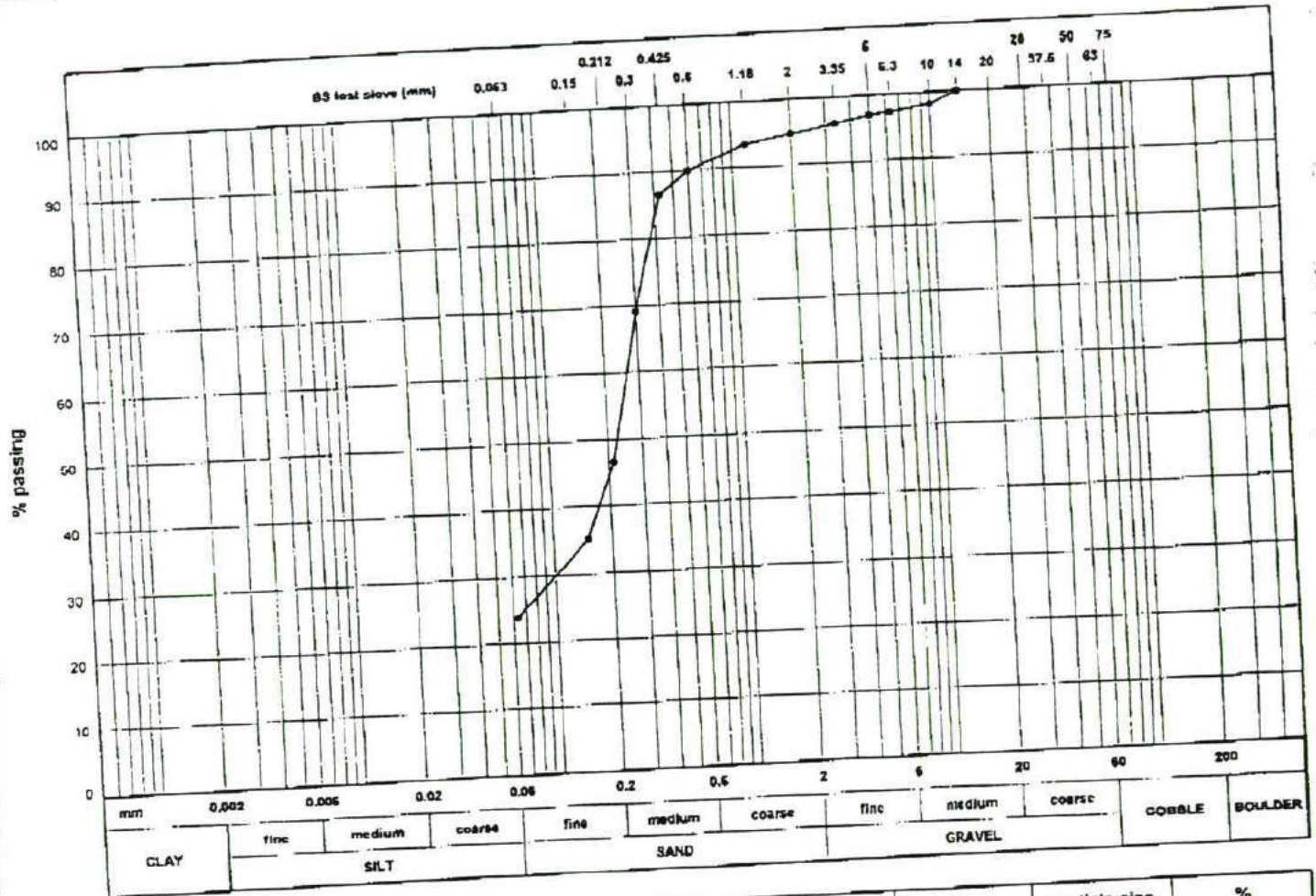
BS.1377 : Part 2 : 1990 : 9

CLIENT PB

SITE SEVENOAKS

DESCRIPTION Yellow-brown very clayey SAND with a little f-m gravel.

BH/TP No. BH01
SAMPLE No./TYPE B
SAMPLE DEPTH (m) 2.80
SPECIMEN DEPTH (m) 2.80



soil type	% fraction	BS test sieve (mm)	% passing	BS test sieve (mm)	% passing	particle size (µm)	% finer
SILT & CLAY	24	75		3.35	96	20	
SAND	71	63		2	95	6	
GRAVEL	5	50		1.18	93	2	
COBBLE & BOULDER		37.5		0.6	90		
test method(s)	9.2	28		0.425	87		
test method:		20		0.3	69		
9.2 - wet sieving		14	100	0.212	47		
9.3 - dry sieving		10	98	0.15	35		
9.4 - sedimentation by pipette		6.3	97	0.063	24		
9.5 - sedimentation by hydrometer		5	97				
remarks:							

