**APPENDIX C**

Site Investigations Report

JOHNSON POOLE & BLOOMER
LAND CONSULTANTS

# SITE INVESTIGATIONS

# at

# VICTORY PARK PAVILION

# CAINSCROSS

# STROUD

MC149-31/TNO

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# VICTORY PARK PAVILION
# CAINSCROSS
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## SITE INVESTIGATIONS REPORT

This report was carried out in accordance with JPB Quality Management procedures.

| | | |
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For the Attention of Ms J Marshall

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March 2013

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Drawings



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# 1 INTRODUCTION

1.1 Further to written instructions received from Ms Jeni Marshall, Deputy Clerk of Cainscross Parish Council, the Client dated 18 December 2012, we have undertaken a site investigation of the proposed recreational site referred to as Victory Park Pavilion, Cainscross, Stroud, as defined on our Drawing No. G/MC149/01.

1.2 The aim of the investigation was to provide information to identify geotechnical and geo-environmental constraints which may impact upon the design of the development.

1.3 In addition, this Report also incorporates the findings of a Phase 1 Desk Study based upon archival researches of internal and external published data.

1.4 The information consulted as part of the desk study searches is outlined in Section 2.0, whilst site investigation works were undertaken in the form of trial pits and in-situ soakaway tests on 21 February 2013.

1.5 A Factual Data Pack (Reference MC149-26) providing the findings of the trial pits, in-situ soakaway tests and laboratory test data was issued to the Client's Architect and Engineer on 14 March 2013, whilst a detailed interpretative Briefing Note (Reference MC149-29/TNO) was issued on 18 March 2013.

1.6 Whilst confident in the findings of our report we are unable to give assurance they will be accepted by other authorities without question. We therefore advise that where appropriate our report and associated matters are submitted to approving bodies and approval obtained or sought before detailed design, site works or other irrevocable action is embarked upon.

1.7 The conclusions reached in this report are necessarily restricted to those which can be determined from the information consulted and may be subject to amendment in the light of additional information becoming available.

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1.10 This report and related documents have been prepared for the sole use for the specified client in response to an agreed brief, for a stated purpose and at a particular time and its application must be made accordingly. No duty of care extends to any other party which may make use of the information contained therein.

1.11 It should be noted that soil and rock conditions are highly variable and may differ between sampling points and this may affect interpolation. Additional features may exist buried at depth and undetected by investigation. Other information may become available on the conditions of the site not available at the date of this report and thus site assessment may be subject to amendment in the light of such additional information becoming available.

1.12 This report is prepared and written in the context of the purpose stated above and should not be used in a differing context. Furthermore, new information, improved practices and legislation may necessitate an alteration to the report in the whole or in part after its submission. Therefore, with any change in circumstances or after the expiry of one year from the date of this report, this report should be referred to Johnson Poole and Bloomer Limited for re-assessment and, if necessary, re-appraisal.

## 2 SOURCES OF INFORMATION

2.1 In preparation of this report, the following documentary sources have been consulted and where appropriate examined:

- British Geological Survey Sheet Gloucester 234 Solid and Drift at 1:50,000 scale.
- British Geological Survey's (BGS) Website for geological data.
- Review of Mining Instability in Great Britain, Arup, 1990.
- BRE Report BR 211 (2007).
- Environment Agency's Groundwater Vulnerability Map Sheet No. 37 at 1:100,000 scale.
- Environment Agency's Website for Groundwater Aquifer Status/Landfill data.

2.2 Reference has also been made to Historical plans dated 1885, 1902/03, 1923/24, 1936/38, 1968 and 1988 available in the public domain on the Internet and in our internal archive.

2.3 No other liaisons with external organisations/regulatory bodies, etc., have been undertaken in preparing this report.

## 3 THE SITE AND SITE HISTORY

### 3.1 The Site

3.1.1 The development site is located approximately two kilometres to the south-west of the town centre of Stroud in the suburb of Cainscross, at Victory Park; the site being defined by the approximate National Grid Reference 38291, 20492, as shown on our Drawing No. G/MC149/01.

3.1.2 The area of investigation lies within the Park and "adjacent" to (north-east of) the current single-storey football/rugby changing rooms facility.

3.1.3 The site comprises an approximately triangular-shaped parcel of land bounded by wide tarmacadam public footpaths to the south-west and south-east and by the "dead ball" line of the adjacent rugby pitch to the north.

3.1.4 The site is level and laid to trimmed grass. A post and wire fence trends partway across the northern "third" of the site in a west-to-east direction; "dividing" the rugby pitch from the general site area.

3.1.5 Along the south-eastern site "margin", several mature trees are present, together with a park bench standing on a concrete base.

### 3.2 Site History

3.2.1 An investigation of the past usage of the site can often provide an indication of the presence of potentially contaminated soils arising from processes associated with former land uses. These researches can help to identify any potential constraints to developments upon which physical investigations can then concentrate.

3.2.2 The land use history of the subject site as determined from the Historical Plans dating back to 1885, is summarised as follows.

3.2.3 The earliest available record of land use examined dated 1885, records the site as forming part of an open field parcel with a footpath trending in a north-east to south-west direction just to the south (and forming the current south-eastern site boundary). To the west of the site a second footpath trended in a north-to-south direction beyond which is a possible small watercourse.

3.2.4 To the east of the field, development had occurred in the form of St. Matthew's Church with graveyard and a school.

3.2.5 At some time between 1903 and 1924 the former field panel was created into "Victory Park". The area of investigation remained unchanged. However, to the south-east of the adjacent footpath, the land had been divided into a rectangular-shaped sub-land parcel. At this time a small "Gravel Pit" was recorded approximately 75 metres to the west of the site.

3.2.6 By 1936/38 the aforementioned sub-land parcel was referenced as a "Bowling Green", whilst the footpath adjacent to the site was recorded as being lined by trees; the site area still remaining unchanged. The small gravel pit remained to the west.

3.2.7 Between 1936/38 and 1968, a small rectangular-shaped building ("Pavilion") had been constructed just to the south-west of the site area, whilst the bowling green to the south-east had been further expanded.

3.2.8 At some time between 1974 and 1988 extension of the Pavilion had occurred just to the south of the site with the construction of the south-eastern "half" of the structure and the footpath now extending to form the south-western boundary of the investigation area, whilst by 1990, the post and wire fence trending through the northern "third" of the site was evident. The gravel pit is no longer evident to the west.

3.2.9 Since 1990 the area of investigation has remained broadly similar to the present day situation.

## 4 ENVIRONMENTAL SETTING

### 4.1 General Geology

4.1.1 The published geology plan (Sheet 234 at 1: 50,000 scale) records the site to be underlain by natural superficial soils comprising Third (Main) Terrace Gravel deposits, associated with the River Frome.

4.1.2 At depth, the site is underlain by solid strata possibly either associated with the Dryham Silts of the Middle Lias, of Jurassic age or Lower Lias Clay or similar geological age; the site lying close to the conjectured solid strata boundary between the two units.

4.1.3 On the basis of the land use history, significant accumulations of Made Ground would not be anticipated, although local disturbance of the upper natural soils associated with existing service runs and from adjacent constructional activity/ construction of the rugby pitch, may be expected.

### 4.2 Mining and Quarrying

4.2.1 On the basis of "The Review of Mining Instability in Great Britain", the site lies within an area with no evidence of underground mining for coal and associated minerals, and concludes that "mining need not be regarded as a planning consideration".

4.2.2 In view of the geological structure beneath the site area, underground mining is not considered to be a criteria for foundation design and selection.

4.2.3 Examination of historical land use plans has recorded no evidence of "quarrying" activity beneath, or in the immediate vicinity of, the site.

4.2.4 However, evidence of a small former (now infilled) gravel pit is recorded approximately 75 metres to the west of the site (paragraph 3.2.5).

4.3 Hydrogeology

4.3.1 The former but now superseded Environment Agency's Groundwater Vulnerability Map Sheet No. 37 classifies the solid strata underlying the site as a Minor Aquifer (Variably Permeable), with soils of High Leaching Potential.

4.3.2 Information obtained from the Environment Agency's website in relation to Aquifer Designation data (post 1 April 2010) indicates that the Bedrock strata very close to the site is divided between a Secondary Undifferentiated Aquifer Designation to the south and a Principal Aquifer Designation to the north.

4.3.3 The same database indicates that the Superficial Deposits beneath the site are recorded as a Secondary "A" Aquifer Designation.

4.3.4 The Environment Agency's website records no Source Protection Zones within one kilometre of the site centred grid reference.

4.4 Hydrology

4.4.1 The nearest main recorded surface water feature to the site is the now disused Gloucester Canal approximately 290 metres to the south and just beyond it to the south, the River Frome.

4.4.2 There is no evidence of any surface water features on or immediately adjacent to the site.

4.4.3 The site does not lie within an area of Extreme Flooding or Flooding from Rivers or Sea Without Defences, as designated by the Environment Agency.

