

PHILIP EVANS ARCHITECT

**THE WOOD YARD
CHURCH STREET, WELDON NN17 3JT**

**REPORT ON PHASE 1 DESK STUDY
AND FLOOD RISK ASSESSMENT**

Contract: 20024

Date: May 2006

Ian Farmer Associates (1998) Limited

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**REPORT ON PHASE 1 DESK STUDY
AND FLOOD RISK ASSESSMENT**

carried out at

THE WOOD YARD

CHURCH STREET, WELDON NN17 3JT

Prepared for

PHILIP EVANS ARCHITECT

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EXECUTIVE SUMMARY

Phillip Evans Architect, on behalf of Mrs L. Murison, gave instructions for a Phase 1 desk study and flood risk assessment.

The purpose of this investigation was to ascertain the suitability of the ground for the construction of housing, and to identify any possible contaminants that may be present on site and to assess the area for flood risks.

The site is situated in Weldon village approximately 4km to the east of the town of Corby. The geological map of the area suggests the site to be covered by alluvial deposits overlaying outcrops of the Upper Lincolnshire Limestone.

The site has had previous use as a wood yard.

Based on the information obtained during this phase, a Phase II investigation has been recommended in order to obtain greater detail with regards the contamination and flood risk at the site.

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INTRODUCTION

- 1.1 It is understood that it is proposed to develop the site for several residential buildings.
- 1.2 On the instructions of Phillip Evans Architect, on behalf of Mrs L Murison, a Phase 1 Desk Study has been carried out in order to assess the potential hazards on and adjacent to the site and prepare a risk assessment for further consideration.
- 1.3 This report has been prepared for the sole use of the Client for the purpose described and no extended duty of care to any third party is implied or offered. Third parties using any information contained within this report do so at their own risk.
- 1.4 It is recommended that a copy of this report be submitted to the relevant authorities to enable them to carry out their own site assessment and provide any comments.
- 1.5 The comments given in this report and the opinions expressed herein are based on the information obtained from the desk study and site reconnaissance. No intrusive investigation has been carried out to confirm the actual ground or environmental conditions.
- 1.6 Any risks identified in this desk study are perceived risks based on information reviewed. Actual risks can only be assessed following a physical investigation of the site.
- 1.7 This report has been based, in part, on information supplied by others. The report has been prepared on the basis of that information being accurate.
- 1.8 The conclusions presented in this report are based on the guidance available at the time of preparation of the report. No liability can be accepted for the retrospective effects of any changes or amendments to legislation or guidance.
- 1.9 This Phase 1 Desk Study has been conducted in general accordance with CLR 3, ref 12.1 and CLR 11, ref 12.2.

2.0 SITE

2.1 Site Location

2.1.1 The site is situated on Church Street, approximately 4 km to the east of the town centre of Corby and may be located by National Grid Reference 492985, 289442. A site location plan and aerial photograph are included in Appendix 1, Figures A1.1 and A1.2.

2.2 Site Walkover and Description

2.2.1 A walkover survey of the site was conducted on the 12th April 2006. The walkover was carried out in general accordance with CLR 2, ref. 12.3

2.2.2 During the walkover survey, the site was observed to be significantly different to that observed in the aerial photograph. The photograph shows the majority of the site to be covered in trees, with a small area to the north covered by what appears to be furrowed grass. The photograph also shows some indiscernible objects, towards the centre of the northern edge of the site, possibly attributed to anthropogenic substances.

2.2.3 At the time of the survey, the majority of the site was covered by scrub and trees, as indicated in the aerial photograph. A low brick wall bounded the majority of the northwest boundary, with a high wall separating the site from the property to the southwest. A wood fence bounded the southeast edge, with the northeast boundary of the site open.

2.2.4 An access-way had been created running along the southwest boundary, presumably for access to the newly built garage immediately beyond the southern corner, by clearing any vegetation.

2.2.5 Several low channels, approximately 300mm deep by 500mm wide, had been created to the east of the access-way, which extended several metres to the east, and all the way to the northwest boundary. These were surrounded by mounded soil, which was covered by vegetation, as were the channels. Information from the client indicated that these were associated with an earlier archaeological investigation undertaken some years previously.

