

R2211-L01/afs  
15<sup>th</sup> December 2015

Mr Nick Bateman, Principal Architectural Assistant  
Assets and Economic Development  
Wrexham County Borough Council

By email: [Nick.Bateman@wrexham.gov.uk](mailto:Nick.Bateman@wrexham.gov.uk)

Dear Nick

**New Build Housing, Gwenfro, Caia Park, Wrexham: Soakaway Testing**

We carried out soakaway tests in accordance with BRE 365 methods at 6 locations as previously agreed at the above site. Locations are shown on the attached plan together with photographs of the test positions. All locations were checked against service plans provided by the Council, and were CAT scanned on site.

Test pits were excavated by hydraulic mini-digger to between 1.0 and 1.1m depth on the 26<sup>th</sup> November 2015 and filled with water and allowed to drain overnight. Trial pits were secured by Heras fencing enclosures for public safety whilst unattended.

The following day, all pits were refilled with water at least once, and water levels were then monitored for around 4-6 hours. Pits 1, 4 and 5 drained down sufficiently quickly to permit refilling and a second round of monitoring. Following monitoring, trial pits were backfilled with the arisings and compacted by machine bucket.

The attached spreadsheets provide the monitoring data and calculations for soil infiltration rates; the calculations assume a drain invert level of 0.5m below ground level. In accordance with BRE 365, the lowest value of permeability is assumed for each location, and the results are summarised as follows for soakaway design purposes.

| location | soil infiltration rate 'f' (ms <sup>-1</sup> ) |
|----------|------------------------------------------------|
| TP1      | 8.4 x 10 <sup>-6</sup>                         |
| TP2      | 4.9 x 10 <sup>-6</sup>                         |
| TP3      | 2.9 x 10 <sup>-6</sup>                         |
| TP4      | 2.8 x 10 <sup>-5</sup>                         |
| TP5      | 1.3 x 10 <sup>-5</sup>                         |
| TP6      | 1.8 x 10 <sup>-6</sup>                         |

