Woods Hardwick
Infrastructure LLP
Civil Engineering Consultants

Land North of Hanwell Fields

Banbury

FLOOD RISK ASSESSMENT

December 2013

Outline planning application for up to 160 dwellings together with associated infrastructure and open space with all matters reserved except access.

WH Ref – CSB/16841/E/B4

Contents

Appendices

1.0 Introduction

1.1 This Flood Risk Assessment (FRA) has been prepared by Woods Hardwick Infrastructure LLP in support of a planning application for a residential development at Dukes Meadow Drive, Banbury.

1.2 An FRA has been prepared as this site lies within flood zone 1 but has an area greater than 1 ha.

1.3 The document has been written in accordance with the Department for Communities and Local Government's document Technical Guidance to the National Planning Policy Framework (TGNPPF; March 2012). The TGNPPF serves as a flood risk related addendum to the National Planning Policy Framework (NPPF; March 2012).

1.4 The document has also been written with due regard to local guidance and it concludes that the proposed development will not lead to the impedance of flood flows and will not increase flood risk on the site or to third parties, either upstream or downstream of the land.

2.0 Existing Site and Proposed Development

2.1 The site is located on the north west edge of Banbury.

2.2 The development site comprises approximately 7.2 ha and the National Grid reference for the site centre is SP 4379 4277.

2.3 A site location plan is included in **Appendix 1** of this document and it shows the land to lie to the north of Dukes Meadow Drive with Warwick Road to the west. Although the land to the north is currently vacant and undeveloped, it benefits from a resolution to grant planning consent for 350 dwellings being known as Hanwell Fields.

2.4 The planning application is in outline with all matters reserved except access, but the proposed scheme is supported by the Development Masterplan which can be found in **Appendix 2**.

2.5 The site has a nominal fall in a southerly direction towards Dukes Meadow Drive but at roughly its midpoint there is a crest which also sheds water to the east and west. A copy of the topographical survey for the land can be found in **Appendix 3**.

3.0 Flood Risk

3.1 The purpose of this section is to identify whether or not there are any flood risks associated with the development which might affect the proposals, or might have some impact on the surrounding environment. All aspects of flood risk have been considered as outlined below.

3.2 Following the increase frequency of flooding during recent years, much work has been undertaken at a National level to access the relationship between new development and flood risk. This work resulted in the publication of Planning Policy Statement 25 (PPS25) in early 2007 with an update being released in March 2012.

3.3 Alongside the release of the NPPF in March 2012, the TGNPPF was released serving as a flood risk based addendum to the National Planning Guidance. These documents replace PPS25, although many of the principles set out in that document remain relevant.

3.4 Table 1 of TGNPPF seeks to define different flood risk zones where Zone 1 is considered to be low risk, since it is outside of the area which is likely to suffer inundation from 0.1% probability rainfall event. Zone 2 is considered to be medium risk, lying between the 0.1% probability contour and the 1% or 100 year flood area. Zone 3 is divided into two categories, with Zone 3A having a less than 1% annual probability of river flooding or less than a 0.5% probability of flooding from the sea. Zone 3B is described as functional floodplain. This guidance re-affirms the guidance and categorisation included within PPS25.

3.5 The Environment Agency flood map demonstrates the site lies within flood zone 1 and a copy of this map is included in **Appendix 4**.

3.6 In addition to considering flood risk from designated floodplain TGNPPF advises that all other potential sources of flood risk need to be assessed as part of the FRA.

3.7 As the site lies remote from the sea in an inland location, it is apparent that sea flooding is not a potential risk to the development.

3.8 There are no existing large water bodies within the vicinity of the site indicating that this potential source is not relevant to the scheme either.

3.9 The topography of the site indicates that there is a continuing rise beyond the northern boundary of the land into the area known as Hanwell Fields. The potential risk of overland flooding therefore needs to be considered, but as the entirety of this area is to be developed with the associated introduction of appropriate drainage facilities, the resultant interruption of overland flow routes suggest that there will be no long term risk from this potential source. During the construction phase, however, depending on progress of the development works, some temporary facilities may be required to guard against overland flow from the site entering the land.

3.10 There are no continuous watercourses or land drainage features crossing the site, although there are some intermittent ditches along the frontage of Dukes Meadow Drive, which appear to fulfil no distinct drainage function other than to act as a cut off to avoid overland flow from the site entering the public highway. It is not proposed that these land drainage features will be retained as part of the scheme, bearing in mind that the overland flow routes will be interrupted by drained development which would intercept flows, although in common with good practice they will be filled with granular materials to maintain a historic flow route.

3.11 Soil investigation work on site has confirmed that the prevailing water table lies a considerable distance below the surface of the land which is reflective of the permeability of the underlying soils and ground water is therefore not considered to pose a flow risk for the scheme.

3.12 There are sewer systems within Dukes Meadow Drive but investigations have not revealed any flooding history from these facilities. In any event it should be noted that as Dukes Meadow Drive lies at the lowest edge of the scheme, any associated escape of water or flooding would not impact on the development proposed.

3.13 There are two depressions, one lying to the east and the other lying to the west, within the site. These are understood to be historic SuDS facilities in the form of dry detention basins but it would appear that they have effectively remained dry since their introduction which is perhaps reflective of the underlying soil permeability. In the event that they did ever contain water or reach a point where they were likely to overspill, the flow route from them would be onto Dukes Meadow Drive, meaning that they posed no flood risk to the scheme.

3.14 In light of the above therefore, it is considered that the land can properly be categorised as lying within Flood Zone 1, meaning that it is a low risk and suitable for the nature of the development envisaged.

3.15 Importantly, it should be noted that TGNPPF encourages the location of new development in areas which are at lowest risk of flooding, and describes a sequential test for this purpose. The findings of this document therefore reinforce the original Banbury wide assessment that this is an appropriate and acceptable location for housing development.

4.0 Surface Water Disposal

4.1 In addition to ensuring that the development is not at risk of flooding from external sources, it is also important to ensure that the scheme itself does not exacerbate flood risk for others. It is therefore essential that the arrangements for storm water disposal are fully assessed to guarantee that the effects are mitigated and that there will be no impact on the existing land drainage regime.

4.2 All of the recent guidance on the arrangements for storm water disposal from new developments has encouraged the application of a hierarchy for surface water disposal. This has now been formalised in the Building Regulations Part H.

4.3 The first choice for surface water disposal which should be pursued is via infiltration and only where it has been determined that the ground conditions are not suitable should the second choice of disposal to a ditch or water course be considered. If there is no alternative the third and last choice of disposal to public sewer can be considered.

4.4 At this location, extensive infiltration has been undertaken and the results of the investigations can be found in **Appendix 5**.

4.5 It is clear from these results that the site is located on soils which are eminently suitable for disposal via infiltration with the prevailing permeability which has been analysed in relation to BRE Digest 365 being a consistent 1 x 10 to -4m/sec. This permeability according to National Guidance can be described as good.

4.6 There is now definitive guidance on the preferred application of sustainable urban drainage systems (SuDS) on new developments, specifically in the form of the Ciria SuDS Manual C697. This document describes an approach to selecting SuDS and also encourages treatment trains which not only benefit the run off regime but also improve water quality.

4.7 At this location the consistency of the permeability throughout the site encourages the use of a blanket approach across the scheme and in the context of Oxfordshire County Council's preferred approach, it is proposed to apply the use of permeable paving on all hard standing areas to benefit from the good disposable characteristics of the underlying soil strata.

