Application for a A2 Permit

Local Authority - Integrated Pollution Prevention and Control

Pollution Prevention and Control Act, 1999
Environmental Permitting (England and Wales) Regulations 2007

Introduction

When to use this form
This environmental permitting regime is known and referred to as Local Authority Integrated Pollution Prevention and Control ('LA-IPPC'). Installations permitted under this regime are known as 'A2' installations. Use this form if you are sending an application for a 'Part A2' installation to a Local Authority under the Environmental Permitting (England and Wales) Regulations 2007 ("the EP Regulations"), SI 2007/3538.

Before you start to fill in this form
You are strongly advised to read relevant parts of the Defra general guidance manual issued for LA-IPPC and LAPPC, republished in 2008 and available at http://ww.defra.gov.uk/environment/ppc/localauth/pubs/guidance/manuals.htm. This contains a list of other documents you may need to refer to when you are preparing your application, and explains some of the technical terms used. You will also need to read the relevant sector guidance note, BREF note or Process Guidance note as relevant. The EP Regulations can be obtained from The Office of Public Sector Information, or viewed on their website at http://www.opsi.gov.uk/stat.htm.

Which parts of the form to fill in
You should fill in as much of this form as possible. The appropriate fee must be enclosed with the application to enable it to be processed further. When complete return to:

Environmental Protection Officer, Environmental Health Department, Huntingdonshire District Council, Pathfinder House, St. Mary's Street, Huntingdon PE29 3TN or e-mail: envhealth@huntsdc.gov.uk

If you require any help or advice on how to set out the information we need please contact us at the above address or telephone 01480 388363.

Other documents you may need to submit
There are number of other documents you will need to send us with your application. Each time a request for a document is made in the application form you will need to record a document reference number for the document or documents that you are submitting in the space provided on the form for this purpose. Please also mark the document(s) clearly with this reference number.

Using continuation sheets
In the case of the questions on the application form itself, please use a continuation sheet if you need extra space; but please indicate clearly on the form that you have done so by stating a document reference number for that continuation sheet. Please also mark the continuation sheet itself clearly with the information referred to above.

Copies
Huntingdonshire District Council's public register is kept electronically and would appreciate your application to be submitted electronically. If you are sending the application in hardcopy please ensure that the application will be scanned so ensure the application is scanner friendly

A - Introduction

A1.1 Name of the installation

……Enval Plant – Alconbury Installation ……

A1.2 Please give the address of the site of the installation

……Buildings 118 & 110, Alconbury Airfield, Alconbury, Huntingdon, PE28 4WX
……

……

Postcode…PE28 4WX ……Telephone……

Ordnance Survey national grid reference *8 characters, for example, SJ 123 456*

T	L	2	0	2	7	4	4

A1.3 Existing authorisations:

Please give details of any existing LAPC or IPC authorisation for the installation, or any waste management licences or water discharge consents, including reference number(s), type(s) and local authority:

……None ……

……

Please provide the information requested below about the "Operator", which means the person who it is proposed will have control over the installation in accordance with the permit (if granted)

A2.1 The Operator – Please provide the full name of company or corporate body

……Enval Limited……

Trading/business name (if different)

……

Registered Office address …23 Science Park (Innovation Centre) Milton Road ……

……

…… Cambridge ……Postcode…… CB4 0EY ……

Principal Office address (if different)……

…… ……

……Postcode:… …… ……

Company registration number…… 05373475 ……

A2.2 Holding Companies
Is the operator a subsidiary of a holding company within the meaning of Section 736 of the Companies Act 1985?

No ☒ Yes ☐

Name of ultimate holding company……

Registered office address……

……

……

……Postcode……

Principal Office address (if different)
……

……

……

……Postcode……

Company registration number: ……

A3.1 Who can we contact about your application?

It will help is to have someone who we can contact directly with any questions about your application. The person you name should have the authority to act on behalf of the operator. This could be an agent or consultant rather than the operator.

Name ……David Boorman ……

Position……Director ……

……23 Science Park (Innovation Centre) Milton Road ……

……Cambridge……Postcode:…CB4 0EY …… ……

……

Telephone number……08452 997 566 (ext 1) ……

Fax number……01223 281455 ……

E. Mail address……david.boorman@enval.com ……

B - About the Installation

Please fill in the table below with details of all the current activities in operation at the whole installation.

In **Column 1, Box A**, please identify all activities listed in Schedule 1 to the EP Regulations that are, or are proposed, to be carried out in the stationary technical unit of the installation.

In **Column 1, Box** B please identify any directly associated activities that are, or are proposed, to be carried out on the same site which:

* have a technical connection with the activities in the stationary technical unit
* could have an effect on pollution

In **Column 2, for Boxes A and B**, please quote the Chapter number, Section number, A(2) or B, then paragraph and sub-paragraph number as shown in Part 2 of Schedule 1 to the EP Regulations. *[For example, Manufacturing glass and glass fibre, unless falling within Part A(1) of that Section, where melting capacity of the plant is more than 20 tonnes per day, would be listed as Chapter 3, Section 3.3, Part A(2)(a).]*

B1.1 Installation table for new permit application

COLUMN 1	COLUMN 2
Activities in the Stationary Technical Unit	**Schedule 1 References**
Waste management Co-incineration of a non-hazardous waste	Chapter 5, Section 5.1, Part A(2) b)

COLUMN 3	COLUMN 4
Directly associated activities	**Schedule 1 References**
Gas Electricity Generator	
Shredder Unit	

B1.2 Why is the application being made?

☑ the installation is new

☐ The installation is existing, but changes to the installation or to the EP Regulations means that an LA-IPPC A2 permit is required.

B.1.3 Site Maps

Please provide:-

* A suitable map showing the location of the installation clearly defining extent of the installations in red

Doc Reference ……Alconbury Enterprise Zone Map……
……Alconbury Building 118 & 110 ……

* A suitable plan showing the layout of activities on the site, including bulk storage of materials, waste storage areas and any external emission points to atmosphere

Doc Reference …… Alconbury Building 118 & 110 ……
…… Confidential Information – Enval Plant Layout ……

* A suitable plan showing the site drainage system and all discharge points to drainage or watercourses.

Doc Reference ……Alconbury Enterprise Zone Map……

B2 The installation

Please provide in this section written information about the aspects of your installation listed below. We need this information to determine whether you will operate the installation in a way in which all the environmental requirements of the EP Regulations are met.

B2.1 Describe the proposed installation and activities and identify the foreseeable emissions to air, water and land from each stage of the process (this will include any foreseeable emissions during start up, shut down and any breakdown/abnormal operation)

The use of process flow diagrams may help to simplify the operations

Doc Reference: ……Please refer to document "Technical Summary". A diagram is presented in Page 5, Figure 3.……

Summary of emissions:

	Normal operation	Start-up / Shut down	Abnormal operation
Air	Exhaust gases from conventional electricity gas generator.	Exhaust gases from conventional electricity gas generator.	Combustion gases from emergency flare Hydrocarbon gases from reactor
Water	No discharges	No discharges	No discharges
Land	No discharges	No discharges	No discharges

B2.2 Once all foreseeable emissions have been identified in the proposed installation activities, each emission should be characterised (including odour) and quantified.

- atmospheric emissions should be categorised under the following

(i) point source (e.g. chimney/vent, identified by a number and detailed on a plan)

Number in Figure 3 of Technical Summary Document	Description	Components	Amount	Other characteristics
1	Exhaust gases from conventional electricity gas generator in normal operation / start-up /shut down	CO_2 Water Air CO	XX m^3 / h	
2	Combustion gases from emergency flare	CO_2 Water CO	XX m^3 / h	
3	Hydrocarbon gases from reactor	H1 to H45 hydrocarbon gases (as per Figures 1 and 2 of Technical Summary document.	XX kg released for approximately 2 seconds only in case of an overpressure in the reactor	Odorous / toxic gases

Given that this would be the first installation of this process, there hasn't been any monitoring of emissions in the past.

(ii) fugitive source (e.g. from stockpiles/storage areas).

If any monitoring has been undertaken please provide the details of emission concentrations and quantify in terms of mass emissions. If no monitoring has been undertaken please state this.

(Emission concentration = e.g. milligrams per cubic metre of air; mass emission = e.g. grams per hour, tonnes per year)

- water emissions should be identified at discharge points and copies of any discharge consents from either the Environment Agency or sewerage undertaker should be submitted, detailing the permitted discharge limits.

  Doc Reference: ……None…….

B2.3 For each emission identified, describe the current and proposed technology and other techniques for preventing or, where that is not practicable, generally reducing the emissions and the impact on the environment as a whole. If no techniques are currently used and the emission goes directly to the environment without abatement or treatment this should be stated.

The electricity gas generator to be used has all the conventional equipment to ensure that the exhaust gas complies with emissions regulations in terms of CO, unburnt hydrocarbons and NOx. For this emission no other abatement technology is being considered given that it is an off-the-shelf equipment.

For the emergency flare, no abatement technologies are being considered given that this is an emergency equipment and it would be financially and environmentally prohibiting to have an oxidation chamber (for

example) in standby and at the right temperature to ensure that the gases would go to said chamber in case they couldn't be used in the generator.

The hydrocarbon gases could be released only by the opening of a pressure relief valve in the reactor in case of an over pressure. Given that the reactor works at atmospheric pressure, the amount of gas released in this scenario is minimal and therefore it will rapidly dissipate in the atmosphere without being a health or environmental hazard for the workers operating the equipment of people in surrounding areas.

Doc Reference: ……

B2.4 Identify the raw and auxiliary materials, other substances and water that you propose to use in carrying on the activities listed in the table in B1.1.

Water will be used to cool down parts of the process but it is not consumed or discharged. All the water in the system will be in a closed circuit recirculating through an (indirect) air cooler.

The only other material used (not consumed) in the process is carbon. Please refer to the attached documents for more information.

Doc Reference: …… Technical Summary (Page 2 The Enval Process, paragraph 2) …
…… WRAP Report (Page 9 and 10 Section 2.3, The Enval Process) …

B2.5 Characterise and quantify each waste stream from the installation and describe the proposed measures for waste prevention and reduction. Please also include waste management, issues storage and handling of the waste. [For each waste stream, identify if an environmental appraisal has been undertaken, and provide details; if not please state why an appraisal has not been undertaken. If you propose any disposal of waste, explain why recovery of that waste is technically and economically impracticable, and go on to describe the measures planned to minimise the production of that waste so as to avoid or reduce any impact on the environment.]

There are no waste streams from the process. Please see attached document for more information. With regard to the operation as a whole, as with any industrial operation, a number of wastes materials will be produced such as spent lubricant oils, used filters etc. These materials will be kept in close containers in an area marked for the purposes and will be managed by an appropriate and authorised disposal company.

Doc Reference: ……. WRAP Report ……

B2.6 Identify if there may be a discharge of any List I or List II substance and if any are identified, explain how the requirements of the Groundwater Regulations 1998 (SI 2746) have been addressed (see attached lists). Also describe the current techniques used to prevent and reduce discharges to groundwater.

None

Doc Reference: ……

B2.7 Provide a breakdown of the proposed energy consumption and generation by source and end-use, and describe the proposed measures for improvement of energy efficiency. If you have entered a climate change levy agreement please provide details.

The operation requires approximately 210 - 220 kW of power (please see attached document for more information) all of which is generated within the process by using the gas products generated in the reactor. Having said that, in the second phase of development of the equipment, once it is operating in the basic mode described in this application and the documents attached, it is intended to add further energy efficiency measures such as the use of the residual heat in the exhaust gases from the generators to run a

drier for the incoming material, increasing in this way the efficiency of the reactor and the overall efficiency of the process.

Doc Reference: ……WRAP Report Page 35, Table 11…….

B2.8 Describe the proposed systems to be used in the event of unintentional releases and their consequences. This must identify, assess and minimise the environmental risks and hazards, provide a risk-based assessment of any likely unintentional releases, including the use of historical evidence. If no assessments have been carried out please explain

This is the first plant of its kind and there is no historical evidence available. However, in the event that there is a failure of the gas generator then, as it has been explained above, Enval's design incorporates an emergency flare to burn any hydrocarbon gases produced.

Doc Reference: …… Technical Summary

B2.9 Detail the following with respect to noise and vibration

(i) the main sources of environmental noise and vibration as identified from your proposed installations' activities (including infrequent sources);

(ii) Identify the nearest noise sensitive locations and include any relevant environmental noise measurement surveys which have been undertaken;

(iii) The current and proposed technology and techniques for the control of noise.

If no assessment has been carried out, please explain.

The main sources of noise and vibration will be the shredder and the electricity gas generator. With regard to the former, the nature of the operation means that there are no ways to control the noise and therefore personal protection equipment will be needed by the operators. In respect to the generator, the equipment will be contained in its standard acoustic cabinet and therefore will comply with current legislation.

Doc Reference: …… Shredder Noise Statement ……
Shredder ……
Acoustic Cabinet for Gas Generator ……
Gas Generator ……

B2.10 Describe the proposed measures for monitoring all identified emissions including any environmental monitoring, and the frequency, measurement methodology and evaluation procedure proposed (e.g. particulate matter emissions, noise measurements). Include the details of any monitoring which has been carried out which has not been requested in any other part of this application. If no monitoring is proposed for a particular emission from the installation please state the reason.

Given that the equipment to be used is a conventional commercial generator there is no plan to have a continuous monitoring of the exhaust gases. A plan is in place to have bimonthly sampling of the exhaust gases from the electricity generator will be carried out to ensure that the process is within the legal requirements. Evidently if for whatever reason the emissions are not within limits the operation will stop and further gas cleaning equipment will be added to the operation.

Doc Reference: …….

B2.11 Describe the proposed measures to be taken, to avoid any pollution risk to land and return the site of the installation to a satisfactory state upon definitive cessation of activities, you may wish to refer to the site report requested at B3.1 below.

Doc Reference: ……

B2.12 Provide detailed procedures and policies of your proposed environmental management techniques, in relation to the installation activities described.

A full HAZOP study has been carried out during the design of the operation and two others will be carried out after the construction and during commissioning. In addition Enval has in place a Health and Safety policy, which includes the requirement to carry out an Equipment Risk Assessment and a Chemical Hazard Risk Assessment every time an equipment is built or modified. The forms used for these assesments are attached to the present applications

Doc Reference: ……Equipment Risk Assessment Form and Chemical Hazard Risk Assessment Form……

B3 Site report

B.3.1 Please provide a site report that demonstrates the condition of the land on the site of the installation. The report must identify any existing or potential sources of contamination, quantifying the presence of materials in, on or under the land which may constitute a pollution risk either in terms of toxic or polluting potential or the potential generation of toxic, flammable or asphyxiant gases. The report should consider, in relation to such sources the potential existence of pathways via which the contaminants travel, and the proximity and nature of potentially sensitive receptors.

During consideration of the likely presence of materials and the design of any intrusive sampling strategies, particular regard should be given to the locations and extent of any former or existing potentially contaminative uses and the locations, nature and likely emissions to land of processes forming part of the installation.

It is acceptable to provide site reports undertaken for other purposes, (e.g. planning applications, which have been carried out up to 6 months prior to submitting this application). Older site reports may, at the discretion of the local authority, be accepted where a further site survey and risk assessment based on the present condition of the site are submitted.

Note: As a first step you should undertake a desk study to produce the information necessary for the report. If that study suggests that there are matters that warrant more detailed investigation, then site-surveying work may be necessary.

Doc Reference: …… Baseline Geoenvironmental Ground Investigation ……

B4 Impact on the environment

Please provide written information about the impact the installations' emissions may have on the environment as listed below.

B4.1 Provide an assessment of the potential significant local environmental effects of the foreseeable emissions (e.g. is there a history of complaints, is the installation in an air quality management area?)

We do not expect Enval's operation to have any foreseeable impact.
Doc Reference: ……N/A……

B4.2 Provide an assessment of whether the installation is likely to have a significant effect on sites of special scientific interest (SSSIs) or European protected sites and, if it is, provide an assessment of the implications of the installation for that site, for the purposes of the Conservation (Natural Habitats etc) Regulations 1994 (see appendix 2 of Annex XVIII of the General Guidance Manual).

We are not aware of any SSSIs in the vicinity of the Enterprise Zone.

Doc Reference: ……N/A……

B5 Environmental statements and the non-technical summary

B5.1 Has an environmental impact assessment been carried out under The Town and Country Planning (Environmental Impact Assessment)(England & Wales) Regulations 1999/293, or for any other reason with respect to the installation? If there has been no such assessment, have there been any screening opinions or directions?

No ■ Yes ☐

Please supply a copy of the environmental impact assessment and details of any decision made

Doc Reference: ……

B5.2 Please provide a non-technical summary of all the information required above. This will enable the public to understand your installation and its environmental impact when viewing the public register.

Enval Limited has developed a technology for recycling laminated packaging. The process is based on a technology known as Microwave Induced Pyrolysis, which is a pyrolytic process in which the energy required for heating the material is provided by microwaves. The outputs are aluminium flakes, and hydrocarbons, in the form of an oil and a gas, suitable for the production of energy but also usable as chemical feedstock.

Laminated films used in the manufacture of the packaging targeted for this plant are an increasingly popular option for lightweight product packaging. They comprise a thin foil of aluminium, which is sandwiched, or laminated in a matrix of paper and/or plastic layers, and are used in a range of packaging formats, including pouches, bags and tubes, for the packaging of consumer goods such as food, drinks, pet foods, toothpastes, and cosmetic products. For convenience, we refer to the range of products as 'laminated packaging'. Because of its relative lightness and due to the absence of a commercially viable recycling process, laminated packaging has not historically been a targeted material for collection by local authorities. The most conservative estimate of the size of the UK market for laminated packaging is some 139,000 tonnes annually, containing approximately 13,500 tonnes of aluminium. Some laminated packaging formats are estimated to be growing by between 10% and 15% per year.

The result of a study commissioned by WRAP (Funded by DEFRA) indicated that Enval's Process is technologically and environmentally sound. Because of the use of microwaves the process has no emissions directly associated with burning a fossil fuel to produce heat and the oxygen -free environment within the reaction chamber minimises the possibility of creating toxic compounds (such as dioxins and furans). Furthermore the energy used to produce the aluminium is less than half the energy used to produce the same primary aluminium from bauxite and the environmental benefit of the proposed plant at Alconbury will be considerably greater in practice due to the surplus energy available from the recovered hydrocarbon products.

Enval's proposal is to process a maximum of 10 tonnes of material each day (one truck delivery per day). The delivered material will be shredded and processed to recover the aluminium, oils and gases. The gases will be used as soon as they are produced, in a conventional gas driven electricity generator to provide electricity to sustain the process.

Doc Reference: ……

B6 National consultee

We will use the information in this section to identify who we will consult about your proposals

B6.1 In which Primary Care Trust (formerly health authority)/Health Board area is the installation located?

……

If premises are on a boundary please give names of all relevant authorities

……

……

B6.2 Could the installation involve the release of any substance into a sewer vested in a sewerage undertaker?

No ■ Yes ☐

Please name the sewerage undertaker……

B6.3 Are there any sites of special scientific interest (SSSIs) or European protected sites which are within 2 kilometres of the installation?

No ■ Yes ☐

Please give names of the sites

Doc Reference: ……

B7 Planning Status

B7.1 Where the installation may involve a specified waste management activity we cannot issue a permit unless one of the following applies, please indicate which of the following applies to the installation:

☐ You have planning permission (please enclose copy of decision notice)
Planning permission through Cambridge County Council is currently being sought for Buildings 118 & 110

Doc Reference ……

☐ You have a certificate of lawful existing use of development
(please enclose copy of certificate)

Doc Reference ……

☐ You have an established use certificate (please enclose copy of certificate)

Doc Reference ……

☐

The General Permitted Development Order applies Please give details (please enclose copy of relevant paperwork)

Doc Reference …….

☐ Planning permission is not required (please say why and enclose written confirmation from the planning authority)

Doc Reference …….

For further advice on the above planning issues, please contact the local planning authority.

B8 Additional information

Please supply any additional information that you would like us to take account of in considering this application.

Doc Reference ……N/A…….

C - Fees and Charges, Information Handling, and Declaration

C1 Fees and Charges

The enclosed charging scheme leaflet gives details of how to calculate the application fee. Your application cannot be processed unless the application fee is correct and enclosed.

C1.1 Please state the amount enclosed as an application fee for this installation:

For the local authority

£ 3,218 (cheques should be made payable to Huntingdonshire District Council)

For the Environment Agency

£ (cheques should be made payable to The Environment Agency)

We will confirm receipt of this fee when we write to you acknowledging your application.

C1.2 Please give any company purchase order number or other reference you wish to be used in relation to this fee.

……

C2 Annual subsistence charges

If we grant you a permit, you will be required to pay an annual subsistence charge, failure to do so will result in revocation of your permit and you will not be able to operate your installation.

C2.1 Please provide details of the address you wish invoices to be sent to and details of someone we may contact about fees and charges within your finance section.

……Enval Limited, Unit 3 High Town Enterprise Centre, York Street, Luton
……

……

Postcode:…LU2 0EZ……Telephone:……08452 997566……

C3 Commercial confidentiality

C3.1 Is there any information in the application that you wish to justify being kept from the public register on the grounds of commercial or industrial confidentiality?

No ■ Yes ☐

Please provide full justification, considering the definition of commercial confidentiality within the EP Regulations.

Doc Reference ……

C3.2 Is there any information in the application that you believe should be kept from the public register on the grounds of national security?

No ■ Yes ☐

Do not write anything about this information on the form. Please provide full details on separate sheets, plus provide a copy of the application form to the Secretary of State/ Welsh Ministers for a direction to exclude information on grounds of national security.

C4 Data Protection

The information you give will be used by the local authority to process your application. It will be placed on the relevant public register and used to monitor compliance with the permit conditions. We may also use and or disclose any of the information you give us in order to:

- consult with the public, public bodies and other organisations,
- carry out statistical analysis, research and development on environmental issues,
- provide public register information to enquirers,
- make sure you keep to the conditions of your permit and deal with any matters relating to your permit
- investigate possible breaches of environmental law and take any resulting action,
- prevent breaches of environmental law,
- offer you documents or services relating to environmental matters,
- respond to requests for information under the Freedom of Information Act 2000 and the Environmental Information Regulations 2004 (if the Data Protection Act allows)
- assess customer service satisfaction and improve our service.

We may pass on the information to agents/ representatives who we ask to do any of these things on our behalf.

It is an offence under regulation 38 of the EP Regulations, for the purpose of obtaining a permit (for yourself or anyone else), to:

- make a false statement which you know to be false or misleading in a material particular,
- recklessly make a statement which is false or misleading in a material particular
- intentionally to make a false entry in any record required to be kept under any environmental permit condition
- with intent to deceive, to forge or use a document issued or required for any purpose under any environmental permit condition.

If you make a false statement

- we may prosecute you, and
- if you are convicted, you are liable to a fine or imprisonment (or both).

C5 Declaration: previous offences (delete whichever is inapplicable)

I/We certify

EITHER

No offences have been committed in the previous five years which are relevant to my/our competence to operate this installation in accordance with the EP Regulations.

OR

The following offences have been committed in the previous five years which may be relevant to my/our competence to operating this installation in accordance with the regulations:

Doc Reference …….N/A……

Signature…….

Name……David Boorman…….

Position…… Director……Date…30th June 2012…

C6 Declaration

C6.1 Signature of current operator(s)*

I/We certify that the information in this application is correct. I/We apply for a permit in respect of the particulars described in this application (including supporting documentation) I/We have supplied.

Please note that each individual operator must sign the declaration themselves, even if an agent is acting on their behalf.

For the application from:

Installation name:…….Enval Plant – Alconbury Installation……

Signature…….

Name……David Boorman ……

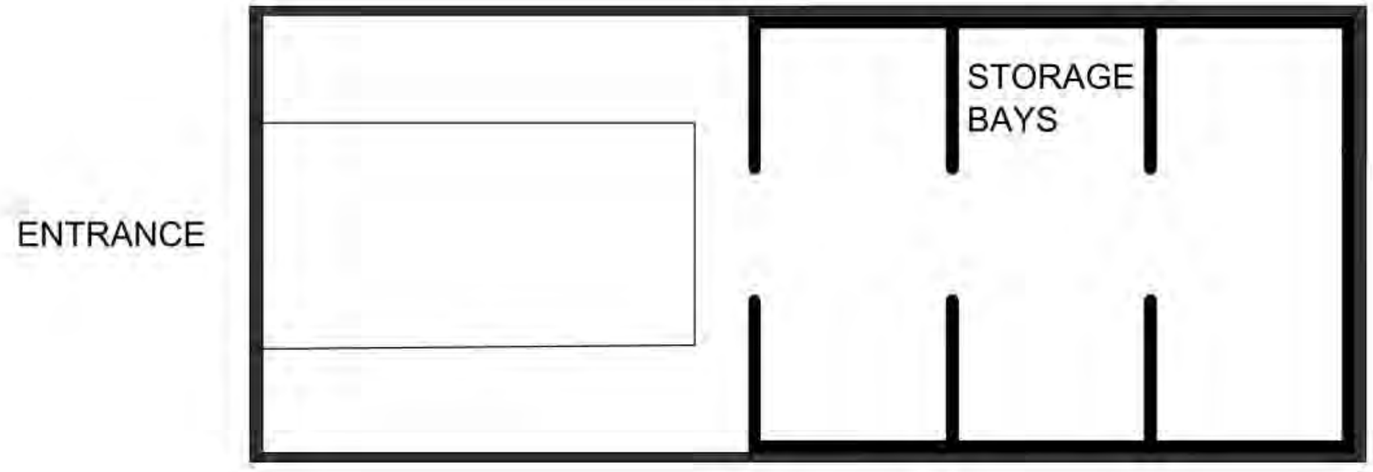
Position……Director……Date…30th June 2012……

Signature…….

Name…….

Position……Date…….

** Where more than one person is defined as the operator, all should sign. Where a company or other body corporate – an authorised person should sign and provide evidence of authority from the board of the company or body corporate.*



N

Revision History		
REV	Description	ZONE

NOTES:

enval

ALCONBURY

TITLE:	SCALE:
BUIILDNG 110	1:50

Material -

Surface finish -

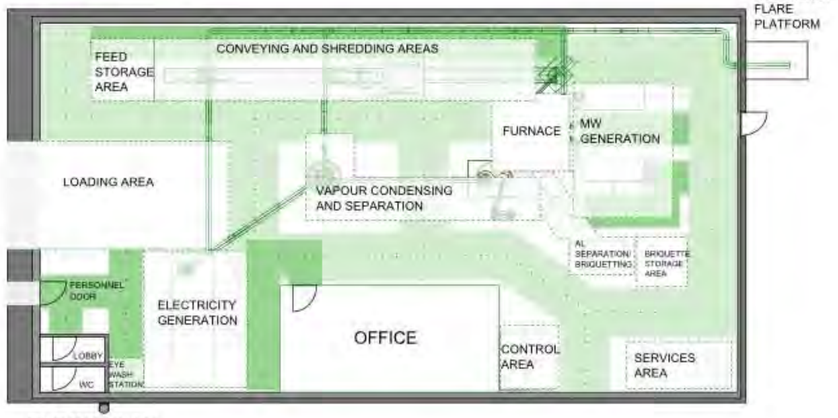
Tolerance unless stated
X ± 0.25
X.X ± 0.10
0.05 ON ALL DIAMETERS RELATIVE TO OTHERS

All dimensions in mm

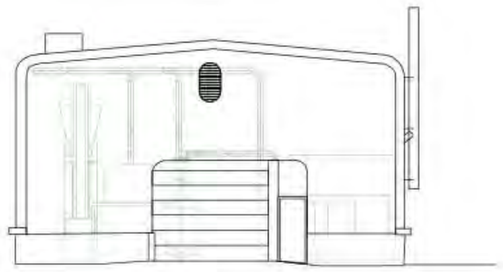
DATE: 27 July 2012

NUMBER:	REVISION:
DW:00-000-0503	-

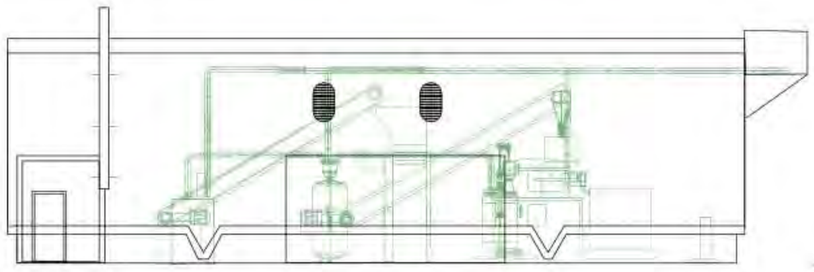
FLOOR-LEVEL PEDESTRIAN AND EQUIPMENT ROUTES



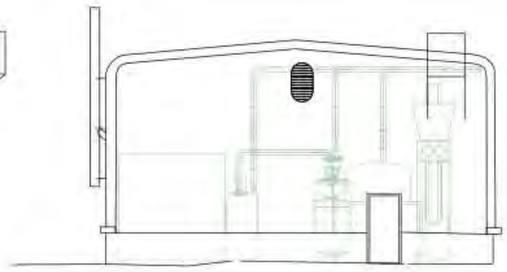
FLOOR PLAN



FRONT ELEVATION



SIDE ELEVATION



REAR ELEVATION

Revision History

REV	Description	ZONE

NOTES:

Scale is 1:100@A1

enval

ALCONBURY

TITLE:	SCALE:
PLANT LAYOUT	1:100

Material	-
Surface finish	-

Tolerance unless stated
X ± 0.25
X.X ± 0.10
0.05 ON ALL DIAMETERS RELATIVE TO OTHERS

All dimensions in mm

DATE: 24 July 2012

NUMBER:	REVISION:
DW:00-000-0502	-

ENVAL PROCESS

TECHNICAL SUMMARY

April 2012

1. About Enval Limited and Laminated Packaging

Enval is a company formed in 2006, dedicated to the development and commercialisation of recycling and environmental technologies. The Company was spun out of the Department of Chemical Engineering at the University of Cambridge and uses technology resulting from a research project which started in 1997. Enval's aim is to develop unique recycling processes that provide financially lucrative and environmentally beneficial alternatives to landfill.

To date the main activity of Enval has focused primarily on the development and commercialisation of its patented process to recycle aluminium/plastic laminates.

Laminates come in a variety of different types but all contain a thin foil of aluminium, typically with a thickness of approximately 6 to 30 microns, laminated in conjunction with paper and/or plastic layers. These materials are very versatile and effective from a financial and environmental point of view: they are low cost, they preserve the integrity of the contents of the package and they save money, and resources in transport and storage. However, against these advantages stands the fact that hitherto no viable technology has existed for recycling aluminium when it is attached or laminated to another material such as paper or plastic to form flexible packaging. As a consequence they have generally been disposed of in landfill or via incineration, thereby consigning the valuable resources contained in them to a single use.

2. The Enval Process

Enval's proprietary process is based on a technology known as Microwave Induced Pyrolysis. Microwave induced pyrolysis combines the advantages of microwave heating with the environmental benefits and commercial opportunities arising from the pyrolysis of plastics.

The process involves mixing plastics, which are known to have a very high transparency to microwaves, with carbon, a highly microwave-absorbent material. When carbon is exposed to a microwave field, it can reach temperatures up to 1,000 ºC in a few minutes. If shredded plastics are mixed with the carbon prior to or during heating, the energy absorbed from the microwaves is transferred to the plastics by conduction, providing a very efficient energy transfer and a highly reducing chemical environment. The latter avoids formation of undesired oxygenated organic compounds, in case oxygen is present in the system within molecules of unused product, plasticizers, additives, paints, inks or other materials such as paper or biowaste. [1-4]

Microwave heating has a number of technical advantages over conventional surface heating because of a more even distribution of heat and easier control over the heating process. Also, sources of microwave radiation enable high temperatures and high rates of heating to be obtained and show excellent efficiencies for conversion of electrical energy into heat (80-85%). Modern equipment has very high reliability and is economically competitive with other heating methods. Modern industrial microwave heating systems are used for a diverse range of processes in the food industry:

tempering and thawing, continuous baking, vacuum drying, pasteurization and sterilization [5], making it a widely used and well-understood technology.

Taking these advantages into account, microwave induced pyrolysis has also proven to be a very useful process to treat some actual wastes where the plastic is mixed with other materials, rather than pure, clean and unmixed plastics. The development work carried out by Enval has shown the potential of this process for the treatment of laminate packaging waste. In addition to the aforementioned advantages, the microwave induced pyrolysis process can be very gentle. Therefore very fragile materials, like the aluminium foil in the laminates, can be recovered clean and ready for reuse. It is this ability that compensates for the necessity for the generation of heat via microwave heating procedures with some reduction in the overall thermal efficiency of the process.

Furthermore, a key attribute of the Enval solution and microwave-induced pyrolysis is that the process can be conveniently and economically operated at a variety of scales that permit local treatment, thus avoiding the need to transport waste to centralised treatment centres.

Products

The aluminium that the process produces has been assessed by a number of aluminium reprocessors who have established that it has a very acceptable quality and that they would be able to mix it with raw aluminium without major problems and are prepared to pay a higher price for it compared to other secondary aluminium.

On the plastic side, upon pyrolysing, the polymer fraction of the laminate turns into a large mixture of hydrocarbons with carbon chain lengths ranging from C_1 to approximately C_{25}. A fraction of these products can be condensed at room temperature and the resulting pyrolytic oil is a mixture of compounds very similar to those found in common fuels (medium and heavy oil mainly). The non-condensable fraction is used within the process to produce electricity (see below). Due to the highly chemically reducing environment within the reactor, the potential production of undesirable compounds such as dioxins and furans is essentially eliminated.

Figure 1 below shows the typical total ion chromatogram (TIC) of the pyrolytic oils obtained during the process and Table 1 shows a list of the most abundant compounds found in the mixture. Figure 2 and Table 2 show the same for the non-condensable product.

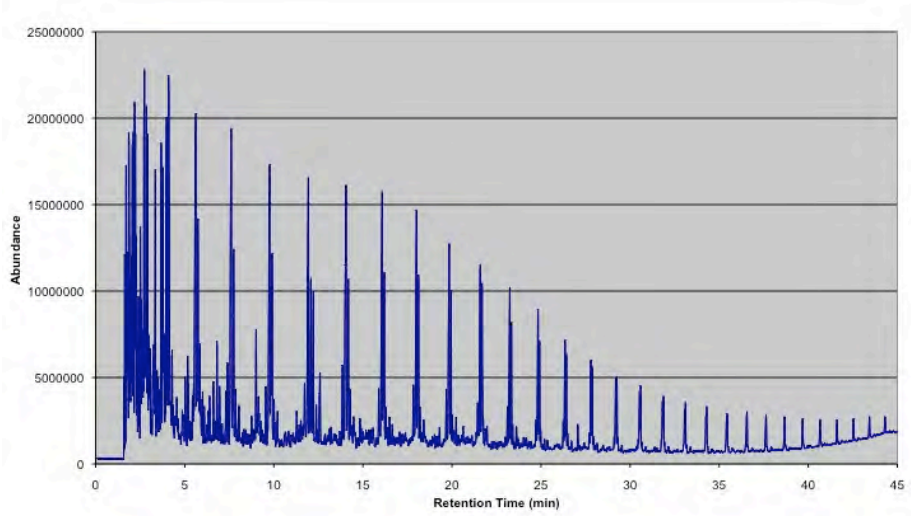


Figure 1. TIC of the condensable products obtained

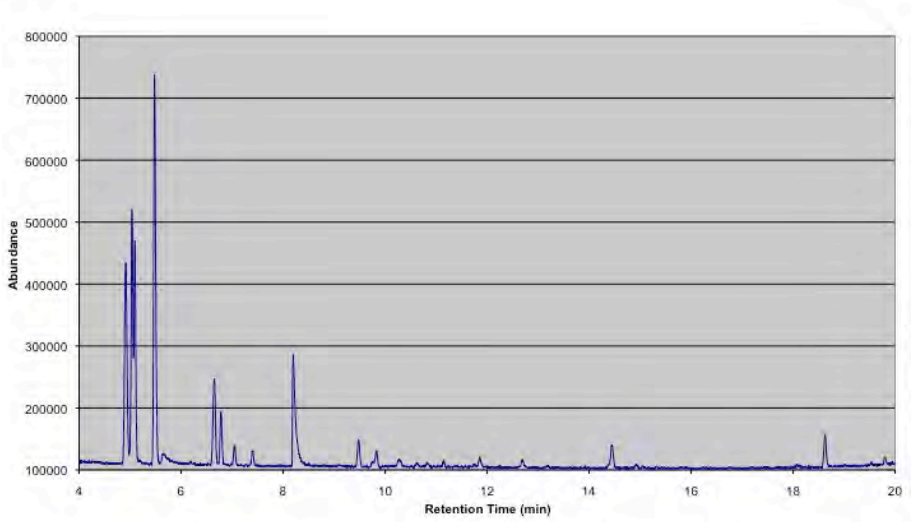


Figure 2. TIC of the non-condensable products obtained

Process Flow Diagram

Figure 3 below presents a schematic diagram of the Enval Process. The reactor is the core equipment of the Enval Process. The other blocks represent the systems that comprise ancillary equipment, fundamental to the process and where Enval's expertise has allowed the use of equipment commonly found in process industries therefore reducing the overall capital cost of the Enval installation. The gas generator allows maximum value to be extracted out of the products, producing electricity for local consumption (from the gaseous products). It is important to notice that by adding the electricity generator, the operation of the plant is totally self-supported and no external sources of energy will be needed (except for start-up) demonstrating the sustainability side of the process.

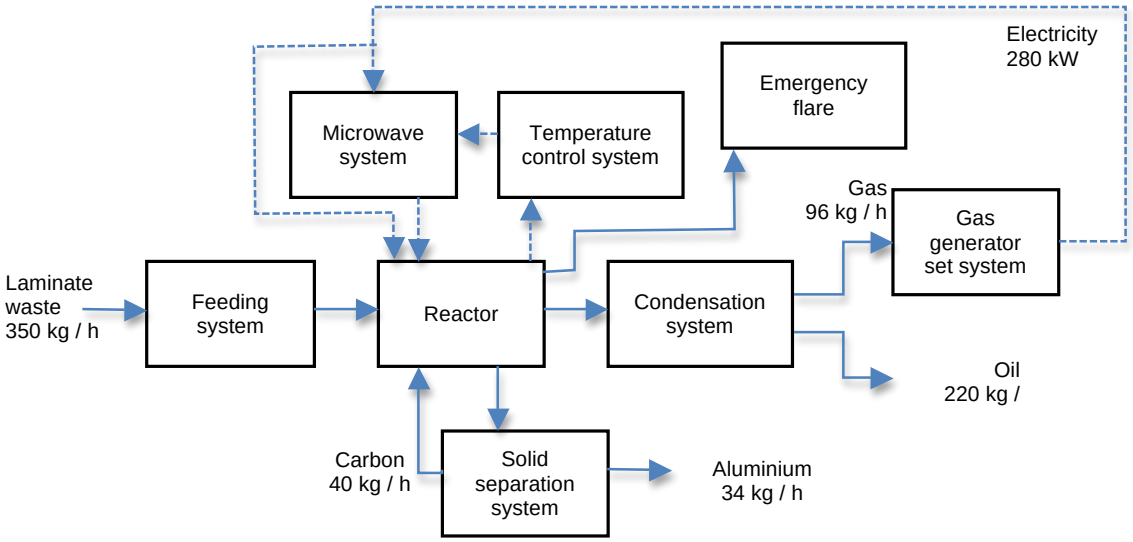


Figure 3: Enval process block diagram

Table 1. Most abundant compounds found in the condensable products (presented in elution order)

Pentene	1H-Indene
Hexene	Undecene
Hexane	Undecane
Cyclopentene, 1-methyl	Dodecne
Benzene	Dodecane
Heptene	Naphthalene
Heptane	Tridecene
Cyclohexane, methyl-	Tridecane
Heptane, 4-methyl-	Naphthalene, 1-methyl
Toluene	Tetradecene
Cyclooctene	Tetradecane
Octene	Pentadecene
Octane	Pentadecane
2-Octene	Hexadecene
Cyclohexene- 1-ethyl	Hexadecane
Ethylbenzene	Heptadecene
p-Xylene	Heptadecane
1,8-Nonadiene	Octadecene
o-Xylene	Octadecane
Nonene	Phenanthrene
m-Xylene	Nondecene
Nonane	Nonadecane
Styrene	Eicosene
Benzene, 1,3-dimethyl-	Eicosane
Benzene, propyl-	Heneicosene
1,9-Decadiene	Heneicosane
Decene	methacrylic acid octadecanyl ester
Decane	Docosane

Table 2. Most abundant compounds found in the non-condensable products (presented in elution order)

Methane
Ethene
Ethane
Carbon monoxide
Propene
Propane
Butadiene
Pentene
Methyl-butene
Pentane
Pentadiene

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Material change for a better environment

Project report

Recycling of laminated packaging

Trials to optimise pilot plant for recycling of laminated packaging wastes

Project code: MDP037
Research date: September 2010 to April 2011 **Date:** September 2011

WRAP's vision is a world without waste, where resources are used sustainably.

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Written by: Stephen Slater and Trevor Crichton, Oakdene Hollins Ltd

Front cover photography: Examples of laminated retail packaging

Executive summary

Laminated films used in the manufacture of the packaging targeted for this project are an increasingly popular option for lightweight product packaging. They comprise a thin foil of aluminium, which is sandwiched, or laminated in a matrix of paper and/or plastic layers, and are used in a range of packaging formats, including pouches, bags and tubes, for the packaging of consumer goods such as food, drinks, pet foods, toothpastes, and cosmetic products. For convenience, this report refers to the range of products as 'laminated packaging'. Because of the relative lightness of laminated packaging, and due to the absence of a commercially viable recycling process, it has not historically been a targeted material for collection by local authorities, as are other, more common forms of packaging.

Enval Limited has developed a technology for recycling these materials. The process is based on a technology known as Microwave Induced Pyrolysis, which is a pyrolytic process in which the energy required for heating the material is provided by microwaves. The outputs are aluminium flakes, and hydrocarbons, in the form of an oil and a gas, suitable for the production of energy.

This report details a series of trials, using a pilot plant built by Enval, to process laminated packaging as a post-consumer waste and reviews the technical, commercial and environmental performance of the process. The project involved research into the market for laminated packaging, including the mix, form and quality of typical materials, how they might be recovered from the household waste stream, practical trials of the process using the pilot plant, and detailed analysis of the findings.

A total of six process trials were performed using a total of 600kg of a 'recipe' of laminated packaging which was formulated to closely simulate the predicted post-consumer mix, including product residues and non-target contamination materials. Output materials were tested for quality and chemical composition. The aluminium was valued by potential reprocessors and the hydrocarbons were priced based on their useable energy equivalents.

The results indicate that the process is technologically and environmentally sound. The carbon emissions associated with the process would be approximately half of that associated with the production of primary aluminium alone. This environmental benefit will be considerably greater in practice due to the surplus energy available from the recovered hydrocarbon outputs which would substitute for non-sustainable energy sources.

The most conservative estimate of the size of the UK market for laminated packaging is some 139,000 tonnes annually, containing approximately 13,500 tonnes of aluminium. Some laminated packaging formats are estimated to be growing by between 10% and 15% per year.

In assessing the commercial viability of the process, it was assumed that post-consumer laminated packaging would become a targeted kerbside recyclable material by waste collection authorities within regions, each supplying one materials recovery facility (MRF). It was further assumed that it would be possible to access one-third of the total laminated packaging disposed by households following a suitable promotional campaign within any region. In this way, the amount of material recovered in any region would be sufficient to feed a commercial scale processing system of 2,000 tonnes per annum gross capacity. This could be placed within, or adjacent to, the MRF. Prior to this happening, the plant will require further development to be sufficiently robust and reliable for operation by semi-skilled operatives. Some modifications would be required within the MRF to automatically recover the materials separately from other aluminium based materials, in particular, used

beverage cans. Based on these assumptions, and including the costs of the modifications to the MRF and those of the transportation of materials, it is estimated that a minimum payback of some four years would be achieved from investment in each commercial scale processing plant. The lifetime of the plant is at least ten years. The payback period, based on the value of the aluminium and the hydrocarbons and the avoided landfill costs, would be improved if the percentage of aluminium in the waste mix was increased, either by the addition of cleaner, post-industrial, waste laminated packaging to the feedstock or by the collection of additional aluminium packaging within the MRF sorting processes.

Contents

Glossary

MBT	Mechanical-Biological Treatment
MRF	Material Recovery Facility
NE	Nichteisen [*non-ferrous*]
2D	Two-dimensional
3D	Three-dimensional

Acknowledgements

We are especially grateful to Enval Ltd, Donarbon Ltd, the Aluminium Packaging Recycling Organisation (Alupro) and Bywaters Ltd for their assistance in the production of this report.

1.0 Introduction

1.1 Aluminium/plastic laminated packaging

As a result of a twin approach to making packaging more reliable whilst minimising its environmental impact, there have been many developments in the packaging sector and one product of these developments has been the aluminium/plastic laminate which is commonly used as packaging for consumer goods such as such as food, drinks, pet foods, toothpastes and cosmetic products. For convenience, this report refers to the packaging under consideration as 'laminated packaging'.

Laminated packaging has become a concern within the recycling sector because, by its very design, it is of low weight, relatively low value, and has, to date, been considered to be completely unrecyclable. In an environment where collection and recovery of recyclates is driven by weight-based targets, they will not be highlighted as an issue until heavier packaging options have been replaced. However, because it makes a significant positive impact on the environmental performance of the packaging product, its use is increasing rapidly.

The low weight of the laminate improves the ratio of product to pack weight and reduces the fraction of transport costs and environmental impacts attributable to the packaging. Also, it ultimately reduces the weight of material that has to be disposed of after the product has been consumed, thus mitigating the effects of landfill taxes. However, the problems associated with recycling the materials used to fabricate these pouches, bags and tubes negate some of their benefits, especially in the view of the consumer who cannot find any environmentally satisfactory method of disposal.

For clarity, reference is made at this point to two other high volume packaging formats that use aluminium as a barrier material but which are not target materials in this project for the reasons given. They need consideration, however, since their aluminium content may bring them into the same recyclable waste streams as the laminated packaging that is targeted for these trials. They are:

- Aseptic beverage cartons – These are predominately fibre-based cartons with aluminium inner linings which serve as a barrier to oxygen, aroma and light. The fibre material is the major element of the pack, with the aluminium content being less than 5% by weight. Used beverage cartons are being collected from the UK household waste stream in increasing numbers for recycling driven by the value of the relatively high quality fibre materials. The recycling process for these items is, therefore, configured around de-pulping and recovery of the fibres, requiring different equipment from that being trialled.
- Crisp packets – These are predominately plastic packs with a very thin aluminium inner coating which is deposited onto the base material. In this instance the aluminium is too thin to recover economically and these packs are not, currently, collected for recycling in the UK.

1.2 Objectives of the project

In an attempt to resolve the problem of recycling laminated packaging, Enval Limited has developed a technology that can recycle these materials and the company had carried out various preliminary studies to assess the technical feasibility of the process. In parallel with this initiative, WRAP supports and promotes the packaging recycling industry with collaborative projects that address the issues of collection, market knowledge, process integration and development with a holistic life cycle assessment view.

Given the potential capability of the Enval process, WRAP commissioned a project to undertake a trial of the Enval process to assess its technical, commercial and environmental

viability and whether it may offer a recycling solution for laminated aluminium packaging not currently recycled or reprocessed in the UK. Oakdene Hollins has worked closely with Enval to deliver the project.

This report details the findings of the project over three phases. These were:

- Research into the mix, form and quality of typical laminated packaging materials that would be found in the household waste stream and sourcing of significant quantities of laminated packaging, including contaminants, such as residual waste product and sundry waste items that would typically be present in these materials should they be recovered from the household waste stream.
- Carrying out practical trials including:
    - a minimum of six recycling process trial runs, each of approximately 100kg gross mass per trial, to establish the technical robustness of the process
    - analysis of process trial data
    - trialling the application of waste sorting technologies at a municipal Materials Recovery Facility (MRF) to determine the technologies required for the recovery of feedstock to the process.
- Detailed consideration of the findings, including the economics of collection and recovery of feedstocks, and marketing of output materials to assess the wider technical, environmental and economic viability of the process in the recovery and recycling of post-consumer laminated packaging.

Whilst the application of the process to post-industrial laminated packaging waste may present a further opportunity to exploit the intellectual property of the process, this is not considered within this project.

1.3 Methodology

The work was carried out between September 2010 and March 2011 by Enval and Oakdene Hollins working in collaboration. The research elements of the project were managed jointly. Enval technical staff carried out the physical sourcing, preparation and processing of the feedstock materials with critical monitoring at all stages by Oakdene Hollins technical consultants.

The following tasks were completed:

- Office-based research using web searches, email, telephone interviews, and peer meetings to establish:
    - the market size for laminated packaging in the UK;
    - the theoretical mix and quality of feedstock that would be expected to be available from householders, were local authorities to include laminated packaging on their lists of targeted recyclable materials;
    - issues associated with the practicalities and costs of recovering waste laminated packaging from the household waste stream; and
    - the potential values of output materials to reprocessors and other end users.
- Visit to a Mechanical Biological Treatment (MBT) plant and a MRF to support the findings of the desk-based research on the mix and quality of feedstock, and to assess and discuss typical optimum sorting processes and the contaminants that might be expected to be present when recovering laminated packaging from co-mingled waste streams using appropriate waste sorting technologies.
- Sourcing, preparation and delivery of feedstock to the trial site.

- Management of six process trials including recording and analysis of all process parameters, mass balance calculations, and characterisation of all output materials, as follows:
    - determination of a set of optimised process parameters that enable Enval to extract clean aluminium foil from the waste;
    - qualitative and quantitative assessments of the reproducibility of the performance of the Enval process when operating with near-industrial scale quantities and on a near-continuous basis;
    - demonstration that the technology is capable of processing mixed post-consumer laminated packaging waste including product residues;
    - demonstration of the recovery of high quality aluminium and a mixed hydrocarbon that may be used as a fuel; and
    - generation of sufficient data to produce detailed assessments of the environmental and financial impact and viability of the Enval process at this scale.
- Analysis of product output qualities, quantities, values and potential end use markets.
- Critical review of the technical, environmental and economic viability of the process.
- Preparation of the final report.

1.4 Report layout

This report presents an introduction to laminates and the Enval process followed by the detailed feedback for each project task and the results obtained.

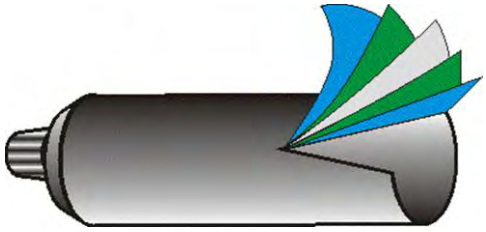
2.0 Laminated packaging

2.1 Materials and applications

Laminated packaging is an increasingly popular option for lightweight product packaging, comprising multiple thin layers of material, each with a particular function. These laminates are currently used in numerous packaging applications such as stand-up pouches, e.g. drinks containers or coffee pouches, or laminate tubes, e.g. toothpaste or cosmetic tubes. They have extremely low densities and the market for laminates is growing particularly strongly at the present due to a trend for 'light-weighting' product packaging.

The laminated packaging targeted for this project is available in a wide range of formats. They all contain a thin foil of aluminium, which is typically between 6-30µm (microns) thick and is sandwiched, or laminated, in a matrix of paper and/or plastic layers. The most commonly used plastic is normally polyethylene terephthalate (PET), often in conjunction with low density polyethylene (LDPE). A typical example of laminate packaging is the tubes used for toothpaste and cosmetic products, a schematic diagram of which is shown in **Error! Reference source not found.**.

Figure 1: Different layers present in a typical toothpaste tube



Key:

Blue:	Polyethylene
Green:	Polyethylene copolymer
Light Grey:	Aluminium foil

Other examples include pouches for pet food, ready meals (for example soups and pulses), baby food, fruit juice and smoothies, bags for ground coffee and sachets for powders such as hot chocolate or sauce mixes etc.

The aluminium foil barrier performs two major functions. Firstly it prevents the loss of any aromas or perfumes in the product, as otherwise it would permeate though the polymer layers and would become slowly lost. Secondly, it also provides long-life protection from ultraviolet (UV) light and gas diffusion into the packaged products. UV light causes photo-oxidation reactions in many foods and other products, especially those containing fats (like milk and cream), thus reducing some of their nutritional value and giving an unpleasant rancid taste caused by the reaction products. Besides these protective attributes, the aluminium foil also helps provide mechanical rigidity to the packaging.

As well as these fundamental attributes provided by the laminated packaging the use of these materials has additional secondary advantages, such as:

- It has an aseptic nature. Products can be packaged for many months without suffering deterioration. This results in a reduced need for refrigeration or freezing, resulting in reduced energy consumption during product storage.
- The preserved food can be transported economically because the volume/weight ratio of the packaging is high.

- In many situations the manufacturers of products packed using these laminates save money because they receive the packaging in the form of printed reels ready to be shaped and filled. This significantly reduces both the transport and storage requirements of empty containers and hence the cost of their products.

In contrast to these advantages, however, laminated packaging systems have one serious drawback: there is currently no adequate and proven technology capable of fully recycling these materials in an efficient and cost-effective manner. Indeed, the combination of plastic and aluminium in the waste presents a technical recycling challenge that until now has remained unsolved, resulting in the need for these materials to be disposed of by conventional means. Despite their lightweight nature, the huge quantities of packages that are involved dictate that many thousands of tonnes per annum of laminate waste are being disposed to landfill or incinerated. Environmentally this is undesirable since the resources (aluminium and plastic) employed to produce it are wasted and more must be extracted from nature to replenish them. Beyond this, on an economic level, not only is the current disposal method costly, there is considerable value in both the aluminium and plastics that could be exploited if a viable recycling route could be identified.

Based on discussions with the Aluminium Packaging Recycling Organisation (Alupro), it was established that aluminium used for laminated packaging is an '8000 series' alloy. This differentiates it from that used in aluminium cans which are produced using a '3000 series' alloy. According to Alupro, this does not detract significantly from the potential value of the material in the reprocessing market since the tonnages of aluminium that might be recovered from laminated packaging using the Enval process would be low relative to that from aluminium can recycling. It follows that the two recycled materials do not necessarily need to be kept separate during waste recovery sorting processes.

2.2 Summary of market size, market trends and product mass

The adoption of laminated packaging has increased significantly in recent years driven by the advantages it offers over more established packaging systems. An estimate of the UK market size is calculated in Section 3.2 at 139,000 tonnes of packaging per year, containing, on average, some 9.7% aluminium foil by weight. The market has a growth rate of approximately 10% annually.

Weights of the laminated materials for the most common products range from 3 grammes each, for some pet food pouches, up to 11 grammes each for some coffee packs. Also, when recovered from the household waste stream the presence of residual product, such as pet food, drinks and toothpaste, add substantially to the waste mass and this has to be considered when assessing waste handling volumes and the organic material outputs from the recycling process.

2.3 The Enval process

The Enval process has been developed to focus on the recycling of aluminium-containing laminate structures and is based on a technology known as Microwave Induced Pyrolysis, which is a pyrolytic process in which the energy required for heating the material is provided by microwave energy.

In general, pyrolysis is a process in which an organic material, such as paper or plastic, is heated in the absence of oxygen, thereby causing the degradation of the material by effectively shortening the material's molecular length, but without any oxidation, combustion or incineration taking place.

Everyday experience demonstrates that plastics do not readily heat up using microwaves; for instance, plastic dishes stay relatively cool even if their contents do become hotter.

However, in the Enval process, carbon is heated by microwaves and the hot carbon is used as the heat source for the pyrolysis of the plastics.

Carbon is a highly efficient microwave absorber that can absorb the microwave energy and then transfer it by conduction to the plastic. This provides a very efficient, but mechanically gentle, heat exchange. In the case of laminates, the Enval process causes the degradation of the plastics present in the laminate and the formation of other useful products, known as pyrolysis oils, which can be used either as fuel to generate electricity or as feedstock for speciality chemicals. The fragile aluminium foil remains undamaged after processing and is extracted as clean material that is suitable for reintroduction into the aluminium recycling supply chain.

It is understood that the Enval process has the potential to treat most flexible aluminium/plastic laminated packaging systems, whether they are in the form of post-consumer waste or commercial and industrial waste from the packaging, production and filling processes.

Commercially, therefore, it offers a route to enable the almost complete recycling of laminated packaging waste by separating and extracting the high value materials contained within. In addition to the value derived from the production of aluminium and energy/chemicals, there is the potential to realise an additional revenue stream by avoiding transport of wastes, gate fees and landfill charges.

Environmentally, the recovery and recycling of aluminium, as well as reducing the demand for virgin materials, is expected to save considerable energy, as the energy consumption used in the production of recovered aluminium is just 4% of that used in the production of primary aluminium from bauxite.

Furthermore, when recycling aluminium, the industry estimates that about 1-2% of the aluminium being reprocessed is lost as oxide; this is in addition to a further 1-2% lost by the presence of aluminium oxide on the feedstock material. When laminated packaging is pyrolysed, the aluminium is not exposed to oxygen during the process, so there is no further oxidation and loss of metal.

The scientific foundations behind the Enval process have been presented in a number of forums and publications.

3.0 Phase I - Initial research

3.1 Introduction

Clearly the mix of packaging formats and contamination is of paramount importance to the validity of the process trials. The waste materials to be used must consist of, or must closely simulate, mixed post-consumer laminated tubes and pouches.

Prior to the start of the project it had been intended to undertake at least one process trial using post-consumer waste taken from actual household collection rounds and recovered in a sorting process at an MBT plant or a MRF. In this way, a typical mix of the different packaging formats, together with appropriate contaminants in the form of product residues, non-targeted items and other wastes, would be achieved.

The balance of the tests were planned to be carried out using a simulated mix of materials sourced from post-industrial sources, i.e. the material that is scrapped during the manufacturing and filling of the packaging. These materials are easily accessible and available in substantial amounts.

In the event, field tests carried out at the MBT plant demonstrated that the option to source an adequate quantity of post-consumer waste taken from household collection rounds was not found to be practical, as described in Section 3.3.1. All of the process trials were, therefore, carried out on the simulated mix of materials sourced from post-industrial sources.

Laminated tubes are predominantly used for toothpaste, but they also contain cosmetics, food, pharmaceutical, and other household and industrial products. Laminated pouches are used for pet food, human food, and drinks and non-food items. To simplify feedstock sourcing for the bulk of the trials, the range of packaging products considered in the research was reduced to:

- toothpaste tubes;
- pet food pouches;
- drinks pouches; and
- coffee bags.

3.2 Market size

Given the diverse range of laminated packaging formats currently being used by the food, drinks and pharmaceutical industries, accurate confirmation of the market size, of packaging items relevant to this project, is not possible. The rapid growth in the use of these products is also a factor. Estimates have been made based on:

- data provided by packaging manufacturers;
- data for aluminium consumption; and
- field analysis of packaging weights.

Data provided by the packaging manufacturers suggest that, on average, laminated packaging contains some 9.7% foil, as a percentage of its total weight. This figure is supported by research carried out by Judge Business School, Cambridge, in 2008, which was based on interviews with the key laminate packaging manufacturers in Europe and on practical studies of aluminium content of sample packs.

Additional data for aluminium in the waste stream is provided by Alupro based on data from Defra in 2008[1]. This suggested that some 14,400 tonnes of aluminium was in the UK waste stream in composite packaging, a figure which includes aseptic fibre based beverage

[1] http://www.alupro.org.uk/facts-and-figures.html

cartons. To arrive at a gross weight of laminated packaging relevant to this project, the weight of aluminium used in beverage cartons in the UK must be deducted. According to Tetrapak the recovery and recycling of used beverage cartons totals some 900 tonnes per year[2].

The above puts our estimate of laminated packaging entering the UK market and, thereby, ultimately entering the household waste stream, at 139,000 tonnes, as set out in **Error! Reference source not found.**.

Table 1: UK Laminate packaging market and potential for the Enval process (2008)

Aluminium foil in composite packaging in the UK	14,400 tonnes / annum
Less aluminium foil in beverage cartons	(900 tonnes / annum)
Net aluminium content of laminated packaging	13,500 tonnes / annum
Average percentage of foil used in laminated packaging	9.7%
Total amount of laminated packaging in the UK (= 13,500 ÷ 9.7%)	139,000 tonnes / annum

Also, according to a report on complex packaging trends, commissioned by WRAP in 2010, and a further study by PCI Films Consulting[3], the growth rates for the total production of pouches and tubes have been of the order of 10% to 15% per annum over the past five years. Assuming that this trend is continuing, and that it applies to other plastic laminated packaging formats, the figures shown in Table 1 are likely to be considerably understated.

The Judge Business School report also estimates that, approximately 190,000 tonnes of aluminium are used in laminated packaging in Europe, excluding those used in fibre-bonded beverage cartons. Information obtained directly from the commercial laminators and convertors of these materials indicates that the production yield loss for laminate pouches is approximately 5% and that wastage for toothpaste or cosmetics tubes can be as high as 20%. This high reject rate, arising both from the manufacture of the laminated packaging and packs and from product filling, strongly indicates that there is also a potentially significant market for a recycling process based on production waste alone. The application of the process to post-industrial waste, however, is outside the scope of this project.

It should be noted that the figures in Table 1 represent 100% of the total available market and it would be unrealistic to expect that all of the above material would be recoverable from the post-consumer waste stream. The commercial analysis of the recycling process that follows, therefore, is based on a realistic estimate of the proportion of this material that is likely to be collectable from households following a promotional drive by the collection authorities.

3.3 Determination of post-consumer material mix

3.3.1 Practical tests with sorted materials from the household waste stream

The data gathered from the above research were analysed to determine the packaging weights and the 'predicted' mix of the targeted packaging types that is currently present in the household residual waste stream.

[2] www.tetrapakrecycling.co.uk/tp_faqs_renew.asp

[3] *PCI Films Consulting 'The European Market for Stand-Up Pouches 2010"*

Secondly, a practical material recovery trial was carried out at an MBT plant which receives 'black bag' household waste and recovers a range of recyclates and a compostable fraction. By manually sampling the recovered aluminium fractions from the plant it was possible to sense-check the market data derived from the desk research and, importantly, to provide best estimates of the degree and type of residual product remaining in the packaging materials at the point of disposal.

The material recovery trial was performed using samples taken from Donarbon's MBT facility near Waterbeach, Cambridgeshire. The plant takes black bag waste and uses a number of separation techniques, including eddy current separators, ballistic separators and near infra-red detection to separate the waste into different fractions. After an initial visit to the MBT plant, it appeared that the laminates could end up in two of the output fractions: the 2D plastics and the NE (Nichteisen or non-ferrous) materials. The 2D bin contained essentially flat, mainly-plastic material and the NE bin contains flat or semi-flat non-ferrous metal-containing materials. It was therefore decided that samples from both fractions would be taken and analysed so that the composition and the kind of laminate could be determined.

A 330kg sample of material was taken from the NE collection bin, after passing through the MBT plant, and manually sorted to determine the presence and quantity of laminates.

Discussions took place with the operator of a municipal MRF to establish if the non-ferrous output stream from a MRF could provide an alternative source of post-consumer waste. However, since laminated packaging is not a targeted recyclable material for collection authorities, it is only present in the MRF feedstock by accident and, therefore, arrives in even smaller quantities in the MRF output stream. It was concluded, therefore, that the process trials could only be carried out by using a simulated mix of post-industrial materials.

Following sorting of material at the MBT plant, samples of the laminates recovered were taken and their individual masses measured. They were then cleaned, dried and reweighed. This allowed the quantification of the residual content to packaging ratio in a representative sample of packaging. A minimum of five samples of each type of laminate was investigated.

3.3.2 Establishing a feedstock recipe for the process trials

Calculations were then performed to estimate the quantity of specific laminate materials (inclusive of residual product) which would be expected to be found in the samples taken from the MBT plant based on the foregoing estimated market data. It was assumed that the flow through to the waste stream, of post-consumer packaging to that particular MBT plant, is in proportion to the estimated consumption

A final calculation was required to establish quantities of non-target materials that might be present in any recovered waste stream. If laminated packaging becomes a targeted material for waste collection authorities, it is anticipated that much of the feedstock for future processing will be collected through MBT plants and/or MRFs. In general, material stream outputs from either sorting process contain a small amount of non-target materials. Therefore to correctly simulate post-consumer waste, non-target materials (non-laminates) should be added to the mix. Previous work by Oakdene Hollins, concentrating on line speeds at MRFs, has generated a significant amount of data on the amount and type of non-target materials found in recyclates. From this, an estimate was made of the amount of non-target materials to add.

Based on the above trials, and considering the materials which are easily accessible in substantial amounts, it was decided that the material 'recipe' to be used for all of the process trials would be as Table 2 (by mass).

Table 2: Material mix, by percentage of clean material and residues

Item	Proportion of clean material	Add	Product residue material	Proportion of product residue
Pet food pouches	30.4%	+	Pet food	11.5%
Drinks pouches	12.0%	+	Juice	2.5%
Coffee pouches	16.3%	+	Coffee	2.7%
Toothpaste tubes	6.1%	+	Toothpaste	14.5%
Aluminium cans	2.0%			
Plastic bottles	1.0%			
Paper	1.0%			
Totals	**68.80%**	**+**		**31.2%**

4.0 Phase 2 - Process trials at Enval

4.1 Introduction

After determining the composition of feedstock laminate mixes in Phase 1, the next stage of the project was to source and prepare suitable feedstock materials and use them to undertake process trials with the Enval Microwave Induced Pyrolysis process.

The aims of this second phase of the project were to:

- establish optimised process conditions for the extraction of clean aluminium including optimisation of waste preparation (shredding, cleaning, etc.)
- explore the sensitivity of the process performance to different process variables to establish a standard process envelope for treating the waste
- assess the reproducibility of the process performance both within a given run and between runs performed at different times
- collect and characterise considerable amounts of hydrocarbon products so that these can be assessed to establish and maximise their value
- collect considerable amounts of aluminium so that the metal obtained can be analysed.

These tests were carried out using the recipe of laminated materials contaminated with product and as described in Section 3 above. Preparation tests were carried out on shredding the waste stream and were performed by Enval using several suppliers of shredding equipment. The pyrolysis tests were also carried out by Enval using its' continuous process pilot-plant in Luton. The aluminium and hydrocarbon process outputs were analysed by the University of Cambridge.

4.2 Waste preparation

The feedstock to the process trials had firstly to be shredded down to two dimensional flakes of approximately 30mm x 30mm, or smaller. Further preliminary trials, therefore, involved the shredding of small amounts of clean laminate with a variety of commercial shredders to find the best type of equipment for this operation. Samples were sent to various suppliers and the shredded samples were returned to Enval for assessment.

Results that conformed to Enval's process feedstock specification were achieved with a standard four-shaft shredder, with 30mm mesh, as shown in Figure 2 and specified in Table 3

Figure 2: An UNTHRA RS-30 Shredder

Table 3: Shredder specification

Model	Untha RS-30
Cutter clearance	450 x 560 mm
Driving power	11 kW
Through-put	Up to 1,000kg / h

Once the correct shredding parameters had been established, a variety of different laminates were separately shredded, down to flakes with a surface area of between 400 and 1,100mm^2.