4.5 Landfill Sites

4.5.1 The Environment Agency's website records no Historical or Authorised Landfills within 250 metres of the site.

4.5.2 However, our researches indicate that the closest recorded landfill to the site is a former Local Authority Landfill located approximately 300 metres to the south-east at the junction with Westward Road and Frome Gardens. Little further information about this particular landfill is known.

4.5.3 The historical plans record an old infilled gravel pit located approximately 75 metres to the west of the site (paragraph 3.2.5).

4.6 Naturally Occurring Radon

4.6.1 In the 2007 Edition of BRE Report 211, the site lies within an area with dark grey shading which indicates a requirement to install a Full level of Radon Protection (Annex A), unless a BRE211 Radon Report is obtained which will give definitive guidance on the level of protection required for the site.

4.7 Conceptual Site Model

4.7.1 The first step in preparing a risk assessment for the site is to utilise the research information in order to develop a Conceptual Site Model (CSM). The CSM describes how potential contamination sources at the site could contribute to increased levels of risk to potentially sensitive receptors. The CSM identifies the sources of contamination, the likely receptors and the potential pathways present between them. If there appears to be a pathway that links a source to a receptor, then this is considered a potential significant pollutant linkage that will require to be assessed.

4.7.2 The CSM is developed at an early stage and constantly re-assessed in light of investigative findings. The first step in producing such a model is to identify whether there are potential hazards on-site through the desktop research outlined above, together with professional expertise and judgement. The above site-specific environmental data is gathered to assess the environmental resources which could be impacted by potential contamination at the site. Within this context, a hazard is defined as a property that has the potential to cause harm to a receptor group.

4.7.3 On the basis of the desk study researches, the following initial ground model would be anticipated:-

- Little or only a thin mantle of Made Ground likely.
- Natural superficial River Terrace Gravel deposits underlying the site.
- Bedrock strata comprising either Dryham Silts or Lias Clay, or Jurassic age at depth.
- A land use history comprising of part of an open field prior to forming part of "Victory Park" in the early 1900's.

- A Secondary A Superficial Aquifer Designation reflecting the Terrace Gravel deposits.
- Site lies close to boundary between solid strata classified as a Principal Aquifer to the north and a Secondary Undifferentiated Aquifer to the south.
- No Source Protection Zones within 500 metres of the site.
- No major surface water features in close proximity to the site.
- No potentially contaminative off-site uses which could impact on site redevelopment (see old gravel pit below).
- No recorded landfill sites within 250 metres of the site. An old (now infilled) gravel pit lies approximately 75 metres to the west of the site.
- Solid strata requiring Full protection against naturally-occurring Radon.

4.7.4 On the basis of the above ground model, the initial Conceptual Site Model (CSM) enclosed as Appendix A has been prepared using the Source-Pathway-Receptor principle; the risk of a full potential linkage being recorded as Low, Medium or High (L, M or H).

4.7.5 Any alterations to the initial CSM required by the investigation works detailed in Sections 5.0 and 6.0 is contained in Section 9.0 of this report.

# 5 SITE INVESTIGATION WORKS

## 5.1 Objectives of the Site Investigation and Methodology

5.1.1 The initial conceptual site model (CSM) was used to inform the design of the site investigation. Where chemical analyses data has been obtained for soils, JPBL's Risk Assessment methodology comprises a quantitative risk assessment of contaminant concentrations performed using appropriate risk assessment models and tools such as CLEA Version 1.06 and RISC4.0.

5.1.2 Where chemical analyses data has been obtained for leachate, JPBL's Risk Assessment methodology comprises an initial Tier 1 approach which compares potential contaminant concentrations with generic assessment criteria such as the Environmental Quality Standards (EQS), 2004 and the Water Supply (Water Quality) Regulations, 2001 and 1989, where relevant.

5.1.3 In order to test and develop the initial CSM, the site investigations had the following objectives:-

- To identify the extent of any Made Ground at the site (potential contaminant source).
- To determine the geotechnical properties of the soils.
- To determine appropriate foundation design solutions for the development.
- To determine buried concrete design.
- To determine permeability/infiltration characteristics of the soils.
- To identify the nature, extent and concentration of contaminants in shallow soil.
- To determine what threat the site poses to on-site human receptors (workers and occupants).
- To determine what threat the site contaminants pose to off-site human receptors (occupants of adjacent properties).

5.1.4 In order to achieve these objectives, the investigation was designed to include trial pitting and in-situ soakaway tests, and specialist laboratory testing of recovered soil samples for geotechnical and chemical characterisation.

5.1.5 These investigations are described in more detail in Section 5.2 of this report.

5.2 Scope of Site Investigation Works

5.2.1 The site investigation works were conducted in general accordance with BS 5930 : 1999 Amendment 2; 2010 "Code of Practice for Site Investigations" and BS 10175 : 2001 "Investigation of Potentially Contaminated Sites - Code of Practice" on 21 February 2013.

5.2.2 All exploratory holes have been logged in accordance with BS5930:1999 A2, taking into account BSEN14688-1, BSEN14688-2, BSEN14689 and BSEN1997-2:2007. The descriptive terminologies such as firm, etc., formerly used within older versions of BS5930 to describe strength now solely relate to consistency. Shear strength is now described below and relates to results obtained in the field (using a vane for example) or in the laboratory (from triaxial tests).

| **Term based on measurement** | **Undrained Strength Classification definition $c_u$ in kN/m$^2$ (from BSEN ISO 14688-2:2004, 5.3, Table 5)** |
|---|---|
| Extremely Low | >10 |
| Very Low | 10 - 20 |
| Low | 20 - 40 |
| Medium | 40 - 75 |
| High | 75 - 150 |
| Very High | 150 - 300 |
| Extremely High | 300 - 600 |

5.2.3 The site investigation comprised the following scope of works:-

(i) Four machine excavated trial pits (referenced Trial Pits 1 to 4) extending to maximum depths ranging between 1.10 and 3.05 metres below ground level to assess the load bearing characteristics and ground chemistry of the near surface soil succession (Appendix B).

(ii) Three large-scale in-situ Soakaway Tests conducted in accordance with BRE Digest 365 : 1991 in Trial Pits 1, 2 and 4; the results being included in Appendix C.

5.2.4 Representative disturbed soil samples were taken from the trial pits for assessment and a selected number submitted for physical and chemical laboratory testing (Appendices D and E, respectively).

5.2.5 The supervision and logging of the site investigation works were carried out in the presence of a Geologist, who examined the ground conditions revealed in-situ and prepared the logs attached in Appendix B.

5.2.6 The approximate locations of the site investigation works are indicated on our Drawing No. G/MC149/03.

5.2.7 It should be noted that no site investigation works were conducted over the northern "third" of the site area (north of the post and wire fence) as this area encroached onto the adjacent rugby pitch (playing area).

# 6 LABORATORY TESTING

## 6.1 Introduction

6.1.1 A programme of Physical Laboratory Testing and Chemical Analyses was undertaken on representative soil samples recovered from the site as follows.

## 6.2 Physical Testing

6.2.1 The following laboratory testing was carried out in accordance with methods laid out in the appropriate section of BS 1377:1990 "Methods of Test for Soils for Civil Engineering Purposes".

Classification Tests

- 2 No. Moisture Content.
- 2 No. Liquid and Plastic (Atterberg) Limits - 2 No. proving Non Plastic.
- 1 No. Particle Size Distribution - wet sieve.

6.2.2 The results of these tests are included in Appendix D.

## 6.3 Detailed Chemical Analyses

Soils

6.3.1 Soil samples obtained from the trial pits were submitted for chemical analyses. The soil samples were selected based on any specific observations and strata encountered to provide as representative a picture as is possible using the current investigation methodology. Samples were analysed for a range of parameters to provide an indication of the overall nature, extent and severity of contamination present on-site on the basis of the Initial Conceptual Site Model (paragraph 4.7).

6.3.2 Detailed chemical analyses was conducted on 3 No. representative soil samples (1 No. Topsoil, 1 No. Clay and 1 No. Gravel) for the following chemical parameters:- total Sulphate, water soluble Sulphate, pH, Sulphide, total Sulphur, monohydric Phenols, total Cyanide, Poly Aromatic Hydrocarbons (PAH USEPA 16), Arsenic, Mercury, Selenium, Lead, (Total and Hexavalent) Chromium, Cadmium, Copper, Nickel, Zinc and Soil Organic Matter.

6.3.3 In order to facilitate the design of buried concrete, two additional (natural) soil samples were analysed for pH and water soluble Sulphate.

6.3.4 In addition to the above, the following analytical tests were conducted on selected soil samples:

- 1 No. Extractable Petroleum Hydrocarbons (EPH) Screen C10 to C40 (with clean-up).

