Flood Risk Assessment and Surface Water Drainage Strategy for Planning

Prepared for:
Premier Property Business Ventures Ltd

November 2021

Location:
Morelands
Arundel Road
Arundel
BN18 0SB

Our reference:
91226-DJM-Morelands



Unda Consulting Limited, Southpoint, Old Brighton Road, Gatwick, West Sussex, RH11 0PR

Document Issue Record

Location:	Morelands, Arundel Road, Arundel, BN18 0SB				
Application:	Demolition of the existing property and construction of 5 new residential dwellings				
Prepared for:	Premier Property Business Ventures Ltd				
Title:	Surface Water Drainage Strategy for Planning				
Project No.:	91226	**Date:**	5th November 2021	**Issue No.:**	1.0
Written By:	A. Rousou BSc (Hons)	**Checked By:**	J. Stone, MSc (Hons)	**Authorised By:**	E.Bouet, BSc (Hons)

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1. Introduction

1.1. This Surface Water Drainage Strategy has been prepared by Unda Consulting Limited on behalf of Premier Property Business Ventures Ltd, in support of a planning application for the demolition of the existing property and construction of 5 new residential dwellings. The development is proposed at Morelands, Arundel Road, Arundel, BN18 0SB. This report assesses surface water drainage arrangements for the proposed development.

1.2. The proposed planning application is for *the demolition of the existing property and construction of 5 new residential dwellings.* Post development the total roof and impermeable patio area of the new residential dwellings will cover approximately 600m².

1.3. In order to mitigate flood risk posed by post development runoff, adequate control measures will be required within the site. This will ensure that surface water runoff is dealt with at source and the flood risk off site is not increased.



Figure 1: Site Location Plan (Source: Provided by the client)

2. Existing Site:

2.1. There is currently a single residential dwelling located on the site. Based upon plans provided by the client the site is approximately 2,300m^2 in size excluding the existing access road.

2.2. The surrounding area is characterised by residential housing and fields.

2.3. The application area is bounded to the north by a dwelling and by fields in all other directions.



Figure 2: Site location (Source: Google)

Site Topography:

2.4. A topographical survey was conducted by Mark Newman Associates and was provided by the applicant for use within this report. The survey indicates site levels range between 31.806m AOD and 29.224m AOD.

Existing Ground Conditions:

2.5. The 1:50,000 BGS map shows the site to be located directly upon the bedrock by Lambeth Group - Clay, Silt and Sand.

2.6. BGS mapping indicates that the site is potentially underlain by Head – Gravel, Sand, Silt and Clay superficial deposits.

2.7. The soil type taken from the BGS UKSO Soil Map Viewer, shows a soil parent material of Colluvium soil parent material with a sand loam to loam soil texture.

2.8. No boreholes are located within the site boundary.

2.9. The published Environment Agency Groundwater Vulnerability map shows the site is located within an area classified medium vulnerability with soluble rock risk and local information.

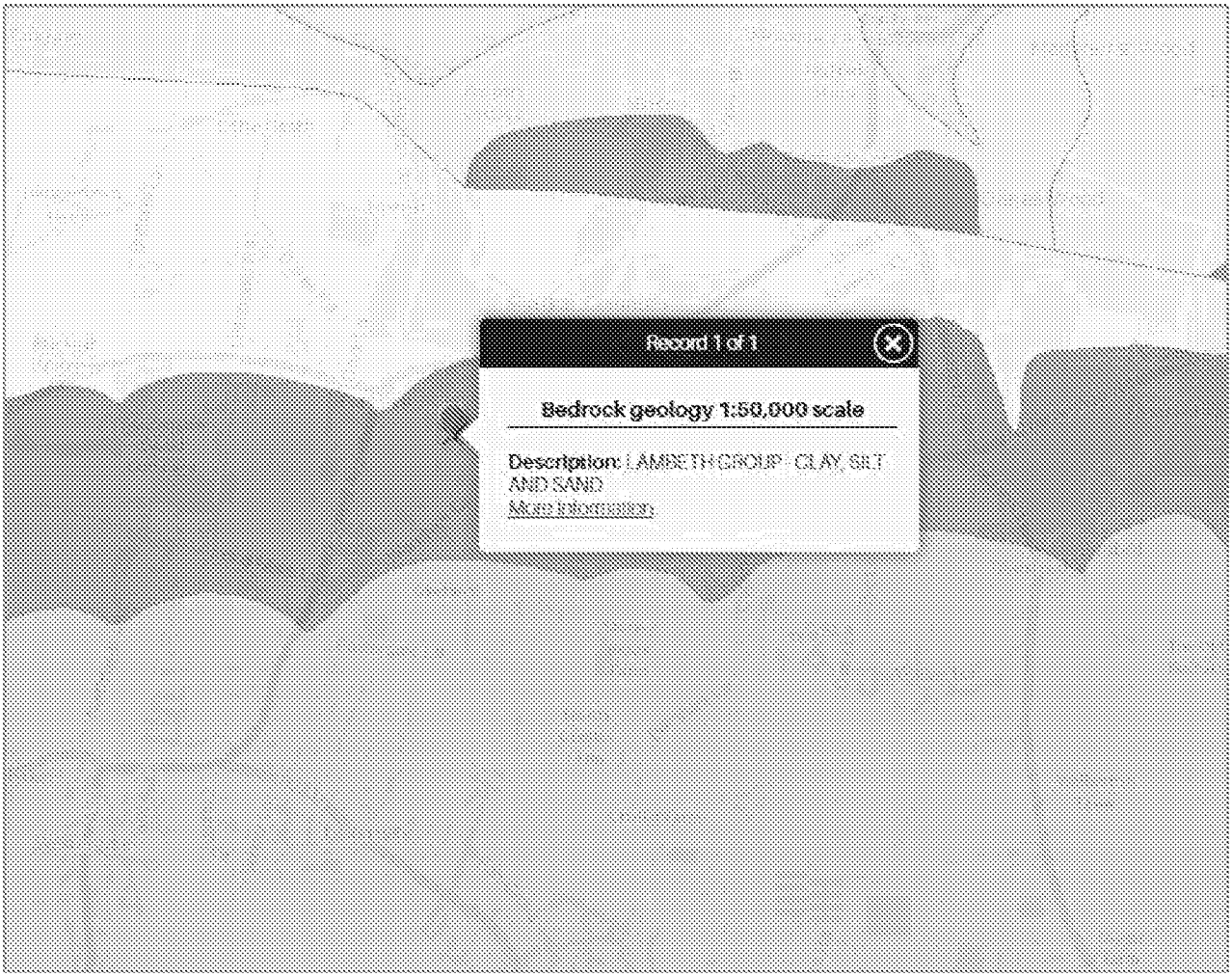


Figure 3: BGS Bedrock Geology (Source: BGS)



Figure 4: BGS Superficial deposits (Source: BGS)

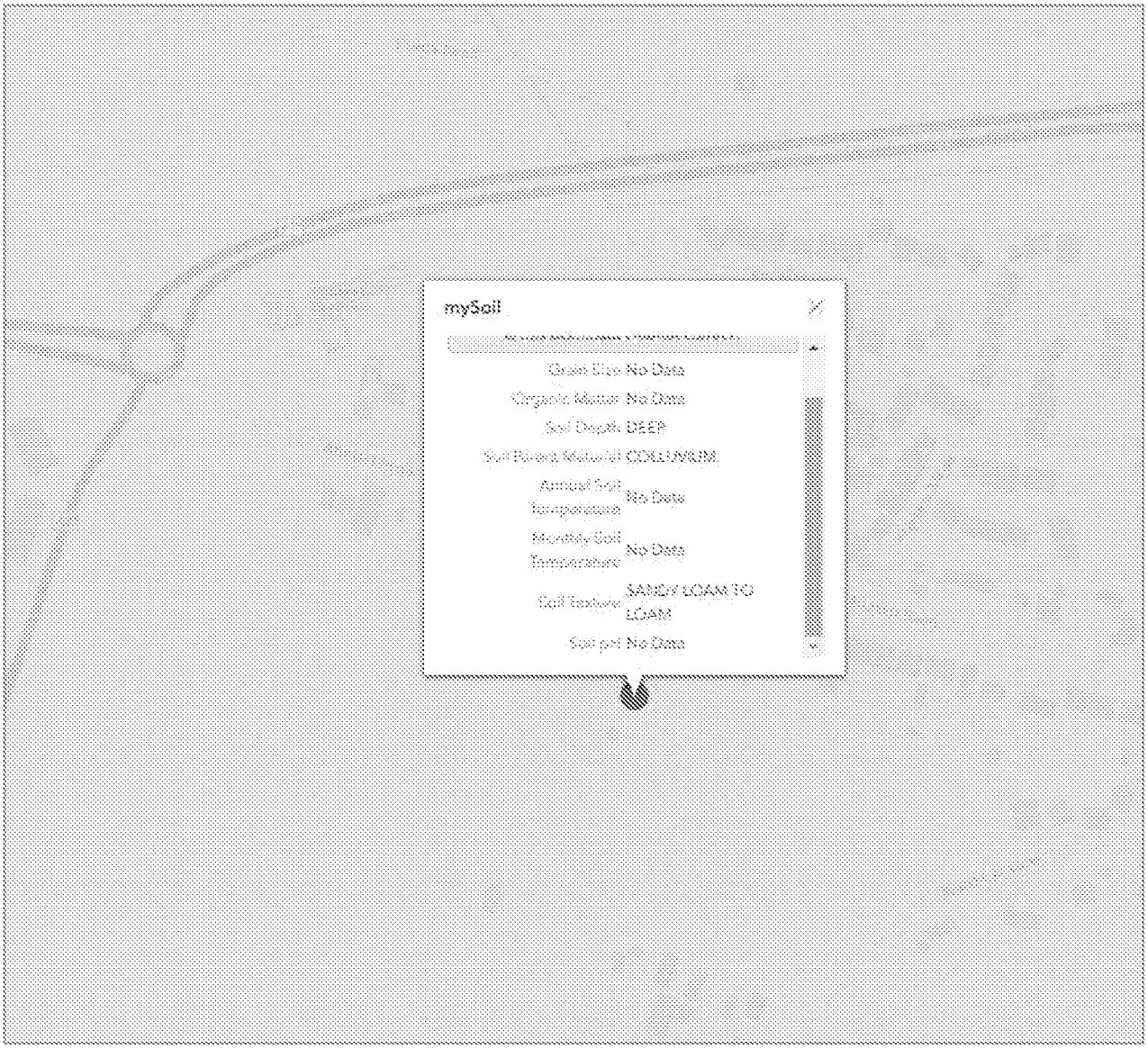


Figure 5: Soil Map (Source: UK Soils, BGS)

Nearby Watercourses / Drainage Features:

2.10. According to Google mapping the there is an unnamed watercourse located 335m East of the site.

Existing Drainage:

2.11. According to the client the existing dwelling discharges to a soakaway.

3. Development Proposals:

Proposed Development:

3.1. The proposed planning application is for *the demolition of the existing property and construction of 5 new residential dwellings.* Post development the total roof and impermeable patio area of the new residential dwellings will cover approximately 600m².

3.2. This SuDS strategy will provide betterment on the site due all impermeable surfaces and roof areas being included within this SuDS strategy.