Since drinks pouches and coffee bags for the trials were sourced from industrial filling operations, they already contained some product residues. They could, therefore, already be categorised as 'post-consumer' wastes and there was no need to add representative residual product to the batches.

However, it was not possible to obtain sufficient quantities of post-consumer pet food pouches or toothpaste tubes. As a result, the mix to be used in the process trials was prepared by using the following materials and the composition shown in Table 2. This comprised a mixture of:

- shredded used juice pouches;
- shredded used coffee bags;
- shredded clean toothpaste tubes;
- shredded clean pet food pouches;
- shredded post-consumer paper, plastic bottles and cans;
- toothpaste; and
- pet food.

It is important to appreciate that by using this formulation, the final mixture presented levels of product residue contamination that would be in excess of actual post-consumer waste, since most of the residual material present in pet food pouches is gravy and not the actual pieces of meat, which was added to the mix. In adding this type of contamination, the boundaries to which the process would normally be expected to operate were extended beyond the expected normal operating conditions. This may be countered in a small way by arguing that some residues, other than those expected to be found in the laminated packs, would be present in a mix of materials recovered from household waste. The form and quantity of such 'external' contamination would depend on the method of recovery. For instance, if recovered from residual waste, as within an MBT plant, such contamination would be greater than if the materials were recovered within a MRF from a co-mingled, recyclable feedstock which would be cleaner. Subsequent sorting trials, carried out at a MRF, are reported later in this report. Based on these trials, and from discussions with some local authorities, it is assumed that, if the recycling process were to be commercially exploited, the favoured source of post-consumer material would be the latter, i.e. the materials would be targeted by the authorities and would remain relatively clean within a co-mingled collection. External contamination of the laminated packaging from household waste collections is, therefore, not considered to be significant.

Trial batches of feedstock were produced by manual mixing of the weighed recipe components to form a homogeneous blend, as shown in Figure 3.

Figure 3: Photograph of the waste mix after preparation

4.3 Process trials

4.3.1 Equipment and method

Figure 4 shows a diagram of the experimental Microwave Induced Pyrolysis apparatus used to perform the tests.

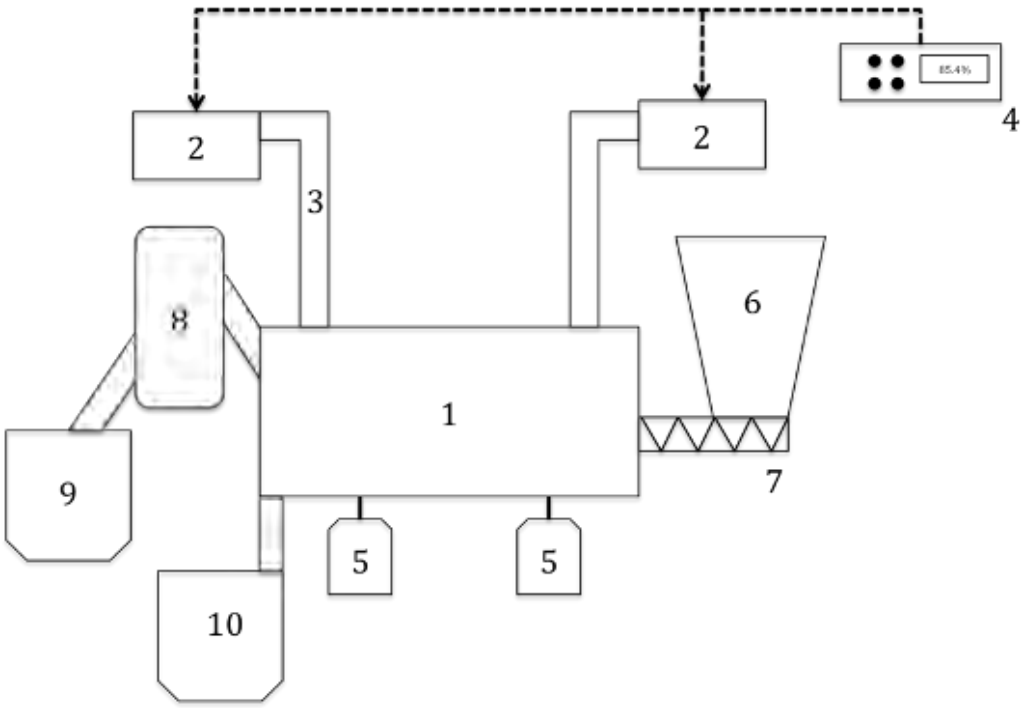
The equipment consists of a kiln (1) connected to two microwave sources (magnetron and iso-circulator) (2) using a standard microwave guide (3). The magnetron output power can be varied from 0 to 100% using the control panel on its power supply (4).

The kiln has an agitation system (5) that ensures an even temperature and promotes heat and mass transfer during the test. The temperature of the kiln is monitored using eight thermocouples that enter the chamber through the side walls. The thermocouples are in direct contact with the load inside the kiln, and are connected via a data acquisition card to a computer that continuously records the temperature.

The kiln is fed using a nitrogen-purged hopper (6) and a screw conveyor (7). The entire apparatus operates at atmospheric pressure and is completely sealed to avoid the presence of oxygen during pyrolysis and the escape of pyrolysis gases.

The pyrolysis products exit the reactor and pass through two water jacket condensers (8). The condensable products are collected in three separate collection drums (9). The recovered aluminium discharges into a solids recovery pot (10).

Figure 4: Schematic diagram of Enval's pilot plant



Key:

1	Kiln	2	Microwave source
3	Microwave guide	4	Power supply
5	Agitation system	6	Hopper
7	Screw conveyor	8	Tube condenser
9	Condensables collection drum	10	Aluminium recovery pot

An image of the plant is shown in Figure 5.

Figure 5: Photograph of Enval's Pilot Plant

4.3.2 Trial method

Each test commenced with heating the kiln and purging it with nitrogen. The kiln contains carbon, which acts as a microwave absorber. The kiln was heated to the required reaction temperature while a small flow of purging gas (N_2) flowed through it. The cooling system of the condensers was set to the appropriate temperature and the auxiliary systems (essentially the magnetrons and the cooling systems for the seals) were started.

Once the kiln had reached a stable operating temperature, material was fed into it from the feeding hopper at the desired feed rate, typically of between 25 and 35kg/hr. Each trial processed a feedstock of 87 to 107kg.

The operating temperature was maintained to within +/- 5% of the set point by manually changing the output power of the magnetron.

The waste laminated plastic feedstock was continuously fed into the kiln through a series of two hoppers that provided an air lock. The waste was put into the first hopper, which was then evacuated to a low pressure and backfilled with nitrogen to remove any oxygen. The feedstock in its nitrogen atmosphere was then transferred to the second hopper located beneath the first one, from where it was fed into the kiln. The feeding and purging of the first hopper is done in batches but the second hopper maintains a level of waste at all times, hence maintaining a continuous feed into the kiln.

The kiln also operates under a nitrogen atmosphere to prevent oxidation and combustion of the feedstock material. It comprises a bed of microwave heated carbon, onto which the laminated packaging is fed and from which heat is conductively transferred to the laminated packaging. Inert atmosphere pyrolysis of the laminate can then take place, during which the plastic is broken down into lower molecular weight species and the aluminium is released from the laminated structure.

The condensed products from the kiln were collected in the collection drums and the aluminium in the solids recovery pot. Gas sampling was possible at the exit of the condensation system by collection into a gas sampling bag which could be later analysed off-site.

After each test, samples of condensable and non-condensable products were analysed by gas-chromatography coupled with mass spectrometry (GC-MS) and the results from the analysis were inputted into a process simulator, to obtain the physical properties of the mixtures. The aluminium was analysed by a pressing and melting test to obtain its metal yield and hence the purity of the product.

A series of six pilot plant trials were conducted during which greater understanding of the process and the effects of feedstock on the process was sought. Trials 1-3 focussed on process parameter identification, whilst Trials 4-6 focussed on process reproducibility and finer tuning of the process parameters.

As is common with demonstration/pilot plant trials, there were a number of unexpected breakdowns of the plant. However, information and experience gained from the breakdowns provided opportunities to improve the robustness of operation of the plant. The results obtained from each successful trial also facilitated the process criteria to be incrementally modified as further experience and knowledge was gained.

5.0 Phase 2 (continued) – Results of process trials

5.1 Magnetron power

Pyrolysis of laminated packaging is an endothermic reaction, that is, it absorbs heat. To maintain the processing temperature, therefore, energy needs to be inputted into the reaction kiln.

Heat was input into the kiln by two separate magnetrons, with both operating at approximately 75% of maximum power, being controlled from one controller.

5.2 Mass balance analysis and process optimisation

During pyrolysis, thermal decomposition of the plastic and waste products takes place. It is important to understand that no oxidation takes place, so all the products are derived from the thermal decomposition of the feedstock materials.

There are four product streams derived from this pyrolysis process:

- Aluminium;
- Water;
- Condensables; and
- non-condensables.

Aluminium is the output material recovered from the laminated plastic and any other waste aluminium product that was present in the feedstock waste stream.

Water is a result of the drying and decomposition of the product contamination.

Condensables are oils and high molecular weight hydrocarbons that can be condensed from the gaseous outputs of the pyrolysis process; they are suitable for use as fuel.

Non-condensables are gases that cannot be easily condensed from the gaseous outputs. They are typically lower molecular weight hydrocarbons and are suitable for burning as a gaseous fuel.

Figure 6 shows a sample of the aluminium recovered from Trial 5, and **Error! Reference source not found.** shows the condensables output from Trial 3.

Figure 6: Photograph of the aluminium flakes produced (Test 5)

Figure 7: Photograph of the condensable products collected (Test 3)

The yields of aluminium and condensable products were obtained by direct measurement of the mass of waste fed into the equipment and the weight of the recovered solid and liquid products. The yield of non-condensable products was taken as the difference between these two weights.

It is possible to calculate the theoretical mass outputs from the laminated plastic waste stream used in the trials and these are compared against the actual mass outputs. The mass balance calculations are summarised in the following tables.

The assumptions used in the mass balance calculations are shown in Table 4.

Table 4: Data and assumptions used for theoretical mass balance

Item	Assumed percentage	Data source
Content of aluminium in packaging actually used in trials	Approx. 10%	Based on data sheets provided by suppliers
Content of polymer in packaging	Obtained by difference from point above	
Organic pyrolysable matter in pet food	25%	Based on data found at US FDA: http://www.fda.gov/animalveterinary/resourcesforyou/ucm047113.htm
Organic pyrolysable matter in coffee grains	90%	Based on data found at CoffeeResearch.org: http://www.coffeeresearch.org/coffee/scaaclass.htm
Organic pyrolysable matter in toothpaste	40%	Based on product data
Water content of products above	Obtained by difference from points above	
Water content of juice	100%	
Water collected with condensable products	100%	
Organic pyrolysable matter that turns into condensable products	10 – 70% depending on process conditions	

From these assumptions it is possible to estimate the theoretical yields of the aluminium, condensables and non-condensables.

Table 5: Theoretical yields of fractions from the pyrolysis of the waste mix

Aluminium yield (%)	Condensables yield (%)	Non-condensables yield (%)
11.7	32.0 - 65.7	22.6 – 56.3

The experimental data obtained are shown, by trial, in Table 6.

Table 6: Yields obtained during tests with the Enval process (% of total waste)

Trial	Aluminium (solid) yield (%)	Water yield (%)	Condensables yield (%)	Non-condensables yield (%)
1	15.7	22.9	39.9%	21.5%
2	13.0	13.2	62.2%	11.6%
3	11.9	24.7	42.6%	20.8%
4	9.1	21.9	16.7%	52.3%
5	9.6	24.3	18.2%	47.9%
6	9.3	28.4	19.2%	43.1%

Note should be made that the water yield is shown in Table 6 and not in Table 5. The water is a necessary by-product when pyrolysing contaminated laminated plastics. It is collected mainly as a condensable product and should be separated from the condensable oil yields. However, there is evidence to suggest that the presence of water in these oils can assist their combustion efficiency. Not all water will be collected as a condensable by-product as a very small amount will be carried over into the non-condensable stream.

Initial trials (Trials 1-3) focussed on process parameter identification, whilst later ones (Trials 4-6) focussed on process reproducibility and finer tuning of the process parameters. Apart from providing an initial check, it was noted that much more information could be obtained by analysing the differences in the aluminium yield between the earlier and later trials, and observing the quality of the metal recovered after each trial. For instance, Trials 1 and 2 gave aluminium yields that were considerably above the theoretical yield, which suggested that some char was present, and this was borne out by a visual check of the output material. This analysis allowed the possibility of assessing the quality of the pyrolysis process for a given set of process conditions and thereby optimising the overall process. Following this analysis and adjustments to the process conditions, the later trials produced more predictable yields and a cleaner output product.

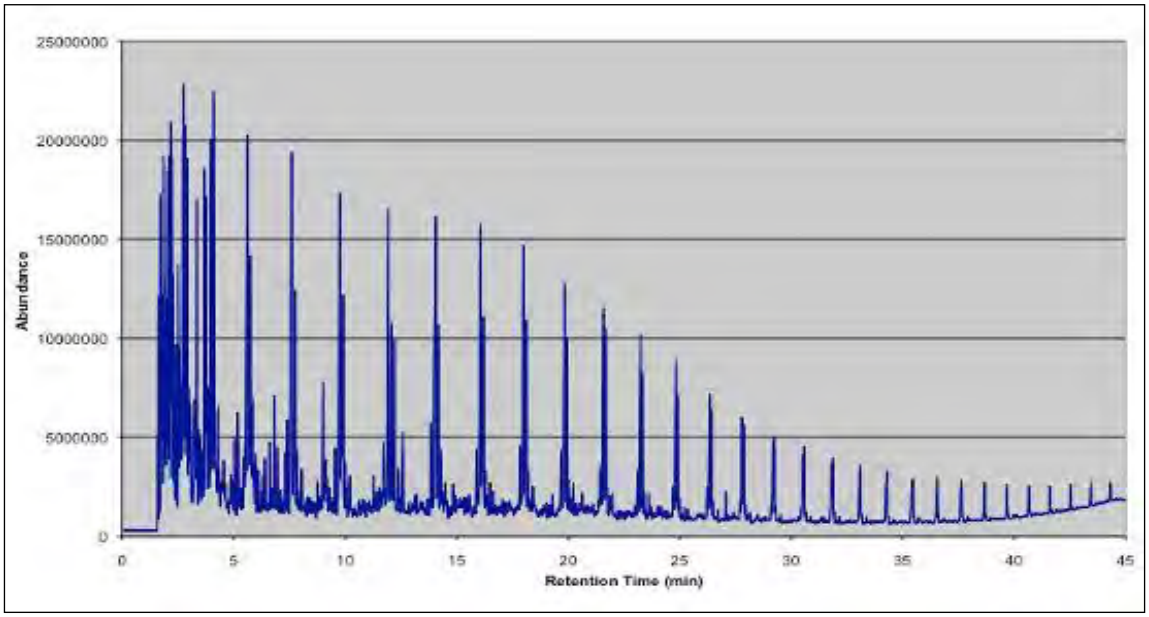
Using the above data, the theoretical yields are compared against the experimental data obtained in Trials 4-6. From this it can be concluded that the amount of aluminium recovered by the pyrolysis process is about 80% of the theoretical yield and that the amount of condensable material, including water, is about mid-range of the predicted range. The non-condensable recovery rate is again about midpoint of the predicted range, but a caveat should be given, as the non-condensable products are calculated by the difference between the quantifiable aluminium and condensable product recovered and the original total mass; it is therefore assumed that any unaccounted mass is due to it being non condensable products. Whilst being a valid assumption, it can also mask other unaccounted losses.

5.3 Chemical analysis of the condensable and non-condensable products

The hydrocarbon products were analysed using GC-MS. Figure 8 shows the typical Total Ion Chromatogram (TIC) obtained for the condensable fraction of the first two trials which, as can be seen, produced substantially more condensables than non-condensables. This was due to a combination of process conditions and carbon used.

The TIC obtained shows all the characteristics that would be expected from the pyrolysis products derived from compounds such as those found in the waste mix. For instance, the TIC shows a large number of aliphatic (linear and branched) and aromatic compounds at lower retention times (on the left hand side of the graph). These compounds would have been produced from the pyrolysis of PET, organic matter in the residues and the paper contamination. On the right hand side, which is the higher retention time area, it is possible to see the typical groups of peaks that are formed from the pyrolysis of LDPE.

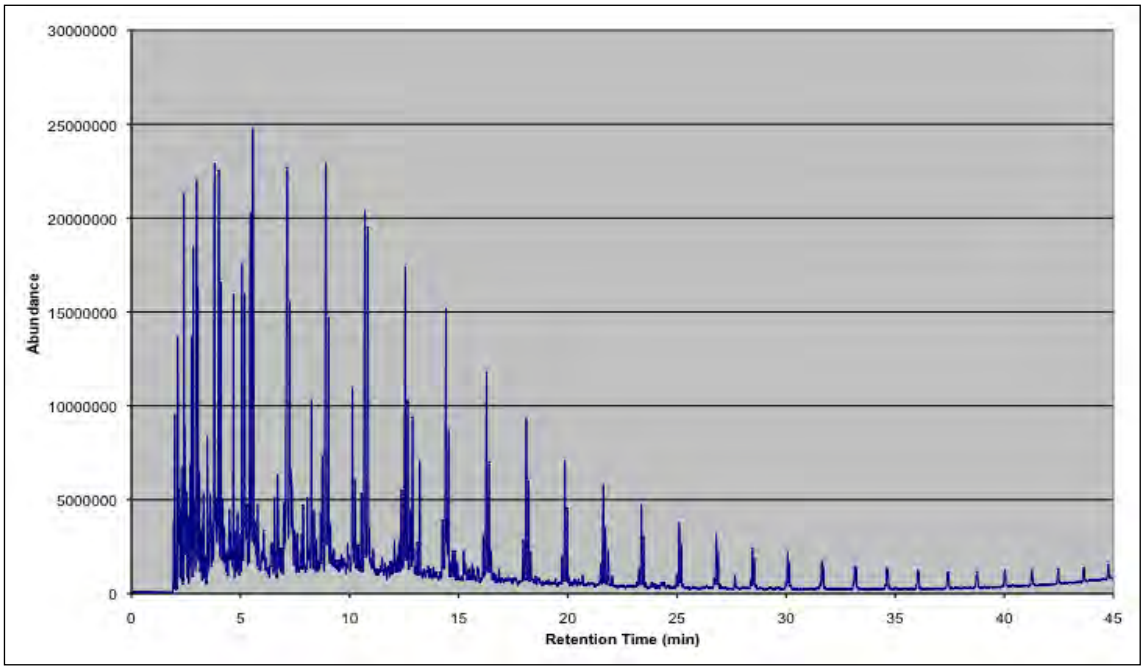
Figure 8: Typical TIC of the condensable products obtained (Tests 1 & 2)



It is important to note that the condensable products were analysed on a 'water-free' basis. This was because the organic compounds and the water form two distinctive liquid phases in the collection drum and it was possible therefore to take samples only of the organic phase for subsequent injection into the GC-MS.

Figure 9 shows a typical TIC obtained for the condensable products of Trials 3-6. Qualitatively, these products were more fluid than the ones obtained during the first two trials and this can easily be seen in the TIC: The number of long chain aliphatic hydrocarbons (right hand side) was substantially reduced and most compounds in the mix presented shorter retention times (left hand side). The compounds presented a higher degree of branching and aromaticity.

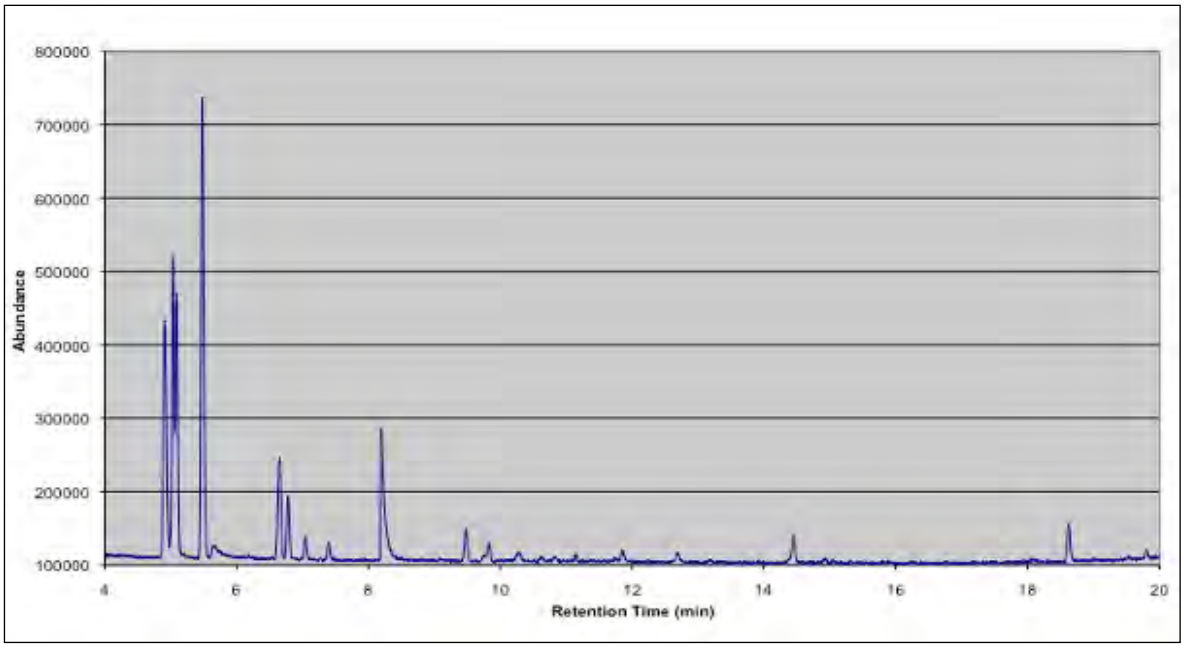
Figure 9: Typical TIC of the condensable products obtained (Trials 3-6)



It is possible to allocate certain compounds to each TIC peak, and this is most readily done by some analysis software included with the GC-MS equipment, from which a breakdown of the most abundant compounds was obtained.

The non-condensable products were also analysed using GC-MS and the number of compounds found in the mixtures was considerably less. Figure 10 shows a typical TIC obtained with the non-condensable products. As with the condensable products, the compounds found were those that would be expected when pyrolysing the kind of materials present in the waste mix. However it is important to note that water is listed in the compounds found. This is due to the fact that considerable amounts of steam were generated in the kiln, either by the pyrolytic reactions or simply from the water already present in the mix and clearly not all of it was being condensed in the condensers. Despite this fact, given that the amount of water found in the non-condensables was not considered substantial, the assumption presented in the analysis of the mass balance (that all the water condenses with the oils) is still considered valid.

Figure 10: TIC of the non-condensable products obtained



Given the nature of the mixtures produced during the process, the results of the GC-MS were entered into a chemical process simulator, so that the main physicochemical characteristics could be calculated; this was carried out using the average composition of the products obtained from Trials 3-5. The results of these simulations are presented in Table 7 and Table 8 for condensables and non-condensables respectively.

Table 7: Main physicochemical characteristics of the condensable products

Characteristic	Value
Molecular Weight (kg / kmol)	134.6
Molar density (kmol / m^3)	6.02
Mass density (kg / m^3)	810.3
Molar heat capacity (kJ / kmol ºC)	256.7
Mass heat capacity (kJ /kg ºC)	1.91
Mass high calorific value (MJ /kg)	37.2
Mass low calorific value (MJ /kg)	32.6
Molar Heat of vaporisation (kJ / kmol)	73650
Mass Heat of vaporisation (kJ /kg)	547.2
Surface Tension (dyne/cm)	22.7
Viscosity (Pa-s, calculated @ 60 ºC	0.000615

Table 8: Main physicochemical characteristics of the non-condensable products

Characteristic	Value
Molecular Weight (kg / kmol)	39.43
Molar calorific value (MJ / kmol)	1600.8
Mass calorific value (MJ /kg)	40.6
Heat capacity (kJ / kmol ºC)	49.7
Compressibility factor (Z)	0.992
Density	1.32
Volume base calorific value (MJ / m^3)	41.7

The results shown in Tables 7 and 8 show that all the hydrocarbon produced by the pyrolysis reactions are suitable for energy generation. The mass calorific value for condensable by-products is between 32.6 and 37.2 MJ/Kg, whilst the value for non-condensable products was found to be 40.6 MJ/kg. These values are comparable with those normally quoted for conventional fuels such as diesel (46 MJ/kg) or natural gas (39 MJ/m^3).

5.4 Analysis of aluminium

From pressing and melting tests with the aluminium obtained from the process, it was found that the aluminium recovered showed a metal yield between 70% and 75%, which correlates well with the visual examination of the product. These values for aluminium content are slightly below what Enval has obtained with other types of waste which did not include the substantial amounts of residual product in the waste mix.

As noted earlier, the type of aluminium used in beverage cans is 3000 series, compared with aluminium as used in laminated packaging, which is 8000 series, and this may affect the value of the recovered material.

The 3000 series aluminium is an aluminium-manganese alloy that can also contain silicon, copper and magnesium. It is widely used in sheet products and is non-heat treatable. It has good corrosion resistance and moderate strength when it is cold worked and is also used in the transportation industry for trucks and marine applications. It has good formability and weldability.

The 8000 series aluminium contains other elements, such as lithium and is a more specialist alloy that is designed to behave electrically more like copper, will retain its strength and does not easily work harden.

5.5 Proof of principle

In summary, the trials conducted on the Enval pilot plant have therefore shown that Microwave Induced Pyrolysis is capable of processing waste laminated packaging. The average weight of aluminium recovered by the process is about 9.3% of the total feedstock weight. About 18% of the waste feedstock weight can be recovered as condensable yields (oils), whilst a further 48% can be recovered as non-condensable combustible gases. The outstanding mass balance is water. Data collected from the pilot plant have been used for the calculation of costings for a commercial unit.

6.0 Phase 2 (continued) - Materials sorting trials at a MRF

The practicalities and cost of separation of laminated packaging from the household waste stream is a key factor in the consideration of the commercial application of recovery and recycling of these materials. Following the MBT plant trials, and subsequent discussions with waste management companies and waste collection authorities, it is considered that the most appropriate recovery method for these materials would be through their selection as a targeted recyclable in co-mingled collections by the authorities. Laminated packaging waste would then be increasingly present in MRF feedstock alongside other packaging items, particularly plastic, steel and aluminium containers. The option of recovering the materials from the residual ('black bag') household waste stream is inappropriate due to the likely increased contamination and the limited availability of appropriate MBT facilities in the UK that could be configured to sort these materials.

To establish the ability of a municipal MRF to sort laminated packaging from co-mingled recyclates, trials were undertaken at a MRF, owned and operated by Bywaters in Bow, London. This MRF processes both commercial and industrial waste and kerbside co-mingled collections. It does not process residual waste. The main waste streams collected at the MRF are plastic containers, other plastic materials, cardboard, mixed paper, ferrous materials, and non-ferrous materials.

For these trials a supply of whole drinks pouches were obtained from the drinks manufacturer. Some were clean and flat (2D) pouches taken from the line before filling, and the remainder were contaminated, crumpled (3D) pouches that had been rejected after filling, emptied, and baled. It is argued that the former form would more closely simulate the form of these materials as they would be presented to a MRF in a post-consumer co-mingled collection.

The trials comprised depositing the pouches into the processing line at the MRF to determine the effectiveness of the automatic sorting equipment to select and divert the materials and to establish which output stream they would be diverted to. It was expected that the eddy current separators, used in MRFs to divert non-ferrous materials from the waste stream, would be the key sorting device.

The items were inserted after the bag slitting and unwanted waste segregation stations. 22kg of the 2D, and 30kg of the 3D, pouches were used, representing in total some 7,000 pouches, which were placed on the belt at irregular intervals. With the existing configuration of the MRF, it was found that some of the 2D pouches passed through with other, mainly paper, 2D materials. Most of the 2D and practically all the 3D pouches were mechanically separated to the 'fines' output stream which comprised, mainly, glass and shredded paper. An estimated 95% of pouches, both 2D and 3D, fed into the MRF were collected with the fines – only 5% reached the eddy current separators at the end of the 3D line.

By feeding pouches manually into the 3D line separately, it was demonstrated that some of the crumpled and 100% of the flat pouches were identified and separated by the eddy current system at the MRF. To capture more of the 3D pouches would require the equipment, to be set specifically to capture these items, by appropriately setting the magnets and the physical barriers. Currently they are set to capture aluminium cans only and to reject foil material, which would otherwise contaminate the aluminium can output stream.

It is clear from these trials that eddy current separation can be used to recover pouches from the fines, along with any other aluminium waste streams that have evaded the MRF process. Clearly, an additional machine would be required for this line. If set up correctly,

the equipment should be capable of collecting both pre- and post-consumer waste stream pouches.

A budget price for a suitable eddy current system is £85,000. To allow for delivery, installation and training and modifications to conveyoring, we have assumed that the total investment would be in the order of £100,000. Since it is a necessary element in the feedstock supply chain to the Enval process, this amount is considered as an additional capital cost in the financial summary, Section 7 of this report. However, it may be that MRF operators are already considering installation of such an additional system in their fines stream to capture aluminium cans that have been missed in the upstream MRF sorting processes.

Initial considerations suggested that hand segregation of pouches may be an economic option. The employment costs of a hand picker are about £12/hr. However, the relatively low feed rate of laminated packaging that would arise in a typical MRF would not warrant the expense of a full time picker. If all the manual pickers were trained to hand pick these materials, along with other non-paper items from the waste paper stream, it is possible to assess the marginal labour cost that would be incurred from the additional picks that would be required. Assuming an average pick rate of, say, 30 items per minute, and an average weight of 7.5g per item, then the picking cost per tonne would be approximately £900. Unless the picking labour is seen as a fixed cost in the MRF, and would not need to be increased to handle the additional tonnage caused by the inclusion of laminated packaging, this would not be economically viable and, therefore, the automatic sorting option is likely to be the only recovery route.

7.0 Financial analysis

7.1 Overview of business model

This section presents the results of calculations to gain an understanding of the first order economic appraisal of the Enval process for recycling of post-consumer laminated packaging. The data obtained during the tests, including the amount of energy used during the process to treat each kilogram of waste mix and the potential value of the products recovered, in addition to a number of assumptions presented below, allow a calculation of the costs that the recycling operation would have and the value that could be extracted from the products.

7.2 Assumptions

The business model used to perform the financial analysis presented in this report contains the following assumptions:

- Process operating costs – Based on costs obtained from the pilot plant operation and scaled accordingly.
- Process operator - Third party, such as a waste management company or waste reprocessor.
- Process location - Operator's premises – the 'recycling centre'. Given that it is assumed that the operator is a waste handler, it is possible to assume that the operation will take place in a MRF belonging to the operator, where they could establish and operate an Enval plant without additional cost for space.
- Availability of feedstock to an individual recycling centre – Following discussions with local waste collection authorities, it is assumed that it would be possible to access one-third of the total laminated packaging disposed by households, in co-mingled kerbside collections, following a publicity campaign by a waste collection authority. It is further assumed that the recycling centre would service an urban or local authority population of around 2 million consumers, equivalent to approximately 3.2% of the UK population. Taking the national consumption of 139,000 tonnes, net weight of packaging, therefore, the feedstock to the recycling centre would be in the order of 1,500 tonnes per annum, net weight of packaging.
- The water content of the feedstock is reduced during storage and transportation. It is assumed that the percentage of laminated plastic is increased to 75% by weight, from the level of 69% of contaminated packaging materials found during the MBT trials. This puts the required throughput of the commercial processing plant at some 2,000 tonnes per annum, gross weight of feedstock.
- Collection of material and transportation to the recycling centre - As discussed in Section 6, it may be assumed that the laminated packaging could be included within the targeted co-mingled materials for each local collection authority. Whilst there may be a marginal increase in transport costs, this would be small, since the collection, bulking and delivery infrastructure will already be in place. However, to make the model more conservative, a cost of £25 per tonne is assumed.
- Operation Licence - It has been assumed that the operator uses the Enval process under licence paying a percentage of its gross margin.
- Quantity of laminated packaging recycled – Based on the availability of feedstock as estimated above, the envisaged capacity of the Enval commercial plant is 2,000 tonnes per annum. This involves a machine capable of treating a gross 500 kg/hr of packaging plus residual product (net 375 kg/hr packaging) over two 40 hour/week shifts.
- Waste composition - As described in previous sections of this report.

7.3 Detailed explanation of products' properties, yields and prices

- Product yields - The average yields obtained from Trials 4-6 show that the aluminium content was 9% of feedstock to the process, water was 25%, condensables were 18% and non condensables were 48%. As shown in Table 2, the feedstock material comprised about 69% packaging materials and 31% residual content. For the purposes of reviewing the financial viability of the process it is assumed that all the water is derived only from the residual product and not from any laminates, making it irrelevant to the mass balance of the laminates.
- The mass balance calculations are summarised in Table 9.

Table 9: Yields of fractions from the pyrolysis of the waste mix

Aluminium yield (%)	Condensables yield (%)	Non-condensables yield (%)
9.3	20.0	70.7

- Value of hydrocarbon products - The value for the hydrocarbon products both condensable and non-condensable was obtained by using the results of the chemical analysis. As can be seen in the results presented in Section 5, the average calorific value for the two fractions is 38.9 MJ/kg. Using a conservative price of crude oil (US$80 per barrel), exchange rate $1.60 = £1.00, and the average energy content of a barrel of crude oil (6,120 MJ) it is possible to calculate a 'value of energy' of 0.8p/MJ. This figure, in combination with the calorific value of the products from the Enval process, leads to a value of £310 per tonne of hydrocarbons. This estimated value, however, cannot be realised in practice, since the high proportion of hydrocarbons (70%) is in gaseous form. In the financial analysis, the average value of the hydrocarbons from the process is taken as 50% of this estimate, i.e. £155 per tonne.

  In practice, this fuel would not be sold on the open market. It would best be used as heat energy, or to generate power within the recycling centre, thereby substituting for imported power to the plant. Since the current price of intermediate fuel oil (which has similar characteristics to the oil produced in the Enval process) is in the order of US$600, using the calculated value is considered to be appropriately conservative for the purpose of this analysis.

  Here it is worth noting that, considering the amount of energy that the hydrocarbon products have, and given the high yields of non-condensable products from the process, these products could be used to produce electricity on-site, using common gas generators. This would substitute for imported electrical power to the plant which costs approximately 1.8p/MJ, which would, in turn, suggest a value from the gases of some £700/tonne. Whilst capital costs and losses in the generation plant would reduce that value, the figures again show that the energy value of the gases that is used in the financial analysis is conservative.
- Value of the aluminium - Correspondence with Alupro, based on discussions with their reprocessing members, states that the material might be valued at 80% of London Metal Exchange prices. Clearly this could only be confirmed following trials at the reprocessors when additional quantities are available from further Enval trials. Given the current price of aluminium (£1,650/tonne) and information directly obtained from metal recyclers (who declined to give a written confirmation of the price), the value of the aluminium obtained from the process has been conservatively established at £800/tonne.

- Profit and Loss (P&L) Account – Figures are based on the assumption that the water content of the feedstock is reduced during storage so that the percentage of laminated plastic is increased to 75% of feedstock weight.
- Other assumptions
    - The variable operating costs have been obtained by extrapolating the current costs of running the Enval pilot-plant. The figures have been obtained from the energy balance of the process, including all peripheral equipment, and the amount of nitrogen used; no other utilities are required. The values calculated and used were £10/tonne of waste for electricity and £3/tonne of waste for nitrogen.
    - Costs for the transportation of recycled products have been considered using quotations from actual industrial carriers. The values used were £10/tonne of aluminium and £15/tonne of oils. It is considered that the non-condensable products will be used on-site and no value has (conservatively) been assumed for these gases.
    - Costs for labour have been considered at £20,000/shift/year. A typical 2,000 tonnes per annum machine would require one operator for each of two shifts. These figures assume that the plant is developed prior to commercialisation to be sufficiently robust and reliable to be operated by a suitably trained semi-skilled operative.
    - The commercial plant will have a lifetime of at least ten years. The majority of the components are fixed vessels and pipe work in stainless steel. Some refurbishment and routine maintenance will be required on the moving parts, such as drive motors and valves, and the cost of this is estimated at 5.0% of the capital cost per year.
    - It has been assumed that by taking laminated packaging as a targeted material into a MRF, there would be a marginal revenue increase of £35/tonne in gate fees to the MRF.

It should be noted that the operating costs of a commercial unit are based on those obtained from pilot plant trials and therefore will be conservative, as no economies of scale have been taken into account.

7.4 Results

By integrating the above assumptions and data into the financial model built for the purpose, the P&L for the operations of the Enval process has been modelled and the results are shown in Table 10.

Table 10: P&L account for the operation of the Enval process (£ per annum)

Income		
Sales of aluminium	112,000	
Value of all hydrocarbons	211,000	
Saving on landfill	70,000	
Gross income		393,000
Expenditure		
Electricity	20,000	
Nitrogen	6,000	
Labour Cost	40,000	
Machine Maintenance	32,500	
Transport		
Feedstock supplies	50,000	
Aluminium	1,100	
Oil	4,500	
Total expenditure		154,100
Net profit		238,900

The calculations carried out for the Enval process suggest a payback period of approximately four years, once the licence fee is incorporated. The savings of landfill disposal costs, net of gate fees, by the collection authorities would be additional benefits within the total supply chain. It is important also to notice that, if cleaner laminates were to be mixed with post-consumer waste, for example coming from scrap generated within the industrial sector, the percentage of aluminium would increase substantially and therefore the return on investment would be greater.

Furthermore, following initial tests with separation equipment it has been established that the amounts of aluminium cans and other foils mixed with laminates during the segregation stages are likely to be considerably more than the quantity of cans added as 'contamination' during this project. Therefore the aluminium yield could be substantially increased.

8.0 Environmental analysis

8.1 Methodology

The results from the pilot-plant trials allowed an environmental assessment of the impact of using the Enval process for recycling laminated packaging to be undertaken by a Life Cycle Assessment (LCA) study. This section presents the results of a comparative LCA where the environmental impact considered is the global warming potential (GWP), expressed in kilograms of carbon dioxide equivalent (kg CO_2e). The GWP compares the environmental benefits of recycling the waste via the Enval Process and obtaining an aluminium ingot from the recovered aluminium with the production of the same mass of aluminium from a primary source. The assessment ignores the additional carbon benefit of surplus energy production from the hydrocarbons.

The technique of life cycle analysis was undertaken via the sequential stages of:

- objective and scope definition
- data collection
- impact assessment
- interpretation and reporting.

8.2 Objective and scope definition

Functional unit: The basis for comparison of the Enval process or the *functional unit*, was defined as one kilogram of aluminium as an ingot.

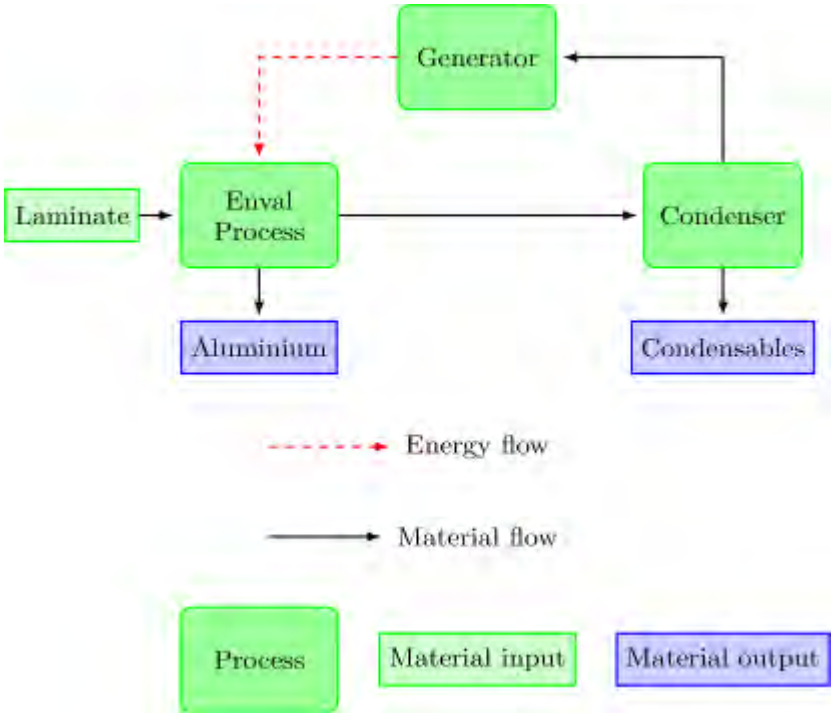
8.3 System boundaries

Laminate waste is not represented in the Product Category Rules (PCR) for LCAs and therefore system boundaries were chosen to comply with PAS 2050 (the UK standard for life cycle greenhouse gas emissions). The 'control volume' in this study encompasses:

- the input of laminate material without taking into account the collection or transport
- the provision and use of all energy requirements, e.g. electricity and nitrogen
- the operation of the Enval process.

The process map is shown in Figure 11.

Figure 11: Process map of the Enval process for purposes of the LCA



8.4 Data collection

The data quality rules specified by PAS 2050 were followed rigorously. The primary data used were fully representative of normal conditions encountered by the process being assessed. These data were used to draw up mass and energy balances, and to determine the overall raw material and energy requirements of the process. Operational parameters and primary data used are shown in Table 11.

Table 11: Operational parameters used in environmental assessment.

Process feeding rate	375kg / hr of laminate
Laminate aluminium content	9.7% in dry base
Nitrogen consumption	0.3 m^3 / hr (extrapolated from pilot-plant operation)
Electricity for motors	10 kW
Operating temperature	450°C
Aluminium recovery	100%
Water condensed	100%
Hydrocarbons condensed	80%
Nitrogen pressure	1 atm
Additional pumping power	5%
Microwave power	200 kW

Secondary data were used for emission factors to calculate the overall greenhouse gas emissions of the processes from the mass and energy balances. The GaBi 4.3 database was used to provide the secondary data required along with basic physicochemical calculations and common process efficiencies. The data used are compliant with ISO 14040 and ISO 14044. Data specific to the UK were used where possible, e.g. emissions associated with electricity usage. The data used to calculate the greenhouse gas emissions associated with electricity and transport are detailed on the next page:

- Electricity GWP: 0.6699 $kgCO_2e$ / kWh.
- Data assumes a power grid mix of 39.3% natural gas, 32.1% coal, 22.7% nuclear, 0.4% blast furnace gas, 1.8% heavy fuel oil, 0.2% solid biomass, 0.8% gaseous biomass, 0.4% waste, 1.9% hydroelectric and 0.3% wind.
- Other secondary data used included:
    - gas electricity generator efficiency: 35% (from manufacturers data); and
    - cooling power required: 128 kW (extrapolated from the Enval pilot-plant).

When investigating disposal methods, to model the landfill route it was assumed that the laminate was made up of purely aluminium and PE, and to model the laminate for incineration it was assumed that the laminate comprised aluminium and plastic packaging in an MSW incinerator, where the energy from the plastic packaging was recovered.

Carbon emissions from the pyrolysis process, based on the foregoing parameters and assumptions, have been calculated.

8.5 Results

All values are in $kgCO_2$ equivalent per kg of aluminium.

Calculated Global Warming Potential (GWP) is as follows:

Production of aluminium ingot via Enval process: 6.30 $kgCO_2e$

Comprising:

Pyrolysis process: 5.88 $kgCO_2e$

Production of aluminium ingot from new scrap: 0.42 $kgCO_2e$[4]

Production of aluminium via bauxite process: 11.03 $kgCO_2e$ [5]

These results demonstrate that the greenhouse gas emissions from production of 1kg aluminium derived from laminated packaging via the Enval process are just over half of those emitted when producing primary aluminium.

As stated above, all the emissions have been attributed to the production of the aluminium only and not to the production of surplus energy from the hydrocarbons. If this was done, the GWP of the aluminium using the Enval process would be further reduced.

Similarly, the Global Warming Potential for disposal of laminate via incineration was calculated and the result showed that this would result in much higher emissions and without the recovery of the valuable aluminium.

Disposal of laminate via incineration with energy recovery: 19.9 $kgCO_2e$.

[4] *Value obtained directly from GaBi 4 software*

[5] *Value obtained directly from GaBi 4 software*

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Noise emission

The figures quoted here are emission values and therefore do not necessarily represent workplace values. As there is no correlation between emission values and workplace values, these cannot be used reliably to establish whether any further measures are necessary. Factors which could influence workplace values include duration of exposure, characteristics of the workshop, other noise sources, the number of machines and other neighbouring influences. Reliable workplace values, therefore, can vary from country to country. This information, however, should enable the operator to be able to make a better estimate of dangers and risks.

Measurements to EN 31 202 with CEN-TC 142 supplement in connection with ISO 7960 for workplace-related emission value L_{pA} = 74.5 dB work noise.

The measurement uncertainty constant K is 4 dB (A).

The sound power level measured to EN 23746 with CEN-TC 142 supplement is L_{WA} = 87.8 dB work noise.

The measurement uncertainty constant K is 4 dB (A).

The following supplements from CEN-TC 142 were taken into account in order to obtain an accuracy class of better than 3 dB:

- The ambient correction factors K_{2A} and K_{3A} are μ 4 dB
- The difference between background noise level and noise sound pressure level at every measuring point is 6 dB
- K_{3A} is calculated according to appendix A, prEN 31204
- A pararellepipidal enveloping surface with 9 measuring points at distances of 1.0 m from the reference surface is used.

Machine-related settings:

Half funnel filling with timber scraps of various dimensions.

Microphone position for workplace-related emission measurement:

Height 1.5 m at 0.5 m distance to funnel edge, centred on output side.

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The high-powered

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economical – sturdy – powerful

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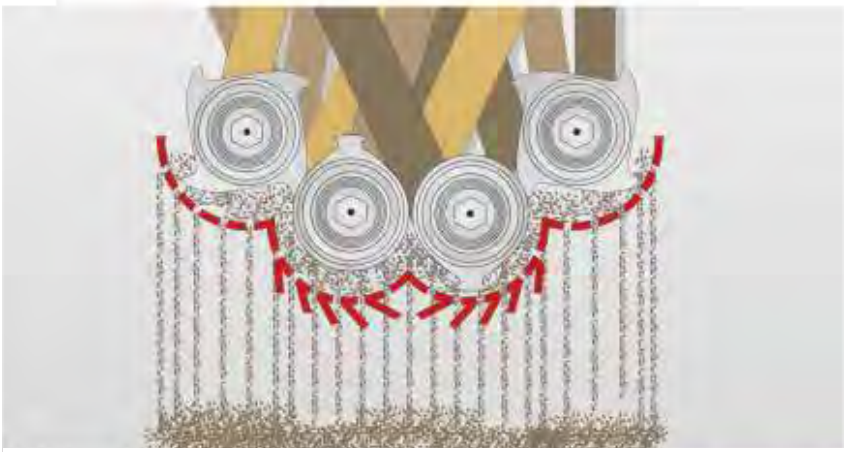
Rugged design, very reliable, operator-friendly, low running costs, wide range of applications and particularly suitable for shredding lengthy objects.

Four Shaft Shredder RMZ 500 - RMZ 1000 S

The classical multi-shaft shredder in a modern design, combined with the know-how of Reinbold.

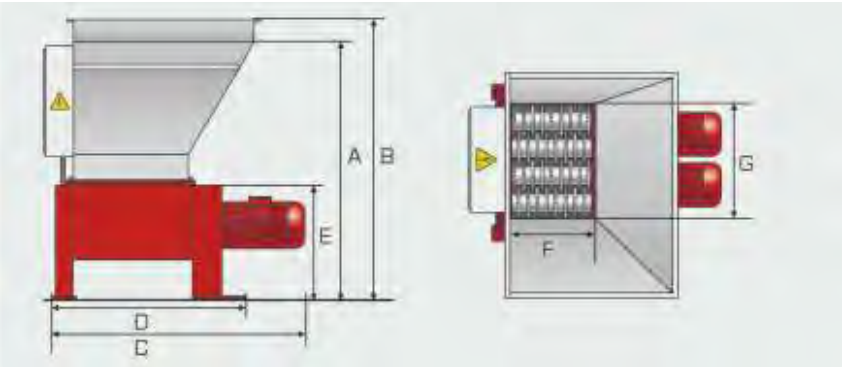
The rugged shredder is fitted with an electronic control system which protects the machine against over-loading and switches off when empty. The large hopper and the blade shaft enable a high throughput rate at low power consumption.

Additional back-up shredders underneath the perforated screen prevent the occurrence of long chips. The radius of the perforation determines the size of the chip.



The cutting system comprises of 2 cutting shafts and 2 broaching shafts or optional of 4 cutting shafts.

The cutting system is driven by firm cogwheels which run in a closed oil bath.



Type		RMZ 500	RMZ 700 S	RMZ 1000 S
Hopper opening				
Width	(mm)	1.000	1.400	1.400
Lenght	(mm)	1.250	1.300	1.500
Cutting tool opening				
Width (F)	(mm)	462	760	680
Lenght (G)	(mm)	562	700	1.000
Plate-Ø	(mm)	235	280	280
Motor output	(kW)	2 x 7,5 2 x 11	2 x 15 / 2 x 18,5 2 x 22	2 x 15 / 2 x 18,5 2 x 22 / 2 x 30
Throughput rate with a				
Perforation-Ø 20 mm	(kg)	300-500	600-1.200	800-1.500
Perforation-Ø 25-40 mm	(kg)	500-800	800-1.500	1.000-2.000
Weight	(approx. kg)	1.300	2.500	3.000
Dimension A	(mm)	1.660	1.660	1.690
Dimension B	(mm)	1.970	1.980	1.980
Dimension C	(mm)	1.400	1.780	2.250
Dimension D	(mm)	1.040	1.250	1.470
Dimension E	(mm)	830	830	830

* depending on material, conditions, screen size and input rate

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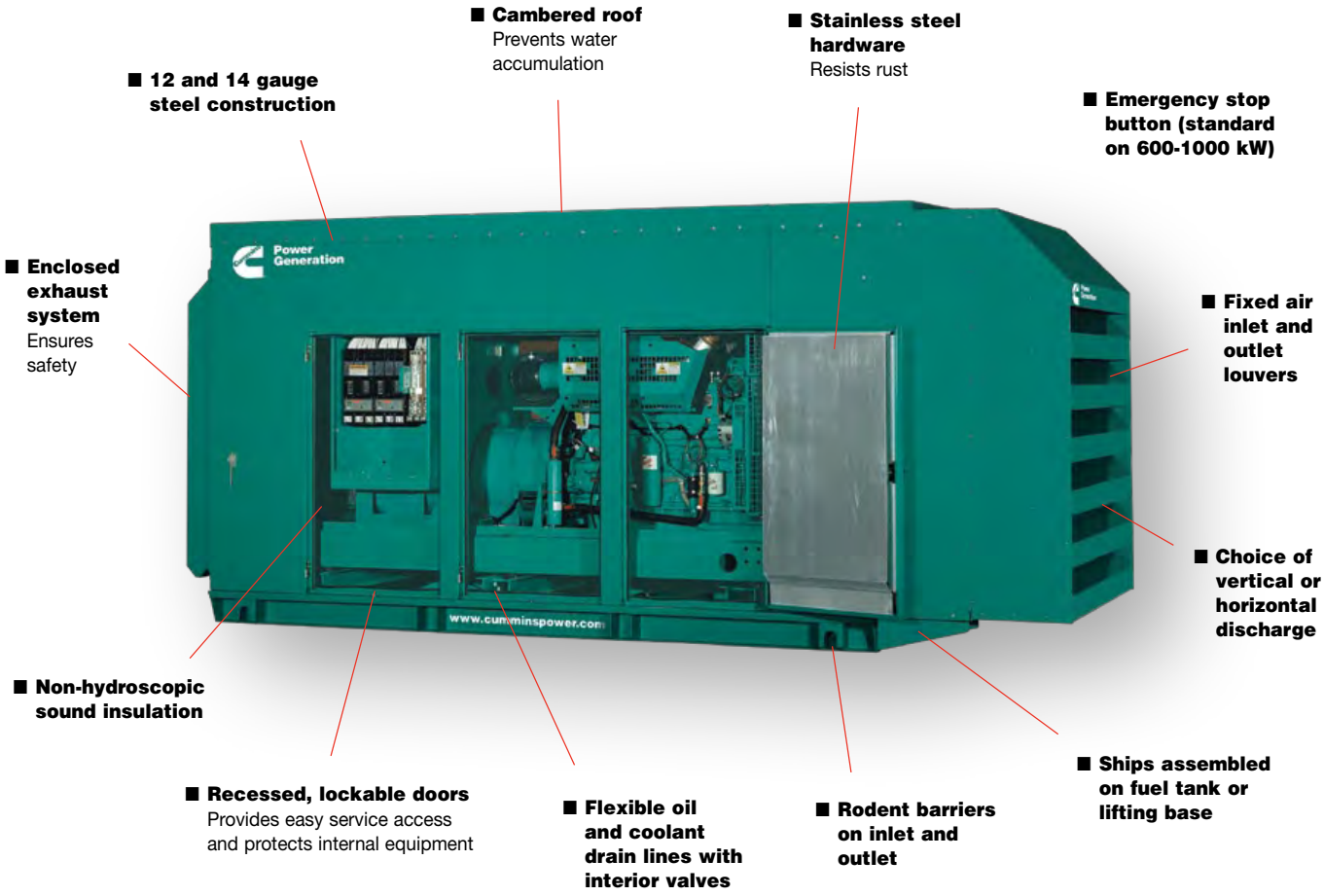

> Three levels of sound attenuation
  Level I: 70 to 89 d(B)A*
  Level II: 63 to 78 d(B)A*
  Level III: 68 to 70 d(B)A*
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> Aluminum enclosure is wind-rated to 150 mph (per ASCE 7-05 exposure D, category 1 importance factor)
> Kits available to up-fit existing generator sets or to upgrade existing enclosures with additional sound attenuation
> Exterior oil and coolant drains with interior valves for ease of service
> Overhead 2-point lifting brackets (some models)

* Full load at 7 meters, steel enclosures

Choose from weather protective enclosure or three levels of sound attenuation:

Sound levels (dB(A))*				
kW	Model	Weather-protective	Level I	Level II
Diesel				
10	DSKAA	78	68	65
15	DSKAB	81	69	66
20	DSKBA	80	70	67
25	DSKFA	82	72	69
35	DGBB	82	71	63
35	DGGD	81	72	66
40	DGBC	82	72	63
40	DGHD	79	71	64
50	DGCA	83	72	66
50	DGHE	79	70	65
60	DGCB	84	73	67
60	DSFAD	87	79	71
80	DGCG	84	76	67
80	DSFAE	87	82	72
100	DGDB	86	77	70
100	DSGAA*	87	-	73
100	DSHAF	95	88	78
125	DGDK	86	80	71
125	DSGAB*	87	-	74
125	DSHAE	95	88	78
150	DGFA	89	77	72
150	DSGAC*	88	-	75
150	DSHAA	95	88	78
175	DGFB	90	78	72
175	DSHAB	95	88	78
200	DGFC	91	80	74
200	DSHAC	95	88	78
230	DGFS	91	81	75
230	DSHAD	96	89	78
250	DQDAA	90	86	71
275	DQDAB	89	86	71
275	DQHAA	86	85	74
300	DFCB	86	84	71
300	DQDAC	89	86	71
300	DQHAB	89	88	76
350	DFCC	87	85	72
350	DFEG	85	83	72
400	DFCE	89	85	73
400	DFEG	89	85	73
450	DFEJ	87	84	73
500	DFEK	88	85	76
600	DFGB	85	78	74
600	DQCA	87	79	74
750	DFGE	87	80	75
750	DFHA	91	81	77
750	DQCB	87	79	74
750	DQFAA	89	79	75
800	DFHB	91	81	77
800	DQCC	87	79	74
800	DQFAB	89	79	75
900	DFHC	93	83	78
900	DQFAC	88	80	76
1000	DFHD	90	80	76
1000	DQFAD	90	80	76

Sound levels (dB(A))*				
kW	Model	Weather-protective	Level I	Level II
Spark-ignited				
20	GGMA	77	N/A	66
25	GGMB	78	N/A	66
30	GGMC	79	N/A	67
35	GGFD	80	73	65
42/47	GGFE	83	73	66
60	GGHE	86	77	68
70/75	GGHF	87	77	69
85	GGHG	85	79	75
100	GGHH	86	80	76
125	GGLA	85	79	75
150	GGLB	85	79	75

***Also available Level III**

100 kW	DSGAA	68 dB(A)
125 kW	DSGAB	69 dB(A)
150 kW	DSGAC	70 dB(A)

Diesel generator sets from 100 to 150 kW (models **DSGAA, DSGAB, DSGAC**) are available in **Level III** sound attenuation.

Shown: 100 kW Tier 3 diesel generator set (model DSGAA).

* Full load at 7 meters, steel enclosures

Diesel package dimensions (in.)

Tank capacity (gal.)	Weather-protective			Level I			Level II, III		
	Length	Width	Height	Length	Width	Height	Length	Width	Height
35-80 kW									
70	83	40	63	83	40	81	102	40	81
140	83	40	71	83	40	89	102	40	89
100-230 kW									
109	105	40	67	108	40	85	142	40	87
173	105	40	72	108	40	90	142	40	92
309	105	44	87	N/A	N/A	N/A	145	43	97
336	105	40	86	108	40	104	142	40	106
230-500 kW									
Lifting base	188	82	100	188	82	100	222	82	100
300	188	82	104	188	82	104	222	82	104
400	188	82	106	188	82	106	222	82	106
500	188	82	108	188	82	108	222	82	108
600	188	82	111	188	82	111	222	82	111
660	188	82	113	188	82	113	222	82	113
720	188	82	114	188	82	114	222	82	114
850	188	82	118	188	82	118	222	82	118
1470	200	82	128	200	82	128	200	82	128
1700	234	82	128	234	82	128	234	82	128
600-1000 kW									
200	260	98	133	303	98	133	315	98	133
660	260	98	133	303	98	133	315	98	133
1000	260	98	137	303	98	137	315	98	137
1500	260	98	142	303	98	142	315	98	142
2000	280	98	142	320	98	142	320	98	142
2400	332	98	142	330	98	142	332	98	142

Spark-ignited package dimensions (in.)

Model number	Weather-protective			Level I			Level II		
	Length	Width	Height	Length	Width	Height	Length	Width	Height
20 kW									
GGMA	65	30	46	N/A	N/A	N/A	85	30	47
25 kW									
GGMB	65	30	46	N/A	N/A	N/A	85	30	47
30 kW									
GGMC	65	30	46	N/A	N/A	N/A	85	30	47
35 kW									
GGFD	83	40	54	83	40	72	83	40	72
45 kW									
GGFE	83	40	54	83	40	72	83	40	72
60 kW									
GGHE	83	40	54	83	40	72	83	40	72
70 kW									
GGHF	83	40	54	83	40	72	83	40	72
85 kW									
GGHG	105	40	70	105	60	70	142	60	70
100 kW									
GGHH	105	40	70	105	60	70	142	60	70
125 kW									
GGLA	105	40	70	105	60	70	142	60	70
150 kW									
GGLB	105	40	70	105	60	70	142	60	70

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FACTORY INSTALLED STANDARD & OPTIONAL EQUIPMENT

System	Standard	Optional
Air Inlet	Single element canister type air cleaner Service indicator	
Cooling	Radiator with guard Coolant drain lines with valves Fan and belt guards Caterpillar Coolant Low coolant level sensors	Jacket water coolant heater with shutoff valves Radiator removal
Exhaust	Stainless steel exhaust flex with weld outlet flange	15 dBA muffler
Fuel	Gas pressure regulator Low pressure fuel system Energize To Run (ETR) gas shutoff valve	
Generator	Self excited Class H insulation Class F temperature rise (105° C continuous/130° C standby) VR6 Voltage Regulator, 3-phase sensing, with reactive droop 2:1 Volts/Hz or 1:1 Volts/Hz Bus bar extension Extension box	Permanent magnet excited Digital Voltage Regulator Digital Voltage Regulator with KVAR/PF control Anti-condensation space heater Oversize & premium generators Circuit breakers, UL, 3 pole with shunt trip Multiple breaker capability
Governor	2301A speed control with EG3P actuator	Electronic load sharing
Ignition	Digital ignition system	
Control Panels	EMCP II	EMCP II+ Customer Communication Module Local alarm & remote annunciator modules
Lube	Lubricating oil and filter Oil drain line with valve Fumes disposal	Manual sump pump
Mounting	Wide base Linear vibration isolators between base and engine-generator	
Starting/Charging	35 amp charging alternator 24 volt starting motor Batteries with rack and cables Battery disconnect switch	Battery chargers, 5 & 10 amp Oversize batteries
General		Automatic Transfer Switches (ATS) Floor standing circuit breakers

SPECIFICATIONS

CAT SR4B GENERATOR

Frame 592
Type . . . . . Self excited, static regulated, brushless
Construction . . . . . Single bearing, close coupled
Three phase . . . . . 12 lead reconnectable
Insulation . . . . . Class H with tropicalization and antiabrasion
IP rating . . . . . Drip proof 22
Alignment . . . . . Pilot shaft
Overspeed capability
  Prototype tested 180%
  Production tested 150%
Wave form . . . . . Less than 5% deviation
Paralleling capability . . . . . Standard
Voltage regulator . . . . . 3-phasing sensing with Volts-per-Hertz
Voltage regulation . . . . . Less than ± 1/2% (steady state)
Less than ± 1% (no load to full load)
Voltage gain . . . . . Automatic
Telephone Influence Factor (TIF) . . . . . Less than 50
Harmonic Distortion (THD) . . . . . Less than 5%

CAT ENGINE

G3412 TA, 4-stroke-cycle, SCAC
Bore – mm (in) 137 (5.4)
Stroke – mm (in) 152 (6.0)
Displacement – L (cu in) 27.0 (1649)
Compression ratio 9.7:1
Aspiration . . . . . Turbocharged-Aftercooled
Ignition system . . . . . Digital ignition
Governor type . . . . . Woodward 2301A

CAT CONTROL PANEL

24 Volt DC Control
NEMA 1, IP22 enclosure
Electrically dead front
Lockable hinged door
Generator instruments meet ANSI C-39-1
Terminal box mounted
Single location customer connector point

Consult your Caterpillar dealer for available voltages.

TECHNICAL DATA

Open Generator Set — 1500 rpm/50 Hz/400 Volts		Continuous DM5449
Package Performance		
Power rating @ 0.8 PF	kVA	350
Power rating	ekW	280
Aftercooler temperature	Deg C	54
Fuel Consumption		
100% load with fan	N•m³/hr	97
75% load with fan	N•m³/hr	78
50% load with fan	N•m³/hr	59
Cooling System		
Ambient air temperature*	Deg C	40
Air flow restriction (system)	kPa	0.12
Air flow (maximum @ rated speed for standard radiator arrangement)	m³/min	990
Engine coolant capacity with radiator	L	106
Jacket water outlet temperature	Deg C	99
Exhaust System		
Combustion air inlet flow rate	N•m³/min	19
Exhaust gas stack temperature	Deg C	454
Exhaust gas flow rate	N•m³/min	20
Exhaust flange size (internal diameter)	mm	203
Exhaust system backpressure (maximum allowable)	kPa	6.7
Heat Rejection		
Low Heat Value (LHV) fuel input	kW	976
Heat rejection to jacket water (includes oil cooler)	kW	360
Total heat rejection to exhaust (LHV to 25° C)	kW	214
Heat rejection to exhaust (LHV to 120° C)	kW	161
Heat rejection to A/C	kW	10
Heat rejection to atmosphere from engine	kW	39
Heat rejection to atmosphere from generator	kW	25
Generator		
Motor starting capability @ 30% voltage dip	kVA	724
Frame		592
Temperature rise	Deg C	105
Emissions**		
NOx	mg/N•m³ @ 5% O_2	10 704
CO	mg/N•m³ @ 5% O_2	690
HC (total)	mg/N•m³ @ 5% O_2	865
HC (non-methane)	mg/N•m³ @ 5% O_2	130
Exhaust O_2 (dry)	%	4.0

*Ambient capability at 200 m (660 ft) above sea level. For ambient capability at other altitudes, consult your Caterpillar dealer.

**Assumes synchronous driver

***Emissions data measurement is consistent with those described in EPA CFR 40 PART 89 SUBPART D and ISO 8178-1 for measuring HC, CO, CO_2 and NOx. Data shown is based on steady state engine operating conditions of 77° F, 28.43 inches HG and fuel having a LHV of 920 BTU per cubic foot at 30.00 inches HG absolute and 32° F. Not to exceed emission data shown is subject to instrumentation, measurement, facility and engine fuel system adjustments.

RATING DEFINITIONS AND CONDITIONS

Continuous — Output available without varying load for an unlimited time.

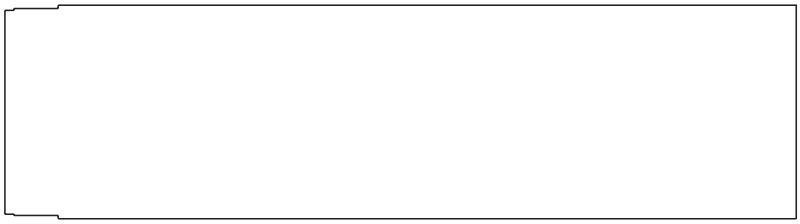
Ratings are based on ISO3046/1 standard reference conditions of 25° C (77° F) and 100 kPa (29.61 in Hg).

Ratings are based on pipeline natural gas having a LHV (low heat value) of 36.2 mJ/N•m³ (920 Btu/cu ft). Variations in altitude, temperature, and gas composition from standard conditions or the use of a three way catalyst may require a reduction in engine horsepower.

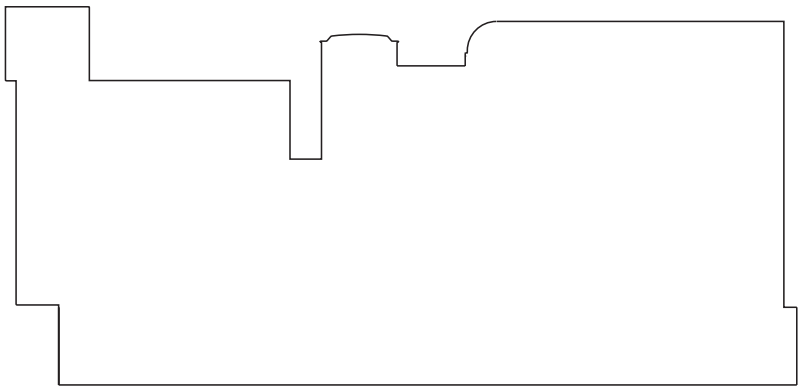
CONTINUOUS 350 kVA
50 Hz

CATERPILLAR®

CONTINUOUS POWER GENERATOR SET PACKAGE — TOP VIEW



CONTINUOUS POWER GENERATOR SET PACKAGE — SIDE VIEW



Package Dimensions		
Length	4543.1 mm	178.86 in
Width	2235.8 mm	88.02 in
Height	2466.4 mm	97.10 in
Shipping Weight	6356 kg	14,000 lb

Note: Do not use for installation design. See general dimension drawings for detail (Drawing #207-4502).

www.CAT-ElectricPower.com

TMI Reference No.: DM5449

U.S. sourced

LEHE1434 (06-01)

Equipment Risk Assessment Form

A written assessment of all significant risks to health and safety must be made before any work commences in the Company. This form will help you to complete a risk assessment for working on a piece of equipment (or 'rig'). If you wish to assess risks which are not associated with a particular piece of equipment, then please use a General Risk Assessment form.

