Kildare Co. Co. Architectural Services

Proposed Residential Development at Glandore, Athy, Co. Kildare

Surface Water & SuDS Design Report

2251-DOB-XX-XX-RP-C-0001

October 2022

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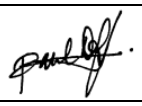
Author:		Paul Doyle		Signed:	
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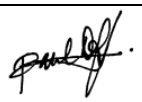
S2.P01	04/10/2022	Draft for Comment	Client	1E	
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1 Introduction

Donnachadh O'Brien & Associates Consulting Engineers Ltd. (DOBA) have been instructed by the Client, Kildare Co. Co. Architectural Services, to prepare a Surface Water & SuDS Design Report (SSDR) to accompany a Planning Application to Kildare County Council (KCC) for the proposed infill residential development at Glandore, Athy, Co. Kildare. This SSDR is structed as follows;

- **Section 2** summarises the attributes of the **Existing Site**,
  Section 3 provides a description of the **Proposed Development**,
- **Section 4** addresses **Surface Water** and demonstrates compliance with the requirements of the Kildare Co. Co. Water Services Department SuDS requirements and the Greater Dublin Strategic Drainage Study (GDSDS). This section demonstrates how the proposed development has adopted a **SuDS Hierarchy** with an emphasis placed on **Nature Based SuDS (NBS)** ensuring that run-off from hardstanding areas firstly discharges at surface level to NBS including bioretention areas and tree pits. Where NBS features are not possible, infiltration and filtration system SuDS have then been deployed to ensure a minimum 2 stage surface water treatment process has been provided to all run-off which intercepts and treats water by filtration and treatment through natural material in accordance with the requirements on the CIRIA SuDS manual.

2 Existing Site

The proposed residential in-fill development, as outlined in **Figure 1** below, is to be located on an existing c. 0.192Ha site which is bound by existing residential developments to the north and east by Castle Park, the west by Woodstock Road and to the south by the Green Hills Road. The site topography is relatively flat with elevation on site ranging averaging +58.50mOD.

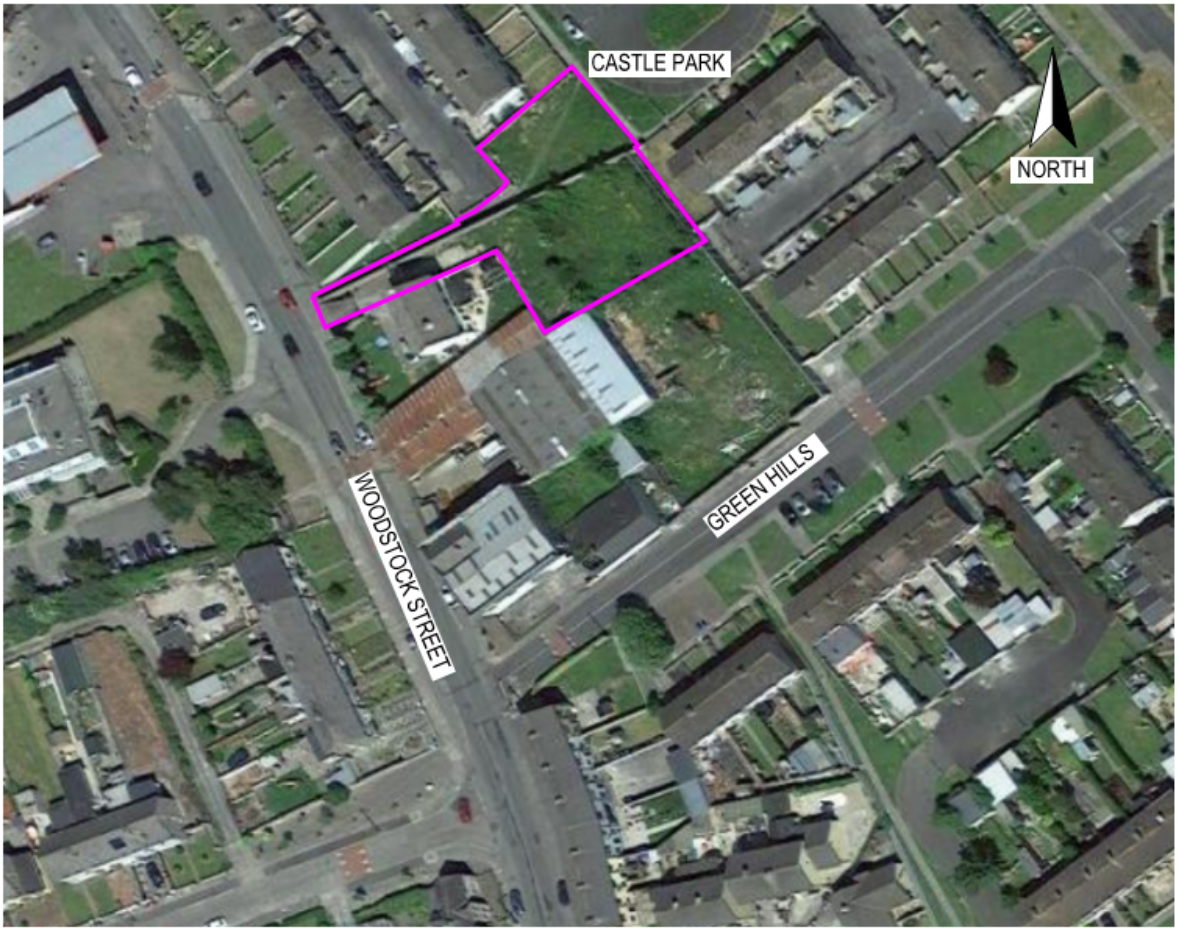


Figure 1 Application Lands outlined in pink (source: Google Maps)

3 Proposed Development Description

The proposed development comprises:

- A terrace block consisting of 2 no. 1-bed Single Storey dwelling, 2 No. 1-bed
- Apartments Two Storey, and 1 no. 2-bed Two Storey dwelling.
- Demolition and alterations to the existing boundary walls and construction of new boundary walls to the proposed site.
- Demolition of existing walls bounding:
- Glandour House, including entrance gate wall to Glandour House, and laneway connecting Woodstock Street with Castle Park housing estate.
- Widening of existing lane way and construction of new wall bounding Glandour House Site.
- Associated site development works including landscaping, drainage, public lighting, new paths and hard landscaping, ancillary site services and site development works above and below ground.

Figure 2 Proposed development (source: Kildare Co. Co. Architectural Services)

4 Surface Water & SuDS Design

The structure of this section of the report is as follows;

- **Section 4.1** provides a response to the **KCC WSD SuDS guidance** document demonstrating compliance of the proposed design with the KCC requirements,
- **Section 4.2** summarises the **existing ground conditions** as silty sandy gravel and notes that infiltration in the underlying sub soils is possible following on site BRE365 soakaway testing,
- **Section 4.3** describes the attributes of the existing surface water on site,
- **Section 4.4** summaries the proposed **SuDS strategy** for the development and outlines the SuDS hierarchy adopted with an emphasis placed on Nature Based SuDS measures,
- **Section 4.5** describes the **proposed SuDS elements** in detail
- **Section 4.6** summarises the **management and maintenance** of the proposed SuDS features which shall be Taken in Charge by Kildare Co. Co.
- **Section 4.7** demonstrates how the proposed surface water design **complies with the requirements in GDSDS**, River Quality, River Protection, Level of Service and River Flood requirements
- Finally, **Section 4.8** describes how, in the event of the exceedance of NBS features, an overflow has been provided to a **linear infiltration trench** which has been designed for a 1:100-year storm event plus 30% Climate Change plus 10% Urban Creep applied to the roof areas.

4.1 Kildare Co. Co. Water Services Department Draft Guidance and SuDS Strategy

The Applicant has provided a response in **Table 1** below to each of the KCC WSD Draft Guidance and SuDS strategy requirements below which demonstrates that the proposed SuDS design is fully in compliance with the KCC SuDS criteria. All SuDS features are illustrated in DOBA Engineering drawing **2251-DOB-XX-SI-DR-C-0020**.

Table 1 Applicant's Response to KCC WSD SuDS Strategy

Kildare Co. Co. Water Services Department Draft Guidance and SuDS Strategy smaller multiple developments	**Applicant's Response**
Up to 10 housing units - An appropriate SuDS strategy shall be prepared for the development by a multi-disciplinary team as outlined above which seeks to deal with surface water runoff at source, at ground surface level and by reducing runoff through maximising the provision of permeable paving-pervious surfacing and green-landscaped areas.	A multi-disciplinary design team consisting of the Architect, Landscape Architect and Civil Engineer have devised an appropriate SuDS strategy to deal with surface water runoff at source, at ground surface level and by reducing runoff through maximising the provision of permeable paving-pervious surfacing and green-landscaped areas.
Nature based SuDS a. Runoff from the remaining impermeable surface areas shall discharge to appropriate nature-based SuDS in the first instance, such as constructed wetlands, retention ponds and bioretention areas for attenuation storage, roadway runoff shall discharge directly to bioretention swales and tree trenches or smaller tree pits. House runoff shall discharge to rain gardens and planters.	• Run-off from each house roof discharges to a rain garden. In the event of exceedance or an extreme rainfall event, an overflow has been provided to a linear infiltration trench which has been designed to cater for storms up to and including a 1:100-year storm event + 30% Climate Change + 10% urban creep applied to the roof areas. • Run-off from the hardstanding footpaths to the front of the units shall drain to unlined permeable paving. Again, in the event of exceedance or an extreme rainfall event, an overflow has been provided to a linear infiltration trench which has been designed to cater for storms up to and including a 1:100-year storm event + 30% Climate Change + 10% urban creep applied to the roof areas. • Run-off from the very small area of impermeable concrete footpaths to the rear of the houses discharges over ground to the adjacent green strip. • Run-off from the impermeable hardstanding car parking area discharges to a tree pit and bioretention area. In the event of exceedance or an extreme rainfall event, an overflow has been provided to a linear infiltration trench which has been designed to cater for storms up to and including a 1:100-year storm event + 30% Climate Change. • Finally, run-off from the access road discharges to a linear filter drain which in turn discharges to a linear infiltration trench. Catchpits will also be provided downstream of the infiltration trenches to provide primary treatment. The granular material and geotextile filter material will provide interception and act as a secondary treatment in preventing ingress of fine material from paved areas. • In summary, the only area of hardstanding on the project that does not

	discharge to a Nature based SuDS feature is the access road which is only 4m wide. It is therefore not geometrically possible to provide a Nature Based SuDS feature and an access road. Instead, infiltration system SuDS has been deployed.
Infiltration system SuDS a. Only where a clear and plausible rationale can be given for excluding nature-based SuDS or where additional treatment-storage of runoff is required, shall infiltration system SuDS such as soakaways, infiltrations basins, blankets or infiltration trenches, which as they are narrow and linear can underdrain the roadside bioretention swales or act as standalone SuDS, unlined permeable paving and unlined, underground attenuation storage structures, be considered. These SuDS discharge runoff to ground and are subject to suitably permeable sub-soils and a favourable site groundwater regime. b. Expert geotechnical and hydrogeological advice should be taken in this regard and infiltration of runoff to ground should be located a safe distance from buildings, structures, walls and foul sewers.'	a) With the exception of the access road, run-off from all of the site hard standing discharges to Nature Based SuDS (NBS) . In the event of exceedance, an overflow from the NBS has been provided to a linear infiltration trench which has been designed for a 1:100-year storm event + 30% Climate Change + 10% urban creep applied to the roof areas. In the event of this criteria being exceeded, a high-level overflow from the infiltration trench to the adjacent Castle Park surface water drainage system has been provided. b) IGSL have provided expert geotechnical advice and confirmed that an infiltration rate of 1.438x10-5 m/s is appropriate for infiltration design through a BRE365 soakaway test. The trench has been located a minimum 7m away from existing and proposed structures.
4. Filtration system SuDS a. Where a clear and plausible rationale can be given for excluding infiltration system SuDS or additional treatment-storage of runoff is required, only then shall filtration system SuDS be considered. These include filter strips, filter drains and which like infiltration trenches can be provided to underdrain swales or as SuDS in their own right and lined permeable paving.	The only area of hardstanding on the project that does not discharge to a Nature based SuDS feature is the access road which is only 4m wide. It is therefore not geometrically possible to provide a Nature Based SuDS feature and an access road in this instance. Instead, infiltration system SuDS has been deployed. The ratio of the access road hardstanding to the site impermeable area is 0.17 and therefore less 20% of the site does not firstly discharge to an NBS feature and instead flows to a filtration system SuDS feature.
5. Detention system SuDS a. Finally, and only where the above SuDS types can be excluded or where additional treatment-storage is required, shall detention systems such as detention basins, rainwater butts and underground, lined attenuation storage structures be considered.	The design does not propose to use detention system SuDS.
6. Typically, nature based and infiltration system SuDS do not discharge runoff a watercourse or dedicated surface water piped drainage network except from an overflow to cater for SuDS failure or design exceedance events. Filtration and detention system SuDS do ordinarily discharge runoff to either a watercourse or piped network.	The nature-based SuDS and filtration system SuDS features discharges to a linear infiltration trench which has been design to cater for a 1:100-year storm event + 30% Climate Change + 10% urban creep applied to the roof areas.
7. SuDS overflows and outfall pipes shall discharge to the nearest available watercourse or dedicated surface water drainage piped network.	SuDS overflows have been provided to a linear infiltration trench. Additionally, an overflow has been provided from the infiltration trench to the existing surface water drainage network in the adjoining existing Castle Park development.

