Infrastruct CS Ltd
The Stables
High Cogges Farm
High Cogges
Nr Witney
Oxon
OX29 6UN

FLOOD RISK ASSESSMENT AND DRAINAGE STATEMENT

Scheme name: Elmsbrook Local Centre, Elmsbrook, Bicester, Oxfordshire.

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Report Prepared By:
Simon Neale

Report Checked By:
Tim Trotman
MEng (Hons), CEng, CWem, FIHE, MCIWEM

Report Authorised By:
Tim Trotman
MEng (Hons), CEng, CWem, FIHE, MCIWEM

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Prepared By:	Simon Neale/Tim Trotman
Prepared For:	A2Dominion Developments Ltd

Document Revision Record

Issue	Checked By	Date	Description
-	**TST**	**4th March 2019**	**Issue**
A	**TST**	**19th March 2019**	**Amended following team comments**
B	**TST**	**23rd May 2019**	**Site Layout Updated**
C	**TST**	**28th May 2019**	**GEA amended**
D	**TST**	**14th October 2019**	**Description and schedule of accommodation changed**

Foreword

This document has been prepared solely as a Flood Risk Assessment for the Client, A2Dominion Developments Ltd. No responsibility or liability will be accepted for any use that is made of this document other than by the Client for the purpose it was written. The conclusions resulting from this study and contained within this report are not necessarily indicative of future conditions or operating practices at or adjacent to the site.

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Some of the information presented within this report is based on third party information which is believed to be correct; no liability will be accepted for any discrepancies in accuracy, mistakes or omissions in such information. The report also assesses the flood risk in relation to the requirements of the Environment Agency and as such assesses the site for a specific flood event and not all flood events. The contents of this document must not be copied or reproduced in whole or in part without the written consent of Infrastruct CS Ltd

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1.0 Summary

A Flood Risk Assessment (FRA) and drainage strategy has been undertaken to accompany a hybrid planning application associated with full planning permission for a Local Centre Community floorspace (Use Class D1 with ancillary A1/A3), with a total GIA of 552 sqm, and 16 residential units (use class C3) with associated access, servicing, landscaping and parking. Outline consent is sought for Local Centre Retail, Community or Commercial Floorspace (flexible Use Class A1/A2/A3/A4/A5/B1/D1).

This report has been prepared by Infrastruct CS Ltd on behalf of A2Dominion in accordance with the guidelines set out in the National Planning Policy Framework.

The following table is an overview of the flood risk and drainage strategy for the proposed development of the site, based upon currently available information and finds the following –

ITEM	RESPONSE
Site Location	The site is located in within the New Elmsbrook Village development in the town of Bicester, Oxfordshire. The site spans Charlotte Avenue on the north and south sides of the road. The approximate grid reference 457823 E, 224801 N.
Size and Current Land Usage	The current site is approximately 0.67ha in plan and was previously used as Agricultural land.
Flood Zone	The development site falls entirely within Flood Zone 1, which is classified as low probability of flooding.
Fluvial Flood Risk	**Low** – Refer to Section 6.1
Overland Flood Risk	**Low** – Refer to Section 6.2
Groundwater Flood Risk	**Low** – Refer to Section 6.3
Sewerage Flood Risk	**Low** – Refer to Section 6.4
Artificial Flood Risk	**Low** – Refer to Section 6.5
Proposed Development	Full permission is sought for Local Centre Community floorspace (Use Class D1 with ancillary A1/A3), with a total GIA of 552 sqm, and 16 residential units (use class C3) with associated access, servicing, landscaping and parking. Outline consent is sought for Local Centre Retail, Community or Commercial Floorspace (flexible Use Class A1/A2/A3/A4/A5/B1/D1).

Based on this assessment, it is concluded that in accordance with the Flood risk vulnerability and flood zone compatibility table in Section 5.6 from the Planning Practice Guidance document, the report considers the proposed development appropriate.

2.0 Introduction

2.1 Commission

A2Dominion Developments Ltd has commissioned Infrastruct CS Ltd, to prepare a Flood Risk Assessment (FRA) and drainage statement to support a planning application for the new Local Centre at the Elmsbrook Residential Development at Bicester.

2.2 Guidance

This flood risk assessment has been compiled in accordance with the recommendations of the National Planning Policy Framework (NPPF) and the Planning Practice Guidance (PPG).

2.3 Aims and Objectives

The purpose of this flood risk assessment is to assess the potential flood risks by and to the proposed development. It will identify the flood risk zone, potential sources of flood risk, consider the proposed drainage and will be used to support the proposed planning application.

3.0 Site Details

3.1 Location

The site is located within the new Elmsbrook residential development, located north of the town of Bicester. The proposed Local Centre spans across Charlotte Avenue adjacent to the southern river crossing and is accessed via the south eastern access serving the residential site.

Figure 3.1.1 - Site Context

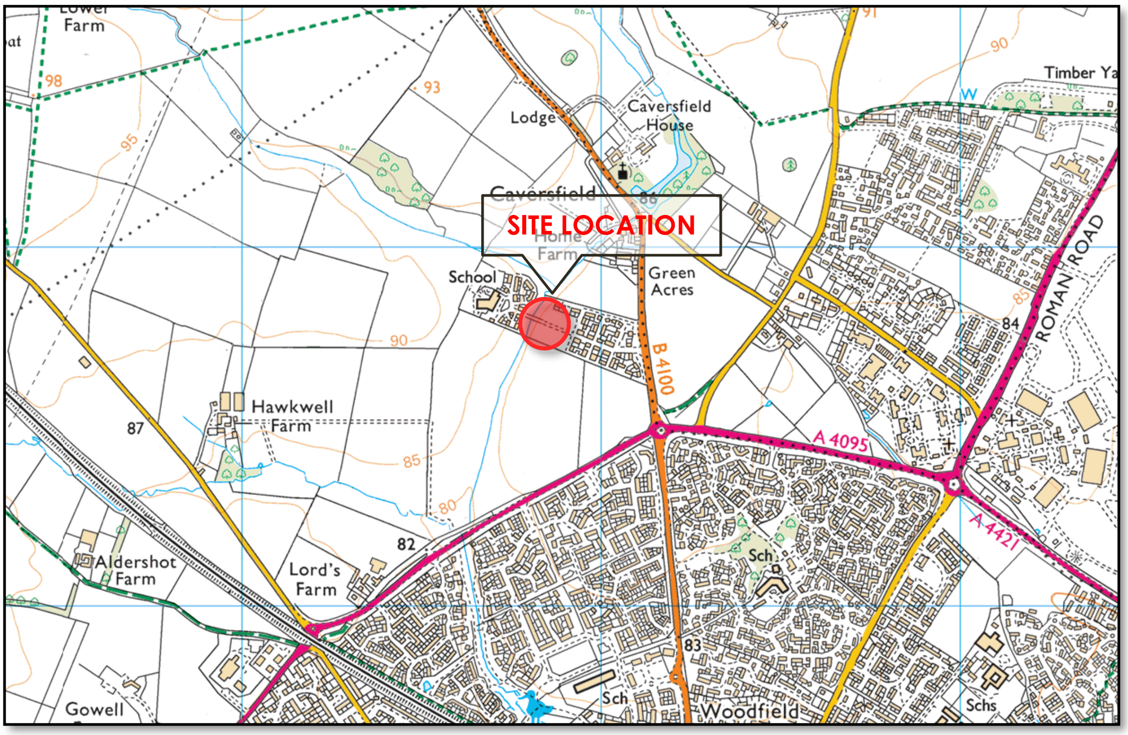


Figure 3.1.2 - Site location

3.2 Grid Reference

The Ordnance Survey National grid reference for the centre of the site is:

457823 E, 224801 N (Nat Grid SU 61081 51020)

3.3 Topography and Site Description

The site covers an approximate greenfield area of 0.67ha, and is located in the new Elmsbrook residential development, located north of the town of Bicester. The site encompasses the land on either side of Charlotte Avenue between the existing river crossing and the energy centre and Eco Business Centre. The outline application site area equates to 0.28ha and the full application site area is 0.39ha.

Levels vary within the site between 83.93mAOD to the south-western corner and 88.30mAOD to the north-eastern corner. The maximum fall across the site is 4.37m over 148m, giving a gradient of 2.95% (1:33.9) See Appendix A for a copy of the topographic survey.

3.4 Ground Conditions

Reference to the Geological survey of Great Britain indicates the proposed site spans (east west split) following strata:

Superficial deposits: No superficial deposits recorded

Bedrock geology - West: Forest Marble Formation - Limestone and mudstone, interbedded. Sedimentary bedrock formed between 168.3 and 166.1 million years ago during the Jurassic period. Town Brook at Bicester.

Bedrock geology - East: Cornbrash Formation - Limestone. Sedimentary bedrock formed between 168.3 and 163.5 million years ago during the Jurassic period. Eco Village Phase 1.

Intrusive site investigations carried within the site have confirmed that the ground conditions consist of Alluvium Clays overlying the Forest Marble Limestone formation at varying depths. Refer to Appendix B for extracts of the site investigation reports for the site.

3.5 Ground Water

Within the various intrusive tests undertaken across the site down to depths of 1.5m, no signs of groundwater were encountered. This report suspects that the water table will be representative of the adjacent watercourse which is set approximately 4m below current site levels.

A review of the maps within the Cherwell District & North Oxfordshire Council SFRA indicate that the site is at a low risk flooding.

3.6 Existing Site Drainage

The Thames Water wastewater plans have yet to be updated to show the drainage network within Charlotte Avenue/Elmbrook. This report can confirm that an extensive network of foul drainage was installed as part of the earlier phases of residential development and these systems are within an adoption agreement with Thames Water.

The surface water network is not being adopted by Thames and purely serves the highway network and is covered by the road adoption agreement with OCC Highways.

3.7 Existing Watercourses

The nearest main river watercourse to the site is the Town Brook at Bicester, which is located 35m to the west of the site.

Figure 3.7.1 – Local Rivers

3.8 Environment Agency Groundwater and Aquifer Protection

Reference to the Environment Agency Groundwater protection zone map shows the area is sited within a Minor Aquifer High groundwater protection zone. The Environment Agency have defined Source Protection Zones (SPZs) for groundwater sources such as wells, boreholes, and springs used for public drinking water supply. These zones show the risk of contamination from any activities that might cause pollution in the area. The closer the activity, the greater the risk.

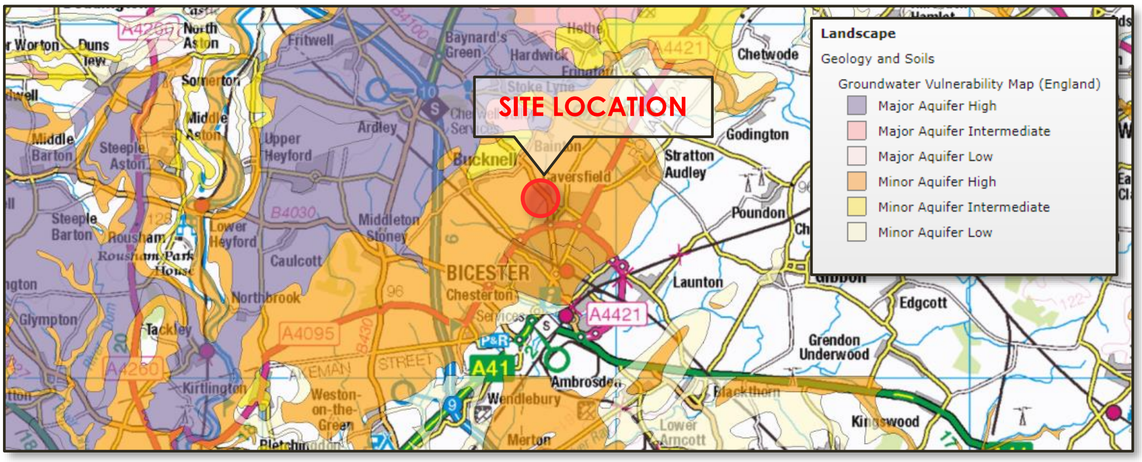


Figure 3.8.1 – Groundwater Protection Zones

The Environment Agency use the zones to set up pollution prevention measures in areas which are at a higher risk, and to monitor the activities of potential polluters nearby.

4.0 Proposed Development

Full permission is sought for Local Centre Community floorspace (Use Class D1 with ancillary A1/A3), with a total GIA of 552 sqm, and 16 residential units (use class C3) with associated access, servicing, landscaping and parking. Outline consent is sought for Local Centre Retail, Community or Commercial Floorspace (flexible Use Class A1/A2/A3/A4/A5/B1/D1). The proposed development plans can be found in Appendix C.

5.0 Flood Risk Policy

5.1 Environment Agency Flood Map

The flood map for the development site shown below suggests that the site wholly falls within flood zone 1, which is defined as land assessed as having a less than 1 in 1000 annual probability of river flooding in any one year.

