

Section 3: Water Recycling Services

In examining the used water system we assess the ability for your site to connect to the public sewerage network without causing a detriment to the operation of the system. We also assess the receiving water recycling centre and determine whether the water recycling centre can cope with the increased flow and influent quality arising from your development.

Water Recycling Centre

The foul drainage from the proposed development is in the catchment of Royston Water Recycling Centre, which currently has capacity to treat the flows from your development site. Anglian Water cannot reserve capacity and the available capacity at the water recycling centre can be reduced at any time due to growth, environmental and regulation driven changes.

Used Water Network

Anglian Water has assessed the impact of gravity flows unfortunately, a desktop study has indicated that a gravity connection to your preferred connection point is likely to be difficult to achieve. We have therefore assessed a pumped solution and can confirm that there is capacity to manhole 5801 off Newmarket Road at National grid reference (NGR) TL36564082.

Surface Water Disposal

We note that you have not requested a surface water connection therefore an assessment has not been made on this occasion.

As you may be aware, Anglian Water will consider the adoption of SuDs provided that they meet the criteria outline in our SuDs adoption manual. This can be found on our website at www.anglianwater.co.uk/developers/sewer-connection/suds.aspx. We will adopt features located in public open space that are designed and constructed, in conjunction with the future SuDs Approving Body, to the criteria within our SuDs adoption manual. Specifically, developers must be able to demonstrate:

1. Effective upstream source control,
2. Effective exceedance design, and
3. Effective maintenance schedule demonstrating that the assets can be maintained both now and in the future with adequate access.

Our preference is that the Local Authority is requested to adopt in the first instance as duty will pass to them in future legislation. Consequently as part of your submission, evidence will need to be provided to show that you have approached the local authority. If you wish to look at the adoption of any SuDs then an expression of interest form can be found on our website at:

http://www.anglianwater.co.uk/assets/media/SuDS_Adoption_Form_2012.pdf

The proposed method of surface water disposal is not relevant to Anglian Water; we suggest that you contact the future SuDS Approving Body for the area, the Environment Agency, the Internal Drainage Board.

Trade Effluent

We note that you do not have any trade effluent requirements. Should this be required in the future you will need our written formal consent. This is in accordance with Section 118 of the Water Industry Act (1991).

Used Water Budget Costs

It has been assumed that the onsite used water network will be provided under a section 104 Water Industry Act application. It is recommended that you also budget for both infrastructure charges and connection costs. The 2014/15 charges are:

Infrastructure Charge	£345.00 per connection
S104 Supervision and inspection costs	2.5% of estimated construction costs
S104 Survey costs	10% of estimated construction costs

Section 4: Map of Proposed Connection Points

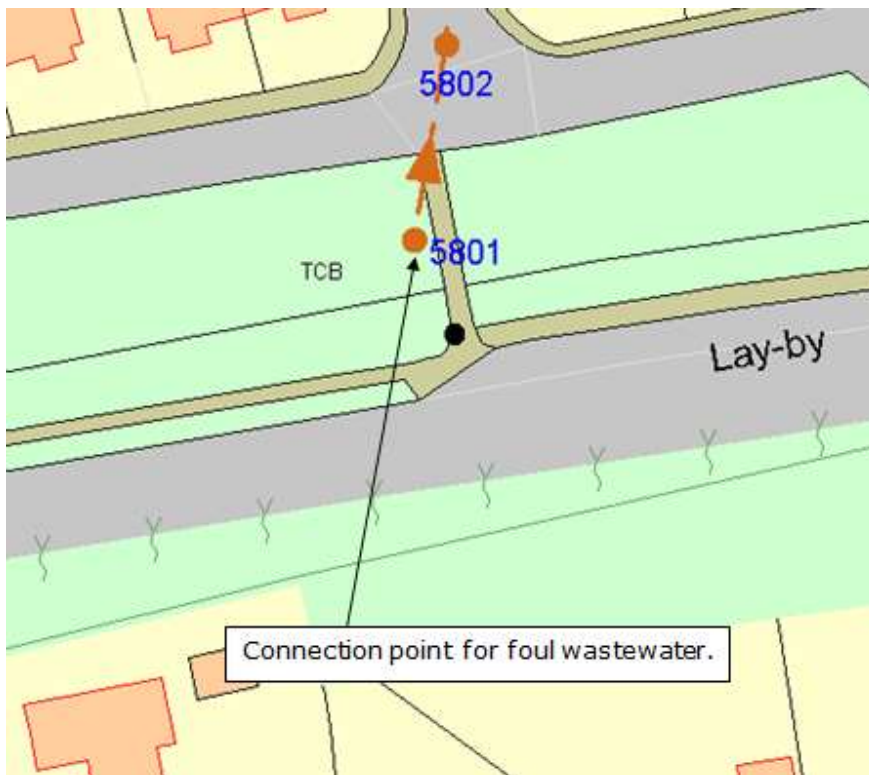


Figure 1: Showing your used water point of connection at manhole 5801

Section 5: Useful Information

Water

Water Industry Act – Key Water Sections:

- **Section 41:** This provides you with the right to requisition a new water main for domestic purposes to connect your site to the public water network.
- **Section 45:** This provides you with the right to have a connection for domestic purposes from a building or part of a building to the public water main.
- **Section 51A:** This provides you with the right to provide the water main or service connection yourself and for us to vest them into our company.
- **Section 55:** This applies where you request a supply of water for non domestic premises.
- **Section 185:** This provides you with the right to make a reasonable request to have a public water main, sewer or public lateral drain removed or altered, at your expense. Details on how to make an application and the s185 form is available on our website at <http://www.anglianwater.co.uk20/developers> or via our Developer Services team on 08457 60 66 087.

Details on how you can make a formal application for a new water main, new connection or diversion are available on from our Developer Services team on 08457 60 66 087 or via our website at www.anglianwater.co.uk/developers

If you have any other queries on the rights to requisition or connect your housing to the public water and sewerage infrastructure then please contact our developer services team at: Developer Services, Anglian Water, PO Box 495, Huntingdon, PE29 6YY or Telephone: 0845 60 66 087 or Email: developerservices@anglianwater.co.uk

Water pressure and flow rate: The water pressure and consistency that we must meet for your site is laid out in the Water Industry Act (1991). This states that we must supply a flow rate of 9 litres per minute at a pressure of 10 metres of head to the external stop tap. If your water pressure requirements exceed this then you will need to provide and maintain any booster requirements to the development site.

Self Lay of Water Mains: A list of accredited Self Lay Organisations can be found at www.lloydsregister.co.uk/schemes/WIRS/providers-list.aspx.

Used Water

Water Industry Act – Key Used Water Sections:

- **Section 98:** This provides you with the right to requisition a new public sewer. The new public sewer can be constructed by Anglian Water on your behalf. Alternatively, you can construct the sewer yourself under section 30 of the Anglian Water Authority Act 1977.

- **Section 102:** This provides you with the right to have an existing sewerage asset vested by us. It is your responsibility to bring the infrastructure to an adoptable condition ahead of the asset being vested.
- **Section 104:** This provides you with the right to have a design technically vetted and an agreement reached that will see us adopt your assets following their satisfactory construction and connection to the public sewer.
- **Section 106:** This provides you with the right to have your constructed sewer connected to the public sewer.
- **Section 185:** This provides you with the right to have a public sewerage asset diverted.

Details on how to make a formal application for a new sewer, new connection or diversion are available on our website at www.anglianwater.co.uk/developers or via our Developer Services team on 08457 60 66 087.

Sustainable Drainage Systems:

Many existing urban drainage systems can cause problems of flooding, pollution or damage to the environment and are not resilient to climate change in the long term. Therefore our preferred method of surface water disposal is through the use of Sustainable Drainage Systems (SuDS). SuDS are a range of techniques that aim to mimic the way surface water drains in natural systems within urban areas. For more information on SuDS, please visit our website at <http://anglianwater.co.uk/developers/sewer-connection/suds.aspx>. We also recommend that you contact the future SuDS Approving Body (SAB) for the area to discuss your application.

Private Sewer Transfers: Sewers and lateral drains connected to the public sewer on the 1 July 2011 transferred into Water Company ownership on the 1 October 2011. This follows the implementation of the Floods and Water Management Act (FWMA). This included sewers and lateral drains that were subject to an existing Section 104 Adoption Agreement and those that were not. There were exemptions and the main non-transferable assets were as follows:

- Surface water sewers and lateral drains that did not discharge to the public sewer, e.g. those that discharged to a watercourse.
- Foul sewers and lateral drains that discharged to a privately owned sewage treatment/collection facility.
- Pumping stations and rising mains will transfer between 1 October 2011 and 1 October 2016.

The implementation of Section 42 of the FWMA will ensure that future private sewers will not be created. It is anticipated that all new sewer applications will need to have an approved section 104 application ahead of a section 106 connection.

Encroachment: Anglian Water operates a risk based approach to development encroaching close to our used water infrastructure. We assess the issue of encroachment if you are

planning to build within 400 metres of a water recycling centre or, within 15 metres to 100 metres of a pumping station. We have more information available on our website at <http://anglianwater.co.uk/developers/encroachment.aspx>

Locating our assets: Maps detailing the location of our water and used water infrastructure including both underground assets and above ground assets such as pumping stations and recycling centres are available from www.digdat.co.uk. All requests from members of the public or non-statutory bodies for maps showing the location of our assets will be subject to an appropriate administrative charge. We have more information on our website at: www.anglianwater.co.uk/developers/our-assets/

Summary of charges: A summary of this year's water and used water connection and infrastructure charges can be found at <http://www.anglianwater.co.uk/developers/charges/>

Disclaimer: The information provided within this report is based on the best data currently recorded, recorded within the last 12 months or provided by a third party. The position must be regarded as approximate. If there is further development in the area or for other reasons the position may change.

