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PLANNING

DESK STUDY AND CONCEPTUAL SITE MODEL
for the site at
FORMER EXPRESS DAIRIES SITE, ORCHARD ROAD,
RICHMOND, TW9 4LZ
on behalf of
HAREPATH LLP

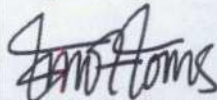
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Title: DESK STUDY AND CONCEPTUAL SITE MODEL
Project: FORMER EXPRESS DAIRIES SITE, ORCHARD ROAD, RICHMOND, TW9 4LZ
Client: HAREPATH LLP
Date: 23 SEPTEMBER 2011
Reference: LS0360
Version: V2 – development proposals revised

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CONTENTS

1.0	INTRODUCTION.....	4
1.1	General	4
1.2	The Site	4
1.3	Form of Development	4
1.4	Standards	4
1.5	Conditions	4
2.0	PHASE I DESK STUDY	6
2.1	Site Walkover Survey.....	6
2.2	Geology	6
2.3	Hydrogeology	7
2.4	Hydrology	7
2.5	Radon Gas	7
2.6	Land Gases	7
2.7	Historical Maps	8
3.0	CONCEPTUAL SITE MODEL.....	9
3.1	General	9
3.2	Potential Sources	9
3.3	Identified Receptors.....	10
3.4	Associated Pathways.....	10
3.5	Source-Pathway-Receptor Linkages.....	11
4.0	GROUND INVESTIGATION	12
4.1	Summary	12
4.2	Strategy.....	12
	GLOSSARY.....	14

FIGURES

FIGURE 1:	Site Location
FIGURE 2:	Existing Layout Plan
FIGURE 3:	Proposed Development Layout Plan
FIGURE 4:	Proposed Investigation Layout

APPENDICES

APPENDIX A:	Historical Maps
APPENDIX B:	Sitecheck Data Report
APPENDIX C:	Local Authority Search

1.0 INTRODUCTION

1.1 General

Land Science (Brighton) Limited was instructed by Harepath LLP to prepare a phase I geo-environmental Desk Study and Conceptual Site Model in relation to the proposed redevelopment of the former Express Dairies site at Orchard Road, Richmond, TW9 4LZ (see figure 1).

1.2 The Site

In summary, the site comprised an industrial unit in a mixed residential and commercial area currently occupied by a hand car wash and a distributor of electrical, plumbing and bathroom supplies. The layout of the existing site is indicated on Figure 2, and a site walkover survey is presented in section 2.0.

1.3 Form of Development

It was understood that the proposed development was to comprise the construction of a two low to medium rise structures to comprise flats with communal soft landscaping. Figure 3 illustrates the ground floor layout of the proposed redevelopment.

1.4 Standards

Where practicable, the ground investigation and subsequent geotechnical and environmental assessments were undertaken in accordance with the following documents and guidance:

- CLR11: Model Procedures for the Management of Contaminated Land, DEFRA and Environment Agency 2004
- Environment Agency Guidance on Requirements for Land Contamination Reports, Version 1 dated July 2005.
- Planning Policy Statement (PPS) 23: Pollution
- Building Regulations Approved Document C: Site preparation and resistance to contaminants and moisture
- NHBC Standards Chapter 4.1 Land Quality - Managing Ground Conditions, September 1999

Other technical sources have been identified in respect of specific aspects of the investigation, as referenced throughout the text.

1.5 Conditions

Environmental interpretations are inherently dependant on the conditions revealed by a limited set of data and the accepted means of interpreting that data in use at the time of the investigation. Every effort is made to ensure that such data is accurate and representative, and that any assessment is performed under current best practice. However, we do not accept any liability for the scope of the investigation, for conditions that have not been directly revealed through the

investigation, or for the ultimate reliability of any published and current assessment criteria or procedures adopted in interpreting that data.

Any spatial or temporal extrapolation or inference is conjectural and no liability can be accepted for its accuracy; in particular, differing conditions may be revealed between or under points of investigation, and the concentrations or levels of mobile liquid and gaseous materials are likely to vary over time. It is also an inherent aspect of any investigation that areas of concern not previously anticipated are identified as works progress, and elements of the project design may vary during or after completion of the investigation; whilst every effort is made to tailor the investigation to suit within practical constraints as works progress, it may become necessary to undertake additional investigation work.

Information contained in this report is intended for the use of the Client and his agents for the purposes set-out in the text, and Land Science (Brighton) Ltd makes no warranty or representation whatsoever express or implied with respect to the use of this information by any other party or for uses other than those described. We do not indemnify the Client or any third parties against any dispute, claim or consequential losses arising from any finding or other result of this investigation report. No aspect of this report should be taken as a guarantee that a site is free of hazardous or potentially contaminative materials.

2.0 PHASE I DESK STUDY

2.1 Site Walkover Survey

In summary, at the time of the investigation the site comprised an industrial unit currently occupied by a hand carwash and an internet based wholesaler electrical, plumbing and bathroom supplier. The site was occupied by a single main building, with two storey office accommodation in the centre, with a glass roofed industrial style area at the rear and a canopied loading area at the front.

Generally the site was flat and level, with external areas occupied by tarmacadam and concrete hardstandings served with surface water drainage provisions. The local area was also generally flat and level.

To the south (rear) of the site were terraced period residential dwellings. To the west was a gas depot including a working gas holder, and to the north-west was a supermarket with a petrol filling station. To the north was a former factory and works which was being redeveloped for residential purposes. To the east were a number of industrial units.

2.2 Geology

British Geological Survey 1:50,000 sheet number 270 entitled "South London" indicated the geology of the site to comprise the following anticipated geological succession:

Unit	Details
Kempton Park Gravel	Sand and gravel, locally with lenses of silt, clay or peat
London Clay	Fine, sandy, silty clay/silty clay. Glauconitic at base

Published Geological Succession

A previous investigation undertaken on the neighbouring site to the north (GESL, reference GE6254, dated 28 May 2008) was made available by the Client. In summary, the following ground conditions were encountered:

Unit	Depth	Details
Made Ground	0.90-2.25m	Dark brown sandy gravel fill, becoming clayey and silty with depth. The gravels were found to comprise flints and brick fragments with occasional concrete, ash, clinker, aggregate, charcoal and rare cement board fragments.
River Terrace Deposits (Kempton Park Gravel)	>5.60mbgl	Orange and light brown gravelly fine to medium sands and occasionally sandy gravels. The gravels comprised fine to coarse angular flints. A slight malodour was noted at depth within WS102 and WS106.
London Clay	4.9-5.60m	Dark grey clays with occasional Selenite crystals

Locally encountered soil conditions

With the exception of ash, clinker and coal etc entrained within the Made Ground, visual evidence of possible contamination restricted to staining and strong organic odours at the base of the River Terrace Deposits at 4.20-5.40mbgl.

