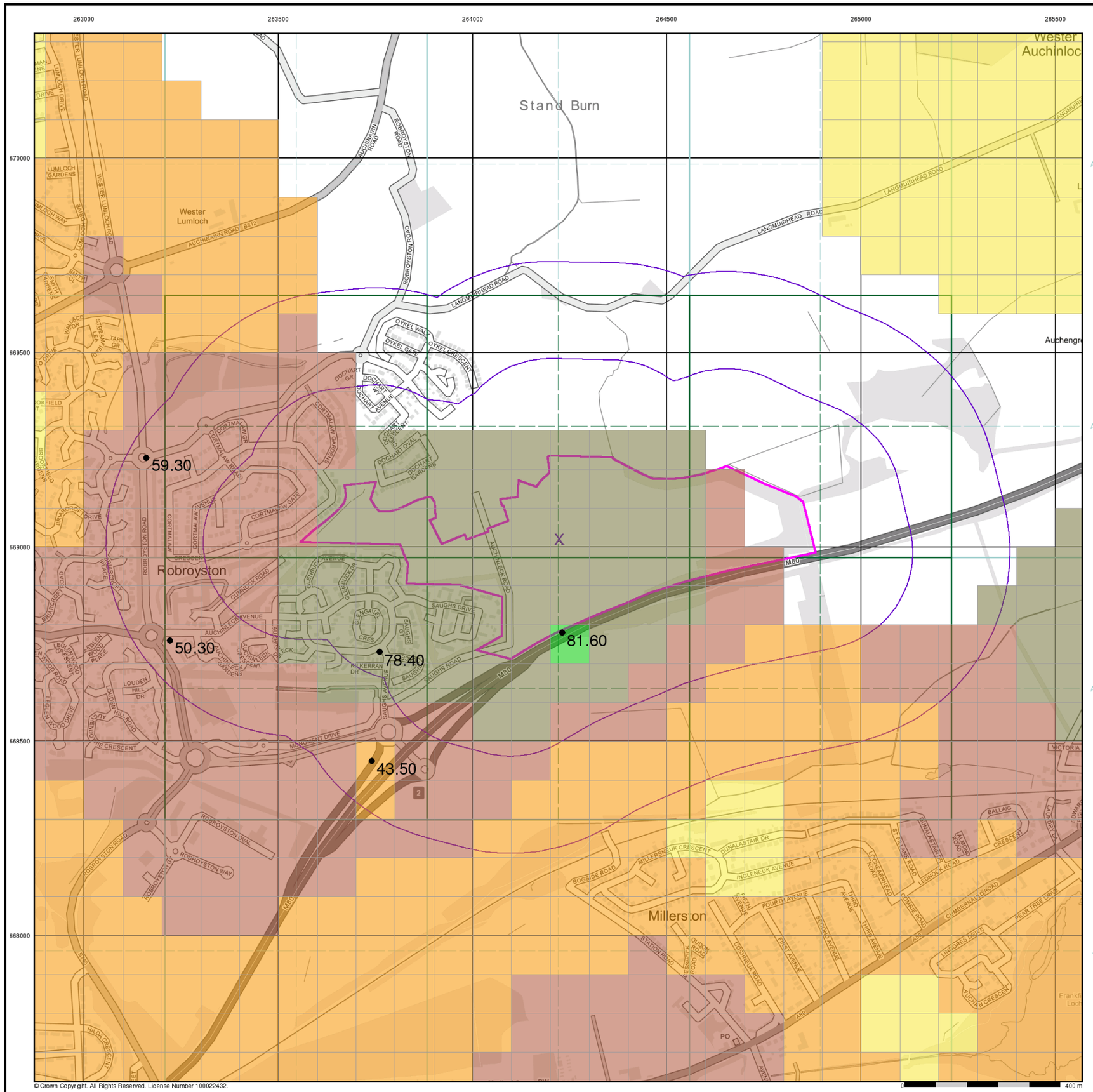





JOHNSON POOLE & BLOOMER
LAND CONSULTANTS

## General

Specified Site | Specified Buffer(s) | X Bearing Reference Point

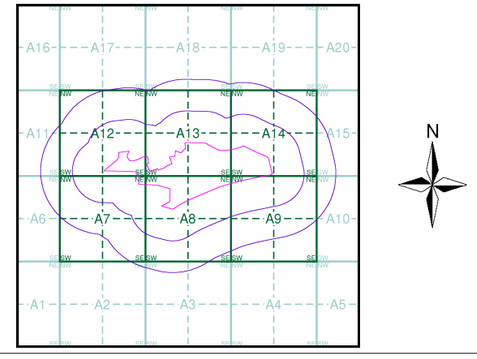
## Urban Soil Chemistry Nickel

● BGS Urban Soil Chemistry Measured Concentration Values (mg/kg)

Nickel Concentrations mg/kg

- < 15
- 15 - 30
- 30 - 45
- 45 - 60
- 60 - 80
- 80 - 100
- > 100

## Urban Soil Chemistry Nickel - Slice A




## Order Details

| | |
|---|---|
| Order Details: | 232171897_1_1 |
| Customer Ref: | TG276 |
| National Grid Reference: | 264220, 669020 |
| Slice: | A |
| Site Area (Ha): | 31.49 |
| Search buffer (m): | 500 |

## Site Details

Robroyston North

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


JOHNSON POOLE & BLOOMER
LAND CONSULTANTS

## General

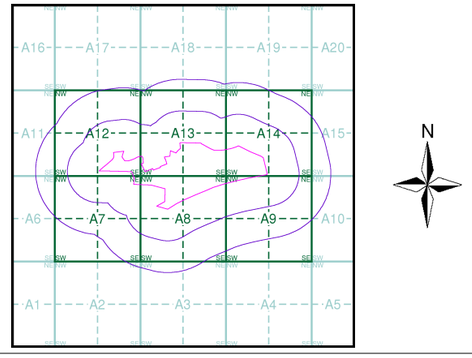
Specified Site | Specified Buffer(s) | X Bearing Reference Point

## Estimated Soil Chemistry Nickel

Nickel Concentrations mg/kg

- < 15
- 15 - 30
- 30 - 45
- 45 - 60
- 60 - 80
- 80 - 100
- > 100

## Estimated Soil Chemistry Nickel - Slice A

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## Appendix 8 Methodology for Exposure Assessment and Ground Gas Risk Assessment

## METHODOLOGY FOR EXPOSURE ASSESSMENT

The following is a general statement of JPB's methodology for investigating and assessing potentially contaminated sites for the purposes of identifying constraints posed by contamination issues. There is a large body of authoritative technical guidance in this field and it would not be either appropriate or worthwhile for this methodology to repeat verbatim that guidance, and the methodology does not seek to do so. Each site will be different, with different constraints and challenges and site specific investigation and assessment details for individual sites are given within the text of each report. The following text provides an informative summary of the methodology JPB generally apply to such sites.

### Regulatory Framework

The assessment of potentially contaminated sites and the associated risk to the proposed development is dependent on a number of factors namely; the intended site end use, distribution and level of contamination, characteristics of the soil (i.e. pH, permeability) the groundwater regime and the sensitivity of the surrounding area. An analysis of the interaction between these various factors allows a decision to be made with regard to the extent of any remedial measures required for the development.

The contaminated land provision of the Environment Protection Act 1990, inserted by Section 57 of the Environment Act 1995, came into force in July 2000. In May 2006 the Scottish Executive issued a revised Statutory Guidance Edition 2 (SE/2000/43). Within this "Contaminated Land" is defined as

> *"any land .....in such a condition by reason of substances in, on or under the land, that*
>
> *a) significant harm is being caused or there is a significant possibility of such harm being caused; or*
> *b) pollution of the water environment is being, or is likely to be caused;"*
>
> In addition *"the questions*
>
> *a) what harm or pollutant of the water environment is likely to be regarded as significant*
> *b) whether the possibility of the significant harm or significant pollution of all the water environment being considered significant"*

In addition, PAN 33 is affected by this and embodies a "suitable for use approach" for land for development, which requires remediation only where there are unacceptable risks to health and the environment depends on the current and proposed end use.

In addition, the guidance requires a significant pollutant linkage to be present which includes;

- A source (pollutant)
- A pathway
- A receptor

JPB have therefore developed a risk assessment approach based on this philosophy, the methodology used is represented diagrammatically in the attached flow chart.

### Stage 1 - Preliminary risk assessment-

*Desk Study*

The methodology utilised for desk studies follows the specifications outlined in CLR2 "Guidance on Preliminary Site Inspection of Contaminated Land", CLR6 "Prioritisation and Categorisation Procedure for Sites which May be Contaminated", CLR11 Model Procedures for the Management of Land Contamination, DEFRA/EA 2004, Contaminated Land Risk Assessment, CIRIA C552 and BS 10175 "Investigation of Potentially Contaminated Sites – Code of Practice", BSI.

During the study, documentary research will include an examination of the Ordnance Survey maps for details regarding previous site and adjacent land uses. Similarly, the available geological maps will be examined to determine the geological/hydrogeological conditions beneath and adjacent to the site. In addition, regional memoirs will be consulted together with mine abandonment plan data and any available borehole records, in order to assess the mining conditions. The assessment also takes cognisance of the information contained in the guidance documents "Risk Based Approach to Development Management – Resources for Developers" published by the Coal Authority and CIRIA SP32 "Construction over Abandoned Mineworkings".

A walkover survey will be carried out to determine the existing site conditions and operations. In addition, a photographic record of the site is taken during the walkover survey.

Information will also be obtained from the SEPA, BGS and Coal Authority websites and other authoritative online resources and from a review of in-house information. A report of environmental database information may also be obtained.

*Conceptual Site Model*

A Conceptual Site Model (CSM), which describes how potential chemical sources at the site could contribute to increased levels of risk to potentially sensitive receptors, is developed at an early stage and constantly reassessed in light of investigative findings. CSMs are generated in accordance with Guide to Good Practice for the Development of Conceptual Models and the Selection and Application of Mathematical Models of Contaminant Transport Processes in the Subsurface - National Groundwater & Contaminated Land Centre report NC/99/38/2 – Environment Agency 2001.

The first step in developing such a model is to identify whether there are potential hazards which may pose a risk on the site through desk top research and professional judgement. In addition, information regarding the site-specific environmental setting including geology, hydrogeology, hydrology etc, is gathered in order to assess the potential exposure pathways which are likely to exist and the location of humans and environmental resources which could be impacted by the site.

Following this desk-based study and the development of an initial CSM (ICSM), a site investigation is designed in order to determine whether any potentially significant pollutant linkages actually exist on the site. The information gathered during the investigation is then used to revise the ICSM and as the basis of the risk assessment process. While any investigation strategy will be specific to each site the following general comments can be made.

*Design of Site Investigations*

JPB design and implement site investigations cognisant of the guidance given in BS10175. Care is taken to target investigations at potentially contaminated locations identified in the ICSM from researches and from site visits or other available information. In addition, during the performance of investigations locations are refocused in the light of known site conditions. Further investigations are also undertaken at randomly selected locations resulting in a mixture of random and targeted investigation locations.

The requirement for adequate site coverage is a key consideration at the design stage and the number and type of investigation locations is determined by the available information, the brief and the requirements of the guidance given in CLR4 and R & D Publication Report P5-066/TR Secondary Model Procedure for the development of Appropriate Soil Sampling Strategies for Land Contamination. BS10175 indicates that in order to provide adequate site coverage a sampling grid of between 10m and 25m should normally be applied for a main investigation, for example where a residential development is considered. Where the ICSM indicates there to be no potential source of contamination on the site, or other land uses are envisaged, JPB consider that a wider grid, for example 50m spacing, may be adopted.

*Site Zoning*

Some sites may need to be divided into geographical sectors where, for example, historical land uses differ or the type of development varies across the site in accordance with R & D Technical Report P5-066/TR. Good practice guidance describes averaging areas as "areas of soil to which a receptor is exposed or which otherwise contributes to the creation of hazardous conditions". Where made ground material is contaminated at variable concentrations, but within a single geological unit, JPB consider that this unit can be adopted as an averaging area for the purposes of making an assessment of human health risks. However, where measured contamination concentrations include statistical outliers of high concentration, where different historical land uses have resulted in different patterns of contamination or where there is a clear distribution of higher contaminant concentrations in one sector of the site, averaging areas are chosen to reflect this contaminant distribution. Single high contaminant concentrations may indicate the presence of "hotspots" which may merit closer scrutiny or additional investigation.

*Site Coverage*

Investigation locations such as trial pits and boreholes are positioned to provide adequate site coverage, where access is available and avoiding existing services. Boreholes are situated at a mixture of targeted and random locations at the site where access is possible.

During the investigation the sampling strategy in CLR 4 "Sampling strategies for contaminated land" together with the guidance given in R & D Publication Report P5-066/TR is followed. The rationale behind the sampling strategy given in the R & D publication is:

| Depth of sample | Rationale |
|---|---|
| 0-0.5 | To assess<br><br>▪ Human/animal intake arising from ingestion and dermal contact.<br>▪ Potential for wind entrainment leading to inhalation (of contaminated soils and dusts) or deposition onto neighbouring land.<br>▪ Surface water run-off (e.g. due to flash flooding).<br>▪ Uptake by shallow rooting plants (e.g. crops, ornamental and wild species).<br>▪ Surface leaching to groundwater. |
| 0.5m in made or natural ground | To assess<br><br>▪ Intake via ingestion/inhalation/dermal contact from "abnormal" (or unpredicted) excavation (e.g. children digging dens) or for other purposes such as swimming pools, ponds house extensions).<br>▪ Uptake by deep rooting shrubs and trees.<br>▪ Intake by, or arising from, the activities of burrowing animals.<br>▪ Intake arsing from construction / maintenance of buildings and services for example.<br>▪ Foundations (usually within 2m of formation level).<br>▪ Water supply pipes, telecommunications, gas & power (0.5-1m of final formation level).<br>▪ Sewers (from 0.5 > 1m of final formation level).<br><br>To locate perched water or groundwater.<br>To confirm depth of made ground.<br>To locate possible lateral pathways for gas or vapour migration in made ground.<br>To establish extent of any leaching of soluble constituents from superficial soils.<br>To detect "deep" contaminants (e.g. gas generating materials, leachable materials, dense solvents located on top of an impermeable stratum).<br>To obtain information of "background" soil properties.<br>To locate "natural" lateral migration pathways. |

Samples are generally taken at shallow depth, then at where relevant changes are noted in materials with depth. Where any made ground is thick and relatively uniform samples are taken at least every 0.5m to 1.0m. Where organic contamination is observed within made ground, a sample of natural soil is generally taken from beneath each made ground horizon where the base is proven. Samples are recovered from each trial pit. Samples are recovered at these regular intervals with additional samples of any atypical horizons also taken. It should be noted that there will always be the possibility of additional unrecorded conditions outwith the sampling points. Samples obtained are stored within appropriate containers and dispatched for analysis within 24 hours of sampling.

Attempts are made to recover water samples from all of the boreholes at which standpipes are installed. Each borehole is extensively purged to a volume in excess of three times the well volume, where feasible, using a submersible mini-whale pump or bailer. Purging before sampling allows a more representative water sample of groundwater to be obtained and ensures that any water initially present in the boreholes is removed as this may have been chemically altered due to reaction with air or with installation materials. Water samples are transferred to appropriate containers before being transported to the testing laboratory in cooled conditions.

Testing parameters scheduled on soil and water samples are based on historical and current operations information and their importance in relation to health risks, phytotoxicity, impact on the water environment, protection of building materials, services and structures from chemical attack and potential impact on the quality of potable water supplies. Where possible chemical testing is targeted at locations at the site where particular contaminants are anticipated, with additional testing scheduled to give horizontal and vertical site coverage. Selection of test parameters is performed on a site specific basis as described in the text of each investigation report.

**Stage 2 Generic Quantitative Risk Assessment**

The next stage of the site-specific assessment is to perform a Stage 2 risk assessment using the information gathered during the site investigation to determine the actual nature and extent of contamination, evaluating the data using conservative generic criteria to determine whether any recorded levels of contaminants could be potentially of concern.

*Stage 2 Criteria*

The Stage 2 generic quantitative assessment of risks to human health, property, ecology, surface water and ground water considers the potential for exposure based on comparison of the results to conservative generic criteria.

*Human Health Risks*

DEFRA and the Environment Agency including; Soil Guideline Values (SGVs) derived using the CLEA model and the methodology described in EA Science Report SC050021/SR3, EA CLEA science reports and the associated TOX and SGV series of reports. In addition, JPB have adopted S4UL values published by LQM/CIEH and GAC values published by EIC/AGS/CL:AIRE as GACs and, where other suitable values are not available, GACs derived by JPB generated using the CLEA model and in accordance with the above guidance.

The Contaminated Land Exposure Assessment (CLEA) model was developed for the Department for Environment, Food and Rural Affairs (DEFRA) and the Environment Agency. The model estimates child and adult exposures to soil contaminants for those potentially living, working and/or playing on contaminated sites over long time periods and has been used to produce the Soil Guideline Values for the UK, first published in 2002. The guidance was updated following the “Way Forward” process, and the revised technical guidance and SGVs above published in 2009.

The CLEA model used to derive generic criteria has undergone a number of updates, the model used for the derivation of current published criteria; SGVs, S4ULs, EIC/AGS/CL:AIRE was Version 1.06. S4ULs were, however, derived using some exposure parameters amended in the light of the C4SL project (see below).

The CLEA model calculates GACs which represent doses “without appreciable health risk” or “minimal human health risk” depending on whether a contaminant is a threshold or non-threshold substance. An update (version 1.071) was released in 2015, and includes the library data sets from the DEFRA research project SP1010 (Development of Category 4 Screening Levels (C4SLs) for assessment of land affected by contamination), allowing the derivation of generic criteria characterised as representing “low” levels of risk.

In addition, CLEA 1.071 continues to allow the derivation of GACs which represent doses "without appreciable health risk" or "minimal human health risk". This procedure has been adopted to calculate JPB derived GACs using CLEA 1.071. JPB derived criteria are based on conservative assumptions including; the development of small terraced houses on the site, a soil organic matter content of 1% and pH value of 7.

C4SLs represent a higher, but still low, level of risk than SGVs, S4ULs, EIC/AGS/CL:AIRE or JPB GACs. Although they represent different levels of risk, JPB consider that both C4SLs and other JPB GACs are appropriately protective generic criteria for assessing contaminated land for the following reasons. S4ULs, EIC/AGS/CL:AIRE and JPB GACs have been derived in accordance with technical guidance and a risk assessment model which are scientifically based and have been published by authoritative bodies. C4SLs have been confirmed to represent levels of risk which are lower than is required to meet the definition of "contaminated land" ("Simplification of the contaminated land regime", Impact Assessment: Defra 1133). Their use is also endorsed by DEFRA in their Policy Companion Document to the SP1010 project which states that C4SLs "are intended to be more pragmatic (whilst still strongly precautionary) compared to existing generic screening levels".

Where available C4SL values have been adopted as JPB GACs. However, to date only a limited number of HCVs for C4SL have been published and consequently a limited number of contaminants have published C4SLs. As selecting an appropriate C4SL HCV requires specialist toxicological competences, JPB have not derived HCV for additional contaminants. Where a published C4SL is not available for a particular contaminant, JPB have adopted a GAC derived using the CLEA model and based on "without appreciable health risk" or "minimal human health risk" risk levels. Where an S4UL or EIC/AGS/CL:AIRE value is available it has been adopted as a GAC, where no C4SL, S4UL or EIC/AGS/CL:AIRE GAC is available, JPB GAC derived in accordance with the above guidance have been adopted.

Annex E of SP1010 indicates that in order to apply the benzo(a)pyrene surrogate approach and C4SL used in the above guidance, the assumptions made in its derivation must be verified, in particular the PAH profile in the site soils must be similar to the test material used in the toxicological study on which the C4SL HCV is based. To assess the PAH profile in the test soil samples, JPB calculate the ratio of seven other genotoxic PAHs (benz(a)anthracene, benzo(b)fluoranthene, benzo(k)fluoranthene, benzo(g,h,i)perylene, chrysene, dibenz(a,h)anthracene and indeno(1,2,3-c,d)pyrene), relative to benzo(a)pyrene, to ensure the site soil PAH profile is similar to the test material used in the study. The ratios relative to benzo(a)pyrene must fit within the upper and lower limits detailed in Table 2.5 and Figure 2.1 of Annex E.

These ratios are calculated for soils at each site and the result appended to the report. It should be noted that PAH ratios are calculated for samples with appreciable PAH contents, as the above ratio test does not work correctly where some genotoxic PAH concentrations are near or below laboratory reporting limits as ratios become skewed by zero or "less than reporting limit" values.

*Phytotoxic Risks*

To assess the site's potential for phytotoxicity JPB refer to the MAFF/DoE document "Review of the Rules for Sewage Sludge Application to Agricultural Land – Soil Fertility Aspects of Potentially Toxic Elements" in the absence of other definitive phytotoxic screening levels. This document is authoritative and scientifically based, it sets out total concentrations of various metallic elements which shouldn't be exceeded in order to maintain soil fertility and avoid toxicity. Therefore, it is considered that these limits can be applied to contaminated land and other situations, e.g. they have been adopted by DEFRA in its "Soil Code" and by the Forestry Commission. It should be noted that plant growth can also be significantly affected by many other factors including: pH, nutrient availability, soil texture and structure, temperature, moisture content and aeration. In addition, reference has been made to "Soil Code" (MAFF 1998), and CLR2, "Guidance on Preliminary Site Inspection of Contaminated Land".

*Structures and Services*

Where structures or services are considered to be viable receptors, risks are assessed using contemporary best practice guidance given in documents published by the Building Research Establishment (BRE), CIRIA, Water Research Council (WRc), UKWIR, the HSE and other relevant organisations.

Risks posed to buildings and services due to aggressive soil sulphate, chloride and pH conditions are assessed using the guidance given in BRE Special Digest 1 (2005), Concrete in aggressive ground.

*Water Supply Pipes*

Risks posed by soil and groundwater contaminant concentrations to water supply pipes are assessed in accordance with the UK Water Industry Research (UKWIR) document, "Guidance for the Selection of Water Supply Pipes to be used in Brownfield Sites", UKWIR report reference 10/WM/03/21, 2010. This guidance identifies the chemicals present in soils which can either permeate pipes or impact on their integrity by causing swelling, cracking and degradation or corrosion. The main focus is, therefore, on organic contaminants and on the soil's conductivity, pH and redox potential. Due cognisance is also taken of the requirements and guidance issued by utility companies.

UKWIR guidance states that where a site has been greenfield and no chemicals have been historically or currently stored or used on it (or part of the site meets these criteria), no restriction is made on the type of water pipes which can be used on the site (or part of the site as appropriate). Direct communication between JPB and Scottish Water (SW) indicates that SW will not require intrusive investigations on sites which have been greenfield throughout their history, providing supporting documentary evidence is supplied.

Where investigations are required, samples are obtained from locations on site as identified in the site ICSM. Where the route of water supply pipes is known, sample locations during investigations would include locations on or within 15m either side of the route, otherwise investigation coverage for the whole site is as described previously in this methodology, as recommended in section 2.5.5 of the UKWIR report and in SW guidance.

Selected soil samples are tested for the parameters recommended in the UKWIR guidance; VOCs (including TIC), SVOCs (including TIC), amines, petroleum hydrocarbons (including "mineral oils"), conductivity, pH value and redox potential. Results of analyses are collated and compound group concentrations summed as described in section 2.7.9 of the UKWIR guidance, these sums are adopted as Representative Contaminant Concentrations (RCCs). The maximum concentration recorded at the site (or if appropriate within a particular site zone) for each substance is used for summing and tabulation, this is a conservative assumption.

The RCCs are compared with the UKWIR threshold values for polyethylene (PE) and polyvinylchloride (PVC pipes) detailed in Table 3.1 of the UKWIR, which have been adopted as JPB GACs. Exceedence of a single GAC indicates PE or PVC pipework is not appropriate and other pipe materials should be selected. Consideration of the corrosive properties of soils is also required where PE, PVC or barrier pipes are not selected as appropriate. The comparison of RCCs with GACs and the other criteria in Table 3.1 of the UKWIR guidance results in a list of pipe materials which would be suitable in terms of chemical properties, a preferred selection can then be made on the basis of cost, appropriateness etc. or the choice of specific materials to be used made by the engineer/developer. Further recommendations on standards and specifications for water supply pipes and fittings for various pipe materials are given in Part 4 of the UKWIR guidance.

*Combustibility*

Where potentially combustible materials are encountered the following assessment methodology is adopted. Despite the potential for combustion in many sites characterised by carbonaceous materials, the number of recorded instances of actual combustion are very few and there has been no definitive study of the phenomena. Consequently, there are no commonly accepted criteria for comprehensively assessing and dealing with the risk of spontaneous combustion. The ICRCL Guidance Note 61/84 "notes on fire hazards of contaminated land" suggests that there is an unacceptable risk of combustion if the material has a Calorific Value in excess of 10 MJ/kg or perhaps only 7 MJ/kg.

However, a paper presented at the Fourth Mineral Waste Utilisation Symposium related to the Utilisation of Coal Refuse for Highway Base or Sub-base Material. In this paper it states that "low permeability values are desirable in order to reduce air circulation and the potential for spontaneous combustion". It then goes on to suggest that "proper compaction of coal refuse reduces air voids to less than 10% and the potential for spontaneous combustion is substantially reduced".