- 2.2.6 The majority of the northwest edge of the site was significantly different to that shown by the aerial photograph. The area just north of that shown on the aerial photograph to contain indiscernible objects was observed to comprise a concrete slab floor at approximately 0.4m above road level, surrounded by walls beyond which ground level was raised by approximately 1.5m, sloping up to approximately 3m above road level by at the southeast boundary. From inspection, the area of interest on the photograph appeared to comprise mounded demolition waste, although further investigation would be necessary to confirm this.
- 2.2.7 Just south of the slab was situated a separate room containing concrete plinths and a pit, thought to be associated with a heavy duty saw.
- 2.2.8 An area in the centre of the slab indicated natural ground directly underlying the slab, comprising a buff coloured, oolitic limestone. This area also contained an area of rusting, possibly associated with pipes or a historical tank.
- 2.2.9 To the north of the slab, the ground had been excavated to approximately road level. Information from the client indicates that this section contained a thin layer of weak concrete underlying soil and vegetation. The geology exposed was a firm, grey gravelly clay. The excavated ground was mounded to the southwest.
- 2.2.10 A river flowed southwest to northeast, some 13m to the north of the site at its closest point. The water level was some 1.5m below road level. The river is evidently braided as it passes the site, with the channels joining before flowing through a brick arch bridge, 30m to the north of the site.
- 2.2.11 The road level is at an approximate height of 78mOD.

2.3 Historical Maps

- 2.3.1 A review of the history of the site has been conducted based on readily available historical maps. Selected maps are included in Appendix 1.

2.3.2 Northamptonshire County Maps 1885 to 1886, 1:2500 scale, Figure A1.3

The map shows the majority of the site to be undeveloped land, possibly associated with a building located immediately to the southwest. A wooded region lies to the south and the east of the site. The north corner is bounded, and less densely populated with trees. The site is bounded on the north and west by roads and to the south by further garden and woods to the east.

There is a small brook running in a north east to south west orientation approximately 10m to the west.

The village of Greater Weldon is located approximately 200m to the north.

The nearest benchmark is situated 20m to the north of the site and is at a height of 261.4 feet (79.67mAOD).

2.3.3 Northamptonshire County Map 1889, 1:10560 scale, Figure A1.4

There are no significant changes to the site since the previously published map.

There are six quarries situated to the southwest of the site. The nearest of these is approximately 450m away.

2.3.4 Northamptonshire County Map 1900 1:2500 scale

There are little or no significant changes to the site, or surrounding area, since the previously published map.

2.3.5 Northamptonshire County Map 1901, 1:10560 scale, Figure A1.5

There are no significant changes to the site, since the previously published map.

The quarries to the south west of the site are all now appear to be disused.

2.3.6 Northamptonshire County Map 1938 1:2500 scale

There are little or no significant changes to the site, or surrounding area, since the previously published map.

2.3.7 Northamptonshire County Maps 1950 to 1952 1:10560 scale, Figure A1.6

There are little or no significant changes to the site since the previously published map.

A larger quarry area is evident approximately 800m to the south west, which appears to incorporate a number of the older quarries.

A hostel has also been built approximately 300m to the south east of the site.

2.3.8 Ordnance Survey Plan 1958 1:10560 scale

There are little or no significant changes to the site, or surrounding area, since the previously published map.

2.3.9 Ordnance Survey Plan 1964 1:2500 scale, Figure A1.7

A number of undisclosed buildings have been constructed at the northern end of the site. The majority of the remainder of the site is shown as being clear of trees, with the exception of the land in the south and east.

An area approximately 120m to the south east of the site, between the wood and the previously discussed hostel has been developed into a residential area with associated housing and infrastructure.

The map also shows a number of springs, wells and a pond situated 200m to the west of the site.

There is a road level adjacent to the northwest boundary of the site shown as being at 256 feet (78.0mAOD).

2.3.10 Ordnance Survey Plan 1967 1:10560 scale, Figure A1.8

There are little or no significant changes to the site since the previously published map.

The large quarry to the southwest has grown to encompass more of the older quarries in the area. The quarries not in the vicinity of the large quarry are no longer shown on the map.

Approximately 400m to the north of the site a mineral railway is shown running east west.

2.3.11 Ordnance Survey Plan 1974 1:2500 scale

There are little or no significant changes to the site or surrounding area, since the previously published map.

2.3.12 Ordnance Survey Plan 1977 1:2500 scale

There are little or no significant changes to the site or surrounding area since the previously published map.

2.3.13 Ordnance Survey Plan 1982 to 1985 1:10560 scale, Figure A1.9

There are little or no significant changes to the site since the previously published map.

The railway situated to the north is now shown as being dismantled.

2.3.14 Ordnance Survey Plan 1985 1:2500 scale, Figure A1.10

There are no significant changes to the site since the previously published map.

The stream to the north of the site is marked as Double Stream, with the flow direction being west to east. Between the footbridge and the road bridge, the stream splits into two channels around a central island, likely to be man made. The channel closest to the site is approximately 6m from the site boundary.

