



7 February 2019

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Titchfield, Hants,
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Crayfern Homes
Victoria House
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Hedge End
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SO30 4AB

FAO: Alastair Dineen

Ref: 1863

Re: Burndell Road, Yapton BN18 0HR

Dear Sirs

We have reviewed the shallow permeability tests results from the Soils Ltd further site investigations and would advise as follows:

1. The quantity size and depth of the test pits correspond to those discussed and agreed with Laura Gibbons at ADC.
2. For ease of reference the results are tabulated below in m/sec:

	SK01	SK02	SK03	SK04	SK05	SK06
Test 1	8.20 x 10 ⁻⁶	2.48 x 10 ⁻⁶	1.83 x 10 ⁻⁶	N/A	1.04 x 10 ⁻⁶	2.19 x 10 ⁻⁶
Test 2	2.35 x 10 ⁻⁶	0.59 x 10 ⁻⁶	1.16 x 10 ⁻⁶	N/A	0.80 x 10 ⁻⁶	1.25 x 10 ⁻⁶
Test 3	2.21 x 10 ⁻⁶	N/A	0.99 x 10 ⁻⁶	N/A	2.52 x 10 ⁻⁶	0.84 x 10 ⁻⁶

3. There is a single result for 8 x 10⁻⁶ on test 1 of SK01 which then drops to around 2.2-2.3 x 10⁻⁶. The test 1 results for SK02 and SK06 was also about 2.2-2.4 x 10⁻⁶. We suspect the SK01 test 1 value was due to initial ground take up of test water. Tests 2 and 3 are more consistent and are considered to indicate the permeability at this location. The methodology calls for three cycles of testing and it is frequently the case that test 1 presaturates the surrounding soil to mimic a higher moisture content as may naturally occur after antecedent rainfall.
4. SK04 failed to drain any significant amount and although topped up to 300mm each time. Whilst there will be a finite infiltration rate the soils at this location have a permeability too low to be viable.
5. SK02 test 2, SK03 tests 2, SK05 tests 1 and 2 and SK06 tests 2 and 3 failed to drain to the 25% point. Soils Ltd have extrapolated a further data points on each in order to determine a permeability value. Whilst there could be some debate about the actual extrapolation points it is unequivocal in each case that the water level fell by around 0.1m in around 1,000 minutes. We therefore consider these determined permeability values to be reliable. For convenience these are highlighted in yellow above. The need to undertake extrapolation is in itself indicative of poor permeability and values of 0.6-1.25 x 10⁻⁶ were determined.

6. Soils Ltd could not determine permeability values for SK04.
7. With the high seasonal GWL at the site and low end permeabilities infiltration infrastructure would need to be shallow ie permeable pavements. The appropriate design standard for this is R156. We have undertaken some sensitivity tests to consider the scope for permeable pavements. At best the permeability is about 2.3×10^{-6} there are also six test values around 1×10^{-6} (1.16, 0.99, 1.04, 0.80, 1.25 and 0.84) so a second illustration value of 1×10^{-6} has also been used. The R156 standard requires a factor of safety (FoS) to be applied to the measured permeability. This depends upon the amount of surface to be drained by infiltration and the consequences of failure. The consequences of failure are considered to be minor eg surface water on car parking and estate roads. R156 requires the following FoS 2 for up to 100m² drained, 3 for 100-1,000m² and 5 for more than 1,000m². ADC are seeking substantial infiltration however this would require a FoS of 5 and given only one location had a test 3 result above 1×10^{-6} would also inherently have a lower base permeability in the first place more reflective of a larger area of site. This is not viable. We have therefore examined a smaller area 300m² for illustration purposes to enable Fos of 3 to be used. Two scenarios have been examined firstly that drained area equals infiltration area, which is the most favourable loading. The second that the infiltration area receives run-off from a further 50% area to reflect roof run-offs and service corridors.
8. The sensitivity tests show the following:
- All scenarios fail to accord with GP3 having little clearance above seasonal high GWL and much less than the 1m recommended.
 - At 1×10^{-6} in both scenarios including the 1:1 area ratio half drain time requirement is failed by a significant amount (40 and 65 hours compared to 24 hour requirement)
9. Mindful that one of the six test locations was a total failure and three of the remaining locations yielded values below 1×10^{-6} and only one location gave all results above 2.2×10^{-6} it is evident that the upper bound illustration is at best only applicable to around 15% of the site area. The total drained area is 0.981 Ha / 9,810m² so, at around 15%, this would be approaching the 1,500m² figure for which the appropriate FoS would increase to 5. At this point the viability of the best test location fails 24 hour half drain requirements. As demonstrated on the additional illustration.
10. There is a considerable amount of uncertainty attached to the permeability but it is clear that it is poor. Given the output from the sensitivity assessments our view is that it would be safer to maintain a total positive drainage system and avoid reliance upon infiltration which is marginal in a limited area at best. In our opinion it would not be good practice to designate any amount of the hard surface on the site as permeable paving on the basis that it may, but equally may not, adequately drain the surface water run off.