There is an imprecise relationship between Loss on Ignition and Calorific Value but previous comparisons by JPB have indicated 10 MJ/kg to be roughly equivalent to 30% Loss on Ignition and 7 MJ/kg to be roughly equivalent to 23% Loss on Ignition.

JPB adopts the following guidelines:

i) combustion may be induced and supported only if the Loss on Ignition value exceeds about 20% and the Calorific Value exceeds 7 MJ/kg.

ii) carbonaceous material needs to be of some bulk ie thicker than 1 metre and greater than 10 $m^3$ in volume.

iii) spontaneous combustion should not occur in thoroughly compacted material to which air is excluded.

*Water Environment*

Current SEPA guidance described in document WAT-PS-10-01: Assigning Groundwater Assessment Criteria for Pollutant Inputs (Live Document) notes that for land contamination four receptors were to be assessed, if identified as being present, namely; surface water; groundwater abstraction, groundwater resource, and groundwater dependant terrestrial ecosystem (GWDTE or wetland). Routine leachability testing is carried out for water soluble contaminants in order to determine if there is a threat from soil borne contaminants to ground and surface waters.

For the protection of surface waters and groundwater resources the concentration of each contaminant in soil leachates, groundwaters and surface waters are compared against relevant assessment limits. The assessment limits may be a UK Drinking Water Standard (UKDWS), Resource Protection Value (RPV) or EQS depending on the nature of the receptor which is being considered to potentially be at risk. In addition, reference is made to SEPA guidance document WAT-SG-53: Supporting Guidance, Environmental Standards for Discharges to Surface Waters, The Scotland River Basin District (Standards) Directions 2014, UKTAG's m-BAT tool and SEPA's River Basin Management Plans.

Where no assessment limit has been provided by SEPA, other limits may be adopted such as WHO Drinking Water Guidelines, US EPA National Primary Drinking Water Regulations or the laboratory's minimum reporting limit (MRL).

*Stage 2 Risk Evaluation*

Stage 2 risk-based guidance levels such as GACs are conservative generic values against which measured contaminant concentrations can be compared. Where measured concentrations are found to be below these screening criteria then the contamination identified is not considered to pose a significant risk. The guidance used to evaluate investigation data is chosen to be relevant for the particular risk and receptor being assessed as well as being applicable to the legislative issues of concern. Where measured concentrations of contaminants exceed generic criteria, the risks posed by the contaminants of concern are considered more fully in a Stage 3 risk assessment. Where no generic criteria are available or a substance, an automatic Stage 3 assessment is carried out if the contaminant is present above laboratory reporting limits.

Stage 2 criteria adopted by JPB for risk assessments are included in reports. If any of the appropriate criteria contained in these documents are exceeded, the conclusion is that significant risk could exist and that a further assessment (Stage 3) is warranted in order to calculate the potential levels of risk. This process, therefore, focuses on the contaminants of concern and can, if necessary, inform any further investigations which may be required for more detailed examination.

**Derivation of JPB Human Health Criteria**

*Assessment of risks to human health*

Each contaminant exceeding Stage 2 criteria is examined for its potential to cause harm. Consideration is then given to the significant pollutant linkages which are plausible for the identified hazards, i.e. whether a contaminant can conceivably come into contact with a specified receptor group. It is possible that a contaminant may be deemed a hazard due to its presence above screening criteria but ultimately not constitute a risk as no viable pathway exists between the source and the receptor. The relative sensitivity of all potential receptors identified is quantitatively assessed using the data obtained during the desk study and site investigation phases.

The risk to human health is determined using an exposure assessment, an estimate of potential doses of the chemicals in exposed individuals via the pathways identified in the ICSM. This focuses on a hypothetical individual within each exposed population and involves the use of models which incorporate assumptions regarding human behaviour and physiological attributes. The assumptions are made in a “worst case” or “reasonable worst case” manner to provide estimates of dose which are unlikely to be exceeded by receptors at or in the vicinity of the site. The main focus of the exposure assessment is the estimation of long-term (chronic) dose levels from repeated exposure to chemicals in the soil and groundwater. In some cases, for example cyanides, acute exposure is also considered. Exposure to each chemical is estimated for each viable pathway and for any potential sensitive receptors.

The purpose of the human health assessment is to identify the levels of exposure to contaminants which, if not exceeded, do not cause unacceptable adverse health effects. The subject of human health assessments is covered in depth in the DEFRA/EA Science reports to which the reader is referred for further background information, however, a short review is given below.

*Health Criteria Values*

Human health assessment criteria are derived by comparing the estimated exposure of critical receptors to the contaminants with Health Criteria Values (HCVs). HCV represent a tolerable or minimal risk to health from chronic exposure to these contaminants or, in the case of C4SLs, a “low” risk level. Acute health risks must be assessed separately. Health Criteria Values are derived through the collation and review of toxicological data and its subsequent use in the derivation of soil contaminant intakes that are considered to be protective of human health. These intakes are guidelines to a risk assessor on the level of long-term human exposure to individual chemicals in soil that are tolerable or pose a minimal risk, or in the case of C4SLs pose a low but acceptable risk. HCVs are established from a review of the evidence from occupational and environmental epidemiological studies, animal studies and from scientific understanding of the mechanisms of absorption, transport, metabolism and toxicity of chemicals within the human body.

The derivation of HCVs for tolerable or minimal risks is described in detail within EA Science report-SC050021/SR2. The derivation of HCVs representing low risks used to derive C4SLs is described in DEFRA report SP1010 – Development of Category 4 Screening Levels for Assessment of Land Affected by Contamination.

Contaminants generally exhibit two possible types of toxicity, threshold toxicity and non-threshold toxicity. For contaminants which exhibit threshold toxicity there is some, non-zero, measurable amount of exposure (dose) that is required before a biological threshold is breached and an adverse health effect is produced. However, in some cases the toxicological mechanism responsible for producing the adverse effect is such that there is no basis to assume a threshold exists. This is most notably the case for genotoxic carcinogens. The biological mechanisms by which these types of chemicals cause damage to DNA and genetic material means that any exposure to these chemicals, no matter how small, will carry some level of risk. The theoretical basis for this is that one 'hit' on DNA can produce a mutation that may eventually lead to a tumour. It is, therefore, not possible to identify the threshold with any confidence. Hence, the prudent assumption is made that such compounds do not have a threshold. It should be noted that not all carcinogens are genotoxic, some may exhibit a threshold, and whether a contaminant is a threshold or non-threshold substance should be determined by a review of the available toxicological evidence.

*HCVs for Tolerable or Minimal Risk*

HCVs for tolerable risk levels for threshold substances are referred to in the UK as Tolerable Daily Intakes (TDIs), some other authorities or organisations derive similar criteria such as Reference Doses (RfDs) or Provisional Tolerable Weekly Intakes (PTWIs). These values are in principle similar and can be thought of as "safe" levels of exposure at which adverse effects are not likely to occur, although some conversion or further consideration may be required before adoption of values from other jurisdictions in the UK context. These health criteria are typically derived by applying "safety" or "uncertainty" factors to intake levels observed to have little or no effects in humans or animals.

Exposure to receptors will occur not just from soil-borne contamination but also from intakes of food, water and air. Where a contaminant is a threshold substance these background intakes of a contaminant must, therefore, be calculated and subtracted from the TDI, to calculate the intake of the contaminant which could be tolerated from exposure to soil contamination alone (this quantity is the TDSI – Tolerable Daily Soil Intake), in addition to normal background exposure. This background intake is the Mean Daily Intake (MDI). Where information is not available on intake levels of contaminants or where the MDI exceeds the TDI, the Science report-SC050021/SR3 states that the TDSI should be set in the model to be 50% of the TDI.

DEFRA/EA have adopted the Index Dose (ID) as the HCV for minimal risk levels for non-threshold substances, which can be considered to present a minimal human health risk from exposure to soil contaminants. For non-threshold contaminants background intake is not considered as there is no "safe level". In addition, application of the ALARP (As Low As Reasonably Practicable) principle for these substances means that intake should be reduced to as low a level as practicable, that this principle is being adopted by the competent authorities for intakes from food, water and air and that actions are being taken to reduce these other intakes.

There are a number of sources of toxicity criteria and background exposure levels which include Department of the Environment, Food and Rural Affairs (DEFRA); World Health Organisation (WHO); the US Environmental Protection Agency (US EPA) IRIS (Integrated Risk Information System) and other published scientific literature. Where available the definitive UK toxicological and background exposure levels published in the DEFRA/EA/SEPA CLEA TOX reports, under the advice of the Department of Health and The Food Standards Agency, are used as the primary source. However, as authoritative UK based information is available for only a limited number of substances, health criteria and other model input data has been sourced from non-UK published information. The methodology outlined in Science report-SC050021/SR2 has been used to derive HCVs where an authoritative UK HCV has not been published.

*HCVs for Low Risk*

HCVs for low levels of risk are known as LLTC, LLTC used in deriving C4SLs adopted by JPB have been derived as described in DEFRA report SP1010 – Development of Category 4 Screening Levels for Assessment of Land Affected by Contamination. The assumptions and decisions used to derive LLTC are discussed in the above document. The overall LLTC derivation methodology described contains several elements which are similar to or, conversely, differ from, those used to derive "minimal risk" HCVs. Key aspects of the similarities and differences between the approaches are summarised in Table 2.4 of the above document.

*General Approach to Risk Estimation*

Stage 2 generic criteria have been selected from published values or derived by JPB as described above. JPB derived GACs using the CLEA 1.071 model where sufficiently reliable UK authoritative or peer-reviewed input data (including HCVs) is available. In the first instance the model input values published by DEFRA/EA, derived by Land Quality Management (LQM) in association with the Chartered Institute of Environmental Health (CIEH) and data published in Environment Industry Commission (EIC)/CL:AIRE Report: Soil Generic Assessment Criteria for Human Health Risk Assessment have been used for JPB derived GAC if available. Both the CLEA model and C4SL methodology derive GACs for use when considering the risk to human health from chronic exposure to toxic metals, metalloids and organic substances in soil. The assessment criteria represent contaminant concentrations in soils, which if exceeded on site may be indicative of unacceptable risks to human health. It is envisaged that these methodologies can also be used as a tool during either the detailed quantitative risk assessment or the risk management process.

These methodologies adopt the risk-based source-pathway-receptor pollutant linkage framework and a deterministic methodology. The exposure pathways considered are direct ingestion of soil and dust, direct dermal contact with contaminated soil, consumption of home grown or allotment vegetables, ingestion of soil attached to such vegetables, inhalation of soil vapours outdoors and inhalation of soil vapours indoors. The CLEA model used in both methodologies is intended to reflect and be compliant with the guidance in DEFRA/EA Science Reports.

Where input data from the above sources is not available, data published by other organisations has been used. It should be noted that the toxicological data available for particular substances in many cases is very limited and incomplete. In order to adopt a relatively consistent approach, where authoritative or peer reviewed UK data is not available, data has been obtained primarily from USEPA and Dutch RIVM report sources as these sources offer a wide range of expert reviewed parameter values such as health criteria values, physical and chemical property data for commonly encountered soil contaminants.

*Risks posed by Polychlorinated biphenyls (PCBs) in soil*

For risk assessment purposes PCB congeners are divided into two groups; (1) dioxin-like PCBs and (2) non-dioxin like PCBs. Dioxin-like PCBs have similar structures and toxic mechanisms to dioxins and furans and so are assessed together with dioxin and furans. Non-dioxin like PCBs have a different toxic end point to dioxin-like PCBs and must, therefore, be assessed separately.

If the criteria set out in the SGV report are fulfilled, the PCB test results can be directly compared with the SGV given in the report. However, SGVs relate to background PCB levels where a site source is absent, and this limits the applicability of the SGV.

Where the assumptions required for the use of the SGV are not met, dioxin-like PCBs are assessed using the SGV worksheets for the standard land uses. Where site specific dioxin and furan data is not available, the median urban or rural dioxin and furan values given in the SGV report are used to account for "background" concentrations of these substances. A hazard index (HI) is calculated using the worksheet and if the HI is >1, then dioxin-like PCBs may pose a risk to human health receptors in the scenario being considered.

A specific methodology to assess risks posed by non-dioxin like PCBs has not yet been published by EA/DEFRA, however, JPB have adopted the current UK methodology used to assess other organic compounds. This involves selecting a list of target compounds, a TDI and other input data and using the CLEA model to derive GACs. PCBs are typically present as mixtures. The most persistent and toxic non-dioxin-like PCBs are present at their highest concentrations in PCB mixture aroclor 1254. The 7 ICES list indicator PCBs make up about 50% of aroclor 1254. JPB, therefore, compare the sum of these indicator PCBs with the assessment criteria. The criteria are derived using a TDI for aroclor 1254 and other input data using the CLEA model. The TDI is adjusted to account for the percentage of the 7 ICES compounds present in aroclor 1254. If the sum of the soil concentrations of the 7 ICES exceeds the GAC, then non-dioxin-like PCBs may pose a risk to human health receptors in the scenario being considered.

Therefore, if either the dioxin-like PCB or non-dioxin-like PCB assessment indicates the presence of a risk, remediation may be required or a further assessment may be proposed.

*Risks posed by Cyanides in soil*

Cyanide compounds exhibit both acute and chronic toxicity, although it should be recognised that complex cyanides are much less toxic than free cyanides. There is currently no UK SGV available to assess chronic cyanide toxicity, although a review of the toxicology of cyanide has been published (DEFRA CLR TOX 5 report).

Criteria derived to be protective of chronic cyanide exposure exceed those derived to be protective of acute exposure to both types of cyanide. Therefore, the criteria derived for acute exposure to free and complex cyanides have been conservatively adopted to be protective of receptors.

The Environment Agency has not published guidance on the assessment of risks due to acute exposure to cyanide compounds. However, HPA publications indicate that hydrogen cyanide and its solutions may be fatal following acute exposure via all intake routes (ingestion, inhalation and dermal). The Committee on Toxicity of Chemicals in Food, Consumer Products and the Environment (COT) published a nominal acute reference dose (ARfD) based on the lowest reported acute lethal dose. JPB have derived assessment criteria for free and complex cyanides in soils based on the above ARfD, exceedence of which is considered to pose a risk to sensitive site receptors.

**Stage 3 Detailed Quantitative Risk Assessment**

*Representative Contaminant Concentrations and Site Specific Assessment Criteria*

To merit a Stage 3 assessment concentrations of contaminants will have exceeded Stage 2 criteria, or there are no available Stage 2 criteria. At this stage the chemical dose to potentially exposed human receptors are calculated, incorporating site specific data together with conservative health assumptions where necessary to derive Site Specific Assessment Criteria (SSACs). Data evaluation and statistical procedures are used to derive representative contaminant concentrations (RCC) for contaminants of concern in the relevant averaging areas of sites. RCCs are compared with SSACs at the risk evaluation stage in order to determine their significance. This process effectively reduces the conservatism of the Stage 2 assessment and provides a site specific assessment at Stage 3.

At Stage 2 all soil contaminant concentrations are compared with GACs. At Stage 3 RCCs are calculated and used for comparison with assessment criteria. Depending on the nature of the data the RCC may consist of either the maximum concentration recorded or a 95% Upper Confidence Limit (UCL95). Where small data sets are available, or where point source contamination such as hydrocarbon spillages are present, statistical analysis is not appropriate and the maximum contaminant concentration recorded is adopted as the RCC. Where larger data sets are available statistical analysis may be performed to derive an RCC where appropriate. Where RCCs exceed assessment criteria this indicates that the contaminant poses a human health risk and that remedial actions may be required to prevent actual harm. As an initial assessment, JPB generally alter only

specific pH and %SOM values and the development type to generate SSACs. Should a more detailed DQRA assessment be merited, a more extensive re-examination of data inputs may be undertaken.

Statistical analysis is carried out in accordance with the methodology outlined in guidance given in CL:AIRE/CIEH Publication, "Guidance on Comparing Soil Contamination Data with a Critical Concentration". A number of statistical tools may be used for deriving UCL95 values, JPB principally use ProUCL, a software package developed by the US EPA for this purpose. In general, RCC values are selected as follows;

- Determine if there is sufficient data for statistical analysis, if not the maximum concentration is selected as the RCC;
- If data is sufficient the data set for each contaminant is tested for distribution type (normal distribution, lognormal etc.);
- The data set for each contaminant is tested for the presence of outliers, and these are considered for removal or inclusion in further calculations;
- An appropriate UCL95 is calculated, based on the distribution type and revised data set, and this is used as the RCC.

Consideration of whether outliers represent potential contaminant hotpots is also undertaken.

Lead risks are assessed using a C4SL value derived using a model which uses the geometric mean of blood lead levels as one of its input parameters. For this reason, the log transformation of soil lead concentrations across a site is required prior to deriving the RCC.

*Stage 3 JPB Risk Estimation Practice*

JPB's Stage 3 assessment practice is to calculate SSACs, incorporating site specific data together with conservative health assumptions where necessary. This effectively reduces the conservatism of the Stage 2 assessment and provides a site specific assessment. Depending on the pollutant linkages identified in the conceptual site model and on the nature of contamination identified during site investigations, particular risk assessment tools are selected which are considered to be appropriate to assess risks to human health under the existing site conditions.

The CLEA model used has been designed to comply with current UK DEFRA guidance on the assessment of contaminants on land and where possible this is JPB's risk assessment tool of choice. Health criteria, toxicological, physical and chemical data are input for each contaminant for the land use envisaged. The model derives a Site-Specific Assessment Criteria (SSAC) for the contaminant which, if exceeded, would represent a human health risk to the sensitive receptor. The basis of the CLEA models are more fully discussed in the CLEA software manual and DEFRA report SP1010 – Development of Category 4 Screening Levels for Assessment of Land Affected by Contamination respectively.

The CLEA model used to derive SGVs, C4SLs, GACs and SSACs includes inhalation of outdoor and indoor dust pathways where appropriate. Inhalation pathways are most important in driving risk assessments where inhalation HCVs are low or where inhalation exposure is high. Where a Stage 3 assessment is required, the inhalation SSACs may be presented in JPB's reports to allow further consideration of these pathways and any remedial actions which may be required.

On completion of contemporary developments, the amount of bare soil exposed is generally limited to localised landscaping. This is considered to be minimal as a proportion of the site area and given that clean topsoil will generally be placed to provide a suitable rooting horizon during development, this pathway will be usually be broken by this cover for most inorganic contaminants and, therefore, JPB do not assess this further. An additional degree of conservatism is build into the assessment here as the overall SSACs still have these pathways included. However, where volatile organic contaminants are present, such as BTEX or naphthalene, these substances may potentially migrate through clean cover and, if present at sufficiently high concentrations, may require the introduction of protective measures such as the installation of membranes in solums of buildings etc. to prevent unacceptable exposure to receptors via vapour migration and inhalation. The generation of dust during site works may also expose site operatives or the occupiers of adjacent properties to health risks and should be

managed by the provision of appropriate PPE and adoption of appropriate site practices as described in CIRIA document 132 “A guide for safe working on contaminated sites”.

*Stage 3 Assessment of Risk to Other Receptors*

The ecological risk assessment is carried out with respect to both on-site and off-site ecologically sensitive receptors. A review of information can indicate whether any nearby ecologically sensitive areas are likely to be impacted by on-site derived contamination; a comparison of contaminant levels found in the on-site ecologically sensitive areas can also be made with the UK Environmental Quality Standards for the protection of wildlife.

Contaminants which are at concentrations in excess of the Stage 2 screening criteria are determined to present a potential risk to the water environment and these contaminants therefore require assessment at a Stage 3 level. The purpose is to ascertain if the concentrations create a risk. It is important to consider factors such as the background groundwater quality, the sporadic nature of the perched groundwater and the separation of the site from the regional groundwater by an aquiclude.

The most significant receptors in the water environment assessment are generally considered to be the local shallow and deep groundwater and local surface waters. At some sites there is the potential for contaminants detected on-site to detrimentally affect off-site water receptors. Deeper (bedrock) groundwater resources may be important in some areas, or where groundwater may be abstracted for use. The significance of the risk to these receptors is assessed by considering, either conceptually or using groundwater models, the potential effects contaminants may have to groundwater and surface water receptors.

*Stage 3 Evaluation of Risks to Groundwater and Surface Waters*

An assessment of the potential for both contaminated soil and groundwater to affect the quality of water resources is undertaken in accordance with current SEPA guidance described in document WAT-PS-10-01: Assigning Groundwater Assessment Criteria for Pollutant Inputs (Live Document). This notes that for land contamination four receptor groups are to be assessed, if identified as being present, namely; surface water, groundwater abstraction, groundwater resource and groundwater dependant terrestrial ecosystem (GWDTE or wetland). Each receptor is considered in turn at the in ICSM stage, and investigations scoped to examine these linkages where necessary.

At Stage 2 the potential linkages identified in the ICSM are re-examined in the light of investigation findings, and only the viable linkages are considered further. Where relevant, recorded soil leachate, groundwater and surface water contaminant results are compared with GACs selected as described in the above guidance, dependant on the receptor being considered (e.g. UKDWS would be used where a water abstraction was the receptor). Where exceedences of GACs occur a Stage 3 assessment is undertaken.

In the Stage 3 Risk Assessment - Water Environment a re-examination of the ICSM is undertaken with respect to water environment receptors on the basis of site investigation data. Where a potential linkage remains, a back calculation is undertaken for the recorded soil leachate and/or groundwater concentration exceedences in accordance with the guidance in document WAT-PS-10-01 using the EA's Remedial Targets Methodology (RTM) and the associated Remedial Targets Worksheet hydrogeological modelling tool. After applying a dilution factor and where appropriate, degradation, the theoretical concentration of each contaminant at an assessment point is compared against the relevant assessment limit at that assessment point.

The assessment limit may be a UK Drinking Water Standard (UKDWS), Resource Protection Value (RPV) or EQS depending on the nature of the receptor which is being considered to be potentially at risk. The assessment point is the point at which assessment limit must be met. For the purposes of risk assessment, the assessment point is selected to be the nearest surface water course for surface water receptors, the site boundary (or 50m downgradient of the site boundary or 250m in a sewered urban environment) for the future groundwater resource receptors or in the raw water prior to any treatment this might receive for current abstractions. It should be noted that in contrast the SEPA guidance defines a compliance point as a "real" sampling point to demonstrate that inputs are acceptable. A compliance point may be the same location as the assessment point or between the source and receptor.

In addition, where required the Remedial Targets Worksheet can be used to calculate soil remedial targets which can be used to determine whether soil contaminant levels on site require remedial actions to prevent impact to water environment receptors.

For the above calculations it is assumed that leachate is theoretically produced by water infiltration from rainfall into site groundwater which can then migrate off site. In this case the leachate migrates through permeable strata until it enters a theoretical deeper groundwater. The remedial target which is calculated represents the maximum concentration of that particular contaminant which can be allowed at the assessment point or at its location on the site in the case of soil remedial targets. If concentrations are recorded above remedial targets, then theoretically by the time impacted groundwater has migrated to the assessment point it will be above the relevant assessment limit for that contaminant and remedial measures would be necessary.

Other analytical, numerical and probabilistic groundwater models are available to aid in the quantitative assessment of contaminated waters, the suitability of each which can be determined upon completion of site assessment and project requirements.

**RISK-BASED CONCLUSIONS**

The comparison of the estimated risks with the appropriate criteria indicates whether;

1) the site presents an insignificant risk based on the analysis; or,

2) there is a potential risk to health or the environment.

Where a risk has been identified remedial strategies can then be developed in order to break any source-pathway-receptor linkage. Strategies may include; source removal, breaking the pathway from the source to the receptor or choosing developments in which sensitive receptors are not included in areas where the risk exists.

As described above a number of remedial strategies can be adopted for a site and JPB select the most appropriate strategy for remediation on a site specific basis. One commonly adopted practice is to break the pollutant linkages by the introduction of clean capping materials. JPB have adopted, where appropriate, the BRE/DTI/NHBC/AGS document as a decision making tool to aid the design of remedial actions. This provides a research and data-based approach to designing cover systems rather than the use of professional judgement alone. It is, however, emphasised this document is used by JPB in the context of professional judgement and experience and a knowledge of site conditions.

As at the time of investigations the concentrations of contaminants present in material to be imported for capping may not be known, a conservative approach in which the imported material is assumed to have a contaminant concentration of 75% of the target guideline value is adopted. The spreadsheet which accompanies the document contains a viability check graph which indicates whether the capping layer calculated is acceptable or whether further consideration is required as to the effectiveness of the cover system proposed. JPB's procedure is to ensure that the effectiveness of the cover system is adequate for the site conditions encountered. Where these are exceeded more stringent remedial actions are recommended. JPB consider that this methodology provides a consistent, scientifically based rationale for designing cover systems in the vast majority of sites we encounter. Where more extreme conditions are encountered, or where there are specific site requirements, these issues will be considered on a site specific basis in order to be protective of receptors at the proposed development.

Specific measures are proposed where asbestos fibres or materials are recorded to be present and are to be retained, encapsulated on site. The recommended design of the environmental capping reflects the magnitude of the risks posed by the different types, concentrations and conditions of asbestos materials recorded to be present.