2.3.15 Ordnance Survey Plan 1988 to 1992 1:10560 scale

There are little or no significant changes to the site, or surrounding area, since the previously published map.

2.3.16 Ordnance Survey Plan 1993 1:2500 scale

There are little or no significant changes to the site, or surrounding area, since the previously published map.

2.3.17 Ordnance Survey Plan 1993 to 1995 1:2500 scale, Figure A1.11

There majority of the buildings on the site are no longer shown as being present, with the exception of one towards the east.

2.3.18 Ordnance Survey Plan 1999 1:10560 scale, Figure A1.12

There are little or no significant changes to the site, or surrounding area, since the previously published map.

The location of the dismantled railway is now shown as the continuation of the A427.

2.4 Anecdotal Evidence

2.4.1 Information provided by the client indicates that the site has been derelict from its former use as a wood yard since approximately 1987. Since then, it is understood that there has been an archaeological survey across part of the site, as well as some earthworks to uncover areas of hardstanding which had become overgrown.

2.4.2 The neighbour to the site, resident for over 30 years, confirmed that the western buildings present housed various sawing equipment, whilst the eastern area was mainly used for storage of timber. He speculated that there was likely to be a source of heating fuel historically on site, although could not remember the locations of any permanent tanks.

2.4.3 The neighbour also indicated that the stream to the north tended to flood approximately once a year, with the water levels reaching the road, although he does not remember water ever entering the site in question.

3.0 SITE SETTING

3.1 Geological Setting

3.1.1 Details of the geology underlying the site have been obtained from the British Geological Survey map, Sheet No. 171, 'Kettering', solid and drift edition, 1:50,000 scale, published 2002.

- 3.1.2 The geological map indicates the site to be underlain by superficial deposits of Alluvium, described as a silty clay with gravel lenses.
- 3.1.3 The superficial deposits are underlain by Upper Lincolnshire Limestone of Jurassic Age. This is described as limestone which is ooidal, peloidal and contains shell-detrital.
- 3.1.4 An area in the centre of the existing concrete slab indicated natural ground directly underlying, comprising a buff coloured, oolitic limestone.
- 3.1.5 To the north the ground had been excavated to approximately road level, exposing a firm, grey gravelly clay.

3.2 Hydrogeological Setting

- 3.2.1 The hydrogeological records indicate that the majority of the site is located upon a major aquifer, namely The Upper Lincolnshire Limestone.
- 3.2.2 The Environment Agency defines a major aquifer as ‘a highly permeable formation with known or probable presence of significant fracturing. These tend to be highly productive and able to support public supply and other abstractions’.
- 3.2.3 The Envirocheck vulnerability map indicates the soil to be of high leaching potential.
- 3.2.4 The site is not located within a groundwater source protection zone.
- 3.2.5 There are no groundwater abstraction wells within 1km of the site.

3.3 Hydrological Setting

- 3.3.1 The nearest surface watercourse is the Willow Brook, located approximately 11m to the northwest of the site. There is a lake located 120m to the north east of the site.
- 3.3.2 The surface water is at approximately 1.5m below the level of the site, and appeared to be fairly shallow, approximately 0.40m above the stream bed.

3.3.3 The majority of the site is not located within a river floodplain area and is therefore not likely to be subject to flood warnings, though the north west corner of the site lies within a river floodplain and may be subject to flooding. A more detailed assessment is located in Section 8.

3.3.4 The available river quality classification is Grade D for chemistry and Grade C for biology. The main parameters for this classification are provided below:

GQA Grade	Environmental Quality	Chemical Parameters			Biological Parameters	
		DO (%)	BOD (mg/l)	Ammonia (mgN/l)	EQI for ASPT	EQI for no. of taxa
C	Fairly good	60	6	1.3	0.77	0.55
D	Fair	50	8	2.5	0.65	0.45
Ref: 12.4, 12.5						

3.3.5 There are no surface water abstraction wells within 1km of the site.

3.4 Radon

3.4.1 The National Radiological Protection Board, ref. 12.6, indicates the site to lie within an area where there is a probability of 10% to 30% of present or future homes being above the action level of 200Bq/m³. As such, the site is classified as a Radon Affected Area. This is confirmed by the Building Research Establishment, Report 211, ref 12.7.

3.4.2 Therefore, full radon protective measures should be installed in the proposed development, in line with BRE guidelines, ref 12.7.