6.3.5 The results of these analyses and the analytical methods adopted are included as Appendix E.

## 7 GROUND CONDITIONS

### 7.1 Soil Succession

7.1.1 Detailed logs of the site investigation works are included in Appendix B, whilst the general ground conditions can be briefly summarised as follows.

7.1.2 No evidence of Made Ground was recorded in any of the four trial pits excavated at the site.

7.1.3 Trial Pits 1, 2 and 4 recorded an upper soft, dark brown, slightly gravelly silty clay (topsoil) extending to a depth of 0.10 metres, whilst in Trial Pit 3, a "disturbed" clayey topsoil containing a rare fragment of metal was recorded to a similar depth below ground level.

7.1.4 The topsoil graded into a soft to firm, locally firm, mid brown, slightly gravelly silty clay, which extended to depths of between 0.40 and 0.65 metres below ground level.

7.1.5 Underlying the "clay", relatively uniform strata in the form of a moderately compact, light buff brown, slightly silty, variably sandy gravel was recorded, with rare to occasional cobbles, which was proven to a maximum depth of 3.05 metres below ground level in Trial Pit 3.

7.1.6 The gravel horizons displayed a distinct bedding in the three deeper pits, reflecting the "terraced" depositional environment associated with their formation.

### 7.2 Engineering Characteristics of the Superficial Soils

General

7.2.1 The results of the laboratory geotechnical testing of the soil samples recovered during the recent investigation are included in Appendix D. The soil parameters from the laboratory testing are summarised below.

7.2.2 The soil strata recovered from the site has recorded the following engineering characteristics, as outlined in the table below.

Natural Superficial Deposits - Granular Soils

| Laboratory Tests | Range of Results |
|---|---|
| Natural Moisture Content (%) | 8 and 11 |
| Plastic Limit (%) | N/A |
| Liquid Limit (%) | N/A |
| Plasticity Index (%) | Non Plastic |
| Soil type based on plasticity chart | N/A |
| Passing 0.425mm sieve (%) | 50 |
| Percentage Passing (%) | |
| Cobbles | 0 |
| Gravel | 84 |
| Sand | 8 |
| Clay and Silt | 8 |
| Soil descriptions from PSD | silty sandy GRAVEL |

7.3 Groundwater Conditions

7.3.1 Groundwater was not encountered in any of the machine excavated trial pits on-site.

7.3.2 It should be noted that the groundwater regime beneath the site may be subject to seasonal and other variations and as such, different groundwater conditions may be encountered whilst undertaking any future investigations or development works at the site.

## 8 GROUND CHEMISTRY

### 8.1 Risk Assessment Approach

8.1.1 The UK framework for chemical risk assessment recently underwent significant change, with the Environment Agency withdrawing, in August 2008, the existing CLEA (Contaminated Land Exposure Assessment) framework. The current CLEA model, CLEA Version 1.06, was released in October 2009, however, all of the withdrawn publications and supporting information have yet to be re-released.

8.1.2 On this basis, JPBL's risk assessment approach is subject to alteration to coincide with changes brought about through the release of documentation under the EA's programme of change. To this end, in the absence of certain data sets, guidance and supporting information, there is currently no single approach to assessing the risk to human health from soil contamination.

Human Health

8.1.3 The assessment of risk to human health can consider the potential for exposure based on comparison of the results from site specific ground investigation to conservative generic criteria.

8.1.4 Soil guideline values (SGVs) have recently been published by the EA for a limited number of determinands for a single soil type. SGVs are scientific; risk based generic assessment criteria for generic land use scenarios that can be used in the preliminary assessments of the risk to human health provided that the scenario is sufficiently representative of, or suitably conservative for, the conceptual site model. SGVs are currently published for eleven determinands; arsenic, cadmium, nickel, mercury, selenium, phenol, benzene, toluene, ethylbenzene, xylenes and dioxins, furans and dioxin-like PCBs.

8.1.5 The published SGVs are based on a sandy loam soil with 6% SOM (Environment Agency, 2009a). If the soil at the site in question departs from the generic assumptions inherent in the SGV, three options are presented by the EA to the risk assessor:-

- If the soil type is likely to be less protective of receptors, the risk assessor should derive a new GAC (SAC) by adjusting the SGV for soil type and SOM. For example, a sandier, SOM-deficient soil is likely to provide less protection against exposure to volatile sources than that used in the derivation of the SGV.
- If the soil type is likely to be more protective (for example a soil with a higher clay content and greater SOM for the same volatile source), or is sufficiently similar to the SGV assumption, the SGV can be used.
- If the soil type is likely to be more protective, a new GAC (SAC) could be derived (particularly where the representative soil concentration of a chemical on a site exceed an SGV) by adjusting the SGV, thereby providing a less overly conservative screening tool.

8.1.6 Where the SGV is considered inappropriate to represent the site conditions, or where an SGV is not yet published for a determinand, soil assessment criteria (SAC) are derived for the site using CLEA Version 1.06 (released on 5 October 2009).

8.1.7 In view of the limited applicability of the published SGVs (in terms of relevant soils types) as part of this assessment, the published SGVs have not generally been adopted and SACs have been derived for the majority of common inorganic and organic analytical determinands using toxicological data from various sources, including the revised TOX Reports (arsenic, cadmium, nickel, mercury, selenium, phenol, benzene, toluene, ethylbenzene, xylenes and dioxins, furans and dioxin-like PCBs), the previously published TOX Reports (TOX 1 to 25) and the data obtained from the LQM/CIEH publication 2nd edition (2009) and the EIC/CL:AIRE publication January 2010.

8.1.8 The TOX reports are currently being replaced on a rolling programme by the EA, as and when each new SGV report is published. The EA has stated "that much of the existing information in the TOX reports will not be affected by changes and will continue to be a useful interim resource until we make our new reports available" (EA website).

8.1.9 It should be noted that in assessing cadmium and its inorganic compounds in residential and allotment land uses, lifetime exposure should be considered. Although young children are generally more likely to have higher exposures to soil contaminants, the renal toxicity of cadmium are based on considerations of the kidney burden accumulated over 50 years or so (Environment Agency, 2009e). It is therefore reasonable to consider exposure not only in childhood but averaged over a longer time period. There is a facility within CLEA Version 1.06 to allow cadmium SACs to be generated based on lifetime exposure.

8.1.10 In the absence of a published SGV for lead, or the availability of toxicological data/ standard input parameters which have been mutually agreed or accepted across the wider professional community (which would allow risk assessment using the CLEA Version 1.06 model), JPBL's current approach is to assess the risks from the recorded soil lead concentrations using the RISC4.0 model, referred to in more detail below. It is understood that Society of Brownfield Risk Assessment (SoBRA) is in the process of developing standard input parameters for use in the human health risk assessment of lead. However, these are yet to be made available.

8.1.11 Using the RISC4.0 model, risk estimates are compared with acceptability criteria at the risk evaluation stage in order to determine their significance for the dermal and ingestion pathways. It is considered that a Human Hazard Index (Quotient) in excess of 1.0, or an increased lifetime cancer risk in excess of one in one hundred thousand ($10^{-5}$) are considered to be significant. Risk estimates for contaminants exceeding these criteria are considered to indicate that the contaminant poses a human health risk and that remedial action may be required to prevent actual harm.

8.1.12 The RISC4.0 modelling is compliant with the Risk Based Corrective Action (RBCA) philosophy and has been the subject of a comparative bench marking study carried out by the EA. Where the model allows, the input parameters have been adjusted to reflect the currently adopted UK approach.

8.1.13 RISC4.0 is currently used to asses lead (as indicated above) and the chronic toxicity of cyanide.

8.1.14 The acute toxicity of cyanide has been assessed using comparison to the worst case known fatal dose.

8.1.15 A summary table of the Human Health Risk Assessment undertaken is included in Appendix F, whilst the soil modelling parameters calculated using both CLEA Version 1.06 and RISC4.0 are included in Appendix G.

8.2 Ground Chemistry - Site Investigations

8.2.1 Whilst conducting the site investigation works, no obvious visual or olfactory evidence of contamination was identified in the soils on-site.

8.3 Summary of Soil Chemical Analyses - Human Health

8.3.1 The guideline concentration considered most appropriate to the proposed end use of the site has been used in the interpretation of the results.

8.3.2 In deriving the Soil Assessment Criteria (SAC), this site has been assessed for a conservative "Residential without home grown produce" end use in view of the recreational/parkland setting, and it has been considered as one averaging area. The exposure pathways considered within this assessment include:-

- Direct ingestion of soil and dust;
- Dermal contact with soil and dust (indoor and outdoor);
- Inhalation of indoor and outdoor dust;
- Inhalation of indoor and outdoor vapours.

8.3.3 The assessment has been primarily based upon an end user considered to be the most conservative for the above end use; a female child of age classes AC1 to AC6. In the case of Cadmium the assessment has been based on a female child of age classes AC1 to AC18.