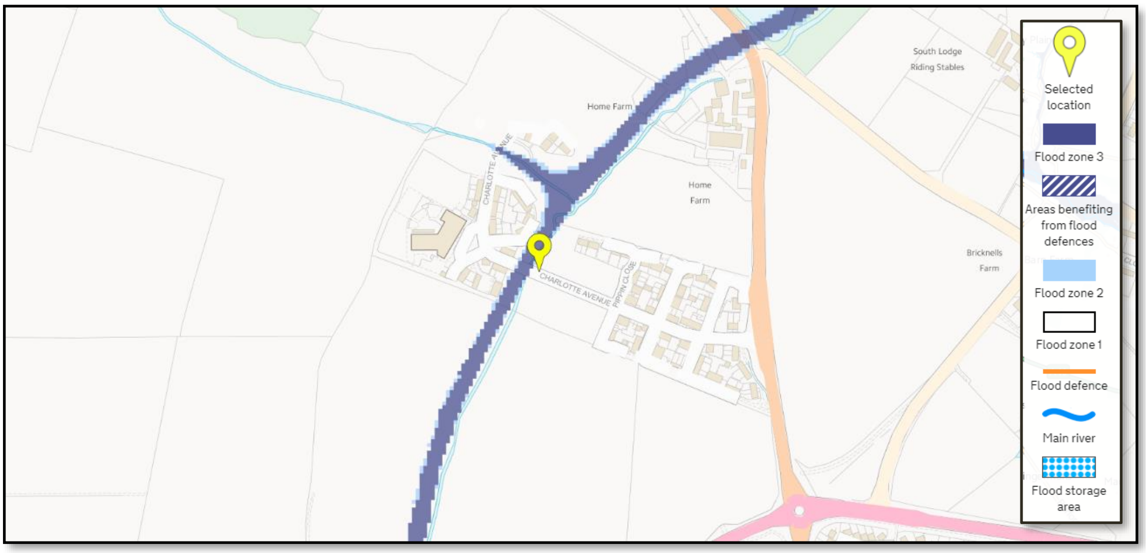


Figure 5.1 - Environment Agency Flood Zone map

5.2 The National Planning Policy Framework

The National Planning Policy Framework (NPPF) and the accompanying Planning Practice Guidance (PPG) gives direction for development with respect to flooding. These documents promote a sequential approach to encourage development away from areas that may be or are susceptible to flooding. In doing so it categorizes flood zones in the context of their probability of flooding, as shown in the table within Section 5.3 below.

5.3 Flood Zone Definition

The National Planning Policy Framework Definition of Flood Zones

Flood zone	Fluvial	Tidal	Probability of flooding
1	< 1 in 1000 year	<1 in 1000 year	Low probability
2	Between < 1 in 1000 year and 1 in 100 year	Between <1 in 1000 year and 1 in 200 year	Medium Probability
3a	> 1 in 100 year	> 1 in 200 year	High probability
3b	Either > 1 in 20 or as agreed between the EA and the LPA	Either > 1 in 20 or as agreed between the EA and the LPA	Functional flood plain

5.4 Flood Zones – Table 1 PPG

(Note: These Flood Zones refer to the probability of river and sea flooding, ignoring the presence of defences)

Zone 1 - Low Probability
Definition
This zone comprises land assessed as having a less than 1 in 1000 annual probability of river or sea flooding in any year (<0.1%).
Appropriate uses
All uses of land are appropriate in this zone.
FRA requirements
For development proposals on sites comprising one hectare or above the vulnerability to flooding from other sources as well as from river and sea flooding, and the potential to increase flood risk elsewhere through the addition of hard surfaces and the effect of the development on surface water run-off, should be incorporated in a FRA. This need only be brief unless the factors above or other local considerations require particular attention. See Annex E for minimum requirements.
Policy aims
In this zone, developers and local authorities should seek opportunities to reduce the overall level of flood risk in the area and beyond through the layout and form of the development, and the appropriate application of sustainable drainage techniques.

5.5 Flood Risk Vulnerability Classification - Extract from Table 2 PPG

More Vulnerable

- Hospitals.
- Residential institutions such as residential care homes, children's homes, social services homes, prisons and hostels.
- Buildings used for: dwelling houses; student halls of residence; drinking establishments; nightclubs; and hotels.
- Non–residential uses for health services, nurseries, and educational establishments.
- Landfill and sites used for waste management facilities for hazardous waste.
- Sites used for holiday or short-let caravans and camping, subject to a specific warning and evacuation plan.

Less Vulnerable

- Police, ambulance and fire stations which are not required to be operational during flooding.
- Buildings used for: shops; financial, professional and other services; restaurants and cafes; hot food takeaways; offices; general industry; storage and distribution; non–residential institutions not included in 'more vulnerable'; and assembly and leisure.
- Land and buildings used for agriculture and forestry.
- Waste treatment (except landfill and hazardous waste facilities).
- Minerals working and processing (except for sand and gravel working).
- Water treatment works which do not need to remain operational during times of flood.
- Sewage treatment works (if adequate measures to control pollution and manage sewage during flooding events are in place).

5.6 Flood Risk Vulnerability & Flood Zone Compatibility Table

Vulnerability classification flood zone	Essential infrastructure	Water compatible	Highly vulnerable	More vulnerable	Less vulnerable
1	√	√	√	√	√
2	√	√	Exception test required	√	√
3a	Exception test required	√	x	Exception test required	√
3b	Exception test required	√	x	x	x

√ Development is appropriate x development is not appropriate

The above table, taken from PPG (table 3), confirms that residential properties within flood zones 1 is appropriate development.

5.7 Other Flooding Mechanisms

In addition to the potential for assessing flooding from fluvial and tidal sources NPPF also requires that consideration is given to other mechanisms for flooding:

- Flooding from land – intense rainfall, often in short duration, that is unable to soak into the ground or enter drainage systems, can run rapidly off land and result in local flooding.
- Flooding from groundwater – occurs when water levels in the ground rise above the surface elevations.
- Flooding from sewers – In urban areas, rainwater is frequently drained into surface water sewers or sewers containing both surface and waste water sewers known as combined sewers. Flooding can result causing surcharging when the sewer is overwhelmed by heavy rainfall
- Flooding from reservoirs, canals and other artificial sources – Non-natural or artificial sources of flooding can result from sources such as reservoirs, canals lakes etc, where water is held above natural ground levels.

6.0 Flood Risk to The Development

6.1 Flooding from Fluvial Sources

The proposed development site lies entirely within flood zone 1 which is classified as land assessed as having a less than 1 in 1000 annual probability of river or sea flooding and is appropriate to all uses of land.

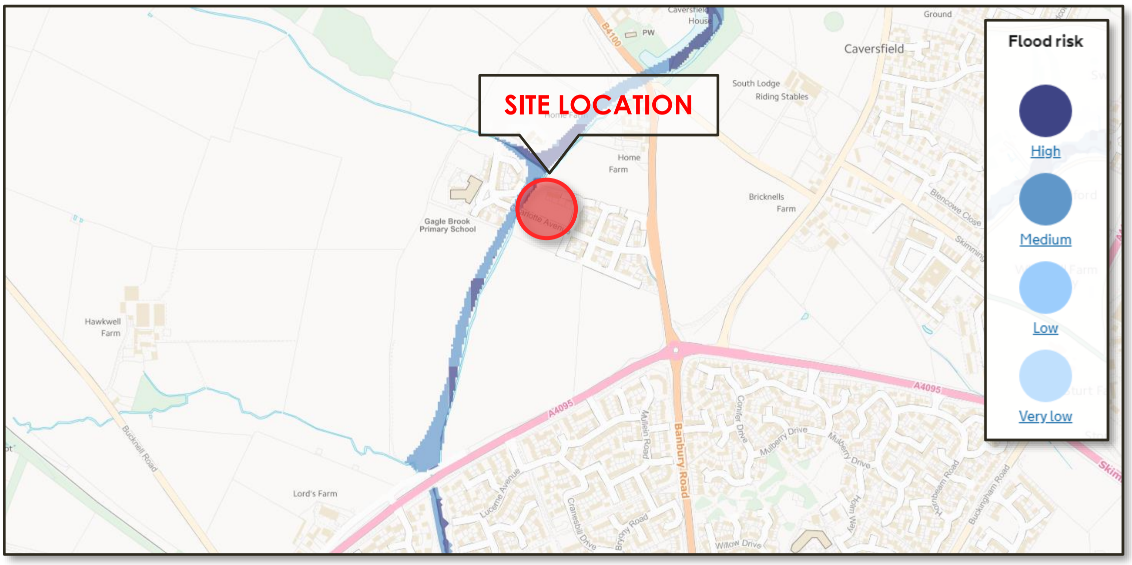


Fig 6.1 – Environment Agency Flood Risk from Fluvial Flows map

It is, therefore, the consideration of this FRA that the site has a low risk of flooding from fluvial sources.

6.2 Flooding from Overland Flows

The risk of flooding due to overland flood flows is considered low by the Environment Agency. The surface water flood data for the site, shown below, indicates that there is high flood risk immediately to the west of the site, along the path of The Town Brook, but very low risk within the site itself.

Fig 6.2 – Environment Agency Flood Risk from Surface Water map

It is, therefore, the consideration of this FRA that the site has a low risk of flooding from overland flow.

6.3 Flooding from Rising Groundwater

Section 3.5 of this report confirms that ground investigations have failed to record the ground water table, but the level is likely to be similar to the level within the adjacent watercourse, which is approximately 4m below current site levels.

A review of the maps within the Cherwell District & North Oxfordshire Council SFRA also indicate the site has a low risk of flooding from Groundwater.

It is, therefore, the consideration of this FRA that the site has a low risk of flooding from rising groundwater levels.

6.4 Flooding from the Local Sewerage Network

The nearest drainage network runs within Charlotte Avenue and the foul pumping station serving the whole site is located within the southern land parcel. Although this pumping station is located close to the proposed development, the lowest point on the drainage network, leading into the pumping station, is located approximate 100m to the northwest. Should this system surcharge and flood, the resultant flooding will not impact the development site.

It is, therefore, the consideration of this FRA that the site has a low risk of flooding by surcharging of the local sewer network.

6.5 Flooding from Reservoirs, Canals & Other Artificial Sources

There are no artificial water sources in close proximity to the site.

It is, therefore, the consideration of this FRA that the site has a low risk of flooding by reservoirs, canals or other artificial sources.

7.0 Flood Risk As A Result Of The Development

7.1 Effect of The Development Generally

Development by its nature usually has the potential to increase the impermeable area with a resultant increased risk of causing rapid surface water runoff to watercourses and sewers, thereby causing surcharging and potential flooding. There is also the potential for pollutants to be mobilised and consequently flushed into the receiving surface water system.

Increases in both the peak runoff rate (usually measured in litres per second l/s) and runoff volume (cubic metres m^3) can result.

7.2 Surface Water Drainage & Sustainable Drainage Systems

Sustainable Drainage techniques (SuDS) covers a range of approaches to manage surface water runoff so that-

'Surface water arising from a developed site should, as far as is practicable, be managed in a sustainable manner to mimic the surface water flows arising from the site prior to the proposed development, while reducing the flood risk to the site itself and elsewhere, taking climate change into account. This should be demonstrated as part of the flood risk assessment.'

7.3 Peak Storm Design Criteria

The proposed sustainable drainage techniques for the development should accommodate the peak rainfall event for a 1 in 100 year storm event with an additional allowance for climate change. Table 5 of NPPG recommends for developments that have a life expectancy beyond 2085 that an additional factor of 40% is applied to the peak volume of runoff.

7.4 Existing Surface Water Runoff Rates

The development site area is approximately 0.67ha and currently drains via infiltration through the permeable surfacing and into the ground. The existing runoff rates calculated for site are highlighted below:

Return Period	Greenfield Runoff Rate l/s
1 in 1 year	2.3
Qbar	2.7
1 in 30 year	6.1
1 in 100 year	8.6

Table 7.4 Existing Runoff rates

Greenfield runoff rates were calculated using the FSR Method within Microdrainage Software. Calculations can be found in Appendix D.

7.5 Infiltration Testing

Soakage rates of $3.5x10^{-5}$ m/s, $2.4x10^{-5}$ m/s and $1.6x10^{-5}$ m/s has been secured from the ground investigation report. It should be noted that these rates were secured within TP3 located within the northern site. Infiltration tests within TP1 and TP2 provided much lower rates, however these were taken within the alluvium clays and not the cornbrash layer believed to be present at depth.

As such this report has utilised the lowest rate if 1.6×10^{-5}m/s for the purposes of the drainage design but notes additional deeper infiltration testing should be undertaken on the sites to substantiate this rate and the proposed drainage strategy.

7.6 Sustainable Drainage Hierarchy

A hierarchical approach has been undertaken in consideration of the application of SuDS in relation to the development. This is in order to meet the design philosophy of ensuring that surface water run-off is managed as close to its source as possible and the existing situation is replicated as closely as possible.

The following drainage hierarchy has been undertaken with reference to the procedures set out in the SuDS Manual (CIRIA C753, 2015) to assess the viability of the application of SuDS techniques to this scheme:

- store rainwater for later use
- use infiltration techniques, such as porous surfaces in permeable strata areas
- Attenuate rainwater in ponds or open water features for gradual release to a watercourse.
- attenuate rainwater by storing in tanks or sealed water features for gradual release to a watercourse,
- discharge rainwater direct to a watercourse
- discharge rainwater to a surface water drain
- discharge rainwater to the combined sewer.

The sustainable drainage hierarchy shown above is intended to ensure that all practical and reasonable measures are taken to manage surface water higher up the hierarchy (1 being the highest) and that the amount of surface water managed at the bottom of the hierarchy is minimised.

Storing rainwater for later use might be an option but it is not sufficient to accommodate the runoff from the whole development.

The site-specific drainage hierarchy checklist considered for the drainage design for this development is detailed in Table 7.6.