4.0 GEOLOGICAL CONSIDERATIONS

4.1 Geological Constraints

4.1.1 The following are brief findings relating to factors highlighted in the Envirocheck report that may have a potential impact upon the engineering of the proposed development

Potential Hazard	Recorded Risk	
	On – site	Off – site (distance / direction)
Coal mining	No	-
Shallow mine workings	Low	-
Compressible ground subsidence	None to Moderate (NW corner)	None (14m NW)
Ground dissolution subsidence	Very low to low	Very Low (30m NW)
Gulls and cambering subsidence	None	Moderate (998m SW)
Swelling clay subsidence	None to Very Low (W)	Low (140m SE)
Landslip subsidence	Very Low	No Hazard (13m N)
Natural Cavities	None	Moderate (998m SW)

4.2 Geological Hazards

4.2.1 Geological hazards which may represent a risk to the proposed development on the site may include the following: -

- 4.2.1.1 Poor bearing pressures / high settlements in weak alluvial soils or Made Ground
- 4.2.1.2 A large number of trees are located on the site. It is understood that a specialist is to be consulted. Should any be high water demand trees be present, shrinkage or swelling of high plasticity cohesive soils should be considered.
- 4.2.1.3 Previous development is known to have been present on the site; therefore the presence of buried cellars or foundations cannot be discounted.

5.0 ENVIRONMENTAL SEARCHES

5.1 Registered Waste Treatment / Disposal Sites

- 5.1.1 There is one waste treatment / disposal site within 1km of the site.
- 5.1.2 The nearest waste treatment / disposal site is located 767m to the south west of the site

5.2 Registered Landfill Sites

- 5.2.1 There are six registered landfill sites within 1km of the site.
- 5.2.2 The nearest registered landfill site is located 461m to the south west of the site.

5.3 Licensed Waste Management Facilities

- 5.3.1 There are five licensed waste management facilities within 1km of the site.
- 5.3.2 The nearest licensed waste management facility is located 773m to the south west of the site

5.4 Air Pollution Controls

- 5.4.1 There is one Air Pollution Control located within 1km of the site.
- 5.4.2 The nearest Air Pollution Control is located 896m to the south west of the site.

5.5 Radioactive Sources

- 5.5.1 There are no Radioactive Source Authorisations issued within 1km of the site.

5.6 Hazardous Substances

- 5.6.1 There are no recorded sites listed under hazardous substances regulations within 1km of the site.

5.7 Pollution Incidents to Controlled Waters

- 5.7.1 There are twenty recorded pollution incidents within 1km of the site.
- 5.7.2 The nearest pollution incident is located 55m to the west of the site.
- 5.7.3 The majority of the incidents registered are Category 3 (minor incidents) though there was one incident 965m to the west that was considered Category 2 (significant incident)

5.8 Discharge Consents to Controlled Waters

- 5.8.1 There are fourteen recorded discharge consents to controlled waters within 1km of the site.
- 5.8.2 The nearest discharge consent to controlled waters is 280m to the north west of the site.

5.9 Green Belt Areas

- 5.9.1 There are no designated areas or as yet un-adopted areas of Green Belt land within 1km of the site.

5.10 Designated Sites

- 5.10.1 A review of the English Nature website was undertaken to assess whether there were any Sites of Special Scientific Interest (SSSI), National Nature Reserves (NNR) or Local Nature Reserves (LNR) which may be impacted by the development.
- 5.10.2 The enquiries indicated there are no SSSIs, NNRs or LNRs within 1km of the site.

5.11 Nitrate Vulnerable Zone

- 5.11.1 The site is located within an area designated as a nitrate vulnerable zone.
- 5.11.2 The Nitrates Directive defines a nitrate vulnerable zone as:
 - a) Surface freshwater which contains or could contain, if preventative

action is not taken, nitrate concentrations greater than 50mg/l.

- b) Groundwater which contains or could contain, if preventative action is not taken, nitrate concentrations greater than 50mg/l.
- c) Natural freshwater lakes or other freshwater bodies, estuaries, coastal waters and marine waters, which are eutrophic or may become so in the near future if protective action is not taken.

5.12 Contemporary Trade Entries

5.12.1 There are nine contemporary trade entries located within 1km of the site of which five are active and four inactive.

5.12.2 The nearest contemporary trade entry is located 622m to the northwest of the site and is inactive.

5.13 Historical Investigations

5.13.1 There have been no previous investigations carried out in the area by Ian Farmer Associates.

5.13.2 An archaeological survey was carried out on the site several years ago, although it is understood that there were no significant findings.

6.0 CONCEPTUAL SITE MODEL

6.1 Contaminated Land

6.1.1 The statutory definition of contaminated land is defined in the Environmental Protection Act 1990, ref 12.8, which was introduced by the Environment Act 1995, ref 12.9, as;

- ‘Land which appears to the Local Authority in whose area it is situated to be in such a condition, by reason of substances in, on or under the land, that –
- significant harm is being caused or there is a significant possibility of such harm being caused; or

- significant pollution of controlled waters is being, or there is a significant possibility of such pollution being caused.’