Elevated Lead was encountered within one borehole, but additional investigation revealed the extent to be limited. Marginally elevated Arsenic was recorded across the site. Locally elevated concentrations of Cadmium and Selenium were identified.

2.3 Hydrogeology

Based on the former classification of the River Terrace Deposits as a Minor Aquifer, it was anticipated that the site overlay strata categorised as a Secondary Aquifer. The site does not lie within a groundwater Source Protection Zone.

Groundwater levels in standpipes installed as part of the previous investigation were monitored on three occasions, and water levels in the range of 2.32mbgl and 3.22mbgl were recorded; it was reported that the investigation was carried out during a period of wet climatic conditions.

Marginally elevated Nickel and Benzo(a)pyrene were recorded within the groundwater in comparison to drinking water standards. Occurrences of possible field evidence of water contamination (such as oily sheens, discolouration, etc) were not recorded.

2.4 Hydrology

No surface water features were identified on the site itself or the immediate vicinity. The River Thames was noted approximately 270m to the north-east. Groundwater flow was anticipated to be towards the north-east, at a shallow hydraulic gradient.

The site was not indicated to be susceptible to flooding, although land a short distance to the east was noted to be susceptible to extreme flooding but benefiting from flood defences.

2.5 Radon Gas

In accordance with BRE 211:2007, the site lies in an area where neither Radon Protection Measures nor a detailed geological assessment are required. It is therefore also unlikely that the government action level for commercial land uses would be exceeded.

2.6 Land Gases

No active landfill sites were identified in the vicinity. The London Borough of Richmond did not hold any records of pre-licensing landfill sites within 250m.

Three pairs of monitoring standpipes were installed, with one of each installed into the Made Ground and the other sealed through the Made Ground and taken into the River Terrace Deposits. The installations were monitored on three occasions during periods of varying atmospheric pressure conditions. No Methane was detected within any of the positions. Carbon Dioxide was

recorded at concentrations ranging between 0.0% and 1.9 %v/v. Depleted Oxygen concentrations were recorded, with a minimum concentration of 18.6 %v/v. A maximum differential flow reading of +0.5l/hr was recorded (the majority were 0.0l/hr). VOC concentrations were found to be relatively low, recorded between 0.0ppm and 21.8ppm.

2.7 Historical Maps

Historical maps dating back to 1870 were obtained as part of the desk study, and a summary of the key features is presented below.

Date	On Site	Off Site
1870	The site falls partly within an open field (tithe no. 14) and a (plant) Nursery. A stream crosses the site from north-west to south-east.	A number of terraced dwellings are noted to the north. To the north-west is Richmond Gas works, with three gas holders and a number of associated buildings shown.
1894	Part of the eastern site boundary is shown. A triangular shaped arrangement of buildings is noted in the north-west corner, representing possible stores or stables etc.	The gas works has been extended and further terraced residential dwellings are noted to the north.
1913	One of the stores or stables is possibly indicated to be a Smithy (Blacksmiths). The southern site boundary is noted.	Terraced dwellings are noted to the south.
1933	The buildings, the stream, or nursery are not indicated. The site is open to the adjoining gas works. A small building is indicated along the eastern boundary.	The gas works to the west has been extended and a new holder is indicated adjacent to the site (in the location of the holder noted in the present day).
1960	The building along the eastern boundary is no longer indicated.	A number of works buildings are noted on land to the east.
1973	The site is indicated to be a Milk Depot, with the site boundaries and building accommodation commensurate with the present day.	Further unidentified works and factories are noted to the north and east. The gas works is now labelled a depot. A number of tanks and sub-stations are shown.
1994	No significant changes noted.	No significant changes noted.

Summary of Historical Map extracts

In summary, the site formed part of open fields and a nursery. The north-west corner was developed as a collection of stables/stores buildings around a courtyard, later with a blacksmiths possibly occupying part; a stream or ditch crossed the site. The buildings were no longer shown c.1933, with the site falling within an adjacent gas works, including for a time one small undifferentiated building along the eastern boundary. The site was then developed as a dairy by c1973, with the boundaries and building accommodation commensurate with the present day.

3.0 CONCEPTUAL SITE MODEL

3.1 General

Possible risks associated with potential contamination have been assessed following a source-pathway-receptor ('SPR') approach. A risk may only exist where a plausible SPR linkage is present, and where the quantity or concentration of a contaminant is sufficient so as to pose harm. The identification of potential sources, receptors, and plausible pathways in the following sections together forms a preliminary Conceptual Site Model ('CSM').

3.2 Potential Sources

A number of possible sources of contamination have been identified, as summarised below. The medium in which resultant contamination might exist is noted, i.e. soil phase (S), water phase (W) or gas/vapour phase (G).

Source	Description	Notes	S	W	G
Made Ground / Fill.	General background chemical quality of any imported Made Ground materials. Any fill will pre-date c.1973. A drainage ditch crossed, and may have been subsequently infilled; any alluvially derived soils may contain organic matter.	Possible elevated metals, non-metals, and organic contaminants. Possible generation of common land gases from fill or alluvial materials (Carbon Dioxide, Methane, depleted Oxygen).	Y	Y	Y
Blacksmiths	A blacksmiths may have been located in the north-west of the site.	Possible elevated metals and PAH's from coal storage and possible deposition of ashes.	Y	Y	
Gas works (on site)	The site formed part of the adjacent gas works and may have been used for materials or waste storage (but not for gas production such as retort houses, liquor tanks, etc)	Materials storage might include lime or coal. Waste materials might include solids such as foul lime, spent oxide or bog ore, but was unlikely to include liquids such as ammoniacal liquors or tars.	Y	Y	
Gas works (off site)	Major gas production infrastructure was located some distance to the north-west. Groundwater flow was anticipated towards the north-east, and so significant water-borne lateral migration on-site was unlikely.	Coal gas generation may give rise to a significant range of contaminants including metals, non-metals and organics, and gases/vapours.		Y	Y
Dairy	The site was used as a milk depot. Electrical vehicles would have been charged and serviced on site.	Electrical vehicles may have given rise to oils and transformer fluids (possible containing PCB's).	Y	Y	Y
Car wash	The site has recently been used as a hand car wash.	Waters contaminated with fuels and oils may have permeated through the hardstandings of entered the ground via the drainage system.	Y	Y	Y

Possible sources of possible soil contaminants

In terms of the recent site uses (dairy, car wash) the prevalence of hardstandings and the provision of surface water drainage system would restrict any widespread contamination, with contaminants being more preferentially located around any soakaways, broken drain runs, petrol interceptors, and the like.