8.3.4 The soil properties have been selected as a sandy clay loam based on a balance between "clay" and "gravel" soils in-situ with the pH and Soil Organic Matter (SOM) adjusted to reflect the average site conditions at pH 8.2 and a SOM of 3.9%.

8.3.5 Comparison of the reported concentrations with the calculated SACs using CLEA Version 1.06 indicates no individual exceedances.

8.3.6 RISC4.0 modelling of the dermal and ingestion pathways based on a child and adult resident end use has calculated the Human Hazard Index (Quotient) and lifetime cancer risk for Lead and Cyanide to be below 1.0 or less than one in one hundred thousand. On this basis, the reported concentrations for Lead and Cyanide are not considered to pose an increased risk to human health.

8.3.7 With respect to Extractable Petroleum Hydrocarbons, 1 No. sample of the Topsoil recorded a low EPH C10 to C40 screen level of 19 mg/kg.

## 9 DISCUSSION AND RECOMMENDATIONS

9.1.1 It is understood that the site is under consideration for the construction of a new single-storey Rugby and Football Changing Room Pavilion; the footprint of the new building being located just to the north-east of the existing pavilion building.

9.1.2 In addition to the above, two proposed lighting towers are to be located flanking the northern building footprint adjacent to the rugby pitch; all as outlined on the "Site Plan" Drawing No. 3137/P/10 Rev A prepared by Quattro Design Architects (Appendix H).

9.1.3 Whilst no details of the form of construction or foundation loadings have been provided, it is anticipated that line loadings would be typical of traditional single-storey residential structures with maximum line loadings of the order of 50 kN/m run.

9.1.4 Archival researches conclude that the site can be regarded as stable in respect to any past underground mining activity and thus the proposed development need only consider the various geotechnical (engineering) and geo-environmental (ground chemistry and ground gas) issues relating to the site.

### 9.2 Foundation Design

9.2.1 Atterberg Limits tests undertaken on the natural granular soils at anticipated founding depths have recorded Non Plastic characteristics and non-shrinkable soils, which are considered to reflect the composition of the sandy gravels recorded.

9.2.2 Thus, in our opinion, minimum foundation depths of 0.60 metres below existing or finished ground level would be required in respect to soil shrinkability alone.

9.2.3 In our opinion, the natural moderately compact, slightly silty sandy gravel strata encountered at typical founding depths of 0.60 to 0.85 metres below existing ground level (when also allowing for a nominal depth of embedment of 200mm into such soils) would provide adequate load bearing characteristics for the design of conventional spread (trench fill or strip) foundations for the single-storey structure proposed, and designed to a nett allowable bearing pressure of up to 125 kN/m$^2$.

9.2.4 The relative close proximity of the mature trees to the proposed development located close to the south-eastern "site boundary" are not considered to be influenced by soil shrinkability due to the presence of non-plastic/non-shrinkable "gravel" soils encountered at shallow depths beneath the site.

9.2.5 In our opinion, the gravel soils recorded below the soft to firm and firm clay horizon would support the use of a direct bearing ground floor slab following proof rolling of the formation and casting the slab off a "mattress" of fully compacted granular engineering stone, commensurate with proposed loadings, although this would necessitate excavating out the clay horizon above.

9.2.6 As an alternative, consideration could be given to suspending the ground floor slab (particularly in view of the Radon gas site classification recorded) (paragraph 9.7.1).

9.2.7 On the assumption that the ground conditions in the area of the two proposed lighting towers are similar to those recorded elsewhere beneath the site to the south, then in our opinion, the moderately compact "gravel" soils would in principal also provide a suitable founding horizon for the structures, and designed to exert a similar maximum allowable bearing pressure to that previously quoted above (paragraph 9.2.3).

9.2.8 However, it should be ensured that sufficient depth of embedment into the gravels occurs to accommodate the base, in order to avoid potential overturning moments due to wind loadings.

9.3 Excavations

9.3.1 The results of the trial pitting infer that excavations to depths of upto 3.00 metres below existing ground level should be feasible with a back-acting wheeled or tracked excavator, although progressively harder "digging" conditions will occur with depth.

9.3.2 Thus, in our opinion, it is considered that the formation of excavations for shallow foundations and services would generally be achievable at the site using conventional mechanical techniques.

9.3.3 In the short term, during their excavation, the sides of trial pits remained generally vertical and stable.

9.3.4 However, when also taking account of the granular nature of anything other than the upper clay horizons, in our opinion, it would be advisable to make an allowance for supporting excavations at the site in the underlying "gravels" in both the intermediate and long term scenario.

9.3.5 No evidence of groundwater ingresses were apparent in the trial pits. Therefore, it is considered that groundwater is unlikely to impact upon foundation and services excavations.

9.4 Buried Concrete Design

9.4.1 Representative soil samples have been submitted for pH and sulphate analyses.

9.4.2 The results indicate slightly alkaline to alkaline pH values in the soils ranging between 8.0 and 8.4 across the site.

9.4.3 Low total and water soluble sulphate concentrations were recorded, with maximum concentrations of 0.14% and 0.027 g/litre, respectively.

9.4.4 Low total sulphur levels were recorded in the soils (maximum of 0.07%) indicating that Total Potential Sulphate is not considered a design criteria for buried concrete.

9.4.5 Thus, in accordance with BRE SD-1, 2005, buried concrete could be designed to Design Sulphate Class DS-1 and the site allocated an ACEC classification of AC-1 due to the site being classified as brownfield with "worst case" mobile groundwater conditions, and in the absence of long term groundwater monitoring.

9.5 Soakaway Tests

9.5.1 In conjunction with this site investigation, large-scale soakaway tests were undertaken in Trial Pits 1, 2 and 4 in general accordance with BRE Digest 365 : 1991 (Appendix C).

9.5.2 All soakaway tests were conducted in the natural gravel soils with pits excavated to depths of between 1.10 metres in Trial Pit 4 and 2.90 metres below ground level in both Trial Pits 1 and 2.

9.5.3 Full drainage was achieved in both Trial Pits 1 and 2 (Three Cycles) and in Trial Pit 4 (Two Cycles); the latter shallow pit reflecting the limited time constraints for conducting the test.

9.5.4 The in-situ soakaway tests have recorded calculated Infiltration Rates ranging between $1.54 \times 10^{-04}$ and $4.13 \times 10^{-04}$ m/s, when taking account of the drained area of the pits with the lower Infiltration Rates being recorded in the shallower trial pit (reflecting the shallower drainage area created in the gravel soils).

9.5.5 In our opinion, the soils display "good" infiltration characteristics and thus, on the basis of the soakaway test results recorded, it is considered that soakaway drainage in the natural "gravel" strata is, in principle, likely to be effective for use on-site.

9.6 Ground Chemistry

9.6.1 The site investigation works have generally confirmed the validity of the initial Conceptual Site Model (Appendix A).

9.6.2 The land use history of the site as a former field parcel then integrated into a long established parkland setting (Victory Park) is such that problematic environmental issues would not be expected.

9.6.3 No visual or olfactory evidence of hydrocarbon contamination of the sub-soils was apparent during the site investigation works, and the associated analyses have identified a ground chemistry falling within the Soil Assessment Criteria (SACs) calculated using CLEA Version 1.06 for a conservative "residential without home grown produce" end use environment when taking account of the recreational/ parkland setting.

9.6.4 On the basis of current proposals (paragraph 9.1.1), a large area of the future proposed site will be covered by the building and hard external surfacings (paths, etc.) and in these areas, no potential exists for direct contact between long term site users and the sub-soils present on-site.

9.6.5 Thus, in our opinion, no mitigation measures are considered necessary in terms of the risk posed to human health in these areas.

9.6.6 Similarly, when also taking account of the proven, "non-problematic" ground chemistry displayed in the natural soils, in our opinion, no mitigation measures would be considered necessary in terms of the risk posed to human health in surrounding landscaped/pitch areas. However, a suitable soil forming material would need to be installed on purely aesthetic grounds in order to encourage plant/vegetation growth in such areas.

9.6.7 It is recommended that the above approach be discussed and agreed with the local Environmental Health Officer, prior to implementing on-site.

9.6.8 With regard to the potential risk posed to construction and maintenance workers from the soils, in our opinion, the anticipated ground chemistry proven would only warrant a "normal" good standard of PPE for any personnel which may come into direct contact with the soils, which would include the wearing of gloves and overalls.

9.6.9 In relation to protection of buried constructional materials, the design of buried concrete is outlined in Paragraph 9.4 of the Report.

9.6.10 With respect to "plastic" ducting, the absence of any significant PAH (USEPA 16) concentrations and low EPH screen levels implies that no upgrading of "ducting" would generally be required for any materials in contact with the soils on-site.