4.8 The permeable paving will be designed with open jointed blockwork underlain by a high void ratio sub base which will be surrounded with an appropriate permeable membrane. The voids within the sub base will be utilised for storage and the permeable membrane will be in contact with the underlying infiltration friendly soils. A typical section of the proposed permeable paving can be found in **Appendix 6** and at detailed design stage the ultimate sub base depth would be determined as being that which is required to store run off for all storms up to 100 year return period including an appropriate allowance for climate change which TGNPPF describes as a potential 30% increase in rainfall intensity.

4.9 The determination of the sub base depth will be established through assessing the roof, road and hardstanding areas which will be drained against the prevailing infiltration rate of the soil with the application of an appropriate factor of safety.

4.10 The nature of the permeable paving is that it will act to improve water quality through filtration and interception and the application of an appropriate factor of safety is therefore considered to be essential given the robust approach which is warranted in relation to dealing with flood risk issues.

4.11 Where the layout permits at detailed design stage individual trench soakaways may also be utilised to deal with runoff from the rear of dwellings. These soakaways will be designed in accordance with BRE Digest 365 and it is felt that as they will only receive roof water, and therefore do not require same level of treatment as zones which will be subject to vehicular use, the distribution of SuDS to effectively deal with runoff at source is beneficial.

4.12 The ability of permeable paving to deal with runoff from even the most intense storms is considerable, but the potential risk of overland flow routes needs to be considered. This is particularly important bearing in mind the topography of the land and the desire to mitigate the effect of the development on the surrounding area, and whilst arguably the intended drainage solution will reduce the risk of overland flow considerably, it is still proposed to direct potential flows towards the historic SuDS features to the east and west through the introduction of gullys at the end of the access roads closest to Dukes Meadow Drive, which will then feed into infiltration trenches containing perforated pipes directed towards the detention zones. This is merely a precautionary measure, bearing in mind the standards of design which are to be applied to the development SuDS but it is in keeping with the robust standards which are expected in TGNPPF. An indicative plan showing the anticipated flood routing can be found in **Appendix 7**.

5.0 Conclusions

5.1 The site is demonstrably within a zone which is at low risk of flooding and there are no local sources of potential flood risk which suggest that that conclusion is inappropriate.

5.2 The expectations of the sequential test which is contained in TGNPPF is therefore complied with, meaning that the site is suitable for the nature of development proposed.

5.3 The arrangements for surface water disposal follow the hierarchy laid down in National Guidance through the intended blanket use of infiltration throughout the scheme. The soil conditions are demonstrably suitable for that method of disposal and at detailed design stage the liberal use of permeable paving and the potential introduction of individual soakaways to accommodate roof water mean that a SuDS approach can be adopted with the benefits of mitigating potential runoff and even reducing overland flow risk through directing water into the ground. In addition there will also be water quality benefits arising from the use of this approach.

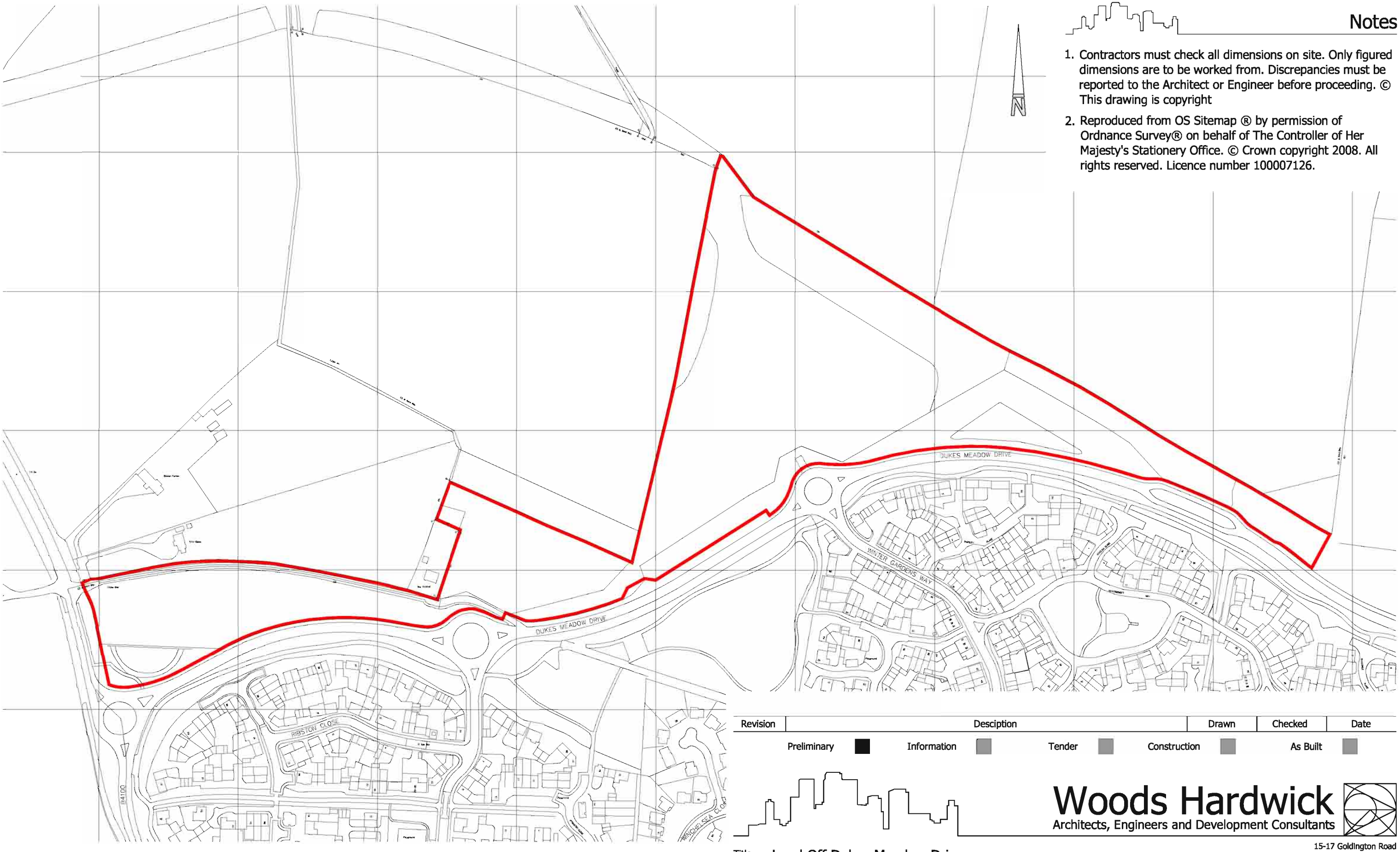
5.4 A robust analysis dictates the consideration of potential overland flow paths and facilities are available to deal with this potential scenario with the intended introduction of conveyance pipes which will firstly rely on infiltration but will allow water to be directed safely to existing depressions where water will ultimately infiltrate into the ground.

5.5 The use of permeable paving has been embraced by Oxfordshire County Council in their design standards and there are many locations within the County Council area where its application is extensively being introduced. Detailed design of the permeable paving will be in accordance with the County Council's standards and the long term integrity and maintenance will be ensured by the ultimate adoption through Section 38 of the Highways Act.

5.6 It is concluded therefore that the scheme complies with the expectations of TGNPPF, although it is of course understood that there will be a need to introduce an appropriate planning condition which requires the submission of the final drainage details in conjunction with the final layout form prior to the commencement of the development.

Appendix 1

Site Location Plan



Notes

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0m 25m 50m 100m 150m 250m

1:2500

Revision	Desciption	Drawn	Checked	Date

Preliminary ■ Information ■ Tender ■ Construction ■ As Built ■

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Title: Land Off Dukes Meadow Drive, Hanwell Fields (North), Banbury.

Details: Location Plan.