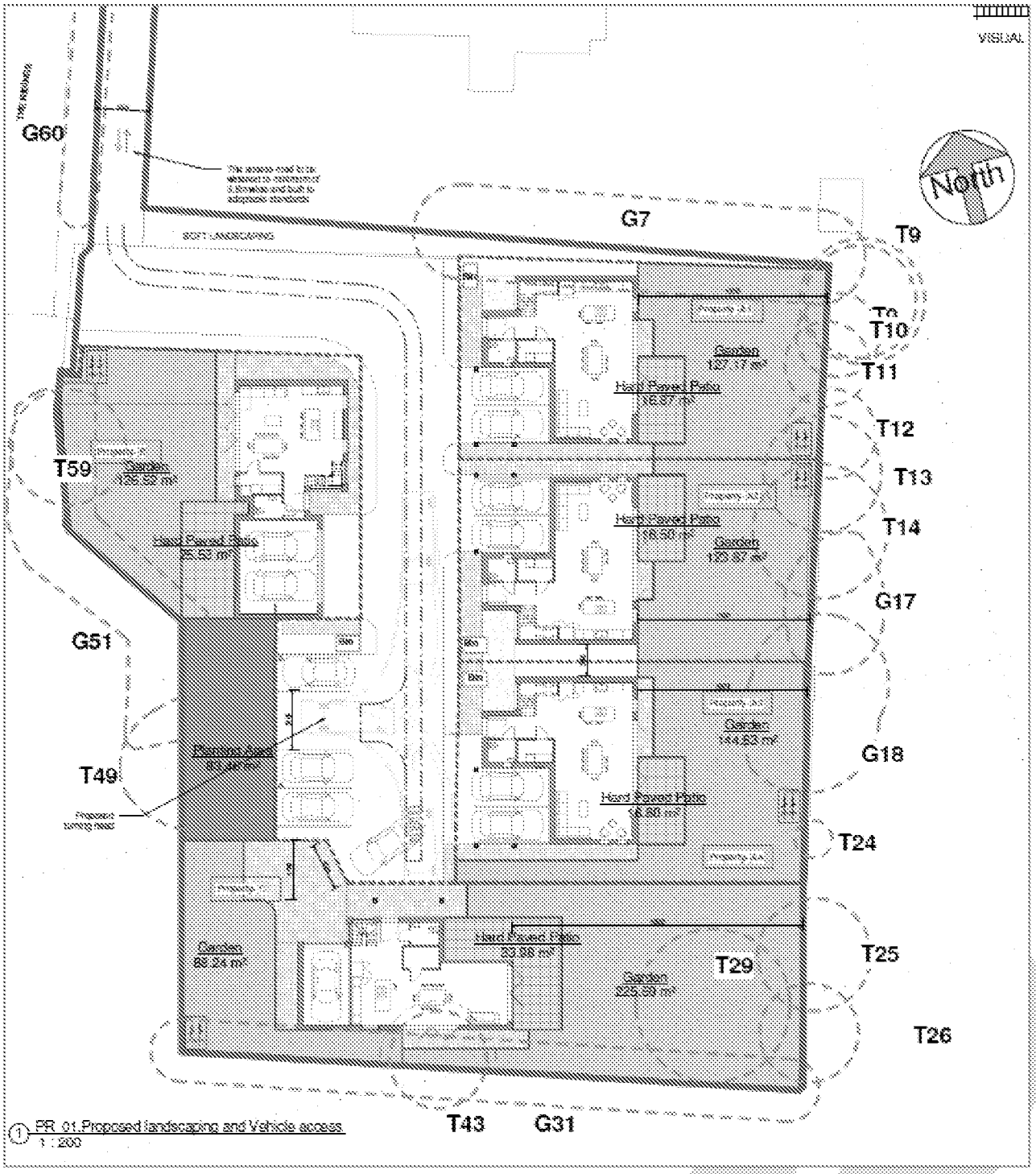


Figure 6: Proposed Site Layout Plan (Source: Krona Design)

4. Surface Water Drainage Strategy:

4.1. In order to mitigate flood risk posed by post development runoff, adequate control measures will need to be considered within the site. This will ensure that surface water runoff is dealt with at source and flood risk is not increased elsewhere.

Drainage Hierarchy:

4.2. The drainage strategy for the site has been prepared according to the drainage discharge hierarchy from CIRIA C753 The SuDS Manual, as follows:

- Infiltration to the maximum extent that is practical;
- Discharge to surface waters;
- Discharge to surface water sewer.

Infiltration Potential:

4.1. The 1:50,000 BGS map shows the site to be located upon the bedrock of bedrock by Lambeth Group - Clay, Silt and Sand.

4.2. In light of this, infiltration testing to BRE 356 Method was carried out on the site by Your Environment. These included three test pits each having three cycles. The lowest measured infiltration rate of $2x10^{-5}$ m/s will be utilised for this strategy.

Proposed Discharge Rate:

4.3. The greenfield runoff rates for the site (excluding the existing access road) have been calculated as 0.4 l/s for the 1:1 annual runoff event, 1.1 l/s for the 1:30 year event and 1.6 l/s for the 1:100 year event. Refer to calculations in appendix.

4.3. Runoff from proposed dwellings will be directed into individual soakaways located in each dwellings garden. The roadway and access road will be constructed from permeable paving with all other surfaces to be of permeable construction.

Cellular Storage soakaway (Property A1-A3 and Property B):

4.4. Runoff from the proposed roofs ($121m^2$) will discharge into the ground via a cellular storage soakaway.

4.5. In order to comply with CIRIA C753 The SuDS Manual, a 10% allowance will be added to the impermeable areas to take into account future urban creep. Applying a 10% allowance to all new impermeable surfacing ($121m^2$) gives a value of $133m^2$. Therefore, all drainage calculations within this assessment have been made based on a total impermeable area of $133m^2$.

4.6. Preliminary calculations indicate that cellular storage with dimensions of $14m^2$ x 0.66m deep x 0.95 (voids) will be sufficient to accommodate all runoff from $133m^2$ of roof area arising from the critical 1:100 year + 40% climate change event.

4.7. Preliminary calculations indicated that some $8.8m^3$ of storage is required to attenuate the runoff for all storms up to and including the 1 in 100 year + 40% climate change event.

4.8. All preliminary surface water drainage calculations have been undertaken using MicroDrainage software. Refer to the appendix.

Cellular Storage soakaway (Property C):

4.9. Runoff from the proposed roofs ($116m^2$) will discharge into the ground via a cellular storage soakaway.

4.10. In order to comply with CIRIA C753 The SuDS Manual, a 10% allowance will be added to the impermeable areas to take into account future urban creep. Applying a 10% allowance to all new impermeable surfacing ($116m^2$) gives a value of $128m^2$. Therefore, all drainage calculations within this assessment have been made based on a total impermeable area of $128m^2$.

4.11. Preliminary calculations indicate that cellular storage with dimensions of $13m^2$ x 0.66m deep x 0.95 (voids) will be sufficient to accommodate all runoff from $128m^2$ of roof area arising from the critical 1:100 year + 40% climate change event.

4.12. Preliminary calculations indicated that some $8.2m^3$ of storage is required to attenuate the runoff for all storms up to and including the 1 in 100 year + 40% climate change event.

4.13. All preliminary surface water drainage calculations have been undertaken using MicroDrainage software. Refer to the appendix.

Water Quality:

4.14. Water quality has been assessed in line with the Simple Index approach from Chapter 26 of CIRIA C753 The SuDS Manual:

Step 1 – Allocate suitable pollution hazard indices for the proposed land use.
Step 2 – Select SuDS with a total pollution mitigation index that equals or exceeds the pollution hazard index.

4.15. The highest pollution hazard level for the proposed land use is Low (residential car parks and low trafficked roads). The pollution hazard indices for this land use are shown in Table 2 below.

Total suspended solids (TSS)	Metals	Hydrocarbons
0.5	0.4	0.4

Table 3: Pollution Hazard Indices for the proposed site (from Table 26.2 of CIRIA C753 The SuDS Manual)

4.16. All SuDS components are assessed for their effectiveness in pollutant removal prior to discharge to sewer in Table 26.3 in CIRIA C753 The SuDS Manual. The pollution mitigation indices for permeable pavements are show in Table 3 below.

Total suspended solids (TSS)	Metals	Hydrocarbons
0.7	0.6	0.7

Table 4: Pollution Mitigation Indices for permeable pavements (from Table 26.3 of CIRIA C753 The SuDS Manual)

4.17. The Pollution Mitigation Indices for permeable pavement are greater than the Pollution Hazard Indices for car parks and low trafficked roads. Therefore, permeable pavements will provide sufficient water quality treatment prior to discharge to ground.

4.18. Runoff from roof areas is considered to be uncontaminated and does not warrant any form of treatment process to improve water quality. Nevertheless, it is suggested to include debris / sediment traps on any new drainage.

Design Exceedance:

4.19. Should the onsite drainage system fail under extreme rainfall events or blockage, flooding may occur within the site. In the event of the drainage system failure, the runoff flow can be managed through detailing the new external levels to direct water away from structures.

Adoption and Maintenance:

4.20. It is proposed that the cellular storage soakaways will be privately maintained by the end users however the permeable paving access road will be jointly by the end users.

4.21. A draft Maintenance Schedule is outlined in the Table below.

Cellular Storage

4.22. It is not envisaged that silt build up within the cellular crate systems will require a rigorous maintenance regime so long as silt is removed from upstream catch pits and inspection chambers on a regular basis. Notwithstanding this, a suitable maintenance regime for the systems will comprise of routine inspection and silt removal (as necessary). Inspection should be undertaken using CCTV equipment offered up the inspection tunnels located within the crate system. Camera access can be gained via inspection chambers and inlet pipework located at each end of the tunnels.

4.23. Silt removal can be achieved by jetting the inspection tunnels. Jetting should be undertaken in accordance with current jetting guidelines, in particular the Code of Practice for Sewer Jetting published by The Water Research Centre. Jetting at 150bar at 300l/min should be more than adequate in removing any build-up of material within the tunnel. The crate system will take higher pressures. However, unlike regular jetting which relies heavily on high pressure to remove hardened deposits on the inner bore of pipes, effective cleansing of a crate system relies more on the delivery flow rate to flush solids back through the system.

A standard jet head with rear facing nozzles should be used. The head should be fed to the far end of the crate tunnel via the nearest inspection chamber, activated and retracted. As the nozzle is removed, debris will be swept back into the inspection chamber where it can then be removed with the use of a standard gully sucker. This method will ensure the effective removal of

gross solids (carrier bags, cans, leaf litter etc.) from the system. Whilst 100% removal cannot be guaranteed, it has been shown that this jetting method will also remove an element of finer material which would otherwise be 'lost' within the system.

Infiltration Permeable Paving

4.24. Permeable surfaces need to be regularly cleaned of silt and other sediments to preserve their infiltration capability. A brush and suction cleaner, which can be a lorry-mounted device or a smaller precinct sweeper, should be used and the sweeping regime should be as follows:

1. End of winter (April) – to collect winter debris.
2. Mid-summer (July/August) – to collect dust, flower and grass-type deposits.
3. After autumn leaf fall (November).

4.25. If reconstruction is necessary, the following procedure should be followed:

1. Lift surface layer and laying course.
2. Remove any geotextile filter layer.
3. Inspect sub-base and remove, wash and replace if required.
4. Renew any geotextile layer.
5. Renew laying course, jointing material and concrete block paving.

4.26. Materials removed from the voids or the layers below the surface of the paving may contain hazardous substances such as heavy metals and hydrocarbons which may need to be disposed of as controlled waste.

Proposed Surface Water Drainage Pipework and Catchpits

4.27. It is not envisaged that silt build up within the pipework systems will require a rigorous maintenance regime so long as silt is removed from upstream catch pits on a regular basis. A suitable maintenance regime for the systems will comprise of routine inspection (every six months) and silt removal (as necessary).

Drainage Element	Maintenance Requirement	Frequency
Gutters & downpipes	Inspect and remove silt/ debris	To be inspected every three months and silt/ debris removed as necessary.
Inspection Chambers and Catch Pits	Inspect and remove silt	To be inspected every three months and silt/ debris removed as necessary. Flow control to be checked for blockages.
Cellular Storage	Inspect and remove debris	CCTCV inspection following first storm event. Monthly CCTV inspections for first 3 months. 6 monthly CCTV inspections thereafter. Jetting to remove silt as necessary.
Infiltration Permeable Paving	Sweeping/vacuuming to remove build-up of silt or other sediments	Three times a year or as necessary
	Removal of weeds Replacement of cracked paving blocks Remedial work to cracks and depressions	As required

Table 3: Suggested Maintenance Regime for Elements of the Drainage Infrastructure

Note: In addition to the above maintenance requirements, it is recommended that all drainage elements are inspected:

- Following the first storm event;
- Monthly for the first 3 months following commissioning.