6.2 Risk Assessment

6.2.1 The definition of contaminated land is based on the principles of risk assessment. Risk is defined as a combination of:

- The probability, or frequency, of exposure to a substance with the potential to cause harm, and:
- The seriousness of the consequence.

6.3 Pollutant Linkage

6.3.1 The basis of an environmental risk assessment involves identifying a ‘source’ of contamination, a ‘pathway’ along which the contamination may migrate and a ‘receptor’ at risk from the contamination.

6.3.2 Current legislation defines the various elements of the pollution linkage as:

- A contaminant is a substance which is in or under the ground and which has the potential to cause harm or to cause pollution of controlled waters.
- A pathway is one or more routes through which a receptor is being exposed to, or affected by, a contaminant, or could be so affected.
- A receptor is either a living organism, an ecological system, a piece of land or property, or controlled water.

6.3.3 A pollutant linkage indicates that all three elements have been identified. The site can only be defined as ‘Contaminated Land’ if a pollutant linkage exists and the contamination meets the criteria in Section 6.1 above.

6.4 Hazard Identification: On-site

6.4.1 The desk based research and historical review identified the following potential hazards on the site:

- High levels of naturally occurring metals, particularly Arsenic.

- Contamination associated with the former use as a timber processing works.

6.5 Hazard Identification: Off-site

6.5.1 The desk based research and historical review did not identify any further potential hazards off-site that may impact upon the site.

6.6 Hazard Assessment

6.6.1 The desk study has therefore identified the following pollutant linkages that require further consideration.

Potential Contamination Sources	Potential Contaminants of Concern	Potential Pathways	Receptor Group
Possible contamination associated naturally occurring minerals	Inorganic Compounds <ul style="list-style-type: none"> • Metals 	<ul style="list-style-type: none"> • Soil ingestion • Vegetable uptake • Dermal contact • Inhalation of contaminated dust 	Human Health <ul style="list-style-type: none"> • Site occupants • Site users • Construction workers • Maintenance workers • Neighbouring site users/general public
		<ul style="list-style-type: none"> • Plant uptake and accumulation of contaminants 	Flora and Fauna <ul style="list-style-type: none"> • Landscaped areas
Possible contamination associated former use as timber processing works	Inorganic Compounds <ul style="list-style-type: none"> • Metals • Sulphate Organic Compounds <ul style="list-style-type: none"> • TPH • PAH 	<ul style="list-style-type: none"> • Soil ingestion • Vegetable uptake • Dermal contact • Dust Inhalation • Vapour inhalation 	Human Health <ul style="list-style-type: none"> • Site occupants • Site users • Construction workers • Maintenance workers • Neighbouring site users/general public

Potential Contamination Sources	Potential Contaminants of Concern	Potential Pathways	Receptor Group
	<ul style="list-style-type: none"> Phenol Chlorinated Hydrocarbons 	<ul style="list-style-type: none"> Plant uptake and accumulation 	Flora and Fauna <ul style="list-style-type: none"> Landscaped areas
	Others <ul style="list-style-type: none"> Asbestos pH 	<ul style="list-style-type: none"> Lateral Migration Surface run-off Infiltration 	Controlled Waters <ul style="list-style-type: none"> Surface waters Groundwater
		<ul style="list-style-type: none"> Direct contact of contaminants with building materials 	Building materials/services <ul style="list-style-type: none"> Concrete Plastic pipes/services Structural iron & steel work

7.0 ASSESSMENT OF POTENTIAL RISK

7.1 General

7.1.1 The assessment of potential risk has been based on the guidelines given in CIRIA report C552, ref 12.10. These guidelines are summarised in Appendix 3.

7.1.2 The assessment of environmental risk is aimed at identifying the possible risk, if any, arising from substances used or deposited on the site, or from any other sources of land contamination. The assessment is based on the proposed future end use, taking account of present and previous use.

7.1.3 The proposed end use will be residential housing.

7.1.4 The assessment is based on the principles of the pollutant linkage. This assessment of the environmental risk is based only on a review of historical data and a walkover survey; therefore it contains some elements of

conjecture. A comprehensive risk assessment can only be made following an intrusive investigation and testing regime.

7.2 Sources of Contamination

7.2.1 The historical review and walkover survey have identified the following potential sources of contamination:

- Naturally occurring metals
- Contamination associated with former land use

7.3 Pathways

7.3.1 Various potential pathways have been identified as being associated with the potential sources of concern, as listed in the table in Section 6.6.