Saved : h\projects

Scale: 1:2500 @ A3 Date: Dec. 2013 Drawn: KO Chk: GRS

16841/1009

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Appendix 2

Indicative Site Masterplan

Notes

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1:2000 — 0m 25m 50m 100m 150m 250m

PRELIMINARY

Revision	Desciption	Drawn	Checked	Date
Preliminary ■	Information □	Tender □	Construction □	As Built □

- Proposed Allocation in Cherwell Local Plan
- Indicative Built Form
- Local Equipped Area of Play & Local Area of Play
- Existing Hedgerows and Trees (to be retained where possible)
- Attenuation Area (size and position subject to drainage design)
- New Planting
- Proposed Site Access
- Adjoining Land Incorporated in Proposed Allocation 'BAN 5'
- Proposed Links to Remainder of 'BAN 5'
- Retained Access to Existing Dwelling
- Existing Public Footpath
- Proposed Pedestrian Crossings
- Potential Footpath Link
- Existing Trees to be retained

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Title: RESIDENTIAL DEVELOPMENT
LAND OFF HANWELL FIELDS, BANBURY

Details: ILLUSTRATIVE MASTER PLAN

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Scale 1:2000 @A2 | Date DEC 2013 | Drawn AJS | Chk JAL

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Appendix 3

Topographical Survey

CONTROL FIXED TO ORDNANCE SURVEY NATIONAL GPS NETWORK				
Station	Description	Easting	Northing	Height
A	PEG	443910.701	242655.461	146.734
B	XCut/Mark	443795.099	242591.403	148.171
C	PK	443782.013	242570.098	147.912
D	PK	443706.678	242559.307	146.012
E	PK	443651.262	242577.337	145.103
F	PK	443644.300	242549.848	145.088
G	PK	443570.353	242562.677	142.605
H	PK	443489.596	242541.212	140.029
I	PK	444457.645	242512.648	133.721
J	PEG	443405.680	242496.487	140.754
K	PK	443986.836	242682.576	145.021
L	PEG	444052.633	242741.021	143.438
M	HILTI	444119.921	242673.214	142.525
N	PK	444189.936	242651.266	140.911
O	PEG	443603.971	242574.842	144.633
P	PK	444265.523	242618.611	139.608
Q	HILTI	444293.652	242584.337	137.921
R	PK	444410.933	242543.162	135.066
T	PEG	444466.801	242746.427	135.067
U	PEG	444201.348	242694.795	140.850
V	PEG	443785.374	242944.362	141.654
W	PEG	443711.392	242619.455	146.341
X	PEG	443658.835	242646.523	145.322
Y	PEG	443722.313	242660.702	146.506
Z	PK	444352.661	242549.070	135.429

KEY

SURVEY STATION — A

BANKING — TOP / BOTTOM

HEDGE SPREADS SHOWN TO SCALE

FOLIAGE

TREES — SPREAD & TRUNK SHOWN TO SCALE HWHEIGHT

DEAD TREE — SPREAD & TRUNK SHOWN TO SCALE HWHEIGHT

GATE POST — GP

ROAD WITH GRAY CENTRE & OFFSET DROPPED KERB — KD / DK

KERB

TRACK

VERGE

FENCE

WALL

OVERHEAD ELECTRIC

OVERHEAD TELECOM

BUILDING

MAJOR CONTOUR INTERVAL — 25.00

MINOR CONTOUR INTERVAL

SPOT LEVEL — + 127.13

BORE HOLE — BH

TRIAL PIT — Tr Pit

SEWER DETAILS

SEWERS FOUL	
SEWERS STORM	
COVER LEVEL	MHCL=
INVERT LEVEL	IL=
BACKDROP INVERT	BDIL=
SIGMAVAY	SA
CATCHPIT INVERT	CPIL=
SOFFIT LEVEL	SL=

NOTE: INVERTS, PIPE SIZES, CONNECTIONS SHOWN ARE OBTAINED FROM SURFACE INVESTIGATIONS ONLY.

GENERAL ABBREVIATIONS

AIR VALVE	AV
BACK DROP	BD
BENCH	BE
BOLLARD	BO
BUS STOP	BUS
BT INSPECTION COVER	BT
CABLE TV COVER	CTV
COVER LEVEL	CL
DOWN PIPE	DP
EAST	E
ELECTRICITY COVER	ELC
ELECTRICITY POLE	EP
EARTH ROD	ER
FIRE HYDRANT	FH
FLOOR LEVEL	FFL
FOUL WATER SEWER	FWS
GAS VALVE	GV
GATE, POST	GP
GULLY	GY
INSPECTION COVER	ICCL
INVERT LEVEL	IL
KERB INLET	KD
LAMP POST	LP
LETTER BOX	LB
MANHOLE	MH,CL
MARKER POST	MK
METER	ME
MILESTONE	MS
ORDNANCE SURVEY BENCH MARK	OSBM
MISSING EYE	ME
ROAD SIGN	RS
SERVICE VALVE	SV
STOP COCK	SC
STORM WATER SEWER	SWS
TACTILE PAVING	TT
TELEPHONE	TP
UNABLE TO LIFT	UTL
VENT PIPE	VP
WATER LEVEL	WR,V
WATER VALVE	WV
WASH OUT	WO

FENCE ABBREVIATIONS

BARBED WIRE FENCE	BWF
CHAINLINK FENCE	CLF
CLOSE BOARD FENCE	CBF
CLOSE BOARDED FENCE	CBF
CORRUGATED IRON FENCE	CIF
CRASH BARRIER	CRF
ELECTRIC FENCE	ELF
HAND RAIL FENCE	HRF
IRON RAILINGS	IRF
LAPPED BOARD FENCE	LBF
LANDSCAPE FENCE	LSF
POST AND RAIL FENCE	PRF
POST AND WIRE FENCE	PWF
STEEL MESH FENCE	SMF
TIMBER PANEL FENCE	TPF
WIRE MESH FENCE	WMF

WALL ABBREVIATIONS

BLOCK WALL	BLW
BRICK WALL	BRW
CONCRETE WALL	CNW
RETAINING WALL	RTW
SANDBAG WALL	SBW
STONE WALL	STW

ORDINATE SYSTEM
LEVELS TO OS DATUM
ASSUMED LOCAL GRID

Revision	-	-	Desciption	-	Drawn	-	Checked	-	Date

Preliminary ■ Information ■ Tender ■ Construction ■ As Built ■

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Title: HANWELL FIELDS
BANBURY

Details: TOPOGRAPHIC SURVEY
SHEET 2 of 2

Saved : Mprojects

Scale: 1-500 @ A0 Date: 07-09-2012 Drawn: SGB Chk: SGB

16841-1002.2

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KEY

SURVEY STATION

BANKING — TOP / BOTTOM

HEDGE SPREADS SHOWN TO SCALE

FOLIAGE

TREES — SPREAD & TRUNK SHOWN TO SCALE, HH=HEIGHT

DEAD TREE — SPREAD & TRUNK SHOWN TO SCALE, HH=HEIGHT

GATE POST — GP

ROAD WITH GULLY AND KERB OFFLET — KO

DROPPED KERB — DK

KERB

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BUILDING

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SEWER DETAILS

SEWERS FOUL

SEWERS STORM

COVER LEVEL — MH.CL=

INVERT LEVEL — IL=

BACKDROP INVERT — BDIL=

SOAKAWAY — SA

CATCHPIT INVERT — CPIL=

SOFFIT LEVEL — SL=

NOTE: INVERTS, PIPE SIZES, CONNECTIONS SHOWN ARE OBTAINED FROM SURFACE INVESTIGATIONS ONLY.