**Remediation Strategy**

Before any works can be carried out on site a Remediation Strategy is prepared in accordance with the “Model Procedures for the Management of Land Contamination” (CLR11) and the EA document “Verification of Remediation of Land Contamination”. JPB integrate the requirements for the various stages of remediation works in Remediation Strategy, Implementation and Verification Plan documents.

## Ground Gas Assessment Methodology

### *Introduction*

The assessment of ground gas as a potential constraint to development has been the subject of a great deal of research and published guidance. Broadly speaking ground gas can be a concern for several reasons; flammable gases may cause an explosion, build up of gases within poorly ventilated areas may lead to asphyxia or toxic gases may cause harm to those exposed to them. In general, we consider principally methane and carbon dioxide levels, however the presence of other gases such as carbon monoxide, hydrogen sulphide, petroleum vapours etc may also be considered where appropriate. Some physical properties of ground gases are tabulated below.

| Gas | Explosive Range | Density of 20ºC | Toxicity % by volume in air* |
|---|---|---|---|
| Methane | 5-15% by vol | 0.72 kg/$m^3$ | 30 (low) |
| Carbon dioxide | N/A | 1.98kg/$m^3$ | 0.5 (high) |
| Carbon monoxide | 12.5-74.2% by vol | 1.25kg/$m^3$ | 0.02 (high) |
| Hydrogen sulphide | 4.2-46% by vol | 1.54kg/$m^3$ | 0.001 (high) |

* short term occupational exposure limits. The long term occupational exposure limit for carbon monoxide is 30ppm and for hydrogen sulphide is 5ppm.

These ground gases may originate from many sources including; mine workings, organic sediments, landfilling, biodegradable materials in made ground on brownfield sites, petroleum hydrocarbons or other site specific sources. The gas concentrations measured are the result of volatile emissions and the microbial degradation of organic materials. The processes by which materials degrade to form ground gases are discussed more fully in EA's Guidance on the Management of Landfill Gas, LFTGN 03, 2004.

### *Data Requirements and ICSM*

JPB's overall methodology for ground gas assessments is summarised in the attached flow chart. In order to assess the degree of risk to receptors we must first develop an initial conceptual site model (ICSM) of the site which can identify the various sources and receptors and any potential pathways by which they may be linked. This process can be undertaken as part of the development of an ICSM for the site for contaminants other than gases. If a potential pollutant linkage is identified for ground gas, site investigations to confirm the nature and extent of ground gases will be required. Guidance on how these site investigations should be undertaken is given in B5930 - Code of Practice for Site Investigations, BS10175 - Investigation of Potentially Contaminated Sites, CIRIA Reports 103 (Vol II) and 150 (Methane Investigation Strategies), CIRIA C665 and BS8485 and other published guidance including the VOC handbook and CIRIA C735.

Investigation methodologies which have been used to measure gas concentrations include spike probe surveys, sinking of boreholes with monitoring standpipes installed and flux boxes. Spike probe surveys are considered to be unreliable for the following reasons: limited depth, spikes into an aerobic layer in an open hole underestimate methane levels and spike probes may not intercept the gas source.

JPB, therefore, generally commission the sinking of boreholes with standpipes to characterise the gas regimes at sites. Where access is restricted, a window sampler is used to install standpipes. The number and position of bores and well response zones are carefully chosen in order to maximise the information to be obtained to fully characterise the site. Table 4.2 in CIRIA C665, reproduced below, gives some guidance on the spacing of wells, which should be interpreted in conjunction with the associated text of that paper ad in the light of actual site conditions.

| Gas Hazard | Typical Examples | Sensitivity of end use | Initial nominal spacing of gas monitoring wells[1,2] |
|---|---|---|---|
| High | Domestic landfill sites | High[3] | Very close (<25m) |
| | | Moderate | Close (25-50m) |
| | | Low | Close (25-50m) |
| Moderate | Older domestic landfills disused shallow mine workings[4] | High | Close/very close (<25m -50m) |
| | | Moderate | Close (25-50m) |
| | | Low | Close/wide (25-75m) |
| Low | Made ground with limited degradable material, organic clays of limited thickness | High | Close (25-50m) |
| | | Moderate | Wide (50-75m) |
| | | Low | Wide/very wide (50->75m) |

1 The initial spacing may need to be reduced if anomalous results indicate this is necessary to give a robust indication of the gas regime below a site. To prove the absence of gas, closer spacings may be required.

2 The spacing assumes relatively uniform ground conditions and the gas source present below a site. The spacing will need to be reduced if ground conditions are varied or if the investigation is trying to assess migration patterns from off site.

3 Placing high-sensitivity end use on a high gas hazard site is not normally acceptable unless the source is removed or treated to reduce gassing potential.

4 Petrol stations and other sources of vapours are most likely to be classified as gas hazard "Moderate" however site specific assessment would be required.

Three bores with standpipes and four sets of readings should be considered an absolute minimum for even the smallest of sites.

Flux boxes can be used to measure surface gas emission rates but do not take into account a deeper source of gas generation. Flux boxes can be used to confirm that a capping layer above a source and the surface has been effective. It should be noted that methane levels at the surface may underestimate ground gas levels as aerobic conditions at the near surface will deplete methane concentrations.

Guidance on the measurement of gas levels at bores is given in the above documents, however, in general a peak gas reading is taken followed by readings at 30 second intervals until a steady state is reached. This allows the assessor to determine how quickly the ground gas is replenished. Flow rate is generally measured first followed by methane/carbon dioxide levels. In addition, atmospheric pressure, weather, date and any other relevant information is recorded.

Flow rates can be positive or negative, they are generally negative where ambient atmospheric pressure is high or where falling groundwater levels reduce pressures in bores. Flow rates between -0.4 and 0.4 L/h indicate that there is probably no overall flow. The length of the monitoring period and frequency of monitoring will vary from site to site depending on the sensitivity of development, geology of the site, the level of risk and other factors. Typical minimum periods and monitoring frequencies are given in Table 5.5 of CIRIA C665. Generally, JPB undertake six visits over 12 weeks for sites proposed for residential development.

Continuous gas monitoring at boreholes over a period of several weeks can also sometimes be utilised to clarify the type of gas generation sources present and levels of risk posed by ground gases at some sites.

The degree of monitoring required must enable the assessor to measure or predict the reasonable worst case gas regime.

*Risk Assessment*

Having obtained factual data from the investigation the ground gas regime can be assessed in a tiered approach. In the past guidance such as Waste Management Paper 27 recommended a highly conservative precautionary principle, i.e. no development within 250m of a landfill site. This approach was seen as anti-development and does not take into account the site conditions, whether a risk exists at the site for the development proposed, the level of risk and whether if can be mitigated by design. More recent approaches characterise the site and the risk and base recommendations on this assessment. Various reports and standards have recently been published to update the guidance on ground gas assessment and this JPB methodology uses the philosophy outlined in these. These include CIRIA C665 "Assessing risks posed by hazardous ground gases to buildings"), NHBC Report No. 10627-R01(04) "Guidance on evaluation of development proposals on sites where methane and carbon dioxide are present" and British Standard BS8485 "Code of practice for the design of protective measures for methane and carbon dioxide ground gases for new buildings".

***Tier 1 assessment***

Following the completion of investigations, the assessor reviews the ICSM in the light of site investigation data and identifies any intact pollutant linkages. If intact pollutant linkages exist a Tier 1 risk assessment is performed using generic screening criteria to determine whether a risk exists. JPB use the following screening levels: **Methane <1% by volume in bores and Carbon dioxide <5% by volume in boreholes.**

These values are derived from Waste Management Paper 27, 1% methane by volume represents 20% of methane's lower explosive limit of 5% by volume, 5% carbon dioxide relates to the known health effects of exposure to this gas. Both screening concentrations are detailed in the Building Regulations Approved Document C (2004) and BRE Report "Construction of New Buildings as Gas Contaminated Land" (BR 212).

A limit to gas flow rates for the above trigger values is inferred by the table given below where the limiting borehole gas volume flows for $CH_4$ and $CO_2$ are <0.07L/hr for characteristic situation 1. These are equivalent to **a limiting borehole flow rate of 7L/h for $CH_4$ at 1% by volume and 1.4L/h for $CO_2$ at 5% by volume.** The above Tier 1 trigger values are only valid, therefore, if these volume flows are not exceeded. Where these volume flows are exceeded a Tier 2 assessment should be undertaken.

Guidelines on screening levels for hydrogen sulphide and other trace gases are given in the VOC Handbook, CIRIA RP711. Other information on VOCs is available in EA Technical Guidance on Management of Landfill Gas (2004) and in the vapour models used in the CLEA model for contamination land assessments.

If these screening concentrations are not exceeded then no significant risk exists and no further action is required. Where screening concentrations are exceeded a Tier 2 assessment is performed.

***Tier 2 assessment***

Where Tier 1 generic screening concentrations are exceeded a Tier 2 assessment is performed using the Wilson and Card (1999) approach as outlined in CIRIA C665. Each site is classified into a "characteristic situation" based on the maximum methane and carbon dioxide concentrations measured. These measurements combined with the maximum borehole flow rate are used to calculate the gas screening value.

Gas screening value (L/hr) = gas concentration (% by volume) x borehole flow rate (L/hr).

(N.B. gas screening value is also known as "site characteristic hazardous gas flow rate ($Q_{hgs}$) in BS8485)

For example, for a borehole flow rate of 1.5 L/h and a methane concentration of 20% the gas screening value = 1.5 x 20/100 = 0.3 L/h.

Gas screening value rates for methane and carbon dioxide can be compared with Table 8.5 of CIRIA C665 “Assessing risks posed by hazardous ground gases to buildings” or Tables 14.1 of NHBC Report No. 10627-R01(04) “Guidance on evaluation of development proposals on sites where methane and carbon dioxide are present”, reproduced below, to determine a characteristic situation for the site.

*Table 8.5 Modified Wilson & Card Classification (CIRIA Report C665)*
***NB Use for most scenarios other than low rise housing with a ventilated underfloor void (min 150mm)***

| Characteristic Situation (CIRIA R149) | Comparable classification in DETR et al (1999) | Risk classification | Gas Screening Value (GSV) $CH_4$ or $CO_2$ (L/hr)[1] | Additional Limiting Factors | Typical Source of generation. |
|---|---|---|---|---|---|
| 1 | A | Very low risk | <0.07 | Typically methane <1% by volume and/or carbon dioxide < 5%. Otherwise consider increase to Situation 2. | Natural soils with low organic content. “Typical” made ground |
| 2 | B | Low risk | <0.7 | Borehole air flow rate not to exceed 70L/hr. Otherwise increase to characteristic situation 3 | Natural soil, high peat/organic content. “Typical” made ground |
| 3 | C | Moderate risk | <3.5 | | Old landfill, inert waste, mineworking flooded |
| 4 | D | Moderate to high risk | <15 | Quantitative risk assessment required to evaluate scope of protection measures | Mineworking – susceptible to flooding, completed landfill, inert waste (WMP 26B criteria) |
| 5 | E | High risk | <70 | | Mineworkings unflooded inactive |
| 6 | F | Very high risk | >70 | | Recent landfill site |

*Table 14.1 Gas Risk Assessment (Traffic Lights) NHBC Report No. 10627-R01(04)*
***NB To be used for low rise housing with a ventilated underfloor void (min 150mm)***

| Traffic Light | Methane[1] | | Carbon Dioxide[1] | |
|---|---|---|---|---|
| | Typical max conc.[5] (% by vol) | Gas screening value [2,4,6] (L/hr) | Typical max conc. [5] (% by vol) | Gas screening value [2,3,4,5] (L/hr) |
| | | | | |
| Green | 1 | 0.13 | 5 | 0.78 |
| | | | | |
| Amber 1 | 5 | 0.63 | 10 | 1.60 |
| | | | | |
| Amber 2 | 20 | 1.60 | 30 | 3.10 |
| | | | | |
| Red | | | | |

Protective measures can then be selected for the site buildings based on the Characteristic Situation and the type of development proposed (building types A-D, Table 3 BS8485) using the guidance and scoring system given in BS8485 and its annexes. Protective measures for new buildings can then be designed which are appropriate to the types and magnitude of the risks posed.

***Radon***

Radon is a naturally occurring radioactive gas that is formed from the decay of uranium and radium present in some types of rocks. It can migrate through cracks and fissures into the soil and by this route into buildings.

Radon can accumulate inside structures over the long term posing a risk to health. Long term exposure increases the risk of developing lung cancer, in a building with high levels of radon, long-term exposure can increase the risk to the point where preventative action is necessary.

For this reason section 3.2 of the Technical Handbook Guidance, which sets functional standards for Scottish buildings under the Building (Scotland) Act 2003, was revised in 2011 to ensure that “every building must be designed and constructed in such a way that there will not be a threat to the health of people in or around the building due to the emission and containment of radon gas”. This document provides guidance on how the risks posed by radon should be assessed. JPB’s methodology for assessing risks posed by radon follows that guidance and this methodology is outlined below.

The location of the site is pinpointed on maps published in Appendix A of BRE BR 211. These maps were the result the result of a joint project between The Health Protection Agency (HPA) and the British Geological Society who prepared detailed maps of radon potential in Scotland by testing radon levels in houses. Depending on the level of risk within the geographical grid square within which the development lies, maps indicate whether; no protection measures are required, basic radon protection measures are required or full radon protection measures are required.

Where the site is indicated to be within an area within which radon protection is required, a further assessment of the risks posed by radon is undertaken. The BR211 Appendix A maps provide information on a large scale, and whole grid squares are categorised based on the worst conditions within the grid square, rather than for a specific site or smaller geographical area. Where the BR211 Appendix A map indicates there is a possibility that radon may pose a risk (or it is unclear), more detailed HPA/BGS mapping data is obtained and the site is assessed accordingly.

If the more detailed report indicates that the site is located on ground where radon protection measures are required, protective measures are recommended. Radon protective measures are recommended in accordance with the guidance contained in BRE Report BR211 “Radon: Protective measures for new buildings”. BRE have also confirmed to JPB that, where gas protection measures are being installed to provide protection against ground gases such as methane and carbon dioxide for CS-2 conditions or above, these measures will also provide adequate protection from risks posed by radon.

It should be noted that this approach has been adopted as monitoring radon concentrations in the ground prior to construction is not considered to be a valid methodology for assessing risks posed by radon in buildings. This is because it is difficult to equate the concentrations of radon measured in boreholes with levels inside houses, as many factors can influence the actual indoor air radon concentration experienced, including; radon generation rates, geology, construction details, ventilation rates, seasonal factors, occupant behaviour etc. Similarly, for newly constructed buildings it is impractical to determine indoor air radon concentrations over the recommended three month monitoring period and the results measured in unoccupied properties would not, in any case, be a valid assessment of conditions in occupied houses.

**Appendix 9 Previous Site Investigation Data**

| Status | | Borehole No |
|---|---|---|
| Final | BOREHOLE LOG | 14 |
| 26/07/2001 | | Sheet 1 of 1 |

# Robroyston, Glasgow

Client: Ambion Holdings — Job No: 9957

Consultant: David R. Murray & Associates

| | | | | | |
|---|---|---|---|---|---|
| Date Started | 13/02/2001 | Initial Boring Diameter: | 150mm | Coordinates: | E |
| Date Complete: | 13/02/2001 | Initial Core Diameter | | | N |
| Hole Type: | CP | Rotary Casing Type | | Ground Level: | Not Recorded |
| Equipment: | Dando 3000 | Core Barrel: | | Plunge: | 90 ° |
| | | Core Bit: | | Scale: | 1:50 |

| Description of Strata | Legend | Depth | OD Level | Sampling/ Core Run | | U | In Situ Testing | | TCR (SCR) RQD | FI | Install -ation |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Test | Result | | | |
| MADE GROUND: Brown sandy topsoil (Driller's Description) | | 0.25 | | B | 0.30 | | | | | | |
| Firm brown mottled orange brown and grey sandy CLAY with some fine to medium sub rounded to sub angular gravel and some roots. | | | | U | 0.60-1.05 | 61 | | | | | |
| | | 0.90 | | D | 1.05 | | | | | | |
| Firm to stiff brown mottled dark grey sandy CLAY with some fine to coarse sub rounded and sub angular gravel. | | | | D | 1.25-1.70 | | S | 27 | | | |
| | | 1.30 | | B | 1.70 | | | | | | |
| Stiff dark brown sandy CLAY with some fine to coarse sub rounded and sub angular gravel and some cobbles (glacial till) | | | | U | 1.80-2.25 | 66 | | | | | |
| | | 2.05 | | D | 2.25 | | | | | | |
| Stiff dark grey sandy CLAY with some fine to coarse sub rounded and sub angular gravel and some cobbles (glacial till) | | | | B | 2.40 | | | | | | |
| | | | | D | 2.60-3.05 | | | | | | |
| | | | | D | 3.05 | | | | | | |
| | | | | B | 3.80 | | | | | | |
| | | | | UNR | 4.00-4.45 | 63 | | | | | |
| | | | | UNP | 4.50 | 150 | | | | | |
| | | | | D | 4.60-5.05 | | S | 72 | | | |
| | | | | B | 4.90 | | | | | | |
| | | 5.05 | | | | | | | | | |
| End of Borehole at 5.05 m | | | | | | | | | | | |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| U | Undisturbed U100 Sample | ▪ | Core Run | S | Standard Penetration Test | CP | Cable Percussion |
| P | Piston Sample | TCR | Total Core Recovery | C | Cone Penetration Test | RO | Rotary Open Hole |
| TW | Thin Wall Sample | SCR | Solid Core Recovery | 32 | N for full 300mm penetration | RC | Rotary Cored |
| D | Small Disturbed Sample | RQD | Rock Quality Designation | /175 | For given penetration (mm) | | |
| B | Bulk Disturbed Sample | FI | Fracture Index | /25# | Seating blows only (mm) | Installation | |
| LB | Large Bulk Disturbed Sample | FI | Fracture Log | NP | No Penetration | Slotted Pipe | Sand Filter |
| W | Water Sample | NI | Non intact | PR | Pressuremeter Test | Piezometer Tip | Bentonite Seal |
| G | Gas Sample | U* | Blows to drive U100 /U86 | K | Permeability Test (m/s) | Grout | Gravel Filter |
| C | Core | | | V | Insitu Vane Test | Concrete | |
| NR | No Recovery | | | L | Packer Test (Lugeons) | | |

Status
Final
26/07/2001

ritchies

# BOREHOLE LOG

Borehole No
14
Information

## Robroyston, Glasgow

Client: Ambion Holdings

Job No: 9957

Consultant: David R. Murray & Associates

| | | | | | |
|---|---|---|---|---|---|
| Date Started | 13/02/2001 | Initial Boring Diameter: | 150mm | Coordinates: | E |
| Date Complete: | 13/02/2001 | Initial Core Diameter | | | N |
| Hole Type: | CP | Rotary Casing Type | | Ground Level: | Not Recorded |
| Equipment: | Dando 3000 | Core Barrel: | | Plunge: | 90 ° |
| | | Core Bit: | | | |

## PROGRESS

| Date | Time | Hole Depth | Casing Depth | Water Depth | Remarks |
|---|---|---|---|---|---|
| 13/02/2001 | 17:00 | 5.00 | 5.00 | - | Dry |

## DRILLING DETAILS

| CP Chiselling | | | Rotary | | | | |
|---|---|---|---|---|---|---|---|
| From | To | Hours | From | To | Hole Dia | Core Dia | Flush |
| 4.50 | 4.60 | 0.25 | | | | | |

## WATER STRIKES

| Date | Time | Strike | Risen To | After n Minutes | Casing Depth | Flow | Sealed |
|---|---|---|---|---|---|---|---|
| | | | | | | | |

## IN SITU SPT TEST DETAILS

| Depth | Blows for 75mm Increments |
|---|---|
| 1.25 | 3,4,5,5,8,9 |
| 4.60 | 19,6,7,8,7,50 |

## NOTES

All depth in metres; all diameters in millimetres.

Groundwater levels are subject to seasonal, tidal and other fluctuations and should not be taken as constant
150mm diameter casing installed to 5.00m depth. Borehole backfilled with arisings on completion.

## PERSONNEL

| Driller: SP | Logged by: GW | Checked by: SKF |
|---|---|---|

| Status | | Borehole No |
|---|---|---|
| Final | BOREHOLE LOG | 15 |
| 25/07/2001 | | Sheet 1 of 1 |

# Robroyston, Glasgow

Client: Ambion Holdings — Job No: 9957

Consultant: David R. Murray & Associates

| | | | | | |
|---|---|---|---|---|---|
| Date Started | 13/02/2001 | Initial Boring Diameter: | 150mm | Coordinates: | E |
| Date Complete: | 13/02/2001 | Initial Core Diameter | | | N |
| Hole Type: | CP | Rotary Casing Type | | Ground Level: | Not Recorded |
| Equipment: | Dando 3000 | Core Barrel: | | Plunge: | 90 ° |
| | | Core Bit: | | Scale: | 1:50 |

| Description of Strata | Legend | Depth | OD Level | Sampling/ Core Run | | U | In Situ Testing | | TCR (SCR) RQD | FI | Install -ation |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Test | Result | | | |
| MADE GROUND: Brown sandy topsoil (Driller's Description). | | 0.35 | | | | | | | | | |
| Firm, locally soft grey mottled orange brown sandy CLAY with some fine to medium sub angular gravel and some rootlets. | | | | B<br>U | 0.50<br>0.55-1.00 | 27 | | | | | |
| | | 0.90 | | | | | | | | | |
| Soft to firm brown locally light brown sandy CLAY with some fine to coarse sub rounded and sub angular gravel (glacial till). | | | | D | 1.00 | | | | | | |
| | | | | B<br>U | 1.40<br>1.50-1.95 | 73 | | | | | |
| | | 1.65 | | | | | | | | | |
| Stiff dark grey sandy CLAY with some fine to coarse sub rounded and sub angular gravel, some cobbles and occasional bands of silty sand (glacial till). | | | | D | 1.95 | | | | | | |
| | | | | B | 2.20 | | | | | | |
| | | | | B<br>UNR | 2.50<br>2.50-2.95 | 79 | | | | | |
| | | | | D | 3.10-3.55 | | S | 17 | | | |
| | | | | B | 3.80 | | | | | | |
| | | | | U | 4.00-4.45 | 75 | | | | | |
| | | | | D | 4.45 | | | | | | |
| | | 5.00 | | B | 5.00 | | | | | | |
| End of Borehole at 5.00 m | | | | | | | | | | | |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| U | Undisturbed U100 Sample | ▪ | Core Run | S | Standard Penetration Test | CP | Cable Percussion |
| P | Piston Sample | TCR | Total Core Recovery | C | Cone Penetration Test | RO | Rotary Open Hole |
| TW | Thin Wall Sample | SCR | Solid Core Recovery | 32 | N for full 300mm penetration | RC | Rotary Cored |
| D | Small Disturbed Sample | RQD | Rock Quality Designation | /175 | For given penetration (mm) | | |
| B | Bulk Disturbed Sample | FI | Fracture Index | /25# | Seating blows only (mm) | Installation | |
| LB | Large Bulk Disturbed Sample | FI | Fracture Log | NP | No Penetration | Slotted Pipe | Sand Filter |
| W | Water Sample | NI | Non Intact | PR | Pressuremeter Test | Piezometer Tip | Bentonite Seal |
| G | Gas Sample | U* | Blows to drive U100 /U86 | K | Permeability Test (m/s) | Grout | Gravel Filter |
| C | Core | | | V | Insitu Vane Test | Concrete | |
| NR | No Recovery | | | L | Packer Test (Lugeons) | | |

| Status | | Borehole No |
|---|---|---|
| Final<br>26/07/2001 | ritchies BOREHOLE LOG | 15<br>Information |

# Robroyston, Glasgow

Client: Ambion Holdings

Job No: 9957

Consultant: David R. Murray & Associates

| | | | | | |
|---|---|---|---|---|---|
| Date Started | 13/02/2001 | Initial Boring Diameter: | 150mm | Coordinates: | E |
| Date Complete: | 13/02/2001 | Initial Core Diameter | | | N |
| Hole Type: | CP | Rotary Casing Type | | Ground Level: | Not Recorded |
| Equipment: | Dando 3000 | Core Barrel: | | Plunge: | 90 ° |
| | | Core Bit: | | | |

## PROGRESS

| Date | Time | Hole Depth | Casing Depth | Water Depth | Remarks |
|---|---|---|---|---|---|
| 13/02/2001 | 17:00 | 5.00 | 5.00 | - | Dry |

## DRILLING DETAILS

| CP Chiselling | | | Rotary | | | | |
|---|---|---|---|---|---|---|---|
| From | To | Hours | From | To | Hole Dia | Core Dia | Flush |

## WATER STRIKES

| Date | Time | Strike | Risen To | After n Minutes | Casing Depth | Flow | Sealed |
|---|---|---|---|---|---|---|---|
| 13/02/2001 | | 2.80 | - | - | - | Seepage | - |

## IN SITU SPT TEST DETAILS

| Depth | Blows for 75mm Increments |
|---|---|
| 3.10 | 2,3,4,4,4,5 |

## NOTES

All depth in metres; all diameters in millimetres.

Groundwater levels are subject to seasonal, tidal and other fluctuations and should not be taken as constant

150mm diameter casing installed to 5.00m depth. Borehole backfilled with arisings on completion.

