

DESIGN CALCULATIONS

JOB:	Four Acres, Dunt Lane, Hurst	JOB No:	15906
CLIENT:	Mr A Saliba	SHEET No:	D1
ITEM:	DRAINAGE CALCULATIONS	DATE:	July '24

RWA

CONSULTING

CIVIL AND STRUCTURAL ENGINEERS
8 Station Approach, Wendover,
Buckinghamshire, HP22 6BN

Site Constraints:

Kempton Park gravel formation over London clay bedrock with high water table of approximately 500mm below ground level (Geotechnical Investigation undertaken 28th November 2023), the only alternative surface water is to go into the local surface water / storm water sewer system. As per Local Authorities Policies, discharge from site cannot exceed 4.90 litres per second. The longest run for the surface water to the last manhole before joining the local surface water / storm water sewer system is 66.50m, meaning that the fall required over the whole site will need to be 800mm to achieve the required 1:100 fall.

Typical surface water pipes are 100mm diameter pipe which at a 1:100 fall has a capacity flow of 6.01 litres per second, or 150mm diameter pipe which at a 1:100 fall has a capacity flow of 17.70 litres per second.

A hydro brake is needed to limit the flow of water to 4.90 litres per second, requiring the system behind the hydro brake has to attenuate the surface water. See pages D2 for volume capacity when discharge is limited to the required 4.90 litres per second.

Site Attenuation:

Volume required is 5.42m³ or 5420 litres.

Based off rainwater harvesting size calculator (<https://www.rainwaterharvesting.co.uk/tank-size-calculator/>) of 400m² roof area and other hard standings, with 5 or more bedrooms a recommended 7500 litres tank size is required.

This alone is sufficient volume capacity to attenuate surface water run off, but the drain run would also have additional capacity built in.

Capacity of 100mm Ø pipes x 66.50m @ 1:100 fall is 522 litres

Capacity of standard 470mm Ø inspection chambers (Min. 600mm invert level, Max. 1520mm invert level, therefore average height capacity is 1060mm) ($\pi \times r^2 \times h$) = $\pi \times 0.235\text{m}^2 \times 1.06\text{m}$ = 0.184 m³ or 184.00 litres

Number of manholes before hydro brake is 4.

4No. 470mm Ø inspection chambers = 0.736m³ or 736.00 litres

Therefore, with 100mm Ø surface water below ground pipework and standard 1470mm Ø inspection chambers achieve minimum 522 litres + 736 litres for a total of 1258 litres. Combined with the rain water harvesting tank, the whole drainage system has a total volume capacity of 8758 litres

By:	DW
Ck:	AE

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Design rainfall intensity

Location of catchment area	Oxford
Impermeable area drained to the system	$A = 400.0 \text{ m}^2$
Return period	Period = 100 yr
Ratio 60 min to 2 day rainfall of 5 yr return period	$r = 0.360$
5-year return period rainfall of 60 minutes duration	$M5_{60\text{min}} = 20.0 \text{ mm}$
Increase of rainfall intensity due to global warming	$p_{\text{climate}} = 40 \%$
Percentage free volume	$V_{\text{free}} = 95 \%$
Soil infiltration rate	$f = 4.90 \times 10^{-3} \text{ m/s}$
Wetted area of pit 50% full	$a_{s50} = l \times d + w \times d = 2000000 \text{ mm}^2$

Table equations

Inflow (cl.3.3.1)	$I = M100 \times A$
Outflow (cl.3.3.2)	$O = a_{s50} \times f \times D$
Storage (cl.3.3.3)	$S = I - O$

Duration, D (min)	Growth factor Z1	M5 rainfalls (mm)	Growth factor Z2	100 year rainfall, M100 (mm)	Inflow (m³)	Outflow (m³)	Storage required (m³)
5	0.36;	10.1;	1.91;	19.3;	7.71;	2.94;	4.77
10	0.51;	14.3;	1.98;	28.3;	11.30;	5.88;	5.42
15	0.62;	17.4;	2.01;	34.9;	13.95;	8.82;	5.13
30	0.79;	22.1;	2.02;	44.7;	17.89;	17.64;	0.25
60	1.00;	28.0;	1.99;	55.6;	22.24;	35.28;	0.00
120	1.22;	34.2;	1.94;	66.2;	26.46;	70.56;	0.00
240	1.48;	41.4;	1.88;	77.8;	31.14;	141.12;	0.00
360	1.67;	46.8;	1.84;	85.8;	34.34;	211.68;	0.00
600	1.90;	53.2;	1.79;	95.1;	38.05;	352.80;	0.00
1440	2.42;	67.8;	1.69;	114.5;	45.78;	846.72;	0.00

Required storage volume $S_{\text{req}} = 5.42 \text{ m}^3$

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Foul Drainage:

With the site not accessible to public foul sewers, requiring the foul to be treated on site. This requires a new private treatment plant (Klargester or similar approved) to suit the required occupancy of the new dwelling. As per Building Regulations part H, where there is areas of high water tables or impervious ground, a drainage mound is required instead of the traditional drainage field system. This allows the grey water to filtrate before reaching the high water table.

Length of Drainage Mound required:

$P \text{ (number of occupants)} \times V_P \text{ (percolation value)} \times 0.2 \text{ (sewage treatment plant factor)}$

As the drainage mound is to be constructed on site, best value of percolation can be used.

Therefore, $7 \times 12 \times 0.2 = 17.00\text{m}^2$

With 900mm wide trench for the perforated / distribution pipe, $17.00\text{m} / 0.90\text{m} = 19.00\text{m}$

Therefore, total pipe length within drainage mound is 19.00m.

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