The use of parts of the site historically as stables/stores or more recently for bathroom, plumbing and electrical supplies were not considered to be significant sources of possible contamination.

3.3 Identified Receptors

Potential receptors associated with the site and its redevelopment, identified or otherwise discounted, are summarised on the following table:

Receptor	Description	Notes	Sensitivity
Site Workers	Persons involved in construction and future maintenance.	Major ground works are proposed including foundation excavations and landscaping.	High
End Users	Occupants of the proposed redevelopment.	The proposed development comprised ground floor commercial units and residential flats above.	High
Building Materials	Elements of the built environment in direct contact with the ground.	Buried plastics (e.g. water supplies) and concrete (e.g. foundations) are anticipated.	Moderate
Soft landscaping	Any areas of proposed planting	Communal soft landscaping was proposed.	Moderate
Adjacent Land Users	Sensitive land uses identified within the immediately vicinity	Existing terraced residential dwellings were noted to the south.	High
Ground Water	Controlled Waters contained within the aquifer(s) beneath the site	Whilst the site overlies a Minor Aquifer, the site does not lie within any groundwater PSZ and no water abstractions have been identified locally.	Moderate

Possible Receptors of Contamination

Surface water and statutory ecological receptors have not been identified as potential receptors; no soft landscaping is proposed, no surface water features were identified on site or the immediate vicinity, and no statutory ecological receptors such as green belt or protected natural areas were identified in the vicinity.

3.4 Associated Pathways

Based on the identified receptors, the following pathways have been evaluated in this assessment (overleaf):

Controlled Waters	
• Leaching into pore water	• Diffusion and dispersal into groundwater
• Downward migration	• Lateral migration and dispersion
Human Health	
• Ingestion of soil and dust	• Inhalation of dust, gases and vapours
• Dermal contact with soil and dust	• Consumption of home-grown produce
• Ignition (fire, explosion)	• Inhalation of gases (asphyxiation)
Building materials	
• Chemical attack	

Identified Pathways

3.5 Source-Pathway-Receptor Linkages

Whilst the various possible sources and receptors have been identified, the following matrix illustrates the identified pathways by which a contaminant linkage might plausibly exist:

		Sources		
		Soils	Waters	Gases / Vapours
Receptors	Site Workers	Ingestion, dermal contact, inhalation	Dermal contact (during deep excavations)	Inhalation, ignition
	End Users	None	None	Inhalation, ignition
	Building Materials	Chemical attack	Chemical attack (deep foundations)	Chemical attack by VOC vapours
	Soft landscaping	Plant uptake	None	Root asphyxiation
	Adjacent Land Users	None	None	Lateral migration, inhalation, ignition
	Ground Water	Leaching, downward migration, lateral migration	Lateral migration	None

Identified Source-Pathway-Receptor linkages

In the absence of a shallow water table and given (at least since 1970) the likely prevalence of hardstandings, no significant mechanisms existed for the shallow lateral migration of contaminants onto adjoining properties. The site is to be completely covered with hardstandings and so no exposure pathway exists between soils and end users. No pathways have been identified between waters and either end users or adjacent land users, on account of the depth to the groundwater table. The leaching and downward migration of contaminants from soils into the water table may be limited due to the current (and proposed) prevalence of hardstandings.

4.0 GROUND INVESTIGATION

4.1 Summary

The conceptual site model identified a number of source-pathway-receptor linkages, which will need to be evaluated by means of intrusive ground investigation, namely:

- Exposure by site workers to contaminants in soil (during demolition and ground works), in water (through deep excavations and dewatering) and gases/vapours (especially in confined spaces such as deep excavations)
- Exposure by end users to gases and vapours
- Chemical attack on building materials including buried pipework and concrete by soil, water and vapours
- Risks of plant uptake and root asphyxiation in terms of proposed soft landscaping
- Lateral migration of gases and vapours onto neighbouring property, particularly residential dwellings to the south
- The leaching-out of contaminants in soils into the water table, and off-site migration.

Investigations have previously been undertaken on another site immediately to the north, and the Local Authority had specific requirements for the scope of ground investigation, including monitoring of gases in the Made Ground and natural soils, analysis of soil samples at regular intervals from the Made Ground and underlying natural soils, and water monitoring and sampling. It is likely that the Local Authority will require a similar level of investigation at this site.

4.2 Strategy

Based on the above, the following scope of investigation is proposed:

- Drilling of window sampler boreholes in the positions shown in figure 4; the positions are targeted to specific areas of concern as identified in the table below.
- Samples of Made Ground should be collected for laboratory analysis at approximate 1m centres, together with one sample from the underlying natural soils. The main suite of analysis is identified below.
- All samples should be screened for VOC's in headspace using a photo-ionisation detector. Where evidence of VOC's is recorded, the samples should be submitted for speciated VOC and SVOC analysis.
- Installation of two monitoring standpipes at each location, one into the Made Ground and the other sealed into the River Terrace Deposits. Six monitoring visits should be undertaken over a period of three months, in accordance with CIRIA C665, and include periods of differing climatic and atmospheric pressure conditions.
- Collection of water samples from the deeper boreholes for a similar suite of analysis.

The analytical suite, based on the known site history, should include (continued overleaf):

- General parameters: Acidity (pH), fraction of organic carbon.

- Metals; Arsenic, Cadmium, Chromium (total), Lead, Mercury, Selenium, Boron, Copper, Nickel and Zinc.
- Non-metals; water soluble Sulphate, Sulphide, Elemental Sulphur, total Cyanide, free Cyanide, Thiocyanate, Ammonia.
- Organic compounds; Monohydric Phenols, Speciated PAH (EPA16). One sample position to be analysed for PCB's, VOC's and SVOC's, depending on the PID screening.
- Asbestos identification where possible Asbestos containing materials are identified.

The borehole positions are targeted as follows:

Area of Concern	WS1	WS2	WS3	WS4	WS5	WS6	WS7
Made Ground	Y	Y	Y	Y	Y	Y	Y
Blacksmiths	Y						
Adjacent gas works	Y	Y					
Gas works on site	Y	Y	Y	Y	Y	Y	Y
Adjacent land users (south)			Y	Y			
Dairy	Y	Y	Y	Y	Y	Y	Y
Car wash	Y					Y	

Investigation strategy

Further boreholes may be required, additional samples analysed or additional determinands added to the analysis, as appropriate, based on any field evidence of possible contamination encountered.