9.6.11 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 evaluates and addresses the appropriate selection of water supply pipes laid in Brownfield sites, both in terms of maintaining their long term protection to water quality (e.g. from permeation of hydrocarbons and solvents, etc.) and also their overall structural integrity (e.g. from corrosive substances, etc.).

9.6.12 In order to fully assess the overall suitability of the particular type of water supply pipes required for use on-site, in compliance with the UKWIR document there is a requirement to undertake a specific extensive suite of chemical analyses on the soils likely to lie in contact with the pipes (unless a Barrier PE Pipe is selected).

9.6.13 Analyses of soils to this specific UKWIR suite of analyses lies outside the current scope of works undertaken and thus, a full assessment of the overall suitability of the particular water supply pipe (in strict compliance with the UKWIR document) for use at the site cannot be made.

9.6.14 However, no visual or olfactory evidence of hydrocarbons was identified during the site investigation works, and the chemical analyses has recorded low total PAH and EPH levels in the shallow soils.

9.6.15 Thus, in our opinion, no special precautions are considered necessary with respect to the protection of the water supply pipe work to the proposed building.

9.6.16 However, it would be prudent to liaise with the local Water Company to ensure that they have no special requirements with respect to the protection of the potable water supply pipework to the proposed building.

9.6.17 In terms of the possible off-site disposal of excess constructional arisings, these materials would essentially comprise natural topsoils, clays and gravels.

9.6.18 Significant uncertainty with respect to the classification of "waste" and the disposal costs at appropriately licensed landfill sites currently exist, but on the basis of the prevailing chemistry the natural soils are unlikely to be problematic, although it may be necessary to carry out WAC testing to confirm that it can be classified as "inert" (subject to the views of the Landfill Operator).

9.6.19 However, if it can be agreed (with the Environment Agency) that site horizons are from an "uncontaminated" site, which is considered to be the case, then it may be possible to classify natural soil arisings as "inert" without carrying out WAC testing.

9.6.20 It should be noted that the Soil Organic Matter level recorded in the topsoil from Trial Pit 1 (at 0.10 metres) at 8% exceeds the WAC Limit Value for "Hazardous Waste", of 6%. Therefore, the disposal of such material at landfill may be potentially "problematic" unless it is to be used for "restoration" purposes; such materials likely to require "recycling", if necessary.

9.6.21 Thus, prior to finalising development costs, it is recommended that liaisons be held with the Environment Agency/individual Landfill Operators regarding the classification of excess constructional arisings and their cost of disposal.

9.6.22 In terms of the wider environment, the site is underlain by superficial Terrace Gravels which are designated a Secondary "A" Aquifer. However, no Source Protection Zones or Surface Water features lie in close proximity to the site.

9.6.23 Furthermore, the investigation has recorded no evidence of any Made Ground at the site and no groundwater proven upto 3.00 metres below ground level.

9.6.24 Thus, on the basis of the findings of the investigation works, it is considered that the site and the current development proposals for them, generally present a low risk to the wider environment, in the context of controlled waters, provided that good "house keeping" control is maintained during future site redevelopment.

9.7 Ground Gas

9.7.1 BRE Report 211 (2007) indicates that Full Radon gas precautions are considered necessary in the sub-structure design of any new residential buildings or extensions at the site. However, a "site specific" BGS Radon Report would be required for a more definitive Radon assessment.

9.7.2 It is recommended that the Radon status be confirmed with the Local Environmental Health Officer particularly in view of the non-residential end use of the structure, with a view to possibly reducing the overall Radon classification required for the changing room facility.

9.7.3 The Environment Agency's Website does not record any documented Landfill Sites encroaching within 250 metres of the site.

9.7.4 In terms of the indigenous soils prevailing, when taking account of the absence of Made Ground and the composition of the natural strata proven, we are of the opinion that no mitigating precautionary measures relating to "ground gas" would need to be incorporated into the foundation design of the structure at the site.

9.7.5 However, the relative close proximity of a former infilled gravel pit to the west is such that it is recommended that this aspect be discussed with the Local Environmental Health Officer to ensure that no more demanding requirements in respect to landfill gas are required, prior to undertaking any irrevocable design or construction works at the site.

## 10 SUMMARY

10.1 Archival researches indicate that the site has remained as parkland since the early 1900's and prior to this, open farmland; the adjacent changing room "pavilion" having been constructed in two phases at some time between 1938 and 1968, and extended in the early 1970's.

10.2 The site can be considered to be stable with respect to past mining activity.

10.3 Investigation works have identified a natural topsoil and a thin upper clay horizon which overlies a competent and uniform sequence of gravel soils at shallow depths beneath the site.

10.4 The near surface natural "gravels" are considered compatible with the use of shallow strip or trench fill foundations and in principle, the use of a direct bearing ground floor slab.

10.5 As an alternative, consideration could be given to the use of a suspended ground floor slab, particularly in view of the recorded Radon Gas classification (paragraph 10.11).

10.6 Buried concrete could be designed to the requirements of Design Sulphate Class DS-1 and the site allocated an ACEC classification of AC-1, after BRE SD1, 2005.

10.7 Large-scale soakaway tests conducted in trial pits have recorded "good" drainage conditions in the natural gravel soils, which are considered conducive to the adoption of soakaway drainage at the site.

10.8 The ground chemistry falls within a conservative Soil Assessment Criteria (SACs) calculated for a "residential without home grown produce" end use, when taking account of the proposed recreational end use/parkland setting.

10.9 In our opinion, no mitigation measures will be required to be adopted at the site in adjacent landscaped areas in respect to ground chemistry.

10.10 If excess constructional arisings are to be disposed off-site, the classification of "waste" and cost of off-site disposal should be clarified with the Environment Agency/Landfill Operators.

10.11 As a guide, Full protective measures with respect to naturally-occurring Radon would be considered necessary in the structural design of the building, although it is recommended that a site specific Radon Report be obtained/discussions be held with the local Environmental Health Officer to agree the Radon classification required in the context of proposed end use.

10.12 The indigenous shallow natural soils proven would not warrant the requirement to install mitigation measures in sub-structure design in respect to "Landfill Gas".

10.13 It is recommended that the Local Environmental Health Officer also be consulted about the presence of a former infilled gravel pit in relative close proximity to the site in the context of "landfill gas" and whether any more demanding mitigation measures would be required in sub-structure design.

10.14 This summary should not be read in isolation or out of context from the foregoing report.

10.15 We trust this report meets with your requirements but if you have any queries, please do not hesitate to contact the undersigned.

T N Owens BSc CGeol FGS
Associate Director

N J Waite BSc CGeol FGS
Director

# APPENDIX H

Proposed Development Layout


# APPENDIX G

## CLEA Version 1.06 and RISC4.0 Model Data

# APPENDIX F

## Human Health Risk Assessment Summary

# APPENDIX E

Laboratory Testing - Chemical (Soils)


# APPENDIX D

## Laboratory Testing - Physical

# APPENDIX C

In-situ Soakaway Test Results

# APPENDIX B

Trial Pit Logs

# APPENDIX A

## Initial Conceptual Site Model

## SUMMARY OF RATES OF INFILTRATION

**SITE:** Cainscross

**JOB No:** MC149

| SOAKAWAY | | Base of Pit (m) | WATER LEVEL DURING TEST (m) | | INFILTRATION RATE (A) (m/sec) - BRE Digest 365 | INFILTRATION RATE (B) (m/sec) - full Area |
|---|---|---|---|---|---|---|
| Pit | Cycle | | Start | Finish | | |
| 1 | 1 | 2.90 | 1.630 | 2.900 | | 4.13 x 10-4 |
| 1 | 2 | 2.90 | 1.840 | 2.900 | | 3.22 x 10-4 |
| 1 | 3 | 2.90 | 1.400 | 2.900 | | 2.84 x 10-4 |
| 2 | 1 | 2.90 | 1.600 | 2.900 | | 4.07 x 10-4 |
| 2 | 2 | 2.90 | 1.450 | 2.900 | | 4.12 x10-4 |
| 2 | 3 | 2.90 | 1.600 | 2.900 | | 2.96 x 10-4 |
| 4 | 1 | 1.10 | 0.640 | 1.100 | | 2.04 x 10-4 |
| 4 | 2 | 1.10 | 0.570 | 1.100 | | 1.54 x 10-4 |

Note :

Infiltration Rate (A ) is the standard calculation outlined in BRE Digest 365, which takes account of actual drained area of pit.

Infiltration Rate (B ) is based on the principles outlined in BRE Digest 365, but also includes the full undrained area of pit.

Where only partial drainage has occurred, the quoted infiltration rate should be used as a guide only and strictly only apply to the drained portion of the pit; substantially lower rates would apply to the lower undrained section of the pit.