8. The environmental considerations of discharging runoff to watercourse, piped networks or to ground shall be addressed in the drainage design for the development.	Surface based SuDS components enables the use of a natural treatment process associated with vegetation and the action of sunlight, easy indentation of sources of contamination, both acute (accidental spills) and chronic (long term, ongoing pollution, including misconnections, cost effective removal of trapped pollutant loads and cost-effective system remedial works.
9. A SuDS strategy based on the above, should be devised by a multi-disciplinary design team consisting of geotechnical engineers, hydrogeologists, landscape architects, ecologists and arboriculturists and shall be agreed with the Water Services department prior to the submission of a planning application	A multi-disciplinary design team consisting of the Architect, Landscape Architect and Civil Engineer have devised an appropriate SuDS strategy to deal with surface water runoff at source, at ground surface level and by reducing runoff through maximising the provision of permeable paving-pervious surfacing and green-landscaped areas
10. Sustainable Drainage Systems (SuDS) should where feasible form part of the public open space provision and must in line with CDP Open Spaces Strategy: a. contribute in a significant and positive way to the design and quality of open space, b. enhance biodiversity and amenity value, and link with the existing Green Infrastructure network in the settlement. c. provide an open space benefit even when holding surface water (for example ponds and wetlands), d. be readily available for use in most weather conditions, e. be accessible and usable, and f. be designed by a multi-disciplinary team (to include a drainage engineer, ecologist, arborist, landscape architect etc.) as part of the overall project.	Noted.
11. SuDS which form part of public open space provision will be assessed on a case-by-case basis by the planning authority, having regard to site specific conditions and the quality of design.	Noted.
12. Culverting entire drains and streams will generally be prohibited; interference with natural drainage systems is to be minimised and the Council will explore opportunities to carry out watercourse restoration projects and to remove culverted drainage systems in favour of open, natural drainage systems.'	Noted. It is not proposed to culvert entire drains as part of this development.
13. A climate change factor of 30% and 10% urban creep factor shall be applied in drainage designs.	A climate change factor of 30% and 10% urban creep factor has been applied to the drainage design.
14. KCC will facilitate the development of nature based Sustainable Urban Drainage Systems, including the retrofitting of SuDS in established urban areas.	Noted.
15. Underground tanks and storage systems will only be accepted in line with an agreed SuDS strategy for a residential development, which should	Noted. It is not proposed to provide underground tanks as part of this development.

complement the development open space strategy.	
16. Single Rural houses, extensions etc - Surface water runoff shall be treated at source and ground surface level, where possible. A risk assessment of surface storage of runoff shall be conducted especially regarding the risk of young children drowning in even shallow depths of water. Safety advice is given in CIRIA SuDS Manual Chapter 36.	Noted.
17. The amount of impermeable surface areas should be reduced and provision of permeable paving-pervious surfacing and landscaped and green areas should be maximised.	The amount of impermeable surface areas has been reduced and provision of permeable paving-pervious surfacing and landscaped and green areas has been maximised.
18. The remaining impermeable surfaces should discharge runoff to Sustainable Drainage Systems (SuDS) as follows.	Noted.
19. Discharge of surface water runoff to nature-based SuDS such as Rain Gardens, Planters, Small bioretention areas and Bioretention swales shall be prioritised, and which as well as reducing and treating surface water runoff, also have the added benefits of promoting biodiversity and providing amenity value.	The discharge of run-off to impermeable surfaces has been prioritised as follows; a. Run-off from each house roof discharges to a rain garden. In the event of exceedance or an extreme rainfall event, an overflow has been provided to a linear infiltration trench which has been designed to cater for storms up to and including a 1:100-year storm event + 30% Climate Change + 10% urban creep applied to the roof areas. b. Run-off from the hardstanding footpaths to the front of the units shall drain to unlined permeable paving. Again, in the event of exceedance or an extreme rainfall event, an overflow has been provided to a linear infiltration trench which has been designed to cater for storms up to and including a 1:100-year storm event + 30% Climate Change + 10% urban creep applied to the roof areas. c. Run-off from the very small area of impermeable concrete footpaths to the rear of the houses discharges over ground to the adjacent green strip. d. Run-off from the impermeable hardstanding car parking area discharges to a tree pit and bioretention area. In the event of exceedance or an extreme rainfall event, an overflow has been provided to a linear infiltration trench which has been designed to cater for storms up to and including a 1:100-year storm event + 30% Climate Change.
20. Infiltration system SuDS a. Only where a clear and plausible rationale can be given for excluding nature-based SuDS or where additional treatment-storage of runoff is required, shall infiltration system SuDS such as soakaways, infiltrations trenches, unlined permeable paving and	a) SuDS overflows have been provided to a linear infiltration trench which has been designed to cater for a 1:100 Year storm event + 30% Climate Change + 10% urban creep applied to the roof areas. Additionally, an overflow has been provided from the infiltration trench to the existing surface water drainage network in the adjoining existing Castle Park development.

unlined, underground attenuation storage structures be considered. These SuDS discharge runoff to ground and are subject to suitably permeable sub-soils and a favourable site groundwater regime. b. Expert geotechnical and hydrogeological advice should be taken in this regard and infiltration of runoff to ground should be located a safe distance from buildings, structures, walls and foul sewers.	b) Expert geotechnical advice has been sought and IGSL carried out BRE365 soakaway testing on the site. The test results have confirmed that an infiltration rate, *f*, of 1.438×10^{-5}m/s may be adopted for the purpose of infiltration design.
21. Filtration system SuDS a. Where a clear and plausible rationale can be given for excluding infiltration system SuDS or additional treatment-storage of runoff is required, only then shall filtration system SuDS be considered. These include filter strips, filter drains and lined permeable paving.	a) Run-off from the access road discharges to a linear filter drain which in turn discharges to a linear infiltration trench. Catchpits will also be provided downstream of the infiltration trenches to provide primary treatment. The granular material and geotextile filter material will provide interception and act as a secondary treatment in preventing ingress of fine material from paved areas. The only area of hardstanding on the project that does not discharge to a Nature based SuDS feature is the access road which is only 4m wide. It is therefore not geometrically possible to provide a Nature Based SuDS feature and an access road. Instead, infiltration system SuDS has been deployed.
22. Detention system SuDS a. Finally, and only where the above SuDS types can be excluded or where additional treatment-storage is required, shall detention systems such as detention basins, rainwater butts and underground, lined attenuation storage structures be considered.	The design does not propose to use detention system SuDS.

4.2 Existing Ground Conditions

A ground investigation was undertaken by IGSL and included Trial Pits and BRE365 soakaway tests. The Trial Pits noted surface top soil overlying silty sandy gravel or sandy gravelly clay which was described as medium dense becoming dense with boulders and cobbles. Ground water was noted at 2.50m below existing ground level in TP3. The results of BRE365 soakaway tests yielded infiltration rate results, *f*, of 1.438 and 1.644×10^{-5} m/s respectively.

4.3 Existing Surface Water Drainage

There is no existing surface water drainage on the site, however, there is an existing surface water network in the adjoining Castle Park residential development.

4.4 Proposed SuDS Strategy

4.4.1 Proposed SuDS Hierarchy

In line with the recommendations of the Greater Dublin Strategic Drainage Study (GDSDS), Sustainable Urban Drainage System (SuDS), KCC Development Plan and Newbridge LAP, it is proposed to provide a SuDS treatment system aimed at enhancing the quality of surface water from the development which will be achieved by intercepting rainfall and other run off, treating the surface water by filtration through natural material and conveying this water to storage facilities before slowly releasing the same to the adjacent public network. **Table 2** below is a summary of the SuDS hierarchy provided in the development with a clear emphasis on the Nature Based SuDS solutions. This table also outlines the rationale as to why some of the SuDS features are not provided on this 0.435Ha Town Centre site.

Table 2 SuDS Hierarchy and the rationale for the provision or otherwise of the same

Sustainable Urban Drainage System		Regional Control	Source Control	Site Control	Other	Suitable for the Scheme	Rationale for the provision or otherwise of proposed SuDS measures
#	**Nature Based SuDS (NBS)**						
1	Constructed Wetlands	●				N	Constructed wetlands are not practical to provide on this 2000m^2 site considering access roads, car parking and 5 residential units are also to be provided. A bio-retention area, rain garden and tree pits are comparable SuDS features which have been provided instead.
2	Retention Pond	●				N	Retention Ponds are not practical to provide on this 2000m^2 site considering access roads, car parking and 5 residential units are also to be provided. A bio-retention area, rain garden and tree pits are comparable SuDS features which have been provided instead.
3	Bioretention Areas		●			Y	Bioretention areas are proposed as source control NBS SuDS measures for this project.
4	Bioswales		●			N	Bioswales are not proposed as source control NBS SuDS measures for this project. There are however, other Source Control NBS SuDS features such as Bioretention Areas, Rain Gardens and Tree Pits.
5	Rain Gardens		●			Y	Raingardens are proposed as source control NBS SuDS measures for this project.
6	Green Roofs		●			N	The proposed scheme intends to provide traditional pitched roofs for this form of development. Therefore, the use of Green Roofs will not be possible on the pitched roof system as Green Roofs are more suited to flat roofs. There are however, other Source Control NBS SuDS features such as Bioretention Areas, Rain Gardens and Tree Pits.
7	Blue Roofs		●			N	The proposed scheme intends to provide traditional pitched roofs for this form of development. Therefore, the use of Blue Roofs will not be possible on the pitched roof system as Blue Roofs are more suited to flat roofs. There are however, other Source Control NBS SuDS features such as Bioretention Areas, Rain Gardens and Tree Pits.
8	Green Walls		●			N	Green walls are most suited to Management Controlled multi-unit apartments as opposed to the type of dwelling being proposed for this development. There are however, other Source Control NBS SuDS features such as Bioretention Areas, Rain Gardens and Tree Pits.
9	Tree Pits		●			Y	Tree Pits are proposed as source control NBS SuDS measures for this project.
	Infiltration System SuDS						
10	Unlined tree pits-trenches		●			Y	An unlined tree pit trench is proposed as a source control Infiltration System SuDS measure on this development.

11	Unlined permeable paving		●			Y	Unlined permeable paving is proposed as a source control Infiltration System SuDS measure on this development.
12	Infiltration trenches		●			Y	An infiltration trench is proposed as a source control Infiltration System SuDS measure on this development.
	Filtration System SuDS						
13	Filter Drains		●			Y	Filter Drains are proposed as source control SuDS measures for this project.
14	Filter Strips		●			N	It is not proposed to provide filter strips on this development.
15	Lined Permeable Paving		●			N	It is not proposed to provide lined permeable paving on this development.
	Detention Systems SuDS						
16	Detention Basin			●		N	It is not proposed to provide a detention basin on this development.
15	Lined Underground Attenuation Tank			●		N	It is not proposed to provide an attenuation tank on this development.
18	Over-sized pipes			●		N	It is not proposed to provide over-sized pipes on this development.
	Proprietary Treatment Systems						
19	Petrol/ oil separators				●	N	Petrol/ oil interceptors are not proposed for use on this development.
20	Rainwater Harvesting		●			N	Rainwater Harvesting are not proposed for use on this development.

4.4.2 Proposed SuDS Treatment Strategy

Figure 4 below illustrates the 2-stage surface water treatment strategy for the proposed development and associated SuDS hierarchy.