GENERAL ABBREVIATIONS

AIR VALVE	AV
BACK DROP	BD
BRICK	BK
BOLLARD	BO
BUS STOP	BUS
BT INSPECTION COVER	BT
CABLE TV COVER	CTV
CATCH PIT	CP
DOWN PIPE	DP
DUCT	D
ELECTRICITY COVER	ELC
ELECTRICITY POLE	EP
EARTH WIRE	EW
FIRE HYDRANT	FH
FLOOR LEVEL	FFL
FOUL WATER SEWER	FWS
GAS VALVE	GAS
GATE POST	GP
GULLY	GY
HIGHWAY JUNCTION COVER	HWCL
INVERT LEVEL	IL
KERB OFFLET	KO
LAMP POST	LP
LETTER BOX	LB
MANHOLE	MHCL
MARKER POST	MK
METER	MT
MILESTONE	MS
ORDNANCE SURVEY BENCH MARK	OSBM
MISSING EYE	ME
ROAD SIGN	RS
SERVICE VALVE	SV
STUMP	STU
STORM WATER SEWER	SWS
TACTILE PAVING	TT
TELEGRAPH POLE	TP
UNABLE TO LIFT	UTL
VENT PIPE	VP
WATER LEVEL	WL
WATER VALVE	WV
WASH OUT	WO

FENCE ABBREVIATIONS

BARBED WIRE FENCE	BWF
CHAINLINK FENCE	CLF
CHESTNUT PALING	CPF
CLOSE BOARDED FENCE	CBF
CORRUGATED IRON FENCE	CIF
CRASH BARRIER	CBF
ELECTRIC FENCE	ELF
HEDGE & FENCE	HF
IRON RAILINGS	IRF
KNEE RAIL FENCE	KRF
LAPELAP FENCE	LLF
POST AND RAIL FENCE	PRF
STOCK PROOF FENCE	SPF
STOCK PROOF TYPE	SPF
TIMBER PANEL FENCE	TPF
WIRE MESH FENCE	WMF

WALL ABBREVIATIONS

BLOCK WALL	BLW
BRICK WALL	BKW
BROKEN WALL	BRW
RETAINING WALL	RTW
SANDING WALL	SDW
SLEEPER WALL	SLW
STONE WALL	STW

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Title: HANWELL FIELDS
BANBURY

Details: TOPOGRAPHIC SURVEY
SHEET 1 of 2

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Scale: 1-500 @ A0 Date: 07-09-2012 Drawn: SGB Chk: SGB

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Appendix 4

Environment Agency Indicative

Flood Map

Environment Agency

Enter a postcode or place name: Other topics for this area...

Go Risk of Flooding from Rivers and Sea View other Interactive Maps

Risk of Flooding from Rivers and Sea

River flooding happens when a river cannot cope with the amount of water draining into it from the surrounding land. Sea flooding happens when there are high tides and stormy conditions.

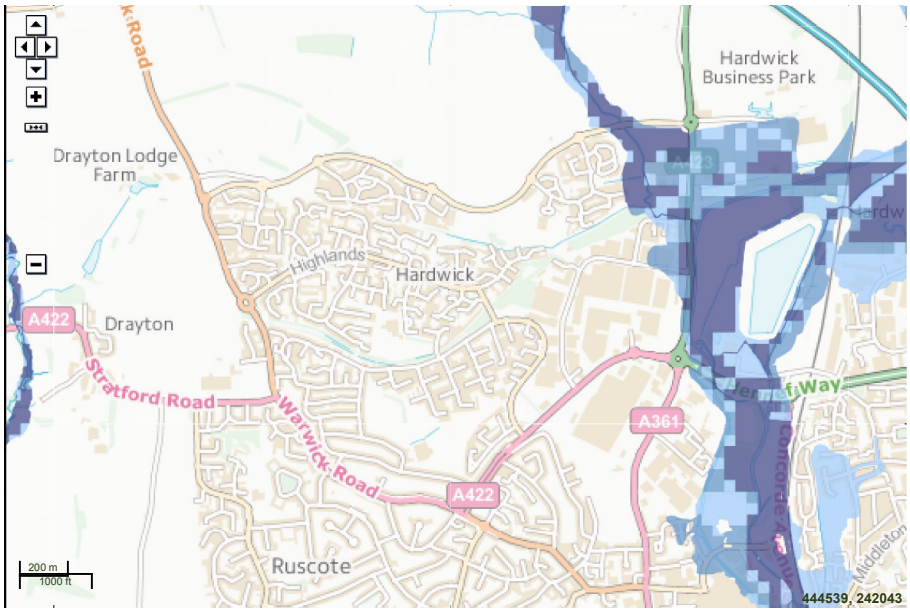
The shading on the map shows the risk of flooding from rivers and the sea in this particular area.

Click on the map for a more detailed explanation.

Map legend

- Risk of Flooding from Rivers and Sea
  - High
  - Medium
  - Low
  - Very Low

Map of X: 444,520; Y: 242,018 at scale 1:15,000 **Data search**



creating a better place

Author: The Environment Agency | enquiries@environment-agency.gov.uk
Last updated: 13 December 2013

Appendix 5

Infiltration Test Results

PRP:
consulting civil & structural engineers

REPORT
on
PERMEABILITY TESTING
for a
RESIDENTIAL DEVELOPMENT
on
LAND ADJACENT
to
DUKES MEADOW DRIVE
BANBURY

Carried out by :

PRP

Consulting Civil & Structural Engineers

Catherine House, Old Harborough Road,

Brixworth, Northampton. NN6 9BX

Telephone 01604 889870 Facsimile 01604 882834

email Northampton@prp.uk.com

For :

Peter and Sheelagh Donger

Seawell Grounds

Foxley

Towcester

Northamptonshire

NN12 8HW

1. Introduction

1.1. The object of this investigation was to discover whether the underlying strata would accept water from soakaways and if so to provide data for the design of those soakaways.

1.2. The holes for the soakaway tests were excavated and filled with water by David Saunders Contractors Ltd under contract to and at the direction of PRP on behalf of the Peter and Sheelagh Donger.

1.3. The sewer records have not been consulted but nevertheless, even if they were available the principle of sustainable urban drainage indicates that soakaways should be used if at all possible.

1.4. The British Geological Survey map for the area, sheet number 201, Banbury was referred to, which indicated that the site was underlain by Marlstone Rock Bed overlying Middle Lias deposits from the Jurassic Period.

2. Site Work

2.1. Four test pits were excavated in the positions shown on the appended location plan. The materials encountered were generally in accordance with the geological map for the area with topsoil up to 100mm thick overlying Limestone cobbles and boulders of in a reddish brown sandy gravelly Clay the lower horizon this stratum was not revealed in these test pits.

2.2. The infiltration test method outlined in BRE Digest 365 requires test pits to be filled and allowed to drain to empty or near empty three times on the same day or consecutive days.

2.3. This result was not achieved in the test pits due to time and cost restraints, but the test pits were filled and monitored over a period of approximately 2½ hours.

3. Results

3.1. Having filled the test pits with water and noted the time taken for it to seep away into the ground the infiltration rates were calculated from the data obtained from site.

3.2. On this basis the results are summarised below:

Hole No.	Test No.	Test Depth	Infiltration Rate (l/m²/min)	(m/h)
TP 1	1	0.910 – 0.120m	5.390	0.323
TP 2	1	1.230 – 0.130m	3.347	0.201
TP3	1	1.000 – 0.000m	16.276	0.977
TP4	1	0.840 – 0.000m	18.083	1.085

The detailed results are appended.

4. Conclusions

4.1. The infiltration rate measured in all test pits was reasonable although it was particularly good in the centre and Eastern sectors of the site and was consistent with the granular nature of the soils encountered. The soils present on the site will support soakaways.