Infl-rates 16/02/2004

# Soakaway Field Record Sheet

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Project Ref:- | MC149 | Project Name:- | Victory Park, Cainscross | | | Sheet | 1 of 1 |
| Soakaway No. | TP1 | Cycle | 1,2,3 | Date | 21.02.13 | Engineer | CG |

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## Cycle 1

| | | | |
|---|---|---|---|
| Total fall in water level (m) | 1.27 | base of Trial pit below datum (m) | 2.90 |
| % water drop | 100.00 | Drainage height (m) | 1.27 |
| Ho = | 0.00 | from graph | |
| H25 = | 0.3175 | t25 = | 00:01:10 |
| H75 = | 0.9525 | t75 = | 00:09:00 |

| Time ( h:m:s ) | depth below datum (m) | Elapsed time (h:m:s) | Total fall in water level (m) |
|---|---|---|---|
| | | | |
| Cycle 1 | | | |
| 10:42 | 1.630 | 00:00:00 | 0.000 |
| 10:43 | 1.930 | 00:01:00 | 0.300 |
| 10:45 | 2.070 | 00:03:00 | 0.440 |
| 10:46 | 2.190 | 00:04:00 | 0.560 |
| 10:47 | 2.310 | 00:05:00 | 0.680 |
| 10:48 | 2.400 | 00:06:00 | 0.770 |
| 10:50 | 2.530 | 00:08:00 | 0.900 |
| 10:51 | 2.590 | 00:09:00 | 0.960 |
| 10:52 | 2.630 | 00:10:00 | 1.000 |
| 10:53 | 2.690 | 00:11:00 | 1.060 |
| 10:54 | 2.900 | 00:12:00 | 1.270 |
| | | - | - |
| | | - | - |
| | | - | - |

## Cycle 2

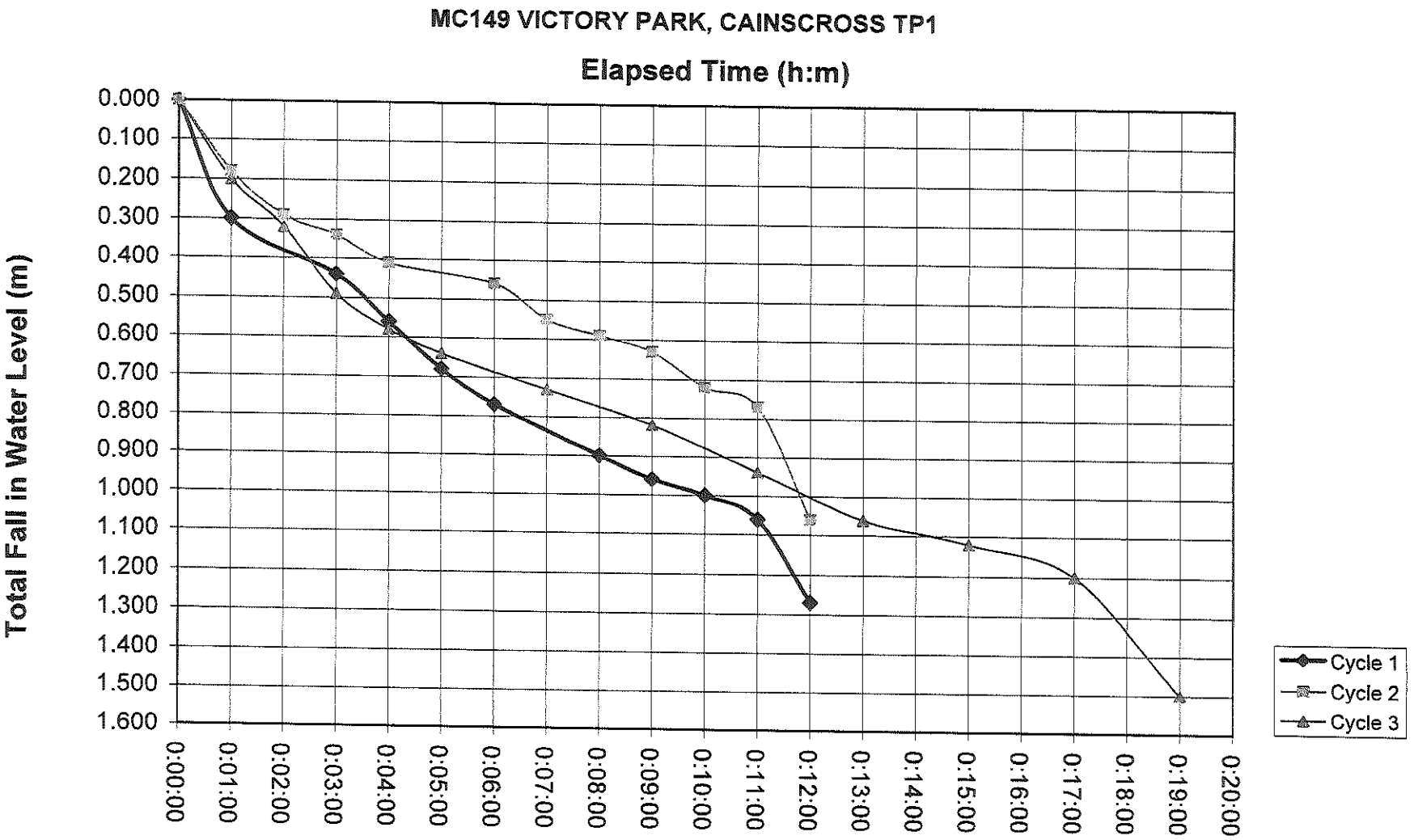
| | | | |
|---|---|---|---|
| Total fall in water level (m) | 1.06 | base of Trial pit below datum (m) | 2.90 |
| % water drop | 100.00 | Drainage height (m) | 1.06 |
| Ho = | 0.00 | from graph | |
| H25 = | 0.265 | t25 = | 00:01:40 |
| H75 = | 0.795 | t75 = | 00:11:05 |

| Time ( h:m:s ) | depth below datum (m) | Elapsed time (h:m:s) | Total fall in water level (m) |
|---|---|---|---|
| | | | |
| Cycle 2 | | | |
| 11:17 | 1.840 | 00:00:00 | 0.00 |
| 11:18 | 2.020 | 00:01:00 | 0.18 |
| 11:19 | 2.130 | 00:02:00 | 0.29 |
| 11:20 | 2.180 | 00:03:00 | 0.34 |
| 11:21 | 2.250 | 00:04:00 | 0.41 |
| 11:23 | 2.300 | 00:06:00 | 0.46 |
| 11:24 | 2.390 | 00:07:00 | 0.55 |
| 11:25 | 2.430 | 00:08:00 | 0.59 |
| 11:26 | 2.470 | 00:09:00 | 0.63 |
| 11:27 | 2.560 | 00:10:00 | 0.72 |
| 11:28 | 2.610 | 00:11:00 | 0.77 |
| 11:29 | 2.900 | 00:12:00 | 1.06 |
| | | - | - |
| | | - | - |

## Cycle 3

| | | | |
|---|---|---|---|
| Total fall in water level (m) | 1.5 | base of Trial pit below datum (m) | 2.90 |
| % water drop | 100.00 | Drainage height (m) | 1.50 |
| Ho = | 0.00 | from graph | |
| H25 = | 0.375 | t25 = | 00:02:20 |
| H75 = | 1.125 | t75 = | 00:14:40 |

| Time ( h:m:s ) | depth below datum (m) | Elapsed time (h:m:s) | Total fall in water level (m) |
|---|---|---|---|
| | | | |
| Cycle 3 | | | |
| 14:12 | 1.400 | 00:00:00 | 0.00 |
| 14:13 | 1.600 | 00:01:00 | 0.20 |
| 14:14 | 1.720 | 00:02:00 | 0.32 |
| 14:15 | 1.890 | 00:03:00 | 0.49 |
| 14:16 | 1.980 | 00:04:00 | 0.58 |
| 14:17 | 2.040 | 00:05:00 | 0.64 |
| 14:19 | 2.130 | 00:07:00 | 0.73 |
| 14:21 | 2.220 | 00:09:00 | 0.82 |
| 14:23 | 2.340 | 00:11:00 | 0.94 |
| 14:25 | 2.460 | 00:13:00 | 1.06 |
| 14:27 | 2.520 | 00:15:00 | 1.12 |
| 14:29 | 2.600 | 00:17:00 | 1.20 |
| 14:31 | 2.900 | 00:19:00 | 1.50 |
| | | - | - |


MC149 VICTORY PARK, CAINSCROSS TP1
Elapsed Time (h:m)
Total Fall in Water Level (m)
0.000
0.100
0.200
0.300
0.400
0.500
0.600
0.700
0.800
0.900
1.000
1.100
1.200
1.300
1.400
1.500
1.600
0:00:00
0:01:00
0:02:00
0:03:00
0:04:00
0:05:00
0:06:00
0:07:00
0:08:00
0:09:00
0:10:00
0:11:00
0:12:00
0:13:00
0:14:00
0:15:00
0:16:00
0:17:00
0:18:00
0:19:00
0:20:00
Cycle 1
Cycle 2
Cycle 3