continued

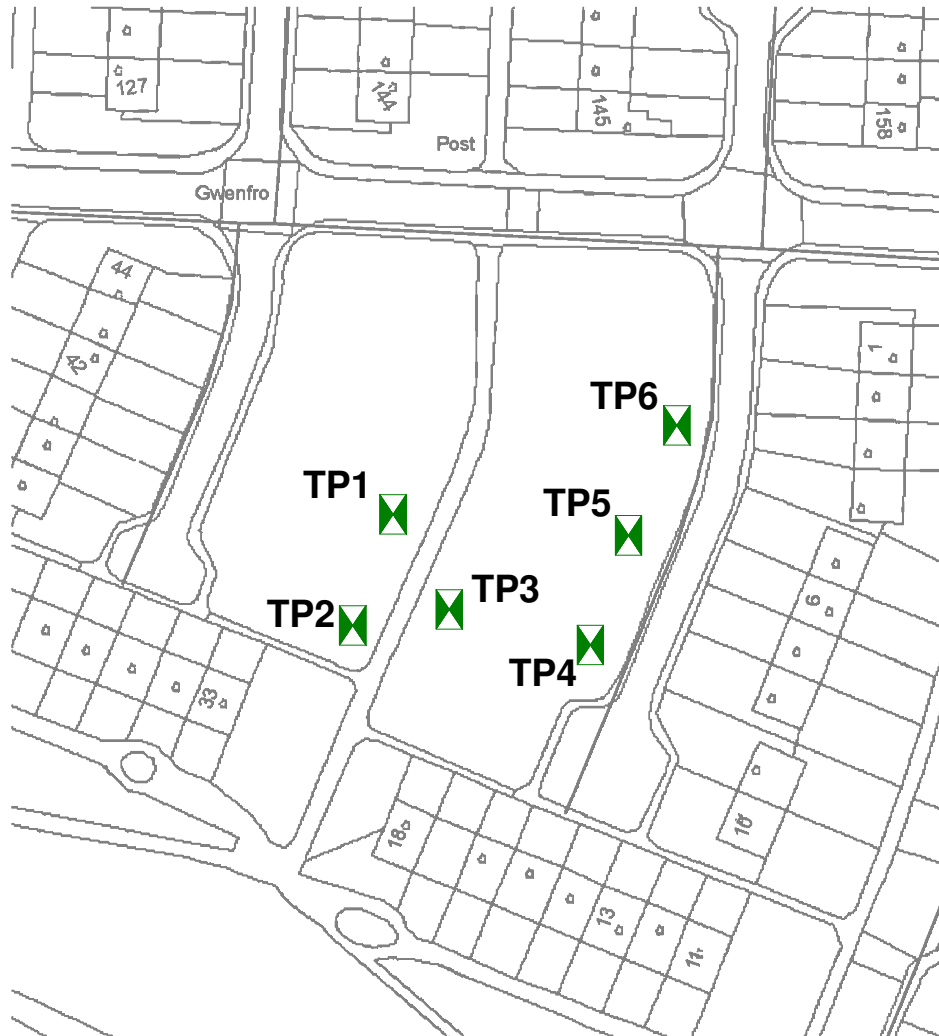


As a general observation, the soils contain mixed deposits including a veneer of made ground near surface in places, with natural strata of fine sands, silts and clays, the latter laminated in some areas. The soils appear to be poor-draining at depth, and the graphs of water drainage suggest a probable water table at around 1-2m depth. This would appear to be consistent with the distance and height difference to the River Gwenfro located between 65 and 100m to the south.

Yours sincerely  
for: Smith Grant LLP

Dr Tony Smith, Partner

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Project:  
**Wrexham Soakaways**

Drawing:  
**Soakaway Trialpit Locations**

|                            |                        |
|----------------------------|------------------------|
| Drawn:<br><b>JS</b>        | Checked:<br><b>AFS</b> |
| Date:<br><b>11/12/2015</b> | Scale:<br><b>nts</b>   |
| Job No:<br><b>R2211</b>    | Drg No:<br><b>D01</b>  |



TP1



TP1



TP2



TP2



TP3



TP3



TP4



TP4



TP5



TP5



TP6



TP6



General View



General view

## Trial Pit Soakage Calculation Sheet

Date: 11/12/2015



Site: Gwenfro, Caia Park, Wrexham

|                  |          |
|------------------|----------|
| <b>Trial Pit</b> | <b>1</b> |
|------------------|----------|

Location

| Trial pit dimensions (m)               |       |
|----------------------------------------|-------|
| Length                                 | 1.250 |
| Width                                  | 1.000 |
| Depth                                  | 1.100 |
| Trial pit fill                         | none  |
| Initial water volume (m <sup>3</sup> ) | 0.888 |

assumed drain invert at 0.5m bgl

effective depth (ed) 0.600 m

75% ed 0.650 m

25% ed 0.950 m

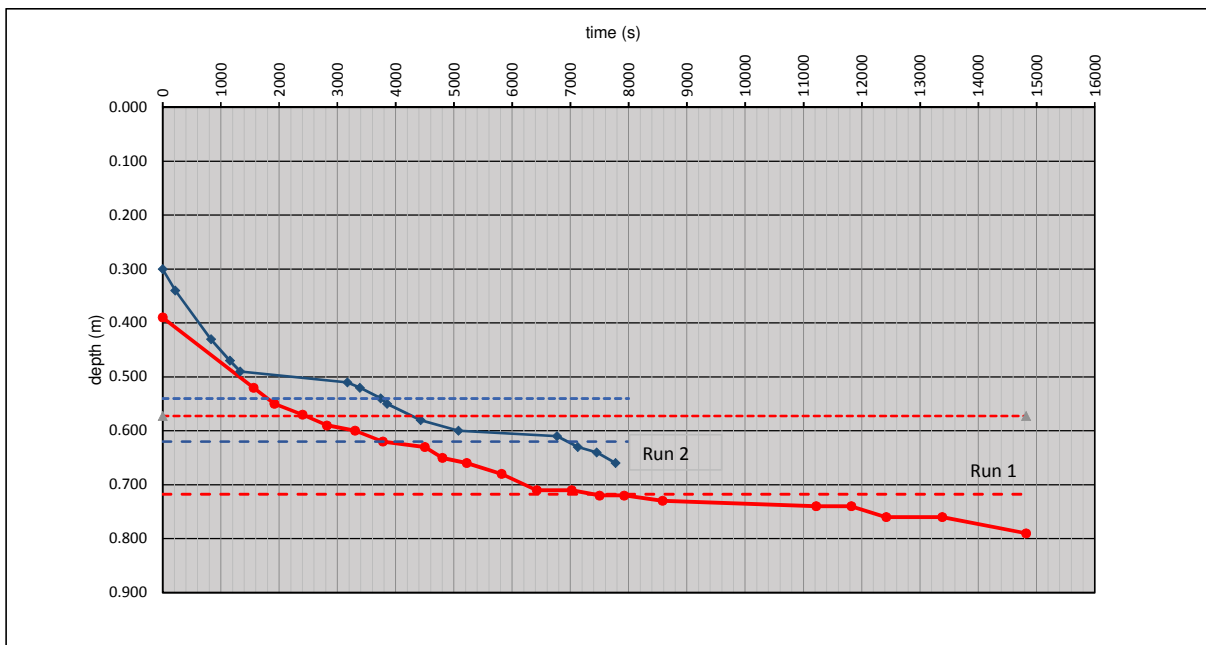
25% effective depth not reached during test;

