

Surface Water Drainage and SuDS Strategy Report

EX22/O50/O6

105 Colemans Moor Road
Woodley
Reading
RG5 4DA



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Revisions and Additional Material

Document History and Status

Revision	Date	Purpose/Status
-	27.06.2022	First Issue
A	05.09.2024	Revision to new planning application

Document Details

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Preamble

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1.0 Introduction

- 1.1 JMS Engineers have been appointed to prepare a surface water drainage strategy and SuDS report which will aim to discharge drainage related planning conditions for the development at 105 Colemans Moor Road, Woodley.
- 1.2 The purpose of this report is to review and meet the requirements as set out by the local planning authority in terms of surface water drainage.
- 1.3 This report will include a surface water drainage strategy and will consider the use of SuDS wherever possible.

2.0 Location & Existing Conditions

- 2.0.1 The site is located off Colemans Moor Road, Reading and is an existing dwelling. A topographical survey of the site has been carried out and can be found in [Appendix A](#).
- 2.0.2 The existing total site area is 0.075ha with the site being made up of roof, hard standing and garden area. The site falls from north to south with a level difference of approximately 2m. The existing site is approximately 40% impermeable.
- 2.0.3 The River Loddon is located approximately 500m to the south of the site.
- 2.0.4 Information taken from the British Geological Survey (BGS) shows the underlying geology as superficial deposits classified as Alluvium – Clay, silt, sand and gravel. Bedrock geology is classified as London Clay Formation – Clay, silt and sand as shown in [Figure 1](#) and [Figure 2](#) below. Local borehole information shown in [Figure 3](#) shows made ground above clay which was encountered at a depth of 2.2m.

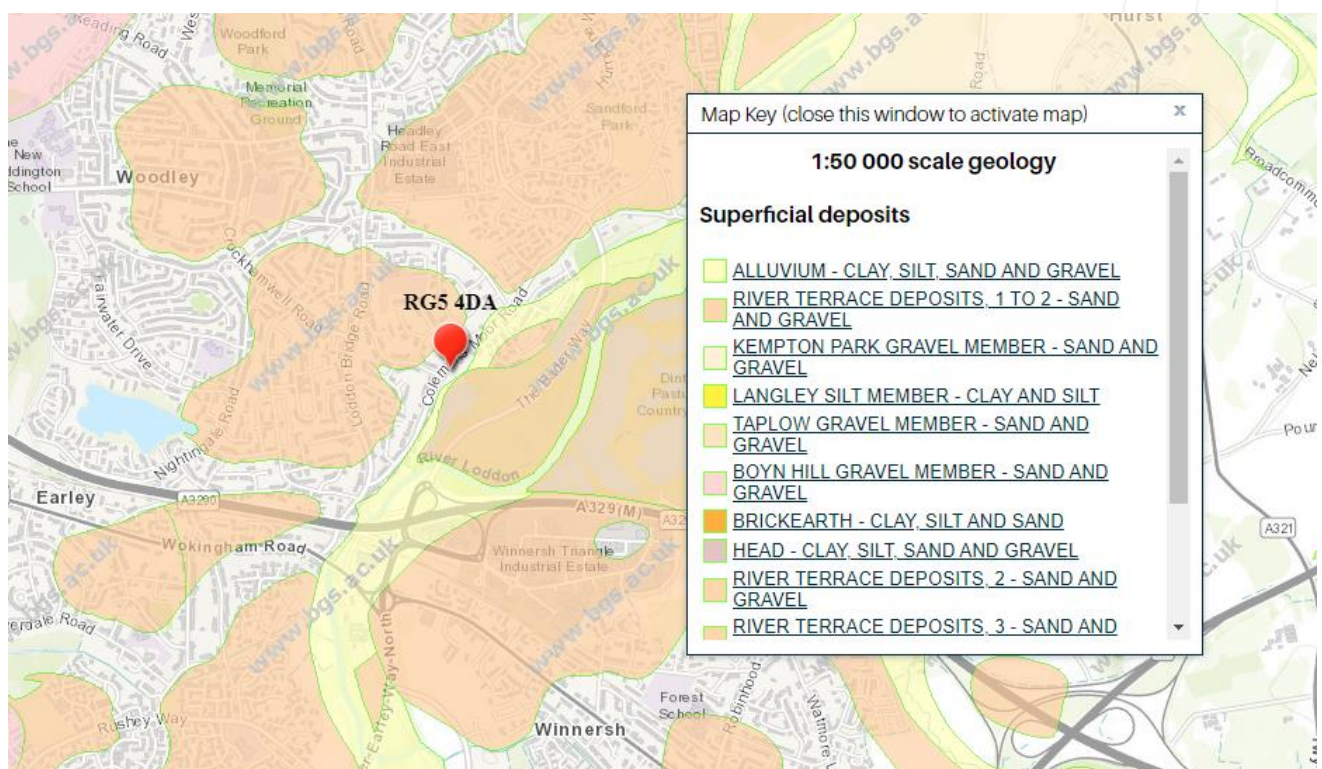


Figure 1: Superficial Geology Plan

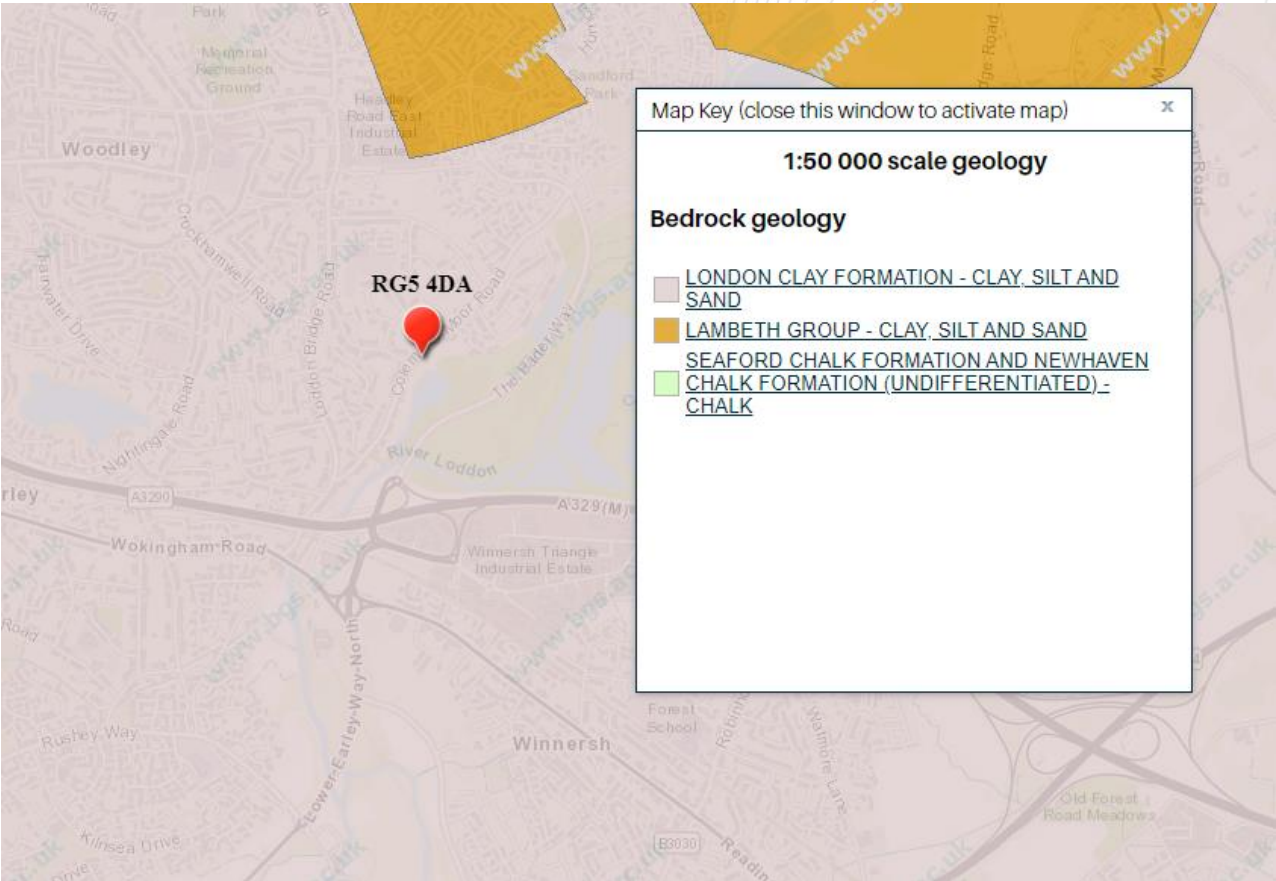


Figure 2: Bedrock Geology Plan

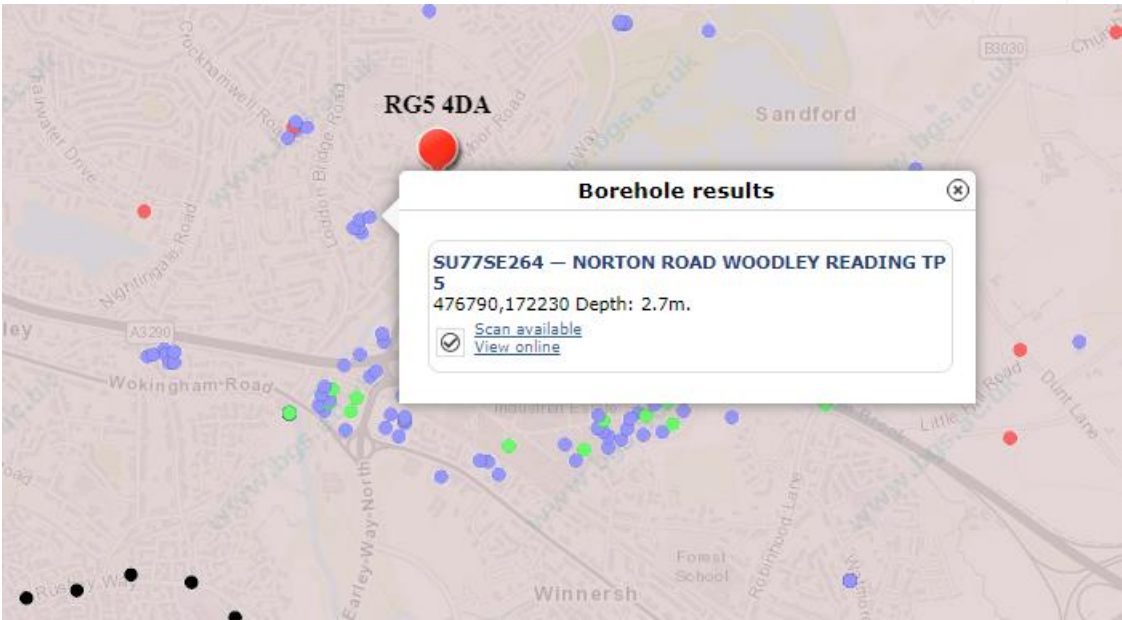


Figure 3: Local Borehole Location

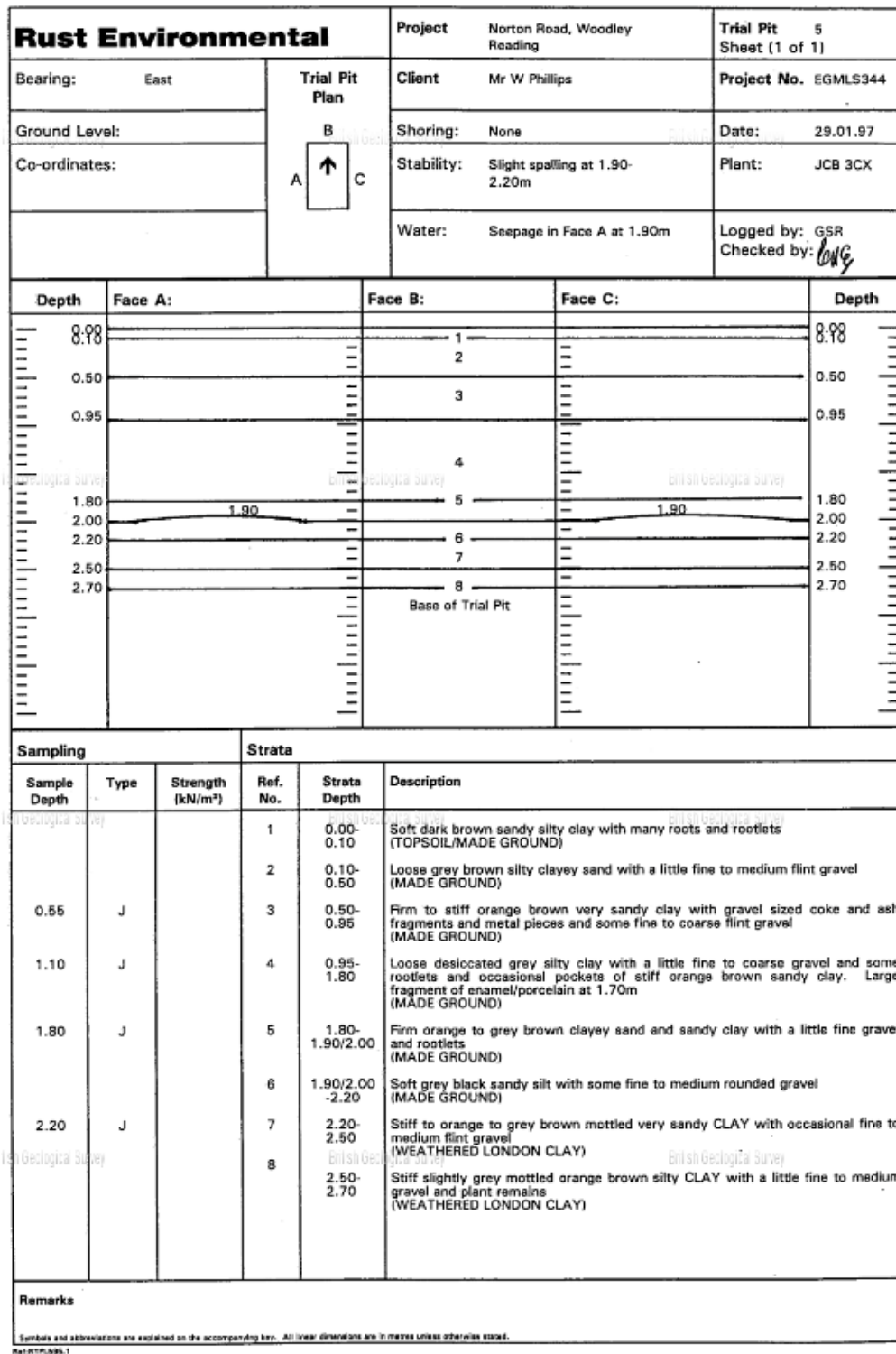


Figure 4: Local Borehole Details (SU77SE264)

- 2.0.5 A site specific ground investigation report Ref: J118 by Sackedgate Ltd was produced in August 2021. Part of the investigation works involved physical investigations where 3 trial pits were excavated along the southwestern boundary to approximately 2m depth. The trial pits found topsoil over sandy clay to 1.5m depth. Clayey sand and gravel were encountered below to the base of the trial pit. No ground water was encountered in any of the trial pits. A copy of the ground investigation report can be found in [Appendix D](#).

- 2.0.6 In addition to the ground investigation report, the site was subject to infiltration testing during October 2021. Testing was carried out in a stone filled trial pit, 2.0m deep in accordance with BRE Digest 365 (2016). The results found an unsatisfactory infiltration rate and concluded that an alternative method of surface water disposal should be considered. The infiltration testing methodology and results can be seen in [Appendix E](#)

2.1 Existing Sewer Assets

- 2.1.1 Thames Water asset plans show a large 900mm diameter foul sewer in Colemans Moor Road to the south of the site. A smaller, 225mm diameter foul sewer is also shown in the same location. A 225mm diameter surface water sewer is shown in the northern footway of Colemans Moor Road, the depth of manhole O454 outside the site is approximately 700mm. Thames Water records can be found in [Appendix B](#).

2.2 Site Proposals

- 2.2.1 Demolition of existing bungalow and construction of four, 2 bed flats and two, 1 bed flats with 6 no. parking spaces, associated access and external works. The proposals at the time of writing can be seen in [Appendix C](#).

2.3 Existing Drainage Regime

- 2.3.1 The existing site is served by a 100mm diameter private drainage network that would appear to connect to the foul manhole in Colemans Moor Road. It is assumed that this run accepts all foul flows from the site. The existing site appears to drain all runoff from roof areas via gutters and down pipes although the exact regime is unknown. From the information available, it is assumed that runoff from the site either follows the natural topography and runs off towards the road or is connected to the drainage network to form a combined system.

- 2.3.2 The average existing runoff rate can be calculated for the existing impermeable area of approximately 0.028ha. The Modified Rational Method is used to consider the existing runoff as set out below:

Section 24.6 of CIRIA 753 states that a value of 35mm/hr and 50mm/hr can be used for rainfall intensity.

$$Q(l/s) = C_v \times C_r \times (2.78 \times I \text{ (mm/hr)} \times A \text{ (ha)})$$

Where:

$$A = 0.028$$

$$C_v = 0.75$$

$$C_r = 1.3$$

$$I = 50 \text{ (max. value)}$$

$$Q = 3.795l/s$$

2.3.3 The table below shows the existing site peak runoff rate for each storm event when considering the 60 minute duration.

	1:1 Year Storm Event	1:30 Year Storm Event	1:100 Year Storm Event	1:100 Year Storm Event (+45% Climate Change)
Greenfield Runoff Rate (l/s)	0.100	0.200	0.200	-
Existing Site Peak Runoff Rate (l/s)	2.690	6.324	8.196	-

3.0 SuDS Considerations

3.0.1 Consideration of SuDS is a planning requirement for new developments. SuDS are designed to replicate the natural course of drainage as closely as possible with a view to reducing the impact of flooding, removing pollutants at source and combining water management with green space.

Developments should utilise SuDS where possible and ensure that surface water run-off is managed as close to its source as possible in line with the following hierarchy:

1. Into ground (infiltration).
2. To a surface water body.
3. To a surface water sewer.
4. To a combined sewer.

3.0.2 Sustainable Drainage Systems should be included in the design in order to manage surface water flood risk. SuDS should be inspired by natural drainage processes and manage water as close to its source as possible whilst offering pollution control and landscape benefits.

3.1 National and Local Planning Policy

- 3.1.1 For this development Wokingham Borough Council are the Local Planning Authority and set out the requirements in relation to the drainage strategy and SuDS.
- 3.1.2 The Wokingham Borough Managing Development Delivery Document (Local Plan) is considered. Reference is also made to the Non-Statutory Technical Standards for SuDS, CIRIA Report C753 and Non-Statutory Technical Standards for SuDS, March 2015
- 3.1.3 Policy CC10: Sustainable Drainage requires all development proposals to ensure that surface water generated by the proposals to be managed in a sustainable manner. In the case of this development a surface water drainage strategy must be submitted.
- 3.1.4 As part of the requirements all development must reproduce greenfield runoff characteristics and return run-off rates and volumes back to the original greenfield levels, for greenfield sites and for brownfield sites both run-off rates and volumes be reduced to as near as reasonably practicable.
- 3.1.5 SuDS designs should be incorporated where practicable, appropriate to the development and offering social and environmental benefits. SuDS designs should include maintenance regimes.
- 3.1.6 The development must not cause any adverse impact on the public sewerage network.
- 3.1.7 Furthermore, the DEFRA guidance states that a surface water drainage assessment should be carried out to demonstrate that the proposed development makes use of SuDS and will not create an increased risk of flooding from surface water to the development site and the surrounding area.
- 3.1.8 The guidance presents standards which should be adopted where feasible. In particular:
- S2. For greenfield developments, the peak runoff rate from the development to any highway drain, sewer or surface water body for the 1 in 1 rainfall event and the 1 in 100 year rainfall event should never exceed the peak greenfield runoff rate for the same event.
 - S3. For developments which were previously developed the peak runoff rate from the development to any drain, sewer, or surface water body for the 1 in 1 year rainfall event and the 1 in 100 year rainfall event must be as close as reasonably practicable to the greenfield runoff rate from the development for the same rainfall event but should never exceed the rate of discharge from the development prior to redevelopment for that event.
 - S4. Where reasonably practicable, for greenfield development, the runoff volume from that development to any drain, sewer or surface water body in the 1 in 100year, 6-hour rainfall event should never exceed the greenfield runoff volume for the same event.
 - S5. Where reasonably practicable, for developments which have been previously developed, the runoff volume from the development to any drain, sewer or surface water body in the 1 in 100year 6-hour rainfall event must be constrained to a value as close as is reasonably practicable to the greenfield runoff volume for the same event, but should never exceed the runoff volume from the development site prior to redevelopment for that event.

- S6. Where it is not reasonably practicable to constrain the volume of runoff to any drain, sewer or surface waterbody in accordance with S4 or S5, the runoff volume must be discharge at a rate that does not adversely affect flood risk.

3.2 SuDS Incorporation

- 3.2.1 Surface water disposal via infiltration methods are considered in the first instance in accordance with the above hierarchy. The British Geological survey mapping data has been consulted along with site specific ground investigations. The site investigations concluded that disposal of surface water via infiltration was not viable owing to the ground strata and subsequent infiltration testing.
- 3.2.2 Following the hierarchy, proposals are to discharge surface water generated by the development to the surface water sewer.
- 3.2.3 In accordance with the SuDS requirements, where disposal of surface water into the ground is not practicable, nor into a surface water body, surface water can be discharged to sewers or highway drains providing it is not detrimental to the overall network.
- 3.2.4 Table 7.1 below from the SuDS Manual sets out the various components that may be considered in providing SuDS.

Component Type	Description	Collection Mechanism	Design Criteria							Further Information (Chapter Ref)
			Water Quantity (Chapter 3)			Water Quality (Chapter 4)	Amenity (Chapter 5)	Biodiversity (Chapter 6)		
			Peak Runoff Rate	Runoff Volumes						
				Small Events (Interceptions)	Large Events					
Rainwater Harvesting Systems	Systems that collect runoff from the roof of a building or other paved surface for use	P		●	●		●		11	
Green roofs	Planted soil layers on the roof of buildings that slow and store runoff	S	○	●		●	●	●	12	
Infiltration systems	Systems that collect and store runoff, allowing it to infiltrate into the ground	P	●	●	●	●	●	●	13	
Proprietary treatment systems	Subsurface structures design to provide treatment to runoff	P				●			14	
Filter strips	Grass strips hat promote sedimentation and filtration as runoff is conveyed over the surface	L		●		●	○	○	15	
Filter drains	Shallow stone-filled trenches that provide attenuation, conveyance and treatment of runoff	L	●	○		●	○	○	16	
Swales	Shallow landscaped depressions that allow runoff to pond temporarily on the surface, before filtering through vegetation and underlying soils	L	●	●	●	●	●	●	17	
Bioretention systems	Trees with soil-filled tree pits, tree planters or structural soils used to collect, store and treat runoff	P	●	●	●	●	●	●	18	

Trees	Structural paving through which runoff can soak and subsequently be stored in the sub-base beneath, and/or allowed to infiltrate into the ground below	P	●	●		●	●	●	19
Pervious pavements	Structural paving through which runoff can soak and subsequently be stored in the sub-base beneath, and/or allowed to infiltrate into the ground below	S	●	●	●	●	○	○	20
Attenuation storage tanks	Large, below-ground voided spaces used to temporarily store runoff before infiltration-controlled release or use	P	●						21
Detention basins	Vegetated depressions that store and treat runoff	P	●	●		●	●	●	22
Ponds and wetlands	Permanent pools of water used to facilitate treatment of runoff – runoff can also be stored in an attenuation zone above the pool	P	●			●	●	●	23

P-Point L-Lateral S-Surface

● – likely valuable contribution to delivery of design criterion

○ – some potential contribution to delivery of design criterion, if specifically included in the design

Figure 5: CIRIA Table 7.1 SuDS Components

- 3.2.5 The above table gives examples of various SuDS components, which may offer SuDS elements in accordance with the requirements. Water-butts and or rainwater harvesting can be implemented within the design. Section 9.2 of BS 8582:2013 states that the use of rainwater harvesting systems should be evaluated to deliver both water supply and surface water management. Rainwater harvesting can be used for landscaping irrigation purposes and will contribute towards a reduction in runoff volume entering the sewer network. Rainwater harvesting units can incorporate an overflow to the drainage system to cater for extreme events.
- 3.2.6 The parking area at the front of the proposed building offers an opportunity to apply permeable surfacing which can be considered a method of managing surface water at source. As per table 7.1 (Figure 5), surface water is slowed at source by soaking through the surfacing. Permeable surfacing offers the added benefit of filtering the runoff as it drains through, hence improving the quality.
- 3.2.7 In accordance with Table 26.2 of CIRIA Report C753, the pollution hazard level can be classified as 'Low'. Using table 26.3 of the same document, the mitigation indices values for permeable surfacing exceed the pollution hazard values taken from the previous table. This ensures that proposals offer enough pollution risk mitigation.
- 3.2.8 The above proposals ensure that an 'at source' SuDS measure is applied, and betterment is provided in terms of surface water runoff velocity and quality. Pollution indices from different land types can be found per as per table 26.15 CIRIA SuDS Manual 2015, below.