The accuracy of this report is therefore not guaranteed and does not obviate the need to make additional appropriate searches, inspections and enquiries. You are advised therefore to renew your enquiry should there be a delay in submitting your application for water supply/sewer connection to re-confirm the situation.

Any cost calculations provided within the report are estimated only and may be subject to change.

The responses made in this report are based on the presumption that your proposed development obtains planning permission. Whilst this report has been prepared to help assess the viability of your proposal, it must not be considered in isolation. Anglian Water supports the plan led approach to sustainable development that is set out in the National Planning Policy Framework (NPPF). As a spatial planning statutory consultee, we assist planning authorities in the preparation of a sustainable local plan on the basis of capacity within our water and water recycling (formerly referred to as wastewater) infrastructure. Consequently, any infrastructure needs identified in this report must only be considered in the context of up to date, adopted or emerging local plans. Where local plans are absent, silent or out of date these needs should be considered against the definition of sustainability set out in the NPPF as a whole.

No liability whatsoever including liability for negligence is accepted by Anglian Water Services Limited for any error or inaccuracy or omission including the failure to accurately record or record at all, the location of any water main, discharge pipe, sewer, or drain or disposal main or any item of apparatus.

12. APPENDIX E – GEOTECHNICAL DATA

DESK STUDY & GROUND INVESTIGATION REPORT

Newmarket Road
Royston
Hertfordshire

Client: Countryside Properties

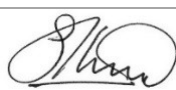
J16202

January 2017



GEA Geotechnical &
Environmental
Associates

Document Control

Project title	Newmarket Road, Royston, Herts, SG8 7NJ		Project ref	J16202
Report prepared by	 Lee Boswell BSc MSc FGS			
Report checked by	 Jack Deaney BSc FGS			
Approved for issue by	 Steve Branch BSc MSc CGeol FGS FRGS MEnvSc			
Issue No	Status	Amendment Details	Date	Approved for Issue
1	Final		30 November 2016	
2	Final		18 January 2017	

This report has been issued by the GEA office indicated below. Any enquiries regarding the report should be directed to the office indicated or to Steve Branch in our Herts office.



Hertfordshire

tel 01727 824666

mail@gea-ltd.co.uk



Nottinghamshire

tel 01509 674888

midlands@gea-ltd.co.uk

Geotechnical & Environmental Associates Limited (GEA) disclaims any responsibility to the Client and others in respect of any matters outside the scope of this work. This report has been prepared with reasonable skill, care and diligence within the terms of the contract with the Client and taking account of the manpower, resources, investigation and testing devoted to it in agreement with the Client. This report is confidential to the Client and GEA accepts no responsibility of whatsoever nature to third parties to whom this report or any part thereof is made known, unless formally agreed beforehand. Any such party relies upon the report at their own risk. This report may provide advice based on an interpretation of legislation, guidance notes and codes of practice. GEA does not however provide legal advice and if specific legal advice is required a lawyer should be consulted.

This report is intended as a Ground Investigation Report (GIR) as defined in BS EN1997-2, unless specifically noted otherwise. The report is not a Geotechnical Design Report (GDR) as defined in EN1997-2 and recommendations made within this report are for guidance only.

© Geotechnical & Environmental Associates Limited 2017

CONTENTS

EXECUTIVE SUMMARY

Part 1: INVESTIGATION REPORT

1.0	INTRODUCTION	1
1.1	Proposed Development	1
1.2	Purpose of Work	1
1.3	Scope of Work	1
1.4	Limitations	2
2.0	THE SITE	3
2.1	Site Description	3
2.2	Site History	3
2.3	Other Information	4
2.4	Geology	4
2.5	Hydrology and Hydrogeology	5
2.6	Preliminary Risk Assessment	5
3.0	EXPLORATORY WORK	6
3.1	Sampling Strategy	6
4.0	GROUND CONDITIONS	7
4.1	Made Ground	7
4.2	New Pit Chalk Formation	7
4.3	Groundwater	7
4.4	Soil Contamination	8
4.5	Generic Quantitative Risk Assessment	8

Part 2: DESIGN BASIS REPORT

5.0	INTRODUCTION	10
6.0	GROUND MODEL	10
7.0	ADVICE AND RECOMMENDATIONS	10
7.1	Earthworks	10
7.2	Spread Foundations	11
7.3	Shallow Excavations	12
7.4	Piled Foundations	12
7.5	Ground Floor Slab	13
7.6	Retaining Walls	14
7.7	Disposal of Surface Water	14
7.8	Pavement Design	15
7.9	Topsoil Testing	16
7.10	Effect of Sulphates	16
7.11	Contamination Risk Assessment	16
7.12	Waste Disposal	16
8.0	OUTSTANDING RISKS AND ISSUES	18

APPENDIX

EXECUTIVE SUMMARY

This executive summary contains an overview of the key findings and conclusions. No reliance should be placed on any part of the executive summary until the whole of the report has been read. Other sections of the report may contain information that puts into context the findings that are summarised in the executive summary.