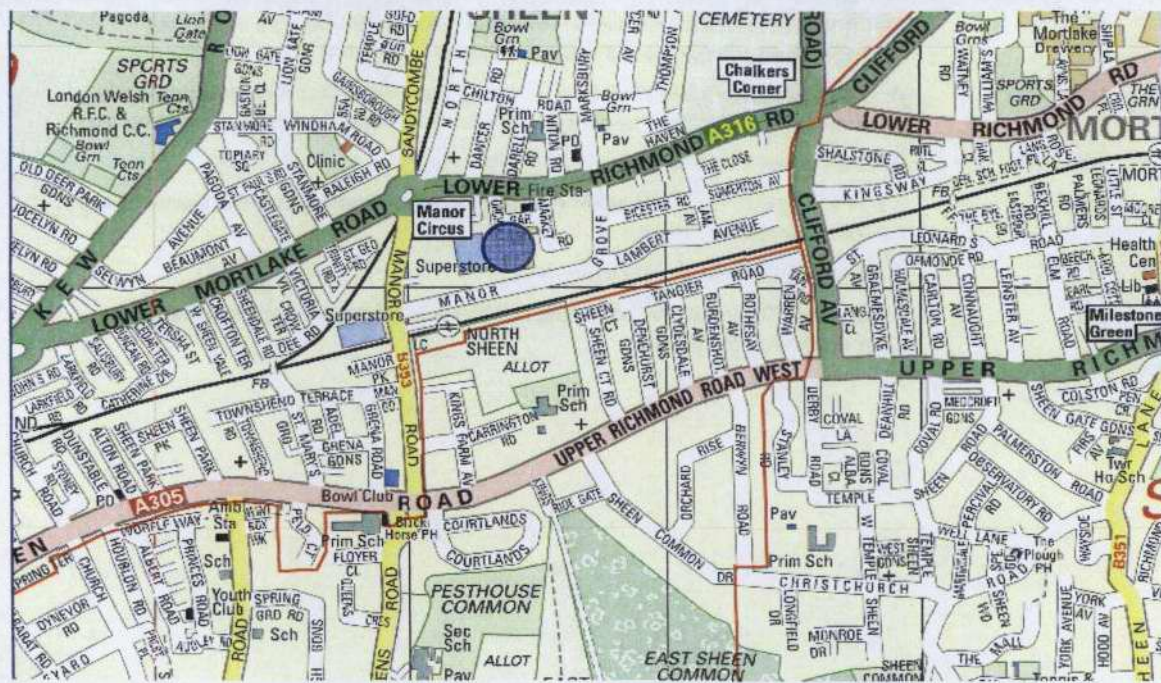
The Local Authority specified that a "phased" approach to the investigation should be taken, and the above is considered to represent a comprehensive scope of works for a main phase of investigation.

Based on the above, the cost for ground investigation by a reputable Consultancy with proper insurance coverage and quality control practices is estimated to be in the order of £10,000 to £12,000 ex VAT.