infiltration rate therefore estimated from 25-75% actual depth data:

| Drainage times      |                       |                     |                       |
|---------------------|-----------------------|---------------------|-----------------------|
| Run 1               |                       | Run2                |                       |
| elapsed time<br>(s) | depth to water<br>(m) | elapsed time<br>(s) | depth to water<br>(m) |
| 0                   | 0.390                 | 0                   | 0.300                 |
| 1560                | 0.520                 | 216                 | 0.340                 |
| 1920                | 0.550                 | 828                 | 0.430                 |
| 2400                | 0.570                 | 1152                | 0.470                 |
| 2820                | 0.590                 | 1332                | 0.490                 |
| 3300                | 0.600                 | 3168                | 0.510                 |
| 3780                | 0.620                 | 3384                | 0.520                 |
| 4500                | 0.630                 | 3744                | 0.540                 |
| 4800                | 0.650                 | 3852                | 0.550                 |
| 5220                | 0.660                 | 4428                | 0.580                 |
| 5820                | 0.680                 | 5076                | 0.600                 |
| 6420                | 0.710                 | 6768                | 0.610                 |
| 7020                | 0.710                 | 7128                | 0.630                 |
| 7500                | 0.720                 | 7452                | 0.640                 |
| 7920                | 0.720                 | 7776                | 0.660                 |
| 8580                | 0.730                 |                     |                       |
| 11220               | 0.740                 |                     |                       |
| 11820               | 0.740                 |                     |                       |
| 12420               | 0.760                 |                     |                       |
| 13380               | 0.760                 |                     |                       |
| 14820               | 0.790                 |                     |                       |

## Calculations

|                                               | Run 1                           | Run 2                           |
|-----------------------------------------------|---------------------------------|---------------------------------|
| level at start (0%)                           | 0.500 m                         | 0.500 m                         |
| level at end (100%)                           | 0.790 m                         | 0.660 m                         |
| 25% level                                     | 0.5725 m                        | 0.54 m                          |
| 75% level                                     | 0.7175 m                        | 0.62 m                          |
| level change (75-25%)                         | 0.145 m                         | 0.08 m                          |
| volume drained (75-25%)                       | 0.18125 m <sup>3</sup>          | 0.1 m <sup>3</sup>              |
| surface area drained (75-25%)                 | 3.2975 m <sup>2</sup>           | 3.59 m <sup>2</sup>             |
| time at 25% level                             | 2500 s                          | 3700 s                          |
| time at 75% level                             | 7400 s                          | 7000 s                          |
| soil infiltration rate (75-25% actual), $f =$ | <b>1.12E-05 ms<sup>-1</sup></b> | <b>8.44E-06 ms<sup>-1</sup></b> |



Site: Gwenfro, Caia Park, Wrexham

**Trial Pit 2**

Location

| Trial pit dimensions (m)               |       |
|----------------------------------------|-------|
| Length                                 | 1.250 |
| Width                                  | 1.000 |
| Depth                                  | 1.100 |
| Trial pit fill                         | none  |
| Initial water volume (m <sup>3</sup> ) | 0.938 |

assumed drain invert at 0.5m bgl

|                      |         |
|----------------------|---------|
| effective depth (ed) | 0.600 m |
| 75% ed               | 0.650 m |
| 25% ed               | 0.950 m |

25% effective depth not reached during test;