BRIEF

This report describes the findings of a site investigation carried out by Geotechnical and Environmental Associates Limited (GEA) on the instructions of Countryside Properties PLC with respect to the redevelopment of the site through the construction of two-storey to three-storey residential units. The purpose of the investigation has been to research the history of the site with respect to possible contaminative uses, to determine the ground conditions and hydrogeology, to assess the extent of any contamination and to provide information to assist with the design of foundations.

SITE HISTORY

The earliest map studied, dated 1878, shows the site to have been undeveloped and surrounded by trees on all sides except to the north where it fronted onto an unnamed road. Between 1903 and 1921 several larger properties were built in the area, including Burloes's Hall approximately 80 m to the southeast, and Icknield Bury, approximately 50 m to the west. A building is shown to the north of the site and was later named Burloes Cottages on the 1971 map. By 1971, an electrical sub-station had been built approximately 20 m to the southeast of the site, whilst the existing residential developments had been constructed to the north and west. Between 1977 and 1984 the junction between the new A505 and Newmarket Road had been constructed, and later, between 1984 and 1989 the residential development to the west was extended to represent its existing condition. The site and surrounding area have since remained unchanged.

GROUND CONDITIONS

Beneath a moderate thickness of made ground, the New Pit Chalk Formation was encountered to the maximum depth of the investigation, of 20.00 m. The made ground ranged in thickness from 0.20 m to 0.70 m, with the thickness apparently increasing towards the north and northeast of the site. It comprised brown silty sand with variable amounts of chalk and flint gravel and fragments of shell, brick, concrete, metal, ash, coal and tile. Within the trial pits the New Pit Chalk Formation consisted of an initially structureless chalk (Grade Dm, becoming Dc) over very weak, low density structured white chalk (Grade C5) with patches of structureless chalk (Grades Dm / Dc); fissures were initially very closely spaced and infilled with brown clay and comminuted chalk, becoming closely spaced and clean (Grade B3) with depth to 3.30 m. Scattered flint gravel and cobbles were noted throughout the chalk.

Groundwater was not encountered. Contamination testing of a number of samples of made ground has not measured any elevated concentrations of contaminants.

Soakage testing has indicated soakage rates of 3.34×10^{-6} m/s to 5.15×10^{-4} m/s.

RECOMMENDATIONS

Spread foundations bearing on the initial low density Grade Dm chalk at a minimum depth of 0.75 m may be designed to apply a net allowable bearing pressure of 200 kN/m². A slightly higher bearing pressure of 225 kN/m² may be applied on the low density Grade Dc chalk.

Groundwater is unlikely to be encountered in the foundation excavations.

Contamination testing has revealed no elevated levels of contamination within the samples of made ground tested and as such no remedial action is considered necessary.

As the laboratory testing has indicated that the chalk is of low density to the full depth investigated in the trial pits, shallow soakaways would need to be located at a minimum distance of 10 m from any foundations. It is considered that soakaways with a 5 m lateral offset and an impermeable plain well screen over the upper 5 m below nearest foundation levels, will provide sufficient assurance.

A cut and fill earthworks scheme is proposed across site and it is considered that generally the chalk encountered, based on the guidance from CIRIA C574 is suitable as fill material, although it may not be economical to use Class CDs material as embankment fill.

Part 1: INVESTIGATION REPORT

This section of the report details the objectives of the investigation, the work that has been carried out to meet these objectives and the results of the investigation. Interpretation of the findings is presented in Part 2.

1.0 INTRODUCTION

Geotechnical and Environmental Associates Limited (GEA) has been commissioned by Countryside Properties PLC to carry out a desk study and ground investigation at Newmarket Road, Royston, SG8 7NJ.

1.1 Proposed Development

It is understood that it is proposed to construct a number of new two-storey to three-storey residential units. A limited programme of earthworks will be required as part of the development.

This report is specific to the proposed development and the advice herein should be reviewed once the development proposals are finalised.

1.2 Purpose of Work

The principal technical objectives of the work carried out were as follows:

- ☐ to check the history of the site with respect to previous contaminative uses;
- ☐ to determine the ground conditions and their engineering properties;
- ☐ to provide advice with respect to the design of shallow foundations;
- ☐ to provide advice with respect to the design of soakaways;
- ☐ to provide information to assist in the design of road pavements and hardstandings;
- ☐ to provide an indication of the degree of soil contamination present; and
- ☐ to assess the risk that any such contamination may pose to the proposed development, its users or the wider environment.

1.3 Scope of Work

In order to meet the above objectives, a desk study was carried out, followed by a ground investigation. The desk study comprised:

- ☐ a review of historical Ordnance Survey (OS) maps and environmental searches sourced from the Envirocheck database;
- ☐ a review of readily available geology maps; and
- ☐ a walkover survey of the site carried out in conjunction with the fieldwork.