SUDS OPTIONS	Comments	Potential for flow rate control	Volume reduction	Maintenance requirement	Space requirement	Cost	Included in final detailed design
Rainwater harvesting	Rainwater from roof runoff collected for re-use. Cost-benefit considerations	L	M	H	L	H	Pos
Water butts	Rainwater collection from roof runoff. Included in final design	L	L	L	L	L	Pos
Living roofs	Vegetated roofs that reduce runoff volume and rate	M	L	M	L	H	N
Bio-retention	Shallow vegetated areas to retain and treat runoff.	L	L	M	M	L	N
Constructed wetlands	Waterlogged areas that can support aquatic vegetation. Replicates existing conditions and provides ecological benefit.	M	L	H	H/M	M	N
Swales	Shallow grassed drainage channels. Replicates existing conditions	H	M	L	M/H	L	N
Soakaways	Subsurface structures that dispose of water via infiltration.	H	H	L	L	M	Y
Permeable pavements	Surface that infiltrate through surface. Retains pollutants.	H	H	M	L	M	Y
Tanked storage systems	Oversized pipes or cellular storage.	H	L	L	M	M/H	N
Infiltration basins	Depressions in the ground to store and release water through infiltration	H	H	H/M	H	M/L	N
Detention basins	Temporary retention of runoff with controlled discharge	H	L	M	H	M/L	N

Table 7.6 Drainage design hierarchy (SuDS techniques considered for use in this scheme)

It should be noted that where the SuDS techniques are noted as feasible or possible it does not necessarily follow that they will all be used. Reference should be made to the drainage strategy drawing in Appendix E which indicates the drainage proposals.

7.7 SUDS Techniques Employed

The parking bays and access roads will be permeable paved surfaces because this is where oil spillage is most likely to occur and, with adequate aggregate sub-bases, permeable paving provides water quality treatment as it breaks down hydrocarbons.

Runoff from roofs will be collected and conveyed via a pipe network into cellular soakaways. Potential sediments will be trapped using catch pit chambers. Urban creep has not been considered when sizing the system given the constraints of the site and the fact that the residential element lies above the non-residential elements on the ground floor. Calculations to support the drainage strategy can be found within Appendix F.

7.8 Residual Flood Risk & Exceedance

It is proposed that finished floor levels will be raised a minimum of 150mm above the average ground level to mitigate against the risk of any surface water flooding.

The proposed surface water drainage measures will however be designed to contain the peak storm event that can be expected for a 1 in 100 year situation. A 40% allowance has already been applied to the site to account for future climate change.

7.9 Flood Risk Management

Unlike conventional drainage systems, SuDS features are visible, and their function should be easily understood by those responsible for maintenance. When problems occur, they are generally obvious and can be remedied simply, using standard landscaping practice. During the first year of operation of all types of SuDS, inspections should usually be carried out at least monthly (and after significant storm events) to ensure that the system is functioning as designed and that no damage is evident.

8.0 Proposed Foul Water Drainage System

The development proposals will seek to discharge foul water from the development site into the existing foul drainage network within Charlotte Avenue. This will be subject to a Section 106 consent from Local Water Authority, Thames Water. Flows into this system will be via a gravity fed connection. The on-site foul system will remain in private ownership.

Although the development site will increase the flow rates and volumes of foul sewerage into the Thames Water network, approval has been granted by the undertaker as part of the overall site wide masterplan.

9.0 Recommendations and Conclusion

The development proposals together with the site layout have been assessed in relation to the provision of SuDS drainage associated with the works.

The report has assessed the feasibility of implementing the SuDS hierarchal approach and has confirmed that this development is likely to be able to install suitable drainage measures into the design proposals.

Flood risk to the site has been assessed, and where risks have been deemed above low, mitigation measures have been proposed to reduce the risk to the site.

Therefore, in line with the recommendations of the National Planning Policy Framework, the development site lies within land classified as flood zone 1, which is considered at a low risk of flooding, and therefore appropriate for a development of this nature. Having assessed the other forms of flood risk to and from the development site, this report finds that the site is not considered at high risk from any other sources of flooding.

10.0 References & Bibliography

- The National Planning Policy Framework July 2018
- Planning Practice Guidance.
- Environment Agency - Rainfall-Runoff Management for Developments
- Environment Agency indicative flood maps https://flood-map-for-planning.service.gov.uk/
- Environment Agency indicative groundwater source protection zone maps http://www.natureonthemap.naturalengland.org.uk/MagicMap.aspx
- Environment Agency indicative Aquifer designation maps http://www.natureonthemap.naturalengland.org.uk/MagicMap.aspx
- CIRIA 2007, The Sustainable Drainage Systems (SUDS) Manual C753
- Sewers for adoption 7th edition
- Cherwell District & North Oxfordshire Council SFRA
- Flood Estimation Handbook

Appendix A - Topographic Survey

KEY

TOPOGRAPHICAL KEY

SURVEY STATION	5	FENCE	
BANKING	TOP / BOTTOM	WALL	
HEDGE SPREADS		BUILDING	
WOODLAND CANOPY		OPEN SIDED BUILDING	
ARROW ON STEPS / RAMPS INDICATES DIRECTION UPWARDS		OVERHANG / CANOPY	
TREES	SPREAD & GIRTH SHOWN TO SCALE	GLASSHOUSE	
GATE		CONTOUR	25.50
KERB CHANNEL		SPOT LEVEL	+ 127.13
ROAD UNKERBED		SONAR LEVEL	127.13
		BORE HOLE	BH
		TRIAL HOLE	TH
		FOOTPATH	
		CHANGE IN SURFACE	

GENERAL

Av.	AVERAGE
(ACP)	ASSUMED CONNECTION POINT
COW	CABLE ON WALL
CW	COMBINED WATER
DIS	DISUSED
DK	DROP KERB
EML	ELECTROMAGNETIC LOCATOR
EOT	END OF TRACE
FO	FIBRE OPTIC
FP	FOOTPATH
FW	FOUL WATER
GP	GATE POST
GPR	GROUND PENETRATING RADAR
HB	HARD BED
H/P	HIGH PRESSURE
HV	HIGH VOLTAGE
KV	KILO VOLT
I/P	INTERMEDIATE PRESSURE
L/P	LOW PRESSURE
LV	LOW VOLTAGE
M/P	MEDIUM PRESSURE
NDI	NO DEPTH INFORMATION
NFI	NO FURTHER INFORMATION
NDV	NO DUCTS VISIBLE
NPV	NO PIPES VISIBLE
OSBM	ORDNANCE SURVEY BENCHMARK
POW	PIPE ON WALL
P.BOX	POST BOX
RED	REDUNDANT SERVICE
RW	RETAINING WALL
SB	SOFT BED
SNP	STREET NAME PLATE
SW	SURFACE WATER
TAC	TACTILE PAVING
TOW	TOP OF WALL
TW	TRADE EFFLUENT WATER
UTL	UNABLE TO LOCATE
UTR	UNABLE TO RAISE
UTS	UNABLE TO SURVEY

APPARATUS

ACU	AIR CONDITIONING UNIT
AV	AIR VALVE
BB	BELISHA BEACON
BO	BOLLARD
BOL	BOLLARD LIGHT
BS	BUS STOP
CATV	CABLE TELEVISION
CB	CONTROL BOX
CCB	CROSSING CONTROL BUTTON
CP	CATCH PIT
CR	CABLE RISER
DCH	DRAINAGE CHANNEL
EB	ELECTRIC CONTROL BOX
EP	ELECTRIC POLE
ER	EARTH ROD
FD	FILTER DRAIN
FFP	FUEL TANK FILL POINT
FH	FIRE HYDRANT
GR	GAS RISER
GV	GAS VALVE
GY	GULLY
IC	INSPECTION COVER
INT	INTERCEPTOR
IT	INLET
KO	KERB OUTLET
LD	LOOP DETECTOR
LH	LAMP HOLE
LP	LAMP POST
MH	MANHOLE
MK	MARKER POST / PLATE
MT	METER
MW	MONITORING WELL
OL	OUTLET
OU	OUTFALL
PO	POST
PTG	PIPE TO GROUND
PTS	PIPE TO SURFACE
PU	PUMP
RE	RODDING EYE
RS	ROAD SIGN
RM	RISING MAIN
RWP	RAIN WATER PIPE
SC	STOP COCK
SP	SOIL PIPE
ST	STAY CABLE
SV	STOP / SLUICE VALVE
SVP	SOIL VENT PIPE
TCB	TELEPHONE CALL BOX
TEL	TELECOM INSPECTION COVER
TL	TRAFFIC LIGHT
TLC	TRAFFIC LIGHT COVER
TM	TICKET MACHINE
TP	TELECOM POLE
VP	VENT PIPE
WM	WATER METER
WO	WASH OUT
WR	WATER RISER
WT	WATER TAP
WW	WET WELL

DEPTHS

d	ELECTRONICALLY DERIVED
Pd	PASSIVELY DERIVED
Bd	BASE DEPTH
Cd	DEPTH TO CROWN
Id	DEPTH TO INVERT
Sd	DEPTH TO SOFFIT

PIPE MATERIALS

AC	ASBESTOS CEMENT
ALK	ALKATHENE
BK	BRICK
CI	CAST IRON
CO	CONCRETE
DI	DUCTILE IRON
HDPE	HIGH DENSITY PE
MDPE	MEDIUM DENSITY PE
PE	POLYETHYLENE
PF	PITCH FIBRE
PP	POLYPROPYLENE
PVC	POLYVINYL CHLORIDE
PVC-U	ULTRA RIB (PVC)
SI	SPUN IRON
ST	STEEL
VC	VITRIFIED CLAY

FENCES

B/W	BARBED WIRE FENCE
C/B	CLOSED BOARDED FENCE
CPL	CONCRETE PANEL FENCE
C/I	CORRUGATED IRON FENCE
CNP	CHESTNUT PAILING
C/L	CHAIN LINK FENCE
I/R	IRON RAILINGS
L/L	LARCH LAP FENCE
P/R	POST AND RAIL FENCE
P/W	POST AND WIRE FENCE
W/M	WIRE MESH FENCE

LEVELS

BD	BACKDROP LEVEL
BL	BASE LEVEL
CL	COVER LEVEL
CWL	CROWN LEVEL
DPC	DAMP PROOF COURSE
FL	FLOOR LEVEL
IL	INVERT LEVEL
PT	P TRAP LEVEL
RL	ROOF LEVEL
SOF	SOFFIT LEVEL
THL	THRESHOLD LEVEL
WL	WATER LEVEL

LINESTYLE

INTERNAL METER	(MT)
POT ENDED SERVICE	
SEWER CAPPED RUN	
SURVEY ABANDONED	
INTERNAL VALVE	
UNKNOWN UNDERGROUND ANOMALY	
UNDERGROUND CHAMBERS	
POST PROCESSING AREA	(FROZEN LAYER)
ABOVE GROUND	(AG)
ASSUMED ROUTE	(AR)
EMPTY DUCTS	(E)
OVERHEAD	(OH)
BACK DROP	
P TRAP	
UTILITY CROSSOVER	
SURVEY BOUNDARY	
VERBAL INFORMATION	(VI)
RECORD INFORMATION	(R)
REDUNDANT SERVICE	
RISING MAIN	