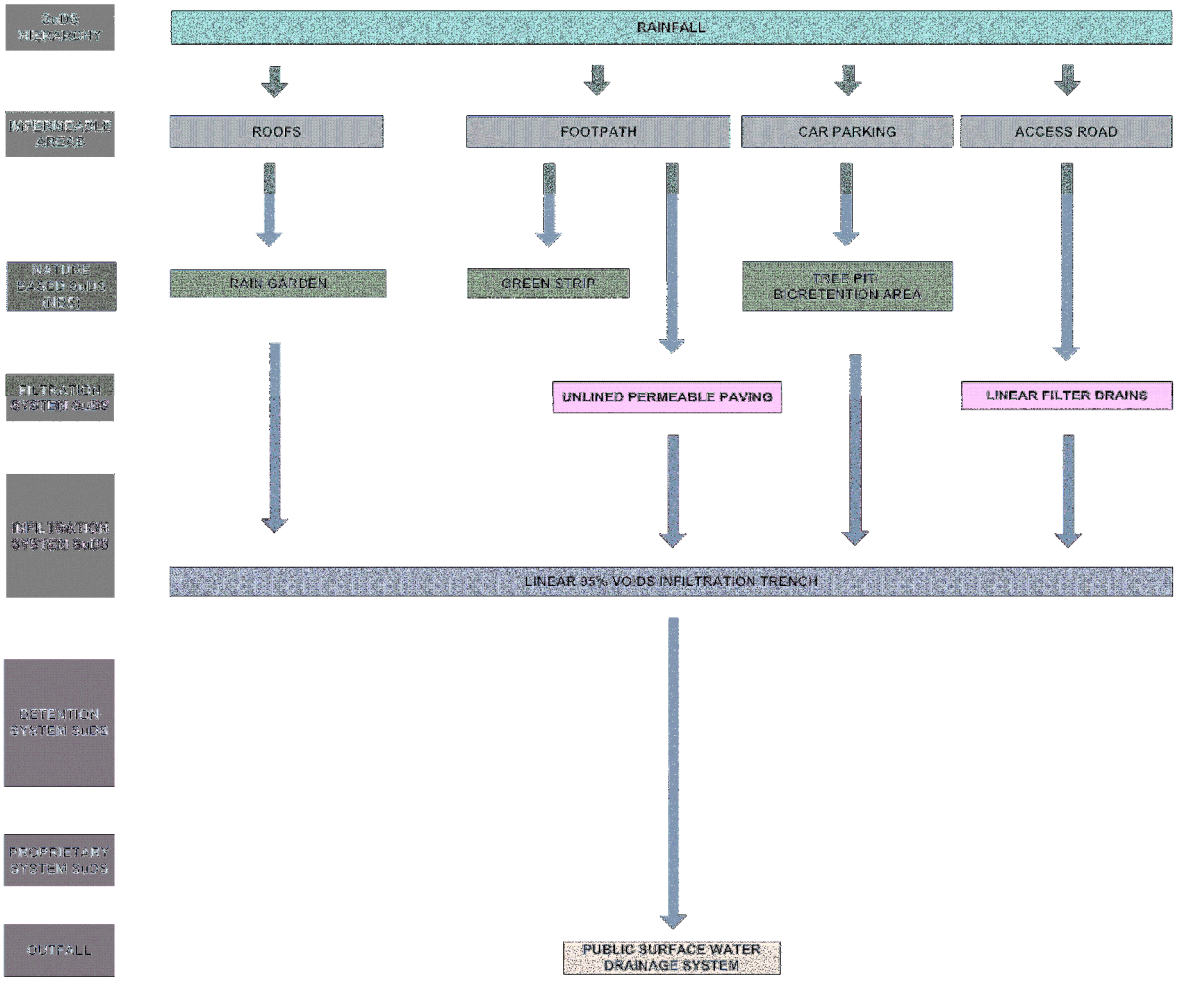


Figure 3 Proposed surface water treatment train

4.5 Proposed SuDS Elements

The proposed SuDS Strategy & associated details are indicated on **DOBA Engineering drawings C-0025** and are described below.

4.5.1 Bioretention Areas/ Tree Pit/ Raingardens

A bioretention tree pit/ raingarden employs engineering topsoil and is used to manage polluted urban rainfall runoff in street locations and car parks. These structures shall include the following as indexed in **Figure 5** below;

1. Dropped kerb to receive overland surface water run-off from the adjacent impermeable car parking bays supplemented by a silt collection apron,
2. Engineered levels above the soil profile to allow water collection and silting before infiltration through the engineered soil,
3. Mulch of organic matter located at the surface to protect the infiltration capacity of ye soul
4. 450-600mm of free-draining soil with 20-30% organic matter which cleans, stores and conveys runoff to the lower drainage layer,
5. Transition layer of sand which protects the under-drained drainage layer,
6. Surface overflow for heavy rain or in the event of a blockage,
7. Perforated land drain to allow full drain down.

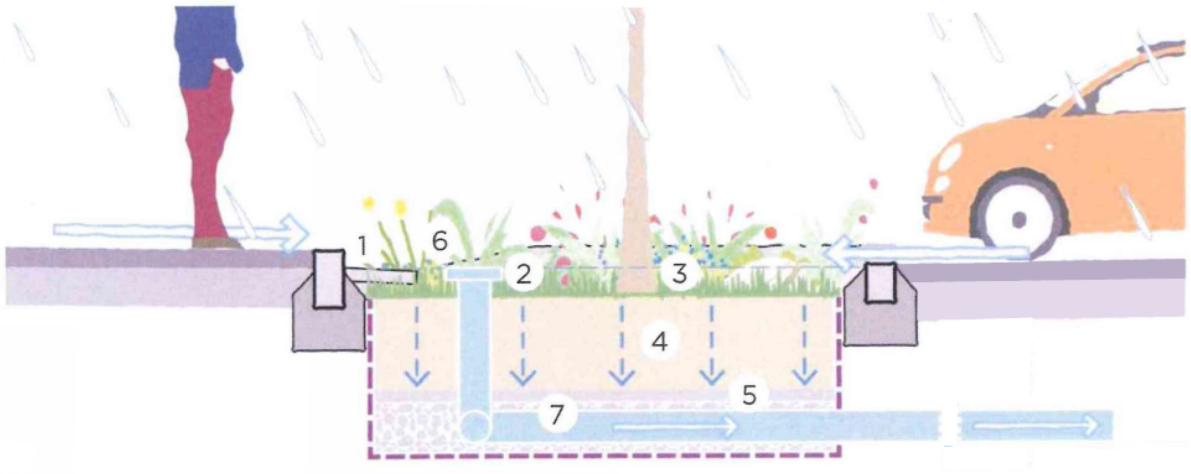


Figure 4 Bioretention Tree Pit Raingarden

4.5.2 Infiltration Trenches

Infiltration trenches allow surface water runoff to infiltrate into the ground over a period of tome thus reducing the volume of runoff during a rainfall event. Infiltration trenches deliver interception for the upstream contributing catchment surface and reduce attenuation storage volume requirements for the site. Infiltration trenches assist in replenishing local aquifers and support local moisture levels which in

urban areas reduces the adverse effects that trees can have on foundations by reducing the potential for shrinkage of soils.

4.5.3 Filter Drains

Filter drains are on line shallow trenches filled with stone/ gravel that create temporary sub-surface storage for the conveyance and filtration of surface water runoff which is lined with a permeable geotextile. Filer drains reduce pollutant levels from runoff by filtering out fine sediments, metals, hydrocarbons and other pollutants and also encourage adsorption and the biodegrading process.

4.6 Proposed Management & Maintenance of SuDS Features

The management and maintenance of the proposed Surface Water system and associated SuDS features for the entire site is the responsibility of the proposed development's Management Company. The regular maintenance and cleaning of the SuDS features shall ensure adequate performance and the Management Company shall prepare a detailed maintenance schedule for each SuDS feature as part of the overall site management strategy.

4.7 Design of Proposed Sustainable Drainage System

The design of sustainable drainage systems, as per Chapter 6 of the Greater Dublin Strategic Drainage Study (GDSDS), is set out below and describes the performance of the proposed surface water drainage system when measured against the relevant GDSDS drainage criterion, namely

- Criterion 1 – River Quality Protection
- Criterion 2 – River Regime Protection
- Criterion 3 – Level of Service (flooding) for the Site
- Criterion 4 – River Flood Protection

The requirements of SuDS are typically addressed through the provision of

- Interception Storage
- Treatment Storage *(not required if interception storage is provided)*
- Attenuation Storage
- Long Term Storage *(not required if growth factors are not applied to Q_{bar} when designing attenuation storage)*

In accordance with KCC requirements, a Climate Change factor of 30% plus an Urban Creep Factor (applied to roof areas only) of 10% will be applied to the design of the surface water system.

4.7.1 River Quality Protection

4.7.1.1 Objective

Interception storage of at least 5mm, and preferably 10mm, of rainfall where run-off to the receiving water can be prevented.

4.7.1.2 Proposal

In accordance with Table 24.6 of the CIRIA SuDS manual, areas of the site drained to unlined bioretention components can be assumed to comply where the impermeable surface area is less than 5 times the vegetated surface area receiving the runoff. The area of the impermeable area draining to the 95m2 bioretention area is 360m2, therefore, there is less than 5 times impermeable area draining to the bioretention area which will intercept the first 5mm of rainfall.

4.7.2 River Regime Protection

4.7.2.1 Objectives

2.1 Discharge rate equal to 1-year Greenfield site peak runoff rate or 2 l/s/Ha, whichever, is the greater. Site critical duration storm to be used to assess attenuation volume.
2. 2 Discharge rate equal to 1 in 100-year Greenfield site peak run off rate. Site critical duration storm to be used to assess attenuation storage volume.

4.7.2.2 Proposals

The proposed development includes a linear infiltration trench which has been designed to cater for a 1:100-year storm event + 30% Climate Change plus an allowance for 10% Urban Creep applied to the roof areas. All SuDS features have overflows which connect to this infiltration trench in the event of exceedance. A high-level overflow from the infiltration trench shall discharge to the adjacent surface water network located in the adjacent Castle Park residential development.

4.7.3 Level of Service (flooding) for the Site

4.7.3.1 Objectives

3.1 No flooding on site except where specifically planned flooding is approved. Summer design storm of 15 or 30 minutes are normally critical.
3.2 No internal property flooding. Planned flood routing and temporary flood storage accommodation on site for short high intensity storms. Site critical duration events.
3.3 No internal property flooding. Floor levels at least 500mm above Maximum River level and adjacent on-site storage retention.
3.4 No flooding of adjacent urban areas. Overland flooding managed within the development.

4.7.3.2 Proposal

No pluvial out-of-manhole flooding of the proposed surface network shall occur for storms up to and including a 1 in 100-year storm event plus 30% Climate Change plus 10% Urban Creep (applied to roof areas). Therefore, no flooding of the site, internal properties or adjacent urban areas occurs. Pipe sizes and gradients have been designed so as to achieve self-cleansing velocities as per the requirements of the Building Regulations Part 'H'. The lowest proposed floor level is set at +58.250mOD which is 500mm above the top of the infiltration trench.

4.7.4 River Flood Protection

4.7.4.1 Objectives

4.1 Long-term floodwater accommodated on site for development runoff volume is in excess of the Greenfield volume. Temporary flood storage drained by infiltration on a designated flooding area brought into operation by extreme flood events only. 100-year, 6-hour duration storm to be used for assessment of the additional volume of runoff.
4.2 Infiltration storage provided equal in volume to long term storage and usually designed to operate for all events.
4.3 Maximum discharge rate of Q_{bar} or 2 l/s/Ha, whichever is the greater, for all attenuation storage where separate long-term storage cannot be provided.

4.7.4.2 Proposals

Infiltration storage provided equal in volume to long term storage designed to operate for all events.

4.8 Proposed Infiltration of Surface Water to Ground

In the event of exceedance of the Nature Based SuDS (NBS) features occurring, an overflow has been provided to a linear infiltration trench which has been designed to cater for all hardstanding surfaces on the site up to and including a 1:100-year storm event plus 30% Climate Change plus 10% Urban Creep applied to roof areas. In the event of an extreme storm event over and above the aforementioned, the infiltration trench has been provided with a high-level overflow to the adjacent surface water network located in the existing Castle Park residential development. The BRE365 soakaway tests carried out on site yielded positive results of f = 1.438×10^{-5} and 1.644×10^{-5} m/s respectively. The worst case (slowest) infiltration rate, and hence conservative design, of 1.438×10^{-5}m/s was adopted for the 22m length of 2.0m wide x 1.5m dp. 95% voids linear infiltration trenches located in the car park as illustrated on the DOBA Engineering drawing C-0020. The design calculations included in **Appendix C** of this report demonstrate the following;

- Volume, $_{required}$ = 47.75m^3
- Volume, $_{provided}$ = 62.70m^3

- Time required for 50% emptying = 24Hrs
- Actual emptying time = 12Hrs 48 mins

Therefore, the infiltration trenches have been designed with a factory of safety of 1.3 and 1.9 respectively for volume and emptying time.

5 Flooding

A Site-Specific Flood Risk Assessment (SSFRA(has been prepared and is contained within a separate report, namely 2251-DOB-XX-SI-RP-C-0002.