In the light of this desk study an intrusive ground investigation was carried out which comprised, in summary, the following activities:

- ❑ three cable percussion boreholes advanced to depths of 15.0 m and 20.0 m;
- ❑ falling head tests carried out in each borehole at depths of 5 m, 6.5 m, 10 m, 15 m and 20 m;
- ❑ five opendrive sampler boreholes advanced to a depth of 5.0 m by means of a Terrier rig;
- ❑ standard penetration tests (SPTs) carried out at regular intervals within the borehole to provide quantitative data on the strength of the soils;
- ❑ twelve trial pits advanced to depths of between 0.9 and 3.3 m to investigate the soakage potential of the chalk across the site;
- ❑ ten shallow trial pits advanced to depths of between 0.1 m and 0.4 m to allow recovery of samples of made ground for the purpose of topsoil testing;
- ❑ testing of selected soil and rock samples for contamination and geotechnical purposes; and
- ❑ provision of a report presenting and interpreting the above data, together with our advice and recommendations with respect to the proposed development.

The report includes a contaminated land assessment which has been undertaken in accordance with the methodology presented in Contaminated Land Report (CLR) 11¹ and involves identifying, making decisions on, and taking appropriate action to deal with, land contamination in a way that is consistent with government policies and legislation within the United Kingdom. The risk assessment is thus divided into three stages comprising Preliminary Risk Assessment, Generic Quantitative Risk Assessment, and Site-Specific Risk Assessment.

The exploratory methods adopted in this investigation have been selected on the basis of the constraints of the site, including but not limited to access and space limitations, together with any budgetary or timing constraints. Where it has not been possible to reasonably use an EC7 compliant investigation technique a practical alternative has been adopted to obtain indicative soil parameters and any interpretation is based upon GEA's engineering experience, local precedent where applicable and relevant published information.

1.4 Limitations

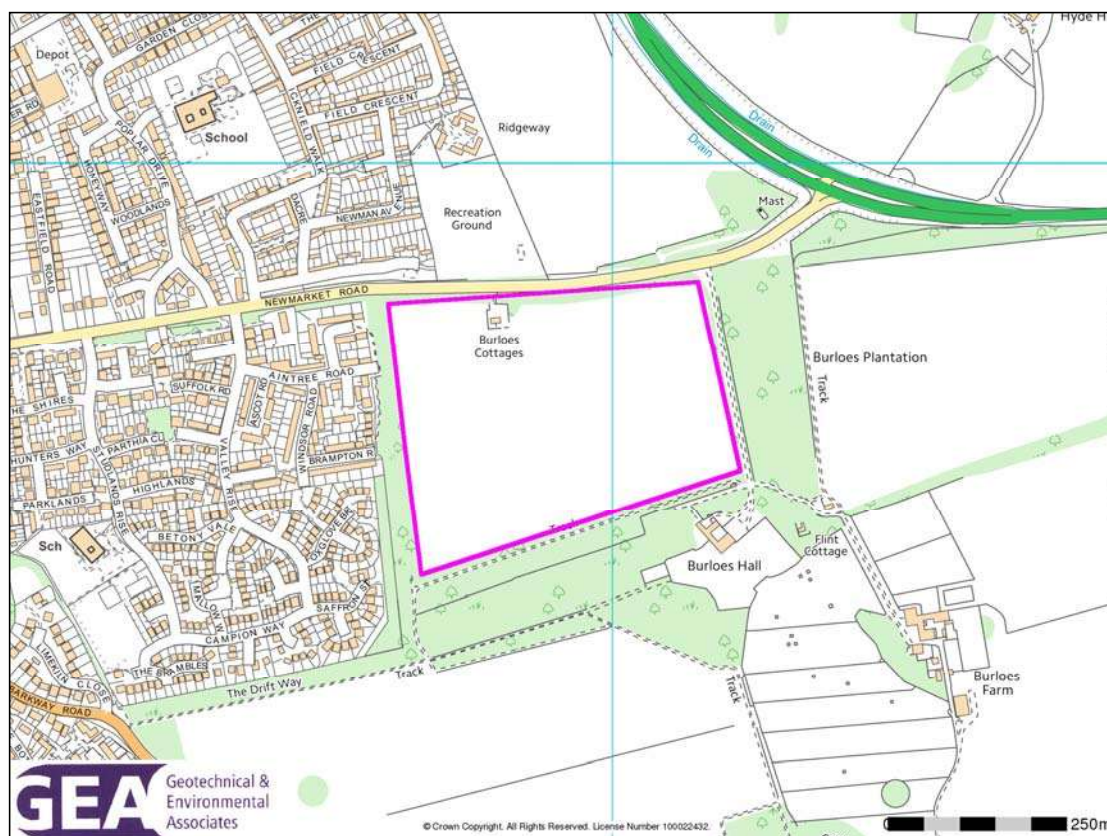
The conclusions and recommendations made in this report are limited to those that can be made on the basis of the investigation. The results of the work should be viewed in the context of the range of data sources consulted and the number of locations where the ground was sampled. No liability can be accepted for information in other data sources or conditions not revealed by the sampling or testing. Any comments made on the basis of information obtained from the client or other third parties are given in good faith on the assumption that the information is accurate; no independent validation of such information has been made by GEA.