5. Discussion and Conclusions:

5.1. This Surface Water Drainage Strategy has been prepared by Unda Consulting Limited on behalf of Premier Property Business Ventures Ltd, in support of a planning application for the demolition of the existing property and construction of 5 new residential dwellings. The development is proposed at Morelands, Arundel Road, Arundel BN18 0SB. This report assesses surface water drainage arrangements for the proposed development.

5.2. The proposed planning application is for *the demolition of the existing property and construction of 5 new residential dwellings.* Post development the total roof and impermeable patio area of the new residential dwellings will cover approximately 600m².

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5.15. The greenfield runoff rates for the site (excluding the existing access road) have been calculated as 0.4 l/s for the 1:1 annual runoff event, 1.1 l/s for the 1:30 year event and 1.6 l/s for the 1:100 year event. Refer to calculations in appendix.

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5.19. Preliminary calculations indicate that cellular storage with dimensions of 14m² x 0.66m deep x 0.95 (voids) will be sufficient to accommodate all runoff from 133m² of roof area arising from the critical 1:100 year + 40% climate change event.

5.20. Preliminary calculations indicated that some 8.8m³ of storage is required to attenuate the runoff for all storms up to and including the 1 in 100 year + 40% climate change event.

5.21. All preliminary surface water drainage calculations have been undertaken using MicroDrainage software. Refer to the appendix.

Cellular Storage soakaway (Property C):

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5.24. Preliminary calculations indicate that cellular storage with dimensions of 13m^2 x 0.66m deep x 0.95 (voids) will be sufficient to accommodate all runoff from 128m^2 of roof area arising from the critical 1:100 year + 40% climate change event.

5.25. Preliminary calculations indicated that some 8.2m^3 of storage is required to attenuate the runoff for all storms up to and including the 1 in 100 year + 40% climate change event.

5.26. All preliminary surface water drainage calculations have been undertaken using MicroDrainage software. Refer to the appendix.

5.27. The Pollution Mitigation Indices for permeable pavement are greater than the Pollution Hazard Indices for car parks and low trafficked roads. Therefore, permeable pavements will provide sufficient water quality treatment prior to discharge to ground.

5.28. Runoff from roof areas is considered to be uncontaminated and does not warrant any form of treatment process to improve water quality. Nevertheless, it is suggested to include debris / sediment traps on any new drainage.

5.29. Should the onsite drainage system fail under extreme rainfall events or blockage, flooding may occur within the site. In the event of the drainage system failure, the runoff flow can be managed through detailing the new external levels to direct water away from structures.

5.30. This drainage strategy has been undertaken in accordance with the principles set out in NPPF. We can conclude that providing the development adheres to the conditions advised above, the said development proposals can be accommodated without increasing flood risk within the locality in accordance with objectives set by Central Government and the EA.

Unda Consulting Limited

November 2021

6. Appendix

A - Proposed Plans and Topographic Survey:

- Proposed Site Plan – Provided by Clients.

B - MicroDrainage Calculations:

- ICP SUDS Rural Runoff Calculations;
- Cellular Storage Soakaway Calculations.

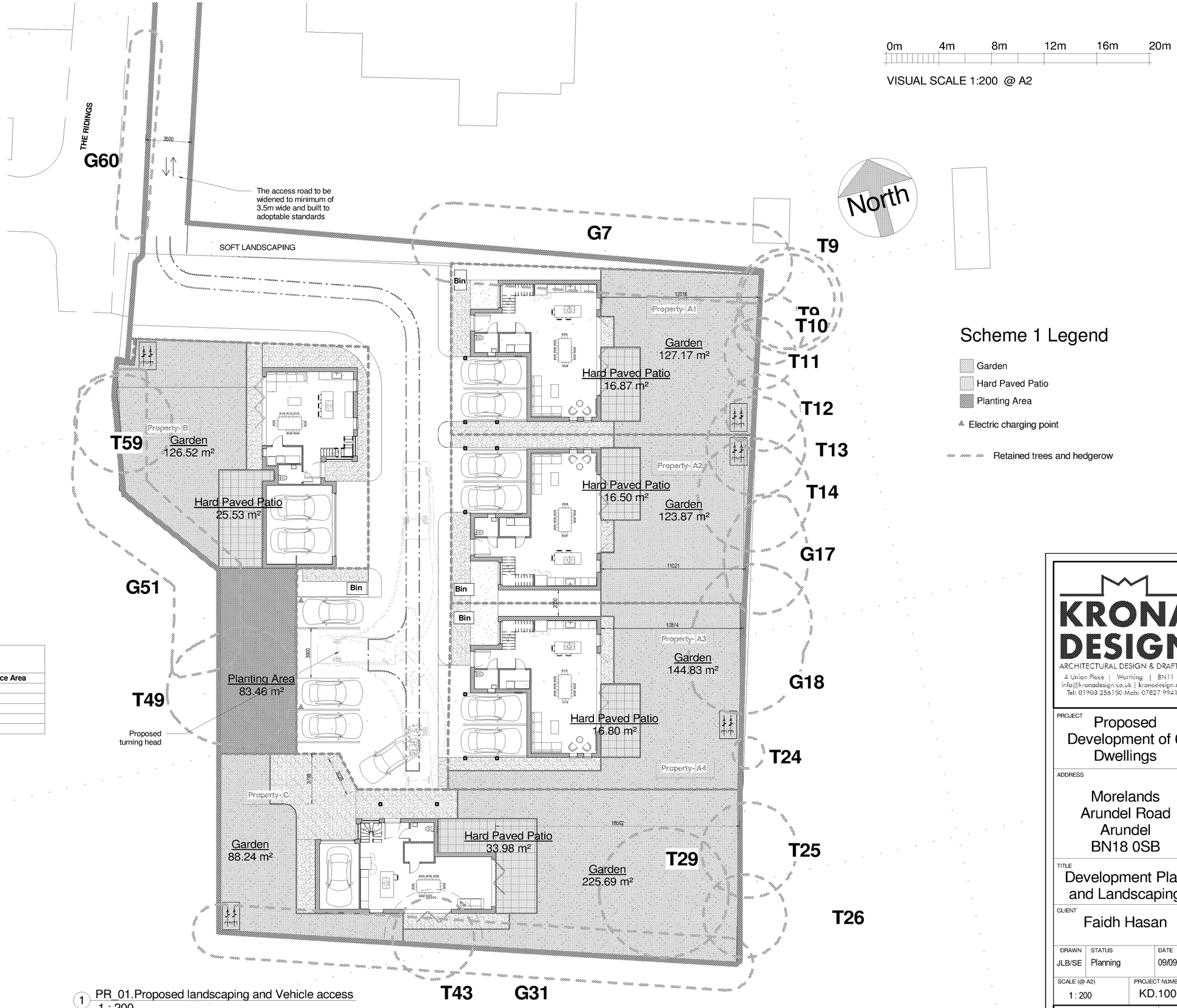
C - Drainage Layout Plans:

- Proposed Drainage Layout [91226-01].

D – Other:

- Infiltration testing – Your Environment.

ARUN DISTRICT COUNCIL WA/42/21/PL



Scheme 1 Legend

- Garden
- Hard Paved Patio
- Planting Area
- Electric charging point
- Retained trees and hedgerow

Site Properties areas	
Name	**Surface Area**
Property-A1	294 m²
Property-A2	285 m²
Property-A3	324 m²
Property-B	393 m²
Property-C	491 m²

1 PR_01.Proposed landscaping and Vehicle access
1 : 200

KRONA DESIGN
ARCHITECTURAL DESIGN & DRAFTING
4 Union Place | Worthing | BN11 1LG
info@kronadesign.co.uk | kronadesign.co.uk
Tel: 01903 256150 Mob: 07827 994111

PROJECT
Proposed Development of 6 Dwellings

ADDRESS
Morelands
Arundel Road
Arundel
BN18 0SB

TITLE
Development Plan and Landscaping

CLIENT
Faidh Hasan

DRAWN	STATUS	DATE
JLB/SE	Planning	09/09/21

SCALE (@ A2)	PROJECT NUMBER
1 : 200	KD.1000

DRAWING NUMBER	REV
A.002	

© KRONA DESIGN

ICP SUDS Mean Annual Flood

Input

Return Period (years)	100	Soil	0.300
Area (ha)	0.230	Urban	0.000
SAAR (mm)	800	Region Number	Region 7

Results l/s

QBAR Rural	0.5
QBAR Urban	0.5
Q100 years	1.6
Q1 year	0.4
Q30 years	1.1
Q100 years	1.6

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

Half Drain Time : 514 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status
15 min Summer	29.079	0.239	0.1	3.2	O K
30 min Summer	29.160	0.320	0.1	4.3	O K
60 min Summer	29.245	0.405	0.1	5.4	Flood Risk
120 min Summer	29.324	0.484	0.1	6.4	Flood Risk
180 min Summer	29.357	0.517	0.1	6.9	Flood Risk
240 min Summer	29.372	0.532	0.1	7.1	Flood Risk
360 min Summer	29.381	0.541	0.1	7.2	Flood Risk
480 min Summer	29.376	0.536	0.1	7.1	Flood Risk
600 min Summer	29.368	0.528	0.1	7.0	Flood Risk
720 min Summer	29.360	0.520	0.1	6.9	Flood Risk
960 min Summer	29.341	0.501	0.1	6.7	Flood Risk
1440 min Summer	29.300	0.460	0.1	6.1	Flood Risk
2160 min Summer	29.238	0.398	0.1	5.3	Flood Risk
2880 min Summer	29.179	0.339	0.1	4.5	O K
4320 min Summer	29.073	0.233	0.1	3.1	O K
5760 min Summer	28.993	0.153	0.1	2.0	O K
7200 min Summer	28.938	0.098	0.1	1.3	O K
8640 min Summer	28.904	0.064	0.1	0.8	O K
10080 min Summer	28.889	0.049	0.1	0.7	O K
15 min Winter	29.108	0.268	0.1	3.6	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)
15 min Summer	125.250	0.0	19
30 min Summer	85.368	0.0	33
60 min Summer	55.544	0.0	62
120 min Summer	34.816	0.0	122
180 min Summer	26.038	0.0	182
240 min Summer	21.042	0.0	242
360 min Summer	15.601	0.0	360
480 min Summer	12.593	0.0	422
600 min Summer	10.656	0.0	484
720 min Summer	9.290	0.0	548
960 min Summer	7.475	0.0	676
1440 min Summer	5.489	0.0	952
2160 min Summer	4.021	0.0	1360
2880 min Summer	3.220	0.0	1756
4320 min Summer	2.348	0.0	2504
5760 min Summer	1.878	0.0	3176
7200 min Summer	1.581	0.0	3824
8640 min Summer	1.373	0.0	4496
10080 min Summer	1.219	0.0	5136
15 min Winter	125.250	0.0	18

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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
30 min Winter	29.201	0.361	0.1	4.8	Flood Risk
60 min Winter	29.298	0.458	0.1	6.1	Flood Risk
120 min Winter	29.390	0.550	0.1	7.3	Flood Risk
180 min Winter	29.432	0.592	0.1	7.9	Flood Risk
240 min Winter	29.453	0.613	0.1	8.2	Flood Risk
360 min Winter	29.471	0.631	0.1	8.4	Flood Risk
480 min Winter	29.471	0.631	0.1	8.4	Flood Risk
600 min Winter	29.461	0.621	0.1	8.3	Flood Risk
720 min Winter	29.447	0.607	0.1	8.1	Flood Risk
960 min Winter	29.422	0.582	0.1	7.7	Flood Risk
1440 min Winter	29.361	0.521	0.1	6.9	Flood Risk
2160 min Winter	29.264	0.424	0.1	5.6	Flood Risk
2880 min Winter	29.171	0.331	0.1	4.4	O K
4320 min Winter	29.014	0.174	0.1	2.3	O K
5760 min Winter	28.913	0.073	0.1	1.0	O K
7200 min Winter	28.886	0.046	0.1	0.6	O K
8640 min Winter	28.880	0.040	0.1	0.5	O K
10080 min Winter	28.876	0.036	0.1	0.5	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)
30 min Winter	85.368	0.0	33
60 min Winter	55.544	0.0	62
120 min Winter	34.816	0.0	120
180 min Winter	26.038	0.0	178
240 min Winter	21.042	0.0	236
360 min Winter	15.601	0.0	350
480 min Winter	12.593	0.0	458
600 min Winter	10.656	0.0	560
720 min Winter	9.290	0.0	588
960 min Winter	7.475	0.0	734
1440 min Winter	5.489	0.0	1038
2160 min Winter	4.021	0.0	1472
2880 min Winter	3.220	0.0	1876
4320 min Winter	2.348	0.0	2596
5760 min Winter	1.878	0.0	3168
7200 min Winter	1.581	0.0	3680
8640 min Winter	1.373	0.0	4408
10080 min Winter	1.219	0.0	5144