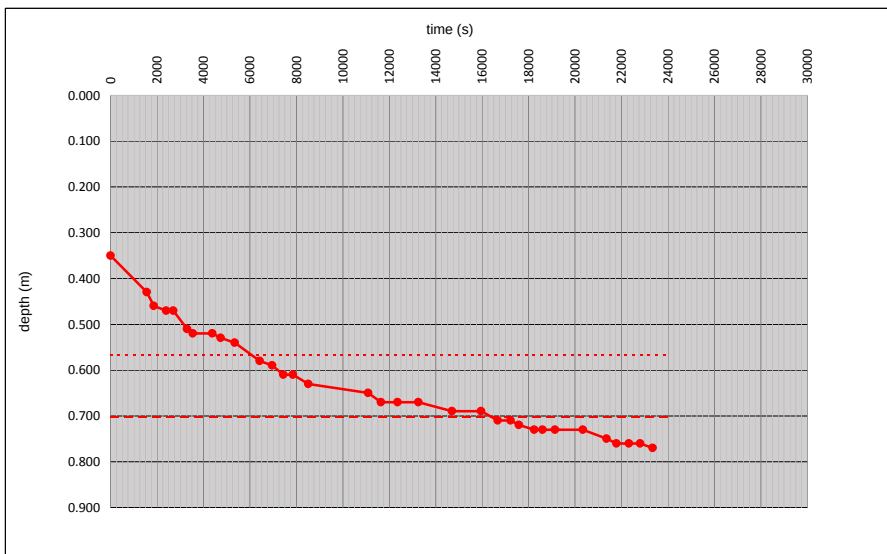
infiltration rate therefore estimated from 25-75% actual depth data:

| Drainage times   |                    |                  |                    |
|------------------|--------------------|------------------|--------------------|
| Run 1            |                    | Run2             |                    |
| elapsed time (s) | depth to water (m) | elapsed time (s) | depth to water (m) |
| 0                | 0.350              |                  |                    |
| 1560             | 0.430              |                  |                    |
| 1860             | 0.460              |                  |                    |
| 2400             | 0.470              |                  |                    |
| 2700             | 0.470              |                  |                    |
| 3300             | 0.510              |                  |                    |
| 3540             | 0.520              |                  |                    |
| 4380             | 0.520              |                  |                    |
| 4740             | 0.530              |                  |                    |
| 5340             | 0.540              |                  |                    |
| 6420             | 0.580              |                  |                    |
| 6960             | 0.590              |                  |                    |
| 7440             | 0.610              |                  |                    |
| 7860             | 0.610              |                  |                    |
| 8520             | 0.630              |                  |                    |
| 11100            | 0.650              |                  |                    |
| 11640            | 0.670              |                  |                    |
| 12360            | 0.670              |                  |                    |
| 13260            | 0.670              |                  |                    |
| 14700            | 0.690              |                  |                    |
| 15960            | 0.690              |                  |                    |
| 16680            | 0.710              |                  |                    |
| 17220            | 0.710              |                  |                    |
| 17580            | 0.720              |                  |                    |
| 18240            | 0.730              |                  |                    |
| 18600            | 0.730              |                  |                    |
| 19140            | 0.730              |                  |                    |
| 20340            | 0.730              |                  |                    |
| 21360            | 0.750              |                  |                    |
| 21780            | 0.760              |                  |                    |
| 22320            | 0.760              |                  |                    |
| 22800            | 0.760              |                  |                    |
| 23340            | 0.770              |                  |                    |

#### Calculations

#### Run 1

|                                             |                                 |
|---------------------------------------------|---------------------------------|
| level at start (0%)                         | 0.500 m                         |
| level at end (100%)                         | 0.770 m                         |
| 25% level                                   | 0.5675 m                        |
| 75% level                                   | 0.7025 m                        |
| level change (75-25%)                       | 0.135 m                         |
| volume drained (75-25%)                     | 0.16875 m <sup>3</sup>          |
| surface area drained (75-25%)               | 3.3425 m <sup>2</sup>           |
| time at 25% level                           | 6000 s                          |
| time at 75% level                           | 16300 s                         |
| soil infiltration rate (75-25% actual), f = | <b>4.90E-06 ms<sup>-1</sup></b> |





Site: Gwenfro, Caia Park, Wrexham

**Trial Pit 3**

Location

| Trial pit dimensions (m)               |       |
|----------------------------------------|-------|
| Length                                 | 1.250 |
| Width                                  | 1.000 |
| Depth                                  | 1.100 |
| Trial pit fill                         | none  |
| Initial water volume (m <sup>3</sup> ) | 0.925 |

assumed drain invert at 0.5m bgl

|                      |         |
|----------------------|---------|
| effective depth (ed) | 0.600 m |
| 75% ed               | 0.650 m |
| 25% ed               | 0.950 m |