CONTRACT 12220 CHECKED

APPENDIX E

DESK TOP ASSESSMENT

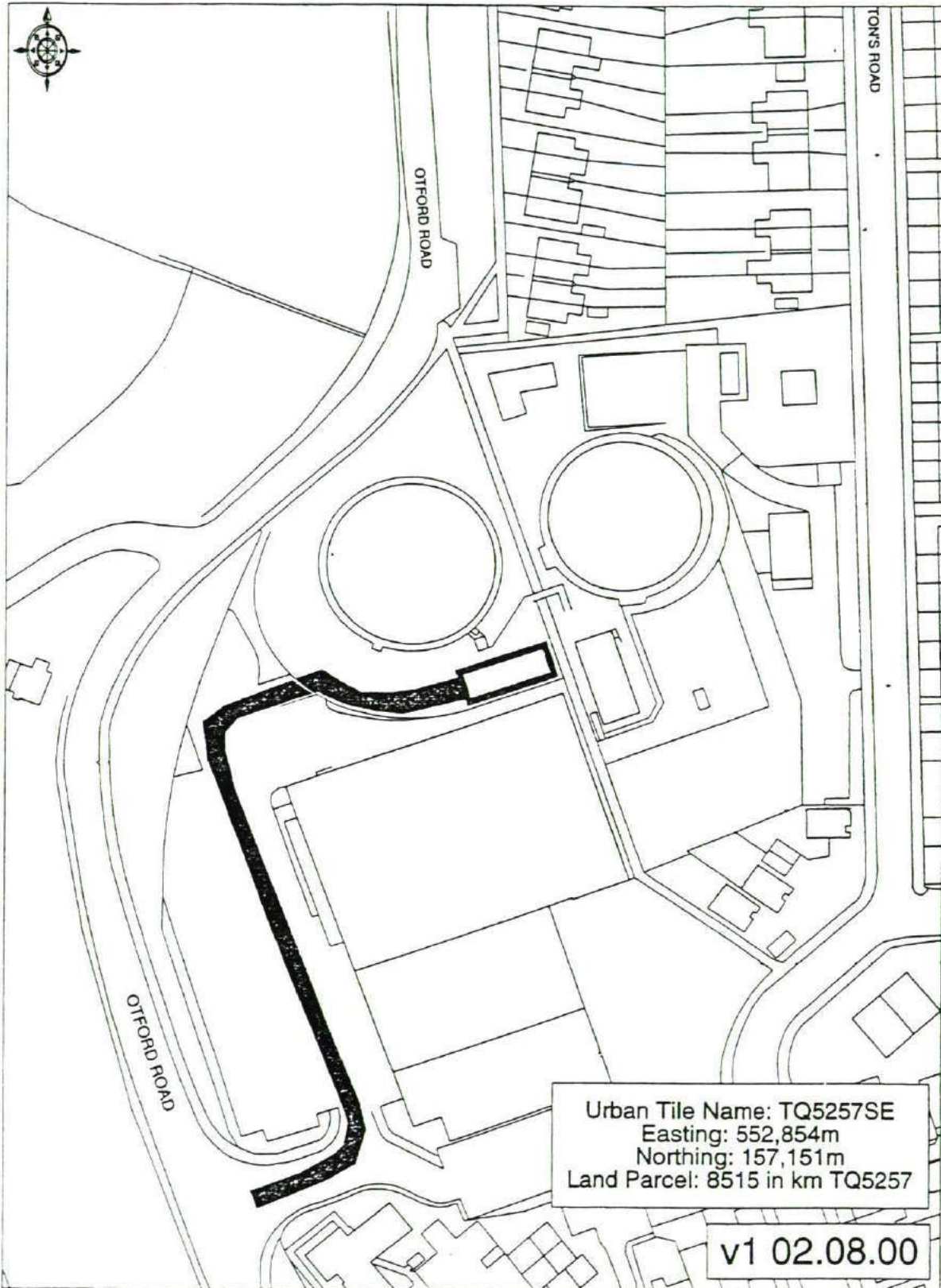
TRANSCO SERVICES PLAN

ORIGINAL GREENLINE PLAN

**TRANSCO/SPECTRASITE COMMUNICATION TOWERS SITE REVIEW
GROUND CONTAMINATION RISK EVALUATION SUMMARY SHEET**

SITE REFERENCE & LOCATION Site Address Number of identified mast sites Site OS NGR Reference Loc Code (Mentor No. if known)	910547 FORMER GAS WORKS, SEVENOAKS RADIO MAST Former Gas Works, Cramptons Road, Sevenoaks, Kent, TN14 5DY 1 Preferred (MP) 20m x 8m. MP: TQ 529 571 11090
Current Use/Site History <i>Mast Area(s)</i> <i>Overall Transco Site</i> <i>General Area/Surrounding Land Uses</i>	MP: Part of old Gas Works Site. Based up on the 1997 site survey, the new MP mast site proposed lies within an area formerly used as gas purifying, below ground tanks. The area is currently un-used (1999) and partially covered in concrete and tarmac. The site is adjacent to an existing Gas Holder (1999) with Transco ground surrounding the site, except for a retail ware house and car park to the south. The overall site is bound to the west by road and open ground, and elsewhere by mixed residential and light industrial properties.
Site Setting <i>Geology</i> <i>Hydrogeology</i> <i>Hydrology</i> <i>General</i>	Site MP consists of made ground (0.5m to 2m thick) predominantly of sandy materials with varying amounts of gravel, brick and ash, overlying sands with gravel belonging to the Folkestone Beds Formation. The sand and gravels of the Folkestone Beds are classified as a major aquifer. Two extraction points are active within 500m, to the north of the site, and used for public water supply. The site has two local field drains within 100m draining in a westerly direction towards the river Darent some 650m to the west, and is classified as D or fair water quality. There is also a wildfowl reserve lake within 300m of the site to the south. Groundwater on the site was not detected in the 1992 investigations. Drainage is to surface water sewers with oil interceptors. From historical maps the proposed area lies on the southern boundary of the retained Transco Gas Holder site. The site, has active gas holders (1999), the mast location is in an un-used area of the site and covered by gravel and concrete paths.
Available Desk Top Reports	Stanger, December 1997 (8440/BGAST7/jz)
Available Ground Investigation Reports	Boundary Survey, Harrison, November 1992, (C1935/22)
Test Result Summary	Two trial pits TP6 (and TP7) carried out in 1992, indicate that the MP site, has significant concentrations in Total Cyanides (900 to 10,000 mg/kg), Phenols (1,200 mg/kg) and PAH (1,000 to 5,000 mg/kg).
Ground Contamination Discussion including Remediation Strategy If Available	The desk study concluded that significant levels of contamination had been identified (1992) from below ground tanks and purifier boxes, Remediation will be necessary with regards to the re-use of excavated materials and work-force will require protection (full PPE), with elevated cost for disposal of excavation materials.
Ground Contamination Risk Rating <i>Land Ownership</i> <i>Construction/Operation</i>	MEDIUM on the basis of potential contaminant sources and limited pathways and receptors. MEDIUM to HIGH due to possibility of high concentration PAH and cyanides contaminants being encountered. Likely elevated disposal cost of excavated materials.
Proposed Contamination Investigation/Testing (Land ownership issues only)	One Trial Pit at MP location to confirm contaminants and pre-classify excavation materials for disposal.
Mast Relocation	Not proposed.
Discussion/Other Factors including Initial Geotechnical Comments and Key Site Features (For information purposes only)	Spread foundations likely to be appropriate.
This sheet is intended to provide a summary only of the initial indicative assessment study of the site in relation to contamination. It does not provide a definitive engineering analysis for the purposes of costing or construction, and is subject to the limitation of the agreed brief. ** Note all depths given as below ground level. (BGL)	