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Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	19.600	Shortest Storm (mins)	15
Ratio R	0.322	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+40

Time Area Diagram

Total Area (ha) 0.014

Time (mins) From:	To:	Area (ha)
0	4	0.014

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Model Details

Storage is Online Cover Level (m) 29.500

Cellular Storage Structure

Invert Level (m) 28.840 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.07200 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	14.0	14.0	0.660	14.0	14.0

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

Half Drain Time : 514 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status
15 min Summer	28.839	0.239	0.1	3.2	O K
30 min Summer	28.920	0.320	0.1	4.3	O K
60 min Summer	29.005	0.405	0.1	5.4	Flood Risk
120 min Summer	29.084	0.484	0.1	6.4	Flood Risk
180 min Summer	29.117	0.517	0.1	6.9	Flood Risk
240 min Summer	29.132	0.532	0.1	7.1	Flood Risk
360 min Summer	29.141	0.541	0.1	7.2	Flood Risk
480 min Summer	29.136	0.536	0.1	7.1	Flood Risk
600 min Summer	29.128	0.528	0.1	7.0	Flood Risk
720 min Summer	29.120	0.520	0.1	6.9	Flood Risk
960 min Summer	29.101	0.501	0.1	6.7	Flood Risk
1440 min Summer	29.060	0.460	0.1	6.1	Flood Risk
2160 min Summer	28.998	0.398	0.1	5.3	Flood Risk
2880 min Summer	28.939	0.339	0.1	4.5	O K
4320 min Summer	28.833	0.233	0.1	3.1	O K
5760 min Summer	28.753	0.153	0.1	2.0	O K
7200 min Summer	28.698	0.098	0.1	1.3	O K
8640 min Summer	28.664	0.064	0.1	0.8	O K
10080 min Summer	28.649	0.049	0.1	0.7	O K
15 min Winter	28.868	0.268	0.1	3.6	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)
15 min Summer	125.250	0.0	19
30 min Summer	85.368	0.0	33
60 min Summer	55.544	0.0	62
120 min Summer	34.816	0.0	122
180 min Summer	26.038	0.0	182
240 min Summer	21.042	0.0	242
360 min Summer	15.601	0.0	360
480 min Summer	12.593	0.0	422
600 min Summer	10.656	0.0	484
720 min Summer	9.290	0.0	548
960 min Summer	7.475	0.0	676
1440 min Summer	5.489	0.0	952
2160 min Summer	4.021	0.0	1360
2880 min Summer	3.220	0.0	1756
4320 min Summer	2.348	0.0	2504
5760 min Summer	1.878	0.0	3176
7200 min Summer	1.581	0.0	3824
8640 min Summer	1.373	0.0	4496
10080 min Summer	1.219	0.0	5136
15 min Winter	125.250	0.0	18

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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
30 min Winter	28.961	0.361	0.1	4.8	Flood Risk
60 min Winter	29.058	0.458	0.1	6.1	Flood Risk
120 min Winter	29.150	0.550	0.1	7.3	Flood Risk
180 min Winter	29.192	0.592	0.1	7.9	Flood Risk
240 min Winter	29.213	0.613	0.1	8.2	Flood Risk
360 min Winter	29.231	0.631	0.1	8.4	Flood Risk
480 min Winter	29.231	0.631	0.1	8.4	Flood Risk
600 min Winter	29.221	0.621	0.1	8.3	Flood Risk
720 min Winter	29.207	0.607	0.1	8.1	Flood Risk
960 min Winter	29.182	0.582	0.1	7.7	Flood Risk
1440 min Winter	29.121	0.521	0.1	6.9	Flood Risk
2160 min Winter	29.024	0.424	0.1	5.6	Flood Risk
2880 min Winter	28.931	0.331	0.1	4.4	O K
4320 min Winter	28.774	0.174	0.1	2.3	O K
5760 min Winter	28.673	0.073	0.1	1.0	O K
7200 min Winter	28.646	0.046	0.1	0.6	O K
8640 min Winter	28.640	0.040	0.1	0.5	O K
10080 min Winter	28.636	0.036	0.1	0.5	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)
30 min Winter	85.368	0.0	33
60 min Winter	55.544	0.0	62
120 min Winter	34.816	0.0	120
180 min Winter	26.038	0.0	178
240 min Winter	21.042	0.0	236
360 min Winter	15.601	0.0	350
480 min Winter	12.593	0.0	458
600 min Winter	10.656	0.0	560
720 min Winter	9.290	0.0	588
960 min Winter	7.475	0.0	734
1440 min Winter	5.489	0.0	1038
2160 min Winter	4.021	0.0	1472
2880 min Winter	3.220	0.0	1876
4320 min Winter	2.348	0.0	2596
5760 min Winter	1.878	0.0	3168
7200 min Winter	1.581	0.0	3680
8640 min Winter	1.373	0.0	4408
10080 min Winter	1.219	0.0	5144

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Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	19.600	Shortest Storm (mins)	15
Ratio R	0.322	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+40

Time Area Diagram

Total Area (ha) 0.014

Time (mins) From:	To:	Area (ha)
0	4	0.014

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Model Details

Storage is Online Cover Level (m) 29.260

Cellular Storage Structure

Invert Level (m) 28.600 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.07200 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	14.0	14.0	0.660	14.0	14.0

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

Half Drain Time : 514 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status
15 min Summer	28.809	0.239	0.1	3.2	O K
30 min Summer	28.890	0.320	0.1	4.3	O K
60 min Summer	28.975	0.405	0.1	5.4	Flood Risk
120 min Summer	29.054	0.484	0.1	6.4	Flood Risk
180 min Summer	29.087	0.517	0.1	6.9	Flood Risk
240 min Summer	29.102	0.532	0.1	7.1	Flood Risk
360 min Summer	29.111	0.541	0.1	7.2	Flood Risk
480 min Summer	29.106	0.536	0.1	7.1	Flood Risk
600 min Summer	29.098	0.528	0.1	7.0	Flood Risk
720 min Summer	29.090	0.520	0.1	6.9	Flood Risk
960 min Summer	29.071	0.501	0.1	6.7	Flood Risk
1440 min Summer	29.030	0.460	0.1	6.1	Flood Risk
2160 min Summer	28.968	0.398	0.1	5.3	Flood Risk
2880 min Summer	28.909	0.339	0.1	4.5	O K
4320 min Summer	28.803	0.233	0.1	3.1	O K
5760 min Summer	28.723	0.153	0.1	2.0	O K
7200 min Summer	28.668	0.098	0.1	1.3	O K
8640 min Summer	28.634	0.064	0.1	0.8	O K
10080 min Summer	28.619	0.049	0.1	0.7	O K
15 min Winter	28.838	0.268	0.1	3.6	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)
15 min Summer	125.250	0.0	19
30 min Summer	85.368	0.0	33
60 min Summer	55.544	0.0	62
120 min Summer	34.816	0.0	122
180 min Summer	26.038	0.0	182
240 min Summer	21.042	0.0	242
360 min Summer	15.601	0.0	360
480 min Summer	12.593	0.0	422
600 min Summer	10.656	0.0	484
720 min Summer	9.290	0.0	548
960 min Summer	7.475	0.0	676
1440 min Summer	5.489	0.0	952
2160 min Summer	4.021	0.0	1360
2880 min Summer	3.220	0.0	1756
4320 min Summer	2.348	0.0	2504
5760 min Summer	1.878	0.0	3176
7200 min Summer	1.581	0.0	3824
8640 min Summer	1.373	0.0	4496
10080 min Summer	1.219	0.0	5136
15 min Winter	125.250	0.0	18

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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
30 min Winter	28.931	0.361	0.1	4.8	Flood Risk
60 min Winter	29.028	0.458	0.1	6.1	Flood Risk
120 min Winter	29.120	0.550	0.1	7.3	Flood Risk
180 min Winter	29.162	0.592	0.1	7.9	Flood Risk
240 min Winter	29.183	0.613	0.1	8.2	Flood Risk
360 min Winter	29.201	0.631	0.1	8.4	Flood Risk
480 min Winter	29.201	0.631	0.1	8.4	Flood Risk
600 min Winter	29.191	0.621	0.1	8.3	Flood Risk
720 min Winter	29.177	0.607	0.1	8.1	Flood Risk
960 min Winter	29.152	0.582	0.1	7.7	Flood Risk
1440 min Winter	29.091	0.521	0.1	6.9	Flood Risk
2160 min Winter	28.994	0.424	0.1	5.6	Flood Risk
2880 min Winter	28.901	0.331	0.1	4.4	O K
4320 min Winter	28.744	0.174	0.1	2.3	O K
5760 min Winter	28.643	0.073	0.1	1.0	O K
7200 min Winter	28.616	0.046	0.1	0.6	O K
8640 min Winter	28.610	0.040	0.1	0.5	O K
10080 min Winter	28.606	0.036	0.1	0.5	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)
30 min Winter	85.368	0.0	33
60 min Winter	55.544	0.0	62
120 min Winter	34.816	0.0	120
180 min Winter	26.038	0.0	178
240 min Winter	21.042	0.0	236
360 min Winter	15.601	0.0	350
480 min Winter	12.593	0.0	458
600 min Winter	10.656	0.0	560
720 min Winter	9.290	0.0	588
960 min Winter	7.475	0.0	734
1440 min Winter	5.489	0.0	1038
2160 min Winter	4.021	0.0	1472
2880 min Winter	3.220	0.0	1876
4320 min Winter	2.348	0.0	2596
5760 min Winter	1.878	0.0	3168
7200 min Winter	1.581	0.0	3680
8640 min Winter	1.373	0.0	4408
10080 min Winter	1.219	0.0	5144

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Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	19.600	Shortest Storm (mins)	15
Ratio R	0.322	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+40

Time Area Diagram

Total Area (ha) 0.014

Time (mins) From:	To:	Area (ha)
0	4	0.014

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Model Details

Storage is Online Cover Level (m) 29.230

Cellular Storage Structure

Invert Level (m) 28.570 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.07200 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	14.0	14.0	0.660	14.0	14.0

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

Half Drain Time : 514 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status
15 min Summer	29.229	0.239	0.1	3.2	O K
30 min Summer	29.310	0.320	0.1	4.3	O K
60 min Summer	29.395	0.405	0.1	5.4	Flood Risk
120 min Summer	29.474	0.484	0.1	6.4	Flood Risk
180 min Summer	29.507	0.517	0.1	6.9	Flood Risk
240 min Summer	29.522	0.532	0.1	7.1	Flood Risk
360 min Summer	29.531	0.541	0.1	7.2	Flood Risk
480 min Summer	29.526	0.536	0.1	7.1	Flood Risk
600 min Summer	29.518	0.528	0.1	7.0	Flood Risk
720 min Summer	29.510	0.520	0.1	6.9	Flood Risk
960 min Summer	29.491	0.501	0.1	6.7	Flood Risk
1440 min Summer	29.450	0.460	0.1	6.1	Flood Risk
2160 min Summer	29.388	0.398	0.1	5.3	Flood Risk
2880 min Summer	29.329	0.339	0.1	4.5	O K
4320 min Summer	29.223	0.233	0.1	3.1	O K
5760 min Summer	29.143	0.153	0.1	2.0	O K
7200 min Summer	29.088	0.098	0.1	1.3	O K
8640 min Summer	29.054	0.064	0.1	0.8	O K
10080 min Summer	29.039	0.049	0.1	0.7	O K
15 min Winter	29.258	0.268	0.1	3.6	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)
15 min Summer	125.250	0.0	19
30 min Summer	85.368	0.0	33
60 min Summer	55.544	0.0	62
120 min Summer	34.816	0.0	122
180 min Summer	26.038	0.0	182
240 min Summer	21.042	0.0	242
360 min Summer	15.601	0.0	360
480 min Summer	12.593	0.0	422
600 min Summer	10.656	0.0	484
720 min Summer	9.290	0.0	548
960 min Summer	7.475	0.0	676
1440 min Summer	5.489	0.0	952
2160 min Summer	4.021	0.0	1360
2880 min Summer	3.220	0.0	1756
4320 min Summer	2.348	0.0	2504
5760 min Summer	1.878	0.0	3176
7200 min Summer	1.581	0.0	3824
8640 min Summer	1.373	0.0	4496
10080 min Summer	1.219	0.0	5136
15 min Winter	125.250	0.0	18