7.4 Assessment of Pollutant Linkage

7.4.1 A conceptual model of plausible pollutant linkages has been formulated on the basis of current guidelines, as presented in Appendix 3, as follows:

- End Users

The areas of the site to be covered by structures or hardstanding are unlikely to present a risk to end users, unless there is a valid inhalation pathway.

- Construction and Maintenance Workers

Construction workers are likely to come into direct contact with the ground and may be potentially exposed to contamination. It is recommended that precautions be put in place to reduce the risk of contact with the ground. As a preliminary assessment, the risk relating to contact with the soil is low.

- Construction Material

It is considered that the risk associated with chemical attack on construction material to be low.

- Gardens and Soft Landscaping

On the basis of this study it is considered that some remedial measures may be required in gardens or soft landscaping. The risk to soft landscaped areas is considered to be low.

- Water Environment

The site is located on a major aquifer and as such, the groundwater may be considered a potential receptor.

The site is located 11m from 'surface water body' and given the permeable nature of the geological conditions anticipated on site, there is considered to be a low risk to this watercourse.

7.5 Conclusions of Risk Assessment

7.5.1 It is recommended that an intrusive investigation be carried out to identify the presence, nature and extent of any potential contamination sources in the ground, and whether plausible pathways exist to complete a pollutant linkage with the identified receptors.

8.0 EXISTING HYDROLOGY AND FLOOD ALLEVIATION MEASURES

8.1 Surface Water Hydrology

8.1.1 The site lies on the southerly limb of Willow Brook, a tributary of the River Nene, on the eastern outskirts of Corby. The site lies approximately 3km downstream of the nearest published EA gauging station at Corby South (OS Grid Ref. SP901 886), and approximately 9km upstream of the gauging station at Blatherwyke, also on Willow Brook. The river has an estimated catchment area in excess of 10km² above the site, draining parts of the Corby urban area and (mainly arable) farmland to the south and east of the town. The published gauging station summary data is reproduced in Appendix 4.

8.1.2 The floodplain is adjoined by industrial and commercial development on its north bank upstream of the site, to a point several hundred metres down-

stream of the site. The south bank of the river is substantially unaffected by development both up-stream and down of the site. The flood plain comprises mainly meadows and agricultural land. Some low-density housing development is present to the south of the River in the vicinity of the site, dispersed along Church Street and Kettering Road.

8.1.3 The River channel up-stream of the site is approximately 2m wide between banks that are not raised or defended. The river channel has not been diverted or straightened over this section. The only channel modification noted in the historical record is the formation of an artificial island during the 1980's immediately opposite the site, by the excavation of a secondary channel to the south of the natural course of the river, which appears to have remained un-altered.

8.1.4 The site lies immediately up-stream of the road bridge carrying Oundle Road. A footbridge of wooden construction lies immediately opposite the site. Another road bridge spans the river approximately 500m up-stream of the site.

8.1.5 Over-bank flow during flood events is unlikely to be significantly constrained by the rear gardens of residential property on the north bank upstream and down of the site. Land to the south of the river remains substantially un-impeded.

8.1.6 The river level is unconstrained by weirs or other artificial hydraulic controls in proximity to the site, with the exception of the Oundle Road Bridge.

8.2 Existing Flood Alleviation Systems.

8.2.1 The Environment Agency advise that there are no specific flood alleviation measure in place to mitigate against fluvial flooding events at or near to the site location.

8.3 Indicative Flood Plain

8.3.1 The Environment Agency indicative flood plain is indicated in Appendix 1, Figure A1.13.

- 8.3.2 The indicative floodplain is between 25m and 75m wide at the site location. The indicative flood level is estimated from the indicative flood plain map at approximately 25.8 m AOD, at the site location.

9.0 POTENTIAL MECHANISM FOR FLOODING AND ASSOCIATED RISKS

9.1 Mechanism of Flooding

- 9.1.1 The mechanism for flooding of the Church Street site would be by means of freshwater inundation during an exceptional fluvial flood event.
- 9.1.2 The river level would rise to overtop the river channel at approximately 78m AOD opposite the site. Overbank flow to the east will not be significantly impaired by the residential developments in this area, since the gardens areas are not visibly defended from flooding. Rising floodwater will spread laterally, progressively inundating the undefended flood plain and the road.
- 9.1.3 The level of the bridge deck has not been established but is estimated at approximately 78.5m, with the apex of the stone portal arch at about 78mAOD.
- 9.1.4 If water levels rise further, the Oundle Road Bridge portal becomes a significant hydraulic control. At a flood level of ~78 mAOD, flood waters reach the invert of the bridge and further increases in flow under the bridge become limited. Locally, the water levels at the bridge abutments may be significantly higher than the surrounding flood level.