25% effective depth not reached during test;  
infiltration rate therefore estimated from 25-75% actual depth data:

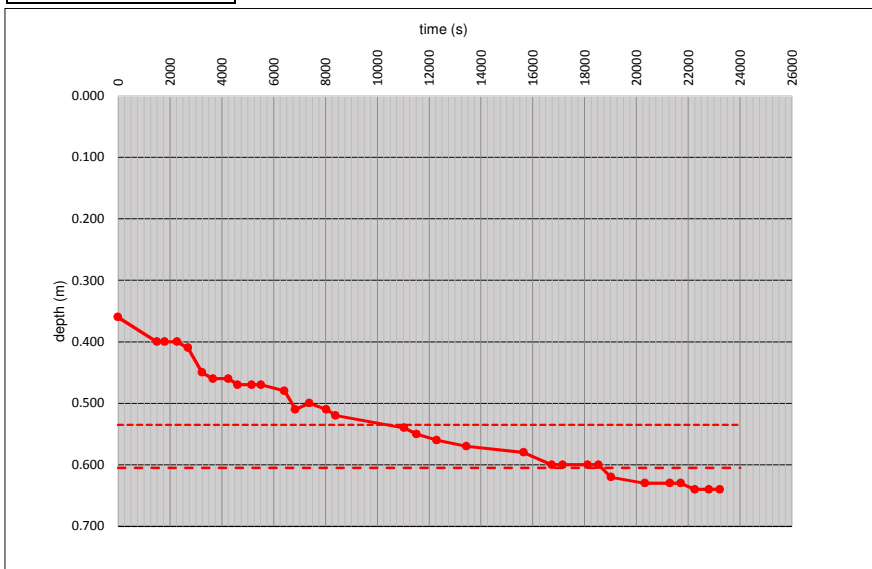
| Drainage times   |                    |                  |                    |
|------------------|--------------------|------------------|--------------------|
| Run 1            |                    | Run2             |                    |
| elapsed time (s) | depth to water (m) | elapsed time (s) | depth to water (m) |
| 0                | 0.360              |                  |                    |
| 1500             | 0.400              |                  |                    |
| 1800             | 0.400              |                  |                    |
| 2280             | 0.400              |                  |                    |
| 2700             | 0.410              |                  |                    |
| 3240             | 0.450              |                  |                    |
| 3660             | 0.460              |                  |                    |
| 4260             | 0.460              |                  |                    |
| 4620             | 0.470              |                  |                    |
| 5160             | 0.470              |                  |                    |
| 5520             | 0.470              |                  |                    |
| 6420             | 0.480              |                  |                    |
| 6840             | 0.510              |                  |                    |
| 7380             | 0.500              |                  |                    |
| 8040             | 0.510              |                  |                    |
| 8400             | 0.520              |                  |                    |
| 11040            | 0.540              |                  |                    |
| 11520            | 0.550              |                  |                    |
| 12300            | 0.560              |                  |                    |
| 13440            | 0.570              |                  |                    |
| 15660            | 0.580              |                  |                    |
| 16740            | 0.600              |                  |                    |
| 17160            | 0.600              |                  |                    |
| 18120            | 0.600              |                  |                    |
| 18540            | 0.600              |                  |                    |
| 19020            | 0.620              |                  |                    |
| 20340            | 0.630              |                  |                    |
| 21300            | 0.630              |                  |                    |
| 21720            | 0.630              |                  |                    |
| 22260            | 0.640              |                  |                    |
| 22800            | 0.640              |                  |                    |
| 23220            | 0.640              |                  |                    |