4.2. Under 'normal' circumstances the Environment Agency and Planning Authority will require a 1m level difference between the underside of the soakway and the groundwater level but this should not be a significant issue with this site as no groundwater was encountered during the investigation. Nevertheless, an appropriate factor of safety should be incorporated into the design of any soakaways.

4.3. Initial calculations demonstrate that for an average infiltration of 0.6465m/hr a 1m3 crate system soakaway will be adequate to drain 50m2 of hardsurfacing and building. This also incorporates a factor of safety of 2 and will have a half drain time or around 43 minutes.

4.4. When the layout of the new development and the hardsurfacing is determined the location(s) of the soakaways can be considered further and using the information gathered in the ground investigation, could be placed so as to take advantage of the better soils. Other constraints (such as accessibility, topography and distance from foundations) will also apply.

4.5. It is unclear whether or not the access road between the properties will be adopted by the local authority or not however, it should be stated that Highways are unlikely to accept soakaways as a suitable means of surface water run-off disposal if suitable public stormwater sewers are available. If highways accept soakaways then they will need to be placed within the highway boundary and must not collect the surface water run-off from any non-adopted surface.

4.6. Soakaway schemes will require approval from Environment Agency and Building Control, this report and a drainage strategy report should be included in the planning application.

Barry Smith
B.Eng. C.Eng. M.I.Struct.E. FGS
Director
PRP UK Ltd

APPENDIX 1
TEST PIT LOCATION PLAN

PRP:
consulting civil & structural engineers

Project: Warwick Road, Banbury

Title: Test Pit Location Plan

Status: **For Information**

Engineer: BMS	Drawn: GAJ	Checked: BMS
Date: Sep 2012	Scales @ A4: NTS	
Drawing No: 60418 - App1		Rev: -

APPENDIX 2
CALCULATIONS

PRP
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Leicester 0116 275 1710 | Northampton 01604 889870 | Huntingdon 01832 710959

SOIL INFILTRATION REPORT

Project No:	60418		
Project:	Warwick Road, Banbury		
Prepared by:	GAJ	Date: 13.09.2012	
Checked by:	CAL	Sheet:	01

Test Pit 1

Soil type	Size	Length (m)	Width (m)	Depth (m)
Red brown sandy gravelly clay with cobbles and boulders		1.30	0.60	1.15

No	Site Readings			
	Time (hh:mm)	Water Level from Base of Pit (mm)	Time (mins)	Depth of Water Below Ground Level (m)
1	09:51	0.91	0	-0.25
2	09:52	0.87	1	-0.28
3	09:52	0.85	1	-0.31
4	09:53	0.82	2	-0.33
5	09:54	0.78	3	-0.37
6	09:55	0.75	4	-0.41
7	09:56	0.72	5	-0.44
8	09:57	0.69	6	-0.46
9	09:58	0.66	7	-0.49
10	09:58	0.63	7	-0.52
11	10:03	0.56	12	-0.59
12	10:05	0.53	14	-0.62
13	10:08	0.49	17	-0.66
14	10:35	0.27	44	-0.88
15	10:40	0.25	49	-0.91
16	11:07	0.12	76	-1.03
17				
18				
19				
20				
21				
22				
23				
24				
25				

	25%	75%	
Effective depth (m)	-0.83	-0.44	
Time (min)	31	6	taken from Graph

Volume outflowing between 75% & 25% effective depth

$V_{p\,75\text{-}25}$ = 1.3 x 0.6 x (0.83 - 0.44) = 0.30615 m3

α_{p50} = (1.3 x 0.39 x 2) +
+ (0.6 x 0.39 x 2) +
+ (1.3 x 0.6) = 2.2715 m2

$t_{p75\text{-}25}$ = 31 - 6 = 25 min

Soil infiltration rate

$$f = \frac{0.30615}{2.272 \times 25 \times 60} = \mathbf{8.99E\text{-}05} \text{ m/sec}$$

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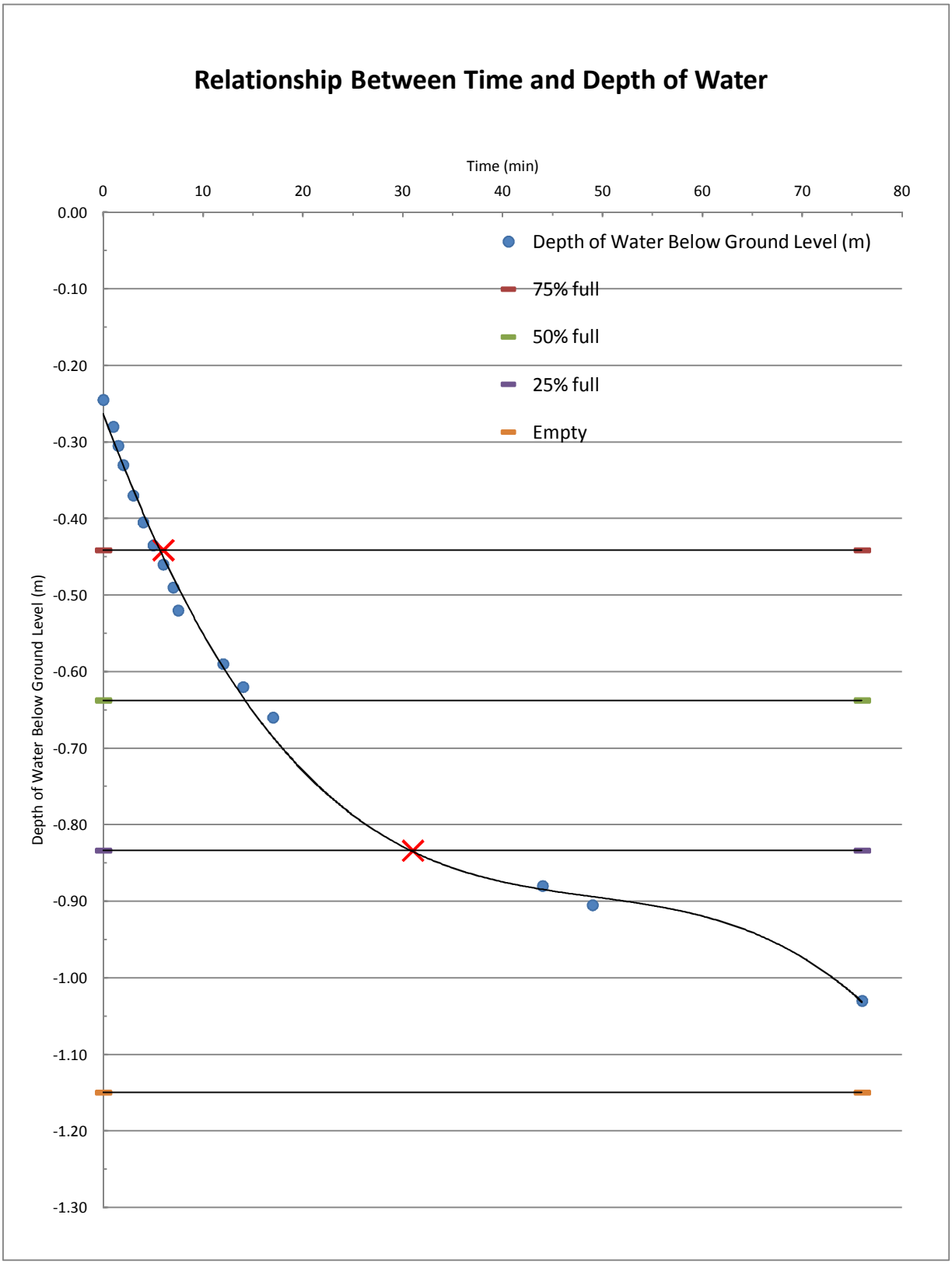
SOIL INFILTRATION REPORT