107, Cramptons Road,
Sevenoaks, Kent



© Crown copyright 2001. All rights reserved. Based on Ordnance Survey digital data Survey Scale - 1:1250 Plotted Scale - 1:1250
(Scales other than at Survey Scale should not be used for accurate measurement). Business occupancy data ©2001 Thomson Directories Ltd.



Reference 910547
Master Lease/Site Licence/Underlease



WorleyParsons

resources & energy

EcoNomics™

SCOTIA GAS NETWORKS
SITE INVESTIGATION FACTUAL REPORT
CRAMPTONS ROAD, SEVENOAKS

FACTUAL SITE INVESTIGATION REPORT

Cramptons Road, Sevenoaks

305008-00031/51679-00

29 October 2014

Infrastructure

Parkview, Brentford, Middlesex TW8 9AZ

Tel: +44 (0) 208 326 5000

www.worleyparsons.com

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**SCOTIA GAS NETWORKS
FACTUAL SITE INVESTIGATION REPORT
CRAMPTONS ROAD, SEVENOAKS**

Report Details	
Site Address	Cramptons Road Sevenoaks Kent TN14 5DY
Report Title	FACTUAL SITE INVESTIGATION REPORT
Report Type	Site Investigation
Report Date	29 October 2014
Draft/Final	Draft
Factual/Interpretative	Factual
Brief description of contents	Summary of current site status, site investigation activities and provision of factual information including investigation logs and laboratory data.
SGN Contact	Andrew Pearson



**SCOTIA GAS NETWORKS
FACTUAL SITE INVESTIGATION REPORT
CRAMPTONS ROAD, SEVENOAKS**

Disclaimer

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**SCOTIA GAS NETWORKS
FACTUAL SITE INVESTIGATION REPORT
CRAMPTONS ROAD, SEVENOAKS**

CONTENTS

1. INTRODUCTION 1

 1.1 Aims..... 1

 1.2 Objectives 1

2. SITE INFORMATION, LOCATION AND SETTING..... 2

3. SUMMARY OF WORKS COMPLETED 6

 3.1 Introduction 6

 3.2 Completed Works 6

 3.3 Monitoring Well Installations..... 6

 3.4 Chemical Analysis of Samples 7

 3.5 Constraints to the investigation 8

4. SITE INVESTIGATION FINDINGS..... 10

 4.1 Ground Conditions..... 10

 4.2 Summary of Visual and Olfactory Contaminant Observations 10

 4.3 Groundwater Observations 11

 4.4 Specialist Testing 11

 4.5 Obstructions and In-Ground Structures observed..... 11

5. REFERENCES 12

Tables (in text)

TABLE A SITE INFORMATION 2

TABLE B SUMMARY OF MONITORING WELL INSTALLATIONS 7

TABLE C SUMMARY OF GROUND CONDITIONS 10

TABLE D REFERENCES..... 12



**SCOTIA GAS NETWORKS
FACTUAL SITE INVESTIGATION REPORT
CRAMPTONS ROAD, SEVENOAKS**

Figures

FIGURE 1	SITE LOCATION
FIGURE 2	SITE LAYOUT
FIGURE 3	HISTORICAL STRUCTURES
FIGURE 4	SERVICE LOCATIONS
FIGURE 5	SITE INVESTIGATION LOCATIONS

Tables (outside text)

TABLE 1	WELL COMPLETION DETAILS AND ELEVATION DATA
TABLE 2	GROUNDWATER QUALITY FIELD PARAMETERS

Plates

Appendices

APPENDIX I	SERVICE PLANS
APPENDIX II	EXPLORATORY HOLE LOGS
APPENDIX III	LABORATORY ANALYTICAL DATA
APPENDIX IV	QA/QC (RPD Analysis)
APPENDIX V	TOPOGRAPHIC SURVEY
APPENDIX VI	SPECIALIST TESTING DATA



**SCOTIA GAS NETWORKS
FACTUAL SITE INVESTIGATION REPORT
CRAMPTONS ROAD, SEVENOAKS**

1. INTRODUCTION

WorleyParsons was retained by Scotia Gas Networks (SGN) to conduct a site investigation of the SGN land at Cramptons Road, Sevenoaks, Kent, TN14 5DY. The site location is shown on Figure 1.

1.1 Aims

The aim of the site investigation was to better characterise the ground and groundwater conditions at the site to enable further evaluation with respect to the potential for soil or groundwater contamination and to assist with any future potential environmental liabilities at the site.

1.2 Objectives

In order to meet the project aims the following objectives were identified:

- An Further investigate the understanding of the geology and hydrogeological regime beneath the site to refine the conceptual model for the site;
- An assessment of the potential for contamination to be present in soils or groundwater across the site, in particular at the presumed down-gradient boundary of the site;
- An assessment of the potential for contamination to be present in the vicinity of former gasworks structures understood to be on site, including the cross-boundary gasholder in the west of the site and the former purifiers on the southern boundary of the site;
- To positively identify gas mains understood to be present on site; and
- To understand shallow soil conditions in the Pressure Reduction Stations (PRS) on site.