CCTV SECTION 4 AND 5 FAULTS ARE SHOWN IN RED

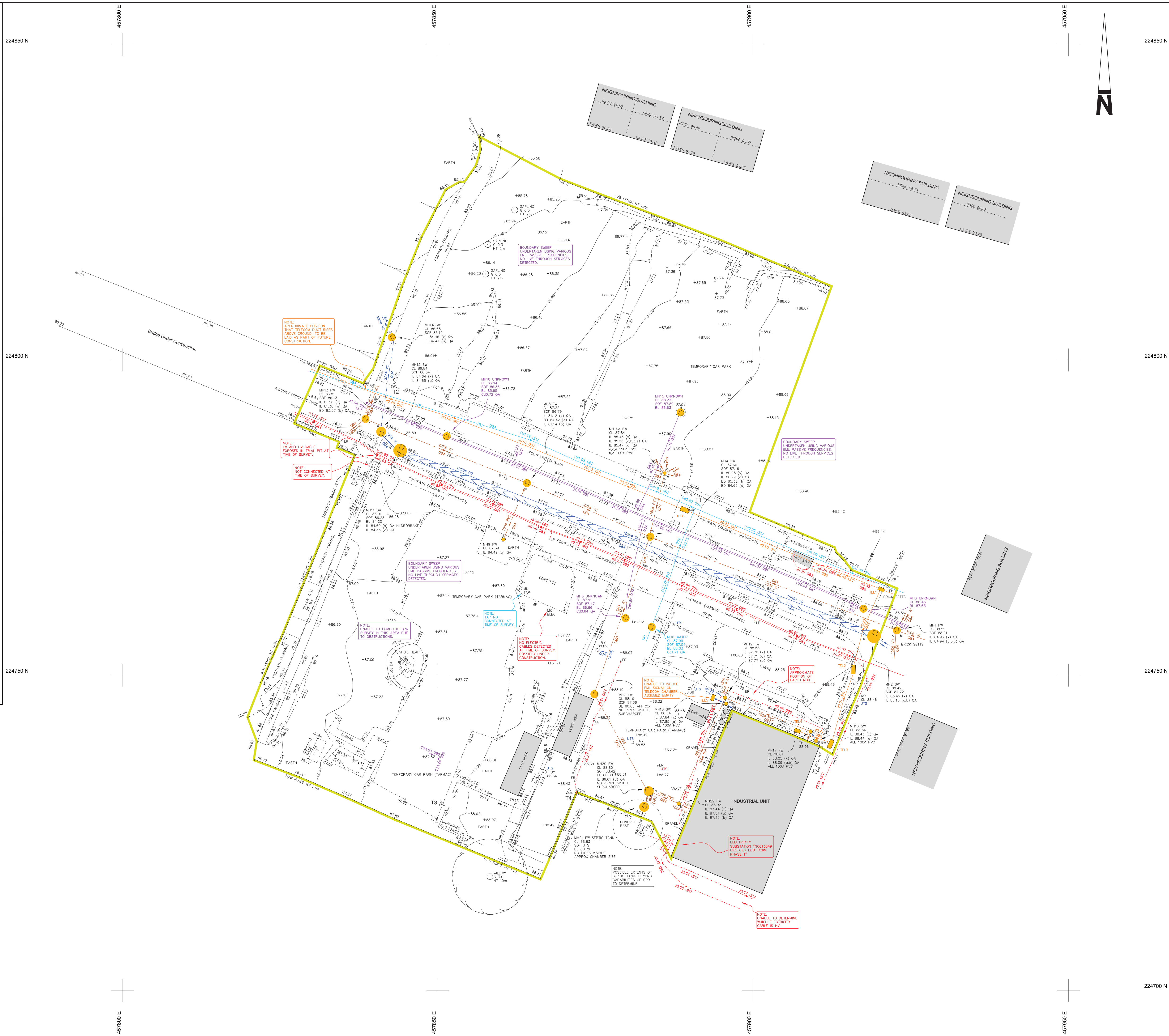
SERVICE TYPE

- CATV / DATA
- ELECTRICITY (HV)
- ELECTRICITY (LV)
- FUEL
- GAS
- HEATING
- OVERHEAD ELECTRIC
- OVERHEAD TELECOM
- TRADE EFFLUENT
- COMBINED SEWER
- FOUL SEWER
- SURFACE SEWER
- UNIDENTIFIED SEWER
- TELECOM
- UNKNOWN SERVICE
- WATER

CAUTIONARY NOTES

1. EML techniques have been used in the detection of underground utilities as outlined in Table 2 of PAS 128:2014. The results are not infallible and trial excavations must be carried out in order to confirm identification, position and in particular depth of the utility.
2. GPR techniques has been used in the detection of non-metallic utilities as outlined in Table 2 of PAS 128:2014. The interpretation of these results is not infallible and success will depend on a number of factors including soil type, ground water levels and surface conditions, hence trial excavations must be carried out in order to confirm identification, position and in particular depth of the utility.
3. Depths derived via EML are taken to the centre of the conductor (cable, metallic pipe) and those derived via GPR are usually to the crown of the utility unless otherwise indicated.
4. Where cables cannot be detected individually an average depth has been obtained and trial excavations are recommended to confirm number and depths of cables banded together.
5. 'Pot-ended' cables are often difficult to detect and although we have made all reasonable efforts to locate or transpose this information from records, we cannot guarantee that all 'pot-ended' cables have been located.
6. Fibre optic cables are often difficult to detect, and commonly access chambers can be locked and thereby made inaccessible by the utility provider. All reasonable efforts have been made to locate these ducts using GPR. Cables not located have been transposed from records.
7. Within close proximity of electric substations and similar structures results using EML may become distorted. All reasonable efforts have been made to verify our results using GPR whenever conditions permitted.
8. Underneath overhead power lines results using EML may become distorted. All reasonable efforts have been made to verify our results using GPR whenever conditions permitted.
9. Drainage information has been obtained without man entry into the chamber.
10. Wherever possible we have attempted to locate the route of the sewer. Issues such as blockages, surcharging, flooding, sedimentation, sewer collapse, root ingress, excessive depth, obstructions or heavy traffic flow may have affected our ability to obtain meaningful results. In these cases recommendations have been made for further survey or maintenance work.
11. Pipe / duct sizes have been recorded from surface inspection or taken from record information. Pipe sizes have been recorded in millimetres and depths in metres, except in instances where sizes are indicated in imperial units on the record information.
12. Water and Gas utilities to individual properties are often of a size that cannot be detected using EML or GPR investigation, wherever possible the route has been added from surface evidence (pipe risers, valves, etc), but this should be viewed as a guide only.
13. All utilities detected by MK Surveys should be considered live unless confirmed otherwise by client or service provider.
14. MK Surveys cannot confirm when utilities are redundant unless there is visual or record evidence to indicate this. In addition MK Surveys cannot guarantee being able to detect all redundant utilities.
15. Wherever available the results of our investigations have been cross referenced with record information. If a utility shown on the records cannot be detected on site, the information has been added to the drawing and indicated as QB4 (R). However it should be noted that the completeness and accuracy of the records cannot be guaranteed.
16. The utility information has been obtained from non-intrusive survey techniques; it always remains possible that there are additional utilities within the survey boundary that we have not been able to detect. We recommend that care is taken on site and that all utility records are used in conjunction with this survey.
17. The responsibility for avoiding damage to assets and utilities on site shall be that of the persons proposing to excavate within the surveyed area, who shall be liable to the asset owner and any third party who may be affected in any way for any loss or damage.

ALWAYS EXERCISE CAUTION WHEN EXCAVATING.



Notes :

1. GRID AND LEVELS BASED ON ORDNANCE DATUM, DERIVED FROM THE NATIONAL GPS NETWORK. LOCAL SCALE FACTOR REMOVED/APPLIED.
2. TREE AND HEDGE SPECIES HAVE BEEN IDENTIFIED AS ACCURATELY AS POSSIBLE BUT SHOULD BE CROSS CHECKED IN CRITICAL AREAS.
3. THIS SURVEY SHOULD ALWAYS BE READ IN CONJUNCTION WITH THE DESKTOP UTILITY REPORT, THAT WAS CARRIED OUT AS A PREREQUISITE TO THIS DETECTION SURVEY.

Coordinate Table

Station	Description	Easting	Northing	Level
T1	Road Nail	457890.120	224776.380	87.883
T2	Road Nail	457843.016	224795.831	86.931
T3	Road Nail	457850.591	224729.500	87.960
T4	Road Nail	457870.825	224731.471	88.478

DETECTION SURVEY REPORT

GENERAL

This survey was carried out in accordance with PAS 128:2014 (Publicly Available Specification from BSI). After a pre-survey consultation with the client it was agreed to carry out the detection survey using methodology M1 as per Table 2 of the PAS 128:2014. The survey boundary has been shown on the drawing: please see linestyle section of the key for reference.

DESKTOP UTILITY REPORT

Prior to the survey commencing record information was gathered and compiled in a separate desktop utility report. This report should be read in conjunction with the information contained in this utility detection survey. Record information was at the time of the survey less than 90 days old in accordance with the requirements of the PAS 128:2014. For a full list of the providers searched, records received and the dates the information was obtained, please refer to the attachments page of the desktop utility report.

DETECTION SURVEY

DRAINAGE

All drainage was lifted with pipe sizes and invert levels recorded. Wherever possible the chamber sizes have been recorded and positioned on the drawing. All connections from gullies, external rainwater pipes and external soil stacks have been plotted or traced into manholes and where no connection is present the position is assumed only until proven otherwise. In instances where other detection methods were unsuccessful connections between manholes have been assumed to be straight and labelled as QB4. Where a saddle connection is present the drainage should be cross checked in critical areas by CCTV survey or verification survey type A. MH7 was surcharged at the time of the survey with any connections unable to be located. Recommend pumping chamber and resurveying to measure inverts and determine flow direction.

WATER

Water mains were located at the site using GPR techniques with depths to crown recorded. Record information confirms this. The water main to the south of MH6 was unable to be located due to poor GPR scan data. Recommend trial excavations in order to determine the position and depth of the service in this area.

GAS

No gas mains have been located within the survey area. Available record information confirms this.

ELECTRICITY

Electricity cables at the site have been located using EML techniques with electronically derived depths recorded. Where GPR techniques have also been used to locate the service a quality level of QB1 has been shown. It was unable to determine which cable was the HV feed to the substation and both have been shown as LV. Recommend trial excavations in critical areas in order to confirm.

TELECOM

All telecom ducts have been traced with depths recorded. Due to lows protecting British Telecom apparatus all ducts have been located using remote detection techniques only and compared with record information. Chamber sizes have been recorded using GPR techniques wherever possible. For further information regarding BT apparatus please contact Openreach directly.

UNKNOWNS

An unknown service has been located using EML techniques with electronically derived depths shown. Where GPR techniques have also been used to locate the service a quality level of QB1 has been shown. Recommend trial excavations in order to determine the service type as well as depth and position in critical areas.

SEE CAUTIONARY NOTES WITHIN THE UTILITY KEY

PAS 128:2014 Quality Level Guide

Quality Level	Description	Accuracy
QB4	A utility is expected to exist but cannot be detected - (AR), (R), (VI)	Undefined
QB3 QB3P	Horizontal location only using one geophysical technique. No depth information - NDI	+/- 500mm Horizontal Undefined Vertical
QB2 QB2P	Horizontal and vertical location only using one geophysical technique	+/- 250mm or +/- 40% of depth whichever is greater
QB1 QB1P	Horizontal and vertical location only using two geophysical techniques	+/- 150mm or +/- 15% of depth whichever is greater
QA	Service verified in an open excavation, inside an inspection chamber / draw pit, or at the point the service enters / exits the ground	+/- 50mm Horizontal +/- 25mm Vertical

Desktop Utility Records

Utility Type	Provider Details	Date Acquired
Drainage	Thames Water	02/12/2016
Water	Thames Water	02/12/2016
Gas	Southern Gas Networks	02/12/2016
Electricity	SSE Energy	15/11/2016
Telecom	Openreach	05/12/2016
New Installations	GTC	05/12/2016

Revision	Description	Surv. by	Appr. by	Date

0m 2 4 6 8 10 12 14 16 18 20 22

mksurveys

www.mksurveys.com
www.surveys4bim.co.uk

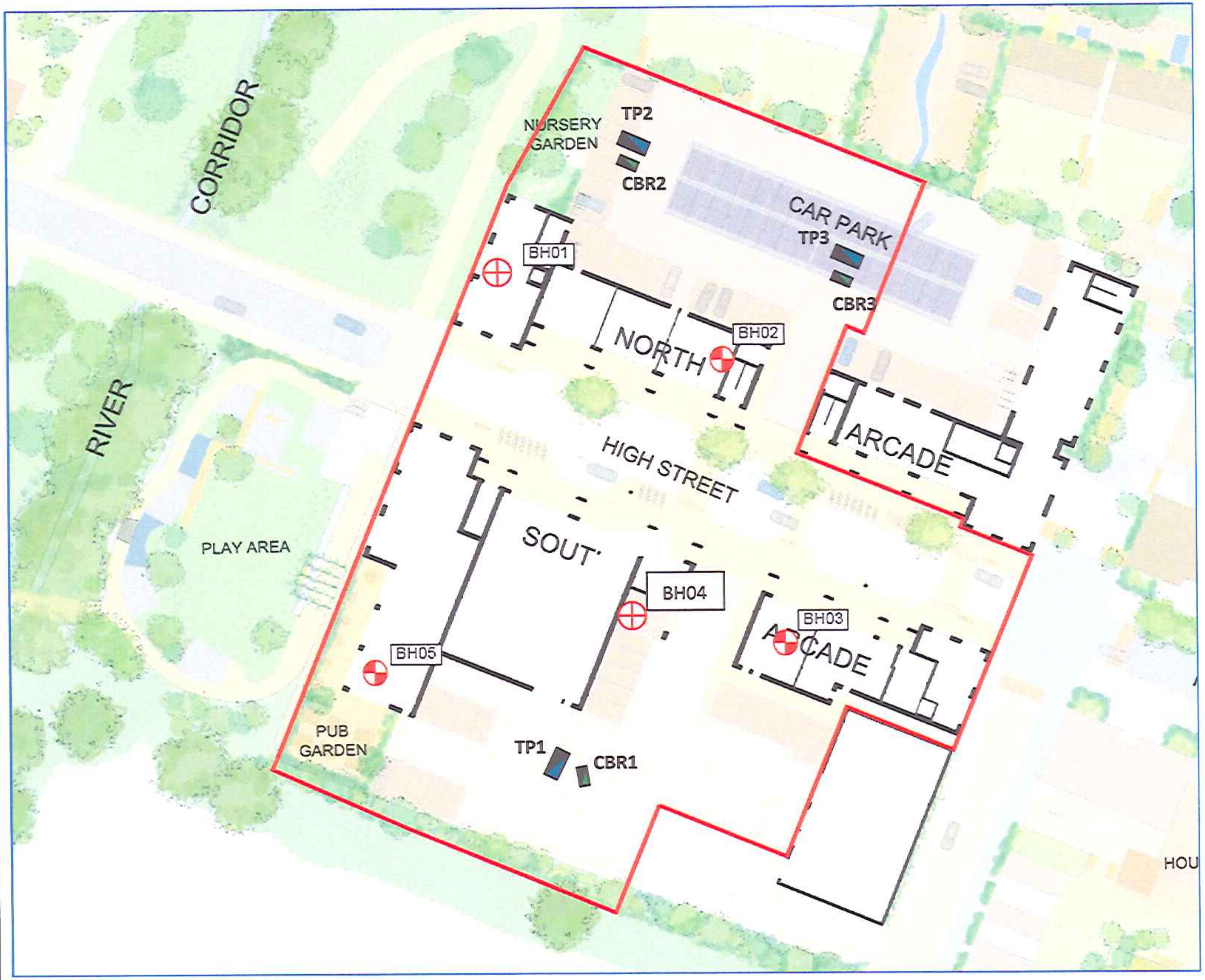
a2dominion

North West Bicester Eco Town
Bicester
Oxford

Topographical and Utility Survey

Scale:	Sheet Size:	Sheet Number:	Date:
1:200	A0	1	December 2016
Project Number:	Rev:	Surveyed By:	Approved By:
23255	-	RL	DF

Appendix B - Extracts from SI Reports



Continuous tube sample borehole to a depth of 5m below existing ground level except BH02 & BH03 which are to extend to 8m.