1 *Model Procedures for the Management of Land Contamination* issued jointly by the Environment Agency and the Department for Environment, Food and Rural Affairs (DEFRA) Sept 2004

2.0 THE SITE

2.1 Site Description

The site is located to the east of Royston, Hertfordshire, approximately 1.40 km southeast of Royston railway station. It is bounded to the north by Newmarket Road, to the east and south by tree plantations and to the west by residential housing, behind a row of trees. The site may additionally be located by National Grid Reference 536927, 240663, and is shown on the map extract below.



The site slopes downwards towards the north at an angle of approximately 5° , falling from approximately 105 m OD on the southern boundary to 75 m OD on the northern boundary. It is roughly rectangular in shape, measuring approximately 450 m east west by 320 m north south. The site is surrounded by mature and semi-mature deciduous trees with a small group of sycamore trees present towards the southeastern corner of the site. There is a pair of semi-detached houses, with associated gardens, encroaching into the northern site boundary.

Access to the site is via the access track to the southeastern corner of the field.

2.2 Site History

The site history has been researched by reference to internet sources and historical Ordnance Survey (OS) maps obtained from the Envirocheck database.

The earliest map studied, dated 1878, shows the site to have comprised part of an open field, with an unnamed road and embankment bordering the site to the north and Burloes's Plantation immediately to the east. Burloes's Farm was present approximately 500 m to the southeast of the site.

The site and immediate surrounding area remained essentially unchanged until some time between 1903 and 1921, when a pair of semi-detached houses is shown to the north, in the centre of the site, which was later named Burloes Cottages, and are assumed to be the existing buildings. An unnamed road was also built to the east of the site, leading to the newly constructed Burloes's Hall, approximately 80 m to the southeast of the site. Icknield Bury had also been constructed around 50 m to the west of the site. By 1938, the unnamed road to the north of the site had been renamed the A505.

By 1971, Icknield Bury had been demolished with the northwest of the site showing increased level of development, which continued until 1973, when residential development is shown to have extended up to the northern half of the western site boundary. An electrical sub-station had been built approximately 20 m to the southeast of the site.

On the map dated 1983 the A505 is shown to have been renamed as Newmarket Road. The current arrangement of the A505 and junction to Newmarket Road is shown approximately 250 m to the northeast of the site.

By 1987, the development to the west of the site extended along the entire western boundary continuing until 1989, when the site and surrounding area are shown to have remained essentially unchanged.

2.3 Other Information

A search of public registers and databases has been made via the Envirocheck database and relevant extracts from the search are appended. Full results of the search can be provided if required.

The Envirocheck report has indicated that no landfill sites, waste management, transfer, treatment or disposal sites are located within 1 km of the site. There are no records of environmental controls or incidents that are likely to have an adverse impact on the site.

No pollution incidents to controlled waters have been recorded within 1 km of the site.

Reference to records compiled by the Health Protection Agency (formerly the National Radiological Protection Board) indicates that the site falls within an area where less than 1% of homes are affected by radon emissions and therefore radon protective measures will not be necessary.

The site is listed as being within a nitrate vulnerable zone, but does not have any other sensitive land uses.

2.4 Geology

The British Geological Survey (BGS) map (Sheet 204) of the area indicates that the site is underlain by the New Pit Chalk Formation from the surface. Head Deposits overlie the chalk in the centre of the north of the site.

The Envirocheck report states that there is a very low potential for ground dissolution stability hazards, and the potential for collapsible ground stability hazards is very low. The potential for landslide stability hazards is low. The nearest recorded man-made cavity is approximately 547 m to the southwest of the site, which is expected to be a historical lime kiln, potentially a chalk mine. There are no recorded natural cavities within 1 km of the site.

2.5 Hydrology and Hydrogeology

The Head Deposits are classified as a Secondary Undifferentiated Aquifer, which refers to the variable characteristics of the drift deposits. The New Pit Chalk Formation is classified as a Principal Aquifer, rather than its former classification as a major aquifer, referring to rock layers or drift deposits with high intergranular and/or fracture permeability that has a high level of water storage and may support water supply and/or river base flow.

There are no listed water abstractions within 140 m of the site.

The site is located within the total catchment (Zone III) of Groundwater Source Protection Zone, as defined by the Environment Agency. The site has a limited potential for groundwater flooding to occur, and is not indicated as being at risk of flooding from rivers and the sea.

The nearest surface water feature is located approximately 186 m to the northeast of the site.