**SCOTIA GAS NETWORKS
FACTUAL SITE INVESTIGATION REPORT
CRAMPTONS ROAD, SEVENOAKS**

2. SITE INFORMATION, LOCATION AND SETTING

Site information is summarised below in Table A:

Table A Site Information

Site Address	Cramptons Road, Sevenoaks, TN14 5DY
National Grid Reference	552850 157150
Site Area	0.67 ha
Site Ownership	Scotia Gas Networks (SGN)
Site Location & Setting	<p>The site is located on the northern edge of Sevenoaks and is comprised of an eastern and a western compound. The site is occupied by two disused above ground gasholders, one located in each compound. The site is split by a public footpath which runs approximately north-northwest/south-southeast in-between the two decommissioned gasholders.</p> <p>The eastern compound also contains an active Pressure Reducing System (PRS) in the north; and disused historical gasholder equipment in the south of the compound. The site location and layout are indicated on Figures 1 and 2, respectively.</p>
Current Site Use	<p>The site is used for operational gas distribution purposes and is occasionally occupied by SGN staff for routine visits and for maintenance works. There is no operational gas infrastructure present on the western portion of the site.</p>
Site Access	<p>The entrance to the eastern compound is from Cramptons Road through an NGPH owned strip of land and via double chainlink gates in the northwest of the National Grid Property Holdings (NGPH) site. The western compound is accessed directly through double chainlink gates on the southwestern boundary via the car park of the adjacent DIY store.</p>
Ground Cover	<p>Approximate groundcover of the site is estimated to be:</p> <ul style="list-style-type: none">• Buildings, PRS and gasholders: 60%• Hard standing: 20%• Sort standing/grass/vegetation: 20%
Site Topography and Elevation	<p>The site topography is undulating due to the presence of in-cuts and bunds created for gas infrastructure installations. However,</p>



**SCOTIA GAS NETWORKS
FACTUAL SITE INVESTIGATION REPORT
CRAMPTONS ROAD, SEVENOAKS**

	<p>generally there is a slight downward slope to the north.</p> <p>Recorded ground elevations range from 69.50 to 72.26m (meters) Above Ordnance Datum (AOD).</p>
Plant and Equipment	<p>There are two disused gasholders on site and an operational PRS system located in the north west of the site. There are numerous governors and other gasholder equipment in the south east of the site.</p>
Site Boundaries	<p>The site is bounded by chain link fencing.</p>
Surrounding Land Uses	<p>Residential properties are present adjacent to the north of the site. Cramptons Road is present to the east of the site, then residential properties, beyond which, to the southeast, is a Water Treatment Works.</p> <p>A retail DIY store is present adjacent to the south and west of the site. Beyond the store to the south are further residential properties. Beyond the store to the southwest and west is the A225 Otford Road and then a field and retail property, beyond which is the Sevenoaks Wildlife Reserve (a SSSI).</p> <p>To the northwest of the site is the A225, then Woodland and fields with tributaries of the River Darent.</p>
Services	<p>The approximate locations of services, based on plans provided by the statutory undertakers and from services found during the service location survey, are shown on Figure 4.</p>
Site History	<p>A gasworks was located on the site from at least 1877, with production buildings being predominantly located to the south of the present site boundary. The two remaining gasholders have been located on the site since approximately 1936 (Atkins, 2001). Historical on-site structures are shown in Figure 3.</p>
Geology	<p>The British Geological Survey (BGS, 2014) indicates that the site is underlain by the Folkestone Formation (a sandstone unit).</p> <p>Akins (2001) reported the presence of Gault Clay overlying the Folkestone Formation in the northern portion of the site. The Gault Clay is shown by the BGS (2014) to be approximately 200 m to the north of the site.</p>
Hydrology	<p>The nearest surface water feature is an unnamed feature located 15 m northwest of the site (Envirocheck 2014). The Sevenoaks Wild Fowl Reserve which is located approximately 100 m to the west and</p>



**SCOTIA GAS NETWORKS
FACTUAL SITE INVESTIGATION REPORT
CRAMPTONS ROAD, SEVENOAKS**

south west of the site. The River Darent is located approximately 200 m to the northwest of the site. There are four licenced surface water abstractions recorded within 500 m of the site, the closest of which is 273 m to the northeast from the site.

Hydrogeology

The site is located within an inner zone (Zone 1) groundwater source protection zone and a major aquifer high groundwater vulnerability zone (Atkins, 2001).

The Folkstone Formation beneath the site is classified as a Principal Aquifer (EA, 2014). There are ten groundwater abstraction licenses within 500m of the site the closest is 95m southeast of the site, licensed to South East Water for possible water supply (Landmark, 2014).

The Cramptons Road Water Works is located approximately 150 m south east of the site (www.sevenoaks.gov.uk). There are four licenced surface water abstractions recorded within 500 m of the site.

Previous Reports relating to the site

Four previous phases of environmental site investigation are known to have been undertaken at the site, these are:

- Parsons Brinckerhoff (2001) Detailed Assessment Report, Sevenoaks Holder Station, Cramptons Road, Sevenoaks Kent.

The site investigation comprised the installation of one groundwater monitoring borehole (referred to as “historical well” herein) and excavation of two trail pits (TP1 and TP2), which were all posited in the south east corner of the western compound. Spent oxide was observed in all three locations, whilst a tar/bitumen odour was noted in one of the trail pits (TP2). A light tar odour was noted within the groundwater. Notable concentrations of cyanide were reported in the made ground and groundwater.

- Atkins (2001) Transco Site Cramptons Road, Sevenoaks. Environmental Assessment Site Investigation.

The site investigation comprised the installation of one groundwater monitoring borehole, three window samples and two trial pits. Soil and groundwater samples were collected and were analysed for typical gasworks compounds. The highest concentrations were from soils within the western compound adjacent to the former purifiers.

- Stanger Science & Scientific (1997) Desk Study of a BG plc
-



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FACTUAL SITE INVESTIGATION REPORT
CRAMPTONS ROAD, SEVENOAKS**

Property at Cramptons Road, Sevenoaks.