Project No:	60418		
Project:	Warwick Road, Banbury		
Prepared by:	GAJ	Date: 13.09.2012	
Checked by:	CAL	Sheet:	02

Test Pit 1



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SOIL INFILTRATION REPORT

Project No:	60418		
Project:	Warwick Road, Banbury		
Prepared by:	GAJ	Date: 13.09.2012	
Checked by:	CAL	Sheet:	03

Test Pit 2

Soil type	Red brown sandy gravelly clay with cobbles and boulders	Size	Length (m)	Width (m)	Depth (m)
			1.25	0.65	1.50

No	Site Readings			
	Time (hh:mm)	Water Level from Base of Pit (mm)	Time (mins)	Depth of Water Below Ground Level (m)
1	10:22	1.23	0	-0.28
2	10:22	1.19	0	-0.32
3	10:23	1.17	1	-0.33
4	10:24	1.14	2	-0.36
5	10:24	1.12	3	-0.38
6	10:25	1.09	4	-0.41
7	10:28	1.02	6	-0.48
8	10:30	0.97	8	-0.53
9	10:31	0.95	9	-0.56
10	10:33	0.91	11	-0.59
11	10:43	0.74	21	-0.76
12	11:04	0.49	42	-1.01
13	11:25	0.35	63	-1.15
14	11:45	0.28	83	-1.23
15	12:37	0.13	135	-1.38
16				
17				
18				
19				
20				
21				
22				
23				
24				
25				

	25%	75%	
Effective depth (m)	-1.10	-0.55	
Time (min)	55	9	taken from Graph

Volume outflowing between 75% & 25% effective depth

$V_{p\,75\text{-}25}$ = 1.3 x 0.7 x (1.10 - 0.55) = 0.446875 m3

α_{p50} = (1.3 x 0.55 x 2) +
+ (0.7 x 0.55 x 2) +
+ (1.3 x 0.7) = 2.9025 m2

$t_{p75\text{-}25}$ = 55 - 9 = 46 min

Soil infiltration rate

$$f = \frac{0.446875}{2.903 \times 46 \times 60} = \mathbf{5.58E\text{-}05} \text{ m/sec}$$

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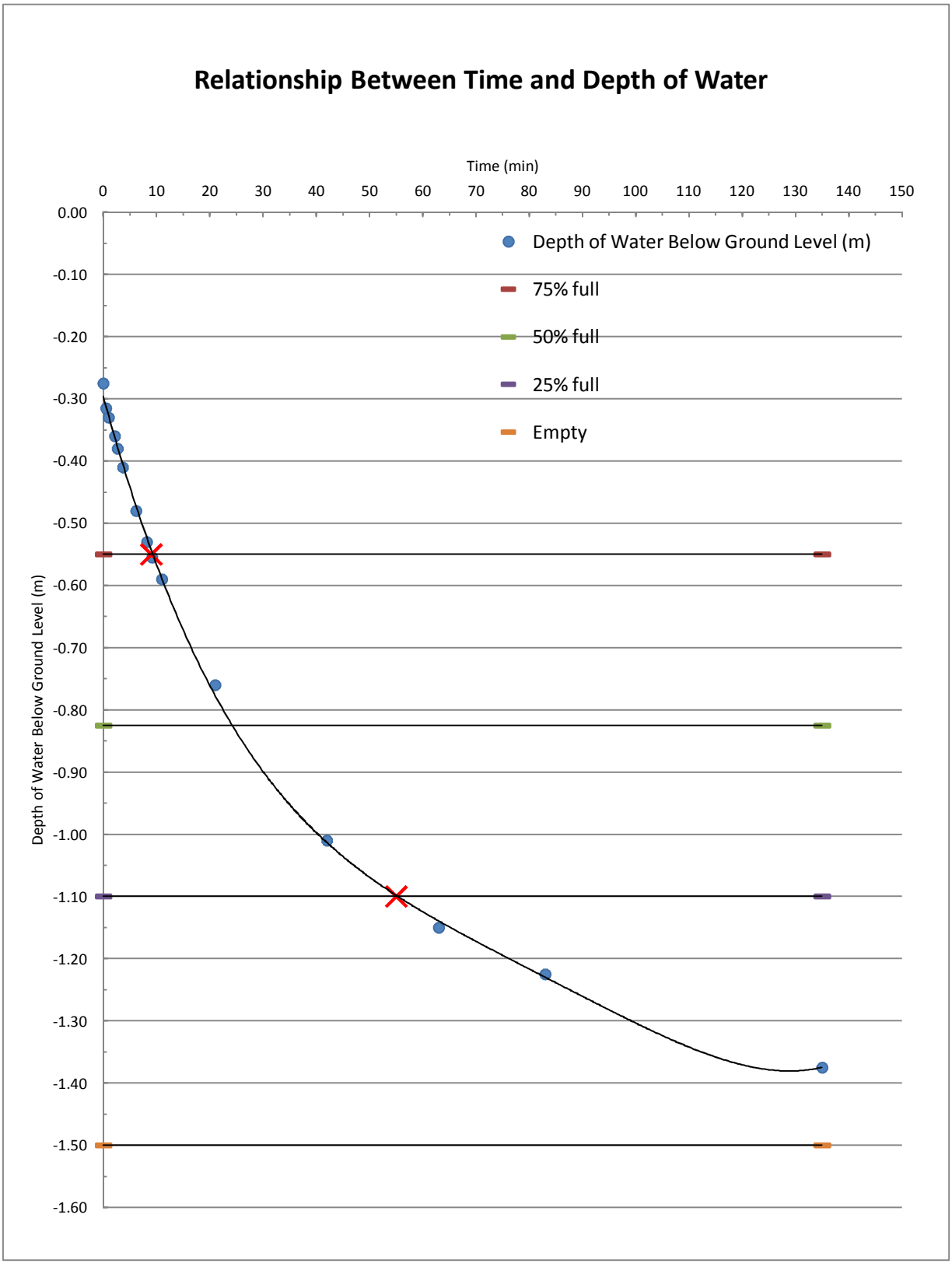
SOIL INFILTRATION REPORT

Project No:	60418		
Project:	Warwick Road, Banbury		
Prepared by:	GAJ	Date: 13.09.2012	
Checked by:	CAL	Sheet:	04

Test Pit 2



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SOIL INFILTRATION REPORT

Project No:	60418		
Project:	Warwick Road, Banbury		
Prepared by:	GAJ	Date: 13.09.2012	
Checked by:	CAL	Sheet:	05

Test Pit 3

Soil type	Size	Length (m)	Width (m)	Depth (m)
Red brown sandy gravelly clay with cobbles and boulders		1.70	0.67	1.75

No	Site Readings			
	Time (hh:mm)	Water Level from Base of Pit (mm)	Time (mins)	Depth of Water Below Ground Level (m)
1	10:47	1.00	0	-0.75
2	10:48	0.68	1	-1.07
3	10:49	0.63	2	-1.12
4	10:50	0.51	3	-1.24
5	10:51	0.46	4	-1.29
6	10:52	0.42	5	-1.34
7	10:53	0.39	6	-1.36
8	10:54	0.35	7	-1.40
9	10:56	0.31	9	-1.44
10	10:57	0.27	10	-1.48
11	11:00	0.23	13	-1.52
12	11:01	0.22	14	-1.53
13	11:22	-0.01	35	-1.76
14				
15				
16				
17				
18				
19				
20				
21				
22				
23				
24				