9.2 Risk of Flooding

- 9.2.1 The Environment Agency indicative flood plain map suggests that a first approximation of the 1 in 100 year flood level is approximately 78mAOD at the site, consistent with the level of the crown of the road immediately adjacent to the site (indicated by a spot height on the OS map).
- 9.2.2 The current site level in the north corner of the site, immediately adjacent to the road is estimated at approximately 79mAOD, and rises to the south and east, to an estimated level of 81mAOD at the southern apex of the site.

- 9.2.3 Development in the south and east of the site at levels of up to 3m above the indicative 1:100 year flood event should be free from significant flood risk.
- 9.2.4 The currently available information suggests that development in the northern corner of the site is at highest risk, with a current site level estimated at ~1m above the indicative 1:100 year flood event level of ~78m AOD at the site. However, the site lies immediately up-stream of a potentially significant hydraulic control (the Oundle Road Bridge portal) and insufficient information currently exists to estimate the local effects of this control on flood levels, particularly in the northern corner of the site.

10.0 PROPOSALS TO MINIMISE FLOOD RISK

- 10.1 It is suggested that the development appears to be free of projected fluvial flooding risks to life and limb and to the fabric of the property, if the floor slab level is set at or above the projected 1 in 100 year fluvial flood level of approximately 78mAOD. An additional factor of safety of 0.6m is conventionally added to this level to establish the elevation of any flood protection infrastructure, bringing the level to 78.6mAOD. The current site level is approximately 79mAOD or above, and significantly higher in places.
- 10.2 It appears that the site access via Church Street adjacent to the river is not significantly above the projected flood level at between 78mAOD, and may be at risk of flooding. Alternative means of access and egress could be considered, via Oundle Road at the eastern apex of the site.
- 10.3 It is stressed that these are preliminary findings, and that the modelling of fluvial flows has not been undertaken as part of this preliminary study. The Oundle Road Bridge may act as a significant hydraulic control under extreme flood conditions, and it is recommended that the interaction of the projected 1 in 100 year flood flow with the bridge structure and abutments be subjected to detailed flow modelling, to confirm the estimated flood levels at the site.
- 10.4 The modelling exercise will determine the likelihood of flooding of the portion of the site (the northern corner) possibly at risk of flooding, along with the projected depth of inundation of Church Street adjacent to the development.

11.0 RECOMMENDATIONS FOR FURTHER WORK

- 11.1 An intrusive investigation should be undertaken to address the issues raised in Sections 4.2 and 6.6.
- 11.2 The following scope of works is suggested in order to collect the required data: -
- 11.1.1 Seven machine excavated trial pits
 - 11.1.2 The recovery of samples for chemical contamination analysis.
- 11.3 Should geotechnical information for the proposed development be required, samples should be obtained at the same time.
- 11.4 A quantitative flood risk assessment should be undertaken to determine the impacts of the hydraulic control imposed by the Oundle Road Bridge.
- 11.5 The following scope of works is suggested in order to collect the required data: -
- 11.1.1 A detailed topographic survey of the site should be undertaken.
 - 11.1.2 The survey should include the survey of sections through the river flood plain at locations up-stream and immediately down-stream of the site.
 - 11.1.3 The river flow should be estimated for a design flood event (normally a 1 in 100 year return period, but subject to agreement with the Environment Agency).
 - 11.1.4 The data should be used to model the flood levels on the site (particularly the northern corner of the site) under the estimated river flow.

12.0 REFERENCES

- 12.1 CLR 3, 'Documentary research on industrial sites', Report by RPS Consultants Ltd, DoE 1994.
- 12.2 CLR 11, 'Model Procedures for the Management of Land Contamination' Report by Defra and the Environment Agency, 2004.
- 12.3 CLR 2, 'Guidance on preliminary site inspection of contaminated land', Report by

- Applied Environmental, DoE 1994.
- 12.4 Environment Agency Chemistry, GQA method, available on the website www.environment-agency.gov.uk.
- 12.5 Environment Agency Biology, GQA method, available on the website www.environment-agency.gov.uk.
- 12.6 National Radiological Protection Board, Report NRPB-W26, 2002, 'Radon Atlas of England and Wales'.
- 12.7 BRE Report 211, 'Radon, Guidance on the Protective Measures for New Buildings, 1999
- 12.8 The Environmental Protection Act, Part IIA, Section 78, 1990.
- 12.9 Environment Act 1995, Section 57, DoE 1995.
- 12.10 'Contaminated Land Risk Assessment, A Guide to Good Practice', CIRIA C552, 2001