This site investigation comprised the drilling of four boreholes and twenty trial pits, including water and gas monitoring standpipes.

- Harrison & Company (1992) Factual Report on a Contaminated Land Boundary Survey at Otford Road, Sevenoaks, Kent.

This boundary condition survey involved the excavation of 20 trial pits around the perimeter of the site. Organic/tar odours were reported from the trial pits on the western boundary.



**SCOTIA GAS NETWORKS
FACTUAL SITE INVESTIGATION REPORT
CRAMPTONS ROAD, SEVENOAKS**

3. SUMMARY OF WORKS COMPLETED

3.1 Introduction

The main investigation was undertaken using approved sub-contractors between 10 June and 26 June 2014. All works were supervised by a suitably competent WorleyParsons consultant under a Permit to Work and Form of Authority of Work issued by SGN representative (Trevor Newman).

The ground investigation was undertaken in general accordance with techniques outlined in BS5930:1999+A2:2010 and BS10175:2001 at the positions shown in Figure 5. The exploratory hole records are presented in Appendix II.

A topographic survey was completed on 9 July 2014. The first, second and third rounds of groundwater monitoring were completed on 9 July and 10 July, 15 July and 22 July 2014, respectively. In-situ hydraulic conductivity testing (slug testing) was carried out during the first monitoring round.

Table 1 at the end of this report presents the groundwater elevation data for the two sampling events and the well installation details. Table 2 at the end of this report presents the groundwater quality field parameters.

3.2 Completed Works

The following works were completed:

- Five boreholes, to a depths between 12.00 and 12.20 m bgl (below ground level);
- Seven trial pits, typically to depths between 2.50 m and 4.00 m bgl;
- Three window sample locations, typically to depths between 3.7 m and 4 m bgl;
- Fourteen hand dug pits, typically to depths between 1.0 m and 1.20 m bgl;
- The collection of soil samples with subsequent laboratory chemical analysis;
- The collection of groundwater samples, using low flow techniques with subsequent laboratory chemical analysis; and
- Topographic surveying of the location and elevation of the site investigation locations together with topographic data of the site as a whole, in order to pick up accessible features potentially relevant to follow-on works. The topographic survey data is provided in Appendix V.

3.3 Monitoring Well Installations

A summary of the monitoring wells installed during this investigation is provided in Table B, details of well construction and completion are provided within Appendix II.



**SCOTIA GAS NETWORKS
FACTUAL SITE INVESTIGATION REPORT
CRAMPTONS ROAD, SEVENOAKS**

Table B Summary of Monitoring Well Installations

Well Number	Depth of Screen (top / base m bgl) with gravel pack	Screened Lithology	Location
MW14-02d	7.0 – 10.3	Folkestone Formation	Along the southern boundary of the western compound
MW14-03	5.9 – 9.1	Folkestone Formation	In the south eastern corner of the eastern compound
MW14-04	5.5 – 8.5	Folkestone Formation	In the north eastern corner of the site in the eastern compound
MW14-05	2.9 – 4.3	Folkestone Formation	In the northern corner of the western compound
MW14-07	6.9 – 10.3	Folkestone Formation	Along the western boundary of the western compound

3.4 Chemical Analysis of Samples

Soil and groundwater samples were sent to Jones Environmental for chemical analysis, a UKAS and MCERTs accredited laboratory. The laboratory is also a WorleyParsons approved supplier.

A total of 57 No. soil samples were collected during the recent investigation program, and were scheduled for laboratory analysis. The samples were schedule for a combination of analysis including:

- Metals(Cr (III and VI), As, Cd, Pb, Hg, Se, Cu, Ni, Zn, B);
- Organics (PAHs, VOCs, TPH-CWG, Speciated Phenols);
- Fraction Organics Carbon (FOC);
- Particle Size Distribution and Bulk Density;
- Asbestos;
- Total and Free Cyanide, Water Soluble Sulphate, pH;
- Ammoniacal Nitrogen; and
- Leachate analysis (40 No. samples).

A total of 20 No. groundwater samples were collected from installed monitoring wells across three monitoring rounds, including three duplicates (one for each round). The samples were schedule for a combination of analysis including:

- Metals(Cr (VI and VIII), As, Cd, Pb, Hg, Se, Cu, Ni, Zn, B);
- Organics (PAHs, VOCs, TPH-CWG, PCBs, Speciated Phenols);



**SCOTIA GAS NETWORKS
FACTUAL SITE INVESTIGATION REPORT
CRAMPTONS ROAD, SEVENOAKS**

- Fraction Organics Carbon (FOC); and
- Total, complex and free Cyanide, Thiocyanate, pH and Ammoniacal Nitrogen.

Laboratory certificates are presented in Appendix III.

3.5 Quality Control / Quality Assurance

Analysis of the quality assurance/quality control (QA/QC) data for soils and groundwater was also undertaken, and the findings are summarised below. The assessment tables are included in Appendix IV.

Soil

Five soil sample duplicate samples were obtained during the recent intrusive work (from parent samples HP14-01 0.01 to 0.6m bgl (Duplicate A), MW14-02d 0.0-0.5m bgl (Duplicate B), MW14-02d 1.8 to 2.1m bgl (Duplicate D and E) and MW14-07 2.5 to 3.0m bgl (Duplicate E).

Of the constituents deemed acceptable for Relative Percentage Difference (RPD) analysis duplicate samples from HP14-01 0.01 to 0.6m bgl, MW14-02d 0.0-0.5m bgl, MW14-02d 1.8 to 2.1m bgl had a number of parameters, notably PAHs that fell outside of the RPD screening criteria. With the exception of sulphate, no parameters exceeded the RPD screening criteria for MW14-07 2.5-3.0m and its duplicate sample.

The observed exceedances were noted within samples collected from made ground and the made ground alluvium interface; it is therefore considered that these RPD exceedances are due to the heterogeneous nature of the made ground rather than laboratory error.