Yours sincerely,
Aqua Callidus Consulting Ltd

Andy Traves

Enc Illustrations

Project No : 1863
Project Title : Burndell Road

Drainage blanket/CGA pavement or 2D planar infiltration (R156)

Site Location: Yapton
r = 0.36 (range 0.12 to 0.45)
Drained Area = 300 m²
Design storm 1 in = 100 year
Runoff volume uplift = 40 % for climate change
Urban Creep allowance = 0 % uplift to Drained Area

Catchment ID: illustraion K max, 1:1

Infiltration Area = 300 m²

Site Considerations

Where determined, what is the depth to highest seasonal groundwater level (GWL) from surface 0.60 m
Is the infiltration far enough from drainage mounds/fields or other soakaways etc to avoid impact? Yes
What Source Protection Zone (SPZ) is the proposed soakaway located in? None
What is known and proposed about potential contaminated ground on the site? EA/LPA accept infiltration

Technical Assessment

Consequence of failure = 2-Minor inconvenience
Measured Soil Filtration Rate = 2.30E-06 m/s
Design Soil Filtration Rate = 7.67E-07 m/s
Storage media thickness = 0.30 m
Effective net porosity = 35 %
Depth of cover over media = 0.15 m

Storm Duration	5 min	10 min	15 min	30 min	1 hr	2 hr	4 hr	6 hr	10 hr	24 hr
(secs)	300	600	900	1800	3600	7200	14400	21600	36000	86400
r= 0.36 Value Z1	0.36	0.51	0.62	0.79	1.00	1.22	1.48	1.67	1.90	2.42
Rainfall M5 (mm)	7.2	10.2	12.4	15.8	20.0	24.4	29.6	33.4	38.0	48.4
M100/M5 gf Value Z2	1.84	1.91	1.95	2.00	2.03	2.01	1.97	1.94	1.91	1.82
Rainfall M100 (mm)	13.3	19.5	24.2	31.5	40.6	49.1	58.4	64.9	72.4	88.2
with CC & UC uplift (mm)	18.6	27.3	33.8	44.2	56.8	68.7	81.8	90.8	101.4	123.5
RUNOFF (m ³)	5.57	8.20	10.15	13.25	17.05	20.62	24.53	27.25	30.42	37.05
Infiltr capacity (m ³)	0.07	0.14	0.21	0.41	0.83	1.66	3.31	4.97	8.28	19.87
INFILTRATED (m ³)	0.07	0.14	0.21	0.41	0.83	1.66	3.31	4.97	8.28	19.87
Req'd STORAGE (m ³)	5.50	8.06	9.94	12.83	16.22	18.97	21.22	22.29	22.14	17.18
	pass	pass	pass	pass	pass	pass	pass	pass	pass	pass

TOTAL STORAGE AVAILABLE 31.50 m³
Time to drain full to half full = 13.5 hours

Overall Assessment

Media base elevation above seasonal high GWL 0.15 m fail??
Will the soakaway drain from full to half full in 24 hours or less? Yes pass
Does the soakaway provide sufficient storage? Yes pass