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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
30 min Winter	29.351	0.361	0.1	4.8	Flood Risk
60 min Winter	29.448	0.458	0.1	6.1	Flood Risk
120 min Winter	29.540	0.550	0.1	7.3	Flood Risk
180 min Winter	29.582	0.592	0.1	7.9	Flood Risk
240 min Winter	29.603	0.613	0.1	8.2	Flood Risk
360 min Winter	29.621	0.631	0.1	8.4	Flood Risk
480 min Winter	29.621	0.631	0.1	8.4	Flood Risk
600 min Winter	29.611	0.621	0.1	8.3	Flood Risk
720 min Winter	29.597	0.607	0.1	8.1	Flood Risk
960 min Winter	29.572	0.582	0.1	7.7	Flood Risk
1440 min Winter	29.511	0.521	0.1	6.9	Flood Risk
2160 min Winter	29.414	0.424	0.1	5.6	Flood Risk
2880 min Winter	29.321	0.331	0.1	4.4	O K
4320 min Winter	29.164	0.174	0.1	2.3	O K
5760 min Winter	29.063	0.073	0.1	1.0	O K
7200 min Winter	29.036	0.046	0.1	0.6	O K
8640 min Winter	29.030	0.040	0.1	0.5	O K
10080 min Winter	29.026	0.036	0.1	0.5	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)
30 min Winter	85.368	0.0	33
60 min Winter	55.544	0.0	62
120 min Winter	34.816	0.0	120
180 min Winter	26.038	0.0	178
240 min Winter	21.042	0.0	236
360 min Winter	15.601	0.0	350
480 min Winter	12.593	0.0	458
600 min Winter	10.656	0.0	560
720 min Winter	9.290	0.0	588
960 min Winter	7.475	0.0	734
1440 min Winter	5.489	0.0	1038
2160 min Winter	4.021	0.0	1472
2880 min Winter	3.220	0.0	1876
4320 min Winter	2.348	0.0	2596
5760 min Winter	1.878	0.0	3168
7200 min Winter	1.581	0.0	3680
8640 min Winter	1.373	0.0	4408
10080 min Winter	1.219	0.0	5144

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Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	19.600	Shortest Storm (mins)	15
Ratio R	0.322	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+40

Time Area Diagram

Total Area (ha) 0.014

Time (mins) From:	To:	Area (ha)
0	4	0.014

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Model Details

Storage is Online Cover Level (m) 29.650

Cellular Storage Structure

Invert Level (m) 28.990 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.07200 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	14.0	14.0	0.660	14.0	14.0

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

Half Drain Time : 514 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status
15 min Summer	28.479	0.239	0.1	2.9	O K
30 min Summer	28.560	0.320	0.1	4.0	O K
60 min Summer	28.645	0.405	0.1	5.0	Flood Risk
120 min Summer	28.724	0.484	0.1	6.0	Flood Risk
180 min Summer	28.757	0.517	0.1	6.4	Flood Risk
240 min Summer	28.772	0.532	0.1	6.6	Flood Risk
360 min Summer	28.781	0.541	0.1	6.7	Flood Risk
480 min Summer	28.776	0.536	0.1	6.6	Flood Risk
600 min Summer	28.768	0.528	0.1	6.5	Flood Risk
720 min Summer	28.760	0.520	0.1	6.4	Flood Risk
960 min Summer	28.741	0.501	0.1	6.2	Flood Risk
1440 min Summer	28.700	0.460	0.1	5.7	Flood Risk
2160 min Summer	28.638	0.398	0.1	4.9	Flood Risk
2880 min Summer	28.579	0.339	0.1	4.2	O K
4320 min Summer	28.473	0.233	0.1	2.9	O K
5760 min Summer	28.393	0.153	0.1	1.9	O K
7200 min Summer	28.338	0.098	0.1	1.2	O K
8640 min Summer	28.304	0.064	0.1	0.8	O K
10080 min Summer	28.289	0.049	0.1	0.6	O K
15 min Winter	28.508	0.268	0.1	3.3	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)
15 min Summer	125.250	0.0	19
30 min Summer	85.368	0.0	33
60 min Summer	55.544	0.0	62
120 min Summer	34.816	0.0	122
180 min Summer	26.038	0.0	182
240 min Summer	21.042	0.0	242
360 min Summer	15.601	0.0	360
480 min Summer	12.593	0.0	422
600 min Summer	10.656	0.0	484
720 min Summer	9.290	0.0	548
960 min Summer	7.475	0.0	676
1440 min Summer	5.489	0.0	952
2160 min Summer	4.021	0.0	1360
2880 min Summer	3.220	0.0	1756
4320 min Summer	2.348	0.0	2504
5760 min Summer	1.878	0.0	3176
7200 min Summer	1.581	0.0	3824
8640 min Summer	1.373	0.0	4496
10080 min Summer	1.219	0.0	5136
15 min Winter	125.250	0.0	18

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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
30 min Winter	28.601	0.361	0.1	4.5	Flood Risk
60 min Winter	28.698	0.458	0.1	5.7	Flood Risk
120 min Winter	28.790	0.550	0.1	6.8	Flood Risk
180 min Winter	28.832	0.592	0.1	7.3	Flood Risk
240 min Winter	28.853	0.613	0.1	7.6	Flood Risk
360 min Winter	28.871	0.631	0.1	7.8	Flood Risk
480 min Winter	28.871	0.631	0.1	7.8	Flood Risk
600 min Winter	28.861	0.621	0.1	7.7	Flood Risk
720 min Winter	28.847	0.607	0.1	7.5	Flood Risk
960 min Winter	28.822	0.582	0.1	7.2	Flood Risk
1440 min Winter	28.761	0.521	0.1	6.4	Flood Risk
2160 min Winter	28.664	0.424	0.1	5.2	Flood Risk
2880 min Winter	28.571	0.331	0.1	4.1	O K
4320 min Winter	28.414	0.174	0.1	2.2	O K
5760 min Winter	28.313	0.073	0.1	0.9	O K
7200 min Winter	28.286	0.046	0.1	0.6	O K
8640 min Winter	28.280	0.040	0.1	0.5	O K
10080 min Winter	28.276	0.036	0.1	0.4	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)
30 min Winter	85.368	0.0	33
60 min Winter	55.544	0.0	62
120 min Winter	34.816	0.0	120
180 min Winter	26.038	0.0	178
240 min Winter	21.042	0.0	236
360 min Winter	15.601	0.0	350
480 min Winter	12.593	0.0	458
600 min Winter	10.656	0.0	560
720 min Winter	9.290	0.0	588
960 min Winter	7.475	0.0	734
1440 min Winter	5.489	0.0	1038
2160 min Winter	4.021	0.0	1472
2880 min Winter	3.220	0.0	1876
4320 min Winter	2.348	0.0	2596
5760 min Winter	1.878	0.0	3168
7200 min Winter	1.581	0.0	3680
8640 min Winter	1.373	0.0	4408
10080 min Winter	1.219	0.0	5144

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Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	19.600	Shortest Storm (mins)	15
Ratio R	0.322	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+40

Time Area Diagram

Total Area (ha) 0.013

Time (mins) From:	To:	Area (ha)
0	4	0.013

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Model Details

Storage is Online Cover Level (m) 28.900

Cellular Storage Structure

Invert Level (m) 28.240 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.07200 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	13.0	13.0	0.660	13.0	13.0

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THE RIDINGS

G60

The access road to be widened to minimum of 3.5m wide and built to adoptable standards (NO DIG CONSTRUCTION METHODS)

North

G7

T9

SOFT LANDSCAPING

Bin

T9

T10

T11

T12

T59

T13

T14

G17

G51

Bin

Bin

Bin

T49

Proposed turning head

G18

T24

T25

T29

T26

T43

G31

Retain

Scheme 1 Legend

- Garden
- Hard Paved Patio
- Planting Area
- Electric charging point
- Retained trees and hedgerow

Notes:

1. Discharge of surface water via each dwelling having a Cellular Storage Soakaway. Preliminary calculations indicate that sufficient storage required to attenuate runoff arising from the proposed increase in impermeable areas, during the critical 1 in 100 year + 40% Climate Change event, can be provided within 5 cellular storage soakaways, 4 of dimensions 14m^2 x 0.66m deep x 0.95 (voids) and 1 of dimensions 13m^2 x 0.66m deep x 0.95 (voids) .

Legend

- Proposed Cellular Storage Soakway
- Proposed Surface Water Pipework
- Proposed Downpipes
- Proposed Permeable Paving
- Design Exceedance Route

Unda Consulting Ltd
Southpoint
Old Brighton Road
Gatwick
RH11 0PR

Tel: 01293 214444
Email: info@unda.co.uk
Web: www.unda.co.uk

Client:
Premier Property Business Ventures Ltd

Site Address:
Morelands
Arundel Road
Arundel
BN18 0SB

Job Reference:	Date:
91226-DJM-Morelands	12-Nov-21
Drawing Number:	**Revision:**
91226-01	v1

Designed by:	Drawn by:	Checked by:
AR	AR	EB

Scale: 1:200@A2

Disclaimer: The drawings provided are for planning purposes only.

ARUN DISTRICT COUNCIL WA/42/22/PL

YEX3145
Morelands – BN18 0SB
November 21

Dear Unda Consulting Ltd,

Please find below the results of your Infiltration testing. The information contained below is a summary of the site works carried out on 05th November 2021

Geology

An examination of the available British Geological Survey data of the area for the site has been examined and indicates that the site has superficial drift deposits composed of Head (Gravel, silt, sand and clay), and bedrock deposits recorded as the Lambeth Group (clay, silt and sand).

Fieldworks

The programme of this investigation included the excavation of three trial pits. The locations of the soakaway tests were selected by the client. During this work, the soils encountered were logged in general accordance with BS5930: 1990, as amended in 2007.

Percolation Testing

During the soakaway tests the water achieved a fall from 75% to 25% of the effective depth of the storage volume. The results obtained from the soakaway tests are summarised below:

WS	Dimensions (m)	Depth (m)	Soil Description	Infiltration Rate (m/sec)	Drainage Characteristics
TP01 test1	1.20 x 0.40	1.50	Orange gravelly, clayey SAND.	3.2E-5	Good
TP01 test2	1.20 x 0.40	1.50	Orange gravelly, clayey SAND.	2.9E-5	Good
TP031 test3	1.20 x 0.40	1.50	Orange gravelly, clayey SAND.	2.0E-5	Good
TP02 test1	1.20 x 0.40	1.50	Orange clayey, gravelly SAND.	1.2E-4	Good
TP02 test2	1.20 x 0.40	1.50	Orange clayey, gravelly SAND.	6.8E-5	Good
TP02 test3	1.20 x 0.40	1.50	Orange clayey, gravelly SAND.	4.0E-5	Good
TP03 test1	1.30 x 0.40	2.50	Dense light brown sandy GRAVEL.	1.1E-4	Good
TP03 test2	1.30 x 0.40	2.50	Dense light brown sandy GRAVEL.	6.4E-5	Good
TP03 test3	1.30 x 0.40	2.50	Dense light brown sandy GRAVEL.	3.8E-5	Good

Conclusion

The soils encountered beneath the site were found to be predominantly SAND and GRAVEL. The soakage rates obtained during the investigation were found to be good and permeable. Given the data from the test, it is considered that the use of soakaways is suitable for this site.