Land use surface type (Lust)	Impermeability (IMP _{RF})	Total suspended solids pollution index (PI _{TSS})	Organic pollution index (PI _{Org})	Hydrocarbon pollution index (PI _{PAD})	Metals Pollution index (PI)
Roofs					
• Industrial / Commercial	1.0	0.3	0.3-0.4	0.2	0.4-0.8
• Residential	0.9	0.4-0.5	0.6-0.7	0.1	0.2-0.5
Highways					
• Motorways	0.8-0.9	0.9	0.7	0.9	0.8
• Major arterial highways	0.7-0.8	0.8	0.7	0.8	0.8
• Urban distributor roads	0.6-0.7	0.7-0.8	0.5	0.8	0.7
• Residential Street	0.4-0.6	0.4	0.6	0.6	0.6
• Pavements	0.5-0.6	0.4	0.6	0.3	0.3

Car Parks / Hardstanding					
• Industrial/Commercial	0.6-0.8	0.6-0.7	0.6-0.7	0.7	0.4-0.5
• Driveways (Residential)	0.5	0.5	0.6	0.4	0.3
Open Areas					
• Gardens (All types)	0.1	0.3	0.2-0.3	0	0.01
• Parks/Golf Courses	0.2	0.2-0.3	0.2	0	0.02
• Grassed Areas (including verges, all types)	0.1	0.2-0.3	0.2-0.3	0.05	0.05
Note					
1	Pollution index values are based on reported land use type EMC distributions and impact potential thresholds from House et al (1991), Luker and Montague (1994), Butler and Clark (1995), D'Arcy et al (2000), Mitchell (2005) and Moy et al (2003)				

Figure 6: Impermeability and pollution indices for different land use types

- 3.2.9 The ground strata means that infiltration through the permeable surfacing sub-base is unlikely. Therefore, proposals are to wrap the sub-base in an impermeable membrane, designed to capture surface water runoff.
- 3.2.10 All roof and parking runoff generated by the development will be directed through the sub-base material and into the perforated pipe below. From here all runoff is directed to an existing sewer at an acceptable flow rate.
- 3.2.11 In determining the flow rate, reference is made to the Non-Statutory Technical Standards for SuDS, March 2015 and Wokingham local guidance. Paragraphs S3 and S5 require the discharge rate and volume from previously developed sites to be as close as reasonably practicable to the greenfield runoff rate for the equivalent rainfall event. The discharge rate and volume of runoff should never exceed the rate of discharge from the development prior to redevelopment for that event.
- 3.2.12 For this development the equivalent Greenfield runoff rate was found to be very low, QBAR 0.1l/s and would require a small diameter flow control with high blockage potential. In some cases, greenfield runoff may not be appropriate as the system would be prone to blockage owing to the small diameter outlet required. Therefore, the system has been designed to reduce the flow rate as much as possible whilst ensuring the outlet diameter is not compromised. The existing runoff calculations in 2.3.2 shows that the average peak runoff rate from the site is 3.795l/s.
- 3.2.13 Discharge rates should be managed as close as possible to the required standard by adopting a suitable flow control measure. On the basis that flow controls can manage flow rates as low as 1-2l/s without incurring blockages this has been taken as the allowable flow rate for flow control devices and applied to this site.
- 3.2.14 car park sub-base storage will provide the necessary attenuation requirements for the worst-case duration of the 1 in 100 year storm event inclusive of climate change.
- 3.2.15 The FFL of the proposed building is set above the adjacent carriageway and therefore the permeable surface of the carpark is designed to intercept any runoff from the development.
- 3.2.16 The above proposals ensure that SuDS measures are applied, and betterment is provided in terms of surface water runoff velocity and quality.

3.3 Preliminary Surface Water Drainage Maintenance Schedules

- 3.3.1 This section of the report gives guidance on the maintenance of the drainage system and outlines who will be responsible. The proposed development comprises of site clearance, landscaping, parking, drainage and supporting infrastructure. The SuDS systems will aim to control runoff in terms of velocity and quality.
- 3.3.2 The rainwater from the roofs is collected via rainwater pipes and will be carried to the network. The maintenance of the collection system is the responsibility of the developer, see [Table 1](#) below.

Table 1: System storage operation and maintenance requirements (rainwater pipes and chambers)

Maintenance Schedule	Required Action	Recommended Frequency
Regular Maintenance	Inspection of silt trap chamber and removal of debris when necessary	Quarterly or as required following monitoring
Remedial actions	Check for blockages in manholes and pipes. Rodding and jetting of pipes to be carried out. CCTV survey can be carried out to inspect condition of pipework.	Quarterly or as required following monitoring
Monitoring	Inspect collection apparatus for debris and litter. Remove where necessary to prevent blockages in the system	Monthly or after periods of heavy rainfall

- 3.3.3 Maintenance of the permeable paving and sub-base will be the responsibility of the developer, see [Table 2](#) below.

Table 2: System storage operation and maintenance requirements (permeable paving)

Maintenance Schedule	Required Action	Recommended Frequency
Regular Maintenance	Sweeping. [NOTE: Any jointing material between the blocks that is lost or displaced as a result of sweeping must be replaced. New jointing material must be the same type as that removed or a suitable replacement]	3 no. times a year: - - At the end of Winter; - Mid-summer; and - After autumn leaf fall. Also as required based on site specific observations
Occasional Maintenance	Stabilise and mow contributing and adjacent areas to prevent excess sediment being washed into the paving	As required
Remedial actions	Remedial work to any depressions, rutting and cracked or broken blocks considered detrimental to the structural performance or a hazard to users	As required

	Rehabilitation of surface and underlying sand a geo-textile	As required (if local distortion or settlement occurs as a result of wash out of bedding)
Monitoring	Inspect for evidence for weed growth or deposits affecting run off. If required, take remedial action	Monthly for 3 no. months after installation, then during regular maintenance visits

- 3.3.4 Rainwater Harvesting – Surface Water runoff is to be directed to the rainwater harvesting unit for irrigation purposes. Maintenance of the unit will be the responsibility of the developer see [Table 3](#) below.

Table 3 System storage operation and maintenance requirements (rainwater harvesting)

Maintenance Schedule	Required Action	Recommended Frequency
Regular Maintenance	Inspection of the tank for debris and sediment build-up, inlets/outlets/withdrawal devices, overflow areas, pumps, filters. Cleaning of tank, inlets, outlets, gutters, withdrawal devices and roof drain filters of silts and debris	Annually (and following poor performance)
Occasional Maintenance	Cleaning and/or replacement of filters	Three monthly (or as required)
Remedial actions	Repair of overflow erosion damage or tank damage. Pump repairs structural performance	As required

- 3.3.5 The maintenance of the flow control is the responsibility of the developer, see [Table 4](#) below.

Table 4 System storage operation and maintenance requirements (flow control)

Maintenance Schedule	Required Action	Recommended Frequency
Regular Maintenance	Remove litter and debris and grass cuttings from upstream to prevent being washed into the flow control. Inspection of the flow control chamber and the removal of any sediment/debris when required.	Quarterly or as required following monitoring
Remedial Actions	Check flow control is functional	Quarterly or as required following monitoring
Monitoring	Inspect flow control and check flows are not impeded	Monthly or after periods of heavy rainfall

3.3.6 The design life of the development is likely to exceed the design life of each of the SuDS components listed above. During the routine inspections of any drainage components it may become apparent that they have reached the end of their functional lifetime. In the interest of sustainability, repairs should be the first-choice solution where practicable. If this is not the case, then it will be necessary for the property owner to undertake complete replacement of the component in question.

4.0 Surface Water Strategy

The surface water strategy is based upon the SuDS implementation as outlined above along with the hierarchy for surface water disposal as follows:

A. Store rainwater for later use:

Rainwater storage to be utilised. The site layout offers an opportunity to utilise rainwater storage for garden irrigation which will reduce the volume of runoff entering the drainage system.

B. Use infiltration techniques, such as porous surfaces:

Permeable paving is proposed for this development as a method of source control. Permeable surfacing will collect, slow and filter the runoff before entering the network.

C. Attenuate rainwater in ponds or open water features for gradual release:

Not applicable.

D. Attenuate rainwater by storing in tanks or sealed water features for gradual release:

Surface water from the roof and permeable surfacing areas will be directed through permeable surfacing to the drainage network. Surface water will be attenuated below ground using the voids within sub-base and a flow control chamber. Calculations show that the maximum storage depth for the most extreme storm event reaches 0.444m which is accommodated within the 0.450m depth sub-base thickness.

Paragraph 2.3.2 shows that the existing site generates approximately 3.795l/s from roof and hard standing areas. The equivalent greenfield runoff rate for this site was found to generate a QBAR 0.1l/s. On that basis the proposed runoff from the development shall be restricted to what is considered the minimum achievable for a flow control device, 1.0l/s for all storm events up to the 1:100 year event including climate change. The current runoff rate is therefore much improved for all storm events up to the 1:100 year event inclusive of climate change.

The table below shows the existing and proposed peak runoff rates when considering the 60 minute duration:

	1:1 Year Storm Event	1:30 Year Storm Event	1:100 Year Storm Event	1:100 Year Storm Event (+45% Climate Change)
Greenfield Runoff Rate (l/s)	0.100	0.200	0.200	-
Existing Site Peak Runoff Rate (l/s)	2.690	6.324	8.196	11.474
Proposed Site Peak Runoff Rate (l/s)	0.600	0.800	0.8	1.000

E. Direct rainwater direct to the watercourse:

Not applicable.

F. Discharge rainwater to a surface water sewer/drain:

Proposals are to discharge all surface water runoff to the surface water sewer in accordance with the hierarchy.

G. Discharge rainwater to combined sewer:

Not applicable.

H. Discharge rainwater to foul sewer:

Not applicable.

The drainage strategy is supported by **Appendices F** and **G** which include calculations and drainage drawings for the above.

4.1 Designing for Exceedance

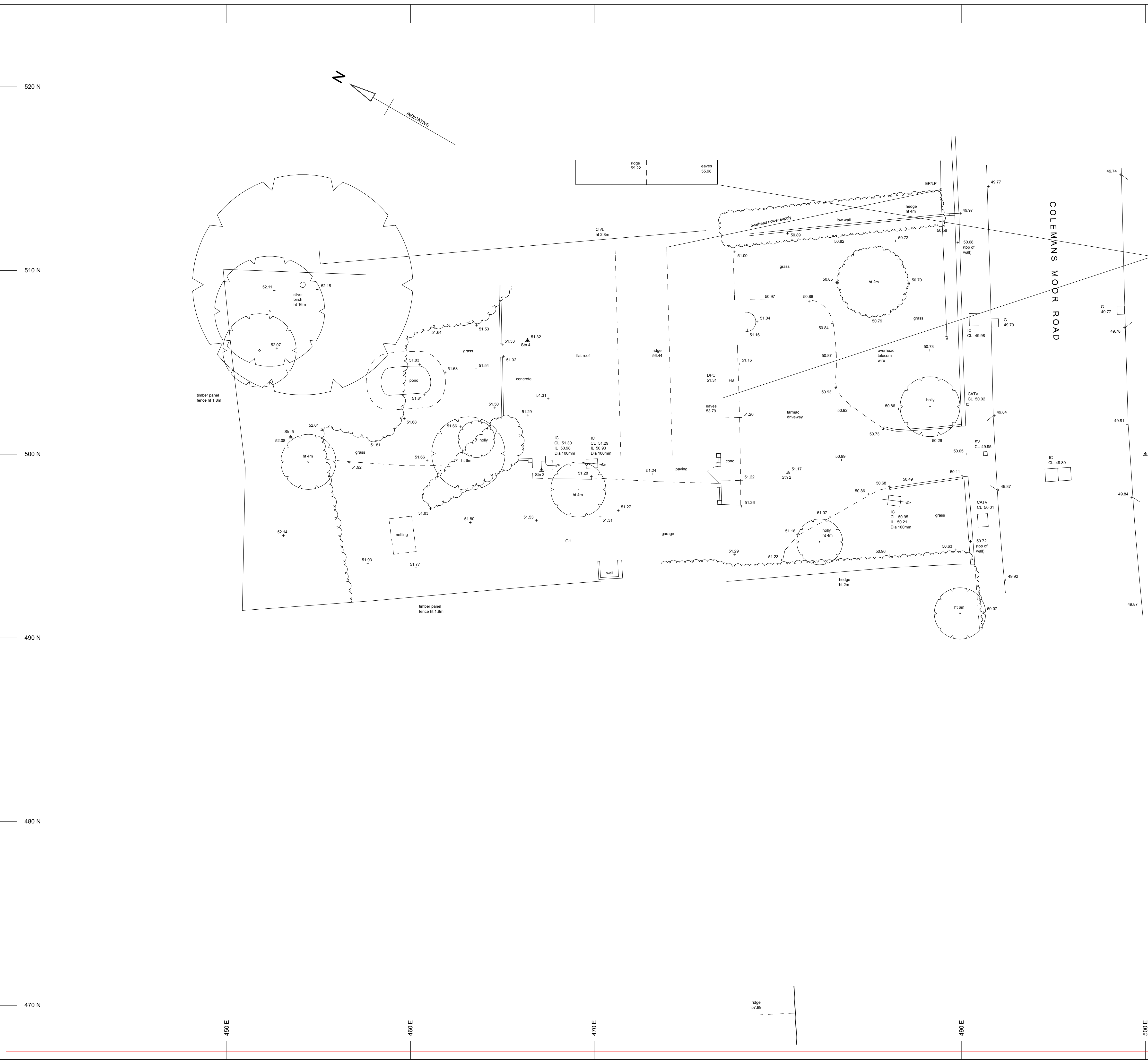
- 4.1.0 Consideration should be given to external levels to ensure they are set above overland flood risk levels, and low points are created to direct water away from the building footprints during exceedance events. Please see appended drawing for exceedance flow directions.
- 4.1.1 CIRIA document C635 *Designing for exceedance in urban drainage – good practice* states that “at present there are no guidelines on the return period of event (extreme event) that should be used for design exceedance”. However, Section 3.4 also states that “it is suggested that return periods of 1 in 30, to 1 in 100 or 1 in 200-year events would form a suitable framework for most applications”.
- 4.1.2 In accordance with the above, the system has been modelled using a 1 in 100-year event inclusive of climate change.

5.0 Conclusions

- 5.1 JMS Engineers have been appointed to prepare a drainage strategy and SuDS Report for the development at 105 Colemans Moor Road, Reading.
- 5.2 Information taken from the British Geological Survey (BGS) and ground investigation suggests the geology will not support infiltration methods.
- 5.3 The drainage strategy is designed to limit the surface water runoff from the proposed development to an appropriate discharge rate.
- 5.4 Various SuDS components are proposed, namely permeable paving, flow control with attenuation and rainwater harvesting. The inclusion of such features means that sustainable drainage principles are used to deal with all surface water runoff.
- 5.5 In conclusion, the proposal applies appropriate SuDS features that ensures source control and pollution control are applied. The SuDS elements also mean that the development offers significant betterment in terms of peak flow and volume.

6.0 Appendices

Appendix A – Topographical Survey



Notes

1. Levels in metres relative to Arbitrary Datum situated on STN 1, value 50.00m.

2. Arbitrary Grid.

Key

B	Bollard	P	Post
BL	Bed level	PB	Pillar box
BS	Bus stop	Ret	Retaining
BT	British Telecom	RS	Road sign
CL	Cover level	S	Stump
Dil	Dilapidated	SL	Soffit level
EP	Electricity Pole	SNP	Street name plate
FB	Flower bed	SV	Stop valve
FH	Fire Hydrant	SW	Surface water
FL	Floor level	TCB	Telephone call box
FW	Foul water	Tk	Tank
G	Gully	TP	Telegraph pole
GH	Greenhouse	UC	Under construction
GV	Gas valve	WIL	Water level
Ht	Height	WM	Water meter
IC	Inspection cover	WO	Wash out
IL	Invert level	WT	Water trough
KO	Kerb offset	CATV	Cable television
LP	Lamp post	ER	Earth rod
MH	Manhole	UTL	Unable to lift
Mkr	Marker		

FENCES

B/W	Barbed wire
C/B	Close boarded
C/I	Corrugated iron
Ch/L	Chain link
I/R	Iron railings
Pal	Paling
P/R	Post and rail
P/W	Post and wire

STN	EASTING	NORTHING	LEVEL	REMARKS
1	500.000	500.000	50.000	NAIL
2	480.562	498.981	51.167	NAIL
3	467.131	499.127	51.302	NAIL
4	466.368	506.190	51.320	NAIL
5	453.476	500.934	52.078	NAIL

Revisions

REV	DETAILS	DATE

Project

105 COLEMANS MOOR ROAD
WOODLEY

Job

SITE SURVEY

For

DV Homes Ltd.

By

Developers Land Surveys
17 Bolton Crescent
Windsor
Berkshire SL4 3JH Tel:01753 851477

Scale	Drawn	Checked
1:100	WHD	CGF
Date	Drawing No.	Rev.
June 2017	1428/1	

1:100

0 1 2 3 4 5 m

THE KEEN PARTNERSHIP
The Courtyard
Edinburgh Road
Reading RG30 2UA
Tel: 0118 9510 855
Fax: 0118 9510 856
chris@keenpartnership.co.uk
www.keenpartnership.co.uk

cabe
chartered association
of building engineers

RICS

Client:

105 Colemans Moor Road LTD

Job Title:

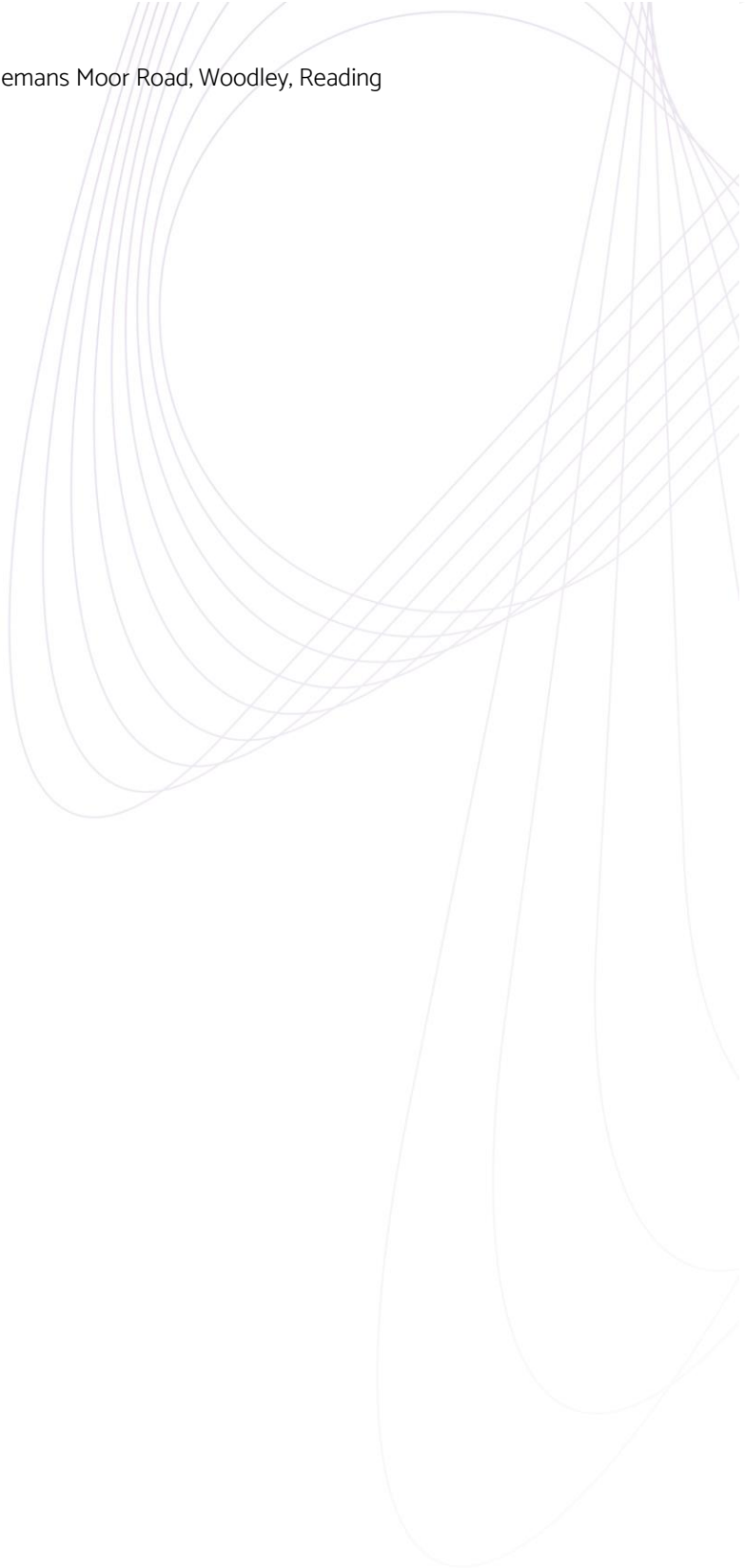
**105 Colemans Moor Road, Woodley,
Reading, RG5 4DA**