The sample and duplicate sample from MW14-07 2.5m to 3.0m bgl were collected from the natural material, and show a good comparison.

Groundwater

Duplicates of the groundwater samples for three rounds indicated relatively good comparable results, with limited, three in round 1, two in round 2 and three in round 3, parameters falling outside the RPD screening criteria of +/- 20%. The elevated RPD values are likely to be attributed to the low detection limits for the constituents analysed rather than analytical error, and therefore do not represent significant concern with the analytical data.

3.6 Constraints to the investigation

The following constraints to the planned investigation resulted in variations from the anticipated scope of works:

- Access to the eastern SGN site is through the adjacent NGPH property bordering onto Cramptons Road;
- Access to the western SGN compound is through the adjacent DIY store with access off Otford Road (A225); and
- A concrete slab was encountered at 0.9 m bgl in three starter pit locations for the proposed monitoring well (MW14-02), as such the monitoring well was located approximately 3 m to the north of its proposed location.



**SCOTIA GAS NETWORKS
FACTUAL SITE INVESTIGATION REPORT
CRAMPTONS ROAD, SEVENOAKS**

Although the access to the SGN site was a variation from the original scope of work, it didn't significantly hinder this investigation, however it could be a potential constraint if further site works are carried out in the future.



**SCOTIA GAS NETWORKS
FACTUAL SITE INVESTIGATION REPORT
CRAMPTONS ROAD, SEVENOAKS**

4. SITE INVESTIGATION FINDINGS

Observed soils and geology have been logged in general accordance with the requirements of BS5930:1999 +A2:2010. A summary of the ground conditions identified during the investigation is given below.

4.1 Ground Conditions

Borehole logs are provided in Appendix II and photographic records of the exploratory positions can be found embedded alongside the trial pit logs and within the plates which accompany this text. The general geological succession encountered beneath the site during this investigation is summarised below in Table C.

Table C Summary of Ground Conditions

Description of Stratum	Thickness (m)	Depth Encountered (m bgl)
MADE GROUND	up to 4.2	From Ground Level
ALLUVIAL CLAY	0.0 – 4.0	From Ground Level – 1.5
FOLKESTONE FORMATION	(Full thickness not proven)	0.3– 3.8

4.2 Summary of Visual and Olfactory Contaminant Observations

Visual and olfactory indication of contamination included the following:

- Ash, clinker and slag were encountered in made ground across the site;
- Spent Oxide (Dark blue/navy staining) was observed in TP14-03 (3.8 – 4.0), TP14-04 (0.9m bgl), TP14-02 (0.4 – 2.5 m bgl) and TP14-01 (3.1 – 4.1);
- Faint to strong hydrocarbon odours and oily sheens in soils were noted in TP14-01 (3.1 – 4.1), TP14-02 (0.4 – 2.5), TP14-03 (3.8 – 4.0), TP14-05 (0.6 – 1.8), TP14-06 (0.8 – 1.8), MW14-02d (0.0 – 1.5) and BH14-01 (4.0 – 4.2);
- Made ground within the former gasholder (TP14-03 and BH14-01) was observed to be very sandy gravelly clay, with brick, concrete clinker, coal and slag present. Hydrocarbon staining and odours were noted. Furthermore cans (2,5L) of tar/grease were noted at the base of TP14-03. Perched water was present at 3.8m bgl, within the historical structure encountered; and
- Slight sulphur odours in groundwater were noted during second round of monitoring in MW14-03.



**SCOTIA GAS NETWORKS
FACTUAL SITE INVESTIGATION REPORT
CRAMPTONS ROAD, SEVENOAKS**

4.3 Groundwater Observations

Groundwater elevation data is presented in Table 1 and recorded in-situ field parameters are presented in Table 2. Water strikes recorded during drilling are shown on the borehole logs presented in Appendix II.

4.4 Specialist Testing

Rising and falling head (slug) tests were carried out during the first monitoring visit at three locations (MW14-03, MW14-04 and MW14-07). Findings are presented in Appendix VI.

4.5 Obstructions and In-Ground Structures observed

The following obstructions and in-ground structures were observed during the site investigation:

- A below ground, curved wall was uncovered near the western boundary of the western gasholder;
- A below ground concrete obstruction at 0.9 m bgl was encountered near the eastern boundary of the western gasholder and was the cause of refusal for MW14-02a, b & c; and
- Intermediate and medium pressure gas mains were proven (by intention) in the northern section of the site at locations HP14-12 and HP14-13.



**SCOTIA GAS NETWORKS
FACTUAL SITE INVESTIGATION REPORT
CRAMPTONS ROAD, SEVENOAKS**

5. REFERENCES

Table D References

Atkins	2001	Transco Site Cramptons Road, Sevenoaks, Environmental Assessment Site Investigation
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Stanger Science & Scientific	1997	Desk Study of a BG plc Property at Cramptons Road, Sevenoaks