	25%	75%	
Effective depth (m)	-1.51	-1.00	
Time (min)	11	1	taken from Graph

Volume outflowing between 75% & 25% effective depth

$V_{p\,75\text{-}25}$ = 1.7 x 0.7 x (1.51 - 1.00) = 0.575195 m3

α_{p50} = (1.7 x 0.51 x 2) +
+ (0.7 x 0.51 x 2) +
+ (1.7 x 0.7) = 3.5327 m2

$t_{p75\text{-}25}$ = 11 - 1 = 10 min

Soil infiltration rate

$$f = \frac{0.575195}{3.533 \times 10 \times 60} = \mathbf{2.71E\text{-}04} \text{ m/sec}$$

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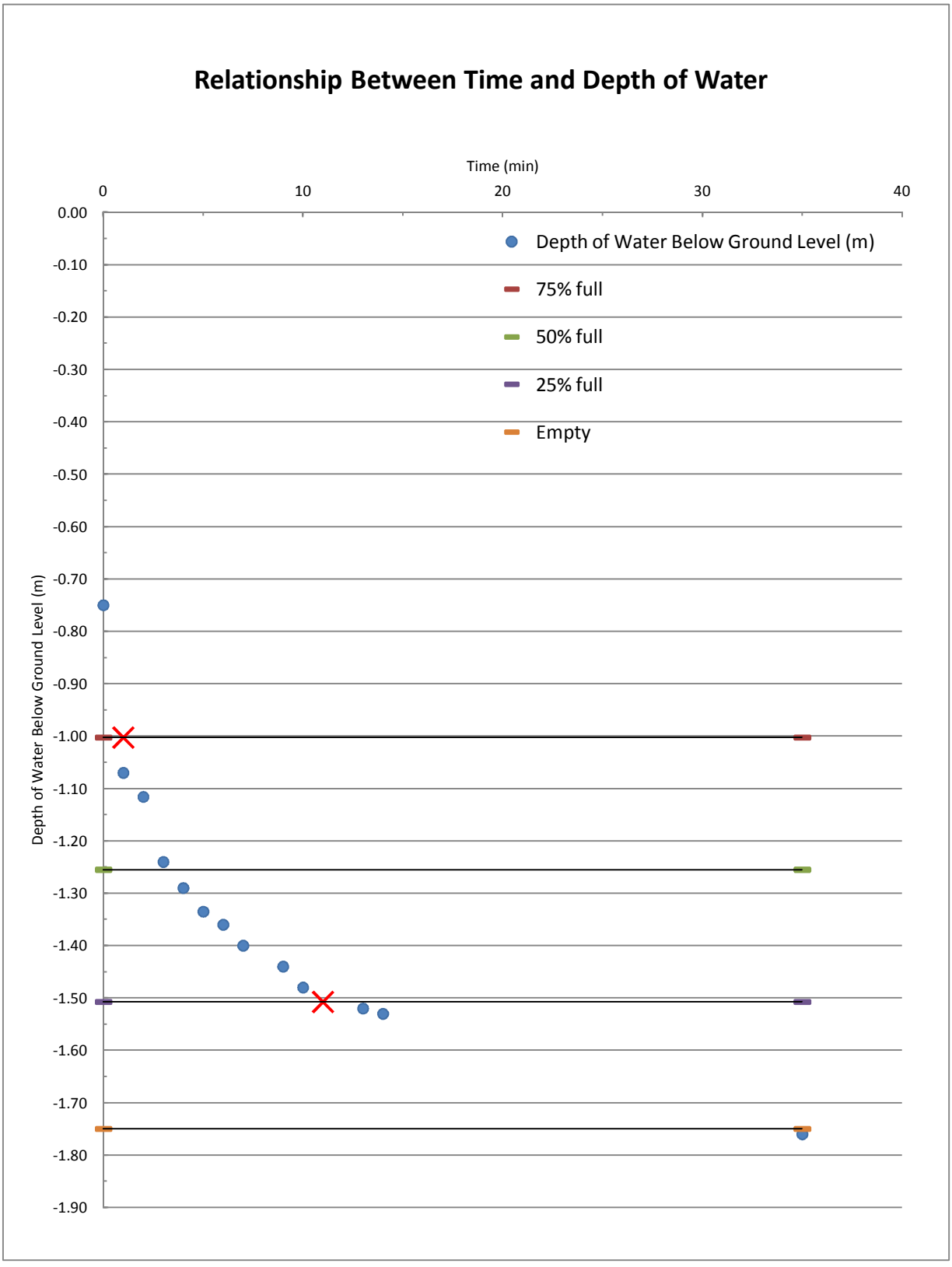
SOIL INFILTRATION REPORT

Project No:	60418		
Project:	Warwick Road, Banbury		
Prepared by:	GAJ	Date: 13.09.2012	
Checked by:	CAL	Sheet:	06

Test Pit 3



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SOIL INFILTRATION REPORT

Project No:	60418		
Project:	Warwick Road, Banbury		
Prepared by:	GAJ	Date: 13.09.2012	
Checked by:	CAL	Sheet:	07

Test Pit 4

Soil type	Red brown sandy gravelly clay with cobbles and boulders	Size	Length (m)	Width (m)	Depth (m)
			1.38	0.65	1.53

No	Site Readings			
	Time (hh:mm)	Water Level from Base of Pit (mm)	Time (mins)	Depth of Water Below Ground Level (m)
1	11:15	0.84	0	-0.69
2	11:17	0.62	2	-0.92
3	11:18	0.51	3	-1.03
4	11:19	0.42	4	-1.11
5	11:20	0.38	5	-1.15
6	11:28	0.15	13	-1.38
7	11:33	0.05	18	-1.48
8	11:40	0.00	25	-1.53
9				
10				
11				
12				
13				
14				
15				
16				
17				
18				
19				
20				
21				
22				
23				
24				
25				

	25%	75%	
Effective depth (m)	-1.32	-0.90	
Time (min)	10	2	taken from Graph

Volume outflowing between 75% & 25% effective depth

$V_{p\,75\text{-}25}$ = 1.4 x 0.7 x (1.32 - 0.90) = 0.375375 m3

α_{p50} = (1.4 x 0.42 x 2) +
+ (0.7 x 0.42 x 2) +
+ (1.4 x 0.7) = 2.59475 m2

$t_{p75\text{-}25}$ = 10 - 2 = 8 min

Soil infiltration rate

$$f = \frac{0.375375}{2.595 \times 8 \times 60} = \mathbf{3.01E\text{-}04} \text{ m/sec}$$