Samples to be collected for laboratory testing to determine:

i. Plasticiy index for shrinkable soils.

ii. Design sulphate (DS) and Agressive Concrete Environment Class (ACEC) in accordance with BRE Special Digest 1

iii. Groundwater levels

Contamination Testing for:

i. Metals and inorganic substances

ii. Speciated polyaromatic hydrocarbons (PAH)

iii. Total petroleum hydrocarbons (TPH)

Interpretive report to include recommendations for:

i. Appropriate foundation types and ground floor slabs

ii. Allowable bearing pressures for shallow foundations and parameters for the design of piled foundations

iii. Parameters for the design of retaining structures

iv. Guidance on requirements for gas barriers (to protect against Radon, Methane etc.)

engineersHRW

Project Title: BET - ELMSBROOK LOCAL CENTRE

Drawing Title: Site Investigation Requirements

Scale at A3	Drawn by	Date	Checked
1:50	PCG	02/11/15	MW

Drawing Status: Information

Project No	Drawing Type	Drawing No	Revision
1562		TP-01	T2

GROUND INVESTIGATION

FOR

ELMSBROOK LOCAL CENTRE

AT

NORTH WEST BICESTER ECO TOWN

CLIENT: A2 DOMINION HOUSING GROUP LTD

PROPERTY CONSULTANT: BIDWELLS LLP

DATE: JANUARY 2017 **REPORT NO:** 1673

GROUND INVESTIGATION SPECIALISTS LIMITED
Ashton House
67 Compton Road
Wolverhampton
WV3 9QZ

Tel: 01902 717653
Fax 01902 421110
e-mail: g.i.s@btconnect.com
Web: www.groundinvestigationspecialists.co.uk

From ground level, continuous 1.0 m long undisturbed samples, of decreasing diameter from 100 to 70 mm, were taken to ensure a complete soil profile to the base of each borehole. The samples were then described and sub-sampled on site by a geotechnical engineer who produced the logs appended to this report in section 10.0.

In-situ Standard Penetration Tests (SPTs) were carried at 1.0 m intervals in order to determine the strength or relative density of the underlying strata from an initial depth of 1.0 m.

On completion of drilling all boreholes were backfilled with arisings.

6.2 Trial/ Soil Infiltration Test Pits

On 19th December, a JCB 3CX mechanical excavator was used to excavate three trial pits (TP1 – TP3) to depths of between 0.65 m and 1.50 m, in order to inspect the soils and carry out infiltration tests. Each excavation was logged and sampled by the attending geotechnical engineer, who produced the trial pit logs included in section 11.0. Testing was carried out in accordance with BRE Digest 365, but limited to one day's duration.

6.3 In Situ California Bearing Ratio (CBR) Tests

On 19th December three test pits (CBR1 – CBR3) were excavated to depths of between 0.50 m and 0.75 m in order to carry out in situ CBR tests. The test results are included in section 12.0.

6.4 Laboratory Testing

GIS specified the following schedule of laboratory testing in accordance with the client's brief accompanying the invitation to tender, the full results of which are given in sections 13.0. and 14.0.

6.4.1 Contamination

In total five samples of the shallow made ground, taken from depths of between 0.10 m to 0.30 m, were screened for asbestos and tested for a general suite of contaminants including arsenic, cadmium, chromium, copper, lead, mercury, nickel, selenium, zinc, banded TPH, speciated PAH, SOM, pH and Total Organic Carbon (TOC).

6.4.2 Geotechnical

In order to aid in their classification, seven samples of the clay soils have undergone determinations of moisture content, liquid limit, plastic limit and plasticity index.

With regards to assessing conditions considered aggressive to buried concrete, five samples of the natural soils were tested for acid soluble sulphate, water soluble sulphate, magnesium, nitrate, total sulphur and pH value.

7.0 GROUND CONDITIONS

Full details of the strata encountered are given on the borehole logs and trial pit logs in sections 10.0 and 11.0. For clarity, the main engineering geology horizons are summarised below.

Made Ground

Made or disturbed ground was encountered in all the exploratory holes. Trial pits TP1 – TP3 and boreholes BH02 – BH04 encountered a thin layer, about 0.2 m thick, comprising a mixture of limestone and dolerite hardcore gravel with soft brown very sandy very gravelly clay and many fragments of limestone, brick, ash, quartzite, concrete and blacktop throughout.

In borehole BH05 similar made ground was encountered to a depth of 0.50 m. However, in borehole BH01, sunk in the northwest part of the site and closest to the new bridge, made ground was encountered to a depth of 1.60 m. This comprised light brown very silty very sandy very gravelly clay with many fragments of limestone and quartzite and occasional brick, concrete and ash fragments.

Cornbrash Formation

Underneath the made ground boreholes BH02 and BH03, along with trial pits TP1 and TP3, encountered the anticipated shallow bedrock geology of the weathered Cornbrash Formation to depths ranging between 0.50 m (BH03) and 1.00 m (BH02). This comprised weak rubbly thinly bedded in places grey to cream limestone with occasional bands of clay containing limestone fragments between the fractures and bedding.

Forest Marble Formation

Beneath the weathered Cornbrash Formation, and below the made ground where the Cornbrash Formation was absent, the anticipated deeper bedrock geology of the weathered Forest Marble Formation was encountered. This comprised soft becoming stiff to very stiff grey and brown silty sandy clay, oolitic and slightly fossiliferous in places, with lithorelicts of weak limestone and occasional thin weak limestone bands. All the boreholes refused on bands of limestone in the Forest Marble Formation, at depths ranging from 1.3 m to 3.0 m.

Groundwater

All exploratory holes remained dry for the short period of time they were left open.

CBR3 was carried out at a depth of 0.50 m on the rubbly limestone of the weathered Cornbrash Formation, but due to the high strength of the rock there was insufficient reaction load to obtain a result; there was no penetration of the plunger even after 2.5 kN of load had been applied.

Based upon the available information it is recommended that the new car parks could be designed to a CBR value of 3% where the firm to stiff clay is exposed as the sub-grade, but increased to a much higher value on the weathered limestone. Prior to construction of the flexible pavement the soils at formation level should be proof rolled with a heavy vibrating roller to remove any soft pockets.

8.3 Soakaways

Soil infiltration tests were attempted in trial pits TP1, TP2 and TP3, at locations specified by Bidwells.

The tests in trial pits TP1 and TP2 were carried out at depths of 1.50 m and 1.46 m in the firm to stiff clay of the weathered Forest Marble Formation. After being monitored for 3.5 – 4.0 hours the water level dropped from 0.95 m to 0.98 m in trial pit 1 (equivalent to a loss of c.20 litres) and from 0.91 m to 1.03 m in trial pit 2 (equivalent to a loss of c. 73 litres). Both excavations failed to achieve sufficient drainage within the time monitored to reliably calculate a soil infiltration rate for this material.

The test in trial pit TP3 was carried out at a depth of 0.65 m in the rubbly limestone of the weathered Cornbrash Formation. The test was carried out three times, in accordance with BRE Digest 365, producing soil infiltration rates of 3.5×10^{-5} ms^{-1}, 2.4×10^{-5} ms^{-1} and 1.6×10^{-5} ms^{-1}.

11.0 TRIAL PIT LOGS

GROUND INVESTIGATION SPECIALISTS LIMITED

TRIAL PIT LOG

CONTRACT: Elmsbrook Local Centre, Bicester	**TRIAL PIT No.** 1
CLIENT: A2 Dominion Housing Group Ltd	**SHEET** 1 **OF** 1
	JOB No. 1673

DATES EXCAVATED: 19.12.16	**GROUND LEVEL:** 87.9 m (approx)	**ENGINEER:** TJM
EXCAVATION METHOD: JCB 3CX	**CO-ORDINATES:** -	**WEATHER:** Overcast

CROSS SECTION

GL	Made ground (dark grey and brown silty sandy clayey GRAVEL hardcore of limestone and dolerite).
0.20	Strong rubbly thinly bedded grey LIMESTONE with occasional clayey pockets between fractures and bedding. (CORNBRASH FORMATION)
0.70	Stiff grey and brown weathered silty sandy oolitic CLAY with occasional limestone lithorelicts. (Completely weathered FOREST MARBLE FORMATION)
1.50	Trial Pit Complete.

GROUND WATER OBSERVATION:

Dry

STABILITY OF EXCAVATION:

Sides uneven and stable

SAMPLES TAKEN:

No samples taken

IN-SITU TESTS UNDERTAKEN:

Soil infiltration test attempted

REMARKS:	**FIG NO.**

GROUND INVESTIGATION SPECIALISTS LIMITED

TRIAL PIT LOG

CONTRACT: Elmsbrook Local Centre, Bicester	**TRIAL PIT No.** 2
CLIENT: A2 Dominion Housing Group Ltd	**SHEET** 1 **OF** 1
	JOB No. 1673

DATES EXCAVATED: 19.12.16	**GROUND LEVEL:** 86.3 m (approx)	**ENGINEER:** TJM
EXCAVATION METHOD: JCB 3CX	**CO-ORDINATES:** -	**WEATHER:** Overcast

CROSS SECTION

GL

Fill (brown silty SAND and fine to coarse GRAVEL of limestone with some brick fragments).

0.17

Terram geomembrane onto stiff light brown and light grey silty sandy oolitic CLAY with some fine to coarse angular oolitic limestone lithorelicts and occasional thin limestone bands.

(Weathered FOREST MARBLE FORMATION)

1.46

Trial Pit Complete.

GROUND WATER OBSERVATION:

Dry

STABILITY OF EXCAVATION:

Sides uneven and stable

SAMPLES TAKEN:

No samples taken

IN-SITU TESTS UNDERTAKEN:

Soil infiltration test attempted

REMARKS:	**FIG NO.**

GROUND INVESTIGATION SPECIALISTS LIMITED

TRIAL PIT LOG

CONTRACT: Elmsbrook Local Centre, Bicester	**TRIAL PIT No.** 3
CLIENT: A2 Dominion Housing Group Ltd	**SHEET** 1 **OF** 1
	JOB No. 1673

DATES EXCAVATED: 19.12.16	**GROUND LEVEL:** 87.9 m (approx)	**ENGINEER:** TJM
EXCAVATION METHOD: JCB 3CX	**CO-ORDINATES:** -	**WEATHER:** Overcast

CROSS SECTION

GL

Fill (brown and grey silty sandy limestone and brick hardcore gravel).

0.21

Terram geomembrane onto strong thinly bedded rubbly grey LIMESTONE.
(CORNBRASH FORMATION)

0.65

Trial Pit Complete.