Calculations

**Run 1**

|                               |                       |
|-------------------------------|-----------------------|
| level at start (0%)           | 0.500 m               |
| level at end (100%)           | 0.640 m               |
| 25% level                     | 0.535 m               |
| 75% level                     | 0.605 m               |
| level change (75-25%)         | 0.070 m               |
| volume drained (75-25%)       | 0.0875 m <sup>3</sup> |
| surface area drained (75-25%) | 3.635 m <sup>2</sup>  |
| time at 25% level             | 10250 s               |
| time at 75% level             | 18500 s               |

soil infiltration rate (75-25% actual),  $f = 2.92E-06 \text{ ms}^{-1}$



Site: Gwenfro, Caia Park, Wrexham

**Trial Pit 4**

Location

| Trial pit dimensions (m)               |        |
|----------------------------------------|--------|
| Length                                 | 1.270  |
| Width                                  | 1.000  |
| Depth                                  | 1.000  |
| Trial pit fill                         | none   |
| Initial water volume (m <sup>3</sup> ) | #NAME? |

assumed drain invert at 0.5m

bgl

|                      |         |
|----------------------|---------|
| effective depth (ed) | 0.500 m |
| 75% ed               | 0.625 m |
| 25% ed               | 0.875 m |

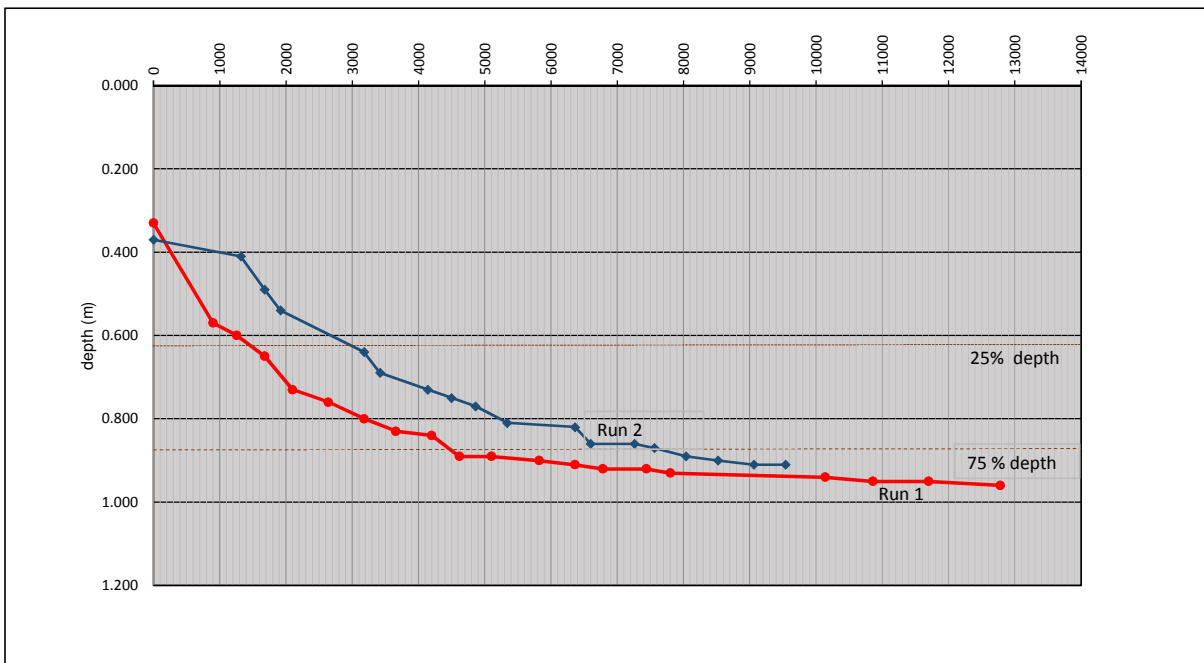
75% effective depth reached during tests;

infiltration rate estimated in accordance with BRE 365:

| Drainage times      |                       |                     |                       |
|---------------------|-----------------------|---------------------|-----------------------|
| Run 1               |                       | Run2                |                       |
| elapsed time<br>(s) | depth to water<br>(m) | elapsed time<br>(s) | depth to water<br>(m) |
| 0                   | 0.330                 | 0                   | 0.370                 |
| 900                 | 0.570                 | 1320                | 0.410                 |
| 1260                | 0.600                 | 1680                | 0.490                 |
| 1680                | 0.650                 | 1920                | 0.540                 |
| 2100                | 0.730                 | 3180                | 0.640                 |
| 2640                | 0.760                 | 3420                | 0.690                 |
| 3180                | 0.800                 | 4140                | 0.730                 |
| 3660                | 0.830                 | 4500                | 0.750                 |
| 4200                | 0.840                 | 4860                | 0.770                 |
| 4620                | 0.890                 | 5340                | 0.810                 |
| 5100                | 0.890                 | 6360                | 0.820                 |
| 5820                | 0.900                 | 6600                | 0.860                 |
| 6360                | 0.910                 | 7260                | 0.860                 |
| 6780                | 0.920                 | 7560                | 0.870                 |
| 7440                | 0.920                 | 8040                | 0.890                 |
| 7800                | 0.930                 | 8520                | 0.900                 |
| 10140               | 0.940                 | 9060                | 0.910                 |
| 10860               | 0.950                 | 9540                | 0.910                 |
| 11700               | 0.950                 |                     |                       |
| 12780               | 0.960                 |                     |                       |