References

- Building Research Establishment (BRE) Digest 365, *Soakaway Design*, September 1991.
- British Standards Institution (1999) BS5930: *Code of practice for site investigations*, B.S.I., London.
- British Standards Institution (2007), Amendment No 1, BS5930: *Code of practice for site investigations*, B.S.I., London.

[redacted]

Regards

[redacted]

Nick Hammond
Geo-Environmental Engineer

Appendix A



Site Investigation Plan

YOUR ENVIRONMENT

Morelands
YEX3145
05/11/2021

Appendix B

YOUR ENVIRONMENT	[redacted]	Log of Boring	TP1
		Sheet 1 of	1

YE Engineer N. Hammond

Location	Morelands, Arundel Road, Arundel, BN18 0SB
Date	November 5, 2021
Project Reference	YEX3145

Water level data

Completion: Depth NA m
Elevation NA m

24 hour: Depth ____ m
Elevation ____ m

Width 0.4 m
Length 1.2 m
Depth 1.5 m

Method (Trial pit, window etc) Trial Pit - Machine Excavation

Stratum depth (m) From	Stratum depth (m) To	Sample Depth From (m)	Sample Depth To (m)	Sample Type	GW	Install Details	LITHOLOGY
0.00	0.40					NONE	Brown gravelly SAND. Sand is fine - medium. Gravel is medium - coarse, sub-angular of mixed lithology.
0.40	1.50						Orange gravelly, clayey SAND. Sand is fine - medium. Gravel is medium - coarse, sub-angular of mixed lithology.
							End of TP1

Remarks: .

[redacted]

Log of Boring	TP2
Sheet 1 of	1

YE Engineer N. Hammond

Location	Morelands, Arundel Road, Arundel, BN18 0SB
Date	November 5, 2021
Project Reference	YEX3145

Water level data

Completion: Depth NA m
Elevation NA m

24 hour: Depth ____ m
Elevation ____ m

Width 0.4 m
Length 1.2 m
Depth 1.5 m

Method (Trial pit, window etc) Trial Pit - Machine Excavation

Stratum depth (m) From	Stratum depth (m) To	Sample Depth From m	Sample Depth To m	Sample Type	GW	Install Details	LITHOLOGY
0.00	0.60					NONE	Brown clayey, gravelly SAND. Sand is fine - medium. Gravel is medium - coarse, sub-angular of mixed lithology.
0.60	1.50						Orange clayey, gravelly SAND. Sand is fine - medium. Gravel is medium - coarse, sub-angular of mixed lithology.
							End of TP2

Remarks: .

YOUR ENVIRONMENT

[redacted]

Log of Boring	TP3
Sheet 1 of	1

YE Engineer N. Hammond

Location	Morelands, Arundel Road, Arundel, BN18 9SB
Date	November 5, 2021
Project Reference	YEX3145

Water level data

Completion: Depth NA m
Elevation NA m

24 hour: Depth _____ m
Elevation _____ m

Width 0.4 m
Length 1.3 m
Depth 2.5 m

Method (Trial pit, window etc) Trial Pit - Machine Excavation

Stratum depth (m) From	Stratum depth (m) To	Sample Depth From (m)	Sample Depth To (m)	Sample Type	GW	Install Details	LITHOLOGY
0.00	0.20					NONE	Brown clayey, gravelly SAND. Sand is fine - medium. Gravel is medium - coarse, angular of mixed lithology.
0.20	2.50						Dense light brown sandy GRAVEL. Sand is fine - medium. Gravel is medium - coarse, angular of flint fragments.
							End of TP3

Remarks: .

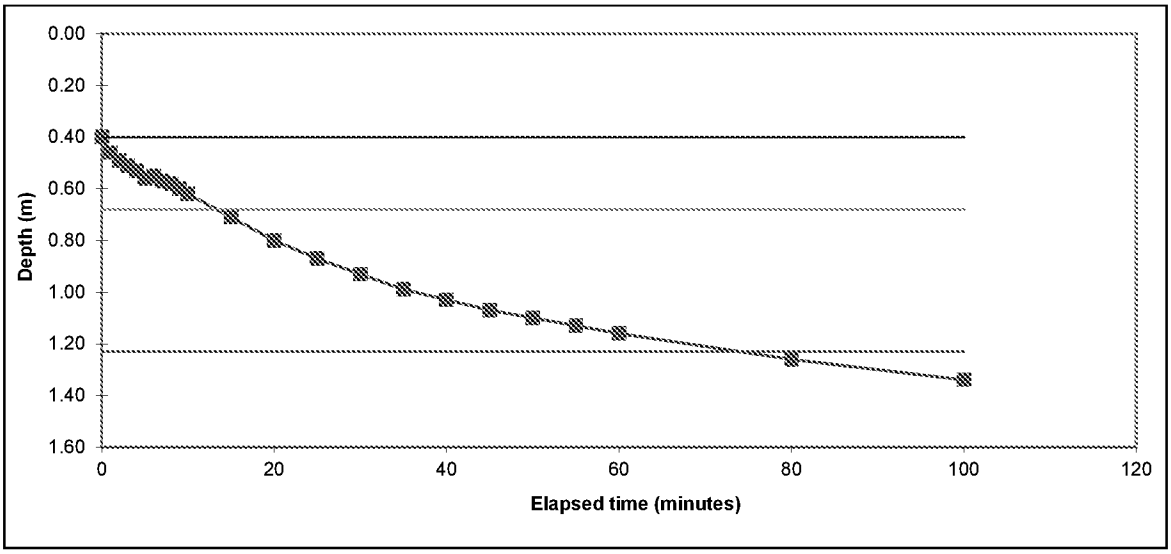
Appendix C

Your Environment

Soakaway Test

Trial Pit No:	TP1	Test No:	1	Date:	05/11/2021
Length (m):	1.200		Datum Height:	0.00	m agl
Width (m):	0.40		Granular infill:	None	
Depth (m):	1.50		Porosity of infill:	1	(assumed)

Elapsed time (minutes)	Water Depth (m below datum)	Elapsed time (minutes)	Water Depth (m below datum)
0	0.400	30	0.930
1	0.460	35	0.990
2	0.490	40	1.030
3	0.510	45	1.070
4	0.530	50	1.100
5	0.560	55	1.130
6	0.550	60	1.160
7	0.570	80	1.260
8	0.580	100	1.340
9	0.600		
10	0.620		
15	0.710		
20	0.800		
25	0.870		



Start water depth for analysis (mbgl)	0.40		
75% effective depth (mbgl):	0.68	Elapsed time (mins):	13.3
50% effective depth (mbgl):	0.95		
25% effective depth (mbgl):	1.23	Elapsed time (mins):	74.0
Base of soakage zone (mbgl):	1.50		

Volume outflow between 75% and 25% effective depth (m^3):	0.264
Mean surface area of outflow (m^2):	2.24
(side area at 50% effective depth + base area)	
Time for outflow between 75% and 25% effective depth (mins):	60.7

Soil infiltration rate (m/s):	**3.2E-5**

Remarks Results processed following BRE 365 (2007).

Client:	Unda Consulting Ltd	**TP1**
Site:	Morelands	

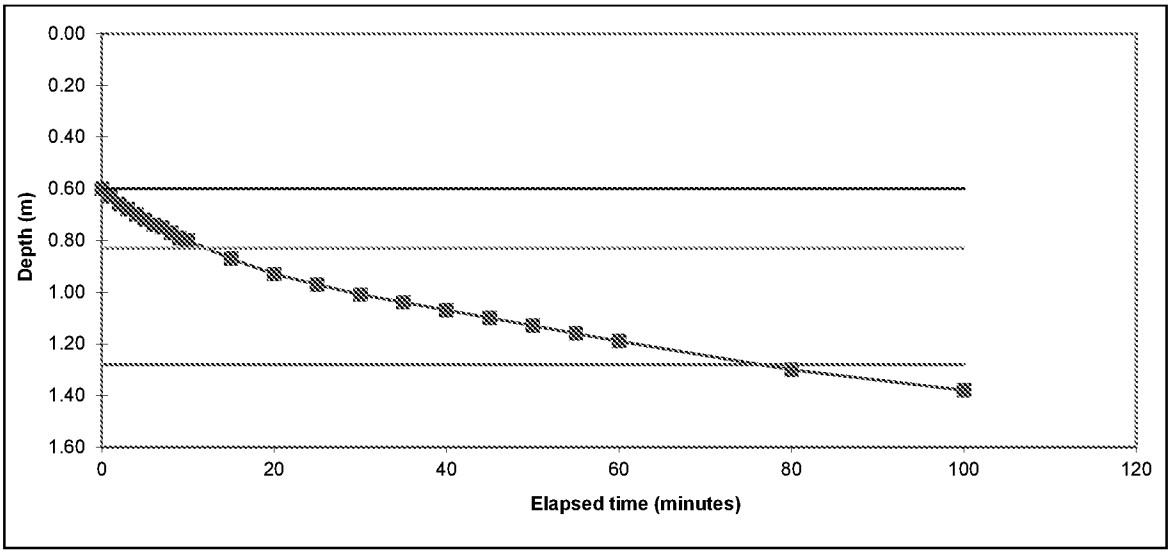
ARUN DISTRICT COUNCIL AW/42/22/PL

Your Environment

Soakaway Test

Trial Pit No:	TP1	Test No:	2	Date:	05/11/2021
Length (m):	1.200		Datum Height:	0.00	m agl
Width (m):	0.40		Granular infill:	None	
Depth (m):	1.50		Porosity of infill:	1	(assumed)

Elapsed time (minutes)	Water Depth (m below datum)	Elapsed time (minutes)	Water Depth (m below datum)
0	0.600	30	1.010
1	0.630	35	1.040
2	0.660	40	1.070
3	0.680	45	1.100
4	0.700	50	1.130
5	0.720	55	1.160
6	0.740	60	1.190
7	0.750	80	1.300
8	0.770	100	1.380
9	0.790		
10	0.800		
15	0.870		
20	0.930		
25	0.970		



Start water depth for analysis (mbgl)	0.60		
75% effective depth (mbgl):	0.83	Elapsed time (mins):	12.1
50% effective depth (mbgl):	1.05		
25% effective depth (mbgl):	1.28	Elapsed time (mins):	76.4
Base of soakage zone (mbgl):	1.50		

Volume outflow between 75% and 25% effective depth (m^3):	0.216
Mean surface area of outflow (m^2): (side area at 50% effective depth + base area)	1.92
Time for outflow between 75% and 25% effective depth (mins):	64.3

Soil infiltration rate (m/s):	**2.9E-5**

Remarks Results processed following BRE 365 (2007).