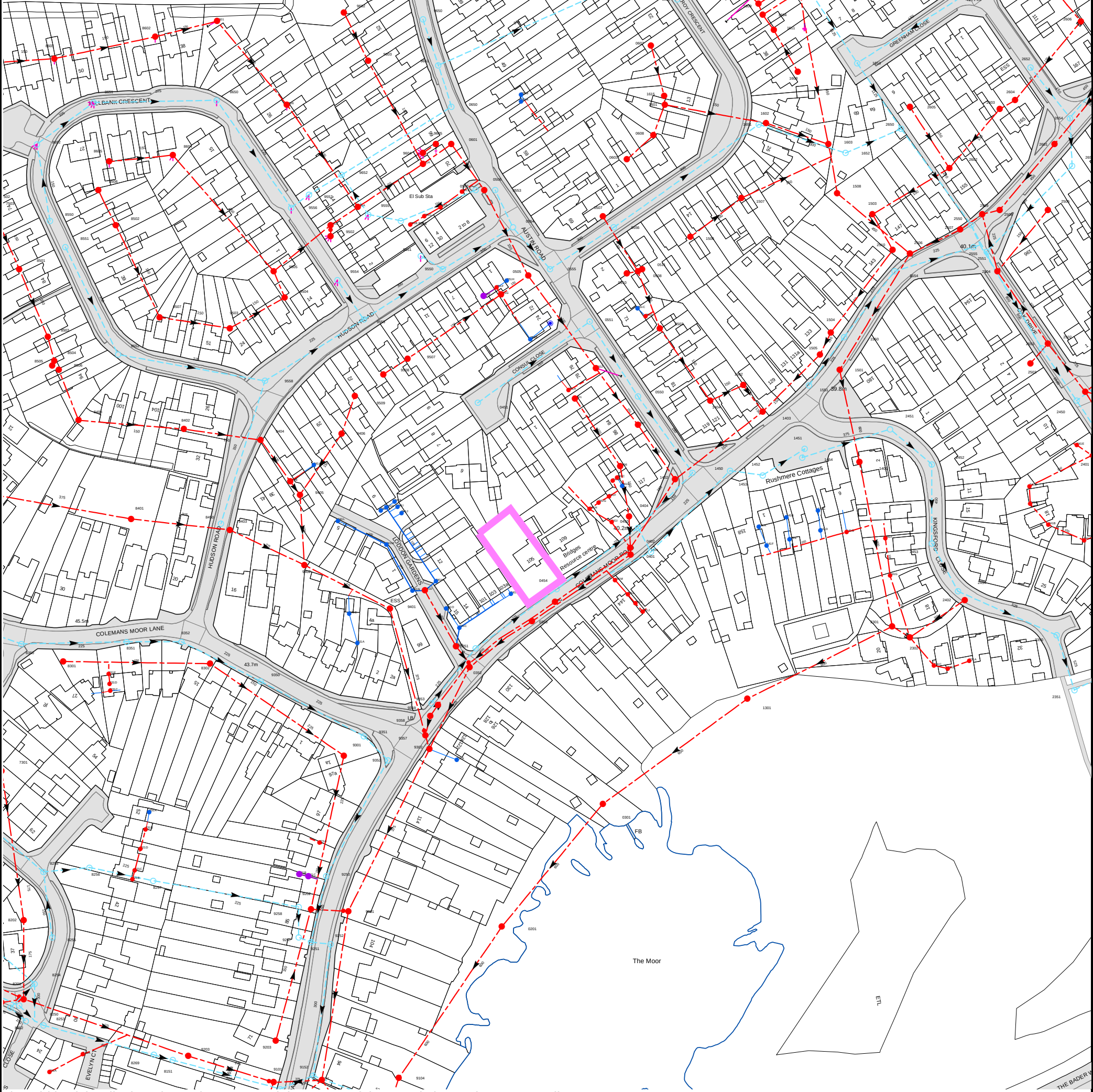
Drawing Title:

Topographic Survey

Drawing Date:	Status:	
###		
Issue Date:	Drawn By:	Scale:
17/08/2018	DR	1:100@A1
Job No:	Drawing No:	Rev:
8794-18	PL-02	

Appendix B – Thames Water Records

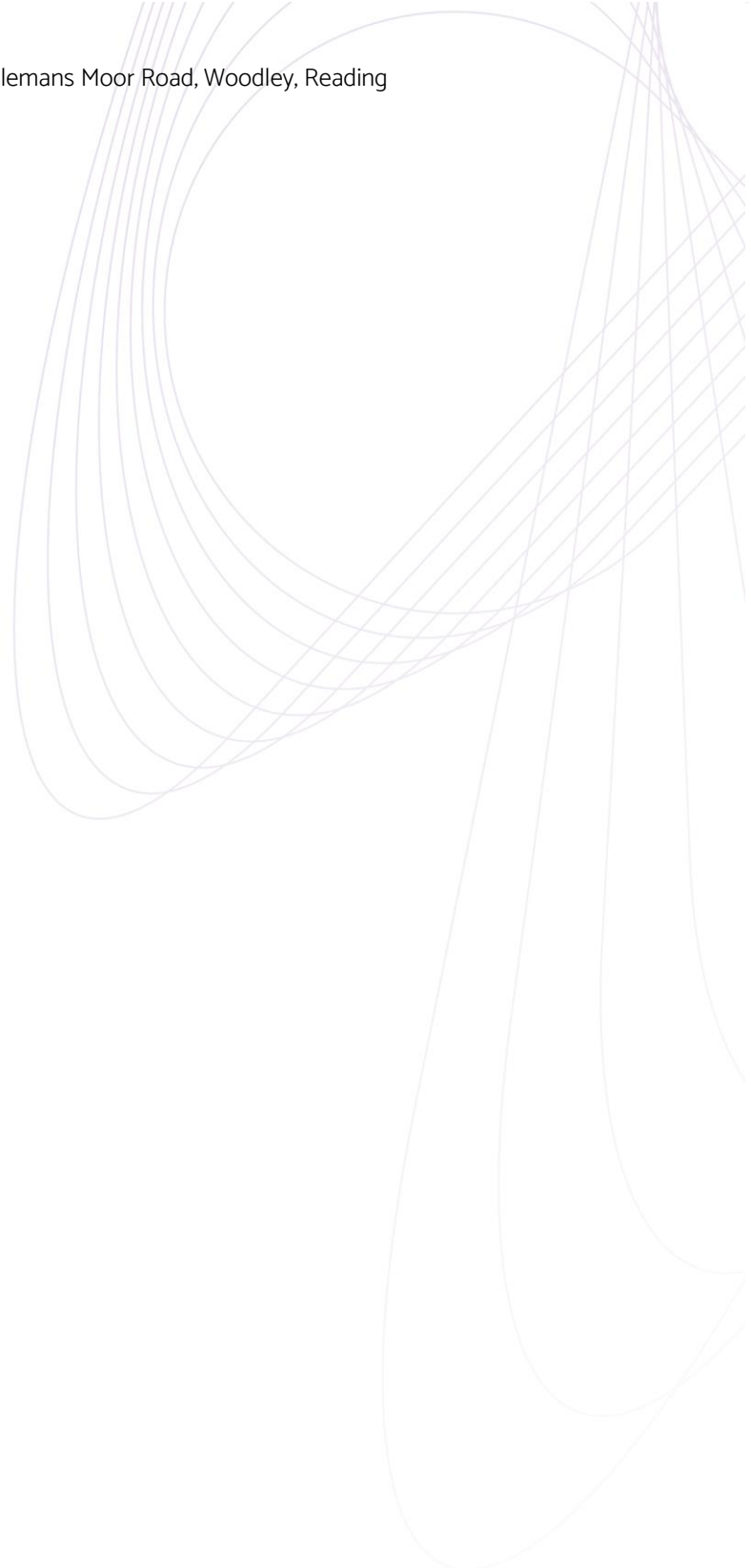




The width of the displayed area is 500 m and the centre of the map is located at OS coordinates 477048,172434
The position of the apparatus shown on this plan is given without obligation and warranty, and the accuracy cannot be guaranteed. Service pipes are not shown but their presence should be anticipated. No liability of any kind whatsoever is accepted by Thames Water for any error or omission. The actual position of mains and services must be verified and established on site before any works are undertaken.

Based on the Ordnance Survey Map (2020) with the Sanction of the controller of H.M. Stationery Office, License no. 100019345 Crown Copyright Reserved.

Appendix C – Proposed Site Layout





PLANNING ISSUE

This drawing and design is for use solely in connection with the project described. The drawing and design is the property of Lytle Associates Architects and must not be reissued, loaned or copied without written consent. All dimensions and setting out to be checked onsite before construction. Do not scale from the drawing. The drawing is to be read in conjunction with all other information relevant to the project. Any apparent discrepancy is to be brought to the attention of Lytle Associates Architects.

Lytle Associates Architects
Lytle Associates Architects is a trading name of Gerry Lytle Associates Ltd

REV	AMENDMENT	BY	CHECK	DATE
B		CM	DP	30.07.24

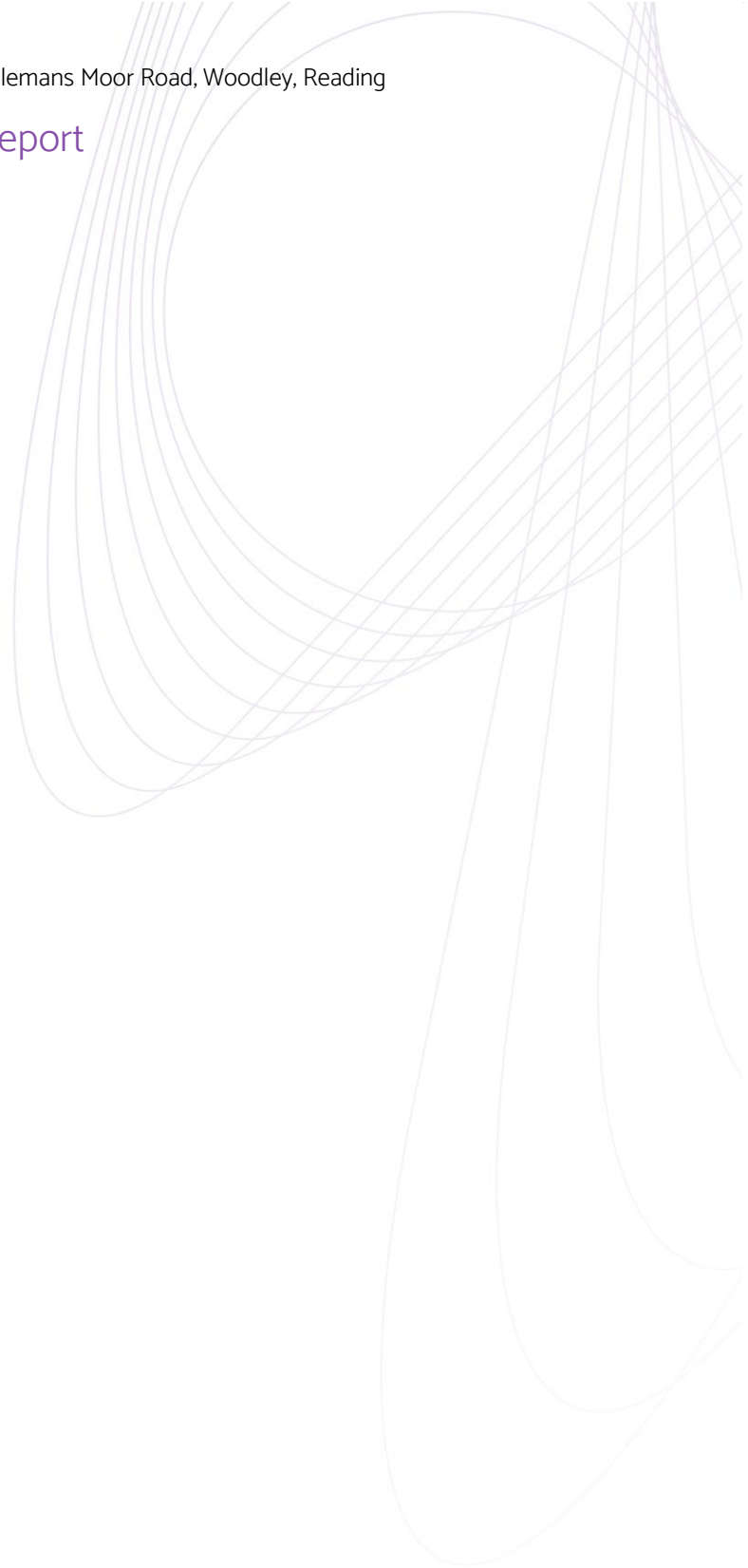


LytleAssociates
ARCHITECTS

THE FOUNTAIN HEAD QUARRY STREET GUILDFORD
SURREY GU1 3UY 01483 301661
LYTLE-ASSOCIATES.COM

CLIENT	PROJECT	TITLE	DRAWING NUMBER	REV
Colemans Moor Heights Ltd.	105 Coleman's Moor Road, Woodley	Proposed Site Plan	2159_005	B

Appendix D – Ground Investigation Report



Phase 1 Geo-Environmental Investigation (Desk Study)

105, Colemans Moor Road,
Woodley,
Berkshire,
RG5 4DA

Project Reference J118



Sackedgate Ltd
26 Reading Road,
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NOTES TO THE REPORT

The Company

This report has been prepared by Julian Puzyna for and on behalf of Sackedgate Ltd. Company registered No. 09712671 at 26 Reading Road, Burghfield Common, Berkshire, RG7 3QA. (sole director and employee of Sackedgate Ltd). This report was produced for the benefit of the client detailed in the appointment section of the report and subject to the provisions set out in the document below and also within the applicable Sackedgate Ltd estimate and terms of engagement.

Confidentiality

This report is produced in confidence. The report, the associated documents and the investigation records will not divulged to any other parties without the express permission or instruction from the client detailed in the report text. This applies to any drawings, proposals, previous investigations or correspondence supplied by the client which is applicable for the site under investigation.

Client details are held for communication, document transfer and billing purposes only. This information is not shared with any other parties whatsoever. A full copy of the records kept by Sackedgate Ltd is available on request.

Reliance

This report was commissioned by the client detailed in the appointment section of the report introduction. This client has reliance on the report, as set out in the terms conditions of the estimate for completion of the report. This reliance is not transferrable and cannot be sold/given/passed on to any third parties without that third party directly making an agreement/contract with Sackedgate Ltd.

Limitations

This assessment has been carried out with reasonable skill, diligence and care with reference to the agreed scope of investigations, limitations set out in the estimate as well as the terms of engagement, applicable guidance and accepted practice.

Contaminated land investigations require forethought regarding the types and nature of any contaminants, as well as the nature of the ground and groundwater. It is not always possible to predict the exact nature of the historical use of any site or the full geological or hydrological setting from the available records. From a wider perspective, it is not always possible to turn over each and every stone during physical investigations within normal financial, logistical and sensible constraints.

It should therefore be understood that a level of uncertainty will always remain after any investigation, no matter how extensive the scope of that investigation. Issues may therefore remain which were undisclosed by the investigations documented in this report, due to being outside the scope of the investigation outlined in the associated estimate, and could not have been sensibly anticipated, predicted or found.

Document Control	
Author	 For and on behalf of Sackedgate Ltd Julian Puzyna BEng Hons MCIEH
Date	24 August 2021
Project Ref	E129/J118
Document Ref	J118 Colemans Moor Road Desk Study rev3.docx
Checked	SJP
Status	Final

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- I. Contamination Assessment Criteria

1.0 Introduction

1.1 Appointment

This report was commissioned by DV Homes Ltd to provide an environmental assessment of the soils underlying the proposed development site at 105 Colemans Moor Road Woodley Berkshire RG5 4DA.

The work was carried out on the basis of Sackedgate Ltd estimate No E129 and subject to the provisions set out in the terms of engagement included with that estimate.

1.2 Proposed Development

I understand that the proposals are to demolish the existing structure and construct four two bedroom flats and two one bedroom flats with associated car parking and other external provisions.

1.3 Scope of Investigation

The work carried out by Sackedgate Ltd to produce this report comprised a phase 1 qualitative contaminated land assessment or desk study with some limited physical investigations.

1.3.1 Concept

The purpose of the investigation is to provide an important step in the assessment of the site prior to any physical soil or groundwater testing. This involves a qualitative search for available information that may identify potential contamination sources, both on and off site and how the ground or groundwater could be accumulating or transporting those contaminants with respect to the site area in question, as well as the surrounding land.

Review of information such as historic mapping, aerial pictures, geology and hydrology maps are the first investigation steps, followed by a review of assembled environmental data from local authorities and Environment Agency etc. More focussed searches are then carried out that follow the leads or blanks identified from mapping and the environmental database reviews where necessary.

The assessment of the information is then carried out on the basis of the well-established source-pathway-receptor linkage assessment described in a number of guidance documents. If any of the three parts is missing, the linkage is not considered plausible. Where a plausible linkage can be made, further consideration of information or quantitative physical investigations will be required.

1.3.2 Limitations

All information sourced by this investigation is considered carefully with respect to its validity and accuracy however Sackedgate Ltd cannot accept responsibility for incorrect information provided in good faith by any third parties.

Although some geotechnical information and ground stability hazard information from third parties is appended to this report, no geotechnical recommendations are provided by Sackedgate Ltd.

Where hazardous ground is disclosed during any investigations, such as mine workings, wells or swallow holes, the issues will be reported as hazards but no design or mitigation recommendations are given.

1.4 Good Practice & Applicable Guidance

The investigations and methods used were carried out with reference to the Environment Agency Land Contamination Risk Management (LCRM) system and BS 10175 (Code of Practice for the Investigation of Potentially Contaminated Sites) and BS 5930:2015 (Code of practice for ground investigations).

Other applicable guidances have also been referred to where appropriate and where stated, such as the Environment Agency Guidance for the Safe Development of Housing on Land Affected by Contamination (R&D Publication 66-2008),

1.5 Investigator and Author of this Report

The investigations, either desk based or physical examinations of this site were carried out and documented by myself, Julian Puzyna. I have an Honours degree in Civil Engineering (BEng Hons) from Kingston University (Kingston Upon Thames) and I am a member of the Chartered Institute of Environmental Health (MCIEH).

My first contaminated land investigation as lead engineer was carried out in 1998 however my first involvement with contaminated land investigations was in 1989 with Exploration Associates Ltd. at the Bell Green Gas Works in east London. Since then, I have carried out approximately 830 ground investigations (as of March 2021).

2.0 Site Details

2.1 Site Location

This site lies about 5.4km south east of central Reading (The Oracle Centre) in a residential suburb of Reading named Woodley. The site lies on the northern side of the A329 (M) motorway about 700m north of the Winnersh, Woodley, Earley junction.

The centre of the proposed development site lies at grid reference 477030, 172430. The postcode for the site is RG5 4DA.

2.2 Site Description

This is a residential site containing a single small bungalow type dwelling with a sloping tarmac drive. The bungalow was seen to be a brick structure with a grey slate tile roof. The garden area was completely overgrown with tall grasses, brambles, nettles, thistles and some cleared garden plant debris.

3.0 Geological and Hydrological Setting

3.1 Topography



The topography shown above is greatly exaggerated to allow it to be visualised.

The site lies at the edge of a large plateau occupied by the suburb of Woodley. Ground levels at the south eastern edge of the plateau where the site is located, slope gently down to the south east and the wide flood plain of the River Loddon. This fall in ground level is only apparent on site as the sloping front garden and driveway down to Colemans Moor Road.

3.2 Published Geology

Data from the British Geological Survey shows that the site is underlain by the London Clay Formation with River Terrace Deposits forming the Woodley plateau to the north west of the site. The lower ground to the south west also comprises River Terrace deposits as well as a ribbons of Alluvium flanking the courses of the River Loddon. No superficial deposits are shown to underlie the site.

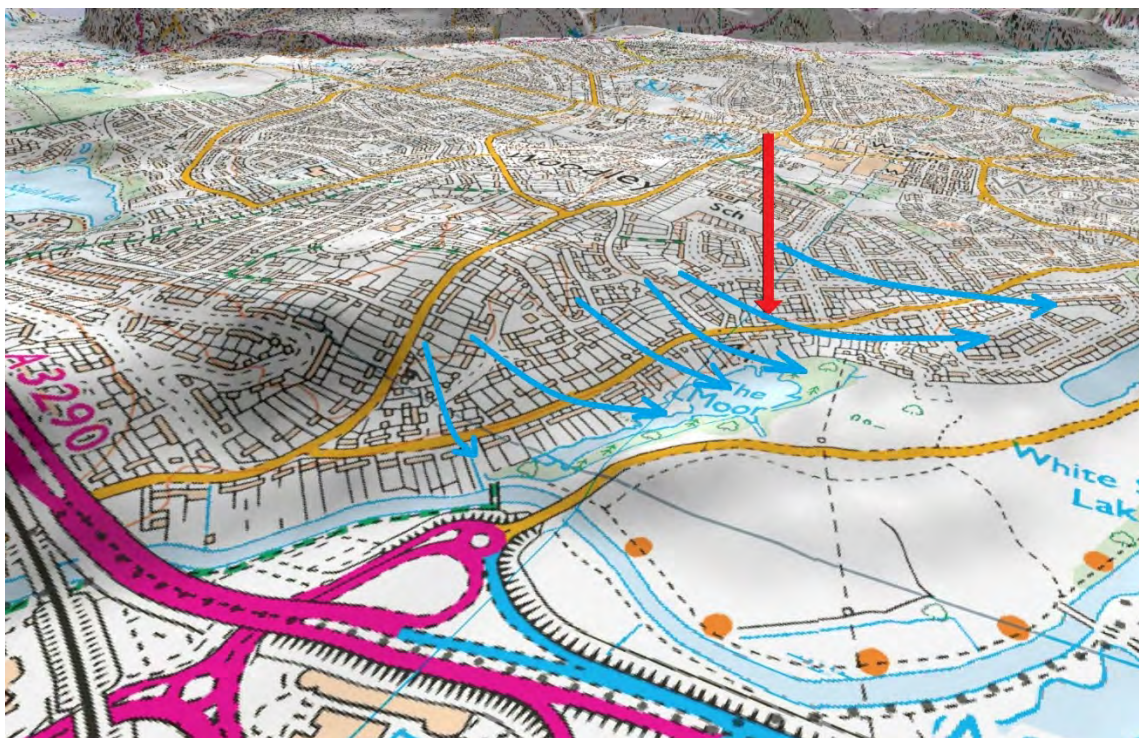
3.3 Published Hydrogeology

Hydrological maps of the area show that the London Clay Formation underlying the site is designated as unproductive strata however, areas of River Terrace deposits to the north west and south east are both designated Secondary aquifers of High Vulnerability.

3.4 Hydrology

No watercourses are shown on maps to the north west of the site on the Woodley Plateau however, a number of small streams or drains are shown on the maps to the southwest of the site which are associated with the River Loddon. Some appear to be springs issuing from the edge of the Terrace Gravels forming the Woodley Plateau. This water issues from a body of groundwater perched in the River Terrace Gravel Aquifer, on top of the London Clay Formation, where the gravel thins at the edge of the terrace.

3.5 Migration of Contaminants



Above, expected direction of surface and shallow groundwater flow

Any mobile contamination in the site area, either floating (fuel or lubricants) or dissolved would be expected to move with surface waters in 1) the streams, drains and culverts and 2) within the flow of shallow groundwater, in made ground, the terrace gravels over the London Clay and downhill to the south east. This water, from drainage systems or from the aquifer, together with its potential contamination, would eventually feed into the River Loddon.

On this basis it is considered that potential sources of contamination lying to north west of the site, pose the greatest risk to the site area. Potential sources of contamination outside this 'catchment' for the site, would not be expected to pose any risks to the site.

4.0 Site History

4.1 Historical Ordnance Survey maps

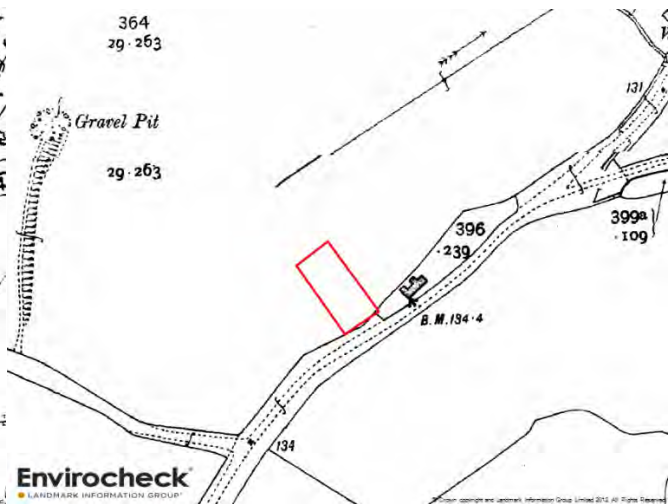
The available historical Ordnance Survey maps have been ordered from the Landmark Information Group and reviewed for this site. The maps are appended. The maps are at two scales. Firstly, are the six inches to one mile maps (1 in 10,560 scale) that was updated to 1 in 10,000 scale in the post war years. The second set of maps (extracts following) is at 1 in 2,500 scale.