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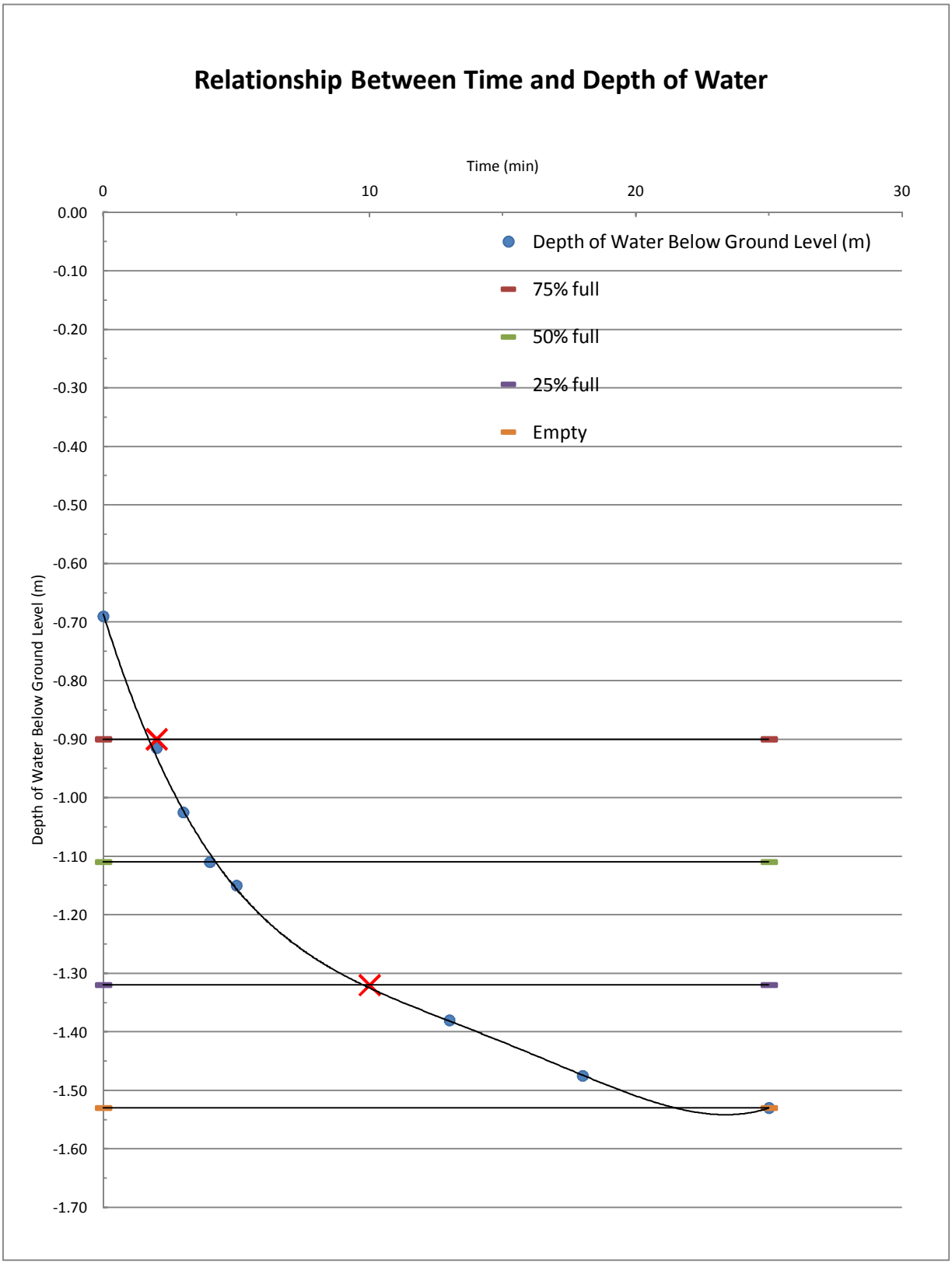
SOIL INFILTRATION REPORT

Project No:	60418		
Project:	Warwick Road, Banbury		
Prepared by:	GAJ	Date: 13.09.2012	
Checked by:	CAL	Sheet:	08

Test Pit 4



APPENDIX 3

1. This report has been prepared and written specifically for the Client named in the introduction and is exclusively for his/her/their benefit. No reliance may be placed in the contents of this report by any third party except with the express agreement of the original Client and the written agreement of PRP. Such written agreement may require the payment of an additional fee.
2. This report has been prepared and written in the context of the proposals for the development of the site as stated by the Client and will not be valid in a differing context. Furthermore, new information, improved practices, or legislation may necessitate alterations to the report in whole or in part after its submission. Therefore, with any change in circumstances or after the expiry of one year from the date of this report, it should be referred to us for re-assessment.
3. Any assessments made in this report are based on the ground conditions as revealed by the test pits and boreholes together with the results of any field or laboratory testing undertaken and where appropriate other relevant data which may have been obtained for the site. The sources of such information are detailed in this report and while PRP use only such sources as are believed to be reliable, PRP will not be liable for the authenticity or reliability of information obtained from others.
4. Notwithstanding that factual reports from third parties concerning asbestos or mould of any kind may have been included for information purposes in this report, PRP will have no liability whatsoever for any claim or claims arising related to asbestos or mould of any kind.
5. There may also be special conditions appertaining to the site which were not revealed by the investigation and which will not, therefore, have been taken into account in this report. Any assessments may be subject to amendment in the light of additional information becoming available.
6. Whilst an opinion may be expressed or implied in this report on possible configurations of strata between or beyond test pit or borehole locations, or on the possible presence of features based on either visual, verbal or published evidence, this is for guidance only and no liability can be accepted for the accuracy of such opinions.
7. Comments on groundwater conditions will have been based on observations made only at the time of the investigation unless otherwise stated. It should be noted, however, that groundwater levels vary due to seasonal and other effects.
8. This report is not a site categorisation, and hazards could occur which have not been detected.
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Appendix 6

Permeable Paving Cross Section

Notes

1. Contractors must check all dimensions on site. Only figured dimensions are to be worked from. Discrepancies must be reported to the Architect or Engineer before proceeding. © This drawing is copyright
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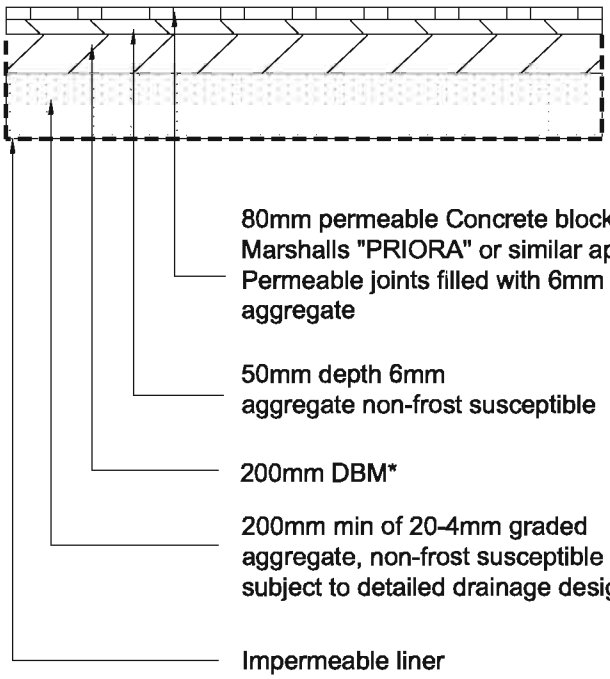

OCC capping depths:

CBR	Capping thickness
2%	600mm
2.5%	400mm
3%	360mm
4%	300mm
5%	250mm
6%	240mm
7%	220mm
8%	210mm
9%	200mm
10%	190mm
11%	175mm
15%	150mm

* Alternatively 115mm depth if 100 good vehicles or less are anticipated

TYPICAL POROUS BLOCK PAVING DETAIL

Revision	Description	Drawn	Checked	Date

Preliminary ☐ Information ☐ Tender ☐ Construction ☐ As Built ☐

Woods Hardwick
Architects, Engineers and Development Consultants

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Bedford
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mail@woodshardwick.com
www.woodshardwick.com

Title

Details

Scale: Date: Drawn: Chk:

Please consider the environment before printing this drawing

Appendix 7

Potential Flood Flow Routing Plan


NORTHERN EXTENT OF 'BAN 5' ALLOCATION
(SUBJECT TO SEPARATE APPLICATION)
N
BROKEN FURROW
EXISTING DWELLING RETAINED
THE NUTSHELL
DUKES MEADOW DRIVE
Flood Flow Route
Dry Depression
WINTER GARDENS WAY
PARSLEY PLACE
SAGE CLOSE
RIBSTON CLOSE
WINCHELSEA CLOSE
B4100
HANWELL FIELDS NORTH
0m
25m
50m
100m
150m
250m
1:2000