GROUND WATER OBSERVATION:

Dry

STABILITY OF EXCAVATION:

Sides uneven and stable

SAMPLES TAKEN:

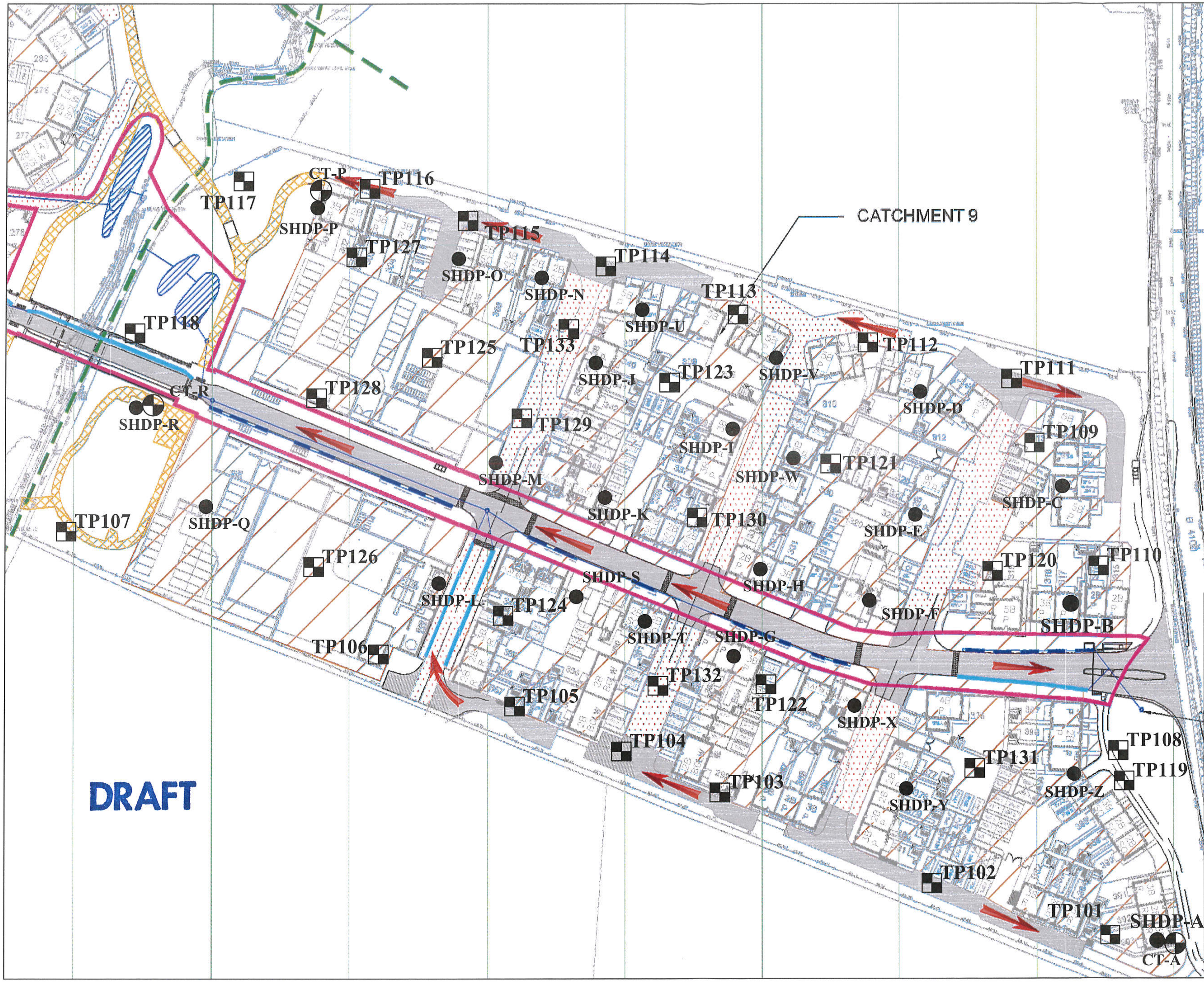
No samples taken

IN-SITU TESTS UNDERTAKEN:

Soil infiltration test undertaken

REMARKS:	**FIG NO.**

Tpitlog.doc



KEY

= Continuous Tube Borehole

= Super Heavy Dynamic Probe

= Trial Pit

Listers Geotechnical Consultants Ltd.

Slapton Hill Barn,
Blakesley Road,
Slapton,
Towcester,
Northants
NN12 8QD.
Telephone: (01327) 860060
Fax: (01327) 860430
E-mail: info@listersgeotechnics.co.uk

Exploratory Hole Location Plan

Site: Phase 1 Bicester Eco Village

Scale: NTS

Date: August 2012 | Job No: 13.01.021

LOCATION: Phase 1, Bicester Eco Village, Bicester

TRIAL PIT: TP106

Date of Excavation: 28/01/2013

Description of Strata	Strata Change: Legend	Strata Change: Depth -m Scale	Strata Change: Depth -m Strata	Samples: Depth -m	Samples: Type	Pocket Pen kPa (Cu)	Water Level -m
TOPSOIL Dark brown sandy clayey silty gravelly TOPSOIL with abundant roots. Gravel is fine to coarse angular limestone		0.00	(0.30) 0.30	0.10	J		
CORNBRASH FORMATION Medium dense to dense brown sandy gravel. Gravel is medium to coarse angular limestone with abundant angular limestone cobbles			(0.25) 0.55	0.50	D		
FOREST MARBLE Moderately strong grey LIMESTONE			(0.05) 0.60				
Trial Pit terminated at 0.60 m		1.00					
		2.00					DRY
		3.00					
		4.00					

DRAFT

Remarks

1. Method of excavation: JCB 3CX
2. Trial pit dimensions: 0.60 x 2.50 x 0.60m
3. Maximum depth of visible roots: 0.30m
4. No groundwater encountered
5. Sides stable

▽	Water Strike
▼	Water (Standing Level)
W	Water Sample
B	Bulk Sample
D	Small Disturbed Sample
V	Vane Test
P	Penetrometer Test
M	Mexe Penetrometer
CBR	CBR Sample
UF	Under Foundations

Date		
January 2013	**TRIAL PIT LOG**	**Report No.** 13.01.021 **Client Ref:**

LOCATION: Phase 1, Bicester Eco Village, Bicester

TRIAL PIT: TP126

Date of Excavation: 30/01/2013

Description of Strata	Strata Change: Legend	Depth -m: Scale	Depth -m: Strata	Samples: Depth -m	Samples: Type	Pocket Pen kPa (Cu)	Water Level -m
TOPSOIL Dark brown silty sandy slightly gravelly clayey TOPSOIL		0.00	(0.20) 0.20				
ALLUVIUM Soft to firm yellow grey silty sandy CLAY.				0.50 0.60-0.70	D D		
			(1.10)				
At 1.00m becoming firm to stiff		1.00		1.00	D	71	
POSSIBLE FOREST MARBLE Moederately strong grey LIMESTONE			1.30 (0.20) 1.50	1.40	D		
Trial Pit terminated at 1.50 m							
		2.00					DRY
		3.00					
		4.00					

DRAFT

Remarks

1. Method of excavation: JCB 3CX
2. Trial pit dimensions: 0.6 x 2.50 x 1.50m
3. Maximum depth of visible roots: 0.40m
4. No Groundwater encountered
5. Sides stable

▽	Water Strike
▼	Water (Standing Level)
W	Water Sample
B	Bulk Sample
D	Small Disturbed Sample
V	Vane Test
P	Penetrometer Test
M	Mexe Penetrometer
CBR	CBR Sample
UF	Under Foundations

Date January 2013	**TRIAL PIT LOG**	**Report No.** 13.01.021 **Client Ref:**

LOCATION: Phase 1, Bicester Eco Village, Bicester

TRIAL PIT: TP127

Date of Excavation: 31/01/2013

Description of Strata	Legend	Depth -m Scale	Depth -m Strata	Samples Depth -m	Samples Type	Pocket Pen kPa (Cu)	Water Level -m
TOPSOIL Dark brown silty slightly sandy slightly gravelly clayey TOPSOIL. Gravel is fine to medium angular limestone		0.00	(0.30) 0.30				
ALLUVIUM Firm to stiff yellow grey silty sandy slightly gravelly CLAY. Gravel is fine to coarse angular limestone		1.00	(0.80) 1.10				
FOREST MARBLE Moderately weak Limestone			(0.20) 1.30				
FOREST MARBLE Stiff to very stiff dark grey slightly gravelly silty CLAY		2.00	(1.70) 3.00				DRY
FOREST MARBLE Strong grey brown calcareous MUDSTONE		3.00	(0.10) 3.10				
Trial Pit terminated at 3.10 m		4.00					

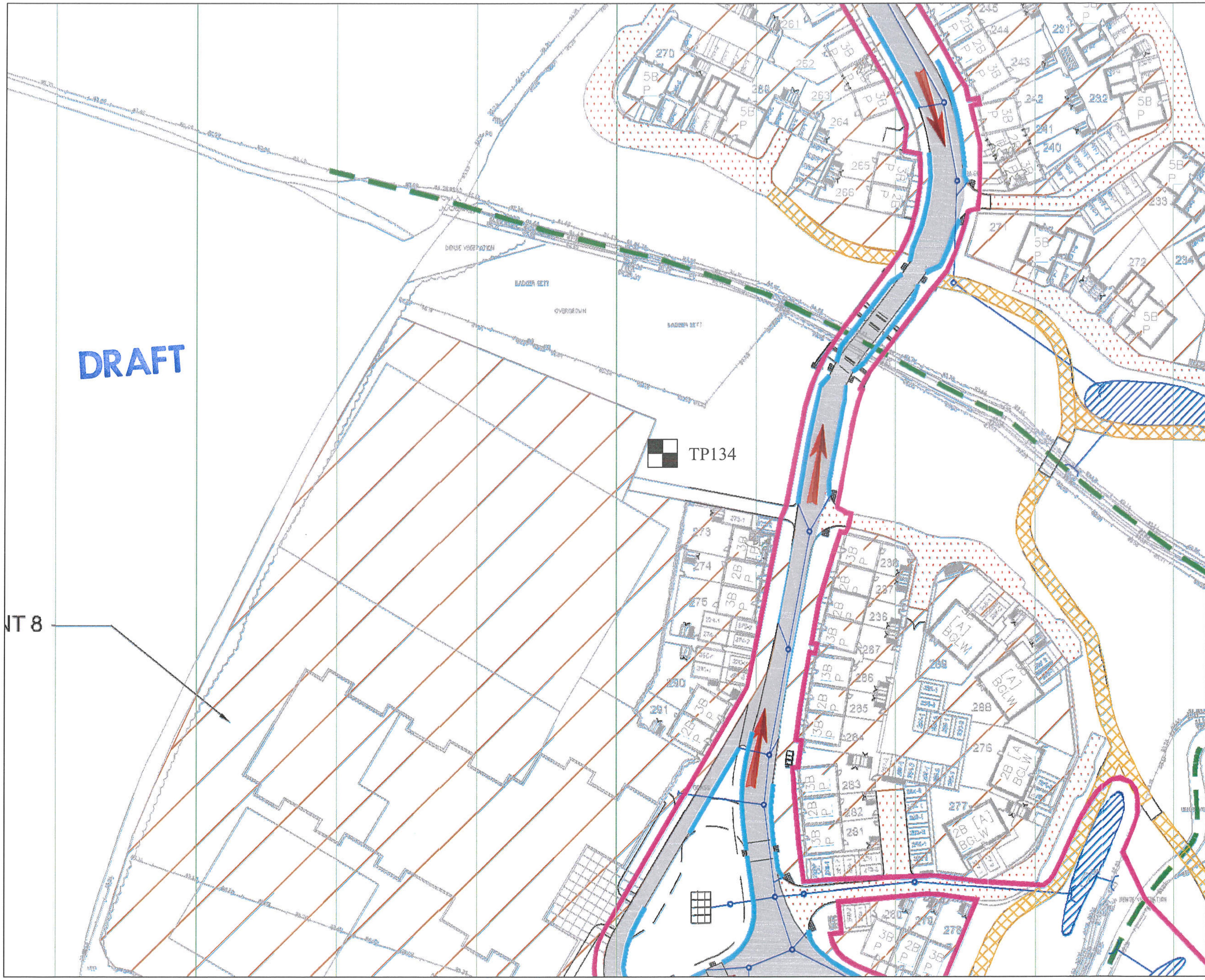
DRAFT

Remarks

1. Method of Excavation: JCB 3CX
2. Trial pit dimensions: 0.7 x 2.9 x 3.10m
3. Maximum depth of visible roots: 0.50m
4. No groundwater encountered
5. Sides stable

▽	Water Strike
▼	Water (Standing Level)
W	Water Sample
B	Bulk Sample
D	Small Disturbed Sample
V	Vane Test
P	Penetrometer Test
M	Mexe Penetrometer
CBR	CBR Sample
UF	Under Foundations

Date		
Date January 2013	**TRIAL PIT LOG**	**Report No.** 13.01.021 **Client Ref:**



KEY

= Continuous Tube Borehole

= Super Heavy Dynamic Probe

= Trial Pit

Listers Geotechnical Consultants Ltd.

Slapton Hill Barn,
Blakesley Road,
Slapton,
Towcester,
Northants
NN12 8QD.
Telephone: (01327) 860060
Fax: (01327) 860430
E-mail: info@listersgeotechnics.co.uk