Appendix A IGSL Ground Investigation

Report on a Site Investigation
At
Woodstock Lodge Athy
for
Kildare County Council
and
Kavanagh Mansfield and Partners
Consulting Engineers

Report No; 12126 October 2006

1 Introduction

The proposed development of the site at Woodstock Lodge in Athy is to be undertaken by Kildare County Council

On the instructions of the project consulting engineers, Kavanagh Mansfield and Partners, a series of trial pits were opened under geotechnical engineering supervision to examine the suitability of the sub soils for foundation purposes, to determine the dimensions of some existing foundations and to establish permeability of the sub soils for drainage purposes.

Following completion of the trial pits and examination and logging of samples it was decided to carry out a number of dynamic probes in accordance with BS 1377 (Eurocode 7) to confirm the pattern of soil strength with depth.

In all, five trial pits were opened to establish geotechnical data. Three pits were opened to examine foundations and two pits excavated for Soakaway Testing. Dynamic probing was carried out at nine positions to determine soil strength.

This report details the findings of the investigation and comments on the results relative to foundation construction.

2 Fieldwork

The exploratory locations are noted on the site plan enclosed in Appendix VI to this report.

The site is located in Athy on Woodstock Road in the grounds of Woodstock House.

a. Trial Pits

A JCB excavator was provided and excavations were made at five locations to give an overall site coverage. The work was supervised by an experienced geotechnical engineer who logged the stratification, recovered representative samples, noted excavation stability and recorded ground water where encountered. Detailed trial pit records are contained in Appendix I to this report.

Trial pits noted surface top soil or fill overlying silty sandy gravel or sandy gravelly silt or clay. The material is described as medium dense to dense in situ, becoming very dense with boulders and cobbles in some locations.

Trial Pits were terminated at depths between 1.60 and 2.60 metres, ground water was noted at 2.50 metres only in TP 3.

Excavations remained generally stable during the short-term excavation period.

b. Foundation Inspection

The foundations of the existing house were examined by opening pits at three locations. Details of the findings are noted in Appendix II

c. Percolation to BRE Digest 365

Two percolation tests were carried out in locations nominated by the engineer. Testing was in accordance with the requirements of BRE Digest 365. Test data is contained in Appendix III.

d. Dynamic Probing

Probing was in accordance with the heavy-duty probe specification of BS 1377: Part 9: 1990. In these tests, the soil resistance is measured in terms of the number of drop-hammer blows required to drive the test probe through each 100 mm increment of penetration. Probing is terminated when the blow count exceeds 25/100mm to avoid damage to the apparatus. Where loose material is present a single blow count may drive the apparatus in excess of 100mm. In this instance blow counts of zero may be recorded.

The results are presented in both graphical and tabular form in Appendix 1.

The probes indicate that the upper 0.50 metres of soil is loosely compacted. Increasing probe resistance below this level confirms a strength increase to medium dense and dense. Probe refusal on very dense soil at depths between 1.00 and 2.50 metres.

3. Laboratory Testing.

Samples were taken from each trial pit and tests carried out to confirm soil classification, grading, sulphate content and CBR value. All laboratory data is contained in Appendix V to the report.

Sulphate and pH levels were determined for two samples. Results indicate low sulphate concentration and neutral pH. No special protection for foundation concrete is required.

CBR values range from 18.3 to 29% indicating that the shallow soils are suitable for road and pavement construction.

4 Discussion

The trial pit and probe investigation has been carried out to determine ground conditions in the area of a proposed new development. The proposed structures are understood to be relatively lightly loaded single or two storey units.

The soils encountered consist generally of granular material, gravelly sand and gravelly silt underlying shallow surface fill or top soil. The deposits probably represent the flood plain deposition of the River Barrow and are fairly typical of this part of Athy. Ground water was noted at 2.50 metres BGL.

Dynamic Probes were taken at nine locations and at a depth of about 1.00 metres below ground the cone resistance indicates medium dense to dense compaction with N_{100} values generally in excess of 6.

An allowable bearing pressure of the order of 150 kN/sq.m. is therefore indicated for conventional reinforced strip or pad foundations at a formation depth of about 1.00 metres.

Settlement of the order of 15 mm can be expected under this load intensity. Settlement should however be uniform and immediate.

Percolation tests have been carried out to BRE Digest 365 in two locations with results indicating a low percolation rate.

CBR tests confirm the suitability of the soil for pavement construction.

IGSL/JC
October 2006

Appendix I – Trial Pit Records

TRIAL PIT RECORD

REPORT NUMBER 12126

CONTRACT	Woodstock Lodge Athy
TRIAL PIT NO.	TP1
SHEET	Sheet 1 of 1
CO-ORDINATES(_)	GROUND LEVEL (m)
DATE STARTED	15/09/2006
DATE COMPLETED	15/09/2006
CLIENT	Kavanagh Mansfield and Partners
ENGINEER	Kavanagh Mansfield and Partners
EXCAVATION METHOD	JCB

Geotechnical Description	Legend	Depth (m)	Elevation	Water Strike	Samples: Sample Ref	Samples: Type	Samples: Depth	Vane Test (KPa)	Hand Penetrometer (KPa)
0.0 TOPSOIL									
Medium dense mottled grey brown sandy gravelly SILT with some cobbles and occasional boulders.Gravel is subrounded to rounded and sub angular		0.30			Y0706	CBR	0.50-0.50		
Medium dense mottled grey brown very gravelly coarse SAND with some cobbles and occasional boulders.Gravel is subrounded to rounded and sub angular		1.50			Y0707 Y0708	B D	1.50-1.50 1.50-1.50		
End of Trial Pit at 2.30m		2.30			Y0709 Y0710	B D	2.30-2.30 2.30-2.30		

1.0
2.0
3.0
4.0

Groundwater Conditions

Stability
STABLE

General Remarks

IGSL TP LOG 12126.GPJ IGSL.GDT 21/9/06

TRIAL PIT RECORD

REPORT NUMBER 12126

CONTRACT	Woodstock Lodge Athy
CO-ORDINATES(_)	GROUND LEVEL (m)
CLIENT	Kavanagh Mansfield and Partners
ENGINEER	Kavanagh Mansfield and Partners
TRIAL PIT NO.	TP2
SHEET	Sheet 1 of 1
DATE STARTED	15/09/2006
DATE COMPLETED	15/09/2006
EXCAVATION METHOD	JCB

Geotechnical Description	Legend	Depth (m)	Elevation	Water Strike	Samples: Sample Ref	Samples: Type	Samples: Depth	Vane Test (KPa)	Hand Penetrometer (KPa)
0.0 TOPSOIL		0.30							
Loose - Medium dense mottled grey brown sandy very gravelly SILT.Gravel is rounded to subrounded to subangular					Y0701	CBR	0.50-0.50		
1.0									
Loose - Medium dense mottled grey brown sandy gravelly SILT with some cobbles.Gravel is rounded to subrounded and sub angular		1.40			Y0702 Y0703	B D	1.50-1.50 1.50-1.50		
Loose -medium dense wet mottled grey sandy slightly gravelly SILT with some cobbles and occasional boulders.Gravel is subrounded to rounded and sub angular		1.80							
2.0									
End of Trial Pit at 2.50m		2.60			Y0704 Y0705	B D	2.50-2.50 2.50-2.50		
3.0									
4.0									

Groundwater Conditions

Stability
STABLE

General Remarks

IGSL TP LOG 12126.GPJ IGSL.GDT 21/9/06

TRIAL PIT RECORD

REPORT NUMBER 12126

CONTRACT	Woodstock Lodge Athy
CO-ORDINATES(_)	GROUND LEVEL (m)
CLIENT	Kavanagh Mansfield and Partners
ENGINEER	Kavanagh Mansfield and Partners
TRIAL PIT NO.	TP3
SHEET	Sheet 1 of 1
DATE STARTED	15/09/2006
DATE COMPLETED	15/09/2006
EXCAVATION METHOD	JCB

Geotechnical Description	Legend	Depth (m)	Elevation	Water Strike	Samples: Sample Ref	Samples: Type	Samples: Depth	Vane Test (KPa)	Hand Penetrometer (KPa)
0.0 MADE comprised concrete and gravel		0.40							
Loose to medium dense mottled grey brown very gravelly SAND with some cobbles with occasional boulders.Gravel is subrounded to rounded to sub angular					Y0718	B	0.50-0.50		
1.0					Y0719	B	1.50-1.50		
Loose wet brown slightly gravelly coarse SAND.Gravel is subrounded to sub angular		1.90							
2.0				1					
End of Trial Pit at 2.50m		2.50			Y0720	B	2.50-2.50		
3.0									
4.0									

Groundwater Conditions
water at 2.5m

Stability
STABLE

General Remarks

IGSL TP LOG 12126.GPJ IGSL.GDT 21/9/06

TRIAL PIT RECORD

REPORT NUMBER 12126

CONTRACT	Woodstock Lodge Athy
CO-ORDINATES(_)	GROUND LEVEL (m)
CLIENT	Kavanagh Mansfield and Partners
ENGINEER	Kavanagh Mansfield and Partners
TRIAL PIT NO.	TP4
SHEET	Sheet 1 of 1
DATE STARTED	15/09/2006
DATE COMPLETED	15/09/2006
EXCAVATION METHOD	JCB

Geotechnical Description	Legend	Depth (m)	Elevation	Water Strike	Samples: Sample Ref	Samples: Type	Samples: Depth	Vane Test (KPa)	Hand Penetrometer (KPa)
TOPSOIL		0.30							
Dense brown very gravelly fine SAND with some cobbles.Gravel is sub angular to angular		1.20			Y0711	CBR	0.50-0.50		
Dense brown very gravelly coarse SAND with some cobbles.Gravel is rounded to subrounded		1.70			Y0712	B	1.50-1.50		
Loose-medium dense brown sandy GRAVEL with some cobbles.Gravel is rounded to subrounded to sub angular		2.10			Y0713	B	2.10-2.10		
End of Trial Pit at 2.10m									

0.0 1.0 2.0 3.0 4.0

Groundwater Conditions

Stability
STABLE

General Remarks

IGSL TP LOG 12126.GPJ IGSL.GDT 21/9/06

TRIAL PIT RECORD

REPORT NUMBER 12126

CONTRACT	Woodstock Lodge Athy
CO-ORDINATES(_)	GROUND LEVEL (m)
CLIENT	Kavanagh Mansfield and Partners
ENGINEER	Kavanagh Mansfield and Partners
TRIAL PIT NO.	TP5
SHEET	Sheet 1 of 1
DATE STARTED	15/09/2006
DATE COMPLETED	15/09/2006
EXCAVATION METHOD	JCB

Geotechnical Description	Legend	Depth (m)	Elevation	Water Strike	Samples: Sample Ref	Samples: Type	Samples: Depth	Vane Test (KPa)	Hand Penetrometer (KPa)
0.0 TOPSOIL		0.30							
Loose -medium dense mottled orange/brown silty SAND					Y0721	CBR	0.50-0.50		
					Y0722	B	0.50-0.50		
Very dense grey slightly gravelly silty SAND.		0.90							
1.0									
End of Trial Pit at 1.50m		1.60			Y0723	B	1.50-1.50		
2.0									
3.0									
4.0									

Groundwater Conditions

Stability
STABLE

General Remarks

IGSL TP LOG 12126.GPJ IGSL.GDT 21/9/06

Appendix II – Foundation Pit Records

TRIAL PIT RECORD /FOUNDATION INSPECTION

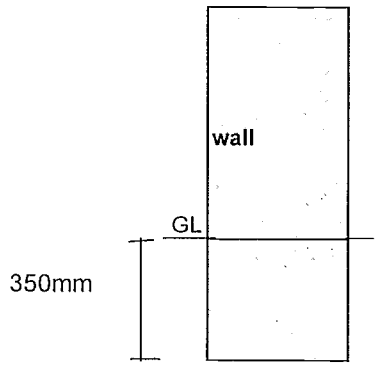
I.G.S.L.

Contract:**Woodstock Lodge Athy**
No:**12126**
Location:**Athy**
Client:**Kavanagh Mansfield and Partners**
Date:**17/09/2006**

PIT No. **TP1**
Sheet **1of 1**
Excavation method:
Hand pit
Ground Level

Description	Red. Level	Legend	Depth	samples Ref. No.	Type	Depth	Remarks
MADE GROUND(Comprised of sand gravel with some cobbles			0-0.60				

Foundation Details:



Observations	Groundwater Conditions
Backfilled with arising.Foundation did not step out	No groundwater encountered
	Logged by: FEMI

TRIAL PIT RECORD /FOUNDATION INSPECTION

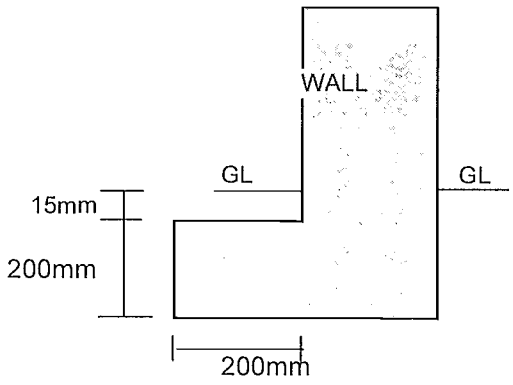
I.G.S.L.