Please Note This form is compulsory for the following classes of equipment:

- Composite rigs which have been designed and/or constructed in-house or by anybody other than an established manufacturer of commercial equipment.
- Commercial equipment which has been modified by anybody other than the manufacturer, or is being used in a way which may not have been envisaged by the manufacturer.
- Equipment presenting particularly high risks, and/or for which specific training and/or competence is necessary in order for a person to use the rig safely.
- Equipment incorporating or comprising a pressure vessel or system containing gases at more than 0.5 barg (or liquids with a vapour pressure above 0.5 bar at its maximum operating temperature or at 17.5 ^{o}C), or containing steam at any pressure.

A) The Apparatus

Name of Apparatus:	Location of Apparatus:
Is this a new or existing apparatus? New☐ Existing☐	
Person in Day-to-Day Charge of Apparatus:	Rig Number:
Brief Description of the Apparatus:	

This assessment may be used to cover other identical or near-identical pieces of apparatus, as long as the hazards, control measures and risks are the same. If you wish other pieces of apparatus to be included, please append a clear list of the pieces of apparatus and their locations.

B) Identifying Hazards

A hazard is anything with the potential to cause harm. The first step in the risk assessment is to identify all of the hazards associated with the use of this apparatus. Below you will find a list of common laboratory hazards. Please tick those hazards which are present in your apparatus and add any additional hazards in the spaces provided.

High temperatures ☐	Chemical hazards ☐	Slips, trips and falls ☐
Low temperatures ☐	Biological hazards ☐	Asphyxiant gases ☐
Pressures ☐	Machinery hazards ☐	Cryogenic liquids ☐
Vacuum/low pressures ☐	Falls from heights ☐	Flammable substances ☐
Explosive substances ☐	Electricity ☐	Lasers ☐
Radioactive substances ☐	Manual handling/lifting ☐	Lone working ☐
Sharp objects or edges ☐	Falling objects ☐	Oxidising substances ☐
Dusts ☐	Repetitive movements ☐	Noise ☐
Magnetic fields ☐	Collapsing structures ☐	Vibration ☐
Ionising radiation ☐	Potential for flooding ☐	Work in darkness ☐
Other (please state) Non-ionising radiation		Other (please state)
Other (please state)		Other (please state)

C) Further Information about Specific Hazards

If you ticked **Chemical hazards** or **Flammable Substances**, then please append a Chemical Hazard Risk assessment form.

If you ticked **Electricity**, then please complete the table below.

Have all portable electrical appliances been 'PATested' (tested for electrical safety)?	Yes☐ No☐
Can you isolate all of the electrical equipment on your rig? I.e. is there a means of making the disconnection from the power supply secure so that it won't be inadvertently reconnected?	Yes☐ No☐
Can you switch off your entire rig quickly and easily by throwing a small number of switches?	Yes☐ No☐
Are these switches easy to find and easy to reach?	Yes☐ No☐

Is there any particular risk of fire from overheating of electrical parts whilst this rig is in use?	Yes☐ No☐
Is there any risk of electric shock from contact with live electrical conductors?	Yes☐ No☐
Are you using any electrical equipment or systems which have been designed, built or modified within the Company or by anybody other than a bona-fide commercial manufacturer?	Yes☐ No☐
Are you using any commercial electrical equipment in a way which may not have been envisaged by the manufacturer?	Yes☐ No☐

If you have answered 'Yes' to either of the last two questions, then you must get an Electrical Safety Adviser to check your rig for electrical safety. The Adviser should sign below to certify that the rig is electrically safe and has suitable means of electrical isolation.

Electrical Safety Adviser Name:	Signature:	Date:

If you ticked **Biological hazards**, then please complete the appropriate biological and/or GM risk assessment forms.

If you ticked **Lasers**, **Radioactive Substances** or **Ionising Radiations** then please consult a Laser Safety Advisor.

If you ticked **Manual handling / lifting** then a specialist Manual Handling risk assessment may be necessary for heavy lifting or awkward tasks.

If you ticked **Pressures**, then please complete the table below.

What is the maximum working pressure of your vessel or system (barg)? Does your pressure vessel or system contain steam (at any pressure)? Yes☐ No☐	
What is the volume (l)?	Does (pressure*volume) exceed 250 barg*litres? Yes☐ No☐ If 'yes' then the Company's insurers must be consulted.
Have any pressure vessels you are using been formally tested and certificated? Yes☐ No☐ Vessels must be pressure-tested. Please supply copies of any relevant certificates with your application.	

If you ticked **Potential for flooding**, then you must get the Company's Chief Technology Officer to check the system for you and make sure that the plumbing is sound. The CTO should sign below to certify that the system appears to have been correctly and robustly plumbed, and that all reasonable measures have been taken to prevent flooding.

CTO Name:	Signature:	Date:

D) Choosing Control Measures and Assessing Risks

You must now look at each hazard in turn and decide what practical steps can be taken to reduce the harm from that hazard. Any measure which is taken to reduce the risk of harm is called a 'control measure'. A control measure may be a physical object, like a machinery guard, or it may be adherence to a safe system of work or a piece of protective clothing worn by staff using the equipment. There is a 'hierarchy' of control measures. If it is reasonably practicable for you to do so, you must use those at the top of the hierarchy (which are less likely to fail) in preference to those further down.

Control Measures – in order of preference

- Eliminate the hazard if practicable.
- Substitute a less hazardous process, substance etc. in place of a more hazardous one if practicable.
- Provide engineering controls (physical guards on machinery, fully enclosed systems for chemicals).
- Use local exhaust ventilation (fume cupboard or other).
- Provide training, information and instruction to users.
- Devise safe working procedures.
- Require the use of personal protective equipment.

Risk Assessment

For each hazard, you must tick the risk assessment matrix to indicate how serious an injury or incident from this hazard would be, and how likely it is to occur. If more than one type of injury or incident is possible from a given hazard then please mark the matrix for each possible outcome. You must use all of your judgement and experience to give the best possible assessment of risk.

The following table gives guidance on interpreting the different levels of likelihood –

Very likely	Event only to be expected, likely to occur frequently.
Probable	Not surprising, may occur several times.
Possible	Could occur sometime.
Remote	Unlikely, though conceivable.

Improbable	So unlikely that probability is close to zero.
Impossible	Could not happen under any circumstances.

The following table gives guidance on the consequences of an incident -

Major injury	Usually defined as amputation of a limb or digit, permanent disablement, permanent damage to health, loss of an eye or other injury of similar severity. May also be a serious injury or condition from which a full recovery is made relatively slowly.
Minor injury	Usually defined as an injury, incapacitation or health from which a full recovery is made relatively quickly. Recovery expected within a month.
Env/Equipment	Damage to the environment or to equipment. Consider discharge of hazardous substances to the atmosphere or to drains.

When completing your risk assessment, please consider the following:

- When assessing risk, you may take into account control measures which have been put into place to protect health and safety. You should, however, also assume that these control measures might sometimes fail if it is possible for them to do so.
- You must assess risk of injury not only to Staff using the apparatus but also to other persons who may be affected by it such as cleaners, visitors, others working nearby etc. Please also consider the safety of Security Control Centre staff who may attend an emergency out of hours.
- You must identify all hazards connected with this equipment. You should consider not only normal operation but also installation, maintenance, failure, adjustment, overhaul and decommissioning.

Hazard 1

Nature of Hazard:
Control Measures:

Assessment of risk

	Very likely	Probable	Possible	Remote	Improbable	Impossible
Fatal Injury	☐	☐	☐	☐	☐	☐
Major Injury	☐	☐	☐	☐	☐	☐
Minor Injury	☐	☐	☐	☐	☐	☐
Env/Equipment	☐	☐	☐	☐	☐	☐

Is this risk acceptable? Yes☐ No☐ Risks below the heavy black line are generally felt to be acceptable, but please remember that we must reduce risks to as low a level as is reasonably practicable.

If the risk is acceptable and you cannot practicably reduce it further, then move on to the next hazard.
If the risk is not acceptable, then review the control measures for this hazard taking help from a Safety Management Consultant.

Hazard 2

Nature of Hazard:
Control Measures:

Assessment of risk

	Very likely	Probable	Possible	Remote	Improbable	Impossible
Fatal Injury	☐	☐	☐	☐	☐	☐
Major Injury	☐	☐	☐	☐	☐	☐
Minor Injury	☐	☐	☐	☐	☐	☐
Env/Equipment	☐	☐	☐	☐	☐	☐

Is this risk acceptable? Yes☐ No☐ Risks below the heavy black line are generally felt to be acceptable, but please remember that we must reduce risks to as low a level as is reasonably practicable.

If the risk is acceptable and you cannot practicably reduce it further, then move on to the next hazard.
If the risk is not acceptable, then review the control measures for this hazard taking help from a Safety Management Consultant.

Hazard 3

Nature of Hazard:
Control Measures:

Assessment of risk

	Very likely	Probable	Possible	Remote	Improbable	Impossible
Fatal Injury	☐	☐	☐	☐	☐	☐
Major Injury	☐	☐	☐	☐	☐	☐
Minor Injury	☐	☐	☐	☐	☐	☐
Env/Equipment	☐	☐	☐	☐	☐	☐

Is this risk acceptable? Yes☐ No☐ Risks below the heavy black line are generally felt to be acceptable, but please remember that we must reduce risks to as low a level as is reasonably practicable.

If the risk is acceptable and you cannot practicably reduce it further, then move on to the next hazard.
If the risk is not acceptable, then review the control measures for this hazard taking help from a Safety Management Consultant.

Hazard 4

Nature of Hazard:
Control Measures:

Assessment of risk

	Very likely	Probable	Possible	Remote	Improbable	Impossible
Fatal Injury	☐	☐	☐	☐	☐	☐
Major Injury	☐	☐	☐	☐	☐	☐
Minor Injury	☐	☐	☐	☐	☐	☐
Env/Equipment	☐	☐	☐	☐	☐	☐

Is this risk acceptable? Yes☐ No☐ Risks below the heavy black line are generally felt to be acceptable, but please remember that we must reduce risks to as low a level as is reasonably practicable.

If the risk is acceptable and you cannot practicably reduce it further, then move on to the next hazard.
If the risk is not acceptable, then review the control measures for this hazard taking help from a Safety Management Consultant.

Hazard 5

Nature of Hazard:
Control Measures:

Assessment of risk

	Very likely	Probable	Possible	Remote	Improbable	Impossible
Fatal Injury	☐	☐	☐	☐	☐	☐
Major Injury	☐	☐	☐	☐	☐	☐
Minor Injury	☐	☐	☐	☐	☐	☐
Env/Equipment	☐	☐	☐	☐	☐	☐

Is this risk acceptable? Yes☐ No☐ Risks below the heavy black line are generally felt to be acceptable, but please remember that we must reduce risks to as low a level as is reasonably practicable.

If the risk is acceptable and you cannot practicably reduce it further, then move on to the next hazard.
If the risk is not acceptable, then review the control measures for this hazard taking help from a Safety Management Consultant.

Hazard 6

Nature of Hazard:
Control Measures:

Assessment of risk

	Very likely	Probable	Possible	Remote	Improbable	Impossible
Fatal Injury	☐	☐	☐	☐	☐	☐
Major Injury	☐	☐	☐	☐	☐	☐
Minor Injury	☐	☐	☐	☐	☐	☐
Env/Equipment	☐	☐	☐	☐	☐	☐

Is this risk acceptable? Yes☐ No☐ Risks below the heavy black line are generally felt to be acceptable, but please remember that we must reduce risks to as low a level as is reasonably practicable.

If the risk is acceptable and you cannot practicably reduce it further, then move on to the next hazard.
If the risk is not acceptable, then review the control measures for this hazard taking help from a Safety Management Consultant.

Hazard 7

Nature of Hazard:
Control Measures:.

Assessment of risk

	Very likely	Probable	Possible	Remote	Improbable	Impossible
Fatal Injury	☐	☐	☐	☐	☐	☐
Major Injury	☐	☐	☐	☐	☐	☐
Minor Injury	☐	☐	☐	☐	☐	☐
Env/Equipment	☐	☐	☐	☐	☐	☐

Is this risk acceptable? Yes☐ No☐ Risks below the heavy black line are generally felt to be acceptable, but please remember that we must reduce risks to as low a level as is reasonably practicable.

If the risk is acceptable and you cannot practicably reduce it further, then move on to the next hazard.
If the risk is not acceptable, then review the control measures for this hazard taking help from a Safety Management Consultant.

Hazard 8

Nature of Hazard:
Control Measures:

Assessment of risk

	Very likely	Probable	Possible	Remote	Improbable	Impossible
Fatal Injury	☐	☐	☐	☐	☐	☐
Major Injury	☐	☐	☐	☐	☐	☐
Minor Injury	☐	☐	☐	☐	☐	☐
Env/Equipment	☐	☐	☐	☐	☐	☐

Is this risk acceptable? Yes☐ No☐ Risks below the heavy black line are generally felt to be acceptable, but please remember that we must reduce risks to as low a level as is reasonably practicable.

If the risk is acceptable and you cannot practicably reduce it further, then move on to the next hazard.
If the risk is not acceptable, then review the control measures for this hazard taking help from a Safety Management Consultant.

Unattended Running

Please choose one category below:

It will not be necessary to run this apparatus unattended.	☐
This is standard unmodified commercial equipment which is designed to be run unattended.	☐
This is a test rig, or modified commercial equipment, which is suitable for unattended running.	☐
This is a test rig which is not suitable for unattended running	☐

A test rig will generally be suitable for unattended running if the following criteria are met:

- The rig will fail to safety.
- The rig does not rely on a supply of cooling water, or on the provision of any other laboratory service, to remain in a safe state. Services can be disrupted without warning.

Emergency Information

Emergency Information

All Permits to Operate contain an Emergency Information panel. This should contain whatever information would be most helpful in the event of an accident, incident or emergency involving this apparatus. Often the Emergency Information panel will include an emergency shut-down procedure. Please fill in this panel as you would wish it to appear on the Permit.

Your instructions should be as simple and clear as possible – so that somebody who is not familiar with the equipment can follow them. Your instructions should not be designed to protect data or equipment if, in doing so, they become more complex or harder to follow.

Safe Operating Procedure

Please specify, or append, an SOP (Safe Operating Procedure) for the use of this apparatus. Please include all points necessary to ensure the safety of users.

Staff Declaration

The Staff signs* to certify that he or she has read and understood this risk assessment and agrees to follow safety-related instructions and procedures.

The CTO signs** to certify that the Staff understands all information given on this form, and has sufficient knowledge and training to safely operate the apparatus.

Name of Staff	Date	Signature of Staff*	Signature of CTO**

Company Director Declaration

I certify that this document constitutes a full and complete risk assessment for the named research apparatus.

Name:	Signature:	Date:

Second Company Director Declaration

This form appears to have been correctly completed and adequate accompanying literature has been provided. The risks, as assessed, are acceptable.

Name:	Signature:	Date:

Review of Assessment

This risk assessment, and all documents appended to it, must be reviewed annually. If there have been no major changes to the apparatus or risk assessment, *and if the previous assessment has not yet expired,* then the CTO may certify this by using the table below. The assessment can be reviewed three times. At the end of the fourth year, a new assessment must be carried out.

Date of Review	Describe changes to equipment and assessment or state 'none'	CTO's Signature	Date next review due

Date:	Review Date:	Assessment Reference:

ENVAL LIMITED

CHEMICAL HAZARD RISK ASSESSMENT FORM

Completing this document fulfils the requirements of the COSHH and DSEAR Regulations relating to a written risk assessment

Procedure (include a brief description & reaction conditions i.e. temperature, solvent, work up procedures and frequency of exposure)**:**

Risks associated with the procedure (What are the hazards and risks?)**:**

Risk implications:

Is there any substance used or formed that might give rise to explosion (e.g. flammable gases/liquids)? Yes / No

If yes, how can you ensure that no explosion occurs.

Is it reasonably foreseeable that the lower explosive limit will be reached in the event of a leak/spillage? Yes / No

If yes, a more detailed risk assessment is required.

Is there likelihood of copious amounts of gas being released or thermal runaway? Yes / No

Can any of the substances be substituted for a less hazardous substance? Yes / No

What could happen if there was catastrophic failure of the apparatus?

In the event of an accident, who might be exposed?

Substances to be used (List *ALL* substances including solvents, expected products and by-products)**:**

Substances Used	Approx. Quantity	Physical Form i.e. dust, vapour, volatile liquid etc	Hazards i.e. flammable, corrosive, irritant, readily absorbed through skin	Exposure Route i.e. skin, eyes

Are any of the substances listed above R42, R43, R45, R46, R49, R60, R61, R64? Yes /No
(If yes, please refer and sign as "Read" the "Working Safely with Carcinogens, Mutagens and Substances Toxic to reproduction, Code of Practice and Guidance" of the University of Cambridge).

Control measures to be used (continue on a separate sheet if necessary)**:**

Containment:		*Personal Protective Equipment:*	
Fume cupboard	Yes / No	Lab coat / overalls	Yes / No
Glove box / isolator	Yes / No	Chemical apron	Yes / No
Safety cabinet	Yes / No	Gloves	Yes / No
Local exhaust ventilation	Yes / No	Eye Protection	Yes / No
Other (specify)		Respiratory protective equipment	Yes / No
		Other (specify)	

Are any additional controls required? (Consider nearby sources of ignition, formation of explosive atmospheres/mixtures, asphyxiation in confined spaces)

Disposal measures to be used during and after the procedure: (Also consider by-products and washings)

Emergency Procedures (emphasise any special hazards)**:**

- Shutdown Procedures:
- Action in the event of fire (type of fire extinguisher):
- Action in the event of spillage or uncontrolled release*:*
- Emergency treatment for personnel in the event of contamination, exposure to fumes or other adverse effects

Eyes:
Skin:
Inhalation:

Name of Company Director:	
Signature:	**Date:**
Name of co-signatory (second Company Director):	
Signature:	**Date:**

Note: This risk assessment should be reviewed at least annually and when there is any significant change in procedure.

Urban & Civic Alconbury

Alconbury Airfield - Building 118

Baseline Geoenvironmental Ground Investigation

Project Ref: 24213/112

Doc Ref: Geo Report A2/draft

June 2012

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Document Control Sheet

Project Name: **Alconbury Airfield - Building 118**

Project Ref: **24213/112**

Report Title: **Baseline Geoenvironmental Ground Investigation**

Doc Ref: **Geo Report A2/draft**

Date: **June 2012**

	Name	Position	Signature	Date
Prepared by:	David Bissell	Associate Engineer		
Reviewed by:	Richard Thomas	LLP Director		
Approved by:	Richard Thomas	LLP Director		
For and on behalf of Peter Brett Associates LLP				

Revision	Date	Description	Prepared	Reviewed	Approved
-	29/06/12	Draft for comment	DBi	RHT	RHT

Contents

Tables

Figures

Appendices

1 Introduction

1.1 Background Information

Peter Brett Associates LLP has been instructed by Savills Commercial Ltd, acting on behalf of Urban & Civic Alconbury (the Client), to carry out an intrusive ground investigation at the location of Building 118 within the Alconbury Airfield complex, at Alconbury, near Huntingdon, Cambridgeshire.

The work is to facilitate the discharge of a planning condition made by Huntingdonshire District Council with respect to an application for change of use. Specifically the planning condition requires a baseline intrusive investigation to be carried out to confirm the absence of remnant contamination from previous land use history.

This report presents the findings of desk study and intrusive ground investigation works carried out to identify the past land use history of this parcel within the airfield site and to identify current baseline ground conditions.

Peter Brett Associates LLP has previously carried out a global Phase 1 desk study for the Alconbury Airfield and adjacent lands for the Client (PBA, 2012).

1.2 Scope of Work

The scope of work undertaken with respect to Building 118 has comprised:

- A review of the site history by reference to:-
  - Ordnance Survey (OS) maps obtained from the Landmark Information Group (the obtained map set is included in **Appendix 1**).
  - Other documentary records contained within the global Phase 1 desk study report carried out by Peter Brett Associates LLP for the airfield site.
- A review of the geoenvironmental setting of the site by reference to:-
  - A parcel specific Envirocheck report procured from the Landmark Information Group (the obtained Envirocheck report is included in **Appendix 2**)
  - Other documentary records contained within the global Phase 1 desk study report carried out by Peter Brett Associates LLP for the airfield site.
- Confirmation of existing baseline ground conditions by:-
  - Three boreholes sunk around the footprint of the building by a track mounted ‘Terrier’ mini percussion sampling rig with recovery of soil samples in rigid plastic liners to facilitate description and sub-sampling for analytical testing (the positions of the boreholes are shown on **Figure 2**, with the engineer compiled records included in **Appendix 3**).
  - Analytical testing for a range of potential contaminants carried out by Alcontrol Laboratories Ltd on twelve submitted soil samples (the laboratory Certificate of Analysis is included in **Appendix 4**).

The report and its accompanying figures and appendices should be read in conjunction with the notes detailed in Section 6 of the main report text.

1.3 Site Location and Description

Building 118 is sited in the northern part of the Alconbury Airfield as shown on **Figure 1.**

The building lies to the north of airfield's outer perimeter roadway and comprises a small industrial type unit of steel clad portal frame construction. In plan the building footprint is approximately 23m x 13m. A second small building lies to the north of Building 118. An above ground tank is present to the south of the building. The land to the north, east and south comprises grassland, whilst to the west the surface is tarmacadam hardstanding (providing access to the roller shutter entrance door which is in the western gable of the unit.

The photographs below (taken in May 2012) show the front of the building's front entrance and the general view looking north-westwards from the airfield perimeter road.

Figure 2 comprises an extract from a topographic survey of the airfield site provided by the Client and shows the general layout of Building 118, together with salient site features including existing service covers and ground levels (m AOD).

A noteworthy topographic feature is the presence of an earth bund feature, the southern boundary to which is approximately 20m to the north (rear) of Building 118; this earth bund surrounds/ comprises the 'POL Site D and E' areas which formed part of the (military) airfields aviation fuel network. These areas contained earth covered (aviation fuel) tanks with associated underground pipework and dispensing points. The tanks are understood to have been installed in 1974.

2 Site Setting

2.1 Land Use History

The wider airfield desk study carried out previously by Peter Brett Associates LLP has identified that prior to the establishment of an airfield the site had only a history of agricultural working. The Alconbury airfield (Station 102) was essentially active from its early acquisition as a "scatter" or satellite landing ground intended to serve RAF Upwood in 1938, until final closure following the departure of US forces in 1995. Today the site remains largely intact although in civilian use.

The map record for the land parcel occupied by Building 118 (see Appendix 1) shows that prior to the development of the airfield, the site was located in a large rectangular field enclosure that lay to the west of one of the lanes that previously crossed the site. A current section of hedgerow approximately 25m to the east of the building (see Figure 2) follows is on the alignment of the historic field boundary that ran alongside the lane. The map record proceeding and immediately post WWII is both incomplete and where in existence censored, with the airbase not shown. The presence of the Alconbury Airfield is shown on the 1958/1959 OS map record, but with no detailed layout shown.

The detailed layout within the airfield is not depicted on OS map records until the 1974 edition, with the plot now occupied by Building 118 shown to be an undeveloped open area immediately to the north of the airfields perimeter roadway.

The 1994 1:10,000 scale OS map record continues to show the plot as an undeveloped area; this map edition however is also partially censored as it does not depict the bunded area immediately to the north of the plot which is known as the 'POL D and E' site (containing covered aviation fuel tanks) and which other records identify were installed in 1974.

The 1995 1:2,500 'Large Scale National Grid' OS map edition shows Building 118 and the (unlabelled) POL D and E site to the immediate north. The layout of Building 118 and surrounding area shown on the 1995 OS map record has remained unchanged to the present day.

An 'Explosive Ordnance Threat Assessment' desk study report has been compiled for the site by BACTEC International Limited (BACTEC, 2012). The report includes a detailed document review of the military history of the airfield site and identifies that the Building 118 plot is not an area where there is evidence of any specific ordnance related land use activity having been carried out.

2.2 Geological Setting

General Geology

The British Geological Survey's (BGS) webhosted BGS 1:50,000 mile DiGMapGB-50 dataset Depicts that the Building 118 plot is underlain by glacial till (formerly termed 'boulder clay' deposits) overlying and masking the Jurassic Oxford Clay Formation bedrock. The glacial till (or boulder clay) is characteristically chalky in nature. It typically comprises a grey clayey matrix with chalk, flint, sandstone, quartzite, limestone and ironstone. Locally the till is sandy and layers, lenses and pockets of sand are common. The memoir for the district notes that *"the boulder clay has been dug from small pits in many localities, for use in both brick-making and as 'marl' for spreading on the land, such pits are now long disused and show no sections."* (BGS, 1965).

The Oxford Clay Formation is underlain by Middle Jurassic aged strata successively comprising the Kellaways Beds, Cornbrash, Great Oolitic Series and Lower Estuarine Series. The Oxford Clay typically comprises a rhythmical sequence of interbedded dark olive and brownish grey fossiliferous shales and pale grey black mudstones which weather to bluish-grey or greenish-grey plastic clay with selenite and other sulphate salts.

Known historic boreholes on the airfield have generally shown the till to be generally >10m in thickness (the majority of boreholes terminating in this deposit with only a few proving the underlying Oxford Clay).

Geological Structure

The published geological memoir (BGS, 1965) describes the regional dip of the bedrock strata in the Huntingdon district to be very slight, generally less than 1 degree but locally increasing to 2 degrees. In the Alconbury part of the district, the regional dip is easterly or east-south-easterly. Contours of the base of the Oxford Clay (given in Figure 3 of the memoir) infer the base to be at approximate OD level of 50 foot (15.25m).

No geological faults are recorded to be present beneath the plot or in the immediate vicinity of the wider airfield site.

Hydrogeology

The superficial glacial till drift cover is classified by the Environment Agency (EA) as 'Unproductive Strata'. Unproductive Strata are rock layers or drift deposits with low permeability that have negligible significance for water supply or river base flow.

2.3 Hydrology

The wider airfield site sits on a local hill-top plateau with the western (airfield) boundary approximately 1km northeast of the Alconbury Brook, which flows in a south-easterly direction towards its confluence with the Cock Brook, Ellington Brook and The Great Ouse river (approximately 6km to the south-east of the airfield).

The northern part of the airfield drains through a network of drains and streams to the north-east towards the River Nene (Old Course) which itself flows towards the north-east.

Anecdotal information infers that there are nine balancing reservoirs located within, and in areas adjacent to, the airfield which regulate the flow of run-off from the airfield to the receiving drains and watercourses.

The Environment Agency Flood Map included within the Envirocheck report shows that the plot does not lie within an area of Zone 2 or 3 flood risk.

3 Intrusive Investigation

3.1 General

An intrusive ground investigation was carried out on the 17th May 2012. The objective was to confirm the nature of the sub-surface geology around Building 118 and to obtain soil samples for analytical testing for a range of potential contaminants to establish current baseline conditions.

The investigation technique used involved small diameter boreholes sunk by a Terrier rig deploying dynamic sampling techniques to recover a continuous soil core in semi-rigid plastic liner. Three boreholes were sunk at the positions shown on **Figure 2**.

The scope of work was designed by Peter Brett Associates LLP and carried out under the technical direction and full time attendance of a geo-environmental engineer, in accordance with BS 10175:2011 (BSI, 2011) where appropriate.

3.2 Site Work Details

3.2.1 Investigation Technique

Geotechnical Engineering Ltd used a 'Terrier' mini percussion sampling rig deploying dynamic sampling techniques to construct three boreholes at positions identified by Peter Brett Associates LLP. A technical sheet describing the unit is included in **Appendix 3** of this report.

The borehole positions were sited away from known services as depicted on the airfield topographic survey and from available service records held by Peter Brett Associates LLP. At each position, following a check for underground services using a cable avoidance tool (CAT) a hand dug inspection pit was formed.

The hand dug pit and subsequent recovered soil cores were examined by a geo-environmental engineer for visual or olfactory contamination, with any odours noted. The strata exposed/ recovered were described with soil descriptions generally following BS5930:1999 and sampled. The sampling strategy from the recovered cores was to take soil samples at regular depth intervals to be representative of the materials encountered. Where any visual or olfactory contamination was evident, targeted samples would additionally be taken.

The boreholes were taken to between 3.85m and 4.85m depth. On completion each bore was backfilled with bentonite pellets and the inspection pit section infilled with spoil arisings.

3.2.2 Site Work Records

Details of the strata encountered, samples collected and groundwater observations (where appropriate) are given in the exploratory hole records presented in **Appendix 4**. The levels given on the individual records were extrapolated from the available topographic survey (which also forms the base plan to **Figure 2**). The positions of the boreholes were taped into salient site features and then the co-ordinates (as given on the records) interpolated from the current OS map record.

3.2.3 Quality Control Measures for Soil Sampling, Storage and Transportation

Soil Sampling
The sample containers used for sampling purposes were supplied by Alcontrol Laboratories Ltd. Each sample set followed the laboratories minimum sample size/ container type protocol and comprised one 400g plastic tub (Container Code ALE 214), one 250g glass amber jar (ALE 210) and two 60g glass jars (ALE 215).

Disposable latex gloves were used when handling any soil.

In order to prevent contamination during transportation to the site, all sampling equipment was stored in clean plastic containers.

Storage
Samples taken during the site work were placed into cool boxes pending transportation to the laboratory.

Transportation
The samples were collected from site and transported by overnight courier to the laboratory on the day following collection. Receipt of the samples in the laboratory on Friday May 18th 2012 was confirmed by the laboratory.

3.3 Laboratory Testing

3.3.1 Laboratory Selection

Analytical (geoenvironmental) testing on the selected site samples was carried out by Alcontrol Laboratories (a trading division of Alcontrol UK Ltd) at their Hawarden laboratory. This laboratory is an approved term contract supplier to Peter Brett Associates LLP for analytical laboratory services and holds UKAS accreditation (UKAS testing laboratory 1291) and MCERTS accreditation for the majority of tests scheduled.

3.3.2 Scheduled Testing

A total of 12 soil samples were submitted for analysis. The rationale for the analytical testing was to check for a range of potential contaminants in the near surface strata (these included a general suite of metals, hydrocarbon screens and other selected parameters), with then additional samples taken of the strata present below 1.2m depth for hydrocarbon screening only.

The scope of the testing is summarised below:

Table 3.1: Summary of Scheduled Soil Analysis

Description	Number of Tests	Soil Sample Depth Range (m)
General suite - Arsenic, Barium, Cadmium, Chromium, Hexavalent Chromium, Copper, Lead, Mercury, Molybdenum, Nickel, Selenium, Nickel, Vanadium and Zinc. pH, Fluoride, Soil Organic Matter and Water soluble Sulphate	6 No	0.20 to 1.20
Detailed Organic Screen – Total Petroleum Hydrocarbons (TPH) C5 – C44 with banding	12 No	0.20 to 3.20
Speciated Poly-Aromatic Hydrocarbons (PAH)	12 No	0.20 to 3.20
Phenols	6 No	0.20 to 1.20

4 Baseline Ground Conditions

4.1 Ground Conditions Encountered

Strata Sequence

The three boreholes (reference BH118/01, BH118/02 and BH118/03) have all proven the presence of glacial till across the plot.

Boreholes BH118/01 and BH118/03 both encountered weathered glacial till beneath a surface cover of topsoil. The till was initially an orange-brown and grey brown clay with flint gravels, which became chalky below about 0.6m depth. The till was assessed to be of firm consistency becoming became less weathered and stiff to very stiff with depth. Both boreholes terminated in the till at 4.85m and 3.9m depth respectively.

In borehole BH118/02, the presence of surface Made Ground was noted beneath the topsoil extending to 1.5m depth. The Made Ground comprised a soft grey and orange brown gravelly clay over a basal (100mm layer) of broken brick. Beneath the Made Ground, weathered till is present comprising firm grey and orange brown gravelly clay; the weathered till sequence includes at 3.4m depth a thin band of orange sand.

In all three boreholes the weathering profile of the glacial till was similar suggesting that the Made Ground present in Borehole 118/02 is not indicative of general make up in ground level at that location but possibly related to some form of backfilled excavation. The local topography in this area does not infer general land raising across this particular plot.

Groundwater

Groundwater seepages were noted in Borehole 118/01 within the glacial till sequence at 2.45m, and in Borehole 118-02 at 1.3m depth within the Made Ground strata.

Olfactory and Visual Evidence of Contamination

No olfactory or visual evidence of contamination was noted in the recovered soil samples during the boring or logging/ inspection process.

4.2 Analytical Test Results

4.2.1 Test Data

The results of the analytical testing carried out by Alcontrol Laboratories on the submitted samples are presented in **Appendix 5**. The Certificate of Analysis issued by Alcontrol Laboratories (Report No 182820, dated 30 May 2012) details the test methods used together with other laboratory quality control data.

4.2.2 Review of Soil Chemical Test Data

To assess the baseline ground conditions, the measured concentrations of the individual determinands have been compared to published/ generic assessment criteria for a defined end use to screen the data. The basis for this screening exercise is detailed in the Peter Brett Associates LLP 'Methodology for assessing ground conditions' which forms **Appendix 5** of this report.

The measured concentrations of the various determinands are summarised in the table overleaf together with comparison with the selected Commercial/ Industrial End Use assessment criterion.

Table 3.2: Summary of Soil Chemistry Data

Determinand	No of Tests	Measured Range (mg/kg)	Assessment Criterion [Note 1] (Commercial/ Industrial End Use) (mg/kg)	Exceedance Identified?[Note 2]
Soil pH	6	8.31 – 8.78 (pH units)	N/A	-
Soil Organic Matter	6	0.4 – 2.45 (%)	N/A	-
Arsenic	6	12.7 - 21.3	640	0
Barium	6	30.6 - 141	N/A	-
Cadmium	6	0.18 - 0.49	230	0
Chromium (trivalent)	6	16.7 - 39.2	30,400	0
Chromium (hexavalent)	6	<0.6	35	0
Copper	6	9 - 12.1	71,700	0
Lead	6	9.7 - 22.6	750	0
Mercury	6	<0.14 - 0.174	26	0
Molybdenum	6	0.213 - 0.669	N/A	-
Nickel	6	17.6 - 36.5	1,800	0
Selenium	6	<1	13,000	0
Vanadium	6	32.6 - 61.7	3,160	0
Zinc	6	35 - 81.4	665,000	0
Fluoride	6	1.51 - 4.68	N/A	-
Soluble Sulphate (SO_4)	6	<0.003 g/l – 0.037g/l	N/A	-
Benzo(a)Pyrene	12	<0.015	14	0
Napthalene	12	<0.009 – 0.0299	480	0
Total Poly-Aromatic Hydrocarbons	12	<0.118 – 0.166	N/A	-
Total Aliphatics & Aromatics (>C5- C35)	12	0.527 – 128.0	Note 3	0
Total Aliphatics & Aromatics (>C5- C44)	12	0.527 – 166.0	Note 3	0

Notes:
1. Refer to Appendix 5 for details of the derivation/ origin of the selected assessment criterion.
2. If the measured concentration is below the screening criteria for the defined end use the parameter is not deemed to be a hazard. Exceedance of the criterion indicates that the parameter is a possible hazard.
3. The measured concentrations of the individual fractions of TPH are all detailed in Appendix 5 – Table 1.

The results of the analytical testing show low recorded levels of metals and inorganics all below the screening criteria for Commercial/ Industrial End Use.

Low concentrations of total petroleum hydrocarbons have been measured, with a maximum concentration of 166 mg/kg (>C5-C44) in the topsoil sample taken from borehole BH118/01 at 0.20m depth. This borehole is located (as shown on **Figure 2**) on the southern side of Building 118, between the actual building footprint and an existing above ground tank.

5 Summary and Conclusions

A baseline geoenvironmental ground investigation has been carried out on the small plot occupied by Building 118 to facilitate the discharge of a planning condition relating to a proposed change of use.

The study has comprised an initial review of available historical and geoenvironmental desk study information, followed by an intrusive ground investigation comprising three boreholes sunk in May 2012 by a Terrier type rig. Soil samples recovered from the boreholes have been submitted for analytical testing for a range of potential contaminants.

The desk study review has confirmed that the plot occupied by Building 118 was, prior to construction of the airfield base, located within part of a rectangular field enclosure that lay to the west of one of the former lanes that crossed the now airfield. On construction of the airfield, the plot came to lie immediate north of the perimeter roadway in an open airfield area. Whilst the footprint of the plot itself does not overlie within an area within the airfield with known specific land use prior to construction of the existing steel clad portal frame building in the mid1990s, the plot lies immediately to the south of an area which formed part of the military airbases aviation fuel distribution system. Specifically, the area to the north of Building 118 is the POL D and E site which contains covered aviation fuel tanks and associated distribution pipework that was reportedly installed in 1974.

The boreholes have confirmed the anticipated site geology with glacial till deposits (chalky boulder clay) proven to a maximum depth of 4.85m. Locally, to the east of the existing building, borehole BH118/02 encountered Made Ground to 1.5m depth. This local presence of Made Ground is considered likely to relate to some form of backfilled excavation (e.g. possible old service run) rather than being indicative of general land raising in this locality.

No olfactory or visual evidence of contamination was noted in the soil samples recovered from the boreholes by the directing geoenvironmental engineer.

A total of 6 soil samples from the near surface strata were submitted for analytical testing for a range of potential contaminants including metals, phenols, total petroleum hydrocarbons (C5-C44 with banding) and poly-aromatic hydrocarbons (speciated USA EPA 16). A further 6 samples from below 1.2m depth were also analysed for total petroleum hydrocarbons and poly-aromatic hydrocarbons.

The analytical testing has identified that the measured levels of all the determinands are below current published/ generic screening criterion for Commercial/ Industrial' End Use. In addition, measured levels of total petroleum hydrocarbons in the three boreholes over a depth range from 0.2m to 3.2m were low with a maximum concentration of 166 mg/kg measured in a sample from 0.2m depth in borehole BH118/01.

6 Essential Guidance for Report Readers

This report has been prepared within an agreed timeframe and to an agreed budget that will necessarily apply some constraints on its content and usage. The remarks below are presented to assist the reader in understanding the context of this report and any general limitations or constraints. If there are any specific limitations and constraints they are described in the report text.

1. The opinions and recommendations expressed in this report are based on statute, guidance, and best practise current at the time of its publication. Peter Brett Associates LLP (PBA) does not accept any liability whatsoever for the consequences of any future legislative changes or the release of subsequent guidance documentation, etc. Such changes may render some of the opinions and advice in this report inappropriate or incorrect and the report should be returned to us and reassessed if required for re-use after one year from date of publication. Following delivery of the report PBA has no obligation to advise the Client or any other party of such changes or their repercussions.

2. Some of the conclusions in this report may be based on third party data. No guarantee can be given for the accuracy or completeness of any of the third party data used. Historical maps and aerial photographs provide a “snap shot” in time about conditions or activities at the site and cannot be relied upon as indicators of any events or activities that may have taken place at other times.

3. The conclusions made in this report and the opinions expressed are based on the information reviewed and/or the ground conditions encountered in exploratory holes and the results of any field or laboratory testing undertaken. There may be ground conditions at the site that have not been disclosed by the information reviewed or by the investigative work undertaken. Such undisclosed conditions cannot be taken into account in any analysis and reporting.

4. It should be noted that groundwater levels, groundwater chemistry, surface water levels, surface water chemistry, soil gas concentrations and soil gas flow rates can vary due to seasonal, climatic, tidal and man-made effects.

5. This report has been written for the sole use of the Client stated at the front of the report in relation to a specific development or scheme. The conclusions and recommendations presented herein are only relevant to the scheme or the phase of project under consideration. This report shall not be relied upon or transferred to any other party without the express written authorisation of PBA. Any such party relies upon the report at its own risk.

6. The interpretation carried out in this report is based on scientific and engineering appraisal carried out by suitably experienced and qualified technical consultants based on the scope of our engagement. We have not taken into account the perceptions of, for example, banks, insurers, other funders, lay people, etc, unless the report has been prepared specifically for that purpose. Advice from other specialists may be required such as the legal, planning and architecture professions, whether specifically recommended in our report or not.

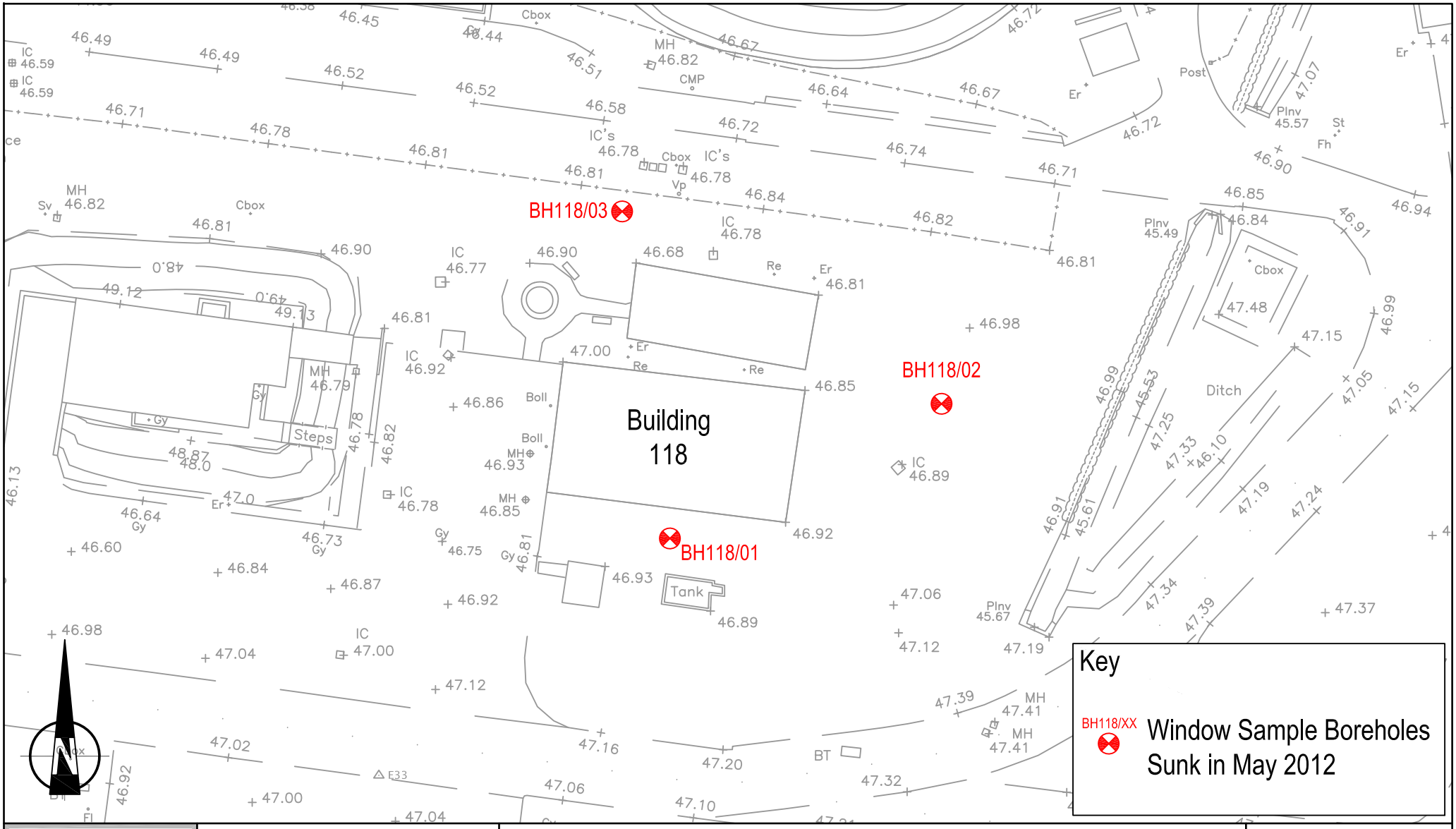
7. Public or legal consultations or enquiries, or consultation with any Regulatory Bodies (such as the Environment Agency, Natural England or Local Authority) have taken place only as part of this work where specifically stated.

7 References

(BACTEC, 2012). Explosive Ordnance Threat Assessment in respect of RAF Alconbury. For Buro Four. Report 3870TA, dated 19th April 2012.

(BGS, 1965). Geological Survey of Great Britain. Geology of the country around Huntingdon and Biggleswade. Memoirs of The Geological Survey of Great Britain, England and Wales. (Explanation of Sheets 187 and 204). Published 1965.

(PBA, 2012). Ground Stability and Phase 1 Contaminated Land Desk Study. Alconbury Weald, Cambridgeshire. For Urban & Civic. Report 24213/026, Revision A, June 2012.



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Client
URBAN & CIVIC

ALCONBURY - BUILDING 118

EXPLORATORY HOLE PLAN

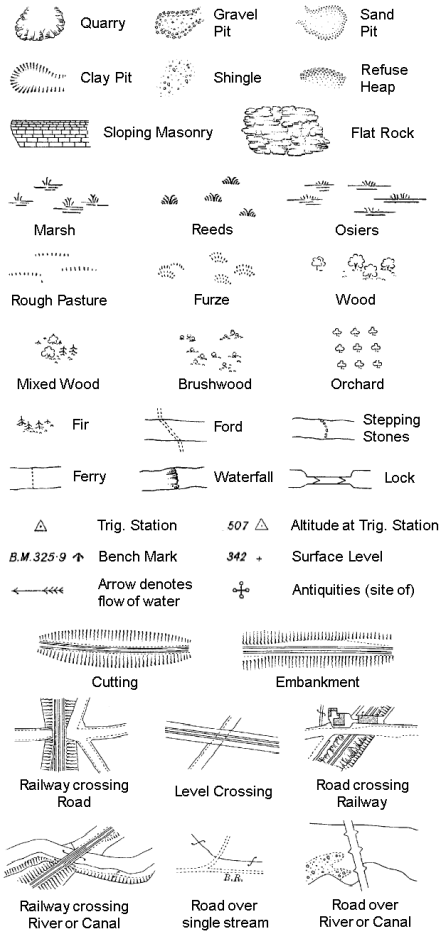
Date	18.06.2012
A4 Scale	1:500
Drawn by	DJM
Checked by	DBi
Figure Number	2

File Location: j:\24213 alconbury\geo\04 cad & graphics\cad\dwgs\geo dwgs\brief 112\figure 2 - exp hole plan.dwg

Appendix 1 - Ordnance Survey Map Record

Historical Mapping Legends

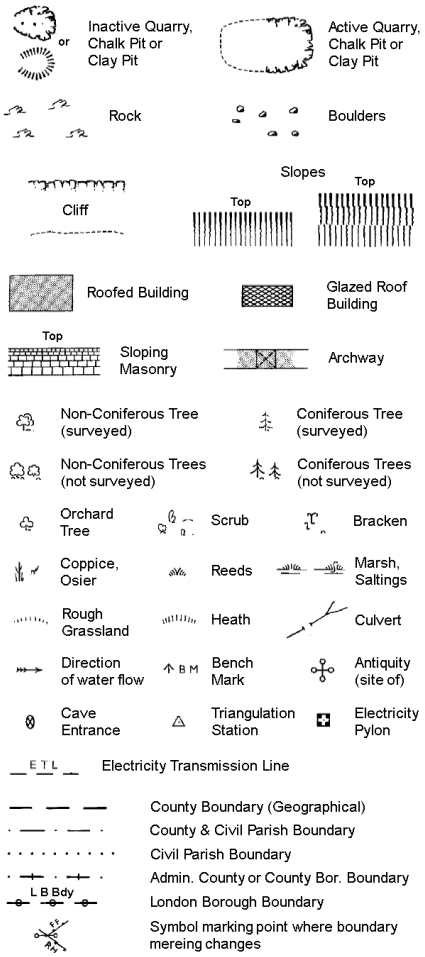
Ordnance Survey County Series and Ordnance Survey Plan 1:2,500



County Boundary (Geographical)
County & Civil Parish Boundary
Administrative County & Civil Parish Boundary
Co. Boro. Bdy. County Borough Boundary (England)
Co. Burgh Bdy. County Burgh Boundary (Scotland)

B P B S	Boundary Post or Stone	P.C.B	Police Call Box
B.R.	Bridle Road	P	Pump
E.P	Electricity Pylon	S.P	Signal Post
F.B.	Foot Bridge	Sl.	Sluice
F.P.	Foot Path	Sp.	Spring
G.P	Guide Post or Board	T.C.B	Telephone Call Box
M.S	Mile Stone	Tr.	Trough
M.P M.R	Mooring Post or Ring	W	Well

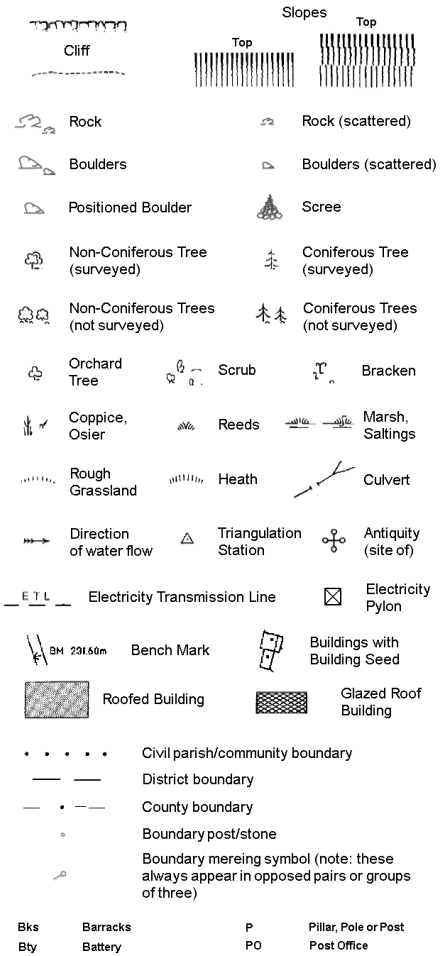
Ordnance Survey Plan, Additional SIMs and Supply of Unpublished Survey Information 1:2,500 and 1:1,250



County Boundary (Geographical)
County & Civil Parish Boundary
Civil Parish Boundary
Admin. County or County Bor. Boundary
L B Bdy London Borough Boundary
Symbol marking point where boundary mereing changes

BH	Beer House	P	Pillar, Pole or Post
BP, BS	Boundary Post or Stone	PO	Post Office
Cn, C	Capstan, Crane	PC	Public Convenience
Chy	Chimney	PH	Public House
D Fn	Drinking Fountain	Pp	Pump
El P	Electricity Pillar or Post	SB, S Br	Signal Box or Bridge
FAP	Fire Alarm Pillar	SP, SL	Signal Post or Light
FB	Foot Bridge	Spr	Spring
GP	Guide Post	Tk	Tank or Track
H	Hydrant or Hydraulic	TCB	Telephone Call Box
LC	Level Crossing	TCP	Telephone Call Post
MH	Manhole	Tr	Trough
MP	Mile Post or Mooring Post	Wr Pt, Wr T	Water Point, Water Tap
MS	Mile Stone	W	Well
NTL	Normal Tidal Limit	Wd Pp	Wind Pump

Large-Scale National Grid Data 1:2,500 and 1:1,250



Civil parish/community boundary
District boundary
County boundary
Boundary post/stone
Boundary mereing symbol (note: these always appear in opposed pairs or groups of three)

Bks	Barracks	P	Pillar, Pole or Post
Bty	Battery	PO	Post Office
Cemy	Cemetery	PC	Public Convenience
Chy	Chimney	Pp	Pump
Cis	Cistern	Ppg Sta	Pumping Station
Dismtd Rly	Dismantled Railway	PW	Place of Worship
El Gen Sta	Electricity Generating Station	Sewage Ppg Sta	Sewage Pumping Station
El P	Electricity Pole, Pillar	SB, S Br	Signal Box or Bridge
El Sub Sta	Electricity Sub Station	SP, SL	Signal Post or Light
FB	Filter Bed	Spr	Spring
Fn / D Fn	Fountain / Drinking Ftn.	Tk	Tank or Track
Gas Gov	Gas Valve Compound	Tr	Trough
GVC	Gas Governer	Wd Pp	Wind Pump
GP	Guide Post	Wr Pt, Wr T	Water Point, Water Tap
MH	Manhole	Wks	Works (building or area)
MP, MS	Mile Post or Mile Stone	W	Well

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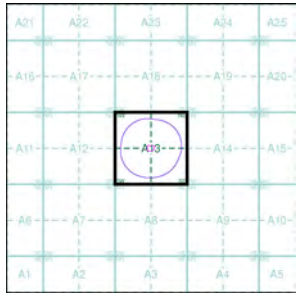
Historical Mapping & Photography included:

Mapping Type	Scale	Date	Pg
Huntingdonshire	1:2,500	1888	2
Huntingdonshire	1:2,500	1901	3
Huntingdonshire	1:2,500	1926	4
Ordnance Survey Plan	1:2,500	1974	5
Additional SIMs	1:2,500	1990	6
Large-Scale National Grid Data	1:2,500	1994	7
Large-Scale National Grid Data	1:2,500	1995	8
Large-Scale National Grid Data	1:2,500	1995	9

Historical Map - Segment A13



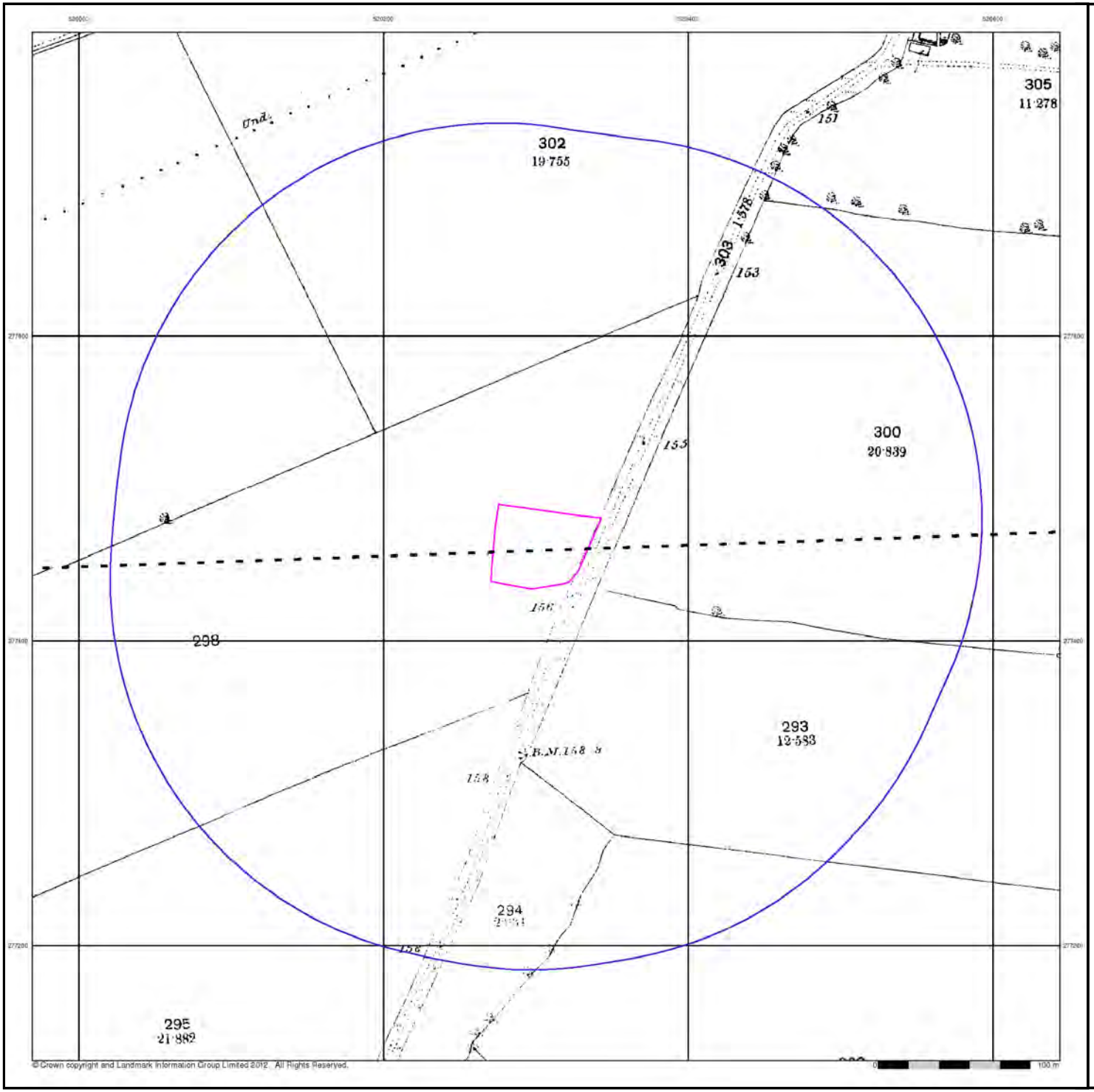
Order Details

Order Number: 39696597_1_1
Customer Ref: 24213/112
National Grid Reference: 520300, 277460
Slice: A
Site Area (Ha): 0.31
Search Buffer (m): 250

Site Details

Building 118, Alconbury Airfield, Alconbury, Cambridgeshire

Landmark Information Group
Tel: 0844 844 9952
Fax: 0844 844 9951
Web: www.envirocheck.co.uk



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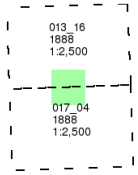
Huntingdonshire

Published 1888

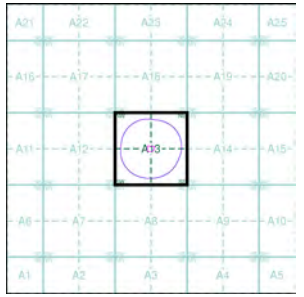
Source map scale - 1:2,500

The historical maps shown were reproduced from maps predominantly held at the scale adopted for England, Wales and Scotland in the 1840`s. In 1854 the 1:2,500 scale was adopted for mapping urban areas and by 1896 it covered the whole of what were considered to be the cultivated parts of Great Britain. The published date given below is often some years later than the surveyed date. Before 1938, all OS maps were based on the Cassini Projection, with independent surveys of a single county or group of counties, giving rise to significant inaccuracies in outlying areas.

Map Name(s) and Date(s)



Historical Map - Segment A13

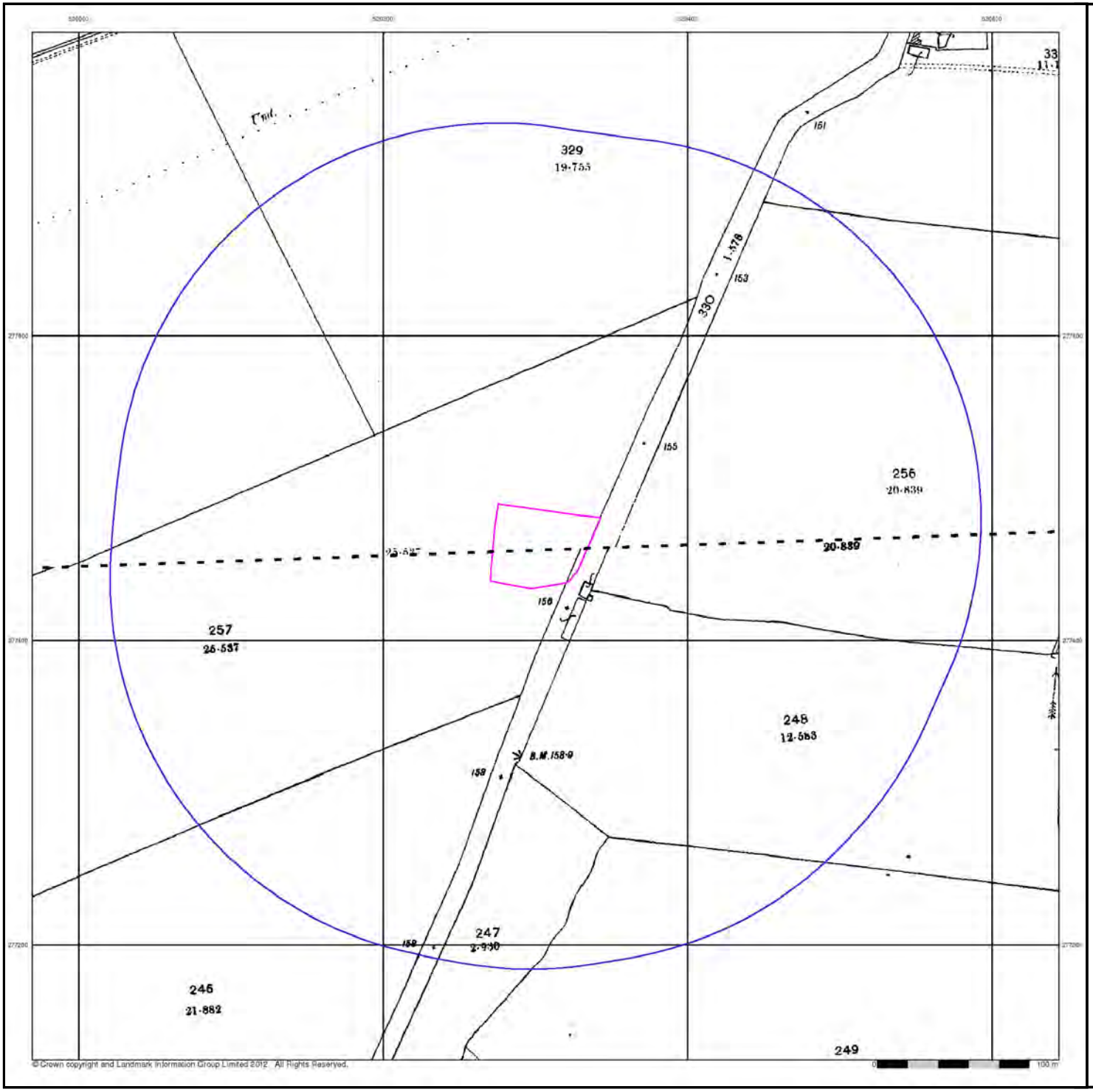


Order Details

Order Number:	39696597_1_1
Customer Ref:	24213/112
National Grid Reference:	520300, 277460
Slice:	A
Site Area (Ha):	0.31
Search Buffer (m):	250

Site Details

Building 118, Alconbury Airfield, Alconbury, Cambridgeshire



pba peterbrett

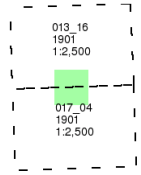
Huntingdonshire

Published 1901

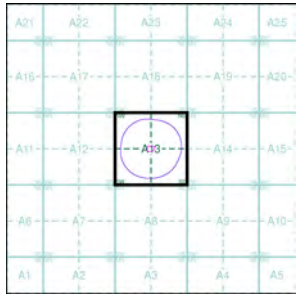
Source map scale - 1:2,500

The historical maps shown were reproduced from maps predominantly held at the scale adopted for England, Wales and Scotland in the 1840`s. In 1854 the 1:2,500 scale was adopted for mapping urban areas and by 1896 it covered the whole of what were considered to be the cultivated parts of Great Britain. The published date given below is often some years later than the surveyed date. Before 1938, all OS maps were based on the Cassini Projection, with independent surveys of a single county or group of counties, giving rise to significant inaccuracies in outlying areas.

Map Name(s) and Date(s)



Historical Map - Segment A13

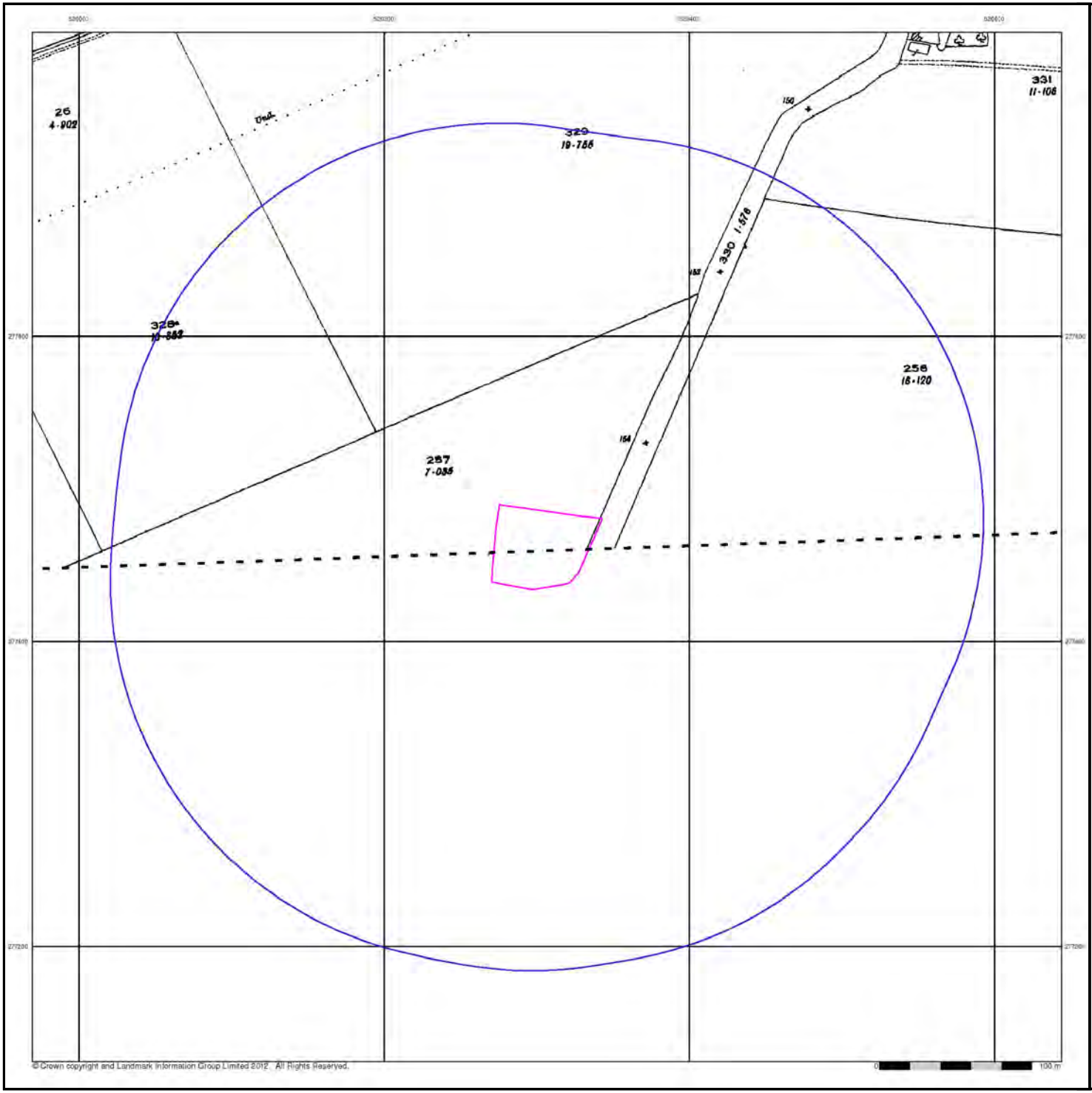


Order Details

Order Number:	39696597_1_1
Customer Ref:	24213/112
National Grid Reference:	520300, 277460
Slice:	A
Site Area (Ha):	0.31
Search Buffer (m):	250

Site Details

Building 118, Alconbury Airfield, Alconbury, Cambridgeshire



pba peterbrett

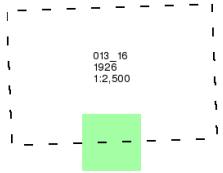
Huntingdonshire

Published 1926

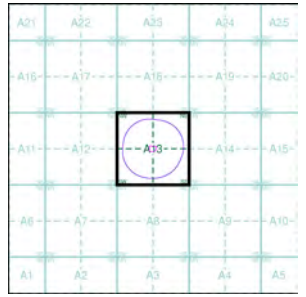
Source map scale - 1:2,500

The historical maps shown were reproduced from maps predominantly held at the scale adopted for England, Wales and Scotland in the 1840`s. In 1854 the 1:2,500 scale was adopted for mapping urban areas and by 1896 it covered the whole of what were considered to be the cultivated parts of Great Britain. The published date given below is often some years later than the surveyed date. Before 1938, all OS maps were based on the Cassini Projection, with independent surveys of a single county or group of counties, giving rise to significant inaccuracies in outlying areas.