Project No : 1863
Project Title : Burndell Road

Drainage blanket/CGA pavement or 2D planar infiltration (R156)

Site Location: Yapton
r = 0.36 (range 0.12 to 0.45)
Drained Area = 450 m²
Design storm 1 in = 100 year
Runoff volume uplift = 40 % for climate change
Urban Creep allowance = 0 % uplift to Drained Area

Catchment ID: illustraion K max, 1.5:1

Infiltration Area = 300 m²

Site Considerations

Where determined, what is the depth to highest seasonal groundwater level (GWL) from surface 0.60 m
Is the infiltration far enough from drainage mounds/fields or other soakaways etc to avoid impact? Yes
What Source Protection Zone (SPZ) is the proposed soakaway located in? None
What is known and proposed about potential contaminated ground on the site? EA/LPA accept infiltration

Technical Assessment

Consequence of failure = 2-Minor inconvenience
Measured Soil Filtration Rate = 2.30E-06 m/s
Design Soil Filtration Rate = 7.67E-07 m/s
Storage media thickness = 0.40 m
Effective net porosity = 35 %
Depth of cover over media = 0.15 m

Storm Duration	5 min	10 min	15 min	30 min	1 hr	2 hr	4 hr	6 hr	10 hr	24 hr
(secs)	300	600	900	1800	3600	7200	14400	21600	36000	86400
r= 0.36 Value Z1	0.36	0.51	0.62	0.79	1.00	1.22	1.48	1.67	1.90	2.42
Rainfall M5 (mm)	7.2	10.2	12.4	15.8	20.0	24.4	29.6	33.4	38.0	48.4
M100/M5 gf Value Z2	1.84	1.91	1.95	2.00	2.03	2.01	1.97	1.94	1.91	1.82
Rainfall M100 (mm)	13.3	19.5	24.2	31.5	40.6	49.1	58.4	64.9	72.4	88.2
With CC & UC uplift (mm)	18.6	27.3	33.8	44.2	56.8	68.7	81.8	90.8	101.4	123.5
RUNOFF (m ³)	8.36	12.29	15.22	19.87	25.58	30.93	36.80	40.88	45.63	55.58
Infiltr capacity (m ³)	0.07	0.14	0.21	0.41	0.83	1.66	3.31	4.97	8.28	19.87
INFILTRATED (m ³)	0.07	0.14	0.21	0.41	0.83	1.66	3.31	4.97	8.28	19.87
Req'd STORAGE (m ³)	8.29	12.16	15.01	19.46	24.75	29.28	33.48	35.91	37.35	35.71
	pass	pass	pass	pass	pass	pass	pass	pass	pass	pass

TOTAL STORAGE AVAILABLE 42.00 m³
Time to drain full to half full = 22.6 hours

Overall Assessment

Media base elevation above seasonal high GWL 0.05 m fail??
Will the soakaway drain from full to half full in 24 hours or less? Yes pass
Does the soakaway provide sufficient storage? Yes pass

Project No : 1863
Project Title : Burndell Road

Drainage blanket/CGA pavement or 2D planar infiltration (R156)

Site Location: Yapton
r = 0.36 (range 0.12 to 0.45)
Drained Area = 300 m²
Design storm 1 in = 100 year
Runoff volume uplift = 40 % for climate change
Urban Creep allowance = 0 % uplift to Drained Area

Catchment ID: illustration K not, 1:1

Infiltration Area = 300 m²

Site Considerations

Where determined, what is the depth to highest seasonal groundwater level (GWL) from surface 0.60 m
Is the infiltration far enough from drainage mounds/fields or other soakaways etc to avoid impact? Yes
What Source Protection Zone (SPZ) is the proposed soakaway located in? None
What is known and proposed about potential contaminated ground on the site? EA/LPA accept infiltration