The wider 1 in 10,560/10,000 scale maps show that the site area was set in open fields with the meandering River Loddon to the east and a large woodland to the west. Scattered farms are present together with a corn mill to the north east. This layout remains relatively unchanged until the 1932 map shows scattered areas of housing and gravel pits to have appeared along existing roads around the area. The 1932 map also shows Reading Aerodrome to have appeared to the north east of the site together with large buildings, probably hangars.

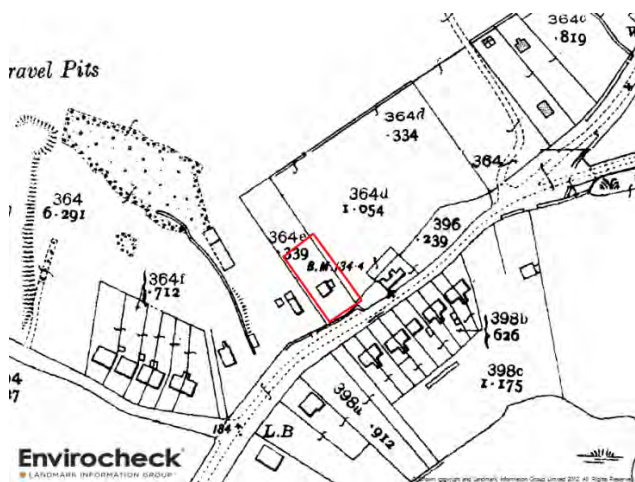
The 1948 aerial picture and 1960 map then show that these residential areas to be expanding however, the 1977 map shows the whole area to be filled with housing, including the areas of the gravel pits. Subsequent maps show little noteworthy change.



1872



11912



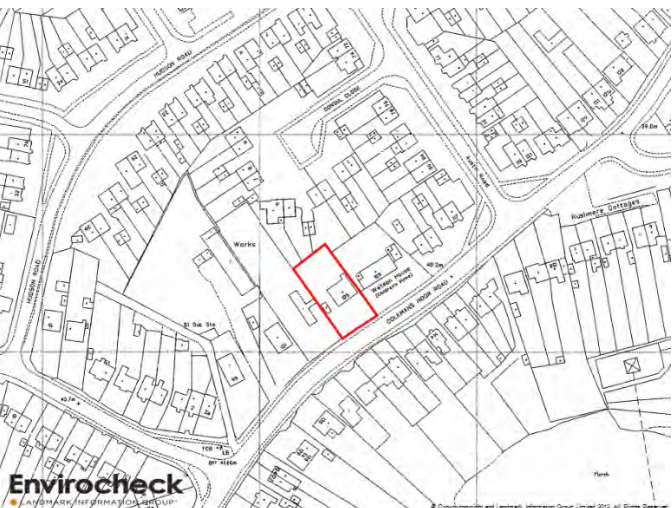
1933



1948



1975



1995

The 1 in 2500 scale maps show that the first building on the site area appears in 1933. The outline is difficult to make out in the 1948 aerial picture however, the 1969 map then shows that the building outline changes to what is apparent on site today. The 1933 map also shows that gravel pits just 50m-80m to the north west of the site have expanded and a tramway is shown connecting one of the pits with Colemans Moor Road. This pit is later shown in records to be named Wheeler's Green Gravel Pit.

The 1948 aerial picture and 1960 map shows that an engineering works has appeared 20m-50m just to the north west of the site, over parts of the gravel pit and tramway. The 1968 map show that Wheeler's Green Gravel Pit itself has been covered with houses and subsequent maps show the engineering works to remain in place until the latest editions (2021) where it is shown to have been developed with houses.

Many gravel pits are shown on the maps prior to the coverage of Woodley with houses sometime in the 1970's. The maps then showed that new pits opened up to the south east of the site, along the River Loddon. A gravel processing works is shown about 200m from the site and conveyors are shown linking the pits with the processing works. Modern maps then show that many of these former gravel pits are now a series of lakes along the River Loddon.

4.1.1 Mapping Observations and Potential Land Contamination Issues

The mapping has shown that this area has developed as a residential suburb of Reading and was not subject to any significant industry. A small engineering workshop is shown 20m-50m from the site to the north west. The only other historical industrial area is the former gravel processing works 200m to the east that is now covered by houses and industrial buildings at the old Reading Aerodrome site over 500m to the north.

The engineering works 20m-50m to the northwest presents a variety of risks that depend on the activities that were carried out. The processing of gravel at the works 200 to the west is not intrinsically contaminative however, all former quarries, including the small pits shown to the north east pre 1960, carry a risk of having been subsequently infilled with waste which could have included contaminants or could be rotting and generating gases which permeate the ground.

4.2 Aerial Pictures



Above, aerial pictures dated 1999 (left) and 2021 (right)

Aerial pictures from Google Earth have also been reviewed however, copies of the pictures are not presented in this report for copyright reasons.

15 pictures are shown on Google Earth dated between 2003 and 2021. The first aerial picture is from the Envirocheck maps (above) and is dated 1999 and shows the site area to be residential use.

The neighbouring property to the west appears to be occupied by a very small long rectangular building with a pitched clay tile roof and white rendered walls set in a neatly tended garden. Subsequent pictures on Google earth after 2008 show this unusual building to have fallen into disrepair.

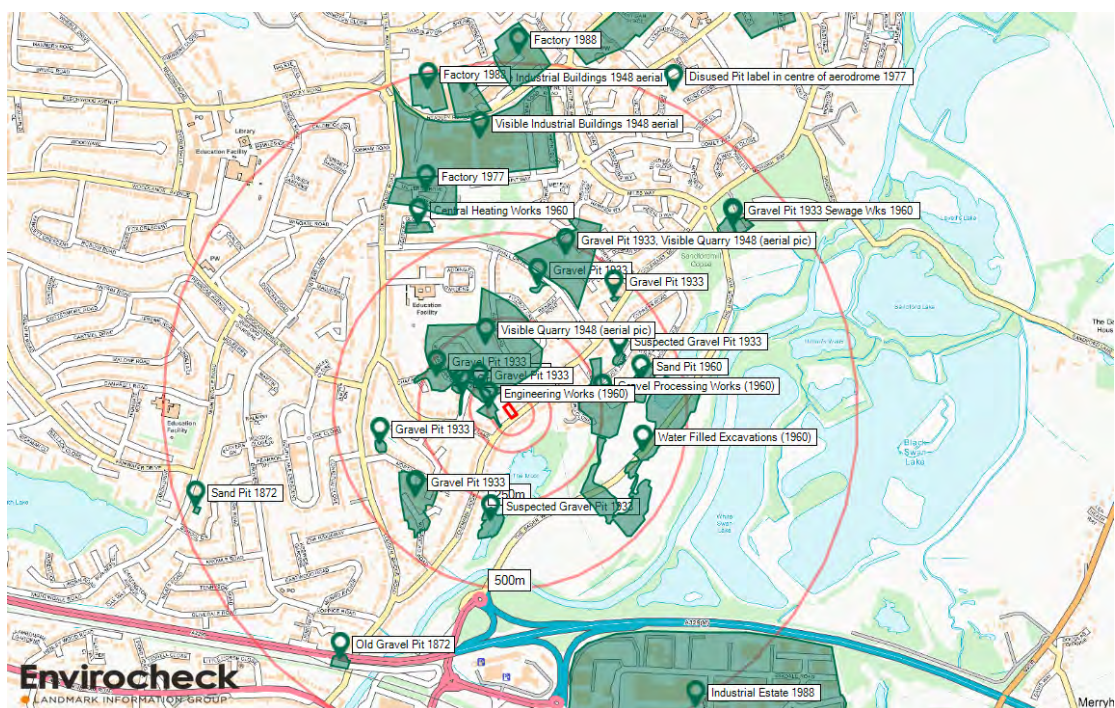
The engineering works to the west of the derelict property show that a long rectangular shed is present on the eastern side of a triangular yard. The yard appears to be filled with brown coloured materials. The colour appears consistent with corroded iron or steel and on this basis this yard appears to be filled with scrap metal.

The 2003 aerial picture shows the yard to be clearer with piles of granular material, perhaps rubble with more pale coloured material on the north eastern boundary which could be any manner of waste or re-cycling scrap. The 2008 picture shows what appear to be tyres or perhaps coils of old cable.

The piles of waste and various skips and containers change in each subsequent aerial picture until the 2017 aerial picture which shows the engineering works yard to have been cleared revealing hardstanding comprising a patchwork of cast insitu concrete slabs.

The site is then shown to be unused on subsequent pictures until the 2020 picture shows that the engineering works and the derelict site bordering the site to the west are in the progress of being developed.

4.3 Summary of Map and Aerial Picture Review



The features found on the historic maps between 1875 and 2020 are presented above.

The maps and aerial pictures have not identified any contamination activities on the site area but have shown that the closest potential source of contamination was an engineering works just 20m-50m to the north west of the site. The maps have also shown that significant amounts of gravel extraction have taken place in the area and there is potential for these old quarries to have been infilled with waste.

Unfortunately, the engineering works lies directly within the catchment that could bring contamination onto the site area. Some of the gravel pits lie within the notional 250m radius around any buried waste, which could be permeated with ground gases.

5.0 Available Information

5.1 Database Search

This database of information is assembled by the Landmark group. The update cycles and the organisations (generally Local Authorities and the Environment Agency) who provided the data are summarised in the appended Envirocheck datasheet. This information is solely provided by third parties and Sackedgate Ltd cannot guarantee its accuracy or completeness.

This information is scrutinised for potential contamination sources to be brought forward for further consideration.

Data Type		0-250m	250-500	Database Description And Notes.	Further Investigation Required
Contaminated Land Register		None	None		No
Regulators	Discharges Consents	None	2	Both Thames Water Pumping Stations	No
	Pollution Incidents	3	6	Mostly centred on the River Loddon, none in the contamination catchment to the north west of the site.	No
	Pollution Controls	None	None		No
	Enforcements	None	None		No
	Prosecutions	None	None		No
Waste Treatment and Landfill	BGS Recorded Landfill Sites	None	None		No
	Local Authority Recorded Landfill Sites	1	2	Mortimer's Meadow 155m south east, inert waste Norton Road – Records unclear, 1948 aerial picture shows trees	Yes
	Registered Waste Treatment Sites	None	None		No
	Registered Waste Transfer Sites	None	None		No
	Licensed Waste Management Facilities	None	None		No
	Other Made Ground	6	11	These entries refer to many, but not all, of the gravel pits identified from the historical mapping.	No
Industrial / Commerce	Light-Heavy Industry	1	None	R E Tanner & Co Ltd, Tradex Meter Co Ltd, Tanner Scrap Metal Merchants and Recycling Services 20m-50m north west. The main centre of industry is at the works associated with former Reading Aerodrome 500m to 1km to the north.	Yes
	General Commercial Activities	9	4	Mostly small businesses including Car Engine Tuning & Diagnostic Services, Lawnmowers & Garden Machinery - Sales & Service, Pest & Vermin Control, Ornamental Metalwork. Although potential contaminators, none were considered to be of sufficient size or close enough to pose a credible risk.	No
	Radioactive Substances	None	None		No
	Areas of Pollution Control	None	None		No
	Areas under remedial Action	None	None		No
Fuel	Road Fuel Dispensing Forecourts	None	None		No
	Fuel Storage Areas	None	None		No
Hazardous Substances/Activities	Control of Major Accident Hazards	None	None		No
	Notification of Installations Handling Hazardous Substances	None	None		No
	Explosives Sites	None	None		No
	Planning Hazardous Substances Consents or Enforcements	None	None		No

5.2 Findings of the Database Search

5.2.1 Potential Landfill Gas Issues



Above, the areas of landfills (red) and areas of potentially infilled land (green and brown) are presented on the 1948 aerial picture.

The environmental database search, supported by the historical mapping, has shown that the site lies within 250m of a number of gravel pits which appear in the 1930's and then in the 1960's. Landfill records show that some were infilled with waste materials.

The large area to the south east of the site shaded in red on the plan above is named Mortimer's Meadow and the records show that these gravel pits were infilled with inert waste. This probably comprised construction and demolition waste and should have contained little contamination or materials which would decay and generate gases. The infill control may not have been rigorous and unacceptable waste may be present.

However, the landfills are separated from the site area by the River Loddon on a geologically separate gravel terrace to the site, which is shown to be underlain by the gas impermeable London Clay. Since no plausible gas migration pathway can be identified between the site and this landfill, the issue of gas migration could be dismissed. Leachate or fluid contaminant migration from the landfill and onto the site would be uphill and against surface drainage and groundwater flow and could also be dismissed.

The smaller landfill to the south west of the site appears on the 1933 and 1938 maps however, the 1948 aerial picture shows it to be overgrown and disused and then in 1977 the entire area becomes covered with houses. The landfill records for this site do not give any idea of the material buried and when infilling ceased. It appears that until 1960 the pit became overgrown and was probably infilled when the houses appear over the pit in the late 1960's to the 1970's or perhaps remains as a steep slope in the gardens of those properties. The gas risk to the site is not considered plausible and the old pit does not lie in the catchment area where contamination could migrate onto the site.



Above, an overlay of the 1933 map and the 1968 map

The closest gravel pit was just 50m - 80m to the north west of the site and was named Wheeler's Green Gravel Pit. This pit partly underlay the engineering works 20m-50m to the north west however, as discussed later in this report, gas monitoring was undertaken at the engineering works and did not reveal any elevated gas concentrations requiring any significant further consideration or mitigation.

5.2.2 R E Tanner & Co Ltd, Tradex Meter Co Ltd



The database search showed that the engineering works some 20m-50m to the north west of the site used by R.E. Tanner & Co. and Tradex for meter manufacture and supply. Further research showed that the meters were simple devices (see picture above) for clocking up the power usage of dwellings or commercial buildings.

Although the manufacture of these meters did not involve any toxic chemicals, there is some risk that light electrical equipment such as fluorescent lighting ballasts or chokes, transformers or the heaviest of supply cables were handled at this workshop. All these components may have contained toxic cooling and insulation oils (PCBs or Poly Chlorinated Biphenyls).

5.2.3 R E Tanner & Co Ltd, Scrap Metal Merchants & Recycling Services

Scrap metal yards can introduce metals into the ground in a variety of ways, Iron and steel will corrode and any alloyed metals such as Chromium, Vanadium or Boron will be released as the Iron oxidises. Steel from construction sites is often painted with 'red lead' type paint (Tri Lead Tetraoxide) to inhibit corrosion or steel items can be galvanised and coated with a thin layer of Zinc with traces of Cadmium which is difficult to separate from Zinc during the smelting of Zinc ore.

More valuable metals such as Copper, Lead, solid Zinc and brass would have been collected. The most concerning of these metals is Lead, particularly when being removed from lead-acid type batteries. The battery electrolyte is heavily contaminated with Lead Sulphides and Sulphates at a very low pH which allows mobility.

Previous connections with Tradex and the work in the electrical industry may have resulted in the targeting of Copper scrap and hence the re-cycling of cables or electrical components large and small which could increase the risk of PCB oils being present.

Electrical cabinets with supply breakers, electrical motor contactors etc were often fitted with asbestos fire shielding or where mounted on asbestos panels. Traces of asbestos, if present, could have been washed into cracks in the hardstanding and drainage.

6.0 Additional Information

As part of the development of the engineering works 20m-50m to the north west of the site, some extensive site investigation work was carried out in order to discharge contaminated land planning conditions (ref 180988). The report has been published on the Wokingham Borough Council planning web pages and has been downloaded and reviewed.

The investigation was carried out by Ashdown Site Investigations (their reference P13639) and titled Combined Geotechnical, Ground Contamination Risk Assessment and Remediation Strategy at Pitts Works 99A-103 Colemans Moor Road.

The investigation work included a desk study and then a series of trial pits and small diameter dynamic sampling boreholes. This revealed made ground over the engineering works site with a maximum depth of 2.4m recorded. I suspect the made ground is infill to the Wheeler's Green Pit which underlies part of the engineering works and the land further to the north west.

Some laboratory analysis was carried on samples recovered from these trial holes. Selected boreholes were fitted with gas monitoring wells and a period of gas monitoring was carried out.

6.1 Ashdown Laboratory Analysis

The investigation revealed high Lead and Cadmium concentrations from shallow samples recovered from borehole WS02 and trial pit TP03. The other samples did not reveal high concentrations of these metals. Of note was that the high Lead and Cadmium values were also accompanied by high Zinc and Copper concentrations.

Low levels of tarry hydrocarbon based combustion residues (PAH or Polycyclic Aromatic Hydrocarbons) were detected. These compounds would have been expected to have been washed into the made ground below the hardstanding if repeated bonfires had taken place.

Volatile hydrocarbons or solvents (VOC or Volatile organic Compounds) were not detected however, hydrocarbons associated with diesel fuels were detected in samples from boreholes WS01 and WS02. These appear to be from a plume of fuel oil spreading from below a former fuel oil tank location.

PCB oils were detected in samples from borehole WS02 which was drilled close to an electrical substation. Although the substation is a tempting scapegoat for the presence of PCBs on this site, there is identified potential for PCBs to have arisen due to the scrapping or maintenance of electrical items containing PCB oils (as listed previously).

Asbestos was detected at the surface in the northern side of the engineering works yard. The fibres were identified as Chrysotile Crocidolite. Although the Chrysotile asbestos can be associated with roof board debris seen on the engineering works site, the Crocidolite is more likely to have come from old electrical installations.

Samples from trial holes in the plot with the derelict house to the south east of the engineering works and directly to the west of the development site at No. 105, did not reveal any elevated concentrations of contaminants in the testing suites used.

6.2 Ashdown Gas Monitoring

The gas monitoring at the engineering works did not reveal any Methane and some traces (0.4% Maximum) of Carbon Dioxide. The boreholes in which the monitoring wells were installed penetrated made ground of various thicknesses (max 2.4m depth) underlain by brown and grey shelly clay (London Clay Formation).

The gas measurements reflect the gas generation in the made ground underlying the engineering works and generally infilling the closest of the gravel pits. The engineering works appears on the 1948 mapping and therefore the infill in the gravel pit below the works has been in place for some 73 years now and gas generation is expected to be at a very slow ebb or even halted, given the monitoring results.

The London Clay could not be transmitting any ground gases. The potential for any of the infilled pits nearby to be introducing ground gases below the development site is therefore considered implausible.

6.3 Ashdown Remedial Recommendations



Above, extracts of the Ashdown Investigations Report for review.

The remedial recommendations for this site involved the removal and replacement of contaminated soil in garden areas to a depth of 600mm and replacement with a break layer or anti capillarity barrier which is covered by subsoil and then topsoil. A lesser recommendation for replacement with 450mm in areas of landscaping. The recommendations included the full removal of the fuel oil and PCB oil contaminated soil around the former fuel tank location.

Construction at the Engineering Works site is now complete and a new Cul-De-Sac named Consul Close is now present with 20 new dwellings. The remedial works validation reports were not available or could not be found however, it is assumed that the removal of the hydrocarbons and the bulk of the metal contaminated soil was successfully carried out.

7.0 Site Walkover / Inspection

7.1 Description



At the time of the first walkover survey the dwelling at 105 Colemans Moor Road was unoccupied and the garden rather overgrown. The dwelling was a single storey brick structure with a pitched slate tile roof with a single chimney breast. A dormer window with a flat roof was present presumably part of converting attic space.

The tarmac driveway rose from the lower level of Colemans Moor Road up to the level of the house. The driveway wrapped around the front and the left hand side (south western) side of the house. Wood piles were stacked against the south western elevation of the house, presumably for use on an open fire grate in the main living room.

To the rear of the house (north western side) there was a small brick rear porch. Paving was probably present along the rear of the house however, it was not visible through the vegetation. There was no evidence for the presence of a fuel oil tank, or the former supports or bunding to a former fuel tank anywhere on the site.

Investigations with an excavator were also carried out described in the sections below. The excavator was also used to partly clear some areas of the site where the trial pits were to be carried out and revealed a lot of garden waste comprising tree cuttings, grubbed up roots and other vegetation. No evidence was found for any fuel containers or building waste, car brake pads or stained areas of topsoil which would have been indicative of past contaminative activities.

8.0 Initial Physical Investigations



During the site visit an excavator was used to carry out three trial pits along the south western boundary of the site, beyond which lay the old engineering works. The locations are shown on the attached site layout plan. The aim was to take a first look at the soils below the site and check for any made ground or evidence of contamination migrating from the engineering works to the north west in the shallow as well as deeper soils.

8.1 Ground Conditions

All three trial pits encountered a layer of brown sandy topsoil to depths of 0.45m to 0.5m with a gradually diminishing organic content with depth. The sand in the topsoil was consistent with the sand in the immediately underlying subsoils. Occasional flints were noted and there was a conspicuous absence of any brick or tile fragments and other construction debris.

Trial pit TP1 then encountered an orange brown and red brown mottled gravelly sandy clay below the topsoil to a depth of 1.5m where although retaining the same colour, the sand content increased significantly to the base of the pit at 2.3m. Samples were recovered at depths of 0.4m and 2.0m for contamination analysis.

Trial pit TP2 showed a similar profile of sandy topsoil over orange brown sandy clays and clayey sands however, unlike TP1, in this pit the clay content increased with depth. A single sample of the shallow soils was recovered from this pit at a depth of 0.35m for contamination analysis.

Trial pit TP3 encountered solely the orange brown and red brown mottled gravelly sandy clay and there was no notable change in the clay sand proportions. Samples were recovered from depths of 0.4m and 1.6m for contamination analysis.

8.2 Sampling Protocols

The samples recovered at this site were placed in laboratory supplied containers suitable for the proposed analysis.

Where Hydrocarbons especially volatiles are to be assessed, glass jars and vials are used and the samples are placed in a cool box with ice packs and kept at a temperature below 9 degrees C for transport to the laboratory.

Holding times for samples are also applicable since some contaminants can degrade quickly once sampled. This is of great concern with regard to samples of groundwater or surface water. No deviating samples were noted by the laboratory indicating that the samples arrived sealed and at a temperature below 9°C.

All laboratory work is carried out by a UKAS accredited MCERTS laboratory firm. The laboratory certificates referenced 20-11493 are appended.

8.3 Generic Assessment Criteria

The measured concentrations were assessed against published guideline values for generic exposure scenarios. Various guidelines are applicable all based on various revisions of the Environment Agency CLEA model.

The Environment Agency produced soil guideline values or SGVs for a limited number of contaminants, the model was then taken up the Chartered Institute of Environmental Health and Land Quality Management (CIEH/LQM) who produced guideline values for a large list of contaminants presented in their S4UL publication (Copyright Land Quality Management Ltd. reproduced with permission Publication Number S4UL3813, All rights reserved).

The Department for the Environment Farming and Rural Affairs (DEFRA) also used a modified version of the CLEA model to provide guideline values for a very limited number of contaminants using a revised version of the model which introduced a new 'lower level of toxicological concern' in their SP1010 C4SL report. The most notable contaminant in the DEFRA publication is Lead which was not considered by the Environment Agency or the Chartered Institute of Environmental Health and Land Quality Management.

8.4 Exposure Scenario

For assessment of measured soil concentrations, the generic exposure scenario for residential gardens where home grown produce would be grown and consumed by the new site residents, has been selected.

8.5 Comparison of Measurements with Guideline Values

The measured values from the samples collected on the site have been compared with the guideline values for the generic exposure scenario set out above.

8.5.1 Metals

The laboratory analysis showed that all of the metals considered in the analysis were within acceptable limits for residential gardens where homegrown produce will be consumed by new residents, in all samples.

8.5.2 Poly-cyclic Aromatic Hydrocarbons or PAH

The analysis of all samples included an assessment of these tarry hydrocarbons. PAH compounds are common contaminants in the UK and a group of 16 of the most toxic or the most prolific have been selected for analysis.

Petrogenic PAH compounds can be present naturally as coal tars in coal measures or tars in crude oil.

Pyrogenic PAH compounds created by low temperature low oxygen availability combustion where instead of completely oxidising, clusters of hydrocarbon (benzene) rings can form. The compounds often contaminate ash, bonfire sites and demolition materials.