Map Name(s) and Date(s)



Historical Map - Segment A13



Order Details

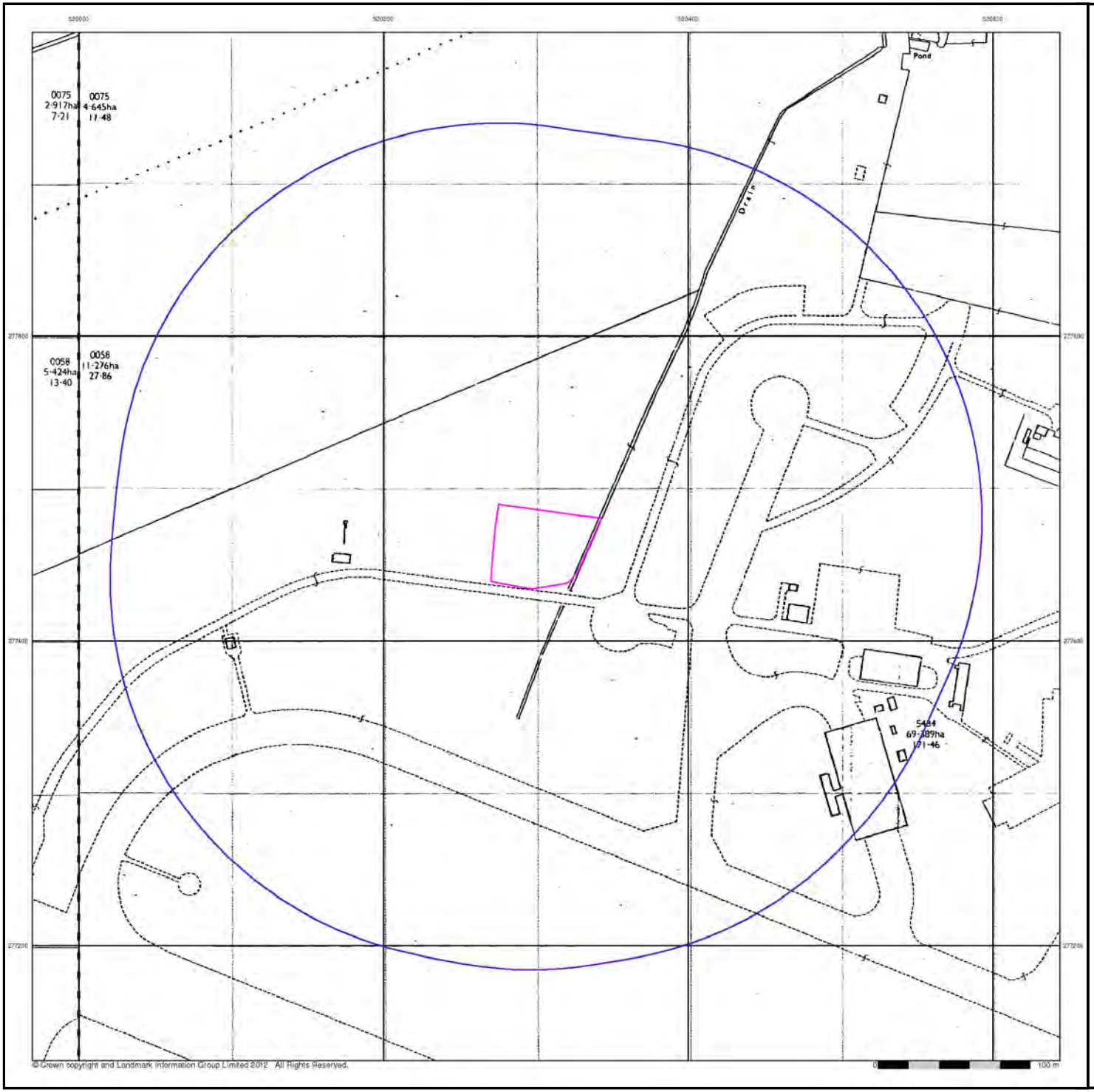
Order Number:	39696597_1_1
Customer Ref:	24213/112
National Grid Reference:	520300, 277460
Slice:	A
Site Area (Ha):	0.31
Search Buffer (m):	250

Site Details

Building 118, Alconbury Airfield, Alconbury, Cambridgeshire

Landmark Information Group

Tel: 0844 844 9952
Fax: 0844 844 9951
Web: www.envirocheck.co.uk



pba peterbrett

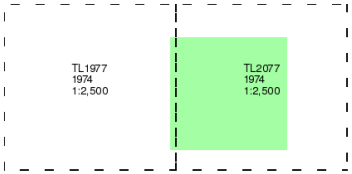
Ordnance Survey Plan

Published 1974

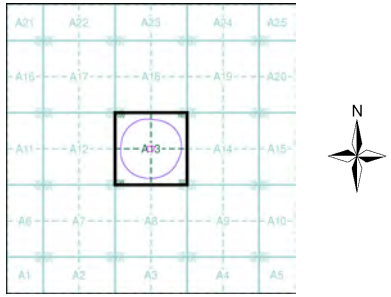
Source map scale - 1:2,500

The historical maps shown were reproduced from maps predominantly held at the scale adopted for England, Wales and Scotland in the 1840`s. In 1854 the 1:2,500 scale was adopted for mapping urban areas and by 1896 it covered the whole of what were considered to be the cultivated parts of Great Britain. The published date given below is often some years later than the surveyed date. Before 1938, all OS maps were based on the Cassini Projection, with independent surveys of a single county or group of counties, giving rise to significant inaccuracies in outlying areas.

Map Name(s) and Date(s)



Historical Map - Segment A13

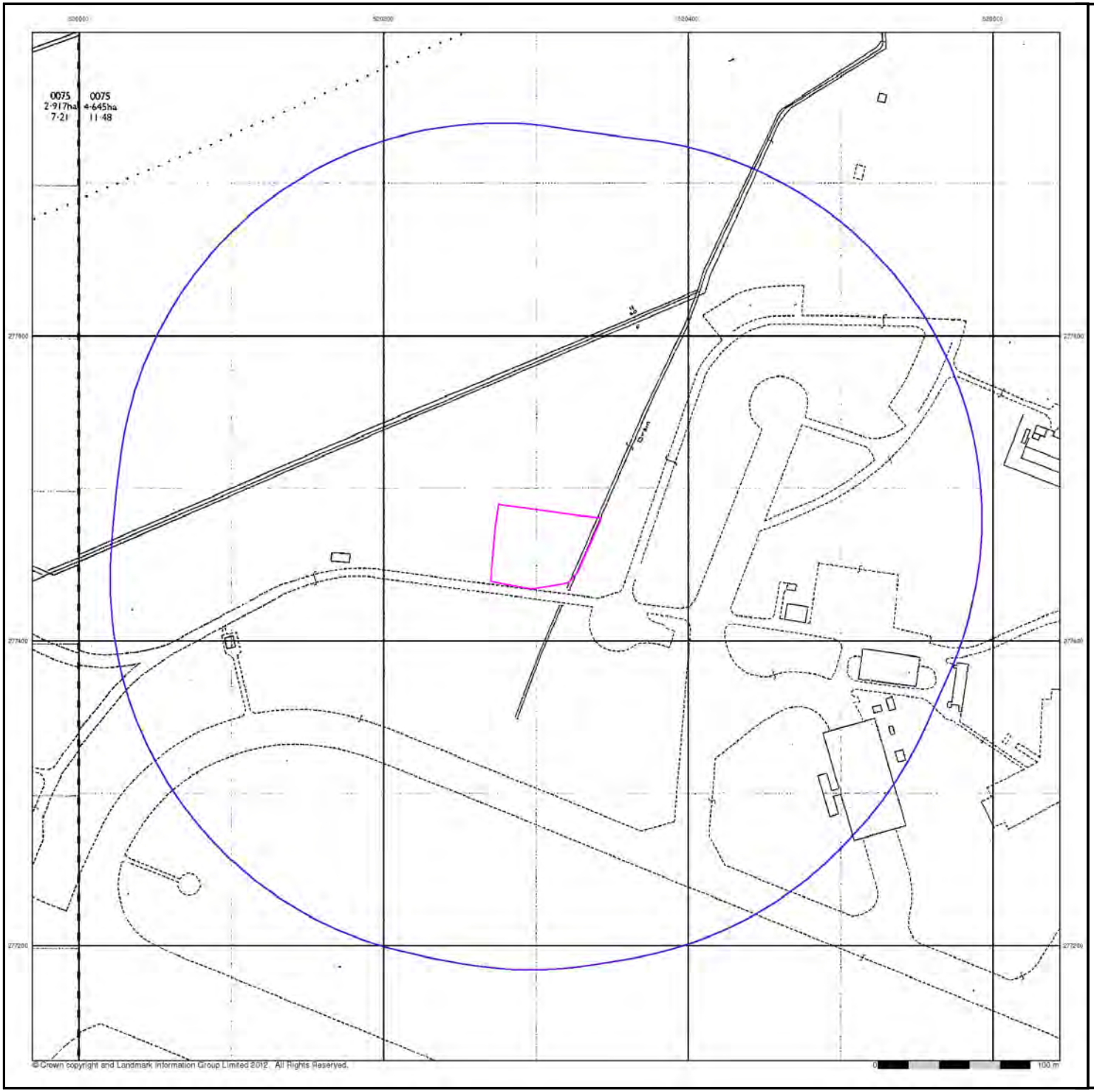


Order Details

Order Number:	39696597_1_1
Customer Ref:	24213/112
National Grid Reference:	520300, 277460
Slice:	A
Site Area (Ha):	0.31
Search Buffer (m):	250

Site Details

Building 118, Alconbury Airfield, Alconbury, Cambridgeshire



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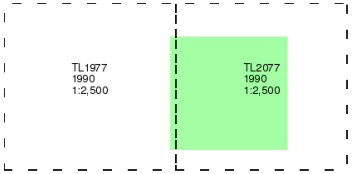
Additional SIMs

Published 1990

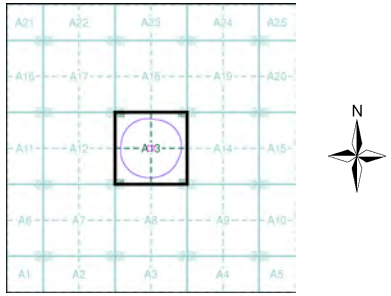
Source map scale - 1:2,500

The SIM cards (Ordnance Survey's `Survey of Information on Microfilm') are further, minor editions of mapping which were produced and published in between the main editions as an area was updated. They date from 1947 to 1994, and contain detailed information on buildings, roads and land-use. These maps were produced at both 1:2,500 and 1:1,250 scales.

Map Name(s) and Date(s)



Historical Map - Segment A13



Order Details

Order Number:	39696597_1_1
Customer Ref:	24213/112
National Grid Reference:	520300, 277460
Slice:	A
Site Area (Ha):	0.31
Search Buffer (m):	250

Site Details

Building 118, Alconbury Airfield, Alconbury, Cambridgeshire

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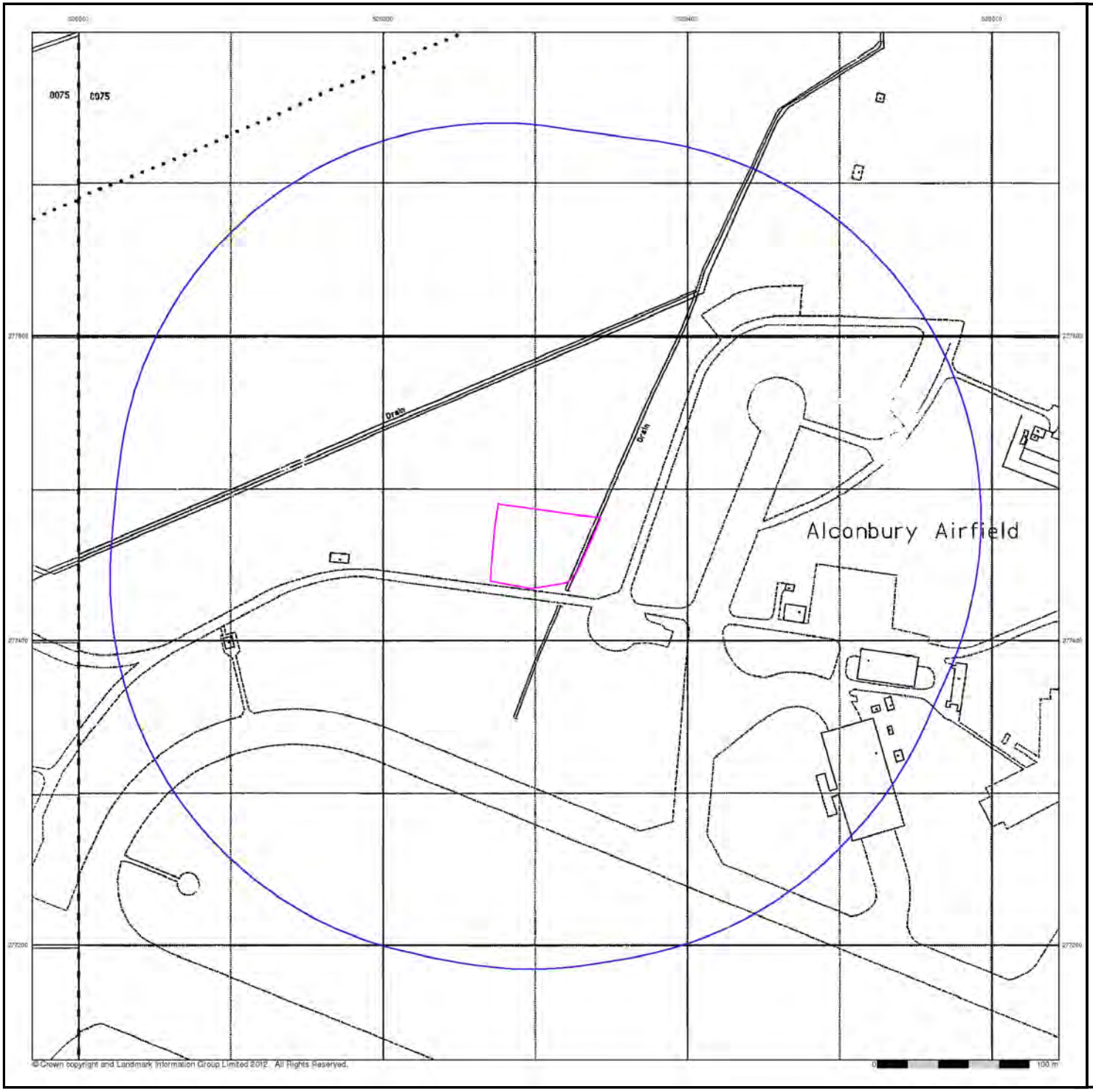
Web: www.envirocheck.co.uk



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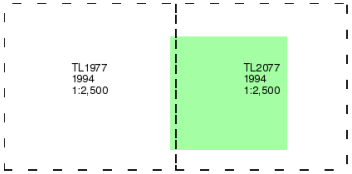
Large-Scale National Grid Data

Published 1994

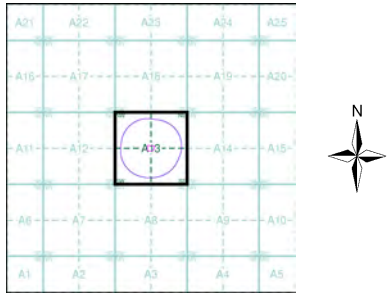
Source map scale - 1:2,500

'Large Scale National Grid Data' superseded SIM cards (Ordnance Survey's 'Survey of Information on Microfilm') in 1992, and continued to be produced until 1999. These maps were the fore-runners of digital mapping and so provide detailed information on houses and roads, but tend to show less topographic features such as vegetation. These maps were produced at both 1:2,500 and 1:1,250 scales.

Map Name(s) and Date(s)



Historical Map - Segment A13



Order Details

Order Number:	39696597_1_1
Customer Ref:	24213/112
National Grid Reference:	520300, 277460
Slice:	A
Site Area (Ha):	0.31
Search Buffer (m):	250

Site Details

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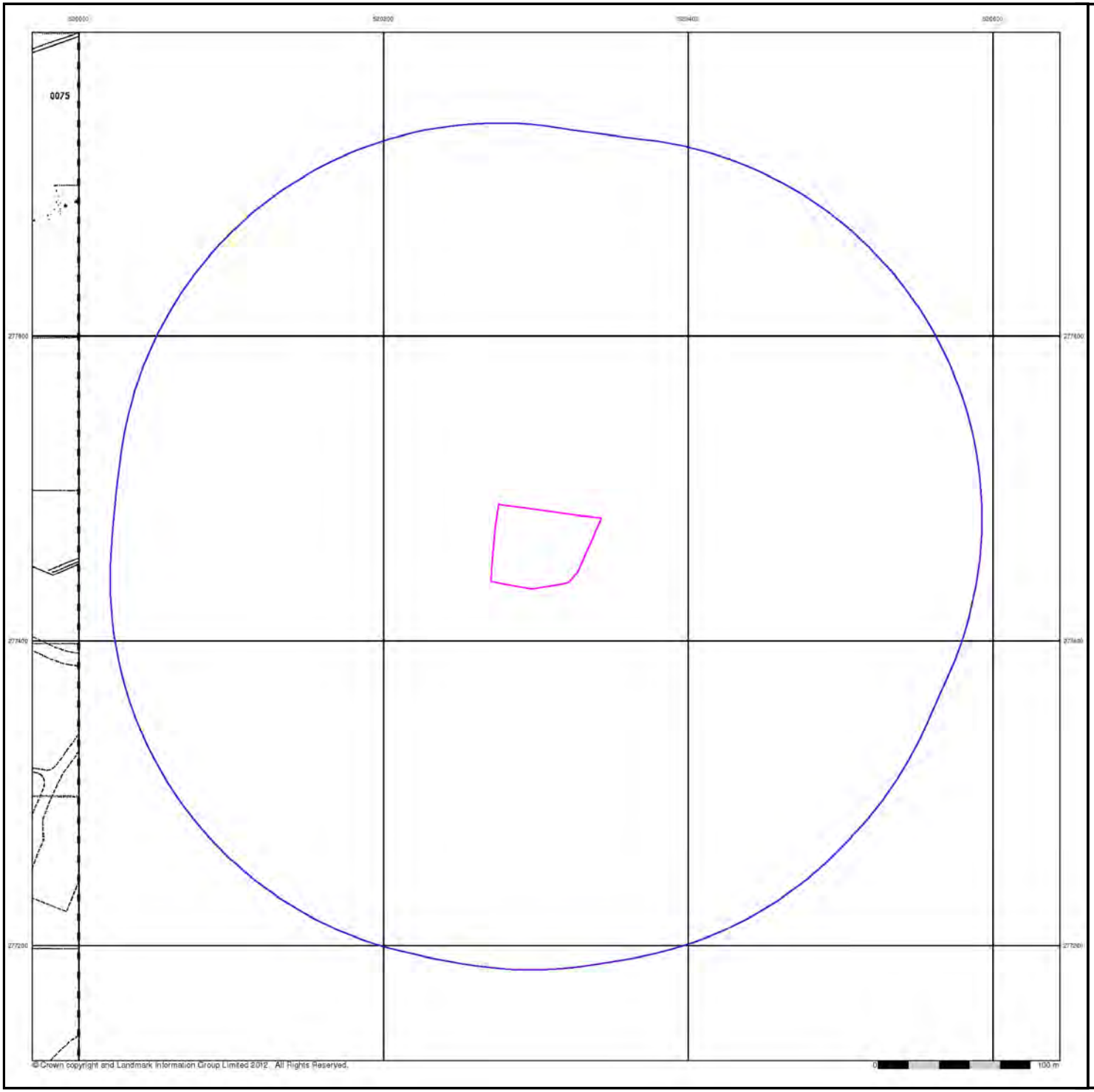
Web: www.envirocheck.co.uk



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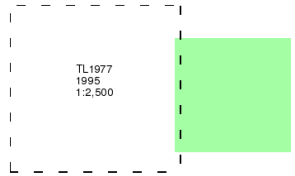
Large-Scale National Grid Data

Published 1995

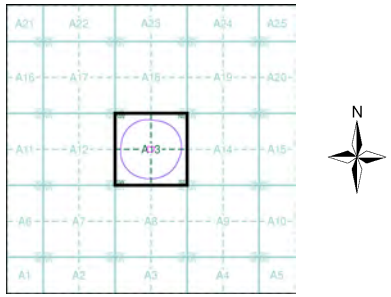
Source map scale - 1:2,500

'Large Scale National Grid Data' superseded SIM cards (Ordnance Survey's 'Survey of Information on Microfilm') in 1992, and continued to be produced until 1999. These maps were the fore-runners of digital mapping and so provide detailed information on houses and roads, but tend to show less topographic features such as vegetation. These maps were produced at both 1:2,500 and 1:1,250 scales.

Map Name(s) and Date(s)



Historical Map - Segment A13



Order Details

Order Number:	39696597_1_1
Customer Ref:	24213/112
National Grid Reference:	520300, 277460
Slice:	A
Site Area (Ha):	0.31
Search Buffer (m):	250

Site Details

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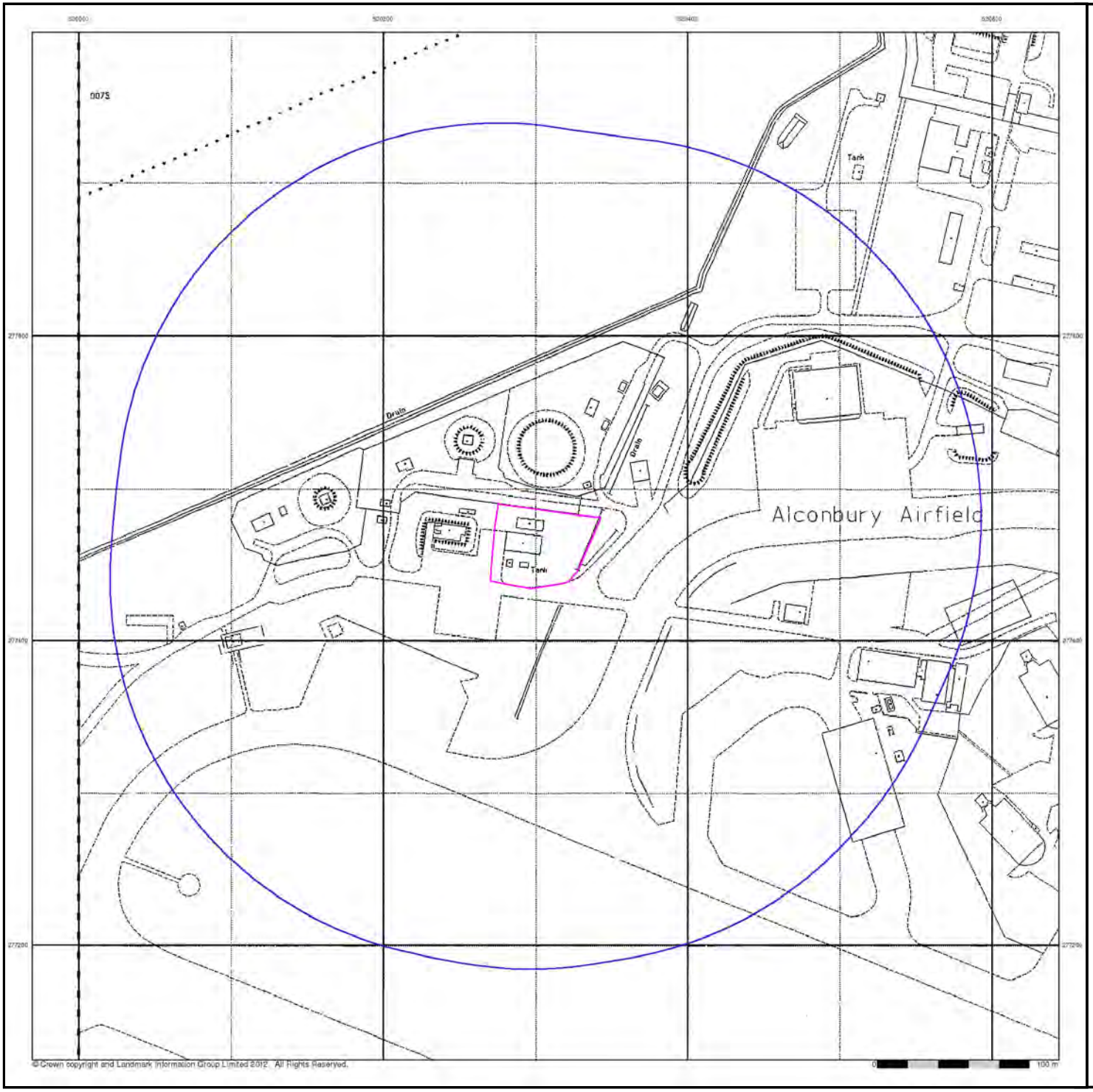

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Large-Scale National Grid Data

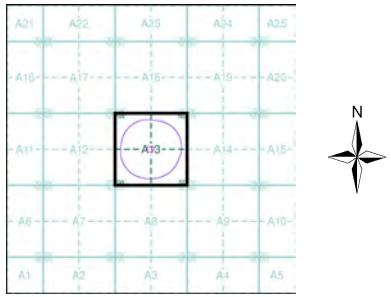
Published 1995

Source map scale - 1:2,500

'Large Scale National Grid Data' superseded SIM cards (Ordnance Survey's 'Survey of Information on Microfilm') in 1992, and continued to be produced until 1999. These maps were the fore-runners of digital mapping and so provide detailed information on houses and roads, but tend to show less topographic features such as vegetation. These maps were produced at both 1:2,500 and 1:1,250 scales.

Map Name(s) and Date(s)

Historical Map - Segment A13



Order Details

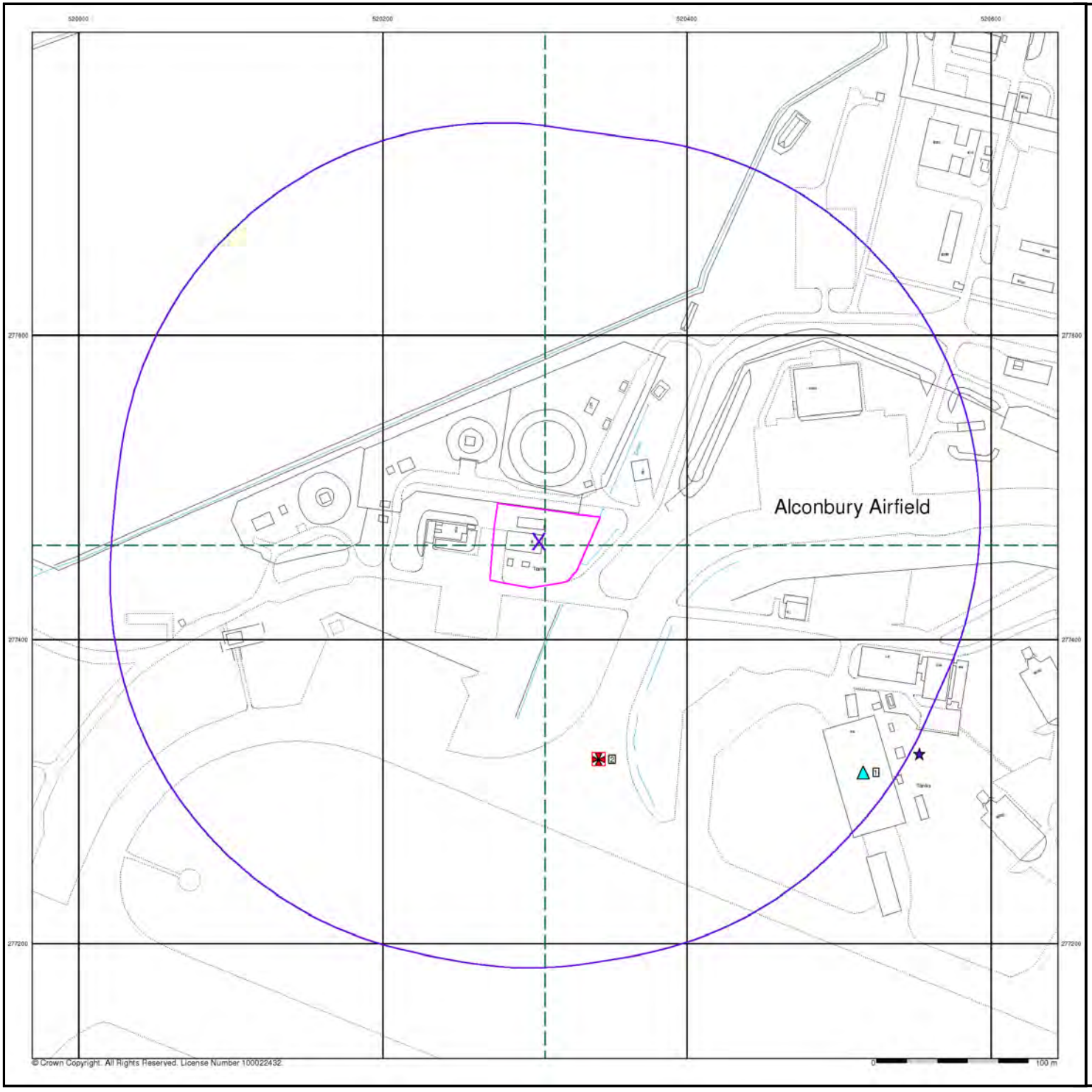
Order Number:	39696597_1_1
Customer Ref:	24213/112
National Grid Reference:	520300, 277460
Slice:	A
Site Area (Ha):	0.31
Search Buffer (m):	250

Site Details

Building 118, Alconbury Airfield, Alconbury, Cambridgeshire

Landmark® Information Group
Tel: 0844 844 9952
Fax: 0844 844 9951
Web: www.envirocheck.co.uk

Appendix 2 - Landmark Envirocheck Report



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General

- Specified Site
- Specified Buffer(s)
- Bearing Reference Point
- Map ID
- Several of Type at Location
- Pylon
- Overhead Transmission Line

Agency and Hydrological

- Contaminated Land Register Entry or Notice (Location)
- Contaminated Land Register Entry or Notice
- Discharge Consent
- Enforcement or Prohibition Notice
- Integrated Pollution Control
- Integrated Pollution Prevention Control
- Local Authority Integrated Pollution Prevention and Control
- Local Authority Pollution Prevention and Control
- Local Authority Pollution Prevention and Control Enforcement
- Pollution Incident to Controlled Waters
- Prosecution Relating to Authorised Processes
- Prosecution Relating to Controlled Waters
- Registered Radioactive Substance
- River Network or Water Feature
- River Quality Sampling Point
- Substantiated Pollution Incident Register
- Water Abstraction
- Water Industry Act Referral

Waste

- BGS Recorded Landfill Site (Location)
- BGS Recorded Landfill Site
- EA Historic Landfill (Buffered Point)
- EA Historic Landfill (Polygon)
- Integrated Pollution Control Registered Waste Site
- Licensed Waste Management Facility (Landfill Boundary)
- Licensed Waste Management Facility (Location)
- Local Authority Recorded Landfill Site (Location)
- Local Authority Recorded Landfill Site
- Registered Landfill Site
- Registered Landfill Site (Location)
- Registered Landfill Site (Point Buffered to 100m)
- Registered Landfill Site (Point Buffered to 250m)
- Registered Waste Transfer Site (Location)
- Registered Waste Transfer Site
- Registered Waste Treatment or Disposal Site (Location)
- Registered Waste Treatment or Disposal Site

Geological

- BGS Recorded Mineral Site

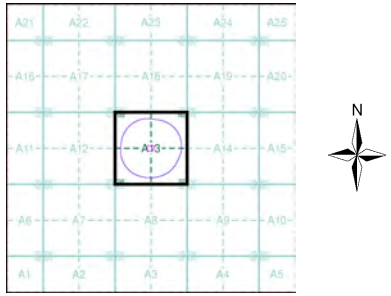
Hazardous Substances

- COMAH Site
- Explosive Site
- NIHHS Site
- Planning Hazardous Substance Consent
- Planning Hazardous Substance Enforcement

Industrial Land Use

- Contemporary Trade Directory Entry
- Fuel Station Entry

Site Sensitivity Map - Segment A13



Order Details

Order Number:	39696597_1_1
Customer Ref:	24213/112
National Grid Reference:	520300, 277460
Slice:	A
Site Area (Ha):	0.31
Plot Buffer (m):	250

Site Details

Building 118, Alconbury Airfield, Alconbury, Cambridgeshire

Landmark Information Group

Tel: 0844 844 9952
Fax: 0844 844 9951
Web: www.envirocheck.co.uk

Envirocheck® Report:

Datasheet

Order Details:

Order Number:
39696597_1_1

Customer Reference:
24213/112

National Grid Reference:
520300, 277460

Slice:
A

Site Area (Ha):
0.31

Search Buffer (m):
500

Site Details:

Building 118
Alconbury Airfield
Alconbury
Cambridgeshire

Client Details:

Mr D Bissell
Brett Consulting Ltd
11 Prospect Court
Courteenhall Road
Blisworth
Northampton
NN7 3DG

Prepared For:

Urban & Civic Alconbury
c/o Savills Commercial Ltd
137 North Gate
Alconbury Airfield
Huntingdon
PE28 4WX

Contents

Introduction

The Environment Act 1995 has made site sensitivity a key issue, as the legislation pays as much attention to the pathways by which contamination could spread, and to the vulnerable targets of contamination, as it does the potential sources of contamination.
For this reason, Landmark's Site Sensitivity maps and Datasheet(s) place great emphasis on statutory data provided by the Environment Agency and the Scottish Environment Protection Agency; it also incorporates data from Natural England (and the Scottish and Welsh equivalents) and Local Authorities; and highlights hydrogeological features required by environmental and geotechnical consultants. It does not include any information concerning past uses of land. The datasheet is produced by querying the Landmark database to a distance defined by the client from a site boundary provided by the client.

In the attached datasheet the National Grid References (NGRs) are rounded to the nearest 10m in accordance with Landmark's agreements with a number of Data Suppliers.

Copyright Notice

Natural England Copyright Notice

Ove Arup Copyright Notice

Peter Brett Associates Copyright Notice

Radon Potential dataset Copyright Notice

Report Version v47.0

Summary

Data Type	Page Number	On Site	0 to 250m	251 to 500m (*up to 1000m)
Agency & Hydrological				
Contaminated Land Register Entries and Notices				
Discharge Consents				
Enforcement and Prohibition Notices				
Integrated Pollution Controls				
Integrated Pollution Prevention And Control				
Local Authority Integrated Pollution Prevention And Control				
Local Authority Pollution Prevention and Controls	pg 1		1	
Local Authority Pollution Prevention and Control Enforcements				
Nearest Surface Water Feature	pg 1	Yes		
Pollution Incidents to Controlled Waters				
Prosecutions Relating to Authorised Processes				
Prosecutions Relating to Controlled Waters				
Registered Radioactive Substances				
River Quality				
River Quality Biology Sampling Points				
River Quality Chemistry Sampling Points				
Substantiated Pollution Incident Register				
Water Abstractions				
Water Industry Act Referrals				
Groundwater Vulnerability	pg 1	Yes	n/a	n/a
Bedrock Aquifer Designations	pg 1	Yes	n/a	n/a
Superficial Aquifer Designations	pg 1	Yes	n/a	n/a
Source Protection Zones				
Extreme Flooding from Rivers or Sea without Defences				n/a
Flooding from Rivers or Sea without Defences				n/a
Areas Benefiting from Flood Defences				n/a
Flood Water Storage Areas				n/a
Flood Defences				n/a
Waste				
BGS Recorded Landfill Sites				
Historical Landfill Sites				
Integrated Pollution Control Registered Waste Sites				
Licensed Waste Management Facilities (Landfill Boundaries)				
Licensed Waste Management Facilities (Locations)				
Local Authority Recorded Landfill Sites				
Registered Landfill Sites				
Registered Waste Transfer Sites				
Registered Waste Treatment or Disposal Sites				

Summary

Data Type	Page Number	On Site	0 to 250m	251 to 500m (*up to 1000m)
Hazardous Substances				
Control of Major Accident Hazards Sites (COMAH)				
Explosive Sites	pg 3		2	1
Notification of Installations Handling Hazardous Substances (NIHHS)				
Planning Hazardous Substance Consents				
Planning Hazardous Substance Enforcements				
Geological				
BGS 1:625,000 Solid Geology	pg 4	Yes	n/a	n/a
BGS Estimated Soil Chemistry	pg 4	Yes		Yes
BGS Recorded Mineral Sites				
BGS Urban Soil Chemistry				
BGS Urban Soil Chemistry Averages				
Brine Compensation Area			n/a	n/a
Coal Mining Affected Areas			n/a	n/a
Mining Instability			n/a	n/a
Man-Made Mining Cavities				
Natural Cavities				
Non Coal Mining Areas of Great Britain				n/a
Potential for Collapsible Ground Stability Hazards	pg 4	Yes		n/a
Potential for Compressible Ground Stability Hazards				n/a
Potential for Ground Dissolution Stability Hazards				n/a
Potential for Landslide Ground Stability Hazards	pg 4	Yes		n/a
Potential for Running Sand Ground Stability Hazards	pg 4	Yes		n/a
Potential for Shrinking or Swelling Clay Ground Stability Hazards	pg 4	Yes		n/a
Radon Potential - Radon Affected Areas			n/a	n/a
Radon Potential - Radon Protection Measures			n/a	n/a
Industrial Land Use				
Contemporary Trade Directory Entries				n/a
Fuel Station Entries				

Summary

Data Type	Page Number	On Site	0 to 250m	251 to 500m (*up to 1000m)
Sensitive Land Use				
Areas of Adopted Green Belt				
Areas of Unadopted Green Belt				
Areas of Outstanding Natural Beauty				
Environmentally Sensitive Areas				
Forest Parks				
Local Nature Reserves				
Marine Nature Reserves				
National Nature Reserves				
National Parks				
Nitrate Sensitive Areas				
Nitrate Vulnerable Zones	pg 6	1		
Ramsar Sites				
Sites of Special Scientific Interest				
Special Areas of Conservation				
Special Protection Areas				

Map ID	Details	Quadrant Reference (Compass Direction)	Estimated Distance From Site	Contact	NGR
1	**Local Authority Pollution Prevention and Controls** Name: Inside Track Location: Unit 94 Alconbury Airfield, Alconbury, Huntingdon, Pe28 4wx Authority: Huntingdonshire District Council, Environmental Health Services Permit Reference: B01/01 Dated: 21st May 2001 Process Type: Local Authority Air Pollution Control Description: PG6/34 Respraying of road vehicles **Status: Authorised** Positional Accuracy: Located by supplier to within 10m	A13SE (SE)	232	1	520516 277311
	Nearest Surface Water Feature	A13SE (SE)	0	-	520331 277452
	Groundwater Vulnerability Soil Classification: Not classified Map Sheet: Sheet 31 Bedfordshire Scale: 1:100,000	A13NW (SE)	0	2	520303 277464
	Drift Deposits None				
	Bedrock Aquifer Designations Aquifer Desination: Unproductive Strata	A13NW (SE)	0	3	520303 277464
	Superficial Aquifer Designations Aquifer Designation: Unproductive Strata	A13NW (SE)	0	3	520303 277464
	Extreme Flooding from Rivers or Sea without Defences None				
	Flooding from Rivers or Sea without Defences None				
	Areas Benefiting from Flood Defences None				
	Flood Water Storage Areas None				
	Flood Defences None				

Map ID	Details	Quadrant Reference (Compass Direction)	Estimated Distance From Site	Contact	NGR
	Local Authority Landfill Coverage Name: Huntingdonshire District Council - Has no landfill data to supply		0	1	520303 277464
	Local Authority Landfill Coverage Name: Cambridgeshire County Council - Has not been able to supply Landfill data		0	8	520303 277464

Hazardous Substances

Map ID	Details	Quadrant Reference (Compass Direction)	Estimated Distance From Site	Contact	NGR
2	**Explosive Sites** Name: Nightstar Fireworks Ltd Location: The Old Bomb Dump, Alconbury Airfield, Huntingdon, Cambridgeshire **Status:** **Active** Positional Accuracy: Manually positioned within the geographical locality	A13SE (S)	112	4	520340 277328
2	**Explosive Sites** Name: Garden Products Ltd Location: Alconbury Airfield, Huntingdon, Cambridgeshire **Status:** **Active** Positional Accuracy: Manually positioned within the geographical locality	A13SE (S)	119	4	520342 277321
3	**Explosive Sites** Name: Alconbury Airfield / Nightstar Fireworks Limited Location: Bunker 3031, Alconbury Airfield, Huntingdon, Cambs, Pe28 **Status:** **Active** Positional Accuracy: Manually positioned to the address or location	A14SW (SE)	465	4	520737 277226

Map ID	Details	Quadrant Reference (Compass Direction)	Estimated Distance From Site	Contact	NGR
	BGS 1:625,000 Solid Geology Description: Oxford Clay and Kellaways Beds	A13NW (SE)	0	3	520303 277464
	BGS Estimated Soil Chemistry Source: British Geological Survey, National Geoscience Information Service Soil Sample Type: Rural Soil Arsenic Concentration: 15 - 25 mg/kg Cadmium Concentration: <1.8 mg/kg Chromium Concentration: 60 - 90 mg/kg Lead Concentration: <150 mg/kg Nickel Concentration: 30 - 45 mg/kg	A13NW (SE)	0	5	520303 277464
	BGS Estimated Soil Chemistry Source: British Geological Survey, National Geoscience Information Service Soil Sample Type: Rural Soil Arsenic Concentration: 15 - 25 mg/kg Cadmium Concentration: <1.8 mg/kg Chromium Concentration: 60 - 90 mg/kg Lead Concentration: <150 mg/kg Nickel Concentration: 30 - 45 mg/kg	A13NW (W)	271	5	520000 277464
	BGS Estimated Soil Chemistry Source: British Geological Survey, National Geoscience Information Service Soil Sample Type: Rural Soil Arsenic Concentration: 15 - 25 mg/kg Cadmium Concentration: <1.8 mg/kg Chromium Concentration: 60 - 90 mg/kg Lead Concentration: <150 mg/kg Nickel Concentration: 30 - 45 mg/kg	A8NW (S)	434	5	520303 277000
	BGS Measured Urban Soil Chemistry No data available				
	BGS Urban Soil Chemistry Averages No data available				
	Coal Mining Affected Areas In an area that might not be affected by coal mining				
	Non Coal Mining Areas of Great Britain No Hazard				
	Potential for Collapsible Ground Stability Hazards Hazard Potential: Very Low Source: British Geological Survey, National Geoscience Information Service	A13NW (SE)	0	3	520303 277464
	Potential for Compressible Ground Stability Hazards Hazard Potential: No Hazard Source: British Geological Survey, National Geoscience Information Service	A13NW (SE)	0	3	520303 277464
	Potential for Ground Dissolution Stability Hazards No Hazard				
	Potential for Landslide Ground Stability Hazards Hazard Potential: Very Low Source: British Geological Survey, National Geoscience Information Service	A13NW (SE)	0	3	520303 277464
	Potential for Running Sand Ground Stability Hazards Hazard Potential: Very Low Source: British Geological Survey, National Geoscience Information Service	A13NW (SE)	0	3	520303 277464
	Potential for Shrinking or Swelling Clay Ground Stability Hazards Hazard Potential: Low Source: British Geological Survey, National Geoscience Information Service	A13NW (SE)	0	3	520303 277464
	Radon Potential - Radon Protection Measures Protection Measure: No radon protective measures are necessary in the construction of new dwellings or extensions Source: British Geological Survey, National Geoscience Information Service	A13NW (SE)	0	3	520303 277464

Map ID	Details	Quadrant Reference (Compass Direction)	Estimated Distance From Site	Contact	NGR
	Radon Potential - Radon Affected Areas Affected Area: The property is in a lower probability radon area, as less than 1% of homes are above the action level Source: British Geological Survey, National Geoscience Information Service	A13NW (SE)	0	3	520303 277464

Sensitive Land Use

Map ID	Details	Quadrant Reference (Compass Direction)	Estimated Distance From Site	Contact	NGR
4	**Nitrate Vulnerable Zones** Name: Not Supplied Description: NVZ Area Source: Department for Environment, Food and Rural Affairs (DEFRA - formerly FRCA)	A13NW (SE)	0	7	520303 277464

Data Currency

Agency & Hydrological	Version	Update Cycle
Contaminated Land Register Entries and Notices Huntingdonshire District Council - Environmental Health Services	April 2012	Annual Rolling Update
Discharge Consents Environment Agency - Anglian Region	April 2012	Quarterly
Enforcement and Prohibition Notices Environment Agency - Anglian Region	June 2012	Quarterly
Integrated Pollution Controls Environment Agency - Anglian Region	October 2008	Not Applicable
Integrated Pollution Prevention And Control Environment Agency - Anglian Region	April 2012	Quarterly
Local Authority Integrated Pollution Prevention And Control Huntingdonshire District Council - Environmental Health Services	May 2012	Annual Rolling Update
Local Authority Pollution Prevention and Controls Huntingdonshire District Council - Environmental Health Services	June 2011	Annual Rolling Update
Local Authority Pollution Prevention and Control Enforcements Huntingdonshire District Council - Environmental Health Services	May 2012	Annual Rolling Update
Nearest Surface Water Feature Ordnance Survey	December 2011	Quarterly
Pollution Incidents to Controlled Waters Environment Agency - Anglian Region	September 1999	Not Applicable
Prosecutions Relating to Authorised Processes Environment Agency - Anglian Region	June 2012	Monthly
Prosecutions Relating to Controlled Waters Environment Agency - Anglian Region	June 2012	Monthly
Registered Radioactive Substances Environment Agency - Anglian Region	April 2012	Quarterly
River Quality Environment Agency - Head Office	November 2001	Not Applicable
River Quality Biology Sampling Points Environment Agency - Head Office	January 2011	Annually
River Quality Chemistry Sampling Points Environment Agency - Head Office	January 2011	Annually
Substantiated Pollution Incident Register Environment Agency - Anglian Region - Central Area	April 2012	Quarterly
Water Abstractions Environment Agency - Anglian Region	April 2012	Quarterly
Water Industry Act Referrals Environment Agency - Anglian Region	January 2012	Quarterly
Groundwater Vulnerability Environment Agency - Head Office	January 2011	Not Applicable
Drift Deposits Environment Agency - Head Office	January 1999	Not Applicable
Bedrock Aquifer Designations British Geological Survey - National Geoscience Information Service	September 2011	Annually
Superficial Aquifer Designations British Geological Survey - National Geoscience Information Service	September 2011	Annually
Source Protection Zones Environment Agency - Head Office	April 2012	Quarterly
Extreme Flooding from Rivers or Sea without Defences Environment Agency - Head Office	May 2012	Quarterly

Data Currency

Agency & Hydrological	Version	Update Cycle
Flooding from Rivers or Sea without Defences		
Environment Agency - Head Office	May 2012	Quarterly
Areas Benefiting from Flood Defences		
Environment Agency - Head Office	May 2012	Quarterly
Flood Water Storage Areas		
Environment Agency - Head Office	May 2012	Quarterly
Flood Defences		
Environment Agency - Head Office	May 2012	Quarterly
Waste	**Version**	**Update Cycle**
BGS Recorded Landfill Sites		
British Geological Survey - National Geoscience Information Service	June 1996	Not Applicable
Historical Landfill Sites		
Environment Agency - Anglian Region - Central Area	January 2012	Quarterly
Integrated Pollution Control Registered Waste Sites		
Environment Agency - Anglian Region	October 2008	Not Applicable
Licensed Waste Management Facilities (Landfill Boundaries)		
Environment Agency - Anglian Region - Central Area	April 2012	Quarterly
Licensed Waste Management Facilities (Locations)		
Environment Agency - Anglian Region - Central Area	April 2012	Quarterly
Local Authority Landfill Coverage		
Cambridgeshire County Council	May 2000	Not Applicable
Huntingdonshire District Council - Environmental Health Services	May 2000	Not Applicable
Local Authority Recorded Landfill Sites		
Cambridgeshire County Council	May 2000	Not Applicable
Huntingdonshire District Council - Environmental Health Services	May 2000	Not Applicable
Registered Landfill Sites		
Environment Agency - Anglian Region - Central Area	March 2003	Not Applicable
Registered Waste Transfer Sites		
Environment Agency - Anglian Region - Central Area	March 2003	Not Applicable
Registered Waste Treatment or Disposal Sites		
Environment Agency - Anglian Region - Central Area	March 2003	Not Applicable
Hazardous Substances	**Version**	**Update Cycle**
Control of Major Accident Hazards Sites (COMAH)		
Health and Safety Executive	May 2012	Bi-Annually
Explosive Sites		
Health and Safety Executive	December 2011	Bi-Annually
Notification of Installations Handling Hazardous Substances (NIHHS)		
Health and Safety Executive	November 2000	Not Applicable
Planning Hazardous Substance Enforcements		
Huntingdonshire District Council	August 2011	Annual Rolling Update
Cambridgeshire County Council	December 2011	Annual Rolling Update
Planning Hazardous Substance Consents		
Huntingdonshire District Council	August 2011	Annual Rolling Update
Cambridgeshire County Council	December 2011	Annual Rolling Update

Data Currency

Geological	Version	Update Cycle
BGS 1:625,000 Solid Geology British Geological Survey - National Geoscience Information Service	August 1996	Not Applicable
BGS Estimated Soil Chemistry British Geological Survey - National Geoscience Information Service	January 2010	Variable
BGS Recorded Mineral Sites British Geological Survey - National Geoscience Information Service	April 2012	Bi-Annually
Brine Compensation Area Cheshire Brine Subsidence Compensation Board	August 2011	Not Applicable
Coal Mining Affected Areas The Coal Authority - Mining Report Service	August 2011	As notified
Mining Instability Ove Arup & Partners	October 2000	Not Applicable
Non Coal Mining Areas of Great Britain British Geological Survey - National Geoscience Information Service	February 2011	Not Applicable
Potential for Collapsible Ground Stability Hazards British Geological Survey - National Geoscience Information Service	February 2011	Annually
Potential for Compressible Ground Stability Hazards British Geological Survey - National Geoscience Information Service	February 2011	Annually
Potential for Ground Dissolution Stability Hazards British Geological Survey - National Geoscience Information Service	February 2011	Annually
Potential for Landslide Ground Stability Hazards British Geological Survey - National Geoscience Information Service	February 2011	Annually
Potential for Running Sand Ground Stability Hazards British Geological Survey - National Geoscience Information Service	February 2011	Annually
Potential for Shrinking or Swelling Clay Ground Stability Hazards British Geological Survey - National Geoscience Information Service	February 2011	Annually
Radon Potential - Radon Affected Areas British Geological Survey - National Geoscience Information Service	July 2011	As notified
Radon Potential - Radon Protection Measures British Geological Survey - National Geoscience Information Service	July 2011	As notified
Industrial Land Use	**Version**	**Update Cycle**
Contemporary Trade Directory Entries Thomson Directories	May 2012	Quarterly
Fuel Station Entries Catalist Ltd - Experian	February 2012	Quarterly

Data Currency

Sensitive Land Use	Version	Update Cycle
Areas of Outstanding Natural Beauty Natural England	February 2012	Bi-Annually
Environmentally Sensitive Areas Natural England	February 2012	Annually
Forest Parks Forestry Commission	April 1997	Not Applicable
Local Nature Reserves Natural England	February 2012	Bi-Annually
Marine Nature Reserves Natural England	February 2012	Bi-Annually
National Nature Reserves Natural England	February 2012	Bi-Annually
National Parks Natural England	February 2012	Bi-Annually
Nitrate Sensitive Areas Department for Environment, Food and Rural Affairs (DEFRA - formerly FRCA)	February 2012	Not Applicable
Nitrate Vulnerable Zones Department for Environment, Food and Rural Affairs (DEFRA - formerly FRCA)	February 2012	Annually
Ramsar Sites Natural England	February 2012	Bi-Annually
Sites of Special Scientific Interest Natural England	February 2012	Bi-Annually
Special Areas of Conservation Natural England	February 2012	Bi-Annually
Special Protection Areas Natural England	February 2012	Bi-Annually

Data Suppliers

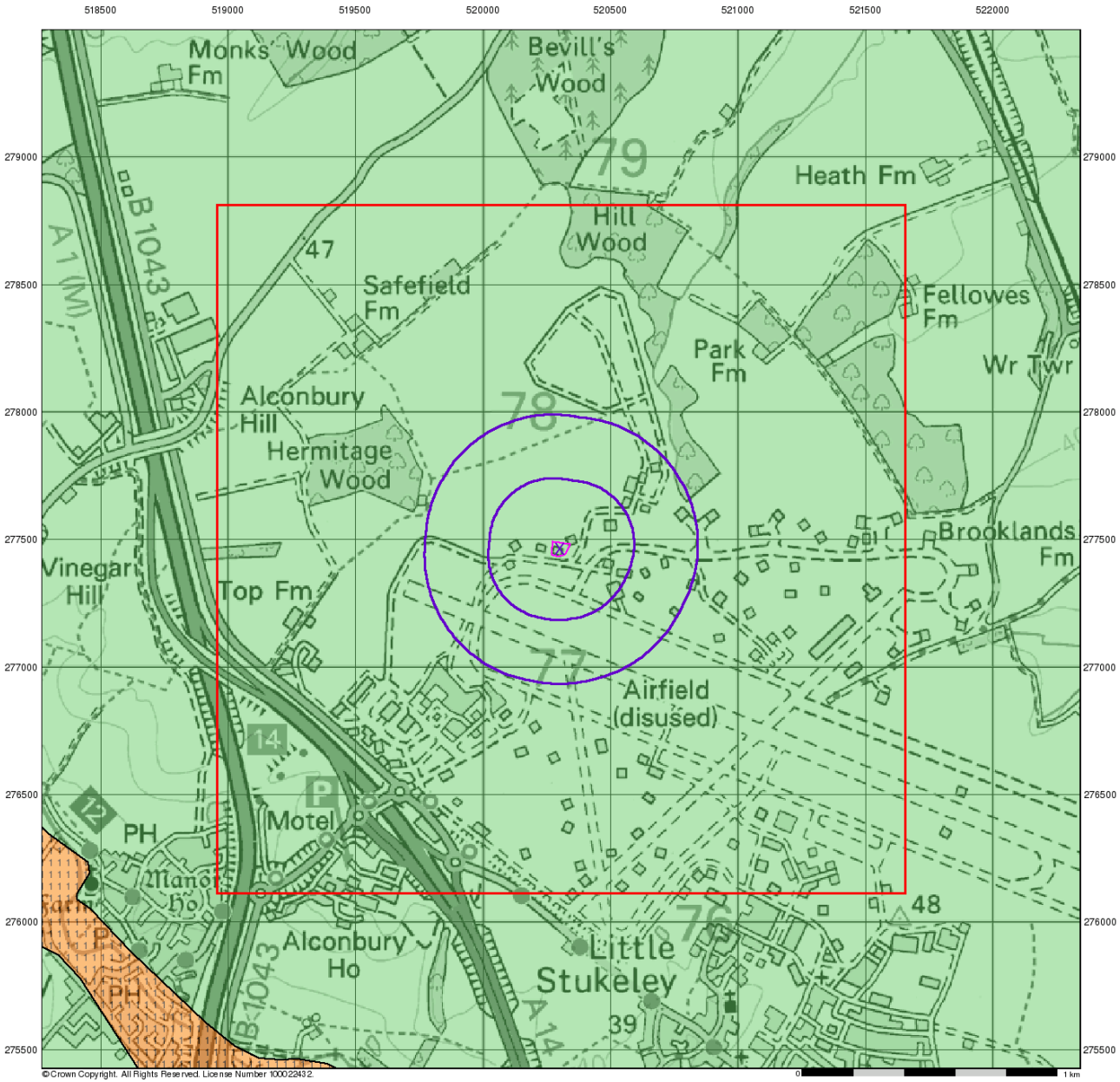
A selection of organisations who provide data within this report

Data Supplier	Data Supplier Logo
Ordnance Survey	
Environment Agency	
Scottish Environment Protection Agency	
The Coal Authority	
British Geological Survey	
Centre for Ecology and Hydrology	
Countryside Council for Wales	
Scottish Natural Heritage	
Natural England	
Health Protection Agency	
Ove Arup	
Peter Brett Associates	

Useful Contacts

Contact	Name and Address	Contact Details
1	**Huntingdonshire District Council - Environmental Health Services** Pathfinder House, St Mary's Street, Huntingdon, Cambridgeshire, PE29 3TN	Telephone: 01480 388312 Fax: 01480 388099 Website: www.huntsdc.gov.uk
2	**Environment Agency - National Customer Contact Centre (NCCC)** PO Box 544, Templeborough, Rotherham, S60 1BY	Telephone: 08708 506 506 Email: enquiries@environment-agency.gov.uk
3	**British Geological Survey - Enquiry Service** British Geological Survey, Kingsley Dunham Centre, Keyworth, Nottingham, Nottinghamshire, NG12 5GG	Telephone: 0115 936 3143 Fax: 0115 936 3276 Email: enquiries@bgs.ac.uk Website: www.bgs.ac.uk
4	**Health and Safety Executive** Explosives Inspectorate, 1.2 Redgrave Court, Merton Road, Bootle, L20 7HS	Telephone: 0151 951 3092 Fax: 0151 951 3891 Email: victoria.holloway@hse.gsi.go.uk Website: www.hse.gov.uk
5	**Landmark Information Group Limited** 5 - 7 Abbey Court, Eagle Way, Sowton, Exeter, Devon, EX2 7HY	Telephone: 01392 441761 Fax: 01392 441709 Email: cssupport@landmarkinfo.co.uk Website: www.landmarkinfo.co.uk
6	**Natural England** Northminster House, Northminster Road, Peterborough, Cambridgeshire, PE1 1UA	Telephone: 0845 600 3078 Fax: 01733 455103 Email: enquiries@naturalengland.org.uk Website: www.naturalengland.org.uk
7	**Department for Environment, Food and Rural Affairs (DEFRA - formerly FRCA)** Government Buildings, Otley Road, Lawnswood, Leeds, West Yorkshire, LS16 5QT	Telephone: 0113 2613333 Fax: 0113 230 0879
8	**Cambridgeshire County Council** Shire Hall, Castle Hill, Cambridge, Cambridgeshire, CB3 OAP	Telephone: 01223 717111 Fax: 01223 717201 Website: www.camcnty.gov.uk
-	**Health Protection Agency - Radon Survey, Centre for Radiation, Chemical and Environmental Hazards** Chilton, Didcot, Oxfordshire, OX11 0RQ	Telephone: 01235 822622 Fax: 01235 833891 Email: radon@hpa.org.uk Website: www.hpa.org.uk
-	**Landmark Information Group Limited** The Smith Centre, Henley On Thames, Oxfordshire, RG9 6AB	Telephone: 0844 844 9952 Fax: 0844 844 9951 Email: customerservices@landmarkinfo.co.uk Website: www.landmarkinfo.co.uk

Please note that the Environment Agency / SEPA have a charging policy in place for enquiries.