Contract:**Woodstock Lodge Athy**
No:**12126**
Location:**Athy**
Client:**Kavanagh Mansfield and Partners**
Date:**15/09/06**

PIT No. **TP2**
Sheet **1of1**
Excavation method: **Hand pit**
Ground Level

Description	Red. Level	Legend	Depth	samples Ref. No.	Type	Depth	Remarks
MADE GROUND Concrete MADE GROUND(comprised of sand,gravel and some cobbles			0-0.15 0.15-0.70				

Foundation Details:



Observations	Groundwater Conditions
Backfilled with arising Foundation is underlain by sand and gravels with some cobbles	DRY
	Logged by: FEMI

TRIAL PIT RECORD /FOUNDATION INSPECTION

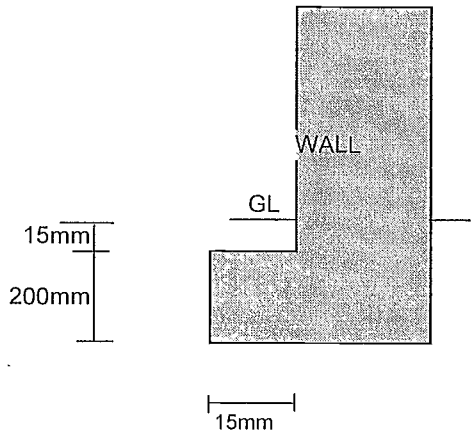
I.G.S.L.

Contract:**Woodstock Lodge Athy**
No:**12126**
Location:**Athy**
Client:**Kavanagh Mansfield**
Date:**17/09/2006**

PIT No. **TP3**
Sheet **1of 1**
Excavation method:
Hand pit
Ground Level

Description	Red. Level	Leg end	Depth	samples Ref. No.	Type	Depth	Remarks
MADE GROUND Concrete			0-0.15				
MADE GROUND(comprised of sand,gravel and some cobbles			0.15-0.60				

Foundation Details:



Observations	Groundwater Conditions
Backfilled with arisings Foundation is underlain by sand and gravel with some stones	
	Logged by: FEMI

Appendix III – Soakaway Test Results

Soakaway Design f -value from field tests IGSL

Contract: Woodstock Lodge Athy Contract No. 12126
Test No. PT1
Client
Date: 15-Sep

Summary of ground conditions

from	to	Description	Ground water
0.00	0.30	TOPSOIL	
0.30	1.00	Medium dense brown gravelly fine SAND	
1.00	2.00	Medium dense brown gravelly fine SAND with some cobbles and occasic	

Field Data

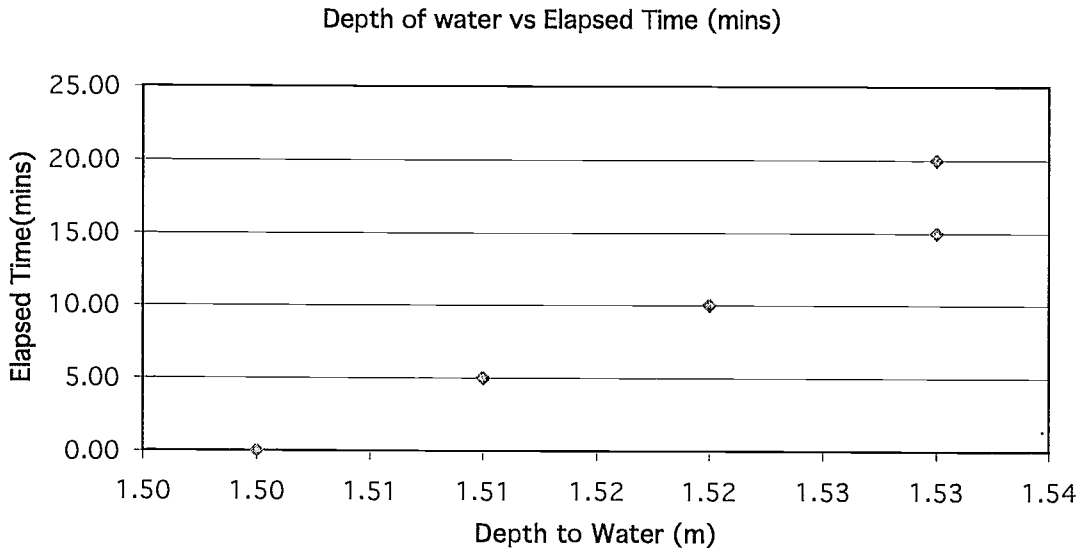
Depth to Water (m)	Elapsed Time (min)
1.50	0.00
1.51	5.00
1.52	10.00
1.53	15.00
1.53	20.00

Field Test

Depth of Pit (D)	2.00	m
Width of Pit (B)	1.30	m
Length of Pit (L)	1.70	m
Initial depth to Water =	1.50	m
Final depth to water =	1.53	m
Elapsed time (mins)=	15.00	
Top of permeable soil		m
Base of permeable soil		m
Base area=	2.21	m2
*Av. side area of permeable stratum over test period=	2.91	m2
Total Exposed area =	5.12	m2

Infiltration rate (f) = Volume of water used/unit exposed area / unit time

f= 0.00086 m/min or 1.4388E-05 m/sec



Soakaway Design f -value from field tests IGSL

Contract: Woodstock Lodge Athy Contract No. 12126
Test No. PT2
Client
Date: 15-Sep

Summary of ground conditions

from	to	Description	Ground water
0.00	0.30	TOPSOIL	
0.30	1.80	Medium dense brown silty very gravelly SAND with some cobbles and oc	

Field Data

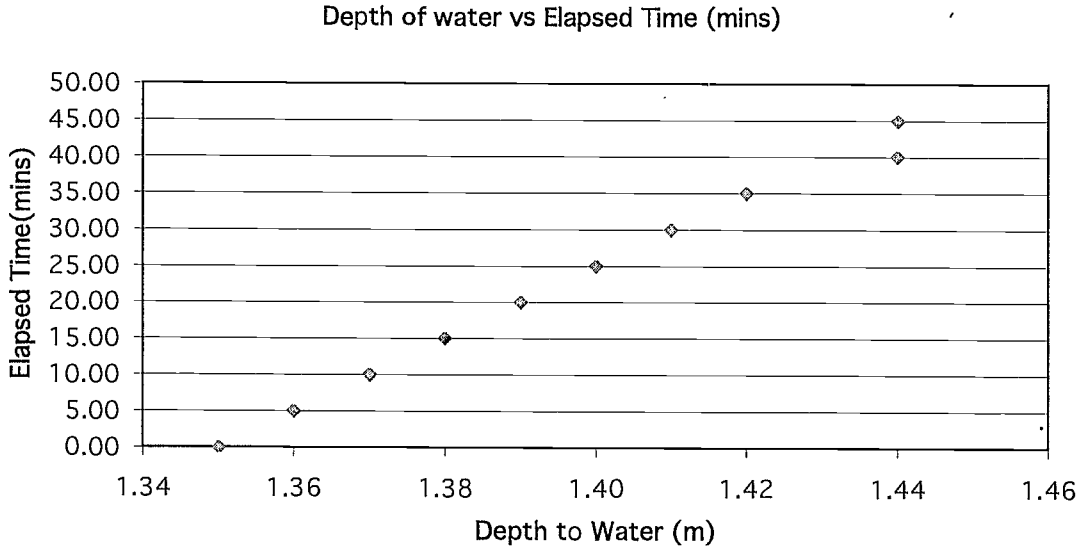
Depth to Water (m)	Elapsed Time (min)
1.35	0.00
1.36	5.00
1.37	10.00
1.38	15.00
1.39	20.00
1.40	25.00
1.41	30.00
1.42	35.00
1.44	40.00
1.44	45.00

Field Test

Depth of Pit (D)	1.80	m
Width of Pit (B)	1.30	m
Length of Pit (L)	2.00	m
Initial depth to Water =	1.35	m
Final depth to water =	1.44	m
Elapsed time (mins)=	45.00	
Top of permeable soil		m
Base of permeable soil		m
Base area=	2.6	m2
*Av. side area of permeable stratum over test period=	2.673	m2
Total Exposed area =	5.273	m2

Infiltration rate (f) = Volume of water used/unit exposed area / unit time

f= 0.00099 m/min or 1.6436E-05 m/sec



Appendix IV – Dynamic Probe Records

DYNAMIC PROBE RECORD

REPORT NUMBER 12126

CONTRACT	Woodstock Lodge Athy	PROBE NO.	DP01
		SHEET	Sheet 1 of 1
CO-ORDINATES(_)		DATE STARTED	02/10/2006
	GROUND LEVEL (m)	DATE COMPLETED	02/10/2006
	HAMMER MASS (kg) 50		
CLIENT	Kavanagh Mansfield and Partners	INCREMENT SIZE (mm) 100	
ENGINEER	Kavanagh Mansfield and Partners	FALL HEIGHT (mm) 500	PROBE TYPE DPH

Depth (m)	Geotechnical Description	Legend	Depth (m)	Elevation (mOD)	Water	Depth (m)	Probe Readings (Blows/Increment)
0.0	.					0.00	1
						0.10	3
						0.20	5
						0.30	5
						0.40	6
						0.50	6
						0.60	4
						0.70	7
						0.80	9
						0.90	22
1.0						1.00	25
	End of Probe at 1.10 m						
2.0							
3.0							
4.0							

Graphic Probe Record: 0 5 10 15 20 25

GROUNDWATER OBSERVATIONS

REMARKS

IGSL DP LOG 12126DP.GPJ IGSL.GDT 3/10/06

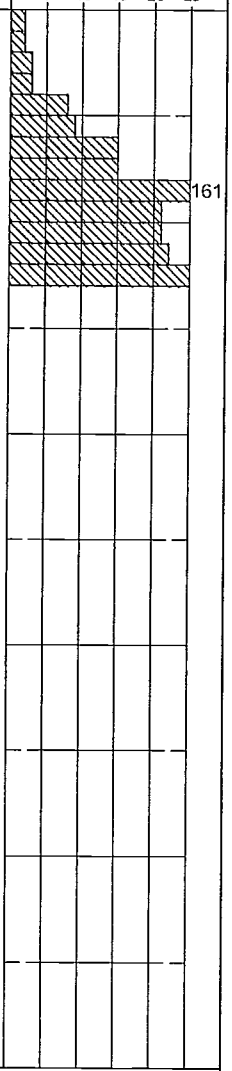
DYNAMIC PROBE RECORD

REPORT NUMBER 12126

CONTRACT	Woodstock Lodge Athy	PROBE NO.	DP02
		SHEET	Sheet 1 of 1
CO-ORDINATES(_)		DATE STARTED	02/10/2006
	GROUND LEVEL (m)	DATE COMPLETED	02/10/2006
	HAMMER MASS (kg) 50		
CLIENT	Kavanagh Mansfield and Partners	INCREMENT SIZE (mm) 100	
ENGINEER	Kavanagh Mansfield and Partners	FALL HEIGHT (mm) 500	PROBE TYPE DPH

Depth (m)	Geotechnical Description	Legend	Depth (m)	Elevation (mOD)	Water	Depth (m)	Probe Readings (Blows/Increment)
0.0	.					0.00	2
						0.10	2
						0.20	3
						0.30	3
						0.40	8
						0.50	9
						0.60	15
						0.70	15
						0.80	161
1.0						0.90	21
						1.00	21
						1.10	22
	End of Probe at 1.30 m					1.20	25
2.0							
3.0							
4.0							

Graphic Probe Record



GROUNDWATER OBSERVATIONS

REMARKS

IGSL DP LOG 12126DP.GPJ IGSL.GDT 3/10/06

DYNAMIC PROBE RECORD

REPORT NUMBER 12126

CONTRACT	Woodstock Lodge Athy	PROBE NO.	DP03
		SHEET	Sheet 1 of 1
CO-ORDINATES(_)		DATE STARTED	02/10/2006
	GROUND LEVEL (m)	DATE COMPLETED	02/10/2006
	HAMMER MASS (kg) 50		
CLIENT	Kavanagh Mansfield and Partners	INCREMENT SIZE (mm) 100	
ENGINEER	Kavanagh Mansfield and Partners	FALL HEIGHT (mm) 500	PROBE TYPE DPH

Depth (m)	Geotechnical Description	Legend	Depth (m)	Elevation (mOD)	Water	Depth (m)	Probe Readings (Blows/Increment)
0.0	.					0.00	4
						0.10	2
						0.20	3
						0.30	4
						0.40	6
						0.50	6
						0.60	3
						0.70	12
						0.80	25
1.0	End of Probe at 0.90 m						
2.0							
3.0							
4.0							