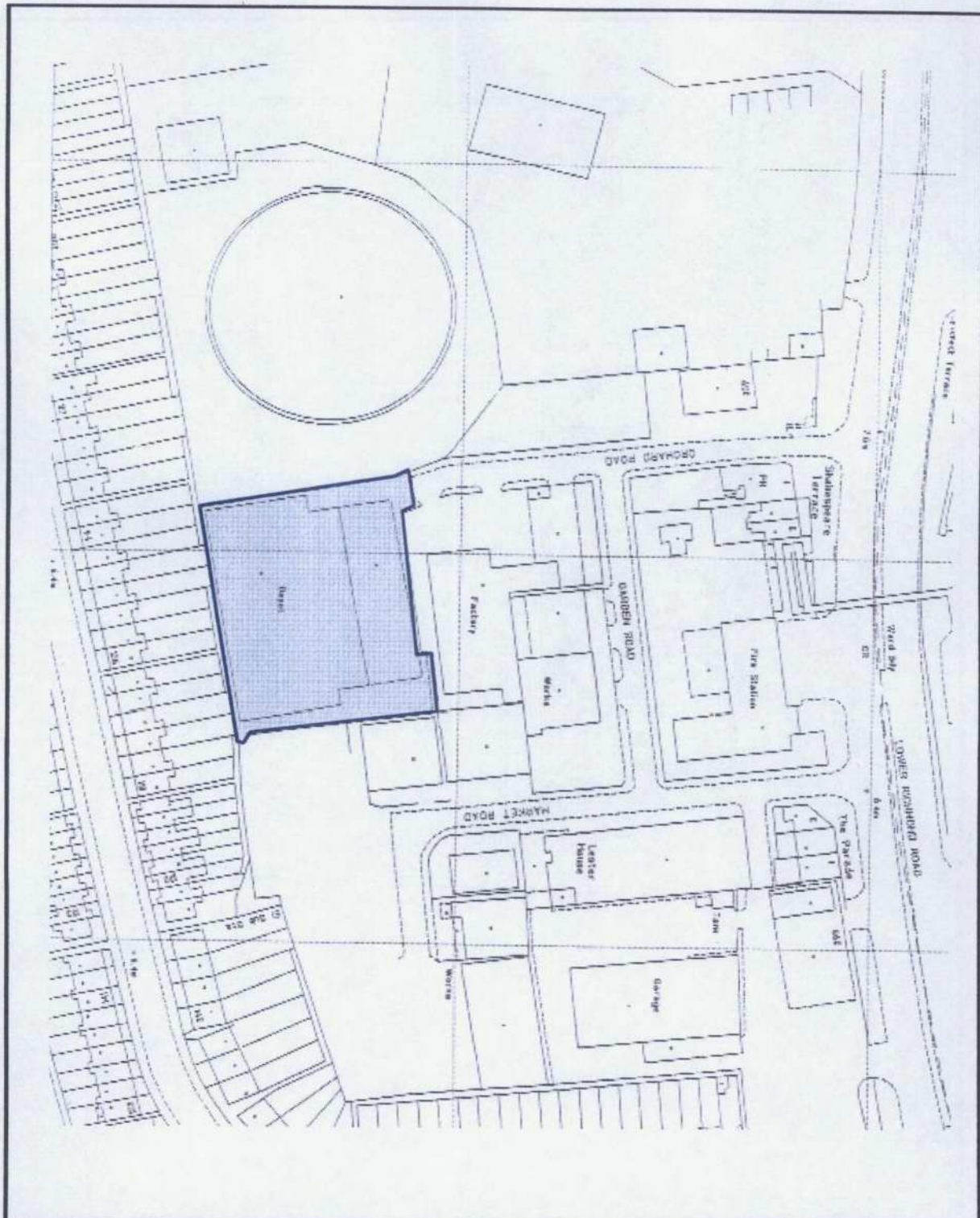
GLOSSARY

BGS	British Geological Survey
BH	Borehole
BRE	Building Research Establishment
BSI	British Standards Institute
CBR	California Bearing Ratio
CDM	Construction Design and Management regulations
CFA	Continual Flight Auger
CIRIA	Construction Industry Research and Information Association
CLEA	Contaminated Land Exposure Assessment model
CLR	Contaminated Land Remediation report
COSHH	Control of Substances Hazardous to Human Health regulations
COMAH	Control of Major Accident Hazards regulations
CSM	Conceptual Site Model
DEFRA	Department for Environment, Food and Rural Affairs
DETR	Department for Environment, Transport and the Regions
DQRA	Detailed Quantitative Risk Assessment
DP	Dynamic Probe
EA	Environment Agency
EQS	Environmental Quality Standards
F.O.C	Fraction of Organic Carbon (used in environmental risk assessments in partitioning contaminants between soil organic matter and other phases)
GAC	Generic Assessment Criterion (a comparative concentration set for screening and assessing soil contamination based on standard exposure parameters)
GQRA	Generic Quantitative Risk Assessment (a preliminary assessment of risk from soil contamination using GAC)
Hot-spot	A distinct zone of elevated results in soil, gas or groundwater
HPA	Health Protection Agency
HSE	Health and Safety Executive
ICRCL	Inter-departmental Committee for the Redevelopment of Contaminated Land
IPC	Integrated Pollution Control
IPPC	Integrated Pollution Prevention and Control
NHBC	National House Building Council
NIHHS	Notification of Installations Handling Hazardous Substances
PAH's	Polycyclic Aromatic Hydrocarbons
PBET	Physiological Based Extraction Testing
PQRA	Preliminary Quantitative Risk Assessment

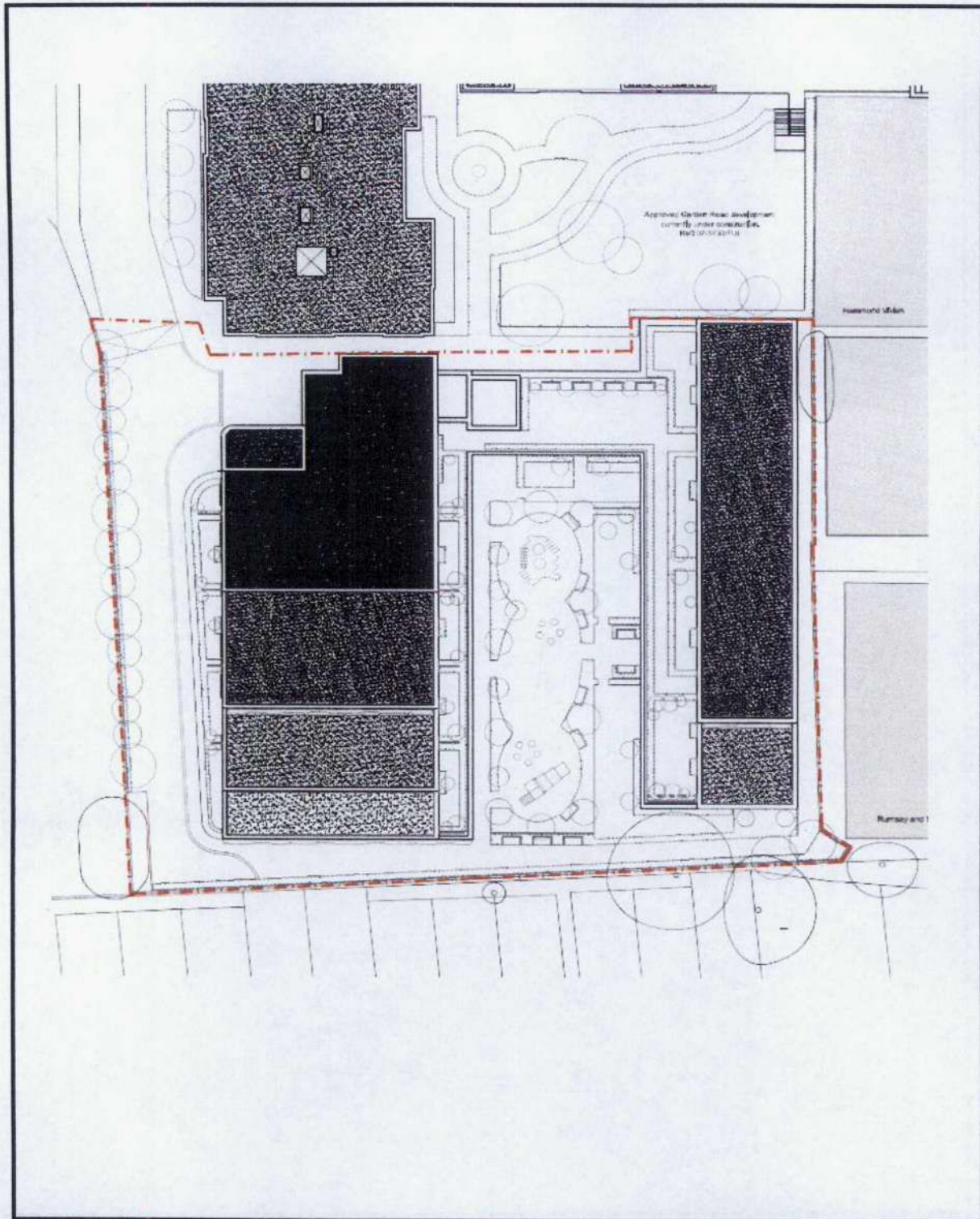
QRA	Quantitative Risk Assessment
SGV	Soil Guideline Value (a GAC calculated by the Environment Agency using the CLEA model)
SOM	Soil Organic Matter (a measure of organic compounds within soil, used in risk assessments)
SPZ	Source Protection Zone (an area placed around a groundwater abstraction borehole of potable quality to protect quality)
SPT	Standard Penetration Test (either a cone or split-spoon driven by a hammer of set weight and dropped a set distance used as a gauge of the density or consistency of soils)
ST-WEL	Short Term Workplace Exposure Limit (a maximum acceptable concentration of a contaminant in air for commercial premises)
SVOC's	Semi-Volatile Organic Compounds
TP	Trial Pit (an excavation made to investigate near surface ground and groundwater conditions, usually undertaken by machine)
TPH	Total Petroleum Hydrocarbons (a bulk measure of all organic compounds usually with equivalent carbon numbers of c10 to c40, some times sub-divided into aromatic and aliphatic species and differing groups of equivalent carbon numbers)
TRRL	Transport Road Research Laboratory
TT	Trial Trench (an elongate excavation usually across a specific feature or area to investigate near surface ground and groundwater conditions)
TWA-WEL	Time Weighted Average Workplace Exposure Limit (an acceptable concentration of a contaminant in air for commercial premises based on average exposure over 8 hours)
VOC's	Volatile Organic Compounds
WAC	Waste Acceptance Criteria (a series of threshold concentrations defining wastes as Inert, Hazardous or Non-Hazardous)
WRAS	Water Regulations Advisory Scheme
WS	Window Sampler (a low-impact drilling technique involving 1m long small diameter tubes driven into the ground)