## PERSONNEL

| Driller: SP | Logged by: GW | Checked by: SKF |
|---|---|---|

| Status | | Borehole No |
|---|---|---|
| Final | BOREHOLE LOG | 16 |
| 25/07/2001 | | Sheet 1 of 1 |

# Robroyston, Glasgow

Client: Ambion Holdings

Job No: 9957

Consultant: David R. Murray & Associates

| | | | | | |
|---|---|---|---|---|---|
| Date Started | 23/02/2001 | Initial Boring Diameter: | 150mm | Coordinates: | E |
| Date Complete: | 23/02/2001 | Initial Core Diameter | | | N |
| Hole Type: | CP | Rotary Casing Type | | Ground Level: | Not Recorded |
| Equipment: | Dando 3000 | Core Barrel: | | Plunge: | 90 ° |
| | | Core Bit: | | Scale: | 1:50 |

| Description of Strata | Legend | Depth | OD Level | Sampling/ Core Run | | U | In Situ Testing | | TCR (SCR) RQD | FI | Install -ation |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Test | Result | | | |
| MADE GROUND: Brown sandy topsoil (Driller's Description) | | 0.20 | | | | | | | | | |
| Firm brown mottled orange brown and grey sandy CLAY with some fine to coarse sub rounded and sub angular gravel and some rootlets. | | | | B<br>U | 0.50<br>0.55-1.00 | 47 | | | | | |
| | | 0.70 | | | | | | | | | |
| Firm to stiff grey mottled orange brown sandy CLAY with some fine to coarse sub rounded and sub angular gravel. | | | | D | 1.00 | | | | | | |
| | | 1.40 | | U | 1.40-1.85 | 150 | | | | | |
| Very stiff dark brown brittle sandy CLAY with some fine to coarse sub rounded to angular gravel. Driller notes cobbles (Glacial till) | | | | D | 1.85 | | | | | | |
| | | 2.20 | | | | | | | | | |
| Stiff dark grey sandy CLAY with some fine to coarse sub rounded and sub angular gravel. Driller notes cobbles (Glacial till) | | | | B<br>U | 2.30<br>2.50-2.95 | 150 | | | | | |
| | | | | D | 2.95 | | | | | | |
| | | | | B | 3.60 | | | | | | |
| | | | | UNR | 4.00-4.45 | 150 | | | | | |
| | | | | D | 4.30-4.75 | | S | 26 | | | |
| | | 5.00 | | | | | | | | | |
| End of Borehole at 5.00 m | | | | | | | | | | | |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| U | Undisturbed U100 Sample | | Core Run | S | Standard Penetration Test | CP | Cable Percussion |
| P | Piston Sample | TCR | Total Core Recovery | C | Cone Penetration Test | RO | Rotary Open Hole |
| TW | Thin Wall Sample | SCR | Solid Core Recovery | 32 | N for full 300mm penetration | RC | Rotary Cored |
| D | Small Disturbed Sample | RQD | Rock Quality Designation | /175 | For given penetration (mm) | | |
| B | Bulk Disturbed Sample | FI | Fracture Index | /25# | Seating blows only (mm) | Installation | |
| LB | Large Bulk Disturbed Sample | FI | Fracture Log | NP | No Penetration | | Slotted Pipe / Sand Filter |
| W | Water Sample | NI | Non Intact | PR | Pressuremeter Test | | Piezometer Tip / Bentonite Seal |
| G | Gas Sample | U* | Blows to drive U100 /U86 | K | Permeability Test (m/s) | | Grout / Gravel Filter |
| C | Core | | | V | Insitu Vane Test | | Concrete |
| NR | No Recovery | | | L | Packer Test (Lugeons) | | |

| Status | | Borehole No |
|---|---|---|
| Final<br>26/07/2001 | ritchies BOREHOLE LOG | 16<br>Information |

# Robroyston, Glasgow

Client: Ambion Holdings

Job No: 9957

Consultant: David R. Murray & Associates

| | | | | | |
|---|---|---|---|---|---|
| Date Started | 23/02/2001 | Initial Boring Diameter: | 150mm | Coordinates: | E |
| Date Complete: | 23/02/2001 | Initial Core Diameter | | | N |
| Hole Type: | CP | Rotary Casing Type | | Ground Level: | Not Recorded |
| Equipment: | Dando 3000 | Core Barrel: | | Plunge: | 90 ° |
| | | Core Bit: | | | |

## PROGRESS

| Date | Time | Hole Depth | Casing Depth | Water Depth | Remarks |
|---|---|---|---|---|---|
| 23/02/2001 | 17:00 | 5.00 | 5.00 | - | Dry |

## DRILLING DETAILS

| CP Chiselling | | | Rotary | | | | |
|---|---|---|---|---|---|---|---|
| From | To | Hours | From | To | Hole Dia | Core Dia | Flush |

## WATER STRIKES

| Date | Time | Strike | Risen To | After n Minutes | Casing Depth | Flow | Sealed |
|---|---|---|---|---|---|---|---|

## IN SITU SPT TEST DETAILS

| Depth | Blows for 75mm Increments |
|---|---|
| 4.30 | 22,14,6,7,6,7 |

## NOTES

All depth in metres; all diameters in millimetres.

Groundwater levels are subject to seasonal, tidal and other fluctuations and should not be taken as constant
150mm diameter casing installed to 5.00m depth. Borehole backfilled with arisings on completion.

## PERSONNEL

| Driller: SP | Logged by: GW | Checked by: SKF |
|---|---|---|

| Status | | Borehole No |
|---|---|---|
| Final | BOREHOLE LOG | 17 |
| 26/07/2001 | | Sheet 1 of 1 |

# Robroyston, Glasgow

Client: Ambion Holdings

Job No: 9957

Consultant: David R. Murray & Associates

| | | | | | |
|---|---|---|---|---|---|
| Date Started | 26/02/2001 | Initial Boring Diameter: | 150mm | Coordinates: | E |
| Date Complete: | 26/02/2001 | Initial Core Diameter | | | N |
| Hole Type: | CP | Rotary Casing Type | | Ground Level: | Not Recorded |
| Equipment: | Dando 3000 | Core Barrel: | | Plunge: | 90 ° |
| | | Core Bit: | | Scale: | 1:50 |

| Description of Strata | Legend | Depth | OD Level | Sampling/ Core Run | | U | In Situ Testing | | TCR (SCR) RQD | FI | Install -ation |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Test | Result | | | |
| MADE GROUND: Brown sandy topsoil (Driller's Description) | | 0.50 | | B | 0.55 | 41 | | | | | |
| Firm grey mottled orange brown sandy CLAY with occasional rootlets. | | | | U | 0.60-1.05 | | | | | | |
| | | | | D | 1.05 | | | | | | |
| | | 1.20 | | D | 1.20-1.65 | | S | 24 | | | |
| Soft brownish grey brittle sandy SILT with some iron staining. | | | | B | 2.00 | | | | | | |
| | | 2.35 | | D | 2.30-2.75 | | S | 124 | | | |
| Recovered as very dense fine to coarse gravel of weak pale grey SILTSTONE, possible bedrock. | | 2.70 | | | | | | | | | |
| Bedrock or boulder (Driller's Description). | | 3.00 | | - | 2.95 | | S | 50/0# | | | |
| End of Borehole at 3.00 m | | | | | | | | | | | |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| U | Undisturbed U100 Sample | | Core Run | S | Standard Penetration Test | CP | Cable Percussion |
| P | Piston Sample | TCR | Total Core Recovery | C | Cone Penetration Test | RO | Rotary Open Hole |
| TW | Thin Wall Sample | SCR | Solid Core Recovery | 32 | N for full 300mm penetration | RC | Rotary Cored |
| D | Small Disturbed Sample | RQD | Rock Quality Designation | /175 | For given penetration (mm) | | |
| B | Bulk Disturbed Sample | FI | Fracture Index | /25# | Seating blows only (mm) | Installation | |
| LB | Large Bulk Disturbed Sample | FI | Fracture Log | NP | No Penetration | | Slotted Pipe / Sand Filter |
| W | Water Sample | NI | Non Intact | PR | Pressuremeter Test | | Piezometer Tip / Bentonite Seal |
| G | Gas Sample | U* | Blows to drive U100 /U86 | K | Permeability Test (m/s) | | Grout / Gravel Filter |
| C | Core | | | v | Insitu Vane Test | | Concrete |
| NR | No Recovery | | | L | Packer Test (Lugeons) | | |

| Status | | Borehole No |
|---|---|---|
| Final | BOREHOLE LOG | 17 |
| 25/07/2001 | | Information |

## Robroyston, Glasgow

Client: Ambion Holdings

Job No: 9957

Consultant: David R. Murray & Associates

| | | | | | |
|---|---|---|---|---|---|
| Date Started | 26/02/2001 | Initial Boring Diameter: | 150mm | Coordinates: | E |
| Date Complete: | 26/02/2001 | Initial Core Diameter | | | N |
| Hole Type: | CP | Rotary Casing Type | | Ground Level: | Not Recorded |
| Equipment: | Dando 3000 | Core Barrel: | | Plunge: | 90 ° |
| | | Core Bit: | | | |

### PROGRESS

| Date | Time | Hole Depth | Casing Depth | Water Depth | Remarks |
|---|---|---|---|---|---|
| 26/02/2001 | 17:00 | 3.00 | 2.70 | - | Dry |

### DRILLING DETAILS

| CP Chiselling | | | Rotary | | | | |
|---|---|---|---|---|---|---|---|
| From | To | Hours | From | To | Hole Dia | Core Dia | Flush |
| 2.70 | 3.00 | 1.00 | | | | | |

### WATER STRIKES

| Date | Time | Strike | Risen To | After n Minutes | Casing Depth | Flow | Sealed |
|---|---|---|---|---|---|---|---|

### IN SITU SPT TEST DETAILS

| Depth | Blows for 75mm Increments |
|---|---|
| 1.20 | 3,4,7,5,6,6 |
| 2.30 | 4,8,12,27,35,50 |
| 2.95 | 50/0mm - Abandoned |

### NOTES

All depth in metres; all diameters in millimetres.

Groundwater levels are subject to seasonal, tidal and other fluctuations and should not be taken as constant

150mm diameter casing installed to 3.00m depth. Borehole backfilled with arisings on completion.

### PERSONNEL

| Driller: SP | Logged by: GW | Checked by: SKF |
|---|---|---|

| Status | | Borehole No |
|---|---|---|
| Final | BOREHOLE LOG | 23 |
| 25/07/2001 | | Sheet 1 of 1 |

# Robroyston, Glasgow

Client: Ambion Holdings

Job No: 9957

Consultant: David R. Murray & Associates

| | | | | | |
|---|---|---|---|---|---|
| Date Started | 14/02/2001 | Initial Boring Diameter: | 150mm | Coordinates: | E |
| Date Complete: | 14/02/2001 | Initial Core Diameter | | | N |
| Hole Type: | CP | Rotary Casing Type | | Ground Level: | Not Recorded |
| Equipment: | Dando 3000 | Core Barrel: | | Plunge: | 90 ° |
| | | Core Bit: | | Scale: | 1:50 |

| Description of Strata | Legend | Depth | OD Level | Sampling/ Core Run | | U | In Situ Testing | | TCR (SCR) RQD | FI | Install -ation |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Test | Result | | | |
| MADE GROUND: Brown sandy topsoil (Driller's Description). | | 0.25 | | B | 0.40 | | | | | | |
| Firm greyish brown mottled orange brown sandy CLAY with some rootlets. Driller records some gravel. | | | | U | 0.50-0.95 | 32 | | | | | |
| Firm dark brown and dark grey sandy CLAY with some fine to coarse sub rounded and sub angular gravel and some iron staining (weathered glacial till). | | 0.80 | | D | 0.95 | | | | | | |
| | | | | B | 1.30 | | | | | | |
| Stiff to very stiff dark grey sandy CLAY with some fine to coarse sub rounded to angular gravel and some cobbles (glacial till). | | 1.40 | | U | 1.50-1.95 | 132 | | | | | |
| | | | | D | 1.95 | | | | | | |
| | | | | B | 2.40 | | | | | | |
| | | | | D | 2.55 | 150 | | | | | |
| | | | | UNR | 2.55-3.00 | | | | | | |
| | | | | D | 3.00-3.45 | | S | 24 | | | |
| | | | | B | 4.15 | | | | | | |
| | | | | U | 4.50-4.95 | 83 | | | | | |
| | | 5.00 | | D | 4.95 | | | | | | |
| End of Borehole at 5.00 m | | | | | | | | | | | |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| U | Undisturbed U100 Sample | ▪ | Core Run | S | Standard Penetration Test | CP | Cable Percussion |
| P | Piston Sample | TCR | Total Core Recovery | C | Cone Penetration Test | RO | Rotary Open Hole |
| TW | Thin Wall Sample | SCR | Solid Core Recovery | 32 | N for full 300mm penetration | RC | Rotary Cored |
| D | Small Disturbed Sample | RQD | Rock Quality Designation | /175 | For given penetration (mm) | | |
| B | Bulk Disturbed Sample | FI | Fracture Index | /25# | Seating blows only (mm) | Installation | |
| LB | Large Bulk Disturbed Sample | FI | Fracture Log | NP | No Penetration | Slotted Pipe | Sand Filter |
| W | Water Sample | NI | Non intact | PR | Pressuremeter Test | Piezometer Tip | Bentonite Seal |
| G | Gas Sample | U* | Blows to drive U100 /U86 | K | Permeability Test (m/s) | Grout | Gravel Filter |
| C | Core | | | V | Insitu Vane Test | Concrete | |
| NR | No Recovery | | | L | Packer Test (Lugeons) | | |

| Status | | Borehole No |
|---|---|---|
| Final<br>26/07/2001 | ritchies BOREHOLE LOG | 23<br>Information |

# Robroyston, Glasgow

Client: Ambion Holdings

Job No: 9957

Consultant: David R. Murray & Associates

| | | | | | |
|---|---|---|---|---|---|
| Date Started | 14/02/2001 | Initial Boring Diameter: | 150mm | Coordinates: | E |
| Date Complete: | 14/02/2001 | Initial Core Diameter | | | N |
| Hole Type: | CP | Rotary Casing Type | | Ground Level: | Not Recorded |
| Equipment: | Dando 3000 | Core Barrel: | | Plunge: | 90 ° |
| | | Core Bit: | | | |

## PROGRESS

| Date | Time | Hole Depth | Casing Depth | Water Depth | Remarks |
|---|---|---|---|---|---|
| 14/02/2001 | 17:00 | 5.00 | 5.00 | - | Dry |

## DRILLING DETAILS

| CP Chiselling | | | Rotary | | | | |
|---|---|---|---|---|---|---|---|
| From | To | Hours | From | To | Hole Dia | Core Dia | Flush |
| 3.00 | 3.60 | 0.75 | | | | | |

## WATER STRIKES

| Date | Time | Strike | Risen To | After n Minutes | Casing Depth | Flow | Sealed |
|---|---|---|---|---|---|---|---|
| | | | | | | | |

## IN SITU SPT TEST DETAILS

| Depth | Blows for 75mm Increments |
|---|---|
| 3.00 | 33,14,9,4,5,6 |

## NOTES

All depth in metres; all diameters in millimetres.

Groundwater levels are subject to seasonal, tidal and other fluctuations and should not be taken as constant

150mm diameter casing installed to 5.00m depth. Borehole backfilled with arisings on completion.

## PERSONNEL

| Driller: SP | Logged by: GW | Checked by: SKF |
|---|---|---|

| Status | | Borehole No |
|---|---|---|
| Final | BOREHOLE LOG | 24 |
| 26/07/2001 | | Sheet 1 of 1 |

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# Robroyston, Glasgow

Client: Ambion Holdings — Job No: 9957

Consultant: David R. Murray & Associates

| | | | | | |
|---|---|---|---|---|---|
| Date Started | 14/02/2001 | Initial Boring Diameter: | 150mm | Coordinates: | E |
| Date Complete: | 14/02/2001 | Initial Core Diameter | | | N |
| Hole Type: | CP | Rotary Casing Type | | Ground Level: | Not Recorded |
| Equipment: | Dando 3000 | Core Barrel: | | Plunge: | 90 ° |
| | | Core Bit: | | Scale: | 1:50 |

| Description of Strata | Legend | Depth | OD Level | Sampling/ Core Run | | U | In Situ Testing | | TCR (SCR) RQD | FI | Install -ation |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Test | Result | | | |
| MADE GROUND: Brown sandy topsoil (Driller's Description) | | 0.20 | | | | | | | | | |
| Firm grey sandy CLAY with some thin bands of pale grey silty sand, some fine to coarse sub rounded gravel and some rootlets. | | | | B | 0.40 | | | | | | |
| | | | | U | 0.50-0.95 | 22 | | | | | |
| | | | | D | 0.95 | | | | | | |
| | | 1.20 | | D | 1.10-1.55 | | S | 9 | | | |
| Firm to stiff becoming stiff dark grey sandy CLAY with some fine to coarse sub rounded and sub angular gravel and some cobbles (glacial till). | | | | B | 1.50 | | | | | | |
| | | | | U | 1.60-2.05 | 60 | | | | | |
| | | | | D | 2.05 | | | | | | |
| | | | | B | 2.15 | | | | | | |
| | | | | UNR | 2.50-2.95 | 67 | | | | | |
| | | 3.00 | | D | 3.00-3.30 | | S | 81/150 | | | |
| Recovered as very dense silty sandy gravel of weak pale grey SILTSTONE, possible bedrock. | | | | | | | | | | | |
| | | 3.50 | | | | | | | | | |
| End of Borehole at 3.50 m | | | | | | | | | | | |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| U | Undisturbed U100 Sample | | Core Run | S | Standard Penetration Test | CP | Cable Percussion |
| P | Piston Sample | TCR | Total Core Recovery | C | Cone Penetration Test | RO | Rotary Open Hole |
| TW | Thin Wall Sample | SCR | Solid Core Recovery | 32 | N for full 300mm penetration | RC | Rotary Cored |
| D | Small Disturbed Sample | RQD | Rock Quality Designation | /175 | For given penetration (mm) | | |
| B | Bulk Disturbed Sample | FI | Fracture Index | /25# | Seating blows only (mm) | Installation | |
| LB | Large Bulk Disturbed Sample | FI | Fracture Log | NP | No Penetration | Slotted Pipe | Sand Filter |
| W | Water Sample | NI | Non Intact | PR | Pressuremeter Test | Piezometer Tip | Bentonite Seal |
| G | Gas Sample | U* | Blows to drive U100 /U86 | K | Permeability Test (m/s) | Grout | Gravel Filter |
| C | Core | | | V | Insitu Vane Test | Concrete | |
| NR | No Recovery | | | L | Packer Test (Lugeons) | | |

| Status | | Borehole No |
|---|---|---|
| Final | BOREHOLE LOG | 24 |
| 26/07/2001 | | Information |

# Robroyston, Glasgow

Client: Ambion Holdings

Job No: 9957

Consultant: David R. Murray & Associates

| | | | | | |
|---|---|---|---|---|---|
| Date Started | 14/02/2001 | Initial Boring Diameter: | 150mm | Coordinates: | E |
| Date Complete: | 14/02/2001 | Initial Core Diameter | | | N |
| Hole Type: | CP | Rotary Casing Type | | Ground Level: | Not Recorded |
| Equipment: | Dando 3000 | Core Barrel: | | Plunge: | 90 ° |
| | | Core Bit: | | | |

## PROGRESS

| Date | Time | Hole Depth | Casing Depth | Water Depth | Remarks |
|---|---|---|---|---|---|
| 14/02/2001 | 17:00 | 3.50 | 3.00 | - | Dry |

## DRILLING DETAILS

| CP Chiselling | | | Rotary | | | | |
|---|---|---|---|---|---|---|---|
| From | To | Hours | From | To | Hole Dia | Core Dia | Flush |
| 3.00 | 3.50 | 1.00 | | | | | |

## WATER STRIKES

| Date | Time | Strike | Risen To | After n Minutes | Casing Depth | Flow | Sealed |
|---|---|---|---|---|---|---|---|
| 14/02/2001 | | 1.00 | - | - | - | Damp | - |

## IN SITU SPT TEST DETAILS

| Depth | Blows for 75mm Increments |
|---|---|
| 1.10 | 1,1,1,2,2,4 |
| 3.00 | 81/150mm (8,19,31,50) |

## NOTES

All depth in metres; all diameters in millimetres.

Groundwater levels are subject to seasonal, tidal and other fluctuations and should not be taken as constant

150mm diameter casing installed to 3.00m depth. Borehole backfilled with arisings on completion.

## PERSONNEL

| Driller: SP | Logged by: GW | Checked by: SKF |
|---|---|---|

| Status | | Borehole No |
|---|---|---|
| Final | BOREHOLE LOG | 25 |
| 25/07/2001 | | Sheet 1 of 1 |

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# Robroyston, Glasgow

Client: Ambion Holdings

Job No: 9957

Consultant: David R. Murray & Associates

| | | | | | |
|---|---|---|---|---|---|
| Date Started | 22/02/2001 | Initial Boring Diameter: | 150mm | Coordinates: | E |
| Date Complete: | 22/02/2001 | Initial Core Diameter | | | N |
| Hole Type: | CP | Rotary Casing Type | | Ground Level: | Not Recorded |
| Equipment: | Dando 3000 | Core Barrel: | | Plunge: | 90 ° |
| | | Core Bit: | | Scale: | 1:50 |

| Description of Strata | Legend | Depth | OD Level | Sampling/ Core Run | | U | In Situ Testing | | TCR (SCR) RQD | FI | Install -ation |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Test | Result | | | |
| MADE GROUND: Brown sandy topsoil (Driller's Description) | | 0.30 | | B | 0.40 | | | | | | |
| Firm brown sandy CLAY with thin layers of greyish brown sandy silt, some fine to coarse sub rounded gravel and occasional cobbles. | | | | U | 0.55-1.00 | 54 | | | | | |
| | | 0.90 | | D | 1.00 | | | | | | |
| Firm to stiff dark brown and dark grey sandy CLAY with some fine to coarse sub rounded and sub angular gravel and occasional iron staining (weathered glacial till) | | | | U | 1.30-1.75 | 78 | | | | | |
| | | 1.45 | | D | 1.75 | | | | | | |
| Stiff dark brown sandy CLAY with some fine to coarse sub rounded and sub angular gravel and occasional cobbles (glacial till) | | | | B | 2.00 | | | | | | |
| | | | | UNP | 2.10 | 150 | S | 50/0# | | | |
| | | | | - | 2.10 | | | | | | |
| | | | | UNP | 2.50 | | S | 21 | | | |
| | | | | D | 2.50-2.95 | | | | | | |
| | | | | B | 3.20 | | | | | | |
| | | | | U | 3.50-3.95 | 150 | | | | | |
| | | 3.80 | | | | | | | | | |
| Recovered as clayey fine to coarse gravel of pale brown SANDSTONE, possible bedrock or boulder. | | | | D | 3.95-4.10 | | S | 81/149# | | | |
| | | 4.10 | | | | | | | | | |
| End of Borehole at 4.10 m | | | | | | | | | | | |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| U | Undisturbed U100 Sample | ▚ | Core Run | S | Standard Penetration Test | CP | Cable Percussion |
| P | Piston Sample | TCR | Total Core Recovery | C | Cone Penetration Test | RO | Rotary Open Hole |
| TW | Thin Wall Sample | SCR | Solid Core Recovery | 32 | N for full 300mm penetration | RC | Rotary Cored |
| D | Small Disturbed Sample | RQD | Rock Quality Designation | /175 | For given penetration (mm) | | |
| B | Bulk Disturbed Sample | FI | Fracture Index | /25# | Seating blows only (mm) | Installation | |
| LB | Large Bulk Disturbed Sample | FI | Fracture Log | NP | No Penetration | Slotted Pipe | Sand Filter |
| W | Water Sample | NI | Non Intact | PR | Pressuremeter Test | Piezometer Tip | Bentonite Seal |
| G | Gas Sample | U* | Blows to drive U100 /U86 | K | Permeability Test (m/s) | Grout | Gravel Filter |
| C | Core | | | V | Insitu Vane Test | Concrete | |
| NR | No Recovery | | | L | Packer Test (Lugeons) | | |

| Status | | Borehole No |
|---|---|---|
| Final | BOREHOLE LOG | 25 |
| 25/07/2001 | | Information |

## Robroyston, Glasgow

Client: Ambion Holdings

Job No: 9957

Consultant: David R. Murray & Associates

| | | | | | |
|---|---|---|---|---|---|
| Date Started | 22/02/2001 | Initial Boring Diameter: | 150mm | Coordinates: | E |
| Date Complete: | 22/02/2001 | Initial Core Diameter | | | N |
| Hole Type: | CP | Rotary Casing Type | | Ground Level: | Not Recorded |
| Equipment: | Dando 3000 | Core Barrel: | | Plunge: | 90 ° |
| | | Core Bit: | | | |

### PROGRESS

| Date | Time | Hole Depth | Casing Depth | Water Depth | Remarks |
|---|---|---|---|---|---|
| 22/02/2001 | 17:00 | 4.10 | 3.80 | - | Dry |

### DRILLING DETAILS

| CP Chiselling | | | Rotary | | | | |
|---|---|---|---|---|---|---|---|
| From | To | Hours | From | To | Hole Dia | Core Dia | Flush |
| 2.10 | 2.60 | 0.75 | | | | | |
| 3.80 | 4.10 | 1.00 | | | | | |

### WATER STRIKES

| Date | Time | Strike | Risen To | After n Minutes | Casing Depth | Flow | Sealed |
|---|---|---|---|---|---|---|---|

### IN SITU SPT TEST DETAILS

| Depth | Blows for 75mm Increments |
|---|---|
| 2.10 | 50/0mm - Abandoned |
| 2.50 | 34,6,5,6,5,5 |
| 3.95 | 81/149mm - Abandoned |

### NOTES

All depth in metres; all diameters in millimetres.