Technical Assessment

Consequence of failure = 2-Minor inconvenience
Measured Soil Filtration Rate = 1.00E-06 m/s
Design Soil Filtration Rate = 3.33E-07 m/s
Storage media thickness = 0.30 m
Effective net porosity = 35 %
Depth of cover over media = 0.15 m

Storm Duration	5 min	10 min	15 min	30 min	1 hr	2 hr	4 hr	6 hr	10 hr	24 hr
(secs)	300	600	900	1800	3600	7200	14400	21600	36000	86400
r= 0.36 Value Z1	0.36	0.51	0.62	0.79	1.00	1.22	1.48	1.67	1.90	2.42
Rainfall M5 (mm)	7.2	10.2	12.4	15.8	20.0	24.4	29.6	33.4	38.0	48.4
M100/M5 gf Value Z2	1.84	1.91	1.95	2.00	2.03	2.01	1.97	1.94	1.91	1.82
Rainfall M100 (mm)	13.3	19.5	24.2	31.5	40.6	49.1	58.4	64.9	72.4	88.2
with CC & UC uplift (mm)	18.6	27.3	33.8	44.2	56.8	68.7	81.8	90.8	101.4	123.5
RUNOFF (m ³)	5.57	8.20	10.15	13.25	17.05	20.62	24.53	27.25	30.42	37.05
Infilt capacity (m ³)	0.03	0.06	0.09	0.18	0.36	0.72	1.44	2.16	3.60	8.64
INFILTRATED (m ³)	0.03	0.06	0.09	0.18	0.36	0.72	1.44	2.16	3.60	8.64
Req'd STORAGE (m ³)	5.54	8.14	10.06	13.07	16.69	19.90	23.09	25.09	26.82	28.41
	pass	pass	pass	pass	pass	pass	pass	pass	pass	pass

TOTAL STORAGE AVAILABLE 31.50 m³
Time to drain full to half full = 39.5 hours

Overall Assessment

Media base elevation above seasonal high GWL 0.15 m
Will the soakaway drain from full to half full in 24 hours or less? No
Does the soakaway provide sufficient storage? Yes

Project No : 1863
Project Title : Burndell Road

Drainage blanket/CGA pavement or 2D planar infiltration (R156)

Site Location: Yapton
r = 0.36 (range 0.12 to 0.45)
Drained Area = 450 m²
Design storm 1 in = 100 year
Runoff volume uplift = 40 % for climate change
Urban Creep allowance = 0 % uplift to Drained Area

Catchment ID: illustraion K not, 1.5:1

Infiltration Area = 300 m²

Site Considerations

Where determined, what is the depth to highest seasonal groundwater level (GWL) from surface 0.60 m
Is the infiltration far enough from drainage mounds/fields or other soakaways etc to avoid impact? Yes
What Source Protection Zone (SPZ) is the proposed soakaway located in? None
What is known and proposed about potential contaminated ground on the site? EA/LPA accept infiltration

Technical Assessment

Consequence of failure = 2-Minor inconvenience
Measured Soil Filtration Rate = 1.00E-06 m/s
Design Soil Filtration Rate = 3.33E-07 m/s
Storage media thickness = 0.45 m
Effective net porosity = 35 %
Depth of cover over media = 0.15 m

Storm Duration	5 min	10 min	15 min	30 min	1 hr	2 hr	4 hr	6 hr	10 hr	24 hr
(secs)	300	600	900	1800	3600	7200	14400	21600	36000	86400
r= 0.36 Value Z1	0.36	0.51	0.62	0.79	1.00	1.22	1.48	1.67	1.90	2.42
Rainfall M5 (mm)	7.2	10.2	12.4	15.8	20.0	24.4	29.6	33.4	38.0	48.4
M100/M5 gf Value Z2	1.84	1.91	1.95	2.00	2.03	2.01	1.97	1.94	1.91	1.82
Rainfall M100 (mm)	13.3	19.5	24.2	31.5	40.6	49.1	58.4	64.9	72.4	88.2
With CC & UC uplift (mm)	18.6	27.3	33.8	44.2	56.8	68.7	81.8	90.8	101.4	123.5
RUNOFF (m ³)	8.36	12.29	15.22	19.87	25.58	30.93	36.80	40.88	45.63	55.58
Infilt capacity (m ³)	0.03	0.06	0.09	0.18	0.36	0.72	1.44	2.16	3.60	8.64
INFILTRATED (m ³)	0.03	0.06	0.09	0.18	0.36	0.72	1.44	2.16	3.60	8.64
Req'd STORAGE (m ³)	8.33	12.23	15.13	19.69	25.22	30.21	35.36	38.72	42.03	46.94
	pass	pass	pass	pass	pass	pass	pass	pass	pass	pass