Graphic Probe Record: 0 5 10 15 20 25

GROUNDWATER OBSERVATIONS

REMARKS

IGSL DP LOG 12126DP.GPJ IGSL.GDT 3/10/06

DYNAMIC PROBE RECORD

REPORT NUMBER 12126

CONTRACT	Woodstock Lodge Athy	PROBE NO.	DP04
		SHEET	Sheet 1 of 1
CO-ORDINATES(_)	GROUND LEVEL (m)	DATE STARTED	02/10/2006
	HAMMER MASS (kg) 50	DATE COMPLETED	02/10/2006
CLIENT Kavanagh Mansfield and Partners	INCREMENT SIZE (mm) 100		
ENGINEER Kavanagh Mansfield and Partners	FALL HEIGHT (mm) 500	PROBE TYPE	DPH

Depth (m)	Geotechnical Description	Legend	Depth (m)	Elevation (mOD)	Water	Depth (m)	Probe Readings (Blows/Increment)
0.0	.					0.00	1
						0.10	1
						0.20	3
						0.30	10
						0.40	10
						0.50	15
						0.60	25
	End of Probe at 0.70 m						
1.0							
2.0							
3.0							
4.0							

Graphic Probe Record: 0 5 10 15 20 25

GROUNDWATER OBSERVATIONS

REMARKS

IGSL DP LOG 12126DP.GPJ IGSL.GDT 3/10/06

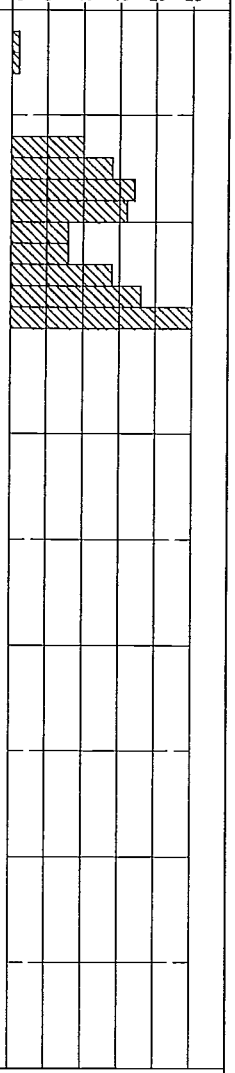
DYNAMIC PROBE RECORD

REPORT NUMBER 12126

CONTRACT	Woodstock Lodge Athy	PROBE NO.	DP05
		SHEET	Sheet 1 of 1
CO-ORDINATES(_)		DATE STARTED	02/10/2006
GROUND LEVEL (m)		DATE COMPLETED	02/10/2006
HAMMER MASS (kg)	50		
CLIENT	Kavanagh Mansfield and Partners	INCREMENT SIZE (mm)	100
ENGINEER	Kavanagh Mansfield and Partners	FALL HEIGHT (mm)	500
		PROBE TYPE	DPH

Depth (m)	Geotechnical Description	Legend	Depth (m)	Elevation (mOD)	Water	Depth (m)	Probe Readings (Blows/Increment)
0.0	.					0.00	0
						0.10	1
						0.20	1
						0.30	0
						0.40	0
						0.50	0
						0.60	10
						0.70	14
						0.80	17
						0.90	16
1.0						1.00	8
						1.10	8
						1.20	14
						1.30	18
						1.40	25
	End of Probe at 1.50 m						
2.0							
3.0							
4.0							

Graphic Probe Record



GROUNDWATER OBSERVATIONS

REMARKS

IGSL DP LOG 12126DP.GPJ IGSL.GDT 3/10/06

DYNAMIC PROBE RECORD

REPORT NUMBER 12126

CONTRACT	Woodstock Lodge Athy	PROBE NO.	DP06
		SHEET	Sheet 1 of 1
CO-ORDINATES(_)		DATE STARTED	02/10/2006
	GROUND LEVEL (m)	DATE COMPLETED	02/10/2006
	HAMMER MASS (kg) 50		
CLIENT	Kavanagh Mansfield and Partners	INCREMENT SIZE (mm) 100	
ENGINEER	Kavanagh Mansfield and Partners	FALL HEIGHT (mm) 500	PROBE TYPE DPH

Depth (m)	Geotechnical Description	Legend	Depth (m)	Elevation (mOD)	Water	Depth (m)	Probe Readings (Blows/Increment)
0.0	.					0.00	2
						0.10	3
						0.20	5
						0.30	5
						0.40	6
						0.50	8
						0.60	16
						0.70	25
	End of Probe at 0.80 m						
1.0							
2.0							
3.0							
4.0							

Graphic Probe Record: 0 5 10 15 20 25

GROUNDWATER OBSERVATIONS

REMARKS

IGSL DP LOG 12126DP.GPJ IGSL.GDT 3/10/06

DYNAMIC PROBE RECORD

REPORT NUMBER 12126

CONTRACT	Woodstock Lodge Athy	PROBE NO.	DP07
		SHEET	Sheet 1 of 1
CO-ORDINATES(_)		DATE STARTED	02/10/2006
	GROUND LEVEL (m)	DATE COMPLETED	02/10/2006
	HAMMER MASS (kg) 50		
CLIENT	Kavanagh Mansfield and Partners	INCREMENT SIZE (mm) 100	
ENGINEER	Kavanagh Mansfield and Partners	FALL HEIGHT (mm) 500	PROBE TYPE DPH

Depth (m)	Geotechnical Description	Legend	Depth (m)	Elevation (mOD)	Water	Depth (m)	Probe Readings (Blows/Increment)
0.0	.					0.00	0
						0.10	1
						0.20	1
						0.30	1
						0.40	1
						0.50	1
						0.60	3
						0.70	15
						0.80	15
						0.90	19
1.0						1.00	25
	End of Probe at 1.10 m						
2.0							
3.0							
4.0							

Graphic Probe Record: 0 5 10 15 20 25

GROUNDWATER OBSERVATIONS

REMARKS

IGSL DP LOG 12126DP.GPJ IGSL.GDT 3/10/06

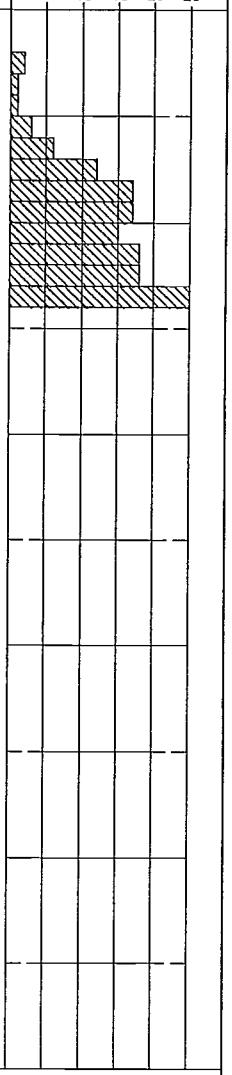
DYNAMIC PROBE RECORD

REPORT NUMBER 12126

CONTRACT	Woodstock Lodge Athy	PROBE NO.	DP08
		SHEET	Sheet 1 of 1
CO-ORDINATES(_)	GROUND LEVEL (m)	DATE STARTED	02/10/2006
	HAMMER MASS (kg) 50	DATE COMPLETED	02/10/2006
CLIENT Kavanagh Mansfield and Partners	INCREMENT SIZE (mm) 100		
ENGINEER Kavanagh Mansfield and Partners	FALL HEIGHT (mm) 500	PROBE TYPE	DPH

Depth (m)	Geotechnical Description	Legend	Depth (m)	Elevation (mOD)	Water	Depth (m)	Probe Readings (Blows/Increment)
0.0	.					0.00	0
						0.10	0
						0.20	2
						0.30	1
						0.40	1
						0.50	3
						0.60	6
						0.70	12
						0.80	17
1.0						0.90	17
						1.00	15
						1.10	18
						1.20	18
	End of Probe at 1.40 m					1.30	25
2.0							
3.0							
4.0							

Graphic Probe Record



GROUNDWATER OBSERVATIONS

REMARKS

IGSL DP LOG 12126DP.GPJ IGSL.GDT 3/10/06

DYNAMIC PROBE RECORD

REPORT NUMBER 12126

CONTRACT	Woodstock Lodge Athy	PROBE NO.	DP09
		SHEET	Sheet 1 of 1
CO-ORDINATES(_)	GROUND LEVEL (m)	DATE STARTED	02/10/2006
	HAMMER MASS (kg) 50	DATE COMPLETED	02/10/2006
CLIENT Kavanagh Mansfield and Partners	INCREMENT SIZE (mm) 100		
ENGINEER Kavanagh Mansfield and Partners	FALL HEIGHT (mm) 500	PROBE TYPE	DPH

Depth (m)	Geotechnical Description	Legend	Depth (m)	Elevation (mOD)	Water	Depth (m)	Probe Readings (Blows/Increment)
0.0	.					0.00	0
						0.10	0
						0.20	0
						0.30	0
						0.40	5
						0.50	6
						0.60	6
						0.70	5
						0.80	3
1.0						0.90	3
						1.00	3
						1.10	3
						1.20	3
						1.30	4
						1.40	4
						1.50	4
						1.60	4
						1.70	3
2.0						1.80	3
						1.90	3
						2.00	4
						2.10	3
						2.20	7
						2.30	5
						2.40	10
	End of Probe at 2.60 m					2.50	25
3.0							
4.0							

Graphic Probe Record: 0 5 10 15 20 25

GROUNDWATER OBSERVATIONS

REMARKS

IGSL DP LOG 12126DP.GPJ IGSL.GDT 3/10/06

Appendix V – Geotechnical Laboratory Records

Summary of Classification Tests

BS1377:Part 2:1990, clauses 3.2, 4.3, 5.3 & 5.4

BH/TP No.	Sample No.	Depth (m)	Sample Type	Moisture Content %	Liquid Limit %	Plastic Limit %	Plasticity Index	<425µm %	Preparation	Description	Classification
TP 1	Y0706	0.50	D	10.8	33	20	13	44.3	WS	Grey brown slightly sandy slightly gravelly CLAY with root hairs & pieces	C L
TP 2	Y0704	2.50	D	21.5	26	NP		90.9	WS	Grey brown sandy SILT	M L

Notes: NAT - tested as received WS - Wet sieved (425µm) NP - Non Plastic

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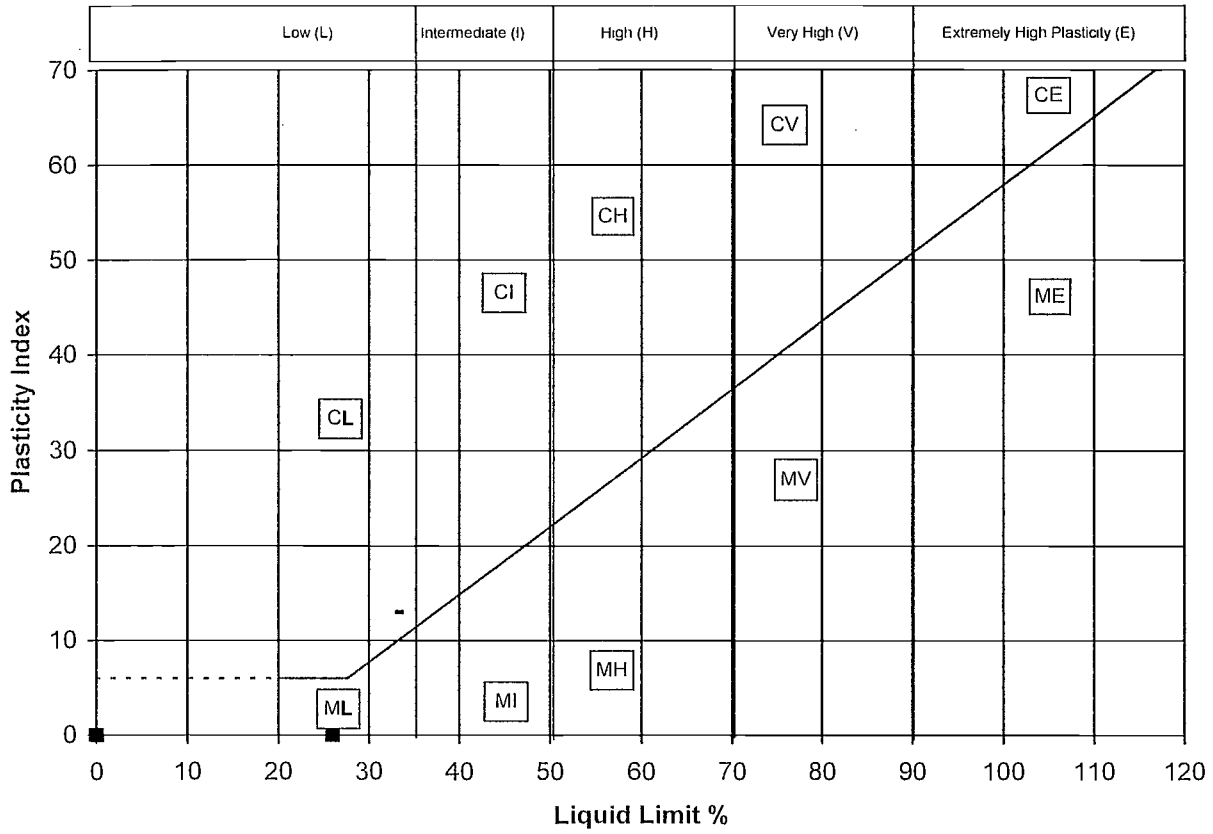
	Issued By	Date		Date	Page
		09/10/2006			of

Plasticity Chart - Summary of Liquid & Plastic Limit Tests
BS1377:Part 2:1990, clauses 3.2, 4 & 5
Chart in accordance with BS5930:1999, fig.18

Contract No. 12126 Contract: WOODSTOCK LODGE ATHY



Code	BH/TP	Sample	Depth (m)	MC%	LL%	PL%	PI%	%<425µm	Description
-	TP 1	Y0706	0.50	10.8	33	20	13	44.3	Grey brown slightly sandy slightly gravelly CLAY with root hairs & pieces of glass
■	TP 2	Y0704	2.50	21.5	26	NP	0	90.9	Grey brown sandy SILT
●									
◆									
❹									
🗍									
⑥									
□									
-									
■									
●									
◆									
❹									
🗍									
⑥									
□									

NP denotes specimen is non-plastic.