Groundwater levels are subject to seasonal, tidal and other fluctuations and should not be taken as constant

150mm diameter casing installed to 3.80m depth. Borehole backfilled with arisings on completion.

### PERSONNEL

| Driller: SP | Logged by: GW | Checked by: SKF |
|---|---|---|

Status
Final
25/07/2001

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# BOREHOLE LOG

Borehole No
26
Sheet 1 of 1

## Robroyston, Glasgow

Client: Ambion Holdings

Job No: 9957

Consultant: David R. Murray & Associates

| | | | | | |
|---|---|---|---|---|---|
| Date Started | 23/02/2001 | Initial Boring Diameter: | 150mm | Coordinates: | E |
| Date Complete: | 23/02/2001 | Initial Core Diameter | | | N |
| Hole Type: | CP | Rotary Casing Type | | Ground Level: | Not Recorded |
| Equipment: | Dando 3000 | Core Barrel: | | Plunge: | 90 ° |
| | | Core Bit: | | Scale: | 1:50 |

| Description of Strata | Legend | Depth | OD Level | Sampling/ Core Run | | U | In Situ Testing | | TCR (SCR) RQD | FI | Install -ation |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Test | Result | | | |
| MADE GROUND: Brown sandy topsoil (Driller's Description) | | 0.35 | | | | | | | | | |
| Firm to stiff brown mottled orange brown and grey sandy CLAY with some fine to coarse sub rounded to sub angular gravel and some rootlets. | | 0.70 | | U | 0.50-0.95 | 63 | | | | | |
| Firm brown locally dark grey sandy CLAY with some fine to coarse sub rounded and sub angular gravel (glacial till) | | | | D | 0.95 | | | | | | |
| | | | | B | 1.30 | | | | | | |
| | | | | U | 1.50-1.95 | 150 | | | | | |
| | | 1.65 | | | | | | | | | |
| Very stiff brown sandy CLAY with some fine to coarse sub rounded and sub angular gravel and some cobbles (glacial till) | | | | D | 1.95 | | | | | | |
| | | | | B | 2.30 | | | | | | |
| | | | | U | 2.40-2.85 | 161 | | | | | |
| | | | | D | 2.85 | | | | | | |
| | | | | B | 3.30 | | | | | | |
| | | | | U | 4.00-4.45 | 131 | | | | | |
| | | | | B | 4.30 | | | | | | |
| | | | | D | 4.45 | | | | | | |
| | | | | D | 4.50-4.95 | | S | 26 | | | |
| | | 5.00 | | | | | | | | | |
| End of Borehole at 5.00 m | | | | | | | | | | | |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| U | Undisturbed U100 Sample | | Core Run | S | Standard Penetration Test | CP | Cable Percussion |
| P | Piston Sample | TCR | Total Core Recovery | C | Cone Penetration Test | RO | Rotary Open Hole |
| TW | Thin Wall Sample | SCR | Solid Core Recovery | 32 | N for full 300mm penetration | RC | Rotary Cored |
| D | Small Disturbed Sample | RQD | Rock Quality Designation | /175 | For given penetration (mm) | | |
| B | Bulk Disturbed Sample | FI | Fracture Index | /25# | Seating blows only (mm) | Installation | |
| LB | Large Bulk Disturbed Sample | FI | Fracture Log | NP | No Penetration | | Slotted Pipe / Sand Filter |
| W | Water Sample | NI | Non Intact | PR | Pressuremeter Test | | Piezometer Tip / Bentonite Seal |
| G | Gas Sample | U* | Blows to drive U100 /U86 | K | Permeability Test (m/s) | | Grout / Gravel Filter |
| C | Core | | | V | Insitu Vane Test | | Concrete |
| NR | No Recovery | | | L | Packer Test (Lugeons) | | |

| Status | | Borehole No |
|---|---|---|
| Final | BOREHOLE LOG | 26 |
| 26/07/2001 | | Information |

# Robroyston, Glasgow

Client: Ambion Holdings — Job No: 9957

Consultant: David R. Murray & Associates

| | | | | | |
|---|---|---|---|---|---|
| Date Started | 23/02/2001 | Initial Boring Diameter: | 150mm | Coordinates: | E |
| Date Complete: | 23/02/2001 | Initial Core Diameter | | | N |
| Hole Type: | CP | Rotary Casing Type | | Ground Level: | Not Recorded |
| Equipment: | Dando 3000 | Core Barrel: | | Plunge: | 90 ° |
| | | Core Bit: | | | |

## PROGRESS

| Date | Time | Hole Depth | Casing Depth | Water Depth | Remarks |
|---|---|---|---|---|---|
| 23/02/2001 | 17:00 | 5.00 | 5.00 | - | Dry |

## DRILLING DETAILS

| CP Chiselling | | | Rotary | | | | |
|---|---|---|---|---|---|---|---|
| From | To | Hours | From | To | Hole Dia | Core Dia | Flush |

## WATER STRIKES

| Date | Time | Strike | Risen To | After n Minutes | Casing Depth | Flow | Sealed |
|---|---|---|---|---|---|---|---|

## IN SITU SPT TEST DETAILS

| Depth | Blows for 75mm increments |
|---|---|
| 4.50 | 2,3,4,6,8,8 |

## NOTES

All depth in metres; all diameters in millimetres.

Groundwater levels are subject to seasonal, tidal and other fluctuations and should not be taken as constant

150mm diameter casing installed to 5.00m depth. Borehole backfilled with arisings on completion.

## PERSONNEL

| Driller: SP | Logged by: GW | Checked by: SKF |
|---|---|---|

Status
Final
25/07/2001

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# BOREHOLE LOG

Borehole No
27
Sheet 1 of 1

## Robroyston, Glasgow

Client: Ambion Holdings

Job No: 9957

Consultant: David R. Murray & Associates

| | | | | | |
|---|---|---|---|---|---|
| Date Started | 26/02/2001 | Initial Boring Diameter: | 150mm | Coordinates: | E |
| Date Complete: | 26/02/2001 | Initial Core Diameter | | | N |
| Hole Type: | CP | Rotary Casing Type | | Ground Level: | Not Recorded |
| Equipment: | Dando 3000 | Core Barrel: | | Plunge: | 90 ° |
| | | Core Bit: | | Scale: | 1:50 |

| Description of Strata | Legend | Depth | OD Level | Sampling/ Core Run | | U | In Situ Testing | | TCR (SCR) RQD | FI | Install -ation |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Test | Result | | | |
| MADE GROUND: Brown sandy topsoil (Driller's Description) | | 0.25 | | | | | | | | | |
| Soft to firm light greyish brown sandy CLAY with some fine to coarse sub rounded and sub angular gravel, some thin lenses of sandy silt, some iron staining and some rootlets. | | 0.75 | | B<br>U | 0.45<br>0.50-0.95 | 43 | | | | | |
| Firm to stiff brown mottled grey sandy CLAY with some fine to coarse sub rounded and sub angular gravel, some iron staining and occasional bands of brown silty fine and medium sand. | | | | D<br>B<br>U | 0.95<br>1.25<br>1.50-1.95 | 81 | | | | | |
| Very soft brown very sandy CLAY with some fine to coarse sub rounded gravel. | | 2.00 | | D<br>- | 1.95<br>2.00-2.45 | | S | 4 | | | |
| Stiff dark brown sandy CLAY with some fine to coarse sub rounded and sub angular gravel, some cobbles, driller notes sandy bands. (glacial till) | | 2.60 | | B<br>D | 2.50<br>2.60-3.05 | | S | 30 | | | |
| | | | | B | 3.60 | | | | | | |
| | | | | U | 4.00-4.45 | 133 | | | | | |
| | | | | D | 4.50-4.95 | | S | 25 | | | |
| End of Borehole at 5.00 m | | 5.00 | | | | | | | | | |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| U | Undisturbed U100 Sample | ▚ | Core Run | S | Standard Penetration Test | CP | Cable Percussion |
| P | Piston Sample | TCR | Total Core Recovery | C | Cone Penetration Test | RO | Rotary Open Hole |
| TW | Thin Wall Sample | SCR | Solid Core Recovery | 32 | N for full 300mm penetration | RC | Rotary Cored |
| D | Small Disturbed Sample | RQD | Rock Quality Designation | /175 | For given penetration (mm) | | |
| B | Bulk Disturbed Sample | FI | Fracture Index | /25# | Seating blows only (mm) | Installation | |
| LB | Large Bulk Disturbed Sample | FI | Fracture Log | NP | No Penetration | Slotted Pipe | Sand Filter |
| W | Water Sample | NI | Non Intact | PR | Pressuremeter Test | Piezometer Tip | Bentonite Seal |
| G | Gas Sample | U* | Blows to drive U100 /U86 | K | Permeability Test (m/s) | Grout | Gravel Filter |
| C | Core | | | V | Insitu Vane Test | Concrete | |
| NR | No Recovery | | | L | Packer Test (Lugeons) | | |

| Status | | Borehole No |
|---|---|---|
| Final<br>26/07/2001 | ritchies BOREHOLE LOG | 27<br>Information |

# Robroyston, Glasgow

Client: Ambion Holdings

Job No: 9957

Consultant: David R. Murray & Associates

| | | | | | |
|---|---|---|---|---|---|
| Date Started | 26/02/2001 | Initial Boring Diameter: | 150mm | Coordinates: | E |
| Date Complete: | 26/02/2001 | Initial Core Diameter | | | N |
| Hole Type: | CP | Rotary Casing Type | | Ground Level: | Not Recorded |
| Equipment: | Dando 3000 | Core Barrel: | | Plunge: | 90 ° |
| | | Core Bit: | | | |

## PROGRESS

| Date | Time | Hole Depth | Casing Depth | Water Depth | Remarks |
|---|---|---|---|---|---|
| 26/02/2001 | 17:00 | 5.00 | 5.00 | - | Dry |

## DRILLING DETAILS

| CP Chiselling | | | Rotary | | | | |
|---|---|---|---|---|---|---|---|
| From | To | Hours | From | To | Hole Dia | Core Dia | Flush |

## WATER STRIKES

| Date | Time | Strike | Risen To | After n Minutes | Casing Depth | Flow | Sealed |
|---|---|---|---|---|---|---|---|
| 26/02/2001 | : | 2.05 | 2.05 | 20 | 2.05 | Seepage | - |

## IN SITU SPT TEST DETAILS

| Depth | Blows for 75mm Increments |
|---|---|
| 2.00 | 1,0,0,1,1,2 |
| 2.60 | 3,2,10,10,5,5 |
| 4.50 | 2,4,4,5,7,9 |

## NOTES

All depth in metres; all diameters in millimetres.

Groundwater levels are subject to seasonal, tidal and other fluctuations and should not be taken as constant
150mm diameter casing installed to 5.00m depth. Borehole backfilled with arisings on completion.

## PERSONNEL

| Driller: SP | Logged by: GW | Checked by: SKF |
|---|---|---|

| Status | | Borehole No |
|---|---|---|
| Final | BOREHOLE LOG | 28 |
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## Robroyston, Glasgow

Client: Ambion Holdings

Job No: 9957

Consultant: David R. Murray & Associates

| | | | | | |
|---|---|---|---|---|---|
| Date Started | 27/02/2001 | Initial Boring Diameter: | 150mm | Coordinates: | E |
| Date Complete: | 27/02/2001 | Initial Core Diameter | | | N |
| Hole Type: | CP | Rotary Casing Type | | Ground Level: | Not Recorded |
| Equipment: | Dando 3000 | Core Barrel: | | Plunge: | 90 ° |
| | | Core Bit: | | Scale: | 1:50 |

| Description of Strata | Legend | Depth | OD Level | Sampling/ Core Run | | U | In Situ Testing | | TCR (SCR) RQD | FI | Install -ation |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Test | Result | | | |
| MADE GROUND: Brown sandy topsoil (Driller's Description) | | 0.30 | | | | | | | | | |
| Firm brown mottled orange brown and grey sandy CLAY with occasional fine to coarse sub rounded and sub angular gravel and some rootlets. | | | | B<br>U | 0.50<br>0.60-1.05 | <br>53 | | | | | |
| | | 0.85 | | | | | | | | | |
| Stiff brown mottled grey sandy CLAY with some fine to coarse sub rounded and sub angular gravel, and some cobbles. | | | | D<br>B<br>U | 1.05<br>1.30<br>1.50-1.95 | <br><br>50 | | | | | |
| | | 1.75 | | | | | | | | | |
| Firm to stiff locally stiff dark greyish brown sandy CLAY with some fine to coarse sub rounded to angular gravel and some cobbles. (glacial till). | | | | D<br>B<br>U | 1.95<br>2.35<br>2.60-3.05 | <br><br>57 | | | | | |
| | | | | D<br>B<br>U | 3.05<br>3.30<br>3.50-3.95 | <br><br> | | | | | |
| | | 3.70 | | | | | | | | | |
| Stiff dark brown sandy CLAY with some fine to coarse sub rounded to angular gravel and some cobbles, (glacial till) | | | | D | 4.50-4.95 | | S | 17 | | | |
| | | 5.00 | | | | | | | | | |
| End of Borehole at 5.00 m | | | | | | | | | | | |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| U | Undisturbed U100 Sample | | Core Run | S | Standard Penetration Test | CP | Cable Percussion |
| P | Piston Sample | TCR | Total Core Recovery | C | Cone Penetration Test | RO | Rotary Open Hole |
| TW | Thin Wall Sample | SCR | Solid Core Recovery | 32 | N for full 300mm penetration | RC | Rotary Cored |
| D | Small Disturbed Sample | RQD | Rock Quality Designation | /175 | For given penetration (mm) | | |
| B | Bulk Disturbed Sample | FI | Fracture Index | /25# | Seating blows only (mm) | Installation | |
| LB | Large Bulk Disturbed Sample | FI | Fracture Log | NP | No Penetration | | Slotted Pipe / Sand Filter |
| W | Water Sample | NI | Non Intact | PR | Pressuremeter Test | | Piezometer Tip / Bentonite Seal |
| G | Gas Sample | U* | Blows to drive U100 /U86 | K | Permeability Test (m/s) | | Grout / Gravel Filter |
| C | Core | | | V | Insitu Vane Test | | Concrete |
| NR | No Recovery | | | L | Packer Test (Lugeons) | | |

| Status | | Borehole No |
|---|---|---|
| Final<br>25/07/2001 | ritchies BOREHOLE LOG | 28<br>Information |

# Robroyston, Glasgow

Client: Ambion Holdings

Job No: 9957

Consultant: David R. Murray & Associates

| | | | | | |
|---|---|---|---|---|---|
| Date Started | 27/02/2001 | Initial Boring Diameter: | 150mm | Coordinates: | E |
| Date Complete: | 27/02/2001 | Initial Core Diameter | | | N |
| Hole Type: | CP | Rotary Casing Type | | Ground Level: | Not Recorded |
| Equipment: | Dando 3000 | Core Barrel: | | Plunge: | 90 ° |
| | | Core Bit: | | | |

## PROGRESS

| Date | Time | Hole Depth | Casing Depth | Water Depth | Remarks |
|---|---|---|---|---|---|
| 27/02/2001 | 17:00 | 5.00 | 5.00 | - | Dry |

## DRILLING DETAILS

| CP Chiselling | | | Rotary | | | | |
|---|---|---|---|---|---|---|---|
| From | To | Hours | From | To | Hole Dia | Core Dia | Flush |
| 3.10 | 3.25 | 0.50 | | | | | |

## WATER STRIKES

| Date | Time | Strike | Risen To | After n Minutes | Casing Depth | Flow | Sealed |
|---|---|---|---|---|---|---|---|
| | | | | | | | |

## IN SITU SPT TEST DETAILS

| Depth | Blows for 75mm Increments |
|---|---|
| 4.50 | 2,3,3,4,5,5 |

## NOTES

All depth in metres; all diameters in millimetres.

Groundwater levels are subject to seasonal, tidal and other fluctuations and should not be taken as constant
150mm diameter casing installed to 5.00m depth. Borehole backfilled with arisings on completion.

## PERSONNEL

| Driller: SP | Logged by: GW | Checked by: SKF |
|---|---|---|

Status
Final
25/07/2001

ritchies

# BOREHOLE LOG

Borehole No
30
Sheet 1 of 1

## Robroyston, Glasgow

Client: Ambion Holdings

Job No: 9957

Consultant: David R. Murray & Associates

| | | | | | |
|---|---|---|---|---|---|
| Date Started | 22/02/2001 | Initial Boring Diameter: | 150mm | Coordinates: | E |
| Date Complete: | 22/02/2001 | Initial Core Diameter | | | N |
| Hole Type: | CP | Rotary Casing Type | | Ground Level: | Not Recorded |
| Equipment: | Dando 3000 | Core Barrel: | | Plunge: | 90 ° |
| | | Core Bit: | | Scale: | 1:50 |

| Description of Strata | Legend | Depth | OD Level | Sampling/ Core Run | | U | In Situ Testing | | TCR (SCR) RQD | FI | Install -ation |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Test | Result | | | |
| MADE GROUND: Brown sandy topsoil (Driller's Description) | | 0.25 | | | | | | | | | |
| Firm light greyish brown mottled orange brown sandy CLAY with some roots and occasional fine to medium sub rounded gravel. | | | | B | 0.45 | | | | | | |
| | | | | U | 0.55-1.00 | 51 | | | | | |
| | | 0.80 | | | | | | | | | |
| Firm to stiff brown sandy CLAY with some fine to coarse sub rounded and sub angular gravel and some iron staining (slightly weathered glacial till) | | | | D | 1.00 | | | | | | |
| | | | | U | 1.50-1.95 | 150 | | | | | |
| | | 1.65 | | | | | | | | | |
| Stiff dark grey sandy CLAY with some fine to coarse sub rounded and sub angular gravel and some cobbles. (glacial till) | | | | D | 1.95 | | | | | | |
| | | | | B | 2.15 | | | | | | |
| | | 2.35 | | | | | | | | | |
| Stiff to very stiff dark brown sandy CLAY with some fine to coarse sub rounded and sub angular gravel and some cobbles, (glacial till) | | | | U | 2.50-2.95 | 108 | | | | | |
| | | | | D | 2.95 | | | | | | |
| | | | | B | 3.40 | | | | | | |
| | | | | U | 4.00-4.45 | 131 | | | | | |
| | | | | D | 4.45 | | | | | | |
| | | | | B | 4.50 | | S | 23 | | | |
| | | | | D | 4.60-5.05 | | | | | | |
| | | 5.05 | | | | | | | | | |
| End of Borehole at 5.05 m | | | | | | | | | | | |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| U | Undisturbed U100 Sample | | Core Run | S | Standard Penetration Test | CP | Cable Percussion |
| P | Piston Sample | TCR | Total Core Recovery | C | Cone Penetration Test | RO | Rotary Open Hole |
| TW | Thin Wall Sample | SCR | Solid Core Recovery | 32 | N for full 300mm penetration | RC | Rotary Cored |
| D | Small Disturbed Sample | RQD | Rock Quality Designation | /175 | For given penetration (mm) | | |
| B | Bulk Disturbed Sample | FI | Fracture Index | /25# | Seating blows only (mm) | Installation | |
| LB | Large Bulk Disturbed Sample | FI | Fracture Log | NP | No Penetration | | Slotted Pipe / Sand Filter |
| W | Water Sample | NI | Non Intact | PR | Pressuremeter Test | | Piezometer Tip / Bentonite Seal |
| G | Gas Sample | U* | Blows to drive U100 /U86 | K | Permeability Test (m/s) | | Grout / Gravel Filter |
| C | Core | | | V | Insitu Vane Test | | Concrete |
| NR | No Recovery | | | L | Packer Test (Lugeons) | | |

| Status | | Borehole No |
|---|---|---|
| Final | BOREHOLE LOG | 30 |
| 25/07/2001 | | Information |

# Robroyston, Glasgow

Client: Ambion Holdings

Job No: 9957

Consultant: David R. Murray & Associates

| | | | | | |
|---|---|---|---|---|---|
| Date Started | 22/02/2001 | Initial Boring Diameter: | 150mm | Coordinates: | E |
| Date Complete: | 22/02/2001 | Initial Core Diameter | | | N |
| Hole Type: | CP | Rotary Casing Type | | Ground Level: | Not Recorded |
| Equipment: | Dando 3000 | Core Barrel: | | Plunge: | 90 ° |
| | | Core Bit: | | | |

## PROGRESS

| Date | Time | Hole Depth | Casing Depth | Water Depth | Remarks |
|---|---|---|---|---|---|
| 22/02/2001 | 17:00 | 5.00 | 5.00 | - | Dry |

## DRILLING DETAILS

| CP Chiselling | | | Rotary | | | | |
|---|---|---|---|---|---|---|---|
| From | To | Hours | From | To | Hole Dia | Core Dia | Flush |

## WATER STRIKES

| Date | Time | Strike | Risen To | After n Minutes | Casing Depth | Flow | Sealed |
|---|---|---|---|---|---|---|---|

## IN SITU SPT TEST DETAILS

| Depth | Blows for 75mm Increments |
|---|---|
| 4.60 | 4,4,4,5,7,7 |

## NOTES

All depth in metres; all diameters in millimetres.

Groundwater levels are subject to seasonal, tidal and other fluctuations and should not be taken as constant

150mm diameter casing installed to 5.00m depth. Borehole backfilled with arisings on completion.

## PERSONNEL

| Driller: SP | Logged by: GW | Checked by: SKF |
|---|---|---|

Status
Final
25/07/2001

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# BOREHOLE LOG

Borehole No
31
Sheet 1 of 1

## Robroyston, Glasgow

Client: Ambion Holdings

Job No: 9957

Consultant: David R. Murray & Associates

| | | | | | |
|---|---|---|---|---|---|
| Date Started | 23/02/2001 | Initial Boring Diameter: | 150mm | Coordinates: | E |
| Date Complete: | 23/02/2001 | Initial Core Diameter | | | N |
| Hole Type: | CP | Rotary Casing Type | | Ground Level: | Not Recorded |
| Equipment: | Dando 3000 | Core Barrel: | | Plunge: | 90 ° |
| | | Core Bit: | | Scale: | 1:50 |

| Description of Strata | Legend | Depth | OD Level | Sampling/ Core Run | | U | In Situ Testing | | TCR (SCR) RQD | FI | Install -ation |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Test | Result | | | |
| MADE GROUND: Brown sandy topsoil (Driller's Description) | | 0.35 | | | | | | | | | |
| Firm brown mottled orange brown and grey sandy CLAY with some fine to coarse sub rounded and sub angular gravel and some rootlets. | | | | B<br>U | 0.50<br>0.55-1.00 | 49 | | | | | |
| | | 0.85 | | | | | | | | | |
| Firm brown and dark grey sandy CLAY with some fine to coarse sub rounded and sub angular gravel and some iron staining. | | | | D | 1.00 | | | | | | |
| | | 1.60 | | U | 1.50-1.95 | 150 | | | | | |
| Stiff dark greyish brown sandy CLAY with some fine to coarse sub rounded to angular gravel (glacial till). | | | | D | 1.95 | | | | | | |
| | | | | B | 2.30 | | | | | | |
| | | 2.55 | | U | 2.50-2.95 | 150 | | | | | |
| Stiff locally very stiff dark grey sandy CLAY with some fine to coarse sub rounded and sub angular gravel and some iron staining (slightly weathered glacial till). | | | | D | 2.95 | | | | | | |
| | | 3.30 | | B | 3.40 | | | | | | |
| Stiff dark grey sandy CLAY with some fine to coarse sub rounded and sub angular gravel, some silty partings. Driller notes some cobbles. (glacial till). | | | | U | 3.50-3.95 | 79 | | | | | |
| | | | | D | 3.95 | | | | | | |
| | | | | D | 4.50-4.95 | | S | 20 | | | |
| | | 5.00 | | | | | | | | | |
| End of Borehole at 5.00 m | | | | | | | | | | | |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| U | Undisturbed U100 Sample | ▚ | Core Run | S | Standard Penetration Test | CP | Cable Percussion |
| P | Piston Sample | TCR | Total Core Recovery | C | Cone Penetration Test | RO | Rotary Open Hole |
| TW | Thin Wall Sample | SCR | Solid Core Recovery | 32 | N for full 300mm penetration | RC | Rotary Cored |
| D | Small Disturbed Sample | RQD | Rock Quality Designation | /175 | For given penetration (mm) | | |
| B | Bulk Disturbed Sample | FI | Fracture Index | /25# | Seating blows only (mm) | Installation | |
| LB | Large Bulk Disturbed Sample | FI | Fracture Log | NP | No Penetration | | Slotted Pipe / Sand Filter |
| W | Water Sample | NI | Non Intact | PR | Pressuremeter Test | | Piezometer Tip / Bentonite Seal |
| G | Gas Sample | U* | Blows to drive U100 /U86 | K | Permeability Test (m/s) | | Grout / Gravel Filter |
| C | Core | | | V | Insitu Vane Test | | Concrete |
| NR | No Recovery | | | L | Packer Test (Lugeons) | | |

| Status | | Borehole No |
|---|---|---|
| Final | BOREHOLE LOG | 31 |
| 25/07/2001 | | Information |

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## Robroyston, Glasgow

Client: Ambion Holdings

Job No: 9957

Consultant: David R. Murray & Associates

| | | | | | |
|---|---|---|---|---|---|
| Date Started | 23/02/2001 | Initial Boring Diameter: | 150mm | Coordinates: | E |
| Date Complete: | 23/02/2001 | Initial Core Diameter | | | N |
| Hole Type: | CP | Rotary Casing Type | | Ground Level: | Not Recorded |
| Equipment: | Dando 3000 | Core Barrel: | | Plunge: | 90 ° |
| | | Core Bit: | | | |

### PROGRESS

| Date | Time | Hole Depth | Casing Depth | Water Depth | Remarks |
|---|---|---|---|---|---|
| 23/02/2001 | 17:00 | 5.00 | 5.00 | - | Dry |

### DRILLING DETAILS

| CP Chiselling | | | Rotary | | | | |
|---|---|---|---|---|---|---|---|
| From | To | Hours | From | To | Hole Dia | Core Dia | Flush |
| 3.05 | 3.20 | 0.50 | | | | | |

### WATER STRIKES

| Date | Time | Strike | Risen To | After n Minutes | Casing Depth | Flow | Sealed |
|---|---|---|---|---|---|---|---|
| 23/02/2001 | | 3.70 | - | - | - | Seepage | - |

### IN SITU SPT TEST DETAILS

| Depth | Blows for 75mm Increments |
|---|---|
| 4.50 | 2,3,4,4,5,7 |

### NOTES

All depth in metres; all diameters in millimetres.