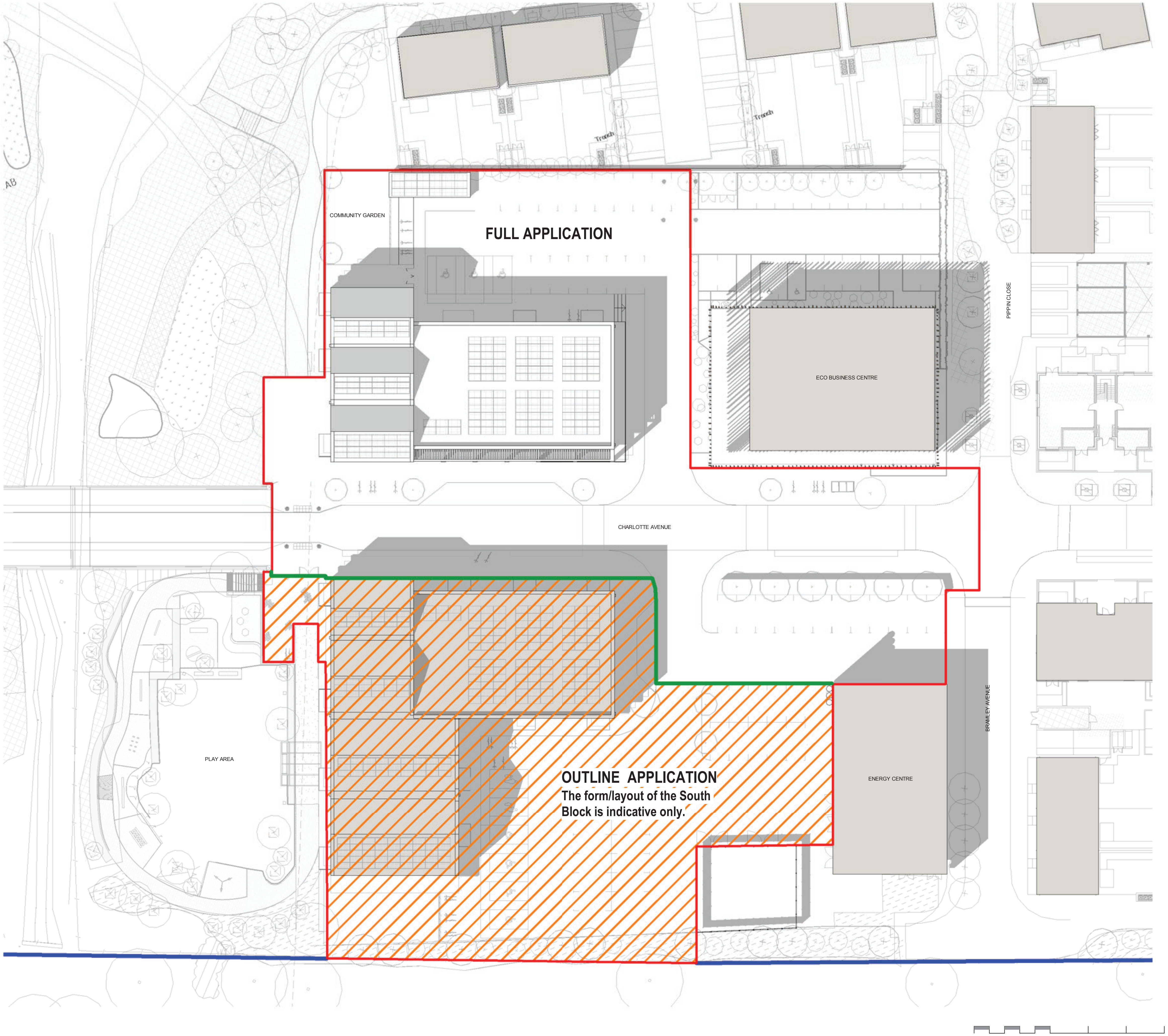
Exploratory Hole Location Plan

Site: New School, Bicester Eco Village

Scale: NTS

Date: August 2012 | Job No:13.01.021

Appendix C - Development Proposals



0 10 m 20 m

This line should measure 100mm along x and y axis when printed

SITE BOUNDARY:
Please note the site boundary position identified on this drawing remains subject to confirmation from Land Registry / verification with the land owner's title deed; ADP take no responsibility for the reliability/accuracy of this survey information

OUTLINE APPLICATION NOTE:
The form and layout of the South Block are for indicative purposes only; the final layout, height, massing and design will be determined as Reserved Matters in accordance with the agreed outline parameters

- Ownership Boundary
- Site Boundary
- Full Application Boundary
- Outline Application Area

REVISION	DATE	DESCRIPTION	ARCHITECT	PARTNER
S2 P 1	03.06.19	Planning Issue		ADP
S2 P 2	03.10.19	Planning update to include full and outline application areas		ADP

CHECK ALL DIMENSIONS AND VERIFY ON SITE. REPORT ANY ERRORS OR OMISSIONS

Cantay House
Park End Street Oxford OX1 1JD
T +44 (0) 1865 248045
E oxford@adp-architecture.com
www.adp-architecture.com

JOB TITLE:
Elmsbrook Local Centre
North West Bicester
for A2Dominion

DRAWING TITLE:
SITE PLAN

SCALE:	DRAWING SHEET SIZE:	
1 : 500	A3	
JOB CODE:	DRAWING NUMBER:	REVISION:
ELC2	ADP-00-XX-DR-A-0901	S2 P 2

Appendix D - Greenfield Runoff Rates

ICP SUDS Mean Annual Flood

Input

Return Period (years)	2	Soil	0.450
Area (ha)	0.670	Urban	0.000
SAAR (mm)	652	Region Number	Region 6

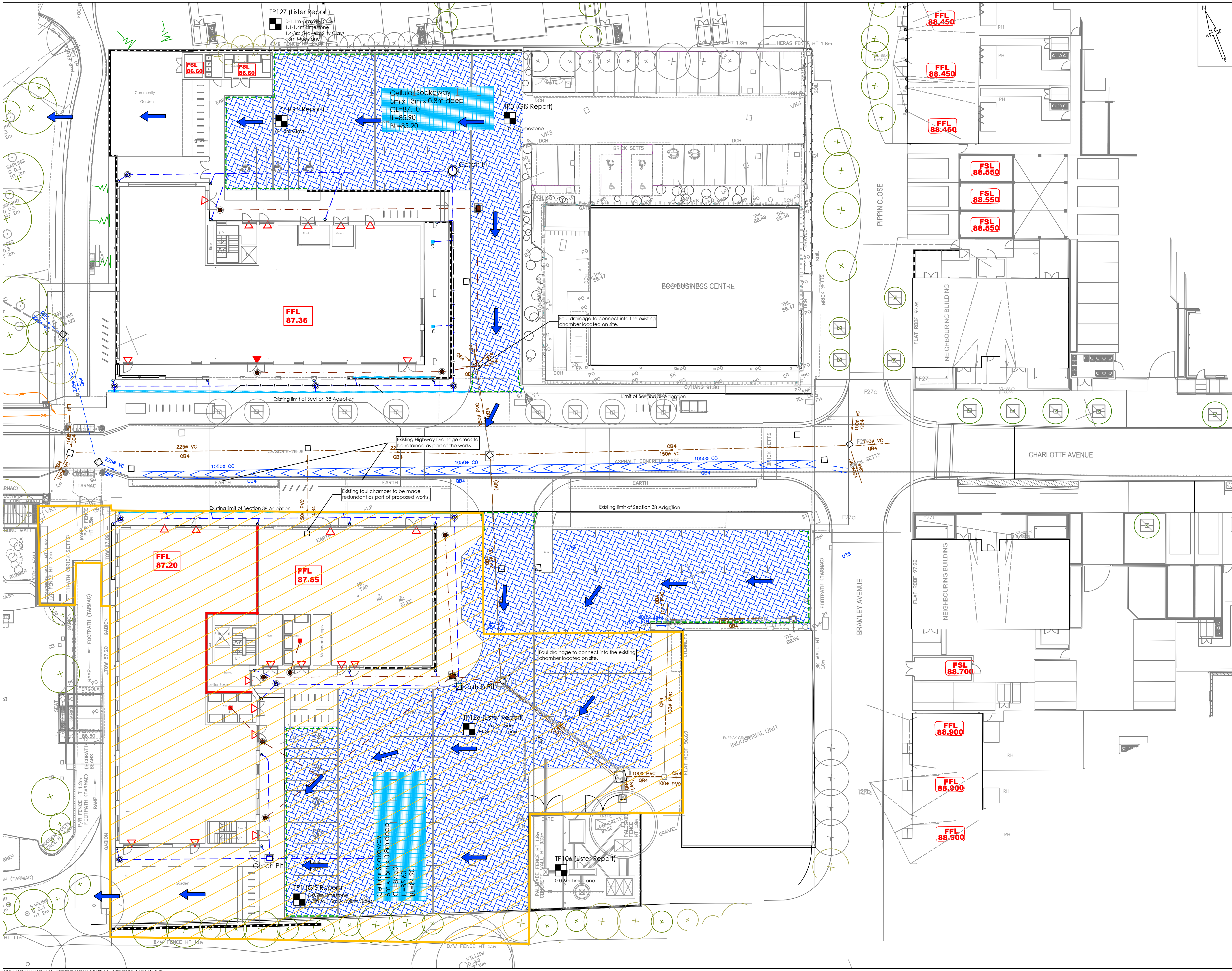
Results l/s

QBAR Rural 2.7
QBAR Urban 2.7

Q2 years 2.4

Q1 year 2.3
Q30 years 6.1
Q100 years 8.6

Appendix E - Drainage Strategy



NOTES

1. All dimensions and levels are in metres unless otherwise noted
2. This drawing is to be read in conjunction with the relevant Architect's/Engineer's drawings, specifications and CDM documentation
3. This drawings has been produced electronically and may have been photo reduced or enlarged when copied. Work to figured dimensions only (DO NOT SCALE). All dimensions to be checked on site. Any errors or omissions to be reported to the engineer immediately.
4. This drawing contains coloured lines / information that may not be clear if reproduced in black and white.
5. Digital copies of this plan can only be considered accurate if supplied directly by Infrastruct CS Ltd.

Drainage Key

Sewers

- Foul water drain (private/non adoptable)
- Surface water drain (private/non adoptable)
- Existing highway drain
- Existing foul water drain (private/non adopted)
- Existing surface water drain (private/non adopted)
- Existing foul water sewer (Adopted)
- Existing surface water sewer (Adopted)

Chamber Key

FW	SW	
mac	mac	Mini access chamber (mac) - 300mmØ *
		PPIC - 475mmØ *
		P.C.C. units/brick *
DM	DM	Adoptable demarcation manhole within 1m of boundary *
		Manhole Depth 1.25 to 1.5m * Depth 1.55 to 3.0m *

* General note
(Refer to standard details & long sections for chamber sizes. Size may need to increase dependant on number of incoming pipes/size of incoming pipes)

RE	Surface water rodding eye
F1	Manhole reference number
	Rain water down pipe (roddable access)
ST	Silt Trap (ST) with removable silt bucket
	Soil vent pipe/soil stack
yg	Yard gully (150m - 200mmØ trapped)
fg	Floor gully (trapped)
	Linear drainage channel
	Cellular storage (refer to drawing for sizes)
	Retaining wall
FFL XX.XX	Finished Floor Level (FFL)
	Block paving - Permeable
	Impermeable barrier to stop lateral movement of water
	Baffle to prevent rapid through flow of water through permeable paving
	Flood Exceedance Route
	Extent of Outline Application

RWP and SVP have been assumed and will be subject to detailed design by others

REV	DRAWN	CHECK	REVISION COMMENTS	ISSUE DATE
P5	TST	NJ	Extent of outline application shown	14/10/19
P4	TST	NJ	Flood Routing added and soakaways amended following updated design criteria from OCC	07/08/19
P3	NJ	TST	Site Layout Updated	23/05/19
P2	NJ	TST	Site layout updated	18/03/19
P1	NJ	TST	Initial issue	04/03/19

DRAWING TITLE
Drainage Strategy Plan

SHEET NO. 1/1

PROJECT
Elmsbrook Local Centre
Elmsbrook
Bicester, Oxon

S2 - INFORMATION

CLIENT
a2dominion

Infrastruct CS Ltd

The Stables, High Cogges Farm, High Cogges, Witney, OX29 6UN - Tel: 01993 709709: info@infrastructcs.co.uk

SCALE @ A1 1:200 (0m 5m 10.0m)

ENGINEER	DRAFT	APPROVED
TST	AC	DJ

PROJECT NUMBER	STATUS	DATE
2346	S2	March 19

PROJECT	ORIGIN	PHASE	LEVEL	TYPE	ROLE	NO.	REVISION
BICE	ICS	01	XX	DR	C	003	P5

Appendix F - Microdrainage Calculations

Summary of Results for 100 year Return Period (+40%)

Half Drain Time : 571 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status
15 min Summer	85.664	0.464	0.7	28.6	O K
30 min Summer	85.734	0.534	0.7	32.9	O K
60 min Summer	85.807	0.607	0.7	37.5	O K
120 min Summer	85.879	0.679	0.7	41.9	O K
180 min Summer	85.914	0.714	0.7	44.1	O K
240 min Summer	85.933	0.733	0.7	45.2	O K
360 min Summer	85.945	0.745	0.7	46.0	O K
480 min Summer	85.939	0.739	0.7	45.6	O K
600 min Summer	85.929	0.729	0.7	45.0	O K
720 min Summer	85.918	0.718	0.7	44.4	O K
960 min Summer	85.894	0.694	0.7	42.9	O K
1440 min Summer	85.848	0.648	0.7	40.0	O K
2160 min Summer	85.785	0.585	0.7	36.1	O K
2880 min Summer	85.727	0.527	0.7	32.5	O K
4320 min Summer	85.602	0.402	0.6	24.8	O K
5760 min Summer	85.502	0.302	0.6	18.6	O K
7200 min Summer	85.423	0.223	0.6	13.8	O K
8640 min Summer	85.361	0.161	0.6	9.9	O K
10080 min Summer	85.314	0.114	0.6	7.0	O K
15 min Winter	85.664	0.464	0.7	28.7	O K
30 min Winter	85.734	0.534	0.7	33.0	O K
60 min Winter	85.808	0.608	0.7	37.6	O K
120 min Winter	85.880	0.680	0.7	42.0	O K
180 min Winter	85.916	0.716	0.7	44.2	O K
240 min Winter	85.936	0.736	0.7	45.5	O K
360 min Winter	85.950	0.750	0.7	46.3	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)
15 min Summer	186.259	0.0	23
30 min Summer	108.411	0.0	38
60 min Summer	63.100	0.0	68
120 min Summer	36.727	0.0	126
180 min Summer	26.760	0.0	186
240 min Summer	21.377	0.0	246
360 min Summer	15.576	0.0	364
480 min Summer	12.442	0.0	470
600 min Summer	10.453	0.0	518
720 min Summer	9.066	0.0	578
960 min Summer	7.227	0.0	706
1440 min Summer	5.251	0.0	984
2160 min Summer	3.815	0.0	1388
2880 min Summer	3.042	0.0	1792
4320 min Summer	2.152	0.0	2596
5760 min Summer	1.684	0.0	3336
7200 min Summer	1.392	0.0	4032
8640 min Summer	1.192	0.0	4752
10080 min Summer	1.045	0.0	5352
15 min Winter	186.259	0.0	23
30 min Winter	108.411	0.0	37
60 min Winter	63.100	0.0	66
120 min Winter	36.727	0.0	124
180 min Winter	26.760	0.0	182
240 min Winter	21.377	0.0	240
360 min Winter	15.576	0.0	354