Client:	Unda Consulting Ltd	**TP1**
Site:	Morelands	

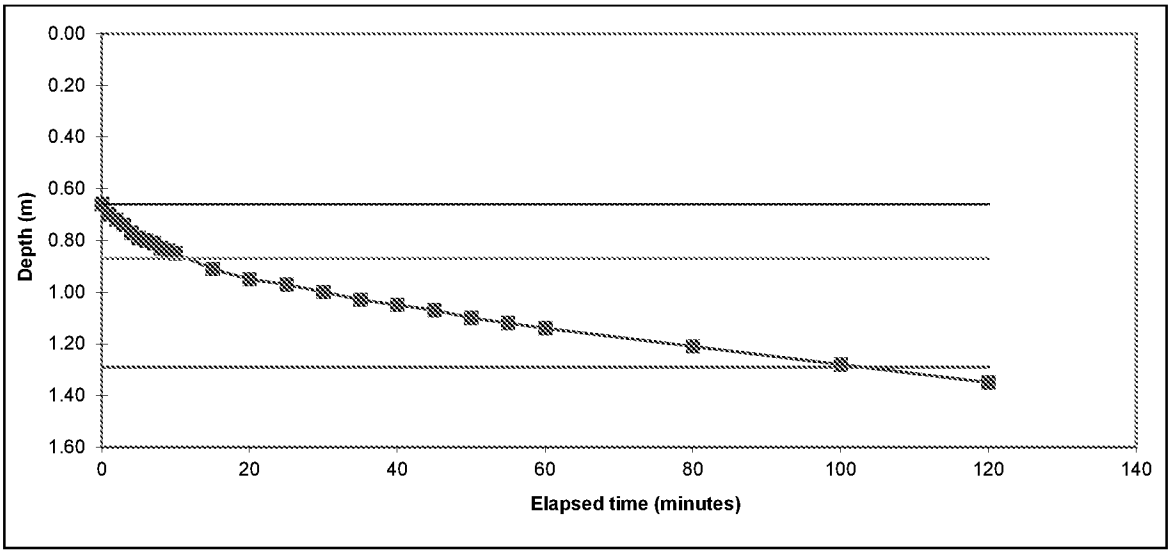
ARUN DISTRICT COUNCIL AW/22/PL

Your Environment

Soakaway Test

Trial Pit No:	TP1	Test No:	3	Date:	05/11/2021
Length (m):	1.200		Datum Height:	0.00 m agl	
Width (m):	0.40		Granular infill:	None	
Depth (m):	1.50		Porosity of infill:	1	(assumed)

Elapsed time (minutes)	Water Depth (m below datum)	Elapsed time (minutes)	Water Depth (m below datum)
0	0.660	30	1.000
1	0.700	35	1.030
2	0.720	40	1.050
3	0.740	45	1.070
4	0.770	50	1.100
5	0.790	55	1.120
6	0.800	60	1.140
7	0.810	80	1.210
8	0.830	100	1.280
9	0.840	120	1.350
10	0.850		
15	0.910		
20	0.950		
25	0.970		



Start water depth for analysis (mbgl)	0.66		
75% effective depth (mbgl):	0.87	Elapsed time (mins):	11.7
50% effective depth (mbgl):	1.08		
25% effective depth (mbgl):	1.29	Elapsed time (mins):	102.9
Base of soakage zone (mbgl):	1.50		

Volume outflow between 75% and 25% effective depth (m^3):	0.202
Mean surface area of outflow (m^2):	1.82
(side area at 50% effective depth + base area)	
Time for outflow between 75% and 25% effective depth (mins):	91.2

Soil infiltration rate (m/s):	**2.0E-5**

Remarks Results processed following BRE 365 (2007).

Client:	Unda Consulting Ltd	**TP1**
Site:	Morelands	

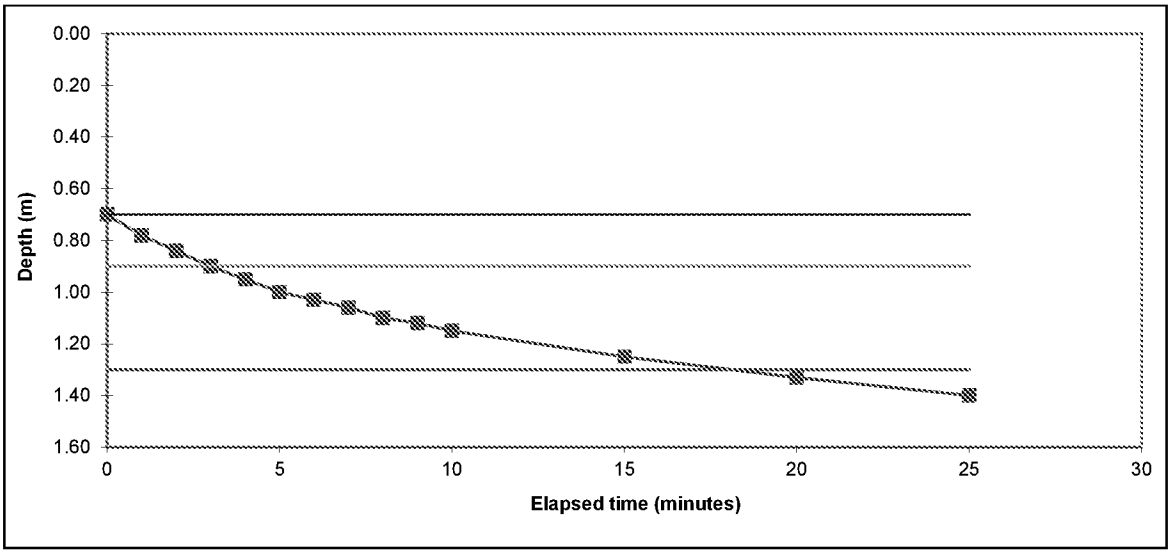
ARUN DISTRICT COUNCIL AW/42/22/PL

Your Environment

Soakaway Test

Trial Pit No:	TP2	Test No:	1	Date:	05/11/2021
Length (m):	1.200		Datum Height:	0.00	m agl
Width (m):	0.40		Granular infill:	None	
Depth (m):	1.50		Porosity of infill:	1	(assumed)

Elapsed time (minutes)	Water Depth (m below datum)	Elapsed time (minutes)	Water Depth (m below datum)
0	0.700		
1	0.780		
2	0.840		
3	0.900		
4	0.950		
5	1.000		
6	1.030		
7	1.060		
8	1.100		
9	1.120		
10	1.150		
15	1.250		
20	1.330		
25	1.400		



Start water depth for analysis (mbgl)	0.70		
75% effective depth (mbgl):	0.90	Elapsed time (mins):	3.0
50% effective depth (mbgl):	1.10		
25% effective depth (mbgl):	1.30	Elapsed time (mins):	18.1
Base of soakage zone (mbgl):	1.50		

Volume outflow between 75% and 25% effective depth (m^3):	0.192
Mean surface area of outflow (m^2):	1.76
(side area at 50% effective depth + base area)	
Time for outflow between 75% and 25% effective depth (mins):	15.1

Soil infiltration rate (m/s):	**1.2E-4**

Remarks Results processed following BRE 365 (2007).

Client:	Unda Consulting Ltd	**TP2**
Site:	Morelands	

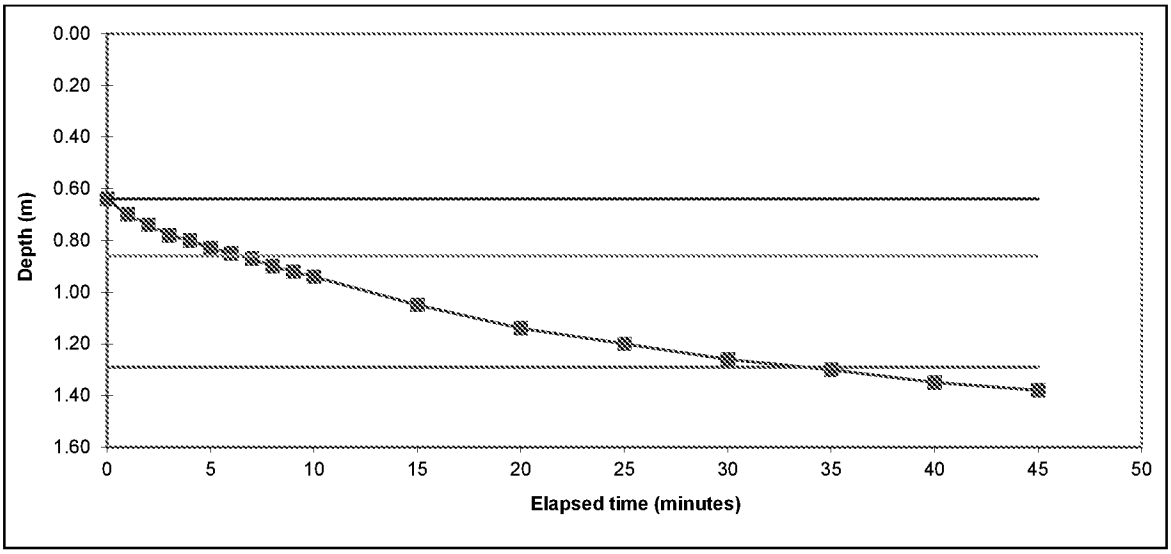
ARUN DISTRICT COUNCIL AW/42/22/PL

Your Environment

Soakaway Test

Trial Pit No:	TP2	Test No:	2	Date:	05/11/2021
Length (m):	1.200		Datum Height:	0.00	m agl
Width (m):	0.40		Granular infill:	None	
Depth (m):	1.50		Porosity of infill:	1	(assumed)

Elapsed time (minutes)	Water Depth (m below datum)	Elapsed time (minutes)	Water Depth (m below datum)
0	0.640	30	1.260
1	0.700	35	1.300
2	0.740	40	1.350
3	0.780	45	1.380
4	0.800		
5	0.830		
6	0.850		
7	0.870		
8	0.900		
9	0.920		
10	0.940		
15	1.050		
20	1.140		
25	1.200		



Start water depth for analysis (mbgl)	0.64		
75% effective depth (mbgl):	0.86	Elapsed time (mins):	6.5
50% effective depth (mbgl):	1.07		
25% effective depth (mbgl):	1.29	Elapsed time (mins):	33.8
Base of soakage zone (mbgl):	1.50		

Volume outflow between 75% and 25% effective depth (m^3):	0.206
Mean surface area of outflow (m^2):	1.86
(side area at 50% effective depth + base area)	
Time for outflow between 75% and 25% effective depth (mins):	27.3

Soil infiltration rate (m/s):	**6.8E-5**

Remarks Results processed following BRE 365 (2007).

Client:	Unda Consulting Ltd	**TP2**
Site:	Morelands	

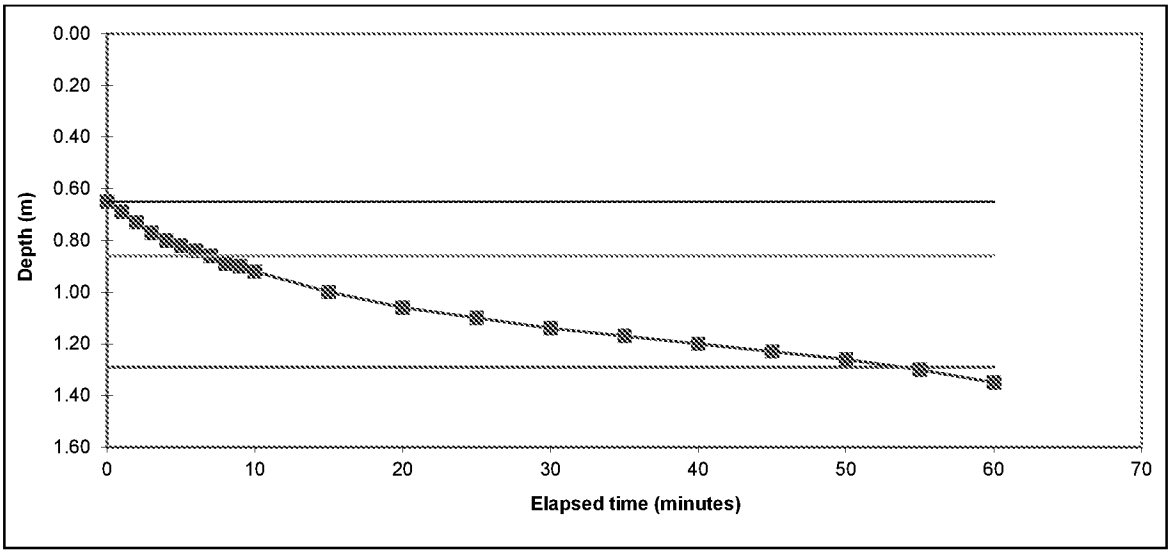
ARUN DISTRICT COUNCIL AW/42/22/PL

Your Environment

Soakaway Test

Trial Pit No:	TP2	Test No:	3	Date:	05/11/2021
Length (m):	1.200		Datum Height:	0.00 m agl	
Width (m):	0.40		Granular infill:	None	
Depth (m):	1.50		Porosity of infill:	1	(assumed)

Elapsed time (minutes)	Water Depth (m below datum)	Elapsed time (minutes)	Water Depth (m below datum)
0	0.650	30	1.140
1	0.690	35	1.170
2	0.730	40	1.200
3	0.770	45	1.230
4	0.800	50	1.260
5	0.820	55	1.300
6	0.840	60	1.350
7	0.860		
8	0.890		
9	0.900		
10	0.920		
15	1.000		
20	1.060		
25	1.100		



Start water depth for analysis (mbgl)	0.65		
75% effective depth (mbgl):	0.86	Elapsed time (mins):	7.0
50% effective depth (mbgl):	1.08		
25% effective depth (mbgl):	1.29	Elapsed time (mins):	53.8
Base of soakage zone (mbgl):	1.50		

Volume outflow between 75% and 25% effective depth (m^3):	0.206
Mean surface area of outflow (m^2):	1.82
(side area at 50% effective depth + base area)	
Time for outflow between 75% and 25% effective depth (mins):	46.8

Soil infiltration rate (m/s):	**4.0E-5**

Remarks Results processed following BRE 365 (2007).