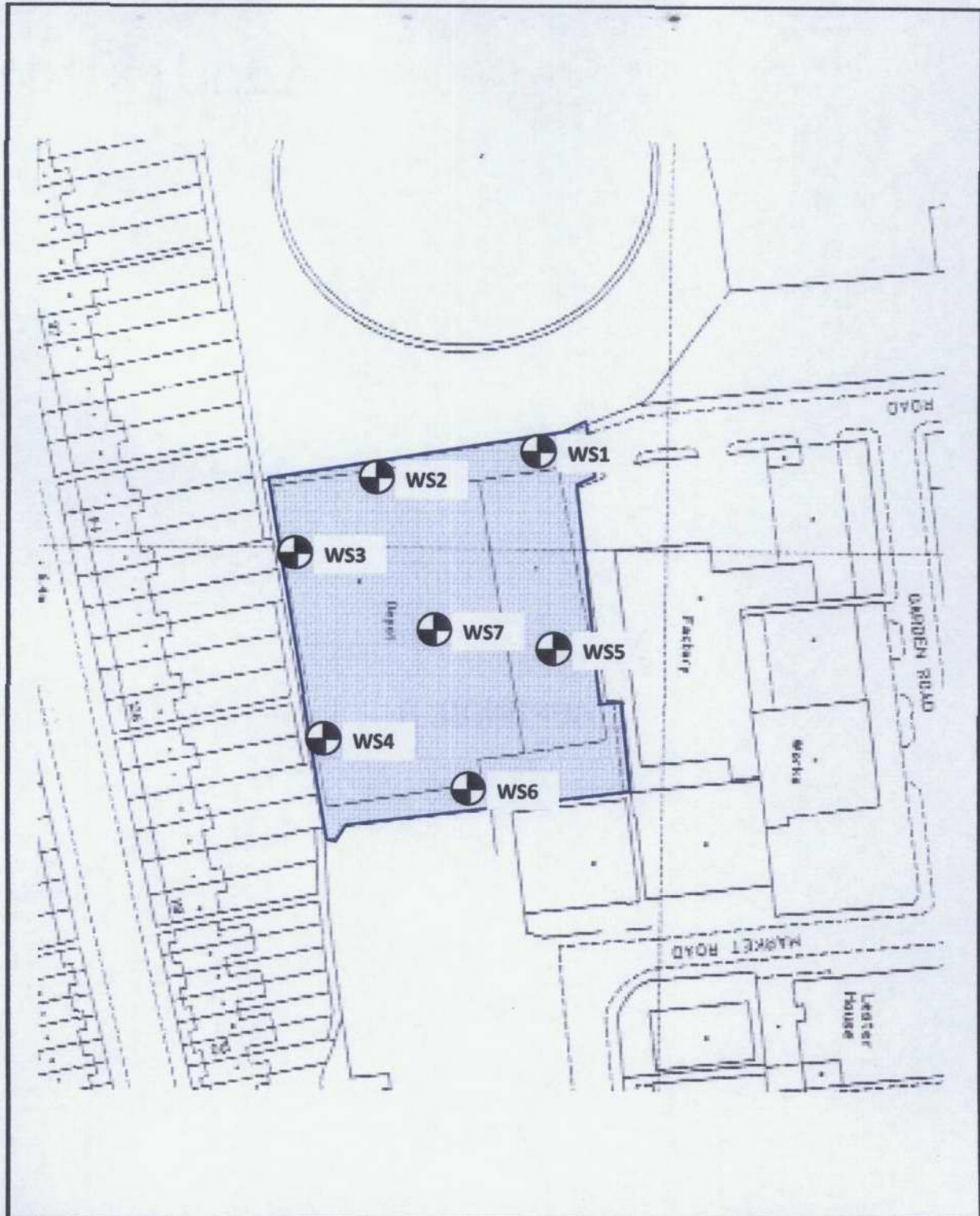
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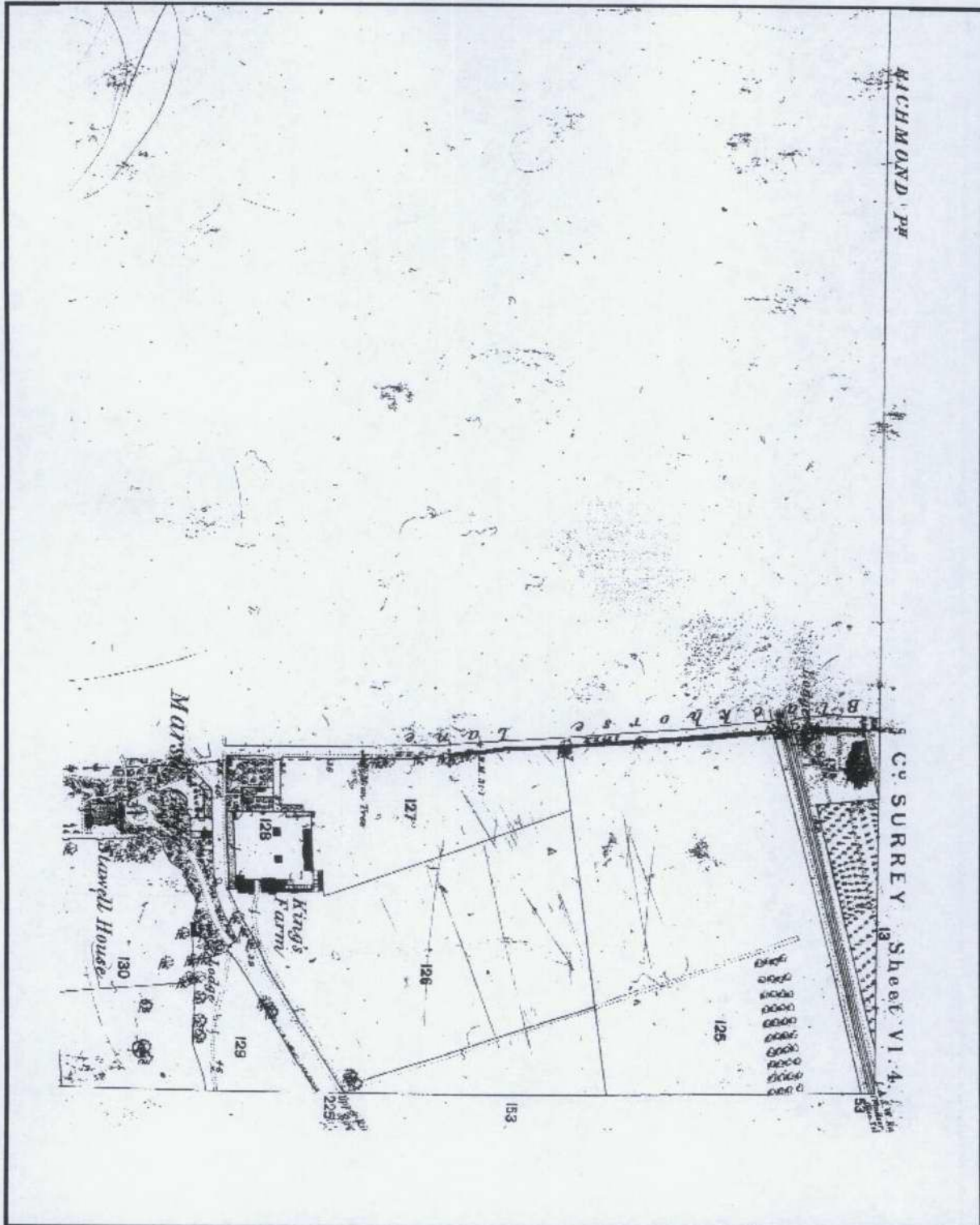