Summary of Results for 100 year Return Period (+40%)

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status
480 min Winter	85.947	0.747	0.7	46.2	O K
600 min Winter	85.936	0.736	0.7	45.4	O K
720 min Winter	85.921	0.721	0.7	44.5	O K
960 min Winter	85.893	0.693	0.7	42.8	O K
1440 min Winter	85.831	0.631	0.7	39.0	O K
2160 min Winter	85.740	0.540	0.7	33.3	O K
2880 min Winter	85.656	0.456	0.7	28.1	O K
4320 min Winter	85.491	0.291	0.6	18.0	O K
5760 min Winter	85.369	0.169	0.6	10.4	O K
7200 min Winter	85.285	0.085	0.5	5.2	O K
8640 min Winter	85.249	0.049	0.5	3.0	O K
10080 min Winter	85.243	0.043	0.5	2.7	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)
480 min Winter	12.442	0.0	462
600 min Winter	10.453	0.0	564
720 min Winter	9.066	0.0	592
960 min Winter	7.227	0.0	738
1440 min Winter	5.251	0.0	1044
2160 min Winter	3.815	0.0	1492
2880 min Winter	3.042	0.0	1908
4320 min Winter	2.152	0.0	2684
5760 min Winter	1.684	0.0	3400
7200 min Winter	1.392	0.0	3968
8640 min Winter	1.192	0.0	4408
10080 min Winter	1.045	0.0	5144

Rainfall Details

Rainfall Model	FEH	D3 (1km)	0.253	Cv (Winter)	0.950
Return Period (years)	100	E (1km)	0.292	Shortest Storm (mins)	15
Site Location		F (1km)	2.465	Longest Storm (mins)	10080
C (1km)	-0.023	Summer Storms	Yes	Climate Change %	+40
D1 (1km)	0.325	Winter Storms	Yes		
D2 (1km)	0.318	Cv (Summer)	0.950		

Time Area Diagram

Total Area (ha) 0.066

Time From:	**(mins) To:**	**Area (ha)**	**Time From:**	**(mins) To:**	**Area (ha)**
0	4	0.000	4	8	0.066

Model Details

Storage is Online Cover Level (m) 87.100

Cellular Storage Structure

Invert Level (m) 85.200 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.05760 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.05760

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	65.0	65.0	0.800	65.0	93.8	0.900	0.0	93.8

Summary of Results for 100 year Return Period (+40%)

Half Drain Time : 635 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status
15 min Summer	85.093	0.493	0.9	42.2	O K
30 min Summer	85.168	0.568	0.9	48.5	O K
60 min Summer	85.247	0.647	0.9	55.3	O K
120 min Summer	85.325	0.725	1.0	62.0	O K
180 min Summer	85.365	0.765	1.0	65.4	O K
240 min Summer	85.388	0.788	1.0	67.3	O K
360 min Summer	85.406	0.806	1.0	68.9	O K
480 min Summer	85.404	0.804	1.0	68.7	O K
600 min Summer	85.394	0.794	1.0	67.9	O K
720 min Summer	85.383	0.783	1.0	67.0	O K
960 min Summer	85.359	0.759	1.0	64.9	O K
1440 min Summer	85.312	0.712	1.0	60.9	O K
2160 min Summer	85.248	0.648	0.9	55.4	O K
2880 min Summer	85.189	0.589	0.9	50.3	O K
4320 min Summer	85.059	0.459	0.9	39.2	O K
5760 min Summer	84.953	0.353	0.8	30.2	O K
7200 min Summer	84.866	0.266	0.8	22.8	O K
8640 min Summer	84.798	0.198	0.8	16.9	O K
10080 min Summer	84.743	0.143	0.8	12.3	O K
15 min Winter	85.093	0.493	0.9	42.2	O K
30 min Winter	85.168	0.568	0.9	48.6	O K
60 min Winter	85.248	0.648	0.9	55.4	O K
120 min Winter	85.327	0.727	1.0	62.2	O K
180 min Winter	85.368	0.768	1.0	65.6	O K
240 min Winter	85.391	0.791	1.0	67.6	O K
360 min Winter	85.413	0.813	1.0	69.3	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)
15 min Summer	186.259	0.0	23
30 min Summer	108.411	0.0	38
60 min Summer	63.100	0.0	68
120 min Summer	36.727	0.0	126
180 min Summer	26.760	0.0	186
240 min Summer	21.377	0.0	246
360 min Summer	15.576	0.0	364
480 min Summer	12.442	0.0	484
600 min Summer	10.453	0.0	550
720 min Summer	9.066	0.0	604
960 min Summer	7.227	0.0	726
1440 min Summer	5.251	0.0	998
2160 min Summer	3.815	0.0	1408
2880 min Summer	3.042	0.0	1820
4320 min Summer	2.152	0.0	2600
5760 min Summer	1.684	0.0	3344
7200 min Summer	1.392	0.0	4104
8640 min Summer	1.192	0.0	4760
10080 min Summer	1.045	0.0	5448
15 min Winter	186.259	0.0	23
30 min Winter	108.411	0.0	37
60 min Winter	63.100	0.0	66
120 min Winter	36.727	0.0	124
180 min Winter	26.760	0.0	182
240 min Winter	21.377	0.0	240
360 min Winter	15.576	0.0	354

Summary of Results for 100 year Return Period (+40%)

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status
480 min Winter	85.414	0.814	1.0	69.4	O K
600 min Winter	85.403	0.803	1.0	68.7	O K
720 min Winter	85.388	0.788	1.0	67.4	O K
960 min Winter	85.359	0.759	1.0	64.9	O K
1440 min Winter	85.298	0.698	1.0	59.7	O K
2160 min Winter	85.207	0.607	0.9	51.9	O K
2880 min Winter	85.121	0.521	0.9	44.5	O K
4320 min Winter	84.947	0.347	0.8	29.7	O K
5760 min Winter	84.814	0.214	0.8	18.3	O K
7200 min Winter	84.716	0.116	0.8	9.9	O K
8640 min Winter	84.657	0.057	0.7	4.9	O K
10080 min Winter	84.646	0.046	0.7	3.9	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)
480 min Winter	12.442	0.0	466
600 min Winter	10.453	0.0	572
720 min Winter	9.066	0.0	668
960 min Winter	7.227	0.0	754
1440 min Winter	5.251	0.0	1058
2160 min Winter	3.815	0.0	1516
2880 min Winter	3.042	0.0	1936
4320 min Winter	2.152	0.0	2728
5760 min Winter	1.684	0.0	3456
7200 min Winter	1.392	0.0	4104
8640 min Winter	1.192	0.0	4584
10080 min Winter	1.045	0.0	5144

Rainfall Details

Rainfall Model	FEH	D3 (1km)	0.253	Cv (Winter)	0.950
Return Period (years)	100	E (1km)	0.292	Shortest Storm (mins)	15
Site Location		F (1km)	2.465	Longest Storm (mins)	10080
C (1km)	-0.023	Summer Storms	Yes	Climate Change %	+40
D1 (1km)	0.325	Winter Storms	Yes		
D2 (1km)	0.318	Cv (Summer)	0.950		

Time Area Diagram

Total Area (ha) 0.097

Time From:	**(mins) To:**	**Area (ha)**	**Time From:**	**(mins) To:**	**Area (ha)**
0	4	0.000	4	8	0.097

Model Details

Storage is Online Cover Level (m) 87.500

Cellular Storage Structure

Invert Level (m) 84.600 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.05760 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.05760

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	90.0	90.0	0.800	90.0	123.6	0.900	0.0	123.6

Summary of Results for 100 year Return Period (+40%)

Half Drain Time : 64 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status
15 min Summer	86.736	0.261	14.2	69.3	O K
30 min Summer	86.748	0.273	14.9	76.3	O K
60 min Summer	86.753	0.278	15.1	78.5	O K
120 min Summer	86.751	0.276	15.0	77.6	O K
180 min Summer	86.745	0.270	14.7	74.2	O K
240 min Summer	86.737	0.262	14.3	70.1	O K
360 min Summer	86.721	0.246	13.4	61.9	O K
480 min Summer	86.706	0.231	12.6	54.6	O K
600 min Summer	86.693	0.218	11.9	48.6	O K
720 min Summer	86.682	0.207	11.2	43.5	O K
960 min Summer	86.661	0.186	10.1	35.4	O K
1440 min Summer	86.631	0.156	8.5	24.8	O K
2160 min Summer	86.601	0.126	6.8	16.1	O K
2880 min Summer	86.580	0.105	5.7	11.3	O K
4320 min Summer	86.553	0.078	4.3	6.3	O K
5760 min Summer	86.537	0.062	3.4	3.9	O K
7200 min Summer	86.526	0.051	2.8	2.7	O K
8640 min Summer	86.522	0.047	2.4	2.2	O K
10080 min Summer	86.519	0.044	2.1	1.9	O K
15 min Winter	86.736	0.261	14.2	69.4	O K
30 min Winter	86.749	0.274	14.9	76.5	O K
60 min Winter	86.752	0.277	15.1	78.3	O K
120 min Winter	86.747	0.272	14.8	75.7	O K
180 min Winter	86.737	0.262	14.3	70.2	O K
240 min Winter	86.726	0.251	13.6	64.2	O K
360 min Winter	86.704	0.229	12.4	53.4	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)
15 min Summer	186.259	0.0	21
30 min Summer	108.411	0.0	35
60 min Summer	63.100	0.0	54
120 min Summer	36.727	0.0	88
180 min Summer	26.760	0.0	122
240 min Summer	21.377	0.0	156
360 min Summer	15.576	0.0	222
480 min Summer	12.442	0.0	286
600 min Summer	10.453	0.0	348
720 min Summer	9.066	0.0	410
960 min Summer	7.227	0.0	532
1440 min Summer	5.251	0.0	770
2160 min Summer	3.815	0.0	1128
2880 min Summer	3.042	0.0	1476
4320 min Summer	2.152	0.0	2208
5760 min Summer	1.684	0.0	2936
7200 min Summer	1.392	0.0	3672
8640 min Summer	1.192	0.0	4400
10080 min Summer	1.045	0.0	5096
15 min Winter	186.259	0.0	21
30 min Winter	108.411	0.0	35
60 min Winter	63.100	0.0	56
120 min Winter	36.727	0.0	92
180 min Winter	26.760	0.0	130
240 min Winter	21.377	0.0	164
360 min Winter	15.576	0.0	232

Summary of Results for 100 year Return Period (+40%)

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status
480 min Winter	86.684	0.209	11.4	44.5	O K
600 min Winter	86.667	0.192	10.4	37.5	O K
720 min Winter	86.652	0.177	9.6	31.9	O K
960 min Winter	86.628	0.153	8.3	23.7	O K
1440 min Winter	86.594	0.119	6.5	14.5	O K
2160 min Winter	86.565	0.090	4.9	8.2	O K
2880 min Winter	86.547	0.072	3.9	5.3	O K
4320 min Winter	86.526	0.051	2.8	2.7	O K
5760 min Winter	86.520	0.045	2.2	2.0	O K
7200 min Winter	86.516	0.041	1.8	1.7	O K
8640 min Winter	86.512	0.037	1.5	1.4	O K
10080 min Winter	86.510	0.035	1.3	1.2	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)
480 min Winter	12.442	0.0	298
600 min Winter	10.453	0.0	360
720 min Winter	9.066	0.0	424
960 min Winter	7.227	0.0	544
1440 min Winter	5.251	0.0	782
2160 min Winter	3.815	0.0	1128
2880 min Winter	3.042	0.0	1476
4320 min Winter	2.152	0.0	2200
5760 min Winter	1.684	0.0	2896
7200 min Winter	1.392	0.0	3632
8640 min Winter	1.192	0.0	4256
10080 min Winter	1.045	0.0	5136

Rainfall Details

Rainfall Model	FEH	D3 (1km)	0.253	Cv (Winter)	0.900
Return Period (years)	100	E (1km)	0.292	Shortest Storm (mins)	15
Site Location		F (1km)	2.465	Longest Storm (mins)	10080
C (1km)	-0.023	Summer Storms	Yes	Climate Change %	+40
D1 (1km)	0.325	Winter Storms	Yes		
D2 (1km)	0.318	Cv (Summer)	0.900		

Time Area Diagram

Total Area (ha) 0.210

Time From:	**(mins) To:**	**Area (ha)**	**Time From:**	**(mins) To:**	**Area (ha)**
0	4	0.000	4	8	0.210

Model Details

Storage is Online Cover Level (m) 87.000

Porous Car Park Structure

Infiltration Coefficient Base (m/hr)	0.05760	Width (m)	34.0
Membrane Percolation (mm/hr)	1000	Length (m)	62.0
Max Percolation (l/s)	585.6	Slope (1:X)	200.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	86.475	Cap Volume Depth (m)	0.000