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APPENDIX 1

DRAWINGS

APPENDIX 2

SITE WALKOVER PHOTOGRAPHS

APPENDIX 3

ENVIRONMENTAL RISK

APPENDIX 3

POLLUTANT LINKAGE ASSESSMENT

A3.1 GENERAL

A3.1.1 The risk evaluation is a qualitative method for interpreting the data from the hazard estimation stage, ref 12.10. It involves the classification of the:

- magnitude of the potential ‘consequence’ (severity) of the risk occurring and:
- magnitude of the ‘probability’ (likelihood) of the risk occurring.

A3.1.2 These may be defined as below.

A3.2 CLASSIFICATION OF CONSEQUENCE

Classification	Definition	Examples
Severe	Short-term (acute) risk to human health likely to result in ‘significant harm’ as defined by the Environment Protection Act 1990, Part IIA. Short-term risk of pollution (note: Water Resources Act contains no scope for considering significance of pollution) of sensitive water resource. Catastrophic damage to buildings property. A short-term risk to a particular ecosystem, or organism forming part of such ecosystem (note: the definitions of ecological systems within the Draft Circular on Contaminated Land, DETR, 2000).	High Concentrations of cyanide on the surface of an informal recreation area. Major spillage of contaminants from site into controlled water. Explosion, causing building collapse can also equate to a short-term human health risk if buildings are occupied.
Medium	Chronic damage to Human Health (‘significant harm’ as defined in DETR, 2000). Pollution of sensitive water resources (note: Water Resources Act contains no scope for considering significance of pollution). A significant change in a particular ecosystem, or organism forming part of such ecosystem, (note: the definitions of ecological systems within Draft Circular on Contaminated Land, DETR, 2000).	Concentrations of a contaminant from site exceed the generic, or site-specific assessment criteria. Leaching of contaminants from a site to a major or minor aquifer. Death of a species within a designated nature reserve.

Mild	Pollution of non-sensitive water resources. Significant damage to crops, buildings, structures and services ('significant harm' as defined in the <i>Draft Circular on Contaminated Land</i> , DETR 2000). Damage to sensitive buildings/ structures/services or the environment.	Pollution of non-classified ground water. Damage to building rendering it unsafe to occupy (eg foundation damage resulting in instability).
Minor	Harm, although not necessarily significant harm, which may result in a financial loss, or expenditure to resolve. Non-permanent health effects to human health (easily prevented by means such as personal protective clothing etc). Easily repairable effects of damage to buildings, structures and services.	The presence of contaminants at such concentrations that protective equipment is required during site works. The loss of plants in landscaping scheme. Discoloration of concrete

A3.2.1 In theory, both severe and medium classification can result in death. The differential is that severe relates to short term risk while medium relates to long-term risk. Therefore, the classification of severe requires urgent action while medium may require urgent action but usually long term action would be sufficient.

A3.3 Classification of Probability

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

A3.4 Comparison of Consequence Against Probability

A3.4.1 These classifications are compared to indicate the risk presented by each pollutant linkage. Once the consequence and probability have been classified they can be used to produce a risk category as below:

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

A3.4.2 The action required for the classified risks are as follows:

Very high risk	<p>There is a high probability that severe harm could a risk to a designated receptor from an identified hazard, OR, there is evidence that severe harm to a designated receptor is currently happening.</p> <p>This risk, if realised, is likely to result in a substantial liability.</p> <p>Urgent investigation (if not undertaken already) and remediation are likely to be required</p>
High risk	<p>Harm is likely to arise to a designated receptor from an identified hazard.</p> <p>Realisation of the risk is likely to present a substantial liability.</p> <p>Urgent investigation (if not undertaken already) is required and remedial works may be necessary in the short term and are likely over the longer term</p>
Moderate risk	<p>It is possible that harm could arise to a designated receptor from an identified hazard. However, it is either relatively unlikely that any such harm would be severe, or if any harm were to occur it is more likely that the harm would be relatively mild</p> <p>Investigation (if not already undertaken) is normally required to clarify the risk</p>

	and to determine the potential liability. Some remedial works may be required in the longer term
Low risk	It is possible that harm could arise to a designated receptor from an identified hazard, but it is likely that this harm, if realised, would at worst normally be mild.
Very low risk	There is a low possibility that harm could arise to a receptor. In the event of such harm being realised it is not likely to be severe.

APPENDIX 4

FLOOD RISK DATA

APPENDIX 5

ENVIROCHECK REPORT