#### Calculations

|                                                 | Run 1                           | Run 2                           |
|-------------------------------------------------|---------------------------------|---------------------------------|
| 50% ed                                          | 0.250 m                         | 0.250 m                         |
| time at 75% ed                                  | 1500 s                          | 3000 s                          |
| time at 25% ed                                  | 4500 s                          | 7700 s                          |
| drainage time $t_{p75-25}$ =                    | 3000 s                          | 4700 s                          |
| area draining, $a_{p50}$ =                      | 2.405 m <sup>2</sup>            | 2.405 m <sup>2</sup>            |
| volume drained, $v_{p75-25}$ =                  | 0.318 m <sup>3</sup>            | 0.318 m <sup>3</sup>            |
| <b>soil infiltration rate, <math>f</math> =</b> | <b>4.40E-05 ms<sup>-1</sup></b> | <b>2.81E-05 ms<sup>-1</sup></b> |



## Trial Pit Soakage Calculation Sheet

Date: 11/12/2015



Site: Gwenfro, Caia Park, Wrexham

Trial Pit 5

Location

| Trial pit dimensions (m)               |       |
|----------------------------------------|-------|
| Length                                 | 1.100 |
| Width                                  | 1.000 |
| Depth                                  | 1.000 |
| Trial pit fill                         | none  |
| Initial water volume (m <sup>3</sup> ) | 0.693 |

assumed drain invert at 0.5m bgl

|                      |         |
|----------------------|---------|
| effective depth (ed) | 0.500 m |
| 75% ed               | 0.625 m |
| 25% ed               | 0.875 m |

25% effective depth almost reached during Run 1;  
infiltration rate therefore calculated using extrapolated time to reach 25% in Run 1,  
and estimated from actual 75-25% data for Run 2:

## Calculations

## Run 1

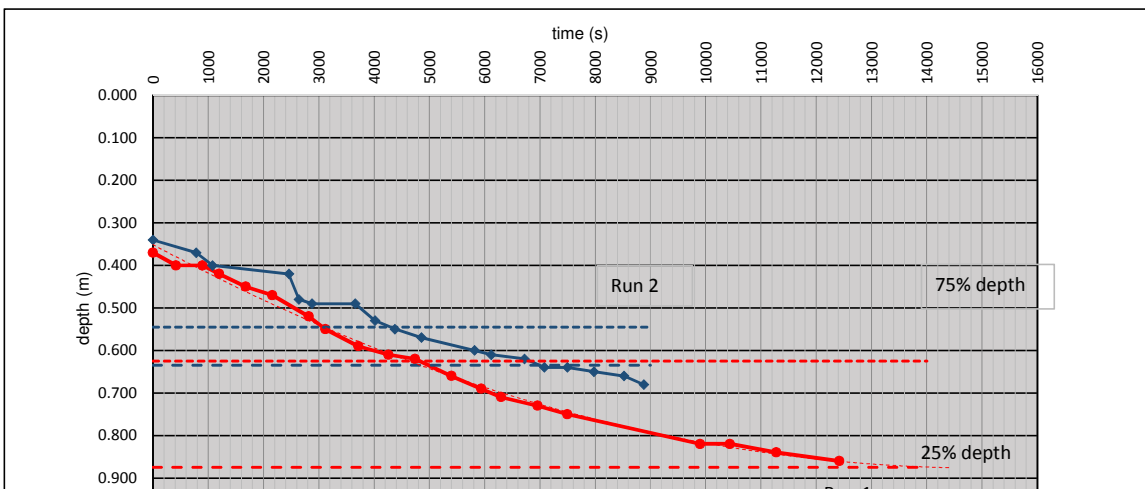
|                               |                      |
|-------------------------------|----------------------|
| 50% ed                        | 0.250 m              |
| time at 75% ed                | 4800 s               |
| time (extrapolated) at 25% ed | 13800 s              |
| drainage time $t_{p75-25}$    | 9000 s               |
| area draining, $a_{p50}$      | 2.150 m <sup>2</sup> |
| volume drained, $v_{p75-25}$  | 0.275 m <sup>3</sup> |

soil infiltration rate,  $f = 1.42E-05 \text{ ms}^{-1}$ 

estimates based on full depth drainage:

## Run 2

|                               |                      |
|-------------------------------|----------------------|
| level at start (0%)           | 0.500 m              |
| level at end (100%)           | 0.680 m              |
| 25% level                     | 0.545 m              |
| 75% level                     | 0.635 m              |
| level change (75-25%)         | 0.09 m               |
| volume drained (75-25%)       | 0.099 m <sup>3</sup> |
| surface area drained (75-25%) | 2.822 m <sup>2</sup> |
| time at 25% level             | 4300 s               |
| time at 75% level             | 7000 s               |

soil infiltration rate (75-25% actual),  $f = 1.30E-05 \text{ ms}^{-1}$ 

## Trial Pit Soakage Calculation Sheet

Site: Gwenfro, Caia Park, Wrexham

**Trial Pit 6**

Location

| Trial pit dimensions (m)               |       |
|----------------------------------------|-------|
| Length                                 | 1.200 |
| Width                                  | 1.000 |
| Depth                                  | 1.100 |
| Trial pit fill                         | none  |
| Initial water volume (m <sup>3</sup> ) | 0.900 |

assumed drain invert at 0.5m bgl

|                      |         |
|----------------------|---------|
| effective depth (ed) | 0.600 m |
| 75% ed               | 0.650 m |
| 25% ed               | 0.950 m |

75% and 25% effective depth not reached during test;  
infiltration rate therefore estimated from 25-75% actual depth data:

## Calculations

## Run 1

|                               |                      |
|-------------------------------|----------------------|
| level at start (0%)           | 0.500 m              |
| level at end (100%)           | 0.600 m              |
| 25% level                     | 0.525 m              |
| 75% level                     | 0.575 m              |
| level change (75-25%)         | 0.050 m              |
| volume drained (75-25%)       | 0.060 m <sup>3</sup> |
| surface area drained (75-25%) | 3.620 m <sup>2</sup> |
| time at 25% level             | 10000 s              |
| time at 75% level             | 19000 s              |

soil infiltration rate (75-25% actual),  $f = 1.84\text{E-}06 \text{ ms}^{-1}$ 

| Drainage times   |                    |                  |                    |
|------------------|--------------------|------------------|--------------------|
| Run 1            |                    | Run 2            |                    |
| elapsed time (s) | depth to water (m) | elapsed time (s) | depth to water (m) |
| 0                | 0.35               |                  |                    |
| 420              | 0.35               |                  |                    |
| 840              | 0.38               |                  |                    |
| 1200             | 0.4                |                  |                    |
| 1620             | 0.41               |                  |                    |
| 2100             | 0.42               |                  |                    |
| 2760             | 0.44               |                  |                    |
| 3300             | 0.45               |                  |                    |
| 3660             | 0.46               |                  |                    |
| 4140             | 0.46               |                  |                    |
| 4860             | 0.47               |                  |                    |
| 5340             | 0.48               |                  |                    |
| 5880             | 0.48               |                  |                    |
| 6240             | 0.49               |                  |                    |
| 6900             | 0.5                |                  |                    |
| 7380             | 0.51               |                  |                    |
| 9780             | 0.52               |                  |                    |
| 10320            | 0.53               |                  |                    |
| 11160            | 0.54               |                  |                    |
| 13920            | 0.56               |                  |                    |
| 15480            | 0.56               |                  |                    |
| 15660            | 0.56               |                  |                    |
| 15960            | 0.57               |                  |                    |
| 16680            | 0.57               |                  |                    |
| 17100            | 0.57               |                  |                    |
| 17940            | 0.57               |                  |                    |
| 18840            | 0.57               |                  |                    |
| 19200            | 0.58               |                  |                    |
| 19800            | 0.59               |                  |                    |
| 20100            | 0.59               |                  |                    |
| 20700            | 0.59               |                  |                    |
| 21300            | 0.59               |                  |                    |
| 21840            | 0.6                |                  |                    |
| 22320            | 0.6                |                  |                    |