# Soakaway Field Record Sheet

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Project Ref:- | MC149 | Project Name:- | Victory Park, Cainscross | | | Sheet | 1 of 1 |
| Soakaway No. | TP2 | Cycle | 1,2,3 | Date | 21.02.13 | Engineer | CG |

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## Cycle 1

| | | | |
|---|---|---|---|
| Total fall in water level (m) | 1.3 | base of Trial pit below datum (m) | 2.90 |
| % water drop | 100.00 | Drainage height (m) | 1.30 |
| Ho = | 0.00 | from graph | |
| H25 = | 0.325 | t25 = | 00:02:20 |
| H75 = | 0.975 | t75 = | 00:10:35 |

| Time ( h:m:s ) | depth below datum (m) | Elapsed time (h:m:s) | Total fall in water level (m) |
|---|---|---|---|
| Cycle 1 | | | |
| 12:03 | 1.600 | 00:00:00 | 0.000 |
| 12:04 | 1.750 | 00:01:00 | 0.150 |
| 12:05 | 1.880 | 00:02:00 | 0.280 |
| 12:06 | 1.990 | 00:03:00 | 0.390 |
| 12:07 | 2.070 | 00:04:00 | 0.470 |
| 12:08 | 2.220 | 00:05:00 | 0.620 |
| 12:09 | 2.300 | 00:06:00 | 0.700 |
| 12:10 | 2.340 | 00:07:00 | 0.740 |
| 12:11 | 2.420 | 00:08:00 | 0.820 |
| 12:12 | 2.480 | 00:09:00 | 0.880 |
| 12:13 | 2.560 | 00:10:00 | 0.960 |
| 12:14 | 2.620 | 00:11:00 | 1.020 |
| 12:15 | 2.900 | 00:12:00 | 1.300 |
| | | - | - |

## Cycle 2

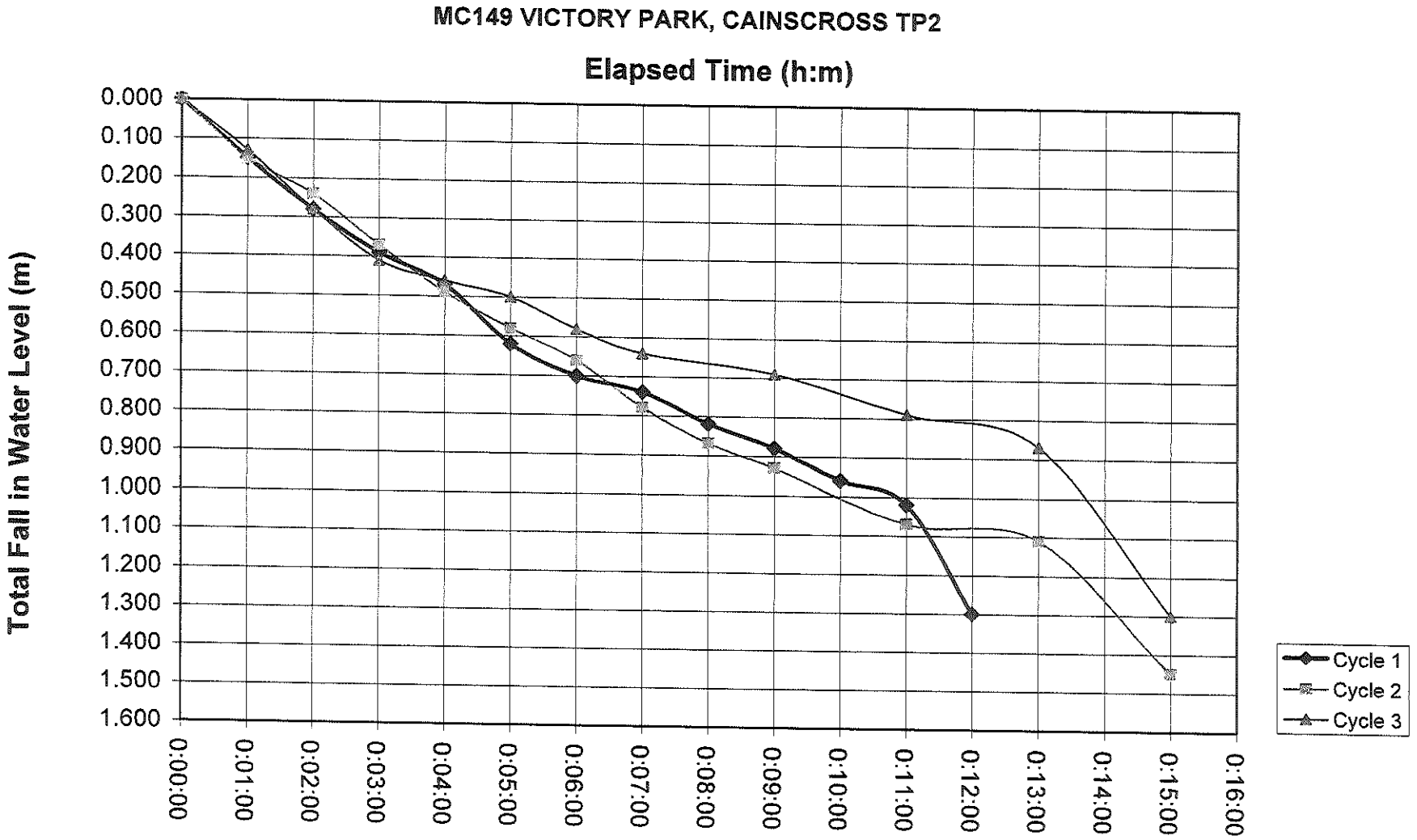
| | | | |
|---|---|---|---|
| Total fall in water level (m) | 1.45 | base of Trial pit below datum (m) | 2.90 |
| % water drop | 100.00 | Drainage height (m) | 1.45 |
| Ho = | 0.00 | from graph | |
| H25 = | 0.3625 | t25 = | 00:03:00 |
| H75 = | 1.0875 | t75 = | 00:11:30 |

| Time ( h:m:s ) | depth below datum (m) | Elapsed time (h:m:s) | Total fall in water level (m) |
|---|---|---|---|
| Cycle 2 | | | |
| 12:38 | 1.450 | 00:00:00 | 0.00 |
| 12:39 | 1.600 | 00:01:00 | 0.15 |
| 12:40 | 1.690 | 00:02:00 | 0.24 |
| 12:41 | 1.820 | 00:03:00 | 0.37 |
| 12:42 | 1.940 | 00:04:00 | 0.49 |
| 12:43 | 2.030 | 00:05:00 | 0.58 |
| 12:44 | 2.110 | 00:06:00 | 0.66 |
| 12:45 | 2.230 | 00:07:00 | 0.78 |
| 12:46 | 2.320 | 00:08:00 | 0.87 |
| 12:47 | 2.380 | 00:09:00 | 0.93 |
| 12:49 | 2.520 | 00:11:00 | 1.07 |
| 12:51 | 2.560 | 00:13:00 | 1.11 |
| 12:53 | 2.900 | 00:15:00 | 1.45 |
| | | - | - |

## Cycle 3

| | | | |
|---|---|---|---|
| Total fall in water level (m) | 1.3 | base of Trial pit below datum (m) | 2.90 |
| % water drop | 100.00 | Drainage height (m) | 1.30 |
| Ho = | 0.00 | from graph | |
| H25 = | 0.325 | t25 = | 00:02:15 |
| H75 = | 0.975 | t75 = | 00:13:35 |

| Time ( h:m:s ) | depth below datum (m) | Elapsed time (h:m:s) | Total fall in water level (m) |
|---|---|---|---|
| Cycle 3 | | | |
| 13:19 | 1.600 | 00:00:00 | 0.00 |
| 13:20 | 1.730 | 00:01:00 | 0.13 |
| 13:21 | 1.880 | 00:02:00 | 0.28 |
| 13:22 | 2.010 | 00:03:00 | 0.41 |
| 13:23 | 2.060 | 00:04:00 | 0.46 |
| 13:24 | 2.100 | 00:05:00 | 0.50 |
| 13:25 | 2.180 | 00:06:00 | 0.58 |
| 13:26 | 2.240 | 00:07:00 | 0.64 |
| 13:28 | 2.290 | 00:09:00 | 0.69 |
| 13:30 | 2.390 | 00:11:00 | 0.79 |
| 13:32 | 2.470 | 00:13:00 | 0.87 |
| 13:34 | 2.900 | 00:15:00 | 1.30 |
| | | - | - |
| | | - | - |