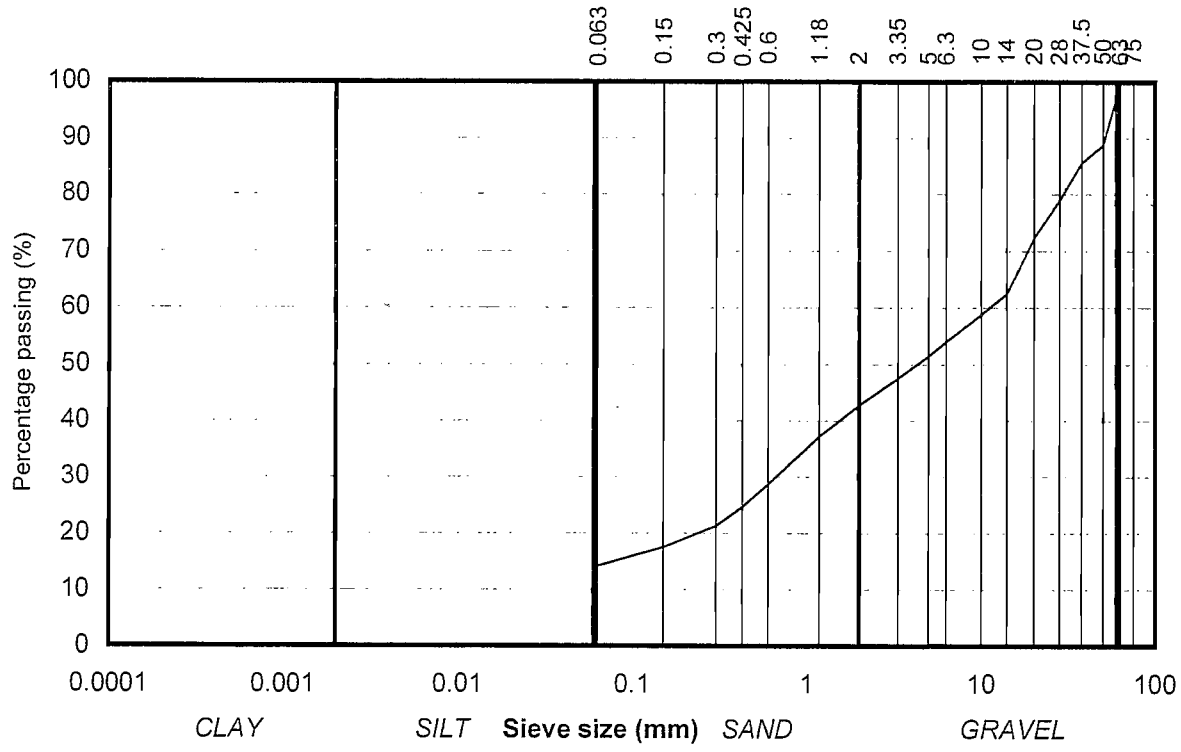
	Issued by	Date		Date	Page
IGSL		########			

Determination of Particle Size Distribution

BS1377:Part2:1990 , clauses 9.2

particle size	% passing	
75	100	COBBLES
63	100	GRAVEL
50	89	
37.5	86	
28	79	
20	72	
14	62	
10	59	
6.3	54	
5	52	
3.35	48	
2	43	SAND
1.18	37	
0.6	29	
0.425	25	
0.3	21	
0.15	18	
0.063	14	SILT/CLAY
0.042	#N/A	
0.030	#N/A	
0.019	#N/A	
0.011	#N/A	
0.008	#N/A	
0.004	#N/A	
0.002	#N/A	

Contract No: 12126
Contract: WOODSTOCK LODGE ATHY
BH/TP No: TP 1
SAMPLE No.: Y0707
DEPTH (m): 1.50
TEST METHOD: Wet sieve
DESCRIPTION: Grey brown clayey/silty, very sandy, GRAVEL



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Determination of Particle Size Distribution

BS1377:Part2:1990 , clauses 9.2

particle size	% passing	
75	100	COBBLES
63	91	GRAVEL
50	91	
37.5	91	
28	84	
20	75	
14	70	
10	65	
6.3	60	
5	57	
3.35	53	
2	50	SAND
1.18	48	
0.6	42	
0.425	37	
0.3	30	
0.15	19	
0.063	13	SILT/CLAY
0.042	#N/A	
0.030	#N/A	
0.019	#N/A	
0.011	#N/A	
0.008	#N/A	
0.004	#N/A	
0.002	#N/A	

Contract No: 12126

Contract: WOODSTOCK LODGE ATHY

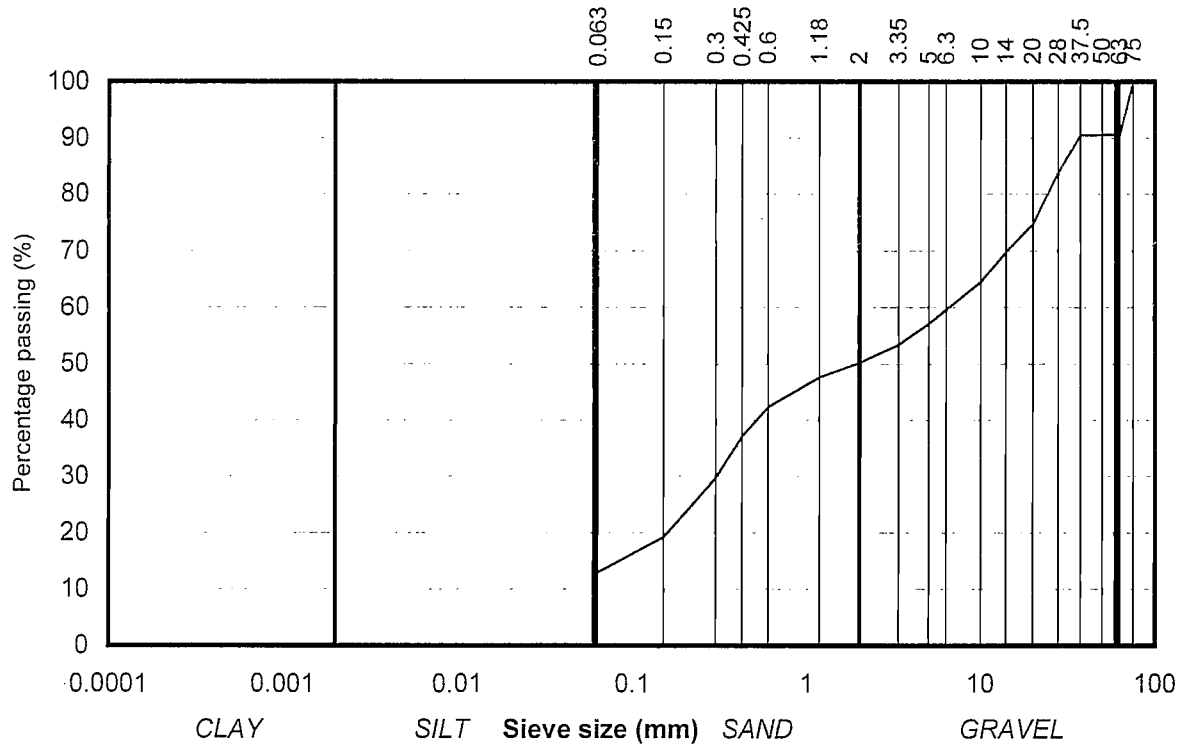
BH/TP No: TP 3

SAMPLE No.: Y0719

DEPTH (m): 1.50

TEST METHOD: Wet sieve

DESCRIPTION: Grey brown clayey/silty, very sandy, GRAVEL with some cobbles



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		09/10/2006			

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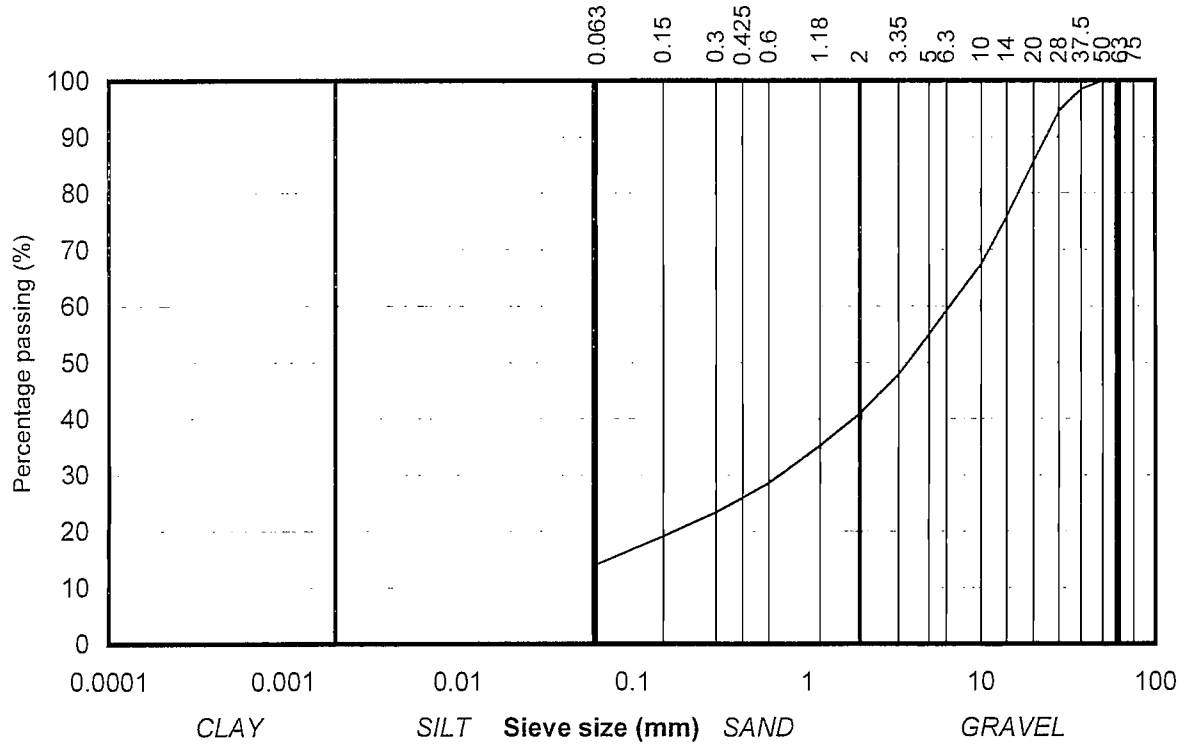
Determination of Particle Size Distribution

BS1377:Part2:1990 , clauses 9.2

particle size	% passing	
75	100	COBBLES
63	100	GRAVEL
50	100	
37.5	99	
28	95	
20	86	
14	76	
10	67	
6.3	59	
5	55	
3.35	48	
2	41	SAND
1.18	35	
0.6	29	
0.425	26	
0.3	23	
0.15	19	
0.063	14	SILT/CLAY
0.042	#N/A	
0.030	#N/A	
0.019	#N/A	
0.011	#N/A	
0.008	#N/A	
0.004	#N/A	
0.002	#N/A	

Contract No: 12126
Contract: WOODSTOCK LODGE ATHY
BH/TP No: TP 4
SAMPLE No.: Y0712
DEPTH (m): 1.50
TEST METHOD: Wet sieve
DESCRIPTION: Grey brown clayey/silty, very sandy, GRAVEL with root hairs