Groundwater is likely to be present at depth within the New Pit Chalk Formation and a BGS borehole located approximately 150 m southeast of the site found groundwater at a depth of approximately 53.00 m (38 m OD).

The site has limited potential for groundwater flooding.

2.6 Preliminary Risk Assessment

Part IIA of the Environmental Protection Act 1990, which was inserted into that Act by Section 57 of the Environment Act 1995, provides the main regulatory regime for the identification and remediation of contaminated land. The determination of contaminated sites is based on a “suitable for use” approach which involves managing the risks posed by contaminated land by making risk-based decisions. This risk assessment is carried out on the basis of a source-pathway-receptor approach.

2.6.1 Source

The desk study findings indicate the site not to have had a potentially contaminative history as it has remained largely undeveloped since prior to 1878, except for Burloes Cottages to the north of the site.

There are no recorded landfill sites within 1 km of the site and there is therefore not a risk of hazardous ground gas.

2.6.2 Receptor

The proposed development of the site for residential purposes will result in the end users representing relatively high sensitivity receptors. The Principal Aquifer below the site is also a sensitive receptor. Buried services are likely to come into contact with any contaminants present within the soils through which they pass and site workers are likely to come into contact with any contaminants present in the soils during construction works.

2.6.3 Pathway

The presence of the permeable New Pit Chalk Formation would allow the migration of contaminated groundwater through the shallow soils to the deep principal aquifer. Within the site, end users may come into contact with any contaminants present within the made ground in areas of soft landscaping and gardens. Buried services may be exposed to any contaminants present within the soil through direct contact and site workers will come into contact with the

soils during construction works. There is thus considered to be a medium to high potential for a contaminant pathway to be present between any potential contaminant source and a target for the particular contaminant.

2.6.4 Preliminary Risk Appraisal

On the basis of the above it is considered that there is a LOW risk of there being a significant contaminant linkage at this site which would result in a requirement for major remediation work.

3.0 EXPLORATORY WORK

In order to meet the objectives described in Section 1.2, three cable percussion boreholes were advanced to depths of 15.00 m and 20.00 m and five opendrive sampler boreholes were advanced to a depth of 5.00 m using a Terrier rig. Additionally, twelve trial pits were excavated to depths of between 0.90 m and 3.30 m in order to provide additional coverage of the site. Soakage tests were conducted within the cable percussion boreholes and within a number of trial pits.

During boring, disturbed samples were obtained from the boreholes for subsequent laboratory examination and testing. Standard Penetration Tests (SPTs) were carried out at regular intervals to provide additional quantitative data on the strength of soils encountered.

A selection of the samples recovered from the boreholes was submitted to a soil mechanics laboratory for a programme of geotechnical testing and an analytical laboratory for contamination testing.

All of the above work was carried out under the supervision of a geotechnical engineer from GEA.

The borehole and trial pit records are appended, together with a site plan indicating the exploratory positions. The National Grid Reference and Ordnance Datum (OD) levels on the borehole and trial pit records were measured using a hand held GPS.

3.1 Sampling Strategy

The trial pit and borehole locations were agreed with the client.

Five samples of the made ground have been tested for the presence of contamination. The analytical suite of testing was selected to identify hydrocarbon contamination resulting from the former use of the site and a range of typical industrial contaminants for the purposes of general coverage. For this investigation the analytical suite for the soil included a range of metals, speciation of total petroleum hydrocarbons (TPH), polycyclic aromatic hydrocarbons (PAH), total cyanide and monohydric phenols. The contamination analyses were carried out at an MCERTs accredited laboratory with the majority of the testing suite accredited to MCERTS standards. A summary of the MCERTs accreditation and test methods are included with the attached results and further details are available upon request.

The geotechnical testing included moisture content, intact dry density and saturated moisture content on selected samples of chalk.

4.0 GROUND CONDITIONS

The investigation has generally confirmed the expected ground conditions in that, beneath a limited thickness of made ground, the New Pit Chalk Formation was encountered to the full depth of investigation. However, the investigation has not encountered the Head Deposits that are indicated on the geology map in the north of the site.

4.1 Made Ground

The made ground comprised brown silty sand with variable amounts of chalk and flint gravel and fragments of shell, brick, concrete, metal, ash, coal and tile, extending to depths of between 0.2 m and 0.70 m.

Apart from the presence of fragments of extraneous material noted above, no visual or olfactory evidence of contamination was observed during the fieldwork. Five samples of the made ground have been analysed for a range of contaminants as a precautionary measure and the results are detailed within Section 4.4.

4.2 New Pit Chalk Formation

On the basis of the inspection of the trial pits, the chalk has been classified in accordance with CIRIA Report C574 (2002), *Engineering in Chalk*.

Within the trial pits the New Pit Chalk initially comprised a structureless chalk, assessed as Grade Dm, becoming Grade Dc, over very weak, low density, white chalk with orange-brown staining and occasional black specks, which extended to the full depth of the investigation, of 20.00 m. Initially the fissures were very closely spaced and infilled with brown clay and comminuted chalk, becoming closely spaced and clean. Scattered flint gravel and cobbles were encountered, as well as partings of brown silty clay. The grade of the chalk was recorded as corresponding to Grades C5 changing to B3 with depth.