MC149 VICTORY PARK, CAINSCROSS TP2
Elapsed Time (h:m)
Total Fall in Water Level (m)
0.000
0.100
0.200
0.300
0.400
0.500
0.600
0.700
0.800
0.900
1.000
1.100
1.200
1.300
1.400
1.500
1.600
0:00:00
0:01:00
0:02:00
0:03:00
0:04:00
0:05:00
0:06:00
0:07:00
0:08:00
0:09:00
0:10:00
0:11:00
0:12:00
0:13:00
0:14:00
0:15:00
0:16:00
Cycle 1
Cycle 2
Cycle 3

# Soakaway Field Record Sheet

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Project Ref:- | MC149 | Project Name:- | Victory Park, Cainscross | | | Sheet | 1 of 1 |
| Soakaway No. | TP4 | Cycle | 1,2 | Date | 21.02.13 | Engineer | CG |

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## Cycle 1

| | | | |
|---|---|---|---|
| Total fall in water level (m) | 0.46 | base of Trial pit below datum (m) | 1.10 |
| % water drop | 100.00 | Drainage height (m) | 0.46 |
| Ho = | 0.00 | from graph | |
| H25 = | 0.115 | t25 = | 00:03:15 |
| H75 = | 0.345 | t75 = | 00:13:00 |

| Time ( h:m:s ) | depth below datum (m) | Elapsed time (h:m:s) | Total fall in water level (m) |
|---|---|---|---|
| | | | |
| Cycle 1 | | | |
| 14:51 | 0.640 | 00:00:00 | 0.000 |
| 14:52 | 0.680 | 00:01:00 | 0.040 |
| 14:53 | 0.710 | 00:02:00 | 0.070 |
| 14:55 | 0.760 | 00:04:00 | 0.120 |
| 14:57 | 0.790 | 00:06:00 | 0.150 |
| 14:59 | 0.840 | 00:08:00 | 0.200 |
| 15:01 | 0.880 | 00:10:00 | 0.240 |
| 15:03 | 0.950 | 00:12:00 | 0.310 |
| 15:05 | 1.020 | 00:14:00 | 0.380 |
| 15:07 | 1.100 | 00:16:00 | 0.460 |
| | | - | - |
| | | - | - |
| | | - | - |
| | | - | - |

## Cycle 2

| | | | |
|---|---|---|---|
| Total fall in water level (m) | 0.53 | base of Trial pit below datum (m) | 1.10 |
| % water drop | 100.00 | Drainage height (m) | 0.53 |
| Ho = | 0.00 | from graph | |
| H25 = | 0.1325 | t25 = | 00:05:40 |
| H75 = | 0.3975 | t75 = | 00:19:40 |

| Time ( h:m:s ) | depth below datum (m) | Elapsed time (h:m:s) | Total fall in water level (m) |
|---|---|---|---|
| | | | |
| Cycle 2 | | | |
| 15:11 | 0.570 | 00:00:00 | 0.00 |
| 15:12 | 0.600 | 00:01:00 | 0.03 |
| 15:13 | 0.630 | 00:02:00 | 0.06 |
| 15:14 | 0.650 | 00:03:00 | 0.08 |
| 15:15 | 0.680 | 00:04:00 | 0.11 |
| 15:16 | 0.690 | 00:05:00 | 0.12 |
| 15:18 | 0.730 | 00:07:00 | 0.16 |
| 15:20 | 0.770 | 00:09:00 | 0.20 |
| 15:22 | 0.820 | 00:11:00 | 0.25 |
| 15:24 | 0.830 | 00:13:00 | 0.26 |
| 15:26 | 0.840 | 00:15:00 | 0.27 |
| 15:28 | 0.880 | 00:17:00 | 0.31 |
| 15:30 | 0.940 | 00:19:00 | 0.37 |
| 15:34 | 1.100 | 00:23:00 | 0.53 |

## Cycle 3

| | | | |
|---|---|---|---|
| Total fall in water level (m) | 0 | base of Trial pit below datum (m) | 1.10 |
| % water drop | 0.00 | Drainage height (m) | 1.10 |
| Ho = | - | from graph | |
| H25 = | 0 | t25 = | |
| H75 = | 0 | t75 = | |

| Time ( h:m:s ) | depth below datum (m) | Elapsed time (h:m:s) | Total fall in water level (m) |
|---|---|---|---|
| | | | |
| Cycle 3 | | | |
| | | - | - |
| | | - | - |
| | | - | - |
| | | - | - |
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| | | - | - |
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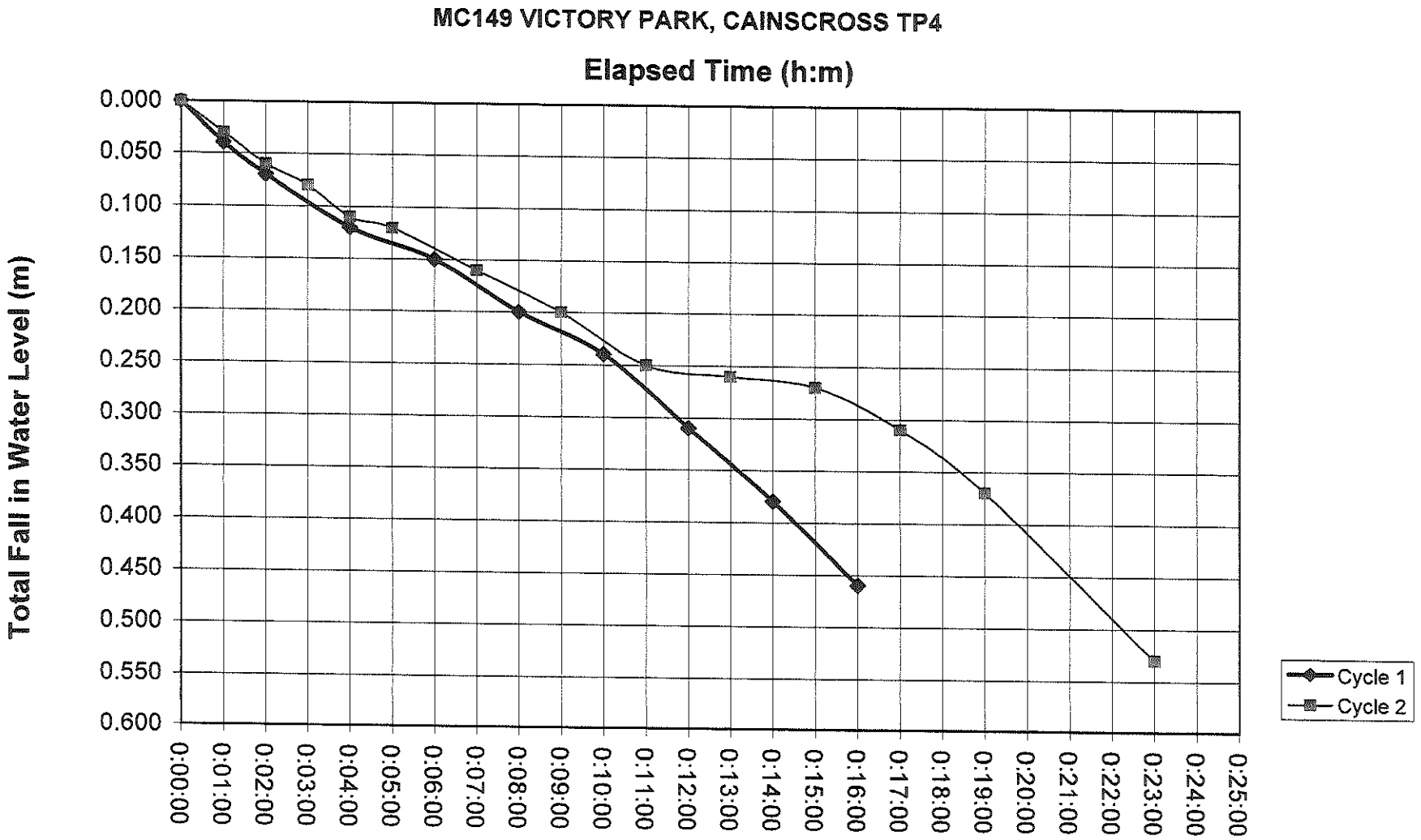
| | | - | - |
| | | - | - |
| | | - | - |
| | | - | - |


MC149 VICTORY PARK, CAINSCROSS TP4
Elapsed Time (h:m)
Total Fall in Water Level (m)
0.000
0.050
0.100
0.150
0.200
0.250
0.300
0.350
0.400
0.450
0.500
0.550
0.600
0:00:00
0:01:00
0:02:00
0:03:00
0:04:00
0:05:00
0:06:00
0:07:00
0:08:00
0:09:00
0:10:00
0:11:00
0:12:00
0:13:00
0:14:00
0:15:00
0:16:00
0:17:00
0:18:00
0:19:00
0:20:00
0:21:00
0:22:00
0:23:00
0:24:00
0:25:00
Cycle 1
Cycle 2