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Groundwater Vulnerability

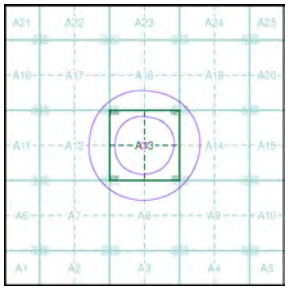
General

Specified Site | Specified Buffer(s) | Bearing Reference Point | Slice | Map ID

Agency and Hydrological

Geological Classes	Soil Classes
Major Aquifer (Highly Permeable)	High (H) 1, 2, 3, U
	Intermediate (I) 1, 2
	Low
Minor Aquifer (Variably Permeable)	High (H) 1, 2, 3, U
	Intermediate (I) 1, 2
	Low
Non Aquifer (Negligibly Permeable)	
Water or Sea	
Drift Deposit	

Site Sensitivity Context Map - Slice A



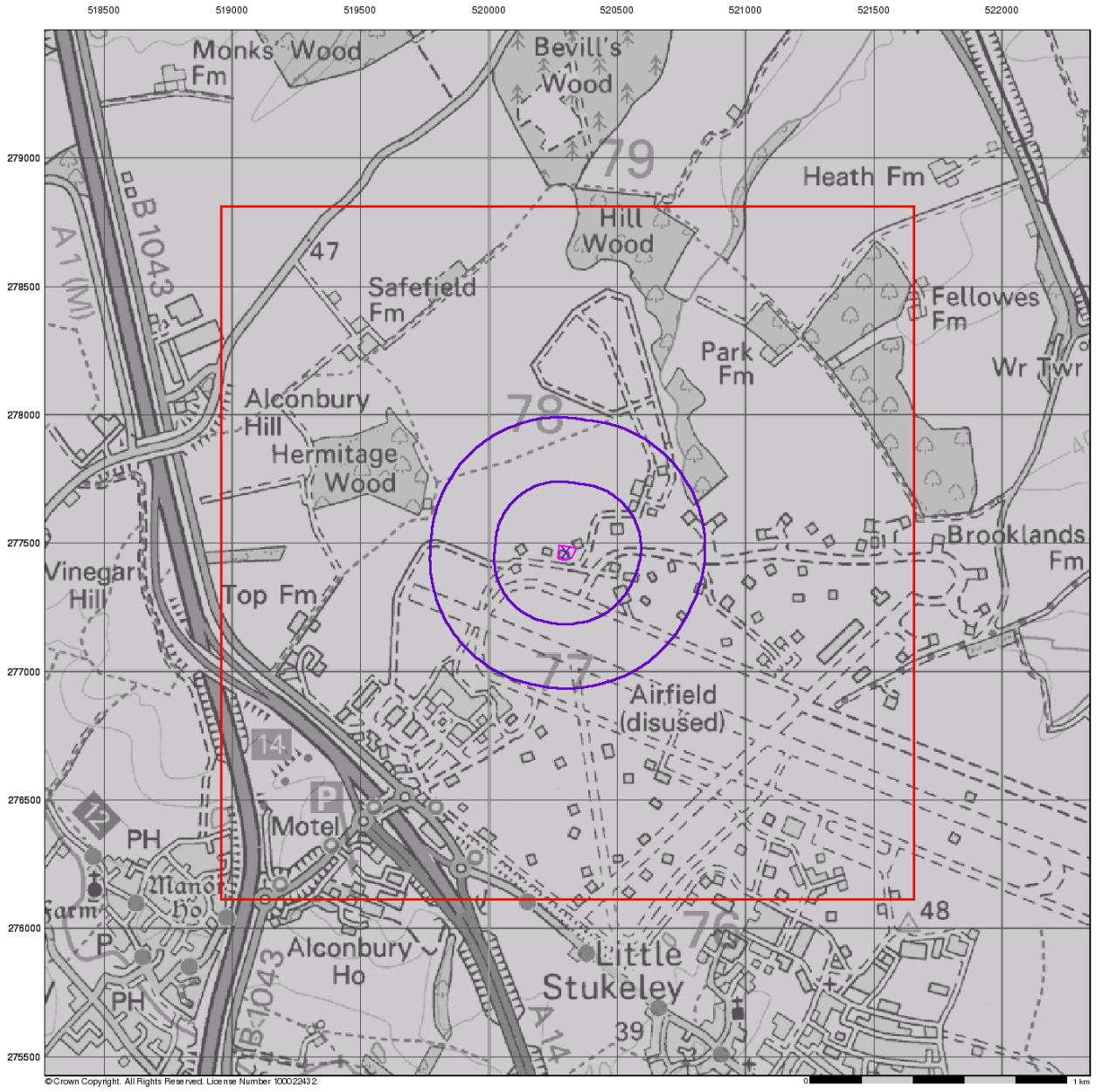
Order Details

Order Number:	39696597_1_1
Customer Ref:	24213/112
National Grid Reference:	520300, 277460
Slice:	A
Site Area (Ha):	0.31
Search Buffer (m):	500

Site Details

Building 118, Alconbury Airfield, Alconbury, Cambridgeshire

Landmark Information Group
Tel: 0844 844 9952
Fax: 0844 844 9951
Web: www.envirocheck.co.uk



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Bedrock Aquifer Designation

General

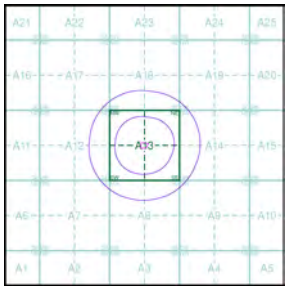
Specified Site | Specified Buffer(s) | Bearing Reference Point | Slice | Map ID

Agency and Hydrological

Geological Classes

- Principal Aquifer
- Secondary A Aquifer
- Secondary B Aquifer
- Secondary Undifferentiated
- Unproductive Strata
- Unknown

Site Sensitivity Context Map - Slice A

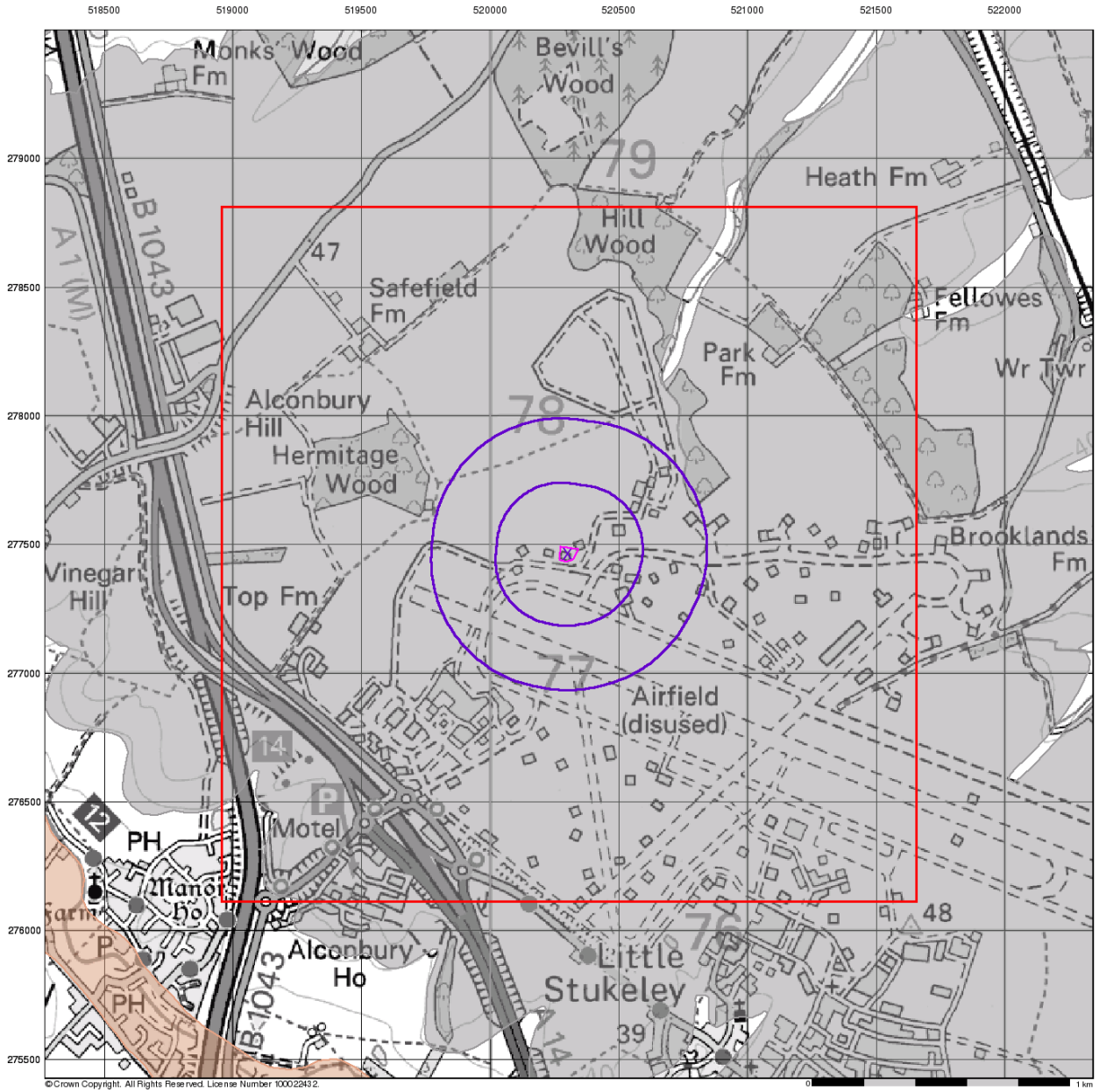


Order Details

Order Number:	39696597_1_1
Customer Ref:	24213/112
National Grid Reference:	520300, 277460
Slice:	A
Site Area (Ha):	0.31
Search Buffer (m):	500

Site Details

Building 118, Alconbury Airfield, Alconbury, Cambridgeshire



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Superficial Aquifer Designation

General

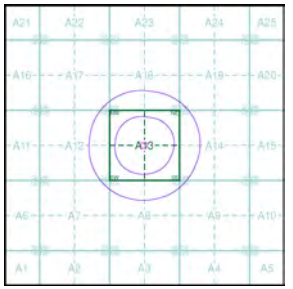
Specified Site | Specified Buffer(s) | Bearing Reference Point | Slice | Map ID

Agency and Hydrological

Geological Classes

- Principal Aquifer
- Secondary A Aquifer
- Secondary B Aquifer
- Secondary Undifferentiated
- Unproductive Strata
- Unknown

Site Sensitivity Context Map - Slice A



Order Details

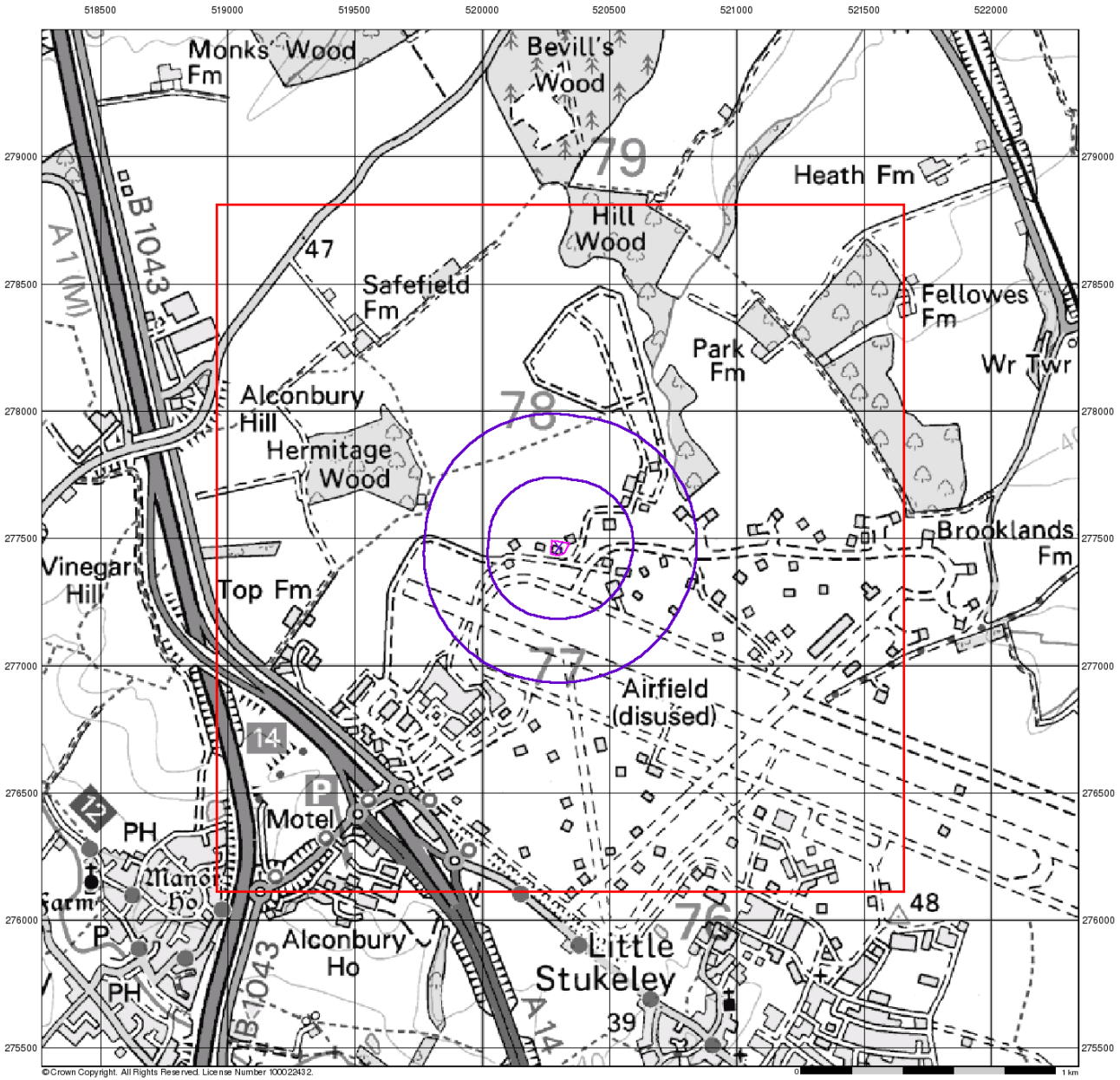
Order Number:	39696597_1_1
Customer Ref:	24213/112
National Grid Reference:	520300, 277460
Slice:	A
Site Area (Ha):	0.31
Search Buffer (m):	500

Site Details

Building 118, Alconbury Airfield, Alconbury, Cambridgeshire

Landmark Information Group

Tel: 0844 844 9952
Fax: 0844 844 9951
Web: www.envirocheck.co.uk



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Source Protection Zones

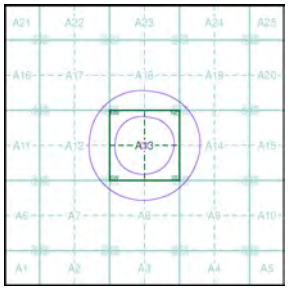
General

Specified Site | Specified Buffer(s) | Bearing Reference Point | Slice | Map ID

Agency and Hydrological

- Source Protection Zone I
- Source Protection Zone II
- Source Protection Zone III
- Zone of Special Interest
- Source Protection Zone Borehole

Site Sensitivity Context Map - Slice A



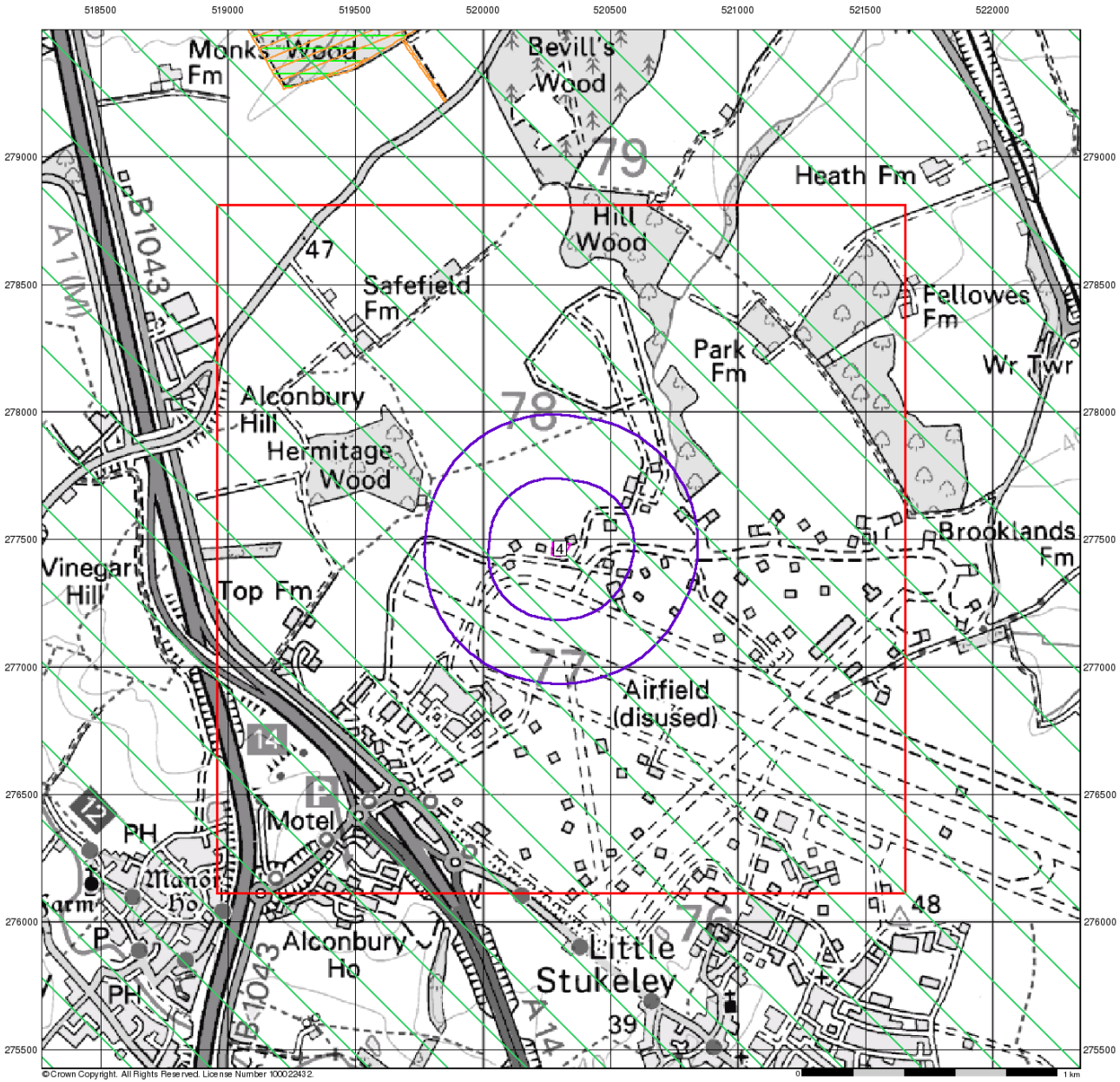
Order Details

Order Number:	39696597_1_1
Customer Ref:	24213/112
National Grid Reference:	520300, 277460
Slice:	A
Site Area (Ha):	0.31
Search Buffer (m):	500

Site Details

Building 118, Alconbury Airfield, Alconbury, Cambridgeshire

Landmark Information Group
Tel: 0844 844 9952
Fax: 0844 844 9951
Web: www.envirocheck.co.uk



pba peterbrett

Sensitive Land Uses

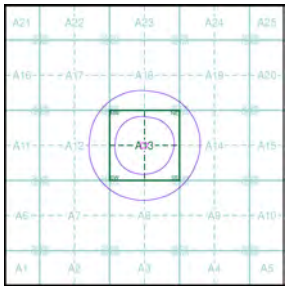
General

Specified Site | Specified Buffer(s) | Bearing Reference Point | Slice | Map ID

Sensitive Land Uses

- Area of Adopted Green Belt
- Area of Unadopted Green Belt
- Area of Outstanding Natural Beauty
- Environmentally Sensitive Area
- Forest Park
- Local Nature Reserve
- Marine Nature Reserve
- National Nature Reserve
- National Park
- Nitrate Sensitive Area
- Nitrate Vulnerable Zone
- Ramsar Site
- Site of Special Scientific Interest
- Special Area of Conservation
- Special Protection Area

Site Sensitivity Context Map - Slice A



Order Details

Order Number:	39696597_1_1
Customer Ref:	24213/112
National Grid Reference:	520300, 277460
Slice:	A
Site Area (Ha):	0.31
Search Buffer (m):	500

Site Details

Building 118, Alconbury Airfield, Alconbury, Cambridgeshire

Landmark Information Group
Tel: 0844 844 9952
Fax: 0844 844 9951
Web: www.envirocheck.co.uk

Appendix 3 - ‘Terrier’ Mini Percussion Sampling Rig Information Sheet

THE TERRIER MINI PERCUSSION SAMPLING RIG

The Terrier rig is a track mounted dynamic sampling system, designed to retrieve high quality soil samples for geotechnical and geoenvironmental investigations. The Terrier can also carry out in situ testing and instrumentation.

The Terrier is self-contained and the mast can be detached from the tracked chassis where access is restricted.

Applications:

- Borehole formation up to 12.00m.
- Casing facility up to 6.00m.
- Surface coring ability of 152mm in concrete and tar macadam.
- Diesel rig fitted with both Chalwyn valve and spark arrestor for explosive environments.

Sampling:

- Continuous dynamic sampling up to 113mm diameter, retained and sealed in a semi-rigid plastic liner
- Traditional 70mm samples can be taken.

In-situ testing:

- SPT's in general accordance to BS EN ISO 22476-3
- Dynamic probing

Instrumentation:

- Installation of standpipes for groundwater or gas monitoring
- Installation of biaxial inclinometer tubing
- Installation of Pneumatic, hydraulic or vibrating wire Piezometers

Dimensions:

- Tracking Width: 0.85m
- Detached Mast Width: 0.65m
- Operational length: 2.50m
- Operational width: 1.20m (with support legs extended)
- Operational height: 2.90

For further details please contact: Chris Morgan chris.morgan@geoeng.co.uk
Or visit our website www.geoeng.co.uk

Geotechnical Engineering Limited, Centurion House, Olympus Park, Quedgeley, Gloucester. GL2 4NF
Tel: 01452 527743

Appendix 4 - Borehole Records

Project	Date		BOREHOLE No
Alconbury Airfield - Building 118	Start: 17-05-12 Finish: 17-05-12		**BH118/01**
Job No 24213/112	Ground Level (m OD_approx) 46.90		
Client Urban and Civic Alconbury	Coordinates (NGR_interpolated) 520290.0 , 277453.0	All dimensions in metres Scale 1:40	Sheet 1 of 1

SAMPLES & TESTS					Water	STRATA			Instrument/ Backfill
Sample Depth (m)	Sample Type	Test Depth (m)	Test Type	Test Result		Legend	Depth (Thickness) (m)	DESCRIPTION	
0.20	S						0.25	Grass over firm and soft dark brown friable organic CLAY with frequent rootlets. [Topsoil].	
							0.55	Firm friable orange brown CLAY. [Weathered Glacial Till].	
1.20	S				1		(2.45)	Firm light orange brown and grey mottled slightly gravelly CLAY. Gravel comprises fine to coarse, sub-rounded weathered chalk and occasional angular flint. Rare weak chalk cobble. [Weathered Glacial Till]. 1.20 - 3.00 Becoming stiff.	
2.00	S						3.00		
3.50	S				1		(1.85)	Very stiff dark grey brown slightly gravelly CLAY. Gravel comprises fine to coarse, sub-rounded chalk. [Glacial Till].	
							4.85	End of Borehole at 4.85m	

Boring Progress and Water Observations

Date	Time	Depth (m)	Casing Depth (m)	Casing Dia. mm	Water
					Strike at 1.9 rising to 4.65

Chiselling

From	To	Hours

General Remarks

Position cleared by contractor using a CAT Service pit excavated to 1.2m bgl
Groundwater seepage at 1.9m bgl
Refusal at 4.85m with sample barrell
Borehole backfilled with arisings

Contractor	Method/ Plant Used		Checked By	
Geotechnical Eng. Ltd	Terrier Mini Percussion Samplin Rig - Dynamic Sampling		Logged By	DBi JG

Project	Alconbury Airfield - Building 118	Date	Start: 17-05-12 Finish: 17-05-12		BOREHOLE No **BH118/02**
Job No	24213/112	Ground Level (m OD_approx)	46.95		
Client	Urban and Civic Alconbury	Coordinates (NGR_interpolated)	520318.0 , 277467.0	All dimensions in metres Scale 1:40	Sheet 1 of 1

SAMPLES & TESTS					Water	STRATA			Instrument/ Backfill
Sample Depth (m)	Sample Type	Test Depth (m)	Test Type	Test Result		Legend	Depth (Thickness) (m)	DESCRIPTION	
							0.20	Grass over firm dark brown organic CLAY with frequent rootlets. [Topsoil].	
0.25	S						0.40	MADE GROUND: Firm friable dark brown to orange brown clay	
							(1.00)	MADE GROUND: Soft grey and orange brown gravelly clay. Gravel comprises fine to coarse, sub-rounded weathered chalk and rare flint	
1.20	S				▼		1.40		
							1.50	MADE GROUND: Cobbles and fine to coarse sub-angular to angular gravel sized fragments of red brick and ceramics	
2.00	S						(1.90)	Firm friable grey and orange brown mottled friable gravelly CLAY. Gravel comprises fine to coarse, sub-angular chalk. [Weathered Glacial Till]. 2.00 - 3.40 Becoming stiff.	
3.20	S						3.40		
							3.50	Orange brown dense slightly clayey fine SAND. [Glacial Till - Sand Lens/Band].	
							(0.35)		
							3.85	Very stiff fissured grey brown locally discoloured orange-brown slightly gravelly CLAY. Gravel comprises fine, sub-rounded to rounded chalk. [Glacial Till].	
								End of Borehole at 3.85m	

Boring Progress and Water Observations

Date	Time	Depth (m)	Casing Depth (m)	Casing Dia. mm	Water
					Strike at 1.2

Chiselling

From	To	Hours

General Remarks

Position cleared by contractor using a CAT Service pit excavated to 1.2m bgl
Slight groundwater seepage within base of hand dug pit at 1.2m bgl
Refusal at 3.85m with sample barrell
Borehole backfilled with arisings

Contractor	Method/ Plant Used		Checked By	
Geotechnical Eng. Ltd	Terrier Mini Percussion Samplin Rig - Dynamic Sampling		Logged By	DBi JG

PBA STD BH LOG LOGS.GPJ PBA_TEMPLATE_SEP08.GDT 2/7/12

Project	Date		BOREHOLE No
Alconbury Airfield - Building 118	Start: 17-05-12 Finish: 17-05-12		**BH118/03**
Job No 24213/112	Ground Level (m OD_approx) 46.75		
Client Urban and Civic Alconbury	Coordinates (NGR_interpolated) 520286.0 , 277480.0	All dimensions in metres Scale 1:40	Sheet 1 of 1

SAMPLES & TESTS					Water	STRATA			Instrument/ Backfill
Sample Depth (m)	Sample Type	Test Depth (m)	Test Type	Test Result		Legend	Depth (Thickness) (m)	DESCRIPTION	
							0.15	Grass over firm friable dark brown clay with frequent rootlets. [Topsoil].	
0.20	S						(0.45)	Firm to stiff orange brown to brown CLAY with occasional medium, sub-angular flint gravels. [Glacial Till].	
							0.60		
								Firm becoming stiff, grey and orange brown mottled slightly gravelly CLAY. Gravel is fine to medium, sub-rounded of chalk with occasional chalk cobbles. [Weathered Glacial Till].	
1.20	S								
2.00	S						(2.90)		
								2.80 - 3.50 Becoming stiff.	
							3.50		
3.60	S						(0.40)	Very stiff light grey brown slightly gravelly CLAY. Gravel is fine, sub-rounded chalk. [Glacial Till].	
							3.90		
								End of Borehole at 3.9m	

Boring Progress and Water Observations

Date	Time	Depth (m)	Casing Depth (m)	Casing Dia. mm	Water

Chiselling

From	To	Hours

General Remarks

Position cleared by contractor using a CAT
Service pit excavated to 1.2m bgl
Refusal at 3.9m with sample barrell
No groundwater encountered
Borehole backfilled with arisings

Contractor	Method/ Plant Used		Checked By	
Geotechnical Eng. Ltd	Terrier Mini Percussion Samplin Rig - Dynamic Sampling		Logged By	DBi JG

PBA STD BH LOG LOGS.GPJ PBA_TEMPLATE_SEP08.GDT 2/7/12

Appendix 5 - Analytical Test Results (Alcontrol Laboratories Certificate of Analysis)

ALcontrol Laboratories

Unit 7-8 Hawarden Business Park
Manor Road (off Manor Lane)
Hawarden
Deeside
CH5 3US
Tel: (01244) 528700
Fax: (01244) 528701
email: mkt@alcontrol.com
Website: www.alcontrol.com

Peter Brett Associates
11 Prospect Court
Courteenhall Road
Blisworth
Northampton
Northamptonshire
NN7 3DG

Attention: David Bissell

CERTIFICATE OF ANALYSIS

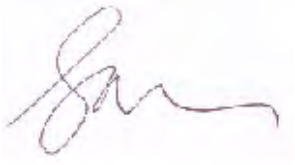
Date:	30 May 2012
Customer:	H_PBRETT_NNT
Sample Delivery Group (SDG):	120519-6
Your Reference:	24213/017
Location:	Alconbury
Report No:	182820

We received 12 samples on Friday May 18, 2012 and 12 of these samples were scheduled for analysis which was completed on Wednesday May 30, 2012. Accredited laboratory tests are defined within the report, but opinions, interpretations and on-site data expressed herein are outside the scope of ISO 17025 accreditation.

Should this report require incorporation into client reports, it must be used in its entirety and not simply with the data sections alone.

All chemical testing (unless subcontracted) is performed at ALcontrol Hawarden Laboratories.

Approved By:



Sonia McWhan

Operations Manager

CERTIFICATE OF ANALYSIS

SDG:	120519-6	**Location:**	Alconbury	**Order Number:**	bc5501327
Job:	H_PBRETT_NNT-11	**Customer:**	Peter Brett Associates	**Report Number:**	182820
Client Reference:	24213/017	**Attention:**	David Bissell	**Superseded Report:**	

Received Sample Overview

Lab Sample No(s)	Customer Sample Ref.	AGS Ref.	Depth (m)	Sampled Date
5607443	BH118/01		0.20	17/05/2012
5607444	BH118/01		1.20	17/05/2012
5607445	BH118/01		2.00	17/05/2012
5607446	BH118/01		3.50	17/05/2012
5607447	BH118/02		0.25	17/05/2012
5607448	BH118/02		1.20	17/05/2012
5607449	BH118/02		2.00	17/05/2012
5607450	BH118/02		3.20	17/05/2012
5607451	BH118/03		0.20	17/05/2012
5607452	BH118/03		1.20	17/05/2012
5607453	BH118/03		2.00	17/05/2012
5607454	BH118/03		3.20	17/05/2012

Only received samples which have had analysis scheduled will be shown on the following pages.

CERTIFICATE OF ANALYSIS

SDG:	120519-6	**Location:**	Alconbury	**Order Number:**	bc5501327
Job:	H_PBRETT_NNT-11	**Customer:**	Peter Brett Associates	**Report Number:**	182820
Client Reference:	24213/017	**Attention:**	David Bissell	**Superseded Report:**	

SOLID

Results Legend

X Test

N No Determination Possible

Lab Sample No(s)	5607443	5607444	5607445	5607446	5607447	5607448	5607449	5607450	5607451	5607452	5607453	5607454
Customer Sample Reference	BH118/01	BH118/01	BH118/01	BH118/01	BH118/02	BH118/02	BH118/02	BH118/02	BH118/03	BH118/03	BH118/03	BH118/03
AGS Reference												
Depth (m)	0.20	1.20	2.00	3.50	0.25	1.20	2.00	3.20	0.20	1.20	2.00	3.20
Container	250g Amber Jar (AL	60g VOC (ALE215)	250g Amber Jar (AL	60g VOC (ALE215)	250g Amber Jar (AL	60g VOC (ALE215)	250g Amber Jar (AL	60g VOC (ALE215)	250g Amber Jar (AL	60g VOC (ALE215)	250g Amber Jar (AL	60g VOC (ALE215)	250g Amber Jar (AL	60g VOC (ALE215)	250g Amber Jar (AL	60g VOC (ALE215)	250g Amber Jar (AL	60g VOC (ALE215)	250g Amber Jar (AL	60g VOC (ALE215)	250g Amber Jar (AL	60g VOC (ALE215)	250g Amber Jar (AL	60g VOC (ALE215)

Anions by Kone (soil)	All	NDPs: 0 Tests: 6	X	X					X	X					X	X								
EPH CWG (Aliphatic) GC (S)	All	NDPs: 0 Tests: 12	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X						
EPH CWG (Aromatic) GC (S)	All	NDPs: 0 Tests: 12	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X						
Fluoride (soluble)	All	NDPs: 0 Tests: 6	X	X					X	X					X	X								
GRO by GC-FID (S)	All	NDPs: 0 Tests: 12		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X						
Hexavalent Chromium (s)	All	NDPs: 0 Tests: 6	X	X					X	X					X	X								
Metals by iCap-OES (Soil)	Arsenic	NDPs: 0 Tests: 6	X	X					X	X					X	X								
	Barium	NDPs: 0 Tests: 6	X	X					X	X					X	X								
	Cadmium	NDPs: 0 Tests: 6	X	X					X	X					X	X								
	Chromium	NDPs: 0 Tests: 6	X	X					X	X					X	X								
	Copper	NDPs: 0 Tests: 6	X	X					X	X					X	X								
	Lead	NDPs: 0 Tests: 6	X	X					X	X					X	X								
	Mercury	NDPs: 0 Tests: 6	X	X					X	X					X	X								
	Molybdenum	NDPs: 0 Tests: 6	X	X					X	X					X	X								
	Nickel	NDPs: 0 Tests: 6	X	X					X	X					X	X								

CERTIFICATE OF ANALYSIS

SDG:	120519-6	**Location:**	Alconbury	**Order Number:**	bc5501327
Job:	H_PBRETT_NNT-11	**Customer:**	Peter Brett Associates	**Report Number:**	182820
Client Reference:	24213/017	**Attention:**	David Bissell	**Superseded Report:**	

SOLID

Results Legend

X Test

N No Determination Possible

			Lab Sample No(s)	Customer Sample Reference	AGS Reference	Depth (m)	Container
Metals by iCap-OES (Soil)	Selenium	NDPs: 0 Tests: 6	5607443	BH118/01		0.20	250g Amber Jar (AL
			5607444	BH118/01		1.20	60g VOC (ALE215)
			5607445	BH118/01		2.00	250g Amber Jar (AL
			5607446	BH118/01		3.50	60g VOC (ALE215)
			5607447	BH118/02		0.25	250g Amber Jar (AL
			5607448	BH118/02		1.20	60g VOC (ALE215)
			5607449	BH118/02		2.00	250g Amber Jar (AL
			5607450	BH118/02		3.20	60g VOC (ALE215)
			5607451	BH118/03		0.20	250g Amber Jar (AL
			5607452	BH118/03		1.20	60g VOC (ALE215)
			5607453	BH118/03		2.00	250g Amber Jar (AL
			5607454	BH118/03		3.20	60g VOC (ALE215)
	Vanadium	NDPs: 0 Tests: 6					
	Zinc	NDPs: 0 Tests: 6					
PAH by GCMS	All	NDPs: 0 Tests: 12					
pH	All	NDPs: 0 Tests: 6					
Phenols by HPLC (S)	All	NDPs: 0 Tests: 6					
Sample description	All	NDPs: 0 Tests: 12					
Total Organic Carbon	All	NDPs: 0 Tests: 6					
TPH CWG GC (S)	All	NDPs: 0 Tests: 12					

CERTIFICATE OF ANALYSIS

SDG:	120519-6	**Location:**	Alconbury	**Order Number:**	bc5501327
Job:	H_PBRETT_NNT-11	**Customer:**	Peter Brett Associates	**Report Number:**	182820
Client Reference:	24213/017	**Attention:**	David Bissell	**Superseded Report:**	

Sample Descriptions

Grain Sizes

very fine	<0.063mm	fine	0.063mm - 0.1mm	medium	0.1mm - 2mm	coarse	2mm - 10mm	very coarse	>10mm

Lab Sample No(s)	Customer Sample Ref.	Depth (m)	Colour	Description	Grain size	Inclusions	Inclusions 2
5607443	BH118/01	0.20	Light Brown	Silty Clay Loam	0.063 - 0.1 mm	Stones	None
5607444	BH118/01	1.20	Yellow	Silty Clay Loam	0.063 - 0.1 mm	Stones	None
5607445	BH118/01	2.00	Light Brown	Clay	<0.063 mm	Stones	None
5607446	BH118/01	3.50	Dark Brown	Clay	<0.063 mm	Stones	None
5607447	BH118/02	0.25	Dark Brown	Clay	<0.063 mm	Stones	None
5607448	BH118/02	1.20	Light Brown	Clay Loam	<0.063 mm	Stones	None
5607449	BH118/02	2.00	Dark Brown	Clay	<0.063 mm	Stones	None
5607450	BH118/02	3.20	Light Brown	Clay	<0.063 mm	Stones	None
5607451	BH118/03	0.20	Light Brown	Clay	<0.063 mm	Stones	None
5607452	BH118/03	1.20	Light Brown	Silty Clay	0.063 - 0.1 mm	Stones	None
5607453	BH118/03	2.00	Dark Brown	Clay	<0.063 mm	Stones	Vegetation
5607454	BH118/03	3.20	Light Brown	Silty Clay	0.063 - 0.1 mm	Stones	None

These descriptions are only intended to act as a cross check if sample identities are questioned, and to provide a log of sample matrices with respect to MCERTS validation. They are not intended as full geological descriptions.

We are accredited to MCERTS for sand, clay and loam/topsoil, or any of these materials - whether these are derived from naturally ocurring soil profiles, or from fill/made ground, as long as these materials constitute the major part of the sample.

Other coarse granular materials such as concrete, gravel and brick are not accredited if they comprise the major part of the sample.

CERTIFICATE OF ANALYSIS

SDG:	120519-6	**Location:**	Alconbury	**Order Number:**	bc5501327
Job:	H_PBRETT_NNT-11	**Customer:**	Peter Brett Associates	**Report Number:**	182820
Client Reference:	24213/017	**Attention:**	David Bissell	**Superseded Report:**	

Results Legend

#	ISO17025 accredited.
M	*m*CERTS accredited.
§	Deviating sample.
aq	Aqueous / settled sample.
diss.filt	Dissolved / filtered sample.
tot.unfilt	Total / unfiltered sample.
*	Subcontracted test.
**	% recovery of the surrogate standard to check the efficiency of the method. The results of individual compounds within samples aren't corrected for the recovery
(F)	Trigger breach confirmed

Component	LOD/Units	Method	Customer Sample R	BH118/01	BH118/01	BH118/02	BH118/02	BH118/03	BH118/03
			Depth (m)	0.20	1.20	0.25	1.20	0.20	1.20
			Sample Type	Soil/Solid	Soil/Solid	Soil/Solid	Soil/Solid	Soil/Solid	Soil/Solid
			Date Sampled	17/05/2012	17/05/2012	17/05/2012	17/05/2012	17/05/2012	17/05/2012
			Sampled Time	-	-	-	-	-	-
			Date Received	18/05/2012	18/05/2012	18/05/2012	18/05/2012	18/05/2012	18/05/2012
			SDG Ref	120519-6	120519-6	120519-6	120519-6	120519-6	120519-6
			Lab Sample No.(s)	5607443	5607444	5607447	5607448	5607451	5607452
			AGS Reference						
Phenols, Total Detected monohydric	<0.035 mg/kg	TM062 (S)		<0.035 M	<0.035 M	<0.035 M	<0.035 M	<0.035 M	<0.035 M
Soil Organic Matter (SOM)	<0.35 %	TM132		1.61 #	0.51 #	2.45 #	0.397 #	1.32 #	0.5 #
pH	1 pH Units	TM133		8.52 M	8.78 M	8.31 M	8.68 M	8.38 M	8.59 M
Chromium, Hexavalent	<0.6 mg/kg	TM151		<0.6 #	<0.6 #	<0.6 #	<0.6 #	<0.6 #	<0.6 #
Arsenic	<0.6 mg/kg	TM181		20.4 M	12.7 M	17.3 M	13.5 M	21.3 M	13.1 M
Barium	<0.6 mg/kg	TM181		141 #	30.6 #	91 #	57.8 #	110 #	134 #
Cadmium	<0.02 mg/kg	TM181		0.485 M	0.321 M	0.394 M	0.313 M	0.413 M	0.179 M
Chromium	<0.9 mg/kg	TM181		36.2 M	16.7 M	39.2 M	23.7 M	40.8 M	19.9 M
Copper	<1.4 mg/kg	TM181		10.1 M	9 M	11.6 M	11.1 M	12.1 M	10.8 M
Lead	<0.7 mg/kg	TM181		18.7 M	6.92 M	22.6 M	11 M	21.4 M	9.67 M
Mercury	<0.14 mg/kg	TM181		<0.14 M	0.161 M	<0.14 M	<0.14 M	<0.14 M	0.174 M
Molybdenum	<0.1 mg/kg	TM181		0.336 #	0.376 #	0.213 #	0.591 #	0.669 #	0.737 #
Nickel	<0.2 mg/kg	TM181		30.9 M	17.6 M	25.9 M	24.4 M	36.5 M	23.9 M
Selenium	<1 mg/kg	TM181		<1 #	<1 #	<1 #	<1 #	<1 #	<1 #
Vanadium	<0.2 mg/kg	TM181		61.7 #	33.1 #	61.3 #	36 #	68.3 #	32.6 #
Zinc	<1.9 mg/kg	TM181		72.4 M	35 M	84.2 M	45.1 M	81.4 M	49.4 M
Fluoride, 2:1 water soluble	<1 mg/kg	TM242		1.79 #	1.85 #	2.24 #	1.74 #	1.51 #	4.68 #
Soluble Sulphate 2:1 extract as SO4 BRE	<0.003 g/l	TM243		<0.003 M	0.0239 M	<0.003 M	0.0144 M	<0.003 M	0.0372 M

CERTIFICATE OF ANALYSIS

SDG:	120519-6	**Location:**	Alconbury	**Order Number:**	bc5501327
Job:	H_PBRETT_NNT-11	**Customer:**	Peter Brett Associates	**Report Number:**	182820
Client Reference:	24213/017	**Attention:**	David Bissell	**Superseded Report:**	

PAH by GCMS

Results Legend

#	ISO17025 accredited.
M	*m*CERTS accredited.
§	Deviating sample.
aq	Aqueous / settled sample.
diss.filt	Dissolved / filtered sample.
tot.unfilt	Total / unfiltered sample.
*	Subcontracted test.
**	% recovery of the surrogate standard to check the efficiency of the method. The results of individual compounds within samples aren't corrected for the recovery
(F)	Trigger breach confirmed

Component	LOD/Units	Method	Customer Sample R	BH118/01	BH118/01	BH118/01	BH118/01	BH118/02	BH118/02
			Depth (m)	0.20	1.20	2.00	3.50	0.25	1.20
			Sample Type	Soil/Solid	Soil/Solid	Soil/Solid	Soil/Solid	Soil/Solid	Soil/Solid
			Date Sampled	17/05/2012	17/05/2012	17/05/2012	17/05/2012	17/05/2012	17/05/2012
			Sampled Time	-	-	-	-	-	-
			Date Received	18/05/2012	18/05/2012	18/05/2012	18/05/2012	18/05/2012	18/05/2012
			SDG Ref	120519-6	120519-6	120519-6	120519-6	120519-6	120519-6
			Lab Sample No.(s)	5607443	5607444	5607445	5607446	5607447	5607448
			AGS Reference						
Naphthalene-d8 % recovery**	%	TM218		93.2	93.3	91.8	96.6	94.5	96.1
Acenaphthene-d10 % recovery**	%	TM218		92	92.4	91.1	95.3	92.9	94.8
Phenanthrene-d10 % recovery**	%	TM218		90.4	89.9	89.2	94.5	91.6	93.4
Chrysene-d12 % recovery**	%	TM218		77.3	86	86.7	80.2	76.5	78.2
Perylene-d12 % recovery**	%	TM218		71.7	87.3	88.1	75.2	73	72.1
Naphthalene	<9 µg/kg	TM218		<9 M	<9 M	13 M	<9 M	<9 M	<9 M
Acenaphthylene	<12 µg/kg	TM218		<12 M	<12 M	<12 M	<12 M	<12 M	<12 M
Acenaphthene	<8 µg/kg	TM218		<8 M	<8 M	<8 M	<8 M	<8 M	<8 M
Fluorene	<10 µg/kg	TM218		<10 M	<10 M	<10 M	<10 M	<10 M	<10 M
Phenanthrene	<15 µg/kg	TM218		24.2 M	<15 M	<15 M	<15 M	32.3 M	<15 M
Anthracene	<16 µg/kg	TM218		<16 M	<16 M	<16 M	<16 M	<16 M	<16 M
Fluoranthene	<17 µg/kg	TM218		31.2 M	<17 M	<17 M	<17 M	42.8 M	<17 M
Pyrene	<15 µg/kg	TM218		25 M	<15 M	<15 M	<15 M	34.4 M	<15 M
Benz(a)anthracene	<14 µg/kg	TM218		<14 M	<14 M	<14 M	<14 M	<14 M	<14 M
Chrysene	<10 µg/kg	TM218		14.3 M	<10 M	<10 M	<10 M	23.3 M	<10 M
Benzo(b)fluoranthene	<15 µg/kg	TM218		<15 M	<15 M	<15 M	<15 M	23.1 M	<15 M
Benzo(k)fluoranthene	<14 µg/kg	TM218		<14 M	<14 M	<14 M	<14 M	<14 M	<14 M
Benzo(a)pyrene	<15 µg/kg	TM218		<15 M	<15 M	<15 M	<15 M	<15 M	<15 M
Indeno(1,2,3-cd)pyrene	<18 µg/kg	TM218		<18 M	<18 M	<18 M	<18 M	<18 M	<18 M
Dibenzo(a,h)anthracene	<23 µg/kg	TM218		<23 M	<23 M	<23 M	<23 M	<23 M	<23 M
Benzo(g,h,i)perylene	<24 µg/kg	TM218		<24 M	<24 M	<24 M	<24 M	<24 M	<24 M
PAH, Total Detected USEPA 16	<118 µg/kg	TM218		<118	<118	<118	<118	156	<118

CERTIFICATE OF ANALYSIS

SDG:	120519-6	**Location:**	Alconbury	**Order Number:**	bc5501327
Job:	H_PBRETT_NNT-11	**Customer:**	Peter Brett Associates	**Report Number:**	182820
Client Reference:	24213/017	**Attention:**	David Bissell	**Superseded Report:**	

PAH by GCMS

Results Legend

#	ISO17025 accredited.
M	*m*CERTS accredited.
§	Deviating sample.
aq	Aqueous / settled sample.
diss.filt	Dissolved / filtered sample.
tot.unfilt	Total / unfiltered sample.
*	Subcontracted test.
**	% recovery of the surrogate standard to check the efficiency of the method. The results of individual compounds within samples aren't corrected for the recovery
(F)	Trigger breach confirmed

Component	LOD/Units	Method	Customer Sample R	BH118/02	BH118/02	BH118/03	BH118/03	BH118/03	BH118/03
			Depth (m)	2.00	3.20	0.20	1.20	2.00	3.20
			Sample Type	Soil/Solid	Soil/Solid	Soil/Solid	Soil/Solid	Soil/Solid	Soil/Solid
			Date Sampled	17/05/2012	17/05/2012	17/05/2012	17/05/2012	17/05/2012	17/05/2012
			Sampled Time	-	-	-	-	-	-
			Date Received	18/05/2012	18/05/2012	18/05/2012	18/05/2012	18/05/2012	18/05/2012
			SDG Ref	120519-6	120519-6	120519-6	120519-6	120519-6	120519-6
			Lab Sample No.(s)	5607449	5607450	5607451	5607452	5607453	5607454
			AGS Reference						
Naphthalene-d8 % recovery**	%	TM218		94.8	101	101	100	99.7	102
Acenaphthene-d10 % recovery**	%	TM218		94.1	99.9	101	98.4	99.1	102
Phenanthrene-d10 % recovery**	%	TM218		92.5	99	99.9	98	98.5	101
Chrysene-d12 % recovery**	%	TM218		86	89.8	91	87.3	92.7	92.3
Perylene-d12 % recovery**	%	TM218		84.4	78.8	80.9	76.3	79.7	79.8
Naphthalene	<9 µg/kg	TM218		<9 M	34.1 M	20.3 M	11.4 M	29.9 M	<9 M
Acenaphthylene	<12 µg/kg	TM218		<12 M	<12 M	<12 M	<12 M	<12 M	<12 M
Acenaphthene	<8 µg/kg	TM218		<8 M	<8 M	<8 M	<8 M	<8 M	<8 M
Fluorene	<10 µg/kg	TM218		<10 M	<10 M	<10 M	<10 M	<10 M	<10 M
Phenanthrene	<15 µg/kg	TM218		<15 M	<15 M	56.7 M	<15 M	<15 M	<15 M
Anthracene	<16 µg/kg	TM218		<16 M	<16 M	<16 M	<16 M	<16 M	<16 M
Fluoranthene	<17 µg/kg	TM218		<17 M	<17 M	40.2 M	<17 M	<17 M	<17 M
Pyrene	<15 µg/kg	TM218		<15 M	<15 M	32.1 M	<15 M	<15 M	<15 M
Benz(a)anthracene	<14 µg/kg	TM218		<14 M	<14 M	<14 M	<14 M	<14 M	<14 M
Chrysene	<10 µg/kg	TM218		<10 M	<10 M	16.6 M	<10 M	<10 M	<10 M
Benzo(b)fluoranthene	<15 µg/kg	TM218		<15 M	<15 M	<15 M	<15 M	<15 M	<15 M
Benzo(k)fluoranthene	<14 µg/kg	TM218		<14 M	<14 M	<14 M	<14 M	<14 M	<14 M
Benzo(a)pyrene	<15 µg/kg	TM218		<15 M	<15 M	<15 M	<15 M	<15 M	<15 M
Indeno(1,2,3-cd)pyrene	<18 µg/kg	TM218		<18 M	<18 M	<18 M	<18 M	<18 M	<18 M
Dibenzo(a,h)anthracene	<23 µg/kg	TM218		<23 M	<23 M	<23 M	<23 M	<23 M	<23 M
Benzo(g,h,i)perylene	<24 µg/kg	TM218		<24 M	<24 M	<24 M	<24 M	<24 M	<24 M
PAH, Total Detected USEPA 16	<118 µg/kg	TM218		<118	<118	166	<118	<118	<118

CERTIFICATE OF ANALYSIS

SDG:	120519-6	**Location:**	Alconbury	**Order Number:**	bc5501327
Job:	H_PBRETT_NNT-11	**Customer:**	Peter Brett Associates	**Report Number:**	182820
Client Reference:	24213/017	**Attention:**	David Bissell	**Superseded Report:**	

TPH CWG (S)

Results Legend

#	ISO17025 accredited.
M	*m*CERTS accredited.
§	Deviating sample.
aq	Aqueous / settled sample.
diss.filt	Dissolved / filtered sample.
tot.unfilt	Total / unfiltered sample.
*	Subcontracted test.
**	% recovery of the surrogate standard to check the efficiency of the method. The results of individual compounds within samples aren't corrected for the recovery
(F)	Trigger breach confirmed

Component	LOD/Units	Method	Customer Sample R	BH118/01	BH118/01	BH118/01	BH118/01	BH118/02	BH118/02
			Depth (m)	0.20	1.20	2.00	3.50	0.25	1.20
			Sample Type	Soil/Solid	Soil/Solid	Soil/Solid	Soil/Solid	Soil/Solid	Soil/Solid
			Date Sampled	17/05/2012	17/05/2012	17/05/2012	17/05/2012	17/05/2012	17/05/2012
			Sampled Time	-	-	-	-	-	-
			Date Received	18/05/2012	18/05/2012	18/05/2012	18/05/2012	18/05/2012	18/05/2012
			SDG Ref	120519-6	120519-6	120519-6	120519-6	120519-6	120519-6
			Lab Sample No.(s)	5607443	5607444	5607445	5607446	5607447	5607448
			AGS Reference						
GRO Surrogate % recovery**	%	TM089		87	110	103	77	85	112
GRO >C5-C12	<44 µg/kg	TM089		<44	<44	446	162	<44	<44
Methyl tertiary butyl ether (MTBE)	<5 µg/kg	TM089		<5 #	<5 #	<5 #	<5 #	<5 #	<5 #
Benzene	<10 µg/kg	TM089		<10 M	<10 M	<10 M	<10 M	<10 M	<10 M
Toluene	<2 µg/kg	TM089		<2 M	<2 M	<2 M	3.45 M	<2 M	<2 M
Ethylbenzene	<3 µg/kg	TM089		<3 M	<3 M	<3 M	<3 M	<3 M	<3 M
m,p-Xylene	<6 µg/kg	TM089		<6 M	<6 M	<6 M	9.2 M	<6 M	<6 M
o-Xylene	<3 µg/kg	TM089		<3 M	<3 M	3.42 M	3.45 M	<3 M	<3 M
sum of detected mpo xylene by GC	<9 µg/kg	TM089		<9	<9	<9	12.7	<9	<9
sum of detected BTEX by GC	<24 µg/kg	TM089		<24	<24	<24	<24	<24	<24
Aliphatics >C5-C6	<10 µg/kg	TM089		<10	<10	<10	<10	<10	<10
Aliphatics >C6-C8	<10 µg/kg	TM089		<10	<10	<10	13.8	<10	<10
Aliphatics >C8-C10	<10 µg/kg	TM089		<10	<10	114	39.1	<10	<10
Aliphatics >C10-C12	<10 µg/kg	TM089		<10	<10	143	34.5	<10	<10
Aliphatics >C12-C16	<100 µg/kg	TM173		6460	7770	16900	8430	6370	10600
Aliphatics >C16-C21	<100 µg/kg	TM173		13900	5290	11000	5540	4520	6350
Aliphatics >C21-C35	<100 µg/kg	TM173		47400	6080	12600	12000	7810	8260
Aliphatics >C35-C44	<100 µg/kg	TM173		16400	<100	<100	<100	<100	<100
Total Aliphatics >C12-C44	<100 µg/kg	TM173		84100	19100	40500	26000	18700	25200
Aromatics >EC5-EC7	<10 µg/kg	TM089		<10	<10	<10	<10	<10	<10
Aromatics >EC7-EC8	<10 µg/kg	TM089		<10	<10	<10	<10	<10	<10
Aromatics >EC8-EC10	<10 µg/kg	TM089		<10	<10	82.1	40.3	<10	<10
Aromatics >EC10-EC12	<10 µg/kg	TM089		<10	<10	94.6	23	<10	<10
Aromatics >EC12-EC16	<100 µg/kg	TM173		4080	<100	<100	2710	<100	<100
Aromatics >EC16-EC21	<100 µg/kg	TM173		10100	<100	<100	2140	<100	<100
Aromatics >EC21-EC35	<100 µg/kg	TM173		45600	<100	<100	9920	<100	<100
Aromatics >EC35-EC44	<100 µg/kg	TM173		22100	<100	<100	2970	<100	<100
Aromatics >EC40-EC44	<100 µg/kg	TM173		8770	<100	<100	<100	<100	<100
Total Aromatics >EC12-EC44	<100 µg/kg	TM173		81900	<100	<100	17700	<100	<100
Total Aliphatics >C5-35	<100 µg/kg	TM173		67700	19100	40800	26100	18700	25200
Total Aromatics >C5-35	<100 µg/kg	TM173		59800	<100	178	14800	<100	<100
Total Aliphatics & Aromatics >C5-35	<100 µg/kg	TM173		128000	19100	41000	40900	18700	25200
Total Aliphatics & Aromatics >C5-C44	<100 µg/kg	TM173		166000	19100	41000	43900	18700	25200

CERTIFICATE OF ANALYSIS

SDG:	120519-6	**Location:**	Alconbury	**Order Number:**	bc5501327
Job:	H_PBRETT_NNT-11	**Customer:**	Peter Brett Associates	**Report Number:**	182820
Client Reference:	24213/017	**Attention:**	David Bissell	**Superseded Report:**	

TPH CWG (S)

Results Legend

#	ISO17025 accredited.
M	*m*CERTS accredited.
§	Deviating sample.
aq	Aqueous / settled sample.
diss.filt	Dissolved / filtered sample.
tot.unfilt	Total / unfiltered sample.
*	Subcontracted test.
**	% recovery of the surrogate standard to check the efficiency of the method. The results of individual compounds within samples aren't corrected for the recovery
(F)	Trigger breach confirmed

Component	LOD/Units	Method	Customer Sample R	BH118/02	BH118/02	BH118/03	BH118/03	BH118/03	BH118/03
			Depth (m)	2.00	3.20	0.20	1.20	2.00	3.20
			Sample Type	Soil/Solid	Soil/Solid	Soil/Solid	Soil/Solid	Soil/Solid	Soil/Solid
			Date Sampled	17/05/2012	17/05/2012	17/05/2012	17/05/2012	17/05/2012	17/05/2012
			Sampled Time	-	-	-	-	-	-
			Date Received	18/05/2012	18/05/2012	18/05/2012	18/05/2012	18/05/2012	18/05/2012
			SDG Ref	120519-6	120519-6	120519-6	120519-6	120519-6	120519-6
			Lab Sample No.(s)	5607449	5607450	5607451	5607452	5607453	5607454
			AGS Reference						
GRO Surrogate % recovery**	%	TM089		105	95	107	94	82	86
GRO >C5-C12	<44 µg/kg	TM089		2540	75.2	<44	675	<44	527
Methyl tertiary butyl ether (MTBE)	<5 µg/kg	TM089		<5 #	<5 #	<5 #	<5 #	<5 #	<5 #
Benzene	<10 µg/kg	TM089		<10 M	<10 M	<10 M	<10 M	<10 M	<10 M
Toluene	<2 µg/kg	TM089		<2 M	<2 M	<2 M	<2 M	<2 M	2.3 M
Ethylbenzene	<3 µg/kg	TM089		<3 M	<3 M	<3 M	<3 M	<3 M	<3 M
m,p-Xylene	<6 µg/kg	TM089		<6 M	<6 M	<6 M	<6 M	<6 M	<6 M
o-Xylene	<3 µg/kg	TM089		<3 M	<3 M	<3 M	5.75 M	<3 M	<3 M
sum of detected mpo xylene by GC	<9 µg/kg	TM089		<9	<9	<9	<9	<9	<9
sum of detected BTEX by GC	<24 µg/kg	TM089		<24	<24	<24	<24	<24	<24
Aliphatics >C5-C6	<10 µg/kg	TM089		<10	<10	<10	<10	<10	<10
Aliphatics >C6-C8	<10 µg/kg	TM089		20.9	<10	<10	<10	<10	15
Aliphatics >C8-C10	<10 µg/kg	TM089		904	17.1	<10	197	<10	187
Aliphatics >C10-C12	<10 µg/kg	TM089		604	20.5	<10	197	<10	113
Aliphatics >C12-C16	<100 µg/kg	TM173		11600	4960	<100	<100	2800	<100
Aliphatics >C16-C21	<100 µg/kg	TM173		7100	4380	<100	<100	3790	<100
Aliphatics >C21-C35	<100 µg/kg	TM173		9790	5340	3040	<100	8190	<100
Aliphatics >C35-C44	<100 µg/kg	TM173		711	<100	<100	<100	<100	<100
Total Aliphatics >C12-C44	<100 µg/kg	TM173		29200	14700	3040	<100	14800	<100
Aromatics >EC5-EC7	<10 µg/kg	TM089		<10	<10	<10	<10	<10	<10
Aromatics >EC7-EC8	<10 µg/kg	TM089		<10	<10	<10	<10	<10	<10
Aromatics >EC8-EC10	<10 µg/kg	TM089		602	16	<10	140	<10	130
Aromatics >EC10-EC12	<10 µg/kg	TM089		404	13.7	<10	131	<10	74.8
Aromatics >EC12-EC16	<100 µg/kg	TM173		1070	<100	3640	2510	2640	<100
Aromatics >EC16-EC21	<100 µg/kg	TM173		<100	<100	3490	1760	<100	<100
Aromatics >EC21-EC35	<100 µg/kg	TM173		<100	<100	11000	<100	3690	<100
Aromatics >EC35-EC44	<100 µg/kg	TM173		1400	<100	6150	<100	4340	<100
Aromatics >EC40-EC44	<100 µg/kg	TM173		1400	<100	2840	<100	2320	<100
Total Aromatics >EC12-EC44	<100 µg/kg	TM173		2470	<100	24300	4260	10700	<100
Total Aliphatics >C5-35	<100 µg/kg	TM173		30000	14700	3040	403	14800	319
Total Aromatics >C5-35	<100 µg/kg	TM173		2070	<100	18100	4540	6340	208
Total Aliphatics & Aromatics >C5-35	<100 µg/kg	TM173		32100	14700	21200	4940	21100	527
Total Aliphatics & Aromatics >C5-C44	<100 µg/kg	TM173		34200	14700	27300	4940	25400	527

CERTIFICATE OF ANALYSIS

SDG:	120519-6	**Location:**	Alconbury	**Order Number:**	bc5501327
Job:	H_PBRETT_NNT-11	**Customer:**	Peter Brett Associates	**Report Number:**	182820
Client Reference:	24213/017	**Attention:**	David Bissell	**Superseded Report:**	

Table of Results - Appendix

Method No	Reference	Description	Wet/Dry Sample [1]	Surrogate Corrected
PM001		Preparation of Samples for Metals Analysis		
PM024	Modified BS 1377	Soil preparation including homogenisation, moisture screens of soils for Asbestos Containing Material		
TM062 (S)	National Grid Property Holdings Methods for the Collection & Analysis of Samples from National Grid Sites version 1 Sec 3.9	Determination of Phenols in Soils by HPLC		
TM089	Modified: US EPA Methods 8020 & 602	Determination of Gasoline Range Hydrocarbons (GRO) and BTEX (MTBE) compounds by Headspace GC-FID (C4-C12)		
TM132	In - house Method	ELTRA CS800 Operators Guide		
TM133	BS 1377: Part 3 1990;BS 6068-2.5	Determination of pH in Soil and Water using the GLpH pH Meter		
TM151	Method 3500D, AWWA/APHA, 20th Ed., 1999	Determination of Hexavalent Chromium using Kone analyser		
TM173	Analysis of Petroleum Hydrocarbons in Environmental Media – Total Petroleum Hydrocarbon Criteria	Determination of Speciated Extractable Petroleum Hydrocarbons in Soils by GC-FID		
TM181	US EPA Method 6010B	Determination of Routine Metals in Soil by iCap 6500 Duo ICP-OES		
TM218	Microwave extraction – EPA method 3546	Microwave extraction - EPA method 3546		
TM242	Method 340.3, Fluoride, EPA, 1997.	Determination of Fluoride in Soil Samples using the Kone Analyser		
TM243		Mixed Anions In Soils By Kone		

[1] Applies to Solid samples only. DRY indicates samples have been dried at 35°C. NA = not applicable.