TOTAL STORAGE AVAILABLE 47.25 m³
Time to drain full to half full = 65.2 hours

Overall Assessment

Media base elevation above seasonal high GWL 0.00 m fail G?2
Will the soakaway drain from full to half full in 24 hours or less? No fail
Does the soakaway provide sufficient storage? Yes pass

Project No : 1863
Project Title : Burndell Road

Drainage blanket/CGA pavement or 2D planar infiltration (R156)

Site Location: Yapton Catchment ID: illustraion K max 1:1 1,500m2
 $r = 0.36$ (range 0.12 to 0.45)
 Drained Area = 1500 m² Infiltration Area = 1500 m²
 Design storm 1 in = 100 year
 Runoff volume uplift = 40 % for climate change
 Urban Creep allowance = 0 % uplift to Drained Area

Site Considerations

Where determined, what is the depth to highest seasonal groundwater level (GWL) from surface 0.60 m
 Is the infiltration far enough from drainage mounds/fields or other soakaways etc to avoid impact? Yes
 What Source Protection Zone (SPZ) is the proposed soakaway located in? None
 What is known and proposed about potential contaminated ground on the site? EA/LPA accept infiltration

Technical Assessment

Consequence of failure = 2-Minor inconvenience
 Measured Soil Filtration Rate = 2.30E-06 m/s
 Design Soil Filtration Rate = 4.60E-07 m/s
 Storage media thickness = 0.30 m
 Effective net porosity = 35 %
 Depth of cover over media = 0.15 m

Storm Duration	5 min	10 min	15 min	30 min	1 hr	2 hr	4 hr	6 hr	10 hr	24 hr
(secs)	300	600	900	1800	3600	7200	14400	21600	36000	86400
$r = 0.36$ Value Z1	0.36	0.51	0.62	0.79	1.00	1.22	1.48	1.67	1.90	2.42
Rainfall M5 (mm)	7.2	10.2	12.4	15.8	20.0	24.4	29.6	33.4	38.0	48.4
M100/M5 gf Value Z2	1.84	1.91	1.95	2.00	2.03	2.01	1.97	1.94	1.91	1.82
Rainfall M100 (mm)	13.3	19.5	24.2	31.5	40.6	49.1	58.4	64.9	72.4	88.2
with CC & UC uplift (mm)	18.6	27.3	33.8	44.2	56.8	68.7	81.8	90.8	101.4	123.5
RUNOFF (m ³)	27.86	40.98	50.74	66.24	85.26	103.12	122.65	136.27	152.10	185.27
Infilt capacity (m ³)	0.21	0.41	0.62	1.24	2.48	4.97	9.94	14.90	24.84	59.62
INFILTRATED (m ³)	0.21	0.41	0.62	1.24	2.48	4.97	9.94	14.90	24.84	59.62
Req'd STORAGE (m ³)	27.66	40.57	50.12	65.00	82.78	98.15	112.72	121.36	127.26	125.65
	pass	pass	pass	pass	pass	pass	pass	pass	pass	pass

TOTAL STORAGE AVAILABLE 157.50 m³
 Time to drain full to half full = 25.6 hours

Overall Assessment

Media base elevation above seasonal high GWL 0.15 m
 Will the soakaway drain from full to half full in 24 hours or less? No
 Does the soakaway provide sufficient storage? Yes