Phytogenic PAH compounds are created by plants such as pine or lavender for example and can be extracted in a retort for use a solvent (Turpentine).

The analysis showed that all of the 16 compounds considered were below detection limits or well below their respective guideline values in all of the samples.

8.5.3 Petroleum Hydrocarbons

In the first instance the analysis has included a basic hydrocarbons test where the total value is divided into weight bands. This analysis does not spilt the band totals into their aliphatic (open ended chain molecules) or aromatic groups (clustered ringed molecules). The guideline concentrations however, do spilt the band totals into their aliphatic or aromatic groups.

The aromatics have the lowest acceptability limits and if the unsplit band totals are lower than the limits for the Aromatic or Aliphatic bands, the split values would not exceed the limits either.

If the measured concentrations in any one band exceed the limits for that aromatic band (or aliphatic band if a lesser values is published), then more detailed analysis will be required that does spit the hydrocarbon band totals into the aliphatic or aromatic groups.

The analysis of the samples recovered from this site has not revealed any concentration in any one band that exceeds limits for aliphatic or aromatic hydrocarbons in the respective bands for residential gardens.

8.5.4 Asbestos

The samples were all screened for asbestos fibres. Unsurprisingly given the absence of construction waste on the site, no fibres were detected.

9.0 Potential Contamination Sources

Following the assessment of maps and aerial photographs, as well as available environmental data for the site and preliminary ground exploration, the following potential sources of contamination have been identified. These are not proven sources at this stage and they do not represent any form of allegation against any persons historically or currently involved with the identified areas or locations.

9.1 Made Ground

Soil import to properties in this area may have taken place for a variety of reasons, the historical maps suggest the main reason was to infill old gravel extractions. The larger pits are marked on historic maps however, development of dwellings in the 1920's – 1930s may have resulted in many small 'borrow' pits where gravel was taken locally for road repairs or construction of individual dwellings.

Imported soils normally arise from demolition or construction, perhaps at old industrial sites and such materials could therefore contain a variety of potential contaminants ranging from those associated with old building materials such as Lead and Asbestos, or contaminants associated with the activities at the source industrial site.

Waste matter such as timber or vegetation arising from demolition was routinely burned and the ash added to the other inert (non-organic) rubble and soil arisings. The reason for burning was to reduce volumes and limit future settlement which was good but it often resulted in increasing the relative concentration of any metals present and adding combustion residues such as tarry carcinogenic Hydrocarbons and Cyanides.

No evidence was found in any of the three trial pits for any significant areas of made ground on the site and as discussed, brick fragments and other construction debris normally present in the surface soils around any normal building, were absent. On this basis, there does not appear to have been any gravel extraction and infill at this property. This does not however dismiss the potential for small waste pits to be present which were filled by the site's previous occupants.

9.2 Engineering Works

Contamination comprising Asbestos, Lead, Cadmium, fuel oil and PCB oils were identified and remediated to a depth of 0.6m at the works 20m-50m north west of the site. Although the fuel contamination is understood to have been removed entirely, some of the contaminated made ground which underlay the former engineering works still remains below the new houses on Consort Close. The potential for gas generation from this 73 year old remaining material is very low and the remaining metals and hydrocarbons are unlikely to be mobile since they have not revealed themselves in the laboratory testing on samples from the proposed development site.

On this basis the engineering works area should still be considered contaminated due to the remaining made ground however, migration onto the site area does not appear to have taken place in the many decades that the engineering works was active. Since the bulk of the contamination has been removed and since no new contamination is being added, the potential for future migration of contamination onto the No. 105 site appears remote.

9.3 Wheeler's Green Gravel Pit



Above the 1933 map overlain on the 1948 aerial picture. Please note offset (visible in the roads). Dark patchy colours inside quarry area are consistent with trees.

This very old pit (73 years since it was seen to be overgrown in 1948 aerial picture) partly underlies the former engineering works and lies just 78m to the north west of the site.

Investigations by Ashdown revealed made ground comprising a grey very gravelly clay with flint brick charcoal (ash) with an organic odour, in the deeper areas of made ground below the engineering works. This is typical old waste material as described in 9.1 above, with demolition rubble, foundation arisings and ash.

Most of the available organic matter was burned before the material was placed leaving little to decay and create gas. Loss on ignition tests carried out by Ashdown as part of Waste Acceptance Criteria (WAC) testing revealed organic matter concentrations of 1.7%, 3.1% and 2.6%. As discussed in the CL:AIRE Research Bulletin RB17, made ground less than 5m in depth and with an organic matter content of less than 5% should not be investigated further by gas monitoring and instead basic gas protection should be applied.

Gas monitoring carried out at the engineering works, via boreholes that intersected the infill to the gravel pit, did not detect elevated concentrations of ground gases.

9.4 Mortimer's Meadow Landfill

The landfill at this location appears to have been infilled with inert material as discussed. Given the low gas generation potential of the material and the implausible gas and leachate migration pathway from that location across the River Loddon and through London Clay (uphill from the view of leached contaminants) and onto the site, this source appears to pose little or no risk to the site.

10.0 Conceptual Model

Potential linkages between sources of contamination and sensitive receptors are presented below in a tabular format. The layout is set up to allow it to be expanded into a number of separate tables if further investigations are required. The risks are assessed on the basis of being acceptable or unacceptable, as formerly set out in Environment Agency CLR11.

10.1 Source-Pathway-Receptor Preamble

10.1.1 Source

Potential Sources have been identified from the available information for the site and brought forward to be assessed with respect to the potential risks posed to receptors.

The source of contamination may not be the point of origin. Contamination may have been introduced into the ground elsewhere, moved along a migration pathway and accumulated on or below the site. This includes the migration and ingress of dust from contaminated ground into dwellings.

10.1.2 Pathways

The pathways that are modelled here, vary according to the receptor. For human health protection, the pathway is the route that the contaminants take into the human body. For assessing human health risk, absorption pathways generally fall into the following categories (Environment Agency CLEA Model v1.071). Direct soil ingestion, consumption of homegrown produce and attached soil, dermal contact indoors, dermal contact outdoors, inhalation of dust indoors, inhalation of dust outdoor, inhalation of vapours indoors and inhalation of vapours outdoors.

For controlled waters and sensitive environments protection, and migration onto a site, the pathway is the geological or hydrological route from the point of origin or accumulation zone, into an aquifer, sensitive ecosystem or surface waters

10.1.3 Exposure Scenario

The applicability of these pathways depends on the exposure scenario for the use of the land. Scenarios where site occupants will not be exposed to any of the underlying soils such as the commercial land scenario differ greatly from the scenario where the land use is residential and close contact with the soil can be expected.

Generic exposure scenarios are used initially which assume various exposure durations and activity types. For this site the private gardens residential scenario, where homegrown garden produce will be consumed, has been selected.

10.1.4 Receptors

For human health, the potential receptors depend on the exposure scenario. The critical receptors at this site would be expected to be the new residential site occupants. Given the known geology of the area, Principal aquifer groundwater was not considered to be at risk given the presence of London Clay below the site. Sensitive Environments or Ecosystems have not been identified downstream from the site.

10.2 Tabulated Conceptual Model

	Potential Source	Potential Location	Associated Contaminants	Potential Migration Pathway	Potential Absorption Pathway	Potential Receptor	Preliminary Risk Assessment	Note
Linkage 1	Made Ground	Whole site	Metals from construction such as Lead Cadmium, Nickel Copper Zinc. Combustion residues such as tarry PAH compounds and Cyanides Fuel from plumes of leaked fuel oil intersected by excavations	Pathway not applicable. Potential source on site	Ingestion of Soil and dust Consumption of homegrown produce and attached soil. Dermal contact indoor	Construction Workers. Service and Maintenance Workers. Site Occupiers	Acceptable	Significant areas of made ground on site are not found or suspected.
Linkage 2	Pitts Works (Engineering Works and scrap metal works)	20m-50m north west	(Identified not potential contaminants) Cadmium, Lead, Fuel Oil, PCB (cable/transformer oils) Chrysotile Asbestos, Crocidolite Asbestos	Potentially granular layers in the gravelly clay seen underlying the site	Dermal contact outdoor Inhalation of Dust Indoor Inhalation of Dust Outdoor	Wider public Groundwater	Acceptable	Bulk of contamination removed. No evidence of past migration.
Linkage 3	Wheeler's Green Gravel Pit	20m - 78m north west	Metals from construction such as Lead Cadmium, Nickel Copper Zinc. Combustion residues such as tarry PAH compounds and Cyanides Fuel from plumes of leaked fuel oil intersected by excavations	Potentially granular layers in the gravelly clay seen underlying the site	Inhalation of Vapour Indoor Inhalation of Vapour Outdoor Groundwater		Acceptable with mitigation measures in the building structure	Some residual risk remains regarding the actual contents of this pit given the introduction of new soakaways etc in all the dwellings that now overlie the pit
Linkage 4	Mortimer's Meadow Landfill	155m south east	Metals from construction such as Lead Cadmium, Nickel Copper Zinc. Combustion residues such as tarry PAH compounds and Cyanides Fuel from plumes of leaked fuel oil intersected by excavations	River Loddon and the London Clay provide barriers to migration of leached contaminants and gases.			Acceptable	Implausible migration pathway

11.0 Interpretation & Recommendations for Physical Investigations

11.1 Plausible Linkages Posing Potential Risks

The assessment of the conceptual model suggests that the potential links between sources of contamination and receptors such as new residents can generally be dismissed

Very limited residual risks remain from the remaining infill present in the Wheeler's Green Gravel Pit 50m to 80m north west of the site. The largest part of the pit has been covered by housing for decades however, changing water levels could result in changes in the activity of the fill. On this basis I would consider that the use of suspended ground floors with adequate ventilation and inclusion of basic gas membrane in the floor structure, would mitigate the residual risks.

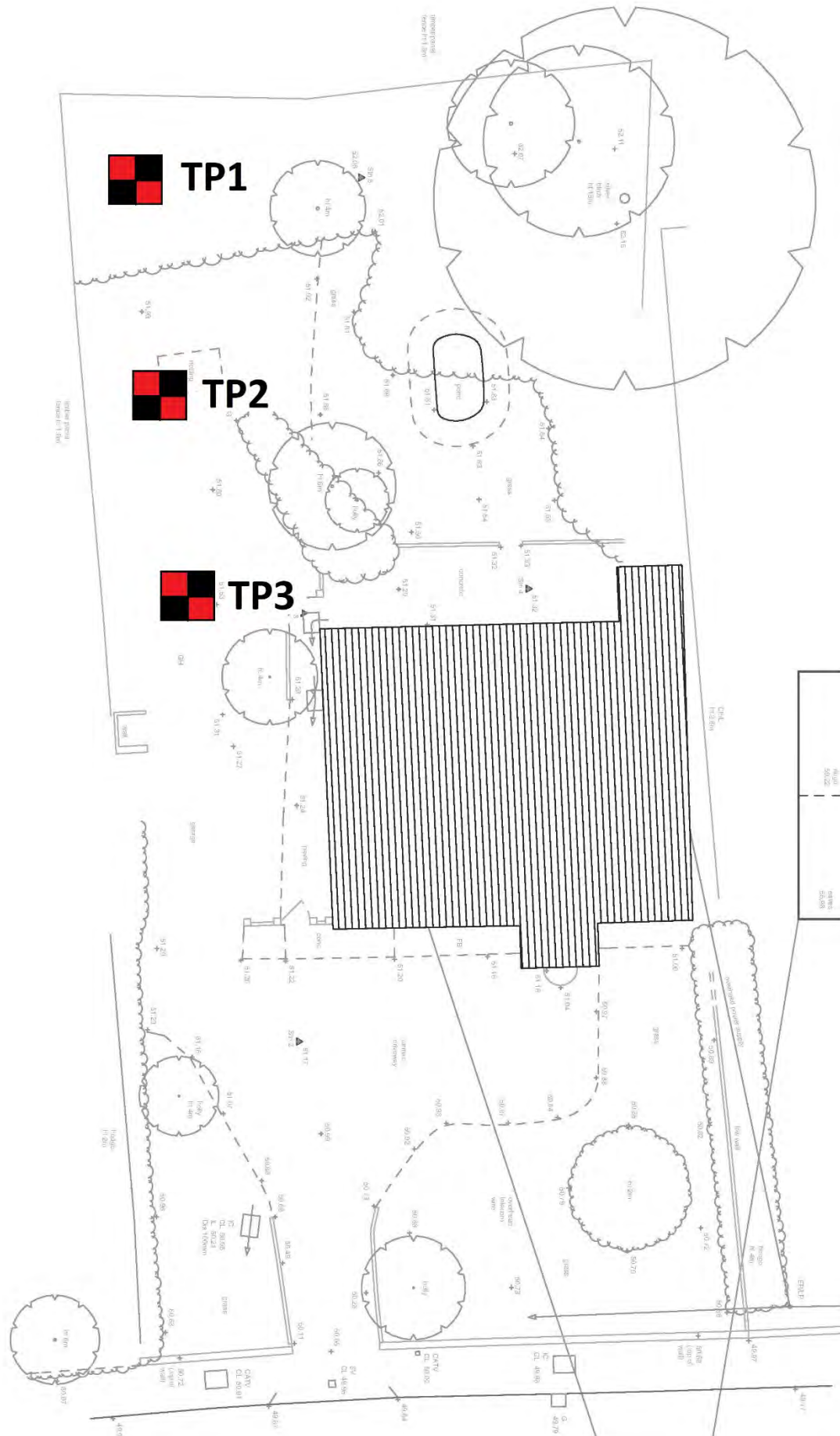
The gas membrane would generally comprise a 2000 gauge polythene material, taped and sealed at joints and around rising services and lapped into the exterior damp proof course. Full details are given in BRE 414 (2001) however, the designer should check if this document has not been superseded.

11.2 Unexpected Areas of Contamination

The coverage of this site was fairly good, with respect to the number of trial pits and targeting of contamination sources. However, any unexpected areas of contamination, or areas of contamination that were undisclosed by the layout of the trial pits, may be found during construction or landscaping works.

If construction or landscaping disclose small old ash or waste pits or perhaps a plume of fuel, even discoloured, odorous or just suspicious ground or man-made inclusions, work should be halted while the situation is assessed and measures are devised if necessary to deal with the unexpected findings. Sackedgate Ltd should be informed immediately before any actions are taken to ensure that the release or spread of contamination does not result.





Appendix G

Trial Pit Records

105, Colemans Moor Road,
Woodley,
Berkshire,
RG5 4DA

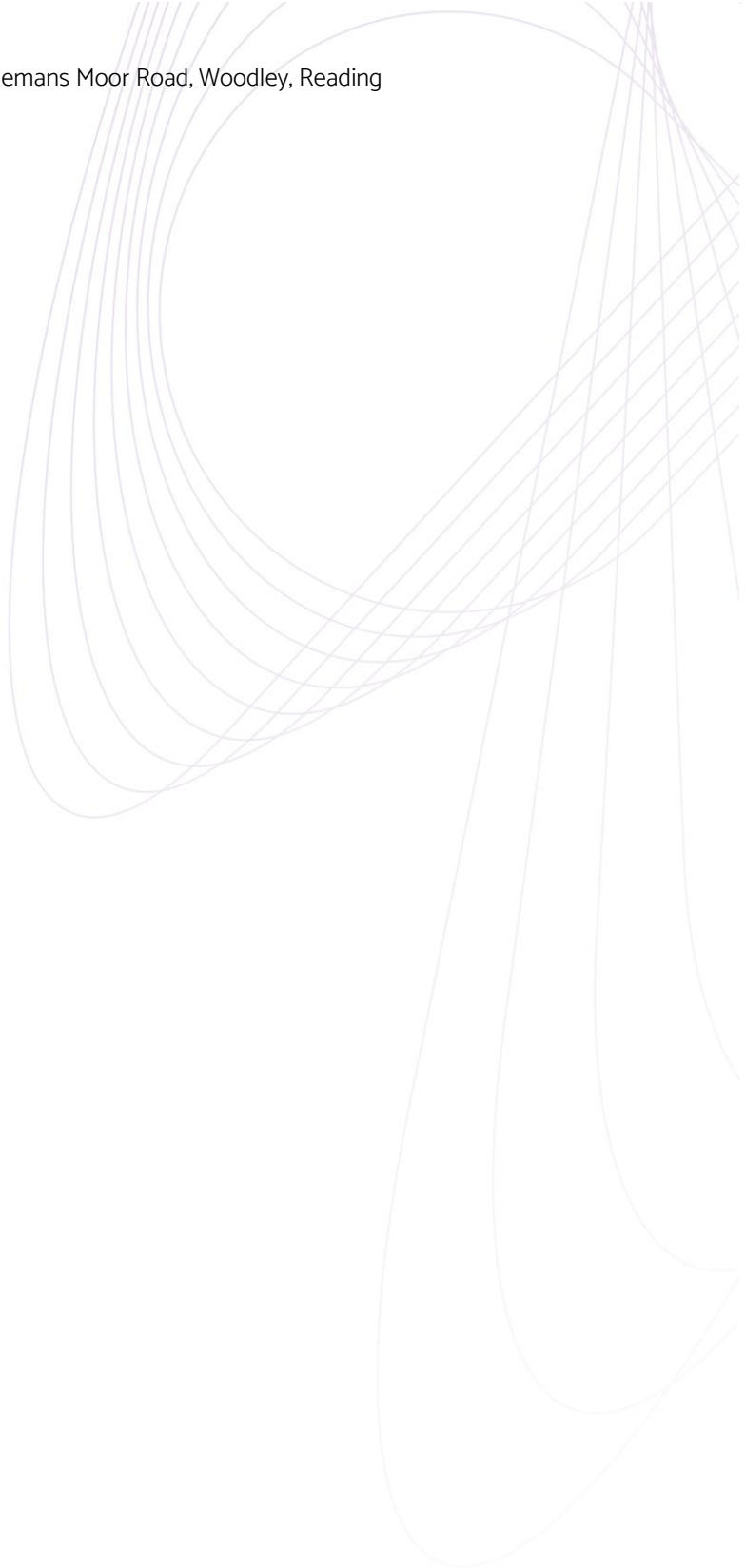
Project Reference J118

Trial Hole TP1		Job No J118 105, Colemans Moor Road, Woodley		
Method – Trial hole carried out using a small track laying excavator Carried out on the 23 rd July 2021				
Legend	Depth	Soil Description	Samples	Notes
	GL 0.00-	Weeds over brown sandy TOPSOIL with rare flint gravel		
	0.5-	Firm orange brown and red brown mottled gravelly very sandy CLAY. Gravel is fine to medium sub rounded to sub angular flint/chert. Sand is fine to medium rounded quartz.	J-0.4	
	1.0		B-1.0	
	1.5-	Medium dense orange brown and red brown mottled gravelly clayey fine to medium rounded quartz SAND. Gravel is fine to medium sub rounded to sub angular flint/chert		
	2.0		J-2.0	
	2.3-	Base of Trial Pit	B-2.2	
		Groundwater not encountered		
	3.0			
	4.0			
 Sackedgate Ltd 26 Reading Road Burghfield Common RG7 3QA		J Jar Samples (inc vials etc) B - Bag/Bulk Sample	Engineer JRP	
			Date 16 Sept 2020	

Trial Hole TP2		Job No J118 105, Colemans Moor Road, Woodley		
Method – Trial hole carried out using a small track laying excavator Carried out on the 23 rd July 2021				
Legend	Depth	Soil Description	Samples	Notes
	GL 0.00-	Weeds and some brick rubble over brown sandy TOPSOIL with rare flint gravel		
	0.5-	Loose to medium dense orange brown and red brown mottled gravelly clayey fine to medium rounded quartz SAND. Gravel is fine to medium sub rounded to sub angular flint/chert	J-0.35	
	1.0		B-1.0	
	1.5-	Firm orange brown and grey mottled gravelly very sandy CLAY. Gravel is fine to medium sub rounded to sub angular flint/chert. Sand is fine to medium rounded quartz.		
	2.0		B-2.2	
	2.4-	Base of Trial Pit		
		Groundwater not encountered		
	3.0			
	4.0			
 Sackedgate Ltd 26 Reading Road Burghfield Common RG7 3QA		J Jar Samples (inc vials etc) B - Bag/Bulk Sample	Engineer JRP	
			Date 16 Sept 2020	

Trial Hole TP3		Job No J118 105, Colemans Moor Road, Woodley		
Method – Trial hole carried out using a small track laying excavator Carried out on the 23 rd July 2021				
Legend	Depth	Soil Description	Samples	Notes
	GL 0.00-	Weeds and some heaped tree roots over brown sandy TOPSOIL with rare flint gravel	J-0.4	
	0.45-	Firm orange brown and grey mottled gravelly very sandy CLAY. Gravel is fine to medium sub rounded to sub angular flint/chert. Sand is fine to medium rounded quartz.		
	1.0			
	1.65-	Base of Trial Pit		
	2.0	Groundwater not encountered		
	3.0			
	4.0			
 Sackedgate Ltd 26 Reading Road Burghfield Common RG7 3QA		J Jar Samples (inc vials etc) B - Bag/Bulk Sample	Engineer JRP	
			Date 16 Sept 2020	

Appendix E – Infiltration Testing





Our Ref: iGeo-21-137B BRE365 Soakage Report

21st October 2021

SITE: 105 COLEMANS MOOR ROAD, WOODLEY.

1. At the request of *DV Homes* soakage testing was carried out on this site to assess the soil infiltration rates of the near surface soils.
2. The scope included one 2.0m deep stone filled BRE365 soakage test to target soils for conventional soakaway design.
3. The British Geological Survey sheet for the area shows the anticipated solid geology to the *London Clay Formation*, although *River Terrace Gravels* are shown to be present close to the west and *Alluvium* is noted close to the east, so it is reasonable to expect that either of these deposits to cap the *London Clay* on site.

BRE DG 365 Soakage Tests

4. The test was carried out in accordance with BRE DG 365 (2016), however due to the expected soils permeability and the stability of the trial pits sides, it was considered three fills would not be possible within a single day, therefore the stone filled method was chosen for these test.
5. The approximate location is shown later in this document. SA1 was excavated to a depth of 2.0m prior to arrival and terminated in a gravelly sandy clay.
6. The trial pit was logged by a geotechnical engineer to BS5930:2015, recording the average pit length, width and depth.
7. The trial pit log and approximate location is shown on the attached layout plan.

8. On completion, a 110mm diameter perforated vertical standpipe was installed in the pit. The top of the pipe was left just above ground level.
9. The trial pit was then filled to the 0.6m below ground level ~20mm single sized aggregate supplied by the developer.
10. An electronic water level data logger was then installed in trial pit prior to filling. In addition, a barometric pressure logger was left on site to provide compensation data for the level loggers.
11. The pit was then filled using a 1000 litre intermediate bulk container (IBC) to the top of the gravel rejects. Once filled, water level measurements were taken over a period of time manually from the standpipes using a dip meter to assess the likely monitoring period, also to provide time/level data to compensate the level logger values. The pit was filled with water on the morning of Tuesday 14th September 2021.
12. The client was responsible for refilling the trial pit with water having been advised to allow the trial pit to drain completely. Using the water level data recovered from the datalogger it is apparent that the trial pit was refilled for a second time on 15th September at 16:46 while the water level was at 1.06m. The $\frac{1}{4}$ full level required for the soakage calculations required the trial pit to drain to 1.67m before the refill. The pit was filled for a third time on 17th September when the logger recorded the water level at 1.16m, again not achieving the $\frac{1}{4}$ full level of 1.65m for the second fill. Data from the third fill was taken for eleven days from the late afternoon of the 17th September 2021 through to the late evening of the 28th September showing the water dropped to a depth of 1.44m, again not achieving the $\frac{1}{4}$ full depth of 1.66m for that fill. Further water level data from the logger shows the water to start to rise from the 28th September; the water level was recorded at 1.40m when the logger was recovered from the trial pit at 12:08 on the 1st October 2021.
13. Water levels were extracted from the SA1 device and are shown on the results attached later in this document. Infiltration rates are calculated for the time it takes the water to drop from $\frac{3}{4}$ full (V_p75) to $\frac{1}{4}$ full (V_p25). Examples of soakaway design are attached to this document and are based on heavily extrapolated data and should be treated with extreme caution as the water levels were extrapolated for 17.5 days to project a water level passed the V_p25 level. Although the example soakaway designs attached show that there is some capacity in a trench or crate filled soakaway none of the examples can half drain within the required 24-hour period.