CERTIFICATE OF ANALYSIS

SDG:	120519-6	**Location:**	Alconbury	**Order Number:**	bc5501327
Job:	H_PBRETT_NNT-11	**Customer:**	Peter Brett Associates	**Report Number:**	182820
Client Reference:	24213/017	**Attention:**	David Bissell	**Superseded Report:**	

Test Completion Dates

Lab Sample No(s)	5607443	5607444	5607445	5607446	5607447	5607448	5607449	5607450	5607451	5607452
Customer Sample Ref.	BH118/01	BH118/01	BH118/01	BH118/01	BH118/02	BH118/02	BH118/02	BH118/02	BH118/03	BH118/03
AGS Ref.										
Depth	0.20	1.20	2.00	3.50	0.25	1.20	2.00	3.20	0.20	1.20
Type	SOLID	SOLID	SOLID	SOLID	SOLID	SOLID	SOLID	SOLID	SOLID	SOLID
Anions by Kone (soil)	30-May-2012	30-May-2012			30-May-2012	30-May-2012			30-May-2012	29-May-2012
EPH CWG (Aliphatic) GC (S)	30-May-2012	30-May-2012	30-May-2012	30-May-2012	30-May-2012	30-May-2012	30-May-2012	30-May-2012	29-May-2012	29-May-2012
EPH CWG (Aromatic) GC (S)	30-May-2012	30-May-2012	30-May-2012	30-May-2012	30-May-2012	30-May-2012	30-May-2012	30-May-2012	29-May-2012	29-May-2012
Fluoride (soluble)	30-May-2012	30-May-2012			30-May-2012	30-May-2012			30-May-2012	29-May-2012
GRO by GC-FID (S)	29-May-2012	29-May-2012	29-May-2012	29-May-2012	29-May-2012	29-May-2012	29-May-2012	29-May-2012	29-May-2012	29-May-2012
Hexavalent Chromium (s)	28-May-2012	28-May-2012			28-May-2012	28-May-2012			28-May-2012	28-May-2012
Metals by iCap-OES (Soil)	29-May-2012	29-May-2012			29-May-2012	29-May-2012			29-May-2012	29-May-2012
PAH by GCMS	29-May-2012	26-May-2012	26-May-2012	29-May-2012	29-May-2012	29-May-2012	26-May-2012	30-May-2012	30-May-2012	30-May-2012
pH	29-May-2012	29-May-2012			29-May-2012	29-May-2012			29-May-2012	29-May-2012
Phenols by HPLC (S)	29-May-2012	29-May-2012			28-May-2012	28-May-2012			28-May-2012	28-May-2012
Sample description	24-May-2012	24-May-2012	24-May-2012	24-May-2012	24-May-2012	24-May-2012	24-May-2012	24-May-2012	24-May-2012	24-May-2012
Total Organic Carbon	30-May-2012	30-May-2012			30-May-2012	30-May-2012			30-May-2012	30-May-2012
TPH CWG GC (S)	30-May-2012	30-May-2012	30-May-2012	30-May-2012	30-May-2012	30-May-2012	30-May-2012	30-May-2012	29-May-2012	29-May-2012

Lab Sample No(s)	5607453	5607454
Customer Sample Ref.	BH118/03	BH118/03
AGS Ref.		
Depth	2.00	3.20
Type	SOLID	SOLID
EPH CWG (Aliphatic) GC (S)	30-May-2012	29-May-2012
EPH CWG (Aromatic) GC (S)	30-May-2012	29-May-2012
GRO by GC-FID (S)	30-May-2012	30-May-2012
PAH by GCMS	30-May-2012	30-May-2012
Sample description	23-May-2012	24-May-2012
TPH CWG GC (S)	30-May-2012	30-May-2012

CERTIFICATE OF ANALYSIS

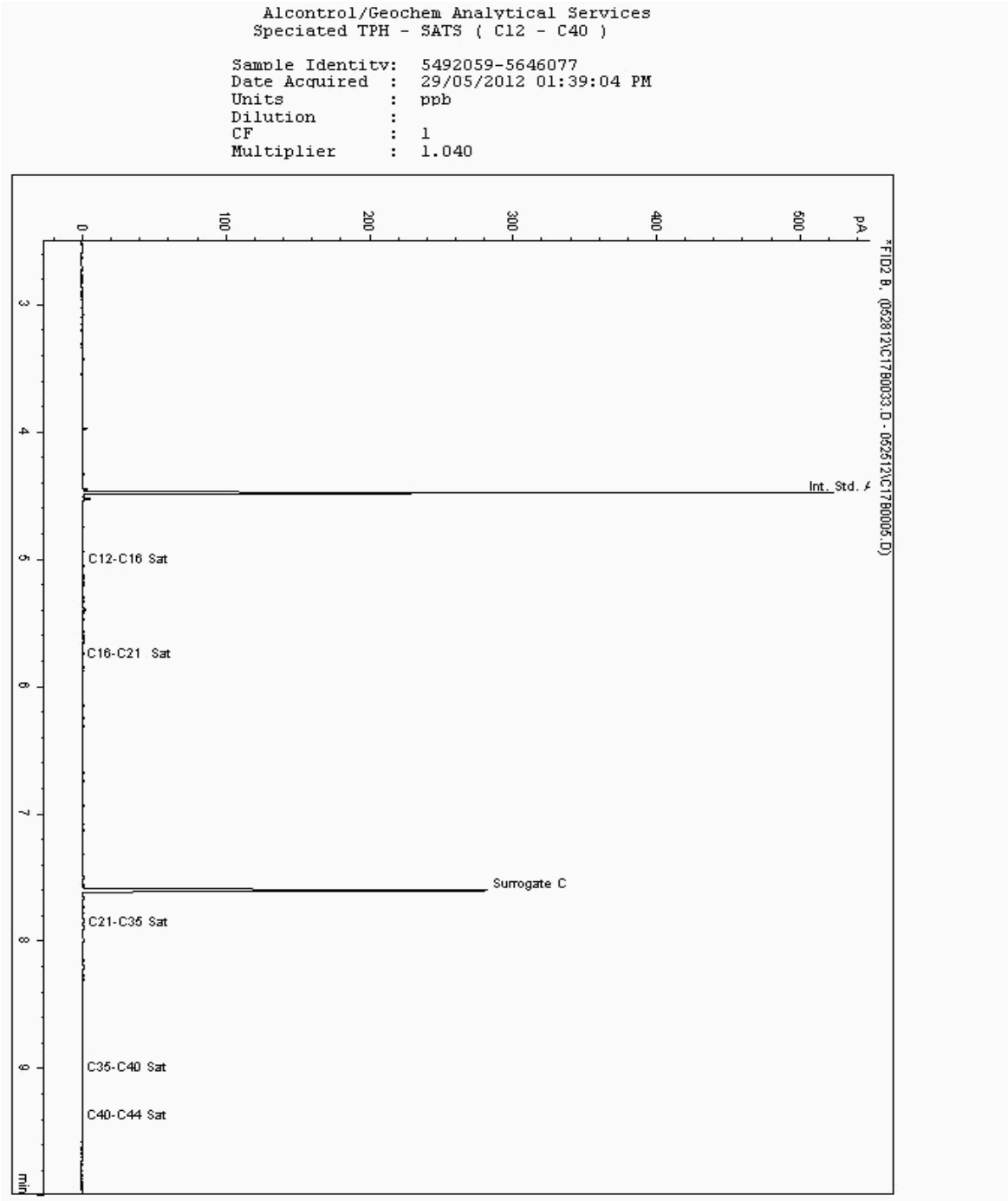
SDG:	120519-6	**Location:**	Alconbury	**Order Number:**	bc5501327
Job:	H_PBRETT_NNT-11	**Customer:**	Peter Brett Associates	**Report Number:**	182820
Client Reference:	24213/017	**Attention:**	David Bissell	**Superseded Report:**	

Chromatogram

Analysis: EPH CWG (Aliphatic) GC (S)

Sample No : 5646077
Sample ID : BH118/03

Depth : 3.20



CERTIFICATE OF ANALYSIS

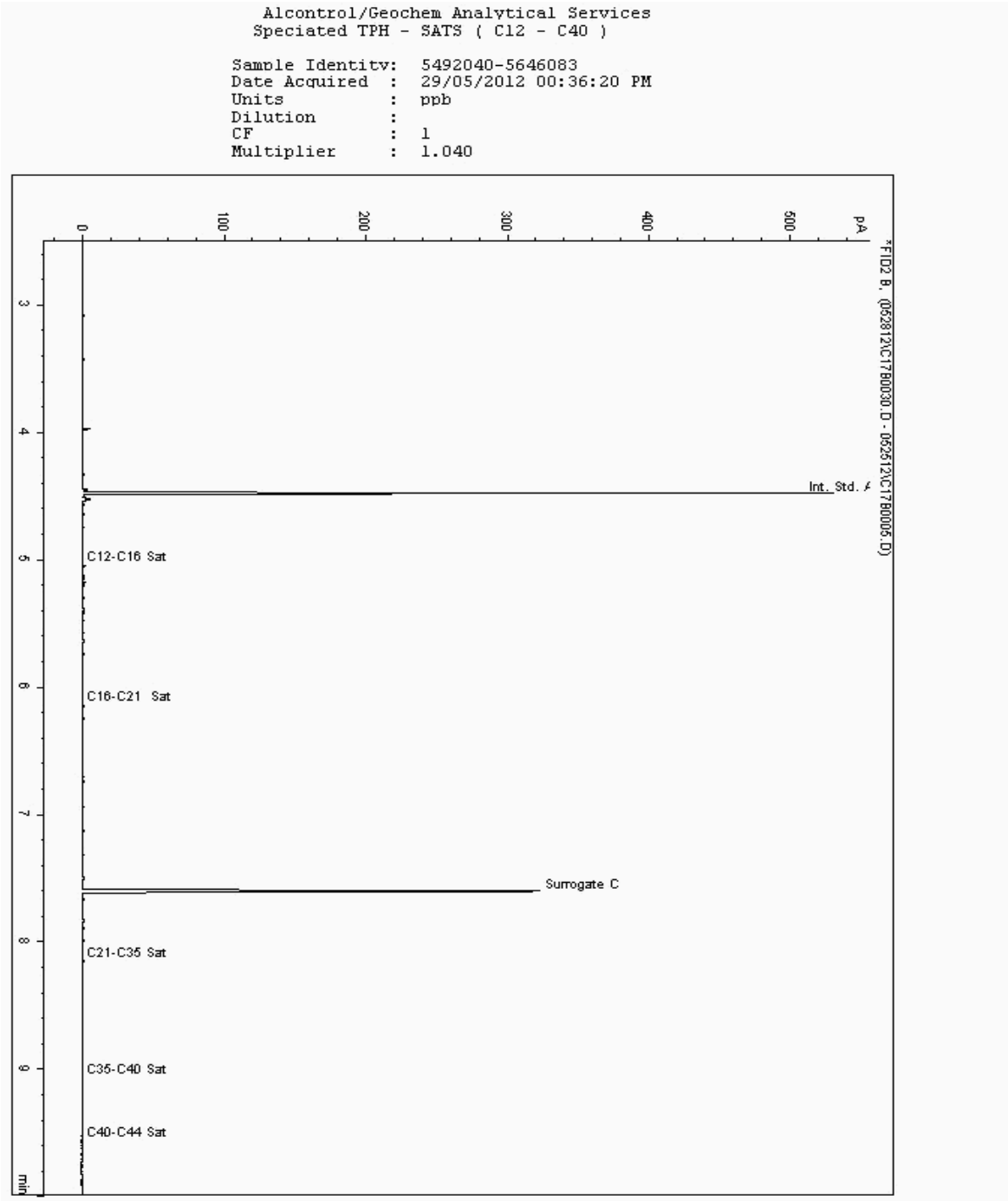
SDG:	120519-6	**Location:**	Alconbury	**Order Number:**	bc5501327
Job:	H_PBRETT_NNT-11	**Customer:**	Peter Brett Associates	**Report Number:**	182820
Client Reference:	24213/017	**Attention:**	David Bissell	**Superseded Report:**	

Chromatogram

Analysis: EPH CWG (Aliphatic) GC (S)

Sample No : 5646083
Sample ID : BH118/03

Depth : 1.20



CERTIFICATE OF ANALYSIS

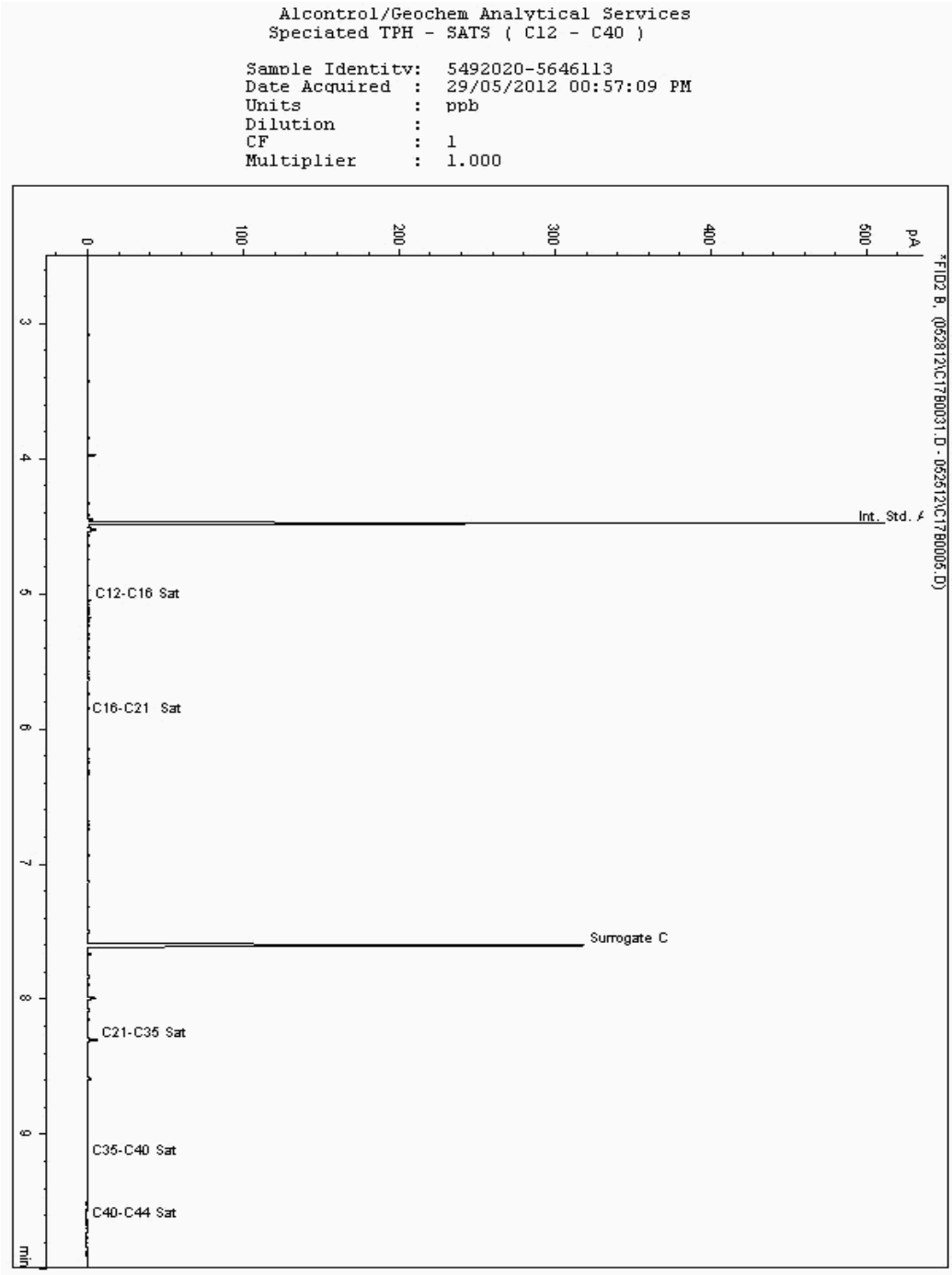
SDG:	120519-6	**Location:**	Alconbury	**Order Number:**	bc5501327
Job:	H_PBRETT_NNT-11	**Customer:**	Peter Brett Associates	**Report Number:**	182820
Client Reference:	24213/017	**Attention:**	David Bissell	**Superseded Report:**	

Chromatogram

Analysis: EPH CWG (Aliphatic) GC (S)

Sample No : 5646113
Sample ID : BH118/03

Depth : 0.20



CERTIFICATE OF ANALYSIS

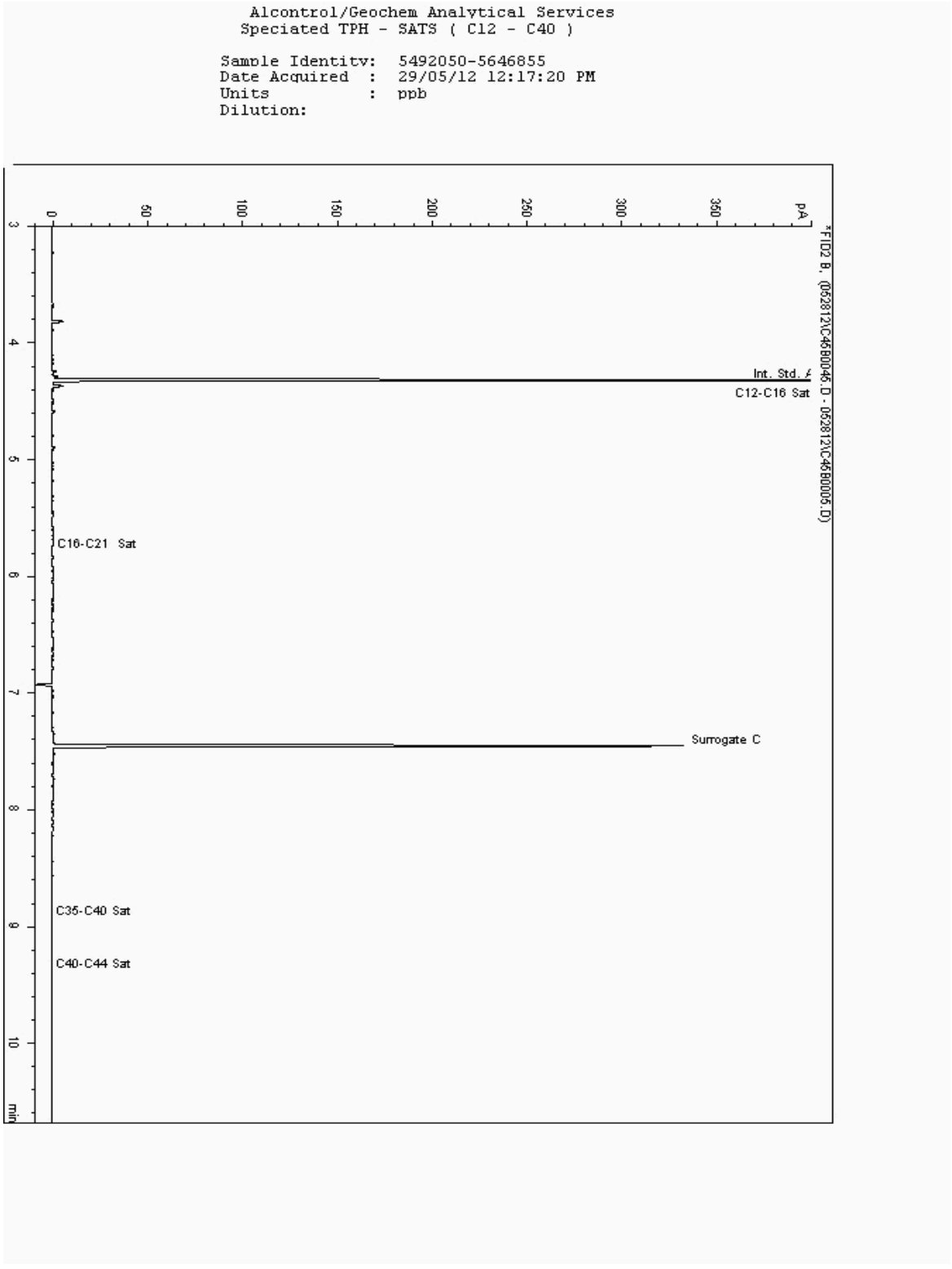
SDG:	120519-6	**Location:**	Alconbury	**Order Number:**	bc5501327
Job:	H_PBRETT_NNT-11	**Customer:**	Peter Brett Associates	**Report Number:**	182820
Client Reference:	24213/017	**Attention:**	David Bissell	**Superseded Report:**	

Chromatogram

Analysis: EPH CWG (Aliphatic) GC (S)

Sample No : 5646855
Sample ID : BH118/03

Depth : 2.00



CERTIFICATE OF ANALYSIS

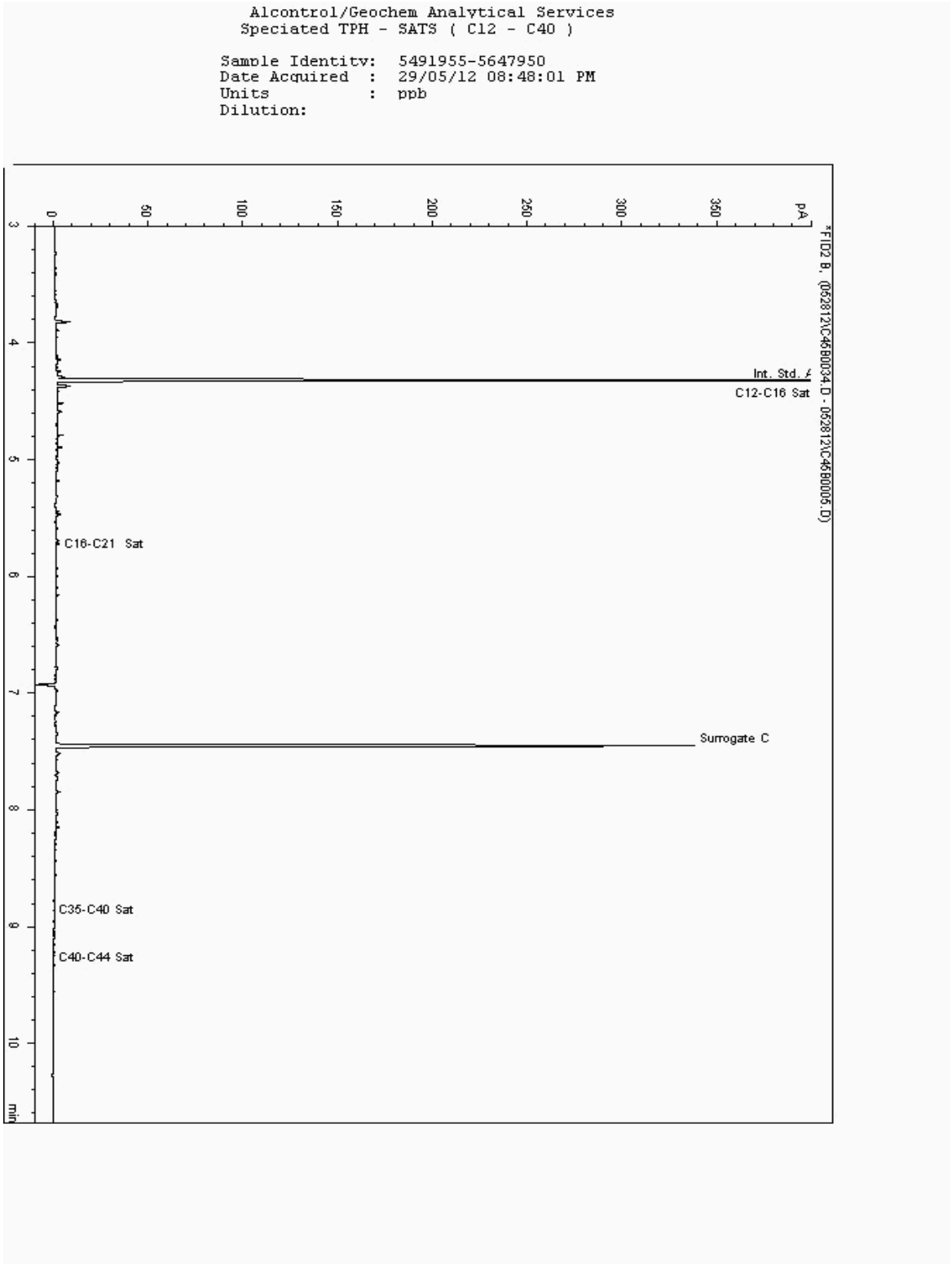
SDG:	120519-6	**Location:**	Alconbury	**Order Number:**	bc5501327
Job:	H_PBRETT_NNT-11	**Customer:**	Peter Brett Associates	**Report Number:**	182820
Client Reference:	24213/017	**Attention:**	David Bissell	**Superseded Report:**	

Chromatogram

Analysis: EPH CWG (Aliphatic) GC (S)

Sample No : 5647950
Sample ID : BH118/01

Depth : 3.50



CERTIFICATE OF ANALYSIS

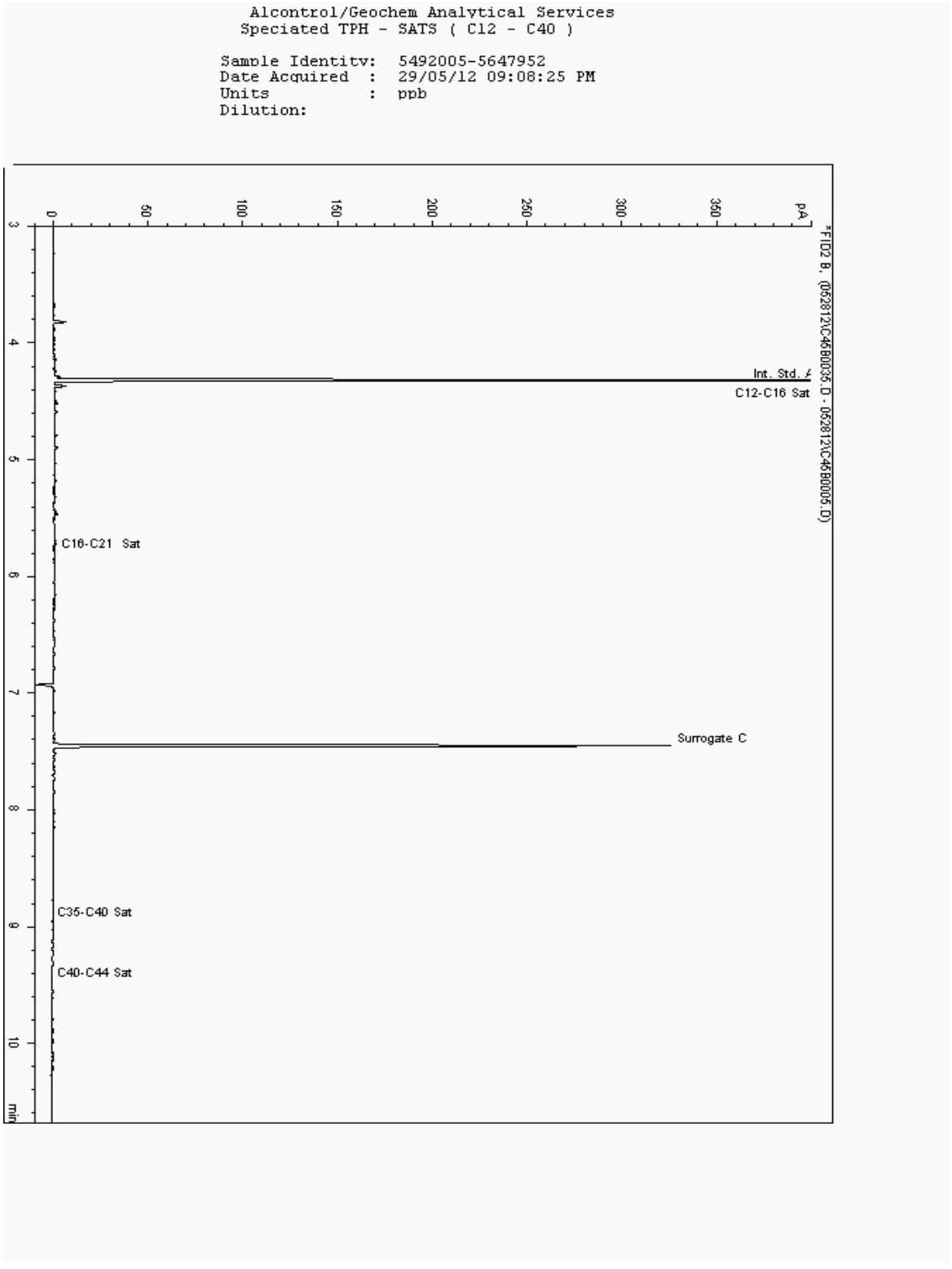
SDG:	120519-6	**Location:**	Alconbury	**Order Number:**	bc5501327
Job:	H_PBRETT_NNT-11	**Customer:**	Peter Brett Associates	**Report Number:**	182820
Client Reference:	24213/017	**Attention:**	David Bissell	**Superseded Report:**	

Chromatogram

Analysis: EPH CWG (Aliphatic) GC (S)

Sample No : 5647952
Sample ID : BH118/02

Depth : 3.20



CERTIFICATE OF ANALYSIS

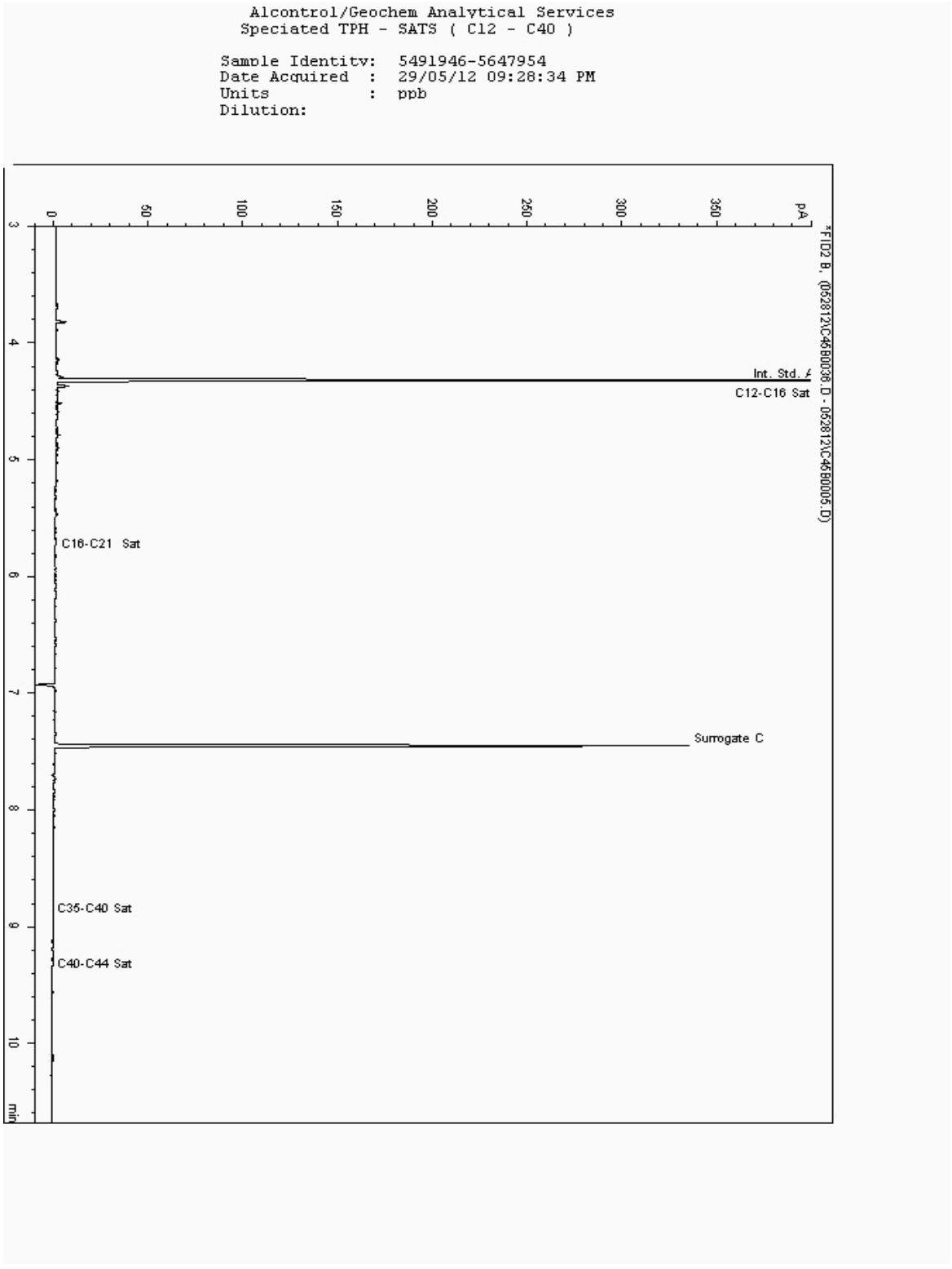
SDG:	120519-6	**Location:**	Alconbury	**Order Number:**	bc5501327
Job:	H_PBRETT_NNT-11	**Customer:**	Peter Brett Associates	**Report Number:**	182820
Client Reference:	24213/017	**Attention:**	David Bissell	**Superseded Report:**	

Chromatogram

Analysis: EPH CWG (Aliphatic) GC (S)

Sample No : 5647954
Sample ID : BH118/01

Depth : 2.00



CERTIFICATE OF ANALYSIS

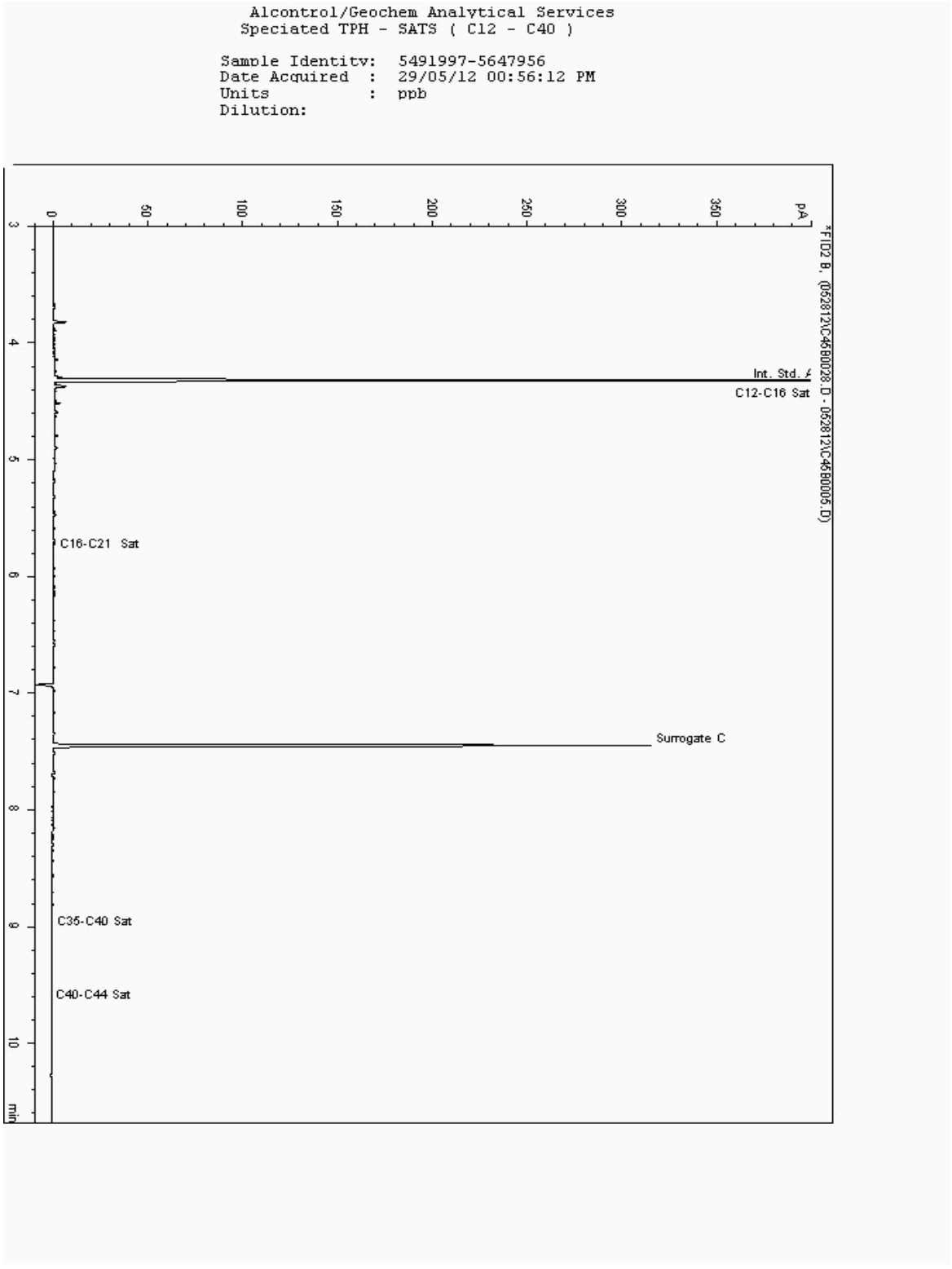
SDG:	120519-6	**Location:**	Alconbury	**Order Number:**	bc5501327
Job:	H_PBRETT_NNT-11	**Customer:**	Peter Brett Associates	**Report Number:**	182820
Client Reference:	24213/017	**Attention:**	David Bissell	**Superseded Report:**	

Chromatogram

Analysis: EPH CWG (Aliphatic) GC (S)

Sample No : 5647956
Sample ID : BH118/02

Depth : 2.00



CERTIFICATE OF ANALYSIS

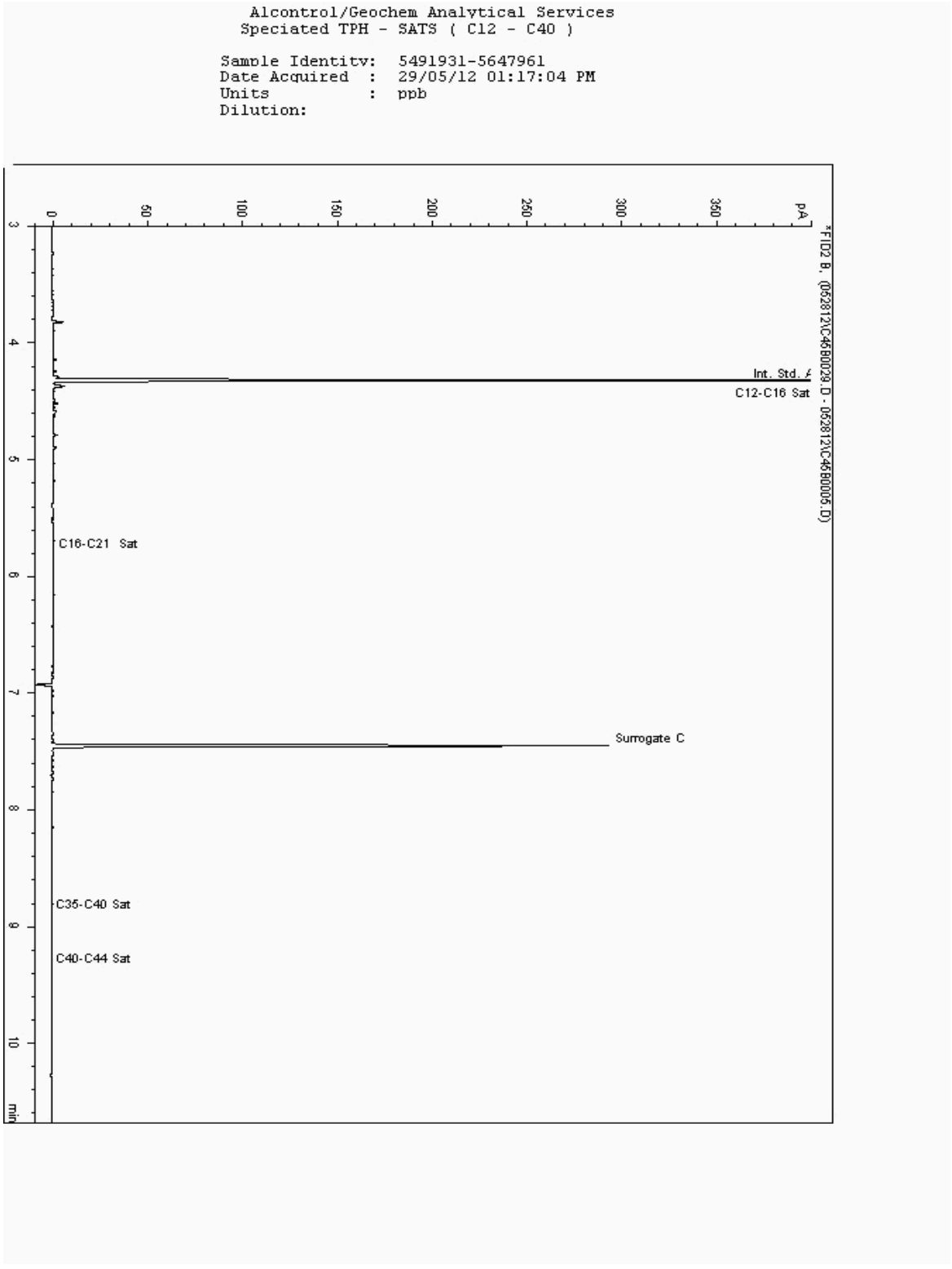
SDG:	120519-6	**Location:**	Alconbury	**Order Number:**	bc5501327
Job:	H_PBRETT_NNT-11	**Customer:**	Peter Brett Associates	**Report Number:**	182820
Client Reference:	24213/017	**Attention:**	David Bissell	**Superseded Report:**	

Chromatogram

Analysis: EPH CWG (Aliphatic) GC (S)

Sample No : 5647961
Sample ID : BH118/01

Depth : 1.20



CERTIFICATE OF ANALYSIS

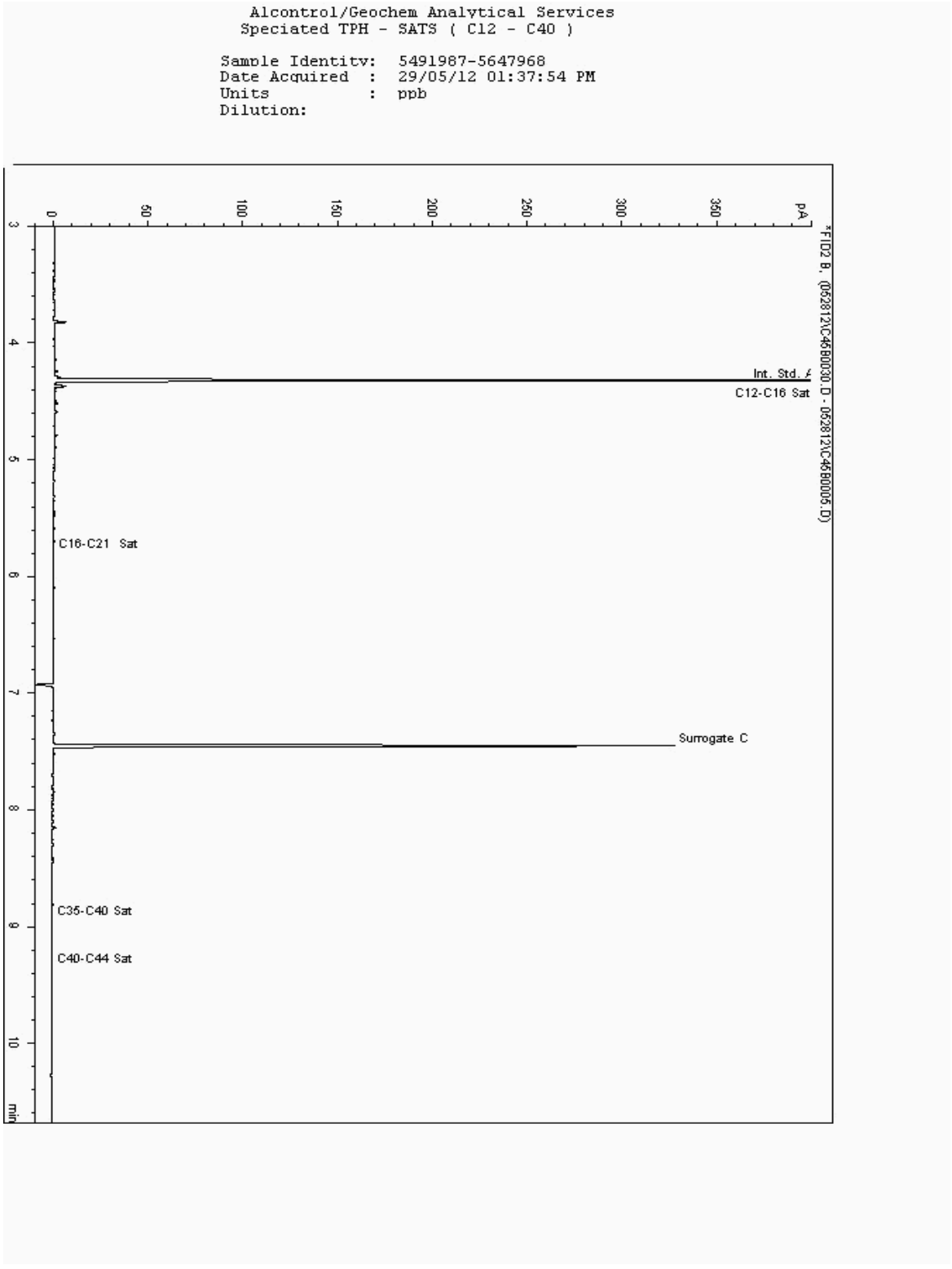
SDG:	120519-6	**Location:**	Alconbury	**Order Number:**	bc5501327
Job:	H_PBRETT_NNT-11	**Customer:**	Peter Brett Associates	**Report Number:**	182820
Client Reference:	24213/017	**Attention:**	David Bissell	**Superseded Report:**	

Chromatogram

Analysis: EPH CWG (Aliphatic) GC (S)

Sample No : 5647968
Sample ID : BH118/02

Depth : 1.20



CERTIFICATE OF ANALYSIS

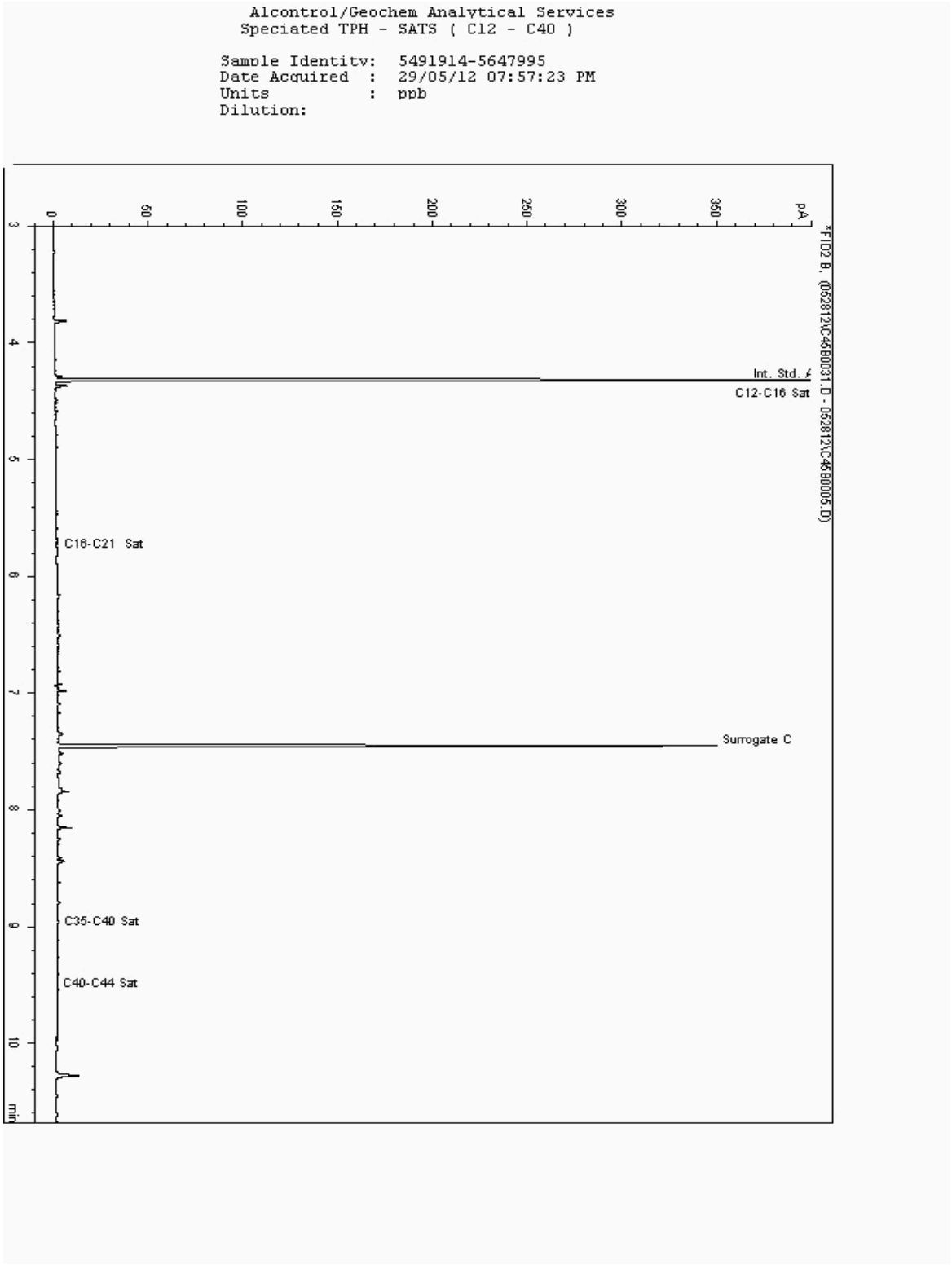
SDG:	120519-6	**Location:**	Alconbury	**Order Number:**	bc5501327
Job:	H_PBRETT_NNT-11	**Customer:**	Peter Brett Associates	**Report Number:**	182820
Client Reference:	24213/017	**Attention:**	David Bissell	**Superseded Report:**	

Chromatogram

Analysis: EPH CWG (Aliphatic) GC (S)

Sample No : 5647995
Sample ID : BH118/01

Depth : 0.20



CERTIFICATE OF ANALYSIS

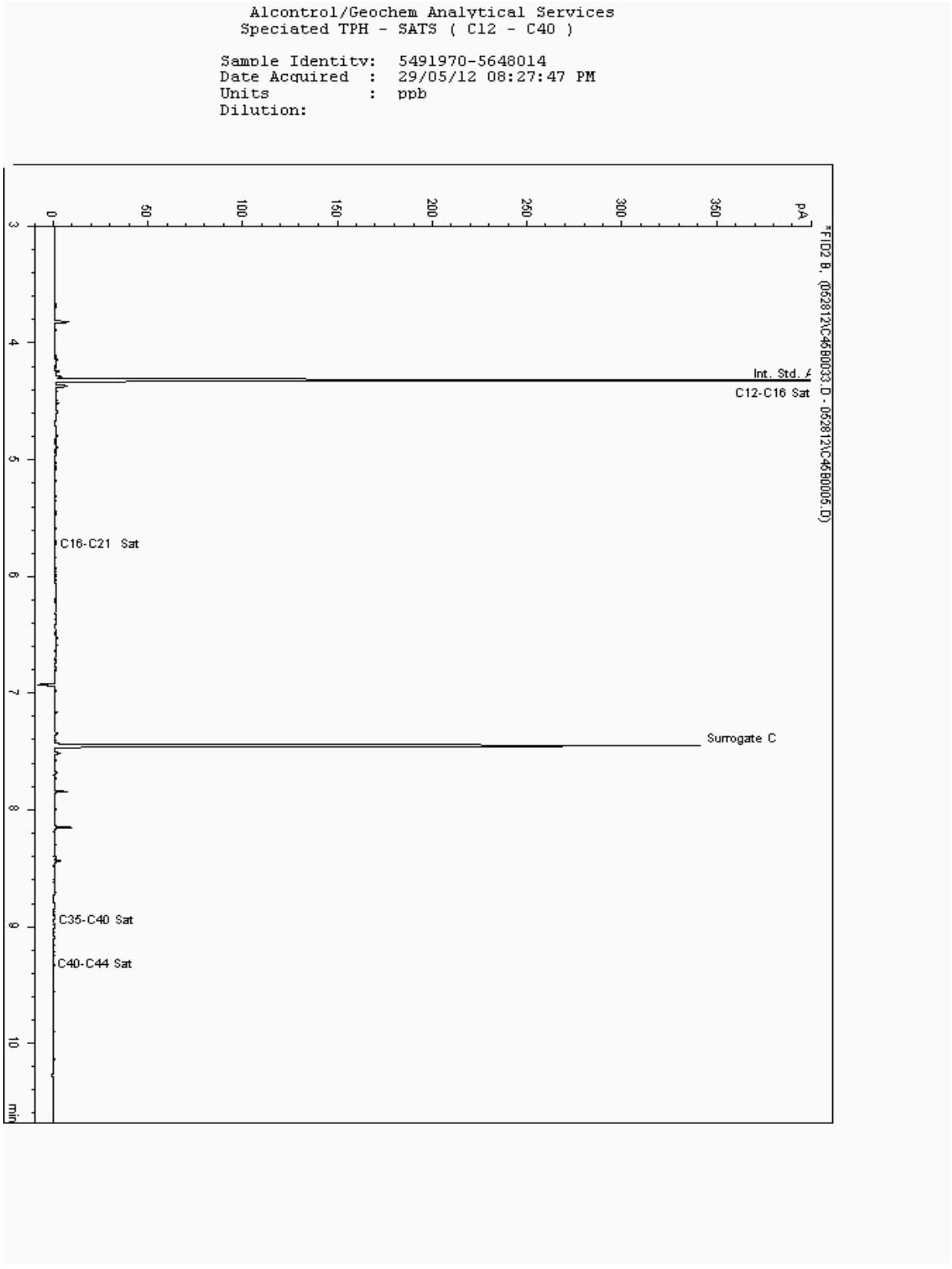
SDG:	120519-6	**Location:**	Alconbury	**Order Number:**	bc5501327
Job:	H_PBRETT_NNT-11	**Customer:**	Peter Brett Associates	**Report Number:**	182820
Client Reference:	24213/017	**Attention:**	David Bissell	**Superseded Report:**	

Chromatogram

Analysis: EPH CWG (Aliphatic) GC (S)

Sample No : 5648014
Sample ID : BH118/02

Depth : 0.25



CERTIFICATE OF ANALYSIS

SDG:	120519-6	**Location:**	Alconbury	**Order Number:**	bc5501327
Job:	H_PBRETT_NNT-11	**Customer:**	Peter Brett Associates	**Report Number:**	182820
Client Reference:	24213/017	**Attention:**	David Bissell	**Superseded Report:**	

Chromatogram

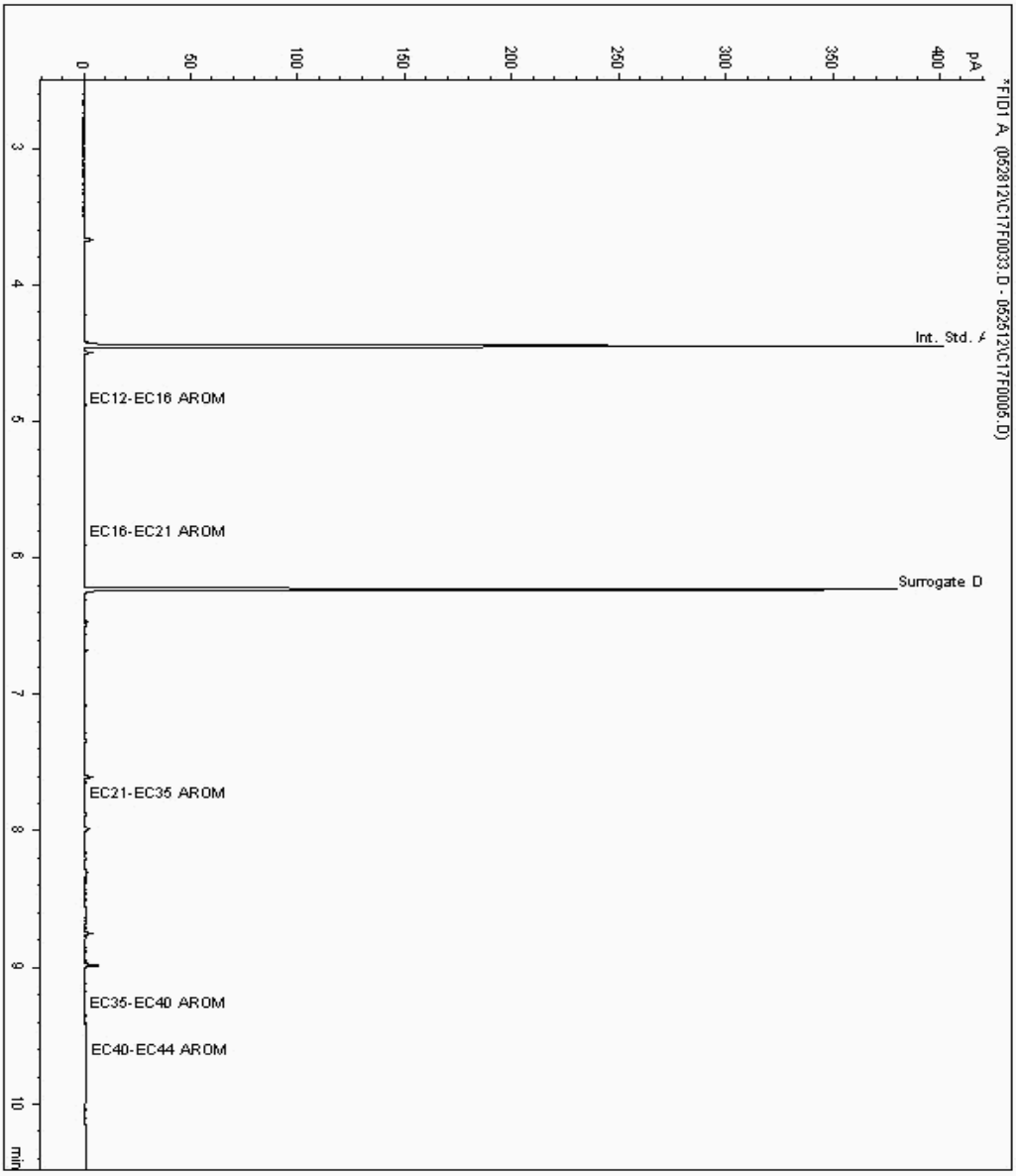
Analysis: EPH CWG (Aromatic) GC (S)

Sample No : 5646077
Sample ID : BH118/03

Depth : 3.20

Alcontrol/Geochem Analytical Services
Speciated TPH - AROM (C12 - C40)

Sample Identity: 5492060-5646077
Date Acquired : 29/05/2012 01:39:04 PM
Units : ppb
Dilution :
CF : 1
Multiplier : 1.040



CERTIFICATE OF ANALYSIS

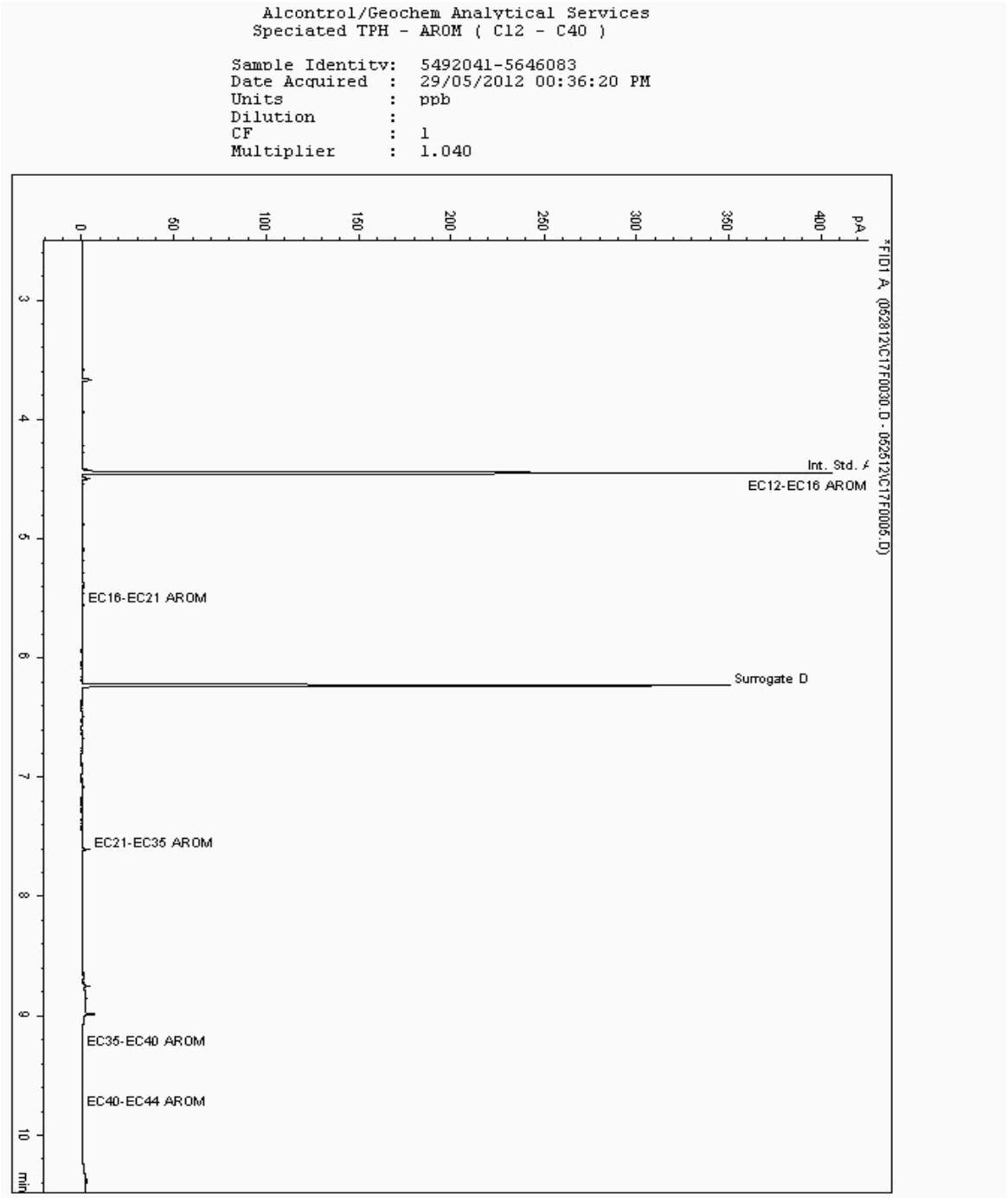
SDG:	120519-6	**Location:**	Alconbury	**Order Number:**	bc5501327
Job:	H_PBRETT_NNT-11	**Customer:**	Peter Brett Associates	**Report Number:**	182820
Client Reference:	24213/017	**Attention:**	David Bissell	**Superseded Report:**	

Chromatogram

Analysis: EPH CWG (Aromatic) GC (S)

Sample No : 5646083
Sample ID : BH118/03

Depth : 1.20



CERTIFICATE OF ANALYSIS

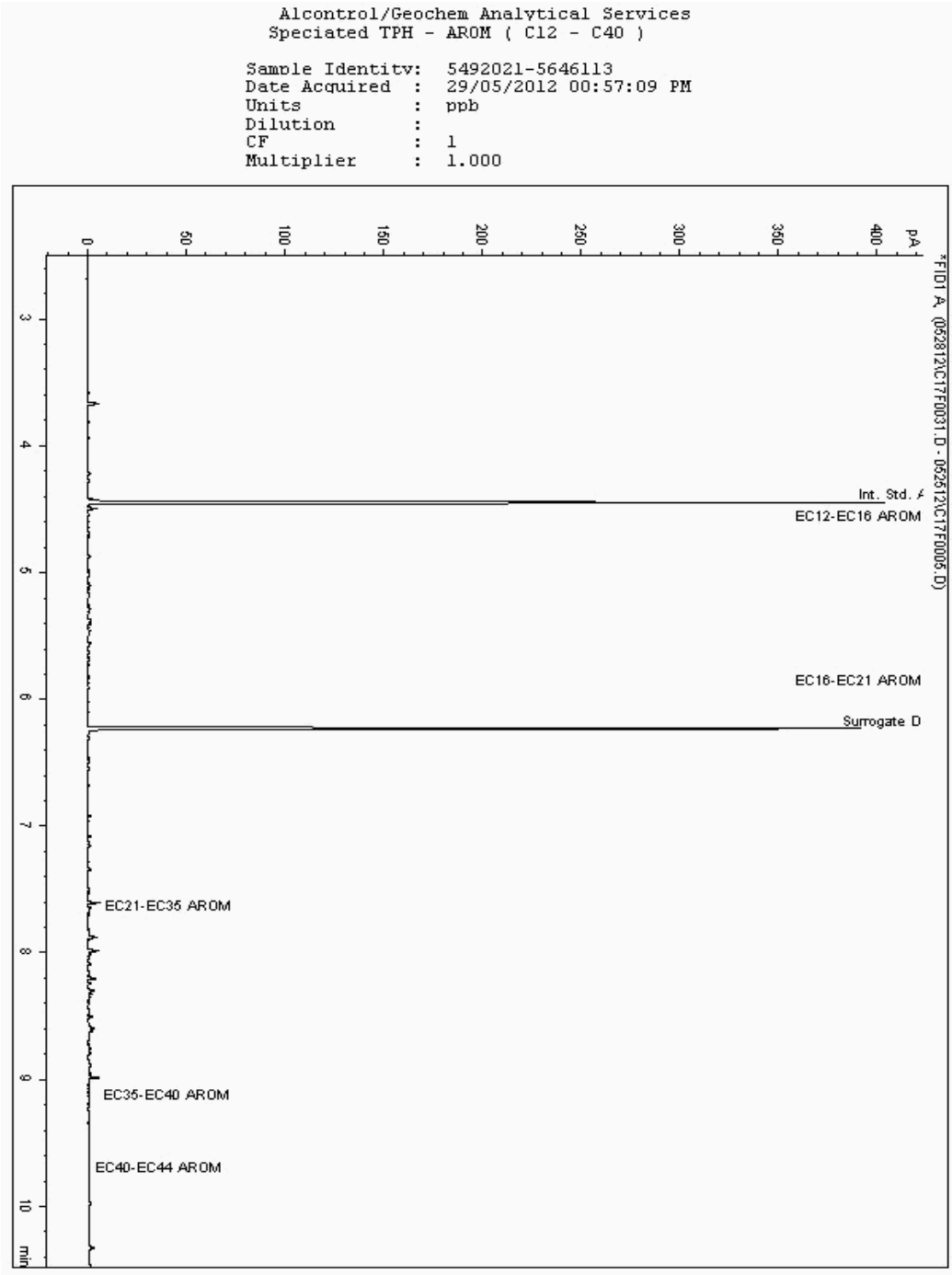
SDG:	120519-6	**Location:**	Alconbury	**Order Number:**	bc5501327
Job:	H_PBRETT_NNT-11	**Customer:**	Peter Brett Associates	**Report Number:**	182820
Client Reference:	24213/017	**Attention:**	David Bissell	**Superseded Report:**	

Chromatogram

Analysis: EPH CWG (Aromatic) GC (S)

Sample No : 5646113
Sample ID : BH118/03

Depth : 0.20



CERTIFICATE OF ANALYSIS

SDG:	120519-6	**Location:**	Alconbury	**Order Number:**	bc5501327
Job:	H_PBRETT_NNT-11	**Customer:**	Peter Brett Associates	**Report Number:**	182820
Client Reference:	24213/017	**Attention:**	David Bissell	**Superseded Report:**	

Chromatogram

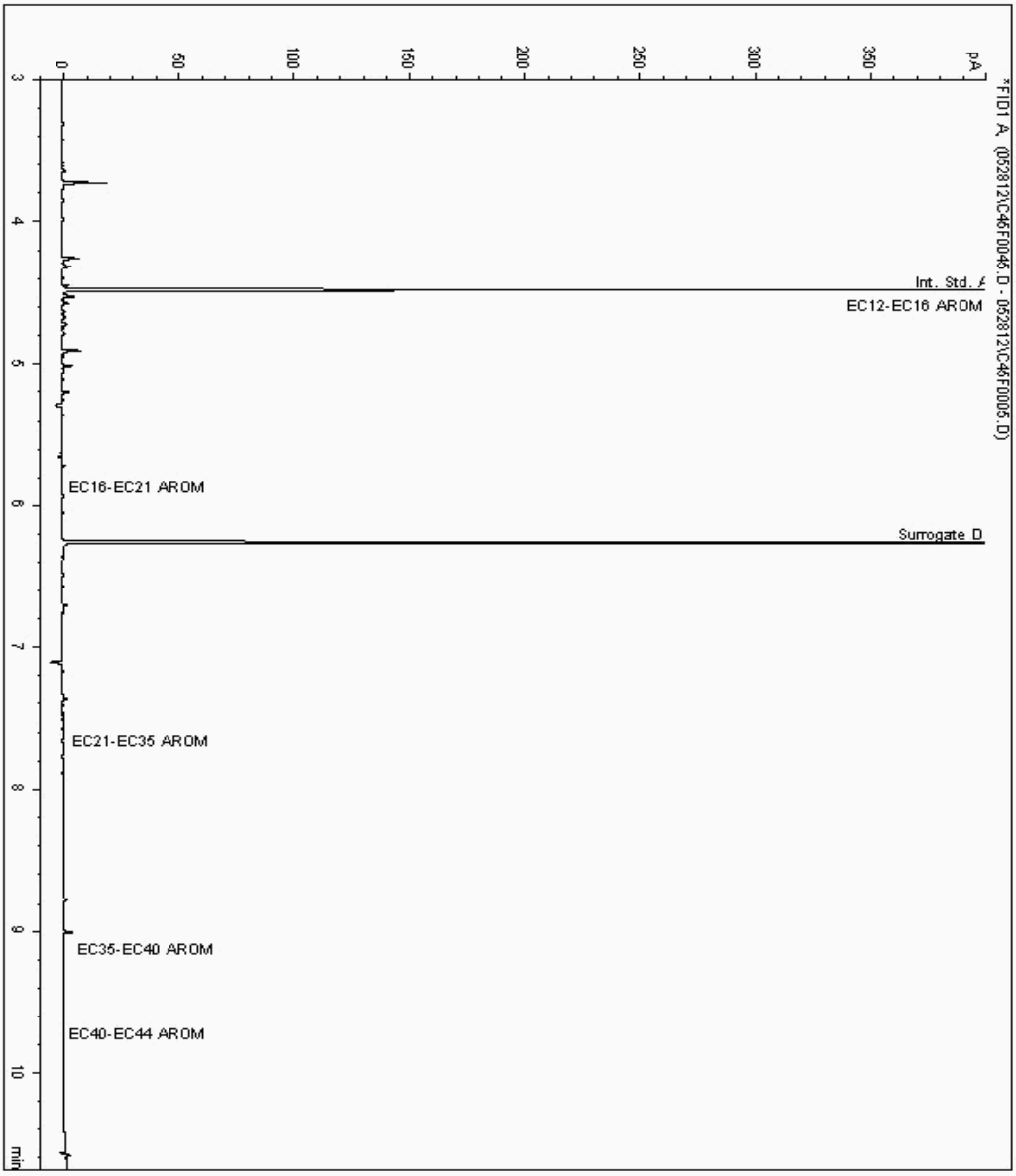
Analysis: EPH CWG (Aromatic) GC (S)

Sample No : 5646855
Sample ID : BH118/03

Depth : 2.00

Alcontrol/Geochem Analytical Services
Speciated TPH - AROM (C12 - C40)

Sample Identity: 5492051-5646855
Date Acquired : 29/05/12 12:17:20 PM
Units : ppb
Dilution:



CERTIFICATE OF ANALYSIS

SDG:	120519-6	**Location:**	Alconbury	**Order Number:**	bc5501327
Job:	H_PBRETT_NNT-11	**Customer:**	Peter Brett Associates	**Report Number:**	182820
Client Reference:	24213/017	**Attention:**	David Bissell	**Superseded Report:**	

Chromatogram

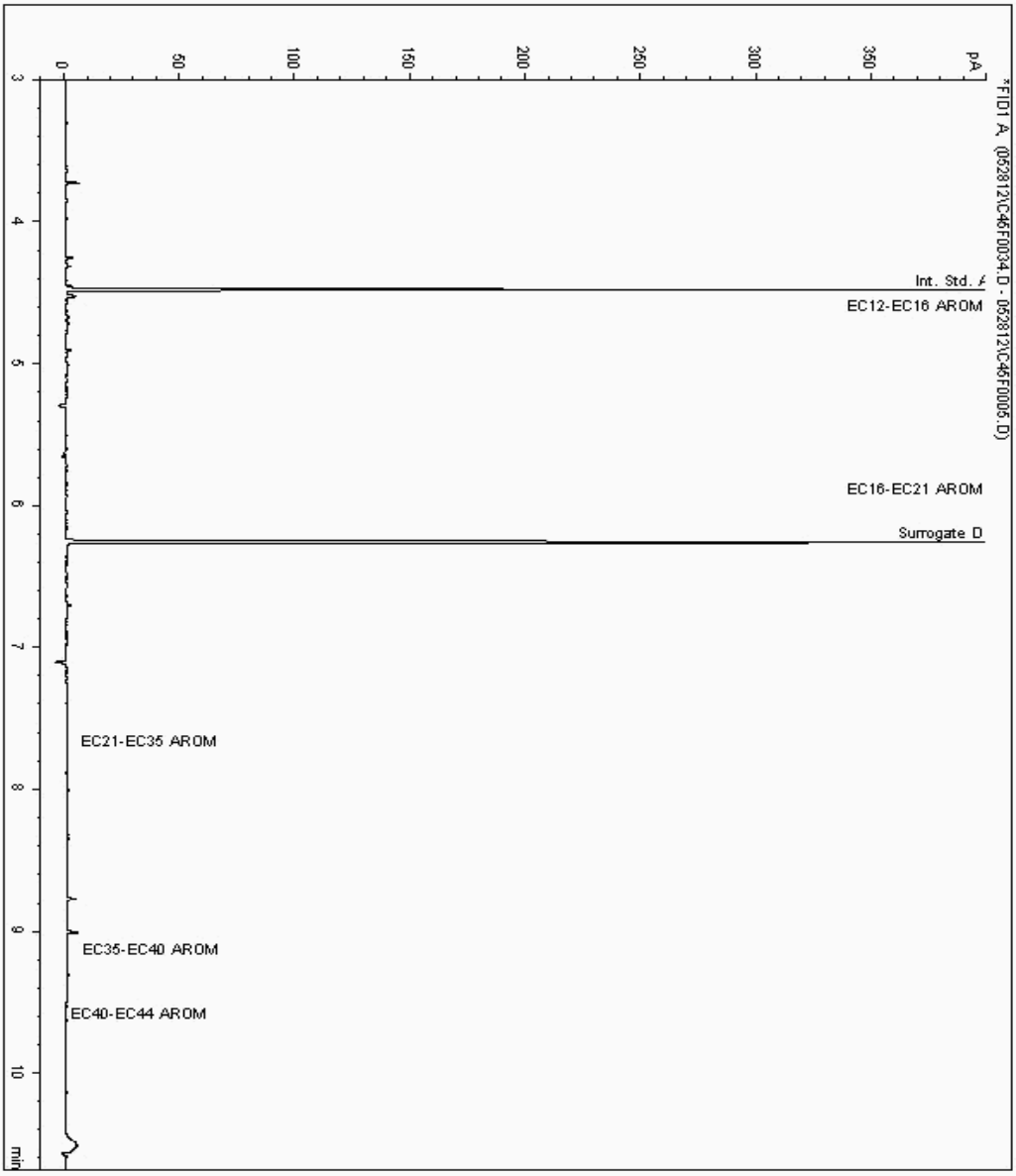
Analysis: EPH CWG (Aromatic) GC (S)

Sample No : 5647950
Sample ID : BH118/01

Depth : 3.50

Alcontrol/Geochem Analytical Services
Speciated TPH - AROM (C12 - C40)

Sample Identity: 5491956-5647950
Date Acquired : 29/05/12 08:48:01 PM
Units : ppb
Dilution:



CERTIFICATE OF ANALYSIS

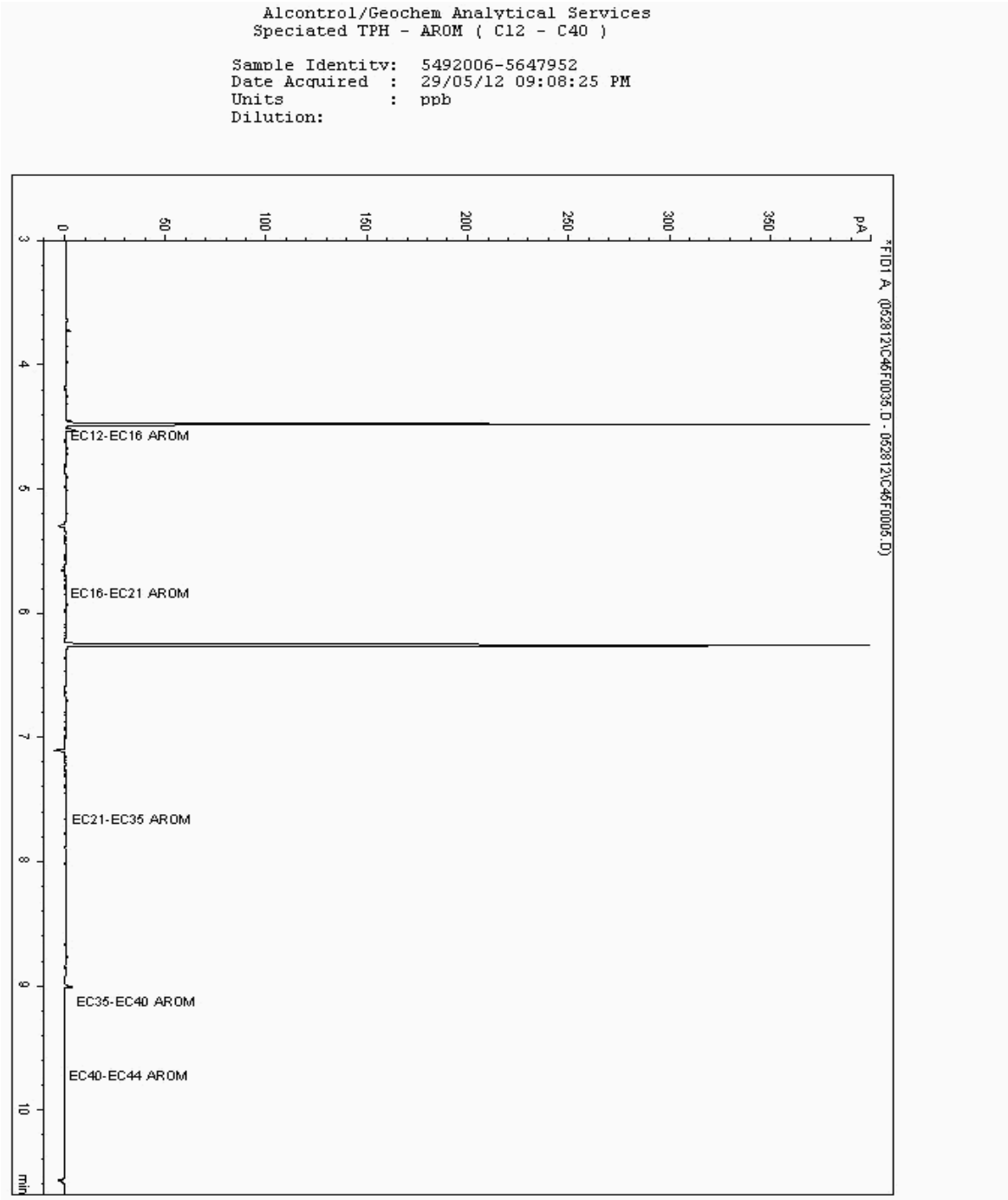
SDG:	120519-6	**Location:**	Alconbury	**Order Number:**	bc5501327
Job:	H_PBRETT_NNT-11	**Customer:**	Peter Brett Associates	**Report Number:**	182820
Client Reference:	24213/017	**Attention:**	David Bissell	**Superseded Report:**	

Chromatogram

Analysis: EPH CWG (Aromatic) GC (S)

Sample No : 5647952
Sample ID : BH118/02

Depth : 3.20



CERTIFICATE OF ANALYSIS

SDG:	120519-6	**Location:**	Alconbury	**Order Number:**	bc5501327
Job:	H_PBRETT_NNT-11	**Customer:**	Peter Brett Associates	**Report Number:**	182820
Client Reference:	24213/017	**Attention:**	David Bissell	**Superseded Report:**	

Chromatogram

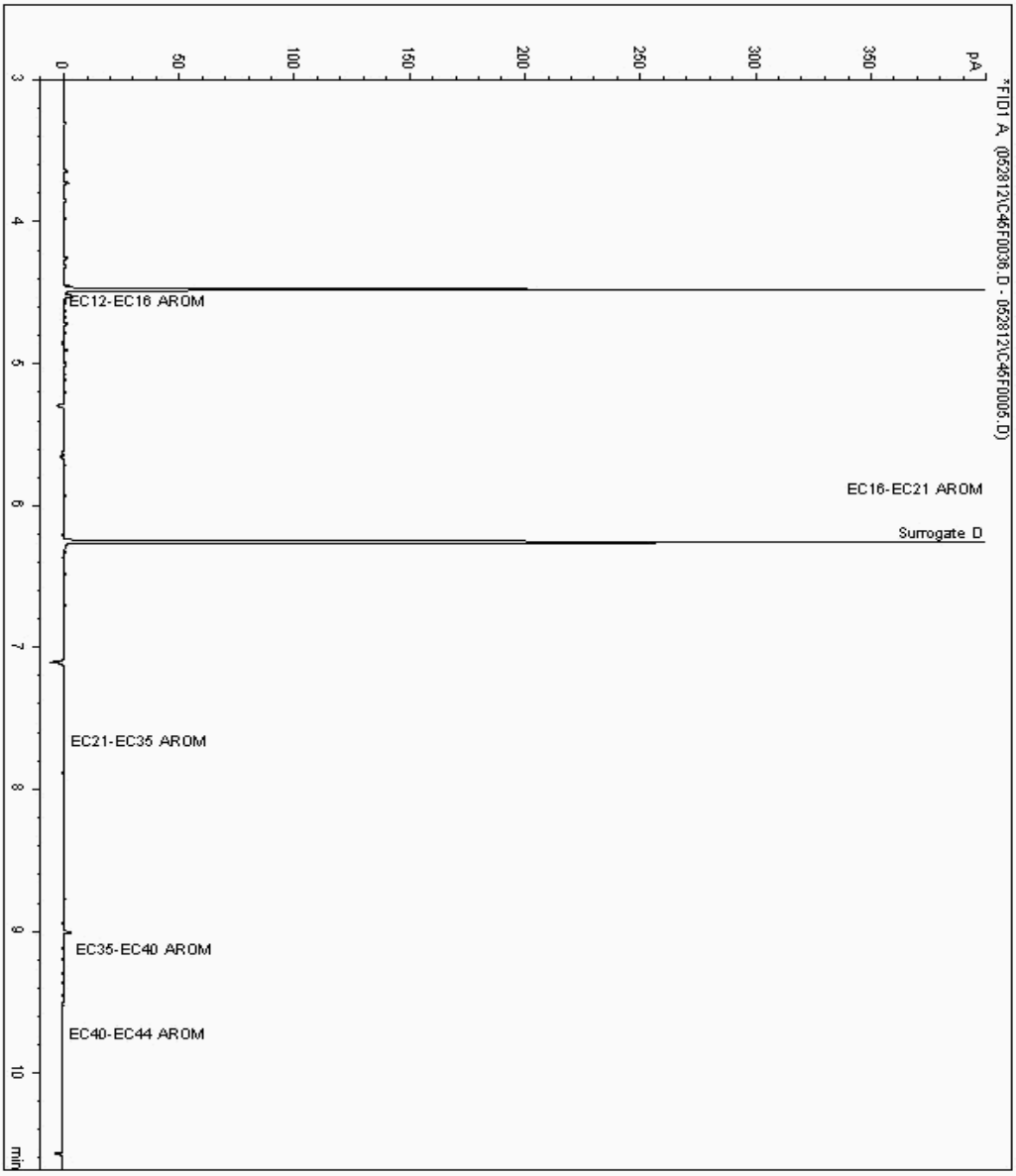
Analysis: EPH CWG (Aromatic) GC (S)

Sample No : 5647954
Sample ID : BH118/01

Depth : 2.00

Alcontrol/Geochem Analytical Services
Speciated TPH - AROM (C12 - C40)

Sample Identity: 5491947-5647954
Date Acquired : 29/05/12 09:28:34 PM
Units : ppb
Dilution:



CERTIFICATE OF ANALYSIS

SDG:	120519-6	**Location:**	Alconbury	**Order Number:**	bc5501327
Job:	H_PBRETT_NNT-11	**Customer:**	Peter Brett Associates	**Report Number:**	182820
Client Reference:	24213/017	**Attention:**	David Bissell	**Superseded Report:**	

Chromatogram

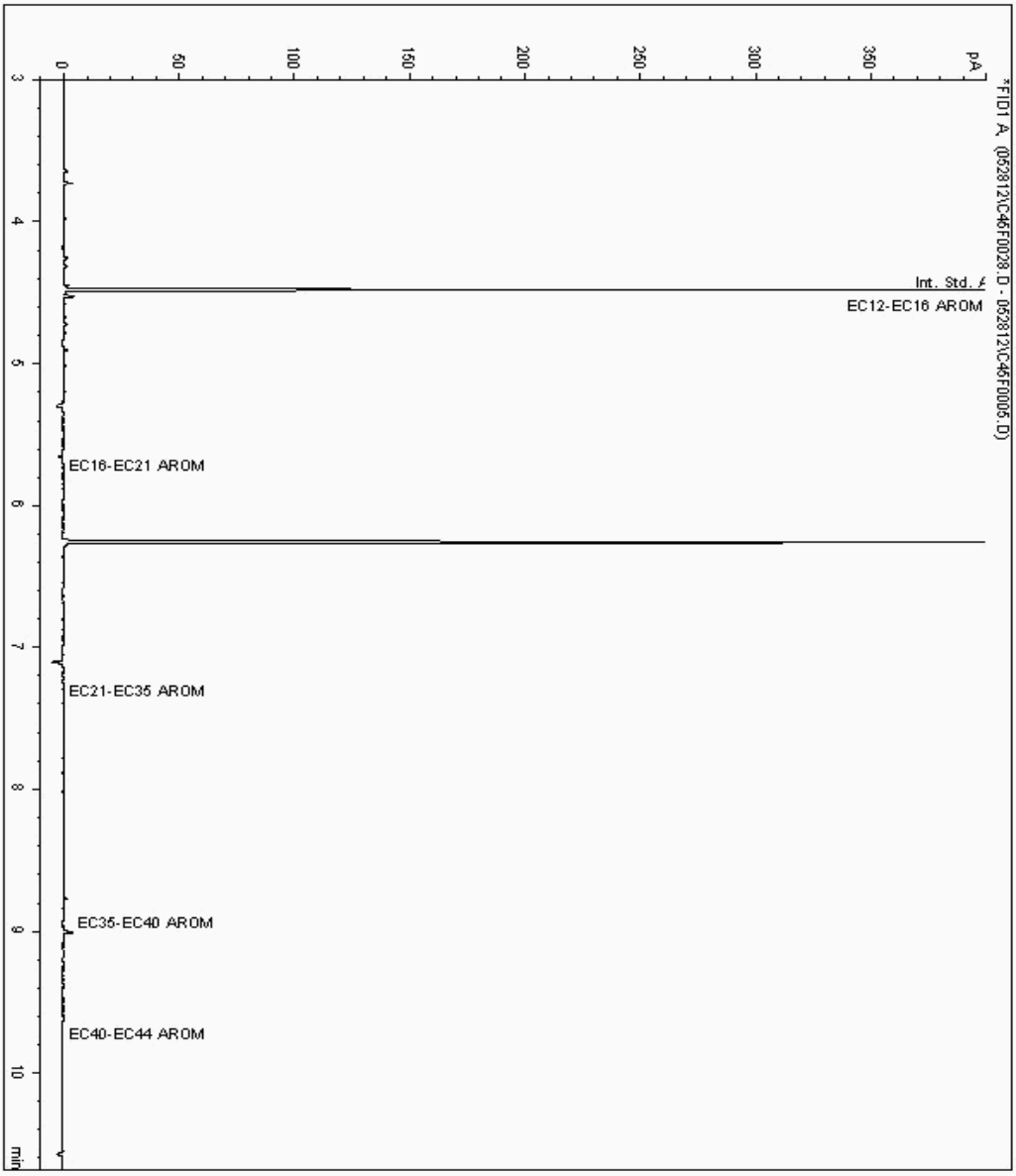
Analysis: EPH CWG (Aromatic) GC (S)

Sample No : 5647956
Sample ID : BH118/02

Depth : 2.00

Alcontrol/Geochem Analytical Services
Speciated TPH - AROM (C12 - C40)

Sample Identity: 5491998-5647956
Date Acquired : 29/05/12 00:56:12 PM
Units : ppb
Dilution:



CERTIFICATE OF ANALYSIS

SDG:	120519-6	**Location:**	Alconbury	**Order Number:**	bc5501327
Job:	H_PBRETT_NNT-11	**Customer:**	Peter Brett Associates	**Report Number:**	182820
Client Reference:	24213/017	**Attention:**	David Bissell	**Superseded Report:**	

Chromatogram

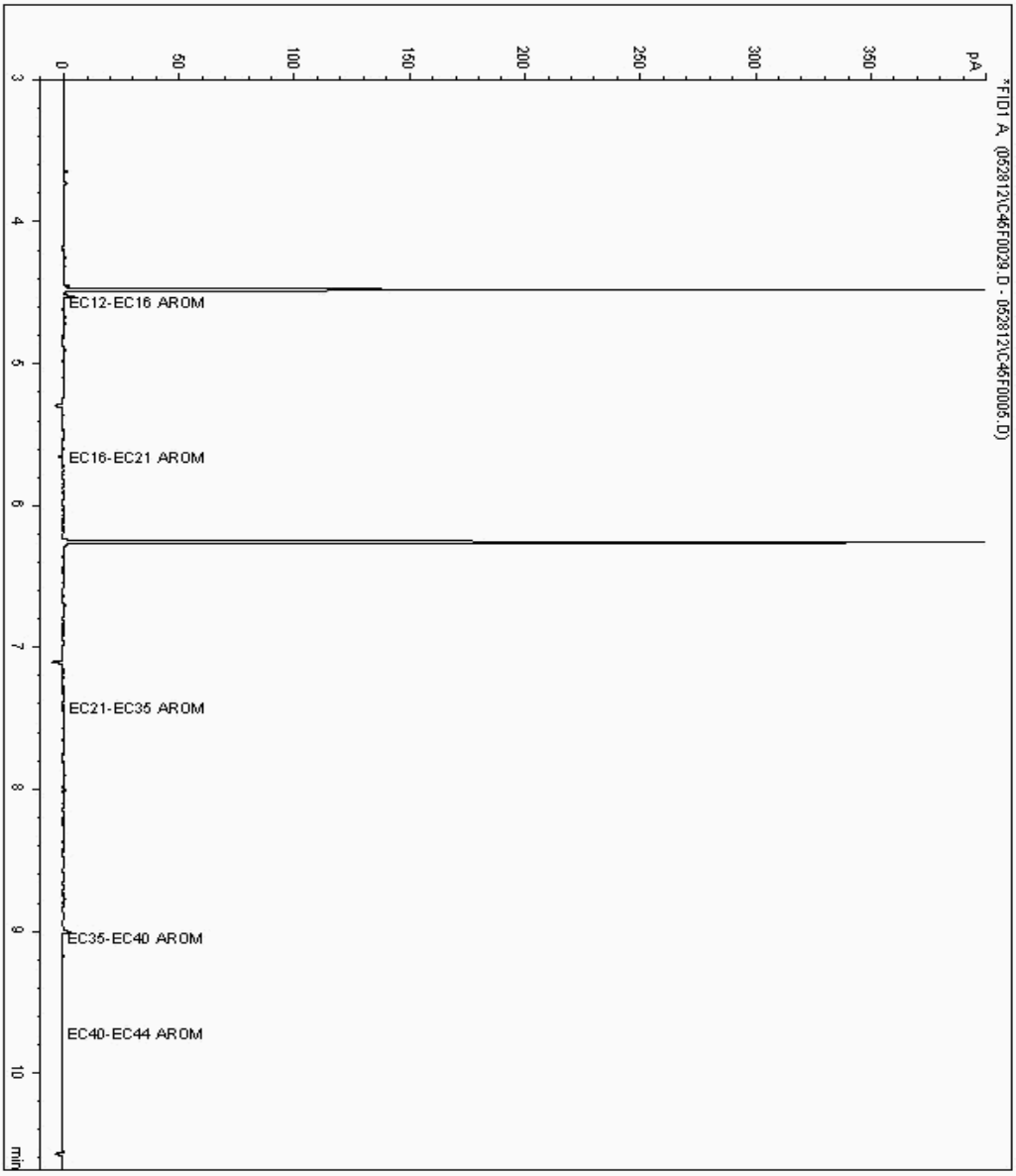
Analysis: EPH CWG (Aromatic) GC (S)

Sample No : 5647961
Sample ID : BH118/01

Depth : 1.20

Alcontrol/Geochem Analytical Services
Speciated TPH - AROM (C12 - C40)

Sample Identity: 5491932-5647961
Date Acquired : 29/05/12 01:17:04 PM
Units : ppb
Dilution:



CERTIFICATE OF ANALYSIS

SDG:	120519-6	**Location:**	Alconbury	**Order Number:**	bc5501327
Job:	H_PBRETT_NNT-11	**Customer:**	Peter Brett Associates	**Report Number:**	182820
Client Reference:	24213/017	**Attention:**	David Bissell	**Superseded Report:**	

Chromatogram

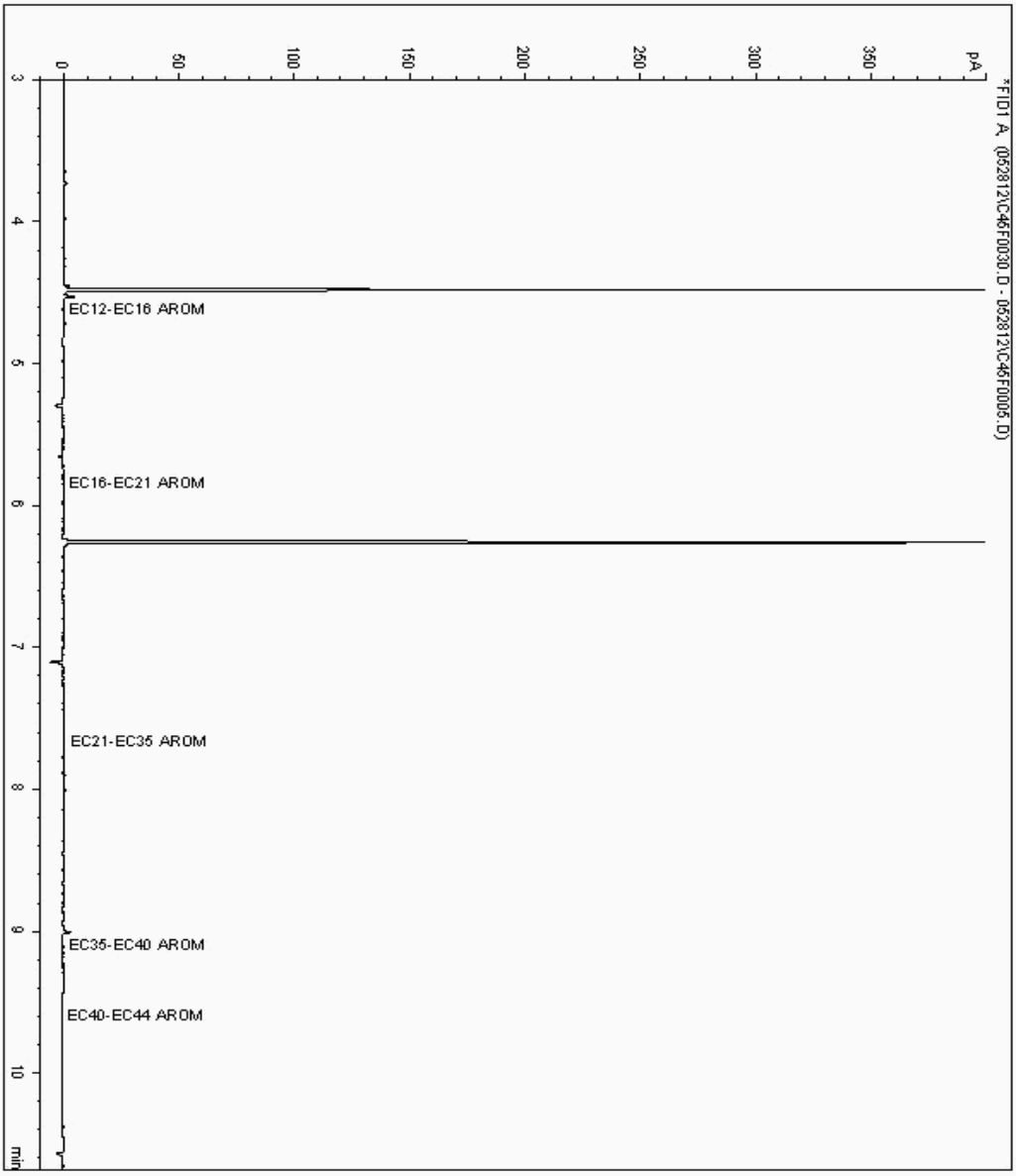
Analysis: EPH CWG (Aromatic) GC (S)

Sample No : 5647968
Sample ID : BH118/02

Depth : 1.20

Alcontrol/Geochem Analytical Services
Speciated TPH - AROM (C12 - C40)

Sample Identity: 5491988-5647968
Date Acquired : 29/05/12 01:37:54 PM
Units : ppb
Dilution:



CERTIFICATE OF ANALYSIS

SDG:	120519-6	**Location:**	Alconbury	**Order Number:**	bc5501327
Job:	H_PBRETT_NNT-11	**Customer:**	Peter Brett Associates	**Report Number:**	182820
Client Reference:	24213/017	**Attention:**	David Bissell	**Superseded Report:**	

Chromatogram

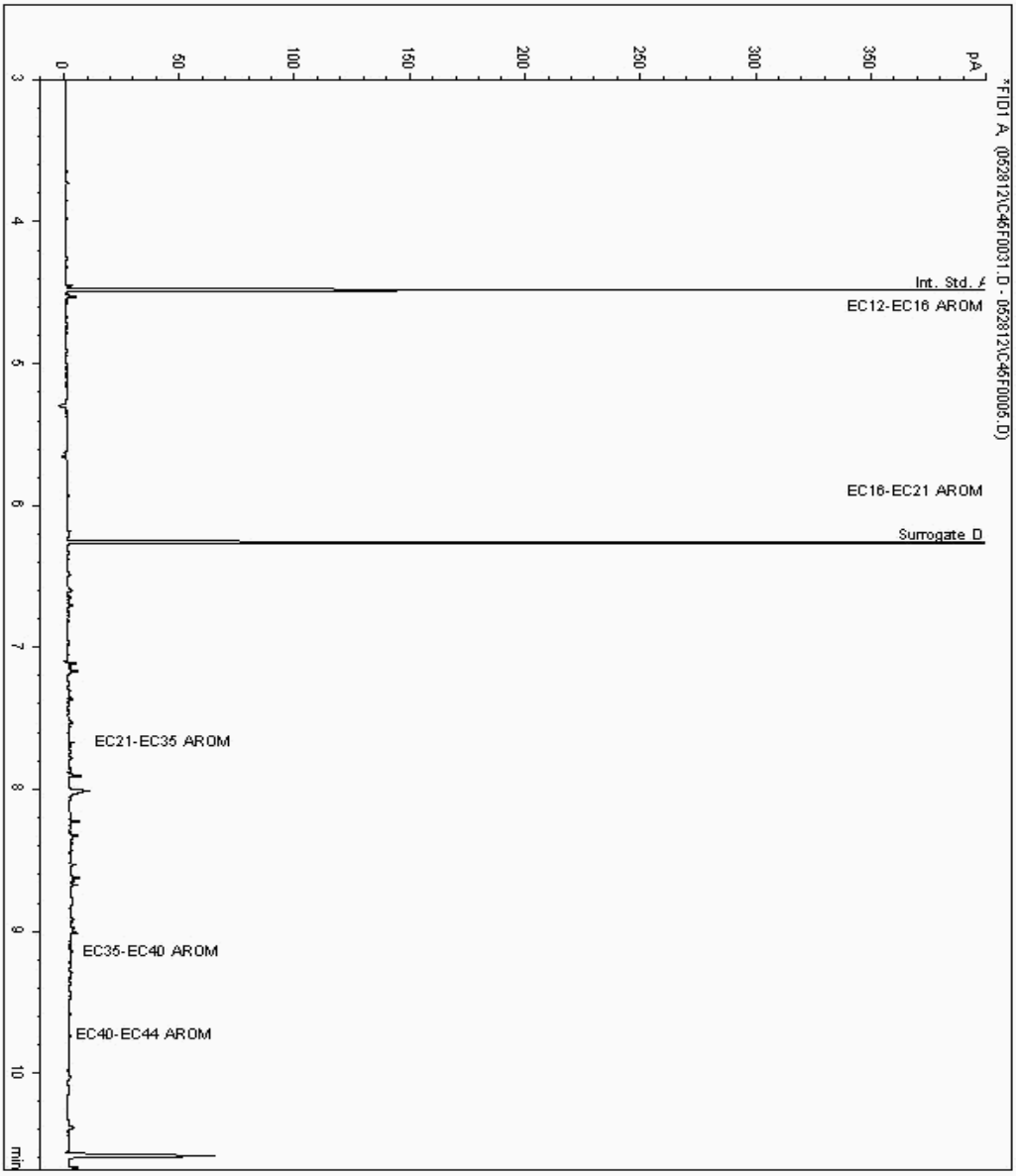
Analysis: EPH CWG (Aromatic) GC (S)

Sample No : 5647995
Sample ID : BH118/01

Depth : 0.20

Alcontrol/Geochem Analytical Services
Speciated TPH - AROM (C12 - C40)

Sample Identity: 5491915-5647995
Date Acquired : 29/05/12 07:57:22 PM
Units : ppb
Dilution:



CERTIFICATE OF ANALYSIS

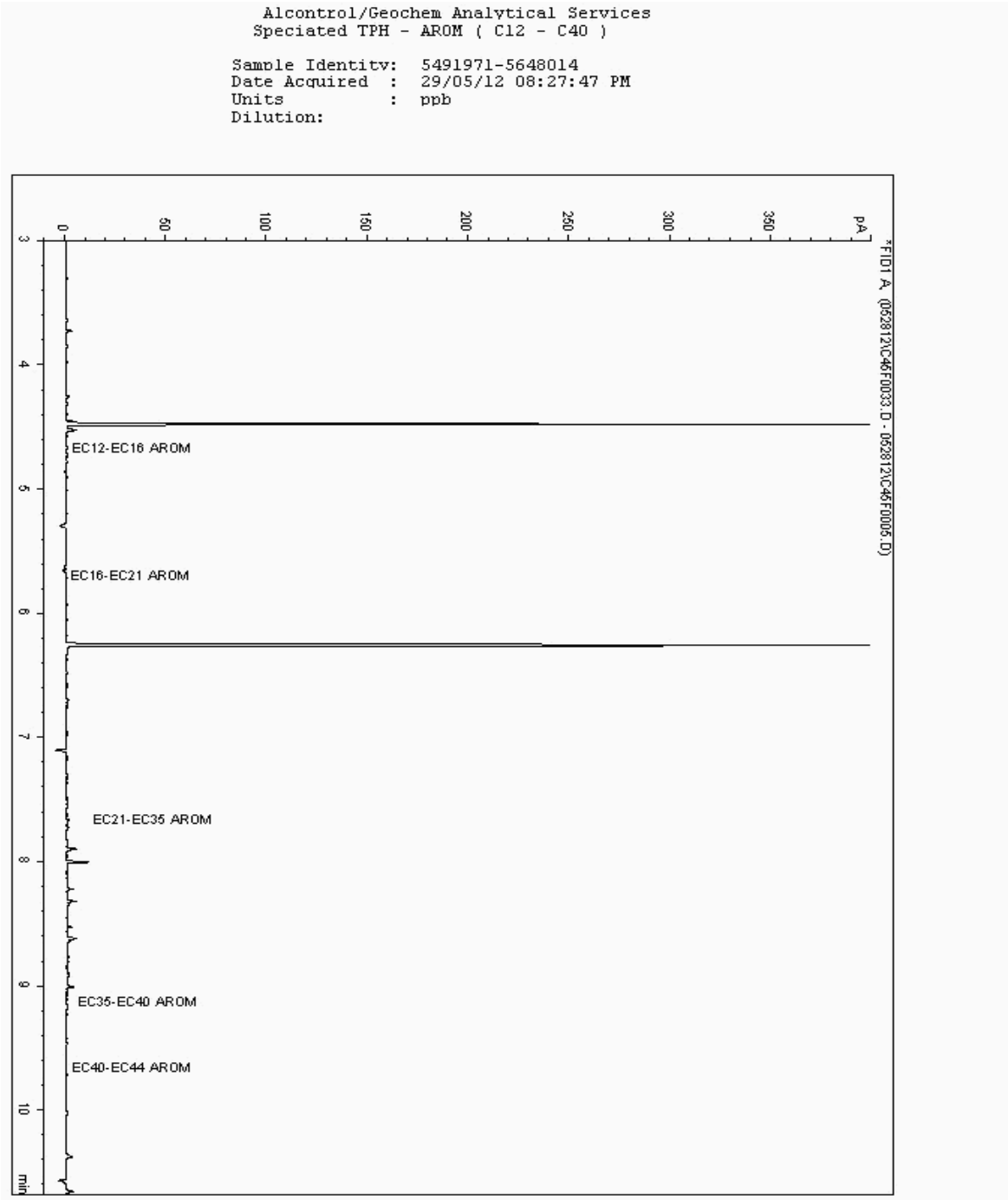
SDG:	120519-6	**Location:**	Alconbury	**Order Number:**	bc5501327
Job:	H_PBRETT_NNT-11	**Customer:**	Peter Brett Associates	**Report Number:**	182820
Client Reference:	24213/017	**Attention:**	David Bissell	**Superseded Report:**	

Chromatogram

Analysis: EPH CWG (Aromatic) GC (S)

Sample No : 5648014
Sample ID : BH118/02

Depth : 0.25



CERTIFICATE OF ANALYSIS

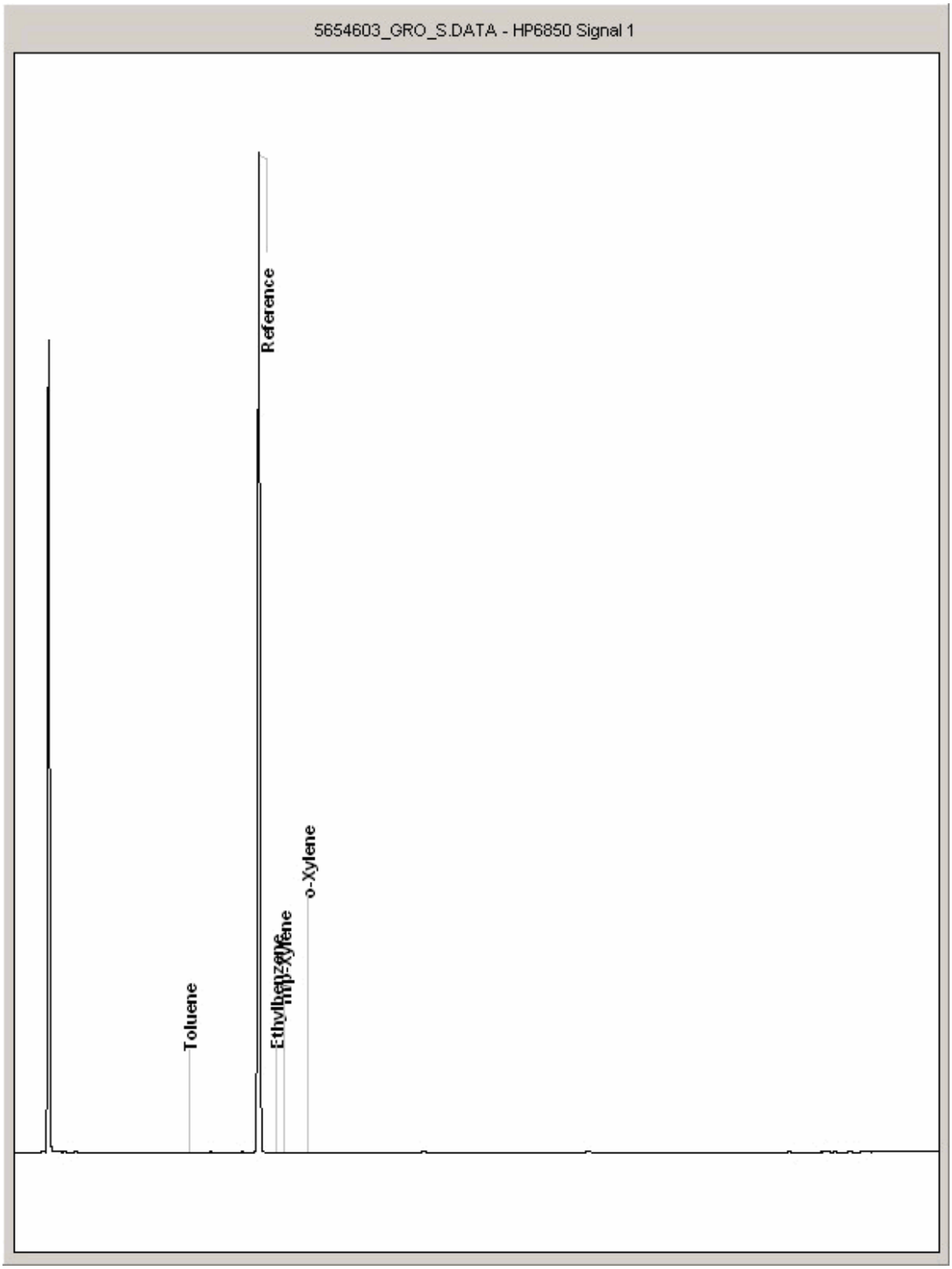
SDG:	120519-6	**Location:**	Alconbury	**Order Number:**	bc5501327
Job:	H_PBRETT_NNT-11	**Customer:**	Peter Brett Associates	**Report Number:**	182820
Client Reference:	24213/017	**Attention:**	David Bissell	**Superseded Report:**	

Chromatogram

Analysis: GRO by GC-FID (S)

Sample No : 5654603
Sample ID : BH118/01

Depth : 0.20



CERTIFICATE OF ANALYSIS

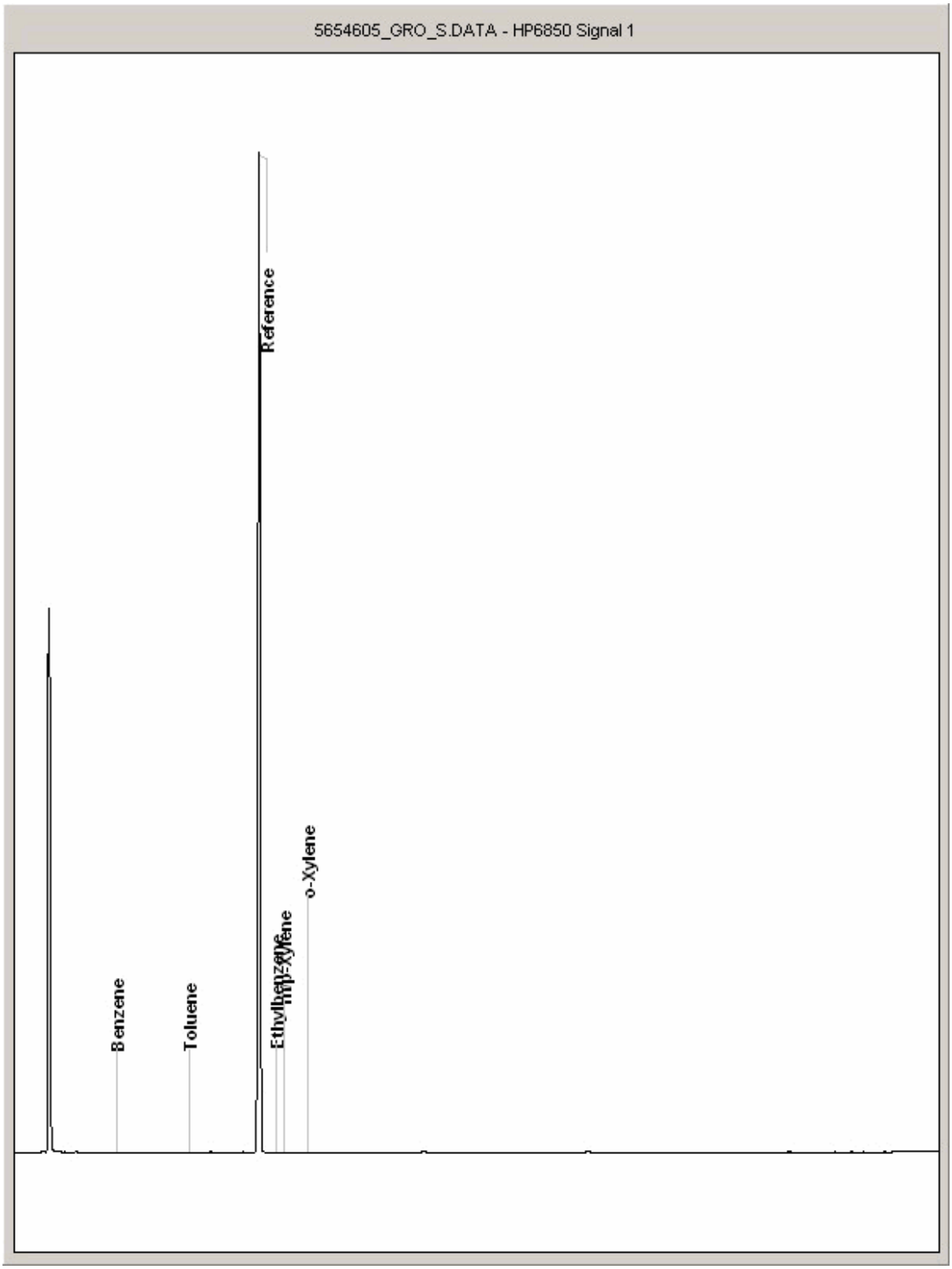
SDG:	120519-6	**Location:**	Alconbury	**Order Number:**	bc5501327
Job:	H_PBRETT_NNT-11	**Customer:**	Peter Brett Associates	**Report Number:**	182820
Client Reference:	24213/017	**Attention:**	David Bissell	**Superseded Report:**	

Chromatogram

Analysis: GRO by GC-FID (S)

Sample No : 5654605
Sample ID : BH118/01

Depth : 1.20



CERTIFICATE OF ANALYSIS

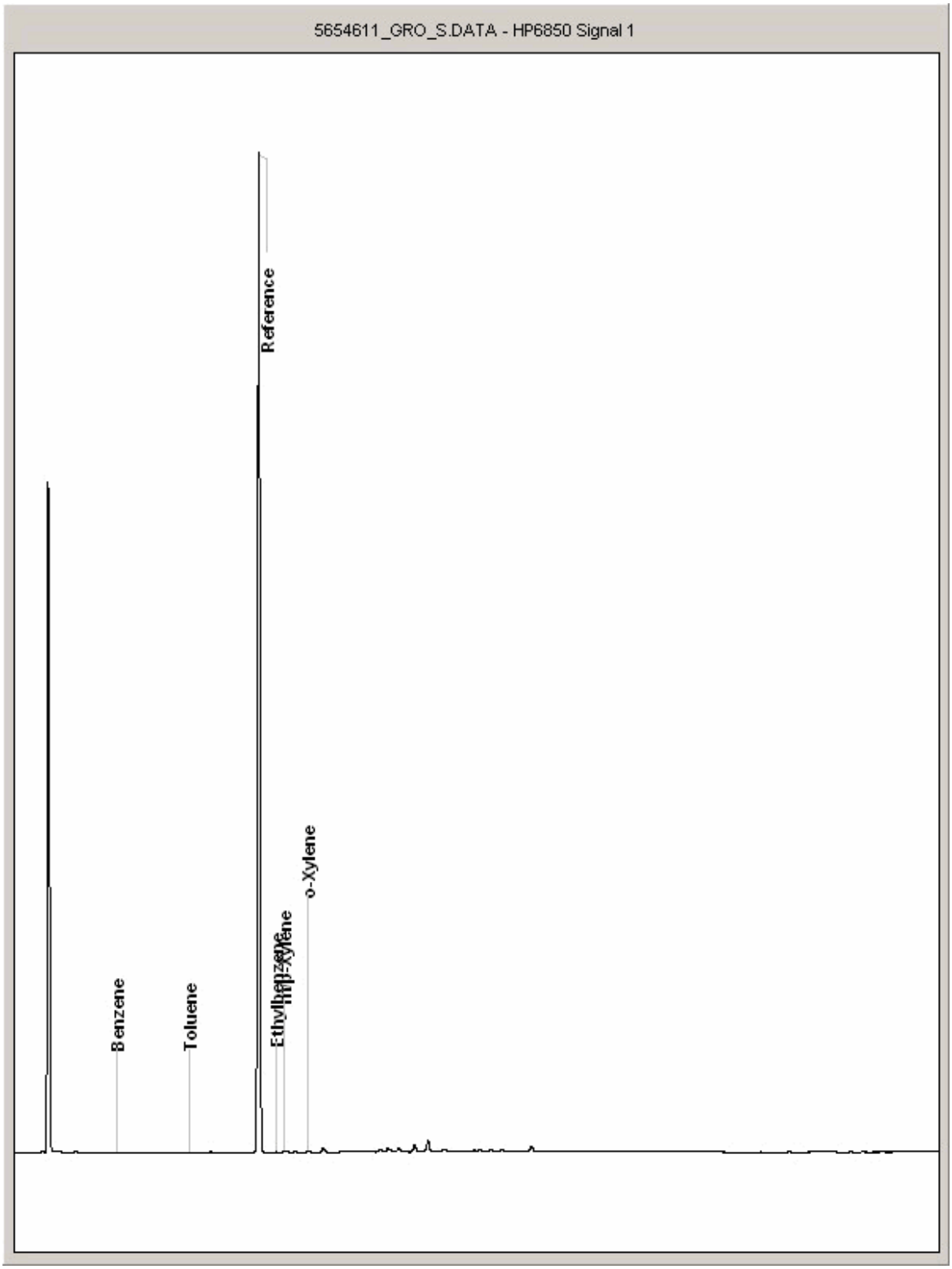
SDG:	120519-6	**Location:**	Alconbury	**Order Number:**	bc5501327
Job:	H_PBRETT_NNT-11	**Customer:**	Peter Brett Associates	**Report Number:**	182820
Client Reference:	24213/017	**Attention:**	David Bissell	**Superseded Report:**	

Chromatogram

Analysis: GRO by GC-FID (S)

Sample No : 5654611
Sample ID : BH118/01

Depth : 2.00



CERTIFICATE OF ANALYSIS

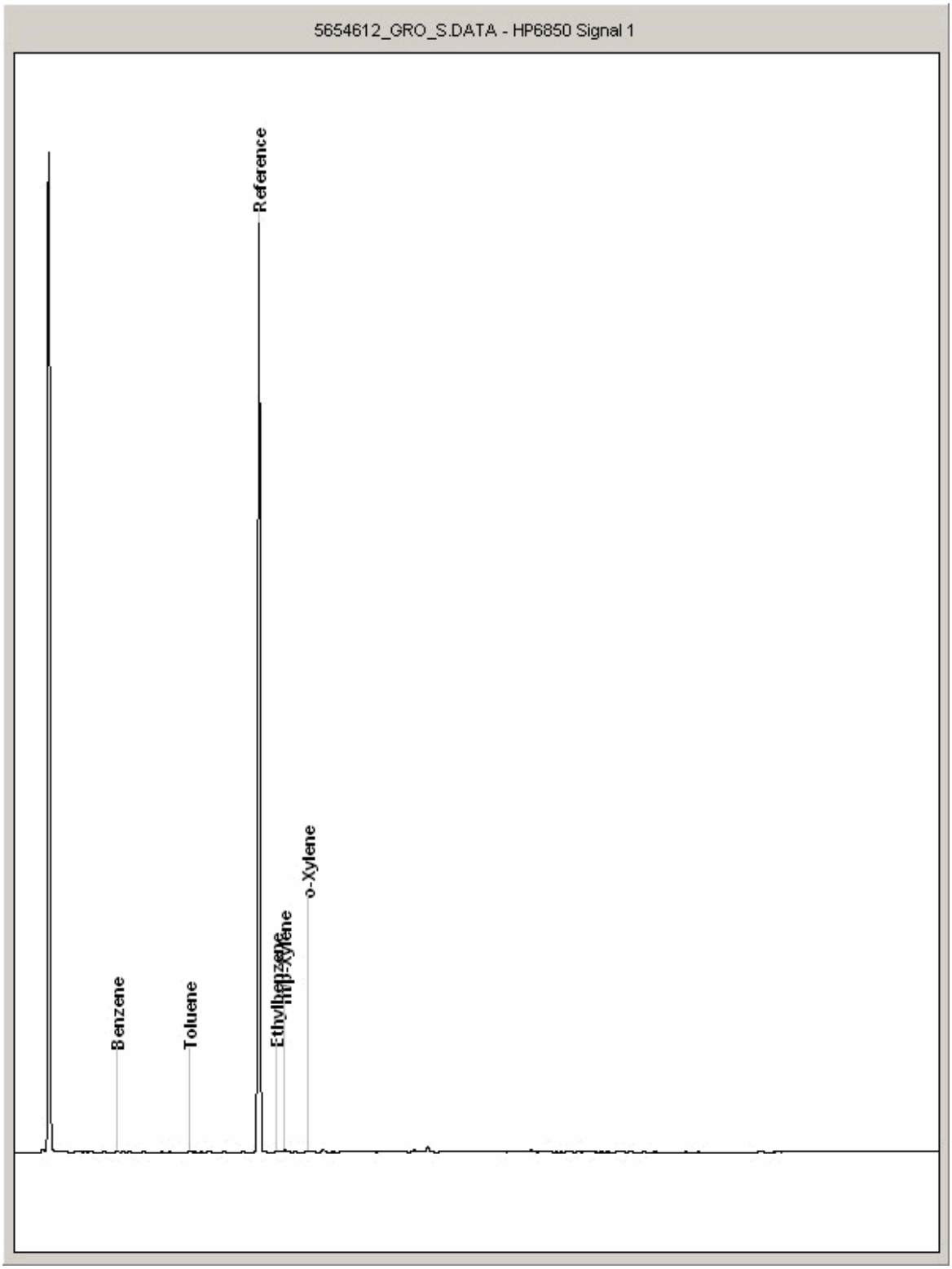
SDG:	120519-6	**Location:**	Alconbury	**Order Number:**	bc5501327
Job:	H_PBRETT_NNT-11	**Customer:**	Peter Brett Associates	**Report Number:**	182820
Client Reference:	24213/017	**Attention:**	David Bissell	**Superseded Report:**	

Chromatogram

Analysis: GRO by GC-FID (S)

Sample No : 5654612
Sample ID : BH118/01

Depth : 3.50



CERTIFICATE OF ANALYSIS

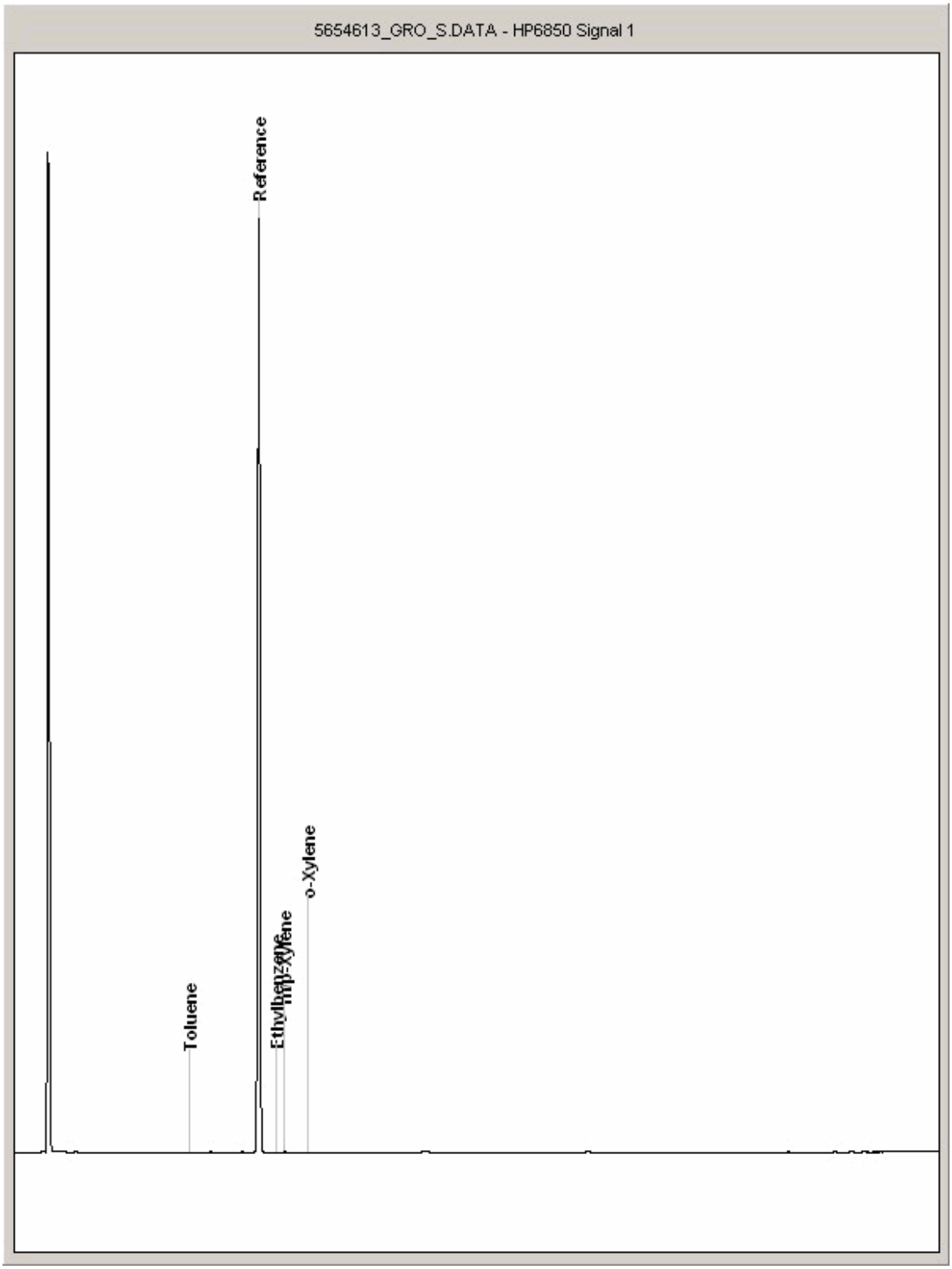
SDG:	120519-6	**Location:**	Alconbury	**Order Number:**	bc5501327
Job:	H_PBRETT_NNT-11	**Customer:**	Peter Brett Associates	**Report Number:**	182820
Client Reference:	24213/017	**Attention:**	David Bissell	**Superseded Report:**	

Chromatogram

Analysis: GRO by GC-FID (S)

Sample No : 5654613
Sample ID : BH118/02

Depth : 0.25



CERTIFICATE OF ANALYSIS

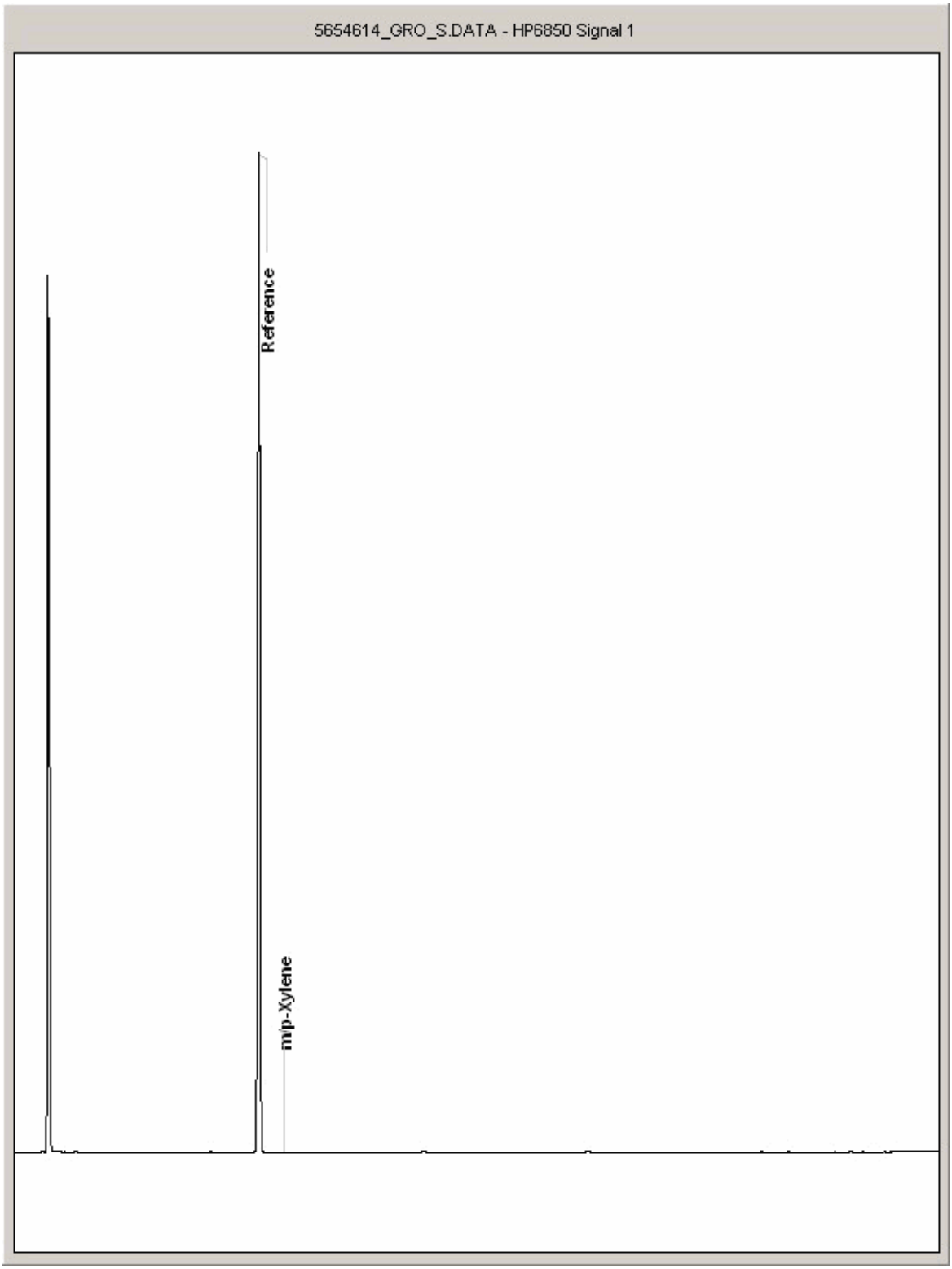
SDG:	120519-6	**Location:**	Alconbury	**Order Number:**	bc5501327
Job:	H_PBRETT_NNT-11	**Customer:**	Peter Brett Associates	**Report Number:**	182820
Client Reference:	24213/017	**Attention:**	David Bissell	**Superseded Report:**	

Chromatogram

Analysis: GRO by GC-FID (S)

Sample No : 5654614
Sample ID : BH118/02

Depth : 1.20



CERTIFICATE OF ANALYSIS

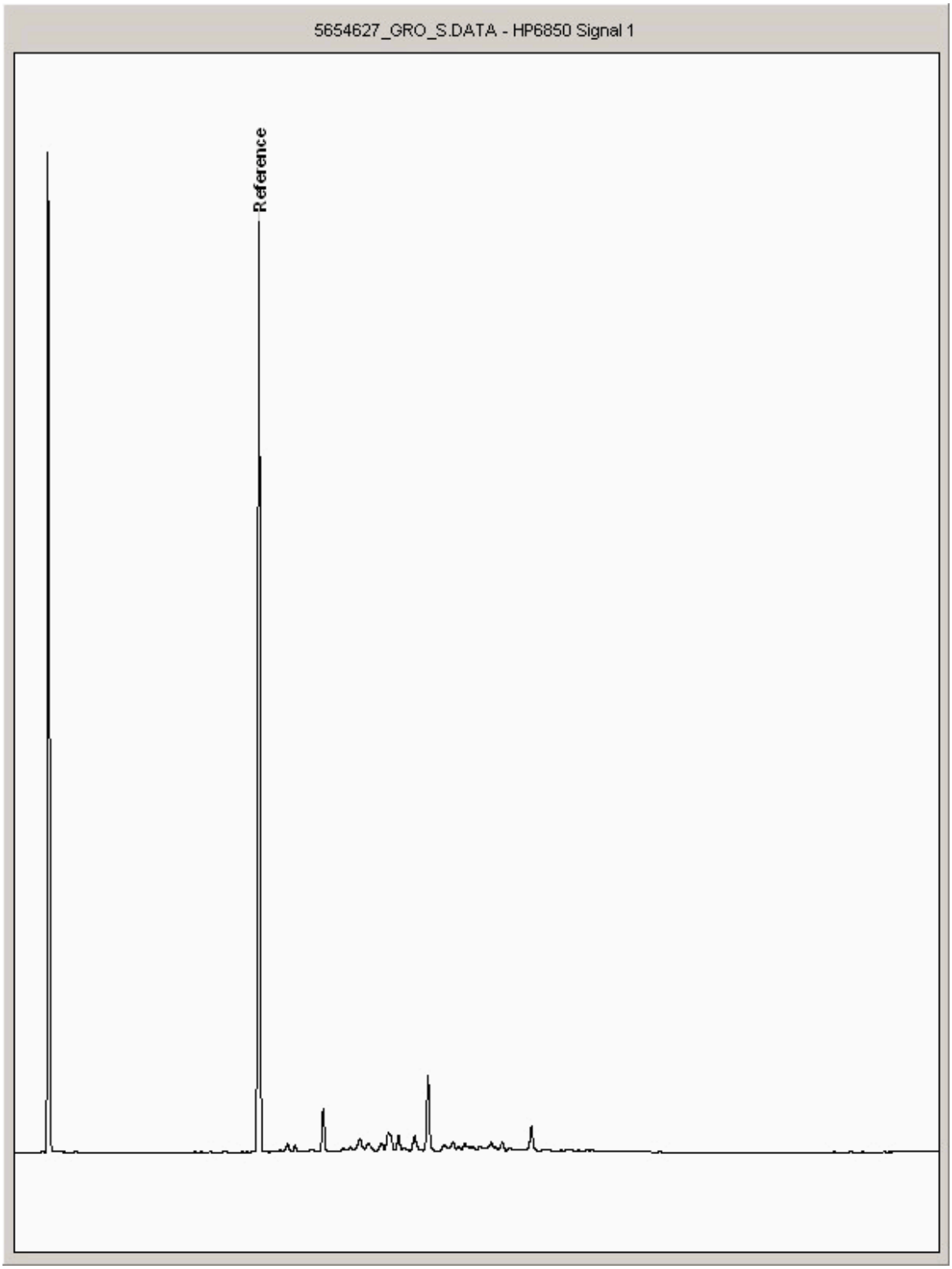
SDG:	120519-6	**Location:**	Alconbury	**Order Number:**	bc5501327
Job:	H_PBRETT_NNT-11	**Customer:**	Peter Brett Associates	**Report Number:**	182820
Client Reference:	24213/017	**Attention:**	David Bissell	**Superseded Report:**	

Chromatogram

Analysis: GRO by GC-FID (S)

Sample No : 5654627
Sample ID : BH118/02

Depth : 2.00



CERTIFICATE OF ANALYSIS

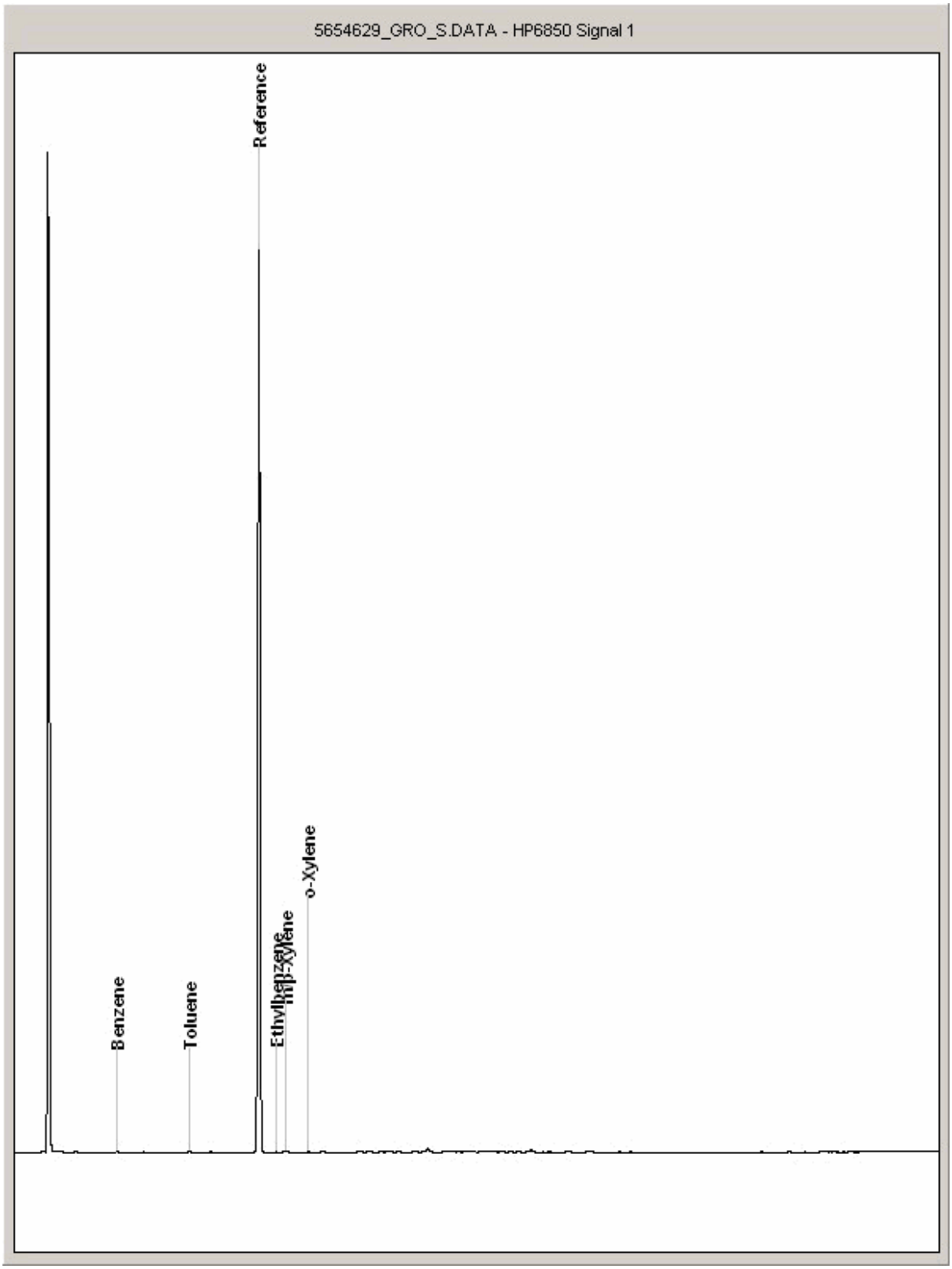
SDG:	120519-6	**Location:**	Alconbury	**Order Number:**	bc5501327
Job:	H_PBRETT_NNT-11	**Customer:**	Peter Brett Associates	**Report Number:**	182820
Client Reference:	24213/017	**Attention:**	David Bissell	**Superseded Report:**	

Chromatogram

Analysis: GRO by GC-FID (S)

Sample No : 5654629
Sample ID : BH118/02

Depth : 3.20



CERTIFICATE OF ANALYSIS

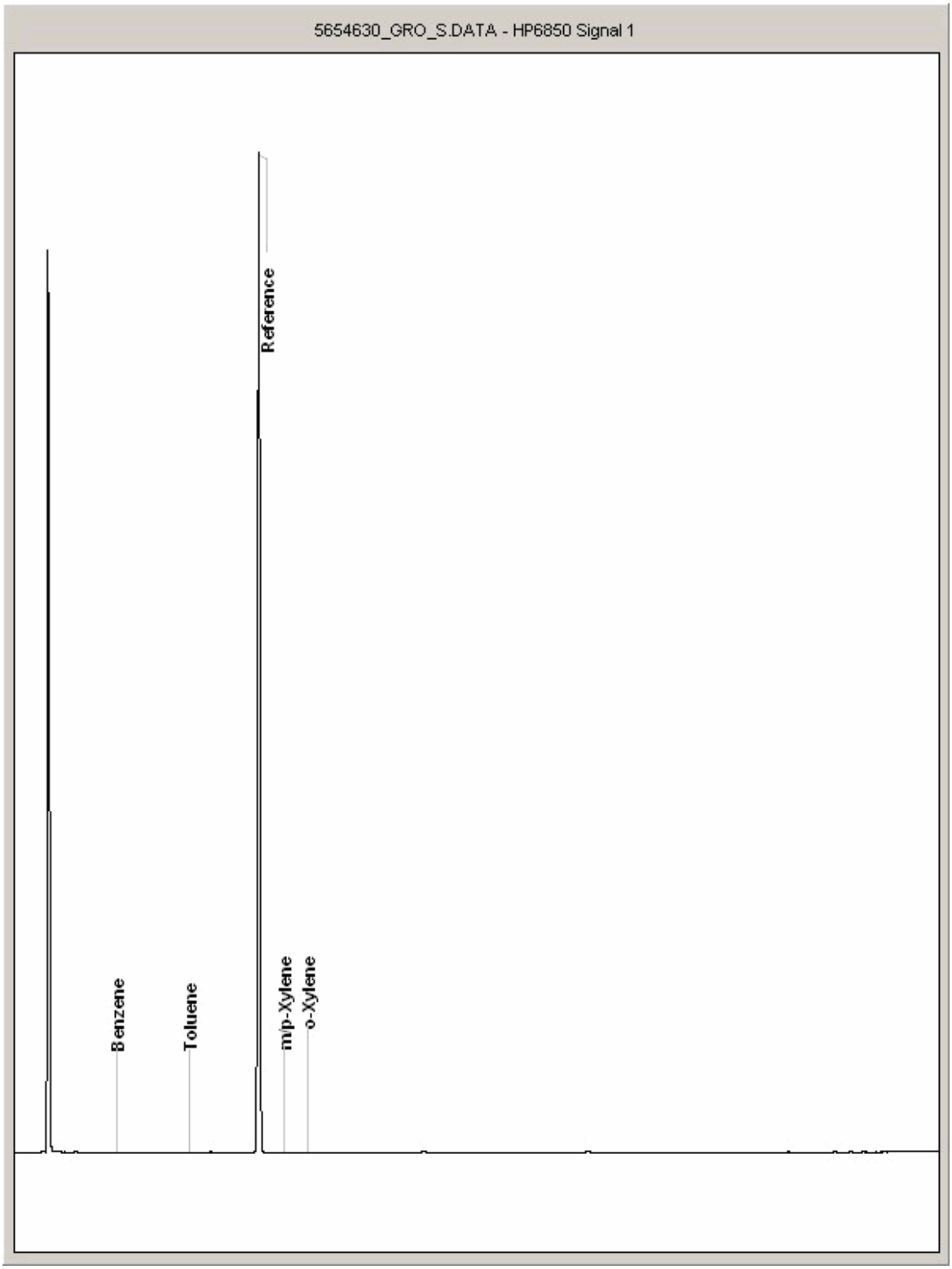
SDG:	120519-6	**Location:**	Alconbury	**Order Number:**	bc5501327
Job:	H_PBRETT_NNT-11	**Customer:**	Peter Brett Associates	**Report Number:**	182820
Client Reference:	24213/017	**Attention:**	David Bissell	**Superseded Report:**	