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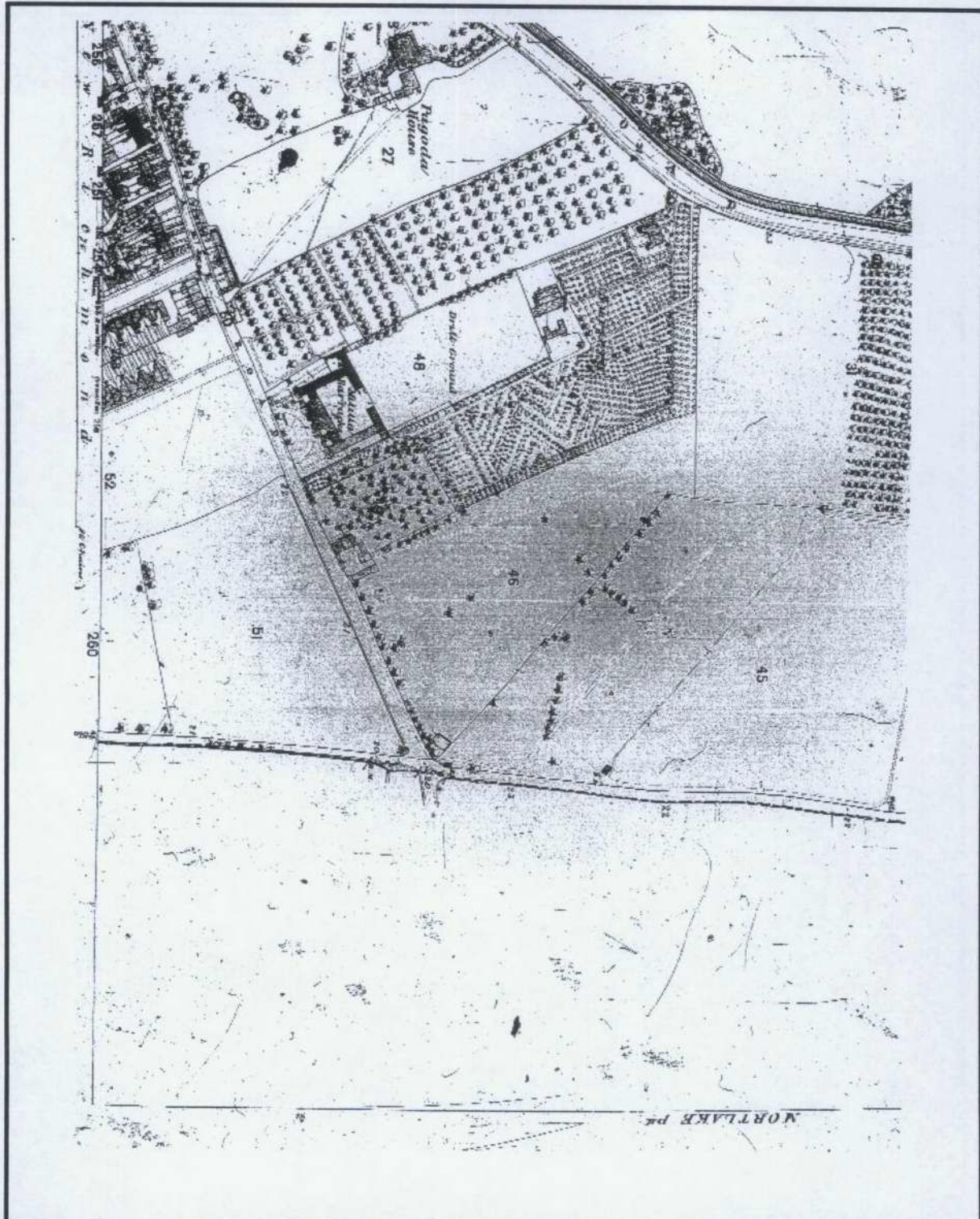