Client:	Unda Consulting Ltd	**TP2**
Site:	Morelands	

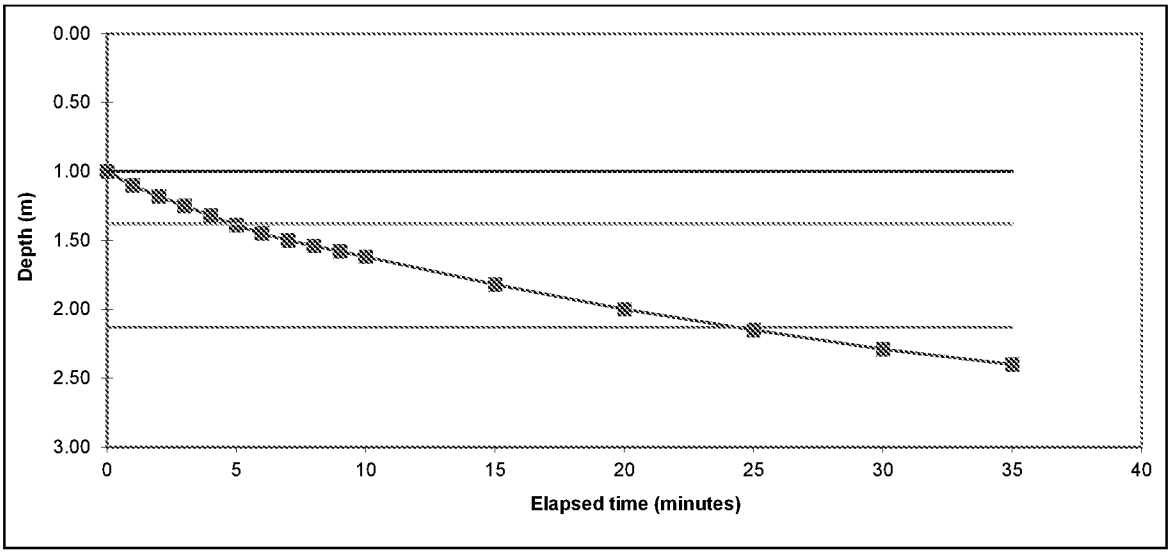
ARUN DISTRICT COUNCIL AL/42/22/PL

Your Environment

Soakaway Test

Trial Pit No:	TP3	Test No:	1	Date:	05/11/2021
Length (m):	1.300		Datum Height:	0.00	m agl
Width (m):	0.40		Granular infill:	None	
Depth (m):	2.50		Porosity of infill:	1	(assumed)

Elapsed time (minutes)	Water Depth (m below datum)	Elapsed time (minutes)	Water Depth (m below datum)
0	1.000	30	2.290
1	1.100	35	2.400
2	1.180		
3	1.250		
4	1.320		
5	1.390		
6	1.450		
7	1.500		
8	1.540		
9	1.580		
10	1.620		
15	1.820		
20	2.000		
25	2.150		



Start water depth for analysis (mbgl)	1.00		
75% effective depth (mbgl):	1.38	Elapsed time (mins):	4.9
50% effective depth (mbgl):	1.75		
25% effective depth (mbgl):	2.13	Elapsed time (mins):	24.3
Base of soakage zone (mbgl):	2.50		

Volume outflow between 75% and 25% effective depth (m^3):	0.390
Mean surface area of outflow (m^2):	3.07
(side area at 50% effective depth + base area)	
Time for outflow between 75% and 25% effective depth (mins):	19.4

Soil infiltration rate (m/s):	**1.1E-4**

Remarks Results processed following BRE 365 (2007).

Client:	Unda Consulting Ltd	**TP3**
Site:	Morelands	

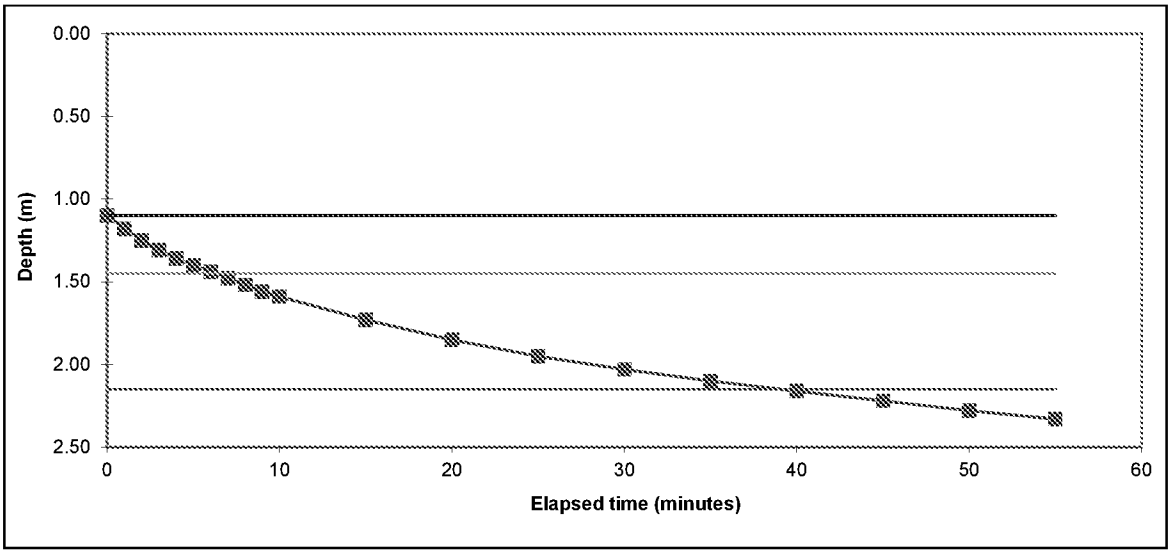
ARUN DISTRICT COUNCIL AW/42/22/PL

Your Environment

Soakaway Test

Trial Pit No:	TP3	Test No:	2	Date:	05/11/2021
Length (m):	1.300		Datum Height:	0.00 m agl	
Width (m):	0.40		Granular infill:	None	
Depth (m):	2.50		Porosity of infill:	1	(assumed)

Elapsed time (minutes)	Water Depth (m below datum)	Elapsed time (minutes)	Water Depth (m below datum)
0	1.100	30	2.030
1	1.180	35	2.100
2	1.250	40	2.160
3	1.310	45	2.220
4	1.360	50	2.280
5	1.400	55	2.330
6	1.440		
7	1.480		
8	1.520		
9	1.560		
10	1.590		
15	1.730		
20	1.850		
25	1.950		



Start water depth for analysis (mbgl)	1.10		
75% effective depth (mbgl):	1.45	Elapsed time (mins):	6.3
50% effective depth (mbgl):	1.80		
25% effective depth (mbgl):	2.15	Elapsed time (mins):	39.2
Base of soakage zone (mbgl):	2.50		

Volume outflow between 75% and 25% effective depth (m^3):	0.364
Mean surface area of outflow (m^2):	2.90
(side area at 50% effective depth + base area)	
Time for outflow between 75% and 25% effective depth (mins):	32.9

Soil infiltration rate (m/s):	**6.4E-5**

Remarks Results processed following BRE 365 (2007).

Client:	Unda Consulting Ltd	**TP3**
Site:	Morelands	

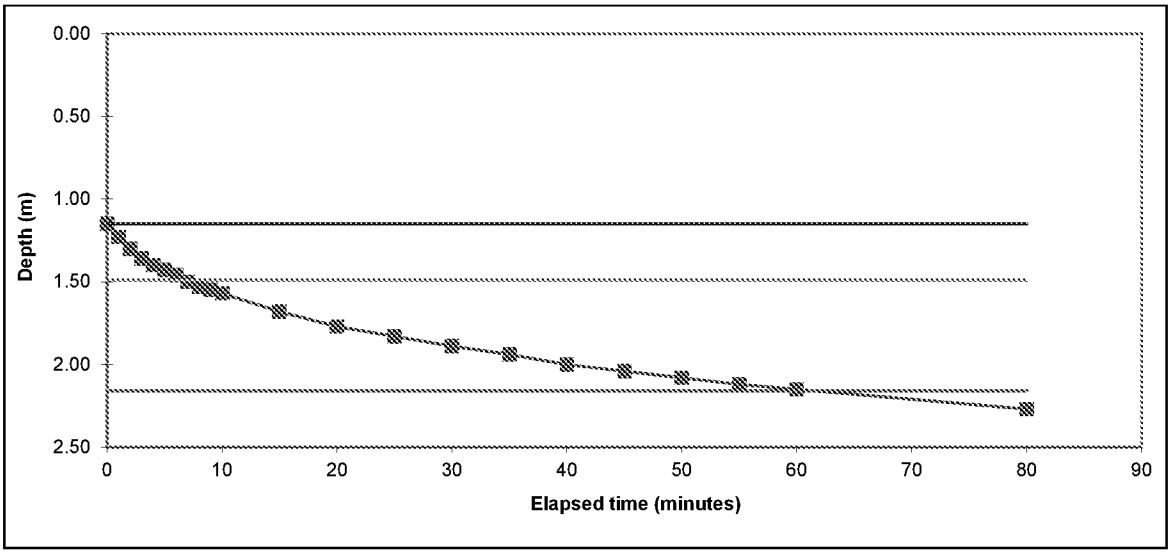
ARUN DISTRICT COUNCIL AW/42/22/PL

Your Environment

Soakaway Test

Trial Pit No:	TP3	Test No:	3	Date:	05/11/2021
Length (m):	1.300		Datum Height:	0.00 m agl	
Width (m):	0.40		Granular infill:	None	
Depth (m):	2.50		Porosity of infill:	1	(assumed)

Elapsed time (minutes)	Water Depth (m below datum)	Elapsed time (minutes)	Water Depth (m below datum)
0	1.150	30	1.890
1	1.230	35	1.940
2	1.300	40	2.000
3	1.360	45	2.040
4	1.400	50	2.080
5	1.430	55	2.120
6	1.460	60	2.150
7	1.500	80	2.270
8	1.530		
9	1.550		
10	1.570		
15	1.680		
20	1.770		
25	1.830		



Start water depth for analysis (mbgl)	1.15		
75% effective depth (mbgl):	1.49	Elapsed time (mins):	6.8
50% effective depth (mbgl):	1.83		
25% effective depth (mbgl):	2.16	Elapsed time (mins):	61.7
Base of soakage zone (mbgl):	2.50		

Volume outflow between 75% and 25% effective depth (m^3):	0.348
Mean surface area of outflow (m^2): (side area at 50% effective depth + base area)	2.80
Time for outflow between 75% and 25% effective depth (mins):	54.9

Soil infiltration rate (m/s):	**3.8E-5**

Remarks Results processed following BRE 365 (2007).

Client:	Unda Consulting Ltd	**TP3**
Site:	Morelands	

ARUN DISTRICT COUNCIL AW/42/22/PL