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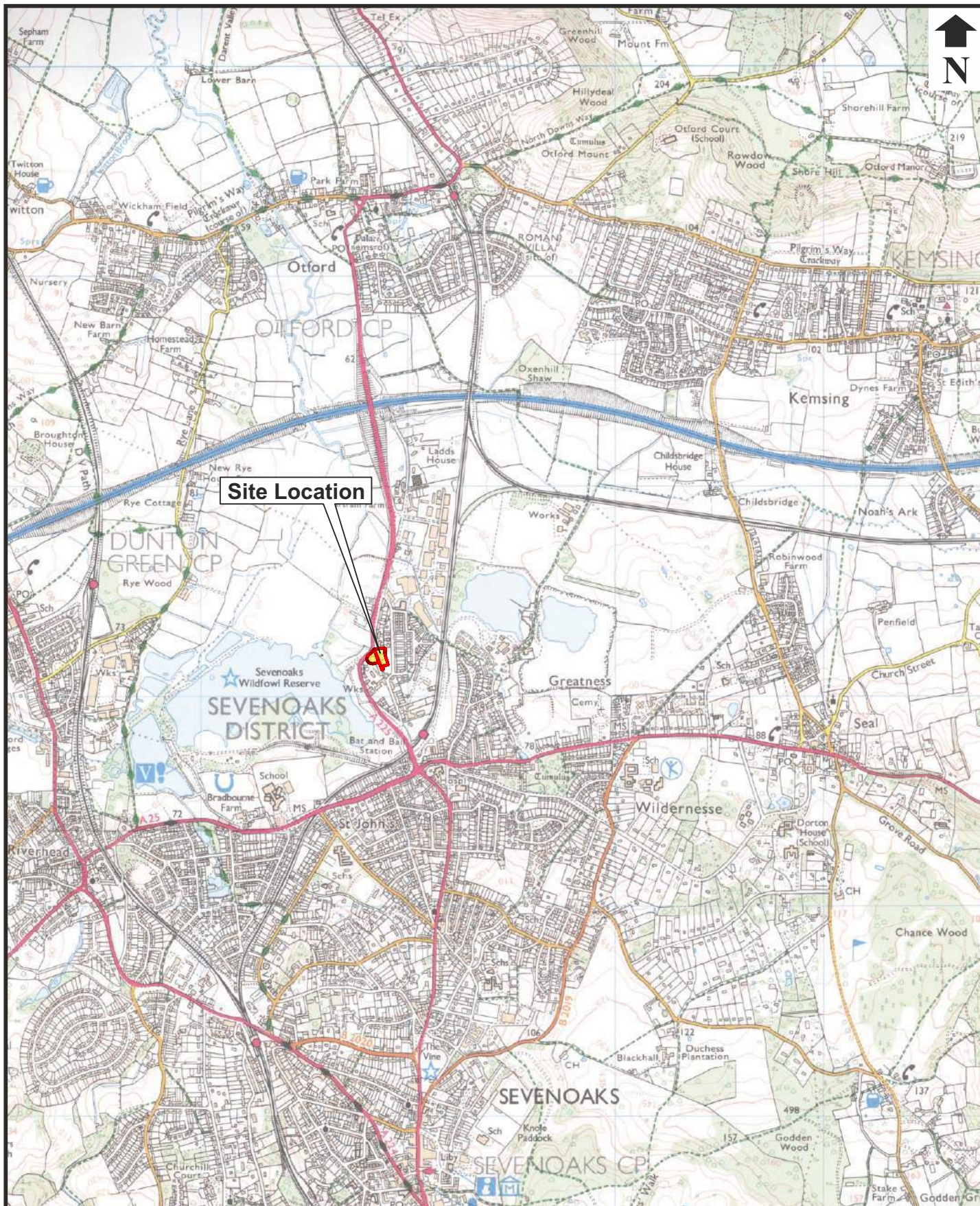
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Figures