14. An alternative form of draining storm water should be considered, such as off-site drainage.
15. The comments on ground water conditions are based on observations made at the time the site work was carried out. It should be noted that ground water levels may vary owing to seasonal or other effects.

Yours sincerely

A solid black rectangular box used to redact the signature of N. Barker.

N. BARKER
iGeo Ltd

PAGE:

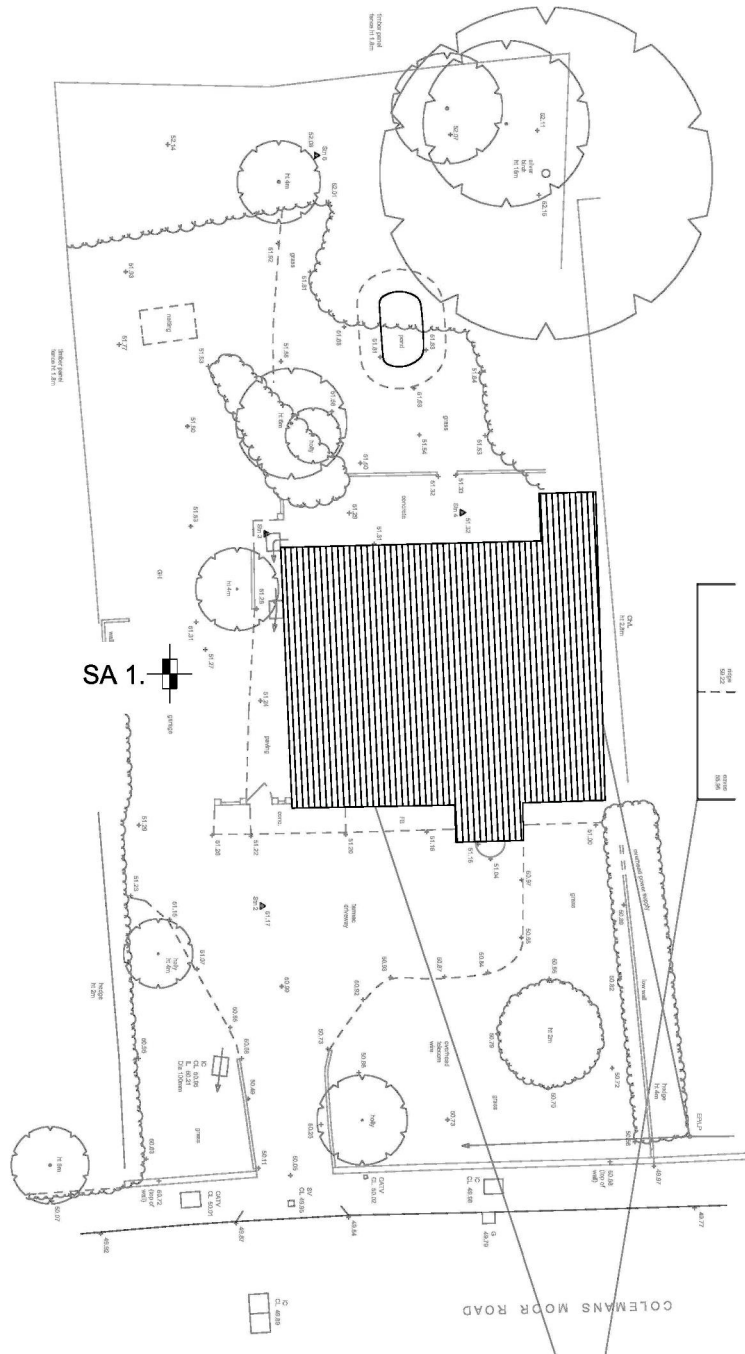
DATE:06.10.21

iGeo-21-137B

137 Colemans Moor Road, Woodley

TRIALPIT
LAYOUT

TRIALPIT LAYOUT



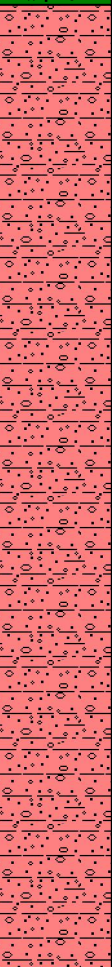
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iGeo-21-137B

137 Colemans Moor Road, Woodley

TRIALPIT
SA1

DESCRIPTION	REDUCED	DEPTH	LEGEND	SAMPLE		THICKNESS	SPT	REMARKS
	LEVEL m			TYPE	DEPTH			
Brown sandy TOPSOIL		0.00				0.45		110mm slotted pipe installed from ground level to 2.0m surrounded by single size aggregate. Data logger installed to monitor water level. Client to refill soakage test once empty.
Firm orange brown and grey mottled gravelly sandy CLAY gravel is sub-rounded and sub-angular		0.45				1.55		
		1.80w						Some water evident, spilt from IBC
		2.00						



iGeo Limited
183 Long Lane Tilehurst Reading RG31 6YW

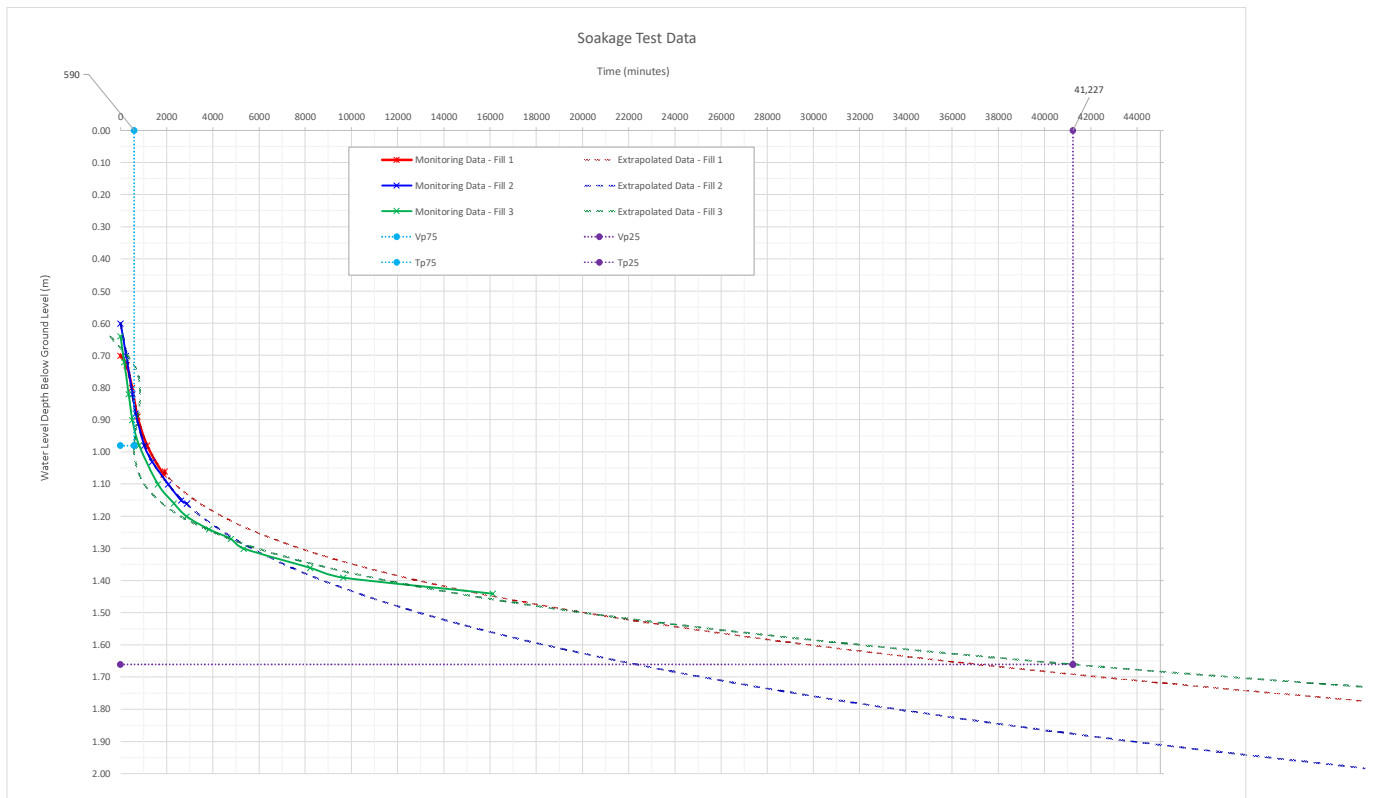
REMARKS:

U100=100mm dia. UNDISTURBED SAMPLE U38=38mm dia. UNDISTURBED SAMPLE D=SMALL DISTURBED SAMPLE
B=BULK SAMPLE W=WATER SAMPLE SPT=STANDARD PENETRATION TEST CPT=CONE PENETRATION TEST

DATE:06.10.21

137 Colemans Moor Road, Woodley

SOAKAGE TESTS



Soakaway Design Calculations to BRE365 (DG 365 Revised 2016)

Slowest Soil Infiltration Rate from Soakage Tests [m/s] = 2.49E-08 (0.000000024869) (Based on Soakage Test SA1)

Rainfall Data (England & Wales Only)
Rainfall Ratio - $(r \times 100) = 40$
 $r = 0.4$

Borehole Soakage Test Flow Rate

Gallons / minute =

Litres /minute =

m³ / minute=

Area to be Drained (m²) = 10

Use 1:100 Year Storm Calculations? Yes

Allowance for Climate Change = 40%

Proposed Soakaway Dimensions Pit Length (m) = 10.00 Pit Width (m) = 0.30 Pit Depth (m) = 1.50 Invert Depth (m) = 0.70 Effective Depth (m) = 0.80 Granular / Modular voids (%) = 43	Perforated Ring Dimensions Ring ID Diameter (m) = 0 (0.00) Wall thickness (mm) = 0 (OD Dia m) Minimum Square Pit Size Recommended [m] = 0 Allow for soakaway sides in outflow calculations? = Yes Allow for soakaway base in outflow calculations - Modular (%) = 0% Soakaway Capacity (m³) = 1.032 Outflow Rate (m3 / minute) = 0.0000123
Remarks / Assumptions A soakaway trench 10m long, 0.3m wide, 1.5m deep, (invert at 0.7m deep) filled with a granular fill (43% voids) will NOT hold 10m2 of storm water. (The soakaway will half drain in 699.5 hours NOT in 24 hours as required by BRE365) 1:100 year storms have been included in these calculations. A 40% allowance been made for climate change Note: BRE365 advocates trail pit tests with three fills of the pits, without using extrapolated values. These calculations based on 3 fill(s). Significant extrapolation used in the first fill, treat with extreme caution	

		Soakaway Calculations									
Storm Duration (D) [mins]		5	10	15	30	60	120	240	360	600	1440
M5-D	Z1	0.37	0.52	0.63	0.80	1.00	1.21	1.44	1.61	1.79	2.23
	R5 [mm]	7.5	10.4	12.7	16.1	20.0	24.1	28.8	32.1	35.8	44.6
M10-D	Z2	1.21	1.22	1.23	1.23	1.24	1.24	1.24	1.23	1.23	1.22
	R10 [mm]	9.0	12.8	15.6	19.8	24.8	29.9	35.7	39.6	44.0	54.3
M100-D	Z2	1.88	1.92	1.95	1.98	2.00	2.01	2.01	2.00	1.99	1.96
	R100 [mm]	14.0	20.1	24.7	31.8	40.0	48.4	57.9	64.3	71.3	87.6
Inflow (I) [m ³] =		0.140	0.201	0.247	0.318	0.400	0.484	0.579	0.643	0.713	0.876
Inflow + Climate (m ³) =		0.196	0.281	0.346	0.445	0.560	0.678	0.811	0.900	0.999	1.226
Outflow (m ³) =		0.000	0.000	0.000	0.000	0.001	0.001	0.003	0.004	0.007	0.018
Required Capacity (m ³) =		0.196	0.281	0.346	0.444	0.559	0.677	0.808	0.896	0.991	1.208
Spare Capacity (m ³) =		0.836	0.751	0.686	0.588	0.473	0.355	0.224	0.136	0.041	-0.176

Summary										
Enough Capacity ?	YES	YES	YES	YES	YES	YES	YES	YES	YES	NO
Half Empty Time (Hrs) =					699.5	(Minutes) = 41968				
Half Empty within 24 hours?					NO					

Soakaway Design Calculations to BRE365 (DG 365 Revised 2016)

Slowest Soil Infiltration Rate from Soakage Tests [m/s] = 2.49E-08 (0.000000024869) (Based on Soakage Test SA1)

Rainfall Data (England & Wales Only)
Rainfall Ratio - ($r \times 100$) = 40
 $r = 0.4$

Borehole Soakage Test Flow Rate

Gallons / minute =

Litres /minute =

m³ / minute=

Area to be Drained (m^2) = 50

Use 1:100 Year Storm Calculations? Yes
Allowance for Climate Change = 40%

Proposed Soakaway Dimensions		Perforated Ring Dimensions	
Pit Length (m) =	60.00	Ring ID Diameter (m) =	0 (0.00)
Pit Width (m) =	0.45	Wall thickness (mm) =	0 (OD Dia m)
Pit Depth (m) =	1.50	Minimum Square Pit Size Recommended [m] =	0
Invert Depth (m) =	0.70		
Effective Depth (m) =	0.80	Allow for soakaway sides in outflow calculations? =	Yes
Granular / Modular voids (%) =	43	Allow for soakaway base in outflow calculations - Modular (%) =	0%
		Soakaway Capacity (m³) =	9.288
		Outflow Rate (m3 / minute) =	0.0000722

Remarks / Assumptions

A soakaway trench 60m long, 0.45m wide, 1.5m deep, (invert at 0.7m deep) filled with a granular fill (43% voids) will hold 50m² of storm water. (The soakaway will half drain in 1072.6 hours NOT in 24 hours as required by BRE365)

1:100 year storms have been included in these calculations. A 40% allowance been made for climate change

Note: BRE365 advocates trail pit tests with three fills of the pits, without using extrapolated values. These calculations based on 3 fill(s). Significant extrapolation used in the first fill, treat with extreme caution

Soakaway Calculations											
Storm Duration (D) [mins]		5	10	15	30	60	120	240	360	600	1440
M5-D	Z1	0.37	0.52	0.63	0.80	1.00	1.21	1.44	1.61	1.79	2.23
	R5 [mm]	7.5	10.4	12.7	16.1	20.0	24.1	28.8	32.1	35.8	44.6
M10-D	Z2	1.21	1.22	1.23	1.23	1.24	1.24	1.24	1.23	1.23	1.22
	R10 [mm]	9.0	12.8	15.6	19.8	24.8	29.9	35.7	39.6	44.0	54.3
M100-D	Z2	1.88	1.92	1.95	1.98	2.00	2.01	2.01	2.00	1.99	1.96
	R100 [mm]	14.0	20.1	24.7	31.8	40.0	48.4	57.9	64.3	71.3	87.6
Inflow (I) [m ³] =		0.699	1.004	1.235	1.589	1.999	2.422	2.895	3.215	3.567	4.378
Inflow + Climate (m ³) =		0.979	1.406	1.729	2.224	2.798	3.391	4.054	4.501	4.993	6.130
Outflow (m ³) =		0.000	0.001	0.001	0.002	0.004	0.009	0.017	0.026	0.043	0.104
Required Capacity (m ³) =		0.979	1.405	1.727	2.222	2.794	3.383	4.036	4.475	4.950	6.026
Spare Capacity (m ³) =		8.309	7.883	7.561	7.066	6.494	5.905	5.252	4.813	4.338	3.262

Summary										
Enough Capacity ?	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Half Empty Time (Hrs) =					1072.6	(Minutes) = 64357				
Half Empty within 24 hours?					NO					

Slowest Soil Infiltration Rate from Soakage Tests [m/s] = 2.49E-08 (0.000000024869) (Based on Soakage Test SA1)

Borehole Soakage Test Flow Rate

Gallons / minute =

Litres /minute =

m³ / minute=

Area to be Drained (m^2) = 30

Use 1:100 Year Storm Calculations? Yes
Allowance for Climate Change = 40%

Remarks / Assumptions

A soakaway trench 10m long, 0.5m wide, 1.5m deep, (invert at 0.7m deep) filled with modular crates (96% voids) will hold 30m2 of storm water. (The soakaway will half drain in 2553.1 hours NOT in 24 hours as required by BRE365)

1:100 year storms have been included in these calculations. A 40% allowance been made for climate change

Note: BRE365 advocates trail pit tests with three fills of the pits, without using extrapolated values. These calculations based on 3 fill(s). Significant extrapolation used in the first fill, treat with extreme caution

Summary

Summary										
Enough Capacity ?	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Half Empty Time (Hrs) =					2553.1	(Minutes) = 153184				
Half Empty within 24 hours?					NO					



Particle Density and Voids Percentage - Summary of Results

Project No.

Project Name

iGeo-21-137B

Colemans Moor Road, Woodley

[illegible]

Sheet no 1

Tested by

All tests performed in accordance with BS1377:1990 unless specified otherwise

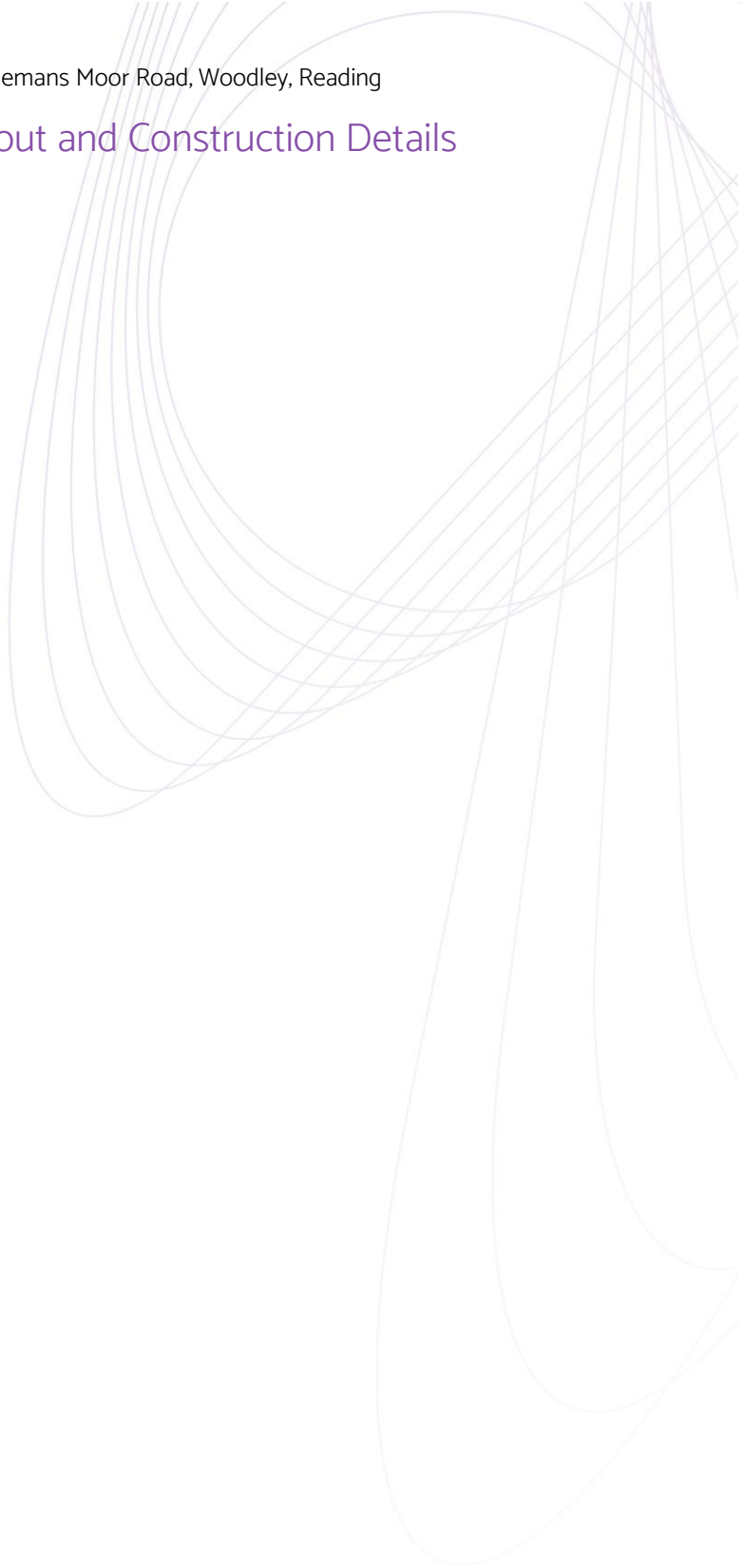
Date Printed 28/09/2021

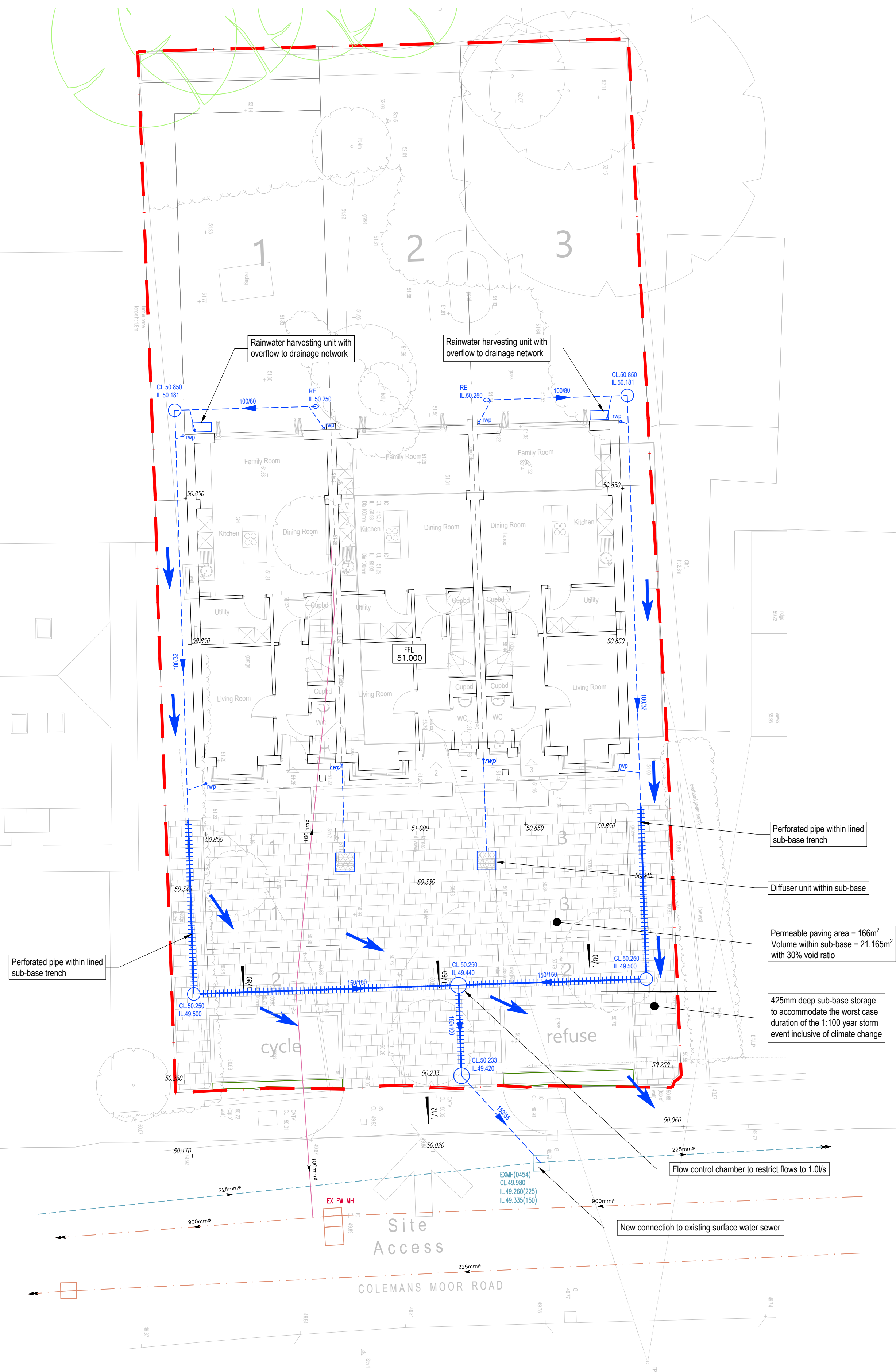
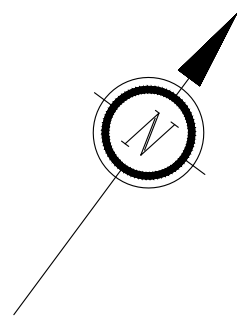
Approved by

iGeo Limited

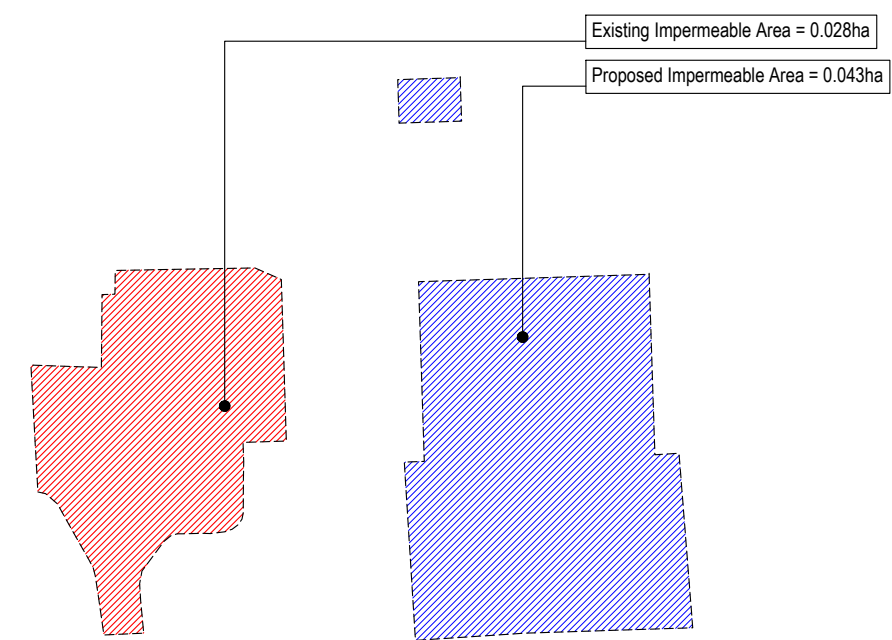
183 Long Lane, Tilehurst, Reading, Berkshire, RG31 6YW
Office: 0118 943 9910 Email: hello@igeo.co.uk Web: www.igeo.co.uk