Chromatogram

Analysis: GRO by GC-FID (S)

Sample No : 5654630
Sample ID : BH118/03

Depth : 0.20



CERTIFICATE OF ANALYSIS

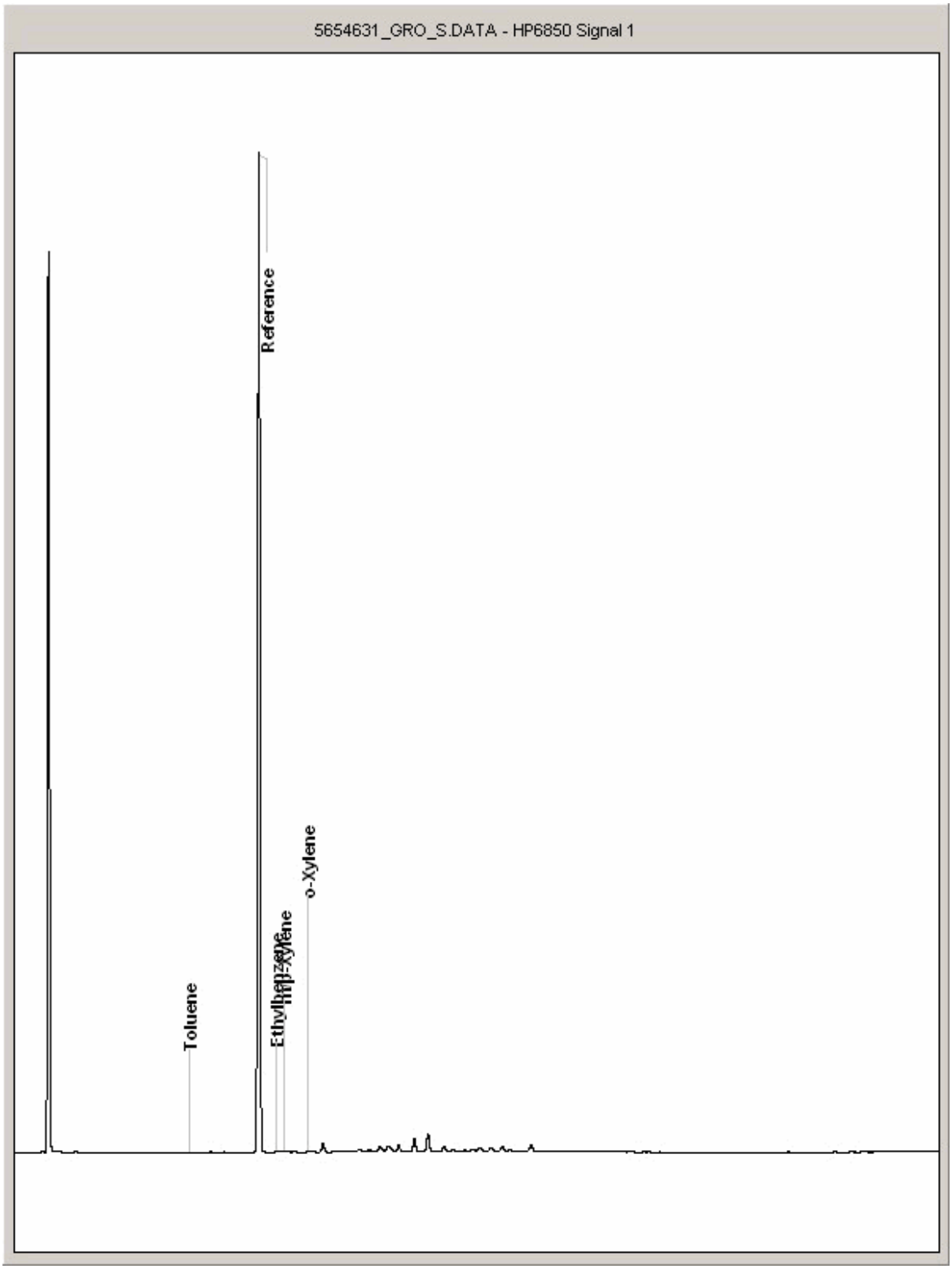
SDG:	120519-6	**Location:**	Alconbury	**Order Number:**	bc5501327
Job:	H_PBRETT_NNT-11	**Customer:**	Peter Brett Associates	**Report Number:**	182820
Client Reference:	24213/017	**Attention:**	David Bissell	**Superseded Report:**	

Chromatogram

Analysis: GRO by GC-FID (S)

Sample No : 5654631
Sample ID : BH118/03

Depth : 1.20



CERTIFICATE OF ANALYSIS

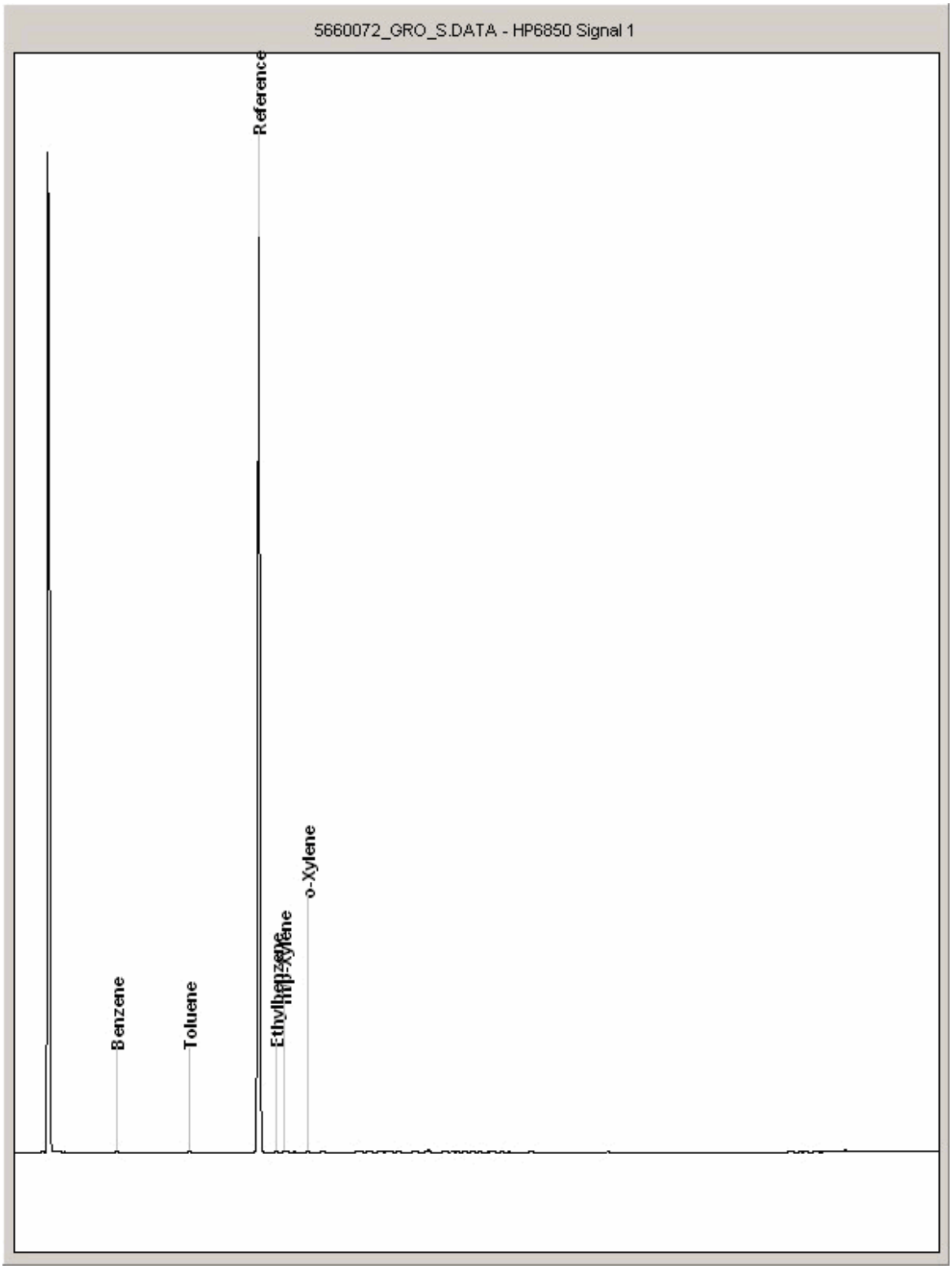
SDG:	120519-6	**Location:**	Alconbury	**Order Number:**	bc5501327
Job:	H_PBRETT_NNT-11	**Customer:**	Peter Brett Associates	**Report Number:**	182820
Client Reference:	24213/017	**Attention:**	David Bissell	**Superseded Report:**	

Chromatogram

Analysis: GRO by GC-FID (S)

Sample No : 5660072
Sample ID : BH118/03

Depth : 2.00



CERTIFICATE OF ANALYSIS

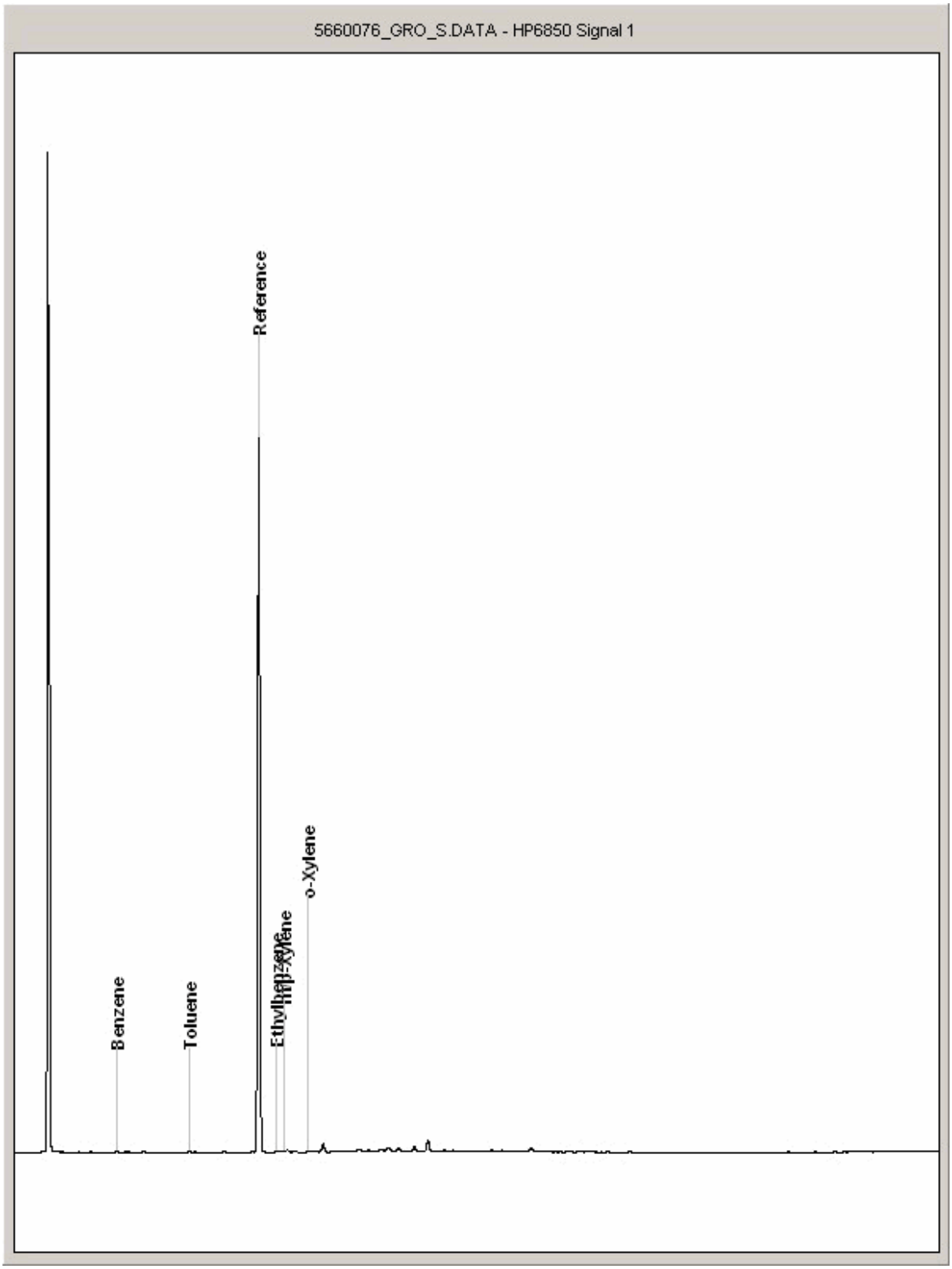
SDG:	120519-6	**Location:**	Alconbury	**Order Number:**	bc5501327
Job:	H_PBRETT_NNT-11	**Customer:**	Peter Brett Associates	**Report Number:**	182820
Client Reference:	24213/017	**Attention:**	David Bissell	**Superseded Report:**	

Chromatogram

Analysis: GRO by GC-FID (S)

Sample No : 5660076
Sample ID : BH118/03

Depth : 3.20



SDG:	120519-6	**Location:**	Alconbury	**Order Number:**	bc5501327
Job:	H_PBRETT_NNT-11	**Customer:**	Peter Brett Associates	**Report Number:**	182820
Client Reference:	24213/017	**Attention:**	David Bissell	**Superseded Report:**	

Appendix

1. Results are expressed on a dry weight basis (dried at 35ºC) for all soil analyses except for the following: NRA and CEN Leach tests, flash point LOI, pH, ammonium as NH4 by the BRE method, VOC TICS and SVOC TICS.

2. Samples will be run in duplicate upon request, but an additional charge may be incurred.

3. If sufficient sample is received a sub sample will be retained free of charge for 30 days after analysis is completed (e-mailed) for all sample types unless the sample is destroyed on testing. The prepared soil sub sample that is analysed for asbestos will be retained for a period of 2 months after the analysis date. All bulk samples will be retained for a period of 6 months after the analysis date. All samples received and not scheduled will be disposed of one month after the date of receipt unless we are instructed to the contrary. Once the initial period has expired, a storage charge will be applied for each month or part thereof until the client cancels the request for sample storage. ALcontrol Laboratories reserve the right to charge for samples received and stored but not analysed.

4. With respect to turnaround, we will always endeavour to meet client requirements wherever possible, but turnaround times cannot be absolutely guaranteed due to so many variables beyond our control.

5. We take responsibility for any test performed by sub-contractors (marked with an asterisk). We endeavour to use UKAS/MCERTS Accredited Laboratories, who either complete a quality questionnaire or are audited by ourselves. For some determinands there are no UKAS/MCERTS Accredited Laboratories, in this instance a laboratory with a known track record will be utilised.

6. When requested, the individual sub sample scheduled will be analysed in house for the presence of asbestos fibres and asbestos containing material by our documented in house method TM048 based on HSG 248 (2005), which is accredited to ISO17025. If a specific asbestos fibre type is not found this will be reported as “Not detected”. If no asbestos fibre types are found all will be reported as “Not detected” and the sub sample analysed deemed to be clear of asbestos. If an asbestos fibre type is found it will be reported as detected (for each fibre type found). Testing can be carried out on asbestos positive samples, but, due to Health and Safety considerations, may be replaced by alternative tests or reported as No Determination Possible. The quantity of asbestos present is not determined unless specifically requested.

7. If no separate volatile sample is supplied by the client, or if a headspace or sediment is present in the volatile sample, the integrity of the data may be compromised. This will be flagged up as an invalid VOC on the test schedule and the result marked as deviating on the test certificate.

8. If appropriate preserved bottles are not received preservation will take place on receipt. However, the integrity of the data may be compromised.

9. NDP -No determination possible due to insufficient/unsuitable sample.

10. Metals in water are performed on a filtered sample, and therefore represent dissolved metals -total metals must be requested separately.

11. Results relate only to the items tested.

12. LODs for wet tests reported on a dry weight basis are not corrected for moisture content.

13. **Surrogate recoveries** -Most of our organic methods include surrogates, the recovery of which is monitored and reported. For EPH, MO, PAH, GRO and VOCs on soils the result is not surrogate corrected, but a percentage recovery is quoted. Acceptable limits for most organic methods are 70 -130 %.

14. **Product analyses** -Organic analyses on products can only be semi-quantitative due to the matrix effects and high dilution factors
employed.

15. Phenols monohydric by HPLC include phenol, cresols (2-Methylphenol, 3-Methylphenol and 4-Methylphenol) and Xylenols (2,3 Dimethylphenol, 2,4 Dimethylphenol, 2,5 Dimethylphenol, 2,6 Dimethylphenol, 3,4 Dimethyphenol, 3,5 Dimethylphenol).

16. Total of 5 speciated phenols by HPLC includes Phenol, 2,3,5-Trimethyl Phenol, 2-Isopropylphenol, Cresols and Xylenols (as detailed in 15).

17. Stones/debris are not routinely removed. We always endeavour to take a representative sub sample from the received sample.

18. In certain circumstances the method detection limit may be elevated due to the sample being outside the calibration range. Other factors that may contribute to this include possible interferences. In both cases the sample would be diluted which would cause the method detection limit to be raised.

19. Mercury results quoted on soils will not include volatile mercury as the analysis is performed on a dried and crushed sample.

20. For the BSEN 12457-3 two batch process to allow the cumulative release to be calculated, the volume of the leachate produced is measured and filtered for all tests. We therefore cannot carry out any unfiltered analysis. The tests affected include volatiles GCFID/GCMS and all subcontracted analysis.

21. For all leachate preparations (NRA, DIN, TCLP, BSEN 12457-1, 2, 3) volatile loss may occur, as we do not employ zero headspace extraction.

22. We are accredited to MCERTS for sand, clay and loam/topsoil, or any of these materials - whether these are derived from naturally occurring soil profiles, or from fill/made ground, as long as these materials constitute the major part of the sample. Other coarse granular material such as concrete, gravel and brick are not accredited if they comprise the major part of the sample.

23. Analysis and identification of specific compounds using GCFID is by retention time only, and we routinely calibrate and quantify for benzene, toluene, ethylbenzenes and xylenes (BTEX). For total volatiles in the C5 -C12 range, the total area of the chromatogram is integrated and expressed as ug/kg or ug/l. Although this analysis is commonly used for the quantification of gasoline range organics (GRO), the system will also detect other compounds such as chlorinated solvents, and this may lead to a falsely high result with respect to hydrocarbons only. It is not possible to specifically identify these non-hydrocarbons, as standards are not routinely run for any other compounds, and for more definitive identification, volatiles by GCMS should be utilised.

SOLID MATRICES EXTRACTION SUMMARY

ANALYSIS	D&C OR WET	EXTRACTION SOLVENT	EXTRACTION METHOD	ANALYSIS
SOLVENT EXTRACTABLE MATTER	D&C	DCM	SOXTHERM	GRAVIMETRIC
CYCLOHEXANE EXT. MATTER	D&C	CYCLOHEXANE	SOXTHERM	GRAVIMETRIC
ELEMENTAL SULPHUR	D&C	DCM	SOXTHERM	HPLC
PHENOLS BY GCMS	WET	DCM	SOXTHERM	GC-MS
HERBICIDES	D&C	HEXANE:ACETONE	SOXTHERM	GC-MS
PESTICIDES	D&C	HEXANE:ACETONE	SOXTHERM	GC-MS
EPH (DRO)	D&C	HEXANE:ACETONE	END OVER END	GC-FID
EPH (MIN OIL)	D&C	HEXANE:ACETONE	END OVER END	GC-FID
EPH (CLEANED UP)	D&C	HEXANE:ACETONE	END OVER END	GC-FID
EPH CWG BY GC	D&C	HEXANE:ACETONE	END OVER END	GC-FID
PCB AROCLOR 1254 / PCB CON	D&C	HEXANE:ACETONE	END OVER END	GC-MS
POLYAROMATIC HYDROCARBONS (MS)	WET	HEXANE:ACETONE	MICROWAVE TM218.	GC-MS
>C6-C40	WET	HEXANE:ACETONE	SHAKER	GC-FID
POLYAROMATIC HYDROCARBONS RAPID GC	WET	HEXANE:ACETONE	SHAKER	GC-FID
SEMI VOLATILE ORGANIC COMPOUNDS	WET	DCM:ACETONE	SONICATE	GC-MS

LIQUID MATRICES EXTRACTION SUMMARY

ANALYSIS	EXTRACTION SOLVENT	EXTRACTION METHOD	ANALYSIS
PAH MS	HEXANE	STIRRED EXTRACTION (STIR-BAR)	GC MS
EPH	HEXANE	STIRRED EXTRACTION (STIR-BAR)	GC FID
EPH CWG	HEXANE	STIRRED EXTRACTION (STIR-BAR)	GC FID
MINERAL OIL	HEXANE	STIRRED EXTRACTION (STIR-BAR)	GC FID
PCB 7 CONGENERS	HEXANE	STIRRED EXTRACTION (STIR-BAR)	GC MS
PCB AROCLOR 1254	HEXANE	STIRRED EXTRACTION (STIR-BAR)	GC MS
SVOC	DCM	LIQUID/LIQUID SHAKE	GC MS
FREE SULPHUR	DCM	SOLID PHASE EXTRACTION	HPLC
PEST OC POPP	DCM	LIQUID/LIQUID SHAKE	GC MS
TRIAZINE HERBS	DCM	LIQUID/LIQUID SHAKE	GC MS
PHENOLS MS	ACETONE	SOLID PHASE EXTRACTION	GC MS
TPH by INFRARED (IR)	TCE	STIRRED EXTRACTION (STIR-BAR)	IR
MINERAL OIL by IR	TCE	STIRRED EXTRACTION (STIR-BAR)	IR
GLYCOLS	NONE	DIRECT INJECTION	GC FID

Identification of Asbestos in Bulk Materials & Soils

The results for identification of asbestos in bulk materials are obtained from supplied bulk materials or those identified as potentially asbestos containing during sample description which have been examined to determine the presence of asbestos fibres using Alcontrol Laboratories (Hawarden) in-house method of transmitted/polarised light microscopy and central stop dispersion staining, based on HSG 248 (2005).

The results for identification of asbestos in soils are obtained from a homogenised sub sample which has been examined to determine the presence of asbestos fibres using Alcontrol Laboratories (Hawarden) in-house method of transmitted/polarised light microscopy and central stop dispersion staining, based on HSG 248 (2005).

Asbestos Type	Common Name
Chrysotile	White Asbestos
Amosite	Brown Asbestos
Crocidolite	Blue Asbestos
Fibrous Actinolite	-
Fibrous Anthophyllite	-
Fibrous Tremolite	-

Visual Estimation Of Fibre Content

Estimation of fibre content is not permitted as part of our UKAS accredited test other than: -
Trace -Where only one or two asbestos fibres were identified.

Further guidance on typical asbestos fibre content of manufactured products can be found in HSG 264.

The identification of asbestos containing materials and soils falls within our schedule of tests for which we hold UKAS accreditation, however opinions, interpretations and all other information contained in the report are outside the scope of UKAS accreditation.

Appendix 6 - Rationale for Generic Assessment Criteria Routinely Used by PBA

1 Introduction

A Tier 2 Risk Assessment is a quantitative assessment using published generic criteria to "screen" the site-specific contamination testing data and identify potential hazards to specific receptors.

The aim of this document is to present an explanation for the selection of the assessment criteria routinely used by PBA when undertaking a Tier 2 risk assessment. This document is divided into general introductory text and sections on soils, waters and soil gases.

This document should be read in conjunction with another entitled "PBA methodology for ground condition assessment" which summarises the legislative regime and our approach to ground contamination and risk assessment.

2 General Notes

Any deviation from the routine criteria and/or selection of criteria for parameters not covered in this document will be described in the report text. The report will also comment on the appropriateness of the routine criteria for project objectives or ground conditions.

Any PBA interpretation of contamination test results is based on a scientific and engineering appraisal. The perceptions of, for example, banks, insurers, lay people etc are not taken into account.

Any summary tables included in this Appendix are produced for ease of reference to the criteria, they do not in any way replace the documents of origin (which are fully referenced) and which should be read to ensure appropriate use and interpretation of the data.

3 Tier 2 Criteria for Assessing Soils

3.1 Potential Harm to Human Health

The criteria routinely used by PBA as Tier 2 soil screening values for the protection of human health are the Governmental Soil Guidance Values (SGVs) and various non-Governmental Generic Assessment Criteria (GAC) and the criteria routinely adopted are presented in Table 1.

DEFRA has yet to produce a comprehensive list of assessment criteria that on its own, would be sufficient to enable the assessment of the potential risks posed by soil contaminants (to human health). A number of industry-driven initiatives have developed to generate contaminated land assessment criteria. This has led to the publication of a series of non-statutory non-Governmental contaminated land assessment criteria. It should be noted that the published DEFRA guidance is also non-statutory.

Both the Governmental and non Governmental sets of criteria have been generated using the Contaminated Land Exposure Assessment model (CLEA) and supporting technical guidance (EA, 2009a, 2009b, 2009c).

PBA has reviewed these publications and where we consider that the non-Governmental criteria are authoritative and robust, and therefore we will refer to such criteria until such time that DEFRA derive and publish Governmental SGVs to replace the non Governmental GACs.

In is important to note that because the GACs are not published by the UK Government, they may be subject to challenge by a regulatory body or their representative. If use of the GACs is challenged, it may be necessary to carry out modelling to generate site-specific assessment criteria.

Soil Guideline Values (SGVs) - Governmental

The first series of SGVs were generated using a probabilistic version of the CLEA model. However, on 22 July 2008 DEFRA announced the withdrawal of these SGVs.

Revised SGVs have been calculated using the revised fully deterministic version of the CLEA model. The standard land use scenarios are residential with plant uptake, allotments and industrial/commercial.

Generic Assessment Criteria (GAC) - Non Governmental

SGVs generated for organic compounds are dependent on the amount of organic matter present in the soil (a lower SGV is generated for soils with lower organic matter contents since organic matter acts to immobilise organic contaminants). The SGVs for BTEX compounds and phenol assume that the 'host' soil has 6% organic matter.

UK soils often have organic matter concentrations below 6% and that it may therefore not be conservative to use the published SGVs for BTEX compounds when assessing the potential risks from these chemicals. The on-line Contaminated Land Strategies Digest (CLSD) formed a consortium of ten practitioners (including representatives from local authorities), to prepare generic assessment criteria for a number of contaminants at more conservative organic matter contents of 1% and 3% for the same end uses. The consortium also reproduced the SGVs using the EA's latest CLEA model and latest CLEA guidance and PBA independently verified the results published using CLEA v1.06. These criteria will be used by PBA where appropriate.

In addition the CLSD consortium derived GAC for selected substances for an additional end use, that being residential without plant uptake (CLSD, 2009).

In July 2009, GAC for 82 substances were published by the Chartered Institute of Environmental Health (CIEH) (LQM and CIEH,

2009) using the then current version of the CLEA software v1.04. These GAC replace those generated in 2006 using the original version of the model CLEA UK *beta*.

In January 2010, GAC for 35 substances were published by the Environmental Industries Commission (EIC), Association of Geotechnical and Geoenvironmental Specialists (AGS) and Contaminated Land: Applications in Real Environments (CL:AIRE), (CL:AIRE, 2010) using the then current version of the CLEA software v1.05. These substances are more rarely found to be contaminants of concern during contaminated land investigations and hence are not routinely tested for. The CL:AIRE GAC are not reproduced in Table 1 but may be referred to as required during the investigation of specific sites.

Note on Appropriate Use of SGV/GAC The SGVs and GACs generated using the CLEA model are based on numerous and complex assumptions. The appropriateness of these assumptions in a site-specific context requires confirmation on a project by project basis.

In general, SGVs/GACs have been developed using highly conservative assumptions and therefore exceedance does not necessarily indicate that a site is statutorily contaminated and/or unsuitable for use (CLAN2-05) and that whilst SGV/GAC provide an aid to decision-making, they do not replace the need for sound professional judgement in risk assessment (EA, 2006b).

Note on Mercury and Arsenic Assessment The analytical testing routinely undertaken by PBA determines total concentration, however, the toxicity of Mercury and Arsenic differ depending on the form.

If there a source of Mercury or Arsenic is identified or the total concentration exceeds the relevant worst case speciated criteria it will be desirable/necessary to undertake additional speciated testing.

3.2 Potential Harm to the Built Environment

PBA use the following primary guidance to assess the significance of soil chemistry with respect to its potential to harm the built environment.

i) Site Preparation and Resistance to Contaminants and Moisture. Approved Document C (BRE 2004);

ii) Concrete in aggressive ground SD1 (BRE 2005); and

iii) Technical guidance on the assessment of soil chemistry with respect to its potential to corrode plastic service pipes has been published by the Water Regulations Advisory Scheme (WRAS, 2002).

3.3 Potential to Harm Ecosystems, Animals, Crops etc

The criteria routinely used by PBA as Tier 2 screening values to assess the potential of soil chemistry to harm ecosystems are taken from the following guidance and summarised in are given in Table 2.

i) Ecological Risk Assessment (ERA) Science Report Series SC070009, published by the Environment Agency, Bristol (EA, 2008);

ii) The Restoration and Aftercare of Metalliferous Mining Sites for Pasture and Grazing (ICRCL 70/90, 1990); and

iii) Code of Practice for Agricultural Use of Sewage Sludge (DOE, 1993).

4 Tier 2 Screening Values for Assessing Controlled Waters

4.1 Potential Harm to Human Health

The criteria routinely used by PBA as Tier 2 water screening values are taken from the Water Supply (Water Quality) Regulations 2000 (DETR (2000a) and are given in Table 3.

It should be noted that some of the prescribed concentrations listed in the Water Supply Regulations have been set for reasons other than their potential to cause harm to human health. The concentrations of iron and manganese are controlled because they may taint potable water with an undesirable taste, odour or colour or may potentially deposit precipitates in water supply pipes.

4.2 Potential to Harm Controlled Waters

Controlled Waters are rivers, estuaries, coastal waters, lakes and groundwaters, but not perched waters.

The criteria routinely used by PBA as Tier 2 screening values are taken from the directions to the Environment Agency in regard to the implementation of the Water Framework Directive (EA 2009d) and are given in Tables 3, 4 and 5.

Table 3 presents the criteria for assessing the chemistry of groundwater bodies and Tables 4 and 5 present the criteria for assessing the chemistry of surface water bodies.

The results from any eluted liquids will be compared to appropriate assessment criteria depending on the receptor of concern.

5 Tier 2 Screening Guidance for Assessing Soil Gases

Guidance on the assessment of risks specifically for sites located adjacent to Landfill Sites has been published by the Environment Agency (EA, 2004d). A tiered approach to assessing risk is advocated by the guidance. This allows the level

of detail in a risk assessment to be proportionate to the nature and complexity of the risk.

The Tier 1 Risk Screening methodology advocated by the Environment Agency (EA) guidance document (EA, 2004) should:

i) Identify complete source-pathway-receptor linkages;

ii) Screen out insignificant risks;

iii) Prioritise the risks and receptors; and

iv) Provide an initial assessment of the potential impacts at a receptor.

A Tier 2 assessment comprises the quantitative analysis of risk following the collection and analysis of soil gas monitoring data.

Guidance on suitable methodologies for the collection of gas monitoring data is provided in CIRIA Report C665 (CIRIA, 2007).

Guidance Available PBA use the following primary guidance to assess the significance of soil gas chemistry with respect to its potential to harm human health.

i) Assessing risks posed by hazardous gases to buildings C665 (CIRIA 2007);

ii) Guidance on evaluation of development proposals on sites where methane and carbon dioxide are present. (NHBC 2007);

iii) Code of practice for the characterization and remediation from ground gas is affected developments (BSI, 2007); and

iv) Waste Management Paper No. 27 (DoE, 1991).

Waste Management Paper No. 27 (DoE, 1991) defines what constitutes a “significant quantity” of gas. WMP27 advises that a site producing (i) Methane concentrations in excess of 1% by volume and with a flow rate of greater than 15 litres per hour; or (ii) Carbon dioxide in excess of 1.5% by volume in air and with a flow rate of greater than 22 litres per hour would be considered as a significant source of soil gas.

Guidance on quantifying the risks from hazardous soil gases to properties and their occupiers is provided in CIRIA, 2007 (commercial developments), NHBC, 2007 (low rise residential developments) and British Standard BS 8485:2007. These documents provide guidance on gas monitoring methods and strategy, the assessment of risk posed by soil gases and mitigating the risks posed by soil gases during site development.

PBA use gas concentrations and borehole flow data in order to obtain the gas screening value (GSV) for methane and carbon dioxide at the site. The GSV can be used to establish the characteristic situation of the site as detailed in CIRIA C665 and in order to make recommendations for gas protection measures for buildings if required.

Radon In addition to the guidance listed above, PBA use the following primary guidance to assess the significance of the radon content of soil gas.

i) Radon: guidance on protective measures for new dwellings. Report BR211 (BRE, 1999); and

ii) Radon Atlas of England, R290 (NRPB, 1996).

6 References

BRE (2004) Site preparation and resistance to contaminants and moisture. Approved Document C, The Building Regulations 2000. Building Research Establishment, Garston, Herts.

BRE (2005) Concrete in aggressive ground. Special Digest 1, Building Research Establishment, Garston, Herts.

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BSI (2007) BS 8485:2007 Code of practice for the characterization and remediation from ground gas is affected developments. British Standards Institute, London.

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CL:AIRE (2010). Soil Generic Assessment Criteria for Human Health Risk Assessment. Published in January 2010 by Contaminated Land: Applications in Real Environments, London. ISBN 978-1-905046-20-1.

CLAN2-05 Contaminated land advice note 02 from September 2005. Department for the Environment, Food and Rural Affairs, London.

CLSD (2009) Contaminated-Land-Strategies Digest - 30 Apr 2009 to 1 May 2009 - Special issue (#2009-89). Posting titled: “JISCmail GACs for SGV substances: April 2009 and subsequent postings”.

DETR (2000a) The Water Supply (Water Quality) Regulations, 2000. Statutory Instrument 2000 No 3184, Department of the Environment, Transport and the Regions, London.

DoE (1991) Landfill Gas, Waste Management Paper No. 27. Department of the Environment, London.

DoE (1993) Code of Practice for Agricultural Use of Sewage Sludge. Department of the Environment, London.

EA (2004) Guidance on Assessment of Risks from Landfill Sites. Environment Agency, Bristol.

EA (2006b) CLEA update No. 4. Environment Agency, Bristol.

EA (2008) Ecological Risk Assessment (ERA). Science Report Series SC070009, Environment Agency, Bristol.

EA (2009a) Using Soil Guideline Values. Science Report SC050021/SGV Introduction. Environment Agency, Bristol.

EA (2009b) Updated Technical Background to the CLEA model. Science Report SC050021/SR3 Introduction. Environment Agency, Bristol.

EA (2009c) Human health toxicological assessment of contaminants in soil. Science Report SC050021/SR2. Environment Agency, Bristol.

EA (2009d) River Basin Typology, Standards and Groundwater threshold values (Water Framework Directive) England and Wales) Direction 2009.

ICRCL (1990) The Restoration and Aftercare of Metalliferous Mining Sites for Pasture and Grazing 70/90. Interdepartmental Committee on the Redevelopment of Contaminated Land, London.

LQM & CIEH (2006) Generic Assessment Criteria for Human Health Risk Assessment. Land Quality Management Limited and the Chartered Institute of Environmental Health, London.

LQM & CIEH (2009) The LQM/CIEH Generic Assessment Criteria for Human Health Risk Assessment (2nd Edition). Land Quality Press, Nottingham. ISBN 0-9547474-7-X.

NRPB (1996) Radon Atlas of England. R290, National Radiological Protection Board, Didcot, Oxfordshire.

NHBC (2007) Guidance on evaluation of development proposals on sites where methane and carbon dioxide are present. National House Building Council.

WRAS (2002) The selection of materials for water supply pipes to be laid in contaminated land. Water Regulations Advisory Scheme.

Table 1: Tier 2 Screening Criteria for the Assessment of Potential Contaminant Concentrations in Soil – Protection of Human Health

Determinand	Allotments	Residential with plant uptake	Residential without plant uptake	Commercial/ Industrial
Metals/Metalloids				
Arsenic (Inorganic)	43[a]	32[a]	35[f]	640[a]
Beryllium	55[c]	51[c]	-	420[c]
Boron	45[c]	291[c]	-	192,000[c]
Cadmium	1.8[a]	10[a]	117[f]	230[a]
Chromium (trivalent)	34,600[c]	3000[c]	-	30,400[c]
Chromium (hexavalent)	2.1[c]	4.3[c]	-	35[c]
Copper	524[c]	2330[c]	-	71,700[c]
Lead	-	450[b]	450[b]	750[b]
Mercury (elemental)	1[a]	26[a]	-	26[a]
Mercury (inorganic)	80[a]	170[a]	235[f]	3600[a]
Methyl Mercury	8[a]	11[a]	-	410[a]
Nickel	230[a]	130[a]	130[f]	1800[a]
Selenium	120[a]	350[a]	595[f]	13000[a]
Vanadium	18[c]	75[c]	-	3160[c]
Zinc	618[c]	3750[c]	-	665,000[c]
BTEX Compounds (1%, 3% and 6% SOM)[d]				
Benzene	0.02[f] / 0.04[f] / 0.07[a]	0.08[f] / 0.18[f] / 0.33[a]	0.27[f] / 0.56[f] / 1.0[f]	28[f] / 57[f] / 95[a]
Toluene	22[f] / 60[f] / 120[a]	120[f] / 320[f] / 610[a]	600[f] / 1500[f] / 2700[f]	870[f]/ 2200[f] / 4400[a]
Ethylbenzene	16[f] / 45[f] / 90[a]	65[f] / 180[f] / 350[a]	165[f] / 450[f] / 840[f]	520[f] / 1400[f] / 2800[a]
Xylenes #	28[f] / 80[f] / 160[a]	42[f] / 120[f] / 230[a]	53[f] / 145[f] / 285[f]	475[f] / 1300[f] / 2600[a]
Polycyclic Aromatic Hydrocarbons (1%, 2.5% and 6% SOM)[d]				
Acenaphthene	34[c] / 85[c] / 200[c]	210[c] / 480[c] / 1000[c]	-	85000[c] / 98000[c] / 100000[c]
Acenaphthylene	28[c] / 69[c] / 160[c]	170[c] / 400[c] / 850[c]	-	84000[c] / 97000[c] / 100000[c]
Anthracene	380[c] / 950[c] / 2200[c]	2300[c] / 4900[c] / 9200[c]	-	530000[c] / 540000[c] / 540000[c]
Benzo(a)anthracene	2.5[c] / 5.5[c] / 10[c]	3.1[c] / 4.7[c] / 5.9[c]	-	90[c] / 95[c] / 97[c]
Benzo(a)pyrene	0.60[c] / 1.2[c] / 2.1[c]	0.83[c] / 0.94[c] / 1.0[c]	-	14[c] / 14[c] / 14[c]
benzo(b)fluoranthene	3.5[c] / 7.4[c] / 13[c]	5.6[c] / 6.5[c] / 7.0[c]	-	100[c] / 100[c] / 100[c]
benzo(g,h,i)perylene	70[c] / 120[c] / 160[c]	44[c] / 46[c] / 47[c]	-	650[c] / 660[c] / 660[c]
benzo(k)fluoranthene	6.8[c] / 14[c] / 23[c]	8.5[c] / 9.6[c] / 10[c]	-	140[c] / 140[c] / 140[c]
Chrysene	2.6[c] / 5.8[c] / 12[c]	6.0[c] / 8.0[c] / 9.3[c]	-	140[c] / 140[c] / 140[c]
Dibenzo(a,h)anthracene	0.76[c] / 1.5[c] / 2.3[c]	0.76[c] / 0.86[c] / 0.90[c]	-	13[c] / 13[c] / 13[c]
Fluoranthene	52[c] / 130[c] / 290[c]	260[c] / 460[c] / 670[c]	-	23000[c] / 23000[c] / 23000[c]
Fluorene	27[c] / 67[c] / 160[c]	160[c] / 380[c] / 780[c]	-	64000[c] / 69000[c] / 71000[c]
Indeno(1,2,3-cd)pyrene	1.8[c] / 3.8[c] / 7.1[c]	3.2[c] / 3.9[c] / 4.2[c]	-	60[c] / 61[c] / 61[c]
Naphthalene	4.1[c] / 9.9[c] / 23[c]	1.5[c] / 3.7[c] / 8.7[c]	-	200[c] / 480[c] / 1100[c]
Phenanthrene	16[c] / 38[c] / 90[c]	92[c] / 200[c] / 380[c]	-	22000[c] / 22000[c] / 23000[c]
Pyrene	110[c] / 270[c] / 620[c]	560[c] / 1000[c] / 1600[c]	-	54000[c] / 54000[c] / 54000[c]
Aliphatic/Aromatic Hydrocarbons (1%, 2.5% and 6% SOM)[d]				
TPH Aliphatic >C5-6	740[c] / 1700[c] / 3900[c]	30[c] / 55[c] / 110[c]	-	3400[c] / 6200[c] / 13000[c]
TPH Aliphatic >C6-8	2300[c] / 5600[c] / 13000[c]	73[c] / 160[c] / 370[c]	-	8300[c] / 18000[c] / 42000[c]
TPH Aliphatic >C8-10	320[c] / 770[c] / 1700[c]	19[c] / 46[c] / 110[c]	-	2100[c] / 5100[c] / 12000[c]
TPH Aliphatic >C10-12	2200[c] / 4400[c] / 7300[c]	93[c] / 230[c] / 540[c]	-	10000[c] / 24000[c] / 49000[c]
TPH Aliphatic >C12-16	11000[c] / 13000[c] / 13000[c]	740[c] / 1700[c] / 3000[c]	-	61000[c] / 83000[c] / 91000[c]

Determinand	Allotments	Residential with plant uptake	Residential without plant uptake	Commercial/ Industrial
TPH Aliphatic >C16-35	260000[c] / 270000[c] / 270000[c]	45000[c] / 64000[c] / 76000[c]	-	1600000[c] / 1800000[c] / 1800000[c]
TPH Aliphatic >C35-44	260000[c] / 270000[c] / 270000[c]	45000[c] / 64000[c] / 76000[c]	-	1600000[c] / 1800000[c] / 1800000[c]
TPH Aromatic >C5-7 (benzene)	13[c] / 27[c] / 57[c]	65[c] / 130[c] / 280[c]	-	28000[c] / 49000[c] / 90000[c]
TPH Aromatic >C7-8 (toluene)	22[c] / 51[c] / 120[c]	120[c] / 270[c] / 611[c]	-	59000[c] / 110000[c] / 190000[c]
TPH Aromatic >C8-10	8.6[c] / 21[c] / 51[c]	27[c] / 65[c] / 151[c]	-	3700[c] / 8600[c] / 18000[c]
TPH Aromatic >C10-12	13[c] / 31[c] / 74[c]	69[c] / 160[c] / 346[c]	-	17000[c] / 29000[c] / 34500[c]
TPH Aromatic >C12-16	23[c] / 57[c] / 130[c]	140[c] / 310[c] / 593[c]	-	36000[c] / 37000 /[c] 37800[c]
TPH Aromatic >C16-21	46[c] / 110[c] / 260[c]	250[c] / 480[c] / 770[c]	-	28000[c] / 28000[c] / 28000[c]
TPH Aromatic >C21-35	370[c] / 820[c] / 1600[c]	890[c] / 1100[c] / 1230[c]	-	28000[c] / 28000[c] / 28000[c]
TPH Aromatic >C35-44	370[c] / 820[c] / 1600[c]	890[c] / 1100[c] / 1230[c]	-	28000[c] / 28000[c] / 28000[c]
TPH Aliphatic + Aromatic >C44-70	1200[c] / 2100[c] / 3000[c]	1200[c] / 1300[c] / 1300[c]	-	28000[c] / 28000[c] / 28000[c]
Chlorinated Hydrocarbons (1%, 2.5% and 6% SOM)[d]				
1,2-dichloroethane	0.0046[c] / 0.0083[c] / 0.016[c]	0.0054[c] / 0.0080[c] / 0.014[c]	-	0.71[c] / 1.0[c] / 1.8[c]
1,1,1 Trichloroethane (TCA)	48[c] / 110[c] / 240[c]	6.2[c] / 13[c] / 28[c]	-	700[c] / 1400[c] / 3100[c]
1,1,1,2 Tetrachloroethane	0.79[c] / 1.9[c] / 4.4[c]	0.90[c] / 2.1[c] / 4.8[c]	-	120[c] / 260[c] / 590[c]
1,1,2,2 Tetrachloroethane	0.41[c] / 0.89[c] / 2.0[c]	1.4[c] / 2.9[c] / 6.3[c]	-	290[c] / 580[c] / 1200[c]
Tetrachloroethene (PCE)	1.6[c] / 3.7[c] / 8.7[c]	0.94[c] / 2.1[c] / 4.8[c]	-	130[c] / 290 / 660[c]
Tetrachloromethane	0.16[c] / 0.37[c] / 0.85[c]	0.018[c] / 0.039[c] / 0.089[c]	-	3.0[c] / 6.6 / 15[c]
Trichloroethene (TCE)	0.43[c] / 0.95[c] / 2.2[c]	0.11[c] / 0.22[c] / 0.49[c]	-	12[c] / 25[c] / 55[c]
Trichloromethane/Chloroform	0.36[c] / 0.70[c] / 1.5[c]	0.75[c] / 1.3[c] / 2.7[c]	-	110[c] / 190[c] / 370[c]
Vinyl Chloride/Chloroethene	0.00055[c] / 0.0010[c] / 0.0018[c]	0.00047[c] / 0.00064[c] / 0.00099[c]	-	0.063[c] / 0.081[c] / 0.12[c]
Pesticides and Other Organic Compounds (1%, 2.5% and 6% SOM)[d]				
Aldrin	1.3[c] / 2.6[c] / 4.0[c]	1.7[c] / 2.0[c] / 2.1[c]	-	54[c] / 54[c] / 54[c]
Atrazine	0.037[c] / 0.085[c] / 0.2[c]	0.24[c] / 0.56[c] / 1.3[c]	-	870[c] / 880[c] / 880[c]
Dichlorvos	0.044[c] / 0.091[c] / 0.20[c]	0.29[c] / 0.6[c] / 1.3[c]	-	842[c] / 872[c] / 893[c]
Dieldrin	0.13[c] / 0.32[c] / 0.73[c]	0.69[c] / 1.4[c] / 2.2[c]	-	90[c] / 91[c] / 92[c]
Endosulfan	0.47[c] / 1.2[c] / 2.7[c]	2.9[c] / 7.0[c] / 16[c]	-	2310[c] / 2990[c] / 3390[c]
Carbon Disulphide	4.8[c] / 10[c] / 23[c]	0.10[c] / 0.20[c] / 0.44[c]	-	12[c] / 23[c] / 50[c]
Chlorobenzene	5.9[c] / 14[c] / 32[c]	0.33[c] / 0.73[c] / 1.7[c]	-	59[c] / 130[c] / 310[c]
Hexachloro-1,3-butadiene	0.25[c] / 0.61[c] / 1.4[c]	0.21[c] / 0.51[c] / 1.2[c]	-	32[c] / 69[c] / 120[c]
Hexachlorobenzene	0.18[c] / 0.42[c] / 0.92[c]	0.59[c] / 1.0[c] / 1.4[c]	-	48[c] / 53[c] / 55[c]
Pentachlorobenzene	1.2[c] / 3.1[c] / 7.1[c]	5.2[c] / 10[c] / 17[c]	-	650[c] / 770[c] / 830[c]
Pentachlorophenol	0.084[c] / 0.21[c] / 0.49[c]	0.55[c] / 1.3[c] / 2.96[c]	-	1200[c] / 1300[c] / 1400[c]
Phenol (1, 3, 6% SOM)	66[f] / 158[f] / 280[a]	184[f] / 316[f] / 420[a]	310[f] / 441[f] / 519[f]	3200[a]
Dioxins, Furans and dioxin-like PCBs	8[a]	8[a]		240[a]

Notes
Units mg/kg
most conservative of the three isomers selected for each scenario
a Soil Guideline Value (2009) with SOM of 6%
b Soil Guideline Value (2002)
c Generic Assessment Criteria (LQM & CIEH 2009)
d Where three values are presented, SGV/GAC for soils with SOM of 1%, 2.5% and 6% or 1%, 3% and 6% are given as detailed in the table. SOM denotes Soil Organic Matter.
f Generic Assessment Criteria generated using CLEA v 1.04 by an independent contaminated land working group and independently verified by PBA (CLSD, 2009)

Table 2 Tier 2 Screening Criteria for the Assessment of Potential Contaminant Concentrations in Soil – Protection of Ecological Systems

Parameter	ICRCL 70/90 [a]			Proposed SSVs [b]	Code of Practice for Agricultural Use of Sewage Sludge [c]
	Threshold [d]	Maximum			
		Livestock	Crop Growth		
	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
Benzo(a)pyrene				0.15	
Arsenic	50	500	1000		50
Cadmium	3	30	50	1.15	3
Chromium				21.1	400
Copper	250	500	250	88.4	80/ 100/ 135/ 200 [e]
Fluoride	500	1000			500
Lead	300	1000		167.9	300
Mercury				0.06	1
Molybdenum					4
Nickel				25.1	50/ 60/ 75/ 110 [e]
Pentachlorobenzene				0.029	
Pentachlorophenol				0.6	
Selenium					3
Tetrachloroethene				0.01	
Toluene				0.3	
Zinc	1000	3000	1000	90.1	200/ 200/ 200/ 300 [e]

Notes

a. Interdepartmental Committee on the Redevelopment of Contaminated Land (ICRCL) 70/90 Restoration and Aftercare of Metalliferous Mining Sites for Pasture and Grazing 1st edition 1990.
b. Proposed Soil Screening Values (SSVs) – Consultation, Environment Agency 2008. Threshold which if exceeded prompts further assessment.
c. Maximum permissible concentration of potentially toxic elements from the Code of Practice for Agricultural Use of Sewage Sludge. Second Edition. DOE 1993.
d. Concentrations are for contamination derived from mine spoil. In other situations the speciation may be more available. Factors include total concentration, speciation, particle size, pH, species of plant, type of animal/grazing habit.
e. Where four values are presented, concentrations are for soils with pH values 5.0-5.5/ 5.5-6.0/ 6.0-7.0/ >7.0

Table 3: Tier 2 Criteria for Screening Selected Contaminants in Groundwater

Parameter	Protection of Human Health	Protection of Controlled Waters			
	Water Supply (Water Quality) Regulations 2000	Test 2 Minimum	Test 2 Maximum	Test 4	Test 5
Metal/Semi Metal:					
Antimony (µg/l)	5				
Arsenic (µg/l)	10	51.6	199	7.5	
Boron (µg/l)	1000			750	
Cadmium (µg/l)	5	0.2	1.1	3.75	
Chromium (µg/l)	50	5	27.6	37.5	
Copper (µg/l)	2000	10.1	57.8	1500	
Iron (µg/l)	200				
Lead (µg/l)	25 (10 from 25/12/13)	7.3	39.8	18.8	
Manganese (µg/l)	50				
Mercury (µg/l)	1			0.75	
Nickel (µg/l)	20	20.2	116	15	
Selenium (µg/l)	10				
Zinc (µg/l)	-	75.8	414	3750	
Other:					
Ammonium NH4 (mg/l)	0.5				
Ammonia NH3 (mg/l)	-	0.3	1.73	0.29	0.29
Chloride (mg/l)	250			188	187.5
Cyanide (mg/l)	50				
Electrical Conductivity (µS/cm)	2500			1880	
pH (pH units)	6.5 to 10				
Nitrate (mg/l)	50			42	42
Sulphate (mg/l)	250			188	188
Organics:					
Anthracene		0.1	0.55		
Benzene (µg/l)	1	10.1	55.2	0.75	0.75
Benzo(a)pyrene (µg/l)	0.01			0.075	
Chloroform (µg/l)	100 a	2.53	13.8	75	75
1.2-Dichloroethane (µg/l)	3			2.25	2.25
Fluoranthene		0.1	0.6		
Naphthalene (µg/l)	-	2.4	13.2		
Phenol Total (mg/l)	0.5	15.2	82.8		
PAHs (µg/l)	0.1 b				
Toluene (µg/l)	-	50.5	276		
Trichloroethene TCE (µg/l)	10 c	10.1	55.2	7.5	7.5
Tetrachloroethene PCE (µg/l)	10 c	10.1	57.8	7.5	7.5
Vinyl Chloride (µg/l)	0.5				
Xylene (µg/l)	-	30.3	166		

Notes

TV Threshold Values for each groundwater body are given in the River Basin Management Plans

Test 2 Groundwater Impacts on Surface Water

Test 4 Groundwater Drinking Water Protected Areas – designed to be equivalent to a 95% standard

Test 5 General Quality of Groundwater Body – designed to be equivalent to a 95% standard

a. Sum for Trihalomethanes – chloroform, bromoform, dibromochloromethane, bromodichloromethane

b. Concentration for sum of benzo(b)fluoranthene, benzo(k)fluoranthene, benzo(ghi)perylene, indeno(1,2,3-cd)pyrene

c. Sum of TCE and PCE

Table 4: Surface Waters - Specific Pollutants – Standards for Ecological Status

Pollutant	Rivers and Freshwater Lakes	Transitional and Coastal Waters
2,4-Dichlorophenoxyacetic acid (2,4-D)	0.3 (1.3)*	0.3 (1.3)*
2,4-Dichlorophenol	20	20
Ammonia (Un-ionised) as Nitrogen	Not applicable	21
Arsenic #	50	25
Chlorine (total available)	2 (5)*	(10)*
Chromium VI	3.4	0.6 (32)*
Chromium III	4.7	(32)*
Copper – standard is hardness dependant for freshwater	1 (CaCO3 <50mg/l) 6 (CaCO3 50-<100mg/l) 10 (CaCO3 100-<250mg/l) 28 (CaCO3 >250mg/l)	5
Cyanide	1 (5)*	1 (5)*
Cypermethrin as ng/l	0.1 (0.4)*	0.1 (0.4)*
Diazinon	0.01 (0.02)*	0.01 (0.1)*
Dimethoate	0.48 (4)*	0.48 (4)*
Iron as mg/l	1	1
Linuron	0.5 (0.9)*	0.5 (0.9)*
Mecoprop	18 (187)*	18 (187)*
Permethrin	(0.01)	(0.01)
Phenol	7.7 (46)*	7.7 (46)*
Toluene	50 (380)*	40 (370)*
Zinc – standard is hardness dependant for freshwater	8 (CaCO3 <50mg/l) 50 (CaCO3 50-<100mg/l) 75 (CaCO3 100-<250mg/l) 125 (CaCO3 >250mg/l)	40

i. All units ug/l unless otherwise stated.
ii. The standard is the annual mean standard over a period of 12 consecutive months unless otherwise stated.
iii. ( ) indicates that this is the 95-percentile standard where the standard is failed if the measured concentration is above the standard for 5% or more of the time.
iv. * indicates that the standard is not to be used for the purpose of classifying the ecological status or potential of bodies of surface water.
v. # indicates that the standard is the dissolved fraction obtained by filtration through a 0.45um filter.

Reproduced from Part 4 of The River Basin Districts Typology, Standards and Groundwater threshold values (Water Framework Directive) (England and Wales) Direction 2009.

Table 5: Surface Waters - Priority Substances – Standards for Chemical Status

Pollutant	***Annual Average***		***Maximum Allowable Concentration***	
	Inland	***Other***	***Inland***	***Other***
Alachlor	0.3	0.3	0.7	0.7
Anthracene	0.1	0.1	0.4	0.4
Atrazine	0.6	0.6	2.0	2.0
Benzene	10	8	50	50
Brominated diphenylether	0.0005	0.0002	NA	NA

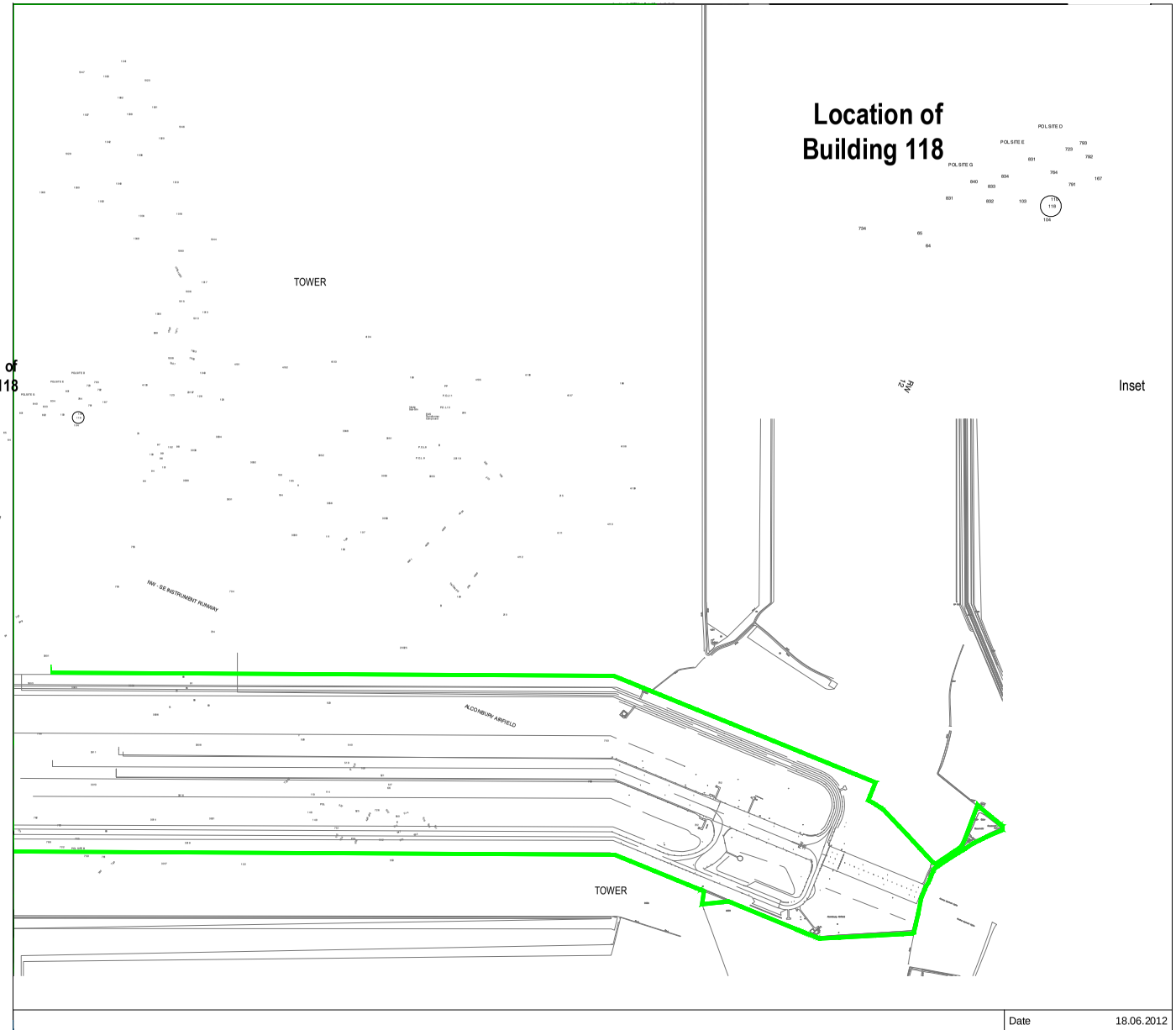
Pollutant	***Annual Average***		***Maximum Allowable Concentration***	
	Inland	***Other***	***Inland***	***Other***
Cadmium (and its compounds) # – hardness dependant – refer to Notes for definitions of C1 to C5	<0.08 C1 0.08 C2 0.09 C3 0.15 C4 0.25 C5	0.2	<0.45 C1 0.45 C2 0.6 C3 0.9 C4 1.5 C5	<0.45 C1 0.45 C2 0.6 C3 0.9 C4 1.5 C5
Carbon tetrachloride	12	12	NA	NA
C10-13 Chloroalkanes	0.4	0.4	1.4	1.4
Chlorfenvinphos	0.1	0.1	0.3	0.3
Chlorpyrifos	0.03	0.03	0.1	0.1
Aldrin, Dieldin, Endrin, Isodrin (Sum)	0.01	0.005	NA	NA
DDT Total	0.025	0.25	NA	NA
Para-para-DDT	0.01	0.01	NA	NA
1,2-Dichloroethane	10	10	NA	NA
Dichloromethane	20	20	NA	NA
Di(2-ethylhexyl)-phthalate (DEHP)	1.3	1.3	NA	NA
Diuron	0.2	0.2	1.8	1.8
Endosulfan	0.005	0.005	0.01	0.01
Fluoranthene	0.1	0.1	1	1
Hexachlorobenzene	0.01	0.01	0.05	0.05
Hexachlorobutadiene	0.1	0.1	0.6	0.6
Hexachlorocyclohexane	0.02	0.002	0.04	0.02
Isoproturon	0.3	0.3	1	1
Lead (and its compounds) #	7.2	7.2	NA	NA
Mercury (and its compounds) #	0.05	0.05	0.07	0.07
Naphthalene	2.4	1.2	NA	NA
Nickel (and its compounds) #	20	20	NA	NA
Nonylphenol	0.3	0.3	2	2
Octylphenol	0.1	0.01	NA	NA
Pentachlorobenzene	0.007	0.0007	NA	NA
Pentachlorophenol	0.4	0.4	1	1
Benzo(a)pyrene	0.05	0.05	0.1	0.1
Benzo(b)fluoranthene + Benzo(k)fluoranthene	0.03	0.03	NA	NA
Benzo(ghi)perylene + Indeno(1,2,3-cd)pyrene	0.002	0.002	NA	NA
Simazine	1	1	4	4
Tetrachloroethylene	10	10	NA	NA
Trichloroethylene	10	10	NA	NA
Tributyl tin compounds	0.0002	0.0002	0.0015	0.0015
Trichlorobenzenes	0.4	0.4	NA	NA
Trichloromethane	2.5	2.5	NA	NA
Tifluralin	0.03	0.03	NA	NA

i. The EQS are expressed as total concentrations in the whole water sample except for #.
ii. # indicates that the EQS is dissolved concentration obtained by filtration through 0.45um filter.
iii. Inland = surface waters encompassing rivers and lakes and related artificial or heavily modified water bodies.
iv. Hardness Classifications C1 <40 mg CaCO3/l, C2 40 to <50 mg CaCO3/l, C3 50 to <100 mg CaCO3/l, C4 100 to <200 mg CaCO3/l, C5 200 mg CaCO3/l.

Reproduced from Part 5 of The River Basin Districts Typology, Standards and Groundwater threshold values (Water Framework Directive) (England and Wales) Direction 2009.

KEY

AIRFIELD AREA SITE BOUNDARY



Client

URBAN & CIVIC

ALCONBURY - BUILDING 118

GENERAL LOCATION PLAN

Date	18.06.2012
A3 Scale	1:12500
Drawn by	DJM
Checked by	DBi
Figure Number	1

Offices throughout the UK, continental Europe, Africa and Asia
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File Location: j:\24213 alconbury\geo\04 cad & graphics\cad\dwgs\geo dwgs\brief 112\figure 1 - general location plan.dwg

PERMIT TO OPERATE EQUIPMENT

Rig No.	

Person in Charge of Apparatus :
Apparatus Name :
Location of Apparatus:
Description of Apparatus:

Staff Authorised to Use Apparatus

Only staff who have read and signed the Equipment Risk Assessment form are authorised to use this equipment.

Date of Issue:
Date of Expiry:
Permit Issued by:
Issuer's Signature *Permit not valid unless signed by a Director of the Company*

To contact emergency services, please dial 999 from any phone

Further information about this equipment can be obtained from the following:

Name:	Name:
Daytime No.:	Daytime No.:
Home No.	Home No.
Mobile No.	Mobile No.

Emergency Shutdown Procedure

The main hazards presented by this rig are:

Unattended Running Information

Please mark one of these boxes – the same one as is marked in the ERAF form.

☐ **It will not be necessary to run this equipment unattended.**

☐ **This is standard unmodified commercial equipment which is designed to be run unattended.**

☐ **This is a test rig, or modified commercial equipment, which may be run unattended with the appropriate authorisation (below).**

The maximum authorisation period is three months. The first signatory (Company Director) signs to say that the equipment is inherently safe to run unattended. The second signatory (another Director or qualified electrician) signs to say that PATesting is current, that this Permit is current and that there are no obvious safety problems which preclude unattended running of this equipment.

From (date)				
To (date)				
Signature 1				
Signature 2				

☐ **This equipment is not suitable for unattended running.**

Environmental Management System

List of documents relevant to environmental performance of Enval Limited

The main documents held on this file are listed below as “Main File” and they are kept at the Company’s Luton Site.

Completed by ..... **Date** .....

Documentation	**Held By**	**Location**
Policy on Environmental Issues	Main File	Luton site
Equipment Risk Assessment Forms (including operators procedures or instructions and emergency procedures)	Main File (copy at equipment site)	Luton site
Permit to operate	Equipment operator	Equipment Site
Chemical Hazards Risk Assessment Form	Main File (copy at equipment site)	Luton site
Pre-acceptance procedure	Main File (copy at equipment site)	Luton site
Emissions to atmosphere records	Equipment operators	Equipment Site
Letters following inspections	Main File	Luton Site
Results of HAZOP, LOPA and DSEAR	Main File (copy at equipment site)	Luton Site
Copy of relevant Process Guidance Notes	Main File	Luton Site
Complaints from related stakeholders over the past 3 years and steps taken as a result	Main File	Luton Site

Drawings and diagrams	Main file and equipment operators	Luton site and equipment site
Copy of duty of care documents	Main File	Luton site
Waste contractors carriers licence (EA number: CB/TM3382zz)	Main File	Luton site
Electricity, water and gas usage records	Equipment operators	Equipment site
Amount of waste produced, and how much sent for re-use, recycling or disposal	Equipment operators	Equipment site
Maintenance Schedules and Records	Equipment operators	Equipment site
Staff suggestions for environmental improvements	Main File	Luton site