Groundwater levels are subject to seasonal, tidal and other fluctuations and should not be taken as constant

150mm diameter casing installed to 5.00m depth. Borehole backfilled with arisings on completion.

### PERSONNEL

| Driller: SP | Logged by: GW | Checked by: SKF |
|---|---|---|

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# TEST RESULTS SUMMARY - SOIL

Borehole No 14

## Robroyston

Client: Ambion Holdings Ltd.

Consultant: D R Murray & Associates

Job No: 9957

| | |
|---|---|
| **Depth m** | 0.60 |
| Natural Moisture Content % | 20.0 |
| Liquid Limit % | 34 |
| Plastic Limit % | 17 |
| Plasticity Index % | 17 |
| Particle Density | |
| Bulk Density Mg/m3 | 2.03 |
| Particle Size Distribution | |
| Organic Matter Content % | |
| Mass Loss on Ignition % | |
| Sulphate Content % | |
| g/l | |
| 2:1 | |
| pH | |
| Optimum Moisture Content % | |
| Maximum Dry Density Mg/m3 | |
| MCV Natural | |
| MCV Calibration Intercept | |
| Slope | |
| Sensitivity | |
| California Bearing Ratio % | |
| Oedometer Consolidation | |
| C kN/m2 | 33.0 |
| C' kN/m2 | |
| Phi ° | 6.0 |
| Vane kPa | |
| Insitu California Bearing Ratio % | |
| Density Mg/m3 | |
| Other | |

### KEY TO SYMBOLS AND ABBREVIATIONS

C - Apparent Cohesion
C' - Cohesion Intercept Based on Effective Stress
Phi - Angle of Shearing Resistance Relating to C or C'
MCV - Moisture Condition Value

S - Sieve Analysis
SS - Sieve and Sedimentation Analysis
* - Test Undertaken

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# TEST RESULTS SUMMARY - SOIL

Borehole No 15

## Robroyston

Client: Ambion Holdings Ltd.

Job No: 9957

Consultant: D R Murray & Associates

| | | |
|---|---|---|
| **Depth m** | 0.55 | 1.50 |
| Natural Moisture Content % | 21.0 | 13.0 |
| Liquid Limit % | | |
| Plastic Limit % | | |
| Plasticity Index % | | |
| Particle Density | | |
| Bulk Density Mg/m3 | 2.10 | 2.20 |
| Particle Size Distribution | | |
| Organic Matter Content % | | |
| Mass Loss on Ignition % | | |
| Sulphate Content % | 0.030 | |
| g/l | | |
| 2:1 | | |
| pH | 5.9 | |
| Optimum Moisture Content % | | |
| Maximum Dry Density Mg/m3 | | |
| MCV Natural | | |
| MCV Calibration Intercept | | |
| Slope | | |
| Sensitivity | | |
| California Bearing Ratio % | | |
| Oedometer Consolidation | * | * |
| C kN/m2 | 22.0 | 71.0 |
| C' kN/m2 | | |
| Phi ° | 4.0 | 0.0 |
| Vane kPa | | |
| Insitu California Bearing Ratio % | | |
| Density Mg/m3 | | |
| Other | | |

### KEY TO SYMBOLS AND ABBREVIATIONS

C - Apparent Cohesion
C' - Cohesion Intercept Based on Effective Stress
Phi - Angle of Shearing Resistance Relating to C or C'
MCV - Moisture Condition Value

S - Sieve Analysis
SS - Sieve and Sedimentation Analysis
* - Test Undertaken

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# TEST RESULTS SUMMARY - SOIL

Borehole No 16

## Robroyston

Client: Ambion Holdings Ltd.

Job No: 9957

Consultant: D R Murray & Associates

| | |
|---|---|
| **Depth m** | 0.55 |
| Natural Moisture Content % | 21.0 |
| Liquid Limit % | |
| Plastic Limit % | |
| Plasticity Index % | |
| Particle Density | |
| Bulk Density Mg/m3 | 2.09 |
| Particle Size Distribution | |
| Organic Matter Content % | |
| Mass Loss on Ignition % | |
| Sulphate Content % | |
| g/l | |
| 2:1 | |
| pH | |
| Optimum Moisture Content % | |
| Maximum Dry Density Mg/m3 | |
| MCV Natural | |
| MCV Calibration Intercept | |
| Slope | |
| Sensitivity | |
| California Bearing Ratio % | |
| Oedometer Consolidation | |
| C kN/m2 | 64.0 |
| C' kN/m2 | |
| Phi ° | 0.0 |
| Vane kPa | |
| Insitu California Bearing Ratio % | |
| Density Mg/m3 | |
| Other | |

### KEY TO SYMBOLS AND ABBREVIATIONS

| | |
|---|---|
| C - Apparent Cohesion | S - Sieve Analysis |
| C' - Cohesion Intercept Based on Effective Stress | SS - Sieve and Sedimentation Analysis |
| Phi - Angle of Shearing Resistance Relating to C or C' | * - Test Undertaken |
| MCV - Moisture Condition Value | |

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# TEST RESULTS SUMMARY - SOIL

Borehole No 17

## Robroyston

Client: Ambion Holdings Ltd.

Job No: 9957

Consultant: D R Murray & Associates

| | |
|---|---|
| **Depth m** | 0.60 |
| Natural Moisture Content % | 27.0 |
| Liquid Limit % | |
| Plastic Limit % | |
| Plasticity Index % | |
| Particle Density | |
| Bulk Density Mg/m3 | 2.04 |
| Particle Size Distribution | |
| Organic Matter Content % | |
| Mass Loss on Ignition % | |
| Sulphate Content % | 0.030 |
| g/l | |
| 2:1 | |
| pH | 4.2 |
| Optimum Moisture Content % | |
| Maximum Dry Density Mg/m3 | |
| MCV Natural | |
| MCV Calibration Intercept | |
| Slope | |
| Sensitivity | |
| California Bearing Ratio % | |
| Oedometer Consolidation | * |
| C kN/m2 | 52.0 |
| C' kN/m2 | |
| Phi ° | 0.0 |
| Vane kPa | |
| Insitu California Bearing Ratio % | |
| Density Mg/m3 | |
| Other | |

### KEY TO SYMBOLS AND ABBREVIATIONS

| | |
|---|---|
| C - Apparent Cohesion | S - Sieve Analysis |
| C' - Cohesion Intercept Based on Effective Stress | SS - Sieve and Sedimentation Analysis |
| Phi - Angle of Shearing Resistance Relating to C or C' | * - Test Undertaken |
| MCV - Moisture Condition Value | |

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# TEST RESULTS SUMMARY - SOIL

Borehole No 23

## Robroyston

Client: Ambion Holdings Ltd.

Consultant: D R Murray & Associates

Job No: 9957

| | | |
|---|---|---|
| **Depth m** | 0.50 | 1.50 |
| Natural Moisture Content % | 22.0 | 12.0 |
| Liquid Limit % | 34 | |
| Plastic Limit % | 18 | |
| Plasticity Index % | 16 | |
| Particle Density | | |
| Bulk Density Mg/m3 | 2.09 | 2.14 |
| Particle Size Distribution | | |
| Organic Matter Content % | | |
| Mass Loss on Ignition % | | |
| Sulphate Content % | 0.040 | |
| g/l | | |
| 2:1 | | |
| pH | 6.0 | |
| Optimum Moisture Content % | | |
| Maximum Dry Density Mg/m3 | | |
| MCV Natural | | |
| MCV Calibration Intercept | | |
| Slope | | |
| Sensitivity | | |
| California Bearing Ratio % | | |
| Oedometer Consolidation | * | * |
| C kN/m2 | 51.0 | 87.0 |
| C' kN/m2 | | |
| Phi ° | 0.0 | 25.0 |
| Vane kPa | | |
| Insitu California Bearing Ratio % | | |
| Density Mg/m3 | | |
| Other | | |

### KEY TO SYMBOLS AND ABBREVIATIONS

C - Apparent Cohesion
C' - Cohesion Intercept Based on Effective Stress
Phi - Angle of Shearing Resistance Relating to C or C'
MCV - Moisture Condition Value

S - Sieve Analysis
SS - Sieve and Sedimentation Analysis
* - Test Undertaken

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# TEST RESULTS SUMMARY - SOIL

Borehole No 24

## Robroyston

Client: Ambion Holdings Ltd.

Job No: 9957

Consultant: D R Murray & Associates

| | |
|---|---|
| **Depth m** | 1.60 |
| Natural Moisture Content % | 15.0 |
| Liquid Limit % | |
| Plastic Limit % | |
| Plasticity Index % | |
| Particle Density | |
| Bulk Density Mg/m3 | 2.19 |
| Particle Size Distribution | |
| Organic Matter Content % | |
| Mass Loss on Ignition % | |
| Sulphate Content % | |
| g/l | |
| 2:1 | |
| pH | |
| Optimum Moisture Content % | |
| Maximum Dry Density Mg/m3 | |
| MCV Natural | |
| MCV Calibration Intercept | |
| Slope | |
| Sensitivity | |
| California Bearing Ratio % | |
| Oedometer Consolidation | |
| C kN/m2 | 62.0 |
| C' kN/m2 | |
| Phi ° | 0.0 |
| Vane kPa | |
| Insitu California Bearing Ratio % | |
| Density Mg/m3 | |
| Other | |

### KEY TO SYMBOLS AND ABBREVIATIONS

| | |
|---|---|
| C - Apparent Cohesion | S - Sieve Analysis |
| C' - Cohesion Intercept Based on Effective Stress | SS - Sieve and Sedimentation Analysis |
| Phi - Angle of Shearing Resistance Relating to C or C' | * - Test Undertaken |
| MCV - Moisture Condition Value | |

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# TEST RESULTS SUMMARY - SOIL

Borehole No 25

## Robroyston

Client: Ambion Holdings Ltd.

Job No: 9957

Consultant: D R Murray & Associates

| | |
|---|---|
| **Depth m** | 0.55 |
| Natural Moisture Content % | 22.0 |
| Liquid Limit % | |
| Plastic Limit % | |
| Plasticity Index % | |
| Particle Density | |
| Bulk Density Mg/m3 | 2.04 |
| Particle Size Distribution | |
| Organic Matter Content % | |
| Mass Loss on Ignition % | |
| Sulphate Content % | |
| g/l | |
| 2:1 | |
| pH | |
| Optimum Moisture Content % | |
| Maximum Dry Density Mg/m3 | |
| MCV Natural | |
| MCV Calibration Intercept | |
| Slope | |
| Sensitivity | |
| California Bearing Ratio % | |
| Oedometer Consolidation | |
| C kN/m2 | 32.0 |
| C' kN/m2 | |
| Phi ° | 9.0 |
| Vane kPa | |
| Insitu California Bearing Ratio % | |
| Density Mg/m3 | |
| Other | |

### KEY TO SYMBOLS AND ABBREVIATIONS

| | |
|---|---|
| C - Apparent Cohesion | S - Sieve Analysis |
| C' - Cohesion Intercept Based on Effective Stress | SS - Sieve and Sedimentation Analysis |
| Phi - Angle of Shearing Resistance Relating to C or C' | * - Test Undertaken |
| MCV - Moisture Condition Value | |

ritchies

# TEST RESULTS SUMMARY - SOIL

Borehole No 26

## Robroyston

Client: Ambion Holdings Ltd.

Job No: 9957

Consultant: D R Murray & Associates

| Depth m | 0.50 | 2.40 |
|---|---|---|
| Natural Moisture Content % | 20.0 | 10.0 |
| Liquid Limit % | 35 | |
| Plastic Limit % | 18 | |
| Plasticity Index % | 17 | |
| Particle Density | | |
| Bulk Density Mg/m3 | 2.11 | 2.26 |
| Particle Size Distribution | | |
| Organic Matter Content % | | |
| Mass Loss on Ignition % | | |
| Sulphate Content % | | |
| g/l | | |
| 2:1 | | |
| pH | | |
| Optimum Moisture Content % | | |
| Maximum Dry Density Mg/m3 | | |
| MCV Natural | | |
| MCV Calibration Intercept | | |
| Slope | | |
| Sensitivity | | |
| California Bearing Ratio % | | |
| Oedometer Consolidation | | |
| C kN/m2 | 63.0 | 229.0 |
| C' kN/m2 | | |
| Phi ° | 8.0 | 0.0 |
| Vane kPa | | |
| Insitu California Bearing Ratio % | | |
| Density Mg/m3 | | |
| Other | | |

### KEY TO SYMBOLS AND ABBREVIATIONS

C - Apparent Cohesion
C' - Cohesion Intercept Based on Effective Stress
Phi - Angle of Shearing Resistance Relating to C or C'
MCV - Moisture Condition Value

S - Sieve Analysis
SS - Sieve and Sedimentation Analysis
* - Test Undertaken

ritchies

# TEST RESULTS SUMMARY - SOIL

Borehole No 27

## Robroyston

Client: Ambion Holdings Ltd.

Job No: 9957

Consultant: D R Murray & Associates

| | |
|---|---|
| **Depth m** | 0.50 |
| Natural Moisture Content % | 22.0 |
| Liquid Limit % | |
| Plastic Limit % | |
| Plasticity Index % | |
| Particle Density | |
| Bulk Density Mg/m3 | 1.98 |
| Particle Size Distribution | |
| Organic Matter Content % | |
| Mass Loss on Ignition % | |
| Sulphate Content % | |
| g/l | |
| 2:1 | |
| pH | |
| Optimum Moisture Content % | |
| Maximum Dry Density Mg/m3 | |
| MCV Natural | |
| MCV Calibration Intercept | |
| Slope | |
| Sensitivity | |
| California Bearing Ratio % | |
| Oedometer Consolidation | |
| C kN/m2 | 25.0 |
| C' kN/m2 | |
| Phi ° | 6.0 |
| Vane kPa | |
| Insitu California Bearing Ratio % | |
| Density Mg/m3 | |
| Other | |

### KEY TO SYMBOLS AND ABBREVIATIONS

| | |
|---|---|
| C - Apparent Cohesion | S - Sieve Analysis |
| C' - Cohesion Intercept Based on Effective Stress | SS - Sieve and Sedimentation Analysis |
| Phi - Angle of Shearing Resistance Relating to C or C' | * - Test Undertaken |
| MCV - Moisture Condition Value | |

ritchies

# TEST RESULTS SUMMARY - SOIL

Borehole No 28

## Robroyston

Client: Ambion Holdings Ltd.

Job No: 9957

Consultant: D R Murray & Associates

| | | | |
|---|---|---|---|
| **Depth m** | 0.60 | 2.35 | 2.60 |
| Natural Moisture Content % | 20.0 | 12.4 | 13.0 |
| Liquid Limit % | | | |
| Plastic Limit % | | | |
| Plasticity Index % | | | |
| Particle Density | | | |
| Bulk Density Mg/m3 | 2.10 | | 2.22 |
| Particle Size Distribution | | | |
| Organic Matter Content % | | | |
| Mass Loss on Ignition % | | | |
| Sulphate Content % | | | |
| g/l | | | |
| 2:1 | | | |
| pH | | | |
| Optimum Moisture Content % | | | |
| Maximum Dry Density Mg/m3 | | | |
| MCV Natural | | 7.7 | |
| MCV Calibration Intercept | | | |
| Slope | | | |
| Sensitivity | | | |
| California Bearing Ratio % | | | |
| Oedometer Consolidation | | | |
| C kN/m2 | 66.0 | | 64.0 |
| C' kN/m2 | | | |
| Phi ° | 0.0 | | 0.0 |
| Vane kPa | | | |
| Insitu California Bearing Ratio % | | | |
| Density Mg/m3 | | | |
| Other | | | |

### KEY TO SYMBOLS AND ABBREVIATIONS

C - Apparent Cohesion
C' - Cohesion Intercept Based on Effective Stress
Phi - Angle of Shearing Resistance Relating to C or C'
MCV - Moisture Condition Value

S - Sieve Analysis
SS - Sieve and Sedimentation Analysis
* - Test Undertaken

ritchies

# TEST RESULTS SUMMARY - SOIL

Borehole No 30

## Robroyston

Client: Ambion Holdings Ltd.

Job No: 9957

Consultant: D R Murray & Associates

| | |
|---|---|
| **Depth m** | 0.55 |
| Natural Moisture Content % | 20.0 |
| Liquid Limit % | |
| Plastic Limit % | |
| Plasticity Index % | |
| Particle Density | |
| Bulk Density Mg/m3 | 2.00 |
| Particle Size Distribution | |
| Organic Matter Content % | |
| Mass Loss on Ignition % | |
| Sulphate Content % | 0.020 |
| g/l | |
| 2:1 | |
| pH | 5.6 |
| Optimum Moisture Content % | |
| Maximum Dry Density Mg/m3 | |
| MCV Natural | |
| MCV Calibration Intercept | |
| Slope | |
| Sensitivity | |
| California Bearing Ratio % | |
| Oedometer Consolidation | |
| C kN/m2 | 39.0 |
| C' kN/m2 | |
| Phi ° | 5.0 |
| Vane kPa | |
| Insitu California Bearing Ratio % | |
| Density Mg/m3 | |
| Other | |

### KEY TO SYMBOLS AND ABBREVIATIONS

| | |
|---|---|
| C - Apparent Cohesion | S - Sieve Analysis |
| C' - Cohesion Intercept Based on Effective Stress | SS - Sieve and Sedimentation Analysis |
| Phi - Angle of Shearing Resistance Relating to C or C' | * - Test Undertaken |
| MCV - Moisture Condition Value | |

ritchies

# TEST RESULTS SUMMARY - SOIL

Borehole No 31

## Robroyston

Client: Ambion Holdings Ltd.

Job No: 9957

Consultant: D R Murray & Associates

| | | |
|---|---|---|
| **Depth m** | 0.55 | 2.50 |
| Natural Moisture Content % | 25.0 | 13.0 |
| Liquid Limit % | | |
| Plastic Limit % | | |
| Plasticity Index % | | |
| Particle Density | | |
| Bulk Density Mg/m3 | 2.03 | 2.11 |
| Particle Size Distribution | | |
| Organic Matter Content % | | |
| Mass Loss on Ignition % | | |
| Sulphate Content % | | |
| g/l | | |
| 2:1 | | |
| pH | | |
| Optimum Moisture Content % | | |
| Maximum Dry Density Mg/m3 | | |
| MCV Natural | | |
| MCV Calibration Intercept | | |
| Slope | | |
| Sensitivity | | |
| California Bearing Ratio % | | |
| Oedometer Consolidation | * | * |
| C kN/m2 | 36.0 | 101.0 |
| C' kN/m2 | | |
| Phi ° | 6.0 | 15.0 |
| Vane kPa | | |
| Insitu California Bearing Ratio % | | |
| Density Mg/m3 | | |
| Other | | |

### KEY TO SYMBOLS AND ABBREVIATIONS

C - Apparent Cohesion
C' - Cohesion Intercept Based on Effective Stress
Phi - Angle of Shearing Resistance Relating to C or C'
MCV - Moisture Condition Value

S - Sieve Analysis
SS - Sieve and Sedimentation Analysis
* - Test Undertaken

Status
Final
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# TRIAL PIT LOG

Trial Pit No
TP108
Sheet 1 of 1

## Robroyston, Glasgow

Client: Ambion Holdings

Job No: 9957

Consultant: David R. Murray & Associates

| | | | |
|---|---|---|---|
| Date Started | 28/02/2001 | Dimensions | ◁ 2.60 ▷ △ 0.60 ▽ Bearing • |
| Date Complete: | 28/02/2001 | | |
| Hole Type: | TP | | |
| Equipment: | JCB 3CX | | |

Coordinates: E
N
Ground Level: Not Recorded
Scale: 1:50

| Description of Strata | Legend | Depth | OD Level | Sampling | | In Situ Testing | | Install -ation |
|---|---|---|---|---|---|---|---|---|
| | | | | | | Test | Result | |
| MADE GROUND: Dark brown clayey sandy topsoil with some fine to coarse gravel and some rootlets. | | 0.20 | | | | | | |
| Firm light greyish brown mottled orange brown sandy CLAY with some fine to coarse sub rounded to sub angular gravel and some thin lenses of grey sandy silt (weathered glacial till). | | | | | | V<br>V<br>V | 36<br>51<br>40 | |
| | | 0.90 | | | | | | |
| Firm to stiff brown sandy CLAY with some fine to coarse sub rounded and sub angular gravel, some cobbles and boulders and occasional iron staining (glacial till). | | | | B | 1.40 | V<br>V<br>V | 48<br>52<br>62 | |
| | | 1.50 | | | | | | |
| Stiff dark bluish grey brittle sandy CLAY with some fine to coarse sub rounded to angular gravel, some cobbles of mudstone and occasional boulders (glacial till). | | | | | | | | |
| | | 2.10 | | | | | | |
| Stiff becoming very stiff to base bluish grey sandy CLAY with some fine to coarse sub rounded and sub angular gravel, some cobbles and boulders. | | | | | | V<br>V<br>V | 110<br>108<br>100 | |
| | | 2.60 | | | | | | |
| End of Trial Pit at 2.60 m | | | | | | | | |

## NOTES

All Dimensions in Metres.
Groundwater levels are subject to seasonal, tidal and other fluctuations and should not be taken as constant

Groundwater: Dry
Stability: Stable.
Shoring: None
General: Trial pit terminated at 2.60m in stiff clay. Trial pit backfilled with arisings on completion.

Logged by: GW
Checked by: SKF

## KEY TO SYMBOLS AND ABBREVIATIONS

| | | | | | |
|---|---|---|---|---|---|
| D | Small Disturbed Sample | W | Water Sample | V | Hand Vane Test. Peak |
| B | Bulk Disturbed Sample | G | Gas Sample | VR | Hand Vane Test. Residual |
| LB | Large Bulk Disturbed Sample | NR | No Recovery | P | Pocket Penetrometer Test |
| U | Undisturbed U100 Sample | • | Estimated Relative Density | ICBR | In Situ CBR Test |
| BLK | Block Sample | | | IDEN | In Situ Density Test |
| CBR | CBR Mould Sample | | | MCV | In Situ MCV Test |

| Status | | Trial Pit No |
|---|---|---|
| Final | TRIAL PIT LOG | TP109 |
| 26/07/2001 | | Sheet 1 of 1 |

# Robroyston, Glasgow

Client: Ambion Holdings

Job No: 9957

Consultant: David R. Murray & Associates

| | | | |
|---|---|---|---|
| Date Started | 28/02/2001 | Dimensions | ◁ 2.60 ▷ △ 0.60 ▽ Bearing * |
| Date Complete: | 28/02/2001 | Coordinates: | E N |
| Hole Type: | TP | Ground Level: | Not Recorded |
| Equipment: | JCB 3CX | Scale: | 1:50 |

| Description of Strata | Legend | Depth | OD Level | Sampling | | In Situ Testing | | Install -ation |
|---|---|---|---|---|---|---|---|---|
| | | | | | | Test | Result | |
| MADE GROUND: Dark brown clayey sandy topsoil with some fine to coarse gravel and some rootlets. | | 0.40 | | | | | | |
| Soft to firm light greyish brown mottled orange brown sandy CLAY with some fine to coarse sub rounded to sub angular gravel and some thin lenses of grey sandy silt (weathered glacial till). | | 0.70 | | B | 0.60 | V | 52 | |
| Firm brown mottled orange brown sandy CLAY with some fine to coarse sub rounded and sub angular gravel,some localised iron staining and some cobbles (glacial till). | | | | | | V | 52 | |
| | | | | | | V | 62 | |
| | | | | | | V | 38 | |
| | | | | | | V | 38 | |
| | | | | | | V | 64 | |
| | | 1.70 | | | | | | |
| Firm dark bluish grey brittle sandy CLAY with some fine to coarse sub rounded to angular gravel, some cobbles, some localised iron staining and occasional boulders (glacial till). | | | | | | | | |
| | | 2.30 | | | | V | 98 | |
| Stiff becoming very stiff to base dark bluish grey sandy CLAY with some fine to coarse sub rounded and sub angular gravel, some cobbles and boulders of mudstone (glacial till). | | | | | | V | 62 | |
| | | 2.80 | | | | V | 68 | |
| End of Trial Pit at 2.80 m | | | | | | | | |

## NOTES

All Dimensions in Metres.
Groundwater levels are subject to seasonal, tidal and other fluctuations and should not be taken as constant

Groundwater: Dry

Stability: Stable.