Appendix F – Proposed Drainage Layout and Construction Details





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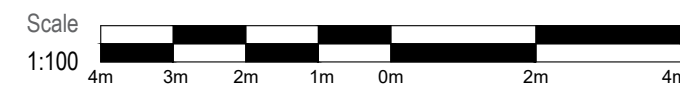
Impermeable Areas Plan

- Note:
All existing drainage is to be checked by the contractor and verified by the engineer prior to the construction of any drainage works
- Note:
Connection to be agreed with Thames Water prior to construction
- Note:
All drainage points are assumed and to be confirmed by the architect

Drainage Key	
Private Surface Water	
Surface Water	CL 00.00 IL 00.00 65.00.00
Manhole Text	150/150
Surface Water Pipe Diameter / Gradient	150/150
Rain Water Pipe	480mm Ø >600mm Depth
Diffuser Unit	
Permeable Paving	
Perforated Pipe	
Flood Exceedance Route	

Existing Drainage Key	
Combined Sewer	0.750%
Surface Water Sewer	0.750%
Foul Water Sewer	0.300%

External Works Key	
Proposed Level	00.000
Existing Level	00.000
Finished Floor Level	FFL 00.000



P2	Drainage amended as per architects layout update	AH	DB	02.09.2024
P1	Preliminary Issue	LF	RN	27.06.2022
Issue	Notes	Drawn	Approved	Date
The logo for JMS Group, featuring the lowercase letters 'jms' in a large, stylized font, with 'Group' written in a smaller font below it. A stylized fingerprint graphic, consisting of concentric, wavy lines that form a circular shape. Engineering That Brings Design To Life.				
Issuing Office: JMS East Anglia (Ipswich): Unit 27, Brightwell Barns Brightwell, Suffolk, United Kingdom, IP10 0BJ, Tel: 01473 487047				
Project 105 Colemans Moor Road, Woodley Reading, RG5 4DA				
Drawing Title Private Drainage Layout				
Project No. EX22 050 06		Drawing No. 200		Issue P2
PRELIMINARY				

Notes:

1.Inspection chamber covers and frames as follows:-

Brickwork and pre-cast concrete -

- i) Brivate drives accepting vehicle traffic: BS EN124 class D400, 600mm clear opening, solid top cover and frame.
ii) Footpaths, verges and gardens: BS EN124 class B125, 600mm clear opening, solid top cover and frame.

Polypropylene

- iii) Areas accepting vehicle traffic: Class B
iv) Soft landscaped areas: Class C

2. Mortar haunching to inspection chamber and frames.

3. i) For use with brick inspection chambers in non adopted roads, private drives, footways and verges; heavy duty (150mm nominal thickness) precast reinforced concrete cover slab to BS 5911, bedded on 10mm thick mortar bed, or 150mm grade C25P in-situ concrete (reinforced with A393 mesh to BS 4483) cover slab.

other locations inaccessible to vehicles; light duty (75mm nominal thickness) precast reinforced concrete cover slab to BS 5911, bedded on 10mm thick mortar bed; or 100mm grade C25P insitu concrete (reinforced with A193 mesh to BS 4483) cover slab.

ii) For use with precast concrete inspection chambers in non adopted roads, private drives, footways and verges; heavy duty (150mm nominal thickness) precast reinforced concrete cover slab to BS 5911, of size and type to suit chamber sections.

Other locations inaccessible to vehicles: light duty (75mm nominal thickness) precast reinforced concrete cover slab to BS 5911, of size and type to suit chamber sections.

4. With precast or brick inspection chambers, cover slabs with a clear opening of 600x600mm are required. Offset to suit chosen face for step rungs.

5. 215mm thick walls in class b engineering bricks to BS 3921 layered in English bond with frogs up. Inner faces to be plumb and in true alignment. brick course to be level. flush jointing to brickwork inner faces and precast concrete chamber sections to BS 5911.

6. All step rungs to BS 1247

i) General purpose pattern (with 230mm tail) to be built into chamber wall of brick inspection chambers.

ii) Precast concrete manhole pattern "let in" to chamber wall of precast inspection chambers. All step rungs to be horizontally and vertically staggered as shown on section x-x. Step rungs are not required to either type of inspection chamber where depth to soffit is less than 750mm.

7. Mass concrete infill.

8. Benching to rise vertically from edges of channel to a height not less than pipe (full section) soffit level. Steel float smooth hard surface with cement mortar 1:1 mix, 25mm thick.

9. 50mm min.thick mortar bed to half round channels.

10. 150mm min. thick mass concrete base slab (grade C20P) to precast, uPVC and brick types of inspection chamber.

11. 75mm thick lean mix concrete blinding.

12. Minimum of 2, and maximum of 4 courses of 215mm thick engineering bricks (Class B) to underside of cover & frame, built off cover slab, may be required to facilitate road or drive construction.

13. A brick relieving arch shall be turned over all pipes where they pass through the walls of a brick inspection chamber.

14. Pipes entering inspection chambers shall have a flexible joint within 150mm of the outer face of the brickwork or concrete surround.

15. Channel junctions within brick or precast concrete inspection chambers to be half round channel sections.

16. Backfill material to be as detailed above for normal pipe bedding.

17. Following the flexible joint from either a precast or brick inspection chamber (note 14 above) a 'rocker' pipe of 600mm length shall be installed.

18. Precast concrete inspection chambers may (if chosen for use) have a purpose made base units.

19. Where precast concrete inspection chambers are constructed wholly above the water table, joints are to be sealed with mortar. In waterlogged ground or where the water table is above the base slab, joints are to be water tight using a mastic sealant or rubber rings of a type suitable to the chamber units.

Minimum Dimensions for Access Fittings and Inspection Chambers

Type	Depth to invert from cover level (m)	Internal dimensions		Cover dimensions	
		Length (mm) x width (mm)	Circular dia. (mm)	Length (mm) x width (mm)	Circular dia. (mm)
Rodding eye		As drain but 100 min.			Same size as pipework.1
Access fitting Small Large	150 dia. 150x100 225x100	0.6 or less, except where situated in a chamber	150x100 225x100 225	150x100.1 225x100.1	Same size as access fitting
Inspection chamber shallow Deep	0.6 or less 1.2 or less >1.2	225x100 450x450 450x450	190.2 450 450	MIN. 430x430 MAX 300x300.3	190.1 430 access restricted to max 350.3

NOTES

1. The clear opening may be reduced by 20mm in order to provide proper support for the cover and frame.
2. Drains up to 150mm.
3. A larger clear opening cover may be used in conjunction with a restricted access. the size is restricted for health and safety reasons to deter entry.

Notes:

1. Formation of trench beds and inspection chambers

i) Excavate immediately before laying beds and pipes or base slabs for inspection chambers.

ii) Remove all mud, rock projections, boulders and hard spots and replace with well compacted selected fill. localised soft spots are to be hardened by tamping in granular bedding material.

iii) If oil contamination is found adjacent to trench, the trench profile is to be cut back by 150mm from the face of bedding material and replaced with crushed concrete.

2. Concrete and mortar

i) The concrete used to surround pipes and in the construction of gullies and inspection chambers is to be grade C20P (unless noted otherwise) and mixed using SRPC unless directed otherwise by the engineer or local authority. sulphate resisting cement is to be used for in-situ or precast concrete and mortars to foul drains.

3. Covers and frames

All inspection chamber cover and frames are to be laid to have the top surface in alignment with both the longitudinal and transverse gradients of adjacent roads, drives, footways and verges. they are otherwise to be laid level. all cover levels as shown on the drainage layout/longsection are approximate. actual cover levels are to be determined on site from the position in the road, drive, footpath or otherwise.

4. Pipes to as follows:

Pipe dia. (mm)	Type	Remark
100 Internal (110 NOM. dia.)	uPVC	BS EN 1401
150 Internal (160 NOM. dia.)	uPVC	BS EN 1401

5. The contractor/developer is to ensure that all of the works comply with the following:

i) BS 8301: 1985 (code of practice for building drainage)

ii) The Building Regulations: Approved Document H 2002

iii) NHBC Technical requirements

iv) BRE Digest No. 363

6. The storage and installation of all proprietary drainage items used are to be strictly in accordance with the manufacturers instructions.

7. All uPVC items as specified on this drawing are to comply with BS EN 1401.

8. Mortar
Mortar shall be mixed only as and when required, the relevant proportions indicated in the following table, until its colour and consistency are uniform. The constituent materials shall be accurately gauged, allowance being made for bulking of sand.

Alternative Nominal Mixes By Volume		
Cement:Lime:Sand	Cement:Sand	Cement:Sand with plasticiser
1 : 1/2 : 3	1 : 3	1 : 2 1/2 TO 3

9. Ready-mixed lime: Sand for mortar and ready-to-use retarded mortar shall comply with the relevant provisions of BS 4721 and to be of category 1.12 and designation (i) respectively.

10. All mortar shall be conveyed fresh to the works as required for use. mortar which has begun to set or which has been site-mixed for a period of more than 1 hour shall not be used. Plasticising and set retarding mortar admixtures shall comply with BS 4887: part 1 and 2, respectively and shall be supplied with instructions for use.

11. Crushed natural stone and shall comply in all respects with BS 1200.

Materials for Below Ground Drainage

Material	British Standard
1. Rigid pies Vitrified clay Concrete Grey iron Ductile iron	BS 65, BS EN 295 BS 5911 BS 437 BS EN 598
2. Flexible pipes UPVC PP Structure walled Plastic pipes	BS EN 1401* BS EN 1852* BS EN 13476

*Application area code ud should normally be specified
Note
Some of these materials may not be suitable for conveying trade effluent.

Notes:

Mortar

1. Mortar shall be mixed only as and when required, the relevant proportions indicated in the following table, until its colour and consistency are uniform. The constituent materials shall be accurately gauged, allowance being made for bulking of sand.

Alternative Nominal Mixes By Volume		
CEMENT:LIME:SAND	CEMENT:SAND	CEMENT:SAND WITH PLASTICISER
1 : 1/2 : 3	1 : 3	1 : 2 1/2 TO 3

2. Ready-mixed lime:sand for mortar and ready-to-use retarded mortar shall comply with the relevant provisions of BS 4721 and to be of category 1.12 and designation (i) respectively.

3. All mortar shall be conveyed fresh to the works as required for use. mortar which has begun to set or which has been site-mixed for a period of more than 1 hour shall not be used. plasticising and set retarding mortar admixtures shall comply with BS 4887: part 1 and 2, respectively and shall be supplied with instructions for use.

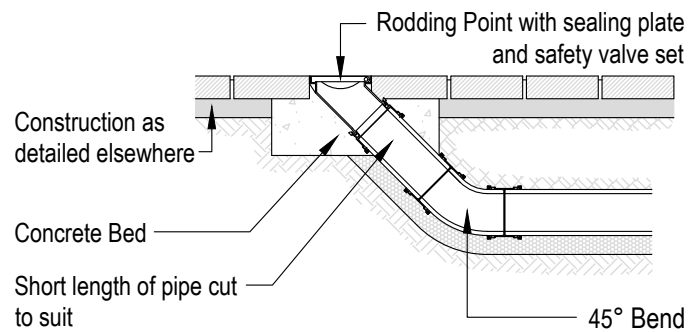
4. Fine aggregate for mortar shall be washed natural sand or crushed natural stone and shall comply in all respects with BS 1200.

5. 20mm thick flexocell, or similar approved filler to be used to form a flexible joint to the concrete surround at the leading edge of a sleeved coupling. dimensions shown are irrespective of type or diameter of pipe. the surrounds must terminate at a pipe joint.

6. If pipes are surrounded in concrete, the joints are to be protected from the ingress of concrete by wrapping them in polythene sheet or building paper.

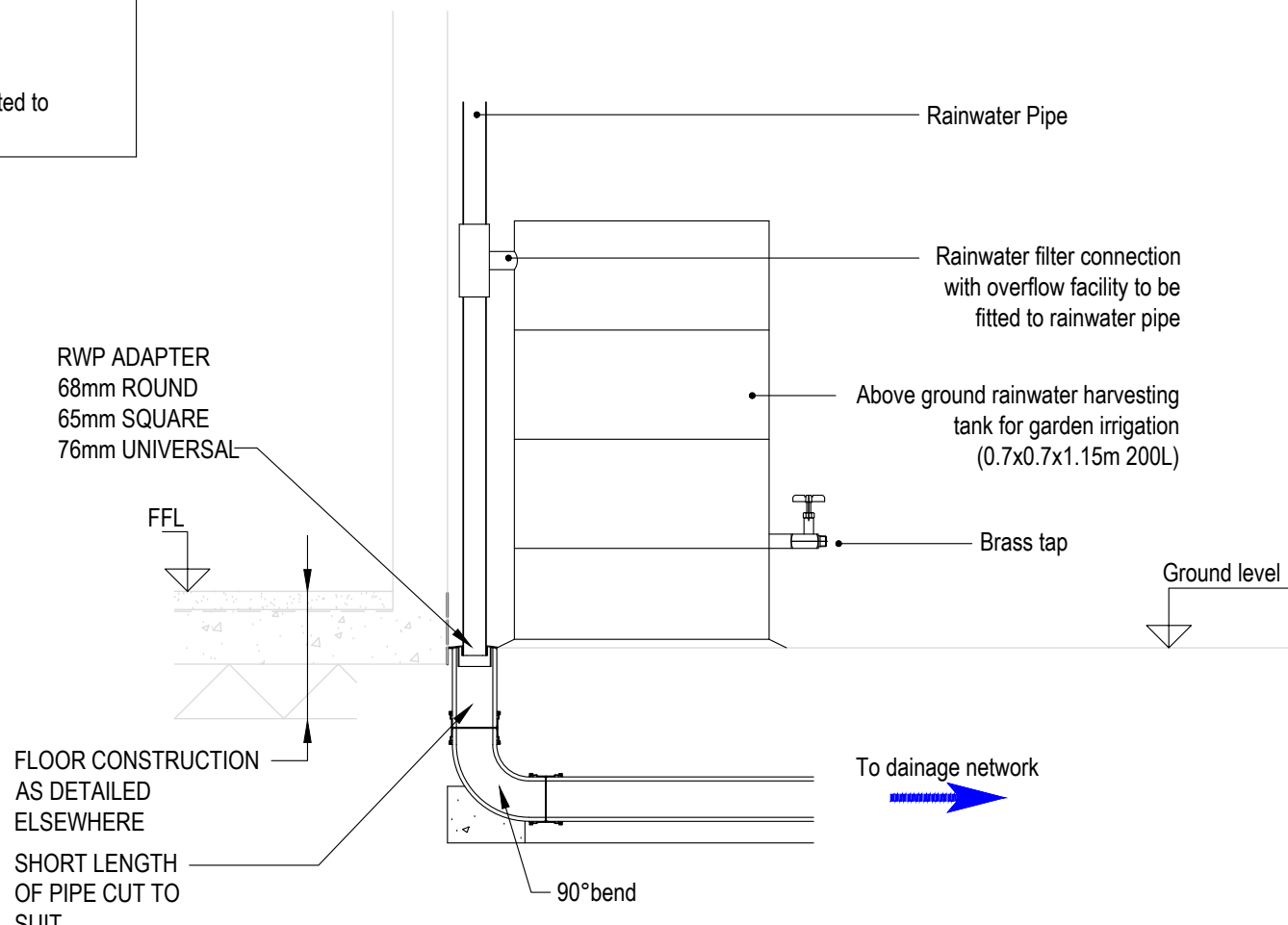
General fill material
May be of selected locally excavated material or imported. it shall be uniform readily compacted material free from stones larger than 40mm dia. lumps of clay over 100mm, timber, frozen material, vegetable matter, tree roots and building rubbish. the material shall be placed and compacted in layers not exceeding 300mm loose depth. mechanical compaction equipment shall not be used until there is a minimum of 450mm of compacted material above the crown of the pipe.

Selected fill material
To be free from stones larger than 40mm dia. lumps of clay over 100mm, timber, frozen material, vegetable matter, tree roots and building rubbish. the material shall be placed uniformly on each side of the pipe in layers not exceeding 100mm. each layer being compacted by hand tamping. care to be taken not to displace the pipe from its correct line and level.



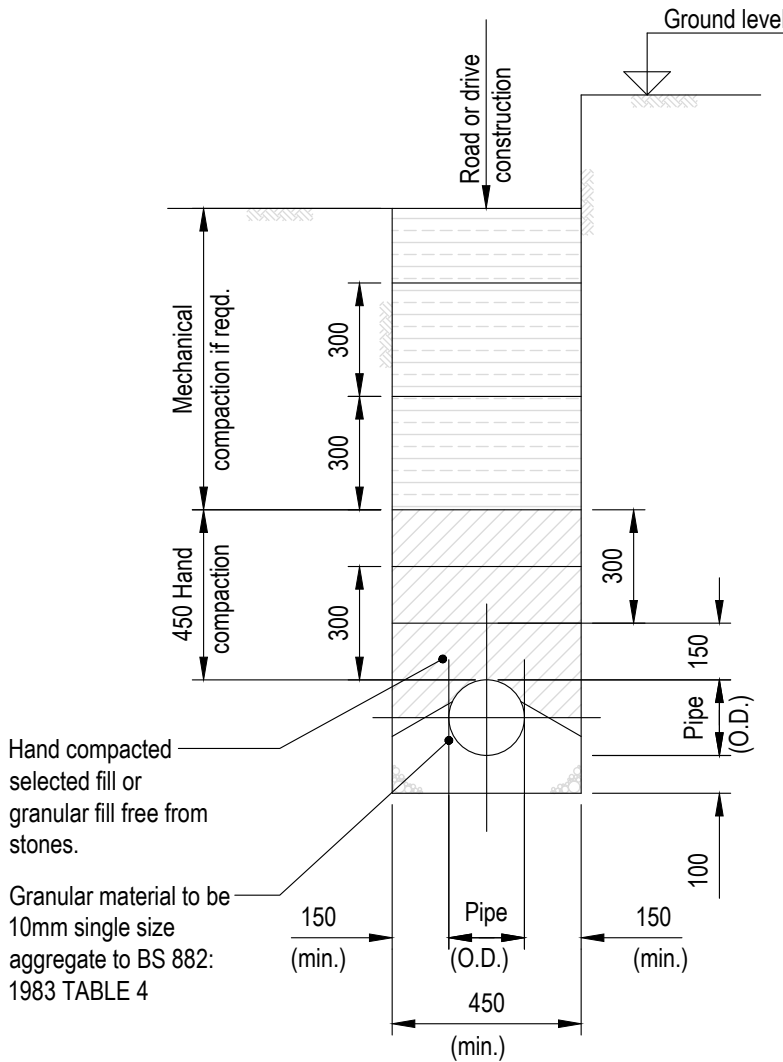
Rodding Point

Scale 1:20



Rainwater Harvesting Detail

SCALE 1:20

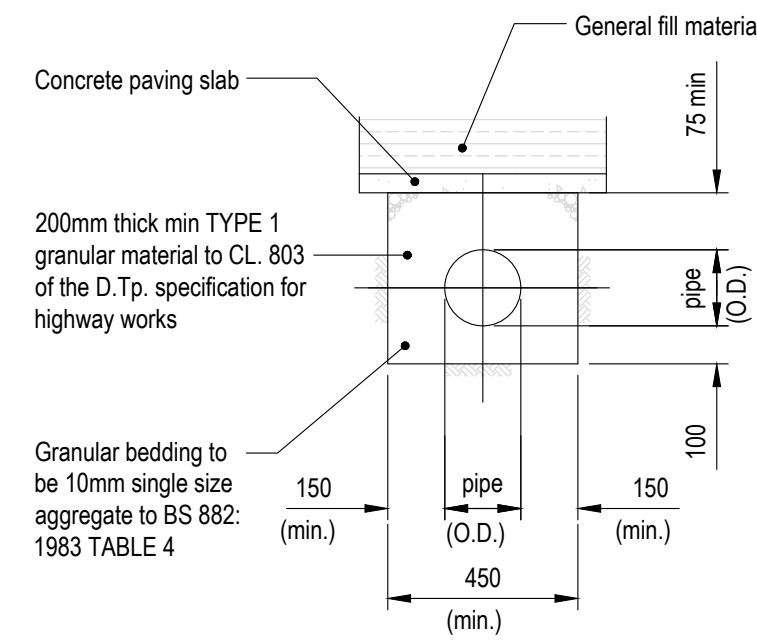


Normal Bedding

Scale 1:20

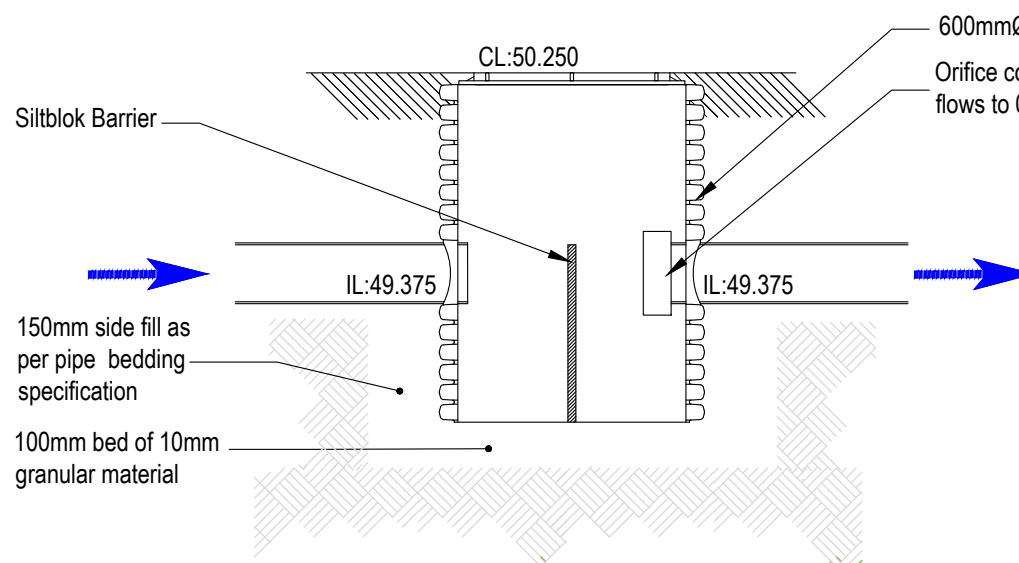
Note:

Pipe protection is required by one of the three methods shown where cover is <600mm in un-trafficked areas and <900mm elsewhere.