IGSL	Issued By	Date:			Page no:
		09/10/2006			

IGSL LIMITED, UNIT F, M7 BUSINESS PARK, NAAS, CO.KILDARE. PSD V3.1 12.01

Determination of Particle Size Distribution

BS1377:Part2:1990 , clauses 9.2

particle size	% passing	
75	100	COBBLES
63	100	
50	100	
37.5	100	
28	99	
20	98	GRAVEL
14	97	
10	95	
6.3	92	
5	91	
3.35	88	
2	85	
1.18	82	
0.6	78	SAND
0.425	75	
0.3	72	
0.15	63	
0.063	52	
0.042	#N/A	
0.030	#N/A	
0.019	#N/A	SILT/CLAY
0.011	#N/A	
0.008	#N/A	
0.004	#N/A	
0.002	#N/A	

Contract No: 12126

Contract: WOODSTOCK LODGE ATHY

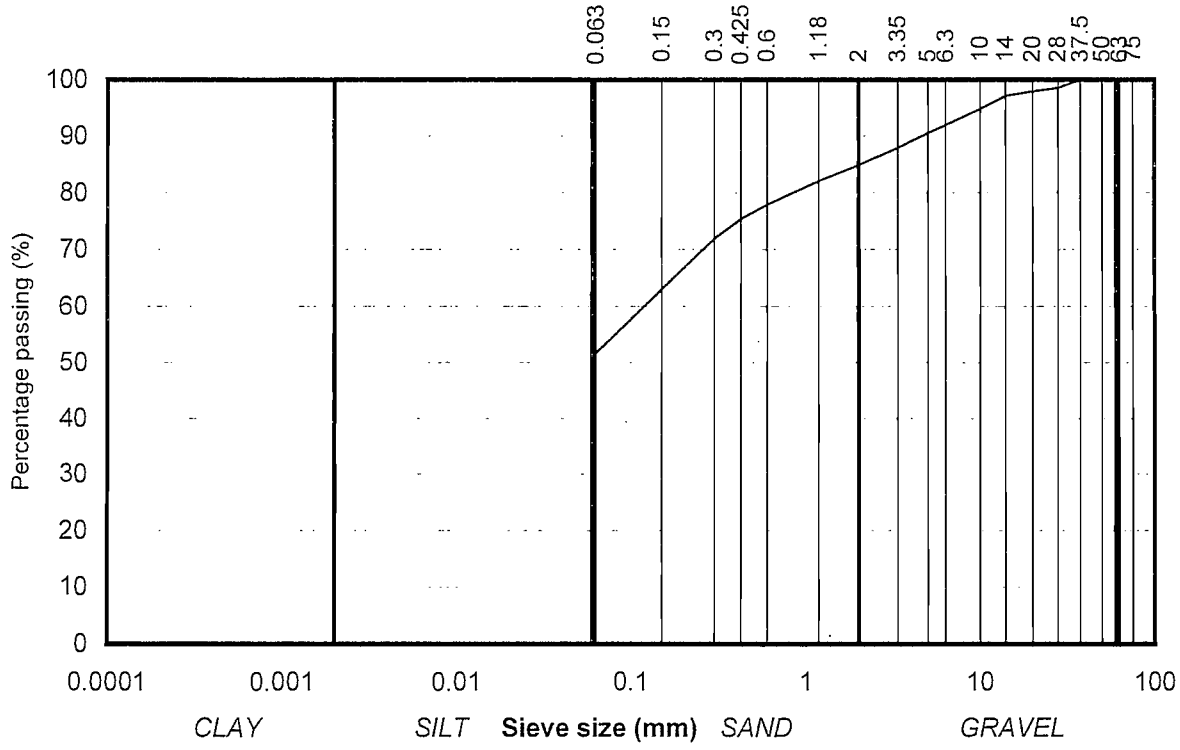
BH/TP No: TP 5

SAMPLE No.: Y0723

DEPTH (m): 1.50

TEST METHOD: Wet sieve

DESCRIPTION: Grey brown slightly sandy, slightly gravelly, SILT/CLAY with root hairs



IGSL	Issued By	Date:			Page no:
		09/10/2006			

Report No. 12126	SULPHATE CONTENT & pH					IGSL
Contract: ATHY						
Location TP	Depth (m)	Reference No.	Description	WATER Parts per 100,000	SOIL Percentage Sulphates	pH
3	0.50	718	Silty Gravelly SAND		0.06	8.0
5	1.50	723	Silty SAND		0.02	7.8
Note:				SO4 = SO3 x 1.2		

Report No.

CALIFORNIA BEARING RATIO

I.G.S.L.

Contract: WOODSTOCK LODGE ATHY

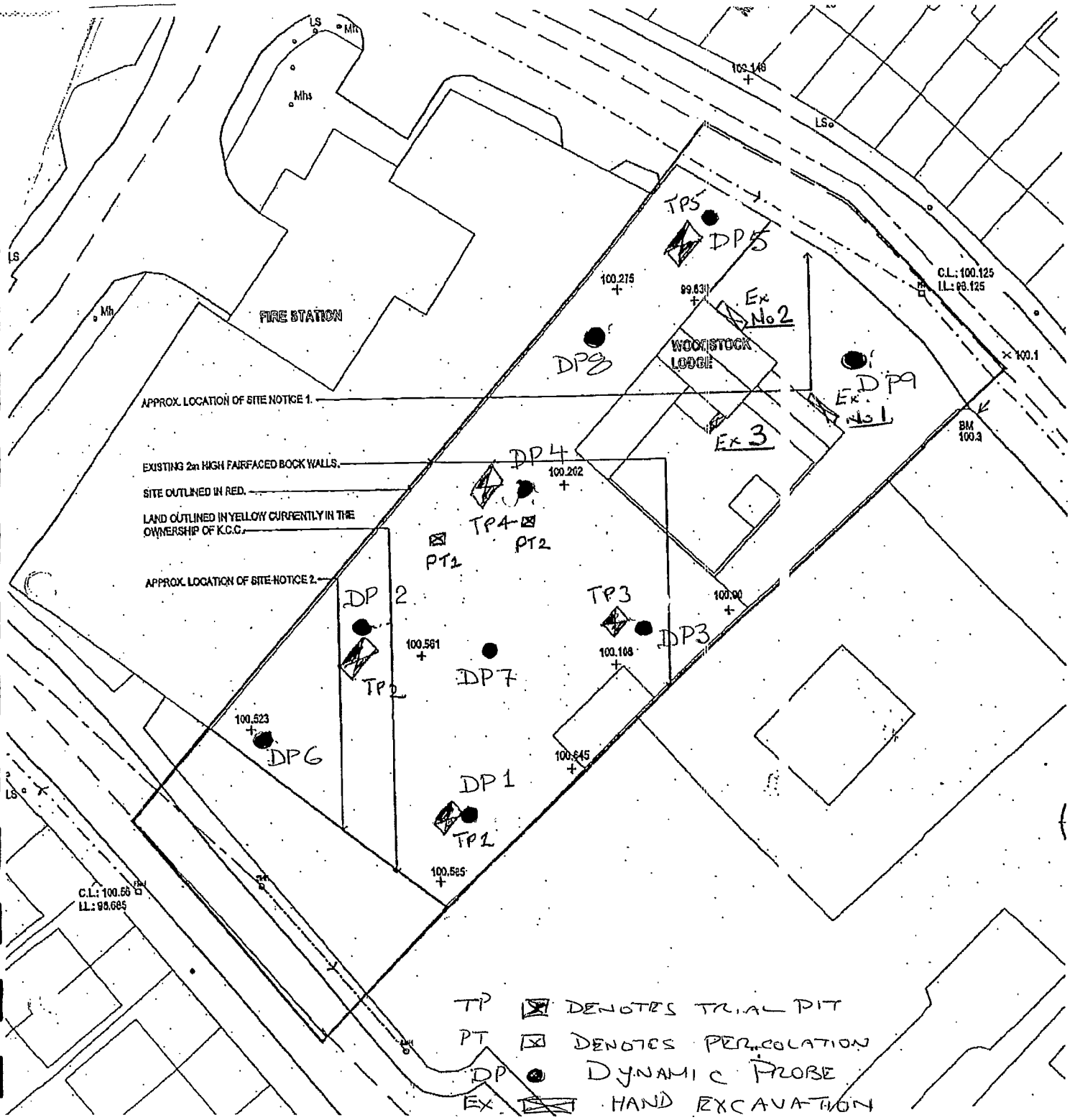
DATE 09/10/2006

CONTRACT No 12126

Location	Sample No.	Depth of Sample	Sample Description	Water Content %	Test Code	Water Content Top %	Water Content Bottom %	Bulk Density Mg/M3	% Passing 20mm	C.B.R. Top %	C.B.R. Base %	C.B.R. Average %
TP 1	Y0706	0.50	Brown slightly sandy slightly gravelly SILT/CLAY	11.9	L/St	11.9	11.9	1.94	93.3	20.8	15.9	18.3
TP 2	Y0701	0.50	Brown slightly sandy slightly gravelly SILT/CLAY with root hairs	10.3	L/St	10.0	10.5	1.94	95.4	32.6	25.4	29.0
TP 5	Y0721	0.50	Brown slightly sandy slightly gravelly SILT/CLAY	14.4	L/St	14.2	14.6	2.02	97.5	19.8	17.7	18.8

Test Code U.-Undisturbed Sample L.-2.5Kg. Rammer A/5.-5% Air Voids Ratio V.- Vibrating Hammer
D.-Dynamic Compaction H.-4.5Kg. Rammer A10.-10% Air Voids Ratio M.- Method Number
St.-Static compaction RN29.- Road Note 29 (St. 95% H.)

Appendix VI – Site Plan



WOODSTOCK HOUSE ATHY

SITE LOCATION PLAN

Appendix B Infiltration Trench Design

Tekla Tedds	Project: Pr. Development at Glandore, Athy, Co. Kildare				Job no.: 2251	
	Calcs for: Linear Infiltration Trench				Start page no./Revision: 1 1 S2.P01	
	Calcs by: PD	Calcs date: 04/10/2022	Checked by: PD	Checked date: 04/10/2022	Approved by: PD	Approved date: 04/10/2022

SOAKAWAY DESIGN

In accordance with BRE Digest 365 - Soakaway design

Tedds calculation version 2.0.04

Design rainfall intensity

Location of catchment area	Other
Impermeable area drained to the system	A = **900.0** m^2
Return period	Period = **100** yr
Ratio 60 min to 2 day rainfall of 5 yr return period	r = **0.330**
5-year return period rainfall of 60 minutes duration	M5_60min = **15.8** mm
Increase of rainfall intensity due to global warming	$p_{climate}$ = **30** %

Soakaway / infiltration trench details

Soakaway type	Rectangular
Minimum depth of pit (below incoming invert)	d = **1500** mm
Width of pit	w = **2000** mm
Length of pit	l = **22000** mm
Percentage free volume	V_{free} = **95** %
Soil infiltration rate	f = **14.4×10^{-6}** m/s
Wetted area of pit 50% full	a_{s50} = l × d + w × d = **36000000** mm^2

Table equations

Inflow (cl.3.3.1)	I = M100 × A
Outflow (cl.3.3.2)	O = a_{s50} × f × D
Storage (cl.3.3.3)	S = I - O

Duration, D (min)	Growth factor Z1	M5 rainfalls (mm)	Growth factor Z2	100 year rainfall, M100 (mm)	Inflow (m^3)	Outflow (m^3)	Storage required (m^3)
5	0.35;	7.2;	1.91;	13.7;	12.35;	0.16;	12.19
10	0.50;	10.3;	1.97;	20.2;	18.21;	0.31;	17.90
15	0.61;	12.5;	1.98;	24.7;	22.27;	0.47;	21.81
30	0.78;	16.0;	1.97;	31.6;	28.40;	0.93;	27.47
60	1.00;	20.5;	1.93;	39.6;	35.60;	1.86;	33.73
120	1.23;	25.3;	1.89;	47.7;	42.93;	3.73;	39.20
240	1.53;	31.4;	1.84;	57.8;	52.00;	7.45;	44.55
360	1.73;	35.5;	1.81;	64.2;	57.75;	11.18;	46.57
600	2.04;	41.9;	1.76;	73.8;	66.39;	18.64;	47.75
1440	2.60;	53.4;	1.71;	91.1;	82.01;	44.73;	37.29

Required storage volume	S_{req} = **47.75** m^3
Soakaway storage volume	S_{act} = l × d × w × V_{free} = **62.70** m^3

PASS - Soakaway storage volume

Time for emptying soakaway to half volume	t_{s50} = S_{req} × 0.5 / (a_{s50} × f) = 12hr 48min 40s

PASS - Soakaway discharge time less than or equal to 24 hours