The boreholes proved the chalk to a depth of 20.00 m (68.00 m OD) and recovered it as Grade Dm / Dc with layers of Grade C5, although the sampling will have resulted in disturbance of the material and the recovered samples will not be indicative of the insitu condition.

The results of intact dry density tests indicate the chalk to be of low to medium density with results ranging between 1.39 Mg/m³ and 1.55 Mg/m³. Natural moisture content results range between 27 % and 31 % whilst saturated moisture content ranges between 24 % and 34 %.

No evidence of any solution features or other anomalous ground conditions associated with chalk dissolution have been encountered during the investigation and the presence of such features is not expected.

4.3 Groundwater

Groundwater was not encountered in any of the excavations and is likely to be at depth within the chalk.

4.4 Soil Contamination

The table below sets out the values measured within the five samples analysed; all concentrations are in mg/kg unless otherwise stated.

Determinant	BH1 0.30 m	BH2 0.30 m	BH3 0.30 m	BH4 0.40 m	BH5 0.20 m
pH	8.3	8.1	8.5	8.5	8.4
Arsenic	2.0	3.1	4.2	1.6	4.6
Cadmium	0.5	0.5	0.5	0.5	0.7
Chromium	10	10	7.4	5.0	7.4
Lead	21	16	17	13	13
Mercury	44	31	30	26	29
Selenium	0.9	< 0.3	< 0.3	0.6	0.7
Copper	6.2	7.9	6.5	5.7	7.8
Nickel	< 1.0	< 1.0	1.6	< 1.0	2.1
Zinc	31	35	29	27	36
Total Cyanide	< 1	< 1	< 1	< 1	< 1
Total Phenols	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Total PAH	< 1.60	< 1.60	< 1.60	< 1.60	< 1.60
Sulphide	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Benzo(a)pyrene	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Naphthalene	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
TPH	12.5	17.1	15.7	8.1	10.7
Total Organic Carbon %	2.1	2.4	2.5	1.8	2.4
Note: Figure in bold indicates concentration in excess of risk-based soil guideline values, as discussed in Part 2 of this report					

The results of the chemical analyses have not indicated any of the samples tested to contain elevated concentrations of contaminants.

4.5 Generic Quantitative Risk Assessment

The use of a risk-based approach has been adopted to provide an initial screening of the test results to assess the need for subsequent site-specific risk assessments. To this end contaminants of concern are those that have values in excess of a generic human health risk based guideline values which are either that of the CLEA² Soil Guideline Value where available, or is a Generic Screening Value calculated using the CLEA UK Version 1.06³ software assuming a residential end use with plant uptake, or is based on the DEFRA Category 4 Screening values⁴. The key generic assumptions for this end use are as follows;

² Updated Technical Background to the CLEA Model (Science Report SC050021/SR3) Jan 2009 and Soil Guideline Value reports for specific contaminants; all DEFRA and Environment Agency.

³ Contaminated Land Exposure Assessment (CLEA) Software Version 1.06 Environment Agency 2009

⁴ CL:AIRE (2013) *Development of Category 4 Screening Levels for Assessment of Land Affected by Contamination* Final Project Report SP1010 and DEFRA (2014) *Development of Category 4 Screening Levels for Assessment of Land Affected by Contamination* Policy Companion Document SP1010

- ❑ that groundwater will not be a critical risk receptor;
- ❑ that the critical receptor for human health will be young female children aged zero to six years old;
- ❑ that the exposure duration will be six years;
- ❑ that the critical exposure pathways will be direct soil and indoor dust ingestion, consumption of homegrown produce, consumption of soil adhering to homegrown produce, skin contact with soils and dust, and inhalation of dust and vapours; and
- ❑ that the building type equates to a two to three-storey small terraced house.

It is considered that these assumptions are acceptable for this generic assessment of this site. The tables of generic screening values derived by GEA and an explanation of how each value has been derived are included in the Appendix.

Where contaminant concentrations are measured at concentrations below the generic screening value it is considered that they pose an acceptable level of risk and thus further consideration of these contaminant concentrations is not required. However, where concentrations are measured in excess of these generic screening values there is considered to be a potential that they could pose an unacceptable risk and thus further action will be required which could include;

- ❑ additional testing to zone the extent of the contaminated material and thus reduce the uncertainty with regard to its potential risk;
- ❑ site specific risk assessment to refine the assessment criteria and allow an assessment to be made as to whether the concentration present would pose an unacceptable risk at this site; or
- ❑ soil remediation or risk management to mitigate the risk posed by the contaminant to a degree that it poses an acceptable risk.

The results of the chemical analyses have indicated the samples tested contain low concentrations of all the tested contaminants.

The significance of these results is considered further in Part 2 of the report.