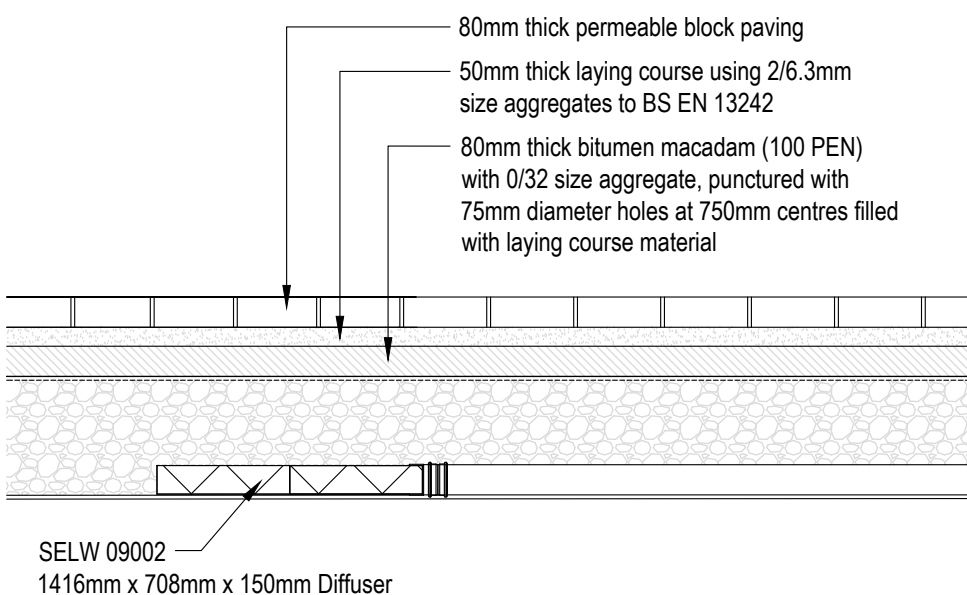
Concrete Paving Slab Bridging

Scale 1:20



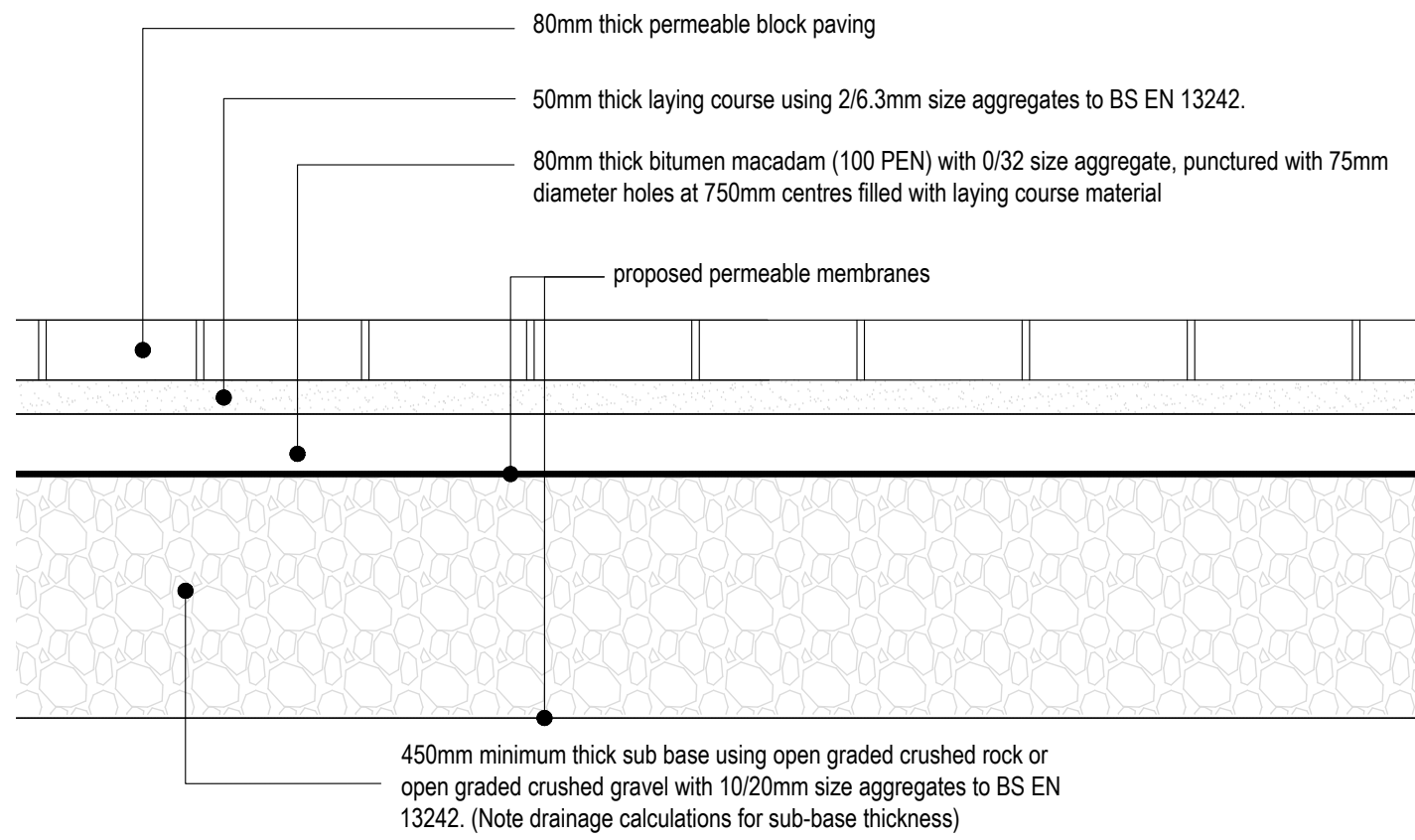
Flow Control Chamber

SCALE 1:20



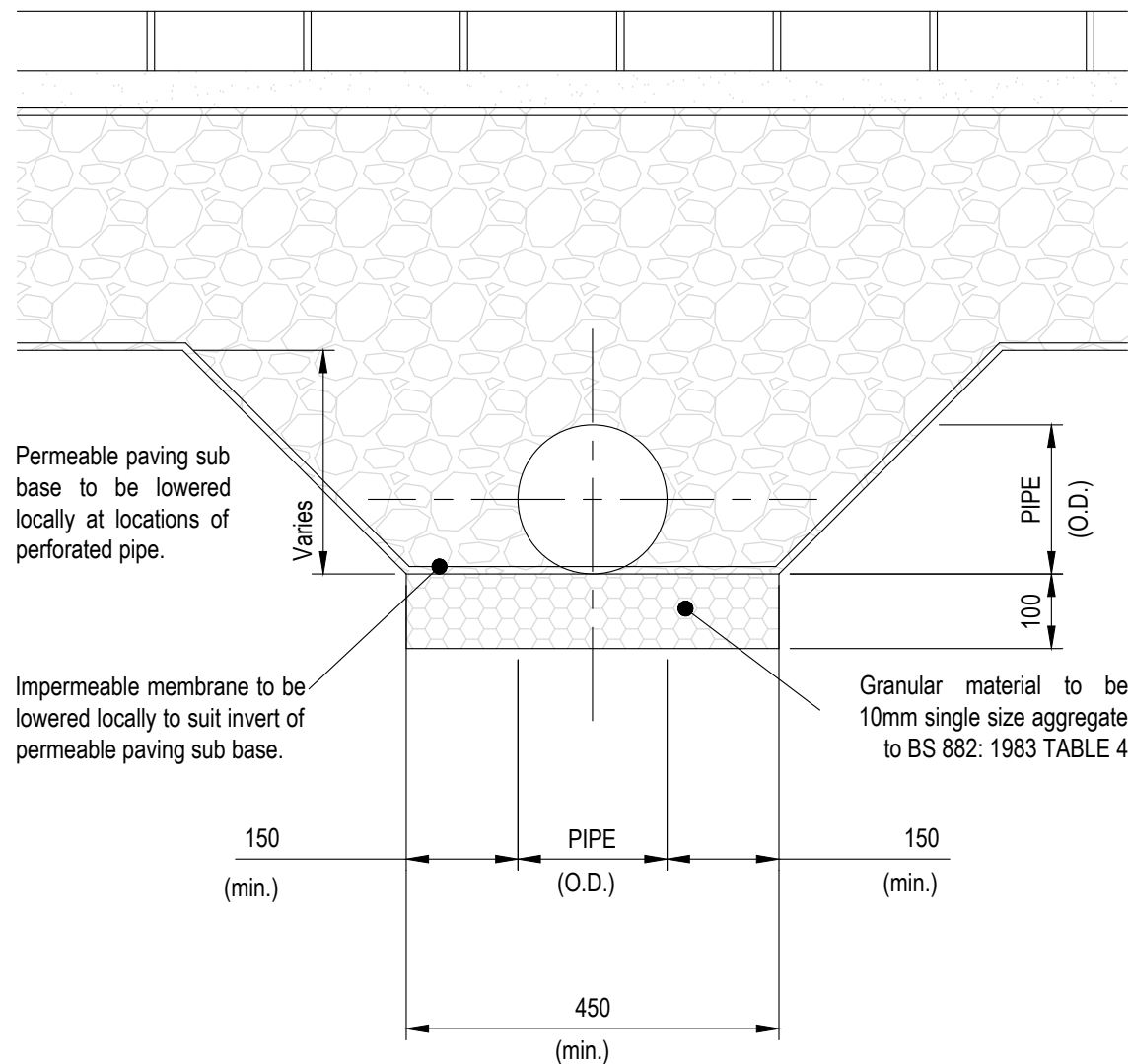
Distribution Tank Detail

Scale 1:20



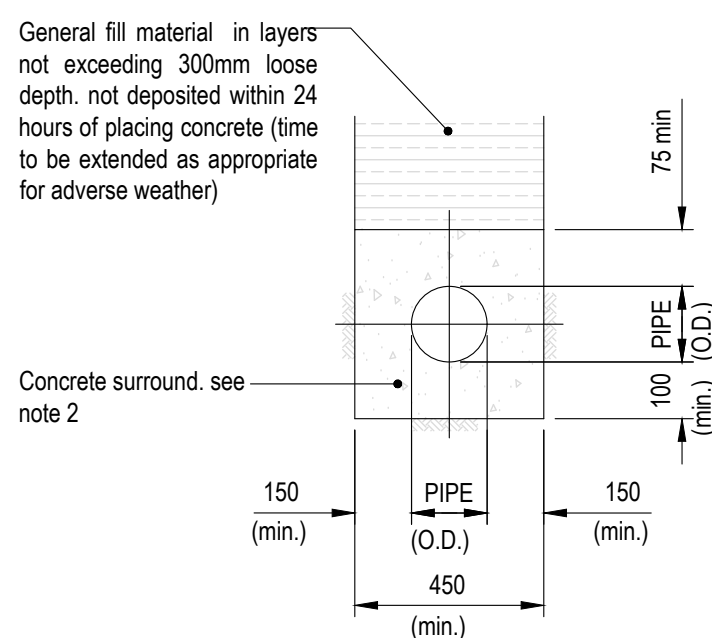
Typical Permeable Paving Construction Detail

Scale 1:10



Perforated Pipe Bedding

Scale 1:10



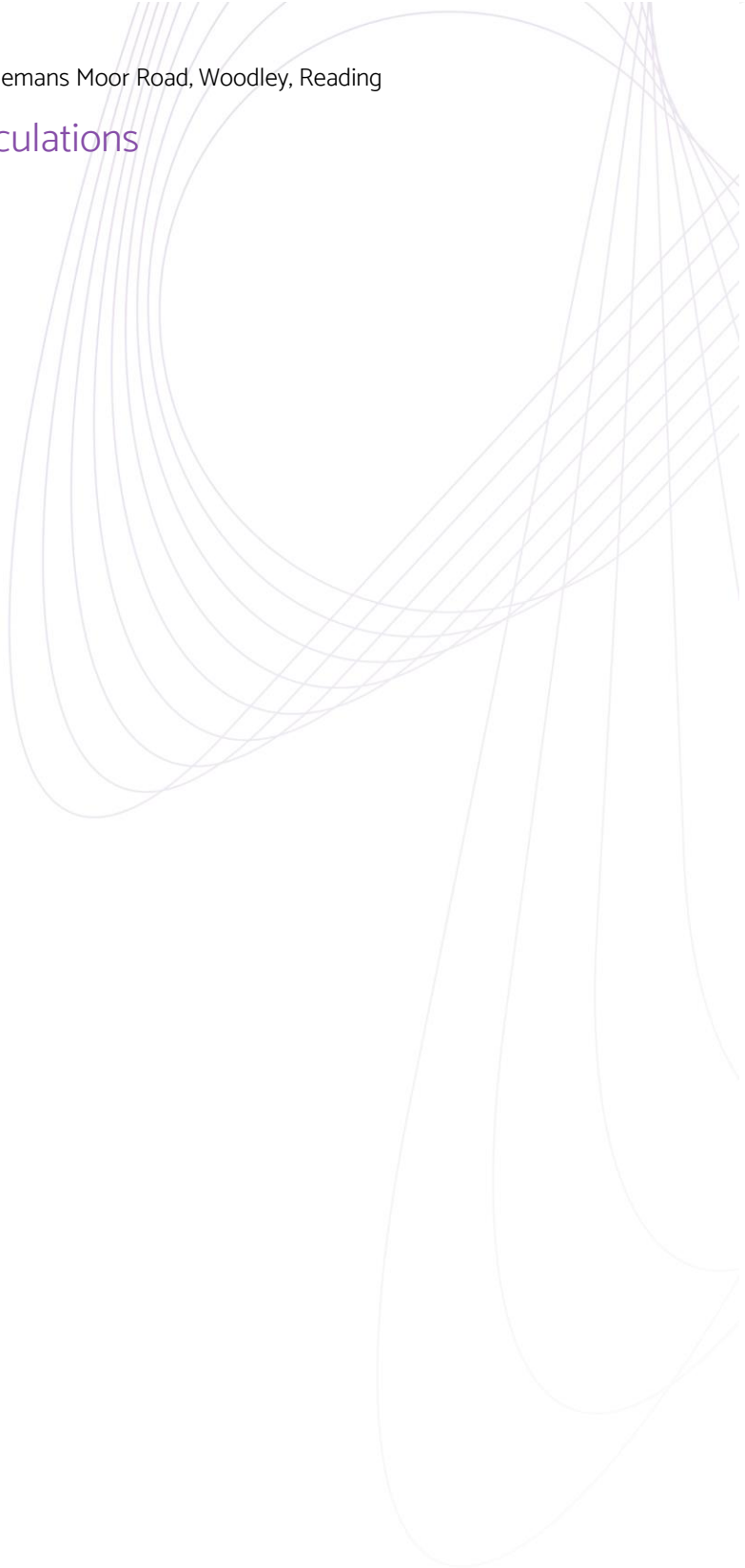
Concrete Surround

Scale 1:20

Scale
As Shown

P2	Drainage amended as per architects layout update	AH	DB	04.09.2024
P1	Preliminary Issue	LF	BN	27.06.2022
Issue	Notes	Drawn	Approved	Date
jmsTM Group Engineering That Brings Design To Life.				
Issuing Office: JMS East Anglia (Ipswich): Unit 27, Brightwell Barns Brightwell, Suffolk, United Kingdom, IP10 0BJ, Tel: 01473 487047				
Project 105 Colemans Moor Road, Woodley Reading, RG5 4DA				
Drawing Title Standard Construction Details				
Project No. EX22 050 06		Drawing No. 201		Issue P2
PRELIMINARY				

Appendix G – Proposed Drainage Calculations



Summary of Results for 100 year Return Period (+45%)

Half Drain Time : 198 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	49.888	0.318	0.0	0.8	0.8	10.7	O K
30 min Summer	49.954	0.384	0.0	0.9	0.9	14.0	Flood Risk
60 min Summer	50.014	0.444	0.0	0.9	0.9	16.9	Flood Risk
120 min Summer	50.032	0.462	0.0	0.9	0.9	17.7	Flood Risk
180 min Summer	50.027	0.457	0.0	0.9	0.9	17.5	Flood Risk
240 min Summer	50.020	0.450	0.0	0.9	0.9	17.2	Flood Risk
360 min Summer	50.003	0.433	0.0	0.9	0.9	16.4	Flood Risk
480 min Summer	49.985	0.415	0.0	0.9	0.9	15.5	Flood Risk
600 min Summer	49.967	0.397	0.0	0.9	0.9	14.6	Flood Risk
720 min Summer	49.950	0.380	0.0	0.9	0.9	13.8	Flood Risk
960 min Summer	49.920	0.350	0.0	0.8	0.8	12.2	O K
1440 min Summer	49.871	0.301	0.0	0.8	0.8	9.8	O K
2160 min Summer	49.817	0.247	0.0	0.7	0.7	7.2	O K
2880 min Summer	49.781	0.211	0.0	0.6	0.6	5.3	O K
4320 min Summer	49.731	0.161	0.0	0.5	0.5	3.1	O K
5760 min Summer	49.698	0.128	0.0	0.5	0.5	2.0	O K
7200 min Summer	49.676	0.106	0.0	0.4	0.4	1.3	O K
8640 min Summer	49.660	0.090	0.0	0.4	0.4	1.0	O K
10080 min Summer	49.649	0.079	0.0	0.4	0.4	0.7	O K
15 min Winter	49.916	0.346	0.0	0.8	0.8	12.1	O K
30 min Winter	49.992	0.422	0.0	0.9	0.9	15.8	Flood Risk
60 min Winter	50.073	0.503	0.0	1.0	1.0	19.2	Flood Risk
120 min Winter	50.113	0.543	0.0	1.0	1.0	20.3	Flood Risk
180 min Winter	50.106	0.536	0.0	1.0	1.0	20.2	Flood Risk

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	149.270	0.0	11.2	18
30 min Summer	98.520	0.0	15.0	33
60 min Summer	62.165	0.0	19.2	62
120 min Summer	35.949	0.0	22.3	120
180 min Summer	26.021	0.0	24.3	154
240 min Summer	20.650	0.0	25.7	186
360 min Summer	14.854	0.0	27.8	252
480 min Summer	11.724	0.0	29.3	320
600 min Summer	9.748	0.0	30.4	388
720 min Summer	8.379	0.0	31.3	456
960 min Summer	6.595	0.0	32.9	588
1440 min Summer	4.707	0.0	35.1	852
2160 min Summer	3.369	0.0	37.5	1216
2880 min Summer	2.668	0.0	39.5	1584
4320 min Summer	1.939	0.0	42.7	2292
5760 min Summer	1.561	0.0	45.5	3000
7200 min Summer	1.331	0.0	48.2	3680
8640 min Summer	1.176	0.0	50.8	4408
10080 min Summer	1.066	0.0	53.4	5144
15 min Winter	149.270	0.0	12.6	18
30 min Winter	98.520	0.0	17.0	32
60 min Winter	62.165	0.0	21.6	60
120 min Winter	35.949	0.0	25.1	118
180 min Winter	26.021	0.0	27.3	170

Summary of Results for 100 year Return Period (+45%)

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
240 min Winter	50.090	0.520	0.0	1.0	1.0	19.7	Flood Risk
360 min Winter	50.058	0.488	0.0	1.0	1.0	18.7	Flood Risk
480 min Winter	50.027	0.457	0.0	0.9	0.9	17.5	Flood Risk
600 min Winter	50.000	0.430	0.0	0.9	0.9	16.3	Flood Risk
720 min Winter	49.976	0.406	0.0	0.9	0.9	15.1	Flood Risk
960 min Winter	49.933	0.363	0.0	0.8	0.8	12.9	Flood Risk
1440 min Winter	49.865	0.295	0.0	0.7	0.7	9.5	O K
2160 min Winter	49.795	0.225	0.0	0.7	0.7	6.0	O K
2880 min Winter	49.750	0.180	0.0	0.6	0.6	3.9	O K
4320 min Winter	49.690	0.120	0.0	0.5	0.5	1.7	O K
5760 min Winter	49.657	0.087	0.0	0.4	0.4	0.9	O K
7200 min Winter	49.638	0.068	0.0	0.3	0.3	0.5	O K
8640 min Winter	49.626	0.056	0.0	0.3	0.3	0.4	O K
10080 min Winter	49.618	0.048	0.0	0.3	0.3	0.3	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
240 min Winter	20.650	0.0	28.9	194
360 min Winter	14.854	0.0	31.2	270
480 min Winter	11.724	0.0	32.9	346
600 min Winter	9.748	0.0	34.2	420
720 min Winter	8.379	0.0	35.2	492
960 min Winter	6.595	0.0	37.0	634
1440 min Winter	4.707	0.0	39.5	896
2160 min Winter	3.369	0.0	42.2	1276
2880 min Winter	2.668	0.0	44.4	1616
4320 min Winter	1.939	0.0	48.1	2292
5760 min Winter	1.561	0.0	51.3	2992
7200 min Winter	1.331	0.0	54.4	3672
8640 min Winter	1.176	0.0	57.4	4408
10080 min Winter	1.066	0.0	60.4	5128

Rainfall Details

Rainfall Model	FEH
Return Period (years)	100
FEH Rainfall Version	2013
Site Location	GB 460405 167211 SU 60405 67211
Data Type	Point
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	0.750
Cv (Winter)	0.840
Shortest Storm (mins)	15
Longest Storm (mins)	10080
Climate Change %	+45

Time Area Diagram

Total Area (ha) 0.043

Time (mins)	Area
From:	To: (ha)
0	4 0.043

Model Details

Storage is Online Cover Level (m) 50.230

Porous Car Park Structure

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	10.0
Membrane Percolation (mm/hr)	1000	Length (m)	16.6
Max Percolation (l/s)	46.1	Slope (1:X)	80.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	49.570	Cap Volume Depth (m)	0.425

Orifice Outflow Control

Diameter (m) 0.026 Discharge Coefficient 0.600 Invert Level (m) 49.570