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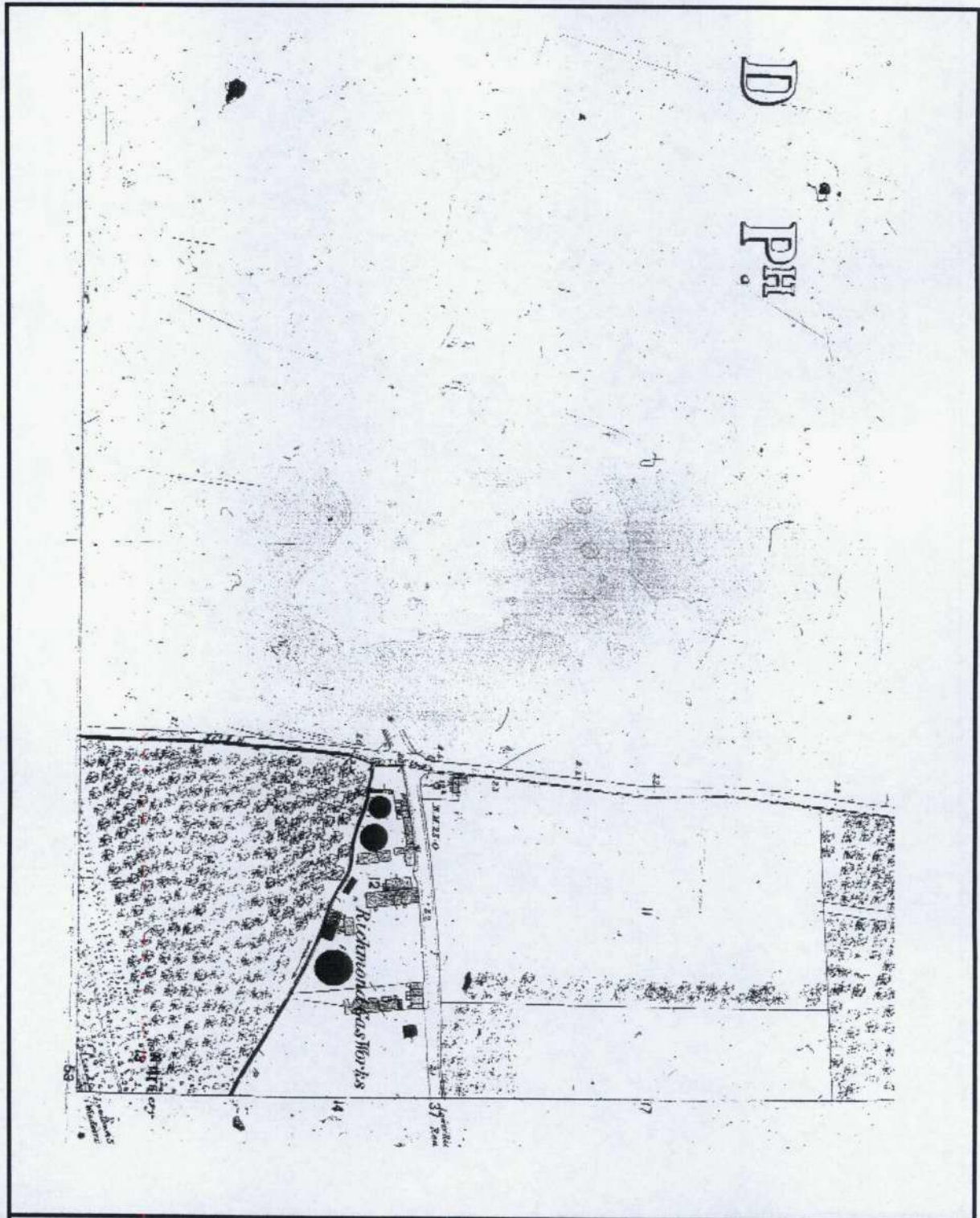
APPENDIX A



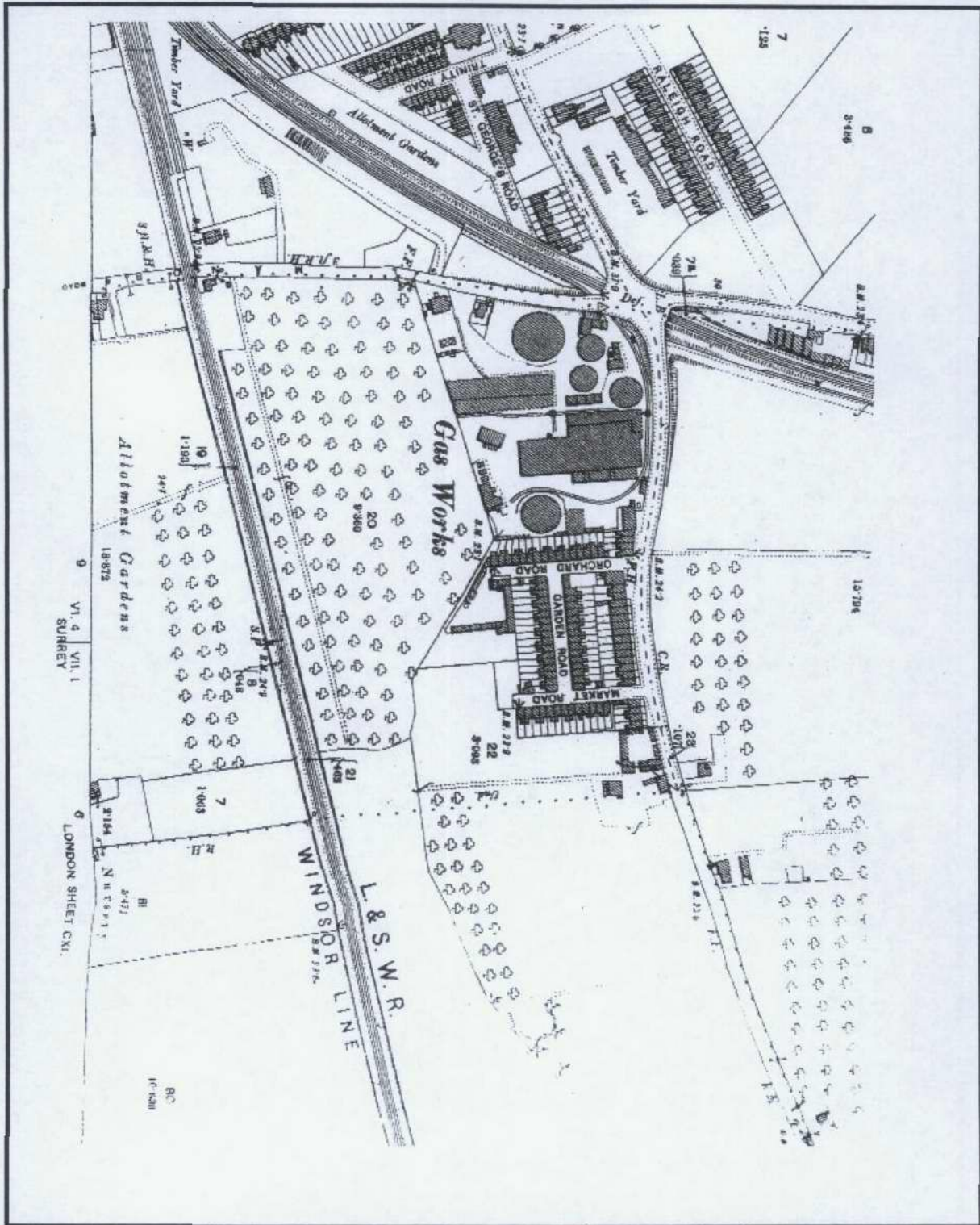
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