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SITE LOCATION



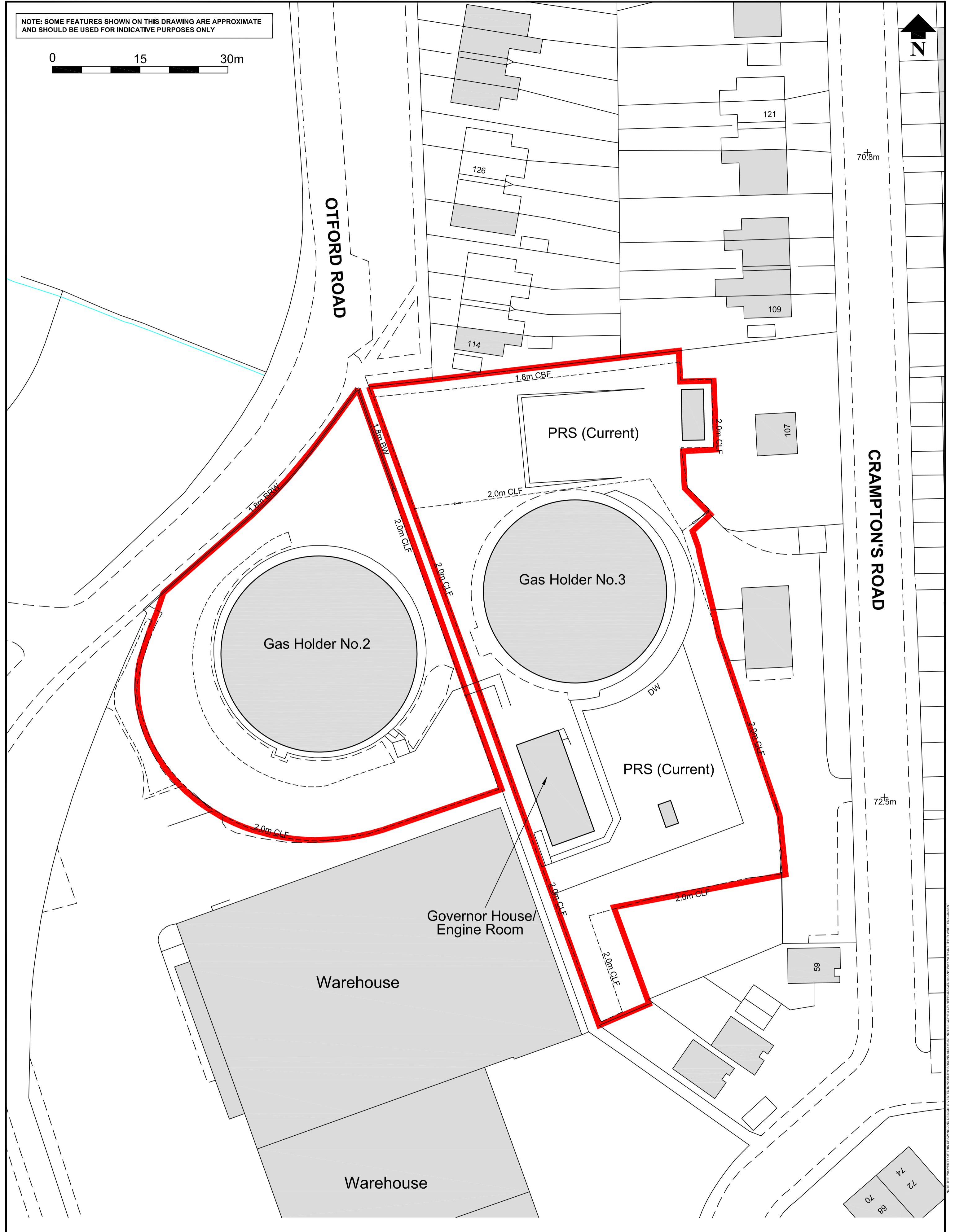
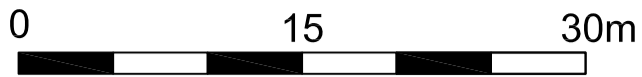
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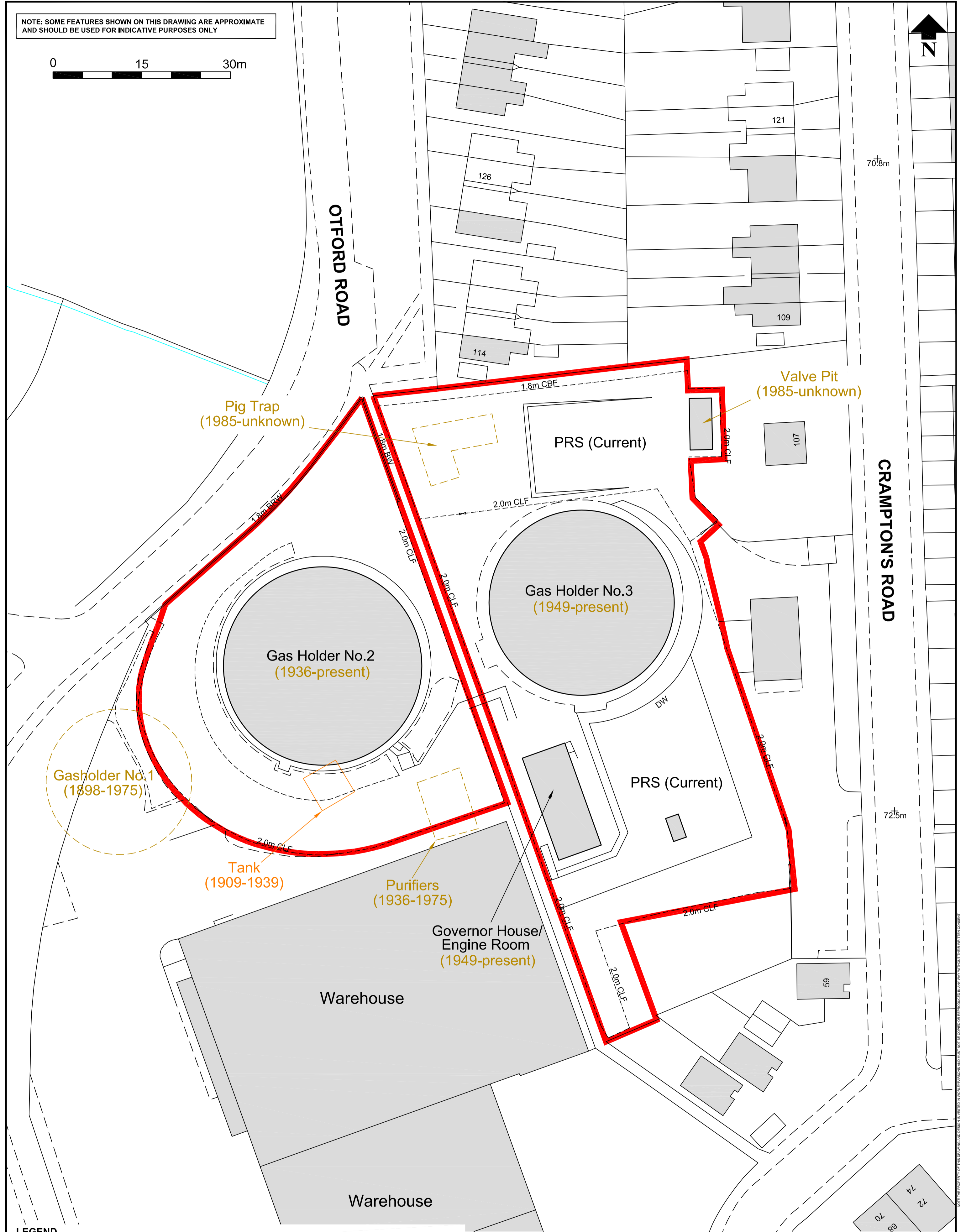
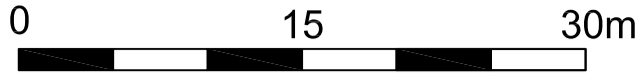
- Scotia Gas Networks site boundary
- Existing Structures

References:
 Base plan detail taken from Promap OS plan
 Service Location Ltd, Basic Topographical Survey, Ref:SL-CC-006-001A, 18.07.14

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- Scotia Gas Networks site boundary
 - Existing Structures
 - Historical Structures (dates shown)
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 - Historical Structures (dates shown)
Envirocheck Report, Ref:58481842_1_1, 18.07.14.

References:
 Base plan detail taken from Promap OS plan
 Service Location Ltd, Basic Topographical Survey, Ref:SL-CC-006-001A, 18.07.14

JOB NO.: 51679-00 SEVENOAKS, KENT					SCOTIA GAS NETWORKS				
HISTORICAL STRUCTURES					WorleyParsons Consulting <small>Tel: 0117 9251304 Fax: 0117 9105139 Web: www.worleyparsons.com</small>				
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