Shoring: None

General: Trial pit terminated at 2.80m in stiff clay. Trial pit backfilled with arisings on completion.

Logged by: GW

Checked by: SKF

## KEY TO SYMBOLS AND ABBREVIATIONS

| | | | | | |
|---|---|---|---|---|---|
| D | Small Disturbed Sample | W | Water Sample | V | Hand Vane Test. Peak |
| B | Bulk Disturbed Sample | G | Gas Sample | VR | Hand Vane Test. Residual |
| LB | Large Bulk Disturbed Sample | NR | No Recovery | P | Pocket Penetrometer Test |
| U | Undisturbed U100 Sample | * | Estimated Relative Density | ICBR | In Situ CBR Test |
| BLK | Block Sample | | | IDEN | In Situ Density Test |
| CBR | CBR Mould Sample | | | MCV | In Situ MCV Test |

| Status | |
|---|---|
| Final | |
| 26/07/2001 | |

# TRIAL PIT LOG

| Trial Pit No | |
|---|---|
| TP110 | |
| Sheet 1 of 1 | |

## Robroyston, Glasgow

Client: Ambion Holdings

Job No: 9957

Consultant: David R. Murray & Associates

| | | | | | |
|---|---|---|---|---|---|
| Date Started | 27/02/2001 | Dimensions | ◁ 2.00 ▷ △ 0.65 ▽ | Coordinates: | E |
| Date Complete: | 27/02/2001 | | Bearing ° | | N |
| Hole Type: | TP | | | Ground Level: | Not Recorded |
| Equipment: | JCB 3CX | | | Scale: | 1:50 |

| Description of Strata | Legend | Depth | OD Level | Sampling | | In Situ Testing | | Install -ation |
|---|---|---|---|---|---|---|---|---|
| | | | | | | Test | Result | |
| MADE GROUND: Turf / topsoil. | | 0.20 | | | | | | |
| Firm brown mottled grey and orange sandy CLAY with some fine to coarse angular to sub rounded gravel and occasional cobbles. | | 1.20 | | B | 1.40 | | | |
| Firm dark greyish brown friable sandy CLAY with some fine to coarse angular to sub rounded gravel. Locally greenish brown. | | 1.80 | | | | | | |
| Stiff dark grey sandy CLAY with some fine to coarse angular to sub rounded gravel and occasional cobbles and boulders. (Glacial till) | | 3.10 | | | | | | |
| End of Trial Pit at 3.10 m | | | | | | | | |

## NOTES

All Dimensions in Metres.
Groundwater levels are subject to seasonal, tidal and other fluctuations and should not be taken as constant

Groundwater: Dry

Stability: Stable

Shoring: None

General: Trial pit terminated at 3.10m in very stiff clay. Trial pit backfilled with arisings on completion.

Logged by: SKF

Checked by: SKF

## KEY TO SYMBOLS AND ABBREVIATIONS

| | | | | | |
|---|---|---|---|---|---|
| D | Small Disturbed Sample | W | Water Sample | V | Hand Vane Test. Peak |
| B | Bulk Disturbed Sample | G | Gas Sample | VR | Hand Vane Test. Residual |
| LB | Large Bulk Disturbed Sample | NR | No Recovery | P | Pocket Penetrometer Test |
| U | Undisturbed U100 Sample | * | Estimated Relative Density | ICBR | In Situ CBR Test |
| BLK | Block Sample | | | IDEN | In Situ Density Test |
| CBR | CBR Mould Sample | | | MCV | In Situ MCV Test |

Status
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# TRIAL PIT LOG

Trial Pit No
TP111
Sheet 1 of 1

## Robroyston, Glasgow

Client: Ambion Holdings

Job No: 9957

Consultant: David R. Murray & Associates

| | | | |
|---|---|---|---|
| Date Started | 26/06/2001 | Dimensions | ◁ 2.80 ▷ △ 0.60 ▽ Bearing 35° |
| Date Complete: | 26/06/2001 | | |
| Hole Type: | TP | | |
| Equipment: | JCB 3CX | | |

Coordinates: E
N
Ground Level: Not Recorded
Scale: 1:50

| Description of Strata | Legend | Depth | OD Level | Sampling | | In Situ Testing Test | In Situ Testing Result | Install -ation |
|---|---|---|---|---|---|---|---|---|
| MADE GROUND: Topsoil | | 0.30 | | | | | | |
| Brown very silty fine to coarse SAND with occasional rootlets (subsoil). | | 0.50 | | | | | | |
| Firm orange brown mottled grey sandy CLAY with some fine to coarse sub rounded to angular gravel, occasional cobbles and boulders and occasional rootlets (weathered glacial till).<br>... at 0.60m, landdrain. | | | | - | 0.60 | V<br>V<br>V | 81<br>86<br>59 | |
| Stiff dark grey sandy CLAY with some fine to coarse sub rounded to angular gravel (glacial till). | | 1.20 | | | | | | |
| Recovered as dark grey sandy fine to coarse flat angular gravel, cobbles and boulders of moderately strong fine grained silty SANDSTONE (presumed bedrock). | | 2.15 | | | | | | |
| End of Trial Pit at 2.50 m | | 2.50 | | | | | | |

## NOTES

All Dimensions in Metres.
Groundwater levels are subject to seasonal, tidal and other fluctuations and should not be taken as constant

Groundwater: Slow ingress at 2.15m and water level standing at 2.45m on completion.
Stability: Stable
Shoring: None
General: Trial pit terminated at 2.50m on rock obstruction. Trial pit backfilled with excavated spoil.

Logged by: SMcQ
Checked by: SMcQ

## KEY TO SYMBOLS AND ABBREVIATIONS

| | | | | | |
|---|---|---|---|---|---|
| D | Small Disturbed Sample | W | Water Sample | V | Hand Vane Test. Peak |
| B | Bulk Disturbed Sample | G | Gas Sample | VR | Hand Vane Test. Residual |
| LB | Large Bulk Disturbed Sample | NR | No Recovery | P | Pocket Penetrometer Test |
| U | Undisturbed U100 Sample | * | Estimated Relative Density | ICBR | In Situ CBR Test |
| BLK | Block Sample | | | IDEN | In Situ Density Test |
| CBR | CBR Mould Sample | | | MCV | In Situ MCV Test |

Status
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26/07/2001

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# TRIAL PIT LOG

Trial Pit No
TP112
Sheet 1 of 1

## Robroyston, Glasgow

Client: Ambion Holdings

Job No: 9957

Consultant: David R. Murray & Associates

| | | | | | |
|---|---|---|---|---|---|
| Date Started | 18/06/2001 | Dimensions | ◁ 2.60 ▷ △ 0.60 ▽ Bearing 88° | Coordinates: | E<br>N |
| Date Complete: | 18/06/2001 | | | Ground Level: | Not Recorded |
| Hole Type: | TP | | | | |
| Equipment: | JCB 3CX | | | Scale: | 1:50 |

| Description of Strata | Legend | Depth | OD Level | Sampling | | In Situ Testing | | Install -ation |
|---|---|---|---|---|---|---|---|---|
| | | | | | | Test | Result | |
| MADE GROUND: Topsoil | | 0.25 | | | | | | |
| Firm brown mottled orange brown and light grey sandy CLAY with some fine to coarse sub rounded to angular gravel, occasional cobbles and boulders and occasional rootlets (weathered glacial till). | | | | - | 0.65 | V<br>V<br>V | 70<br>70<br>74 | |
| ... at 0.65m, landdrain. | | 0.90 | | | | | | |
| Firm locally firm to stiff dark grey mottled greyish brown sandy CLAY with some fine to coarse sub rounded to angular gravel, some cobbles and boulders and occasional orange brown ironstaining in rootlet tracks at top (weathered glacial till). | | 1.70 | | | | | | |
| Very stiff dark grey extremely closely fissured brittle sandy to very sandy CLAY with some fine to coarse sub rounded to angular gravel, some boulders and greyish brown/orange brown ironstaining in fissures (glacial till). | | | | B | 2.00 | | | |
| | | 2.25 | | | | | | |
| Very stiff dark grey sandy CLAY with some fine to coarse sub rounded and sub angular gravel and occasional cobbles and boulders (glacial till). | | 2.45 | | | | | | |
| End of Trial Pit at 2.45 m | | | | | | | | |

## NOTES

All Dimensions in Metres.
Groundwater levels are subject to seasonal, tidal and other fluctuations and should not be taken as constant

Groundwater: Occasional water inclusions adjacent to boulders at 1.60m, trial pit dry on completion.
Stability: Stable
Shoring: None
General: Trial pit terminated at 2.45m on boulder obstruction. Trial pit backfilled with excavated spoil.

Logged by: SMcQ Checked by: SMcQ

## KEY TO SYMBOLS AND ABBREVIATIONS

| | | | | | |
|---|---|---|---|---|---|
| D | Small Disturbed Sample | W | Water Sample | V | Hand Vane Test. Peak |
| B | Bulk Disturbed Sample | G | Gas Sample | VR | Hand Vane Test. Residual |
| LB | Large Bulk Disturbed Sample | NR | No Recovery | P | Pocket Penetrometer Test |
| U | Undisturbed U100 Sample | * | Estimated Relative Density | ICBR | In Situ CBR Test |
| BLK | Block Sample | | | IDEN | In Situ Density Test |
| CBR | CBR Mould Sample | | | MCV | In Situ MCV Test |

Status
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26/07/2001

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# TRIAL PIT LOG

Trial Pit No
TP116
Sheet 1 of 1

## Robroyston, Glasgow

Client: Ambion Holdings

Consultant: David R. Murray & Associates

Job No: 9957

| | | | |
|---|---|---|---|
| Date Started | 18/06/2001 | Dimensions | ◁ 2.60 ▷ △ 0.60 ▽ Bearing 172° |
| Date Complete: | 18/06/2001 | | |
| Hole Type: | TP | | |
| Equipment: | JCB 3CX | | |

Coordinates: E
N
Ground Level: Not Recorded
Scale: 1:50

| Description of Strata | Legend | Depth | OD Level | Sampling | | In Situ Testing Test | In Situ Testing Result | Install -ation |
|---|---|---|---|---|---|---|---|---|
| MADE GROUND: Topsoil | | 0.30 | | | | | | |
| Soft dark grey sandy peaty CLAY with occasional rootlets (topsoil). | | 0.55 | | | | | | |
| Soft to firm greyish brown mottled grey sandy CLAY with some bands of light grey silty fine to coarse sand, occasional lenses of dark brown amorphous peat and occasional rootlets (alluvium). | | | | - | 0.70 | V<br>V<br>V | 43<br>47<br>43 | |
| | | 1.30 | | B | 1.10 | | | |
| Very soft dark grey sandy CLAY with some fine to coarse sub rounded to angular gravel and occasional cobbles (glacial till). | | | | - | 1.60 | V<br>V<br>V | 14<br>19<br>16 | |
| ... at 2.20m, becoming firm. | | | | | | | | |
| End of Trial Pit at 3.00 m | | 3.00 | | | | | | |

## NOTES

All Dimensions in Metres.
Groundwater levels are subject to seasonal, tidal and other fluctuations and should not be taken as constant

Groundwater: Wet in sand bands at 1.20m, trial pit dry on completion.
Stability: Unstable at 1.00m.
Shoring: None
General: Trial pit terminated at 3.00m in very stiff clay. Trial pit backfilled with excavated spoil.

Logged by: SMcQ
Checked by: SMcQ

## KEY TO SYMBOLS AND ABBREVIATIONS

| | | | | | |
|---|---|---|---|---|---|
| D | Small Disturbed Sample | W | Water Sample | V | Hand Vane Test. Peak |
| B | Bulk Disturbed Sample | G | Gas Sample | VR | Hand Vane Test. Residual |
| LB | Large Bulk Disturbed Sample | NR | No Recovery | P | Pocket Penetrometer Test |
| U | Undisturbed U100 Sample | * | Estimated Relative Density | ICBR | In Situ CBR Test |
| BLK | Block Sample | | | IDEN | In Situ Density Test |
| CBR | CBR Mould Sample | | | MCV | In Situ MCV Test |

Status
Final
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# TRIAL PIT LOG

Trial Pit No
TP117
Sheet 1 of 1

## Robroyston, Glasgow

Client: Ambion Holdings

Job No: 9957

Consultant: David R. Murray & Associates

| | | | | | |
|---|---|---|---|---|---|
| Date Started | 18/06/2001 | Dimensions | ◁ 2.40 ▷ △ 0.60 ▽ Bearing 163° | Coordinates: | E<br>N |
| Date Complete: | 18/06/2001 | | | Ground Level: | Not Recorded |
| Hole Type: | TP | | | | |
| Equipment: | JCB 3CX | | | Scale: | 1:50 |

| Description of Strata | Legend | Depth | OD Level | Sampling | In Situ Testing: Test | In Situ Testing: Result | Install -ation |
|---|---|---|---|---|---|---|---|
| MADE GROUND: Topsoil | | 0.10 | | | | | |
| Soft dark brown and black amorphous PEAT with some rootlets (alluvium). | | 0.35 | | | | | |
| Light grey slightly silty to silty fine to coarse SAND (alluvium). | | 0.70 | | | | | |
| Recovered as greyish brown slightly silty sandy fine to coarse angular gravel of moderately weak medium grained SANDSTONE and some cobbles and boulders of sandstone (presumed bedrock). | | 1.10 | | | | | |
| End of Trial Pit at 1.10 m | | | | | | | |

## NOTES

All Dimensions in Metres.
Groundwater levels are subject to seasonal, tidal and other fluctuations and should not be taken as constant

Groundwater: Dry
Stability: Stable
Shoring: None
General: Trial pit terminated at 1.10m on rock obstruction. Trial pit backfilled with excavated spoil.

Logged by: SMcQ

Checked by: SMcQ

## KEY TO SYMBOLS AND ABBREVIATIONS

| | | | | | |
|---|---|---|---|---|---|
| D | Small Disturbed Sample | W | Water Sample | V | Hand Vane Test. Peak |
| B | Bulk Disturbed Sample | G | Gas Sample | VR | Hand Vane Test. Residual |
| LB | Large Bulk Disturbed Sample | NR | No Recovery | P | Pocket Penetrometer Test |
| U | Undisturbed U100 Sample | * | Estimated Relative Density | ICBR | In Situ CBR Test |
| BLK | Block Sample | | | IDEN | In Situ Density Test |
| CBR | CBR Mould Sample | | | MCV | In Situ MCV Test |

Status
Final
26/07/2001

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# TRIAL PIT LOG

Trial Pit No
TP138
Sheet 1 of 1

## Robroyston, Glasgow

Client: Ambion Holdings

Job No: 9957

Consultant: David R. Murray & Associates

| | | | | | |
|---|---|---|---|---|---|
| Date Started | 27/02/2001 | Dimensions | ◁ 1.80 ▷ △ 0.65 ▽ Bearing • | Coordinates: | E<br>N |
| Date Complete: | 27/02/2001 | | | Ground Level: | Not Recorded |
| Hole Type: | TP | | | | |
| Equipment: | JCB 3CX | | | Scale: | 1:50 |

| Description of Strata | Legend | Depth | OD Level | Sampling | | In Situ Testing | | Install -ation |
|---|---|---|---|---|---|---|---|---|
| | | | | | | Test | Result | |
| MADE GROUND: Turf / topsoil. | | 0.30 | | | | | | |
| Firm becoming firm to stiff brown mottled grey and orange sandy CLAY with some fine to coarse angular to sub rounded gravel and occasional cobbles | | | | - | 0.50 | V<br>V<br>V | 65<br>70<br>70 | |
| Firm to stiff dark greyish brown sandy CLAY with some fine to coarse angular to sub rounded gravel and occasional cobbles.<br>.... From 1.50m becoming very stiff and closely fissured. | | 1.30 | | | | | | |
| Very stiff dark grey sandy CLAY with some fine to coarse angular to sub rounded gravel and occasional cobbles and boulders. (Glacial till) | | 2.10 | | | | | | |
| End of Trial Pit at 2.40 m | | 2.40 | | | | | | |

## NOTES

All Dimensions in Metres.
Groundwater levels are subject to seasonal, tidal and other fluctuations and should not be taken as constant

Groundwater: Dry
Stability: Stable
Shoring: None
General: Trial pit terminated at 2.40m in very stiff clay. Trial pit backfilled with arisings on completion.

Logged by: SKF

Checked by: SKF

## KEY TO SYMBOLS AND ABBREVIATIONS

| | | | | | |
|---|---|---|---|---|---|
| D | Small Disturbed Sample | W | Water Sample | V | Hand Vane Test. Peak |
| B | Bulk Disturbed Sample | G | Gas Sample | VR | Hand Vane Test. Residual |
| LB | Large Bulk Disturbed Sample | NR | No Recovery | P | Pocket Penetrometer Test |
| U | Undisturbed U100 Sample | * | Estimated Relative Density | ICBR | In Situ CBR Test |
| BLK | Block Sample | | | IDEN | In Situ Density Test |
| CBR | CBR Mould Sample | | | MCV | In Situ MCV Test |

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# TRIAL PIT LOG

Trial Pit No
TP139
Sheet 1 of 1

## Robroyston, Glasgow

Client: Ambion Holdings

Job No: 9957

Consultant: David R. Murray & Associates

| | | | | | |
|---|---|---|---|---|---|
| Date Started | 27/02/2001 | Dimensions | ◁ 1.80 ▷ △ 0.65 ▽ Bearing ° | Coordinates: | E<br>N |
| Date Complete: | 27/02/2001 | | | Ground Level: | Not Recorded |
| Hole Type: | TP | | | | |
| Equipment: | JCB 3CX | | | Scale: | 1:50 |

| Description of Strata | Legend | Depth | OD Level | Sampling | | In Situ Testing | | Install -ation |
|---|---|---|---|---|---|---|---|---|
| | | | | | | Test | Result | |
| MADE GROUND: Turf / topsoil. | | 0.30 | | | | | | |
| Firm to stiff locally firm brown sandy CLAY with some fine to coarse angular to sub rounded gravel and occasional cobbles and boulders. Locally mottled orange at depth. | | | | B | 0.90 | | | |
| Very stiff dark greyish brown closely fissured sandy CLAY with some fine to coarse angular to sub rounded gravel and occasional cobbles. | | 1.30 | | | | | | |
| Very stiff dark grey sandy CLAY with some fine to coarse angular to sub rounded gravel and occasional cobbles and boulders. (Glacial till) | | 2.10 | | | | | | |
| End of Trial Pit at 2.40 m | | 2.40 | | | | | | |

## NOTES

All Dimensions in Metres.
Groundwater levels are subject to seasonal, tidal and other fluctuations and should not be taken as constant

Groundwater: Dry
Stability: Stable
Shoring: None
General: Trial pit terminated at 2.40m in very stiff clay. Trial pit backfilled with arisings on completion.

Logged by: SKF

Checked by: SKF

## KEY TO SYMBOLS AND ABBREVIATIONS

| | | | | | |
|---|---|---|---|---|---|
| D | Small Disturbed Sample | W | Water Sample | V | Hand Vane Test. Peak |
| B | Bulk Disturbed Sample | G | Gas Sample | VR | Hand Vane Test. Residual |
| LB | Large Bulk Disturbed Sample | NR | No Recovery | P | Pocket Penetrometer Test |
| U | Undisturbed U100 Sample | * | Estimated Relative Density | ICBR | In Situ CBR Test |
| BLK | Block Sample | | | IDEN | In Situ Density Test |
| CBR | CBR Mould Sample | | | MCV | In Situ MCV Test |

| Status | | Trial Pit No |
|---|---|---|
| Final | TRIAL PIT LOG | TP140 |
| 26/07/2001 | | Sheet 1 of 1 |

ritchies

## Robroyston, Glasgow

Client: Ambion Holdings

Job No: 9957

Consultant: David R. Murray & Associates

| | | | |
|---|---|---|---|
| Date Started | 27/02/2001 | Dimensions | ◁ 1.90 ▷ △ 0.65 ▽ Bearing ° |
| Date Complete: | 27/02/2001 | | |
| Hole Type: | TP | | |
| Equipment: | JCB 3CX | | |

Coordinates: E N

Ground Level: Not Recorded

Scale: 1:50

| Description of Strata | Legend | Depth | OD Level | Sampling | | In Situ Testing | | Install -ation |
|---|---|---|---|---|---|---|---|---|
| | | | | | | Test | Result | |
| MADE GROUND: Turf / topsoil. | | 0.25 | | | | | | |
| Firm brown becoming mottled orange and grey sandy CLAY with some fine to coarse angular to sub rounded gravel and occasional cobbles. | | | | - | 0.50 | V<br>V<br>V | 53<br>55<br>59 | |
| Very stiff dark greyish brown closely fissured sandy CLAY with some fine to coarse angular to sub rounded gravel and occasional cobbles. | | 1.40 | | | | | | |
| Very stiff dark grey sandy CLAY with some fine to coarse angular to sub rounded gravel and occasional cobbles and boulders. (Glacial till) | | 1.90 | | | | | | |
| End of Trial Pit at 2.30 m | | 2.30 | | | | | | |

## NOTES

All Dimensions in Metres.
Groundwater levels are subject to seasonal, tidal and other fluctuations and should not be taken as constant

Groundwater: Dry
Stability: Stable
Shoring: None
General: Trial pit terminated at 2.30m in very stiff clay. Trial pit backfilled with arisings on completion.

Logged by: SKF Checked by: SKF

## KEY TO SYMBOLS AND ABBREVIATIONS

| | | | | | |
|---|---|---|---|---|---|
| D | Small Disturbed Sample | W | Water Sample | V | Hand Vane Test. Peak |
| B | Bulk Disturbed Sample | G | Gas Sample | VR | Hand Vane Test. Residual |
| LB | Large Bulk Disturbed Sample | NR | No Recovery | P | Pocket Penetrometer Test |
| U | Undisturbed U100 Sample | * | Estimated Relative Density | ICBR | In Situ CBR Test |
| BLK | Block Sample | | | IDEN | In Situ Density Test |
| CBR | CBR Mould Sample | | | MCV | In Situ MCV Test |

| Status | | Trial Pit No |
|---|---|---|
| Final | TRIAL PIT LOG | TP141 |
| 26/07/2001 | | Sheet 1 of 1 |

# Robroyston, Glasgow

Client: Ambion Holdings

Job No: 9957

Consultant: David R. Murray & Associates

| | | | |
|---|---|---|---|
| Date Started | 27/02/2001 | Dimensions | ◁ 2.00 ▷ △ 0.65 ▽ Bearing ° |
| Date Complete: | 27/02/2001 | Coordinates: | E |
| Hole Type: | TP | | N |
| Equipment: | JCB 3CX | Ground Level: | Not Recorded |
| | | Scale: | 1:50 |

| Description of Strata | Legend | Depth | OD Level | Sampling | | In Situ Testing | | Install -ation |
|---|---|---|---|---|---|---|---|---|
| | | | | | | Test | Result | |
| MADE GROUND: Turf / topsoil. | | 0.20 | | | | | | |
| Firm brown mottled orange and grey sandy CLAY with some fine to coarse angular to sub rounded gravel.<br>.... At 0.60m excavated old red clay field drain. | | 1.30 | | | | | | |
| Soft to firm initally firm greyish brown sandy CLAY with some fine to coarse angular to sub rounded gravel and occasional cobbles. Locally mottled grey. | | 2.00 | | | | | | |
| Very stiff dark grey sandy CLAY with some fine to coarse angular to sub rounded gravel and occasional cobbles and boulders. (Glacial till) | | 3.00 | | B | 2.10 | | | |
| End of Trial Pit at 3.00 m | | | | | | | | |

## NOTES

All Dimensions in Metres.
Groundwater levels are subject to seasonal, tidal and other fluctuations and should not be taken as constant

Groundwater: Dry
Stability: Stable
Shoring: None
General: Trial pit terminated at 3.00m in very stiff clay. Trial pit backfilled with arisings on completion.

Logged by: SKF Checked by: SKF

## KEY TO SYMBOLS AND ABBREVIATIONS

| | | | | | |
|---|---|---|---|---|---|
| D | Small Disturbed Sample | W | Water Sample | V | Hand Vane Test. Peak |
| B | Bulk Disturbed Sample | G | Gas Sample | VR | Hand Vane Test. Residual |
| LB | Large Bulk Disturbed Sample | NR | No Recovery | P | Pocket Penetrometer Test |
| U | Undisturbed U100 Sample | * | Estimated Relative Density | ICBR | In Situ CBR Test |
| BLK | Block Sample | | | IDEN | In Situ Density Test |
| CBR | CBR Mould Sample | | | MCV | In Situ MCV Test |

Status
Final
26/07/2001

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# TRIAL PIT LOG

Trial Pit No
TP142
Sheet 1 of 1

## Robroyston, Glasgow

Client: Ambion Holdings

Job No: 9957

Consultant: David R. Murray & Associates

| | | | |
|---|---|---|---|
| Date Started | 27/02/2001 | Dimensions ◁ 1.90 ▷ △ 0.65 ▽ Bearing ° | Coordinates: E N |
| Date Complete: | 27/02/2001 | | Ground Level: Not Recorded |
| Hole Type: | TP | | |
| Equipment: | JCB 3CX | | Scale: 1:50 |

| Description of Strata | Legend | Depth | OD Level | Sampling | | In Situ Testing Test | In Situ Testing Result | Install -ation |
|---|---|---|---|---|---|---|---|---|
| MADE GROUND: Turf / topsoil. | | 0.30 | | | | | | |
| Firm brown mottled orange and grey sandy CLAY with some fine to coarse angular to sub rounded gravel. Locally very sandy at top. | | | | - | 0.70 | V<br>V<br>V | 50<br>54<br>52 | |
| Firm locally soft to firm dark greyish brown sandy CLAY with some fine to coarse angular to sub rounded gravel and occasional cobbles. | | 1.30 | | | | | | |
| Stiff dark grey sandy CLAY with some fine to coarse angular to sub rounded gravel and occasional cobbles and boulders. Occasional light grey silty laminations. (Glacial till)<br>.... At 2.00m boulder obstruction. | | 1.90 | | | | | | |
| End of Trial Pit at 3.00 m | | 3.00 | | | | | | |

## NOTES

All Dimensions in Metres.
Groundwater levels are subject to seasonal, tidal and other fluctuations and should not be taken as constant

Groundwater: Dry
Stability: Stable
Shoring: None
General: Trial pit terminated at 3.00m in very stiff clay. Trial pit backfilled with arisings on completion.

Logged by: SKF

Checked by: SKF

## KEY TO SYMBOLS AND ABBREVIATIONS

| | | | | | |
|---|---|---|---|---|---|
| D | Small Disturbed Sample | W | Water Sample | V | Hand Vane Test. Peak |
| B | Bulk Disturbed Sample | G | Gas Sample | VR | Hand Vane Test. Residual |
| LB | Large Bulk Disturbed Sample | NR | No Recovery | P | Pocket Penetrometer Test |
| U | Undisturbed U100 Sample | * | Estimated Relative Density | ICBR | In Situ CBR Test |
| BLK | Block Sample | | | IDEN | In Situ Density Test |
| CBR | CBR Mould Sample | | | MCV | In Situ MCV Test |

| Status | | Trial Pit No |
|---|---|---|
| Final | TRIAL PIT LOG | TP143 |
| 26/07/2001 | | Sheet 1 of 1 |

## Robroyston, Glasgow

Client: Ambion Holdings — Job No: 9957

Consultant: David R. Murray & Associates

| | | | |
|---|---|---|---|
| Date Started | 27/02/2001 | Dimensions | ◁ 2.00 ▷ △ 0.65 ▽ Bearing ° |
| Date Complete: | 27/02/2001 | Coordinates: | E |
| Hole Type: | TP | | N |
| Equipment: | JCB 3CX | Ground Level: | Not Recorded |
| | | Scale: | 1:50 |

| Description of Strata | Legend | Depth | OD Level | Sampling | | In Situ Testing | | Install -ation |
|---|---|---|---|---|---|---|---|---|
| | | | | | | Test | Result | |
| MADE GROUND: Turf / topsoil. | | 0.25 | | | | | | |
| Orange brown clayey silty fine to coarse SAND with occasional roots. | | 0.60 | | B | 0.50 | | | |
| Firm light brown mottled orange sandy CLAY with some fine to coarse angular to sub rounded gravel. Locally very sandy. | | 1.20 | | | | | | |
| Firm to stiff dark greyish brown friable sandy CLAY with some fine to coarse angular to sub rounded gravel and occasional cobbles. Locally mottled grey. | | 2.00 | | B | 1.50 | | | |
| Stiff dark grey sandy CLAY with some fine to coarse angular to sub rounded gravel and occasional cobbles and boulders. Occasional light grey silty laminations. (Glacial till) | | 2.80 | | | | | | |
| End of Trial Pit at 2.80 m | | | | | | | | |

## NOTES

All Dimensions in Metres.
Groundwater levels are subject to seasonal, tidal and other fluctuations and should not be taken as constant

Groundwater: Dry
Stability: Stable
Shoring: None
General: Trial pit terminated at 2.80m in very stiff clay. Trial pit backfilled with arisings on completion.

Logged by: SKF — Checked by: SKF

## KEY TO SYMBOLS AND ABBREVIATIONS

| | | | | | |
|---|---|---|---|---|---|
| D | Small Disturbed Sample | W | Water Sample | V | Hand Vane Test. Peak |
| B | Bulk Disturbed Sample | G | Gas Sample | VR | Hand Vane Test. Residual |
| LB | Large Bulk Disturbed Sample | NR | No Recovery | P | Pocket Penetrometer Test |
| U | Undisturbed U100 Sample | * | Estimated Relative Density | ICBR | In Situ CBR Test |
| BLK | Block Sample | | | IDEN | In Situ Density Test |
| CBR | CBR Mould Sample | | | MCV | In Situ MCV Test |

| Status | | Trial Pit No |
|---|---|---|
| Final | TRIAL PIT LOG | TP144 |
| 26/07/2001 | | Sheet 1 of 1 |

## Robroyston, Glasgow

Client: Ambion Holdings — Job No: 9957

Consultant: David R. Murray & Associates

| | | | |
|---|---|---|---|
| Date Started | 01/03/2001 | Dimensions | ◁ 2.50 ▷ △ 0.60 ▽ Bearing ° |
| Date Complete: | 01/03/2001 | | |
| Hole Type: | TP | | |
| Equipment: | JCB 3CX | | |

Coordinates: E N

Ground Level: Not Recorded

Scale: 1:50

| Description of Strata | Legend | Depth | OD Level | Sampling | | In Situ Testing | | Install -ation |
|---|---|---|---|---|---|---|---|---|
| | | | | | | Test | Result | |
| MADE GROUND: Dark brown clayey sandy topsoil with some fine to coarse gravel, some fragments of crockery and glass to medium gravel size and some rootlets. | | 0.30 | | | | V | 72 | |
| Soft to firm light brown mottled orange brown sandy CLAY with some fine to coarse sub rounded to angular gravel, some roots and timber to coarse gravel size, some cobbles and occasional boulders. | | | | | | V | 38 | |
| . . . at 0.50m, excavated clay field drain | | 1.00 | | | | V | 48 | |
| Firm brown mottled grey and orange brown sandy CLAY with some fine to coarse sub rounded to angular gravel, some cobbles and boulders ( weathered glacial till). | | | | | | V | 38 | |
| | | | | | | V | 38 | |
| | | | | | | V | 40 | |
| | | 1.90 | | B | 2.00 | | | |
| Stiff bluish light grey sandy CLAY with some fine to coarse sub rounded to angular gravel, some yellowish brown sandy pockets, some thin silt layers and some cobbles (glacial till). | | | | | | | | |
| ... a layer of silty sand at 2.10m. | | | | | | | | |
| | | 2.60 | | | | | | |
| End of Trial Pit at 2.60 m | | | | | | | | |

## NOTES

All Dimensions in Metres.
Groundwater levels are subject to seasonal, tidal and other fluctuations and should not be taken as constant

Groundwater: Dry

Stability: Stable.

Shoring: None

General: Trial pit terminated at 2.90m in very stiff clay. Trial pit backfilled with arisings on completion.

Logged by: GW — Checked by: SKF

## KEY TO SYMBOLS AND ABBREVIATIONS

| | | | | | |
|---|---|---|---|---|---|
| D | Small Disturbed Sample | W | Water Sample | V | Hand Vane Test. Peak |
| B | Bulk Disturbed Sample | G | Gas Sample | VR | Hand Vane Test. Residual |
| LB | Large Bulk Disturbed Sample | NR | No Recovery | P | Pocket Penetrometer Test |
| U | Undisturbed U100 Sample | * | Estimated Relative Density | iCBR | In Situ CBR Test |
| BLK | Block Sample | | | IDEN | In Situ Density Test |
| CBR | CBR Mould Sample | | | MCV | In Situ MCV Test |

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# TRIAL PIT LOG

Trial Pit No
TP145
Sheet 1 of 1

## Robroyston, Glasgow

Client: Ambion Holdings

Job No: 9957

Consultant: David R. Murray & Associates

| | | | |
|---|---|---|---|
| Date Started | 12/06/2001 | Dimensions | ◁ 2.60 ▷ △ 0.60 ▽ Bearing 168° |
| Date Complete: | 12/06/2001 | Coordinates: | E |
| Hole Type: | TP | | N |
| Equipment: | JCB 3CX | Ground Level: | Not Recorded |
| | | Scale: | 1:50 |

| Description of Strata | Legend | Depth | OD Level | Sampling | | In Situ Testing | | Install -ation |
|---|---|---|---|---|---|---|---|---|
| | | | | | | Test | Result | |
| MADE GROUND: Topsoil | | 0.30 | | | | | | |
| Firm brown mottled light grey and orange brown sandy CLAY with some fine to coarse sub angular and angular gravel, occasional rootlets and locally some bands of light grey silty fine and medium sand at top. ... at 0.50m, landdrain. | | 0.65 | | - | 0.70 | V<br>V<br>V | 78<br>94<br>97 | |
| Firm becoming stiff at base grey mottled orange brown sandy CLAY with some fine to coarse sub rounded to angular gravel, some cobbles and boulders and occasional orange brown ironstained rootlet tracks (weathered glacial till). | | 1.40 | | | | | | |
| Very stiff locally stiff at top dark grey extremely closely fissured becoming closely fissured brittle sandy to very sandy CLAY with some fine to coarse sub angular and angular gravel, occasional cobbles and boulders and locally greyish brown ironstaining | | 2.40 | | | | | | |
| Very stiff dark grey sandy CLAY with some fine to coarse sub rounded to angular gravel, occasional cobbles and boulders and locally closely fissured at top with greyish brown ironstaining in fissures (glacial till). | | 2.70 | | | | | | |
| End of Trial Pit at 2.70 m | | | | | | | | |

## NOTES

All Dimensions in Metres.
Groundwater levels are subject to seasonal, tidal and other fluctuations and should not be taken as constant

Groundwater: Dry
Stability: Stable
Shoring: None
General: Trial pit terminated at 2.70m in very stiff clay. Trial pit backfilled with excavated spoil.

Logged by: SMcQ

Checked by: SMcQ

## KEY TO SYMBOLS AND ABBREVIATIONS

| | | | | | |
|---|---|---|---|---|---|
| D | Small Disturbed Sample | W | Water Sample | V | Hand Vane Test. Peak |
| B | Bulk Disturbed Sample | G | Gas Sample | VR | Hand Vane Test. Residual |
| LB | Large Bulk Disturbed Sample | NR | No Recovery | P | Pocket Penetrometer Test |
| U | Undisturbed U100 Sample | * | Estimated Relative Density | ICBR | In Situ CBR Test |
| BLK | Block Sample | | | IDEN | In Situ Density Test |
| CBR | CBR Mould Sample | | | MCV | In Situ MCV Test |

| Status | | Trial Pit No |
|---|---|---|
| Final | TRIAL PIT LOG | TP146 |
| 26/07/2001 | | Sheet 1 of 1 |

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# Robroyston, Glasgow

Client: Ambion Holdings

Job No: 9957

Consultant: David R. Murray & Associates

| | | | |
|---|---|---|---|
| Date Started | 12/06/2001 | Dimensions | ◁ 2.70 ▷ △ 0.60 ▽ Bearing 167° |
| Date Complete: | 12/06/2001 | Coordinates: | E |
| Hole Type: | TP | | N |
| Equipment: | JCB 3CX | Ground Level: | Not Recorded |
| | | Scale: | 1:50 |

| Description of Strata | Legend | Depth | OD Level | Sampling | | In Situ Testing | | Install -ation |
|---|---|---|---|---|---|---|---|---|
| | | | | | | Test | Result | |
| MADE GROUND: Topsoil | | 0.35 | | | | | | |
| Firm locally soft to firm at depth grey mottled dark orange brown sandy CLAY with some fine to coarse sub rounded to angular gravel, occasional cobbles and boulders and occasional rootlets (weathered glacial till). ... at 0.50m, landdrain. | | | | - | 1.10 | V | 65 | |
| | | | | | | V | 67 | |
| | | 1.30 | | B | 1.40 | V | 54 | |
| Soft to firm locally soft and becoming firm at depth dark grey sandy CLAY with some fine to coarse sub rounded to angular gravel and occasional decayed and saturated roots and rootlets (weathered glacial till). | | | | | | V | 32 | |
| | | | | | | V | 43 | |
| | | 2.00 | | | | V | 54 | |
| Stiff locally very stiff dark grey very closely fissured sandy CLAY with some fine to coarse sub rounded and sub angular gravel, some bands of silty fine and medium sand at top and greyish brown ironstaining in fissures (glacial till). | | 2.40 | | | | | | |
| Stiff dark grey sandy CLAY with some fine to coarse sub rounded to angular gravel and some cobbles and boulders (glacial till). | | 2.80 | | | | | | |
| End of Trial Pit at 2.80 m | | | | | | | | |

## NOTES

All Dimensions in Metres.
Groundwater levels are subject to seasonal, tidal and other fluctuations and should not be taken as constant

Groundwater: Dry
Stability: Stable
Shoring: None
General: Trial pit terminated at 2.80m in stiff clay. Trial pit backfilled with excavated spoil.

Logged by: SMcQ

Checked by: SMcQ

## KEY TO SYMBOLS AND ABBREVIATIONS

| | | | | | |
|---|---|---|---|---|---|
| D | Small Disturbed Sample | W | Water Sample | V | Hand Vane Test. Peak |
| B | Bulk Disturbed Sample | G | Gas Sample | VR | Hand Vane Test. Residual |
| LB | Large Bulk Disturbed Sample | NR | No Recovery | P | Pocket Penetrometer Test |
| U | Undisturbed U100 Sample | * | Estimated Relative Density | ICBR | In Situ CBR Test |
| BLK | Block Sample | | | IDEN | In Situ Density Test |
| CBR | CBR Mould Sample | | | MCV | In Situ MCV Test |

| Status | | Trial Pit No |
|---|---|---|
| Final | TRIAL PIT LOG | TP147 |
| 26/07/2001 | | Sheet 1 of 1 |

ritchies

# Robroyston, Glasgow

Client: Ambion Holdings

Job No: 9957

Consultant: David R. Murray & Associates

| | | | |
|---|---|---|---|
| Date Started | 12/06/2001 | Dimensions | ◁ 2.60 ▷ △ 0.60 ▽ Bearing 82° |
| Date Complete: | 12/06/2001 | Coordinates: | E |
| Hole Type: | TP | | N |
| Equipment: | JCB 3CX | Ground Level: | Not Recorded |
| | | Scale: | 1:50 |

| Description of Strata | Legend | Depth | OD Level | Sampling | | In Situ Testing | | Install -ation |
|---|---|---|---|---|---|---|---|---|
| | | | | | | Test | Result | |
| MADE GROUND: Topsoil | | 0.30 | | | | | | |
| Firm becoming soft to firm at depth grey mottled dark orange brown sandy CLAY with some fine to coarse sub rounded to angular gravel, occasional cobbles and some bands of light grey silty fine and medium sand at top (weathered glacial till). | | | | LB | 0.50-0.60 | | | |
| | | | | - | 0.60 | V | 69 | |
| | | | | | | V | 46 | |
| | | | | | | V | 59 | |
| | | 1.00 | | - | 1.00 | V | 63 | |
| Soft to firm becoming stiff at base dark brownish grey sandy CLAY with some fine to coarse sub rounded to angular gravel, some boulders of sandstone and occasional inclusions of brown silty fine and medium sand at depth (glacial till). | | | | | | V | 65 | |
| | | | | | | V | 48 | |
| ... at 1.90m, becoming firm. | | | | | | | | |
| | | 2.60 | | - | 2.60 | V | 188 | |
| End of Trial Pit at 2.60 m | | | | | | | | |

## NOTES

All Dimensions in Metres.
Groundwater levels are subject to seasonal, tidal and other fluctuations and should not be taken as constant

Groundwater: Dry
Stability: Stable
Shoring: None
General: Trial pit terminated at 2.60m in stiff clay. Trial pit backfilled with excavated spoil.

Logged by: SMcQ

Checked by: SMcQ

## KEY TO SYMBOLS AND ABBREVIATIONS

| | | | | | |
|---|---|---|---|---|---|
| D | Small Disturbed Sample | W | Water Sample | V | Hand Vane Test. Peak |
| B | Bulk Disturbed Sample | G | Gas Sample | VR | Hand Vane Test. Residual |
| LB | Large Bulk Disturbed Sample | NR | No Recovery | P | Pocket Penetrometer Test |
| U | Undisturbed U100 Sample | * | Estimated Relative Density | ICBR | In Situ CBR Test |
| BLK | Block Sample | | | IDEN | In Situ Density Test |
| CBR | CBR Mould Sample | | | MCV | In Situ MCV Test |

Status
Final
26/07/2001

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# TRIAL PIT LOG

Trial Pit No
TP148
Sheet 1 of 1

## Robroyston, Glasgow

Client: Ambion Holdings

Job No: 9957

Consultant: David R. Murray & Associates

| | | | |
|---|---|---|---|
| Date Started | 12/06/2001 | Dimensions | ◁ 2.50 ▷ △ 0.65 ▽ Bearing 85° |
| Date Complete: | 12/06/2001 | Coordinates: | E |
| Hole Type: | TP | | N |
| Equipment: | JCB 3CX | Ground Level: | Not Recorded |
| | | Scale: | 1:50 |

| Description of Strata | Legend | Depth | OD Level | Sampling | | In Situ Testing | | Install -ation |
|---|---|---|---|---|---|---|---|---|
| | | | | | | Test | Result | |
| MADE GROUND: Topsoil | | 0.30 | | | | | | |
| Firm to stiff grey sandy locally very sandy CLAY with some fine to coarse sub angular and angular gravel, occasional rootlets and some bands of light grey silty fine and medium sand generally at top (weathered glacial till). ... at 0.45m, landdrain. | | 0.65 | | | | | | |
| Brown mottled light grey silty fine SAND. | | 0.80 | | - | 0.95 | V | 30 | |
| Soft locally soft to firm at depth dark grey sandy CLAY with some fine to coarse sub rounded to angular gravel and occasional lenses of light brown silty fine sand (glacial till). | | | | | | V | 39 | |
| | | | | | | V | 48 | |
| Recovered as dark grey sandy fine to coarse flat angular gravel of moderately weak MUDSTONE , gravel locally very weak at top (presumed bedrock). | | 1.70 | | | | | | |
| End of Trial Pit at 2.65 m | | 2.65 | | | | | | |

## NOTES

All Dimensions in Metres.
Groundwater levels are subject to seasonal, tidal and other fluctuations and should not be taken as constant

Groundwater: Strata wet at 2.65m, trial pit dry on completion.
Stability: Stable
Shoring: None
General: Trial pit terminated at 2.65m on rock obstruction. Trial pit backfilled with excavated spoil.

Logged by: SMcQ

Checked by: SMcQ

## KEY TO SYMBOLS AND ABBREVIATIONS

| | | | | | |
|---|---|---|---|---|---|
| D | Small Disturbed Sample | W | Water Sample | V | Hand Vane Test. Peak |
| B | Bulk Disturbed Sample | G | Gas Sample | VR | Hand Vane Test. Residual |
| LB | Large Bulk Disturbed Sample | NR | No Recovery | P | Pocket Penetrometer Test |
| U | Undisturbed U100 Sample | * | Estimated Relative Density | ICBR | In Situ CBR Test |
| BLK | Block Sample | | | IDEN | In Situ Density Test |
| CBR | CBR Mould Sample | | | MCV | In Situ MCV Test |

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# TRIAL PIT LOG

Trial Pit No
TP149
Sheet 1 of 1

## Robroyston, Glasgow

Client: Ambion Holdings

Job No: 9957

Consultant: David R. Murray & Associates

| | | | | | |
|---|---|---|---|---|---|
| Date Started | 12/06/2001 | Dimensions | ◁ 2.40 ▷ △ 0.60 ▽ Bearing 168° | Coordinates: | E |
| Date Complete: | 12/06/2001 | | | | N |
| Hole Type: | TP | | | Ground Level: | Not Recorded |
| Equipment: | JCB 3CX | | | Scale: | 1:50 |

| Description of Strata | Legend | Depth | OD Level | Sampling | In Situ Testing: Test | In Situ Testing: Result | Install -ation |
|---|---|---|---|---|---|---|---|
| MADE GROUND: Topsoil | | 0.30 | | | | | |
| Very stiff dark grey sandy CLAY with some fine to coarse sub rounded to angular gravel, occasional rootlets and some bands of light brown silty fine and medium sand at top (weathered glacial till). | | 0.70 | | | | | |
| Recovered as greyish brown slightly silty sandy fine to coarse angular gravel of moderately strong faintly weathered medium grained SANDSTONE with some cobbles and boulders of sandstone at depth (presumed bedrock). | | 1.30 | | | | | |
| End of Trial Pit at 1.30 m | | | | | | | |

## NOTES

All Dimensions in Metres.
Groundwater levels are subject to seasonal, tidal and other fluctuations and should not be taken as constant

Groundwater: Dry
Stability: Stable
Shoring: None
General: Trial pit terminated at 1.30m on rock obstruction. Trial pit backfilled with excavated spoil.

Logged by: SMcQ

Checked by: SMcQ

## KEY TO SYMBOLS AND ABBREVIATIONS

| | | | | | |
|---|---|---|---|---|---|
| D | Small Disturbed Sample | W | Water Sample | V | Hand Vane Test. Peak |
| B | Bulk Disturbed Sample | G | Gas Sample | VR | Hand Vane Test. Residual |
| LB | Large Bulk Disturbed Sample | NR | No Recovery | P | Pocket Penetrometer Test |
| U | Undisturbed U100 Sample | * | Estimated Relative Density | ICBR | In Situ CBR Test |
| BLK | Block Sample | | | IDEN | In Situ Density Test |
| CBR | CBR Mould Sample | | | MCV | In Situ MCV Test |

Status
Final
26/07/2001

ritchies

# TRIAL PIT LOG

Trial Pit No
TP150
Sheet 1 of 1

## Robroyston, Glasgow

Client: Ambion Holdings

Job No: 9957

Consultant: David R. Murray & Associates

| | | | |
|---|---|---|---|
| Date Started | 12/06/2001 | Dimensions | ◁ 2.40 ▷ △ 0.60 ▽ Bearing 162° |
| Date Complete: | 12/06/2001 | Coordinates: | E<br>N |
| Hole Type: | TP | Ground Level: | Not Recorded |
| Equipment: | JCB 3CX | Scale: | 1:50 |

| Description of Strata | Legend | Depth | OD Level | Sampling | | In Situ Testing Test | In Situ Testing Result | Install -ation |
|---|---|---|---|---|---|---|---|---|
| MADE GROUND: Topsoil | | 0.25 | | | | | | |
| MADE GROUND: Stiff dark brown friable very sandy clay with occasional cinders and occasional rootlets. | | 0.45 | | | | | | |
| Soft light grey and brown mottled locally mottled orange brown sandy CLAY with some fine to coarse sub angular and angular gravel, occasional rootlets and locally some bands of silty fine and medium sand generally at top (weathered glacial till). | | 1.20 | | LB | 0.90 | V<br>V<br>V | 104<br>83<br>67 | |
| Firm to stiff locally soft at top dark grey mottled greyish brown at top sandy to very sandy CLAY with some fine to coarse sub angular and angular gravel and occasional cobbles and boulders (glacial till). | | 2.90 | | - | 1.70 | V<br>V<br>V | 40<br>24<br>34 | |
| Very stiff dark grey very sandy CLAY with some fine to coarse sub angular and angular gravel and some cobbles and boulders (glacial till).<br>... at 3.30m, boulder. | | 3.30 | | | | | | |
| End of Trial Pit at 3.30 m | | | | | | | | |

## NOTES

All Dimensions in Metres.
Groundwater levels are subject to seasonal, tidal and other fluctuations and should not be taken as constant

Groundwater: Dry
Stability: Stable
Shoring: None
General: Trial pit terminated at 3.30m on boulder obstruction. Trial pit backfilled with excavated spoil.

Logged by: SMcQ

Checked by: SMcQ

## KEY TO SYMBOLS AND ABBREVIATIONS

| | | | | | |
|---|---|---|---|---|---|
| D | Small Disturbed Sample | W | Water Sample | V | Hand Vane Test. Peak |
| B | Bulk Disturbed Sample | G | Gas Sample | VR | Hand Vane Test. Residual |
| LB | Large Bulk Disturbed Sample | NR | No Recovery | P | Pocket Penetrometer Test |
| U | Undisturbed U100 Sample | * | Estimated Relative Density | ICBR | In Situ CBR Test |
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